# WESTERN CONSTRUCTION NEWS

WITH WHICH IS CONSOLIDATED
WESTERN HIGHWAYS BUILDER

PUBLISHED MONTHLY
VOLUME X, No. 2

FEBRUARY, 1935

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$2.00 PER YEAR

A Twelve-Yard Bite From All-American Canal by the Largest Dragline in the West

Roberts & Roberts Photo

# TRUSTWORTHY


## SAN FRANCISCO — OAKLAND BAY BRIDGE
### (EASTBAY)

*Over 1,400,000 sacks of Golden Gate Portland Cement being used in its construction*

Concrete used in any project, large or small is expected to serve indefinitely. When you specify Golden Gate Portland Cement for your jobs you are taking the ultimate precaution to insure unquestioned performance. For every sack of Golden Gate is *TRUE* Portland Cement, backed by a manufacturer whose record for reliability extends over a third of a century.

PACIFIC PORTLAND CEMENT COMPANY
SAN FRANCISCO


# GOLDEN GATE PORTLAND CEMENT

NORTHWEST ENGINEERING COMPANY
1736 Steger Bldg., 28 E. Jackson Blvd., Chicago, Ill., U. S. A.
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Now it's 5
CRD
Another
for MORRISON-KNUDSEN CO.
BOISE, IDAHO.
with a
NORTHWEST OIL ENGINE
PROVED IN SERVICE
SUCH well known contractors as Morrison-Knudsen have proved that the economy and dependability of the Northwest Oil Engine is worth your consideration. Remember it is lower in first cost, brings you the economy of low priced furnace oil—and it has been proved in service. Send for a bulletin describing it.
NORTHWEST ENGINEERING CO.
Steger Bldg., 28 East Jackson Boulevard
Chicago, Ill., U. S. A.
IN addition to being the fourth Northwest purchased by this concern it is the second Model 80, 2-yd. shovel.
SHOVELS, CRANES, DRAGLINES, PULLSHOVELS, SKIMMER SCOOPS
NORTHWEST
GASOLINE, OIL, DIESEL OR ELECTRIC POWERED
NORTHWEST ENGINEERING CO.
255 Tenth Street, San Francisco, Calif.; 3707 Santa Fe Ave., Los Angeles, Calif.; W. B. JONES, 6206 S. E. 30th Ave., Portland. REPRESENTATIVES—Pacific Hoist & Derrick Co., 3200 Block, 4th Ave. S., Seattle; Arnold Machinery Co., Inc., 149 W. 2nd St., S., Salt Lake City; The Mine & Smelter Supply Co., 1422 17th St., Denver, Colo.; Neil B. McGinnis Co., 1401 S. Central Ave., Phoenix, Ariz.
SHOVELS, CRANES, DRAGLINES, PULLSHOVELS, SKIMMERS
NORTHWEST
GASOLINE, OIL, DIESEL OR ELECTRIC POWERED
BUILT IN A RANGE OF 10 SIZES, 1/2 YD. CAPACITY AND LARGER

# WESTERN CONSTRUCTION NEWS

WITH WHICH IS CONSOLIDATED WESTERN HIGHWAYS BUILDER

G. E. BJORK, Acting Editor


## Acknowledgment—

Several letters have come in from our readers asking the same question, "Who is Fred W. Crocker, author of the article, 'Tidal Currents of Golden Gate Create Hazard in Fender and Pier Construction', which appeared in your January issue, and what is his connection with this work?"

During construction of this difficult underwater job, author Fred W. Crocker served as chief engineer for Pacific Bridge Co. and was responsible for the design of the original fender frame and other engineering work done by the contracting firm. He was previously employed by Strauss Engineering Corp., Chicago, in the final studies preceding construction. Crocker, long associated with Pacific Bridge Co., has also been responsibly connected with many large bridge foundation jobs in the Northwest.

As designing engineer he had much to do with development of Six Companies Inc.'s plant at Hoover dam. He is now engaged in similar work for Columbia Construction Co., at Bonneville dam.

We might also add that due credit should also be extended to George W. Glick of consultants, Moran & Proctor, who made the adaptation of the steel to the final plan following the guide tower accident of October 31, 1933.—Editor.

## A Name for Grand Coulee Dam

It has been suggested by James O'Sullivan, secretary of the Columbia Basin Commission that the high dam at Grand Coulee should be called Colonel Butler Dam in honor of an officer who through his federal service did much for the future development of Washington. It is O'Sullivan's contention that the Columbia Basin Project when completed will prove an imperishable monument to the memory of John S. Butler.

John S. Butler, colonel, Corps of Engineers, U. S. Army, died October 20, 1934, at Fort Leavenworth, Kansas. As district engineer, U. S. Engineers Office, at Seattle, Butler had charge of the War Department surveys of Columbia river (1929-1932) from the mouth of the Snake to the International boundary.

In his report, he recommended construction of the Grand Coulee high dam as a feasible means of reclaiming the Columbia Basin Project and creating a new empire in the Northwest. This dream of reclaiming the central Washington desert is now not merely an idle dream but may soon be fulfilled. Construction is well along on the low dam, the initial unit in the ultimate scheme of reclamation. Butler exemplified to the highest degree a devotion to duty and to truth, characteristic of officers and men of the United States Army.

# Contents—February, 1935



## A Problem for the District

Judgment was refused on the suit filed in Federal Court by Metropolitan Water District against Wenzel & Henoch Construction Co. in which the District has declared their contract suspended and restraining the contractors from further interfering with the project. General Manager F. E. Weymouth suspended the $7,339,100 contract on January 15, declaring that the contractors' work on the 12.7-mi. San Jacinto tunnel had been unreasonably and unnecessarily delayed. Weymouth pointed out that only 156 ft. had been excavated on the major 8.2-mi. tunnel section since October, 1934. This compares with a scheduled rate of about 800 ft. per month required to complete the tunnel by December 17, 1938, the time when the entire tunnel is to be completed and water made available for the district.

Considerable trouble has been experienced by the contractor due to excessive water at Potrero shaft. To date the contracting firm has refused to surrender the work to the district.

A far-reaching decision affecting riparian rights was handed down by the Supreme Court of California on January 31. In the case of G. L. Peabody against the City of Vallejo, which involved the right to flood his land for enrichment purpose from the Gordan Valley creek, the court ruled against Peabody. The ruling was based on a 1928 amendment which provided, 'the water resources of the State shall be put to the greatest beneficial use of which they are capable.' The supreme court in deciding for the City of Vallejo stated, 'Such wasteful use of water is no longer countenanced in this state.'


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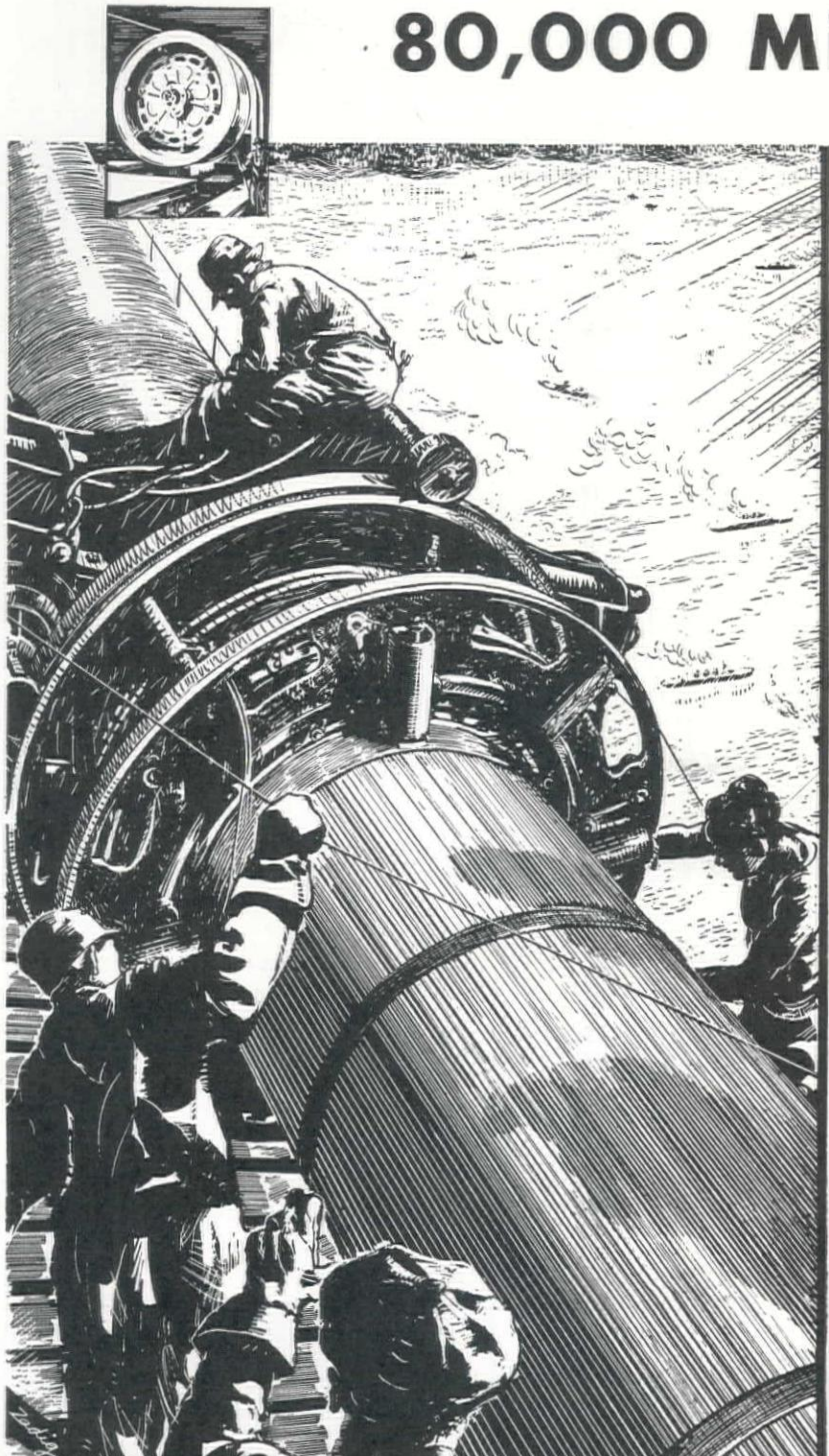
# A LIFE-LINE
## 80,000 Miles Long!



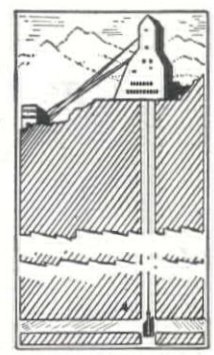
When the great bridge to be thrown across San Francisco's famed Golden Gate is completed, the safety of countless thousands will largely depend on two mighty main cables of steel. Weight: 11,000 tons each.

Spun by Roebling, these cables will contain 80,000 miles of Roebling Open-hearth Acid Steel Wire...wire noted the world-over for its strength, toughness, and stamina.

**STEEL THAT "CAN TAKE IT"— MADE BY ROEBLING'S CUSTOM METHODS**

All Roebling Steel for bridge cables and wire rope is made in small, acid open-hearth furnaces...in Roebling's own mill...by painstaking custom methods. The exceptional uniformity and fatigue-resistance of Roebling Wire are largely due to this fine steel.

**OVER 1 MILE INTO THE BOWELS OF THE EARTH**



At new Ross Shaft of Homestake Mining Co., Lead, S.D., Roebling 1⅞" "Blue Center" Wire Rope is used for the ore hoist, one of the largest of its kind in the world. Active vertical lift now 5000 ft., eventually will be 5400 ft., over a mile.

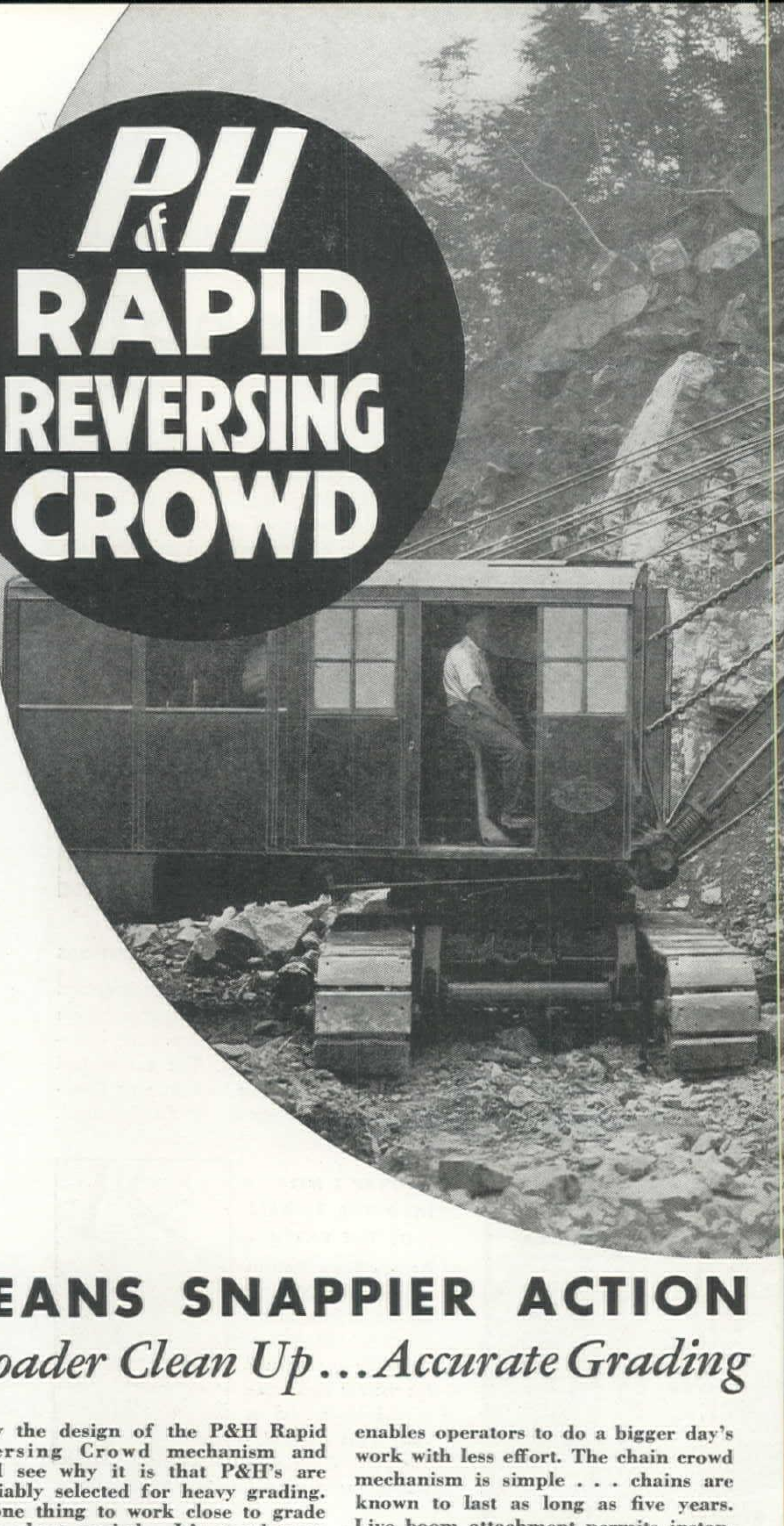
**DIRIGIBLE "MACON" USES ROEBLING BALLAST CONTROL ROPES**

*TO MAKE CERTAIN* that Roebling Wire Rope will give the user the highest obtainable degree of safe, economical service, Roebling has enlisted the aid of the finest and most complete research, testing and manufacturing facilities. The small, acid open-hearth furnaces shown are examples. John A. Roebling's Sons Co. of California.
*San Francisco · Los Angeles · Seattle · Portland*

**ROEBLING ...THE PACEMAKER IN WIRE ROPE DEVELOPMENT**

*When writing to* John A. Roebling's Sons Co., *please mention Western Construction News*

# P&H RAPID REVERSING CROWD



## MEANS SNAPPIER ACTION

*Broader Clean Up . . . Accurate Grading*

**Study the design of the P&H Rapid Reversing Crowd mechanism and you'll see why it is that P&H's are invariably selected for heavy grading. It's one thing to work close to grade for a short period. It's another to maintain floor level hour on hour and day after day.**

**P&H positive, close cutting chain crowd with the Split Second haul-back enables operators to do a bigger day's work with less effort. The chain crowd mechanism is simple . . . chains are known to last as long as five years. Live boom attachment permits instantaneous booming to the desired angle.**

**Ask for new engineering specifications on the various models. Capacities ⅜ to 4 cubic yards.**

### HARNISCHFEGER CORPORATION

4490 W. NATIONAL AVE. *Established 1884* MILWAUKEE, WIS.

*Warehouses and Service Stations*

HARNISCHFEGER SALES CORPORATION, 82 Beale St., San Francisco; R. M. Taylor.
WESTERN LOGGERS MACHINERY CO., 302 S. W. Fourth Ave., Portland, Oregon
SEATTLE DALLAS LOS ANGELES SAN FRANCISCO

### P&H Chain Crowd For Fast Grading

Big yardage at low cost depends largely upon fast, positive crowding action. This applies not only to the crowding out speed but to the return as well. The faster the dipper can be spotted for the next bite, the greater the yardage.

### Provides Even Faster Return

P&H Split Second planetaries make possible return crowd speeds as high as 180 feet per minute. This is particularly advantageous in grading work. Also for cutting shoulders. It is possible to cut within one inch of grade . . . . . the control is so sensitive that a dipper full of dirt can be suspended in the air without the use of the foot brake.

### Front End Equipment

Through the most ideal location of the shipper shaft and the use of P&H Patented Saddle Blocks, all Split Second machines afford an unusually wide clean up area . . . . move-ups are reduced . . . . yardage increased.

Various length dipper sticks can be supplied to meet your specific requirements.

### Dipper Stick Construction

The dipper handle consists of two members designed to straddle the boom, allowing a more wide spread, rigid connection to the dipper. These double sticks are driven by pinions from both sides of the boom and consequently always travel square with the boom and shipper shaft. Each stick is built up from an extra strong white oak core . . . . armored with riveted and welded steel plates on all sides.

Dipper braces, of forged steel, are so designed that the adjustment arrangement can not become jammed. It is always easy to change the cutting angle of the dipper to accommodate varying angles of grade.

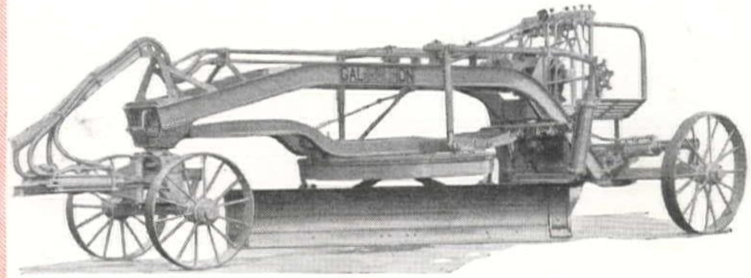
split second CONTROL

1. Sure Feel Power Clutches
2. Self Starter
3. Power Dipper Trip
4. Super Smooth Swing Clutches
5. Rapid Reversing Crowd Planetaries
6. Full Vision Cabs

# P&H PERFORMANCE SPEEDS UP YOUR PROFIT PACE

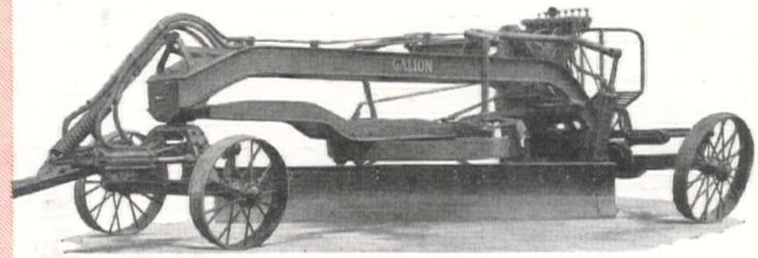
# More Work per Day — per Dollar

## with Hydraulic Power



Galion No. 10 Leaning Wheel Grader

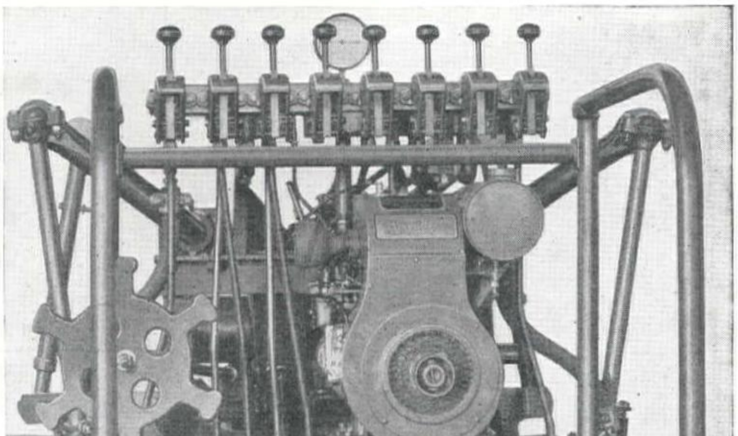
Equipped with Hydraulic Control, a feature that permits all adjustments to be instantly made at the touch of one of the eight levers. Can be furnished with 8, 9 or 10 ft. Moldboard and Blade.



Galion No. 14 Leaning Wheel Grader

Also equipped with Hydraulic Control. This big No. 14 Grader weighs 14,000 pounds and can be furnished with 12 or 14 ft. Moldboard and Blade. Galion also builds various sizes of E-Z Lift Manually Controlled Leaning Wheel Graders.

8 Levers give Finger tip Instant Control



## GALION

### Leaning Wheel Graders

Almost human . . . a Robot . . . that's what Galion Leaning Wheel Graders have become. Hydraulic Power makes them that way. It takes all the hard work out of Grader operation . . . puts in a new touch in adjustment and performance that is hard to equal in any other Grader.

Operators who have tried these Hydraulically-controlled Galion Graders claim that they accomplish nearly twice as much work as with the manually-controlled machines, and be less fatigued at the end of the day.

Investigate Hydraulic Control . . . make a comparison and see for yourself how much more Galion today gives you for your money.

Write your nearest Distributor. Ask him to explain how Galion has built feature after feature in these Graders to make them mean so much for economy, performance and dependability. Or write direct to . . .

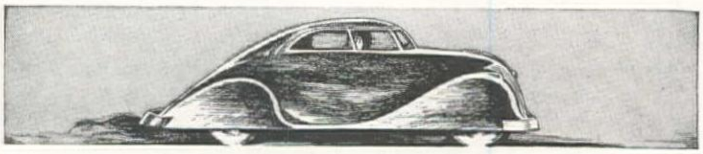
**The Galion Iron Works & Mfg. Co.**
Galion Ohio

***Distributors in Principal Cities***

# Are Explosives Old-Fashioned?

Do you think of them as belonging to the horse and buggy days?

Or do you class them with streamlined automobiles and other marvels of modern science?



# Actually, Modern Explosives have become Controlled Force

## ...a miracle of engineering achievement

## ARE YOU MAKING THE MOST OF IT?

The progress of explosives manufacture would make a long chapter in the history of the conquest of nature. The old idea of explosives as representing terrific destructive power has changed to the modern concept of controlling this tremendous energy to work engineering miracles. To solve innumerable problems, science has found the way to accomplish efficiently desired results at the lowest cost.

In mining, in construction, in land reclamation, in many fields explosives have become the miracle of controlled force.

Present day explosives provide the controlled energy to move a mountain or to drive a rivet. Explosives action may be controlled with a definiteness that assures the moving of masses in the direction and with the breakage desired.

Control has been achieved by developing types in powders, in creating new blasting methods, in inventions that steadily reduce problems and hazards. In recent years, notable contributions from the laboratory have proved amazingly practical in the field. In all this work, Atlas has been a pioneer, constantly introducing innovations and continually improving both products and methods.

*Have you seen the* Twin-Fifty Blasting Machine?

It fires two series of fifty electric blasting caps with a short interval between.

ATLAS POWDER COMPANY

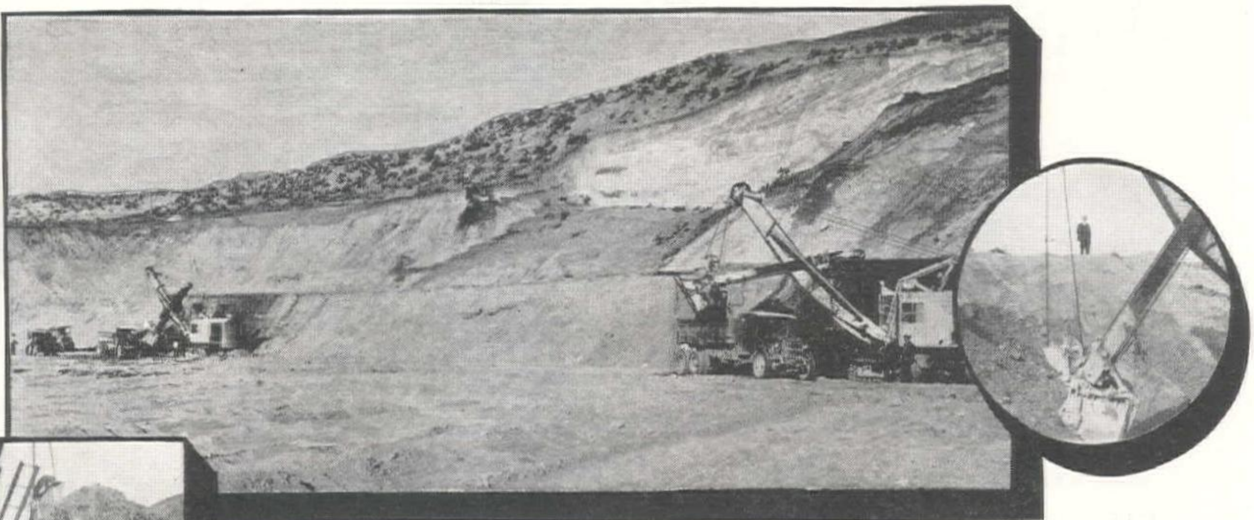
*Everything for Blasting*

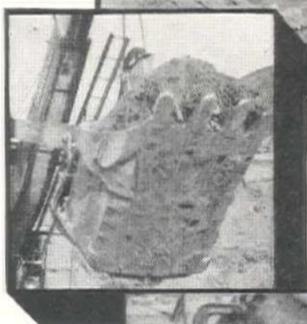
THE GIANT DIVISION
SAN FRANCISCO, CALIF.

Cable Address—ATPOWCO
Wilmington, Delaware

ATLAS EXPLOSIVES

ATLAS EXPLOSIVES





# At Grand Coulee Damsite .......

Two Northwest shovels, equipped with two yard AMSCO Renewable Lip Dippers (U. S. Patent No. 1,945,064), were used on an 800,000 yard excavation at the Grand Coulee dam. When the photographs shown above were made this job was a month ahead of schedule due in equal parts to good management, good operation and up-to-date equipment.

In the first 31 days this equipment moved 324,368 cubic yards of material—an average of 10,463 cubic yards for each 21 hour day.

No small credit is due the AMSCO Renewable Lip Dippers for this record performance. The thin cutter edge lip, correct placement of dipper teeth at the lip corners, smooth dipper interior and correct body taper made for faster, easier filling and instantaneous dumping.

Easy renewal of lip (tooth bases are an integral part of lip), all manganese steel (long life) construction and renewable wearing band at the heel are added advantages of AMSCO Renewable Lip Dippers. They are made for all shovels in sizes from 3/4 yard up, and (without renewable lip) in 3/8, 1/2 and 5/8 yard sizes.

Get the facts on this long lasting, fast digging, profit increasing dipper from your shovel manufacturer or our nearest office. Do it now—today!

### SIX EXCLUSIVE FEATURES OF AMSCO RENEWABLE LIP DIPPERS!

Tooth bases are cast integral with lip (no expense for renewing bases).

◆

The dovetail joint allows for changing lips quickly and easily merely by loosening two U-bolts and removing four wedges.

◆

The U-bolt fastening between lip and back supplements and reinforces the dovetail joint between lip and front.

◆

Back lugs can be arranged to fit any type of dipper stick. Dippers are made either with or without bail.

◆

A renewable manganese steel wearing band compensates for wear at the dipper heel.

◆

Furnished with double wall lip and teeth for hard digging and rock handling; single wall cutter type lip and teeth for rehandling, stock piling and loose material digging; and a thin, serrated edge, cutter type lip for mucking and clay digging.

**AMSCO**

TRADE MARK REGISTERED

**AMERICAN MANGANESE STEEL COMPANY**

*Division of American Brake Shoe & Foundry Company*

402 East 14th Street, Chicago Heights, Ill.

*Foundries at Chicago Heights, Ill.; New Castle, Del.; Denver, Colo.; Oakland, Calif.; Los Angeles, Calif. • Offices in Principal Cities.*

# PACIFIC COAST HEADQUARTERS

*for*

*anything and everything needed in*

## GAS or ELECTRIC
# WELDING

*and*

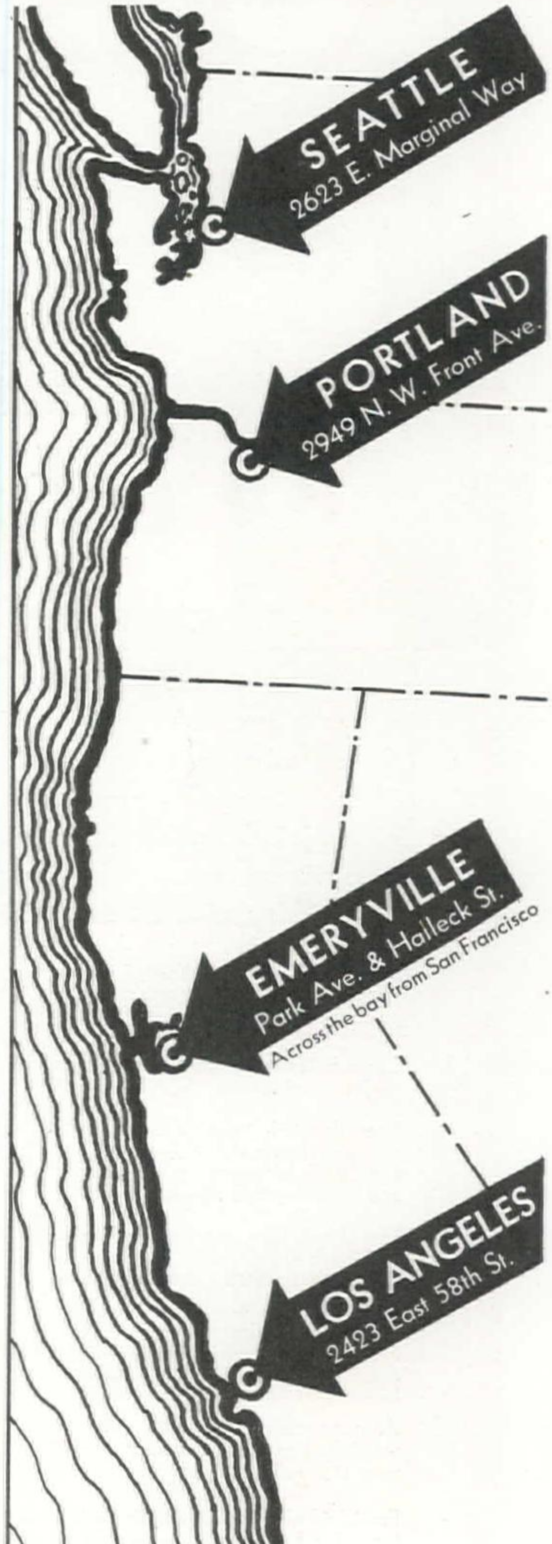
## HAND or MACHINE
# GAS CUTTING

•

AIRCO OXYGEN, ACETYLENE, NITROGEN
HYDROGEN . . . AIRCO-DB WELDING and
CUTTING APPARATUS and SUPPLIES
AIRCO-NATIONAL CARBIDE
AIRCO-WILSON ELECTRIC WELDING MACHINES
WILSON ELECTRIC WELDING RODS

•

With OFFICES and PLANTS in the important centers shown, AIRCO offers to all users of welding and gas cutting on the Pacific Coast, a service that is complete and satisfying from every angle. Go to AIRCO for your answer to any question pertaining to welding and gas cutting, for your equipment, apparatus and supplies, for practical aid in training your welders and cutters, and for full engineering cooperation on any welding or gas cutting problem.



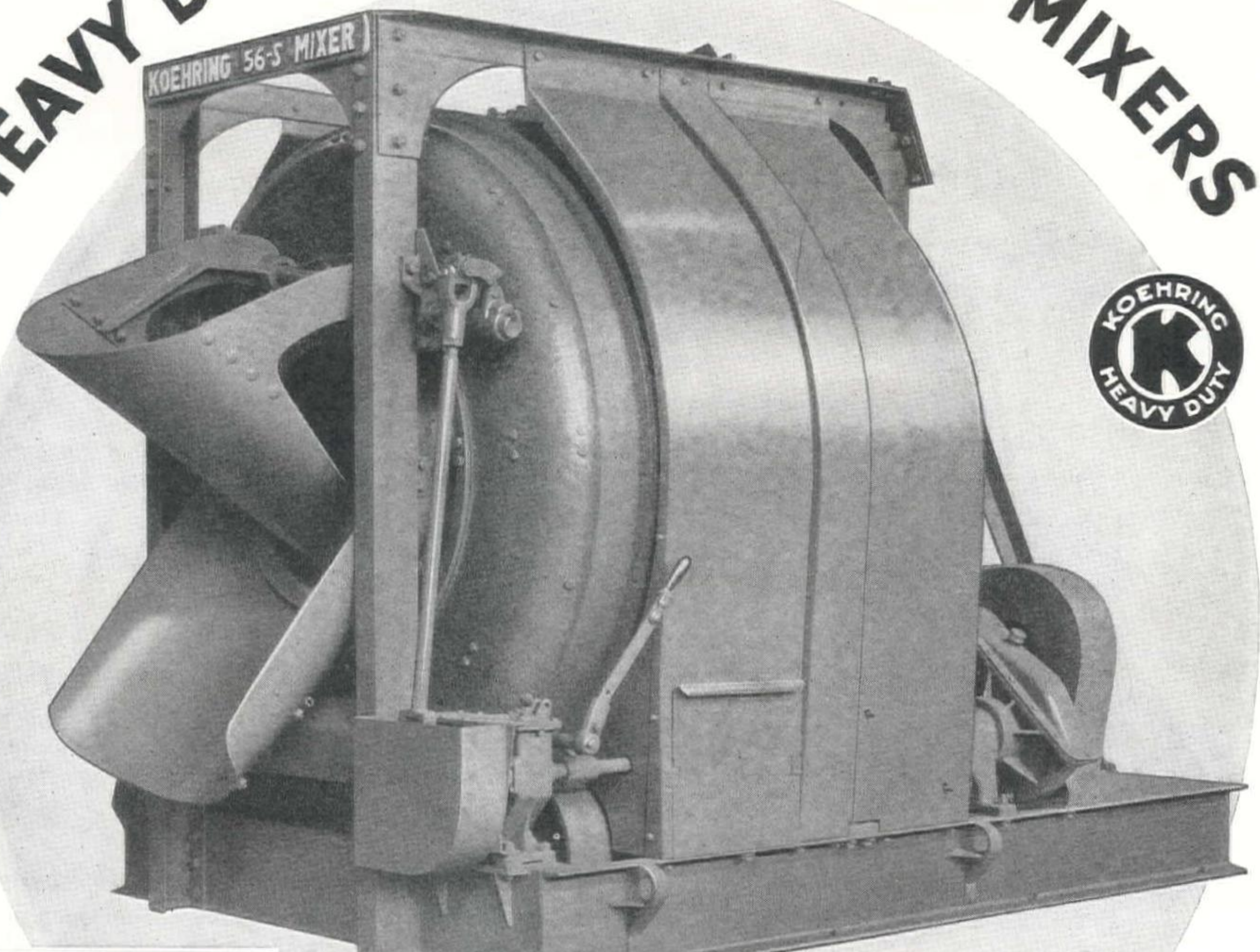

# AIR REDUCTION
## SALES COMPANY

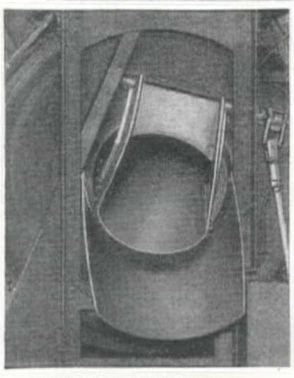
A NATION-WIDE WELDING and CUTTING SUPPLY SERVICE

# KOEHRING

## HEAVY DUTY CONSTRUCTION MIXERS

### 28-S • 56-S • 84-S



*FASTER DISCHARGE*
with the KOEHRING
Flow-Line Discharge.

KOEHRING concrete mixers, suitable for large volume concrete projects as well as commercial concrete plants, are furnished in a range of sizes—28-S, 56-S, 84-S — adaptable to any job.

Short, compact frame design, because of the power plant, completely housed, directly *behind* the drum — and exceptionally low overall height — therefore, less space required for plant installation.

The Koehring Flow-Line discharge greatly decreases discharge time—causes a minimum of segregation—substantially reduces abrasive wear and permits an unbroken, natural flow of concrete.

Greater yardage—because of fast charging and speedy Flow-Line discharge — continuous operation because of Heavy Duty Construction—are important profit-earning features of Koehring Mixers.

## KOEHRING COMPANY

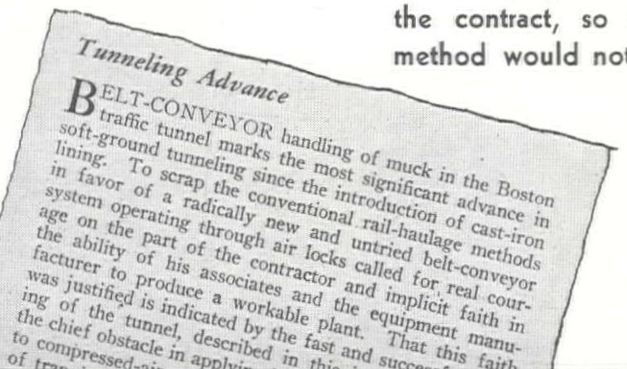
MILWAUKEE WISCONSIN

HARRON, RICKARD & McCONE CO., San Francisco, Calif. - Los Angeles, Calif. L. A. SNOW CO., Seattle - Spokane CRAMER MACHINERY CO., Portland

## .... BOSTON

### Traffic Tunnel Under Boston Harbor ....

**Portal to Portal Length, 5635 Feet; Unfinished Diameter, 31 Feet**


*Tunneling Advance*

BELT-CONVEYOR handling of muck in the Boston traffic tunnel marks the most significant advance in soft-ground tunneling since the introduction of cast-iron lining. To scrap the conventional rail-haulage methods in favor of a radically new and untried belt-conveyor system operating through air locks called for real courage on the part of the contractor and implicit faith in the ability of his associates and the equipment manufacturer to produce a workable plant. That this faith was justified is indicated by the fast and successful driving of the tunnel, described in this ... the chief obstacle in applying ... to compressed-air ... of tra...

On this job, speed was the essence of the contract, so the slow rail-haulage method would not do.

After consulting with us, the builders applied a continuous line of Jeffrey 30-inch wide Belt Conveyor, from shield face to street level — through automatic air locks.

The swift, successful completion of this project, far ahead of schedule, has placed a new method at the disposal of softground tunnel builders.

Article on Tunneling Advance (left) is reproduced from the Editorial columns of Engineering News-Record, issue of June 30, 1932.

## ... FT. PECK

### The Four Diversion Tunnels Each Approximately 1.2 Miles Long; Unfinished Diameter, 32 Feet .....

Again, speed is the prime element of the job. Before the dam, come the diversion tunnels. The main job waits for their completion.

These tunnels, curved through the hills, are being driven from both ends. Material blasted from the faces is loaded into trains of cars by overhead conveyor equipment . . . Jeffrey 100-ft. Muck Loaders . . . eight of them.

Taken to the outside, the material is discharged through Jeffrey Feeders to Jeffrey 36″ x 48″ Double Roll Shale Breakers, which break it down to handleable size.

On the South end of the tunnels, Jeffrey Conveyors carry the material overland to a Jeffrey Stacker, extensible from a telescopic Conveyor.

Jeffrey Handling Equipment is incorporated in the aggregate and cement plants, too . . . Belt Conveyor, Spiral Feeders, Spiral Conveyor, Bucket Elevator and Jeffrey-Traylor Electric Vibrating Feeders. Four Jeffrey concrete-placing Conveyors will speed the lining of the tunnels.

## .... GRAND COULEE

### The Biggest Excavation Job Ever Undertaken by Conveyors ............

Jeffrey is furnishing all the giant Conveyors . . . to handle approximately 14,023,228 cu. yd. from the dam excavations at the rate of 4,000 cu.yd. per hour. 60″ Belt Conveyors for the West side (25 units with 200 H.P. drives) and 48″ Belt Conveyors for the East side (16 units with 125 H.P. drives). In all . . . 28,000 lin.ft. of belting! Over 6,000 Jeffrey "Hercules" and "Reliance" Idlers! Also the seven huge Feeders are Jeffrey-made. So are the two 150-ft. caterpillar-type Stackers.

Preference for Jeffrey on these three big jobs . . . Boston Tunnel, Fort Peck and Grand Coulee . . . adds another chapter to a story of success in the handling of materials.

Jeffrey's success can be made your success. If your problem is materials handling, Jeffrey can solve it. There is no problem too big or too small for our undertaking.

# SOMETHING TO PUMP?

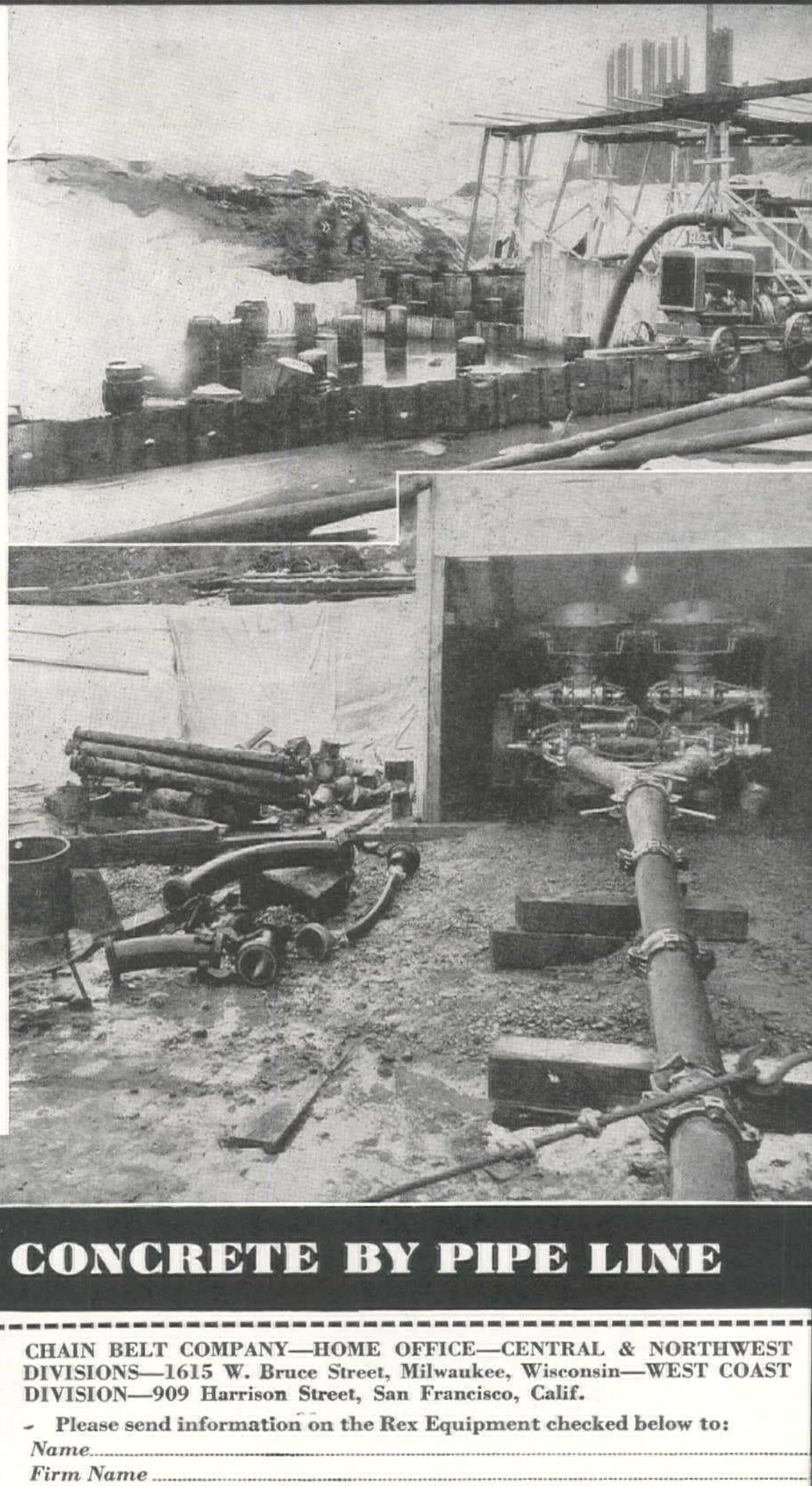
## Some Water Somewhere

Rex Speed Prime Pumps are fast, are completely automatic, give full rated capacity for any given lift. They constantly restore their prime and pump so long as there is any water in the line.

They make ideal pumps for well point systems. Here, at last, due to their self-priming feature, you get the big advantages of the low-cost, high capacity centrifugal pumping combined with sure and continuous operation to keep the hole dry.

## Or Some Concrete?

Or, if your problem is placing some concrete instead of displacing some water, investigate the Rex Pumpcrete, the greatest development in the placing of concrete since man first built with cement.



## Or, Check the Coupon

for other information on items that interest you in the most complete line built for concrete mixing, placing and pumping.

REX

**CONSTRUCTION EQUIPMENT**

## CONCRETE BY PIPE LINE

CHAIN BELT COMPANY—HOME OFFICE—CENTRAL & NORTHWEST DIVISIONS—1615 W. Bruce Street, Milwaukee, Wisconsin—WEST COAST DIVISION—909 Harrison Street, San Francisco, Calif.

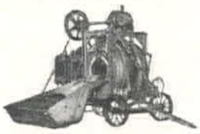
Please send information on the Rex Equipment checked below to:

*Name* ..........

*Firm Name* ..........

*Address* ..........

*City* .......... *State* ..........



**REX JOB MIXERS**

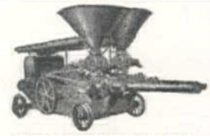
☐ 10-S ☐ 5-S
☐ 7-S ☐ 3½-S

**REX PLANT MIXERS**

☐ 14-S ☐ 28-S
☐ 56-S ☐ 84-S

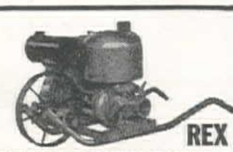
**REX MOTO-MIXERS**

☐ 1 Yd. ☐ 1½ Yd. ☐ 2 Yd.
☐ 3 Yd. ☐ 4 Yd. ☐ 5 Yd.



**REX PUMPCRETE**

☐ Concrete by Pipe Line



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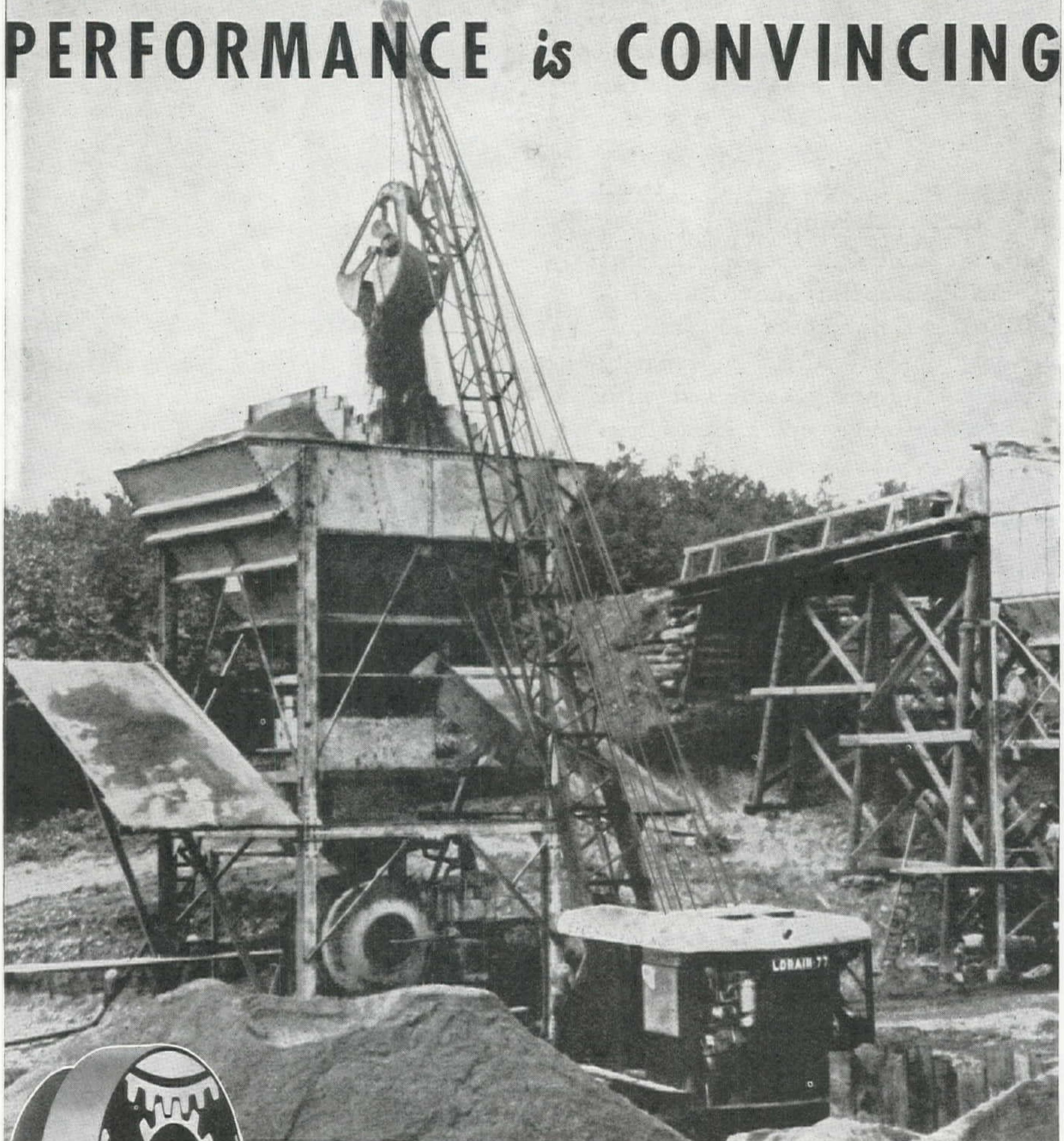



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• *Again, proof that Diesel Lorains increase output 10-20%, cut fuel costs 50-80%.*

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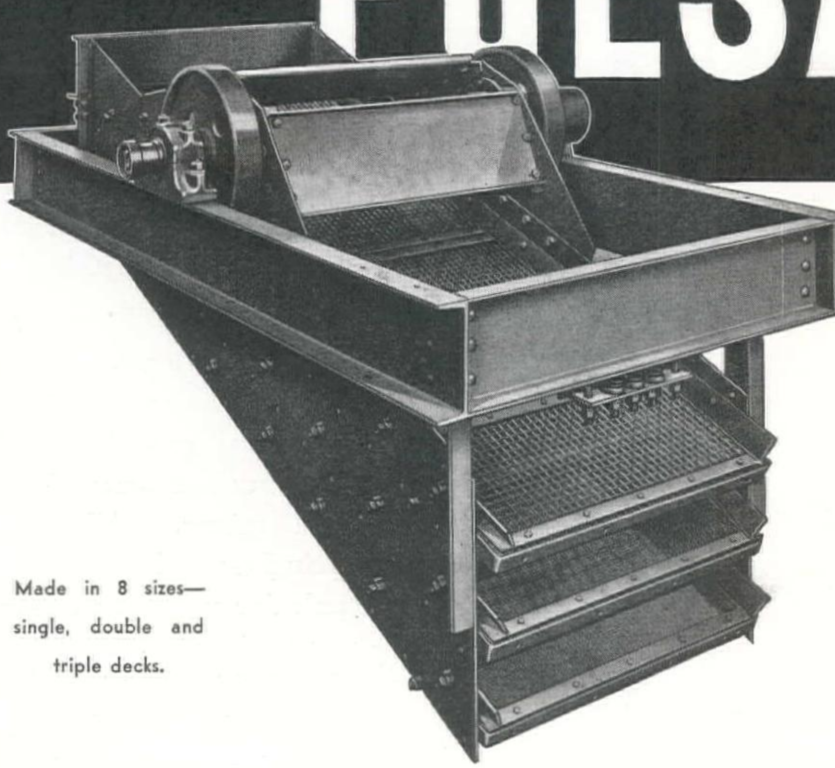
# THE NEW TELSMITH PULSATOR



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The nested springs are centrally located, to assure uniform support at all points of the deck. These springs carry practically all the load of both decks and aggregate, thereby greatly lengthening the life of the end bearings.

Construction is typically Telsmith—utilizing the toughest alloy steels, the finest anti-friction bearings, special labyrinth and piston ring seals for the protection of working parts. Thus greater value, in the form of longer life and lower upkeep, is built into the Telsmith Pulsator.

Bulletin V-30 gives complete details. It also contains the first table ever published by any manufacturer for figuring the capacities of vibrating screens of any size and any make.

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# T E L S M I T H

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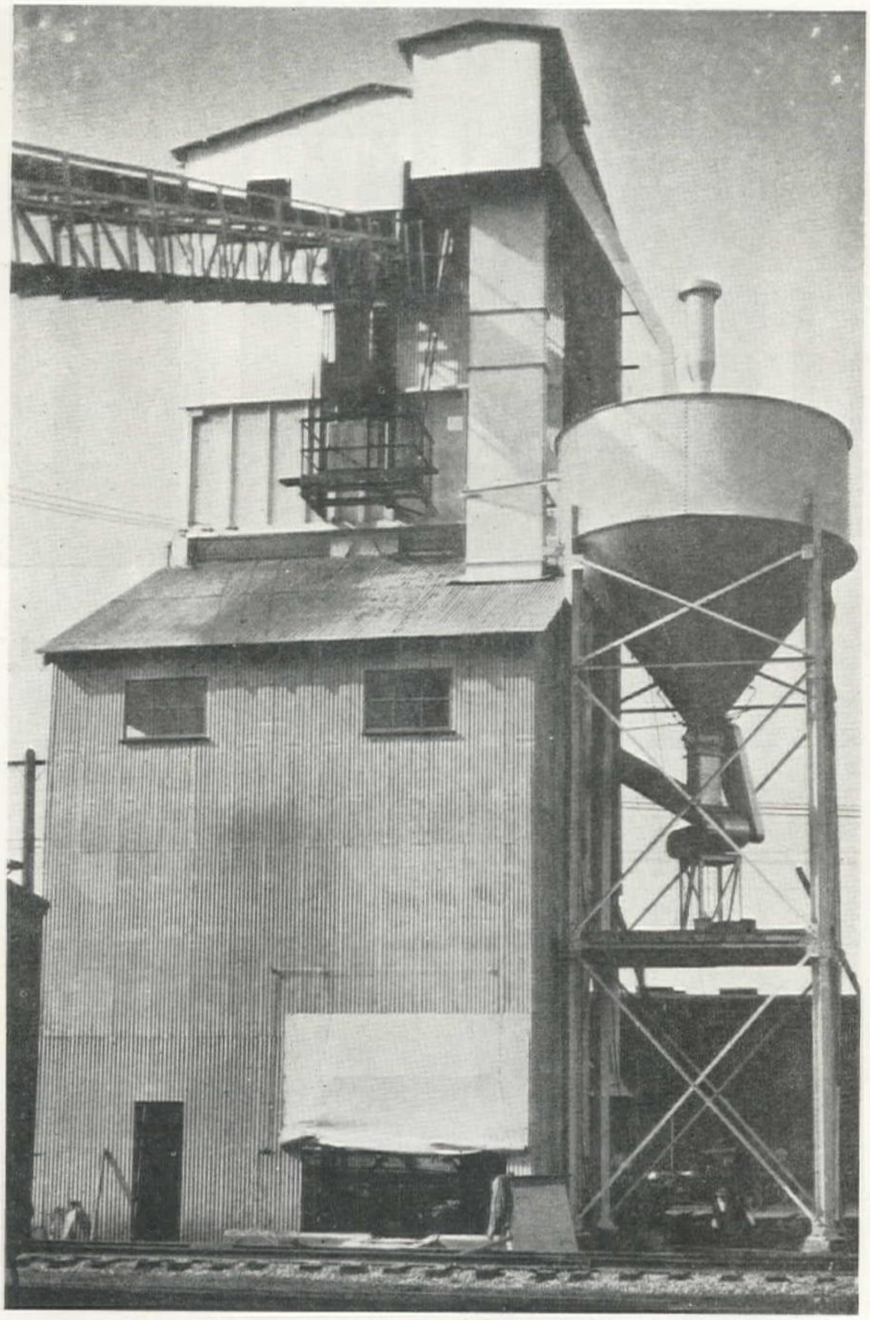
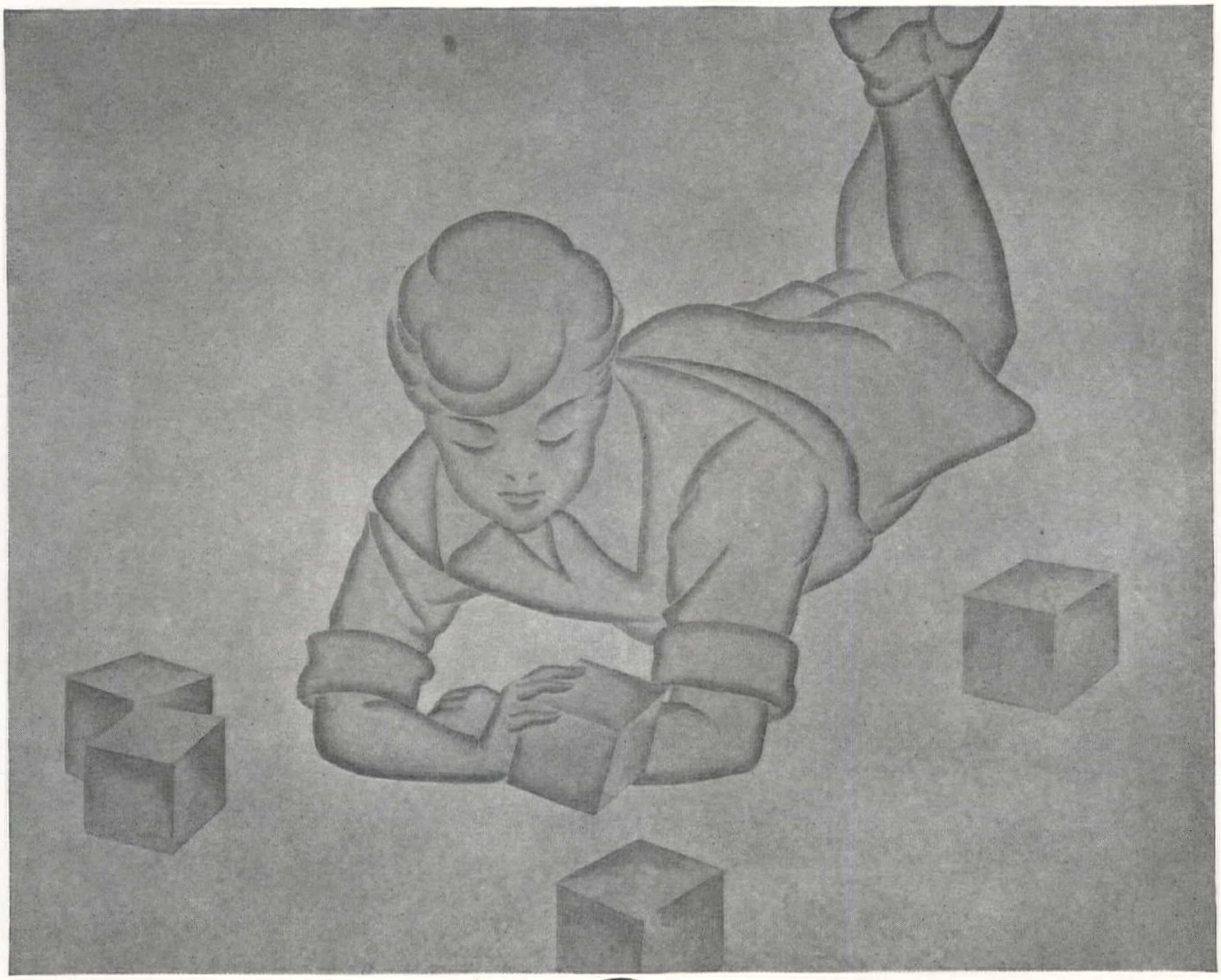
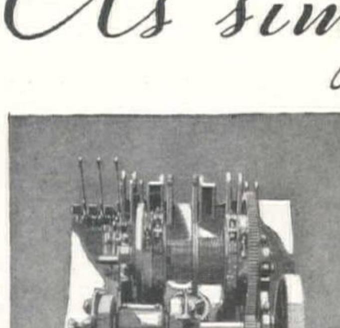








# More than seven million feet sold

Recent installation of Super-de Lavaud Pipe at Pelham, New York

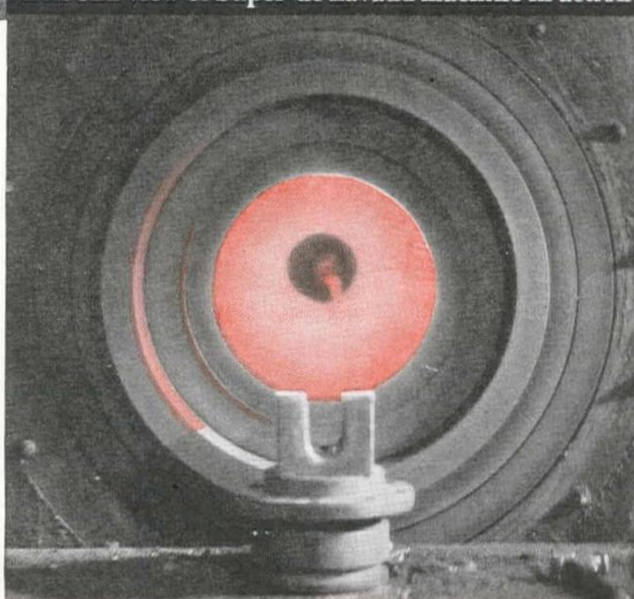
## *The Margin of Protection Against Damage in Handling has been Doubled*

ew products face the hazards of amage in transit, handling and stribution that cast iron pipe en- unters.

By doubling the impact-resistance Super-de Lavaud Pipe we have creased its inherent protection ainst these hazards to a point where ey become a negligible factor. In e 22 months we have been ship- ng Super-de Lavaud Pipe, damage etween plant and underground has been almost unknown. Yet during this period we have sold *more than seven million feet.*

Protected to the maximum against damage *above* ground, this tougher, more ductile pipe with doubled impact strength renders super-service *under* ground. It is made by a patented process in which the pipe is centrifugally cast without chill in a metal mold. For further information, send for booklet.

Bell end view of Super-de Lavaud machine in action



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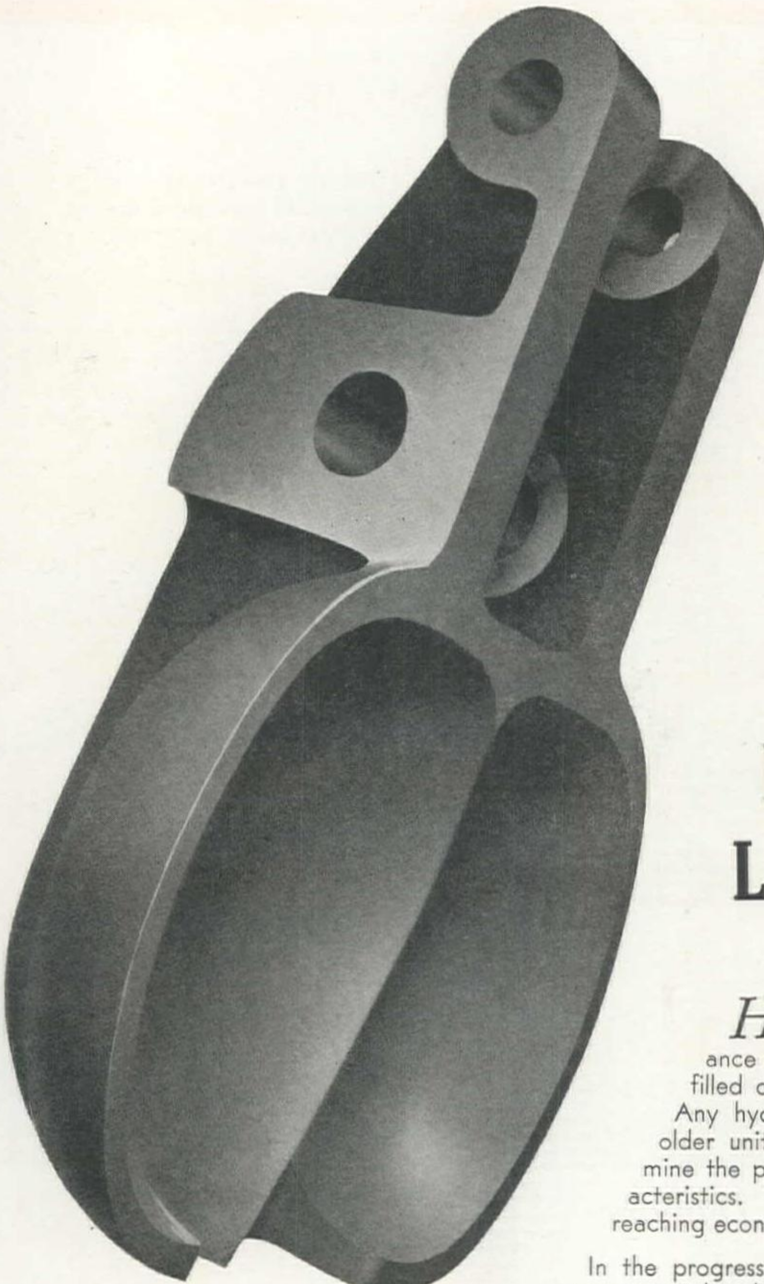

# *Ease* of Handling

## ...Just One of the 7 Reasons Why Federal Wood Pipe Is Most Economical to buy

Light in weight . . . Easy to handle . . . Larger loads make Federal Wood Pipe the most economical pipe to transport. Deduct this from the low first cost and Federal will prove to be the lowest cost pipe from any angle.

The economy does not stop there, however, for installation costs, too, are much lower than ordinary pipe. It need be buried only a few feet below the surface in most any climate. There's one marked difference that makes this possible. Federal pipe is almost immune to freezing—the cellular structure of this wood seals it against cold. The sections, too, are easily joined . . . and there are fewer of them. Longer sections are made practical and do not impair the light weight advantage. No heavy equipment is required for placing—just a minimum of man power . . . another point to consider when lines are laid in out-of-the-way, or inaccessible places.

Aside from these advantages, many communities have specified this pipe simply for its quality for preserving pure drinking water. Others have built for permanency and lasting qualities—a life of 40 to 50 years. But in any event, all considered, it's the lowest cost pipe per year of trouble-free service that money can buy.

For any water transportation problem, our engineering department is ready with expert counsel and advice. Address: FEDERAL PIPE & TANK COMPANY, 5332 24th Avenue, N.W., Seattle, Washington. P.O. Box 5055, Ballard Station, Seattle, Washington.

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2. Most practical regardless of service requirement.
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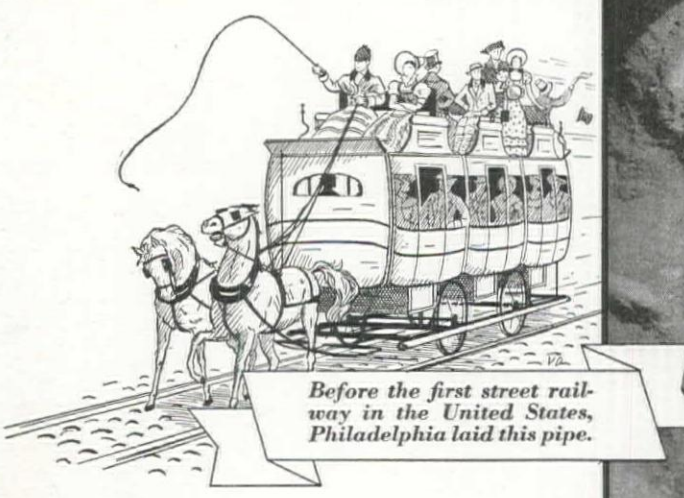
4. Easy to transport—easy to handle — without costly labor.
5. Insulation against heat and cold is unequalled . . . removes freezing hazard.
6. Keeps water supplies fresh and cool in all weather.
7. Not affected by corrosion—for all purposes which water transportation demands.

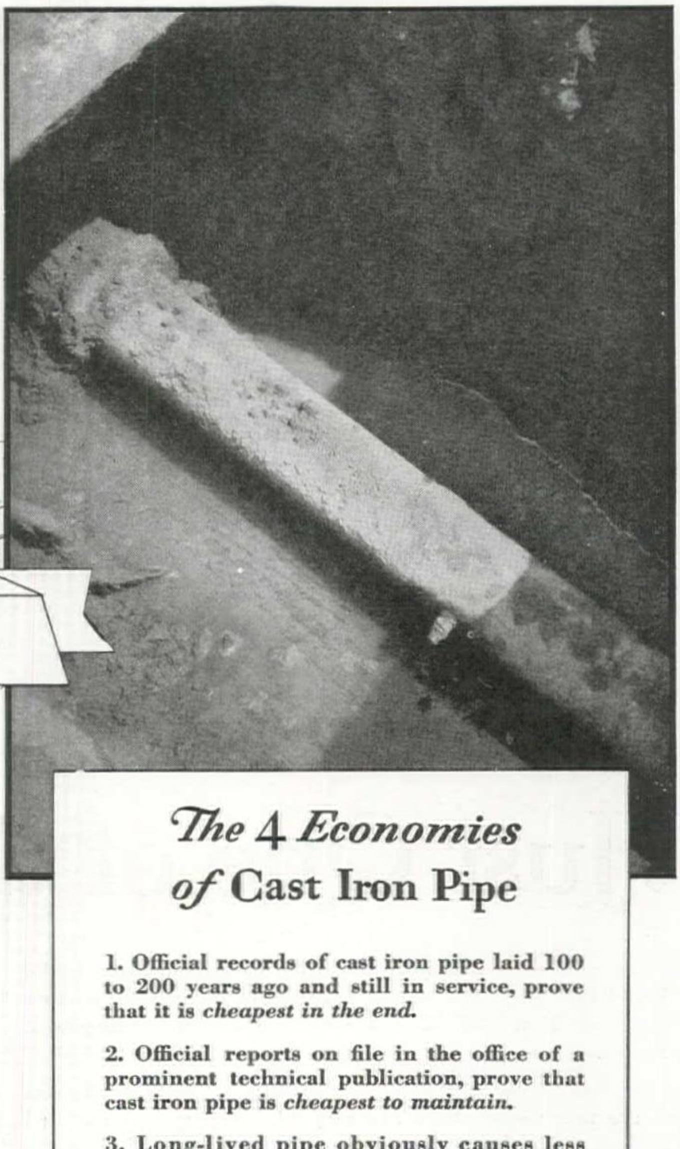
F. P. & T. CO.

# FEDERAL CREOSOTED DOUGLAS FIR PIPE

# After 105 years

## *this pipe was uncovered, inspected and okayed.*



AT AN official inspection of the cast iron main shown at right, former Mayor Mackey of Philadelphia said over the radio: "Notwithstanding the great changes that have taken place in our city, this cast iron pipe stands perfect in all its integrity as disclosed to us tonight after having made the excavation and taken out a section." Now 105 years old, this line of cast iron pipe is good for many more years of service.

Cast iron pipe with bell-and-spigot joints offers a combination of pipe material and design that is time-tested and proved by mains still in use after serving 100 to 200 years and longer.

The four major economies resulting from the long life of cast iron pipe are due to its effective resistance to rust. Cast iron is the one ferrous metal for water and gas mains, and for sewer construction, that will not disintegrate from rust. This characteristic makes cast iron pipe the most practicable for underground mains since rust will not destroy it.

### *The 4 Economies of* Cast Iron Pipe

1. Official records of cast iron pipe laid 100 to 200 years ago and still in service, prove that it is *cheapest in the end.*

2. Official reports on file in the office of a prominent technical publication, prove that cast iron pipe is *cheapest to maintain.*

3. Long-lived pipe obviously causes less street-opening for replacements and repairs. Therefore, cast iron pipe *saves money on street-openings.*

4. When replaced by larger pipe, or a main is abandoned or rerouted, cast iron pipe *pays a final dividend in salvage value.*

For further information, address The Cast Iron Pipe Research Association, Thomas F. Wolfe, Research Engineer, 309 Peoples Gas Building, Chicago, Ill.

# CAST IRON PIPE

METHODS OF EVALUATING BIDS NOW IN USE BY ENGINEERS RATE THE USEFUL LIFE OF CAST IRON PIPE AT 100 YEARS

TRADEMARK REG.

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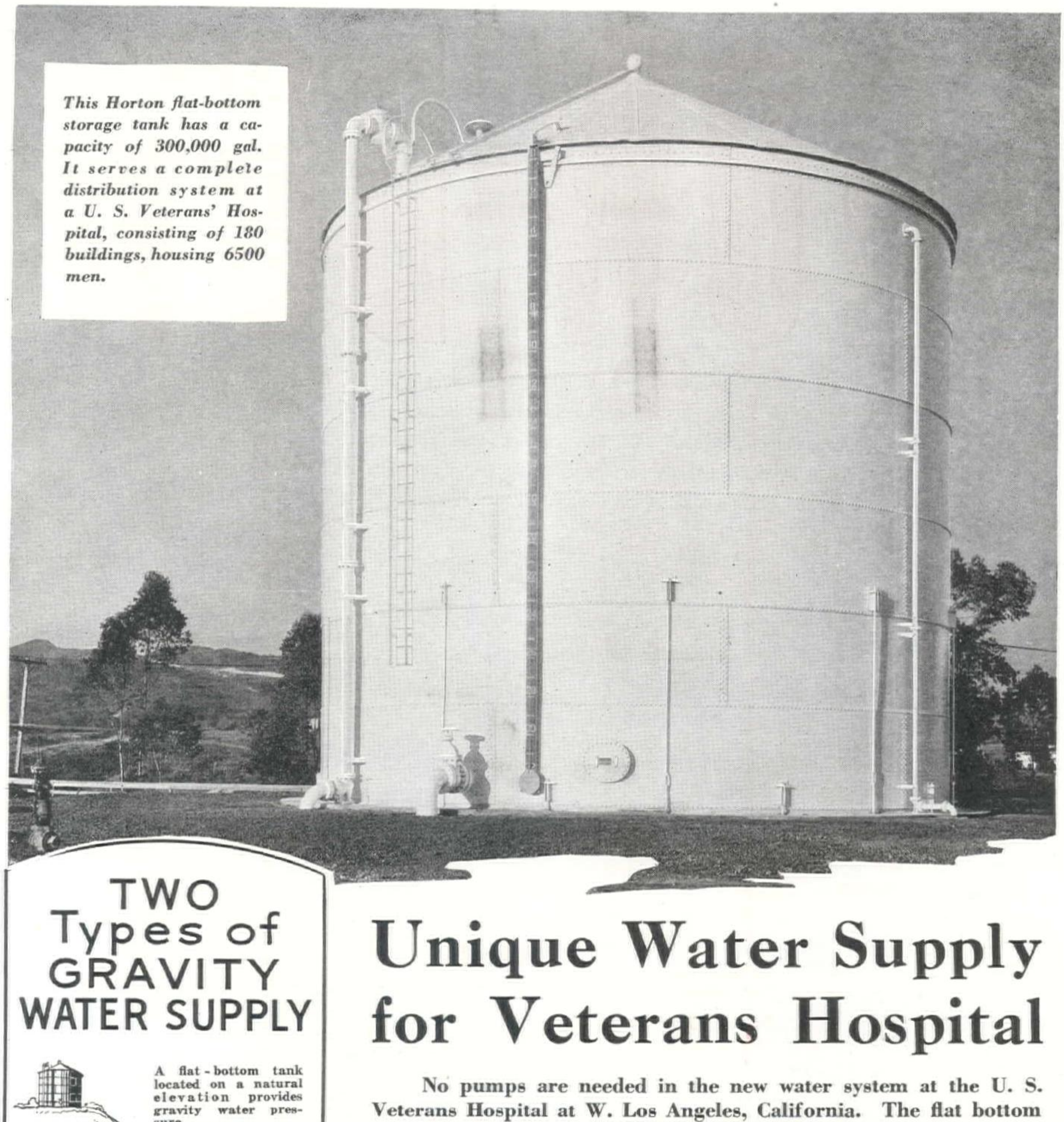
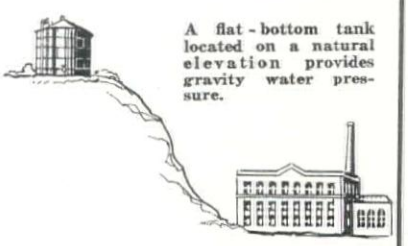


*This Horton flat-bottom storage tank has a capacity of 300,000 gal. It serves a complete distribution system at a U. S. Veterans' Hospital, consisting of 180 buildings, housing 6500 men.*







WESTERN CONSTRUCTION NEWS
WITH WHICH IS CONSOLIDATED WESTERN HIGHWAYS BUILDER
February, 1935 Vol. 10, No. 2

G. E. BJORK, Acting Editor
H. W. PYERITZ, News Editor
R. P. BRYAN, News Editor

## Let the PWA Continue Its Work

The entire construction industry is anxiously awaiting further information regarding details of the expenditure and administration of $4,880,000,000 provided by the Administration's work relief bill now pending in Washington. This vast sum can be spent wisely or foolishly, depending on the purpose for which it is used and the agency responsible for execution of the work involved.

The President, when he said, 'the federal government must and shall quit this business of distributing direct doles,' sounded the keynote of a program that intends to **replace** relief work instead of fostering it. Further indication of the type of work to be done, calls for such projects that are 'useful and designed to create permanent improvement of future new wealth.' This definitely hints at the development of natural resources.

Such a move is highly recommended since it means development and placing under construction of many economically sound and worthwhile projects that have already been carefully studied. Throughout the West are many such projects which have been merely marking time until a favorable financing scheme was available. These are varied in magnitude and purpose and include such projects as Central Valley project in California, which involves power, navigation, flood control, and land conservation, Columbia Basin reclamation in central Washington, and Willamette Valley sewerage disposal in Oregon.

All eleven western states are ready and willing to extend and improve their highway systems, providing funds are available; and from a survey already made by the U. S. Bureau of Public Roads, a record amount of grade crossing work is ready for construction immediately. Much also remains to be done in soil erosion and flood control work in scattered locations throughout the West.

Administration of this public works program is another question under much debate. We can only hope, as do many others who are vitally interested in the western construction industry, that unqualified government agencies, such as the now dead CWA, have no hand in the direction of this new work. Mark Tuttle, manager of the Inter-Mountain branch of Associated General Contractors, has aptly summed up the situation when he said, 'A lot of politicians have been handling FERA funds during the past year and they will, no doubt, try to convince Uncle Sam that this policy should be continued and the big public works program squandered under their direction. These funds should be supervised and expended under the present constituted agencies and the work done by contract under competitive bids. Thus will the public who pays the bills be assured of getting something for their money.'

By contract method of doing this work, benefits are more wide spread, extending as it does to the contractor, engineer, skilled workers, and laborers who are directly connected with the work, and through a similar cycle with the equipment and materials manufacturer. In this way the money is turned over several times instead of only once or twice as is the case where day labor is used on work such as has been done under the relief organizations.

The success of the entire program will depend, as does any well managed business, on the personnel directing it.

Never have we had as capable a nation wide organization for directing public works program as the Public Works Administration. After nearly two nerveracking years of floundering through a morass of red tape and obstructions, the PWA has finally come through the battle of the first National Recovery program with its force intact and a better understanding of pending problems.

The PWA has learned to delegate to the Bureau of Reclamation, Bureau of Public Roads, Department of Agriculture, and Forestry, and other agencies, such work as each is best qualified to handle. State engineers, along with the inspection division, have an understanding of local problems and are now qualified to handle the new program with much less effort and blundering than was prevalent a year and a half ago.

To permit any other agency than the PWA to administer the new publics works program will result in the waste of national resources and money, and will defeat the purpose for which the appropriation is intended.

## Why Not a Promotional Rate

With construction going forward at an ever-increasing rate on several federally financed power projects throughout the West, the problem of power distribution is demanding more and more attention from engineers, power companies, and interested citizens.

Closely allied with the distribution problem is the question of equitable rates to be put into effect. Considering present economic conditions, a surplus of power will undoubtedly be created when these new projects, such as Bonneville and Grand Coulee are completed.

Studies regarding the feasibility of a 'promotional rate' for Bonneville power is now being made by engineers. This arrangement involves construction of a 42-mi. transmission line from the generating plant to Portland, the nearest large center, and an exceedingly low rate for large blocks of power. This 'promotional rate' means attracting new industries, which in turn means more pay rolls. All in all this scheme appears to be a sensible one and one that should receive favorable reaction.

## The Latest Word in Dams

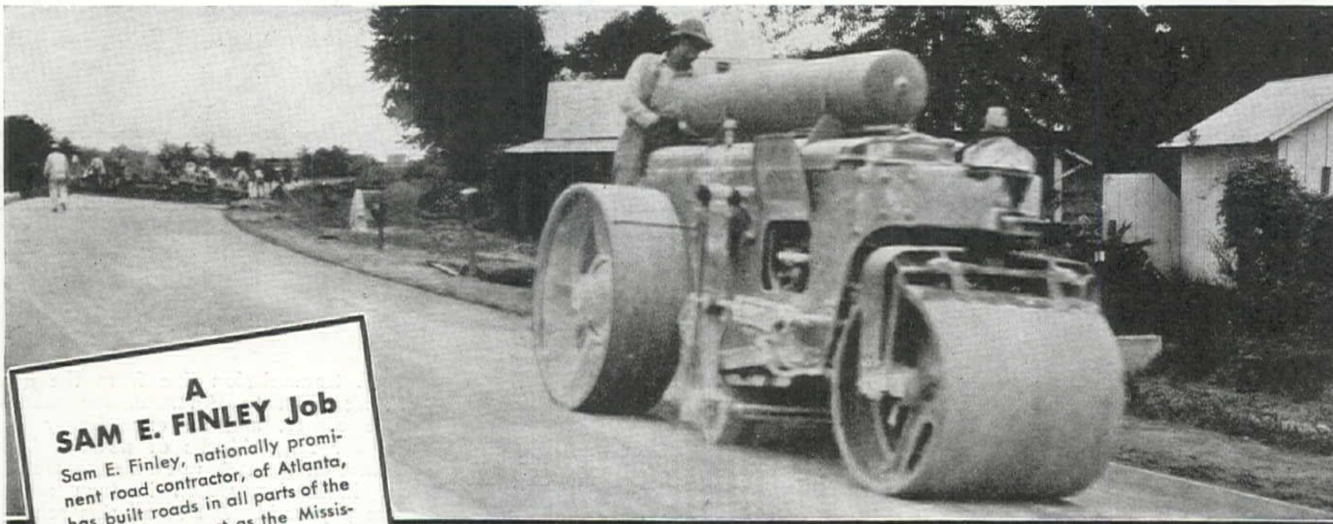
During the past few years considerable change has occurred in both design and construction of dams. Due to research by both designers and builders, it is now possible to dissipate heat generated in placing concrete by mechanical refrigeration and to construct earth dams to unprecedented heights.

A new type of dam is looming up prominently—namely the steel faced gravel-fill dam. With this dam, it is possible to use a relatively cheap material for the body and the steel face assures water tightness. With new and untried materials, the present day engineer dares do anything to facilitate its successful use.

## Concerning Diversion of State Highway Funds

A bill (assembly bill No. 313) has been introduced in the California legislature which, if passed, will stop all raids and diversion of state highway funds. This bill is an amendment to section 444 of the political code and relates to the transfers of money from one fund to another in the state treasury. As stated in the present section, 'Nothing in this section warrants the transfer of any money from any fund so as to in any manner interfere with the object for which such fund was created.' Diversion heretofore has evidently been made under the guise that it did not interfere with the functioning of the highway department.

We can only hope that legislators will be far-sighted and wise enough to vote 'YES' on the amendment which provides, **'nothing in this section warrants the transfer of any money now or hereafter available, under any law of this state, for the acquisition of rights of way for, or for the construction, maintenance, repair, construction or improvement of, state highways or county highways.'** The vote on this amendment will, no doubt, indicate the trend of thought regarding diversion of $16,600,000 in highway funds as is proposed by pro-diversionists. California, as well as other states in the west, should do as Colorado did when voters of that state passed amendment No. 5 which definitely prevents diversion of highway funds.



### A SAM E. FINLEY Job

Sam E. Finley, nationally prominent road contractor, of Atlanta, has built roads in all parts of the South, as far west as the Mississippi. Last fall he won new laurels when he finished the Luverne, Alabama road.

This already famous seven-mile stretch of sand-asphalt highway, even though it has sharp, superelevated curves, is the smoothest "black top" road in the country. And the Austin Roll-A-Plane, Mr. Finley will tell you, played a most important part in building it.

# BEATS SPECIFICATIONS

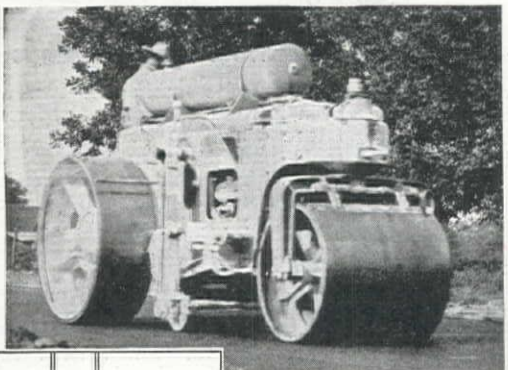
## Operator, Rolling Roads 8 Years, Uses **ROLL-A-PLANE** First Time— Declares, *"Smoothest I ever put down!"*

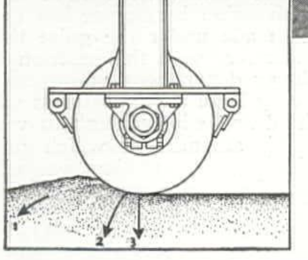
● Sam E. Finley usually goes his specifications "one better" and he did at Luverne, obtaining, with the Roll-A-Plane, a 1/8" tolerance in 10' instead of the 3/16" called for. One of the operators of the five Roll-A-Planes on this job explains it this way: "This knot bumper is a great thing. It saves a lot of rolling. This is the first time I've used one and the road is the smoothest I've put down in the eight years I've been at this kind of work."

Already state highway departments across the country know a better tolerance can be gotten than is required by their standard specifications. Modification of the specified 1/4" tolerance in 10' has already been made in several cases. The new clauses written into state specifications call for 1/8" in 10'—and to reach such tolerance quickly and economically requires an Austin-Western Roll-A-Plane. It can easily be forecast that new clauses will be written into all road specifications universally.

All who purchase new rolling equipment will want to prepare for the new conditions. If present specifications do not call for the immediate purchase of one or more Roll-A-Planes, may we suggest this: Be sure in buying new equipment to get Austin-Western Rollers of the three-wheel type. These will not become obsolete because provision has already been made for converting them into Roll-A-Planes as needed.

*Send for complete descriptive bulletin on the Roll-A-Plane.*






The Roll-A-Plane's third, small diameter roller *establishes* a plane by its Leveling Action, Kneading Action and Spot Pressure. (1) by pushing the bump first forward, (2) then slant-wise, (3) then straight down, it quickly achieves a smoothness that cannot be obtained with ordinary rollers regardless of the 45-ing and cross-rolling done.

**The Austin-Western Road Machinery Co.**
L, Aurora Illinois
Please send me complete details on the Austin-Western Roll-A-Plane.
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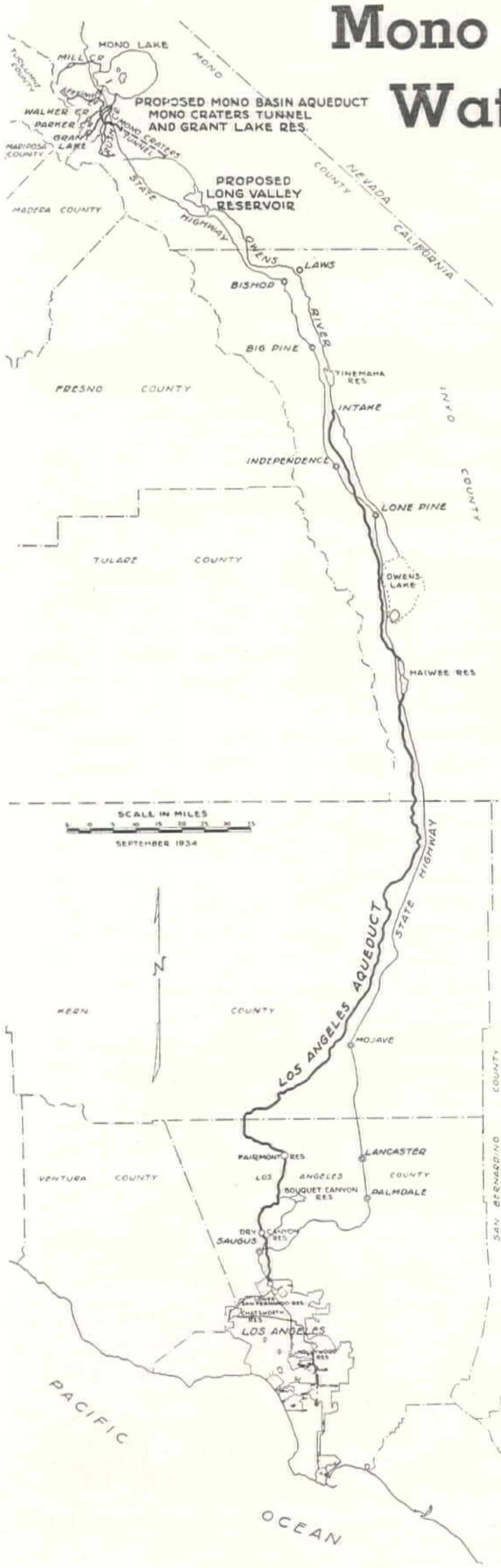
# WESTERN CONSTRUCTION NEWS

FEBRUARY, 1935


# Mono Craters Tunnel Taps New Water Supply for Los Angeles

**Construction started on $7,000,000 project to bring water from Mono Basin in Central California to Los Angeles, a distance of 350 miles. Work involves building reservoirs and driving tunnel over eleven miles long.**


By H. P. BLISS

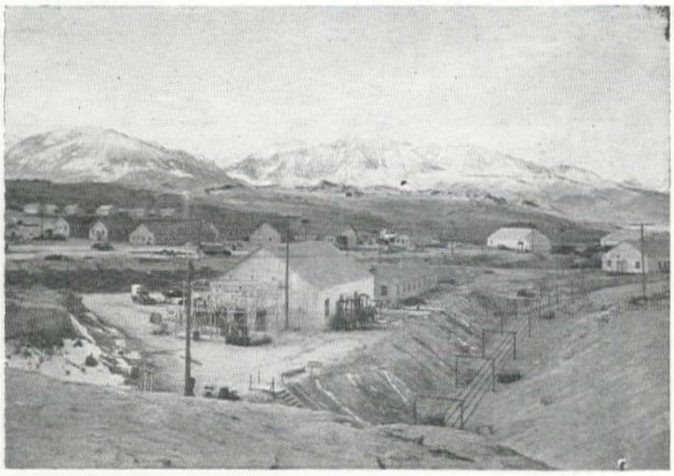
Assistant Field Engineer, Mono Basin Project


THE Mono Basin project is a plan to provide additional water for the City of Los Angeles. This plan embraces the acquisition of properties and water rights and construction of conduits, tunnels, and reservoirs necessary for the collection and storage of waters of the several streams in Mono basin and their transmission to Owens river, thence to Los Angeles. The project was made financially possible by a water bond issue authorized by voters of the City at an election held on May 20, 1930.

Mono basin is situated partly in Mono county, Calif., and partly in Mineral county, Nev. It is about 47 mi. in length and 22 mi. in width and ranges in elevation above sea level from about 6,400 ft. at Mono Lake water surface to more than 13,000 ft. on its highest peaks.

The principal water supply of Mono basin has its origin on the eastern slope of the Sierra Nevada which forms the western terrain of the basin. The run-off from this area is collected by several streams, all of which empty into Mono lake, lying approximately in the center of the basin at elev. +6419 ft. This lake, in June, 1931, had an area, exclusive of its two islands, of 86.8 sq. mi. The surface drainage into Mono lake is supplemented by many springs, some of them of considerable size. Most of these springs are either in the bottom of the lake or near its shores, being quite numerous along the base of the mountains which skirt the western shore. The easterly portion of the basin is very arid, largely destitute of vegetation, and not productive of sufficient water to reach far into the basin.

The important streams of the basin, in the order of the magnitude of their flow, beginning with the largest, are: Rush creek, including its tributaries—North Fork, Reversed creek, Parker creek, and Walker creek; Leevining creek, including its tributaries—Glacier Canyon creek and Warren Fork; Mill creek and its tributary—Lake Canyon Creek; and Gibbs Canyon creek. The combined flows of these creeks constitute practically the entire flow of the basin and are the streams from which a supplementary supply of water could be obtained.



West Portal of Mono Craters Tunnel
With Camp Buildings in Background.

The City of Los Angeles has long been interested in Mono basin as a logical source of additional water supply. As early as 1915 the Department of Public Service (now the Department of Water and Power) made a preliminary study, consisting of field surveys and investigations, to consider the feasibility of diverting waters of the basin. The investigating engineers originally considered diverting waters of Rush creek and Leevining creek to Owens river through a tunnel under Deadman pass, and utilizing this additional supply primarily in connection with the Owens River Gorge power development.

Hydrographic studies have shown that it would be possible to impound within and divert from Mono basin, a quantity of water which, when added to the Owens River supply, and supplemented by the Owens Valley underground water supply when necessary, would enable the City to operate the Los Angeles aqueduct continuously at its maximum mean annual flow of 480 c.f.s.

For the twenty-six year period, 1906 to 1931, inclusive, the average annual flow of all these Mono Basin streams, as nearly as can be determined, was approximately 226 c.f.s, of which 195 c.f.s., or 86%, could have been diverted had the water supply system herein proposed been in operation. However, for the eleven years—1923 to 1933, inclusive, which was a period of subnormal stream flow, the average annual flow of these streams was about 150 c.f.s. of which 140 c.f.s, or 93%, could have been diverted.

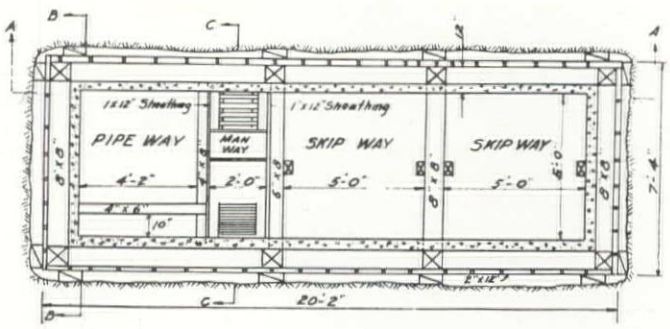
In January, 1930, a detailed survey of the Mono Basin project was commenced by the Department of Water and Power. Prior to that date the only available authentic maps of the region were those of the U. S. Geological Survey and those of the earlier Department surveys. The Geological Survey quandrangles were of such small scale and large contour interval as to make their use impracticable as a basis for selecting an aqueduct route. The earlier Department surveys were limited to the Silver lake-Deadman route only. The possibility of, and the need for, examining other routes soon became apparent and a comprehensive detailed survey of the entire south half of the basin was therefore found necessary. Four routes for a gravity aqueduct from Mono basin to the Owens Valley drainage, as well as several possible pumping routes, were investigated during the course of the survey.

The diversion of water by either of the three routes into Long valley and the Owens river would require construction of a long tunnel under Deadman divide. In order to obtain information concerning underground conditions along each of the long tunnel lines, numerous test holes were drilled to tunnel grade, ranging in depth from 386 to 1,320 ft. Core samples and samples of drill cuttings were taken and a record kept showing per cent of core recovery. Also underground water conditions were noted and temperatures recorded.

In August, 1931, a board of consulting geologists and engineers, composed of Allan E. Sedgwick, Charles T. Leeds, and J. B. Lippincott, of Los Angeles, and Charles P. Berkey and Thaddeus Merriman, of New York, was called upon to review all engineering data and select a route for construction. Members of this board examined the hydrographic, topographic, geologic, and economic features of the proposed development and submitted a report favoring the Mono Craters route. In this report the following statement was made: 'In our judgement the plan which is based on storage of water at Grant lake on Rush creek, with a tunnel thence to the Owens river near the base of Bald mountain, the so-called 'J' line, appears to be geologically and economically the most feasible route, and will yield the largest supply of water.'

Engineering investigations have shown that Grant lake is the most suitable reservoir site of large capacity in Mono basin. The dam for this reservoir would be located on Rush creek at the narrows below Grant lake. It would be of the earth-fill type and would rest on a morainal foundation. A dam approximately 80 ft. in height above the stream bed at this location would create a reservoir of about 48,000 ac. ft. capacity.

THREE COMPARTMENT SHAFT
MONO CRATERS TUNNEL




PLAN (CONCRETING)

The different sections of the proposed Mono basin aqueduct would vary in capacity to carry the added water as the different streams are diverted into it at convenient points along the line. From Leevining creek to Walker creek the capacity of the aqueduct would be 200 c.f.s., increasing to 250 c.f.s. at Walker creek diversion and continuing with this capacity to Grant Lake reservoir. The aqueduct from Grant Lake reservoir to the Owens river would be a pressure line, consisting of a short tunnel at Grant lake, about 3 mi. of concrete pressure pipe and the Mono Craters tunnel, 11.3 mi. long, with a maximum capacity of 500 c.f.s.

Mono Craters tunnel, 59,812 ft. in length, as being built, has a 9 ft. section of wide horseshoe type, and will be concrete lined throughout. Due to its length, two shafts, one of them (shaft No. 1) 900 ft. deep, and the other (shaft No. 2) 300 ft. in depth, are being sunk along its axis to avoid an unduly long construction period. Excavation will be carried on from 6 headings, two at each shaft and one each at the portals. The estimated time required to complete Mono Craters tunnel is 3½ yr.

The estimated construction cost of the Mono Basin project is $7,300,000, segregated as follows:

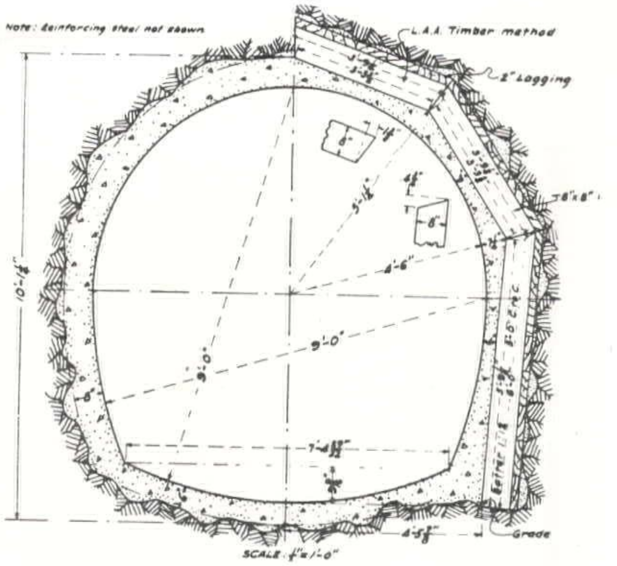
| | |
|---|---|
| Leevining to Grant lake | $ 842,000 |
| Grant Lake reservoir | 453,000 |
| Grant lake to Mono Craters tunnel | 387,000 |
| Mono Craters tunnel | 5,618,000 |

An average of 1,000 men will be employed over the 42 months construction period, with a maximum of 1,800 men at any one time.

Provision is made for a future extension of the aqueduct to divert the waters of Mill creek. The Mill creek extension, approximately 8.5 mi. in length, is estimated to cost $371,500.

Construction on the Mono Basin project was authorized by the Board of Water and Power Commissioners on July 3, 1934, and actual drilling was started at West portal on September 24 and at East portal on November 23. Excavation for sinking shaft No. 1 was begun November 28, 1934. Up to January 10, of this year, 470 ft. of tunnel had been drilled at West portal, 168 ft. at East portal, and shaft No. 1 had been sunk to a depth of 41 ft.

In January, 1930, at the beginning of the field surveys, camp was established on Cain ranch to provide accommodations for the engineers and surveyors assigned to the work. This camp has been kept open since then, except for short periods during the winter months of the past two years when work was temporarily suspended on account of weather conditions. When construction work was begun in July and pending erection of four permament camps along the tunnel line, Cain Ranch camp was greatly enlarged to serve as a temporary base of operations. Four permanent construction camps are now being built; headquarters camp at West portal, to house 200 men, being practically completed, shaft No. 1 camp to accommodate 250 men, shaft No. 2 camp for 250 men, and East portal camp for 150 men. All camps are electrically lighted and all kitchens are electrically equipped throughout. For heating, Butane gas is used as fuel, the dormitories being equipped with hot air units while the other buildings are heated directly by gas stoves. Roads have been built to provide access to all camps and a water supply for domestic and construction use has been completed. A 33 kv power transmission line from the Southern Sierras Power Company's Leevining plant No. 3 to each camp has been erected with a substation at each. Telephone lines have been built to provide direct communication by telephone and teletype from Los Angeles to the work. Because of snow conditions and deep drifts during winter months, snowsheds have been erected at each portal to provide access to the tunnel.

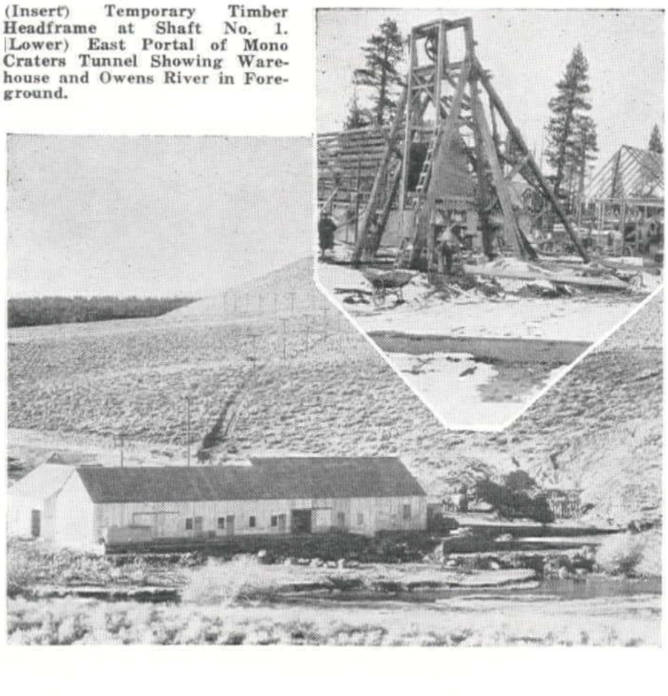


Concrete Lined Mono Craters Tunnel Showing Timbered and Un:imbered Sections.

It is planned to carry on construction at all times with crews working three 8-hr. shifts per day for six days a week. Four 3½-in. automatic feed drifter drills mounted on a drill carriage built in the Water and Power Department shops will be placed at each of the 6 faces, using 1¼-in. hollow round drill steel. Six-inch compressed air lines will be installed and ventilation will be provided through an 18-in. diam. pipe. A mucking machine, emptying the muck into 70 cu. ft. capacity, two-way side dump cars, will be used at each face. Excavated material will be carried out in 9-car trains hauled by storage-battery locomotives operating on a 24-in gauge track of 40 lb. rail. Switches are of the portable jump type.

Work on the Mono Basin project is being carried on by H. L. Jacques, construction engineer, and E. A. Bayley, field engineer, under the direction of H. A. Van Norman, chief engineer and general manager of the Bureau of Water Works and Supply, City of Los Angeles.

(Insert) Temporary Timber Headframe at Shaft No. 1. (Lower) East Portal of Mono Craters Tunnel Showing Warehouse and Owens River in Foreground.

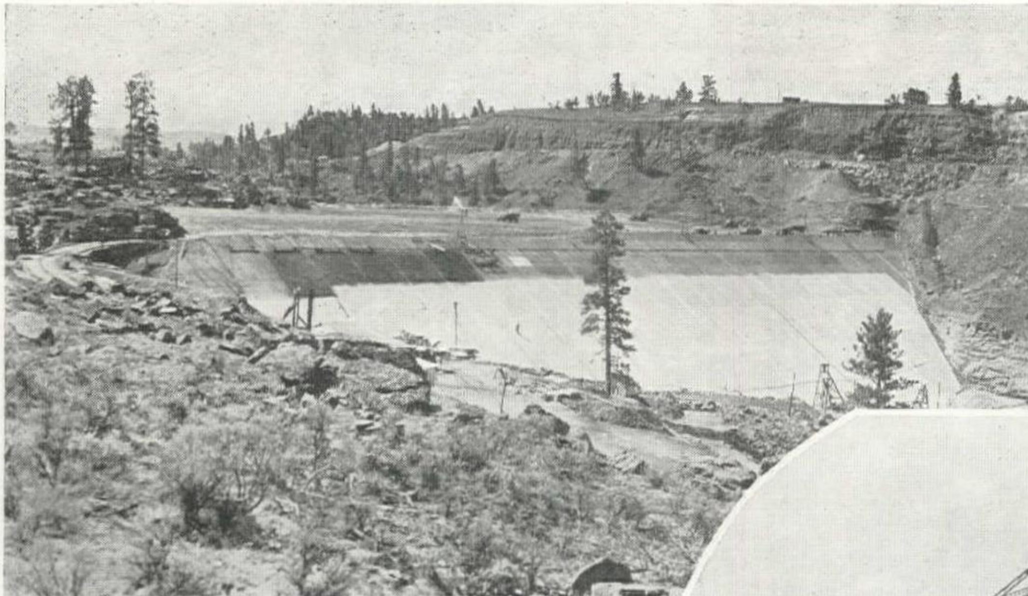


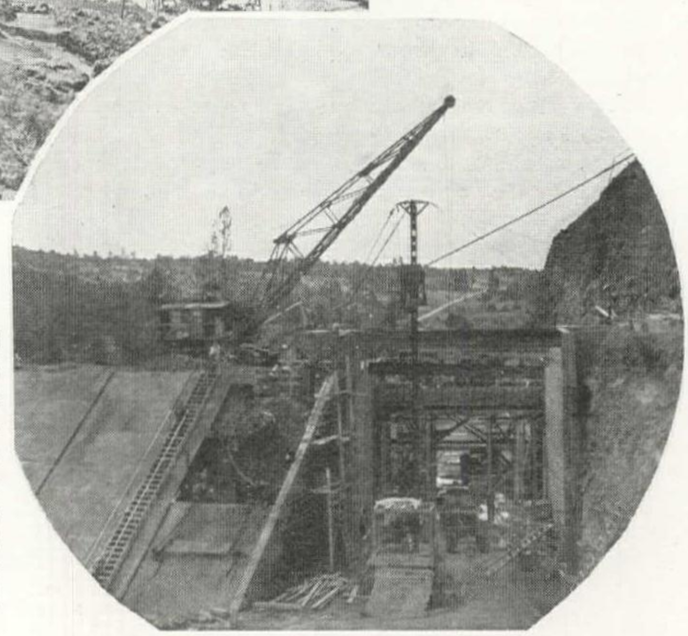
# Denver to Build New Flood Control Dam

Advertisement of bids for construction of Cherry Creek dam in Colorado will be made shortly after February 6, the final date for filing objections against the formation of an improvement district for handling the project. This dam will be built by the City of Denver and negotiations have already been completed for the damsite near Sullivan, Colo., including an area of 800 ac. designed for reservoir area. The project is primarily a flood control measure and is the outgrowth of several recent disastrous floods.

A $290,000 general obligation bond issue was approved by voters in January, 1934, and bonds to the amount of $118,000 will be sold to cover the cost of the damsite and defray engineering costs which have been advanced by the city. The general obligation bond will cover 35% of the construction costs. A special improvement district will pay 35% and the remaining 30% will be taken care of by a PWA grant. Specifications are now available. A. K. Vickery is city engineer and is in charge of work.

# Constructing Steel Faced Storage





(Upper) General View of Upstream Side (Steel Face) of Dam Looking Toward Right Abutment. (Lower) Placing Bridge Beams Over Spillway Opening with P&H Dragline Crane. Note Uncompleted Section of Steel Face at Left of Spillway.

EL VADO dam, the first large metal faced gravel fill dam to be built, forms the storage unit on Chama river for Middle Rio Grande Conservancy District in New Mexico. The construction program of the Conservancy District includes: drainage of one of the oldest irrigated areas in the United States; flood protection for the communities and agricultural lands; and construction of a modern irrigation system to replace one which had been more or less existent in the valley for a period prior to 1539 when Spaniards first explored the valley and found Indians irrigating their lands.

The district extends from White Rock canyon, about 50 mi. above Albuquerque, N. M., to a point near San Antonio, N. M., the total length being about 150 mi., and covering an irrigated area of 123,265 ac. Most of the land is already settled. The District's program is, therefore, one of conservation and restoration, rather than development.

Riverside drains and levees parallel the Rio Grande on each side for practically the entire length of the project. Interior drains are built to serve all lands where drainage was needed. Water for irrigation is diverted from the Rio Grande by means of 4 diversion dams and two headings.

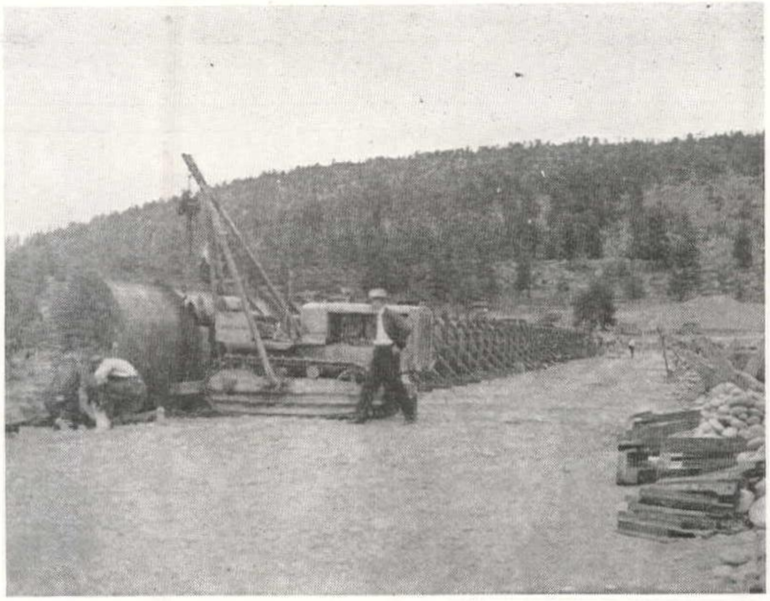
During the summer months the river flow is inadequate to supply the canals, and in the spring, floods occur which endanger the entire valley. To supply water for the dry months and to cut down flood danger, a storage dam upstream of the project was a necessity. Studies made on both the Rio Grande and Chama river, its main tributary, indicated the most feasible site was at El Vado, located on Chama river where it enters a box canyon about 30 mi. southwest of Chama, N. M., (the nearest point on the railroad). Chama is located on the Denver & Rio Grande Western Railway narrow gauge line from Alamosa to Durango, Colo. A graded highway and telephone line provides communication with the dam site.

Camp buildings are of a semi-permanent character and will be used as a summer camp for tourists after all construction is completed. Water for the camp is supplied from a deep well, with suitable storage facilities and distribution system. Hot and cold water, as well as steam heat and sewage facilities are furnished all buildings excepting the garage, warehouse and shops. Sewage passes through a septic tank and onto an aeration field, from which the effluent finally seeps into the river. Electric current for the camp is furnished by a 4-cylinder Atlas Diesel engine, driving a direct connected 37 kw. Westinghouse generator. Three 1½ kw. Kohler plants were used to light remote parts of the works.

Irrigation demands for the District are based on supplying 4.5 ac. ft. per acre at the point of diversion and 3 ac. ft. on the land. To supply the deficiency in the river flow it was estimated that a capacity of 190,000 ac. ft. of water was needed at El Vado. The reservoir behind the dam, which is 174 ft. high, (allowing 13 ft. freeboard) has an impounding capacity of 198,000 ac. ft. and an area of 3,300 ac. The drainage area of the Chama above the dam is 650 sq. mi. The average computed runoff is 400,000 ac. ft., which means that an average of 200,000 ac. ft. will be wasted through the spillway each year. The dam is at elev. 6,900 ft. and in a territory of heavy snowfall so that most of the runoff occurs in the spring months as a result of melting snows. The maximum flood on record is 6,700 c.f.s.

At the dam site the river cuts through alternate beds of shale and sandstone. A concrete cutoff wall extends to good rock the entire length of the dam. From sta. —1+00 to 1+60 (looking downstream) the dam is founded on solid sandstone; from sta. 1+60 to 9+60 a mass of slide rock, composed of sandstone blocks of various sizes and

# The First Large Dam for Irrigation in New Mexico



El Vado Dam on Chama river involves unique method of constructing concrete cut-off wall and placing welded steel face on gravel fill and in spillway channel.

By H. P. BUNGER*
Designing Engineer, Middle Rio Grande Conservancy District, Alburquerque, N. M.

filled in or bedded in decomposed shales or loam, was encountered. An unreinforced concrete cutoff wall of 3 ft. minimum thickness was carried through the slide mass and bedded into the undisturbed shales. The cutoff in this section varied from 10 to 130 ft. in depth. Shafts were sunk to the undisturbed shales at the base of the cutoff wall at sta. 2+80, 4+07, 5+26, 6+25, 7+25, 8+50 and 9+37. Shafts at sta. 2+80, 4+07 and 5+26 were equipped with skip hoists and all material between them was removed by a method of drifting. Where large unfractured rocks were encountered they were left in place and incorporated into the wall. Material was taken out in 7-ft. layers. As excavation progressed, drifts were filled with concrete. All horizontal timbers or braces were removed and replaced by precast concrete struts which were incorporated into the wall. All vertical timbers were left in place and the remaining excavation filled with concrete.

An average of 4.5 sk. of extra finely ground cement was used per yard of concrete in the wall. The water content was carefully controlled and vibrators were used to help insure a water-tight wall.

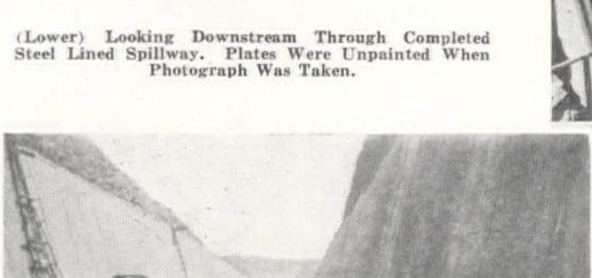
The upper portion of the cutoff wall, deep enough to accommodate the apron plate, was constructed in an open trench the entire length of the dam. This was done to permit placing the gravel fill and the steel face without being held up by the deep underground work. The underground wall was brought up and sealed onto the underside of the portion which was in place near the base of the dam. A total of 8,000 yd. of material was removed by stoping and 5.500 cu. yd. of concrete were placed underground.

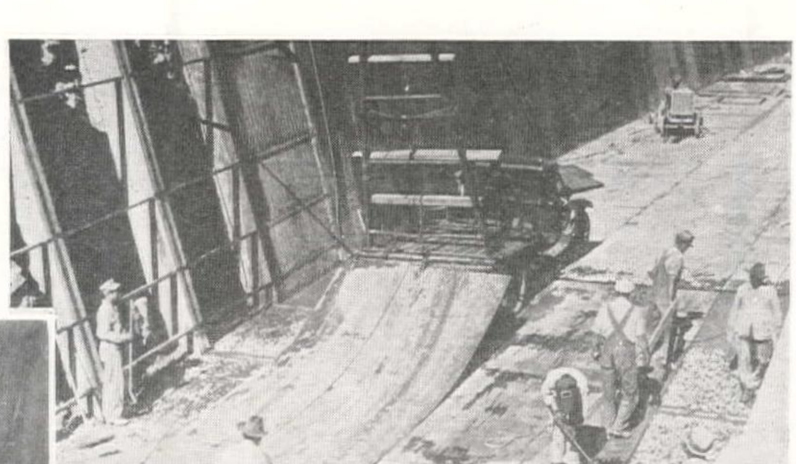
Shafts at sta. 6+75, 7+25, 8+50 and 9+37 were sunk for exploration purposes after which they were filled with concrete. Inspections showed a tight shale which could be left in place. At sta. 9+37 a narrow channel 40 ft. deep was found in which was an 8-ft. layer of river gravel just overlying the undisturbed shale. This layer of gravel was found to pinch out in a distance of 135 ft. The space occupied by the gravel was carefully filled with concrete, care being taken to make a tight seal between

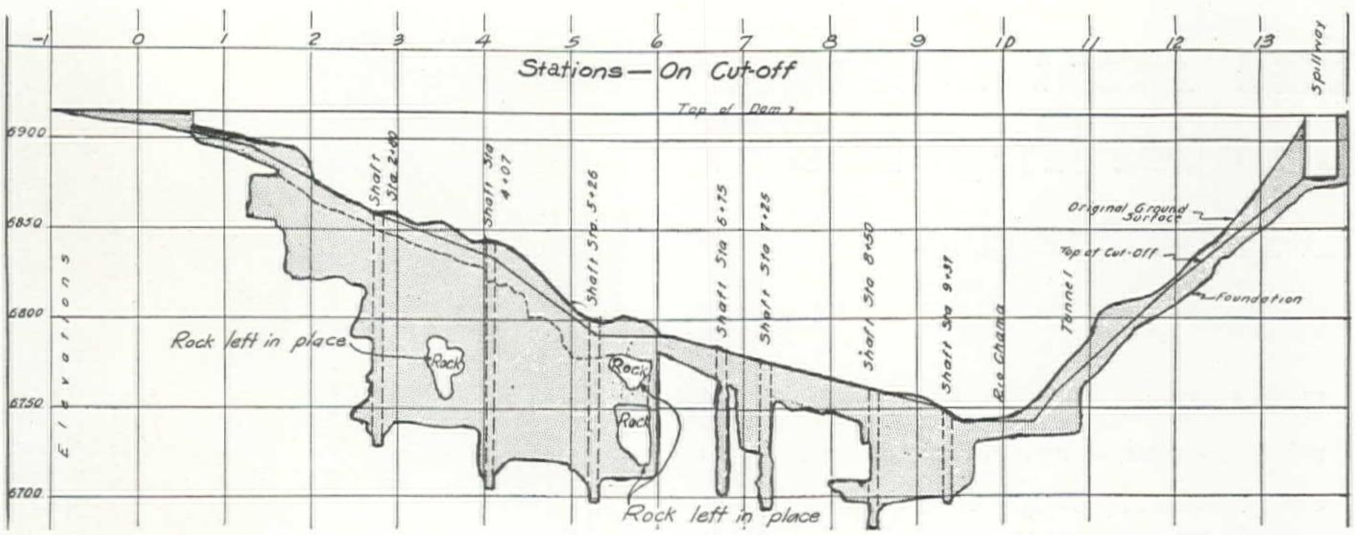
(Upper Right) Erecting Steel Plate Parapet. Gravel Fill Will Be Brought to Top of Parapet.

(Right) Placing and Welding Steel Plates in Spillway Channel. Note Anchor Panel and Beams in Sidewall and Gravel Fill in Place on Floor.

(Lower) Looking Downstream Through Completed Steel Lined Spillway. Plates Were Unpainted When Photograph Was Taken.








Cut-off Wall (Shaded Area—Looking Downstream) Under Upstream Toe of Dam. Portion of Wall Below Line Marked 'Top of Cut-off' Was Concreted Underground in Area Excavated by Drifting From Several Shafts Shown.

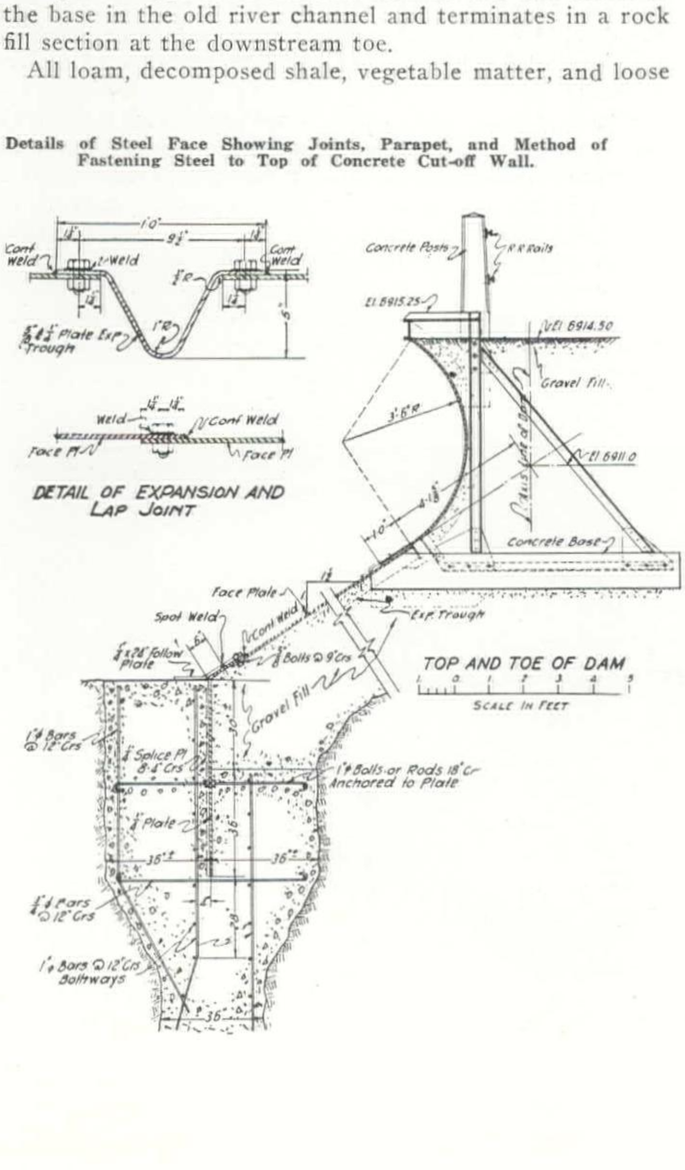
the underlying and overlying beds of shale. From sta. 9+60 to the end of the dam the beds of shale and sandstone are undisturbed, and presented no difficulty from a construction standpoint.

From one to three lines of 2 or 4-in. grout holes at 5-ft. centers each way and 30 to 40 ft. deep were drilled along the upstream edge of the cutoff and were grouted at 100-lb. pressure. No excessive amount of grout was taken by any hole.

The upstream slope of the dam is 1½:1, the downstream slope being 2:1, excepting for the top 10 ft., where it changes to 1½:1. A rock fill extends the full width of the base in the old river channel and terminates in a rock fill section at the downstream toe.

All loam, decomposed shale, vegetable matter, and loose irregular masses of rock were removed from the site before gravel was placed. The gravel fill contains approximately 600,000 cu. yd. of material which was hauled from a deposit located about one mile upstream from the dam site.

Details of Steel Face Showing Joints, Parapet, and Method of Fastening Steel to Top of Concrete Cut-off Wall.




Two 50-B Bucyrus-Erie draglines were used to handle the material at the pit. One dragline, equipped with a 60 ft.-boom and a 1½ yd.-bucket, was used to strip the overburden from the gravel; the other dragline, equipped with a shovel attachment and 1½ yd.-dipper, was used to load trucks. All loading, stripping, spreading, and rolling of the material in the dam was done by the District's forces, as well as construction and maintenance of roads. Hauling was contracted to Springer Transfer Co. of Albuquerque at a price of 20c per cu. yd., measured in the dam. Placing of the gravel fill was begun March 15, 1934 and completed by October 10, 1934, except for about 6 ft. of depth at the crest. This was placed by the District after the parapet was in place.

The contractor used fifteen R-95 special Indiana trucks, equipped with Wood hydraulic hoists and dump bodies with extra side boards to enable them to carry 3 cu. yd. loose measurement per load. Trucks and shovels worked 3 shifts of 7½ hr. every day except Sundays and holidays. Thirteen trucks were kept in the line, with two for reserves. The record of hauling was as follows: 575,000 cu. yd. were placed in 176 days or 487 shifts. A total of 217,002 loads were hauled, making an average of 448 loads each shift. The highest average for any month was during August, when 489 loads per shifts was made. The best output for 24 hours was 1,704 loads in 1,350 min., using 13 trucks.

Material was partially spread as it was dumped from the trucks, the spreading into 8-in. layers being completed by bulldozers mounted on Caterpillar tractors. The fill was then sprinkled as much as was possible without bogging down the trucks, and was compacted by a roller weighing 2 tons per foot, drawn by a Caterpillar tractor. All boulders exceeding 6-in. diam. were removed from the working surface by hand and were dumped on the downstream face, forming a rock blanket varying from 3 to 30 ft. thick.

On the upstream slope the gravel fill is protected from wave action and percolation by a water tight diaphragm of steel plates of more than 5 ac. in extent, and resting directly upon the slope of the fill. The plates are ¼ in. thick throughout and, except for the sketch plates, are 8⅓ by 25 ft. They are placed so as to lap 2½ in. and are attached along all edges by ⅝-in. bolts at 18-in. centers and a ¼-in. fillet weld. A vertical expansion joint is placed every 25 ft. No provision was made for expansion or contraction in the vertical direction. Face plates were attached at the base to the apron plates, which were thoroughly embedded into the top of the cutoff wall. At the top of the dam they were attached by bolts and clips to the curved parapet plates. The plates were placed and bolted up ahead of the gravel fill, thus forming an upstream form against which to place the fill.

The fill directly under the plate was hand placed and tamped. 'A' frames made of angles, with one vertical leg and the other on a 1½:1 slope, were placed on 8-ft.-4 in. centers and brought to line and grade by the engineers. Plates were then placed on these frames and bolted into position after which the frames were embedded in the gravel, thus forming not only a support for the plates but also an anchor.

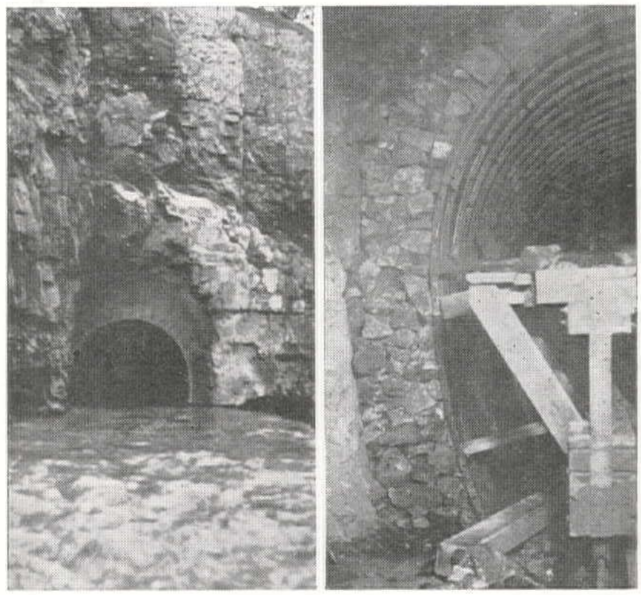
One 400 amp. Lincoln electric welding machine and heavy coated 'Fleetweld' welding rods were used throughout for all welding operations.

At the crest of the dam the steel face terminates in a curved steel plate parapet supported by and anchored into the gravel fill by steel frames anchored into concrete sleepers.

All steel for the face and parapet was fabricated and erected by American Bridge Co. A total of 1,280 tons of steel was placed in the face at a total cost, including overhead, of 5.6 cents per lb. The parapet steel weighed 84 tons and cost 8 cents per lb. in place.

The plates were shipped unpainted and field painting is being done by District forces. No painting was done on the underside of the plates. The exposed surface is given an undercoat of red lead and a top coat of a metallic coating which is manufactured by Acorn Refining Co. and Sherwin-Williams Paint Co.

In order to take care of the flow of the river during construction, and also to serve as an outlet after completion of the dam, a 12 ft.-diam. horseshoe tunnel 650 ft. long was constructed under the right abutment. At the upper end, the tunnel was in a layer of dense black shale which scaled off badly and required timbering. However, the greater part of the tunnel was in sandstone and required no timbering. For a distance of 70 ft. from the intake portal the entire excavation outside of the neat lines was filled with concrete and grouted. For the remainder of the length an interior form, made of steel liner plates of a type manufactured by Commercial Shearing Co., covered by a heavy wire mesh and 3 in. of gunite, was used as a lining. All over break or area outside of the plates was carefully back packed with rock. At 32-in.



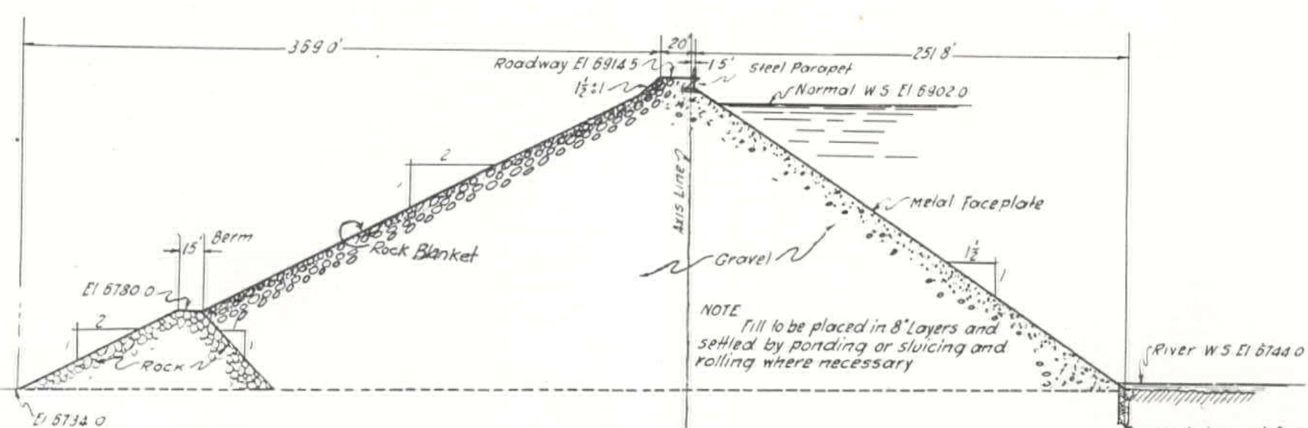
(Left) First Water Through Diversion Tunnel. A Valve House Will Be Placed at This Tunnel Portal. (Right) Tunnel Section Showing Steel Liner Plates and Back-Packed Rock Which Is Gunited.

intervals the face of this rock packing was shot with gunite sufficient to form an 8-in. ring of solid masonry. This method of lining the tunnel has proved satisfactory and saved considerable time and cost over the usual monolithic method.

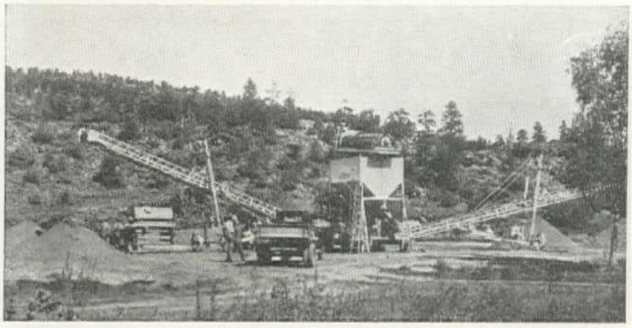
A trash rack structure, made up of horizontal and vertical C-B sections was placed at the intake to the tunnel. After the fill was completed and the storage of water was possible, the trash rack was sealed off, stopping the flow of water through the tunnel and a concrete plug was placed near the upper end. The plug is bonded into the lining and forms a transition from the tunnel section to the 78-in. diam. cast iron conduit sections which serve as an anchor and connection for the outlet penstock.

The outlet penstock, 78-in diam. pipe of butt strap welded construction is 635 ft. long, and consists of plates that are 7/16 in. thick throughout. The penstock is controlled at its upper end by a 78 in. emergency butterfly type, valve which is both manually and hydraulically operated. At the lower end the penstock branches into two 60-in. outlets, each of which is controlled by a horizontal sleeve valve of a type patented by C. H. Howell and the writer.

The capacity of the outlet is figured to be 1,500 c.f.s. with a half reservoir. Water released from the dam will flow down the Chama river channel, a distance of about




MAXIMUM SECTION THRU DAM



**Aggregate Plant at Pit Located About One Mile Upstream From Dam.**

75 mi., and empty into the Rio Grande, from which it will be diverted into the District's canals.

The spillway is located at the right end of the dam and is formed by a cut approximately 1,000 ft. long and 90 ft. maximum depth. It has a base width of 36 ft. at the intake and tapers to 20 ft. at the lower end, where it discharges over a cliff 60 ft. high into the riverbed. The point of discharge is about 600 ft. downstream from the toe of the dam. The excavation was contracted to Frank Shufflebarger of Albuquerque and consisted of removing 80,000 cu. yd. of shale and sandstone.

At the inlet end the excavation was through hard shale which required shooting before it could be moved, but which broke up very rapidly on being exposed to the air. At the lower end of the excavation was through heavy dense sandstone, which formed an excellent anchor and base for the spillway lining.

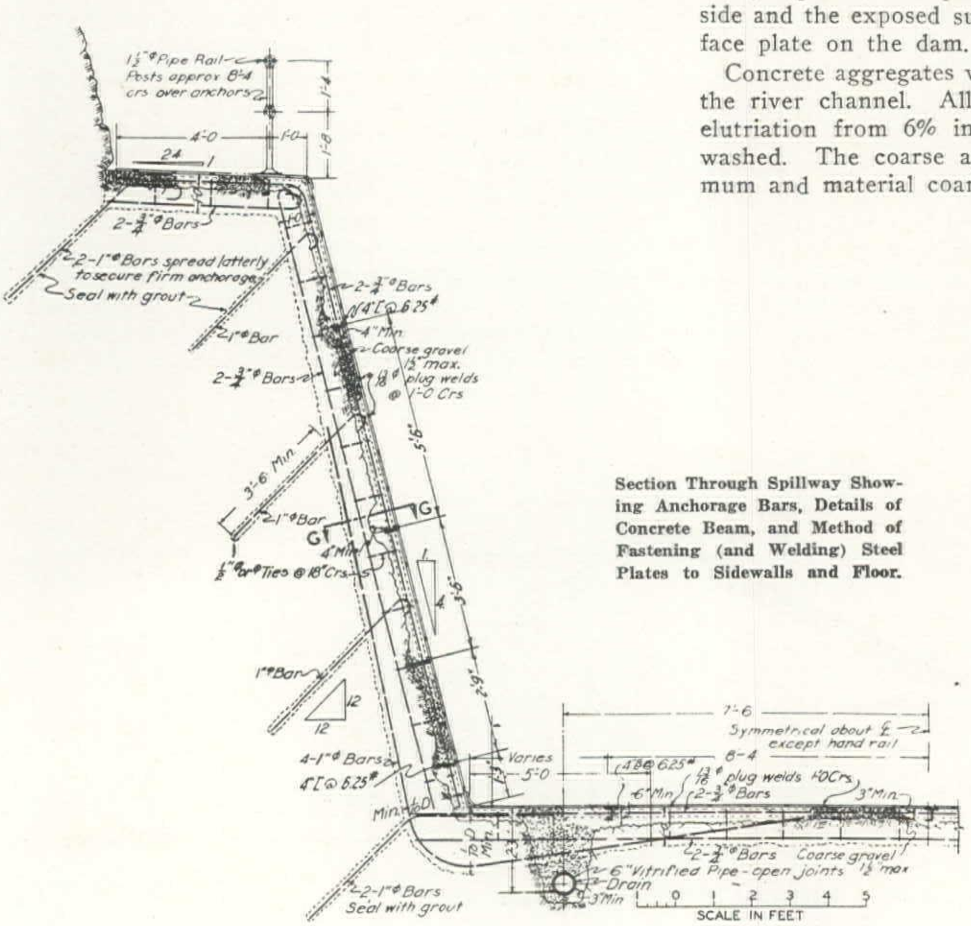
The capacity of the spillway is estimated to be 12,000 c.f.s. with the water at normal elevation, and 20,000 c.f.s before the dam is endangered. The rate of discharge is controlled by an automatic radial gate 36 ft. wide and 23½ ft. high, so balanced by counterweights and floats that it will open as the water rises above normal in the reservoir and will close as the water drops. This is the largest automatic radial gate ever constructed and differs from the usual type of radial gate in that it has five arms equally spaced along the face instead of the usual two. The reactions from the arms are taken by a concrete beam extending from wall to wall of the gate structure.

At the gate the concrete structure is 36 ft. wide with vertical cantilever side walls 36 ft. high. Just below the gate beam the structure tapers to a base width of 32 ft., a depth of 21 ft. and side slopes ¼ to 1. Below the point where the above section is reached the chute is lined with steel plates. The plates are 5/16 in. thick on the floor and ¼ in. thick on sides and beams. These plates are anchored to tees set in concrete beams placed 8 ft.-4 in. centers. The beams are 12 in. wide and of sufficient depth and reinforced to take the loads due to side pressures of the material below the beams. The beams are also anchored to the shale and sandstone by means of 1-in. dowel rods extending a minimum of 3½ ft. into the rock. In the upper section the space between every sixth beam was filled solid with concrete. In the lower or steep section every fourth panel was filled. A minimum of 4 in. of coarse screened gravel was placed under the base plate and back of the side plates to form a drain. Two lines of open joint tile drains embedded in coarse gravel extend the entire length of the chute.

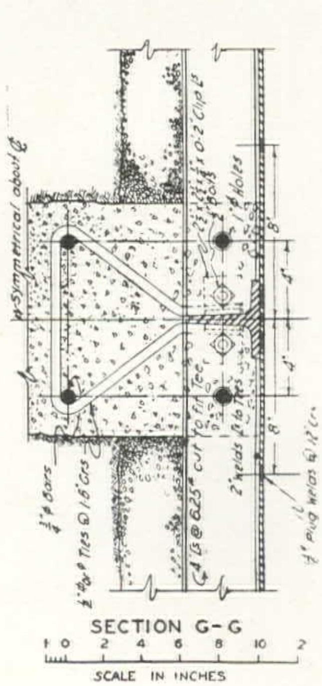
The plates are attached to the tees by means of ¾-in. plug welds at 12-in. centers at all intermediate beams and by ¾-in. plug welds at 12-in. centers and by butt welds at all joints and along all edges. No expansion joints were provided.

The steel for the lining was furnished and erected by the Wyatt Boiler Works of Dallas, Texas. The total weight was 460 tons and the final cost, including overhead, 6c per lb. The plates were not painted on the underside and the exposed surface was treated the same as the face plate on the dam.

Concrete aggregates were obtained from the deposits in the river channel. All sand was washed to reduce the elutriation from 6% in the natural sand to 2% in the washed. The coarse aggregate was 1½-in. diam. maximum and material coarser than this was crushed.




**Section Through Spillway Showing Anchorage Bars, Details of Concrete Beam, and Method of Fastening (and Welding) Steel Plates to Sidewalls and Floor.**



All work was done by force account except as noted. The maximum number of men employed was 649, the average being about 300. Money for building the dam was obtained by the sale of bonds to the Reconstruction Finance Corporation. Due to the remoteness of the work the men were permitted to work 48 hr. per week.

The work has been done under the supervision of the Board of Commissioners of the District and C. H. Howell, chief engineer, assisted by D. C. Henny, Andrew Weiss, E. H. Wells and Kirk Bryan, acting in consulting capacities. Field work has been under the direct supervision of H. V. R. Thorne as construction superintendent, and Mr. C. P. Seger as resident engineer. The writer has been in charge of all designs.

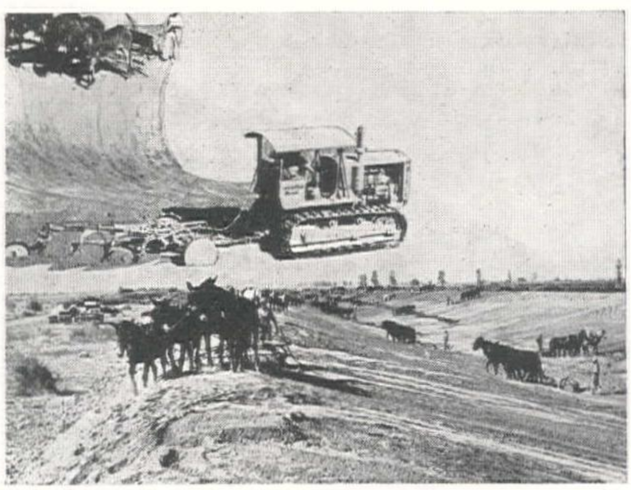
***H. P. Bunger was born at Wheatridge, Colo., and graduated from University of Colorado in 1914 with a B. S. C. E. degree. For the next three years he was connected with the Atchison, Topeka & Santa Fe Railway Co., serving as rodman, transitman, chief of party on valuation work, and structural designer. The following year and one-half, Bunger was in private practice on survey and water filings, and as mine engineer for Leyden Coal Co. at Leyden, Colo.**


H. P. BUNGER

**From April, 1918, to February, 1919, he was office engineer and chief inspector on the water works system constructed at Explosive Plant 'C' at Nitro, W. Va. During 1919 Bunger was instructor of hydraulics and water power at University of Colorado, and 1920 he was designer for Colorado Builders Supply Co. on grain elevator foundations and reinforced concrete buildings. From 1920 to 1926, Bunger was with the Bureau of Reclamation, Denver, working on design of all types of wood, concrete, and steel irrigation structures, outlet works, trash racks, spillways, etc.; also checking designs of three diversion and two storage dams.**

**From 1926 to 1933 he was with J. G. White Engineering Corp., Mexico City. This work involving water studies, designs and estimates for proposed projects, designing and detailing of all types of irrigation structures including concrete gravity and arch dams. During the last three years with this firm he was designing engineer in charge of all design work on projects in Mexico. For the past two years Bunger has been with Middle Rio Grande Conservancy District as designer in charge of all designs and detailing for El Vado dam, the 180-ft. gravel-fill storage dam described in this issue. He is a member of American Society of Civil Engineers.—Editor's Note.**

# Modern and Ancient Excavation Methods Employed on All-American Canal


**A Few of the Hundreds of Mules and Horses Employed on Force Account Construction Near Calexico. (In the Insert) A Modern Tractor and Farm Plow Loosens Material for 4-Up Fresnoe Outfits.**

**Forty-four miles of canal, involving over 45 million cubic yards of material is being excavated with twelve and six-yard draglines and nearly 1000 head of horses and mules.**

FORMAL dedication ceremonies were held December 16, 1934, at the Potholes area near Laguna dam on Colorado river to inaugurate work on the new $27,000,000 All-American canal which is now being pushed forward at three points on the 80 mi. site of the project along the Mexican border in Southern California.

Water will be taken from Colorado river at Imperial dam about 4½ mi. above Laguna dam (15 mi. above Yuma) and will be used for irrigation on an ultimate area of 900,000 to 1,000,000 ac. of fertile but arid lands in the Imperial and Coachella valleys. The diversion dam, which will be advertised for bids about April, will probably be of the floating or Indian-weir type with a crest length of 1,770 ft. at elev. 180 ft. providing a floodway capacity of 170,000 c.f.s. without overtopping the gate structure. Six desilting basins are proposed—these to be located adjacent to the diversion dam.

Capacity of the canal from Imperial dam to Siphon drop, a distance of nearly 15 mi., will be 15,000 c.f.s. From Siphon drop to Pilot Knob, a distance of about 7 mi., the capacity will drop to 13,000 c.f.s. From the latter point westerly, the canal capacity will decrease as diversions are made to the north end of Imperial valley, the capacity at the end of the west side main canal to be about 2,500 c.f.s.

A 130-mi. branch canal of 2,000 c.f.s. initial capacity, estimated to cost $7,000,000, will probably be built later to serve Coachella valley. The upper portion of the canal parallels Colorado river for about 5 mi. and from this point to Pilot Knob it roughly follows the Yuma main canal, cutting through foothills at the edge of the mesa. In this stretch are two points at which solid rock is encountered—the only places on the entire canal where such material is found. The rock work extends from sta. 1140 to 1170 and involves about 540,000 cu. yd. of material.

In the length between the dam and Pilot Knob will also be the only wash crossings of any consequence—the two principal ones being Un-named, and Picacho washes. There will also be several smaller crossings near Pilot Knob. In all cases it is planned to carry the canal under the washes through reinforced concrete siphons. The siphon at Un-named wash is estimated to cost about $250,000 and for Picacho wash, approximately $350,000.

From Pilot Knob to sta. 1860, a distance of some 14 mi. and the end of the present contract work, the major portion of the canal will be cut through the sand hills area. In this division, the canal is being dug to a maximum depth of nearly 100 ft. There will be only one structure, a crossing of the state highway at the western end at Government Gap. Total excavation in the sand hills region amounts to 22,000,000 cu. yd. on nearly one half of the total of the entire main canal.

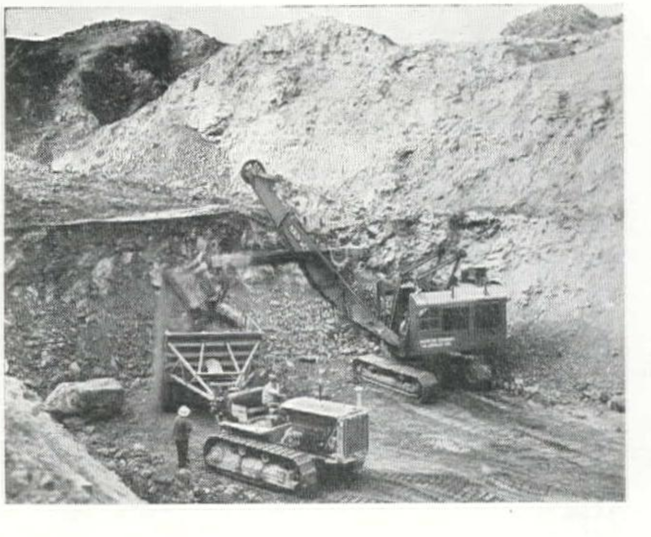
Specifications for the approved cross section in the sand dune area are as follows: Base width, 130 ft.; depth of water, 16.38 ft.; side slopes, 2:1; velocity, 3.75 ft. per sec.; and berms of 20 ft. in width at the intersection with the floor of the mesa.

The work on the main canal is being done under two separate contracts and with force account labor. Schedules 1 to 6, inclusive, covering the work from sta. 245 to 1860, a distance of about 30 mi., is under contract to W. E. Callahan, of St. Louis, H. Gunther, and J. P. Shirley, of Dallas, at a price of $4,859.587. The total yardage involved under the 6 schedules amounts to 39,325,000 cu. yd. of common and 57,000 cu. yd. of rock. The average price on the common was 12¼ per cu. yd. The rock work mentioned previously is under contract to Griffith Co., Los Angeles, at a price of $228,800.

About 11½ mi. of canal on both sides of the town of Calexico, Calif., is being done by force account labor. This work is being financed by PWA relief appropriations alloted mostly because of distress in Imperial valley due to last summer's drought. This force account work extends between sta. 3110 and 3330 east of Calexico and between sta. 3900 and 4242 on the west side of Calexico.

Work which is covered under the major contract was started on December 11 at Potholes and Andrade near Pilot Knob. By February 1 nearly 1,000,000 yd. of material had been moved on several schedules. Schedule No. 3 is under sub-contract to Boyce & Igo of Baton Rouge, La. and involves about 6,000,000 cu. yd. of common. The sub-contractors are using a 12-yd. and 3-yd. Bucyrus-Monighan dragline. On schedules 1 and 2, involving more than 8 mi. of canal, three Bucyrus-Monighan draglines of 12, 6, and 1½ cu. yd. capacities, are used and on schedules 4, 5, and 6, one 12-yd., two 6-yd., and one 1½-yd. machines are being used. The 12-yd. machines are the largest dragline excavators ever used in the west and have a total weight of 650 tons each. These machines have been previously used on Mississippi river levee work by the contractors. The largest machines have 175-ft. booms, the 6-yd. machines are equipped with 150-ft. booms and the 1½-yd. draglines have 100-ft. booms. These machines employ the walking principle which is used to advantage in soft dirt and mud.

**A Tractor Drawn 25-Yd. LeTourneau Wagon and 2-Yd. Northwest Shovel Are Used in the Rock Work on Griffith's Contract.**



The major draglines are equipped with 450 hp. diesel driven motors and 40 h.p. auxiliary units; and the 1½-yd. machines have 240 hp. diesel driven motors. The largest equipment is used for roughing out the channel of the canal and the smaller machines are used for finishing.

The width of the excavation through the sand dune area ranges from 130 to 160 ft. at the bottom and at some places where the banks are high, the width at the top is nearly 400 ft. Although the ground is largely sand and clay, there are numerous pockets of cemented gravel which require blasting. Blast holes are drilled to a maximum depth of 10 or 12 ft. by Ingersoll-Rand jackhammers using Crusca steel and removable Timken bits.

A specially constructed all-welded rooter has been tried successfully by the contractor to dispense with blasting in these cemented gravel areas. The beam of the rooter is 25 ft. long with a plow section 6 ft. deep and 8 ft. long. The rooter, which has a weight of 20,000 lbs., is balanced so as to be suspended from the boom of the dragline in a manner similar to that which the dragline bucket is supported. It is operated in the same way, being buried to the beam on the pull. With this device, which can be kept handy to the dragline, a blasting crew is not necessary each time a patch of cemented gravel is encountered and much time is saved. The material is of a crumbly nature which is troublesome in drilling. In excavating with the draglines, material is usually taken out to the full depth and cast each way. Limits of the excavation are marked for the operator with lime lines on the ground. Dipper teeth of Amsco, Esco, and H & L type are made to a special design. Two LeTourneau bulldozers mounted on Caterpillar diesel tractors are used for leveling the waste material in the bank.

The headquarters camp of Callahan & Gunther—Shirley Co., located at Colorado Siding near Winterhaven, Calif., includes a machine shop for general repairs and maintenance of excavating equipment. Most of the heavy repair work is done in the shops of Imperial Water District at Andrade. A temporary machine shop is also maintained at Boyce-Igo's camp and includes a Lincoln 'arc shield' welding machine and a Gardner-Denver compressor driven by belt from a Caterpillar '30' tractor.

A total of 150 men, employed on the dragline work, in four 6-hr. shifts. These men are hired through the Federal-Re-employment Agency in El Centro.

Personnel of the Callahan, Gunther-Shirley Co. includes W. E. Callahan, president; L. D. Crawford, vice-president and general manager; and V. H. Gray, superintendent of construction. Rex Igo is superintendent for the sub-contracting firm of Boyce-Igo Co.

More than 175,000 cu. yd. of rock has been taken out on Griffith Co.'s contract on the rock work at Pilot Knob. This rock is of granitic formation through which runs streaks of extremely hard rock ranging in thickness from 6 in. to 3 ft. This rock is so hard that as many as 50 Stellite bits have been used in drilling 2 ft. of hole. An average of 1¼ lb. of powder per cubic yard of rock is required in blasting. Two Cleveland wagon drills and 3 Ingersoll-Rand jackhammers are used, the latter, largely in secondary blasting of which there is considerable. From 60 to 80 wagon drill holes, spaced about 26 ft. apart, and ranging in depth to 30 ft., are usually fired at one time. The holes are first sprung with special dynamite, then loaded with 60% stick and 70% bag powder. As much as 30,000 cu. yd. has been broken up in one shot.

Width of the excavation ranges from 69 ft. at the bottom to about 250 ft. at the top with a maximum depth of 15 ft. Materials are taken out in 30-ft. lifts, a 2-yd. Bucyrus-Erie shovel being used in the earlier excavation, and two 2-yd. Northwest shovels being used at present. Material is wasted in ravines adjacent to the ends of the cut. This material is hauled in two 25-yd. Le Torneau pneumatic tired, all-welded buggies drawn by Caterpillar '75' diesel tractors and in a 12-yd. Mack truck. A bulldozer is used in leveling the waste dumps and sloping the sides of the cut. Forty men are employed on the rock work.

**Two 12-Yd. Bucyrus-Monighan Draglines in Action Near Andrade. (Right) A 10-Ton Rooter Loosening Cemented Material for Dragline Excavation.**

The contractors' personnel includes S. M. Griffith, president; John Holstrom, vice-president in charge of construction; and Cliff Bong, field superintendent. James Atkinson is resident engineer on Griffith's schedule for the Bureau of Reclamation.

More than 300 men and nearly 1,000 head of horses and mules are employed on the day labor work near Calexico. Specifications for the canal being done by day labor are as follows: Height of bank, 15.8 ft.; water level, 11.3 ft.; bottom width, 60 ft.; slope of bank, 1½:1; width of bank at top, 20 ft.; capacity, 2,600 c.f.s. An average of 70 cu. yd. per team per day of 6 hr. is being moved by the force account crews who furnish their own horses and mules and excavating equipment which consists of fresnoes and tractor plows and scrapers.

In the beginning, it was found that the hard top soil when blasted, made rough clods which hurt the feet of the teams. Consequently tractor drawn scrapers were employed to clear off this layer of earth. Sixteen tractor-plows all owned by Imperial valley farmers are used to loosen up the material for the 2-up and 4-up fresnoe teams.

Beginning at sta. 3900, a mile of canal was roughed out with the idea of using dragline excavators to finish the channel. It has since been found, however, that the teams can do a good job of finishing and the remaining 5½ mi. will be completed this summer. Excavated material is dumped on both sides of the channel and the banks are leveled to uniform grade on which an operating road will be maintained.

To date, day labor earth moving cost has been about 13c per cu. yd. although it is expected that this figure will be increased somewhat near the end of the job. A decision has not yet been made as to whether the canal will pass through or around the City of Calexico. Jerome Fertig is division engineer and Frank Higley is superintendent of construction for the force account work.

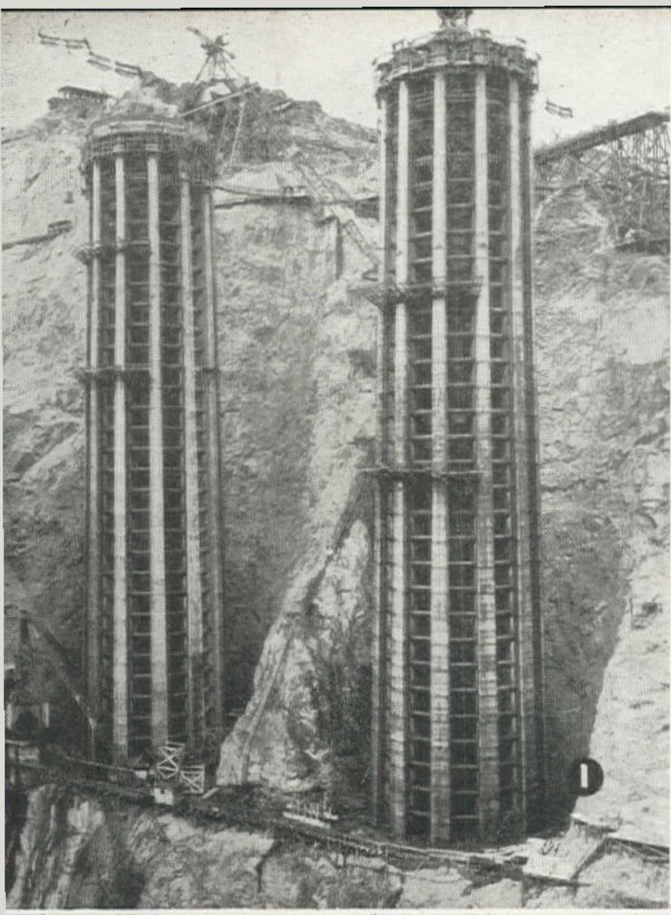
## Maintaining Nevada's Highway System

During the fiscal year ending June 30, 1934, Nevada Department of Highways spent $502,712 for maintaining 2,287 mi. of roads. Total mileage and expenditures for various types of improved and unimproved highways are as follows:

| Type of Road | Mileage | Expenditures |
|---|---|---|
| Cement concrete | 18 | $ 7,214 |
| Asphaltic concrete | 43 | 12,178 |
| Asphaltic macadam | 5 | 385 |
| Bit. treated surface | 1153 | 191,022 |
| Gravel | 942 | 188,791 |
| Graded and unimproved | 126 | 14,208 |
| Miscellaneous seal coating, etc. | .. | 88,814 |
| | 2287 | $502,712 |

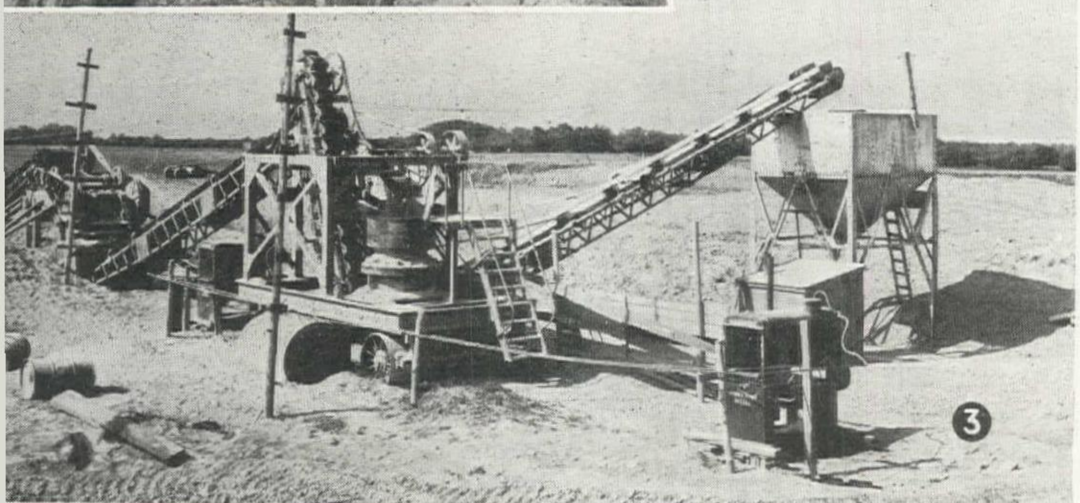
The cost per mile varied from $77 for asphaltic macadam to $399 for cement concrete, with an average of $180. The actual cost per mile of maintaining surfaces and building and repairing shoulders for the various types of roads is as follows:

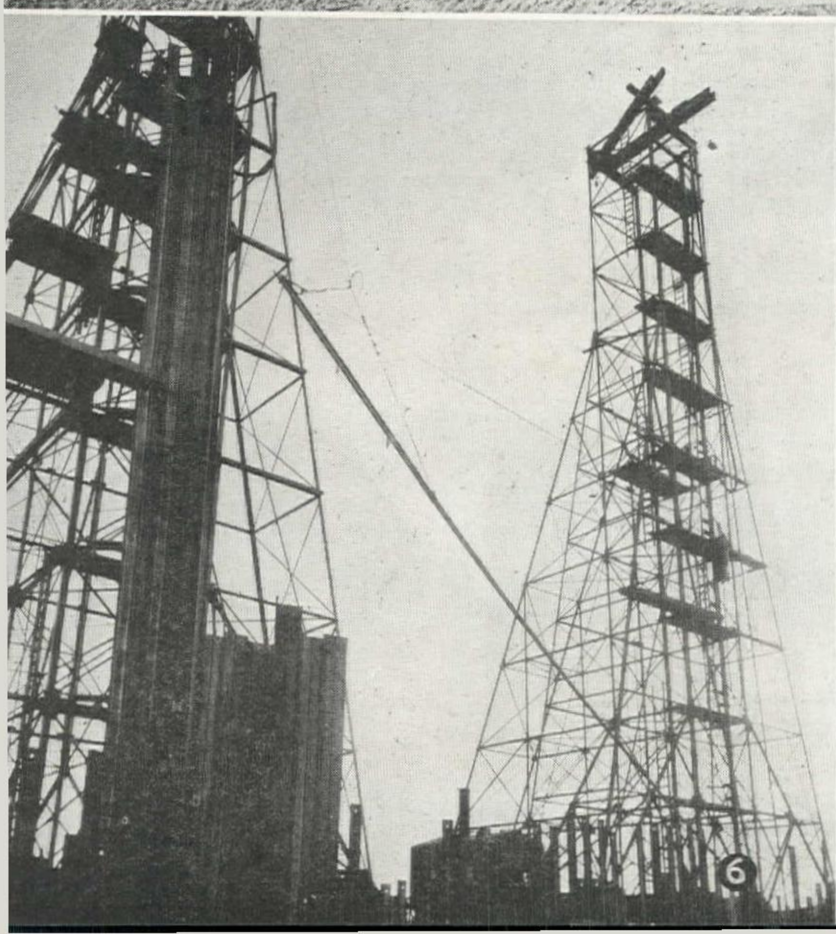
| Type | Mileage | Cost | Cost Per Mile |
|---|---|---|---|
| Cement concrete | 18 | | |
| Filling joints and cracks and patching, etc. | | $ 1,167 | $ 65 |
| Build and repair shoulders | | 950 | 53 |
| Total | | | $118 |
| Asphaltic concrete | 43 | | |
| Filling joints and cracks and patching, etc. | | 1,352 | 31 |
| Build and repair shoulders | | 3,857 | 90 |
| Total | | | $121 |
| Asphaltic macadam | 5 | | |
| Filling joints and cracks and patching, etc. | | 215 | 43 |
| Build and repair shoulders | | | .. |
| Total | | | $ 43 |
| Bituminous treated | 1153 | | |
| Filling joints and cracks and patching, etc. | | 43,251 | 37 |
| Build and repair shoulders | | 51,871 | 45 |
| Total | | | $ 82 |
| Gravel | 942 | | |
| Dragging and blading | | 134,430 | 143 |
| Hauling and spreading patching material | | 10,628 | 11 |
| Raking rocks | | 5,130 | 5 |
| Total | | | $149 |
| Graded and unimproved | 126 | | |
| Dragging and blading | | 6,535 | 52 |
| Hauling, spreading, patching material | | 3,805 | 30 |
| Raking rocks | | 1,305 | 10 |
| Total | | | 92 |

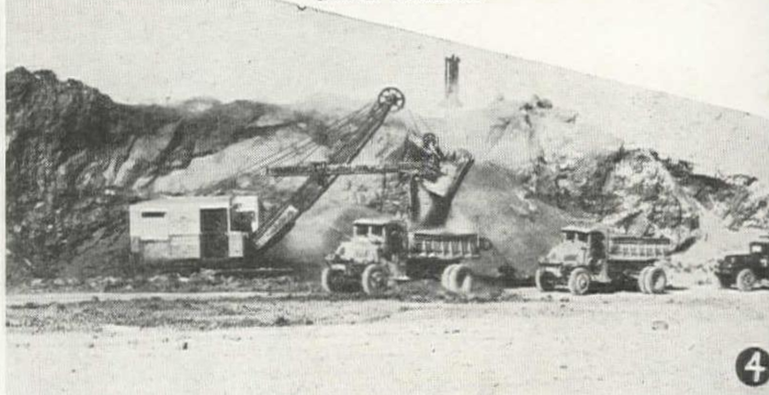


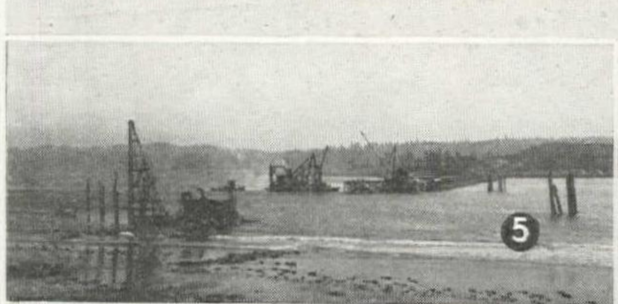

# On the Wester

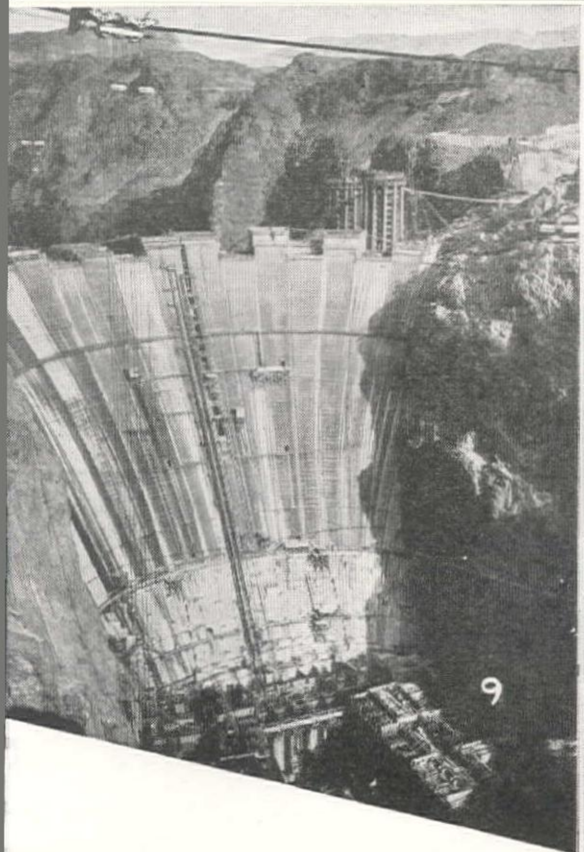
1. Concreting operations near top of Nevada intal towers—Boulder Dam Project.
2. Taking out material in spillway cut of Fort Pe dam in Montana with Bucyrus-Erie 43-B shovel a a fleet of White trucks.
3. Crushing plant set up for 9.2-mi. surfacing job ne Driggs, Idaho. The double unit plant, driven by tw McCormick-Deering diesel power units has an ou put of 80 cu. yd. per hr. W. C. Burns, Idaho Fall contractor.
4. Excavating along center line of spillway cut f Fort Peck dam. A Lima '701' shovel is loadi 10-yd. Mack trucks.
5. Erecting construction trestle at site of Yaquina B bridge, Oregon. Piledriver is working in foregrou and dredge 'Coos' is operating in mid-channel.
6. Driving sheet steel piling for cut-off wall in Fo Peck dam. The 195-ft. high driving towers are esp cially built for driving piles to a maximum pen tration of 140 ft. Frazier-Davis Construction C and G. J. Tarlton, contractors.
7. Finished lower roadway decks at east end of Sa Francisco-Oakland Bay bridge with double deck ste structure in foreground and suspension towers loo ing up on far side of island.
8. Welding (electrically) outside seam of 54-in. Suns reservoir supply line for City of San Francisc Barrett & Hilp, general contractors, and H. Price, welding contractor.
9. Downstream face of Boulder dam showing powe house construction in foreground and top of intak towers behind dam.
10. Constructing deck plate girder detour bridge f Sacramento Northern railroad during constructio of 'M' Street bridge, Sacramento. George Polloc general contractor.

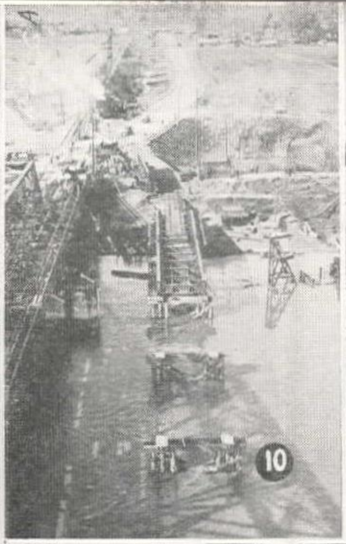


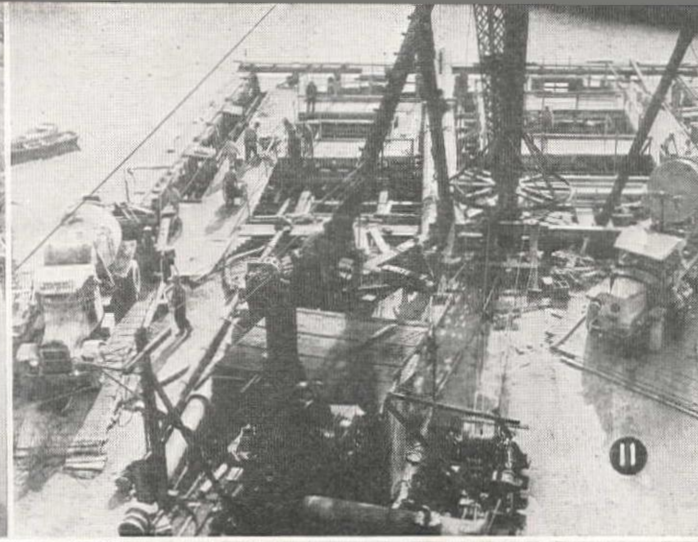


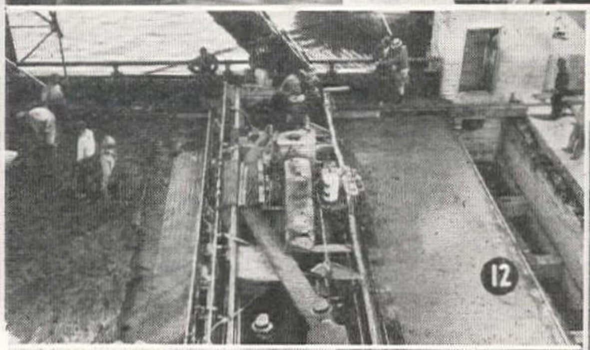


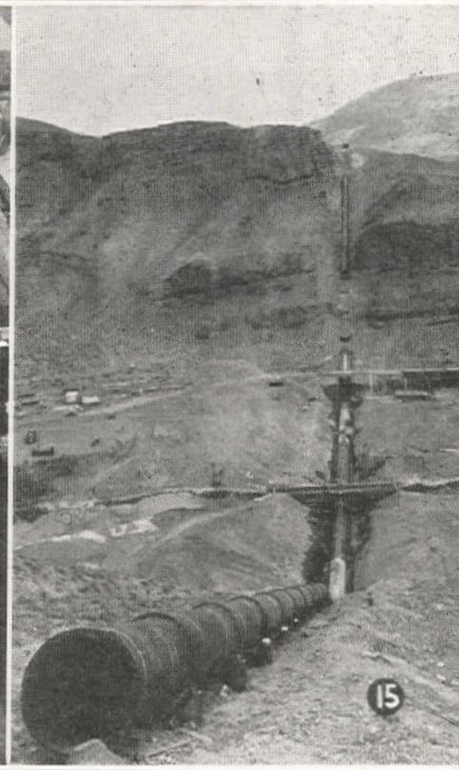




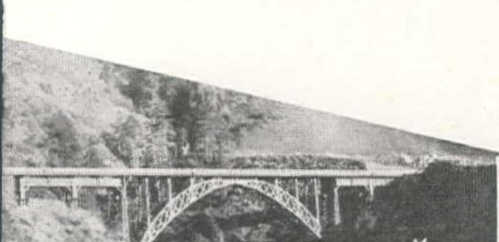



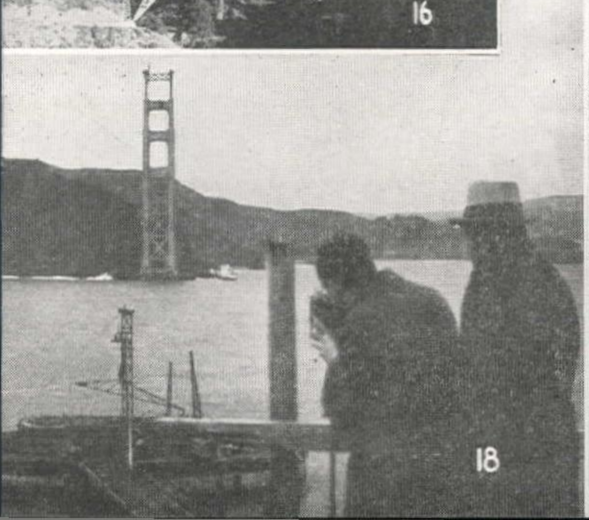



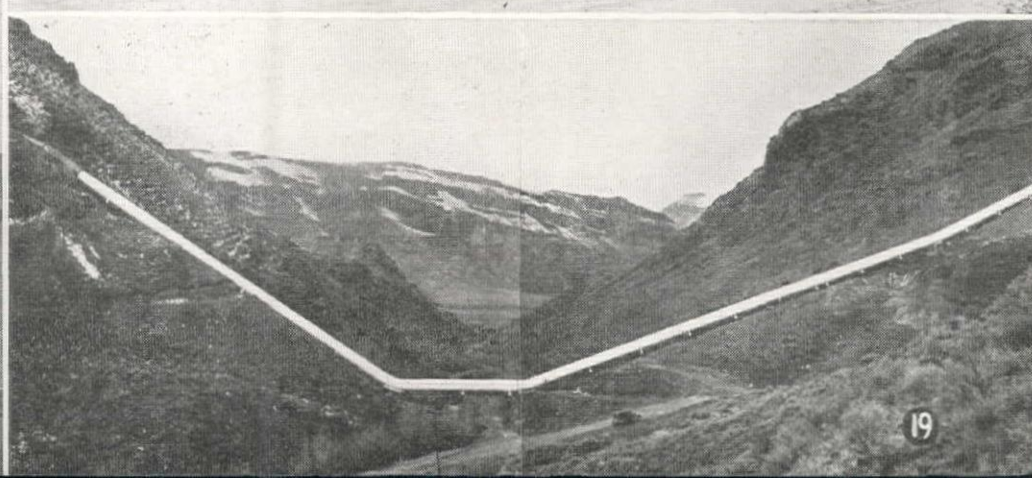

11. Pouring concrete for pier and counterweight pit for Park Street double bascule bridge crossing estuary between Oakland and Alameda, Calif. McDonald & Kahn, contractors.
12. Placing and finishing lower concrete floor deck at eastern terminus of San Francisco-Oakland Bay bridge.
13. Construction of 'M' Street railroad detour bridge showing towers of timber lift span to provide 80-ft. horizontal and 85-ft. vertical clearances for navigation. The existing bridge on left will be dismantled to facilitate constructing new bridge.
14. Completed electrically-welded 54-in. Sunset reservoir supply line, San Francisco.
15. Nine-foot diameter electrically welded steel siphon of Owyhee project crossing Owyhee river. This siphon is 1630 ft. long and has a maximum head of 348 ft. Note flume carrying river over siphon crossing. Morrison-Knudson, contractors.
16. Recently completed timber arch bridge (using steel ring timber connectors) over Dolan creek about 45 mi. south of Monterey on California coast highway.
17. Maintenance work performed by Galion grader drawn by McCormick-Deering diesel TD 40 diesel 'tractractor' on Wolf Creek pass in southwestern Colorado at about elev. 11,000 ft.
18. View across Golden Gate showing south pier fender and nearly completed pier within, with completed suspension tower on opposite Marin shore. (Photo by Standard Oil Co.)
19. Completed Snively siphon on Owyhee project. Steel barrel has a diameter of 10.5 ft., length of 1080 ft. and operates under maximum head of 210 ft. Morrison-Knudson, Contractors.



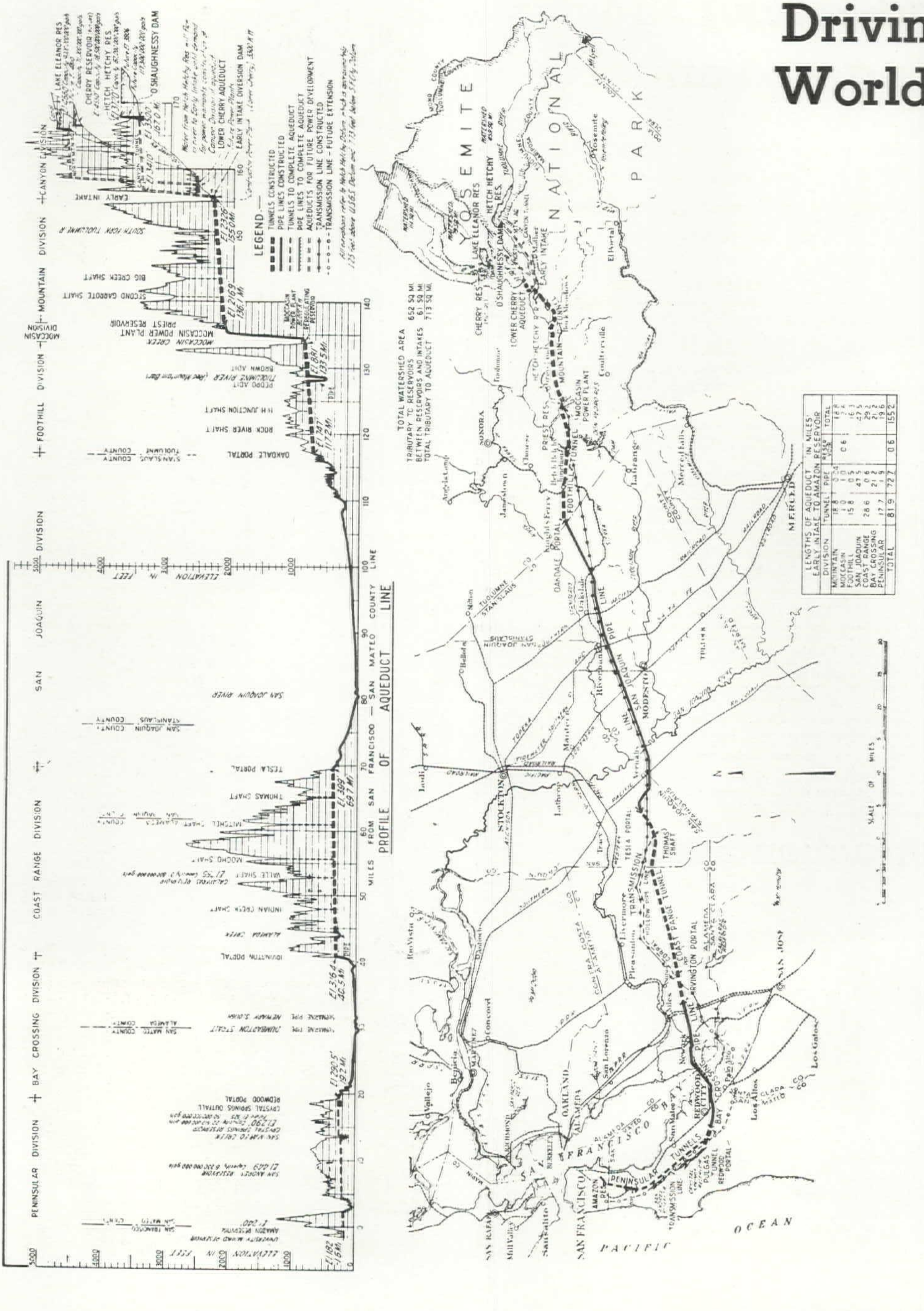
# onstruction Front

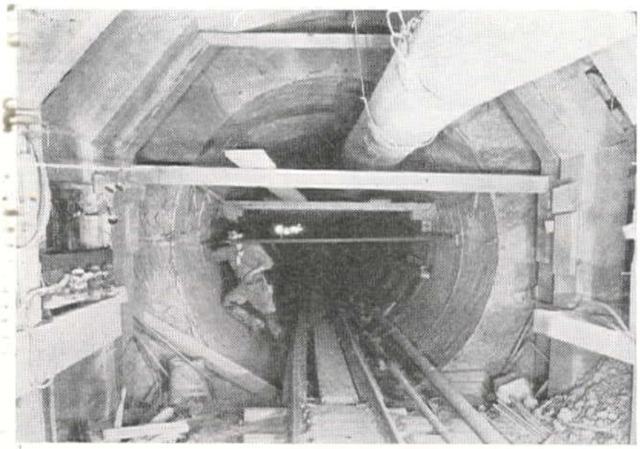



# Driving World's




| LENGTHS OF AQUEDUCT (IN MILES) EARLY INTAKE TO AMAZON RESERVOIR | | | | |
|---|---|---|---|---|
| DIVISION | TUNNEL | PIPE | RESERVOIR | TOTAL |
| MOUNTAIN | 18.8 | 0.04 | | 18.8 |
| MOCCASIN | 1.0 | 1.0 | 0.6 | [illegible] |
| FOOTHILL | 15.8 | 0.5 | | 16.3 |
| SAN JOAQUIN | | 47.5 | | 47.5 |
| COAST RANGE | 28.6 | 0.6 | | 29.2 |
| BAY CROSSING | | 21.2 | | 21.2 |
| PENINSULAR | 17.7 | 1.9 | | 19.6 |
| TOTAL | 81.9 | 72.7 | 0.6 | 155.2 |

# and Lining the Longest Tunnel



Gunite Lining in Tunnel Near East Portal at Thomas Shaft. Precise Measurement of Diameter Is Being Made by Engineer.

## Coast Range Tunnels Of Hetch Hetchy Water Supply For City Of San Francisco Encounter Many Construction Difficulties . . Troublesome Gases and Heavy Ground

By LESLIE W. STOCKER
Chief Civil Engineer, Hetch Hetchy Water Supply, San Francisco.

October 28, 1934, stands out in the chronology of San Francisco as one of the most notable dates in the city's history. On that day water flowing from a distant source in the Sierra Nevada through the Hetch Hetchy aqueduct was officially welcomed into the city's local water system. The Coast Range tunnel, the final link in the aqueduct line, was completed a short time previously and is now in service.

The purpose of this article is to describe the design and construction of the last-completed division. A statement on the system plan and its evolution is, however, appropriate, so that the place of the Coast Range tunnel in the aqueduct as a whole, and the reasons for adopting this relatively costly form of construction instead of one of lower first cost, may be clearly understood.

**Early plans for the Hetch Hetchy Aqueduct**—The Hetch Hetchy region, in the high mountain area tributary to upper reaches of the Tuolumne river, was suggested more than fifty years ago as a source of water supply for the City of San Francisco and the Bay district. A map dated 1882 shows 'the course of the proposed canal of the Tuolumne and San Francisco Water Co.' In this plan water was to be diverted from the river at a point a few miles downstream from the site actually chosen, which is known as Early intake, and flow thence in a ditch 44 mi. to a reservoir at elev. 1000 ft.; near La Grange, in the foothills east of San Joaquin valley. A line of 48-in. steel pipe, 125 mi. long, was to extend from the reservoir to San Francisco. Another pipe line was included to supply the East Bay region, and a branch to Stockton and Sacramento was indicated. This was apparently to be a gravity system throughout, with a maximum head of about 800 ft. in San Joaquin valley, and with a tunnel about 4 mi. long through the highest part of the Coast range. The suggestion of the Tuloumne source appears in a report of the U. S. Geological Survey published in 1899, but without definite plans.

In 1902, C. E. Grunsky, then City Engineer of San Francisco, recommended the Tuolumne as the most available source for a greater water supply for the city. His plan was for an ultimate development of 160 m.g.d. with 60 m.g.d. initial development. The aqueduct was to be 182 mi. in length, consisting of 141 mi. of steel pipe, 28 mi. of open canal in the Sierra Nevada, and numerous short tunnels of 13 mi. total length. Later modifications by Marsden Manson, City Engineer from 1908 to 1912, increased the proposed ultimate capacity to 300 m.g.d., and reduced the aqueduct length to about 170 mi., with 30 mi. of tunnels. Both Grunsky and Manson planned to deliver water by gravity at the west side of the San Joaquin valley and pump it up the east slope of the Coast range, using hydro-electric power generated along the aqueduct line in the Sierra foothills.

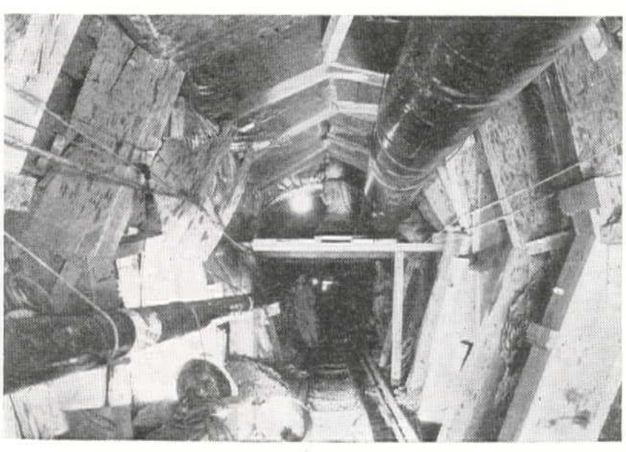
**The Adopted Plan**—In 1912 John R. Freeman, consulting engineer to the City, proposed a plan for ultimate delivery of 400 m.g.d., in which, by use of long tunnels in both mountain ranges, canals and their maintenance problems, were eliminated increased power development possibilities were increased, the aqueduct, was shortened to about 152 mi., the grade was lowered in the Coast range section to provide for gravity delivery to San Francisco, conserving power that would otherwise be consumed in pumping. The total length of tunnels proposed was 84 mi.

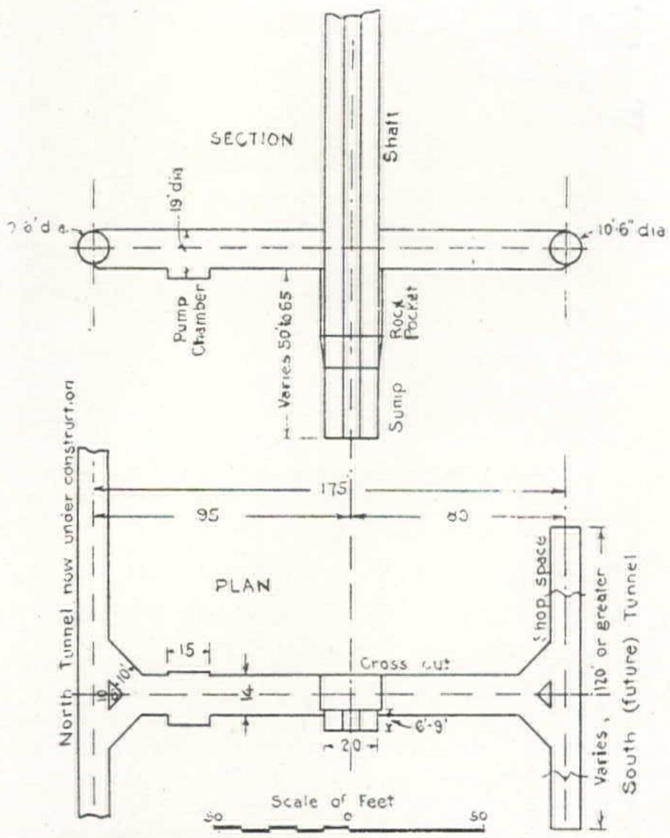
Definite planning for construction under M. M. O'Shaughnessy, City Engineer of San Francisco from 1912 to 1932, and Consulting Engineer to the Public Utilities Commission of San Francisco from 1932 until his death October 12, 1934, confirmed the merits of the Freeman plan, and the aqueduct now in service conforms in the main to that plan.

The most notable change in the scheme as a whole since the earliest plan is the increase in the ultimate quantity of water to be diverted to San Francisco, and the most outstanding points of difference as to physical features between the adopted plan and the earlier ones are the elimination of pumping and the use of tunnels of great length in the main aqueduct.

The introduction of the Coast Range tunnel, 28.64 mi. long, for gravity delivery led to a great deal of controversy. Some critics declared that the tunnel project could never be carried out because of the nature of the ground to be

Tunnel Section in Heavy Ground Near Indian Creek Shaft. Note Crushed Condition of Roof Timbers.





Typical Arrangement of Shaft Cross-Cut and Tunnels Showing Loading Pocket and Sump.

penetrated. Others, not so pessimistic as to physical feasibility, pronounced the tunnel plan economically unsound because of its greater initial cost. However, a comparative estimate, made shortly before work was commenced on the tunnel, resulted in the conclusion that the cost of a 10.5 ft. diam. tunnel, designed for a capacity of 200 m.g.d. as a part of the ultimate development, and capable of being operated at a higher capacity pending completion of the ultimate scheme, would not materially exceed the sum of construction cost and capitalized operation, and maintenance and depreciation costs of a pumping system of only 60 m.g.d. capacity. The tunnel cost has exceeded the figure used in that estimate, but if the present value of the future investment necessary for additional capacity of the pumping system be added, together with capitalized annual charges, the comparison still favors the tunnel.

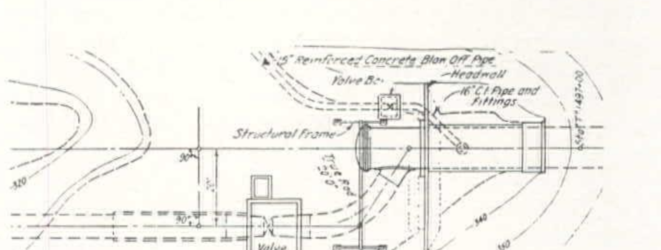
**The constructed system**—The Hetch Hetchy system has two storage reservoirs, Hetch Hetchy and Lake Eleanor, of 67 billion and 9 billion gallons capacity respectively. Water from Hetch Hetchy flows in Tuloumne river 12 mi. to the point of diversion at Early Intake, headworks of the main aqueduct, at elev. 2346 ft. Water from Lake Eleanor flows 8 mi. in natural channels to a diversion dam on Cherry river, thence in a 4-mile aqueduct to Early intake, where it also enters the main aqueduct. The fall now wasted in stream channels is to be utilized later for power development. These reservoirs and diversions control a watershed area of 713 sq. mi., whose easterly boundary is the main ridge of the Sierra Nevada, and also forms a part of the west boundary of the Mono Lake watershed area, now being tapped to increase the water supply of Los Angeles. The joke about Los Angeles extending to meet San Francisco has become a fact as regards water supply.

From Early intake the main aqueduct extends 137.5 mi. to its west terminus at Crystal Springs reservoir on the San Francisco peninsula. The direct 17-mi. connection from this point to the City, was included in the Freeman and earlier plans. The aqueduct includes 65.9 mi. of tunnels, 70.8 mi. of pipe lines (not including duplication where pipes are parallel), 0.6 mi. in two small regulating reservoirs, and 0.2 mi. of open canal at Crystal Springs outfall. The system is designed for an ultimate delivery of 400 m.g.d. Tunnels and pipe lines from Early Intake to the east side of San Joaquin valley (37.7 mi.) are built for this full capacity, and the other units will be paralleled as increased capacity becomes necessary until the ultimate is reached. Additional reservoir storage in the mountains will be required for the full development. Bids for raising the crest of O'Shaughnessy dam 85½ ft. were opened on January 24, Transbay Construction Co., San Francisco, submitting a low bid of $3,219,965.

**Location and length**—The east portal of the Coast Range tunnel, known as Tesla Portal, is on the west side of San Joaquin valley, 7 mi. south of Tracy. From this point easterly the line passes 7 mi. south of Livermore and Pleasanton, and terminates at Irvington Portal, 2 mi. northeast of the town of Irvington. The tunnel is interrupted by the valley of Alameda creek, which is crossed by a pipe siphon, so that actually there are two tunnels. The easterly one is 25.2 mi. in length, and is the longest tunnel ever driven. The westerly section is 3.44 mi. long.

**Designed capacity**—The tunnel is designed for a capacity of 200 m.g.d. when operating under hydraulic grade conditions of the ultimate 400 m.g.d. system. In the acquisition of right of way and in the arrangement of shafts and under-ground working chambers provision was made for construction of a second tunnel parallel to the present one, to raise the aqueduct capacity to the final figure of 400 m.g.d. The second tunnel will not be required for many years, and economics of the situation favored the adopted scheme rather than immediate construction of a larger tunnel for 400 m.g.d. flow.

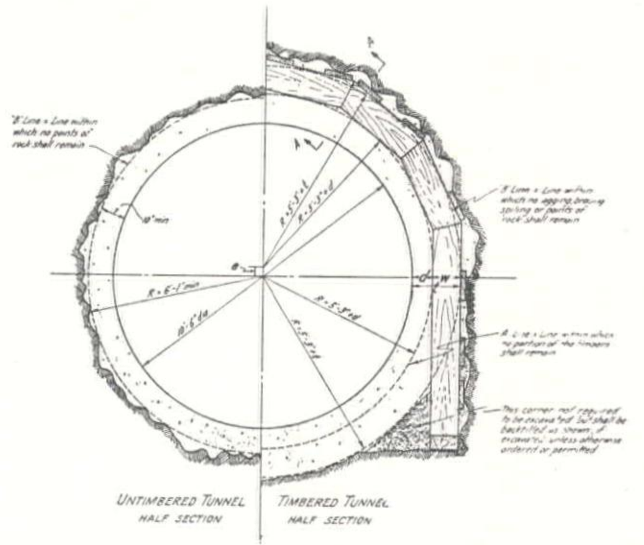
The tunnel operates under pressure. This permits working the tunnel somewhat beyond the capacity of 200 m.g.d. already mentioned, by adding sufficient pipe line capacity west of the tunnel to reduce temporarily the loss of head in the pipe lines and make a greater head available to force water through the tunnel. In this manner it will be feasible and probably economical to use the tunnel up to 250 m.g.d. or even more, by tolerating a temporary loss in the pipe line capacity, the postponement of construction of a



Connection Between Tunnel and Pipe at Alameda Creek East Portal.

second tunnel making it worth while to make an addition to the pipe line capacity for that purpose in advance of the time when such an addition would otherwise be necessary.

**Grades**—The tunnel is concrete-lined, with a 10.5-ft. diam. circular waterway. The slope of the hydraulic grade line for a flow of 200 m.g.d. is 0.29 ft. per 1,000 ft., based on C=120 in the Williams-Hazen formula, which corresponds in this case to n=.013 in Kutter's formula. The slope of the tunnel invert is 0.5 ft. per 1000 ft. (0.7 ft. in the most westerly section), being made steeper than the hydraulic grade line to improve drainage conditions during construction and to permit temporary use for heavier flows by the expedient mentioned above. With 200 m.g.d. flowing, the tunnel will be under a pressure head of 41 ft. above invert at the east end and 77 ft. at the west. The east portal invert elevation was determined so that, with an initial flow of 60 m.g.d., the hydraulic grade line, projected back from its elev. 393 ft. at the west portal, reaches the east portal at approximately invert elevation, thus giving the maximum possible fall in the pipe line east of (upstream from) the tunnel. A higher portal elevation would reduce the pipe line capacity; and lowering it would unnecessarily add to the pressure head on the tunnel when flowing full and under pressure.

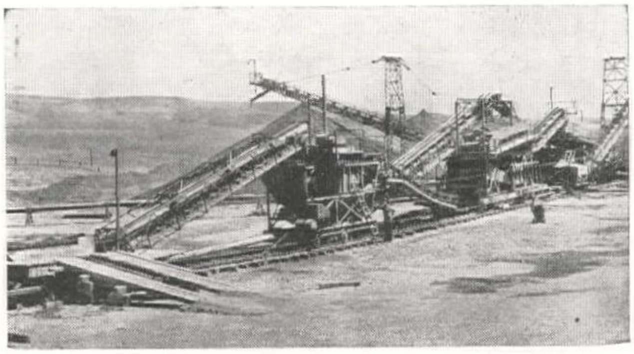



**Tunnel Cross-Section Showing Relation Between Concrete Lining, Side Walls, and Timber.**

**General design of lining**—Thickness of the concrete lining varies from 10 in. to 3 ft. within the neat line. Minimum thickness occurs in a few short sections in hard rock, where timbering was unnecessary. The average nominal or effective thickness is 24 in., and the average volume of concrete is 3.3 cu. yd. per lin. ft.

Concrete is reinforced with steel for several hundred feet in from each portal, each reinforced section extending well past the point at which the hydraulic grade line intersects the ground line.

**Overflow shafts**—At Tesla portal and the two Alameda Creek portals, 5-ft. diam. overflow shafts are provided to limit the internal pressure to which the tunnel lining may be subjected in case of an inadvertent or accidental stoppage of flow while water is still entering the tunnel from the east. Water rising through the shaft flows over a circular weir at the top and is conducted down the hillside through a pipe, to the natural watercourse at the base of the hill. This probably will never occur. These shafts serve also as air vents or inlets when the tunnel is being filled or emptied.



**Portable Gravel Plant Set Up at Corral Hollow. This Plant Was Used at Three Different Locations to Prepare Sand and Gravel for Concrete.**

**Pipe line connections at portals**—At each portal a section of 10.3-ft. diam. steel pipe is imbedded in the tunnel lining and carried out a short distance into the open. The adjoining pipe line branches off from the 10.5-ft. diam. pipe, and other branch openings will be provided in the future to accommodate parallel pipe lines. The outer end of the 10.5-ft. diam. manifold pipe section is closed with a dished head of full pipe diameter, riveted into a cast steel flange bolted to a companion flange on the pipe. This permits maximum convenience of access to the tunnel should a major repair operation ever be necessary.

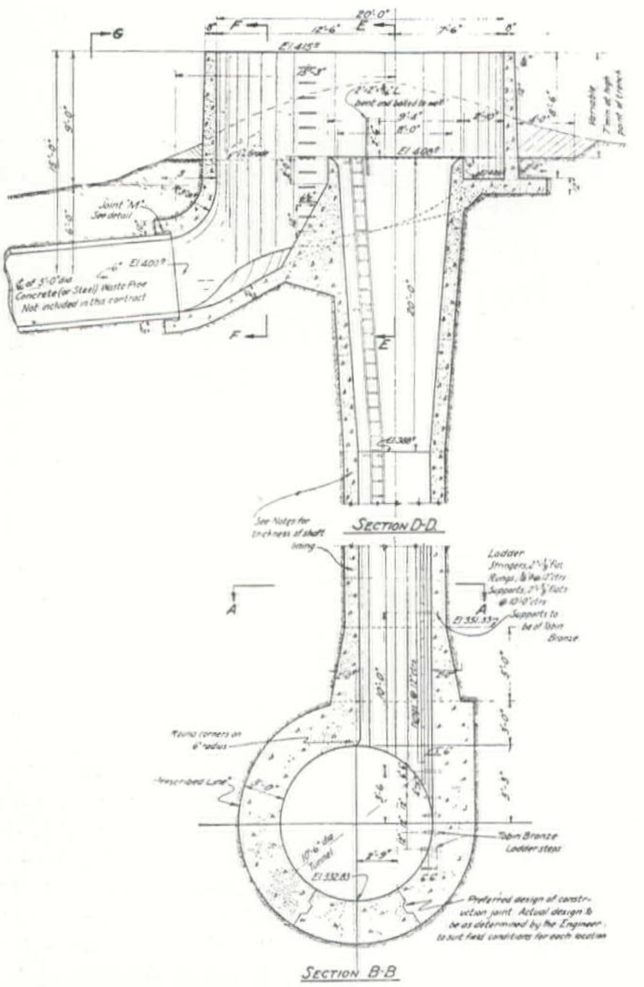
The manifold at Irvington Portal is spherical, being 14-ft. diam. with three 6-ft. branch openings. This was preferred at that location on account of space limitation.

**Working points**—The tunnel between Tesla and Alameda East portals was divided into 6 sections by 5 shafts. The entire tunnel west of Alameda creek was driven from two portals. Thus there were in all, 7 sections and 14 headings, 4 from portals and 10 from shafts. The distances between working points varied from 2.9 to 5.3 mi. and distances driven in individual headings varied from 0.75 to 2.95 mi.

**Power for construction**—Electric power for construction was distributed over 22,000 v. lines to all working points from a 6,000 k.v.a. substation on the City's 110,000-v. Moccasin transmission line. All construction plant and machinery were electrically operated either directly or through the medium of compressed air. Storage battery locomotives were used for underground haulage.

**Shafts**—The five construction shafts ranged in depth from 301 to 823 ft. including 50 to 65 ft. below tunnel level. The shafts were, in general, timbered as sinking progressed, but in some parts it was found advisable to line them with concrete at once. All are now concrete-lined throughout. Each shaft is rectangular in plan, 6 ft. 9 in. by 20 ft. outside of timbering, and divided into 3 compartments, two for hoisting and one for pipes and manway.

The arrangement of the shafts with respect to the tunnel, as shown on Fig. 6, is unusual. To permit future use of the shafts for construction of a parallel tunnel about 175 ft. south of the present tunnel, they are located midway between the two tunnel locations, so as to communicate with both tunnels through a cross-cut. At each end of the cross-cut is a 'Y' extending east and west into the tunnel. A stub of the future south tunnel was constructed in each direction about 60 ft. from the cross-cut and was used for shop space and for charging storage batteries of electric locomotives. On completion of construction legs of the 'Y' leading into the north tunnel were plugged with concrete. A cast steel manhole with an opening 6 ft. square provides for access to the tunnel from the shaft. A rock-pocket was constructed beneath the floor of the cross-cut, and excavated material from the headings was




**Detail of Over-Flow Shaft Located Near Alameda East Portal.**

dumped from the cars into this pocket and then drawn off through gates into skips for hoisting to the surface.

**Tunnel construction**—The tunnel penetrates all classes of ground from quicksand to a trace of granite. In general, it is in soft sandstone, crushed shale, and crushed schist formations, and in much of the distance the ground is very heavy, necessitating extreme measures to support it after excavation. A squeezing action, which might be from any or all directions, was frequently encountered. This action sometimes caused rising of the tunnel bottom, where the sides and roof were adequately supported by timbering, and necessitated re-excavating the bottom repeatedly to lower the track by a total of several feet, the maximum being 8 ft. Such ground was most difficult to hold shortly after initial excavation. The heaviest timbers were apt to be crushed, requiring retimbering two or three times, and then become stable and giving little or no further trouble. A few short sections, up to about 200 ft. lone, stood without timbering for years, from the time of excavation until lined with concrete.

Nearly all timbering was done as shown on Fig. 3, using vertical posts and segmental arches. The lightest timbering was of 8 by 8-in. sets spaced 7 ft. center to center, and the heaviest, 18 by 24 in. sets at 2 ft.

Usually, in heavy ground, 12 by 16-in. and 16 by 16-in. sets were spaced 5 ft. center to center, and additional sets were placed between these later if the pressure developing made them necessary.

After costly experiences with displacement or crushing of timber, engineers decided to try lining the tunnel in very heavy ground with gunite immediately following excavation, without timbering except for such lagging, crown bars and breast-boards as were necessary to hold the ground long enough to permit concrete to substantially set. This proved very successful and was continued until excavation was completed, gunite being placed sometimes in rings a few feet long, and sometimes continuously for hundreds of feet. Cement developing high early strength was used for this purpose, and the set was further accelerated where necessary by adding calcium chloride in the proportion of 3% of cement by weight. In this way a compressive strength of 1,000 lb. per sq. in. as attained in 3 or 4 hr., and over 3,000 lb. in 24 hr.

**Lining**—The gunite lining already mentioned is in general 15 to 24 in. thick, with an extreme thickness of 36 in., and a minimum thickness of 8 in. Because of high cost of gunite as compared with poured concrete, it was only placed in such thickness as was necessary to hold the ground until regular lining operations. In general space was left inside the gunite for a poured concrete inner shell not less than 9 in. thick to improve the factor of safety and to provide a smooth inner surface.

In some parts of the tunnel, however, the entire lining is of gunite, the originally placed gunite being finished later with a layer of gunite about 1½ in. thick, troweled to a smooth surface. There are three classes of lining, as follows:

| | | |
|---|---|---|
| Poured concrete for entire thickness of lining | 104,573 ft. | (19.80 mi.) |
| Gunite with poured concrete inner shell | 36,370 ft. | ( 6.89 mi.) |
| Gunite with thin surface finish | 10,288 ft. | ( 1.95 mi.) |
| Total | 151,231 ft. | (28.64 mi.) |

The total volume of lining is approximately 500,000 cu. yd. of concrete, of which about 135,000 cu. yd. is gunite.

The gunite contains 10 to 12 sacks cement per cubic yard of concrete. Tests showed a compressive strength of 6,000 lb. per sq. in., and upwards, at the age of 28 days. Test specimens made from blocks cut out of the gunite lining several months old gave strengths varying from 8,000 to 10,000 lb. per sq. in.

Poured concrete was placed in the invert by chutes from the mixer, and in the sides and arch afterward by pneumatic guns. Three central batching plants were used, one at Alameda creek, one at Valle camp, and one at Thomas shaft. Sand and gravel were prepared and stock-piled long in advance of concreting near these three points. Cement and aggregates proportioned dry batches were loaded into special cars and hauled a maximum underground distance of 7 mi. The concrete gun, mixer, ramp which the cars were run up to dump into the mixer formed a train running on the tunnel track. The invert concrete was screeded to the required circular arch. Steel forms were used for the sides and arch, which were vibrated during placement of concrete.

The concrete mix was in general designed for a 28-day strength of 3,000 lb. per sq. in. This required 5¼ sk. of cement per cubic yard in the invert, and 6 sk. per cubic yard in the sides and arch, the difference being necessary on account of the different methods of placement, and the greater amount of water required in the pneumatic process.

Before concreting was commenced a survey of the entire section to be concreted was made, and the condition of the timbering noted. Results of this survey were used to determine the necessary strength of concrete lining at all points. Where it appeared that 3,000 lb. concrete would not give the required strength without shifting timbers to provide additional thickness of lining, the cement content was increased to give 4,000 lb., or even 5,000 lb. strength.

of apparent stress up to incipient failure. Studies of ground pressure had been made over long periods of time, based on measurements of the deflections of concrete test rings. These tests provided a foundation for the conditions found on the final timber survey, inferring the necessary strength of lining. There have been no failures of completed lining.

After the placing of the concrete the final step in lining was grouting behind the lining, through holes or pipes set for that purpose during lining operations. Besides filling spaces that inevitably remain unfilled outside of the concrete in the upper part of the tunnel, the grouting sealed off most of the water entering the tunnel from adjacent ground, but it is not expected that all such inward leakage will be stopped.

**Construction difficulties**—Besides the general ground conditions already mentioned, the most serious problem of construction was handling of gases encountered in the tunnel. Hydrogen sulphide entered the workings at a few points, and at first was quite troublesome, as a very small quantity of this gas seriously affects the eyes, and may cause temporary blindness. Methane gas was the chief danger since air containing 5 to 15% methane is an explosive mixture. The usual safety regulations of the U. S. Bureau of Mines require that methane be held down to a maximum of 0.25%. To keep within this maximum it was necessary to provide an unusually large volume of air in the tunnel ventilation system. In each of the gassy headings, 4,000 cu. ft. or more per minute was necessary to provide the proper dilution. Fortunately the methane usually occurred in pockets which, when tapped, rapidly drained out, so that progressive additions to the tunnel ventilation equipment were not necessary. Despite all usual safety precautions, an explosion occurred in the tunnel July 17, 1930, in which twelve men were killed. This led to the introduction of still further safety regulations, including discontinuance of fixed electric lights in gassy sections, and substitution of cap lamps, the introduction of 'permissible' electric locomotives, and other electrical equipment, the use of 'permissible' explosives, and changing the ventilation from blowing to exhaust. One engineer was assigned to devote all his time to safety matters, fire bosses were employed on all shifts, and rescue crews were organized, provided with first-class equipment for all conditions, and kept in training by frequent drilling.

At a point about 4,000 ft. west of Indian Creek shaft, excavation broke into a quicksand deposit. Sand and water rushing into the tunnel filled it almost completely for ½ mi., and the sand was carried back as far as the shaft. After removing the sand from the tunnel, another flow occurred, which, however, was of comparatively small volume. No further attempt was made to drive through this formation until about 1½ yr. later by which time the ground had drained out so that it was readily enough handled by driving a small drift, and then widening out and removing the bench.

High temperature and humidity made working conditions unpleasant in the later part of the work when warm air coming from the surface and traveling considerable distances to the heading picked up moisture on the way. Toward the last men were working in air at 85° F. and during concreting operations higher temperatures occurred, due to heat generated by the setting of the concrete.

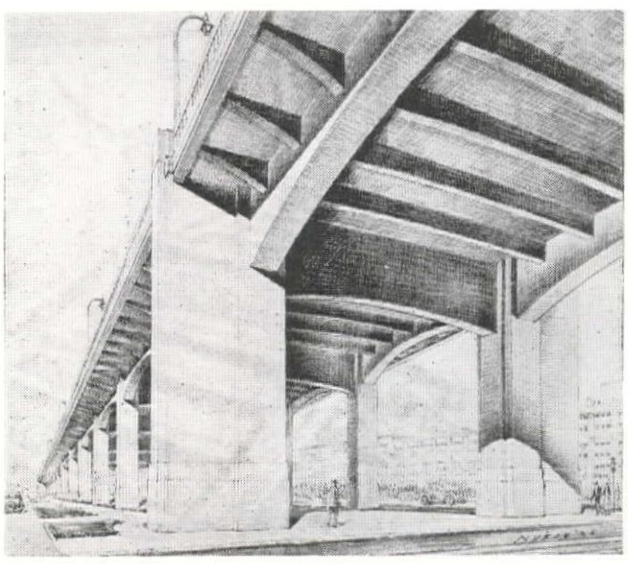
**Organization**—The Hetch Hetchy Water Supply work, up to 1932, was in charge of M. M. O'Shaughnessy as City Engineer of San Francisco. In 1932, a change in the city charter placed the Public Utilities Commission in authority over all water supply, power, and other utilities of the city, and O'Shaughnessy was appointed Consulting Engineer to the Commission. L. T. McAfee was made Chief Engineer and Manager of Hetch Hetchy work. Leslie W. Stocker is Chief Engineer at the headquarters office, and Carl R. Rankin is Construction Engineer in charge of the work in the field. All Coast Range tunnel construction has been performed by day labor.

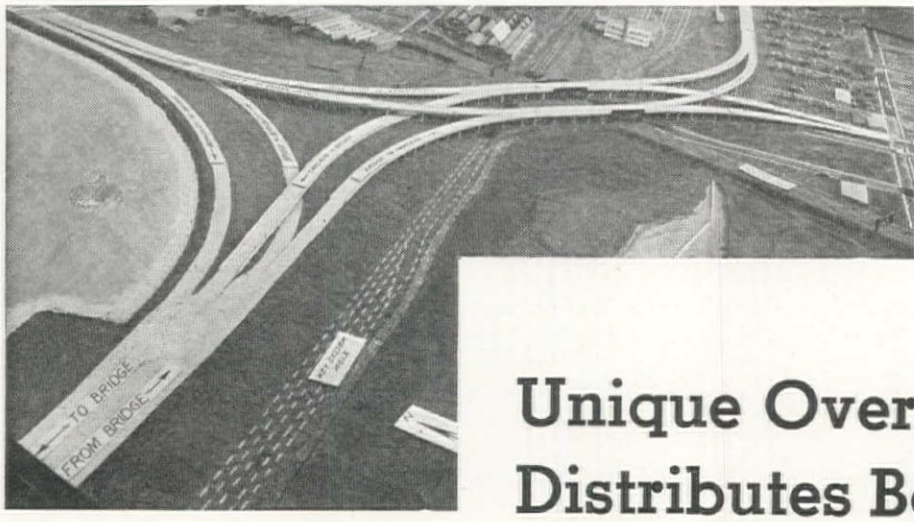
* Paper presented at California Section, A. W. W. A. convention held at Long Beach, October 24-27, 1934.

# Design for Bay Bridge Approach Ramps Completed

The Board of Consulting Architects of San Francisco-Oakland Bay bridge, composed of Timothy L. Pflueger, Arthur Brown, Jr., and John J. Donovan has recently completed the architectural design of the San Francisco approach ramps. These ramps, more than one-half mile in length, will be 68 ft. wide (6 lanes) and will rise from roadway elevation at Fifth St. near Bryant St. to a height of nearly 100 ft. at Rincon hill. An eastbound fast-moving traffic ramp will start at Harrison and Fremont sts. and terminate at the bridge proper on top of Rincon hill where an "off" or westbound ramp leaves the bridge and curves out to street elevation at First and Clementina sts.

Clearing of the site preliminary to construction of this ramp was recently started. This is one of the largest wrecking jobs undertaken in San Francisco since 1906, the year of the fire and earthquake, and covers an area two blocks wide and nearly a mile long. Within this area there are approximately 135 frame, 20 brick, and 9 concrete buildings, ranging from the smallest hut to good sized brick and concrete industrial structures. Salvage of 5,000 M. brick, 3,000 M. ft. B. M. lumber and several hundred tons of steel is expected to be made out of the structures wrecked. This work is under contract to Healy-Tibbitts Construction Co. at $1,172,622 and involves 330,000 cu. yd. of excavation, 43,000 cu. yd. of concrete and 6,100,000 lb. of reinforcing steel.






Model of East Bay Distribution structure showing braided roadway to eliminate cross traffic

# Unique Overcrossing Distributes Bay Bridge Traffic

By NORMAN C. RAAB

Supervising Bridge Designing Engineer
California State Department of Public Works

A CONTRACT is to be awarded the early part of this year for a crossing over the tracks of the Southern Pacific, Santa Fe and Key System railways to connect with the approaches of the new San Francisco-Oakland Bay bridge, which are rapidly nearing completion. A contract for construction of the east end of this structure which crosses several busy arteries in the City of Emeryville and extends to Market and 38 sts., in Oakland, will be advertised for bids in the early summer of this year.

This structure will be situated in Oakland near the intersection of Beach st. and Yerba Buena ave.; or approximately at the site of the Key System underpass. This location was selected because it was the only site where the three railroads could be crossed with one structure.

This crossing, which is known as the distribution structure, is unique in plan as well as outline, and has many interesting details, differentiating it from other traffic distributing structures. It serves to separate, at different grades, traffic to and from the new Bay bridge and trains of the three railroads; as well as distributing this traffic to several East Bay municipalities and various arteries leading to outlaying districts. By braiding the roadways no two opposing lines of traffic cross each other at the same grade.

Traffic coming from the bridge may take either the 'MC' or 'MS' routes depending upon its destinations. The 'MC' route dips below grade (elev. + 9 ft. approximately) and passes under the 'NM' and 'CS' lines. It comes to grade (elev. + 14 ft.) on entering the 'C' line which is part of the new East Shore highway leading to Berkeley, Albany, Richmond, or to northern points by way of the ferry at Richmond or Carquinez bridge. The 'MS' line rises in grade on concrete trestle bents of approximately 40-ft. spans, crossing over the Key System subway on concrete bents with steel stringers; continuing on the 'S' line over the Southern Pacific, Santa Fe, and spur tracks of the Key System. Here again the traffic is divided depending upon the route it wishes to follow. From this point the 'SB' line takes the traffic into Oakland over the 'B' (east end) line (to be let in a later separate contract). Ramps are to be provided on this line to have traffic enter or leave the structure near San Pablo ave. The 'B' line ends near Market st. which will form a new arterial through the City of Oakland called 'Moss Avenue extension.'

The 'SA' line continues down grade to the 'A' line, which runs into a new 'Cypress Street arterial' ending at Seventh st. in Oakland. From this point motorists may continue through Posey tube to the City of Alameda. Both the 'SB' and 'SA' branches are on 40-ft. spans with concrete trestle bents.

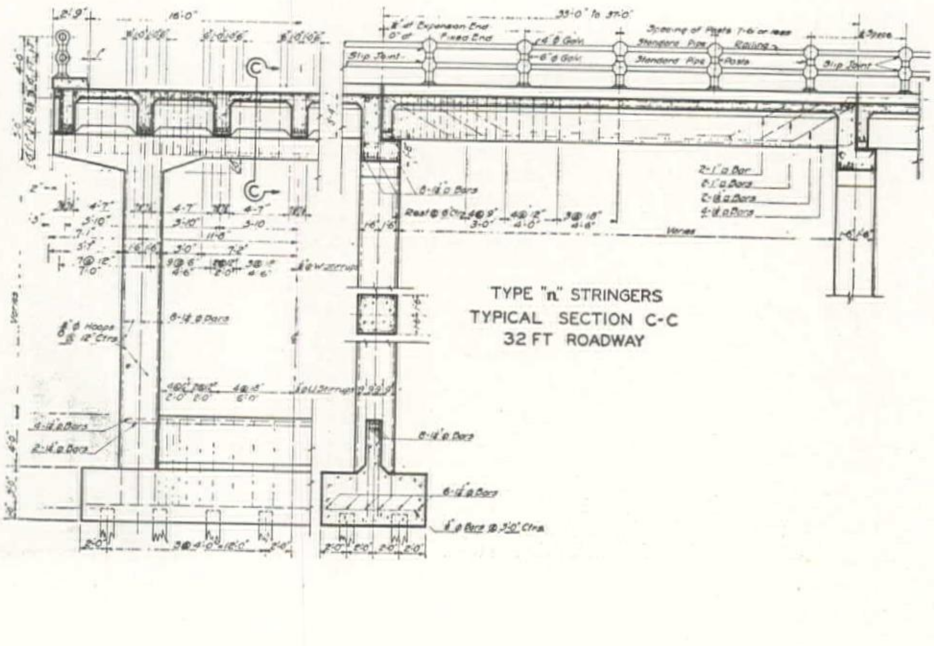
Coming from Alameda and Seventh st., the 'AN' line is used, which crosses under the 'SB' line before joining the 'BN' branch at the 'N' line. Here the structure passes over spur tracks of the Key System and main lines of the Santa Fe and Southern Pacific Railroads, where the motorist may select his route by taking either the 'NC' branch for northern points or the 'NM' branch for the Bay bridge. The 'NM' line crosses under the 'CS' line and over the 'MC' line.

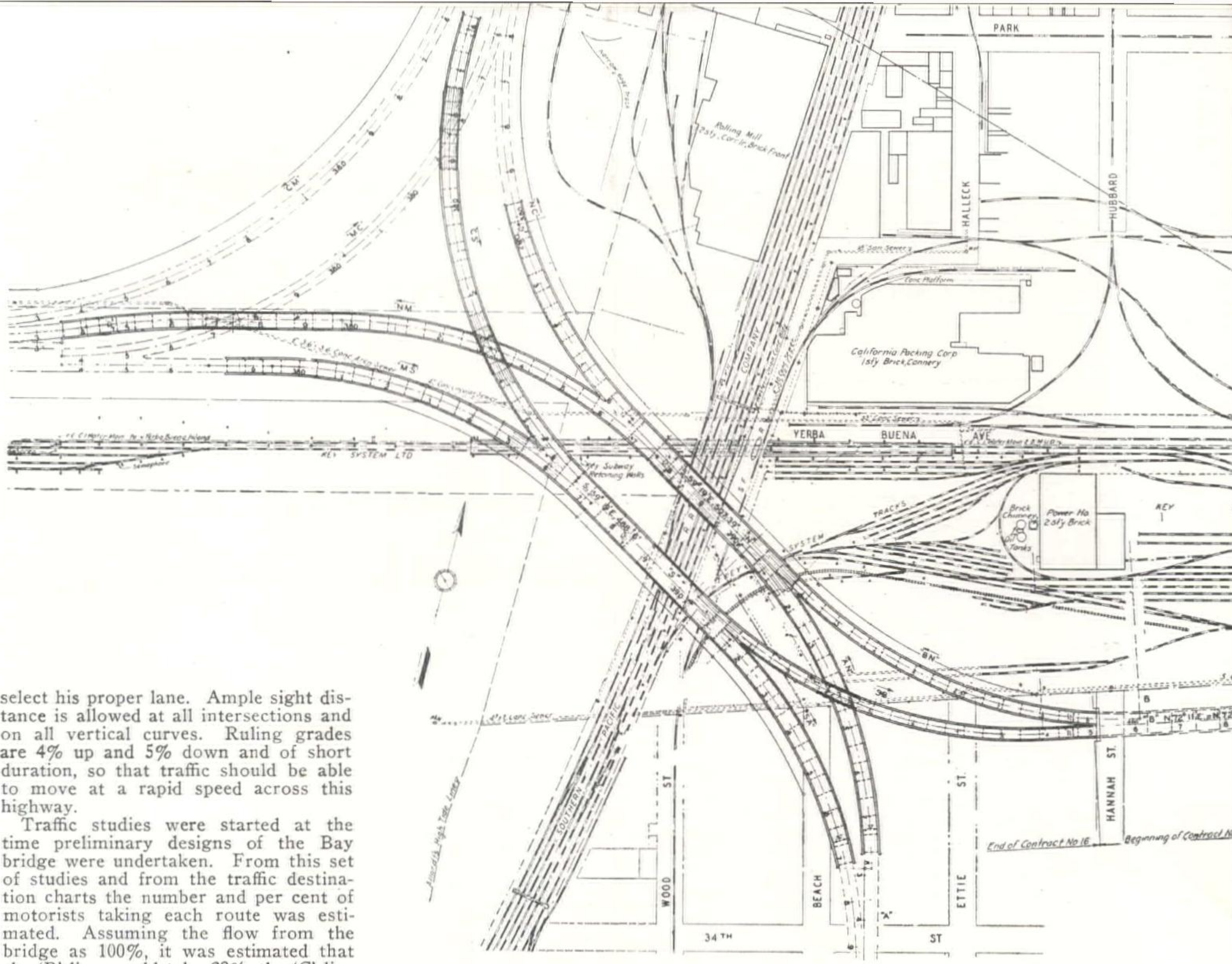
Because of this braiding of the highways none of the opposing traffic lines cross each other at the same grade, although traffic has to shift from one lane to another on both the 'N' and 'S' lines in order to select their proper routes. No trouble is anticipated from this shifting as a free way of approximately 500 ft. is obtained on both the 'N' and 'S' lines to help the motorist

**Norman C. Raab graduated from University of California with B. S. C. E. degree in 1921 and an M. S. degree in 1923. He served for a short time as bridge inspector for San Joaquin county and during 1922 was junior hydraulic engineer with the State Department of Engineering and Irrigation. In 1923 to 1925 Raab was junior bridge designing engineer with the California Highway Commission following which he served in a senior capacity until 1931.**

**From 1931 to date he has been supervising bridge designing engineer for the design and detailing of various parts of the main and approach structures of San Francisco-Oakland Bay bridge. The year previous, Raab's work involved preliminary design and estimate of cost of several bridges for three different routes across San Francisco bay as set forth in the Hoover-Young report. Prior to 1930 his work included the design of many new Pacific Highway bridges, the Oroville arch and San Luis Rey bridges, and the Bixby Creek arch.**

Typical concrete bent (32-ft. roadway) showing expansion joint which is standard for all bents.






select his proper lane. Ample sight distance is allowed at all intersections and on all vertical curves. Ruling grades are 4% up and 5% down and of short duration, so that traffic should be able to move at a rapid speed across this highway.

Traffic studies were started at the time preliminary designs of the Bay bridge were undertaken. From this set of studies and from the traffic destination charts the number and per cent of motorists taking each route was estimated. Assuming the flow from the bridge as 100%, it was estimated that the 'B' line would take 28%, the 'C' line 24%, and the 'A' line 48% of the traffic. Besides this the 'C' and 'A' lines will have an additional flow from the new East Shore highway, of which these two lines will be a part.

Roadway widths conform to the number of traffic lanes coming into and taking off from the structure. All widths on the north side of the Key System subway are 32 ft. (3 lanes) while the 'N' and 'S' lines are 5 lanes (52 ft.) in width. The 'BN' and 'SB' lines are 22 ft. (2 lanes) connecting with the 4-lane 'B' line. The 'AN' and 'SA' lines are 32 ft. in width.

The design offered many interesting details which will be briefly summarized. It was desirable to make all framing of tangent spans square, while bents on curves were placed radially. This necessitated cantilevering some of the through girders which rest on skewed bents. This is especially true of the heavy 150-ft. through-girder spans over tracks of Southern Pacific Railroad which have diagonal end panels cantilevered out over the piers. Due to the soft material underlying these footings, piles of approximately 100 ft. in length are to be used. The spans are all simple with either a construction or expansion joint at each end to take care of temperature changes, deflections, and any settlement that may occur. Design loads were H30 trucks with one-third impact, which provides equivalent of a 40-ton truck. On account of the heavy live loads, rather high unit stresses of 22,000 and 1,050 lb. per sq. in. were permitted in carbon steel and concrete. Concrete slabs with reinforcing trusses welded to the steel stringers are used on the steel spans. Owing to the many sewers, railroad tracks, roads, and structures crossed by the various roadways, a large number of the bents and footings were of unusual design and outline. In some cases bents straddled the obstacle while in others they were skewed or cantilevered. The sewers, in some instances, had to be changed in location in order to miss these footings.

In designing this braided highway, the contractor's problems were kept in mind. Most of the structure over the railroad tracks will be built of steel, not only to cut vertical clearance to a minimum, but to facilitate erection of the structure without the use of falsework. This was required due to the large number of trains, both passenger and freight, that pass this point during the course of the day. To facilitate cutting erection costs, shelf angles are provided on all girders on which to set the stringers during erection, anchor bolts are set in pipe sleeves to allow play for imperfections in fabrication, as many spans as possible are duplicated to decrease framework, and rigid concrete bents are used.

The crossing bridge will contain 2,900 piles, 2,300 tons of structural steel, 3,000,000 lb. of reinforcing steel and 27,000 cu. yd. of concrete of which 8,000 cu. yd. are in the footings and 1,900 cu. yd. in the superstructure. A separate contract will be let for lighting and electrical fixtures. Large electric signs, visible both by day and night, will be placed at convenient locations near the branches to guide motorists. Lights are spaced about 150 ft. apart on one side of the 2 and 3-lane roadway and on both sides of the 4 and 5-lane roadways.

The structure is to be built by the California Department of Public Works of which Earl Lee Kelly is director. Jno. H. Skeggs, district engineer, Division of Highways will have general supervision, with Paul O. Harding his assistant. The structure has been designed in the office of the San Francisco-Oakland Bay bridge of which C. H. Purcell is chief engineer; Chas. E. Andrew, bridge engineer; and Glenn B. Woodruff, engineer of design.

## Toll Bridge Authority May Operate Trains

The Reconstruction Finance Corporation recently modified the conditions under which a $10,000,000 loan was recently made to a California Toll Bridge Authority covering the operation of railroads over the San Francisco-Oakland Bay bridge. Previously the R.F.C. resolution did not clearly permit initial operation of railroad by the Toll Bridge Authority but more specifically designated 'responsible railroad companies'. Studies are being made at present on the best method under which the railroad facilities of the bridge will be handled.

# Abstracts of American Water Works Ass'n Papers

DURING the annual convention of California Section, American Water Works Association, held at Long Beach, October 24-27, some twenty-four papers by members and others that covered various fields of water works practice were presented (see program, page 304, September issue, Western Construction News). Following are abstracts of some of the most important papers.

## Emergency Treatment of Water Following Major Catastrophies

By R. F. GOUDY
Sanitary Engineer
Los Angeles Bureau of Water Works and Supply

SOUTHERN California has been experiencing local catastrophies about once every other year including the Santa Ana typhoid epidemic, Santa Barbara earthquake, St. Francis dam failure, Long Beach earthquake and the Montrose flood. Curiously, the greatest stress in emergency treatment has been where water supplies were safest and in one case where contamination was most severe neither was the water treated or the public warned.

There is no assurance that catastrophies will not continue to visit Southern California at fairly regular intervals. Definite steps should be taken to meet them with a proper organization. Each case will be different and will require special consideration. There are certain fundamentals, however, which are common to all.

1. There is a need to recognize catastrophes involving pollution of water as soon as they occur. When a large percentage of the population of all age groups is suddenly attacked with stomach disorders, diarrhea, and severe prostration, it is well to assume that water is to blame and act accordingly.

2. There is need to recognize emergency organizations which correlate city and county activities in order to avoid all possible conflicts. Wild newspaper stories, exaggerated radio announcements and all early publicity should be censored and only accurate information should be given.

3. Health officers and other officials should absolutely be prohibited from ordering water to be boiled until the General Manager or Water Superintendent has given his permission and the latter after he has received a report as to the exact condition of the water supply.

4. Each water department should have either the full time services of a sanitary engineer or should have engineers or inspectors of City, County and State Health Departments who are thoroughly familiar with their supplies and are available to make reports following emergencies.

5. Each water department should have available a reserve chlorinator, supplies of gas and hypochlorites and any necessary fittings required for emergency treatment. Each department should list all chlorinators used for swimming pools in its vicinity which might also be used in case of emergencies. The person responsible for the safety of the water should be familiar with all methods of disinfection, including, the crudest of using calcium hypochlorite with the meagerest of equipment, homemade affairs using bleach solutions with orifice boxes, up to the latest types of portable equipment.

6. Each small water department should provide at once, corporation cocks at strategic points where its supply could be chlorinated on short notice.

7. Immediately at the outset of any catastrophe bacteriological samples should be taken for analysis and the public be kept informed of such results from day to day. Supplies of sterile bottles and bacteriological equipment should be cached for emergencies.

## Industrial Pollution of Underground Waters

By WALTER M. BROWN
Office Engineer
Long Beach Water Co., Long Beach, Calif.

INDUSTRIAL pollution is seldom if ever responsible for water-borne epidemics but affects water as to its salinity and hardness and adds elements detrimental to irrigation. Due to meandering of streams in the vicinity of Los Angeles, irregular shaped gravel beds have been buried at depths ranging from a few to several thousand feet in loosely consolidated sedimentary deposits in which clay predominates as the coast line is approached. Industrial effluents discharged into any of these stream beds will inevitably percolate into the underlying gravel beds and mingle with the underground waters of the coastal plain to the detriment of water users of this area. From studies made at several key points in the area the following conclusions are reached:

(1) Public policy demands that the use of our local water courses as industrial sewers must cease.

(2) To accomplish this satisfactorily, it probably will be necessary to zone certain types of industry and to require disposition of their liquid wastes in a separate system of industrial sewers discharging directly into the sea.

(3) Manufacturers of certain types should be required to file periodic statements of kinds and quantities of wastes they produce and the methods used in disposing of them.

(4) Severe penalties should be provided for disposing of waste material of any kind in such manner that undesirable solutions can reach the underground water supply.

(5) When oil wells are drilled in an area definitely known to be valuable for its fresh water supplies, the driller should be required to keep an accurate log of the sediments passed through, and of the water encountered, and its characteristics. This record should be filed with the State Division of Oil & Gas or with the division of Water Resources, where the public may have access to it.

(6) Greater precautions than are now customary should be taken in the drilling of water wells in a metropolitan area. Water tight casings should be required, and the protection of the more important water bearing strata by cement plugs above and below them. The water from each gravel bed encountered while drilling should be immediately sampled and analyzed and its characteristics noted in the drilling log.

(7) When oil or water wells are abandoned, they should be completely filled and thoroughly sealed in order that they may not provide channels for the spread of pollution when casings collapse or rust out.

(8) The gravel envelope type of well should not be permitted in a highly industrialized area because of the opportunity it provides for spreading pollution from one stratum to another.

The last three points will be more fully appreciated when it is recognized that, in addition to the conditions already described, there are in some areas pockets—usually but not always shallow—of water too strongly saline for domestic use, which can be shut off from the main water supply if proper precautions are taken, but which may jeopardize the entire supply for some distance if they are not. Three wells which were observed showed a permanent increase in salinity of from 100 per cent to 300 per cent following the earthquake of March 10, 1933. The lesson is obvious.

## Operating Experiences at Wilmington Water Treatment Plant

By ROY O. VAN METER

Chief Operator Wilmington Water Treatment Plant, Bureau of Water Works and Supply, Los Angeles

THIS paper covered in very complete and interesting style problems of the Wilmington plant which was first placed in operation on February 9, 1932. This plant is of especial interest because it is one of the first to use ferric chloride as a coagulant. The original plan of feeding ferric chloride solution with an automatic feed device proved unreliable. In its place orifice boxes with hand regulators were installed. Duplicate rubber battery boxes with rubber floats and hard rubber needle valves provide accurate regulation and stand-by service.

The plant had a limited settling capacity with inlet and outlet arrangements providing for a treatment of only 1.5 m.g.d. Its capacity was increased by changing the 'hydraulic jump' weir to a deep inlet with deflection baffles to divide the flow equally along the inlet side of the clarifier and by increasing the length of outlet weirs.

The paper further covered the problems dealing with sand filters, chlorination treatment, clarifier and filter growths, return of backwash water to clarifier, and storage of ferric chloride.

The plant, which at first could treat only 1.5 m.g.d. is now regularly operating at 6 m.g.d. and has treated as much as 6.7 m.g.d. In accomplishing these results conformance as much as was necessary was made to standard practice. However, such problems as operating a clarifier at 2,400 gal. per sq. ft. per day, and of controlling clarifier and filter growths, were solved by methods which still can be considered innovations.

## Occurrence and Control of Weed Growths in Reservoirs and Open Canals

By G. E. ARNOLD

IN the operation of a water system where open reservoir storage is used weed growths present a serious problem in that it produces taste and odor and tends to impede the flow of water. The best methods of controlling growths is by varying the water level, burning exposed reservoir banks when water is low, and cutting and raking weeds from the water. The continuous application of copper sulphate is satisfactory for use in canals or small reservoirs, but is not altogether successful for large reservoirs. If weeds impart a taste to water the best method of combatting them is with the use of activated carbon, and aeration may also help.

# Observations in Lives of Water Works Structures

By G. A. ELLIOTT
Consulting Engineer

THE expression of useful lives of structures in financial terms has developed several accounting methods for recognizing depreciation. All are based on assumed lives presumably derived from experience. The most prominent because most used are: (1) the so-called 'straight line' method which presupposes that the structure in question deteriorates at a regular annual rate requiring setting aside the same percentage of cost each year which will at the end of the assumed life period, without interest, equal the original expenditure and (2) the sinking fund method which provides for the annual setting aside of a sum of money which at a predetermined rate of compound interest will amount to the original cost at the end of the life period.

Useful lives of all utility structures are limited to two ways: by obsolescence and by actual deterioration of structures to a point where it no longer serves its purpose. The life of pipe and machinery installations of course vary but there are examples in western cities of pipe lines being in service for a period of over 70 yrs. and of steam pumping units operating for a period of more than 45 yrs.

Selecting the best material that can be afforded and constant vigilance in maintenance and upkeep will result in maximum life of structures and will be reflected in decreased cost of service. Present condition of component parts of a utility plant cannot be determined by application of a percentage derived from the relation of expired life to assumed total life based on general records of experience. Such figures have only a very general relation in a specific case and should be modified by actual conditions found by thorough inspection of the plant.

## Water Supply for Construction Camps on Colorado River Aqueduct

By C. C. ELDER

Metropolitan Water District of Southern California

WHEN construction of the $220,000,000 aqueduct for the Los Angeles Metropolitan area became a reality the problem of providing camp facilities, transportation, and communications across one of the largest and inaccessible areas in U. S. became important. It was first assumed that water for camps along the first 150 mi. of the aqueduct line must necessarily be pumped from Colorado river. Investigations were made of well sites and three wells were drilled early in 1932 near Desert Center, two being unfit for human consumption, the third being of good quality. As the need for additional camp water supply sources became more acute rigs were put to work along the route for development of dependable wells.

Eventually a total of twelve producing wells were drilled ranging in depth from 26 to 785 ft. and in capacity from 150 to 750 g.p.m. Distribution of the water required 20 two to six stage booster pump stations employing 36 pumps varying in capacity from 110 to 300 g.p.m. and with an operating head from 200 to 800 ft.

The distribution system consists of four separate units as dictated by topographical condition and limitations of sources of supply. The western section extends from Morongo Wells to Berdoo camp where the line is terminated because of rough topography and limited supply sufficient for camps from Berdoo westward only. The central section extends from Fargo camp to Iron Mt. tunnel, a distance of 79 mi. This line is laid over Coxcomb range, requiring considerable booster pumping but provides service further east by gravity. The eastern section from Iron Mt. tunnel to Colorado river at Earp supplies 70 mi. of aqueduct work. A short river section supplies tunnel projects within a radius of about 3 mi. of Colorado river.

Distribution pipe lines were designed on the following basis:

| Duty | Gal. |
|---|---|
| Camps—per man per day | 100. |
| Compressors per 1000 cu. ft. of free air | 0.67 |
| Tunnel drills per drill per day | 167. |
| Mixing concrete per cu. yd. | 40.0 |
| Washing aggregates per cu. yd.—net loss | 48.0 |

Additional allowances were made for miscellaneous uses and waste. The system consists of 180 mi. of 5, 6, and 8 in. light-weight welded steel gas-line pipe laid in a trench with 18 in. cover.

Storage is provided by six 300,000 gal. gunited reservoirs and four 300,000 gal. steel tanks.

Aerators, chlorinators, and dry lime feeders are installed as required along the entire system. Treatment is required because of (1) excess free carbon dioxide, (2) crenothrix, an iron bacteria, (3) sulfate reducing bacteria, (4) excessive iron in natural well waters.

(A detailed article 'Colorado Aqueduct Construction Water System' appeared in October, 1933, issue, page 421, Western Construction News.—Editor).

# Practical Aspects of Coagulation With Ferric Chloride

By CHARLES GILMAN HYDE
University of California, Berkeley

In this paper the practical aspects of employment of ferric chloride used in water and sewage treatment was considered under the following heads: Chemical and physical nature of the substance; its behavior as a coagulant; its availability and extent of use; its purchase, delivery and storage; its proper application; the production and conditioning of the floc; its effect upon a deficiency sedimentation and filtration; and the general character of the effluent of a suitable treatment plant utilizing the particular coagulant in question.

Ferric chloride as a chemical substance has been known for a very long time and nearly 50 years ago Ira Remsen stated, "The simplest way to make a solution of the ferric compound is to dissolve iron in hydrochloric acid and pass chlorine into it to complete saturation." The use of ferric compounds as utilized to produce coagulum or floc for the removal of turbidity and/or color from natural waters developed from its first use at Quincy, Illinois, in 1898, up to the present time when they have become commercially available in quantity and price to compete with other coagulants such as aluminum sulphate.

In the clarification of water by ferric salts there are three chemical factors which determine the optimum conditions for floc formation. These are: (1) there must be present in the water a certain minimum quantity of ferric ion, (2) there must be present an ion of strong coagulating power, such as the sulphate ion, (3) the hydrion concentration must be properly adjusted.

Since waters vary greatly in composition and characteristics each in itself is a problem and must be made the subject of careful study and experiment to determine the best and most effective method of clarification and/or decolorization.

The actual cost of ferric chloride depends upon: (1) the form in which it is purchased, whether solid (or lump) or aqueous solution, (2) the amount purchased at any one time, (3) the transportation distance from point of manufacturer.

Ferric chloride is delivered and stored in many different ways, depending on the amount purchased. Rubber-lined steel tank cars, holding some 8000 gallons, as well as rubber-lined steel delivery trailers, having a capacity of 1000 gallons, are employed in California. In eastern United States lump ferric chloride is shipped by certain manufacturers in heavy paraffine-lined airtight wooden casks of 55 gallon capacity.

Hyde quotes from 'Handy Information on Isco Ferric Chloride' by Innes, Spiden & Co., New York, on suggestions relative to preparation of solutions from solid cake and from lump form of ferric chloride for application of feed machines: 'For ease and cleanliness in handling lump ferric chloride adequate and convenient equipment is necessary, since it cannot be fed dry because of its deliquescence, and provisions must be made for dissolving a solid material. This requires proper planning of the dissolving tank.

The major difficulty in dissolving ferric chloride arises from the fact that when a mass of solid lies in the bottom of the container the liquid in contact with the undissolved salt quickly becomes saturated. The saturated solution being heavier than the overlying liquid, there is little or no transfusion and all dissolving action comes to a halt. To overcome this difficulty requires (1) the direct introduction of steam into a closed container of ferric chloride will melt the solid, since the temperature of only 100°F. is needed, (2) the type of mechanical mixing to keep the solution in the entire tank at more or less uniform concentration, (3) inducing a natural circulation by suspending the undissolved lump near the top of the tank, thus the heavier solution falls away from the solid mass, leaving the lightest and weakest solution always in contact with the solid salt.

Individual floc particles should be large and firm and not unduly fragile. The procedure of building up this type of floc has become known as floc conditioning. A well-conditioned floc will settle rapidly and will withstand a certain amount of shock in transportation in conduits.

Floc conditioning may be successfully effected by turbulent flow in long channels, provided with various types of baffles or in basins provided with compressed air agitation alone or combined with mechanical stirring. The period required for floc conditioning varies with different types of waters, temperatures, etc., but generally the period of from 20 to 30 min., provides for the average rate of yield of a plant.'

In his paper, Hyde refers to a well-selected list of references which were a part of his paper.

## The California Type Well

By JEPTHA A. WADE
Chief Engineer
California Water Service Company

THE California type well, so named because it was first developed and largely confined to California, is also known as the stovepipe well because the sections of casing resemble stove pipes. This resemblance was more pronounced in the earlier days when thinner sheets were used than at present. Two factors influenced the early design of the well structure. First, water was very close to the surface and secondly—the great bulk of water requirements was for irrigation purposes. Consequently, large quantities at minimum expense was the primary consideration.

The well is formed by a two-ply casing, made up in sections about 30 in. long. The ends are cut truly at right angles to the axis, so that joints butt together in driving.

As the casing is sunk into the hole either by driving or jacking, alternate sections of inner and outer casing are added at the top, one pair at a time, so that the top is always at a convenient height far handling tools. In shallow holes, drilling is done with a mud scow, which is a large heavy bailer with a heavy cutting edge, and cutting bar across the diameter. In deep holes and in tough material a bitt or spud is used alternately with the scow.

One great advantage of this well is the fact that a very accurate log can be kept of the material penetrated by the well.

## A.I.S.C. OFFERS PRIZES

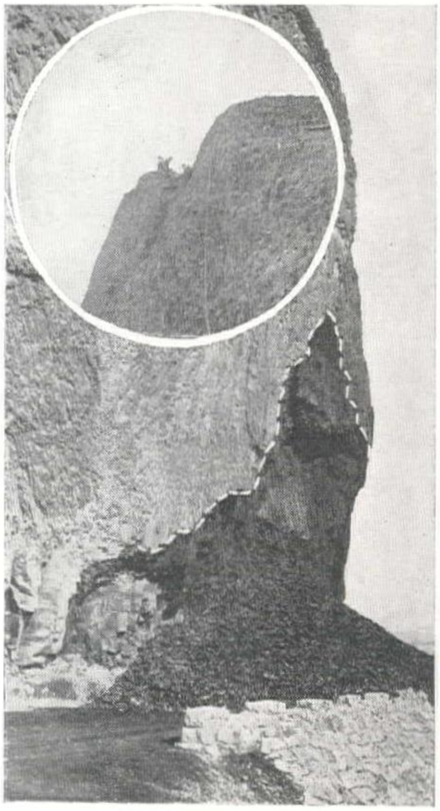
As a continuation of its program of encouraging improvement in the aesthetics of steel bridge design, the American Institute of Steel Construction announces its Seventh Annual Bridge Design Competition, open to bona fide registered students of structural engineering and architecture in recognized technical schools of the United States and offers two cash prizes of $100 and $50 respectively for the designs placed first and second.

The general specifications designate a steel grade crossing elimination bridge. The bridge carries a highway in a straight line over and beyond a railroad and another highway parallel to the railroad. All drawings of the 32-ft. wide bridge must be in black ink only. Preliminary drawings, which include a side elevation and cross-section of the main span and a side elevation and plan of the entire structure, must be submitted by March 20, 1935.

Following notification of those chosen to develop their preliminary drawings to final form will be made immediately thereafter and final judgment of the competition will be made May 1. Further details regarding the competition may be had from the executive offices of the American Institute of Steel Construction, 200 Madison Avenue, New York City.

Clyde MacCornack is chairman of the Committee and F. H. Frankland is technical director.

# Difficult Job Results After Yellowstone Rock Cavein



AN unusually difficult and hazardous job was recently completed on a section of road in Yellowstone National Park near Tower junction. This consisted of scaling off the front side of a cliff ranging in height from 80 to 140 ft. which overhung the roadway. In widening the original road, which skirted the bottom of the cliff, the new roadway was extended back about 11 ft. under the cliff, a half tunnel design being used.

Recently a huge slab of rock weighing approximately 1,650 tons, cracked off the overhanging ledge, burying the new roadway. It became evident that this section of the road would never be safe until the entire side of the cliff extending over the roadway had been scaled off. More than 9,500 tons of rock were eventualy taken off on a 16:1 slope terminating along the inner edge of the roadway.

The work was extremely hazardous in that workmen had to be tied on to the face of the cliff to operate jackhammers. The only access to several working locations was from the top of the cliff, necessitating letting workmen down on ropes. Vertical holes, drilled by a team of two men, were spaced from 2 to 4 ft. apart and ranged from 8 to 12 ft. in depth. The holes were loaded lightly since it was required that all material be saved. Twenty holes were shot at one time. Following each blast, two days were required for removing loose rock, it being necessary to cleanup after each shot to prevent loss of material over the outer edge of the road. A problem was presented in providing air lines to the men working on the face also. Compressors were placed about 150 ft. back from the slide and a straight airline was run to about the center of the slide area. A vertical line was then run up the side of the cliff for about 70 ft. from where a rubber hose extended to the workmen. A 20-ft. high, hand laid rock embankment extended along the outer edge of the road opposite the under-cut cliff. This rock slope withstood the shock of the original cavein but was gradually battered away from the impact of constantly falling rock. Replacement of this embankment was the final step in the job.

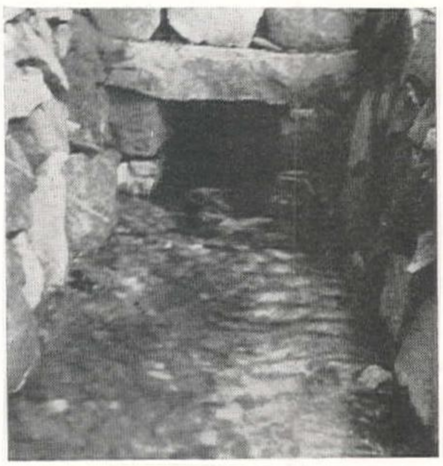
The work was under the jurisdiction of the U. S. Bureau of Public Roads, Denver, being planned by C. F. Capes, engineer in charge of construction work in Yellowstone Park. H. E. Dalton was resident engineer and J. A. Elliott is district engineer at Denver.

# Dry Rubble Masonry Used in Drain

IN constructing a section of the St. Helens National Forest highway, from Castle rock to Spirit lake, in Cowlitz county, Wash., which was under contract to LaDee Logging Co., Portland, Ore., a heavy sub-surface runoff was encountered along a portion of the work. In excavating for the roadway ditches, seepage was found to extend over a distance of 360 ft. Surface material was a sandy clay, mixed with boulders, permitting free percolation of the seepage water to more stable material at a depth of about 6 ft. below grade. Provisions for intercepting the seepage flow had to be carried below the level of the surface material. An open ditch was impractical under the conditions.

The road location follows the Toutle river, but construction of culverts was not economical due to the depth of excavation necessary and also considering the length of pipe required at this particular point. The volume of runoff was observed to be constant even during the dry summer season, and averaged about 7 in. in depth in a ditch 20 in. wide on a 3.2% grade.

A covered blind drain was considered the best solution of the problem. Excavation for the drain was carried below the roadway ditch, vertical from the intersection of the grade line with the cut slope, down to the firmer material, to an approximate width of 4 ft. at the bottom. The standard width of ditch constructed on the project was 10 ft. in common material, and 5 ft. in solid

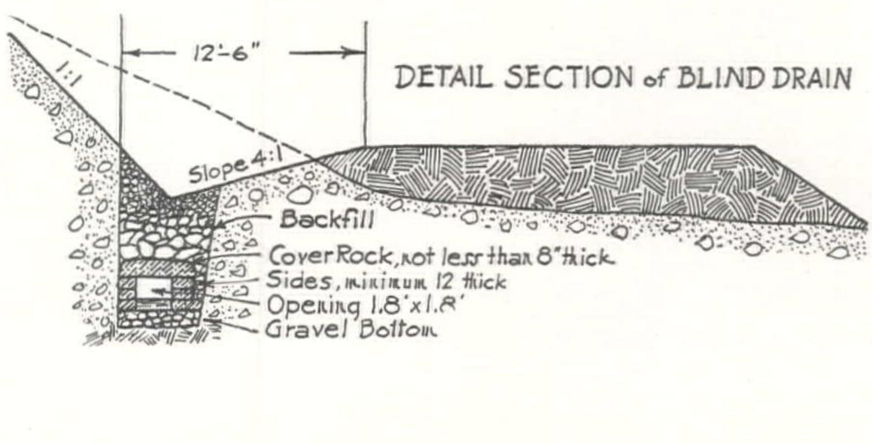


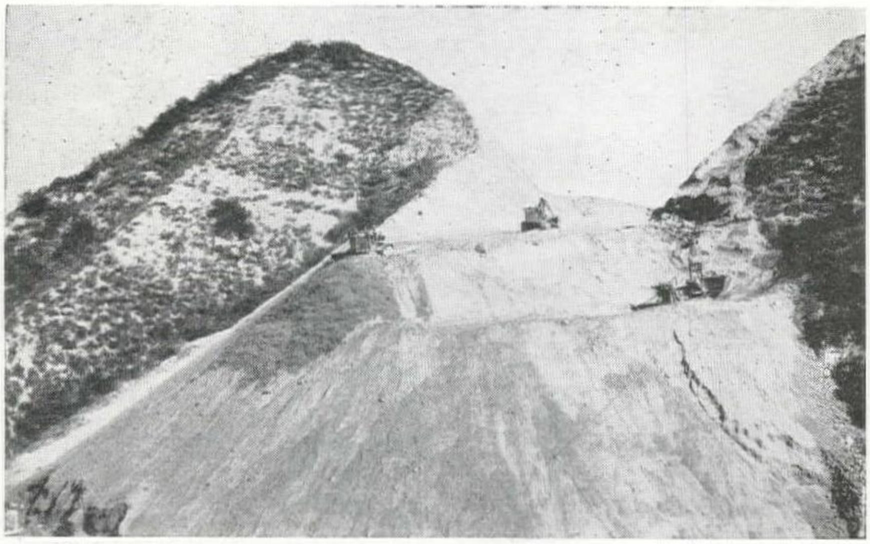
**Entrance to Drain From Open Ditch.**

rock excavation, but the width of ditch in this case was increased to 12.5 ft.

A layer of coarse gravel was placed in the bottom of the ditch to a depth of 8 in. Dry rubble masonry side walls of the drain were laid up to a minimum of 12 in. of thickness, and stone slabs not less than 8 in. thick were used for covering the top. The neat inside dimensions of the drain were 1.8 by 1.8 ft. Loose rock, graded roughly for size, was deposited over and around the drain with the larger rock on the bottom, and smaller material near the top.

An additional 260 ft. of open drain was required from the end of the blind drain to the nearest culvert. Construction of this drain was similar to the construction of the covered section, gravel base and rubble walls being used. The work was completed under a force account work order by the contractor for U. S. Bureau of Public Roads. The labor cost for placing the rock totaled 48c per lin. ft. of covered drain, and 37c per lin. ft. of open ditch. E. N. Moore, resident enginer supervised the work.





Pioneering—Bulldozers and Cowdozer Working in Three Stages.

# Well Planned Operation Speeds Jack Rabbit Trail Construction

**More than one million cubic yards of excavation handled entirely by tractor-drawn equipment on Imperial valley cut-off.**

By ALMON COONROD
District Office Engineer, San Bernardino
California Division of Highways

FOR the past few years steadily increasing traffic on the Jack Rabbit trail has made evident the necessity of reconstructing the route to modern standards of alignment and grade. This section of State highway route No. 19 serves as a convenient cut-off between Imperial valley and the Los Angeles metropolitan area, as well as connecting the Imperial valley arterial with the inland route between San Diego and Riverside. The Jack Rabbit trail is that portion of the Riverside-Beaumont lateral which crosses the deeply eroded table lands betwen Moreno and Beaumont in Riverside county.

As the first step in accomplishing this improvement, the Division of Highways last September awarded a $360,809 contract to Mittry Bros. Construction Co. of Los Angeles for grading and surfacing 6.8 mi. of the route between Theodore st., 1.5 mi. north of Moreno, and a connection with the San Bernardino—El Centro route at a point about 2.5 mi. west of Beaumont. The project, estimated to cost more than $400,000, was financed entirely from State funds.

The new alignment crosses the deep gulches and hog-back ridges of the Moreno 'bad lands' approximately at right angles, necessitating excavation of heavy cuts and construction of high fills to meet the desired high standards of alignment and grade.

Although the engineer's estimate included many large items of work, such as long culverts under high fills and high grade oil treated plant-mix surfacing, two items which reveal the extent of the project are: 1,260,000 cu. yd. of roadway excavation and 5,333,000 sta. yd. of overhaul, all within the 6.8 mi. of the contract limits.

Early surface tests indicated sandy and gravelly material intermixed with clay well compacted and slightly cemented. This condition has been verified as shown in grading operations completed to date. The contractor's equipment has proven equal to the task of loosening the material without explosives so that work is advancing at a consistently steady pace.

The contractor's execution of the project has shown excellent coordination, and from the first day's work each unit of equipment has worked consistently without interference or delay. A definite plan of operation is being followed and a distinctive type of equipment is being used for each type of work.

Each major unit employs a Caterpillar '75' or '60' deisel tractor equipped with various devices being operated ahead or drawn behind. One unit carries a bulldozer in front and draws a heavy rooter behind. Two units with bulldozers in front draw sheepsfoot rollers behind, while one is equipped with only a bulldozer and another tractor pulls only a cowdozer. Another unit is equipped with a bulldozer in front and a cowdozer behind, and three tractors draw two 12-yd. Le Tourneau carryalls each.

Grading operations consist of excavating, hauling, depositing material in layers in the embankments, and compacting the fills. Due to the alignment of the road through sharp ridges and along steep slopes, 'pioneering' has been a distinct and important operation. The smaller units carrying bulldozers and cowdozers are used for this work.

Ten miles of pioneer roads already constructed, provide temporary one-way access roads that are wide enough to move in equipment and culvert material. These preliminary routes must of necessity lead to the top of all 'hog back' ridges where grading operations are started. Pioneering work continues until cuts are sufficiently opened and fills are brought up to such a level that the carryall units can operate straight through, picking up material in cuts and spreading it in layers in the fills. Until this stage is reached the material is pushed out and allowed to roll down the slopes of the ridges into the adjoining canyons where it is spread in layers and compacted with a unit carrying a bulldozer and sheepsfoot roller.

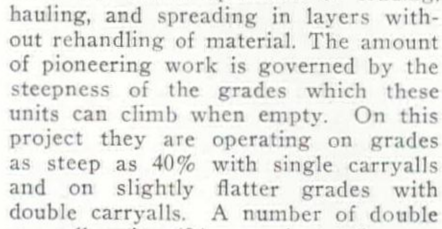
Pioneering equipment consists of three units, one carrying a bulldozer, one a cowdozer, and one a bulldozer and a cowdozer. (Bulldozers, which are mounted in front of the tractor, are used for pushing material over banks or spreading it in layers, and cowdozers, mounted in the rear, are used for drawing material forward on short hauls.) The unit with both bulldozer and cowdozer is effective for working in a small space. This unit can (1) back up to a bank of material and draw a load forward the length of the unit, (2) back over the deposited load, (3) lower the bulldozer, and (4) push it forward over a fill slope.

When the pioneering operation is completed, carryall units move in to complete the grade. These units perform the entire operation of loading, hauling, and spreading in layers without rehandling of material. The amount of pioneering work is governed by the steepness of the grades which these units can climb when empty. On this project they are operating on grades as steep as 40% with single carryalls and on slightly flatter grades with double carryalls. A number of double carryall units (24 cu. yd. total) were able to make round trips on a 2,100-ft. haul in 15 min. This time varies, of course, being dependent on the steepness of the haulage grade.

A 3-in. pipe line, laid along the right of way, supplies water for embankment compaction. Several portable electric lighting plants supply energy for flood lights for night work.

P. O. Carver is general superintendent for Mittry Bros. Construction Co. and Crow Bros., sub-contractors, are in charge of grading operations. H. O. Ragan is resident engineer and E. Q. Sullivan is district engineer at San Bernardino for California Division of Highways.

Two LeTourneau 12-yd. Scrapers Used for Making Overhaul.



# New Equipment and Methods Developed for California Maintenance Work

NEARLY $15,000,000 will be spent by California Division of Highways during the biennial ending June 30, 1935, for maintenance on the State highway system. Of this amount $6,783,000 will be spent during the current fiscal year. An addition of some 6,800 mi. of country and city streets was made to the State highway system in August, 1933. The present system of more than 13,660 mi. represents a capital investment estimated at more than $300,000,000. For the fiscal year ending June 30, 1934, the cost per mile of maintenance amounted to $629 and involved the following general expenditures:

| | |
|---|---|
| General maintenance | $4,777,699 |
| Drawbridge and ferries | 56,251 |
| Major slides | 645,445 |
| Specific maintenance | 2,439,150 |
| | 110,660 |
| Total | $8,029,205 |

All maintenance work is under the direction of the State maintenance engineer. Field operations are divided into the 11 highway districts and are under the direct supervision of a district maintenance engineer who works under the district engineer. The district mileage is divided into territories of from 125 to 200 mi. of road, all of which are under the direct supervision of a superintendent. From 3 to 10 foremen and several leading men are employed in each territory. The present state highway system under maintenance by types is as follows:

| Types | Mileage | Percent |
|---|---|---|
| Portland cement concrete | 2,486 | 19.4 |
| Asphalt concrete | 1,364 | 10.7 |
| Bituminous macadam | 2,056 | 16.1 |
| Oil treated crushed gravel or stone | 2,788 | 21.9 |
| Dust oiled | 2,405 | 18.9 |
| Gravel | 152 | 1.2 |
| Earth | 1,429 | 11.2 |
| Bridges | 71 | 0.6 |
| Total | 12,751 | 100. |

Equipment used on maintenance work is in generally State-owned, although it is practice as far as possible to rent privately owned equipment such as power shovels, oil distributors, heavy trucks, etc. State-owned equipment is rented from the Equipment Department on a monthly or shift basis and the rents cover upkeep, depreciation, and necessary administrative expenses. This procedure permits not only a correct distribution of equipment expenses to each portion of the work, but also more specialized supervision in purchase and upkeep. The method has the advantage also of ready inter-district transfer of equipment and wider distribution of information as to improvements of equipment and methods of use.

In an organization as wide-spread and diversified as the maintenance force, the question of proper housing and storage facilities is an important one. With a force in excess of 2,600 men and equipment valued at more than $4,000,000, centrally located working headquarters have been provided to insure protection for men and equipment. Standard plans have been prepared for some 14 types of buildings such as are necessary at each station. Where living headquarters are provided for families, as in the case of superintendents' or foremen's cottages, rentals are charged on the basis of 4% depreciation plus estimated annual upkeep for water and light, if furnished by the State.

**Dust Palliative**—During the current year a total of 1,660 mi. of secondary road was given dust oil application. This included 871 mi. of new treatment and 789 mi. of retreatment at a total cost of $706,630.

The average cost of this work is about $425 per mile and while the cost of maintenance on the road is not materially reduced, a vastly improved surface is furnished to the public.

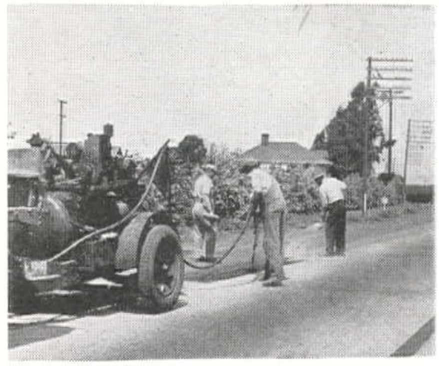
In addition to the application of oil as a dust palliative, about 300 mi. of State highway has been mixed or remixed. The mix type of treatment requires from 1 to 1½ gal of from 60—70% or 70—80% asphaltic oil. An oil

**Bucking Heavy Snow With a "Sno-Go" On Tioga Pass Road in the Sierra Nevada Near Yosemite National Park.**

cake from 2 to 4 in, in thickness is produced which, with a light seal coat provides a smooth dustless surface of more enduring character than dust oil application.

**Retread-surfacing** — During the past few years funds have not been sufficient to provide for reconstruction of older pavement surfaces which require constant patching. Considerable study has been given to the development of a comparatively thin type of surfacing at a reasonably small cost which would serve to smooth up and seal broken surfaces and at the same time have stability and carrying power of its own.

The so called retreated surface as finally developed follows in general the



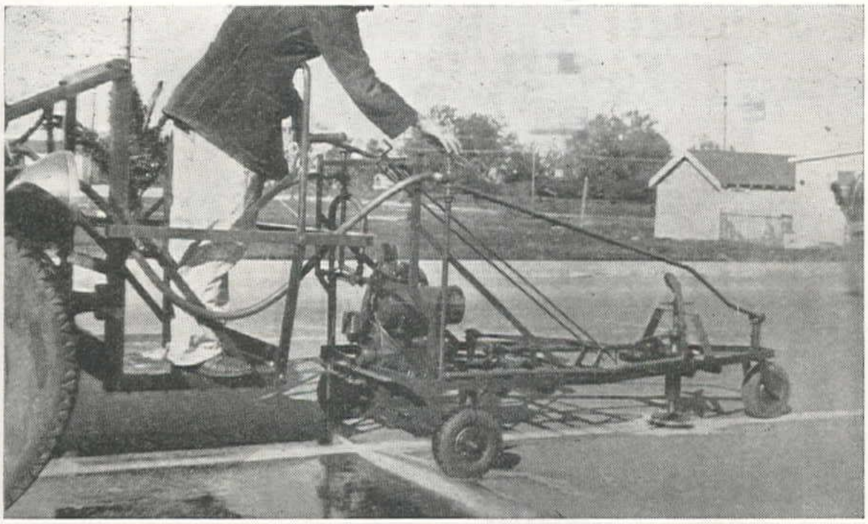
**(Upper)—Placing Four-Inch 90-95 Road Oil Stripe on Concrete Pavement, Using Fifty Gallons Emulsion and Two Tons ⅜-in. to 10 Mesh Screenings Per Mile. (Lower) Applying Emulsified Asphalt to Fine Screenings Placed to Form Transition Between Pavement and Oiled Shoulders. Asphalt is Covered by Hand-Placed Screenings.**

practice in other States and consists of application of from 100 to 125 lb. of 1¼ to ¾-in. or 1 to 1½-in. crushed rock depending on the thickness desired, road mixed with 0.5 to 0.7 gal. of mixing type of emulsified asphalt per square yard of surface. This application is bladed into place and rolled. After the mix is set, ½ to ¼-in. key rock is spread at the rate of from 10 to 20 lb. per sq. yd. and the excess rolled and broomed until the voids are sealed and any excess evenly distributed.

Penetration type emulsion is then spread at the rate of from 0.2 to 0.3 gal. per sq. yd. and immediately covered with ⅜-in. to No. 10 mesh screenings at the rate of 10 to 18 lbs. per sq. yd. and the surface broomed and rolled.

The surface is then checked for ruts or other irregularities and necessary smoothing taken care of by patching. After this surface has been thoroughly cleaned with power brooms, a penetration type emulsion is spread at the rate of 0.2 to 0.3 gal. per sq. yd. of surface and immediately covered with fine screenings at the rate of 8 to 12 lb. per sq. yd. After the screenings have set sufficiently, the surface is broomed and rolled with an 8 ton roller. The cost of this work varies from $4,000 to $5,000 per mile for a course of 1¼ to 1½-in. compacted thickness.

**Crack Fillers for Portland Cement Concrete Pavement**—A 4,000-ft. test section, sponsored by American Association of State Highway Officials, has been laid near Williams for the trial of 18 separate expansion joint and crack filler products. The items considered in this study were: (1) economy of material, preparation and placing, equip-



**Special Equipment Developed for Washing Traffic Stripe Which Provides Revolving Scrubbing Brushes, a Sodium Meta-Silicate Washing Solution Tank, and Spray Arrangement for Flushing Cleaned Stripe.**

ment required, and service life; (2) time of set with reference to traffic; (3) adhesive and cohesive properties at extremes of temperature; (4) resilience; (5) weather resistance.

Some of the materials used in the experiments were eliminated during the summer due to the loss of volatile constituents, which changed them to a hard brittle mass; while others were discarded because they were excessively soft and either bled badly or ran out at the end of the joint. Similarly, some of the material also became brittle and failed due to cold weather.

Of the uncombined materials, asphaltic cement listed as 50-60 penetration material, but actually having a penetration of 47, appeared to give the best results. Mixtures of air-blown asphaltic cement of a penetration of 31-40 combined with an 81 penetration 'D' grade asphalt, or with 90 to 95% type road oil, showed promising results.

**Traffic Stripe**—Although striping of all pavements is not possible, it is the policy to stripe all pavements in the normal fog areas, likewise on curves in the mountainous portion of all main routes. In general a 4-in. wide white stripe is placed to divide the pavement into two or more traffic lanes. On newly constructed Portland cement concrete a raised stripe of emulsified asphalt and screenings is applied which serves satisfactorily to guide traffic until the pavement surface darkens, at which time white lacquer is applied to the raised stripe.

The lacquer used is purchased under specifications developed by the Division of Highways laboratory. From 8 to 12 gal. of lacquer per mile of 4-in. stripe are now used in restriping work and from 12 to 18 gal. for new stripes. Consideration has been given during the past year to the possibility of prolonging the effective life of the traffic stripe by washing with a solution of sodium meta-silicate. Special equipment was developed by the Equipment engineer which provided revolving scrubbing brushes, a tank to carry the washing solution, and a spray arrangement to flush the cleaned stripe. No doubt, a longer life will be secured as a result of re-painting over the cleaner surface, but it appears doubtful if the benefits justify the added expense of washing.

**Snow Removal and Control**—This work, now on a permanent and well organized basis, provides for modern equipment and suitable quarters in the more difficult areas. The State is now equipped with 155 snow plows including light motor grader 'V' plows, straight blade speed plows, large 'V' plows attached to 5 ton, 4-wheel drive trucks equipped with side wings and capable of bucking hard compacted drifts up to 4 ft. in depth, augur type and railroad type rotaries with digger arms and sloping blades, as well as rotary widening units, making it possible to cope with nearly any kind of road opening assignment. The railroad type rotary consists of a large diameter wheel with fixed blades. The wheel is mounted vertically on the rear of the truck which operates backward in the snow drift. The rear and top of the wheel is covered and chutes are provided so the snow may be thrown either to right or left.

The 'V' type plows are especially heavy and the truck and entire unit is designed for heavy bucking work. The widening unit are designed to trail behind a truck and throw out the windrowed after the road has been opened.

The most spectacular snow removal throughout the system will be found near Donner summitt on U. S. Highway No. 40 at elev. 7,000 ft. Here, during a severe winter, snow has been known to fall at a rate of one foot per hour, and wind velocities of 80 mi. per hr. have been recorded with a thermometer well below 0°F.

During the past two years (with snowfall being comparatively light) more than $150,000 has been expended for snow removal on more than 2,000 mi. of road in snow area. During a winter of heavy snow fall, snow removal on some 3,300 mi. of state highway is required.

**Storm Damage and Protection**—The principal item in connection with storm damage is the removal of major slides. During the fiscal year, nearly $700,000 will be spent on slide removal and drainage ditch repairs. Considerable advances have been made in the problem of controlling slide areas by proper ditching and installation of perforated pipe below the slip line with rock fill trenches above to catch the water. In some cases bulkheads along the toe of the slides are effective.

Progress has also been made in flood control by providing protection against cloudbursts in the desert areas and floods along stream channels and in building adequate drainage systems for the roadway itself. In cloudburst areas, elaborate systems of contour dikes are constructed, leading the water to appointed bridge opening. Many of these dikes exceed a mile in length.

Charles H. Purcell is state highway engineer; T. H. Dennis, state maintenance engineer, and R. H. Stalnaker, equipment engineer for California Division of Highways.

## Spinning San Francisco-Oakland Bay Bridge Cables

IMMEDIATELY following completion of the center anchorage (pier No. 4) of the San Francisco-Oakland Bay bridge, preparations will be made for spinning of the first half of the world's longest suspension bridge between San Francisco and Yerba Buena island. More than 13,000 tons or 55,500 miles of galvanized steel cable wire with a diameter of 0.196 in. have already been assembled at the contractor's (Columbia Steel Co.) plant at the foot of 20th St. in San Francisco. This wire is being fabricated at Worcester, Mass.

The cable wire, which is drawn in 3,900-ft. lengths, is treated, mitred, spliced with couplings, and wound on 2½-ton spools, each spool containing 16 tons or some 60 mi. of the approximate pencil-size wire. These spools will be barged to the concrete center anchorage and trucked to the Rincon Hill anchorage, preparatory to the unreeling of these cables for the suspension spans on the west side of the island.

In the spinning of the cables, the spools will be unwound by stringing loops over the saddles on the tops of the tower from one anchorage of the suspension span to the other. When the spool is unwound, the end of the wire will be coupled to the end of the wire in the next spool, loops of which will also be strung across the two towers.

Workmen on the cat-walks, which are erected first, will adjust the strands of wire to sag with an equal deflection. When 400 of these wires have been laid over the tower tops they will be bound into one strand. Thirty-seven of these strands will comprise the 28¾-in. diam. cable which will contain a total of 17,464 parallel steel wires and weigh approximately 1,780 lbs. per ft. with wrappings.

# Association Notes . . . .

During the annual meeting of Colorado Association of Highway Contractors held in Denver, January 12, the following officers were elected for 1935. president, G. W. Hamilton of Hamilton and Gleason Co., Denver; vice-president, Vance J. Driscoll of Driscoll Construction Co., Pueblo; secretary- treasurer, James B. Kenney, re-elected; directors, Luke E. Smith, Denver; Platt Rogers, Pueblo; E. H. Honnen, Colorado Springs; Andrew Pople, Grand Junction; Harry Gardner, Glenwood Springs; Edward Selander, Greeley; and Henry Monaghan, Denver.

During the business session, the association took a strong stand against day-labor projects. A specific case was brought out where the cost of a project by day labor amounted to $79,387, whereas, the cost under bids actually submitted would have amounted to only $53,888.

Speakers at the evening banquet included R. N. Campbell, Deputy NRA administrator on construction codes; L. W. Hickey, executive engineer, divisional code authority; B. L. Knowles, Charles D. Vail, state highway engineer, and J. A. Elliott, district engineer, U. S. Bureau Public Roads. In Vail's talk he brought out the fact that he favored contract work over day labor.

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The annual meeting of Colorado Society of Engineers was held January 19, in Denver. Four interesting papers delivered during the business session included: 'Engineering as a Profession,' by Fred C. Carstarphen; 'Engineering Education a Preparation for Life,' by Dr. M. F. Coolbaugh; 'Early History of Engineering in Colorado' by A. W. Ainsworth; and 'Welding Design vs. Cast and Riveted Design' by Arthur Halliwell.

Banquet speakers included Governor E. D. Johnson, Mayor G. D. Bagole of Denver, and W. W. Grant, Jr. Officers elected for the following year were as follows: president, R. J. Tipton; vice-president, H. S. Sands; secretary-treasurer, C. M. Lightburn; directors, C. A. Davis, S. A. Ionides, R. W. Lindsay, C. H. Coberly, G. H. Garrett, D. J. McQuaid, F. A. Lockwood, and F. H. Prouty.

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At the annual meeting, held January 9 in Seattle, of the Northwest Branch, Associated General Contractors, the following officers were elected: President, George F. Christensen of Columbia Power and Investment Co. of Stevenson; treasurer, H. S. Woodward, Tacoma; secretary, John W. Rumsey, Seattle. M. E. Norris of Burlington was elected president of the Mountain-Pacific chapter; T. D. Tyrer, Seattle, vice-president; L. P. Fiorito, secretary-treasurer. Henry Nolan is executive manager.

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At a meeting of the Long Beach Civil and Structural Engineers Association held January 16, the following officers were elected for the coming year: president, R. D. Van Alstine; vice-president, Aaron J. Smith; secretary-treasurer, Vern D. Hadden; directors, A. L. Ferber, past president, E. Harnett, Howard Peacock, and E. B. Howes.

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Officers of the Utah Section of American Society of Civil Engineers for 1935 are: president, F. M. Allen; First vice-president, K. C. Wright; Second vice-president, O. C. Lockhart; secretary-treasurer, F. H. Richardson.

John H. Moser, President.

H. B. Way, Director

A. O. Thorn, Director

## Intermountain A.G.C. Elects Officers

Ernest A. Strong, V. Pres.

Mark Tuttle, Manager

At the annual meeting of the Inter-Mountain Section of Associated General Contractors held January 19, Salt Lake City, the following officers for 1935 were elected: President, John H. Moser; vice-president, Ernest A. Strong, Springville; secretary-treasurer, C. L. Wheeler, Salt Lake City; new directors, A. O. Thorn, Springville; and H. B. Way of Ogden. The holdover directors are G. M. Paulson and T. G. Rowland, both of Salt Lake City.

During the business session of the meeting, K. C. Wright, chief engineer of Utah Highway Commission, outlined the $13,000,000 program for Utah which includes $4,000,000 for grade crossing elimination and $6,000,000 for secondary highways and municipal roads.

Mark Tuttle, manager of the Intermountain Branch, called attention to the governmental inroads in the contracting industry, outlining the mistakes of using untrained workers on jobs requiring skilled men under contract conditions.

Other speakers included Harry H. Blood, Governor of Utah; Louis Marcus, Mayor of Salt Lake City, and Ora Bundy, contractor of Ogden. K. C. Wright announced that the silver shovel, used for breaking ground on the first National Recovery Highway project in 1933, will be awarded to the first contractor to obtain a 1935 NRA highway contract. Mark Tuttle, A. E. Christiansen, and John H. Moser represented the local chapter at the national meeting in Washington.

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J. F. Craemer has been appointed assistant director of California Department of Public Works. He will be stationed in Los Angeles and will supervise the public works program in Southern California.

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At the first meeting in 1935 of San Diego Section, American Society Civil Engineers held January 24, H. W. Jorgenson, City Engineer, spoke on 'Sewerage and drainage problems in the City of San Diego.'

The annual meeting of the Seattle Section, American Society of Civil Engineers was held January 21 during which the following officers were elected for 1935: president, Thomas D. Hunt; vice-president, R. P. Howell; secretary-treasurer, Miles E. Clark.

An interesting talk was given by A. C. Horner of the National Lumber Manufacturers' Association on the 'Lateral Stability of Timber Buildings and Combination Masonry and Timber Buildings, with Special Reference to Earthquake Stresses.'

# Personally Speaking......

Frank J. Connolly Receives Cassman Trophy From Bert L. Knowles, Chairman, Membership Committee. Nick F. Helmers, President of A. G. C., in Center. Copyright by Harris & Ewing.

## Southern California A.G.C. Wins National Membership Trophy

At the sixteenth annual convention of Associated General Contractors of America, held in Washington, D. C., January 30, the Cassman trophy was presented to Southern California chapter. This trophy is presented semi-annually to the chapter which shows marked efficiency and aggressive action in behalf of membership work in the Association.

The presentation was made by Bert L. Knowles of Worchester, Mass., chairman of the membership committee, to Frank J. Connolly, secretary-manager of the honored chapter. Knowles pointed out that the Southern California Chapter was now the largest one in the country and that Connolly was also instrumental and responsible for organizing a chapter in Arizona which has over thirty members. In response to the tribute paid his Chapter, Connolly said, 'We have, perhaps, 250 contractors in the A.G.C. in California, so that leaves us 6,750 more prospects to work on during the next six months. I would like to issue a challenge to my competitors, one and all, throughout the whole United States to try and take this trophy away from us.' (We have little doubt but that Frank Connolly will make good his boast—The Editor.

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R. E. Van Liew, PWA engineer inspector for Utah, was recently transferred from the Salt Lake City office to the Denver PWA office. In his new position he will be office engineer working under R. C. Hardman, State PWA inspector for Utah, Colorado, Wyoming, Montana and Idaho. He will be in charge of about 75 inspectors scattered throughout the region.

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### Conroy Appointed New Mexico State Highway Engineer

Grover F. Conroy was appointed state highway engineer of New Mexico following the resignation of G. D. Macy on January 2. Conroy attended the University of California and has been a resident of New Mexico for the past 15 years. From 1910 he was employed on highway, railroad, irrigation, and reclamation work, and in 1920 he became identified with the New Mexico State Highway Department.

Conroy served 4 years as locating and project engineer and in 1924-25 he was district engineer and maintenance superintendent for district No. 4 at Las Vegas. For several years prior to his appointment as state highway engineer, Conroy was engineer and consultant for Portland Cement Association in New Mexico. Conroy is a member of the American Society Civil Engineers.

D. A. Bourne, representative of The Asphalt Institute has moved his headquarters from Seattle to Security Building, Olympia, Wash.

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Harold D. Fowler has been re-appointed superintendent of the city water department for the City of Seattle, the appointment being for 3 years.

Alfred Jones has been appointed county surveyor for Los Angeles county. Jones has been connected with the county surveyor's office since 1912, having been chief deputy surveyor since 1917. He graduated from Purdue University in 1909 with a B.S.C.E. degree. Prior to his employment by Los Angeles County, he served in an engineering capacity with the Illinois-Central, B & O, and Santa Fe Railroads. In addition to his duties as surveyor, Jones is also chairman of the county special assessment committee, county relief commission, and SERA co-ordinator for Los Angeles county.

At the present time the surveyor's office has a staff of 250. Its work concerns mainly with surveying, mapping, designing construction, and work connected with sanitary and storm drain sewers. Jones is a member of American Society of Civil Engineers, being president of the Los Angeles Section for 1935.

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H. G. Gerdes has been transferred from the U. S. Engineers Office of Portland to the permanent staff of the Federal Power Commission, Washington, D. C. Gerdes' work will concern general hydro-electric engineering in connection with the administration of the Federal Water Power Act.

For the past two years he has served as designing engineer on the main spillway dam for the Bonneville project now under construction on Columbia river, 42 mi. above Portland. Prior to 1932 he was designing engineer on Hetch Hetchy Water Supply for the City of San Francisco and also with Fred H. Tibbitts, consulting engineer, San Francisco, and Loveland Engineers, Inc. Gerdes is associate member of American Society of Civil Engineers.

Roy R. Clark, former assistant to Gerdes, has been appointed designing engineer in his place.

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C. H. Howell has been appointed chief flood control engineer of the Los Angeles Flood Control District. Howell was formerly chief engineer of the Middle Rio Grande Conservancy District, Albuquerque, New Mexico.

S. M. Fisher, former chief flood control engineer, has been retained as chief dam designer.

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Lieut. Col. Herbert J. Wild was recently appointed district engineer at Seattle for the U. S. Engineers Office. Wild has been on duty with the Sixth Engineers at Fort Lewis and will succeed Col. C. L. Sturdevant.

# Obituaries

Edward H. Harnett, 46, city engineer and director of public service, Long Beach, Calif., died suddenly at his home on January 20. Harnett had served as city engineer for 2 years.

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Guy H. Wilson, 49, construction superintendent, on Boulder dam, died suddenly at Las Vegas, New Mexico, January 21. Wilson was formerly a contractor of Redwood City, California, and is well known in the Bay region. He is survived by his widow and three daughters.

# NEW Materials and EQUIPMENT

## Koehring Announces New Two Cubic Yard Shovel

The Koehring Company, Milwaukee, Wis., announces their new Model 801, two- cu. yd. shovel. This machine is convertible to either crane or dragline and is furnished with gasoline, diesel, oil or electric power. It has the independent and positive chain or cable crowd, and is equipped with a high strength welded shovel boom. Among the many features are the Koehring hydraulically cushioned clutch and the exclusive Koehring boom foot shock absorber.

## New Giant Stripping Shovel Announced

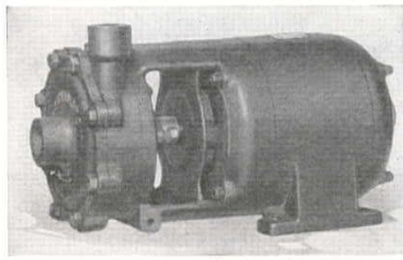
A new stripping shovel, with dippers up to 22 cubic yards and a working weight of 2,400,000 lbs., was recently announced by Bucyrus-Erie Company. Unusual in output capacity and working ranges, the 950-B is readily convertible to shovel or drag-line operation, and according to the manufacturer has the fastest digging cycle yet offered in machines of its class. It is available with booms up to 110 feet in length, with dipper handles up to 70 feet long, and with dippers of 14 to 22 cubic yard capacities.

Many features combine to give this big stripper ability to move overburden rapidly. Individual motors on each of the four caterpillar units give variable speeds for turning, which is further simplified by hydraulic steering, minimizing slewing of units and skidding of belts. Savings in output time result from hydraulic leveling—while the machine is digging. Steadiness is given the dipper by twin, single-part hoists. Power peaks are reduced by counterbalanced hoist.

## New Motor-Driven Grab Bucket

Improved motor driven grab buckets ranging from ½ to 3 cubic yards capacity for power houses and material yards handling such as slag, sand, cinder, clay, coal, and similar bulk materials are announced by Erie Steel Construction Company, Erie, Pa. With d-c special Westinghouse control makes possible the use of only two conductors between the control cab and bucket.

Since each bucket carries its own motor, the buckets can be attached to cranes, monorail hoists, or any hoisting equipment at whih electric power is available. Power is supplied either through a loop cable or a cable paid out from a light-weight drum—frequently spring operated. Since the unit is self-contained, there is no tendency to lift out of the material while closing; and it digs itself in without being dropped.



## Advanced Development of 2 Stage Centrifugal Pump

An advanced development of its 2 stage Monobloc centrifugal pump is announced by the Worthington Pump & Machy. Corp., Harrison, N. J. The low power requirements and simplicity of this unit make it applicable to all services requiring small capacities and medium discharge head. The casing, designed to withstand 150-lb. pressure, is bolted directly to the motor frame without an intermediate distance piece. thus eliminating the necessity for a baseplate.

The impeller design is a unit construction consisting of two enclosed type impellers cast back to back so that the overhung weight is actually no greater than that on a single stage pump. The impeller, which is keyed, is held firmly to the shaft by an impeller nut and the shaft sleeve, also keyed, in a separate, renewal part. The motor features oversize grease lubricated ball bearings. In this unit, which follows closely the design of larger Worthington pumps, the impeller is mounted directly on the motor shaft, eliminating the additional space and weight of the coupling.

## Power Control Available On Adams Leaning Wheel Grader

The availability of power-operated controls on Adams Leaning Wheel Grader No. 22 (10 ft. blade) is announced by J. D. Adams Company of Indianapolis, Indiana.

The power control mechanism is the same type as has been used on Adams 12 ft. blade machines for several years. Power is supplied by a single-cylinder, 5½ H.P., air-cooled Wisconsin motor mounted forward of the operator's platform from where the power is transmitted by roller chain and sprockets to the power control box in front of the operator.

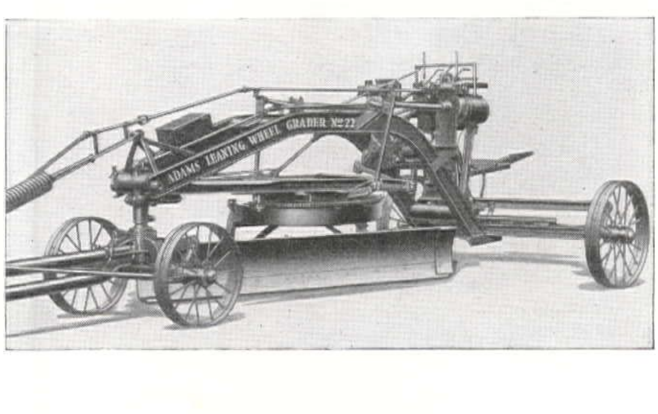
Through convenient levers all operating adjustments are made quickly and easily—these adjustments include leaning of the wheels, vertical and lateral adjustment of the blade, and operation of the steerable tongue. Claims stressed by the manufacturer are that these mechanical controls are very positive in action permitting very positive and accurate adjustments and that two or more adjustments can be made as quickly as one thus speeding up operations.

The machine weighs approximately 7250 lbs. and is intended for use with tractors of 40 to 50 drawbar H.P. Hand-operated controls are available if desired.

## One Man Prospecting Core Drill

A new eight page bulletin has just been issued by Sullivan Machy. Co., on its one-man No. 6 Prospecting Core Drill. This machine, suitable for either surface or underground prospecting, takes a ⅞" core to 250-ft. and one man can handle the outfit. Standard "E" rods and "EX" fitting are used.

The No. 6 is designed for tight working quarters and can be directed at any point on the wall, ceiling or ground around the operator. The rate of feed on the drill bit is widely selective so that the speed of maximum efficiency can be secured in any rock formation. The drill is quickly taken apart into three convenient loads.



# With The MANUFACTURER and DISTRIBUTOR

### Bates Announces a New Tractor

The Bates Mfg. Co., of Joliet, Ill, announce a new model 35 tractor. Improved design provides greater riding comfort, greater steering ease, smoother operation. Rear end engine vibration, a result of play in wearing clutch parts, is eliminated. The main engine clutch contains a supporting feature in which the weight of the clutch parts is supported midway of two bearings. The transmission gear shaft extending from the clutch is supported on two bearings, one of which is the same bearing as is used on the clutch shaft. A gear type coupling is incorporated between the clutch shaft and transmission shaft so that flexibility is obtained between two methods and each bearing has its proportionate loading. Greater clearance has been introduced between the truck wheel flanges and track rails, resulting in longer wear before flange replacement is necessary.

The seat has been moved to provide more leg room and the operator sits directly over the rear axle, thus riding on a pivoting point instead of a pitching point. The braking pressure of the steering brakes has been increased, and the crawler can be stopped with a relatively light pressure of the foot. By flexing the foot forward the tractor and its load can be held stationary on any hill position. This machine has a drawbar pull of slightly over 43 h.p. and can be powered for either oil, Diesel, or gasoline.

### Huber Announces Improved Road Roller

The Huber Mfg. Co., Marion, Ohio, has just brought out a new and improved six cylinder, three speed, hydraulically controlled road roller. This roller, which offers many new features, will appeal to operators and owners alike.

Power is furnished by an industrial type six cylinder engine developing 59 h.p. at 1200 r.p.m. This provides a steady flow of excess power always available for emergencies. It offers a new dual steering control which provides a quick, hydraulic power steer changeable instantly to the dependable hand steel in working in tight quarters.

Many other features are presented such as: a leak proof removable dry cylinder; precision engine bearings, that eliminates the necessity of removing engine from chassis to replace bearings; self-adjusting clutch; differential lock from operator's platform. The low pivot front roll arch makes rolling a straight line over rough ground possible, and is equipped with three speeds in both directions ranging from ¾ to 6 m.p.h.

### Henry Purdy Appointed Manager San Francisco Organization

The Hyman-Michaels Company of Chicago and its subsidiary, the United Commercial Company of San Francisco, have appointed Henry L. Purdy as manager of its San Francisco office. Purdy was formerly in charge of the St. Louis office, and now fills the vacancy of F. L. Botsford who has resigned. United Commercial Company, who specialize in railroad equipment, and are agents for Western Wheeled Scrapers, and American Hoist & Derrick Co. plan to increase their facilities on the Pacific Coast. Increased business has made an increased demand for their products which necessitates expansion.

### Inertol Company Adds to Pacific Coast Staff

H. A. Knoedler, formerly assistant to the vice-president, Interol Company, has been transferred to the Pacific Coast offices at 447 Sutter St., San Francisco, according to B. W. Mueller, Western Manager. Sales during the past year for this branch have been tripled compared with the year 1933. Many new products for concrete and steel protection are soon to be discussed, and will be placed for sale early in the year.

### Thompson Representative Gives Talk Before Colorado Society

G. H. Garrett, chief engineer of the Thompson Mfg. Co., Denver, gave an illustrated talk before the Colorado Society of Engineers, Dec. 11, on the 84 inch welded steel pipe used in the Santa Marie reservoir and pipeline job. The pipe was the largest ever used in the West.

### Arizona Tractor New Bucyrus-Erie Representatives

Bucyrus-Erie Company of South Milwaukee, Wisconsin, announces the appointment of Arizona Tractor & Equipment Company of 138 S. 1st Avenue, Phoenix, as distributor for the sale of power shovels and draglines up to two cubic yard capacity, throughout the state of Arizona.

### Used Equipment House Established in Los Angeles

Contractors Equipment Company, Inc., has been formed by H. M. Keller, A. J. Pierce and John Bisher. This new establishment has its office, warehouse, and yard located at 2150 Laura Ave., Huntington Park, Calif. All of the principles of the company have long been connected with the equipment business both in the east and on the coast.

A staff of trained mechanics is maintained by the company and are capable of rebuilding and servicing all types of construction and mining equipment.

### General Machinery Adds Wire Rope Account

Macwhyte Company, Kenosha, Wisconsin, has just announced the appointment of General Machinery & Supply Company, San Francisco, as distributors for Macwhyte Wire Rope and slings. A complete stock of Macwhyte products will be carried, including Monarch Whyte Strand Preformed and internally lubricated wire rope.

General Machinery & Supply Company are now in their new office, sales room and warehouse at 1346 Folsom Street, San Francisco.

### Ohio Power Shovel Co. Now Known as Lima

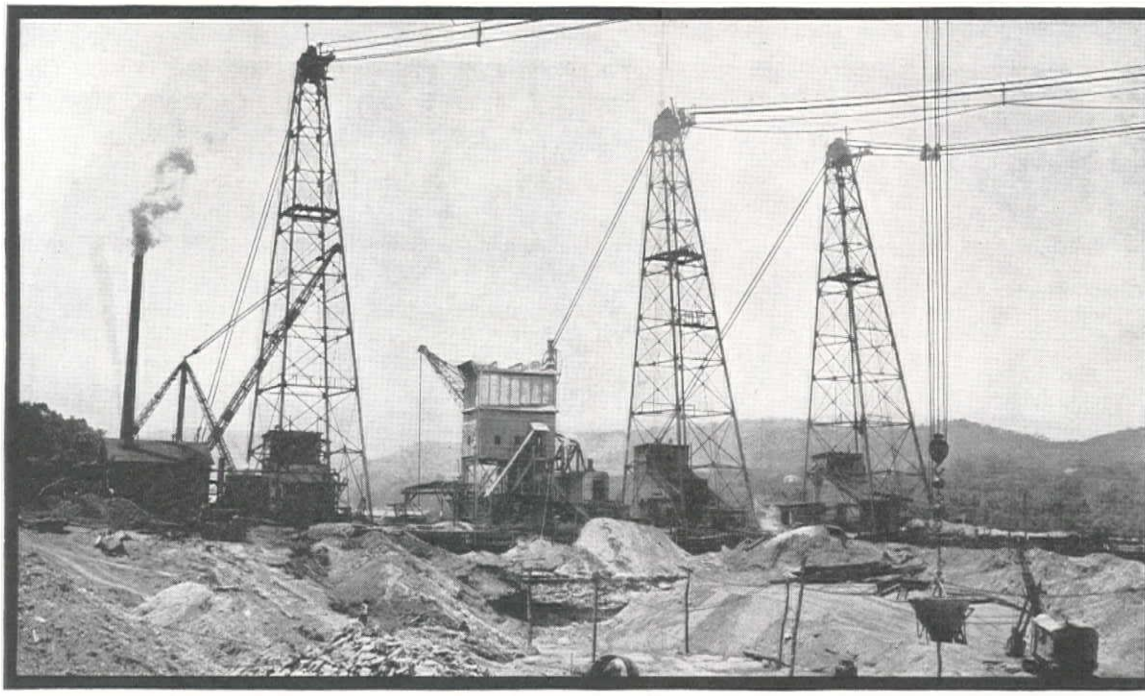
On January 1, The Ohio Power Shovel Co., a subsidiary of Lima Locomotive Works, was consolidated with the parent company. All business which involves Lima Shovels, draglines and cranes will be handled by Lima Locomotive Works, Inc. According to the management, there will be no changes in the personnel.

### H. C. Peters Joins Smith Co.

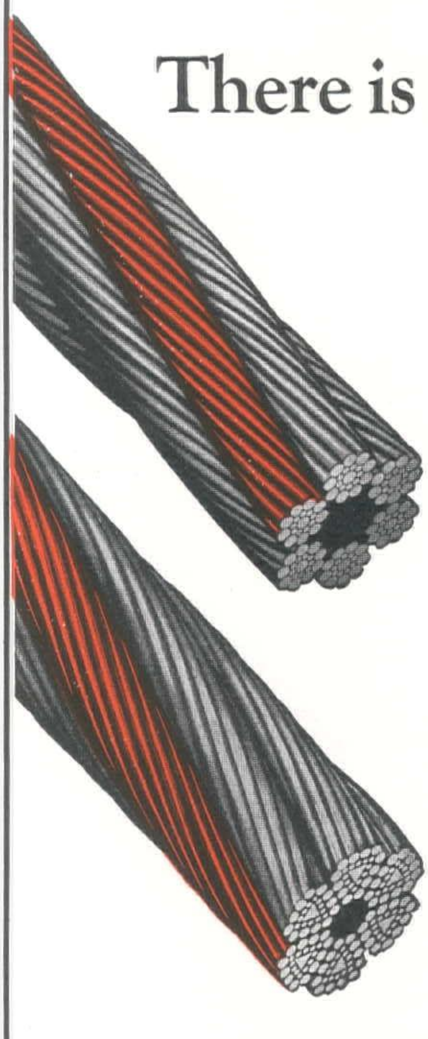
H. C. Peters has joined the sales department of the T. L. Smith Company, at Milwaukee, Wis., to act as special factory representative. Peters is a graduate of Mechanical Engineering, Ohio Northern University. He spent several years after graduation in mechanical design work, and more recently served in various capacities with the Ransome Concrete Machinery Co.

### Modernized Hauling Equipment Offered by Dodge Bros.

A few of the engineering and contracting firms' uses of modernized trucks are pictured in these recent camera-shots of Dodge Brothers equipment at work. Two views show Dodge dump truck transporting gravel on the new $8,000,000 Hamilton Field Bombing Base, Marin County, Calif. Another shows a Dodge Tractor doing heavy work in transporting steel beams in a viaduct-building job. The elongated, narrow-guaged highway monstrosity shown in lower left) has an important job to do. It is a 228-in. wheelbase vehicle for marking highways with the center stripes. The machine also sprinkles heated asphalt and gravel on road shoulders.



Head towers of three cableways used by Booth & Flinn Co., Pittsburgh, in handling the Montgomery Island Locks on the Ohio River. All three cableways equipped with "HERCULES" (Red-Strand) Wire Rope. One of these track cables was used originally for erecting two bridges in Minneapolis twenty years ago. All three track cables were used on the Westinghouse Memorial Bridge in Pittsburgh, which was completed in 1932.



# There is Economy in Long Service

**The actual cost of wire rope is not its purchase price alone. The expense of putting it on and taking it off must be added—and the longer a rope lasts, the less this expense will be.**

**The one word that best describes "HERCULES" (Red-Strand) Wire Rope is "Durability", and this quality is not a matter of chance, for that is our goal throughout its entire process of manufacture, and our principles and methods are based on 78 years of manufacturing experience.**

**Why not take advantage of the economy that is to be had by using this dependable and long lasting wire rope? It is made in Round Strand, Flattened Strand, Preformed, Steel Clad and Non-Rotating types so as to be suitable for any and all working conditions.**

Made Only By **A. Leschen & Sons Rope Co.** Established 1857

5909 Kennerly Avenue, St. Louis, Mo.

Pacific Coast Office & Warehouse: 520 Fourth St., San Francisco
Portland Warehouse: P. O. Box 175; Telephone ATwater 7425

WESTERN DISTRIBUTORS

| | |
|---|---|
| Billings | Connelly Machinery Company |
| Boise | Olson Manufacturing Company |
| Glasgow | Wm. H. Ziegler Co., Inc. |
| Idaho Falls | Westmont Tractor & Eqpt. Co. |
| Los Angeles | Garlinghouse Brothers |
| Missoula | Westmont Tractor &Eqpt. Co. |
| Phoenix | Pratt-Gilbert Hardware Co. |
| Salt Lake City | Z. C. M. I. |
| Seattle | H. J. Armstrong Company |
| Spokane | Nott-Atwater Company |

# UNIT BID SUMMARY

Note: These unit bids are extracted from our Daily Construction News Service

## WATER SUPPLY SYSTEMS

### SAN FRANCISCO, CALIF.—CITY—O'SHAUGHNESSY DAM ENLARGEMENT

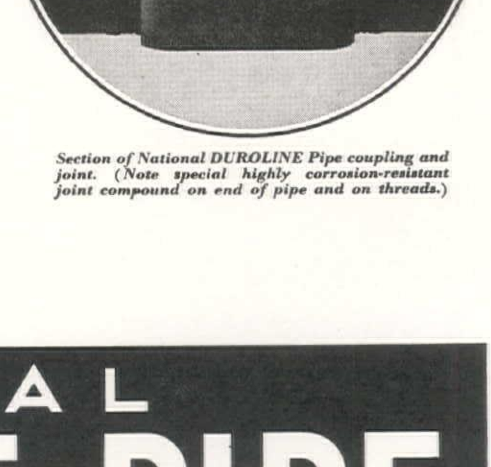
Transbay Const. Co., Pier 24, San Francisco (consisting of MacDonald & Kahn Co., Ltd., Pacific Bridge Co.,; General Const. Co.; J. F. Shea Co.; and Morrison-Knudsen Co.—Officers: Chas. F. Swigert, Pres.; J. A. McEachern, Vice-Pres.; C. A. Shea-Secty.; Felix Kahn, Treasurer; and H. W. Morrison, Director)—$3,219,965.00 low to Public Utilities Comm., City Hall, San Francisco, for enlargement of the O'Shaughnessy Dam by the construction of an addition to the existing dam. for the purpose of increasing the capacity of Hetch Hetchy Reservoir. The addition will raise the crest of the dam by 85.5 ft. from elev. 3726.5 to elev. 3812. Construction of a new spillway, installation of new outlet control valves and spillway gates, clearing of the reservoir area between the present and future high water surface elevations, road and trail construction and other appurtenances and incidental work are included in the required work. The O'Shaughnessy Dam is located at the west end of the Hetch Hetchy Valley on the Tuolumne River, Tuolumne County, Calif. under H.H.W.S. Contract No. 149. Bids from:

(1) Transbay Const. Co., San Francisco......$3,219,965.00
(2) Utah-Bechtel-Kaiser Co., San Francisco...$3,447,598.00
(3) Southwestern Contr. Group.............$3,485,485.00
(4) W. E. Callahan Const. Co., Los Angeles..$4,687.795.00

| | (1) | (2) | (3) | (4) |
|---|---|---|---|---|
| 385 acres clearing reservoir site | $160.00 | $300.00 | $120.00 | $300.00 |
| 30,000 cu. yd. excavation for dam foundation, all classes | 2.75 | 4.00 | 3.65 | 8.00 |
| 28,000 cu. yd. excav. for spillway, all classes | 1.80 | 1.95 | 2.50 | 6.00 |
| 8,000 cu. yd. excav. for roads, common | .50 | .60 | 1.10 | 2.00 |
| 21,000 cu. yd. excav. for roads, solid rock | 1.40 | 1.50 | 1.10 | 4.00 |
| 3,600 cu. yd. tunnel excavation | 8.00 | 8.40 | 6.25 | 15.00 |
| 500 cu. yd. excav. for trails, common | 1.00 | 1.20 | 1.50 | 5.00 |
| 500 cu. yd. excav. for trails, solid rock | 4.00 | 3.00 | 3.00 | 10.00 |
| 1,000 cu. yd. excav. of concrete from exist. dam | 5.00 | 14.40 | 14.00 | 35.00 |
| 37,000 sq. ft. roughening surfaces of exist. dam | .11 | .12 | .09 | .20 |
| 55,000 sq. ft. roughening surfaces of siph. spillway cond | .11 | .18 | .20 | .30 |
| 175 cu. yd. removal of concrete structures | 6.00 | 18.00 | 12.00 | 35.00 |
| 3,000 lin. ft. drill grout holes not over 30' deep | .85 | 1.15 | .75 | 2.00 |
| 1,750 lin. ft. drill grout holes over 30' deep | 2.50 | 2.40 | 2.00 | 4.00 |
| 700 lin. ft. drill drain. holes not over 30' deep | 2.20 | 2.00 | 2.75 | 4.00 |
| 700 lin. ft. drill drain. holes over 30' deep | 2.75 | 3.50 | 2.75 | 6.00 |
| 150 lin. ft. drill grout holes (from faces) | 2.50 | 1.70 | 2.00 | 6.00 |
| 150 lin. ft. drill grout holes (from gallery) | 3.00 | 2.30 | 2.00 | 8.00 |
| 120 lin. ft. drill grout holes (from inspection wells) | 3.50 | 2.30 | 2.00 | 10.00 |
| 25,000 lin. ft. drill holes for anchor and grout bars | .55 | 1.15 | .45 | 2.00 |
| 4,400 lin. ft. caulking joints in concrete | .60 | 1.30 | .90 | 2.00 |
| 230 ea. make connections to grout pipes in foundation | 3.00 | 2.30 | 2.75 | 4.00 |
| 30 ea. make connections to grout pipes in galleries | 4.00 | 3.00 | 8.80 | 5.00 |
| 60 ea. make connection to grout pipes (inspec. wells) | 5.00 | 3.00 | 8.80 | 6.00 |
| 7,500 cu. ft. pressure grouting | 1.20 | 1.30 | 1.10 | 2.50 |
| 205,000 cu. yd. mass concrete in dam | 4.80 | 5.80 | 6.34 | 8.00 |
| 32,000 cu. yd. concr. to form impervious surface | 4.80 | 5.90 | 6.34 | 9.00 |
| 17,000 cu. yd. concr. in slots in dam | 4.80 | 5.90 | 6.20 | 10.00 |
| 3,700 cu. yd. concr. for plugging siphon spillways | 4.80 | 8.00 | 8.50 | 11.00 |
| 6,300 cu. yd. concr. spillway bridge and weir | 7.25 | 10.00 | 10.50 | 15.00 |
| 1,000 cu. yd. concr. in valve house, screen rack, etc | 18.00 | 17.00 | 32.00 | 30.00 |
| 150 cu. yd. concrete railings | 46.00 | 30.00 | 60.00 | 30.00 |
| 50 cu. yd. concrete precast stairways | 31.00 | 21.00 | 50.00 | 50.00 |
| 1,500 cu. yd. concr. spillway lining and in walls | 9.00 | 10.50 | 16.50 | 20.00 |
| 16 cu. yd. concr. precast screens | 75.00 | 48.00 | 90.00 | 30.00 |
| 600 cu. yd. precast dense concrete blocks | 19.00 | 12.00 | 14.00 | 25.00 |
| 850 cu. yd. precast porous concrete blocks | 17.00 | 12.00 | 10.00 | 25.00 |
| 350 lin. ft. drainage holes through masonry | .70 | 1.70 | 1.10 | 1.50 |
| 10,000 sq. ft. mortar coating ¾" placed by cem. gun | .11 | .10 | .28 | .20 |
| 285,000 bbls. Portland cement | 4.60 | 3.90 | 3.85 | 4.00 |
| 450,000 lb. reinforcing steel | .055 | .06 | .05 | .08 |
| 400,000 lb. anchor bars | .05 | .05 | .045 | .08 |
| 100 cu. yd. rubble masonry | 10.00 | 10.00 | 16.50 | 20.00 |
| 100 cu. yd. masonry guardrails | 12.00 | 14.00 | 16.50 | 20.00 |
| 500 cu. yd. dry rubble masonry | 5.50 | 7.00 | 8.00 | 12.00 |
| 500 lin. ft. furn. and place ½" wr. steel pipe | .11 | .13 | .11 | .15 |
| 14,500 lin. ft. furn and place ½" metal tubing | .07 | .13 | .11 | .15 |
| 2,000 lin. ft. furn. and place 1" wrought steel pipe | .17 | .16 | .17 | .20 |
| 300,000 lin. ft. furn. and place 1" metal tubing | .12 | .13 | .12 | .20 |
| 5,000 lin. ft. furn. and place 1½" wrought steel pipe | .23 | .22 | .25 | .30 |
| 27,000 lin. ft. furn. and place 1½" metal tubing | .18 | .20 | .16 | .20 |
| 1,000 lin. ft. furn. and place 2" wrought steel pipe | .30 | .32 | .33 | .35 |
| 125,000 lb. furn. and place 2" to 8" wrought steel pipe | .08 | .11 | .08 | .12 |
| 10,000 lb. furn. and place wrought steel pipe fittings | .20 | .35 | .16 | .25 |
| 18,000 lb. furn. and place metal tubing fittings | .70 | .67 | .65 | .50 |
| 400 ea. furn. and place 1" gate valves | 1.45 | 1.45 | 1.10 | 1.25 |
| 200 ea. furn. and place 1½" gate valves | 2.30 | 2.30 | 2.20 | 2.00 |
| 100 ea. furn. and place 2" gate valves | 3.25 | 3.50 | 3.30 | 3.00 |
| 2,500 lb. furn. and place 2" to 8" valves | .35 | .27 | .22 | .25 |
| 10,000 lb. remove and reinstall pipe and fittings | .065 | .17 | .05 | .20 |
| 3,200 ea. connections from headers to cooling coils | .85 | .200 | 1.10 | 1.25 |
| 6,000 ea. grout pipe outlets | .35 | .28 | .55 | .40 |

*(Continued on next page)*


Corrosive municipal and industrial waters, salt water, drainage, and certain chemical solutions have no ill effect on Duroline. This highly protective cement lining was scientifically developed primarily to resist the destructive action of waters that rust, corrode, or otherwise attack exposed metal pipe. And the price, only slightly higher than galvanized pipe, involves no handicap to its general use. Try it out! Since it is offered in regular National Pipe you obtain the strength, convenient joints, and other desirable features of the highest quality steel pipe, plus this new defense against corrosion and tuberculation. Duroline Pipe will solve many of your corrosion problems once and for all. Outstanding installations are giving added proof every day. An interesting bulletin describes in detail the development of this remarkable product, and its known serviceability. Write for it today!



*Section of National DUROLINE Pipe coupling and joint. (Note special highly corrosion-resistant joint compound on end of pipe and on threads.)*

NATIONAL TUBE COMPANY · Pittsburgh, Pa.

*Pacific Coast Distributors*—Columbia Steel Co., San Francisco, Calif.
*Export Distributors*—United States Steel Products Co., New York, N. Y.

United States Steel Corporation Subsidiary

# NATIONAL DUROLINE PIPE

| | | | | |
|---|---|---|---|---|
| 1,500 lb. furn. and install elec. metal conduit | .25 | .28 | .40 | .25 |
| 13,300 lb. galv. pipe hand railing | .20 | .20 | .22 | .25 |
| 18,500 lb. copper water stops | .45 | .24 | .50 | .50 |
| 50,000 lb. sheet metal grout stops | .14 | .15 | .22 | .30 |
| 50,000 lb. corr. metal drains | .12 | .13 | .12 | .10 |
| 55,000 lb. stairs, ladders and gratings | .16 | .15 | .13 | .20 |
| 1,000 lb. miscellaneous steel work | .25 | .25 | .33 | .50 |
| 5,000 lb. cast iron gratings and frames | .14 | .15 | .08 | .30 |
| 4,000 lb. miscellaneous brass and bronze | .55 | .50 | .45 | .50 |
| 50,000 lb. galvanizing | .04 | .05 | .02 | .04 |
| 5,000 lb. remove miscell. equip. and install in new location | .08 | .17 | .13 | .20 |
| Lump sum remove water stage recorder and inst. new location | 600.00 | 1,200.00 | 1,100.00 | 1,000.00 |
| Lump sum removing accumulators and frames, etc. | 1,100.00 | 1,400.00 | 1,650.00 | 2,500.00 |
| Lump sum remove and reinstall 3 36″ valves | 1,100.00 | 4,000.00 | 2,700.00 | 2,000.00 |
| 50,000 lb. install 3 42″ steel pipes | .027 | .02 | .017 | .04 |
| 500,000 lb. install outlet valves (City furnished) | .02 | .03 | .017 | .04 |
| 110,000 lb. install fixed supports, pier plates, etc. | .027 | .02 | .033 | .05 |
| 250,000 lb. install drum gates and seals | .018 | .02 | .033 | .04 |
| 100,000 lb. install flanged pipe and fittings and valves | .03 | .04 | .033 | .05 |
| 35,000 lb. install control mechanism, piping, etc. | .09 | .05 | .06 | .12 |
| 2,000 lb. install misc. metal work (city furnished) | .11 | .10 | .11 | .20 |
| 3,500 sq. ft. paint concr. surfaces in waterways | .22 | .10 | .16 | .30 |
| 7 squares roofing on concrete houses | 65.00 | 50.00 | 55.00 | 30.00 |
| 800 cu. yd. crusher run base | 2.50 | 2.50 | 3.30 | 3.50 |
| 5,000 gal. emulsified asphalt | .20 | .12 | .11 | .30 |
| 110 cu. yd. base rock | 2.50 | 3.00 | 5.00 | 3.50 |
| 60 cu. yd. screenings | 3.00 | 3.00 | 8.80 | 3.50 |
| 3,200 lb. corr. metal pipe culverts | .15 | .10 | .16 | .15 |
| 500 lin. ft. 6″ drain tile | .65 | .70 | .65 | 1.00 |
| L. S. furnish and install 1 cooling plant | 25,000.00 | 20,000.00 | 25,000.00 | 32,000.00 |
| 7,200 hrs. operating refrigerating plant | 3.00 | 2.90 | 2.25 | 4.00 |

### LOS ANGELES, CALIF.—BIG MORONGO & SAN ANDREAS SIPHONS

Contract awarded to Morrison-Knudsen Co., Title Guaranty Bldg., Los Angeles, $327,189. (SCHED. 18J) by Metropolitan Water Dist., 306 W. 3rd St., L. A., for const. the Big Morongo and San Andreas siphons of the Colorado River Aqueduct—1.86 mi. long betw. 7 mi. N. and 5 N. W. of Garnet, Calif., under Spec. No. 84. Bids from:

(1) Morrison-Knudsen Co., L. A. ....$327,189
(2) S. Pearson, C. O. Sparks & Mundo.... 330,080
(3) Shofner & Gordon Const. Co. ....$345,760
(4) J. F. Shea, Inc., Mecca .... 450,493

| SCHED. 18J—9811'2 cir. jt. cast in place conc. siphons | (1) | (2) | (3) | (4) |
|---|---|---|---|---|
| 163,000 cu. yd. com. exc. for siphons | .17 | .20 | .20 | .25 |
| 49,000 cu. yd. rock exc. for siphons | .57 | .80 | .60 | .85 |
| 15 cu. yd. comm. exc. for structures | 2.00 | 1.00 | 2.00 | 1.50 |
| 5 cu. yd. rock exc. for structures | 4.00 | 3.00 | 5.00 | 3.00 |
| 96,000 cu. yd. backfill for siphons | .10 | .10 | .08 | .08 |
| 20,200 cu. yd. concrete in siphons | 9.75 | 9.00 | 10.50 | 13.50 |
| 900 cu. yd. reinf. concrete in structures | 16.00 | 14.00 | 18.00 | 16.00 |
| 25 cu. yd. plain concrete in structures | 14.00 | 10.00 | 15.00 | 16.00 |
| 3,800,000 lb. place reinforcing steel in siphon | .01 | .01 | .01 | .015 |
| 120,000 lb. place reinforcing steel in structures | .01 | .01 | .01 | .015 |
| 142 lock joints for monolithic siphons | 37.00 | 50.00 | 20.00 | 50.00 |
| 26,000 lb. install miscellaneous metal work | .05 | .10 | .05 | .05 |
| 4,500 lb. place hand railings | .06 | .10 | .10 | .05 |
| 14,500 ton mi. haul steel | .15 | .10 | .08 | .10 |
| 40,000 ton mi. haul cement | .05 | .08 | .06 | .10 |

# STREET and ROAD WORK

### SACRAMENTO, CALIF.—STATE—GRADING—MADERA COUNTY

Geo. J. Bock & Son, 1007 South Harvard Blvd., Los Angeles, $121,722, low to Calif. Div. of Highways, Sacramento, for 3.7 mi. grading betw. Coarse Gold and Hawkins School in MADERA COUNTY, Calif. Bids from:

(1) George J. Bock & Son, Los Angeles....$121,722
(2) Mittry Bros., Los Angeles....$123,144
(3) A. Teichert & Son, Inc....$126,888
(4) Fredrickson & Watson & Fredrickson Bros...$134,097
(5) Peninsula Paving Co., S. F....$136,375

| | (1) | (2) | (3) | (4) | (5) |
|---|---|---|---|---|---|
| L. S. clearing and grubbing | $4500. | $4000. | $3400. | $2400. | $2500. |
| 140,000 cu. yd. roadway excavation | .47 | .475 | .50 | .57 | .58 |
| 280,000 sta. yd. overhaul | .01 | .01 | .005 | .005 | .01 |
| 2,965 cu. yd. struc. excavation | 1.30 | 2.00 | 2.00 | 1.75 | 1.75 |
| 722 cu. yd. 'A' concrete (struc.) | 24.00 | 22.00 | 25.00 | 22.00 | 23.00 |
| 52 cu. yd. 'B' concrete (struc.) | 15.00 | 21.00 | 20.00 | 14.00 | 19.00 |
| 81,200 lbs. reinf. steel (structures) | .05 | .055 | .05 | .055 | .045 |
| 270 lin. ft. 8-in. corr. metal pipe | 1.15 | 1.10 | 1.00 | .90 | .95 |
| 1,442 lin. ft. 18-in. corr. metal pipe | 2.10 | 2.00 | 2.00 | 1.90 | 1.75 |
| 1,056 lin. ft. 24-in. corr. metal pipe | 3.25 | 2.75 | 2.70 | 2.60 | 2.65 |
| 316 lin. ft. 30-in. corr. metal pipe | 4.35 | 3.45 | 3.50 | 3.30 | 3.35 |
| 104 lin. ft. 36-in. corr. metal pipe | 6.50 | 5.15 | 5.00 | 5.00 | 5.25 |
| 23 ea. spillway assemblies | 20.00 | 15.00 | 15.00 | 15.00 | 16.00 |
| 2 ea. cast steel grates and frames | 40.00 | 40.00 | 47.00 | 35.00 | 40.00 |
| 550 ea. timber guide posts | 1.50 | 2.00 | 1.50 | 1.80 | 1.80 |
| 60 culvert markers (each) | 1.50 | 2.00 | 1.60 | 1.80 | 1.80 |
| 7.0 mi. new fence | 450.00 | 450.00 | 450.00 | 400.00 | 500.00 |
| 18 fence gates | 25.00 | 20.00 | 18.00 | 18.00 | 22.00 |
| 5,640 M gallons water | .80 | .90 | 1.15 | 1.30 | 1.00 |
| 9 M ft. BM Redwood timber (dense) | 95.00 | 95.00 | 100.00 | 100.00 | 100.00 |
| 22 M ft. BM Redwood timber (select) | 87.00 | 95.00 | 85.00 | 100.00 | 90.00 |
| 195 sta. finish roadway | 5.00 | 6.00 | 5.00 | 8.00 | 10.00 |
| 104 ea. monuments | 3.00 | 4.00 | 3.00 | 3.00 | 4.00 |

## LOS ANGELES, CALIF.—STATE—GRADING & ASPH. CONC. PAVING—VENTURA COUNTY

Contract awarded to Basich Brothers Const. Co., 20550 Normandie Avenue, Torrance, $214,957 by Calif. Div. of Highways, State Building, Los Angeles, Calif., for 3.6 miles grading and asphalt concrete paving between Sea Cliff and Benham in VENTURA COUNTY, California. Bids from:

(1) Basich Bros. Const. Co. $214,957
(2) Sharp & Fellows Contracting Co., Los Angeles. 233,088
(3) Mundo Engrg. Corp. and Sander Pearson, L. A. $241,910
(4) Oswald Bros., Los Angeles 249,774

| | (1) | (2) | (3) | (4) |
|---|---|---|---|---|
| 192 sta. clear and grub | 9.00 | 5.00 | 3.00 | 5.00 |
| 60,000 cu. yd. roadw. exc. | .33 | .30 | .35 | .33 |
| 78,000 mi. yd. overhaul | .12 | .10 | .10 | .065 |
| 2,400 cu. yd. struc. exc. | .90 | .80 | .75 | .90 |
| 18,100 sq. yd. subgr. prep. | .12 | .12 | .12 | .10 |
| 24,300 sq. yd. asph. pt. bind. | .02 | .03 | .02 | .02 |
| 14,200 tons asph. concr. | 3.10 | 3.70 | 3.00 | 3.70 |
| 230 cu. yd. A conc. (pav.) | 10.20 | 11.00 | 12.00 | 10.75 |
| 390 cu. yd. A conc. (str.) | 18.00 | 21.00 | 20.00 | 21.00 |
| 49,000 lb. bar reinf. st. | .0315 | .045 | .05 | .05 |
| 440 ea. pavem. dowels | .20 | .12 | .25 | .12 |
| 2,300 lb. misc. ir. and steel | .12 | .10 | .12 | .11 |
| 2 ea. spillw. assemb. | 18.00 | 15.00 | 20.00 | 30.00 |
| 8 ft. 8" cor. met. pipe | 1.50 | 1.00 | 1.00 | 2.00 |
| 16 ft. 15" cor. met. pipe | 2.00 | 1.60 | 1.50 | 2.00 |
| 100 ft. 18" cor. met. pipe | 2.50 | 2.00 | 1.75 | 2.15 |
| 60 ft. 24" cor. met. pipe | 3.60 | 3.00 | 2.25 | 3.00 |
| 30 ft. 30" cor. met. pipe | 4.80 | 3.50 | 3.00 | 3.75 |
| 30 ft. 36" cor. met. pipe | 5.80 | 5.25 | 4.50 | 6.00 |
| 2,050 ft. solid. timb. grdrail | 1.20 | 1.00 | 1.00 | .90 |
| 0.8 mi. new prop. fence | 480.00 | 500.00 | 500.00 | 650.00 |
| 2.2 mi. move and reset fence | 250.00 | 350.00 | 200.00 | 425.00 |
| 1,823,000 lb. fur. st. sheet piles | .032 | .0305 | .04 | .0375 |
| 2,147 ea. drive piles and TP | 6.80 | 11.00 | 8.00 | 12.50 |
| 66.5 MFBM Doug. Fir (seaw&G) | 90.00 | 80.00 | 120.00 | 100.00 |
| 215 cu. yd. A conc. (seaw&Gr.) | 20.00 | 20.00 | 20.00 | 24.00 |
| 12,000 lb. bar reinf. st. (seaw&Gr.) | .0315 | .045 | .05 | .05 |
| 304,000 lb. str. steel (seaw&Gr.) | .052 | .05 | .058 | .056 |
| 145,000 lb. str. metal (seaw&Gr.) | .08 | .08 | .065 | .084 |
| 1 lot treat steel and piles | 3000.00 | 9000.00 | 1100.00 | 5400.00 |
| 800 M. gallons water | 1.00 | 1.50 | 2.00 | 2.00 |
| 275 tons fuel oil | 6.00 | 7.00 | 10.00 | 8.30 |
| 33,800 sq. yd. prep., mix&shp. shld. | .05 | .05 | .05 | .05 |
| 192 sta. finish roadway | 6.00 | 5.00 | 5.00 | 3.00 |

## OLYMPIA, WASHINGTON—STATE—GRADING—SKAMANIA COUNTY

Contract awarded to Orino & Nyberg, Realty Bldg., Spokane, $199,792.00 by Director of Highways, Olympia, Wn., for 2.0 mi. grading on State Road No. 8 Cooks East to Underwood West, and Underwood vicinity in SKAMINIA COUNTY, Proj. 112-E & 21) Wn. Bids from:

(1) Orino & Nyberg, Spokane $199,792.00
(2) Elliott & Co., Inc., Seattle 215,970.00
(3) Colonial Const. Co., Spokane 223,046.00
(4) Myers & Goulter, Seattle 223,332.00
(5) J. D. Harms, Inc., Seattle 255,957.00
(6) Tony Marrazzo, Spokane 237,486.00
(7) L. Coluccio & Co., Seattle 248,405.00
(8) Kern & Kibbe, Portland $252,764.00
(9) Morrison-Knudsen Co., Boise 266,024.00
(10) The Mirene Co., Portland 266,062.00
(11) L. Romano Engr. Corp., Seattle 273,321.00
(12) A. C. Greenwood Co., Inc. 288,315.00
(13) Earl L. McNutt, Eugene 288,908.00
(14) Guthrie-McDougall Co., Portland 317,267.00

| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) | (10) | (11) | (12) | (13) | (14) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 10.13 acres clearing | $40 | $100 | $100 | $500 | $100 | $80 | $200 | $125 | $100 | $100 | $100 | $150 | $100 | $100 |
| 6.14 acres grubbing | $40 | $100 | $100 | $100 | $100 | $80 | $225 | $125 | $100 | $100 | $100 | $150 | $100 | $100 |
| 225,570 cu. yd. B excav. | .33 | .40 | .45 | .45 | .38 | .38 | .49 | .60 | .47 | .54 | .65 | .65 | .54 | .78 |
| 86,400 cu. yd. rock excav. | .78 | .75 | .60 | .65 | .80 | .95 | .85 | .65 | .67 | .74 | .65 | .73 | 1.02 | .78 |
| 1,040 cu. yd. struc. excav. | 1.00 | 1.50 | 1.50 | 1.50 | 1.50 | 1.50 | 1.75 | 1.00 | 2.00 | 1.00 | 1.50 | 1.50 | 1.50 | 2.50 |
| 210 cu. yd. D excav. | 1.00 | 2.00 | .75 | .50 | .75 | .60 | 1.25 | 1.00 | 1.50 | 1.00 | 1.00 | 1.50 | 1.00 | 1.25 |
| 125,570 sta. yd. overhaul | .01 | .01 | .01 | .01 | .02 | .01 | .02 | .01 | .015 | .02 | .01 | .03 | .01 | .01 |
| 307,960 cu. yd. mi. overhaul | .12 | .12 | .15 | .12 | .15 | .15 | .12 | .12 | .25 | .18 | .15 | .16 | .18 | .16 |
| 450 cu. yd. grav. backfill | .50 | 2.50 | 2.50 | 2.00 | 2.00 | .75 | 3.00 | 2.00 | 1.50 | 2.00 | 3.00 | 2.00 | 2.00 | 2.00 |
| 69 cu. yd. 'B' concrete | $25 | $25 | $20 | $25 | $27 | $25 | $24 | $30 | $24 | $25 | $30 | $24 | $23 | $25 |
| 7,280 lb. reinf. steel | .07 | .05 | .07 | .07 | .07 | .06 | .06 | .06 | .06 | .06 | .10 | .08 | .07 | .07 |
| 1,000 ft. conc. cribb. headers | .40 | .45 | .45 | .60 | .45 | .50 | .50 | .55 | .50 | .40 | .45 | .70 | .50 | .40 |
| 3,216 ft. conc. cribb. stretchers | .50 | .52 | .50 | .70 | .55 | .55 | .60 | .65 | .65 | .38 | .50 | .80 | .60 | .48 |
| 60 ft. wood flume | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 2.50 | .60 | .60 | 1.00 | 1.00 | .50 | 1.50 | 3.00 | .75 |
| 2 ea. spec. concr. catchbasins | $100 | $75 | $50 | $25 | $100 | $25 | $85 | $15 | $40 | $30 | $25 | $80 | $50 | $55 |
| 2,300 ft. 8" perf. cor. pipe | .70 | .90 | 1.00 | 1.00 | .80 | 1.25 | .90 | 1.00 | .90 | 1.50 | .80 | 1.00 | .70 | .90 |
| 60 ft. 36" corr. met. pipe | 5.00 | 4.50 | 5.00 | 6.00 | 5.00 | 4.80 | 4.50 | 4.50 | 5.00 | 5.00 | 5.50 | 8.00 | 7.00 | 5.00 |
| 474 ft. 18" reinf. concr. pipe | 2.20 | 2.50 | 2.40 | 2.50 | 2.50 | 2.50 | 2.25 | 2.30 | 2.50 | 2.25 | 2.50 | 3.00 | 2.60 | 2.60 |
| 117 ft. 36" rein. conc. pipe | $10 | 9.00 | 8.00 | $10 | 8.50 | 8.00 | 8.50 | 8.50 | $10 | 7.50 | 9.00 | $12 | 7.85 | 9.20 |

## ALMIRA, WASHINGTON—GOVT.—SLIDE REMOVAL, ETC.

Contract awarded to David H. Ryan, Coulee City, Wn., $110,505, by Bureau of Reclamation, Almira, Wn., for removal of a slide on highway and constructing railroad, Station 1090 to Station 1101 at Grand Coulee Dam, Columbia Basin Project, Wn., under Specification No. 649-D. Work is located 22 miles Northwest of Almira, Wn. Bids from:

(1) David H. Ryan, Coulee City, Wn. $110,505
(2) James Crick, Spokane $117,730
(3) Guy F. Atkinson Co., San Francisco $120,630
(4) Goodfellow Bros., Inc., Coulee City $126,900
(5) Colonial Const. Co., Spokane $129,280
(6) J. A. Terteling & Son, Boise $129,317
(7) Rowland Const. Co., Inc. $138,500
(8) M. S. Ross, Spokane, Wn. $149,182
(9) L. Coluccia & Co., Seattle $154,660
(10) Morrison-Knudson Company, Inc., Boise, Idaho $178,950
(11) Alex Besoloff Co., Seattle $217,170

| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) | (10) | (11) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 347,000 cu. yd. com. excav. | .24 | .25 | .26 | .28 | .24 | .2775 | .26 | .2675 | .28 | .35 | .49 |
| 11,400 cu. yd. rock exc. | 1.25 | 1.20 | 1.15 | 1.85 | 1.00 | 1.00 | 1.20 | 1.15 | 1.25 | 1.25 | 1.10 |
| 8,650,000 sta. yd. overhaul | .0015 | .002 | .002 | .001 | .004 | .0025 | .004 | .005 | .005 | .005 | .004 |

### SACRAMENTO, CALIF.—STATE—GRADING AND PAVING—SHASTA COUNTY

Contract awarded to T. M. Morgan Paving Co., 472 N. Barrington Ave., L. A. $92,485. ALT. "B"—CONCRETE by Calif. Div. of Highways, Sacramento, for 0.9 mi. grading and asph. concr. OR concr. paving at north entrance to Redding, SHASTA COUNTY, Calif. Bids from:

(1) T. M. Morgan Paving Co. .... $ 95,321 $ 92,485
(2) Frederickson & Watson & Frederickson Bros. .... 115,386 112,334
(3) A. Teichert & Son, Inc. .... 115,834 113,750
(4) Peninsula Pav. Co. .... 119,183 114,431
(5) C. W. Caletti & Co. .... $118,241 $115,476
(6) Hanrahan Wilcox Corp., S. F. .... 118,569
(7) J. F. Knapp, Oakland .... 121,685 119,847
(8) Geo. Pollock Co., Sacramento .... 121,508 125,514
(9) Dunn & Baker, Kl. Falls .... 128,194 126,953

| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) |
|---|---|---|---|---|---|---|---|---|---|
| 6.4 acres clear and grubbing | $65 | $60 | $120 | $125 | $100 | $55 | $75 | $100 | $100 |
| 142,500 cu. yd. rdw. excavation | .22 | .30 | .27 | .27 | .29 | .34 | .30 | .38 | .37 |
| 3,560,000 sta. yd. overhaul | .002 | .004 | .004 | .005 | .0062 | .004 | .005 | .004 | .005 |
| 1,250 cu. yd. struc. excav. | 1.00 | 1.00 | 1.00 | .90 | .90 | 1.00 | 1.50 | 1.00 | 1.00 |
| 5,400 sq. yd. prep. subgrade | .10 | .12 | .10 | .12 | .15 | .10 | .12 | .10 | .10 |
| 3,030 cu. yd. cr. run base | 1.75 | 2.00 | 2.10 | 2.00 | 2.15 | 2.20 | 2.00 | 1.50 | 2.00 |
| 17 tons fuel oil (prime ct.) | 20.00 | $15 | $20 | 18.50 | 18.50 | $20 | $15 | $12 | 15.00 |
| 1,300 cu. yd. cr. grav. or stone | 1.90 | 2.50 | 2.50 | 2.30 | 2.30 | 2.50 | 3.00 | 1.80 | 2.65 |
| 112 tons cutb. asphalt | 20.00 | $24 | $22 | 22.00 | 22.80 | $26 | $25 | $20 | 23.50 |
| 220 cu. yd. A concr. (curbs, etc.) | 15.00 | $15 | $15 | 17.40 | 14.00 | $15 | $16 | $16 | 14.00 |
| 600 cu. yd. A conc. (slope pav.) | 15.00 | $17 | $15 | 18.60 | 12.00 | $12½ | $14 | $16 | 16.00 |
| 434 cu. yd. A concr. (struc.) | 20.00 | $16 | $20 | 19.80 | 16.50 | $20 | $16 | $25 | 14.00 |
| 24,400 lb.. reinf. steel (struc.) | .06 | .05 | .05 | .05 | .05 | .06 | .045 | .06 | .055 |
| 24,600 lb. mesh reinf. steel | .06 | .05 | .07 | .06 | .065 | .07 | .06 | .07 | .04 |
| 91,000 lb. str. steel (erect only) | .02 | .015 | .02 | .02 | .015 | .02 | .02 | .025 | .025 |
| 4,700 lb. pipe handrail (erect only) | .08 | .05 | .03 | .025 | .03 | .02 | .03 | .03 | .03 |
| 424 ft. 18" corr. met. pipe | 2.50 | 1.90 | 2.00 | 1.70 | 2.00 | 1.70 | 1.75 | 2.00 | 1.60 |
| 214 ft. 24" corr. met. pipe | 3.50 | 2.60 | 3.00 | 2.50 | 2.50 | 2.70 | 2.50 | 3.00 | 2.50 |
| 330 cu. yd. rem. asphalt concr. | 2.00 | 1.25 | 2.00 | 1.80 | 1.50 | 2.50 | 3.00 | 1.00 | 2.00 |
| 60 cu. yd. rubble masonry | 12.00 | $10 | $12 | 11.00 | 12.00 | $12½ | $15 | $20 | 10.00 |
| 1,700 M. gallons water | .75 | 1.25 | 1.50 | 1.00 | 1.00 | 1.00 | 2.00 | 1.00 | 1.00 |
| 45 sta. finish roadway | 5.00 | 7.00 | 5.00 | 6.00 | 6.00 | 7.50 | 6.00 | $10 | 7.00 |
| 2,176 tons asph. concr. pavem. ALT. "A" | 6.00 | 6.35 | 7.32 | 6.90 | 6.00 | ... | 6.50 | 7.50 | 6.50 |
| 1,005 cu. yd. 'A' concr. pavem. ALT. "B" | 10.00 | $10½ | $13½ | $10 | 10.00 | $10 | $12 | $10 | 12.60 |
| 1,400 lb. reinf. steel (pavement) | .06 | .05 | .07 | .07 | .07 | .07 | .06 | .07 | .07 |
| 714 ea. pavement dowels | .12 | .20 | .25 | .16 | .20 | .20 | .20 | .25 | .20 |

# TUNNEL CONSTRUCTION

### DENVER, COLORADO—CITY—TUNNEL LINING

Contract awarded to Utah-Bechtel-Morrison, Inc., 1st National Bank Bldg., Ogden, Utah, $972,576 (subject to P. W. A. approval) by Board of Water Commissioners, City-County Bldg., Denver, Colo., for enlarging and lining the Moffatt Tunnel, intake shaft and wye, constructing intake works at West Portal and the outlet works at East Portal in GILPIN and GRAND COUNTIES, Colo. Bids from:

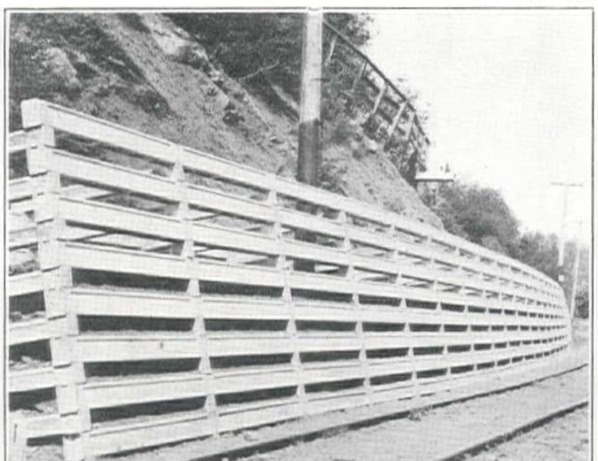
(1) Utah-Bechtel-Morrison, Inc. .... $ 972,576
(2) Winston Bros., L. E. Dixon Co. and Johnson, Inc., L. A. .... 1,158,534
(3) S. S. Magoffin Co., Adrian .... 1,280,534
(4) W. S. Broderick and Warren Bros. .... $1,242,800
(5) Shofner & Gordon and Hinman Bros. .... 1,424,000
(6) Engineers estimate .... 1,206,722

| | (1) | (2) | (3) | (4) | (5) | (6) |
|---|---|---|---|---|---|---|
| 8,000 cu. yd. enlarge water tunnel | 14.00 | 15.00 | 15.30 | 13.60 | 22.00 | 15.00 |
| 100 cu. yd. enlarge shaft | 20.00 | 16.00 | 20.00 | 42.35 | 50.00 | 9.50 |
| 250 M. ft. BM permanent timber | 40.00 | 72.00 | 65.00 | $105 | 60.00 | 60.00 |
| 100 M. ft. BM temporary timber | 40.00 | 72.00 | 65.00 | 87.00 | 60.00 | 40.00 |
| 100 cu. yd. dry packing tunnel | 6.50 | 10.00 | 10.00 | 8.00 | 16.00 | 3.00 |
| 200 M. ft. maintain present timber | 40.00 | 50.00 | 55.00 | 51.00 | 60.00 | 40.00 |
| 1,115 cu. yd. concr. (intake shaft & wye) | 11.00 | 15.00 | 18.80 | 15.00 | 20.00 | 14.50 |
| 31,430 cu. yd. concr. (tunn. lining No. 1, 2, 3, 10 and 11) | 9.00 | 15.00 | 13.64 | 13.85 | 15.50 | 14.50 |
| 4,600 cu. yd. concr. (tunn. lining No. 4) | 10.00 | 15.00 | 13.64 | 15.75 | 16.50 | 14.50 |
| 75 cu. yd. concr. (tunn. lining No. 5) | 20.00 | 15.00 | 20.00 | 22.00 | 24.00 | 14.50 |
| 10 cu. yd. concr. (bulkheads) | 20.00 | 15.00 | 20.00 | 32.00 | 18.00 | 14.50 |
| 7,160,000 lb. reinforcing steel | .0492 | .0455 | .0535 | .0552 | .057 | .055 |
| 500 l. ft. drill 1½" or smaller holes | 1.50 | .40 | 2.00 | .56 | 1.00 | .25 |
| 500 l. ft. drill 1¾ to 2½" holes | 2.00 | .60 | 2.00 | .70 | 1.00 | .30 |
| 12,000 lin. ft. steel pipe for grouting | 1.00 | .40 | .75 | .57 | .50 | .50 |
| 4,000 make grout connections | 1.00 | 2.50 | 2.00 | 4.17 | 4.00 | 2.00 |
| 2,000 cu. yd. place grout | 22.00 | 20.00 | 26.00 | 27.00 | 27.00 | 20.00 |
| 150 cu. yd. refill cross cut | 3.00 | 3.40 | 4.00 | 2.40 | 6.00 | 3.00 |
| 18,700 lin. ft. lay drain pipe | 1.50 | .50 | 2.00 | 1.13 | 3.50 | 1.32 |
| 105,000 lb. steel plate lining | .14 | .10 | .15 | .141 | .15 | .07 |
| 10,500 sq. ft. gunite and coating | .26 | .20 | .30 | .54 | .35 | .30 |
| 3,600 cu. yd. earth excav. open cut | .80 | 1.00 | 1.00 | 1.10 | 2.00 | 1.00 |
| 1,200 cu. yd. rock excav. open cut | 1.70 | 1.70 | 2.00 | 3.53 | 2.00 | 1.50 |
| 135 cu. yd. refilling and embanking | 1.50 | .60 | 1.00 | .80 | .75 | .50 |
| 47 cu. yd. reinf. concr. (portal walls) | 15.00 | 24.00 | 17.15 | 23.50 | 24.00 | 14.00 |
| 121 cu. yd. reinf. concr. (valve house) | 20.00 | 26.00 | 17.15 | 31.70 | 20.00 | 14.00 |
| 166 cu. yd. reinf. concr. (stilling basin) | 12.00 | 24.00 | 10.50 | 30.80 | 20.00 | 14.00 |
| 121 cu. yd. reinf. concr. (Venturi flume) | 20.00 | 23.00 | 18.30 | 31.30 | 22.00 | 14.00 |
| 59 cu. yd. reinf. conc. (highway bridge deck) | 20.00 | 32.00 | 17.15 | 21.70 | 20.00 | 18.00 |
| 351 cu. yd. conc. lining (outlet canal) | 12.00 | 14.00 | 11.20 | 22.30 | 15.00 | 14.00 |
| 12,410 lb. structural steel | .10 | .08 | .08 | .07 | .08 | .06 |
| Lump sum, meter house, valves and pipes | $700 | $1050 | $615 | $685 | $800 | 25.00 |
| 51,000 lb. reinforcing steel | .0525 | .06 | .0535 | .058 | .055 | .055 |
| Lump sum, erect valves, pipes and reducers | $1300 | $1150 | $2800 | $255 | $700 | $1250 |
| 180 lin. ft. lay cast iron pipe | 1.00 | 1.20 | 1.00 | .82 | 3.00 | 2.00 |
| 375 cu. yd. earth excav. channel change | 1.00 | .56 | 1.00 | 1.20 | 1.25 | 2.00 |
| 125 cu. yd. rock excav. channel change | 2.00 | 1.10 | 2.00 | 3.25 | 1.25 | 4.00 |
| 2,091 cu. yd. dry rubble wall | 4.00 | 4.00 | 5.00 | 2.40 | 9.00 | 5.00 |


# ARMCO Metal Cribbing

## is as simple as your boy's new blocks!

*. . . as simple, in fact, as this:*



**Armco Metal Cribbing comes to you fabricated for immediate and easy erection, virtually tailor-made for the job. Putting it together is as simple for your men as it is for your son . . . or somebody else's son . . . to build a structure with modern interlocking toys. And when it's up, it's up to stay! Ask for full details!**

CALIFORNIA CORRUGATED CULVERT CO.
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H. H. HAZELWOOD, Representative
P. O. Box 777, Olympia, Wash.

WESTERN METAL MFG. CO.
HOUSTON
El Paso San Antonio Dallas

# IRRIGATION and RECLAMATION

## ONTARIO, ORE.—GOVT.—EARTHWORK, TUNNELS & STRUCTURES—OWYHEE PROJECT

Contract awarded to Morrison-Knudsen Co., 319 Broadway, Boise, Idaho, $232,991.00 by Bureau of Reclamation, Ontario, Oregon, for const. earthwork, tunnels and structures, South Canal, Station 2 to Station 736, Succor Creek Division, Owyhee Project, Oregon-Idaho, under Spec. No. 607. Bids from:

| | Sch. 1 | Sch. 2 | Sch. 3 | Sch. 4 | TOTALS |
|---|---|---|---|---|---|
| (1) Morrison-Knudsen Co., Boise, Idaho | $ 57,160 | $33,036 | $ 99,802 | $45,493 | $232,991 |
| (2) J. A. Tertling & Sons, Boise | 65,129 | 34,930 | 93,455 | 44,836 | 238,350 |
| (3) John Klug, Nyssa, Oregon | ...... | 29,942 | ...... | ...... | ...... |
| (4) Haas Doughty & Jones and Marshall & Stacy, San Francisco. | 71,172 | ...... | ...... | 46,035 | ...... |
| (5) T. E. Connolly, San Francisco | ...... | 40,432 | 106,725 | ...... | ...... |
| (6) Barnard-Curtiss Co., Minneapolis | ...... | 37,704 | ...... | 68,196 | ...... |
| (7) Dunn & Baker, Klamath Falls | 98,174 | 47,454 | 122,365 | 72,215 | 325,208 |
| (8) S. S. Magoffin & Co., Adrian, Ore. | ...... | ...... | 130,282 | ...... | ...... |
| (9) A. Teichert & Son, Inc., Sacramento | 95,625 | 49,779 | 161,065 | 76,067 | 375,952 |
| (10) Guthrie-McDougall Co., Portland | ...... | ...... | ...... | 71,204 | ...... |

| SCHEDULE 1.—Earthwork, etc. South Canal | (1) | (2) | (4) | (7) | (9) | (10) |
|---|---|---|---|---|---|---|
| 165,000 cu. yd. canal excav. Class 1 | .0685 | .08 | .086 | .15 | .12 | .11 |
| 305,000 cu. yd. canal excav. Class 2 | .0685 | .08 | .086 | .15 | .14 | .17 |
| 30,000 cu. yd. canal excav. Class 3 | .30 | .35 | .40 | .35 | .40 | .40 |
| 32,000 cu. yd. core bank excavation | .15 | .15 | .15 | .15 | .10 | .15 |
| 25,000 sta. yd. overhaul | .02 | .03 | .05 | .02 | .02 | .03 |
| 2,300 cu. yd. struc. excav. Class 1 | .20 | .30 | .20 | .30 | .40 | .25 |
| 2,200 cu. yd. struc. excav. Class 2 | .30 | .30 | .40 | .40 | .70 | .40 |
| 200 cu. yd. struc. excav. Class 3 | 1.00 | .50 | .50 | .70 | 1.25 | 1.00 |
| 1,500 cu. yd. exc. drain. chann. for culv., Class 1 | .10 | .12 | .16 | .25 | .12 | .20 |
| 1,100 cu. yd. exc. drain. chann. for culv., Class 2 | .20 | .12 | .16 | .35 | .15 | .35 |
| 100 cu. yd. exc. drain. chann. for culv., Cl. 3 | 1.00 | .50 | .50 | .60 | 1.25 | 1.00 |
| 16,000 cu. yd. backfill about structures | .10 | .15 | .15 | .15 | .30 | .17 |
| 2,200 cu. yd. puddle or tamp backfill | .40 | .30 | .50 | .30 | .40 | .40 |
| 370 cu. yd. concrete in structures | 13.00 | 15.00 | 16.00 | 14.00 | 20.00 | 18.00 |
| 29,000 lb. place reinforcing steel | .03 | .02 | .02 | .02 | 1.50 | 2.00 |
| 220 lin. ft. lay 24" lock joint concr. pipe | 1.00 | 1.00 | 1.00 | .90 | 1.25 | 1.30 |
| 200 sq. yd. dry-rock paving | 2.00 | 1.00 | 2.50 | 1.25 | 1.80 | 2.00 |
| 1,900 lb. install gates and gate hoists | .05 | .03 | .04 | .04 | .05 | .05 |

| SCHEDULE 2—Tunnel No. 6 | (1) | (2) | (3) | (5) | (6) | (7) | (9) |
|---|---|---|---|---|---|---|---|
| 7,500 cu. yd. open cut exc., Class 1 | .08 | .15 | .20 | .30 | .40 | .35 | .30 |
| 8,000 cu. yd. open cut exc., Class 2 | .08 | .15 | .35 | .30 | .40 | .40 | .35 |
| 300 cu. yd. open cut exc., Class 3 | .50 | .40 | .70 | .30 | .40 | .60 | 1.50 |
| 150 cu. yd. backfill | .30 | .20 | .25 | .20 | .20 | .40 | .30 |
| 100 cu. yd. puddle or tamp backfill | .50 | .30 | .40 | .50 | .20 | .50 | .40 |
| 2,900 cu. yd. tunnel excavation | 6.25 | 6.50 | 4.75 | 8.50 | 6.30 | 9.50 | 9.35 |
| 23 M. ft. BM furn and erec. tunn. timb | 60.00 | 100.00 | 50.00 | 60.00 | 35.00 | 100.00 | 100.00 |
| 500 lin. ft. 6" tunnel drain | .30 | 1.00 | .30 | .70 | .50 | 1.50 | .50 |
| 200 lin. ft. lay 6" dr. pipe, cem. joints | .35 | 1.25 | .30 | .70 | .60 | .50 | .70 |
| 100 cu. yd. conc. (portal struc. and transit) | 20.00 | 15.00 | 16.50 | 14.00 | 16.00 | 15.00 | 25.00 |
| 625 cu. yd. conc. (tunnel lining) | 15.00 | 14.00 | 13.25 | 12.00 | 16.00 | 14.00 | 18.50 |
| 9,700 lb. place reinforcing steel | .03 | .02 | .02 | .01 | .02 | .03 | .02 |
| 75 sq. yd. dry-rock paving | 2.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.20 | 1.50 |
| 200 lb. install met. stop plank grooves | .05 | .03 | .10 | .10 | .10 | .04 | .10 |

| SCHEDULE 3.—Tunnel No. 7 | (1) | (2) | (5) | (7) | (8) | (9) |
|---|---|---|---|---|---|---|
| 3,000 cu. yd. open cut excav., Class 1 | .08 | .15 | .30 | .35 | .25 | .30 |
| 7,000 cu. yd. open cut excav., Class 2 | .08 | .15 | .30 | .40 | .60 | .35 |
| 300 cu. yd open cut excav., Class 3 | .50 | .40 | .30 | .60 | .80 | 1.50 |
| 150 cu. yd. backfill | .30 | .20 | .20 | .40 | .30 | .30 |
| 100 cu. yd. puddle or tamp backfill | .50 | .30 | .50 | .50 | .60 | .40 |
| 8,670 cu. yd. tunnel excavation | 7.25 | 6.50 | 9.00 | 9.50 | 9.25 | 13.40 |
| 33 M. ft. BM furn. and erect tunnel timber | 60.00 | 100.00 | 60.00 | 100.00 | 125.00 | 100.00 |
| 1,000 lin. ft. 6" tunnel drain | .30 | 1.00 | 1.00 | 1.50 | .75 | .50 |
| 200 lin. ft. lay 6" drain pipe, cem. joints | .35 | 1.25 | 1.50 | .50 | .75 | .70 |
| 80 cu. yd. concr. (portal struc. and transit) | 20.00 | 15.00 | 14.00 | 15.00 | 18.00 | 25.00 |
| 2,100 cu. yd. concr. (tunnel lining) | 15.00 | 14.00 | 10.00 | 14.00 | 18.00 | 16.50 |
| 7,500 lb. place reinforcing steel | .03 | .02 | .01 | .03 | .02 | .02 |
| 75 sq. yd. dry-rock paving | 2.00 | 1.00 | 1.00 | 1.20 | 3.00 | 1.50 |
| 1,500 lb. install gates and gate hoists | .05 | .03 | .05 | .03 | .10 | .10 |

| SCHEDULE 4.—Earthwork, etc., South Canal | (1) | (2) | (4) | (6) | (7) | (9) | (10) |
|---|---|---|---|---|---|---|---|
| 160,000 cu. yd., canal excav., Class 1 | .0685 | .07 | .074 | .10 | .15 | .14 | .11 |
| 140,000 cu. yd. canal excav., Class 2 | .0685 | .07 | .074 | .17 | .15 | .16 | .17 |
| 15,000 cu. yd. canal excav., Class 3 | .50 | .35 | .40 | .40 | .35 | .40 | .40 |
| 23,000 cu. yd. core bank excavation | .15 | .15 | .15 | .15 | .15 | .10 | .15 |
| 15,000 sta. yd. overhaul | .02 | .03 | .03 | .05 | .02 | .02 | .03 |
| 5,000 cu. yd. struc. excav., Class 1 | .20 | .30 | .15 | .30 | .30 | .40 | .25 |
| 2,500 cu. yd. struc. excav., Class 2 | .30 | .30 | .20 | .40 | .40 | .70 | .40 |
| 100 cu. yd. struc. excav., Class 3 | 1.00 | .50 | .50 | .40 | .70 | 1.25 | 1.00 |
| 14,500 cu. yd. exc. drain. chan. (culv) Class 1 | .10 | .10 | .12 | .12 | .25 | .15 | .20 |
| 5,500 cu. yd. exc. drain. chann. (culv.) Class 2 | .10 | .10 | .12 | .18 | .35 | .17 | .35 |
| 200 cu. yd. exc. drain. chann. (culv.) Class 3 | 1.00 | .50 | .25 | .30 | .60 | 1.25 | 1.00 |
| 9,500 cu. yd. backfill about struc. | .10 | .14 | .15 | .20 | .15 | .30 | .17 |
| 1,900 cu. yd. puddle or tamp backfill | .40 | .30 | .30 | .25 | .30 | .40 | .40 |
| 480 cu. yd. concrete (structures) | 13.00 | 15.00 | 14.00 | 18.00 | 14.00 | 22.00 | 18.00 |
| 40,000 lb. place reinforcing steel | .02 | .02 | .02 | .03 | .02 | .015 | .02 |
| 6 M. ft. BM erect timb. in bridge | 50.00 | 15.00 | 20.00 | 30.00 | 17.00 | 25.00 | 25.00 |
| 36 lin. ft. lay 24" lock joint conc. pipe | 2.00 | 1.00 | 1.00 | 1.00 | .90 | 1.25 | 1.30 |
| 250 sq. yd. dry-rock paving | 2.00 | 1.00 | 2.00 | 1.60 | 1.25 | 1.80 | 2.00 |
| 350 lb. install gates and gate hoists | .06 | .03 | .04 | .10 | .04 | .05 | .05 |

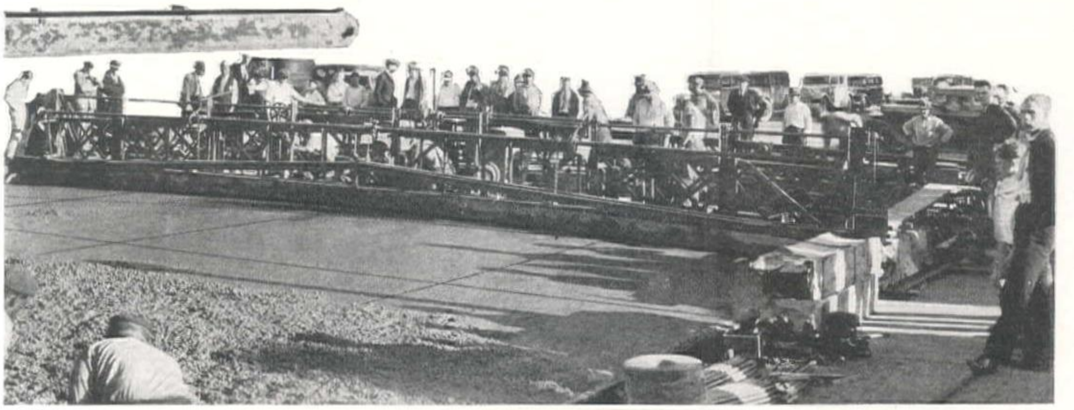
# 7 Month Job Completed in 3 Months With the FLEX-PLANE

*A More Complete Western Service*

*After years of successful operation in Eastern, Southern and Northern states FLEX-PLANE offers a new, complete service to the west. service and information now through KRATZ & McCLELLAND, Inc., 522 Bryant St., San Francisco, Calif. Write for details.*

**So reports a contractor who has recently completed a four lane concrete road . . . Screeding, Jointing and finishing in one operation. Such reports are not uncommon. Flex-Plane offers machines in any size up to 50 feet . . . equipped with forward and backward screeding . . . starter springs for screeds. The price of the machine is lower than you would imagine. The time saving advantages and quality of work should be investigated . . . *today*.**

**FLEXIBLE ROAD JOINT MACHINE COMPANY**
**Warren, Ohio**



*Successful operation— at a saving in time and money is offered. Machines up to 50-ft. available*

# Dismantling Chicago's Historic Train-Shed*

Working with a 100 ft. boom, this Industrial Brownhoist type L crane dismantled the portal frame and some of the trusses of the famous old La Salle Street station train-shed.

The F. H. Ketler Company, Chicago, who did the dismantling of all steel work on the trusses, say of this crane: "We generally use booms 50 to 80 ft. in length, but are well pleased with the way she handles with the 100 ft. boom. Our crane received favorable comment on this job from several noted engineers... and we want you to know that we appreciate the treatment received from your service department."

*Described in Nov. 17th Railway Age and December 20th Engineering News Record

GENERAL OFFICES: BAY CITY, MICHIGAN

**INDUSTRIAL BROWNHOIST**

Bevis Machinery Co., 3649 Santa Fe Ave., Los Angeles, Calif.; H. G. Purcell, Colman Building, Seattle, Washington; Garfield & Company, Hearst Building, San Francisco, Calif.

### SALT LAKE CITY, UTAH—GOVT.—MOON LAKE DAM

T. E. Connolly, 461 Market St., San Francisco, $547,221. low to Bureau of Reclamation, Salt Lake City, Utah, for const. the Moon Lake Dam, Moon Lake Project, Utah, under Spec. No. 605. Bids from:

(1) T. E. Connolly, S. F.......................$547,221.00
(2) Winston Bros., Los Angeles.............. 579,922.00
(3) W. W. Clyde & Co., Springville............ 585,419.00
(4) J. A. Terteling & Son, Boise..............$657,141.00
(5) Utah Const. Co. & Morrison-Knudsen Co., Ogden, Utah ............................... 691,596.00

| | (1) | (2) | (3) | (4) | (5) |
|---|---|---|---|---|---|
| L. S. diversion and care of river | $500.00 | $2,150.00 | $3,000.00 | $4,000.00 | $10,000.00 |
| 34,000 cu.yd. excav. strip borrow pits | .30 | .22 | .32 | .465 | .45 |
| 43,500 cu.yd. excav. strip embankments | .50 | .27 | .40 | .60 | .60 |
| 2,800 cu.yd. common excav. open cut for intake | 1.00 | .40 | .40 | .60 | .58 |
| 1,050 cu.yd. rock excav. open cut for intake | 1.00 | 1.50 | 1.00 | .60 | 1.32 |
| 12,400 cu.yd. excavation in tunnels and shafts | 8.00 | 7.70 | 11.30 | 7.00 | 11.50 |
| 24,000 cu.yd. common excav. embankm. toe dr. etc. | .50 | .27 | .40 | .70 | .46 |
| 550 cu.yd. rock excav. embankm. toe dr. etc. | 1.00 | 1.50 | 1.25 | 4.00 | 2.30 |
| 240 cu.yd. common excav. cutoff wall | 6.00 | 3.00 | 6.50 | 5.00 | 5.75 |
| 700 cu.yd. common excav. cutoff wall (stoping) | 6.00 | 3.00 | 7.00 | 10.00 | 9.20 |
| 110 cu. yd. rock excav. cuoff wall | 8.00 | 4.00 | 8.00 | 20.00 | 11.50 |
| 12,700 cu. yd. common exc. open cut spillw. intake | .40 | .40 | .44 | .60 | .42 |
| 15,400 cu. yd. rock excav. open cut spillw. intake | 1.00 | .85 | .90 | .60 | 1.15 |
| 115 cu.yd. comm. excav. concrete cutoff wall | 1.00 | 1.00 | 1.30 | .75 | 1.15 |
| 40 cu.yd. comm. excav. control house | 1.00 | 1.00 | 1.50 | .75 | 1.15 |
| 400,000 cu.yd. comm. excav. borrow pit | .36 | .27 | .325 | .465 | .33 |
| 32,500 cu.yd. rock excav. borrow pits | .60 | 1.00 | .80 | .465 | .46 |
| 8,400 sq.yd. coat surfaces of shale excavation | .10 | .15 | .10 | .15 | .115 |
| 6,000 cu.yd. backfill about structures | .30 | .40 | .35 | .60 | .46 |
| 413,000 cu.yd. earthfill in embankment | .10 | .12 | .09 | .10 | .115 |
| 77,000 cu.yd. rock fill on downstream slope | .40 | .35 | .325 | .30 | .57 |
| 29,200 cu.yd. riprap on upstream slopes | .30 | .42 | .35 | .50 | .63 |
| 740 lin. ft. const. 12" sewer pipe drain | .70 | .60 | .90 | 1.00 | .69 |
| 260 lin. ft. const. 8" sewer pipe drain | .70 | .50 | .65 | 1.00 | .58 |
| 350 lin. ft. const. 8" sewer pipe dr. (por. conc.) | 1.00 | .50 | 1.50 | 1.50 | .92 |
| 150 lin. ft. const. 6" sewer pipe dr. (por. conc.) | 1.00 | 1.40 | 1.50 | 1.50 | .74 |
| 150 cu.yd. porous concr. under spillw. int. str. | 5.00 | 8.00 | 6.00 | 16.50 | 9.20 |
| 30 cu.yd. screen. grav. spillw. struc. drain | 1.00 | 3.50 | 2.00 | 2.00 | 3.45 |
| 800 lin. ft. drill grout holes | .50 | .60 | 1.00 | 1.50 | 1.15 |
| 640 lb. install grout pipe and fittings | .10 | .20 | .15 | .10 | .20 |
| 1,000 cu.ft. pressure grouting | 1.00 | 1.00 | 1.30 | 1.25 | 1.15 |
| 300 cu.yd. concr. embankment cutoff wall | 8.00 | 18.00 | 10.00 | 16.50 | 11.50 |
| 960 cu.yd. concr. cutoff wall in stopes | 5.00 | 12.00 | 7.50 | 16.50 | 10.35 |
| 205 cu.yd. concr. trash rack struc. & transit | 14.00 | 24.00 | 13.00 | 20.50 | 20.70 |
| 2,400 cu.yd. concr. tunnels and shafts | 10.00 | 18.00 | 15.00 | 16.50 | 13.80 |
| 1,300 cu.yd. concr. in gate chamber, etc. | 16.00 | 20.00 | 11.00 | 16.50 | 20.70 |
| 360 cu.yd. concr. at outlet portal of tunnel | 10.00 | 17.00 | 11.00 | 18.50 | 11.50 |
| 2,950 cu.yd. concr. spillway intake struc. | 10.00 | 16.00 | 10.40 | 16.50 | 20.70 |
| 40 cu.yd. concr. in control house | 25.00 | 30.00 | 23.00 | 25.00 | 28.75 |
| 390 cu.yd. concr. parapet and curb walls | 8.00 | 26.00 | 10.50 | 5.00 | 11.50 |
| 110 cu.yd. concr. in cutoff wall | 8.00 | 13.00 | 7.50 | 16.50 | 9.20 |
| 870,000 lb. place reinforcing bars | .015 | .02 | .018 | .02 | .0175 |
| 90,000 lb. furn. and inst. steel tunnel liner plates | .08 | .10 | .12 | .10 | .092 |
| 1,500 sq.yd. spec. finish concrete surfacing | .20 | .60 | .50 | .25 | .69 |
| Lump sum, construct control house except concr. | 500.00 | 330.00 | 300.00 | 500.00 | 575.00 |
| 210 cu.yd. rubble concrete paving | 5.00 | 5.00 | 6.00 | 6.00 | 6.40 |
| 120 cu.yd. dumped riprap (outlet of spillw. tun.) | 2.00 | 1.30 | 1.50 | 1.50 | 2.30 |
| 44,000 lb. install trash rack metal work | .02 | .02 | .015 | .03 | .025 |
| 90,000 lb. install slide gates and metal cond. lining | .03 | .035 | .025 | .04 | .025 |
| 13,000 lb. install control apparatus for gates | .03 | .06 | .05 | .05 | .09 |
| 16,000 lb. install metal spiral stairway | .03 | .05 | .02 | .04 | .055 |
| 6,000 lb. install pipe handrailing | .03 | .10 | .02 | .04 | .12 |
| 4,800 lb. install ventilating duct and dr. ejector | .03 | .06 | .05 | .10 | .08 |
| 1,100 lb. install miscell. metal work | .10 | .07 | .05 | .10 | .12 |
| 780 lin. ft. install elec. metal conduit | .10 | .25 | .10 | .20 | .23 |
| Lump sum, inst. elec. conductor and apparatus | 500.00 | 500.00 | 300.00 | 600.00 | 575.00 |

# STREET and ROAD WORK

### PHOENIX, ARIZ.—STATE—CONCRETE PAVING—MARICOPA COUNTY

Contract awarded to Tanner & Hall, Phoenix Title & Trust Bldg., Phoenix, $49,505, by State Highway Comm., Phoenix, Arizona, for widening existing concrete pavement with cutback plant mix from 19th Ave., and Buckeye Road, westerly 13 miles to Agua Fria Bridge, on the Phoenix-Yuma Highway, MARICOPA COUNTY, Proj. NRH 46-A. Bids from:

(1) R. C. Tanner & W. E. Hall, Phoenix........$49,504.00
(2) Heafey-Moore Co., Phoenix............... 59,463.00
(3) Pearson & Dickerson, Prescott............. 63,117.00
(4) Pleasant Hasler Constr. Co., Phoenix.......$67,122.00
(5) Phoenix-Tempe Stone Co., Phoenix........$71,860.00

| | (1) | (2) | (3) | (4) | (5) |
|---|---|---|---|---|---|
| 19,083 cu.yd. roadway excavation, unclass. | $.52 | $.63 | $.67 | $.58 | $.75 |
| 14,136 cu.yd. coarse aggr. base course | .65 | 1.03 | .85 | .96 | 1.05 |
| 4,512 cu.yd. fine aggr. base course | .08 | 1.05 | 1.33 | 1.34 | 1.30 |
| 9,347 tons plant mix | 1.43 | 1.70 | 1.88 | 2.43 | 2.50 |
| 449 tons cutback asphalt | 24.00 | 22.50 | 27.00 | 26.00 | 26.00 |
| 444 cu.yd. screenings | 3.50 | 4.00 | 5.00 | 4.00 | 3.15 |
| 50 M. gals. sprinkling | 2.50 | 2.50 | 3.00 | 2.50 | 4.00 |
| 50 hours rolling | 3.00 | 5.00 | 5.00 | 3.00 | 4.00 |

# CONSTRUCTION

Note: For additional information regarding projects in this summary refer to Daily Construction News Service, date appearing at end of each item.

## Large Western Projects

### WORK CONTEMPLATED

**SAN FRANCISCO, CALIF.**—Additional contracts to be advertised early in 1935 by the S. F.-Oakland Bay Bridge Office, 500 Sansome St., S. F.: (1) 4-lane subway under S. P. tracks at Folger Ave., Berkeley; (2) Distribution structure over S. P. tracks and Key Route Subway at east end of fill; (3) Administration Bldg. and Toll Plaza; (4) Bridge lighting and electrical work; (5) Overhead structure from east end of distrib. struc. to 38th and Market Sts., Oakland; (6) Paving of fill along Keyroute mole.

**SACRAMENTO, CALIF.**—Calif. Div. of Highways Program for the biennium, July 1, 1934, to June 30, 1937, allocates $26,498,980 for 181 projects.

**ALMIRA, WN.**—Estimated cost of materials to be purchased by the Bureau of Reclamation for use in construction of the Grand Coulee Dam is $25,000,000.

**CARSON CITY, NEVADA**—Nevada State highway program for 1935 allocates $3,756,600 for construction of highway projects.

**PALO ALTO, CALIF.**—Earth fill dam for Stanford University. Est. cost $400,000.

**BUCKEYE, ARIZ.**—4,911,000 sq. ft. gunite lining canals for Roosevelt Irrigation Dist. Est. cost $702,000.

**VENTURA, CALIF.**—Hoffman earthfill dam for City, est. cost $700,000.

**CALEXICO, CALIF.**—Power development and distribution in connection with the All American Canal by the Imperial Irrigation Dist. $12,-000,000 loan being sought from P.W.A.

**CARLSBAD, N. M.**—Dam canal lining for Carlsbad Irrigation Dist. Est. cost $2,225,000.

### CALL FOR BIDS

**GUNNISON, COLO.**—Concrete arch or earth and rock fill dam, Taylor Park Dam, Uncompahgre Proj. for Bur. of Reclamation, bids to Feb. 18. Est. cost $2,000,000.

### BIDS RECEIVED

**PHOENIX, ARIZ.**—Irrigation work from 25 to 30 miles west and northwest of Phoenix for Maricopa County Municipal Water Conservation Dist. low bids from five bidders on five schedules total $435,430.

**SAN FRANCISCO, CALIF.**—Enlargement of O'Shaughnessy Dam for City low bid Transbay Const. Co., S. F., $3,219,965.

**TACOMA, WN.**—Green River Gravity Pipeline Replacement for City, low bid Puget Sound Machy. Depot, Seattle, $538,091.

### CONTRACTS AWARDED

**DENVER, COLO.**—Cylinder gate hoists for Boulder Dam by Bureau of Reclamation to Consolidated Steel Corp., L. A., $205,500.

**DENVER, COLO.**—Enlarging and lining Moffatt Tunnel for Board of Water Comm., Denver, to Utah-Bechtel-Morrison, Inc., $972,576.

**ONTARIO, ORE.**—Earthwork, tunnels and structures on South Canal, Owyhee Proj., for Bur. of Reclamation to Morrison-Knudsen Co., Boise, $232,991.

**LOS ANGELES, CALIF.**—3.6 mi. grade and asph. concrete betw. Sea Cliff and Benham, Ventura County, for Calif. Div. of Highways, to Basich Bros. Const. Co., Torrance, $214,957.

**PORTLAND, ORE.**—Reconst. and repair outer 4700 ft. Columbia River South jetty for U. S. Engineer Office, to Winston Bros. Co. and Guy F. Atkinson Co., Portland, $1,493,535.

**HELENA, MONT.**—Concrete and steel bridge over Stillwater River and 5 tr. timber pile trestle I-beam bridges for State Highway Dept., to Colonial Const. Co., Spokane, $443,691.

## STREET and ROAD WORK

### WORK CONTEMPLATED

**GLENDALE, CALIF.**—Construction projects for the City of Glendale are being outlined for 1935 and City Engineer is preparing preliminary plans and studies of work which include paving, storm drains, bridges and other improvements. Est. cost exceeding $1,000,000. 1-24

### CALL FOR BIDS

**PHOENIX, ARIZ.**—Bids to 10 a.m., March 5, by Bureau of Public Roads, Phoenix, Arizona, for 2,989 miles grading Section B of Rt. 11, the Payson-Colcord Mt. National Forest Highway, Tonto National Forest. GILO COUNTY, Arizona. Work involves: 17,900 cu. yd. excavation. 802 cu. yd. exc. struc., 5,000 sta. yd. overhaul, 858 lin. ft. corr. metal pipe, 112 cu. yd. concrete, 22,700 lb. reinf. steel, 473 cu. yd. cem. rubble masonry, 1.43 M ft. BM untr. timber, 238 cu. yd. handlaid riprap, 25,600 lin. ft. Type I protection ditch, 12 ea. monuments, 6,600 lin. ft. new fence. 1-16

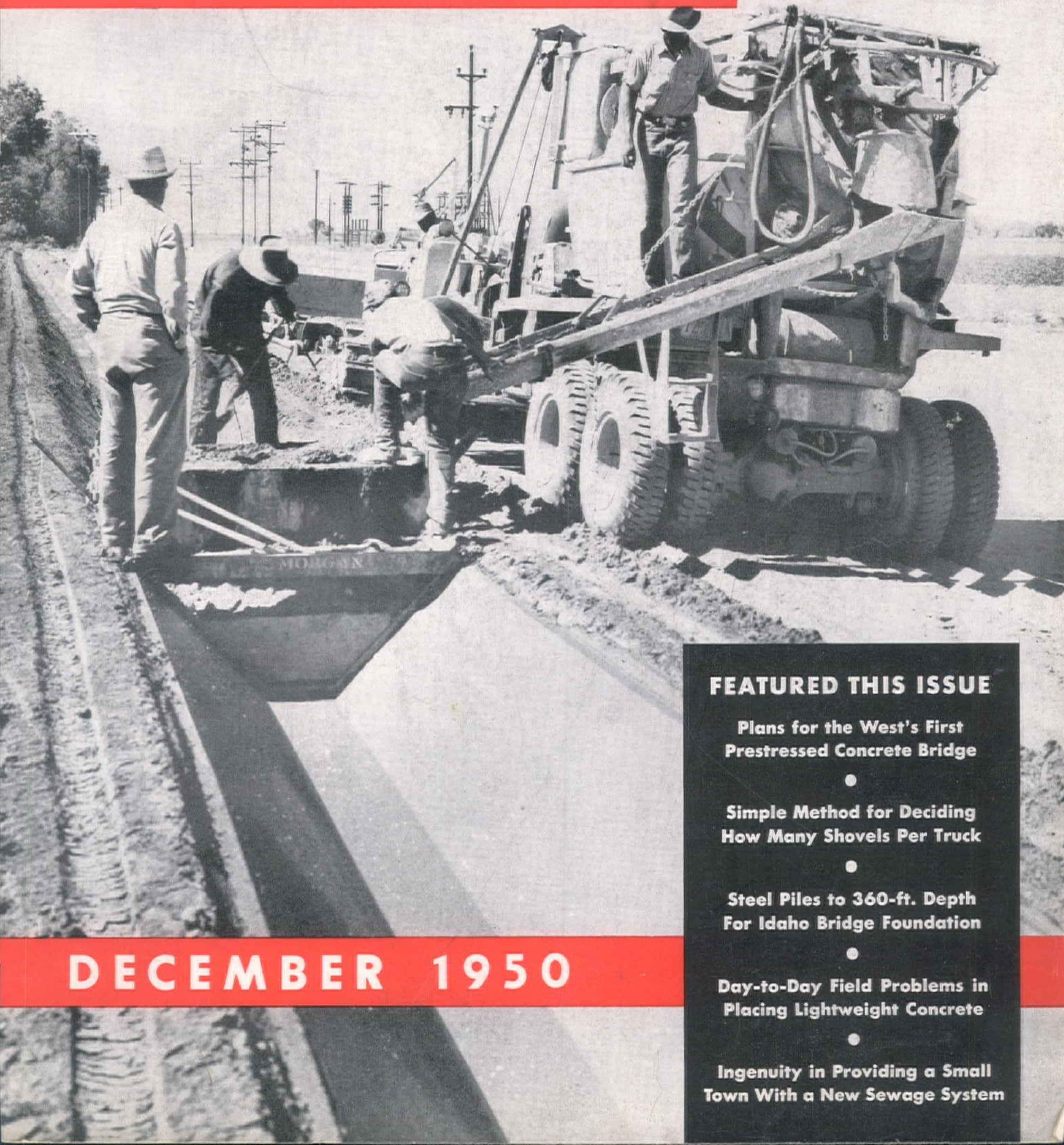
**LOS ANGELES, CALIF.**—Bids to 10 a.m., Feb. 20, by City Clerk, Los Angeles, for improvements of alley south of 12th St., near Pacific Blvd., San Pedro, involving: Lump sum, grading 3,198 sq. ft. 5" concrete pavement. 1-29

**LOS ANGELES, CALIF.**—Bids to 2 p.m., Feb. 21, by Calif. Div. of Highways, Los Angeles, for 1.1 mi. surf. with bitum. tr. cr. grav. or stone on Hill St. betw. Wisconsin Ave. and 8th St., in Oceanside, SAN DIEGO COUNTY, Calif., inv.: 15 tons emuls. asphalt road oil, 3,500 tons cr. gravel or stone, 160 tons cutback asphalt. 1-29

**LOS ANGELES, CALIF.**—Bids to 2 p.m. Feb. 14 by Calif. Div. of Highways, State Bldg., L. A., for 0.8 mi. grad. and concr. pav. betw. Pier Ave. and Sepulveda Blvd., Rt. 175 in Redondo Beach, Manhattan Beach and Hermosa Beach, LOS ANGELES COUNTY, Calif., involving: 65,800 cu. yd. excavation, 72,000 sta. yd. overhaul, 20,500 sq. yd. subgrade preparation, 750 tons asphalt concrete, 3,425 cu. yd. 'A' concrete pavement, 45,500 lb. reinforcing steel. 1-22

# WESTERN CONSTRUCTION






## DECEMBER 1950

### FEATURED THIS ISSUE

Plans for the West's First Prestressed Concrete Bridge

Simple Method for Deciding How Many Shovels Per Truck

Steel Piles to 360-ft. Depth For Idaho Bridge Foundation

Day-to-Day Field Problems in Placing Lightweight Concrete

Ingenuity in Providing a Small Town With a New Sewage System

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# LOWER COSTS

## Use the Texaco air compressor oil recommended for your specific operating conditions

No one lubricant can be used effectively for *all* air compressor operations. Different operating conditions demand different lubricants. Texaco offers a complete line of air compressor oils that assure greater efficiency and lower maintenance costs whatever your set-up may be. For example:

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2. Where rust is a problem, Texaco specially inhibited air compressor oils are best.
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4. For normal operation Texaco straight mineral oils are recommended.

When used as recommended, all the oils in the Texaco air compressor series improve performance, assure *clean* compressors and systems, and bring down maintenance costs.

A Texaco Lubrication Engineer will gladly help you select the proper oil for your particular operation. Just call the nearest of the more than 2,000 Texaco Wholesale Distributing Plants in the 48 States, or write:

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# TEXACO Air Compressor Oils

**FOR ALL OPERATING CONDITIONS**

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# WESTERN CONSTRUCTION

Volume 25 **DECEMBER 1950** Number 12

## FEATURE ARTICLES



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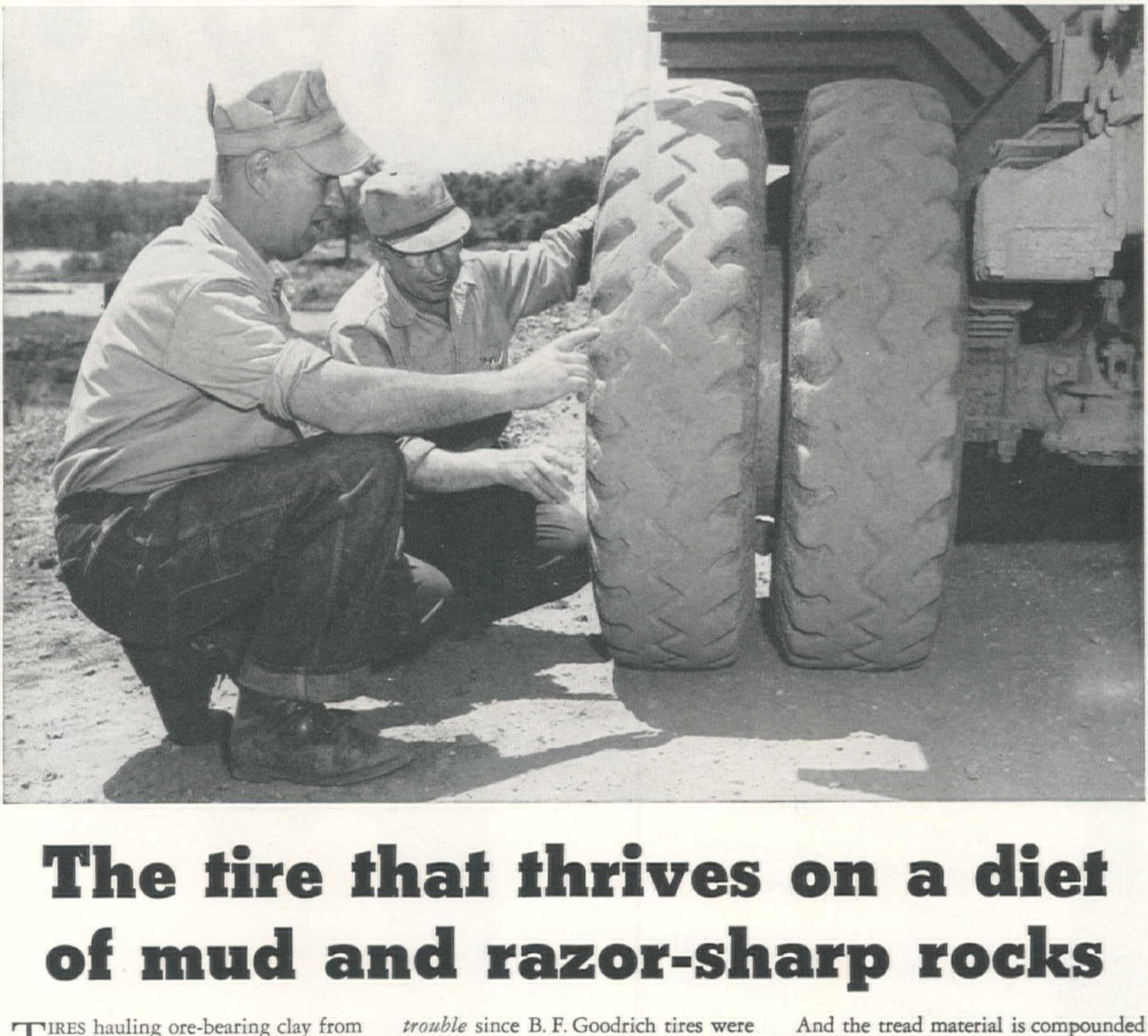

## The tire that thrives on a diet of mud and razor-sharp rocks

TIRES hauling ore-bearing clay from pit to mill in barite mining service lead a difficult life. The tires on the equipment shown being examined above, operated by the Baroid Sales Division of the National Lead Company, Potosi, Mo., have been working under the following routine:

One minute they are backing out on raw clay in the pits — a clay that has the consistency of putty when moist, but like rough stone when dry. Next, they are carrying a twelve-ton load to the mill over a road of flint and quartz — a surface similar to broken razor blades.

Yet, the operators report they have experienced *no road delays due to tire trouble* since B. F. Goodrich tires were put into service in 1947. This big cut in operating costs is largely due to the exclusive protection of the patented *nylon shock shield* found only in B. F. Goodrich tires (with *double* nylon shock shield in larger sizes). Layers of nylon cord, built between the tread and body plies, shield the cord body by smoothly distributing shocks and strains.

These BFG tires have a special deep tread designed for just such service. The BFG Rock tires shown above have wide, continuous-running ribs that give more wear at vital points. The heavy, non-directional cleats on the shoulders give a deep bite in forward or reverse, on moist clay or hard quartz. And the tread material is compounded to resist cutting.

Regardless of the type of tire service your equipment demands, your B. F. Goodrich retailer has a cost-cutting answer. See him and be sure to specify BFG tires for your new equipment. Enjoy the extra savings of patented nylon shock shield protection at no extra cost. *The B. F. Goodrich Company, Akron, Ohio.*

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## Allis-Chalmers Model HD-20

## Hydraulic Torque Converter Tractor...

- **BIG AND RUGGED** . . . 41,800 lb. of properly balanced weight . . . long, wide, sure-gripping tracks. Handles the toughest jobs in stride!

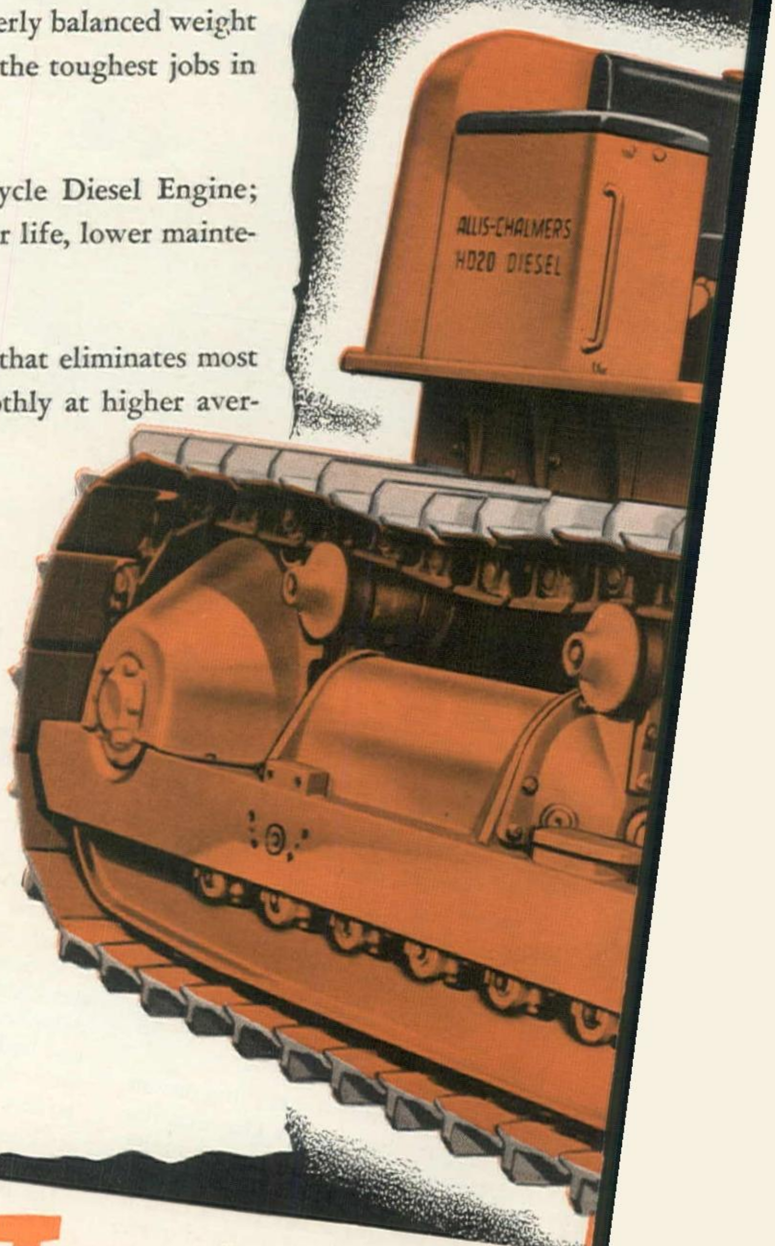
- **POWERFUL** . . . Newest, latest GM 2-Cycle Diesel Engine; Model 6-110. Plenty of POWER . . . for longer life, lower maintenance, increased production.

- **HYDRAULIC TORQUE CONVERTER DRIVE** that eliminates most gear shifting and keeps tractor working smoothly at higher average speeds.

- **SIMPLE UNIT ASSEMBLY** . . . major assemblies removed and repaired or replaced without removing adjacent parts.

- **EXTENDED LUBRICATION PERIODS THROUGHOUT** . . . plus 1,000-hour periods on truck wheels, track idlers and support rollers with A-C's POSITIVE SEAL.

- **EVERY OPERATOR COMFORT** . . . seat, platform, controls, visibility . . . hydraulic finger-tip steering, self-energizing brakes, practically no gear shifting.




## World's Finest Tractor

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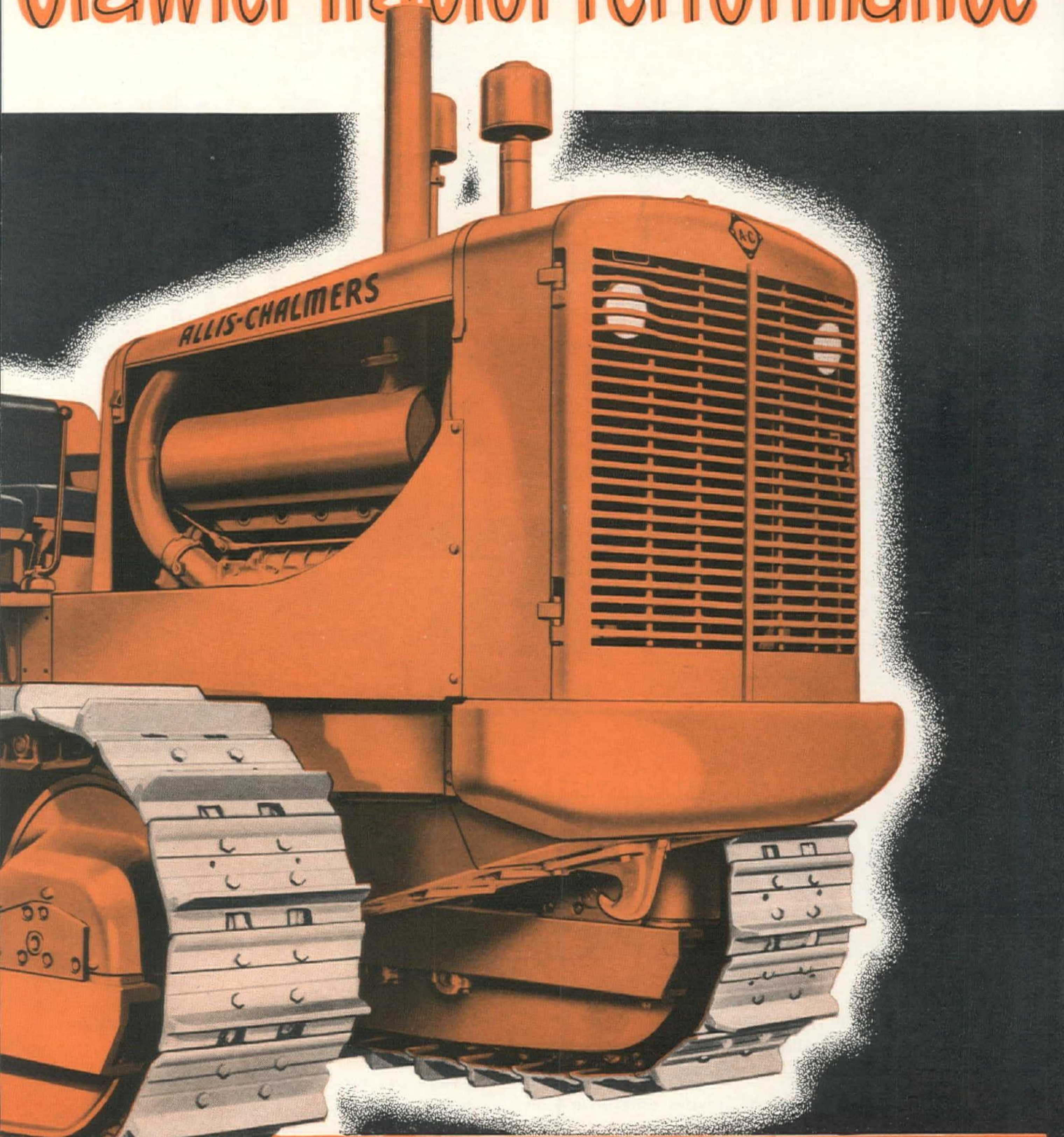
# Crawler Tractor Performance




## SEE YOUR ALLIS-CHALMERS DEALER

**ARIZONA: Phoenix**—Neil B. McGinnis. **NORTHERN CALIFORNIA: Oakland and Eureka**—Buran Equipment Company; **Modesto**—J. M. Equipment Co.; **Fresno**—Peerless Tractor and Equipment, Food Machinery and Chemical Corp.; **Salinas and King City**—Livingston Bros. Tractor Co.; **No. Sacramento, Stockton, Redding**—Moore Equipment Company, Inc.; **Mountain View**—Redwine Tractor Co.; **Visalia**—Tulare County Tractor Co. **SOUTHERN CALIFORNIA: Bakersfield**—San Joaquin Tractor Co.; **Los Angeles, San Diego and Santa Barbara**—Shaw Sales & Service Company. **IDAHO: Idaho Falls and Boise**—Southern Idaho Equipment Company. **MONTANA: Missoula**—Mountain Tractor Company; **Sidney**—Northland Machinery Company; **Billings**—Seitz Machinery Company, Inc. **NEVADA: Elko**—C. W. Paul Hardware and Machinery; **Reno**—Moore Equipment Company, Inc. **OREGON: Eugene, Roseburg and North Bend**—Farm and Industrial Equipment Co.; **The Dalles**—Dielschneider Equip. Oreg. Ltd.; **La Grande**—Oregon Tractor Company; **Medford**—Tractor Sales and Service, Inc.; **Klamath Falls**—West Hitchcock Corp.; **Portland**—Wood Tractor Company. **UTAH: Salt Lake City**—Cate Equipment Co., Inc. **WASHINGTON: Seattle, Tacoma and Wenatchee**—A. H. Cox & Company; **Walla Walla**—Northern Harris; **Spokane**—American Machine Company. **WYOMING: Casper**—Studer Tractor & Equipment Co.

### THE DW20 TRACTOR AND W20 WAGON UNIT

***This big-capacity unit offers:***

17 cu. yds. capacity, struck; 25 cu. yds., heaped.

Travel speeds, through five gear ratios, from 2.88 to 26.6 m.p.h.

Wide-mouthed hopper to provide easy-to-hit target for shovel or dragline loading.

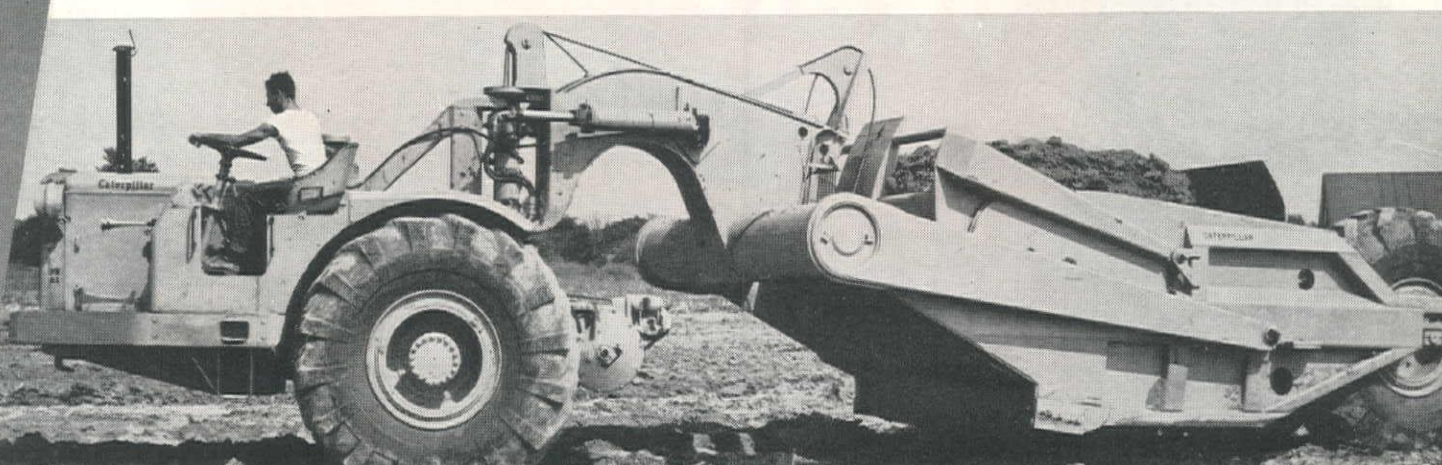
Controlled dumping — openings can be varied without mechanical adjustment — permitting either dumping or windrowing.

Accurate hydraulically controlled dumping with positive mechanical lock on dump doors.

***The DW20 Tractor with No. 20 Scraper offers:***

The same capacities, speeds and general specifications (except in type of gooseneck) as the No. 21 Scraper.

***The DW20 Tractor is also available with the No. 20S Bulldozer.***



### THE DW21 TRACTOR AND NO. 21 SCRAPER UNIT

***This big-capacity unit offers:***

Full 90° turn each way—non-stop turn in 35 ft.

15 cu. yds. capacity, struck; 19½ cu. yds., heaped. With available 12" extensions: 18 cu. yds., struck; 22½ cu. yds., heaped.

Travel speeds, through five gear ratios, from 2.16 to 20 m.p.h.

Bowl and apron designed to promote "boiling" action of earth through center of load—for full-measure yardage, minimum loading time.

Large low-pressure tires for easy load flotation.

'Dozer-type ejection for positive "kicking out" of sticky material; dependable spring-action ejector return.

Open bowl design for visible loading under shovel or dragline.

Adjustable rear axle to permit level cuts and desired settings.

Double bottom of special alloy steel. Self-sharpening, reversible cutting edge.

High apron lift, low center of gravity.

Built to the exacting standards that characterize all "Caterpillar" equipment, these big yellow earthmovers are production boosters from the word "go!" What's more, your nearby "Caterpillar" dealer is on call for immediate service. For full information about these rigs, see him or write the factory.

•

**Caterpillar Tractor Co., San Leandro, Calif.; Peoria, Ill.**

#### DW20 AND DW21 TRACTOR FEATURES

**NEW ENGINE:** The completely new 6-cylinder "Cat" Diesel Engine . . . 225 HP. at 1900 r.p.m. available at the flywheel . . . 275 HP. peak capacity at 2000 r.p.m. tested in accordance with A.S.M.E. Power Test Codes.

**TRANSMISSION:** Constant-mesh transmission and heavy-duty clutch. Special locking device prevents gears from becoming disengaged.

**STEERING:** Hydraulic booster steering follows the natural "feel-of-the-road" hand guidance. Heavy steel stops keep gooseneck of drawn equipment from jack-knifing.

**BRAKES:** Each large, heavy-duty brake is 22" in diameter, 7" wide. Compressed air energized brakes on both tractor and drawn member of unit. Handy control valves for applying both sets of brakes, and to either right or left driving wheel.

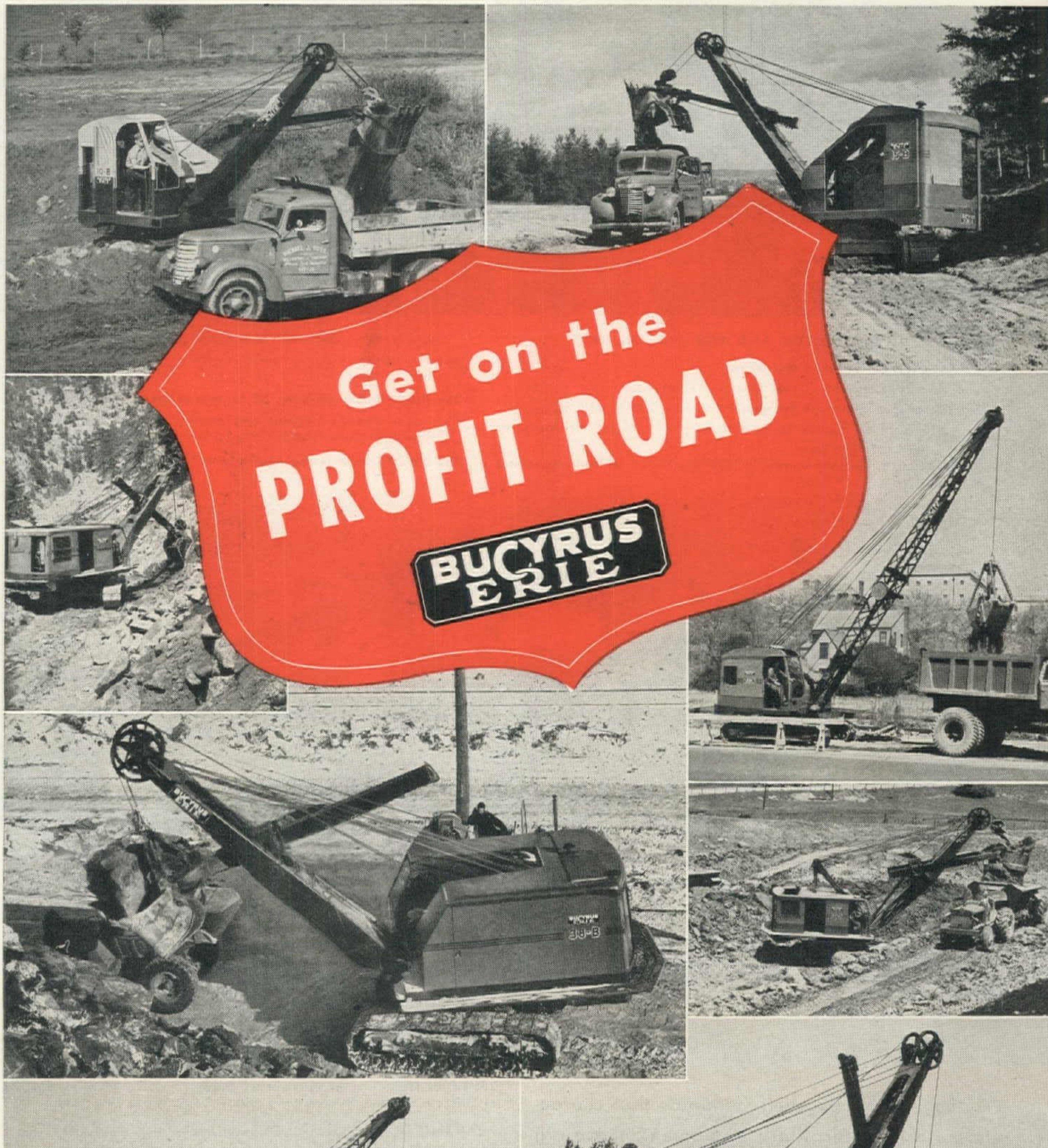
**OPERATOR COMFORT:** Airfoam rubber cushion on bucket-type seat mounted on coil spring with hydraulic snubber. All controls within easy reach. Excellent visibility.

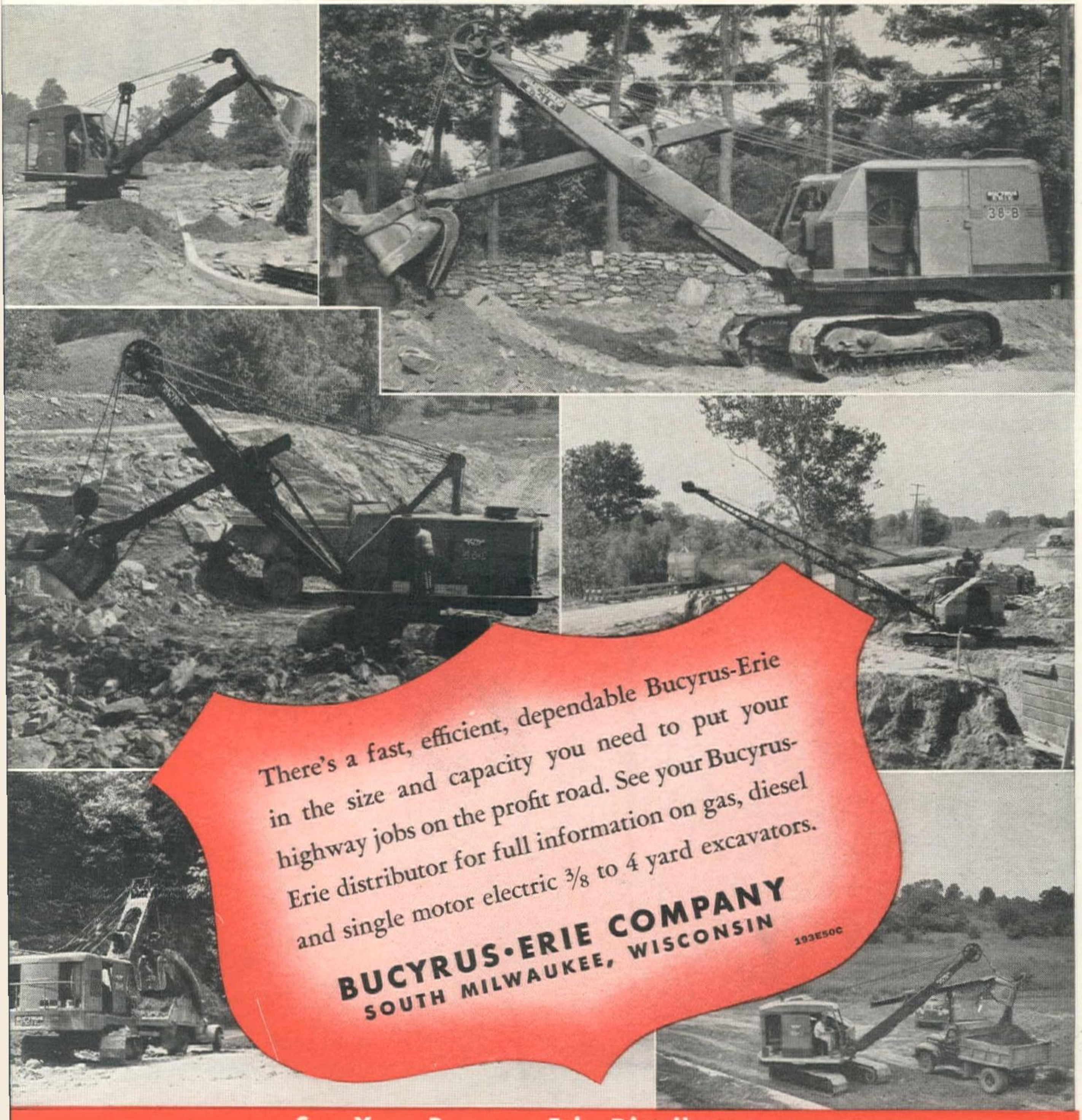
# CATERPILLAR

REG. U. S. PAT. OFF.

**DIESEL ENGINES • TRACTORS**

**MOTOR GRADERS • EARTHMOVING EQUIPMENT**


Get on the
PROFIT ROAD
BUCYRUS ERIE
38-B
15-B




## See Your Bucyrus-Erie Distributor

| | |
|---|---|
| BROWNING-FERRIS MACHINERY CO. | DALLAS & HOUSTON |
| CLYDE EQUIPMENT COMPANY | PORTLAND & SEATTLE |
| THE COLORADO BUILDERS' SUPPLY CO. | DENVER |
| CONTRACTORS MACHINERY CO. | SAN ANTONIO |
| CROOK COMPANY | LOS ANGELES |
| GREAT NORTHERN TOOL & SUPPLY CO. | BILLINGS |
| R. L. HARRISON COMPANY, INC. | ALBUQUERQUE |
| INTERMOUNTAIN EQUIPMENT COMPANY | BOISE, POCATELLO, SPOKANE |
| THE LANG COMPANY | SALT LAKE CITY |
| THE MERRILL-BROSE COMPANY | SAN FRANCISCO |
| NEVADA EQUIPMENT SERVICE | RENO |
| THE O. S. STAPLEY COMPANY | PHOENIX |
| TRI-STATE EQUIPMENT COMPANY | EL PASO |
| WESTMONT TRACTOR & EQUIPMENT COMPANY | MISSOULA & KALISPELL |

# PRODUCTION

## of Ideal Cubical Shaped Aggregate

## with Cedarapids

# DOUBLE IMPELLER IMPACT BREAKER

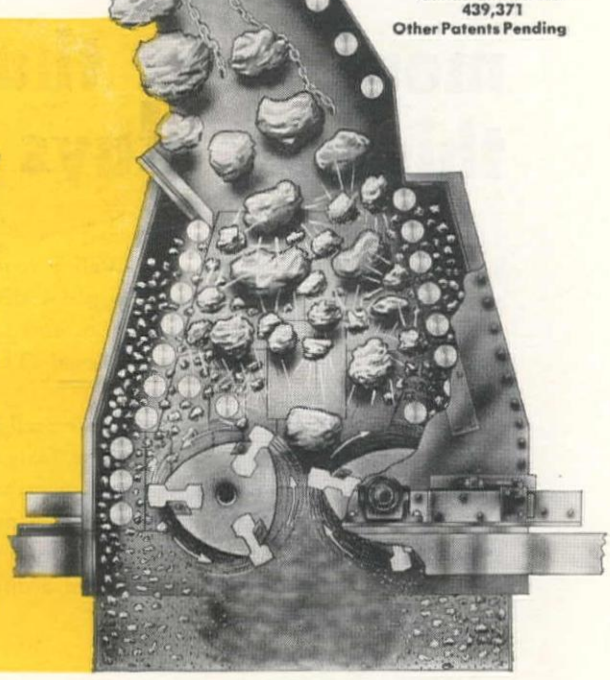
***(formerly made by New Holland)***

HERE'S the unit that will give you greater hourly tonnage capacities, better quality and shape of finished products, lower horsepower per ton of aggregate produced and a higher reduction ratio.

The Cedarapids Model 5050 Double Impeller Impact Breaker can produce up to 400 tons per hour of minus 4" clean, cubical aggregate required in so many specifications today. The smaller models—4040, 3030 and 2020 can deliver from 75 tons per hour—up, depending on the material fed, horsepower used and size product desired.

You can use the Cedarapids Double Impeller Impact Breakers for basalt, cinders, tuff, perlite, limestone, coral rock, sandstone, coal, copper ore, lead zinc ore, low grade iron ore, or dozens of other materials with a relatively low silica content. They will operate in wet, sticky material that jams, packs or clogs conventional machines.

U. S. Pat. No. 2,373,691
2,486,421
Canadian Pat. No.
439,371
Other Patents Pending



## Set up your plants NOW— for stepped up capacity

PUT *your* plant in the big money picture with the high capacity production made possible by the Cedarapids Double Impeller Impact Breaker. Think of the profit in producing greater hourly tonnage of a better product . . . and at the same time reducing your power and maintenance costs, with a lower plant investment! The illustration at the right shows how it is done . . .

Rock is broken by impact (not crushed) into the ideal cubical aggregate required in so many specifications. And a high percentage of the material is *broken in mid-air* by rock striking rock! Result . . . the Breaker can be fed larger rocks, handles greater volume, reduces pit run material to specification size *in one pass.* This extremely high ratio of reduction reduces your plant investment because it eliminates the need for much accessory equipment such as screens, conveyors, secondary crushers, etc.

Stone broken in mid-air requires no power . . . you save on horsepower. Approximately 50% less contact of stone on metal keeps replacement and maintenance costs low.

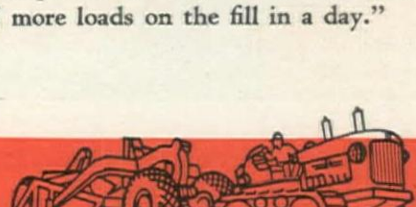
Get this big volume, low cost set-up operating in your plant now!

## IOWA MANUFACTURING COMPANY

Cedarapids

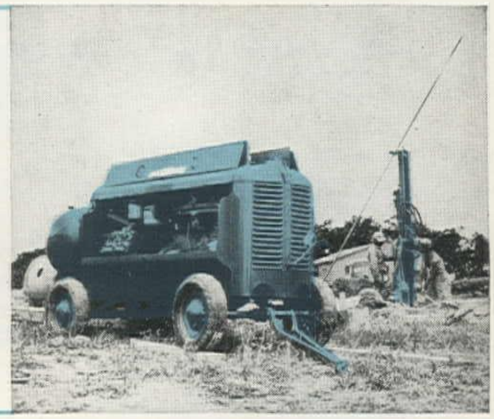
**Cedar Rapids, Iowa, U. S. A.**

Built by IOWA



# You hear it from coast to coast*...

# "It's BLUE BRUTES For My Money!"



***PENNSYLVANIA**

A 315' Portable Compressor and UMW Wagon Drill, one of many Blue Brute teams owned by Cramer Construction Co. of Lebanon, Pa. Pres. G. B. Cramer writes: **"We have used Blue Brutes for several years, and on our Lebanon Veterans' Hospital job have five Blue Brute Compressors powering Worthington Wagon Drills and Rock Hammers. As evidence of their entirely satisfactory performance we recently purchased another 315' Blue Brute Compressor."**

***OHIO**

In Waterville, Ohio, the Crawford Steel Construction Co., Inc., of Cincinnati, erected the structural steel on the new highway bridge across the Maumee River. Company official J. A. Crawford says: **"Our 210' Blue Brute Compressor is efficient, well constructed and rugged. It has given us excellent service, and we are more than willing to recommend it highly . . . This first experience with your products is evidence to us of Blue Brutes' superiority.**

***WISCONSIN**

Opening up a new limestone quarry in Sussex, Wisconsin, is easy work for these rugged, hard-hitting Blue Brute team-mates. The fast, versatile UMW Wagon Drill is drilling 6-foot holes for explosive charges. Power source is a 315' Blue Brute Compressor, that gets all the air out of every drop of fuel. Vice-President Lloyd Wolf of the Quality Limestone Corporation, reports: **"After thorough investigation we decided Worthington equipment was best . . . They are fine machines."**

***OREGON**

It's another Blue Brute UMW Wagon Drill. Ready to swing into action at any angle, it is here helping to cut through a road out where the timber grows tallest. The Kuckenberg Construction Company of Portland, Ore., are the owners and the report from this firm says they **"wish all their other machines on the job were as good . . . and are going to change to Blue Brutes in future replacements."**

From the Atlantic to the Pacific you'll find Blue Brute owners — on every type of construction project, from the smallest to the largest — glad to tell you of the cost-cutting, trouble-free performance that is helping make estimates pay handsomely.

There are a lot of sound reasons for this country-wide acclaim — all adding up to the fact that *there's more worth in Worthington*. Your nearby Worthington-Blue Brute Distributor is ready with those reasons, and can make immediate deliveries. See him, or write us direct.

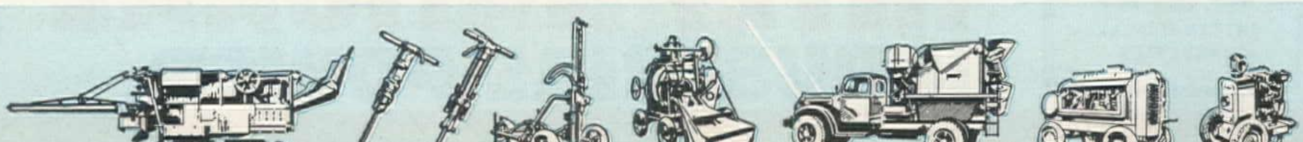
Worthington Pump and Machinery Corporation
Construction Equipment Department
Harrison, New Jersey

*Distributors In All Principal Cities*

**WORTHINGTON**

# BUY BLUE BRUTES

HO.5

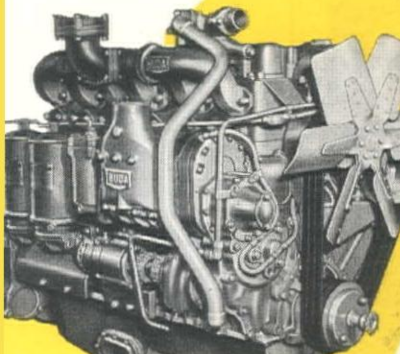


**IF IT'S A CONSTRUCTION JOB, IT'S A BLUE BRUTE JOB**

# MORE POWER
## BUDA 6-DAS 844
**280 h.p. at 2100 r.p.m.**

# MORE POWER
## CUMMINS NHS-600
**275 h.p. at 2100 r.p.m.**


## . . . Now your choice in LAPLANT-CHOATE MOTOR SCRAPERS

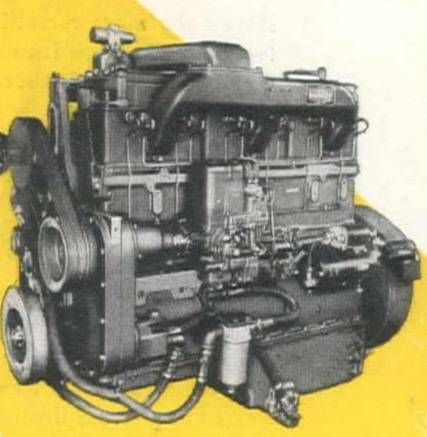


**BUDA DIESEL 6-DAS 844—**
*Here's a newer, bigger Buda Diesel that gives you 20 h.p. per struck yard of capacity . . . a new high in power and performance!*

HERE'S a power boost for the already powerful Motor Scraper . . . a step-up from 225 h.p. to your choice of either 275 or 280 h.p.! Two great Diesels, Buda or Cummins, whichever fits your set-up best. Power to spare in the toughest going! Power that's useable through a heavier final drive! Power that provides new highs in average haul road speeds!

In addition, you get all the original Motor Scraper features: — big capacity . . . big tires . . . double-acting hydraulic steering . . . four-wheel air brakes . . . faster, easier loading . . . positive forced ejection *plus* high apron lift, and many others — your assurance of more yards per trip . . . more trips per hour.

Don't overlook the profit potential of the TS-200—the little earthmoving giant in the 9 to 12 yard class, now available with the Cummins HRB-600, 165 h.p. Diesel.



**CUMMINS DIESEL NHS-600—**
275 h.p. that steps up Motor Scraper production performance and profits to new heights!

LaPlant-Choate Manufacturing Co., Inc.
Cedar Rapids, Iowa

LaPlant-Choate Sales and Service
1022 77th Ave., Oakland, Calif.

# LAPLANT CHOATE

**INDUSTRIAL EQUIPMENT COMPANY**
4441 Santa Fe Avenue — LOS ANGELES 11, CALIFORNIA

**LaPLANT-CHOATE SALES AND SERVICE**
1022 - 77th Avenue — OAKLAND, CALIFORNIA

**WESTERN EQUIPMENT COMPANY**
. O. Box 2196, 3400 E. Olive St. — SPOKANE, WASHINGTON

**ESTERN CONSTRUCTION EQUIPMENT CO.**
505 N. 24th Street, BILLINGS, MONTANA — Stephens & Mount Ave., MISSOULA, MONTANA

**GENERAL EQUIPMENT COMPANY**
1201 East 2nd Street — RENO, NEVADA

**ENGINEERING SALES SERVICE, INC.**
410 Capitol Boulevard — BOISE, IDAHO

**EQUIPMENT SALES CO.**
720 So. 19th Avenue — PHOENIX, ARIZONA

**STUDER TRACTOR & EQUIP. CO.**
East Yellowstone Hwy., P. O. Box 779, CASPER, WYOMING

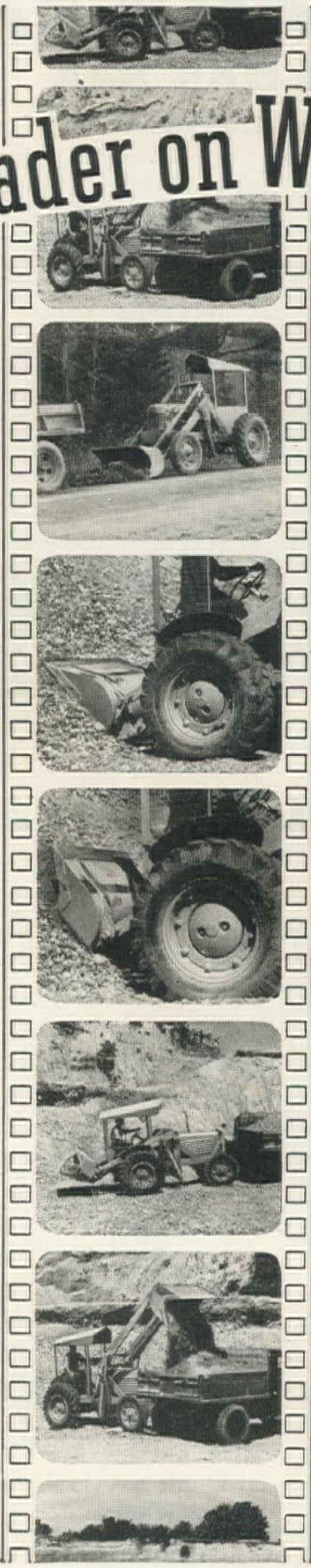
**ARNOLD MACHINERY CO., INC.**
433 West Second South St. — Salt Lake City 1, Utah

**H. W. MOORE EQUIPMENT CO.**
Sixth and Acoma Streets — DENVER 1, COLORADO

**N. C. RIBBLE CO.**
1304 N. Fourth St. — ALBUQUERQUE, NEW MEXICO

**COLUMBIA EQUIPMENT CO.**
1240 S. E. 12th Ave., PORTLAND, OREGON — 5030 1st Ave. South, SEATTLE, WASHINGTON

# Now...
# the Most Versatile Loader on Wheels!

*Conventional front digging, primarily used with Strait-Line where unit digs and moves straight ahead to load.*

*Back digging. Note how extended loading lips easily penetrate the bank.*

*PUSH-TILT action which lifts cutting edge 20" and thrusts it into bank.*

*Carrying position—bucket is tilted to retain load and is carried low enough to increase both traction and stability.*

*Dumping position. Bucket has been carried over the roof and dumps in front.*

Here's the most versatile, practical loader ever developed for wheel tractors. It can dig in front . . . dump in front like the conventional loader. BUT, it can also dig in *back* and load in *front.*

You can dig in back . . . move straight forward to the truck . . . the bucket swings *straight over* the roof . . . and the load is dumped into the truck. Thus you eliminate the turning necessary with ordinary front end loaders . . . eliminate *half* the gear shifts and *half* the clutch wear. You save time and fuel . . . cut operator fatigue. You speed loader operations . . . *can load at better than a yard a minute.*

You get far greater traction and almost effortless steering with the Strait-Line. Rear-carried bucket load adds needed weight to the rear driving wheels . . . subtracts weight from the front steering wheels. Increased traction plus the new PUSH-TILT bucket with extended loading lips, enables you to get bigger bucket loads. Two levers control all operations.

Add them all up . . . ability to select your type of digging, front or back as the job requires . . . Strait-Line operation with back digging which gives you faster operation, greater traction and easy steering . . . fuller buckets . . . and you'll see where your operations can profit with the Strait-Line. For information and literature, see your Oliver Industrial Distributor or write direct to The OLIVER Corporation, 19300 Euclid Avenue, Cleveland 17, Ohio.

THE OLIVER CORPORATION

## THE OLIVER CORPORATION

**State of Arizona: Guerin Implement Co., Phoenix, 1401 S. Central St.; State of California: Gustafson Tractor Co., Eureka; Mechanical Farm Equipment Dist., Inc., San Jose; Ashton Implement Co., Salinas; Comber & Mindach, Modesto; Cal-Butte Tractor Co., 820 Broadway, Chico; Tractor & Equipment Co., San Leandro; Flood Equipment Co., Sacramento; W. J. Yandle Co., Santa Rosa; Jim Ingle Co., Fresno, Hanford and Tulare; Oliver Implement Co., Bakersfield and Shafter; Turner & Chapin, Whittier and Covina; Farmers Tractor & Implement Supply Company, Colton. State of Washington: Inland Diesel & Machinery Company, Spokane; Pacific Hoist & Derrick Co., Seattle and Puyallup; Melcher-Ray Machinery Co., 202 East Alder Street, Walla Walla; Central Tractor and Equipment Co., Wenatchee. State of Oregon: Loggers & Contractors Machinery Co., Portland and Eugene. State of Idaho: Idaho Cletrac Sales Company, Lewiston and Cottonwood; Engineering Sales Service, Inc., Boise. State of Montana: Western Construction Equipment Company, Billings and Missoula. State of Nevada: B & M Tractor & Equipment Corp., 1420 S. Virginia St., Reno. British Columbia: Pacific Tractor & Equipment, Ltd., 505 Railway Street, Vancouver.**

Bottom-Dump Euclids have a struck measure capacity of 13 to 25 cu. yds. . . . powered by a diesel engine of 190 or 300 h.p. . . . loaded top speeds range up to 35 m.p.h.

# "Eucs"

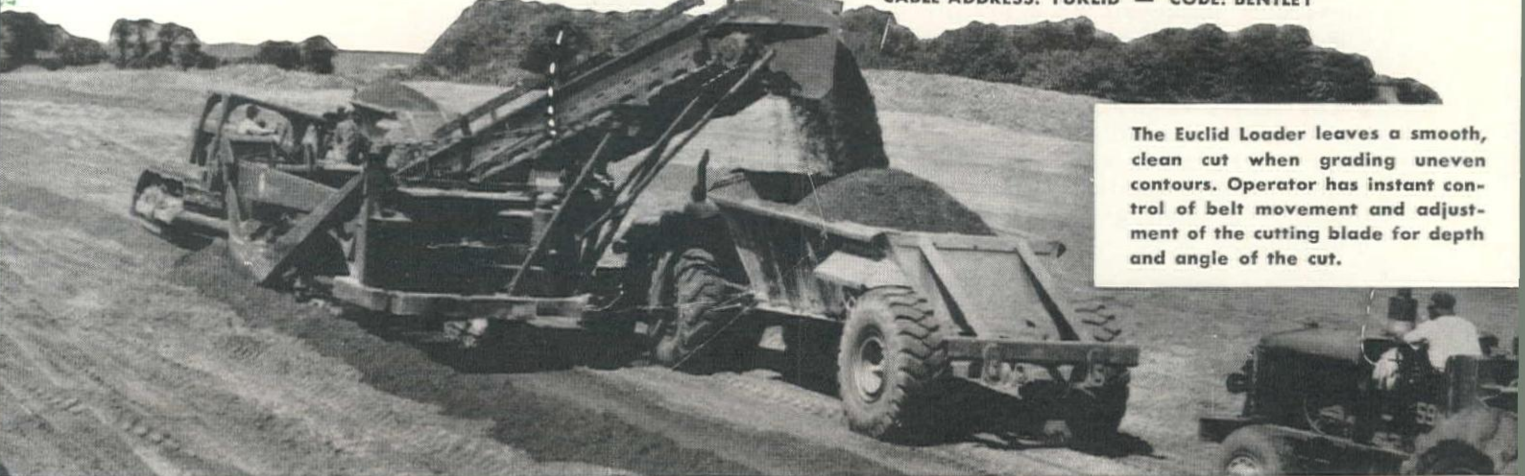
## TEAM UP FOR YOUR EARTH MOVING PROFITS!

Here's a team — the Euclid Bottom-Dump and the Euclid Loader — that has set new records for low cost earth moving on a wide range of jobs... dams, levees, airports, highway and railroad construction, industrial plant grading and overburden removal.

Bottom-Dump Euclids combine rugged construction, large capacity and fast travel speeds for more profit per load. Designed and built for rugged off-the-highway hauling, "Eucs" provide dependable performance and low hauling cost per pay yard. Owners say: "Bottom-Dumps sure do the job, and at lower cost, too."

Built to match the speed and efficiency of other Euclid earth moving equipment, the Euclid Loader is designed for use with Bottom-Dump "Eucs" and other large capacity hauling units. It provides fast, mobile loading of practically any material, from loose sand to hard clay and shale, in a short travel distance.

**The EUCLID ROAD MACHINERY Co.**
**Cleveland 17, Ohio**
**CABLE ADDRESS: YUKLID — CODE: BENTLEY**



The Euclid Loader leaves a smooth, clean cut when grading uneven contours. Operator has instant control of belt movement and adjustment of the cutting blade for depth and angle of the cut.

EUCLID THE PIONEER

**EUCLIDS** *Move the Earth*


● The General L. C. M., for most work off-the-road, has a massive, lugged tread that develops extra traction forward or backward. Exceptionally difficult to cut, chip or bruise even under difficult working conditions.

● The General H. C. T., for most work on-the-road, rolls easily, quietly; gives more safety, more quick-stopping power—rain or shine. Unusually thick, deep tread gives amazingly long mileage.

For lighter trucks—the General All-Grip's thick tread blocks give extra traction on or off-the-highway. Rolls quietly, smoothly; stops quicker . . . rain or shine. Ideal tire for pick-up trucks under heavy loads.

The General Tractor Grader Tire combines maximum drive-wheel traction with two-way, self-cleaning tread design for extra traction, forward or backward. The General Ribbed Grader tire steers easily; prevents side slip.

**THE GENERAL TRUCK TIRE**

**SPECIFY GENERAL TIRES ON YOUR NEW EQUIPMENT**

# PICK FORD POWER...
# RIGHT 3 WAYS!

Ford 239 V-8 Industrial Engine, with four-speed transmission. (Displacement—239 cu. in.)

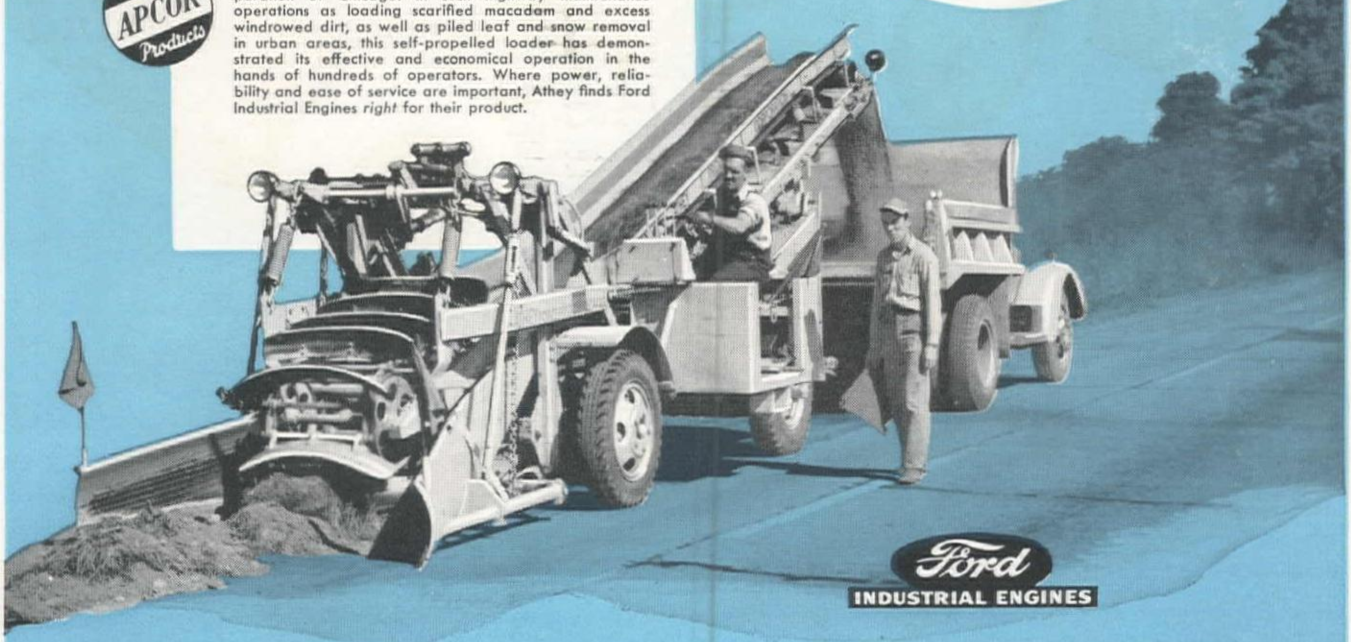
1 **RIGHT POWER** for your job . . . five great engines in the Ford Industrial Engine line. Available as complete power units or engine assemblies—both with a variety of attachments.

2 **RIGHT FEATURES.** Ford Industrial Engines and Power Units incorporate the newest advancements of Ford's famed progressive engineering.

3 **RIGHT SERVICE**—as near as your Ford Dealer, clear around the world!

Athey APCOR Products

A Ford Industrial Engine is the power plant for the Athey Force-Feed Loader, made by the Athey Products Corporation of Chicago. In such highway maintenance operations as loading scarified macadam and excess windrowed dirt, as well as piled leaf and snow removal in urban areas, this self-propelled loader has demonstrated its effective and economical operation in the hands of hundreds of operators. Where power, reliability and ease of service are important, Athey finds Ford Industrial Engines *right* for their product.



Ford INDUSTRIAL ENGINES

● For the *right* power, pick Ford! Five models from which to choose—a Four with 120 cu. in. displacement . . . two Sixes—226 cu. in. and 254 cu. in. displacement . . . two V-eights—239 cu. in. and 337 cu. in. Available both as engine assemblies and complete power units. Completely new, and completely right for farming . . . construction . . . power generating . . . material handling . . . pumping . . . lumbering, many other applications. Write today for specifications.

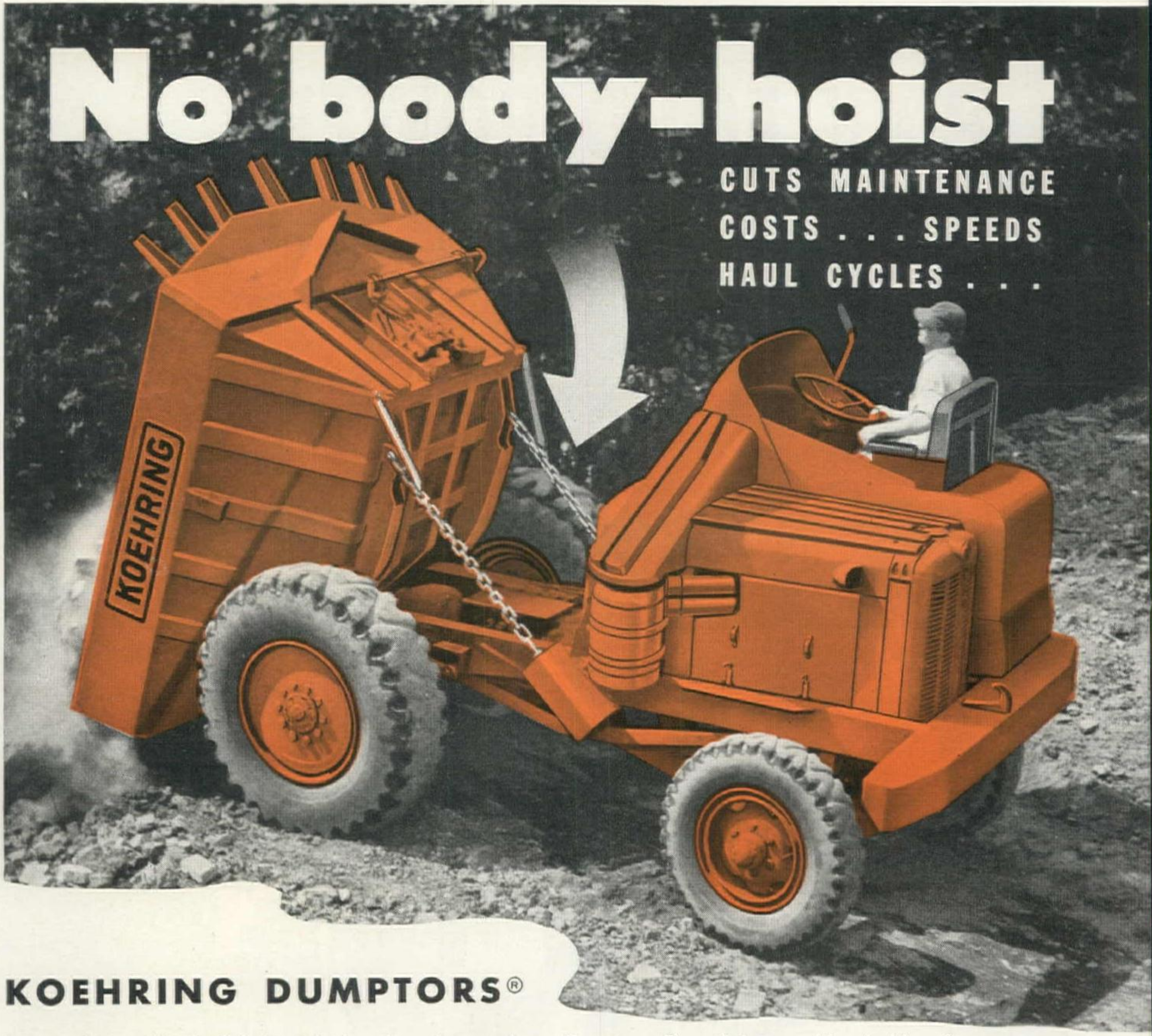
***See your nearest Ford Dealer, Ford District Sales Office, or write direct to***

INDUSTRIAL ENGINE DEPARTMENT

**FORD MOTOR COMPANY**

Dearborn, Michigan

**YOUR JOB IS WELL-POWERED WHEN IT'S FORD-POWERED**




## KOEHRING DUMPTORS®

have no slow-working body hoists. Trip the release lever and gravity dumps the 6-yard load in one second. It's as simple as that! No complicated mechanical hoists to slow up haul cycles . . . no expensive replacement parts, costly hoist maintenance or down time to eat into your profits. And gravity dump is instantaneous and trouble-free in all temperature extremes . . . never wears out.

*No costly spring maintenance* is another money-saving advantage you get with Koehring Dumptors. There is just one big, double-coil chassis spring on steering axle . . . none on driving axle. Extra big, shock-absorbing drive tires eliminate need for more. You save spring maintenance time and replacement costs.

Check your body hoist and spring maintenance costs for a year . . . see how much you'll save by using Dumptors. What's more, Dumptor's no-turn shuttle haul and constant-mesh transmission for 3-speed travel forward and reverse, increase your production . . . and your profits.

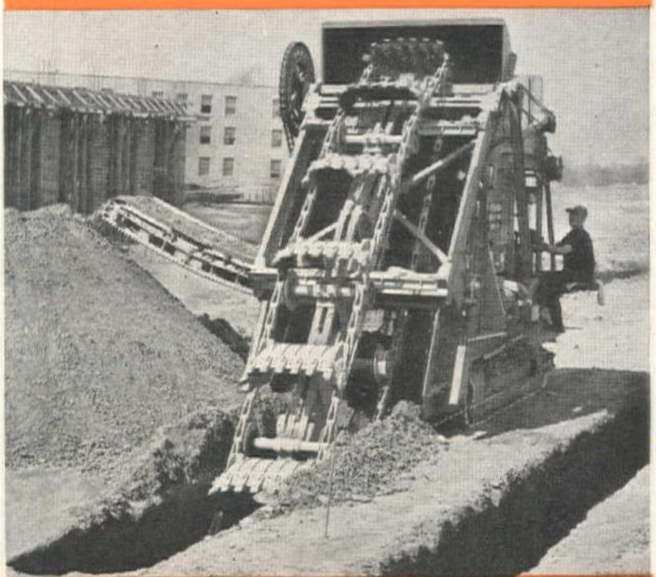
CK114

KOEHRING HEAVY DUTY

**SEE YOUR KOEHRING DISTRIBUTOR FOR COMPLETE FACTS**

**Pacific Hoist & Derrick Co., *Seattle, Washington***
**Western Machinery Co., *Spokane, Washington***
**Columbia Equipment Co., *Boise, Idaho; Portland, Oregon***
**Harron, Rickard & McCone Co. of Southern California, *Los Angeles, California***
**McKelvy Machinery Co., *Denver, Colorado***
**Kimball Equipment Co., *Salt Lake City, Utah***
**Neil B. McGinnis Co., *Phoenix, Arizona***
**The Harry Cornelius Co., *Albuquerque, New Mexico***
**San Joaquin Tractor Co., *Bakersfield, California***
**Engineering Sales Service, Inc., *Boise, Idaho***
**Koehring Company, West Coast Division, *Stockton, California***

# PARSONS TRENCHLINERS®

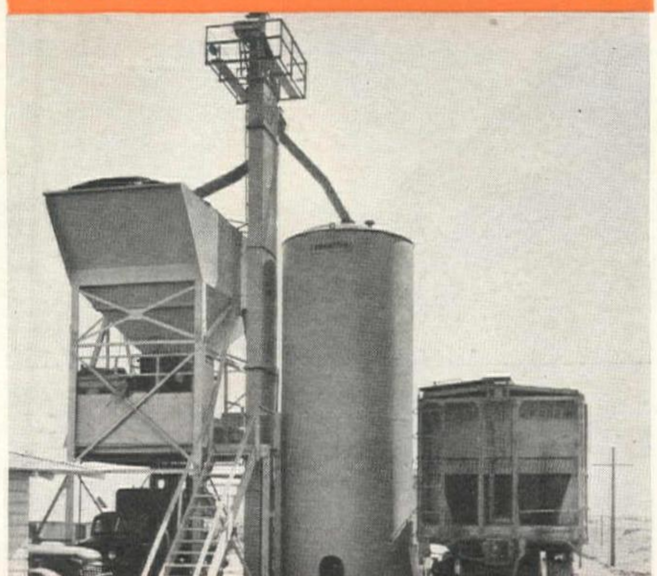


## 45 digging feeds on the 310 . . . from 8" to 15'-6" per minute

. . . provide maximum trenching efficiency under any working condition. This big-capacity Trenchliner also has 2 optional speed selections for travel, bucket line and conveyor belt. All operations are simultaneous and reversible. You get clean, smooth trenches 1½' to 4½' wide, 17' deep with single boom . . . up to 6' wide and 11' depth with dual booms. Single boom shifts across full width of carriage for off-set digging. Reversible power-shift spoil conveyor dumps right or left. Get facts on this 310, or any of the 4 smaller Trenchliners.

| | |
|---|---|
| **Pacific Hoist & Derrick Co.** | ***Seattle*** |
| **Western Machinery Co.** | ***Spokane*** |
| **Columbia Equipment Co.** | ***Portland*** |
| **Harron, Rickard & McCone Co. of So. Calif.** | ***Los Angeles*** |
| **McKelvy Machinery Co.** | ***Denver*** |
| **Kimball Equipment Co.** | ***Salt Lake City*** |
| **Neil B. McGinnis Co.** | ***Phoenix*** |
| **The Harry Cornelius Co.** | ***Albuquerque*** |
| **San Joaquin Tractor Co.** | ***Bakersfield*** |
| **Engineering Sales Service, Inc.** | ***Boise*** |
| **Koehring Company, West Coast Division** | ***Stockton*** |

# JOHNSON Roadbuilders BINS



## Flexible for transit-mix operation . . . this

Johnson Roadbuilders All-Welded Bin can be used as a portable batch plant for handling 2, 3 or 4 aggregates or converts to Transit-Mix Plant, illustrated, or Central-Mix Plant, for bulk cement handling plus 2 or 3 aggregates. Can be equipped with 1 or 2 multiple-material Hi-Speed Batchers, size 34 Roadbuilders Batcher, or with a truck-mixer charging batcher in 2, 3 or 4 yd. sizes. Bin available in 2, 3 or 4 compartments, 50 to 125 cu. yds. Has easy charging 11' width, extra wide openings for fill and discharge, steep, 50° bottom slopes for fast flow.

| | |
|---|---|
| **Bow Lake Equipment Co., Inc.** | ***Seattle*** |
| **Western Machinery Co.** | ***Spokane*** |
| **Cramer Machinery Co.** | ***Portland*** |
| **Harron, Rickard & McCone Co. of So. Calif.** | ***Los Angeles*** |
| **Western Machinery Co.** | ***Salt Lake City*** |
| **Neil B. McGinnis Co.** | ***Phoenix*** |
| **The Harry Cornelius Co.** | ***Albuquerque*** |
| **San Joaquin Tractor Co.** | ***Bakersfield*** |
| **Coast Equipment Company** | ***San Francisco*** |
| **King and Kringel Machinery Corp.** | ***Denver*** |
| **Engineering Sales Service, Inc.** | ***Boise*** |

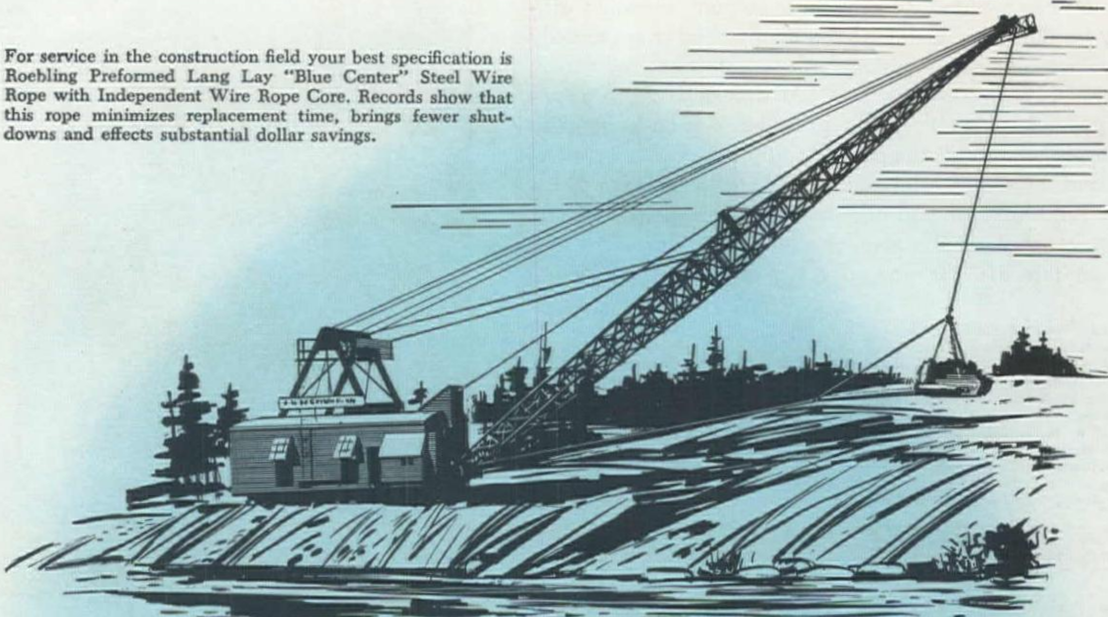
# KWIK-MIX bituminous MIXERS

## Non-tilt, end discharge, 10, 14 cu. ft.

. . . Kwik-Mix Bituminous Mixers offer you many time and money-saving features: non-tilting drum . . . wide, flow-line, power-raised skip . . . pug-mill mixing action . . . blades specially designed to thoroughly coat all aggregates . . . accurate heat control, even oil distribution for top-texture mix . . . 6-second discharge. Both sizes can be used with handy Tower Loader attachment (illustrated), for overhead discharge into trucks. See us for more information about Kwik-Mix 3½-S, 6-S, 11-S and 16-S concrete Dandies [R], 6-P and 10-P plaster-mortar mixers, 4 h.p. power wheelbarrow.

| | |
|---|---|
| **Pacific Hoist & Derrick Co.** | ***Seattle*** |
| **Western Machinery Co.** | ***Spokane*** |
| **Columbia Equipment Co.** | ***Boise, Portland*** |
| **Harron, Rickard & McCone Co. of So. Calif.** | ***Los Angeles*** |
| **McKelvy Machinery Co.** | ***Denver*** |
| **Kimball Equipment Co.** | ***Salt Lake City*** |
| **Neil B. McGinnis Co.** | ***Phoenix*** |
| **The Harry Cornelius Co.** | ***Albuquerque*** |
| **San Joaquin Tractor Co.** | ***Bakersfield*** |
| **Engineering Sales Service, Inc.** | ***Boise*** |
| **Koehring Company, West Coast Division** | ***Stockton*** |

For service in the construction field your best specification is Roebling Preformed Lang Lay "Blue Center" Steel Wire Rope with Independent Wire Rope Core. Records show that this rope minimizes replacement time, brings fewer shutdowns and effects substantial dollar savings.



## Preformed that lasts longer and saves money!... that's why

# *Today it's Roebling!*

YOU WANT ROPE that's *extra* tough, *extra* long-lived! And you *get* these extras in Roebling Preformed "Blue Center" Wire Rope, for "Blue Center" steel has completely superior resistance to abrasion, shock and fatigue. Roebling developed and is the only maker of "Blue Center" steel... and Roebling research, workmanship and modern, precision machines are your added assurance of rope quality that pays off.

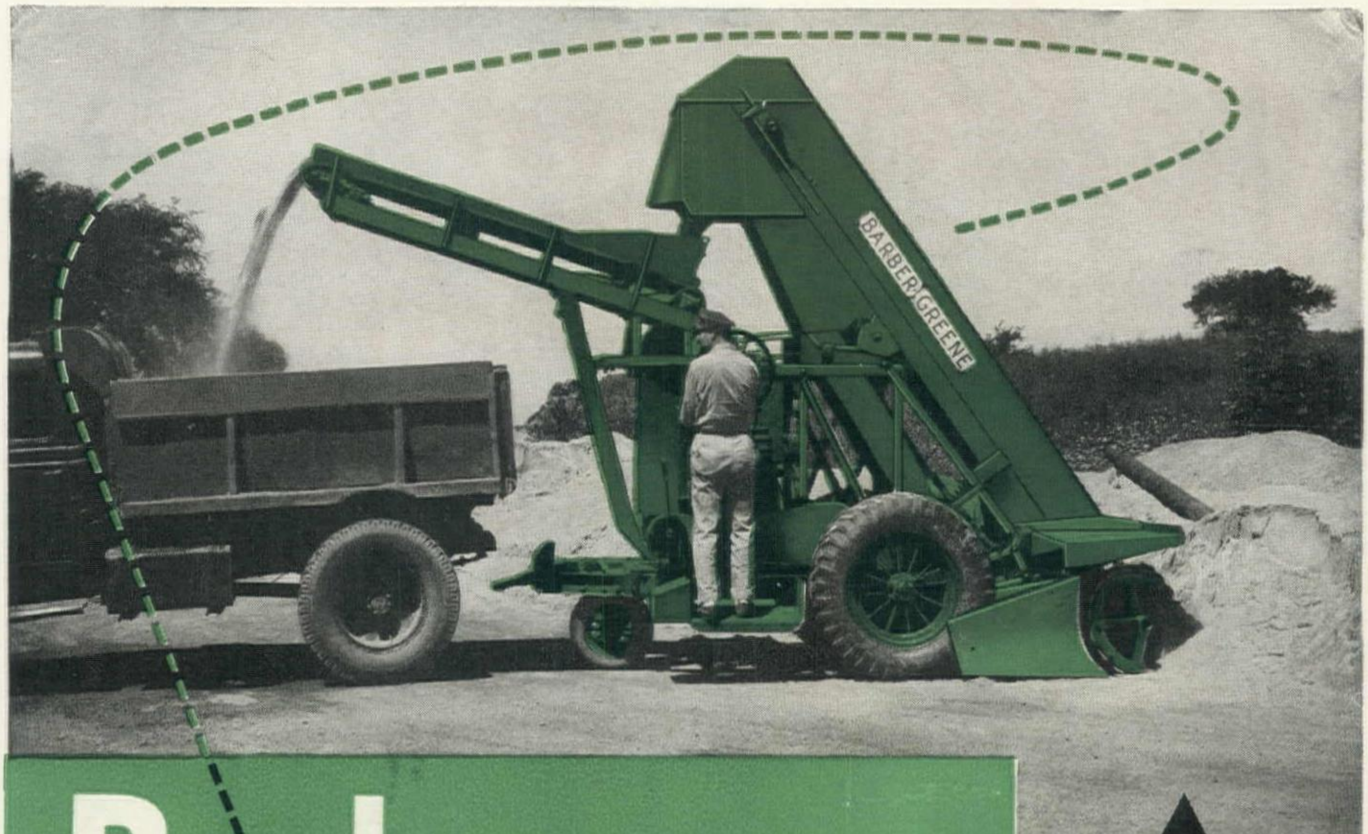
But for everything wire rope can give, be sure to get Preformed. Roebling Preforming makes rope easier to handle and install. It can be cut without seizing. It spools better . . . is not inclined to set or kink . . . minimizes vibration and whipping.

There's a Roebling wire rope of the right construction, grade and size for every type and make of rope-rigged equipment. Have your Roebling Field Man tell you which rope will give the best and the lowest-cost performance for every installation. John A. Roebling's Sons Company of California – San Francisco – Los Angeles – Seattle – Portland.

**ROEBLING**

**A CENTURY OF CONFIDENCE**

***Atlanta,*** 934 Avon Ave. ★ ***Boston,*** 51 Sleeper St. ★ ***Chicago,*** 5525 W. Roosevelt Road ★ ***Cincinnati,*** 3253 Fredonia Ave. ★ ***Cleveland,*** 701 St. Clair Ave., N. E. ★ ***Denver,*** 4801 Jackson St. ★ ***Houston,*** 6216 Navigation Blvd. ★ ***Los Angeles,*** 216 S. Alameda St. ★ ***New York,*** 19 Rector St. ★ ***Philadelphia,*** 12 S. Twelfth St. ★ ***Portland,*** 1032 N. W. 14th Ave. ★ ***San Francisco,*** 1740 Seventeenth St. ★ ***Seattle,*** 900 First Ave. S.




# Barber-Greene

**Model 522**

## Paying Off On Jobs Like Yours . . . .

Want to speed up loading from stock piles? Or have you a variety of truck loading jobs, or clean-up work? Either way, the B-G Model 522 has the portability and the performance you're after.

Companion to the larger B-G Heavy-Duty Loaders, the 522 is a leader in its own right. On its pneumatic tires it's highly maneuverable and is readily towed behind your truck. With its synchronized spiral feed it masters all types of bulk materials to give the constant flow that cuts loading time, cuts costs.

The 522 is ideal for loading, leveling and cleaning up—as so many Barber-Greene users well know. For your information, see your B-G distributor.

1. *Low Boom Swivel Conveyor 522 (shown above) has advantages of low clearance—and side discharge to trucks driving parallel to loader.*
2. *High Boom Swivel Spout 522. For high clearance work where swivel conveyor is not necessary.*
3. *Friction clutch and brake steering. Hi-cleat pneumatic tires.*
4. *Patented B-G Overload Release gives positive protection against overload damage.*

**FOR SALE BY:**

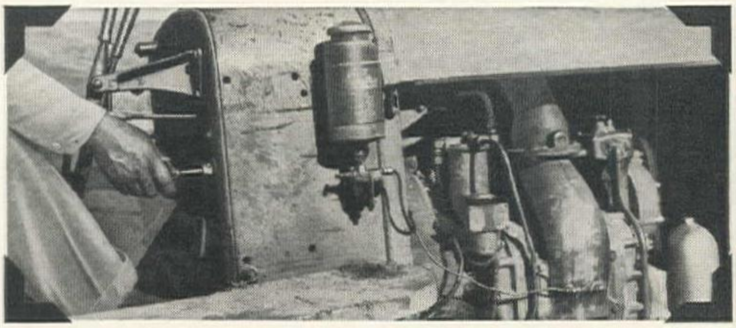
**BROWN-BEVIS EQUIPMENT CO.,** Los Angeles 58, California; **COLUMBIA EQUIPMENT CO.,** Spokane, Washington, Seattle, Washington, Boise, Idaho, Portland 14, Oregon; **WILSON EQUIPMENT & SUPPLY CO.,** Cheyenne, Wyoming, Casper Wyoming; **CONTRACTORS' EQUIPMENT & SUPPLY CO.,** Albuquerque, New Mexico; **RAY CORSON MACHINERY CO.,** Denver 9, Colorado; **JENISON MACHINERY CO.,** San Francisco 7, California; **WESTERN CONSTRUCTION EQUIPMENT CO.,** Billings, Montana, Missoula, Montana; **KIMBALL EQUIPMENT COMPANY,** Salt Lake City 10, Utah; **STATE TRACTOR & EQUIPMENT CO.,** Phoenix, Arizona.

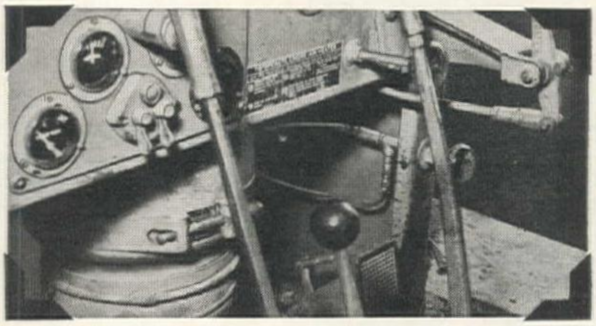
# STANDARD ENGINEER'S REPORT

**DATA**

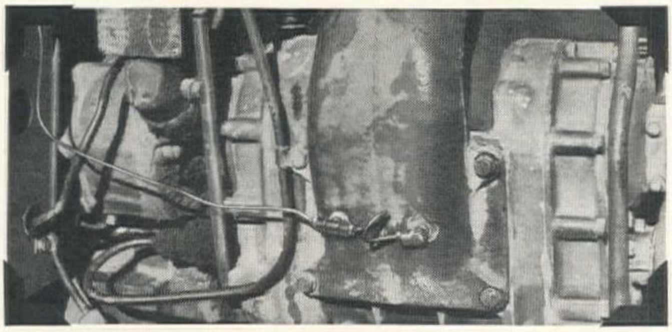
| | |
|---|---|
| PRODUCT | Chevron Starting Fluid |
| UNITS | A. C. diesel engines HD-7 tractors |
| CONDITIONS | 25° below zero weather—parked in open shed |
| EQUIPMENT | Permanent primer with atomizers on blower |
| FIRM | John W. Graves Heppner, Oregon |

# Engine starts on first turn at 25° below zero!



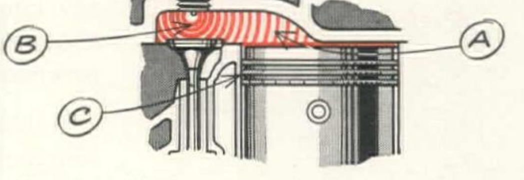


CHEVRON STARTING FLUID started this engine instantly every time during a severe Oregon winter, even when the tractor had been idle for several days in temperatures down to 25° below zero! John W. Graves, owner, says, "Power in the starter battery would last only for two or three revolutions of the engine, but Chevron Starting Fluid required only one turn to kick it off." With one or two strokes of the dash-mounted pump, fluid was forced from the storage tank (left center) into the "blower", before the starter button was pushed.



ATOMIZER NOZZLES, as shown on this diesel "blower", are also used to inject Chevron Starting Fluid into intake manifolds of gasoline engines. Complete primer equipment may be purchased from your fluid supplier. Chevron Starting Fluid comes in 3-pint cans, and capsules of two sizes—7CC's and 17CC's, packed 12 and 24 per can. It is approved by leading engine manufacturers.

## How CHEVRON Starting Fluid Starts Gasoline and Diesel Engines Instantly




A. Atomizes in lowest temperatures and provides powerful, easily fired vapor in combustion chamber.

B. Pressure, or the weakest spark, fires mixture—turns engine and heats air for regular fuel mixture.

C. Contains lubricant and additives—prevent cylinder wear and ice formation in primer equipment.


FREE BOOKLET gives you more facts on Chevron Starting Fluid—shows where it should be applied in different type engines. Write or ask for it today.

CHEVRON STARTING FLUID

TRADEMARK REG. U.S. PAT. OFF

STANDARD TECHNICAL SERVICE checked this product performance. For expert help on lubrication or fuel problems, call your Standard Fuel and Lubricant Engineer or Representative; or write Standard Oil Company of California, 225 Bush St., San Francisco.

**STANDARD OIL COMPANY OF CALIFORNIA**

MINNEAPOLIS-MOLINE MM MODERN MACHINERY

# INDUSTRIAL WHEELERS

**FLEXIBILITY • SPEED • HIGH CAPACITY WITH MINIMUM OPERATOR FATIGUE**

## "Front-End Designed*"

**FOR FRONT-END ATTACHMENTS**

* Dependable performance of MM Industrial Wheelers is obtained by heavy-duty industrial design. Their outstanding efficiency for handling all jobs is largely the result of their flexibility in operation with a complete selection of attachments.

Heavy-duty H-section front axle, front wheels that are heavy cast and inset for easy steering, and oversize tires provide load capacities up to 10,000 lbs. without overloading.

The "shuttle gear" for fast reversing . . . roller steering that makes easier handling of any load . . . enable MM Industrial Wheelers to handle more loads per hour on loading and dozing jobs with less operator fatigue.

## "Drawbar Designed*"

**FOR PULL-BEHIND ATTACHMENTS**

* MM Industrial Wheelers are available with adjustable pintle hook or swinging drawbar for a wide range of job applications . . . they give you extra utility and greatest flexibility.

A selection of single or dual rear tire equipment is available for maximum flotation and grip on all surfaces.

Front, side, and rear power take-offs provide direct drive for all hydraulically or mechanically operated equipment.

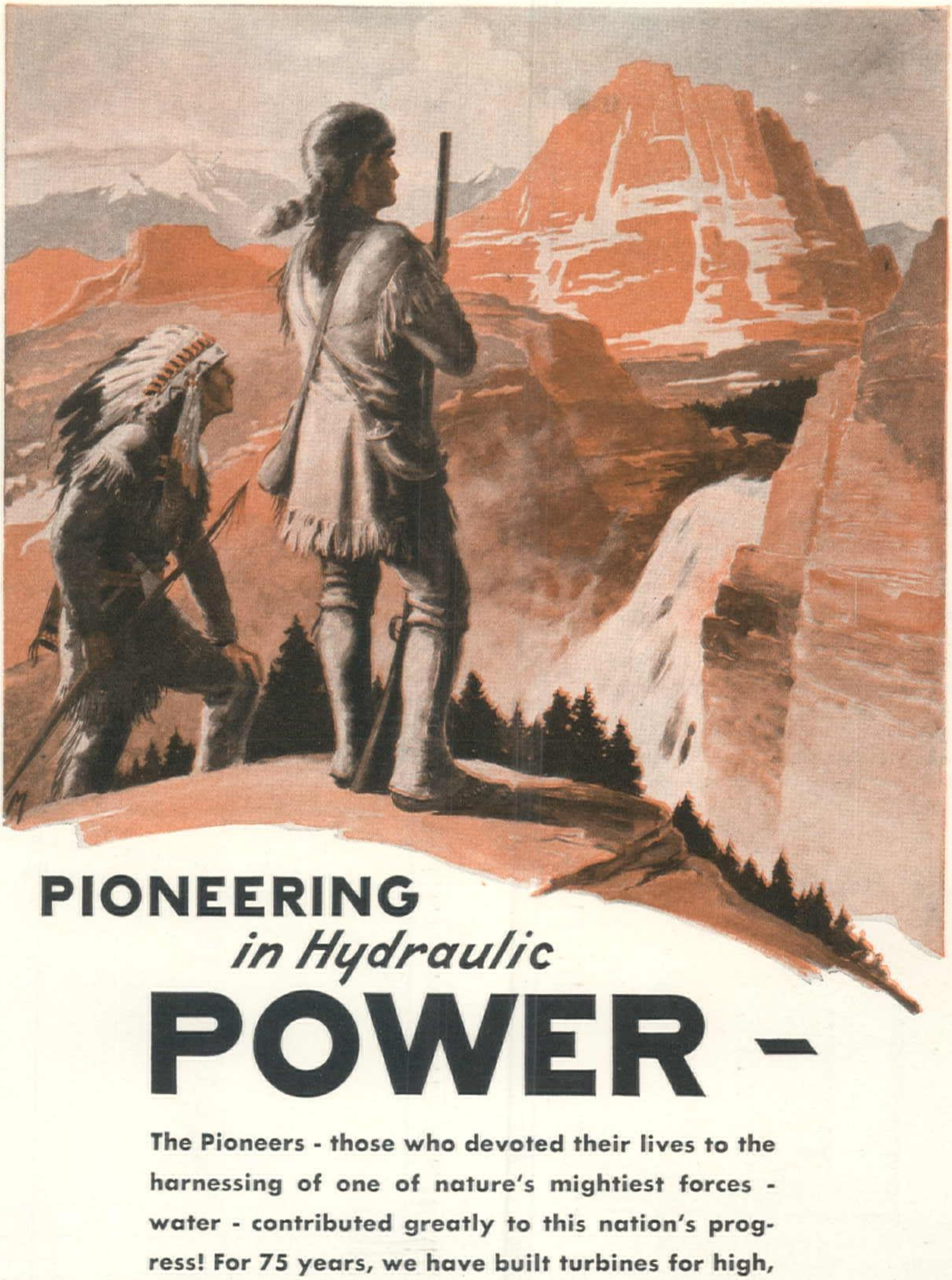
**SOLD AND SERVICED BY**

LEE REDMAN EQUIPMENT CO....................Phoenix, Ariz.
EDWARD R. BACON CO....................San Francisco, Calif.
CLYDE EQUIP. CO.........Portland, Ore. & Seattle, Wash.
MODERN MACHINERY CO........................Spokane, Wash.
THE SAWTOOTH CO....................Twin Falls & Boise, Idaho
REED HARDWARE & IMPLT. CO.............Idaho Falls, Idaho
MISSOULA MERC. CO..........................Missoula, Montana
HAMILTON EQUIPMENT CO...............Salt Lake City, Utah
HARRY CORNELIUS CO...........Albuquerque, New Mexico
BASIN TRUCK & IMPLT. CO.................Durango, Colorado
CONSTRUCTORS EQUIPMENT CO...........Denver, Colorado
LADD LUMBER & MERC. CO..................Pueblo, Colorado
CENTRAL MACHINERY CO..............Great Falls, Montana
CROSKREY-CARLSON CO.....................Kalispell, Montana
NORINE MOTORS, INC.......................Bozeman, Montana
MILLS IMPLT. CO..................................Billings, Montana
TRACTOR & EQUIPMENT CO.............Miles City, Montana
WYOMING ELEV. & SUPPLY CO.........Worland, Wyoming
GARVEY TRUCK SERVICE..........................Stockton, Calif.
CASEY-METCALF MACHY. CO., INC.....Los Angeles, Calif.

*Get Complete Information*

**FROM YOUR NEAREST MM DEALER**

**MINNEAPOLIS-MOLINE**
**MINNEAPOLIS 1, MINNESOTA**



# PIONEERING
## *in Hydraulic*
# POWER -

**The Pioneers - those who devoted their lives to the harnessing of one of nature's mightiest forces - water - contributed greatly to this nation's progress! For 75 years, we have built turbines for high, medium and low heads, many types of valves, hoists and gates, pumps, trash rack rakes and kindred hydraulic equipment. Put your problem up to us.**

**S. MORGAN SMITH Co.**
YORK. PENNA. U.S.A.

# Here's Why

# YOU GET TOP PERFORMANCE FROM BUCYRUS-ERIE DREDGES

Bucyrus-Erie has been building successful dredges since 1884 . . .

. . . scores of these dredges now in operation bear out the superiority of Bucyrus-Erie's "years ahead" engineering design . . .

. . . "on the spot" control of all stages of production — in our own laboratories, shops and foundries — assures you of top craftsmanship and finest materials in your Bucyrus-Erie dredge . . .

. . . Bucyrus-Erie manufactures all types of dredges to deliver top output on any job site.

At Bucyrus-Erie, the first step toward building a successful dredge is the gathering of complete information about your job. Such considerations as availability of power, distance to spoil area, water conditions, type of material to be excavated, source of fresh water for cooling purposes —to name only a few — are carefully analyzed.

With the complete picture thus obtained, Bucyrus-Erie's "years ahead" engineering sets to work. Your dredge is designed to deliver outstanding performance with low operating cost year after year. Engineering experience and foresight combine to assure this goal.

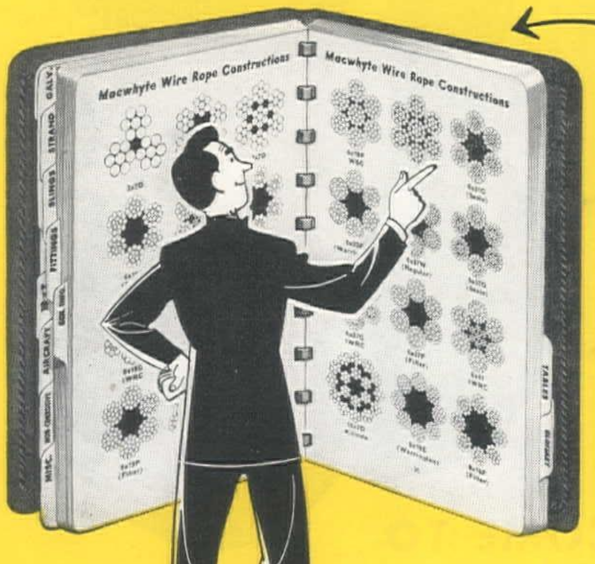
Next, Bucyrus-Erie's extensive foundries, laboratories and shops "bring to life" the custom design. Casting, metal-hardening, testing, machining and assembling are done in our own shops and laboratories under the guidance of skilled engineers and foremen schooled in years of "know how." Special alloy steels and heat treating procedures, for example, receive the continuous surveillance that guarantees best results.

When your dredge is completed, you can anticipate — as have Bucyrus-Erie customers for over 65 years — long-term peak performance.


**Bucyrus-Erie Company,** South Milwaukee, Wisconsin

BUCYRUS ERIE

# WHY guess about wire rope selection?




# GET the right wire rope for each job!

**You get better service when you order the right rope from**

***the thousand and one wire ropes***

***made by* MACWHYTE**


A Macwhyte representative will gladly supply you with specifications for the correct rope to use on each machine you have. Call your Macwhyte distributor, or write direct to Macwhyte Company for recommendations. Catalog on request.

**MACWHYTE COMPANY • Portland • Seattle • San Francisco • Los Angeles**

*Manufacturers of Monarch Whyte Strand PREformed, Internally Lubricated Wire Rope, ATLAS Braided Wire Rope Slings, Aircraft Cables and Assemblies, Monel Metal and Stainless Steel Wire Rope.*

804-L


List 58½ — (Short face to face), Rising Stem, Low Pressure, Double Disc Iron Gate Valve

List 25 — Rising Stem, Solid Wedge, Iron Gate Valve

# COME TO CHAPMAN

## for Standard Gate Valves

### *... For all purposes ... For all pressures ... In all sizes*

Be sure to check Chapman first whenever you need standard gate and check valves. Here you'll find iron valves in a complete range of sizes—both solid wedge and double disc types—for a complete range of working pressures from 25 to 800 lbs. for steam, water, oil or gas service. Operation may be by hand wheel, with or without bevel or spur gearing, floor stand, electric motor, hydraulic or pneumatic cylinder.

If, however, you need bronze valves — we have them. Just as we have a complete line of steel valves. And valves of many other types such as tilting disc, iron and steel check valves. Whenever special valves for unusual service are required, Chapman engineers will be glad to help you develop them.

**The Chapman Valve Manufacturing Company**

INDIAN ORCHARD, MASSACHUSETTS

**Most outstanding increase in steel-making capacity in the West (since World War II) has been that of the Kaiser Fontana plant . . . ”**

THAT quotation from *Iron Age*, authoritative journal of the steel industry, is confirmed by these facts:

Kaiser Steel's Fontana plant has increased ingot production from 553,000 tons in 1944 to an estimated 1,200,000 tons for 1950—doubling the output of the peak war year!

Equally important is the diversification which has taken place in the past nine years. Kaiser Steel now makes the following products which were not produced in the seven western states prior to World War II: Plates, continuous weld pipe, electric weld pipe, cold rolled strip and sheet, alloy bars, and certain sizes of structural shapes.

Today, when more steel is vitally needed, Kaiser Steel looks forward to further expansion.

This constant growth is another reason why the West's only integrated *independent* steel plant is bringing more industry, more jobs, more wealth to the West!

***It's good business to do business with***

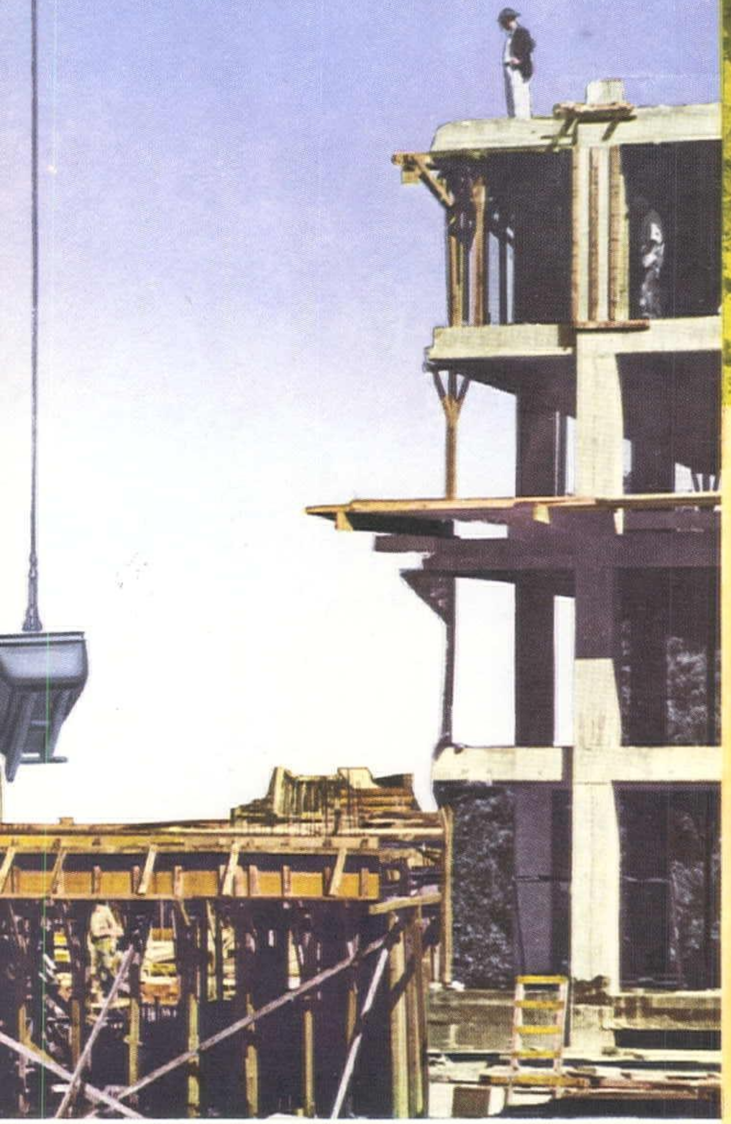
# Kaiser Steel

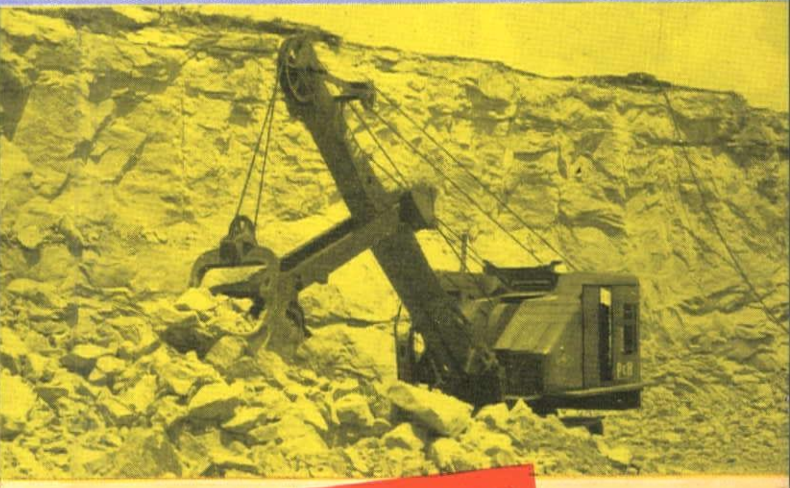
***built to serve the West***

**PROMPT, DEPENDABLE DELIVERY AT COMPETITIVE PRICES** • plates • continuous weld pipe • electric weld pipe • hot rolled strip • hot rolled sheet • alloy bars carbon bars • structural shapes • cold rolled strip • cold rolled sheet • special bar sections • semi-finished steels • pig iron • coke oven by-products For details and specifications, write: **KAISER STEEL CORPORATION, LOS ANGELES, OAKLAND, SEATTLE, PORTLAND, HOUSTON, TULSA, NEW YORK**

# ER STABILITY

## THE HOOK





LOOK TO **P&H** FOR ADDED VALUES

### GIVES YOU MORE POWER AT THE TOOTH POINT

Stability is the major function of digging power, too. The same stability which gives P&H greater lifting capacity also gives you more tooth point digging power. Without useless deadweight, you have more power available . . . faster overall operation . . . lower production costs.

1. All welded construction of rolled alloy steels . . . originated by P&H . . . more highly developed by P&H.
2. True tractor type crawlers, most efficient traction on any excavator. You can make sharp or gradual or about-face turns.
3. Low pressure hydraulic control is smoother . . . more responsive . . . easier on both operator and machine.
4. Rapid reversing planetary chain crowd gives you faster, more positive bite. Crowd chain outlasts 20 to 30 crowd cables.
5. Simpler design gives you an easier machine to work on . . . simplifies maintenance . . . reduces lay-up time . . . cuts costs.

*Only P&H gives you these Added Value features and at no extra cost.*

## ASK YOUR P&H DEALER

ALLIED EQUIPMENT CO.
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BERGLUND TRACTOR & EQUIP. CO.
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LOGGERS & CONTRACTORS MACHY. CO.
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82 Beale Street

Warehouse, Service Stations:
Seattle
Los Angeles
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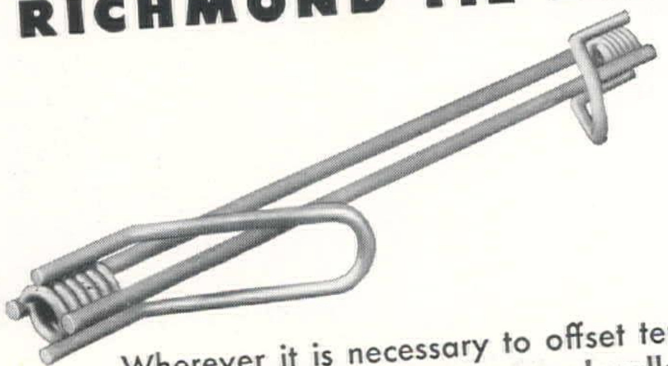
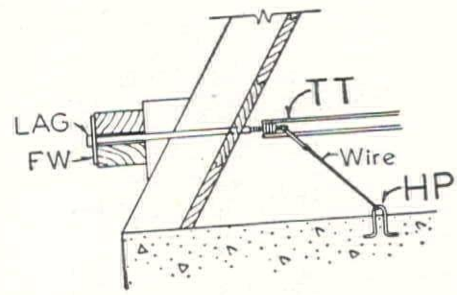
# RICHMOND TIE DOWN TYSCRU



Wherever it is necessary to offset tendencies toward uplift in the form, such as on battered walls, this Richmond Tyscru is the simple and efficient answer. It is a standard 2-strut Tyscru with a 45° Tie Down Loop at one or both ends. The loop is wired to a Hairpin or Ty-loop imbedded in the footing. Richmond's Technical Department will gladly demonstrate the advantages of this device by preparing working drawings and estimates on your next job.





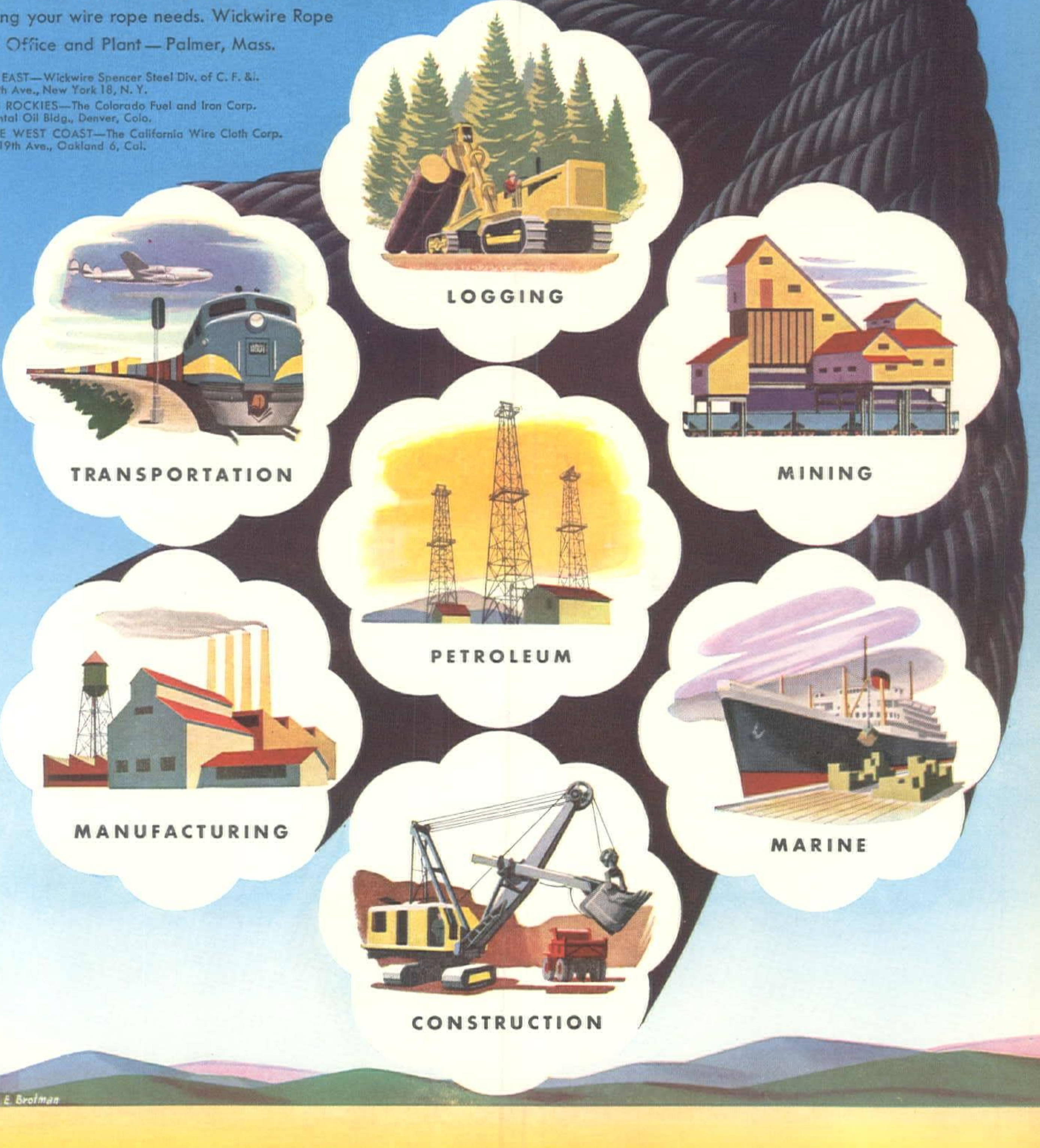
**RICHMOND KNOW-HOW—DEPENDABILITY—SERVICE—ESTIMATES & JOB PLANNING**

# WICKWIRE ROPE A PRODUCT OF CF&I

## Ask any user . . . you'll find them everywhere

In scores of industries, users of Wickwire Rope have developed an affectionate respect for its performance, safety and long life. And, for true economy, they use Wickwire's WISSCOLAY® Preformed. It lasts longer — is easier to cut, splice and install. It's kink-resistant and safer to handle. Wickwire Distributors and Rope Engineers, in key cities everywhere, are prepared to render prompt service in meeting your wire rope needs. Wickwire Rope Sales Office and Plant — Palmer, Mass.

IN THE EAST—Wickwire Spencer Steel Div. of C. F. &I.
500 Fifth Ave., New York 18, N. Y.
IN THE ROCKIES—The Colorado Fuel and Iron Corp.
Continental Oil Bldg., Denver, Colo.
ON THE WEST COAST—The California Wire Cloth Corp.
1030—19th Ave., Oakland 6, Cal.




**OPERATORS KNOW** their position on a loader is important to their safety. On a LULL SHOVELOADER, they know they are well clear of moving arms and falling rocks. They know they have full freedom of movement without fear of the giant they operate.

**OPERATORS ARE CONFIDENT** in the SHOVELOADER'S safe, versatile operation. They like its safer lifting, loading, scraping, bulldozing, digging and transporting. Accidents cost man hours, law suits, and increase insurance rates. Get the facts about LULL SHOVELOADER'S safety today!

**THE LULL LOG LIFTING FORK,** like all other LULL attachments, has the same LULL safety design as the SHOVELOADER. Even with the high lift of the lifting fork, the operator is well clear of falling logs and moving arms. Log stacking can be dangerous but not with a LULL LOG LIFTING FORK.


LULL Manufacturing Company
3612 East 44th Street, Minneapolis 6, Minn.
Please send illustrated literature on:
LULL SHOVELOADER
AND ATTACHMENTS

Name.................... Title....................

Company ....................

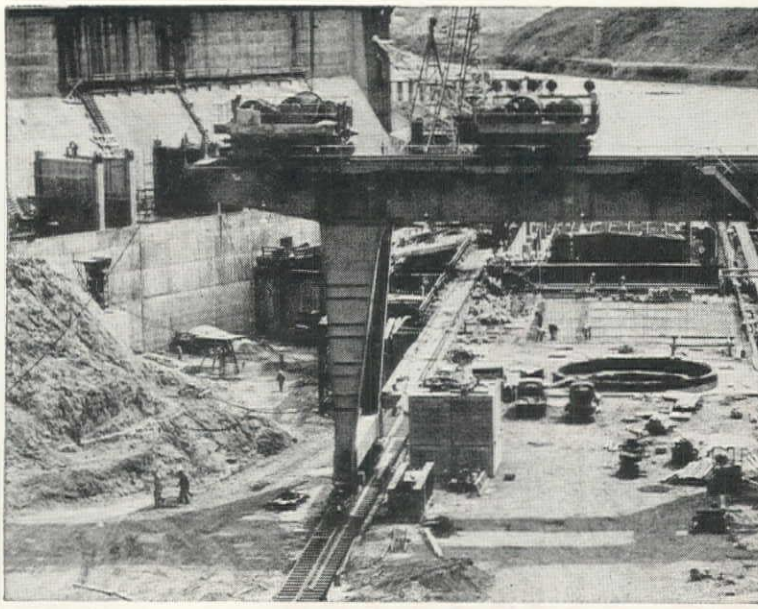
Address ....................

City.......... 12 . . . . State..........

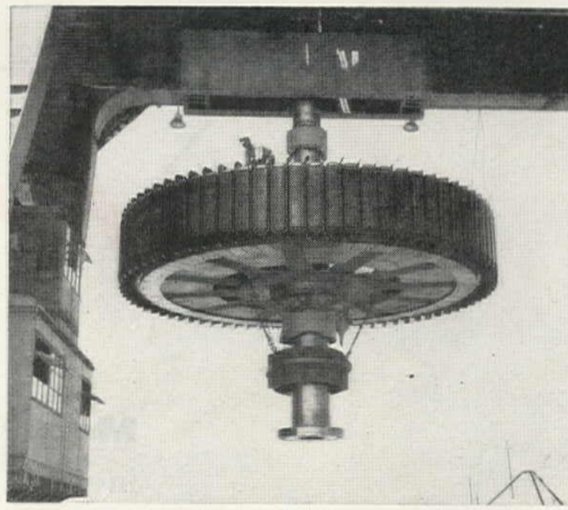
**LULL Manufacturing Company**
3612 East 44th Street Minneapolis 6, Minn.

Designers and Builders of
The Largest Line of Allied Equipment
for Industrial Wheel Type Tractors

**SHOVELOADERS ● UNIVERSAL LOADERS ● FLUID-DRIVEN SWEEPERS ● LULLDOZERS ● SHOULDER MAINTAINERS**



325-ton G-E powered gantry Star Iron and Steel crane at the Davis Dam site on the Colorado River. The crane must operate almost continuously during installation of five turbine generators.



G-E hoist motors and control lift and accurately position turbine-generator rotors weighing over 300 tons.

# Jogging a 325-ton load 1/10,000 inch at a time

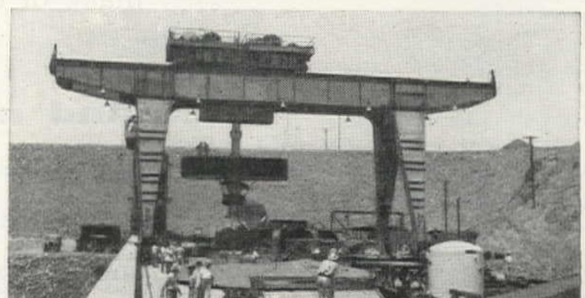
*... Electrically*

## G-E powered DAVIS DAM CRANE positions heaviest loads accurately, smoothly, safely

It's an unusually versatile crane drive that can either handle an empty hook at twice rated speed, or jog a 325-ton load to within 1/32 inch. Bureau of Reclamation's specifications for Davis Dam outdoor powerhouse crane called for just that type of operation.

The General Electric drive beat the requirements for this job by a wide margin—the full-load jogging accuracy in the lowering direction was .000114 inch.

Electrified construction equipment can work for you too—can give you the fast, safe, efficient service your job calls for. And when you combine G-E motors and control with a G-E power distribution system, you'll get all that electrified equipment can offer with the extra benefits of G-E engineering assistance in application, installation and service. *Apparatus Dept, General Electric Company, Schenectady 5, N. Y.*



From hoist and trolley motors atop the bridge to master switches inside the cab, all G-E equipment on this Star Iron and Steel crane works smoothly to move heavy loads accurately and safely.

*Ask him Today!*

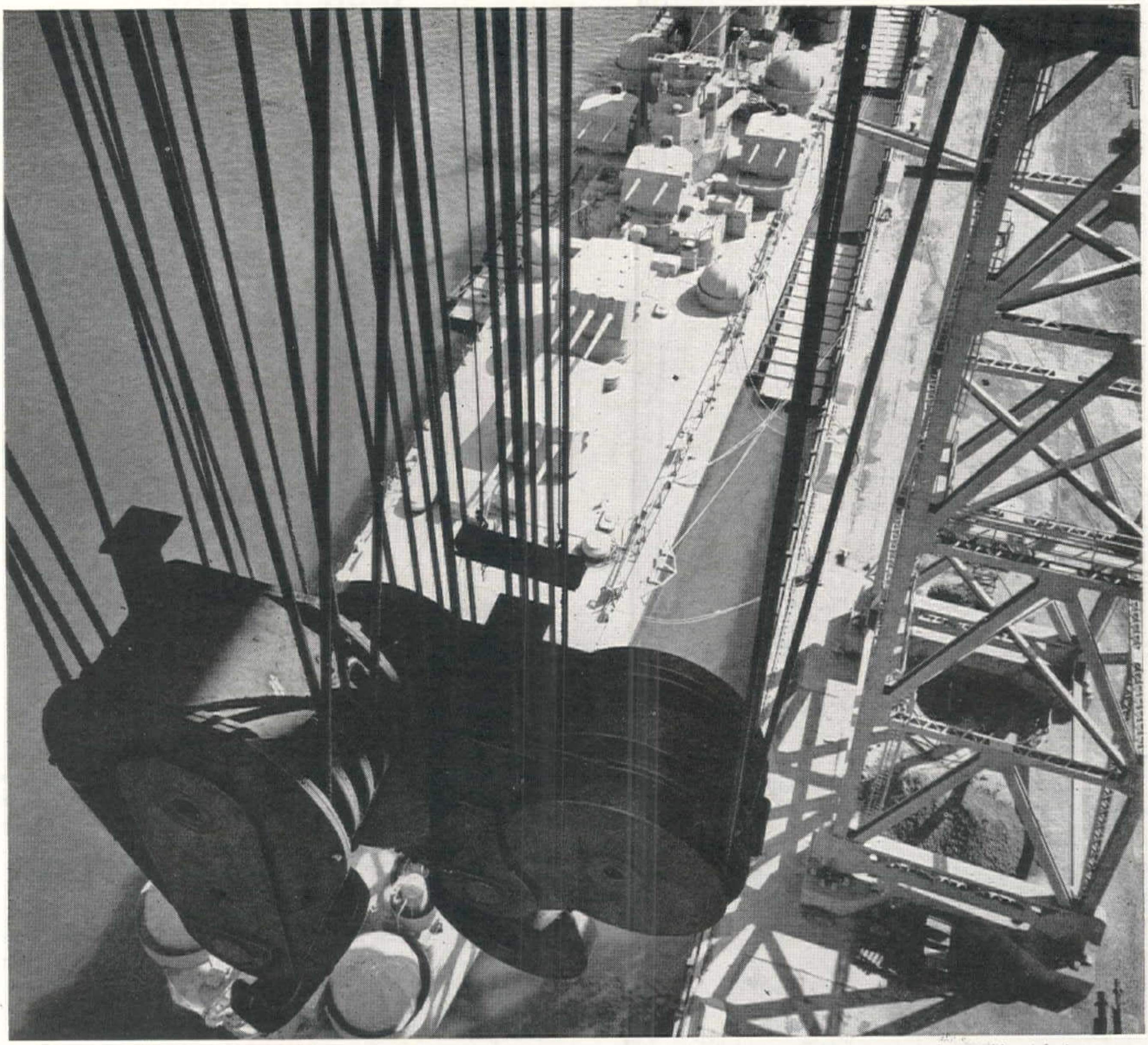
Whether you buy or build construction equipment, your G-E representative can show you how to do a better job—at lower cost—by complete electrification. Write him now, and he'll call on you at your convenience.

WESTERN PLANTS OR SERVICE SHOPS: Anaheim, Denver, Los Angeles, Oakland, Ontario, Portland, Richland, Salt Lake City, San Diego, San Francisco, San Jose, Seattle. WESTERN SALES OFFICES: Albuquerque, Bakersfield, Butte, Denver, Eugene, Fresno, Los Angeles, Medford, Oakland, Pasco, Phoenix, Portland, Riverside, Sacramento, Salt Lake City, San Diego, San Francisco, San Jose, Seattle, Spokane, Stockton, Tacoma.

*Electrified Construction*
BETTER PRODUCT
LOWER COST

**GENERAL ELECTRIC**

664-13



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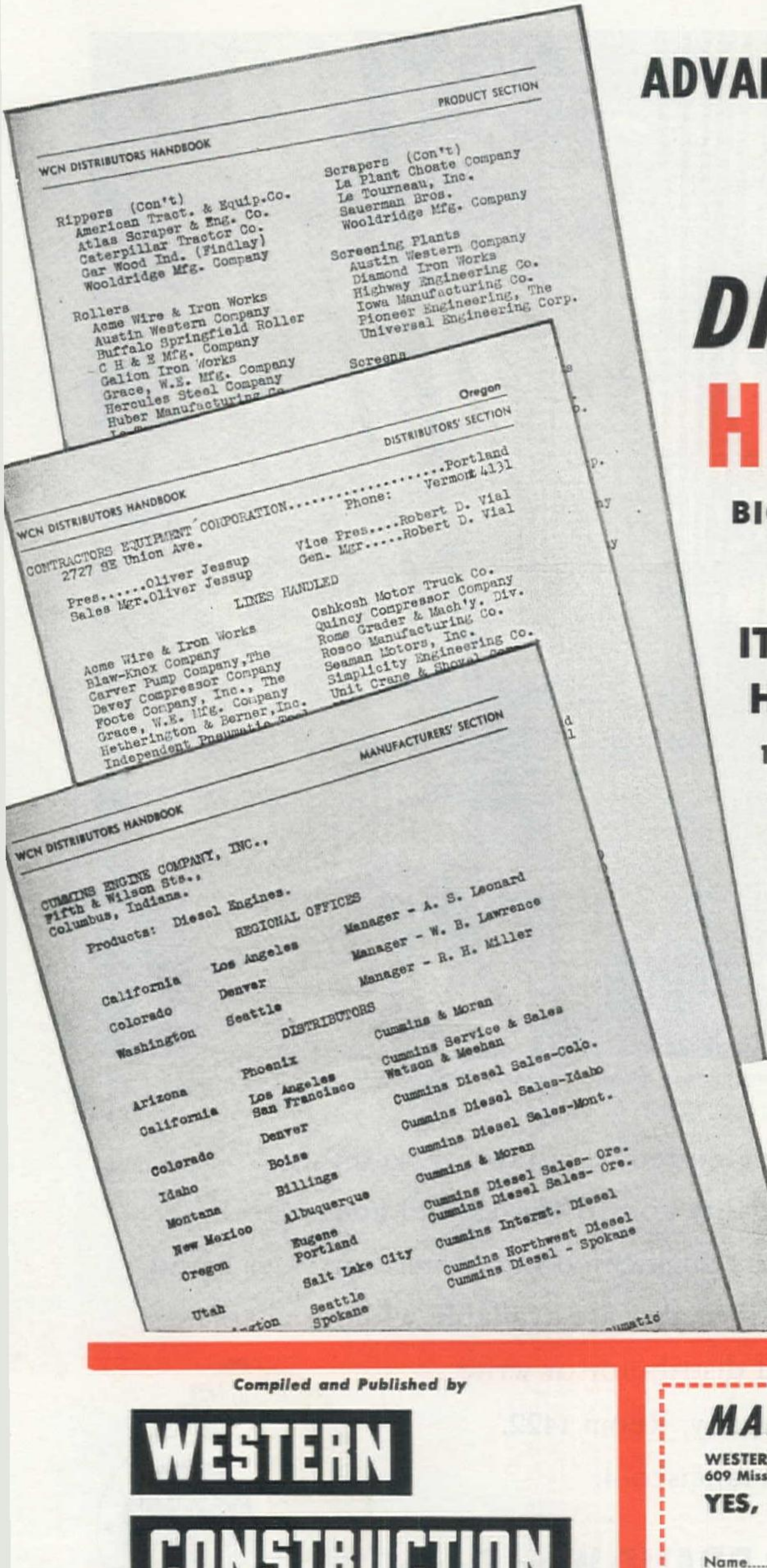


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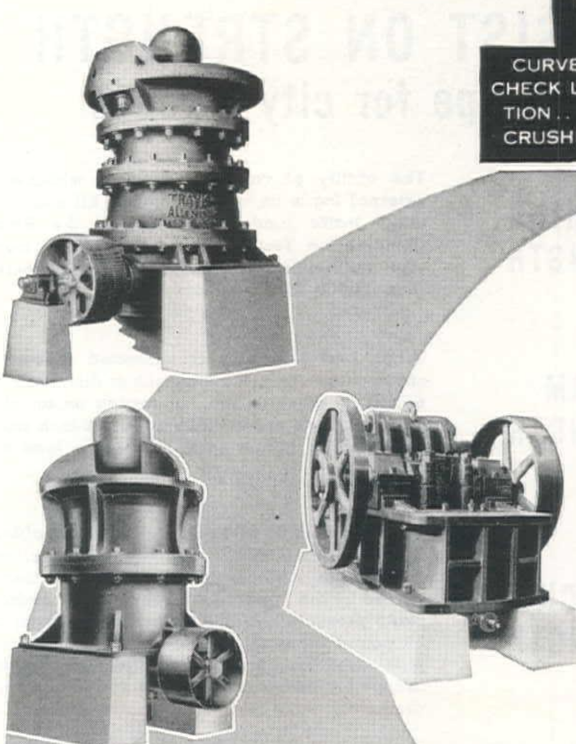

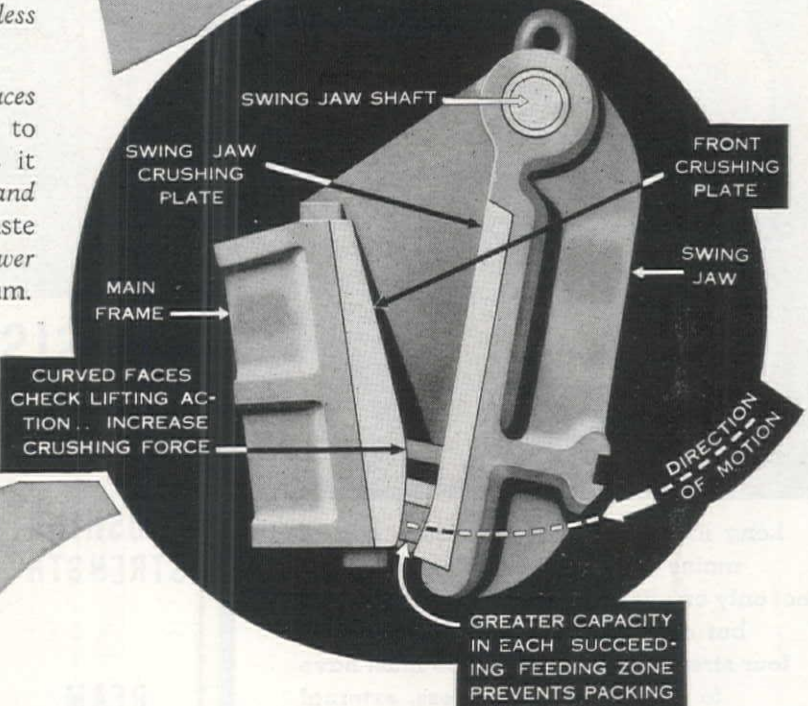


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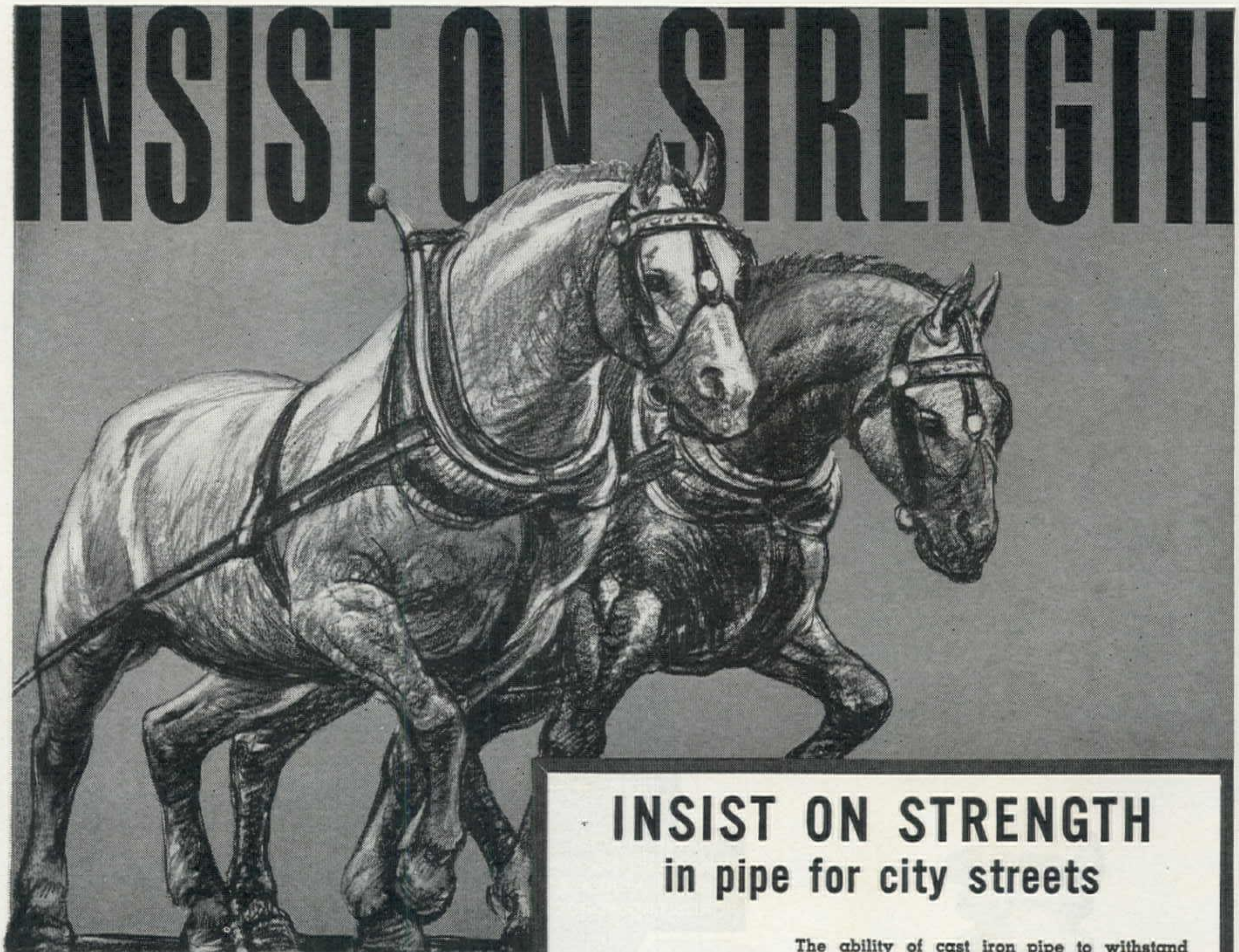


# INSIST ON STRENGTH
## in pipe for city streets

Long life and low maintenance cost of mains laid under city streets depend not only on effective resistance to corrosion but on definite strength factors. The four strength factors that pipe must have to withstand beam stress, external loads, traffic shocks and severe working pressures, are listed in the box opposite. No pipe that is deficient in any of these strength factors should ever be laid in paved streets of cities, towns or villages. Cast iron water and gas mains, laid over a century ago, are serving in the streets of more than 30 cities in the United States and Canada. Such service records prove that cast iron pipe not only resists corrosion but combines all the strength factors of long life with ample margins of safety.

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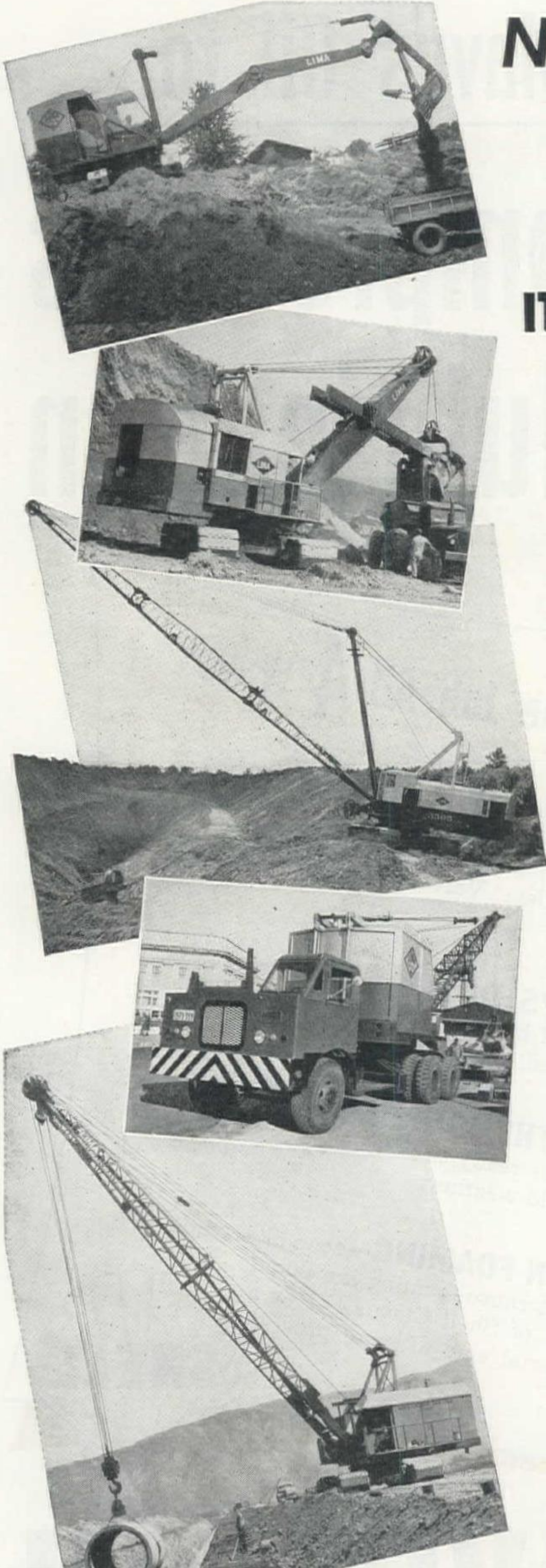

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The new 6½ yard machine enables you to **deliver more yards of concrete per man hour and per truck hour.** It is designed to load, mix and discharge, at record speed, even dry or low slump batches. Handles critical concrete to the satisfaction of engineers, contractors and operators, no matter how rigid the specifications. Low weight. Built of the toughest, wear-resistant materials. Conforms to NRMCA standards.

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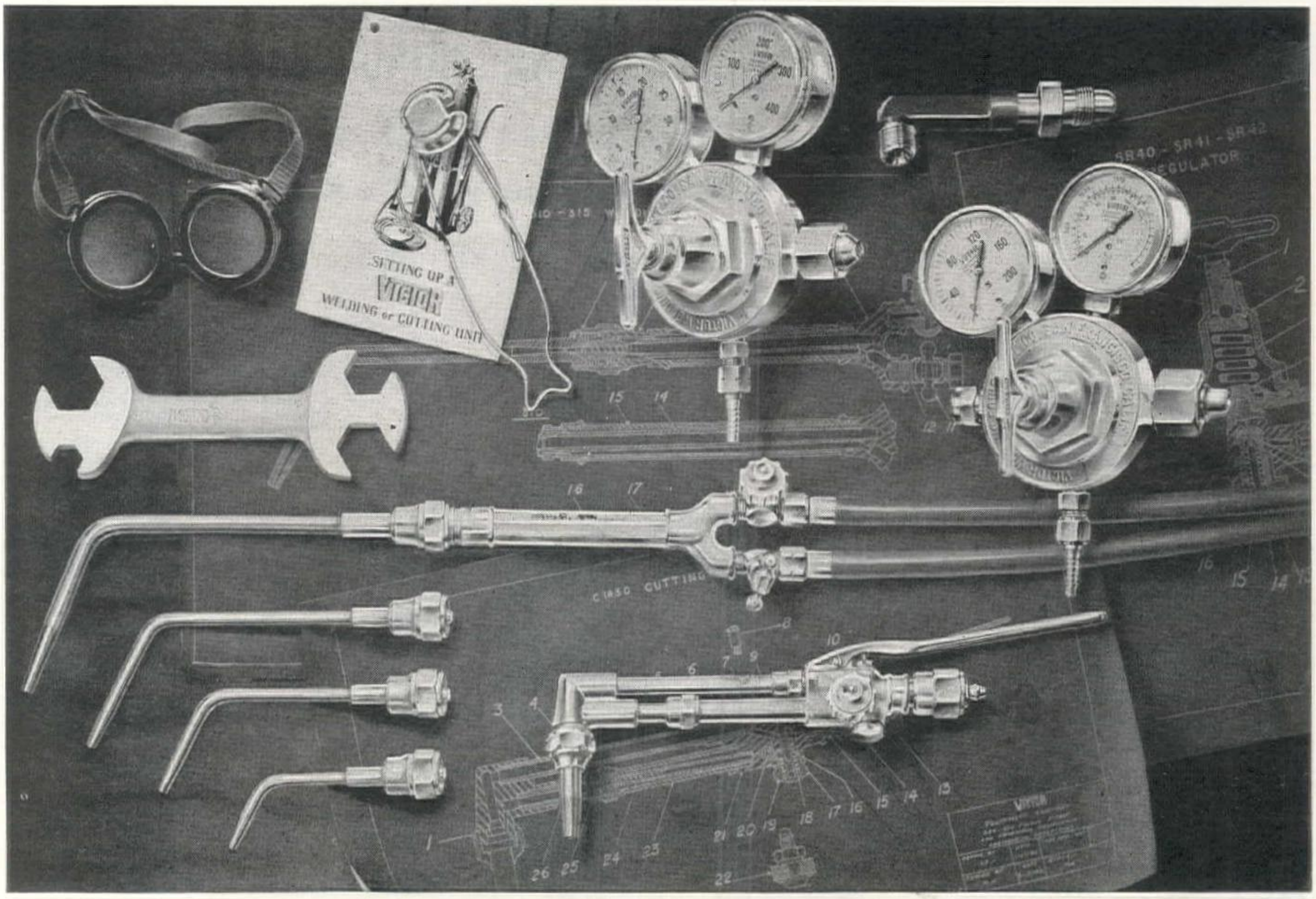


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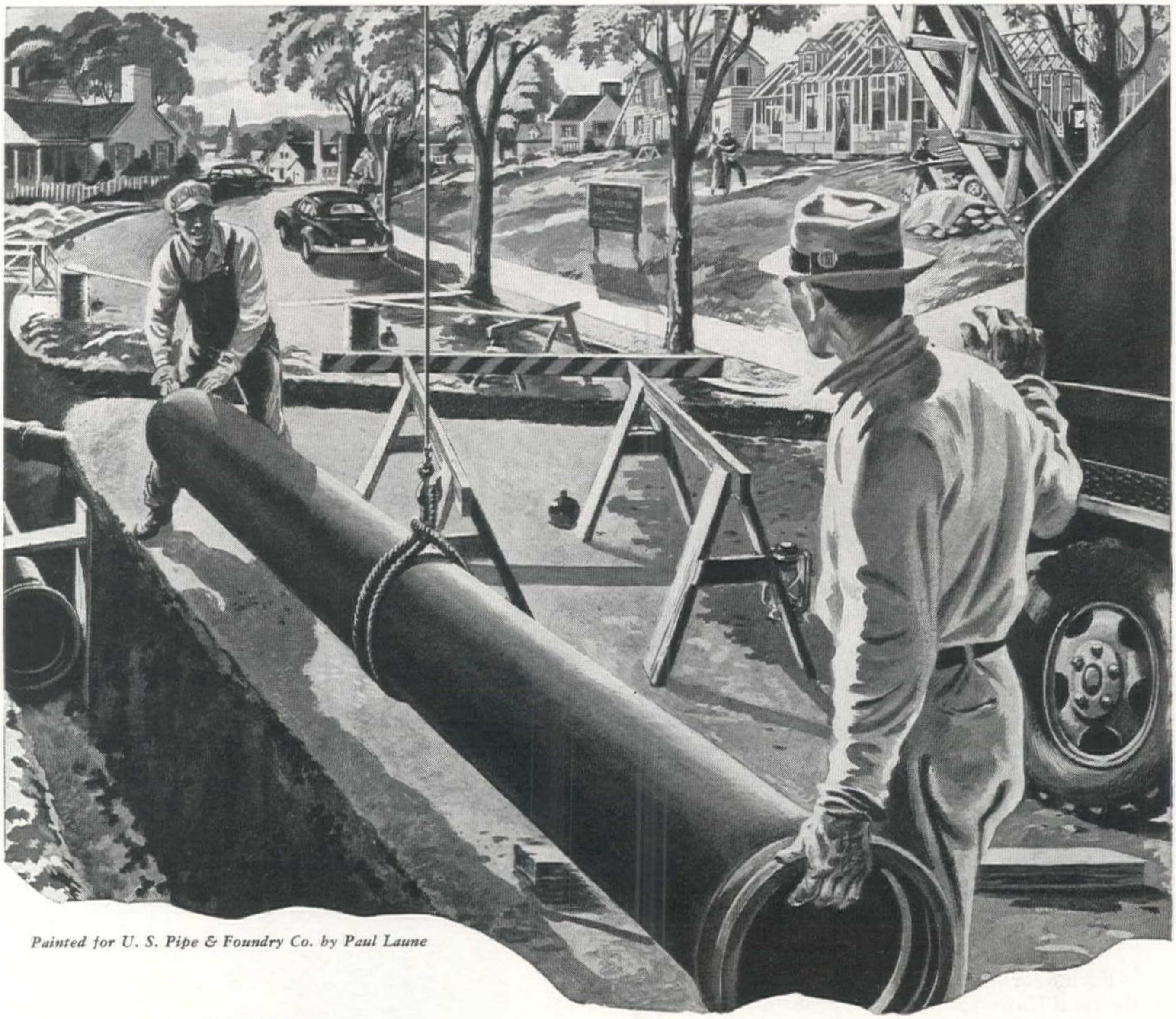

*Painted for U. S. Pipe & Foundry Co. by Paul Laune*

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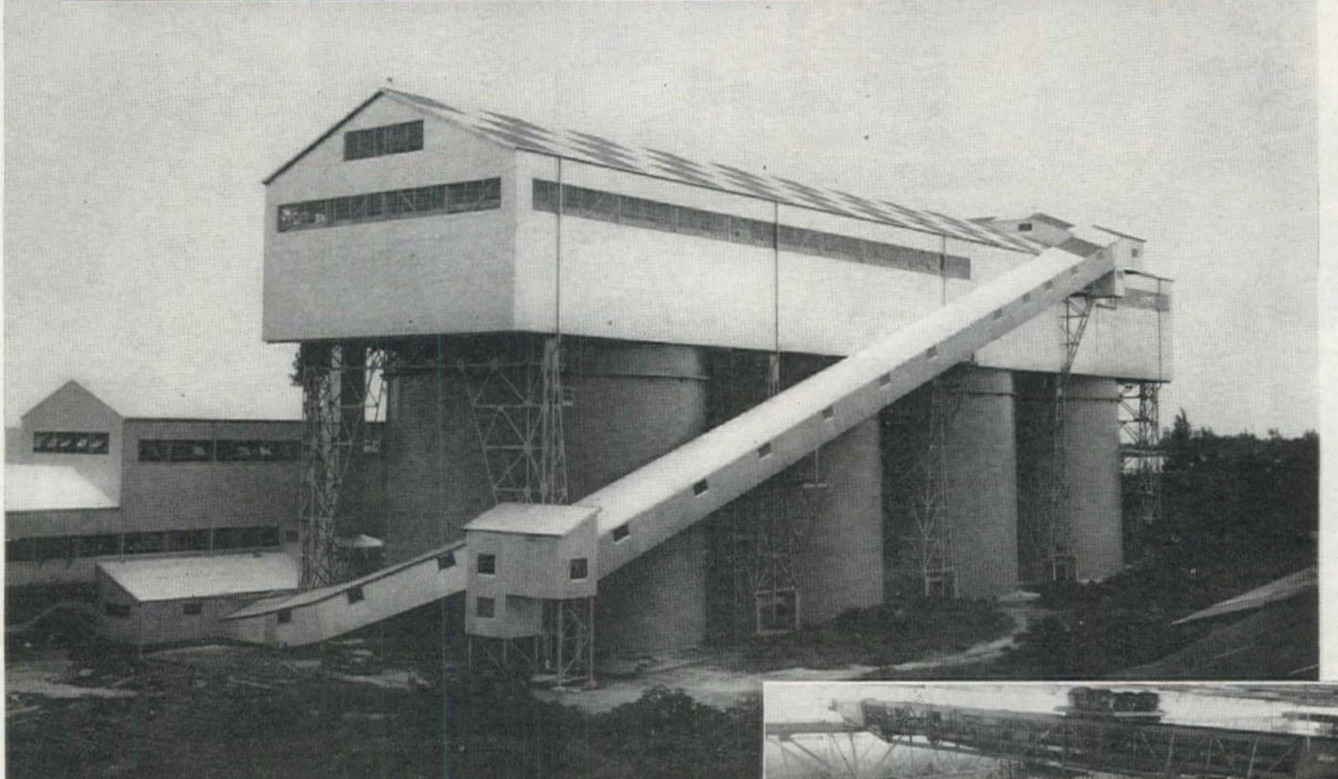
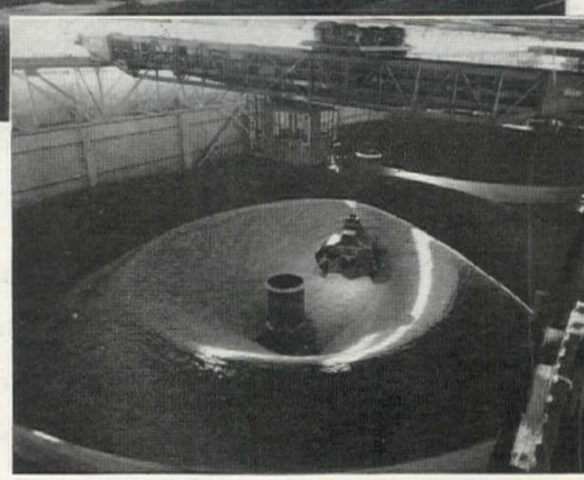
# Hawaiian Bulk Sugar Storage Plant Uses Welded Steel Tanks





Each year about 450,000 tons of raw sugar—nearly half the total Hawaiian output—are shipped from the islands to the refineries in bulk, rather than in 100-lb. bags.

To store the raw sugar produced on the island of Hawaii, the Matson Navigation Co. recently installed the tanks shown above at Hilo. Each tank is 80 ft. in diameter by 76 ft. high and stores 10,000 tons of sugar. The sugar is transported from the plantation by trucks, weighed in the scale house at the left and then carried to the top of the tanks by the inclined conveyor.

Storage facilities are essential at Hilo in order to build up sufficient tonnage for steamer arrivals. Horton welded steel tanks offer two added advantages for this type of service. First, welded joints have a high efficiency—they are strong as the metal itself. Second, these tanks are easy to maintain because their surfaces are SMOOTH—there are no lap joints or rough edges to collect paint-deteriorating dirt and water.

These sugar storage tanks are an example of the steel plate structures we build. Write our nearest office for a quotation when you need storage tanks or other steel structures.

*The illustration at the top of the page shows four Horton welded steel tanks for storing raw sugar at Hilo, Hawaii.*

*The view directly above shows one tank nearly full of bulk raw sugar and the crane and clamshell used to discharge the sugar. The clamshell picks up the sugar and drops it down the sectional discharge pipe shown in the center of the tank. Conveyors then carry the sugar to the docks. The discharge tube is removed section by section as the level of the sugar in the tank becomes lower.*

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WESTERN CONSTRUCTION

December 1950 Vol. 25, No. 12



## Contracting Is a Business

THE YOUNG and ambitious contractor is usually long on field ability and short on cost information. He is well experienced in the output to be expected from his equipment and his crews, under various conditions, but probably would have a hard time answering questions on his costs per unit of time or machine. In other words, he knows more about construction than he knows about business. To advance successfully into larger opportunities, the ambitious contractor must become a businessman.

To draw a parallel, a small manufacturer doing a gross annual business equal to that of a contractor will know the costs in each step of his operations, and the balance to be maintained in the use of machines for achieving minimum costs. This manufacturer will grow as he develops sharper cost figures. The contractor is no different, and the faster he gets away from thinking in terms of "yards-per-hour" and starts to think about "cost-per-yard-per-machine" the quicker will his operations graduate from gambling to business.

Since many young contractors come up the ladder of directing field operations, it is only natural that they measure the results of the day's work in units of volume, rather than dollars. It may never occur to them that a different scheduling of equipment might cut down the output, but increase the profit.

A simple example could relate to the efficiency of a shovel loading trucks. Mr. Average Contractor will say that any good superintendent could tell by observation what this set-up should be. But will it cost more to have some waiting time on the shovel than to add another truck, and how much? Mr. Smart Contractor will know the exact answer, and his profit, as well as his bid on the next job will reflect this information to his advantage. This type of simple cost analysis problem is solved in clear and easy steps on another page in this issue. The method will open the way to meeting more serious problems.

But, Mr. Average Contractor will contend that unforeseen factors will rule out any exact solution—"It's O.K. as to theory, but no good in the field." However, Mr. Smart Contractor will admit this and use the paper work as a starting solution to be modified and adjusted as required.

Finally, Mr. Average Contractor will insist that the cost of analyzing field problems on paper is more than the value of the result—especially since he is so expert in these problems. Mr. Smart Contractor knows that his growth and expansion will depend on the time he spends studying costs. With all its elements of uncertainty, its intangibles of men, weather and the whims of the "resident," and just plain breaks-of-the-game, a contracting enterprise is still a business and will grow as business methods are applied.

## Compromise for the Columbia Compact

A CHANCE to forestall the establishing of a Valley Authority over the states of the Columbia River Basin is in the making. The existing commission which was set up to represent the five states, has appointed a legal committee to draft an interstate compact for river development and utilization. In spite of all the conflict of interests among these states, the advantages to be realized make any effort toward a successful compact seem small.

The physical plans for developing the Columbia for beneficial use are not of pressing concern at this point. In addition to the construction projects already completed and in progress there are plans in the blueprint stage which could be the basis for another stage of development. Further, engineering talent continues to study the ultimate possibilities for useful control.

Today's problem concerns reaching an agreement on the interests and needs of the several states, to the end that a unified front can be presented against the threat of an Authority. If the states of the basin wish to control and direct the utilization of this great resource, then the initial step of framing a compact must be vigorous and prompt. It is now a matter of water development philosophy and not engineering. There is precedent for reaching an interestate agreement, and it is not necessary to squabble over an inadequate supply as it was among the Colorado Basin states. With an earnest desire to allocate an adequate resource, the framework of an agreement should not be impossible.

All elements of the construction industry should use their influence in promoting an atmosphere of willingness to compromise, to the end that the compact can be consummated.

## A Bridge Worth Watching

NEVER RELUCTANT to adopt new engineering ideas, the bridge department of the California Division of Highways is making a field-size study of a prestressed concrete bridge. This European development, which is being tried in Philadelphia for the first time in America, may or may not be adaptable to the bridge problems of the West. At the present stage the field operations that are dictated by prestressed design tend to require additional man-hours on the job, which may over-balance the savings in materials. Western engineers are accustomed to consider reinforced concrete as a material to be used without too serious concern over yardage. Generous supplies of aggregates in the West and contractors with adequate equipment tend to keep the unit cost of the concrete low. At least this approach is quite different from the European regard for concrete as an engineering material. On the other hand, possibly Western engineers, teamed with Western construction talent, will develop field methods which will make it possible to utilize some of the peculiar advantages of prestressed concrete. At least Western bridge engineers, and all others interested in designing with reinforced concrete will watch with interest this full-scale field test.

Rx

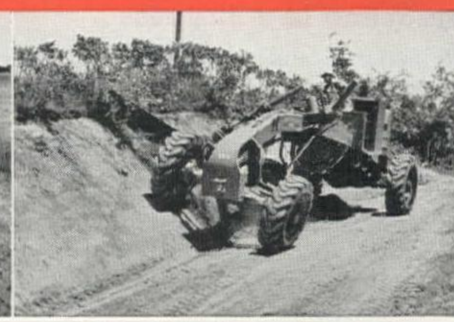
# A-W POWER GRADER

# BEST

## For What Ails Your Roads

Blading in reverse is easy, thanks to All-Wheel Steer.

All-Wheel Drive provides ample power for heavy ditch cuts.



Riding the bank to reach extra high with the 13-foot blade.

The Loader Attachment solves the ditch and shoulder cleaning problem.

The Roller Attachment has many construction and reconstruction uses.

"Controlled Traction," an exclusive feature, moves more material, farther and faster.

**BEST, because** All-Wheel Drive makes every pound of weight a powered pound, harnessed to a driving wheel. For maximum traction—primary element in Power Grader efficiency—*there is no substitute for All-Wheel Drive.*

**BEST, because** All-Wheel Steer directs and controls this tremendous traction to maximum advantage, provides superb earth-moving ability, and mastery of all types of work.

**BEST, because** of the additional values offered by specialized attachments – many exclusively Austin-Western – which greatly increase the usefulness and profit-making ability of the grader.

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# Foundations to Record Depth For a Unique Bridge in Idaho

***Four-leg towers consisting of steel-and-concrete columns developed by the Bureau of Public Roads to reach rock at maximum depth of 325 ft. below grade—Contractor uses pontoon barges***

REACHING down a maximum of 325 ft. below profile grade a unique foundation has been completed for the Blue Creek Bay Bridge, being built by the U. S. Bureau of Public Roads. The project is located across an arm of Lake Coeur d'Alene on Idaho Forest Highway Route 7 and on U. S. Highway 10 just east of Spokane. Of exceptional interest to bridge engineers is the design of the substructure, providing steel and concrete columns extending through a maximum mud depth of about 215 ft., and contractors will be interested in the construction methods used for placing these columns and the tower system of bracing. The contract is being carried out by Paul Jarvis, Inc., of Seattle, on a bid of $871,155.

Location problems at the site of this 1,300-ft. crossing and the studies which reviewed comparative designs were described in *Western Construction,* April 1950, pg. 96. The present article reviews the methods and procedures developed by the contractor in constructing the substructure. The field problems can best be appreciated by a brief review of the three key features: (1) structural steel towers, (2) steel casings extending to, and into foundation rock, and (3) steel cores (piles).

**Towers**—Key to the design was the requirement that the long columns have lateral support through about 80 ft. of water. The solution provided that the four piles in each of the seven piers be placed in, and stiffened by the 24-in. cylindrical corner posts of 30-ft. square towers. These towers acted as templates for placing the 18-in. casings and piles. The two end towers (Nos. 1 and 7) were designed to extend to rock, and the intervening five reach about 20 ft. into mud bottom. The four corner cylinders are braced in a conventional manner in 30-ft. vertical panels (see drawing).

**Casings**—Inside each corner cylinder an 18-in. steel casing was to be inserted and driven to rock. It was then to be drilled at least 5 ft. into rock to form a socket for the pile. These casings were to extend up inside the cylinders a distance of 20 ft. and there be cut off. The annular space was to be filled with grout. Purpose of the casings was to insure direction and seating of the piles.

**Cores**—Finally, inside the cylinders and the casings the column cores (10-in. BP 57-lb. steel bearing piles) were to be threaded and seated in the rock sockets. The last step required the cleaning out of the casing and cylinder, and filling with tremie concrete.

Estimated quantities involved were:

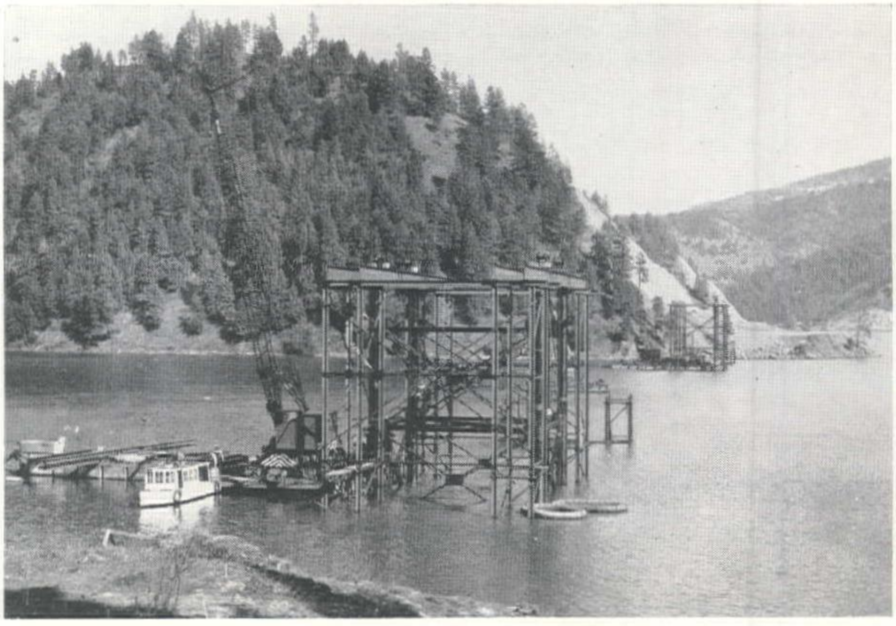
| | |
|---|---|
| Structural steel in towers | 820,000 lb. |
| Casings (18-in.) left in place | 3,200 ft. |
| Cores (steel piling) | 370,000 lb. |
| Concrete filling | 1,180 cu. yd. |

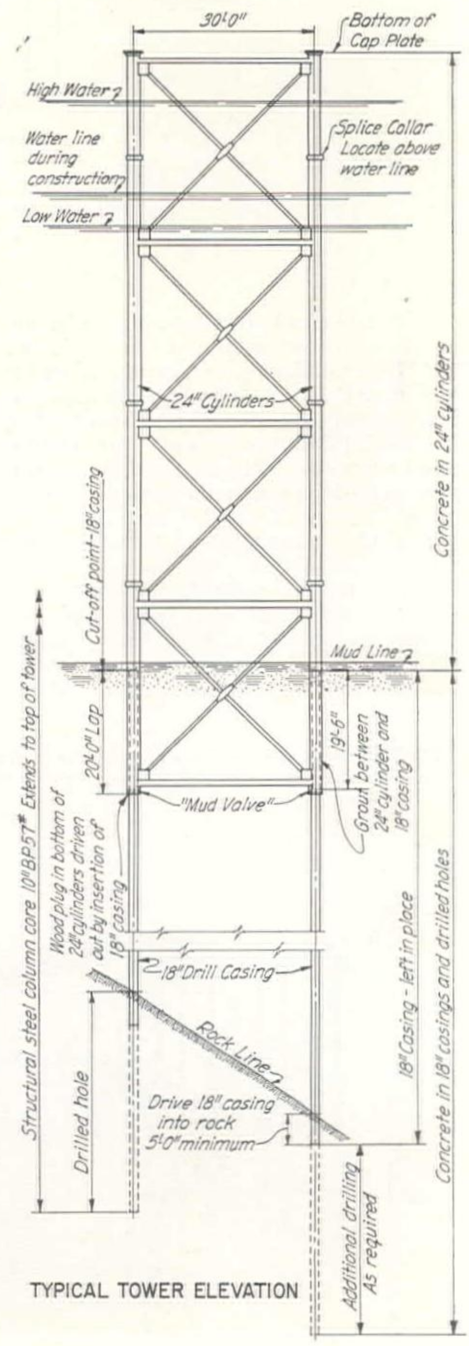
**Falsework**

At the four end towers (Nos. 1, 2, 6 and 7) the contractor used steel piles to support the working platform, and to hold and lower the tower as it was as-

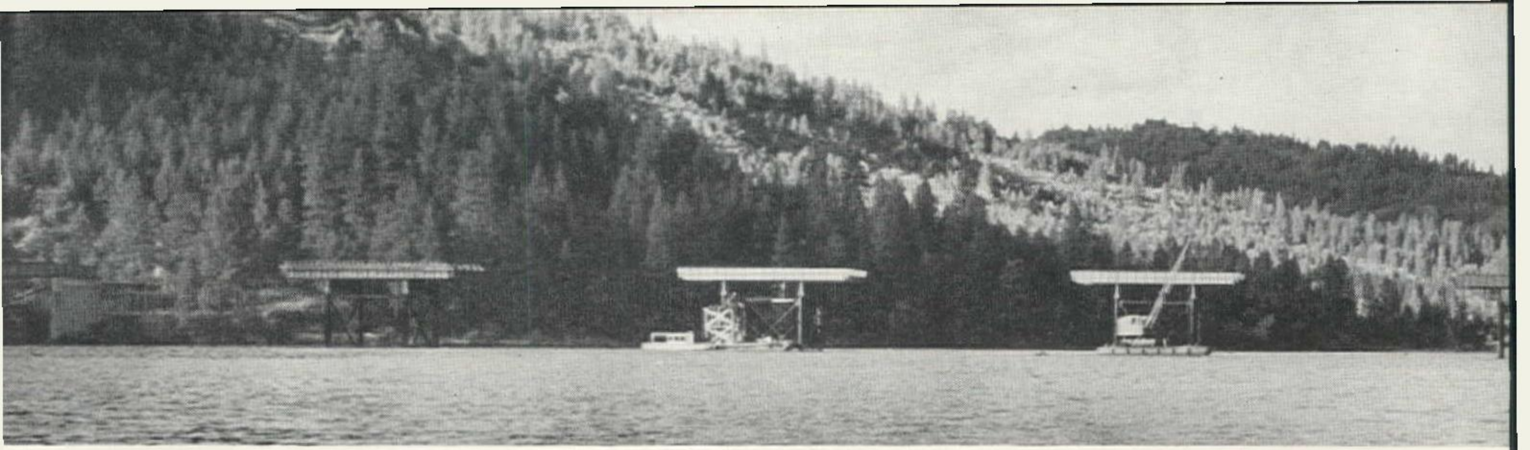
RIGHT—Design features of the foundation towers indicating braced section through water and concrete-encased steel piles reaching to sockets drilled into rock.

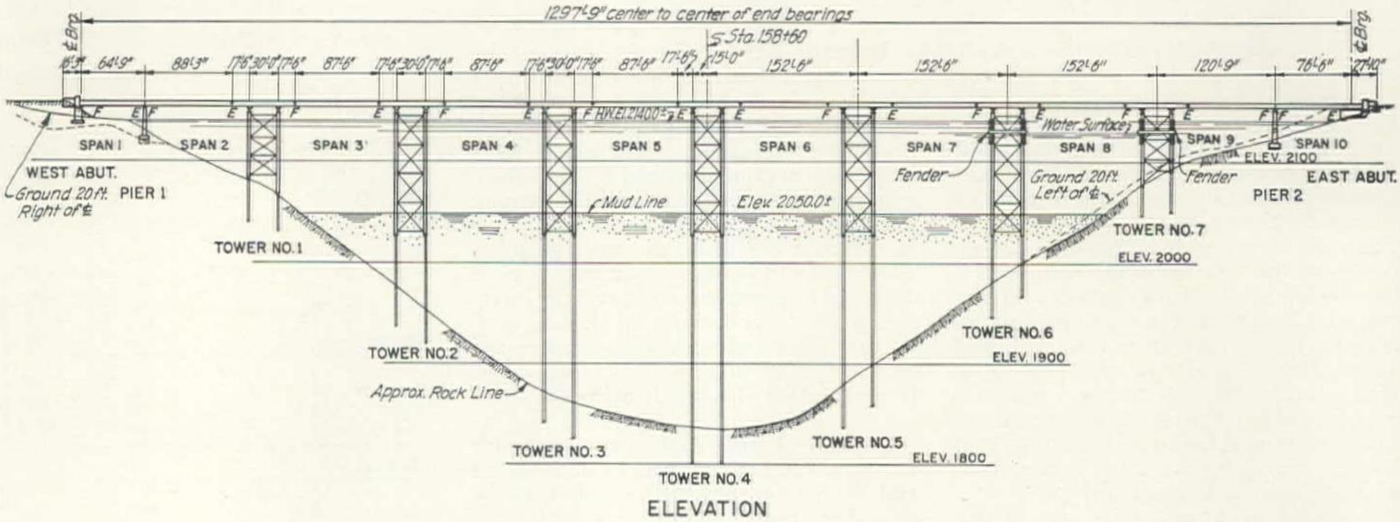
BELOW—Shore towers were built from pile falsework, which supported four beams with 15-ton hand winches used to lower fabricated sections of towers as they were assembled.





TYPICAL TOWER ELEVATION






ELEVATION

sembled. Sixteen piles were driven, made up of an inner group of eight (10-in. BP 57-lb.) and an outer group of eight (10-in. BP 42-lb.). Across the tops of these piles were placed four beams (30-in. WF 108-lb.) carrying four 15-ton hand winches. This supporting system was well braced with all-welded connections.

For the three central locations the contractor used floating falsework. Two pontoon barges, each 20 x 60 ft., were tied together with steel trusses, at the proper spacing. On these barges were set the top frames, cross-beams and hoists from the fixed falsework. Thus equipped, and anchored at the location, the barges were ready to support and lower the towers.

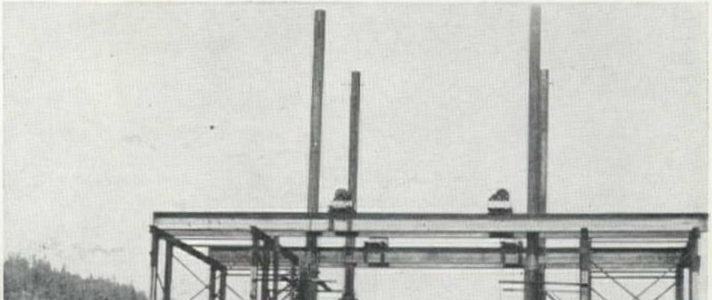
Anchors consisted of 1-cu. yd. concrete cubes, each provided with twenty 1¼-in. bars extending out from the concrete face 12 in. Lines were adjustable and the barges were spotted by instrument and held to within the 3-in. tolerance. Wind forces did not develop any problems with this anchorage system.

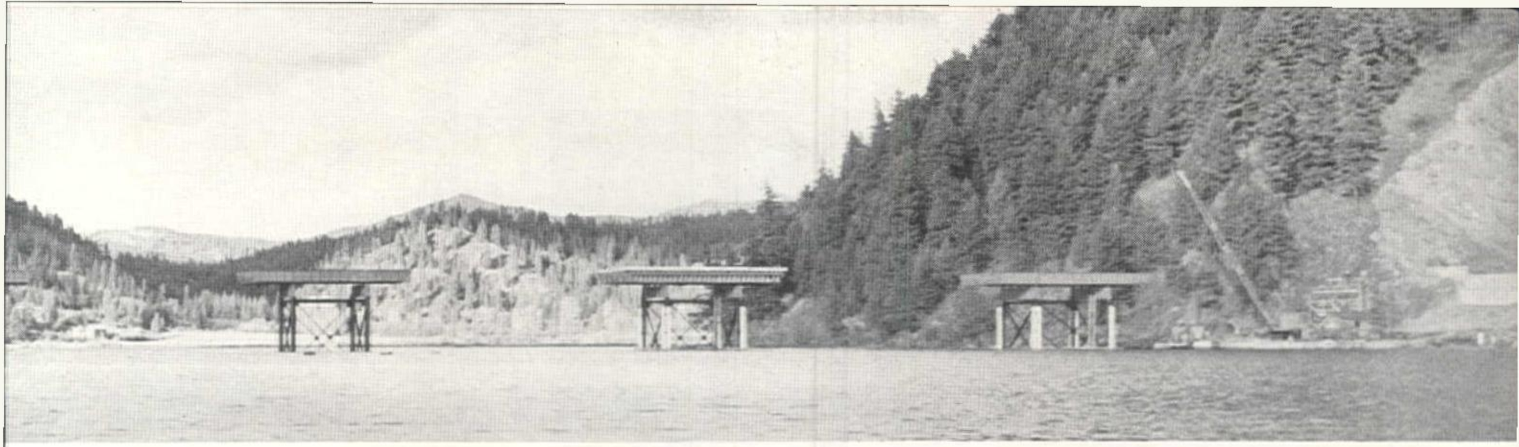
Steel for the towers was shop-fabricated, delivered to Coeur d'Alene, Idaho, by rail, and from there to the site by barge. The tower sections were not assembled in the shop during fabrication and because of the tubular corner columns there was some concern over the field assembly, but the sections went together without difficulty and the positioning of the gusset plates on the cylinders was accurate.

Working from pile falsework or from barges the 30-ft. depth panels of the tower were placed in position and held by four hand winches. After the connecting members and bracing were placed, the section was lowered by the hand winches to a position where the next 30-ft. panel could be assembled. This process was repeated to include three of the tower sections. The con-

TOWER 6 being erected from pile falsework, showing the winches used to support and lower the 30-ft. square sections as they were assembled.

THREADING down through the 24-in. corner cylinders are the 18-in. casings which will be driven through mud and into sockets in the rock.





TOP—Seven towers completed and ready for 87½-ft. sections of deck. The four central towers were constructed entirely from floating equipment anchored and held on line within 3-in. tolerance.

LEFT—Foundation rock, covered with 230-ft. maximum depth of mud, shown in section through the site, dictated unusual design for the towers.

tractor elected to omit the top tower section until after the casings had been placed. The complete tower as suspended from the falsework or barges weighed approximately 60 tons.

Specifications provided for a 3-in. tolerance in both directions for the positioning of the towers. On those towers built from pile falsework the exact position was fixed by means of set screws adjusted from the falsework. For the towers set from barges the position was checked constantly by instrument. The results have been gratifying and indicate that the 3-in. tolerance was not exceeded in the longitudinal direction and the lateral alignment was within 1½ in.

Towers were put together with high tensile strength field bolts. These field connections were tightened with an impact wrench until the tension in the bolt was slightly less than the yield point of the steel. Time required for the erection of the end towers from falsework was about one week for each.

According to plans all towers except those at the two ends were to be lowered about 20 ft. into the mud bottom. However, field work indicated that the mud provided enough support, particularly under the horizontal steel bracing, to hold the towers above this penetration. As a result, the contractor resorted to jetting to secure the 20-ft. depth into mud. This was done by welding 2½-in. perforated pipes on the underside of all bottom struts and jetting with fire pumps.

With the towers in position, they were ready for the next operation of inserting and lowering the 18-in. casing which extended through the deep mud and into foundation rock.

### Placing casing

Casing of 18-in. diameter and ⅜-in. steel thickness was assembled by welding 20- or 40-ft. lengths and lowering into position through the corner cylinders. The casings were centered in the cylinders by means of guides. Normally the casings sunk about 25 ft. into mud under their own weight and were then driven through intervening layers to rock line.

After the casings reached rock a churn drill was used to drill the required socket for the core (pile). The churn drill with a 13-ft. length of stem weighed about 3,500 lb. and was operated with a 24-in. stroke. The drilled holes averaged 30 ft. deep into rock. As the drilling progressed the casings were driven from 5 to 10 ft. into rock. Drilling was then continued an extra 20 ft. below the bottom of the casing to help bond the concrete between the lower end of the pile and the rock. Drilling was continued until hardness indicated that solid rock had been reached and that the casing had sealed off all seams.

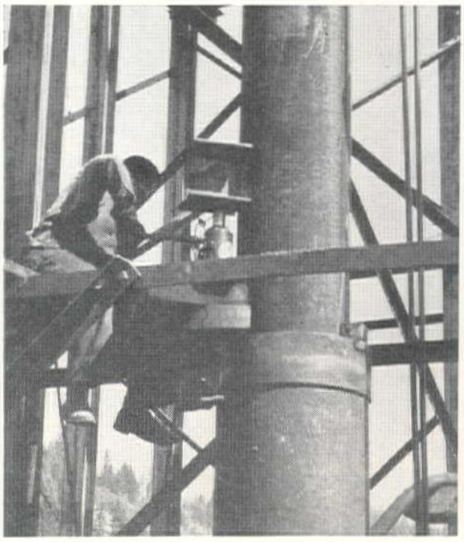
Drill holes were then cleaned out. The operation included both flushing and baling. Flushing did not prove too successful because of the pressure built up in the casing and the tendency to stir up mud above the rock.

### Cutting off the casing

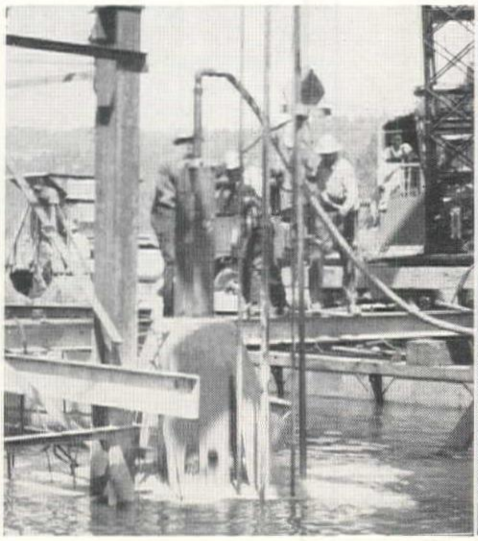
After cleaning was completed, the next step was to cut off the casing 20 ft. above the bottom of the surrounding corner cylinder. This provided the 20-ft. lap and an annular ring which was to be filled with grout. The contractor developed an interesting device for cutting off the casing at a depth of about 80 ft. below the water line on the deep towers. This device provided four horizontal cutting wheels turned by a 6-in. drill pipe which was turned by hand on the working platform. First attempts to cut the casing were not too successful because it had become slightly out-of-round during driving and the cutters did not hit the entire wall. This difficulty was overcome by a tapered swedge which forced the pipe into true cylindrical form, permitting the cutters to work around the entire periphery. After this addition the cutting device proved most successful and required only about one hour for each operation.

According to the original design plans, the sequence was to include: (1) lowering the towers into position, and to required depth, followed by (2) inserting and driving the casings. However, the

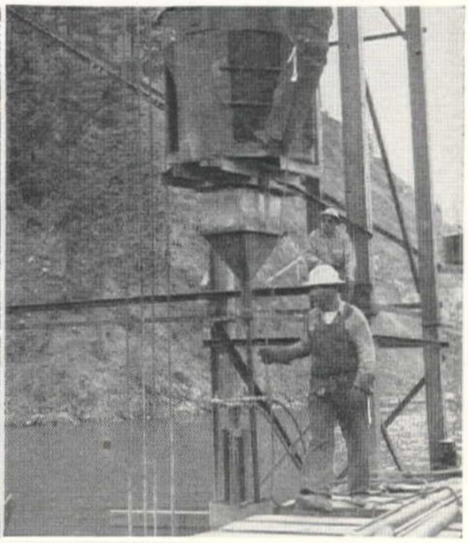
JACKING tower down the required 20 ft. into mud against resistance of the deep casings.

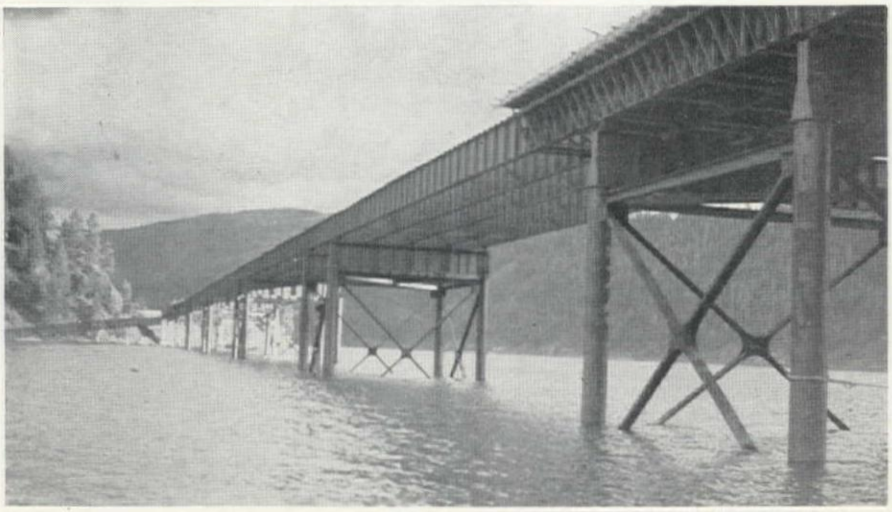


SLUICING out the casing for a tower leg to clean out mud before filling with concrete.



GROUTING the annular space between the cylinder and casing by tremie using 2-in. pipe.





THIS LOCATION was studied for a suspension span, a pontoon bridge and a rockfill causeway, any one of which would have cost almost $2,000,000 as compared to the bid price of $871,155 for the unique design finally developed.

contractor elected to assemble the three, 30-ft. panels of the deep towers, and then hold them suspended by the winches, while the casings were inserted, welded to required length, and driven. Then, the towers were completed, lowered, and jetted to position, using the casings as a guide. This procedure proved acceptable and in the interest of speed and economy.

### Steel core, or bearing pile

With the casing in place and cut, the steel bearing pile member was then assembled by splicing 60-ft. lengths of 10-in., 57-lb. section and lowering to final bearing at the bottom of the rock socket. The sections were butt-welded and splice plates were also welded on the flanges. These steel cores were centered in the columns by means of guide lugs welded on the piles at 20-ft. spacing.

With the four steel cores in place for the tower, the remaining operations related to placing grout in the annular space between the cylinder and the casing and then filling the entire cylinder from the bottom of the footing to the water surface. Grout was placed in the annular space by the tremie method, using a 2-in. pipe. This pipe was charged without difficulty, using a wooden plug forced down through the pipe by the grout. Only about 1½ hr. were required for setting up the tremie pipe and placing the material. The surface of the grout was kept about 2 ft. below the top of the 18-in. casing to avoid overflow which would drop to the bottom of the column.

The next and last step was to fill the entire cylinder and casing down to its final depth. This provided definite problems since it included placing concrete by tremie method to depths up to almost 350 ft. By comparison, concrete placed under water at the Tacoma Narrows Bridge and the San Francisco-Oakland Bay Bridge was only about 220 ft. The preliminary operation consisted of cleaning of all silt from the socket and soundings were made to determine that solid rock was exposed. Concrete was more correctly a grout of 1:3 mix using ⅜-in. maximum aggregate and an 8-in. slump.

For the first piers, concrete was placed through a 3-in. pipe which was provided with an air-operated valve at the lower end to control discharge. As lowered, the tremie pipe filled with water and the pipe was charged by forcing a wooden plug down under pressure of the concrete. Concrete was deposited in the pipe from a hopper and at all times a head of not less than 30 ft. was kept on the valve at the bottom. About 20 min. was required to remove each 20-ft. length of pipe as pouring advanced. Time required for placing concrete in one of the columns which was 190 ft. long was 5 hr.

For placing concrete in the columns at towers 3, 4 and 5 the 3-in. tremie was replaced with a 4-in. pipe to avoid plugging of the tremie pipe and the bottom valve. The open 4-in. tremie, using a wooden plug with a canvas attached to form a pocket for the concrete, proved very satisfactory. Use of the 4-in. tremie also speeded the concrete operation by about 50%.

### Construction plant

The contractor's plant was located on the east shore of the bay. Equipment included a 2-yd. mixer and necessary batching plant, with a crawler crane to handle aggregate. Mixed concrete was dumped into hoppers and moved by barge to place of pour where it was handled by barge-mounted crane.

Steel was moved from shore to towers on pontoon barges and there erected by a 20-ton floating crane equipped with a 75-ft. boom.

Practically the entire barge fleet was built up with 5 x 7 x 5-ft. pontoons. These were assembled to provide various sizes of barges for the floating plant. The false work barges were 20 x 60 ft., made up of 10 x 20 x 6½-ft. pontoons used in the erection of the three deep towers. The largest barge for the floating equipment was 36 x 70 ft.

Physical construction of the bridge was commenced on March 15 when the ice went out. The seven towers were complete about October 15 and steel erection was finished about November 15. About one-third of the floor slab was poured by November 10, and unless weather is bad, the contractor will complete the work, except for painting, this fall.

### Organization

Operations of the contractor have been carried out under the personal direction of Paul Jarvis and Paul Jarvis, Jr. Steel for the towers and the casings was provided and fabricated by Consolidated Western Steel Corp.

The project is being carried forward under the direction of the Bureau of Public Roads by L. M. Huggins, district engineer for Idaho, and W. H. Lynch, division engineer at Portland, Ore. The type of bridge was conceived and recommended by R. B. McMinn, bridge engineer in the Portland office. The design was prepared in the Western Headquarters at San Francisco under the direction of H. R. Angwin, principal bridge engineer. Charles E. Andrew of Tacoma, Wash., served as consultant, and John Zoss is resident engineer.

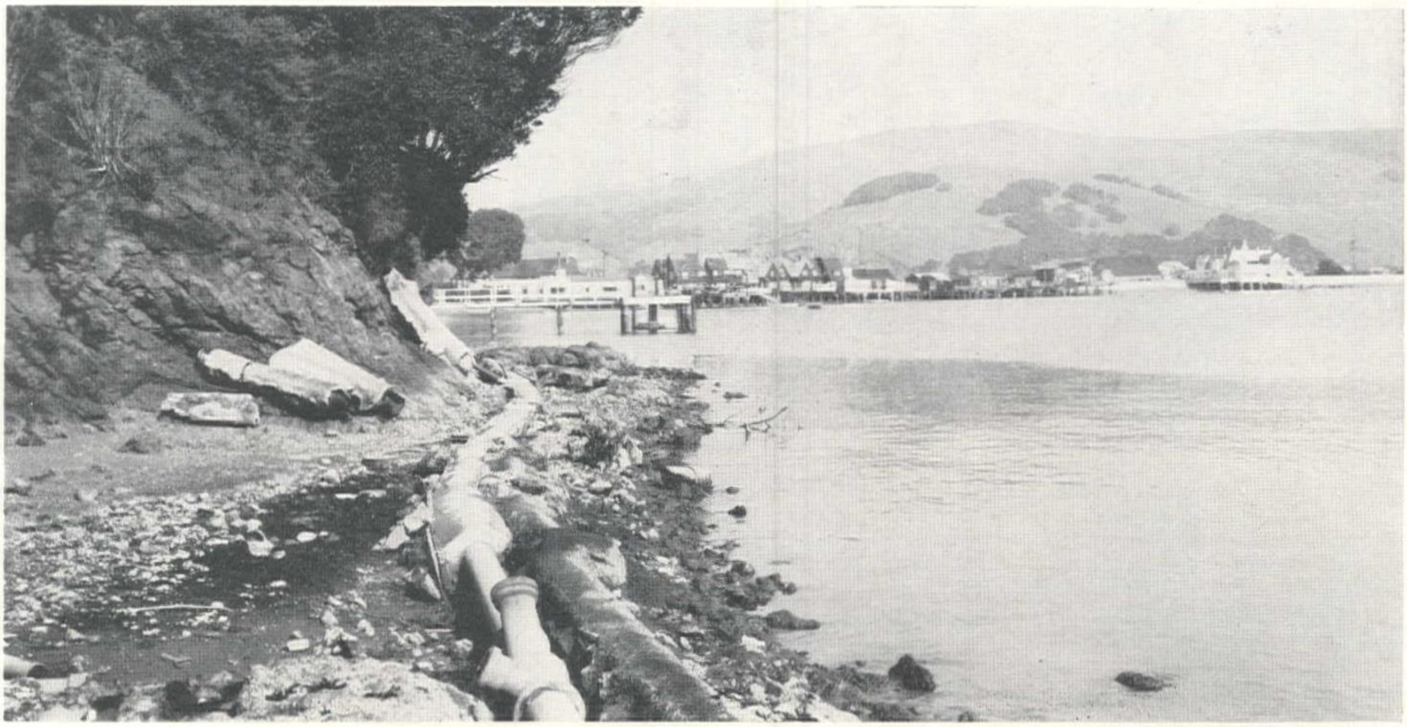
## Power Plant on the Line At Anderson Ranch Dam

THE PACIFIC Northwest's newest hydroelectric power plant, situated at Anderson Ranch Dam in southern Idaho, was placed in production on November 20, with the Bureau of Reclamation putting the first of three 13,500-kw. generators on the line. In addition to producing power, Anderson Ranch Dam is providing supplemental water for 255,000 acres in the Boise Federal Reclamation project, which heretofore have suffered periodical shortages. It will also aid in the control of floods in the Boise Valley. The second of Anderson Ranch Dam's three generators is scheduled to go into operation next year. At some future date, the third unit may be added.

The power plant will be operated by the Bureau of Reclamation in coordination with existing Bureau plants on the Boise and Minidoka Projects to obtain a greater output of firm power. The combined system will provide energy for pumping on the Boise, Owyhee and Minidoka Projects, serve a Rural Electrification Administration cooperative at Fairfield, and provide additional power for the Raft River REA at Malta, Idaho. A small amount of peaking power and the surplus energy will be sold to the Idaho Power Co.

Anderson Ranch Dam is the highest earth-fill dam in the world. The crest is 456 ft. above bedrock. The structure is 2,650 ft. wide at the base, 1,350 ft. long at the crest, and contains 9,653,300 cu. yd. of earth and rock. Its reservoir has a storage capacity of 493,200 acre-feet.

Construction of the new dam was begun in August 1941. Due to wartime conditions, including stop-orders, diversion of critical materials to war industries, labor shortages and other reasons, the embankment was not finished until 1949. The power plant, spillway and outlet works are being completed this fall.

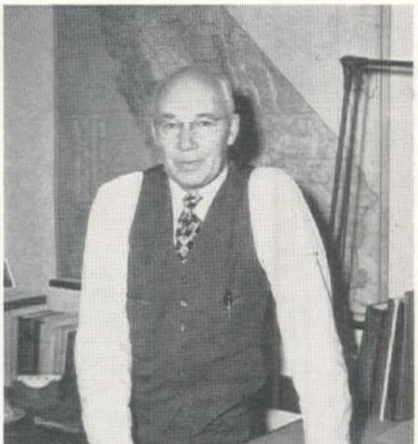


*Problems at Belvedere, Calif., Show That—*

# Small-town Sewerage Can Be Complex

***Providing new disposal facilities for a municipality of 700 population requires ingenuity of both engineer and constructors — System designed to take best advantage of city's tidal water frontage***

By CHARLES H. LEE
Consulting Engineer
San Francisco, Calif.



PUBLIC WORKS in small municipalities may not be as spectacular as those undertaken by metroplitan areas or by the federal government. But, in their small way, they can be complex and present problems which demand as great ingenuity and resourcefulness on the part of the engineer and construction organization. This is illustrated by the municipal sewage system recently constructed for the City of Belvedere in Marin County, Calif.

Belvedere is an incorporated city of the 6th class with a population of about 700. It is located 6 mi. north of San Francisco and has tidal water frontage on Richardson Bay, San Francisco Bay, Belvedere Cove, and Raccoon Strait. It includes Belvedere Island and the west portion of Corinthian Island, both of which slope steeply to narrow, rocky beaches submerged at high tide. Sand spits connect the islands and extend to the mainland so as to enclose a controlled tidal lagoon. A large tract of marsh land in the lagoon area was recently reclaimed and subdivided with prospect of rapid growth in population.

Belvedere has long been a select suburban community with no industries or public resorts. It is popular as an aquatic recreational area and is a center of yachting activity in San Francisco Bay. Many of the existing residential lots of the city and most of the newly subdivided lots have water frontage, making it desirable that the shores and adjacent waters be attractive in appearance and free from bacterial pollution.

At the outset it was recognized that there are few cities in the world which have natural advantages for sewage disposal equal to that of the City of Belvedere. The southern tip of Belvedere Island drops off steeply into 180 ft. of water and is washed by a continuous tidal stream amounting to 700,000 cubic feet per second on the flood tide and 800,000 cfs. on the ebb, flowing with a maximum velocity of 3 to 4 ft. per sec. The total amount of dissolved oxygen contained in the tidal stream passing the point of the island during a cycle is at least 7,600 tons. With adequate diffusion this is sufficient to oxidize and render innocuous the sewage from a population of 50,000,000.

With this background of diverse topography, tide-washed perimeter, shallow ground-water, exacting sanitary requirements, and low property values, the engineer was called upon to design a complete sewer system adequate to serve the ultimate population, but so separated into units that the city could proceed to final plans and construction of either the whole system or a part thereof as necessity arose and finances permitted.

The older portion of the community was sewered prior to 1900, but facilities

PICTURED AT TOP OF PAGE—

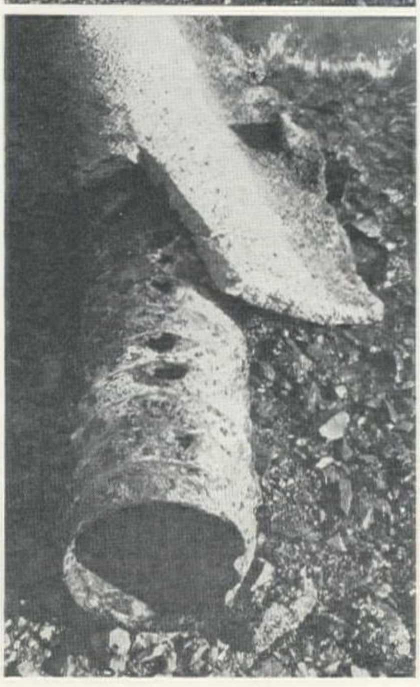
**BEACH OUTFALL** sewer on Belvedere Island showing 8-in. cast-iron pressure pipe encased in concrete with 6-in. "Y"-branch cleanout and 4-in. "T" for lateral connection. Lengths of old corrugated culvert sewer with gunited top lying to left.

CLOSE-UP of 6-in. "Y"-branch cleanout and mechanical joint sealed with rubber gasket, on the Belvedere Island beach outfall sewer.

had deteriorated with age and were inadequate for the increasing population which might ultimately reach 3,000. Most of the west side of the island was without sewers and dependent upon individual septic tanks. Raw sewage from the northern portion of the city was discharged into Richardson Bay. Due to the flat grade of collecting lines in this area, tidal backwater would often cause overflow from toilet fixtures. Sanitary outlets from houses on the thickly built-up west slope of Corinthian Island discharged directly onto the tidal beach with resulting pollution of the shore line.

TOP—Vitrified clay sewer pipe, 50 years old, shows almost complete deterioration of cement joint material. Most of clay pipe was still in good condition.

BOTTOM—Corrugated culvert sewer pipe with perforated crown caused by gas from decomposing sewage solids.



The main sewer outlet from Belvedere Island and the southern sand spit was a 10-in. vitrified clay line 4,700 ft. in length laid within the tidal range along the beach on the west side of Belvedere Cove. This flowed into a rock tunnel at the southerly point of the island from which sewage was discharged into San Francisco Bay.

Much of the pipe was exposed and in many places had been broken by the action of waves and drift during winter storms. The original joint material was cement and had largely disappeared due to action of salt water. A section of pipe, 500 ft. in length, had deteriorated so badly that in 1938 it had been replaced with 10-in. No. 14 gage, asbestos bonded and hot-asphalt-dipped corrugated culvert pipe. Blockage from heavy debris in the vitrified line beyond the new section prevented free flow, and the hydrogen sulfide gas, generated by decomposition of accumulated organic solids, attacked the metal in the crown of the arch and soon perforated it, leaving a shell of asbestos. In 1946 the upper portion of the pipe was gunited on the outside to prevent structural collapse. This prolonged the life but did not clear the pipe of sludge or prevent the escape of raw sewage into Belvedere Cove through openings in the side of the pipe.

### Initial plans

To remedy these unsanitary conditions, plans were initially prepared for extending the collecting system into all unsewered areas, for providing trunk lines, including sewage pumping plants, and for replacing the defective outfall sewer. A plant for primary treatment of raw sewage was also provided in order to meet the requirements of the State Health Department whose rules would not permit the discharge of either raw sewage or digested sludge into San Francisco Bay.

Bid sheets initially submitted to contractors called for construction of a complete municipal sewage system consisting of

9,718 ft. of 6-in. vitrified clay sewer pipe.
3,223 ft. of 8-in. vitrified clay sewer pipe.
64 manholes.
1,159 ft. of 4-in. B&S cast-iron force main.
1,153 ft. of 6-in. B&S cast-iron force main.
1,220 ft. of 6-in. cast-iron mechanical joint pipe (Corinthian Island beach line).
2,628 ft. of 10-in. Transite pipe (beach outfall line).
5 sewage pumping plants
1 primary sewage treatment plant located on the shores of Belvedere Cove and supported on fill protected by rock sea-wall. Digested sludge was to be pumped up 120 ft. to Bay View Ave., a select residential street, where it could be loaded onto tank trucks for disposal.

The engineer's estimate for this work as of January 1949 was $174,485, based upon prices of early 1948, with percentage added for increased cost of labor and material during the year 1948. One partial bid was received for the work on city streets only. Another bid was for the complete project, including work on the beaches but amounting to $325,239. This exceeded funds available for construction as well as the total bonding limit of the city which was approximately $225,000.

Such an unexpectedly large bid price was not an uncommon experience in those days of rapidly rising construction prices, but it was felt that in addition it reflected a greater allowance for hazard than was warranted on beach pipe lines and treatment plant, as well as for occurrence of rock in trenches. All bids were rejected by the city council, and the engineer was authorized to prepare modified plans for immediately necessary items whose cost would be within funds available to the city.

### Modified plans

The most important changes in the plans, other than elimination of sewer lines not immediately needed, were made in the treatment plant and outfall sewer. At the treatment plant the principal change was the elimination of the sludge pumping and loading facilities. This was accomplished through a modification of the State Health Department rule, adopted March 11, 1946, which forbade the discharge of digested sludge into natural waters. The rule was changed so as to permit such discharge along with the clarified effluent if digested sludge was released in small quantities so as not to create unsightly conditions or form sludge beds.

In connection with this matter, conditions were examined at Portland, Ore., where, after joint investigation by the state sanitary authorities of Washington and Oregon, the city was planning to discharge sludge into the Columbia River from a treatment plant being designed to handle intercepted raw sewage formerly discharged into Willamette River. Investigation was also made of experiments under way in Southern California in connection with disposal of digested sludge by the Los Angeles County Sanitation District.

The beach outfall sewer presented a

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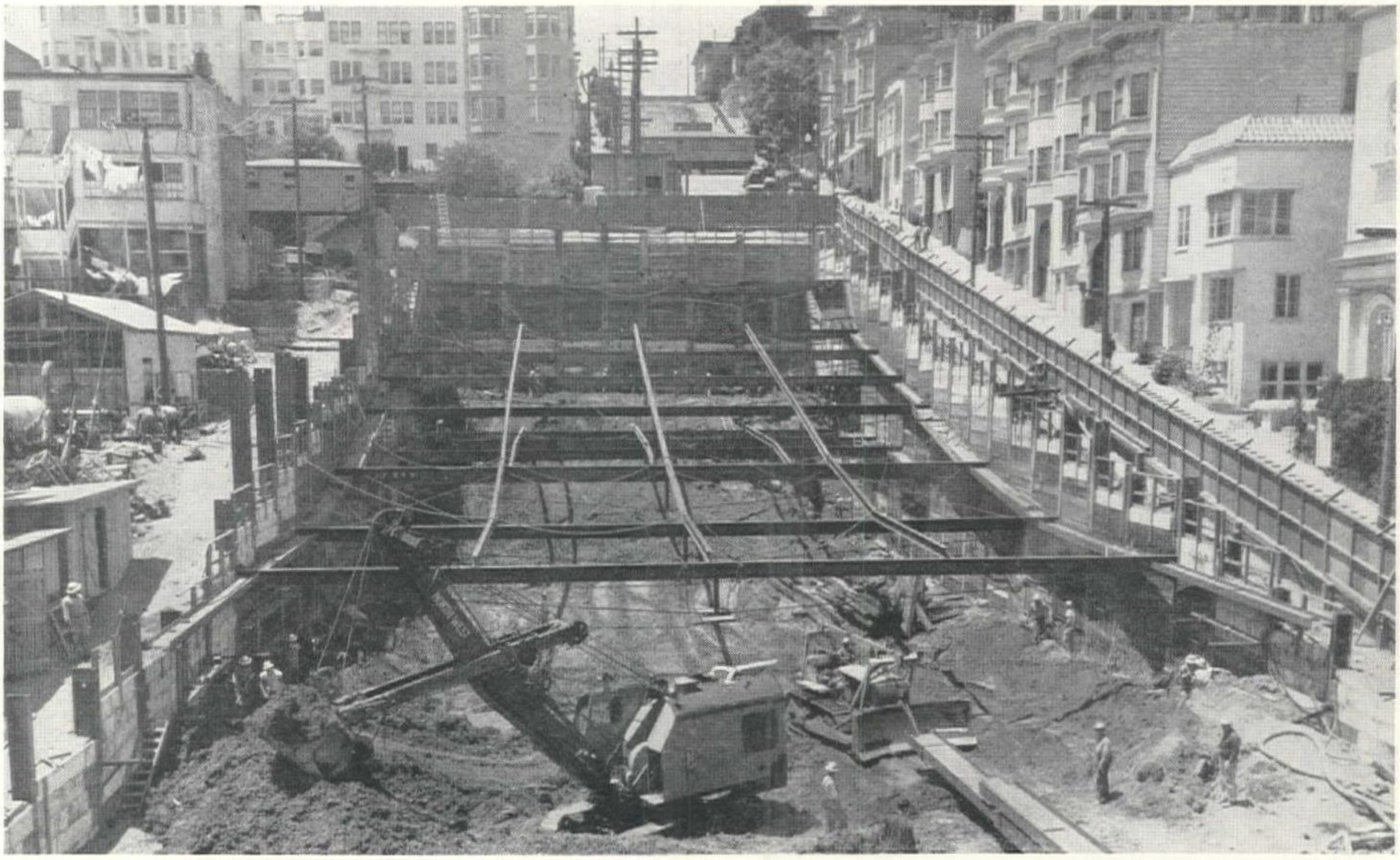


*Going Underground in the Heart of a Big City Driving—*

# San Francisco's Twin Tubes for Traffic

***Morrison-Knudsen Co., Inc. begins excavation for Broadway Tunnel — Project extends 3,300 ft. through heavily built-up section—Complete survey made of all nearby buildings before blasting***

By
HARRY KIRMOND
Assistant Project Manager
Morrison-Knudsen Co., Inc.

THE CITY of San Francisco is now building one of the most up-to-date vehicular tunnels in the world. Known as the Broadway Tunnel, it will provide a new traffic arterial through historic Russian Hill and create a new route from the downtown district to the northwesterly portion of the city and the Golden Gate Bridge. The tunnel will relieve traffic congestion on narrow Pacific St., and tend to alleviate crowded conditions on Bush, Pine and California Sts. The entire project, including tunnel approaches, extends from Powell St. on the east to Polk St. on the west, a distance of 3,300 ft.

### Up-to-date design

The portals of the tunnel extend from a point between Mason and Taylor St. to a point between Leavenworth and Hyde St. Broadway, originally laid out as a wide street, provided the ideal location for such a tunnel as this. The distance between the portals of the tunnel will be 1,616 ft., with a maximum grade of 3%. The tunnel consists of twin bores, each 28½ ft. wide, and each providing for two lanes of traffic in one direction plus a sidewalk. Except for a short distance from the portal, the two bores will be about 35 ft. apart.

The tunnels will be supported by steel ribs fabricated from 10-in. I-beams and lined with 2 to 3 ft. of concrete, depending upon the type of ground. The inside facing will be of light-colored ceramic tile and illuminated by an ultra-modern lighting system. A ventilating building will be constructed at each end of the tunnel, providing fresh air to the tunnels and removing noxious gases. The amount of air forced through the tunnels is controlled automatically according to the percentage of carbon monoxide existing in the tunnels. Due to the fact that the prevailing winds in this part of San Francisco come from the west, the ventilating system in the ventilating building at the east end is designed to deliver more air than the system at the west portal.

During a portion of the construction period it has been necessary to suspend operation of the historic old cable cars on Mason and Hyde St. These have been temporarily replaced by buses, but it is expected that when the bridges at Hyde and Mason Sts. have been constructed service will be resumed.

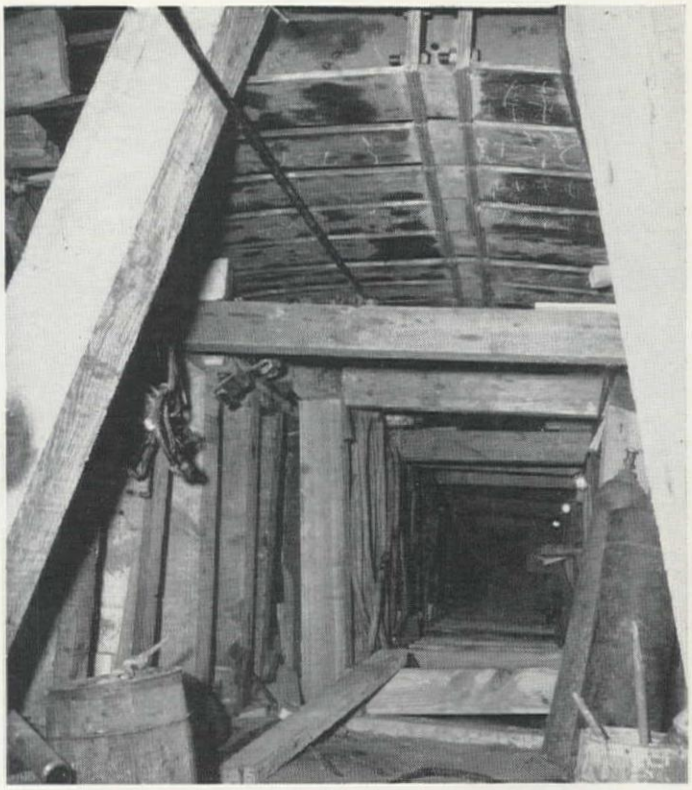
### An 85-year history

The conception of a tunnel under Russian Hill is not a new one. City records show that as far back as 1865 proposals for construction of such a tunnel were presented to the city council. In 1876, proponents of a tunnel in this location again tried to secure enough support for the construction of such a project. A great deal of opposition was encountered, however. One of the principal ob-

PICTURED AT TOP OF PAGE—

EXCAVATION for the east approach and ventilating building. Soldier beams around excavation are to 65-ft. depth. Spaces between beams were filled solidly with wooden lagging as excavation progressed.

SETTING soldier beams at the east approach. Rig in background is drilling holes for the beams a number of feet below final sub-grade.



TOP HEADING at east approach with arch ribs in position. Excessive settlement necessitated pouring concrete footings from drifts.

jections was that it would be a menace to health, as people entering a dark, damp tunnel from the open air would be subject to colds. It was also suggested at this time that an open cut be made through the crest of the hill. Nothing definite was done about the project, however, until the voters approved its construction and a bond issue in 1946.

## Planning and problems

Plans for the project were prepared by the city engineer's office under the direction of Ralph G. Wadsworth, city engineer, and Sherman P. Duckel, director of public works. Ole Singstad, world authority on tunnels and consulting engineer of New York, was retained by the city on a consulting basis to advise on the basic design. The contract for the construction of the project was awarded February 8, 1950, to Morrison-Knudsen Company, Inc., on a bid of $5,253,552. The official starting time was May 1, 1950, and the scheduled completion date is April 30, 1952. Morrison-Knudsen Company assigned T. Y. Johnson of the M-K Los Angeles district as project manager to have general supervision of the entire project.

In order to secure sufficient right-of-way for the portals to the tunnel, it was necessary for the city to buy 40 parcels of land, all occupied by buildings ranging from single dwellings to 12-unit apartment buildings. Some of these have been moved back to clear the right-of-way, others have been moved to other locations and a great many of the older buildings have been demolished.

Constructing a tunnel in the heart of a city presents problems such as are not encountered in the ordinary course of tunnel driving. In constructing tunnels in the mountains and in the wide open spaces, relations with the public are practically non-existent and the danger of damage to surrounding property is also negligible. Such is not the case, however, in constructing a tunnel through a highly-developed portion of a metropolitan area. Here, the general public becomes a major factor in controlling the work and methods used in construction. It can be readily seen how a project of this kind, with its unavoidable accompanying noises, relocation of sidewalks, streets, and utilities, and the accompanying dust and dirt could easily upset the well ordered and routine lives of the residents in the locality. The necessity of protecting houses, apartments, and other buildings from settlement damage is also apparent. These factors made it necessary to make a complete analysis of all the property and buildings in the vicinity of the tunnel for the protection of the public, the city, and the contractor.

## Area survey

An area survey was made under the direction of the writer, in which 12 engineers and architects were employed, and every room in every building and every foundation and retaining wall were minutely examined in order to determine their present condition and their ability to withstand such shocks as might occur due to blasting. These surveyors worked in pairs, each pair being assigned to a different block. In each case they requested the owner of the property or the owner's representative to accompany them while making the survey. The owner was then requested to sign the report, together with the survey team. In cases where there were already rather serious defects occurring in the buildings, photographs were taken which were appended to the written report.

## Property owners cooperate

The degree of cooperation given to the contractor by the property owners has been remarkably high. It has been the contractor's experience on other projects that owners were continuously trying to take advantage of the contractor to secure repairs to their property which in a great many cases had been needed before the project was even conceived. Thus far, the contractor has encountered nothing of this nature in dealings with the residents of Russian Hill. The chief difficulty encountered in the survey was due to the fact that a great many residents of this area are Chinese, and many do not speak English. This problem was solved by employing several young Chinese engineers and assigning them to the various teams working in the area.

The contractor thus had a documentary record of the existing condition of all buildings in the area before work commenced. In driving a tunnel and working in the type ground so far encountered, the contractor has realized that some settlement is to be expected regardless of any precautions which may be taken to prevent it. This being the case, the record of the survey will enable the contractor to determine the extent to which various properties have been damaged since construction began. This will also greatly assist anyone in making a fair settlement to the owners. In order to study and control the size of the charges to be used in blasting, a seismograph was purchased and readings are always taken when blasting is in progress.

Before the actual construction of the tunnel and approaches, a great deal of preliminary work was made necessary by the relocation of sewers, water lines, electric services, and telephone lines. With the exception of sewer work, which was done by Morrison-Knudsen forces, the various utility companies performed their own relocations. The work on the project commenced with the excavation for the East Ventilating Building and the East Approach. This was accompanied simultaneously by the drilling of holes for a series of soldier beams extending completely around the excavation east of the tunnel portals. These holes were drilled to a depth up to 65 ft., extending a number of feet below final sub-grade. Soldier beams, the largest being 36-in. WF, 230 lb. per ft., were then placed in these holes and concrete poured to a point below final subgrade. These beams were then connected by whalers, struts and diagonals, and the spaces between the beams were filled solidly with wooden lagging as the excavation progressed. This network of beams and struts was designed to support an ultimate load considerably greater than that for which the walls of the permanent structures of the tunnel were designed.

In view of the contractor's later experience, this was a fortunate precaution. In order to determine the actual loading of the steel in place, electronic strain gages were placed on the struts and diagonals. On a few exceptionally hot days the strain gage readings were extremely high, due to the expansion of the steel. In order to prevent a recurrence of this high strain, the entire steel network was painted with aluminum paint, and in some cases covered with aluminum foil. The struts were covered with burlap which was kept wet, either by spraying or by seepage garden hoses placed on the web.

### Hill really old fill

The contractor had assumed from the pre-bid information furnished by the city that the material comprising the hill from Mason to Taylor St. was original ground. As excavation progressed, it was discovered that work was continuing in an old fill, up to a depth of some 35 ft. Old bottles, timbers, shoes, cooking pots, bullets, and numerous other articles were discovered down at these depths. Later, the contractor managed to secure a picture of Russian Hill showing that in 1856, all of the portion of Broadway covering the East Approach and the East Tunnel Portal was a draw or ravine which at some later date had been filled. This fill material was also permeated with streams and water arising either from natural springs, leaky water lines or broken sewers. These conditions caused far greater pressures than had been anticipated to be placed upon the supporting steel network. Because of these increased pressures, the city redesigned portions of the retaining walls and ventilating buildings in order to sustain greater stresses.

It was the contractor's original intention to drive the tunnels by the top heading method, placing wall plates and arch tunnel ribs in position, and then excavating the remaining core with an electrified Northwest 6 shovel which has had both the boom and dipper stick shortened. The excavated material would have been removed from the tunnel by means of 10-cu. yd. end-dump Euclid trucks, equipped with "scrubbers" to prevent the exhaust gases from entering and polluting the tunnel. The geological report indicated that a stratum of Franciscan sandstone would be first encountered, followed by a hard blue sandstone which would be self-supporting.

### Settlement changes plans

The unit bids for driving the tunnel had been based on two types of tunnel. The "A"-type section would be used in that portion of the tunnel where the ground was not considered to be self-supporting, and the lining of this section would consist of 3 ft. of concrete and a curved invert of concrete 3 ft., 6 in. thick. The "B"-type section of tunnel was to have been used in rock sections where the ground would be considered self-supporting, or nearly so, and only 2 ft. of concrete would be used, without invert, as a tunnel lining. According to the plans prepared by the city, it was anticipated that less than 100 ft. at the East Portal would be "A"-type tunnel. After driving the top heading and wall plate drifts, and placing the steel ribs, the contractor found that there was too much settlement in the tunnel. It appeared that the entire hill was showing settlement all the way from the tunnel portals to Taylor St., a distance of 200 ft. This settlement, while very gradual, continued for several weeks. In view of this fact, it became necessary to pour a concrete footing on which to set the tunnel ribs. The contractor proceeded to drive 2-ft. drifts in the North Bore, one extending about 210 ft. into the hill. Curb forms were then placed, and foot blocks and curbs poured in one pour using a Rex Pumpcrete machine.

Thus far in the longest drift, the formation is composed of an extremely fragmented soft sandstone, interspersed with lenses of slick clay. Very little blasting has been done to date. Most of the material has been removed with pneumatic spades and picks, Joy HL20 mucking machines being used to load the excavated material into the mine cars. Most of the material excavated thus far has been hauled to Islais Creek fill site, a distance of 5½ mi. across the city. If the character of the material changes as the drifts progress, so that the rock will break to a minimum of 6 in. and be reasonably free from dirt, then much closer dumping sites can be secured. Ingersoll-Rand jackleg drills have been adopted for drilling. These are mounted on two 3-deck jumbos carried on trucks which were designed and built in the contractor's Southgate, Calif., shops. In order to reduce concussion to a minimum, milli-second delay blasting caps will be used.

### Present plans

It is planned at present to place the concrete lining near the portals before removing the center core. Air supply for the tunnel is delivered by a battery of three model XLE Ingersoll-Rand compressors, delivering a total of 2,550 cfm. A 6-in. air line has been laid the entire length of the project to deliver air to the West Portal. It was planned to drive the major part of the tunnels from the east end, although now that it is considered necessary to open up only a short length of tunnel before concreting, it will probably be necessary to do some driving from the West Portal in order to keep up with the proposed schedule.

### Personnel

For the San Francisco Department of Public Works, Sherman P. Duckel is director, and Ralph G. Wadsworth is city engineer. Resident engineer in the field is George Partridge.

For Morrison-Knudsen Co., Inc., T. Y. Johnson is project manager; Harry Kirmond is assistant project manager; L. B. Wheeler is project engineer; John Erdle is office engineer; Dan Butler is office manager; Carl Larson is tunnel superintendent; Axel Hallberg is building superintendent, east side; Ken Gooding is building superintendent, west side, and Paul Benner is master mechanic.

**ALUMINUM PAINT**, aluminum foil and wet burlap are being used to prevent high temperatures from causing strains in the steel network at the east approach.

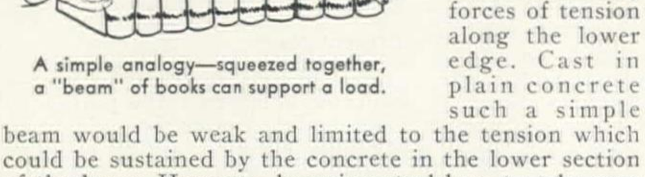
# THE *A B C* OF PRESTRESSED CONCRETE

BASED on the engineering fact that concrete is strong in compression, but weak in tension, designers have worked for years to improve methods for using this basic material in a most economical manner, considering: (1) the cost of labor and (2) the cost of materials.

A simple beam provides a quick illustration of the problems involved. To support a load—even its own weight—this simple engineering member must sustain forces of compression along its upper surface and corresponding forces of tension along the lower edge. Cast in plain concrete such a simple beam would be weak and limited to the tension which could be sustained by the concrete in the lower section of the beam. However, by using steel bars to take care of this tension, engineers design concrete beams and girders to combine the properties of concrete and steel in an economical method.

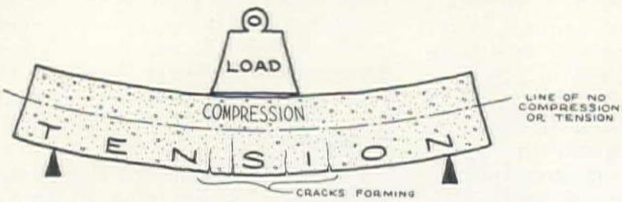
A simple analogy—squeezed together, a "beam" of books can support a load.

Considering the problem further, it was obvious that the reinforcing steel merely embedded in the concrete does not exert any initial force on the concrete to help resist the applied load and resulting tendency for cracking along the bottom of the beam. Since the steel is not being stretched, it is not able to "go to work" as fast in resisting any tension resulting from the load. To use a simple illustration, a weight placed on an unstretched rubber band will cause more sag that a similar weight placed on one which has been stretched tight. Any stretching of the steel will tend to open up small cracks, which is undesirable even though not directly affecting the strength of the beam. Further, this situation is an uneconomical design since it brings a small proportion of the concrete (lower part of the beam) up to the point of overload before the rest of the concrete is up to anywhere near working strength.




Tension in bottom of plain concrete beam is the problem.

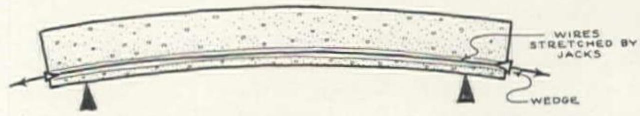
For years, engineers recognized the fact that if steel of proper strength could be inserted in the concrete and then given an initial load (stretched) the result would place the concrete in compression before it had received any dead or live load. Theoretically, if the steel could be pulled just the right amount, and clamped, it would compress the concrete with a force equal to the effect of the load, which would bring the concrete back to "no load."




Reinforced beam combines properties of steel and concrete.

The action of stretching the steel and applying this force to compress the concrete is called prestressing. This procedure allows a more economical use of both materials, but involves new principles of design, new techniques in the field, a greater amount of labor on the job.

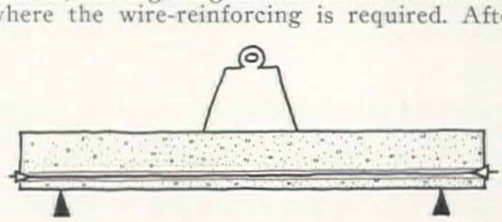
This same basic principle was being used in the design and construction of cylindrical tanks for storing water and other liquids. When these tanks were cast in plain concrete the pressure of liquid on the inside would tend to pull apart the concrete wall, producing cracks, leakage and potential failure. Engineers recognized the possibility of putting tension of hoops around this concrete and subjecting it to compression to balance the load imposed by the water when the tank was filled. An original design to meet this problem was developed by William S. Hewett about 1921, and many concrete tanks were built with steel bands around the outside which were pulled tight by turnbuckles. The size, number and tightness of these bands were determined by the pressure of water to be sustained. More recently, the Preload Corporation extended this idea by developing a method for wrapping the concrete wall with steel wire which was applied under stress. The net result was the same—placing the concrete under compressive load before it was called upon to sustain the inside force. Tanks of this design are being built in the West by The Preload Pacific Corp., San Francisco.




In prestressing, stretched wires compress bottom concrete.

In general, two methods have been developed for "prestressing" a simple concrete beam:

1. Steel wires (about 0.2-in. diam.) are placed in the proper position in the lower section of the form and held under tension while the concrete is poured. After the concrete has taken final set, the pull on the wires is released, and this force is transferred to the concrete by the bond between the wires and the concrete. The process puts compression in the concrete. This procedure was first developed by a German engineer, and is called the Hoyer process of prestressing.
2. Pipes or tubes are inserted in the form—with or without wires already in place—and the concrete poured, leaving longitudinal holes at the locations where the wire-reinforcing is required. After the concrete has set and the form stripped, these wires are stretched to proper tension by hydraulic jacks and wedges applied at the ends of the pipe. This places compression on the concrete and introduces the prestress.



Under load, prestressed beam has minimum tension in bottom.

During the past several years, a Belgian engineer (G. Magnel) and a French engineer (M. Freyssinet) have led the technical studies in developing the theory of prestressed concrete, and its field applications.

The first time this method was applied to a bridge structure in the United States was in the design and construction of a bridge for the City of Philadelphia. The project has been under way during the past year and watched with interest by engineers and contractors throughout the country.

Now, a Western bridge has been designed using the principle of prestressed concrete, and *Western Construction* presents a description of the structure and its design features in the following article.

## *California Division of Highways Building the West's—*

# First Bridge of Prestressed Concrete

***Pedestrian bridge in Los Angeles, with single span of 110 ft., considered ideal structure for experimental use of method—Design data to be obtained by careful measurement of stresses and deflections—Many details of construction materials and procedures left to discretion of contractor***

By
LEONARD C. HOLLISTER
Engineer of Design
Bridge Department
California Division of Highways

BRIDGE DESIGNERS of the California Division of Highways have been watching with interest the recent developments being made in prestressed concrete design. There have been many useful and economical applications made of prestressed concrete in other fields of construction and it is felt that there may be many useful places for it in highway bridge construction as well.

### What are the advantages?

The advocates of prestressed concrete design claim several advantages over standard reinforced concrete designs. For instance many feel that under favorable conditions a prestressed design could be made to show economy over a standard reinforced concrete design.

We do know that a prestressed concrete design can be made to show considerable economy of materials such as concrete and especially reinforcing steel. In normal times this saving of materials might not be of particular significance unless it could also be translated into a saving in dollars. However, there was a period not long ago, during the last world war, when a saving in reinforcing steel was a definite advantage in itself, and of course, we cannot tell when that condition may again return.

We also know that a prestressed concrete girder design can be made with a much smaller depth to span length ratio. In the design of our many freeway structures we often find ourselves very limited for head room. Therefore a prestressed concrete design with its reduction in headroom requirements could in many cases be a useful facility to have at the disposal of the bridge engineer.

In addition to this the architect often feels that he could make our concrete freeway structures more attractive if he had more slender and graceful members to deal with. It is possible therefore, that a prestressed concrete design could be made to show a considerable advantage in this field.

In the southern area of California where the state highways cross deserts at many points there are hundreds of timber bridges which some day soon must be replaced. These structures are located in remote areas and in climates that make construction very difficult.

It is entirely possible that prestressed precast concrete members will make an excellent solution to this problem. These members could be precast in an area close to labor and materials. Being light in sections they could easily be transported to the site and erected with the minimum of men and equipment.

These then are some of the possible advantages of prestressed concrete design that we hope to investigate.

### Avoiding dictatorial specs

While the theory of prestressed concrete design is quite simple and fairly well established it is not easy to jump in and start designing and constructing bridge structures so radically different from standards that have been developed over the past 20 years.

In the first place the two principal methods of prestressing are patented and it was our desire to prepare the plans and special provisions so as not to eliminate any of the accepted methods of prestressing concrete girders.

It was, therefore, necessary to make considerable investigation before adequate plans and special provisions could be prepared that would not dictate any particular type or method and yet would be specific enough to maintain a sufficiently firm control over materials and construction to insure a first class structure when completed.

Since both design and construction experience had to be developed, it was felt that the first few jobs would be considered experimental and should be on not too large a scale.

### Arroyo Seco pedestrian bridge

The pedestrian bridge across the Arroyo Seco in the Los Angeles area appeared to be an ideal structure with which to start our prestressed concrete experience. It is a small structure with a fairly long single span carrying moderate live loads not subject to extreme overloads and located in an accessible area for experimental work.

NOTE: The prestressed concrete design for the Arroyo Seco pedestrian bridge was previously discussed by Mr. Hollister before the annual convention of the Structural Engineers Association of California at Coronado, Calif., October 12-14.—Editor.

The Arroyo Seco pedestrian bridge has a span of 110 ft. between supports, is simply supported, and provides for an 8-ft. clear sidewalk, with a live load of 55 lb. per sq. ft.

The final section of this structure as designed is shown on page 68.

In preparing the design and special provisions for this job it was our thought that it should be left open to any of the accepted methods of prestressing available to the construction industry. Accordingly we secured as much information as possible from the Pacific Bridge Company, which is interested in the Mangel or Belgian method of prestressing, and with the Raymond Concrete Pile Co., which is interested in the Freyssinet method.

The plans, therefore, did not show specific details as to size, number or strength of wires, wire enclosures, distribution and anchorage plates or jacking details. The special provisions made the following requirements.

### Working stresses

The unit working stresses used were conservative, being 1,700 psi. for concrete testing 5,000 psi. at 28 days, and for the prestressing wires 0.6 of the ultimate tensile strength with a minimum ultimate strength of 200,000 psi. In this case wires with an ultimate strength of 200,000 psi. would be worked at 120,000 psi.

To allow for shrinkage in the concrete, and creep in both the steel and concrete this 120,000 psi. will gradually be reduced by approximately 15%, or $0.85 \times 120{,}000 = 102{,}000$ psi.

### Prestressing wires

As with the ultimate strength requirements for the wire the special provisions are open as to exact size of wire that might be used stating only that the wire must have a diameter of not less than 0.100 in. and not more than 0.300 in., and comply with ASTM oil-tempered steel spring wire Designation A 229-41 or wire with equal or better physical characteristics.

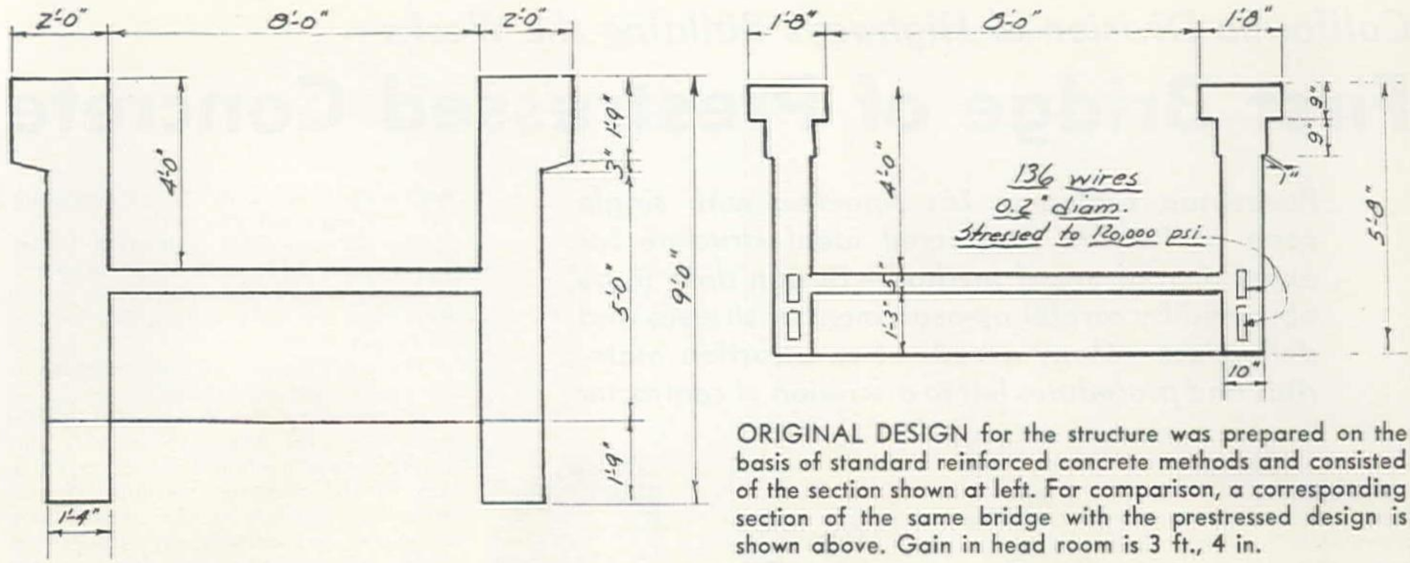
### Distribution plates and anchorage

Details for distribution plates and anchorage devices were not detailed on the plans. These were left to the contractor with the following provisions.

All wires are to be secured to the ends of the girders by means of approved anchoring devices which will be of such nature that they will not kink, neckdown or otherwise damage the wire.

Anchorage devices shall hold the wire without creep or slip of more than ⅛ in. at a load of 150% of the working stress.

Distribution plates consisting of welded steel or cast steel bearing assemblies for the support and distribution of the load from the anchorage de-




ORIGINAL DESIGN for the structure was prepared on the basis of standard reinforced concrete methods and consisted of the section shown at left. For comparison, a corresponding section of the same bridge with the prestressed design is shown above. Gain in head room is 3 ft., 4 in.

vices shall be provided. They shall meet the following requirements:

1. Bearing stress on concrete not to exceed 3,000 psi.
2. Maximum bending stress in plates 20,000 psi.
3. Bearing pressure to be distributed evenly from wires to concrete girders.

### Prestressing

Immediately after placing wires the ends of wire enclosures are to be sealed to prevent moisture from entering. After concrete is poured and in place for 28 days seals are to be removed and wires stressed by hydraulic jacks. Jacks are to be actuated by means of a hydraulic pump. Jacks are to have pressure gages to permit computing stress in steel wires at any time.

Wires are to be stressed to 110% of working stress and held for 2 minutes, then lowered to 106% of working stress and anchored. Wires can be stressed individually or in pairs as would be done by the Mangel method or in groups of 12 as by the Freyssinet method.

### Cost comparison with standard design

Since one of our main objectives in the use of prestressed concrete is eventual economy it is fair that we should compare this first prestressed job with a standard reinforced concrete design for the same location.

The original design for this structure was prepared on the basis of standard reinforced concrete methods and consisted of section with proportions as shown in the drawing above.

For comparison the typical section of the prestressed design is shown alongside.

A comparison of quantities between the two sections is:

| | Standard | Prestressed |
|---|---|---|
| Concrete | 88 cu. yd. | 50 cu. yd. |
| Reinforcing steel | 40,000 lb. | 7,000 lb. |

This indicates a savings of 38 cu. yd. of concrete and 33,000 lb. of reinforcing steel.

Assuming that the amount of falsework and forms would be approximately the same for either design, the savings would be the cost of furnishing and placing 38 cu. yd. of concrete. At $20.00 per cu. yd., this would be

$$38 \times 20 = \$760.00$$

The savings in reinforcing steel would be $33{,}000 \times 11 = \$3{,}630$.

The total of these two items is $4,390 against which must be charged the cost of the prestressing wire and the prestressing operations.

For this work the contractor has bid $5,000.

Actually for a true cost comparison consideration should have been given to the fact that the standard design would have required somewhat larger abutments, and larger ramps.

Thus it can be seen that for our first prestressed job we have not effected much economy, if any. This was as anticipated, however, on the first job. Ultimate economy we feel will come as greater facility for both design and construction is developed. This can be done only by experience and we feel that now is the time to gain that experience.

A tabulation of the four bids received accompanies this article. Walter Kaucher of Los Angeles was low bidder and he proposes to have the Prestressed Concrete Corp. of Kansas City, Mo., do the prestressing.

### Field measurements of concrete stresses

Since this structure is to be considered as an experiment from which not only the Division of Highways but also the construction industry of the West can gain valuable information for possible application on future jobs, tests are to be made.

The Division of Highways has made arrangements with the Institute of Traffic and Transportation Engineering at the University of California to make certain tests.

From these tests it is hoped to determine:

1. Stress distribution in the concrete during prestressing and immediately after.
2. Loss of prestressing in concrete.
3. Stress distribution in concrete due to design live load and double design live load.
4. Deflections.

Twelve Carlson gages are to be embedded in the two girders in the north half of the span. Three gages will be placed at the CL section and 3 at the ¼-point section.

One of the advantages of prestressed concrete is the resulting low unit stress for diagonal tension because of the concrete being held in compression. The calculated maximum unit stress for diagonal tension was 12 psi. It was therefore necessary to use only a nominal amount of shear reinforcing. U-stirrups of ½-in. diameter at 18-in. centers were used, except at the ends where concentration of prestressing forces

## *From This Month's Unit Bid Summary*

### Prestressed Concrete Pedestrian Bridge in Los Angeles

**California—Los Angeles County—State.** Walter Kaucher, Los Angeles, with a bid of $23,770, was low before the California Division of Highways for constructing a prestressed concrete girder pedestrian bridge over Arroyo Seco Channel near Avenue 58 in Arroyo Seco Park, Los Angeles County, Calif. Unit bids were as follows:

(1) Walter Kaucher .......... $23,770
(2) J. E. Haddock, Ltd. .......... 24,810
(3) McClain Construction Co., Inc. .......... $42,280
(4) Concrete Const. Service, Inc. .......... 46,811

| | (1) | (2) | (3) | (4) |
|---|---|---|---|---|
| 5 cu. yd., removing concrete | 20.00 | 10.00 | 10.00 | 23.00 |
| 300 cu. yd. structure excavation | 4.00 | 5.00 | 5.00 | 9.87 |
| 110 cu. yd. class "A" P.C.C. (structure) | 65.00 | 60.00 | 107.00 | 74.00 |
| 50 cu. yd. class "E" P.C.C. (girders) | 120.00 | 112.00 | 185.00 | 182.00 |
| 170 lin. ft. concrete railing | 10.00 | 10.00 | 13.00 | 37.00 |
| 8 cu. yd. class "A" P.C.C. (curb and sidewalk) | 50.00 | 40.00 | 45.00 | 58.00 |
| 17,000 lb. bar reinforcing steel | .11 | .12 | .12 | .24 |
| 1,000 lb. miscellaneous iron and steel | .35 | .50 | .50 | 1.15 |
| Lump sum, prestressing and reinforcement (girders) | $5,000 | $6,500 | $14,600 | $14,511 |

was high and in this area ¾-in. stirrups were used.

Computations for deflections indicate that the girders will deflect about 0.8 in. from their poured-in-place position under dead load. A live load of 55 lb. per sq. ft. will produce a deflection of about 0.58 in.

After completion of the structure it is planned to take readings on the Carlson gages and measure deflections periodically until no appreciable change in stress or deflection is noted.

### Method of prestressing

During the preparation of these plans much helpful information was received from Pacific Bridge Co. of San Francisco, The Preload Enterprises Inc. of N. Y., the Raymond Concrete Pile Co., and The John A. Roebling's Sons Co.

The Pacific Bridge Co. has the rights to the Mangel prestressing process on the West Coast, and the Raymond Concrete Pile Co. has the rights to the Freyssinet prestressing methods in the United States.

Information from the contractor is to the effect that he does not propose to use either the Mangel or the Freyssinet method, but proposes to prestress the girders by a method which has been patented by the Prestressed Concrete Corp. of Kansas City.

It consists chiefly of threading five wires through a stressing block which is a steel block with a 4- by 1-in. face and 3½ in. deep. After the wires are threaded through drilled holes in these stressing blocks ⅝-in. washers are placed and a button head is formed on the end of each wire with a high pressure hydraulic press. The Prestressed Concrete Corp. assures us that these fastenings will meet specifications without creep or slip of more than ⅛ in. at 150% of design load.

The wires are then placed in metal sheaths and erected accurately in place in the girder forms before pouring any concrete.

After the concrete girders have been poured and before concrete has reached its full 28-day strength of 5,000 psi., a small initial tension is placed on the wires.

After concrete has reached its full strength of 5,000 psi., the jacking operations will commence by jacking, one at a time, the stressing blocks, each of which will stretch five ¼-in. wires with a hydraulic jack. In order to induce a stress of 120,000 psi. in the wires which are approximately 110 ft. long it will be necessary to jack them 5.3 in. for a modulus of elasticity of 30,000,000. However, the jacks are to have accurate gages for measuring the force exerted. To stretch five ¼-in. wires the required amount the jacks need not have a capacity larger than 20 tons. After all wires have been prestressed to the required amount, the wires will be pressure grouted through 1-in. holes in the large steel jacking blocks which are approximately 20 in. long by 6½ in. wide and 3 in. deep.

### Girders to be prefabricated

We also understand from the contractor, Walter Kaucher, that he proposes to prefabricate each of the girders to one side and lift them into place. Each girder will weigh approximately 50 tons. This method of erection will save the cost of falsework and permit construction of the girders during the winter months at a time when the flood control district will not permit falsework in the Arroyo Seco channel.

Thus the contractor proposes to make use of one of the advantages of prestressed concrete; that is, that it requires a smaller section with a considerable reduction in weight. The standard concrete design would have required waiting until next spring for falsework in the channel or lifting girders weighing 88 tons, rather than 50 tons, into place.

# Will Winter Put the "Freeze" on Your Equipment?

WITH Old Man Winter just around the corner in some places and really here in others, it's high time to get your equipment in tip-top condition for snow and zero weather. Battling snow, ice and frozen ground isn't easy, but it can be made easier if your equipment is ready for winter work.

Follow these suggestions to get ready to meet cold weather.

### Cooling system

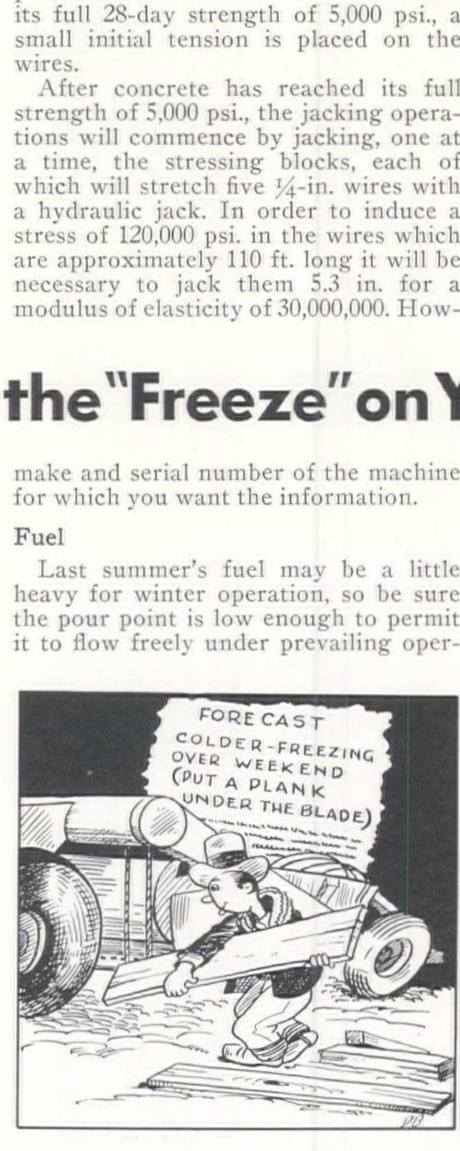
Perhaps the most important step in cold weather is to keep the cooling system of your earthmoving equipment ready for freezing weather. Check the radiator for leaks, making sure that all the hoses and gaskets are in good condition, and that all connections are tight. Use a good grade of antifreeze—preferably a permanent, ethylene glycol antifreeze solution because it has a boiling point higher than 185 deg. F. Test the solution periodically to make sure it is strong enough for protection against prevailing temperatures.

### Winter lubrication

Change crankcase, transmission and final drive case oil to the correct winter grade. An oil that is too heavy in cold weather will cause such a drag on the starting motor that the engine will not start, even though the battery is in good condition. Manufacturers' operators manuals give the details of where and when to lubricate. If you don't already have the information, write the manufacturer of the machine concerned for it. Most lubrication charts can be obtained for little or no cost. In requesting manuals or charts be sure to give the make and serial number of the machine for which you want the information.

### Fuel

Last summer's fuel may be a little heavy for winter operation, so be sure the pour point is low enough to permit it to flow freely under prevailing operating temperatures. For cold weather operating, lighter fuels such as No. 1 Diesel have a lower pour point. Your own oil man will be able to fix you up with the correct grade of oil. After you get the proper fuel, be sure to keep it clean.




### Check batteries

In extreme cold weather, there is danger of batteries freezing if the specific gravity of the solution is low. Batteries with a specific gravity of 1.225 will freeze at —35 deg. F. Make sure there is charge enough to withstand freezing weather. Check the water level often, but do not add water to batteries at the end of the day's work as the water added at that time will freeze overnight. Add the water during the day when the water will have a chance to mix with the solution in the battery. A good battery will mean quicker starting.

### Overnight parking

A good point to keep in mind is parking your equipment. Many equipment owners, when they have to park their equipment for any length of time, follow the practice of parking their equipment on planks. If that is not practical for you to do, at least make sure that the dozer blade and scraper bowl are resting on blocks or planks when parked in cold weather areas. By doing this, you make sure that the dozer blade or scraper bowl won't be frozen down if allowed to rest for a considerable time on the ground itself.

In addition, be sure to clean off your dozer blade and your scraper bowl and blade. If dirt is left on, it might freeze on so hard you'll have to thaw it out before you can do any work. It's a good practice to spray a thin film of oil in the scraper bowl and on the dozer blade. This will be added protection to keep dirt from freezing.

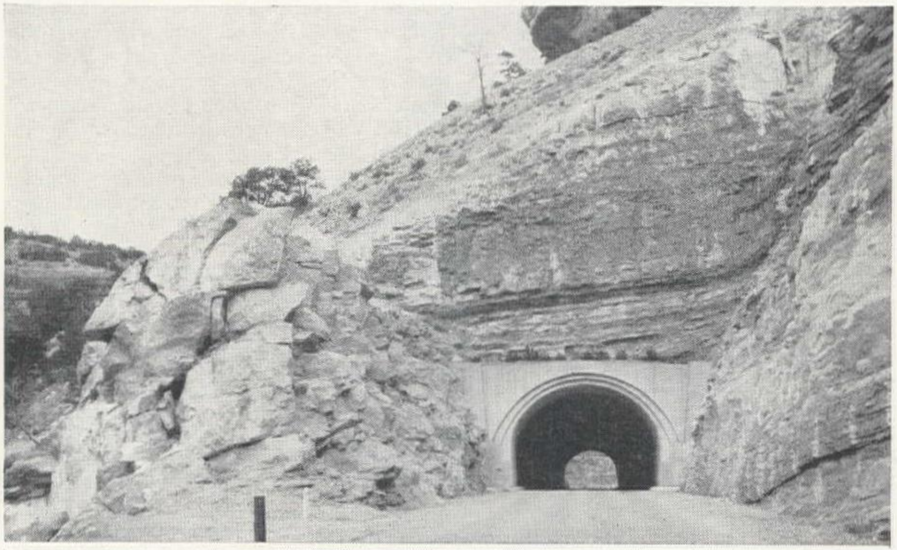
Be sure to keep all these points in mind. You'll find that by following them, cold weather operation will be made much easier.

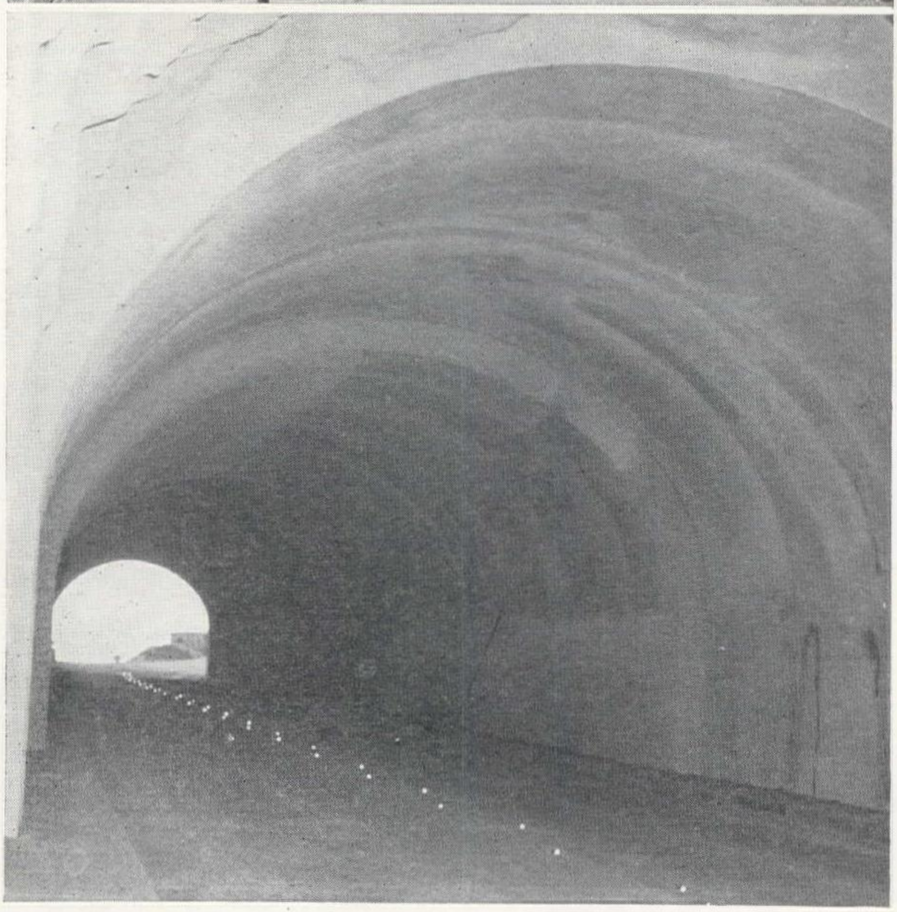
These tips and the accompanying cartoon were prepared by the Service Department of R. G. LeTourneau, Inc.

*On the Alamogordo-Cloudcroft Highway—*

# New Mexico's First Vehicular Tunnel

***500-ft. tunnel required to preserve alignment through rough terrain for new highway replacing narrow and steep route—Tunnel lined with both reinforced concrete and gunite***





TOP—View of west portal. Jutting limestone ridge obstructed optimum alignment.

BOTTOM—Interior view. Final 3/8-in. gunite coating covers initial reinforced concrete and gunite lining. Photographer's flash bulb lit up center line reflectors.

RECONSTRUCTION of the Alamogordo-Cloudcroft Forest Highway Route 35 in New Mexico is progressing at an accelerated rate to compensate for the abandonment of a branch line of the Southern Pacific Railroad. A 16.9-mi. section of New Mexico State Highway 83 provides a modern highway connection from Cloudcroft, located on the crest of the Sacramento Mountains, with U. S. Highway 70 just north of Alamogordo. To accomplish this, the U. S. Bureau of Public Roads has expended $1,864,000 for contract construction of the easterly 13.5 mi. since 1946. In addition, a contiguous 3.4-mi. section has been completed through the bituminous surfacing stage by the New Mexico State Highway Department as a Federal-aid Secondary project.

## Alignment considerations

The new highway saves 5.5 mi. of distance between Alamogordo and Cloudcroft over the routing afforded by the old highway. The old highway, circuitous in alignment, narrow and steep, was functionally obsolete for the traffic load even prior to abandonment of the rail line in 1947. Cloudcroft is the center of a vast recreational and logging area in the Sacramento Mountains. The improvment of the highway was essential to serve the heavy recreational, logging and commercial traffic demand.

The easterly 13.5 mi. constructed by the U. S. Bureau of Public Roads traverses exceptionally rough terrain. At an intermediate point where the route traverses a secondary rim within Fresnal Canyon, it was necessary to construct a 500-ft. vehicular tunnel through a limestone ridge to preserve alignment. The construction of this tunnel was of unusual interest in that it is the only vehicular tunnel in New Mexico. Details attending the construction, as taken from the final construction reports prepared by Bureau of Public Roads engineers A. O. Stinson and T. A. Smith, follow:

The tunnel was excavated by the contracting firm of Henry Thygesen and Co. and Frank P. Llewellyn, Albuquerque, bidding as partners. Tom Taylor was the superintendent in charge of tunnel work for the contractor, and A. O. Stinson was the project engineer for the Bureau of Public Roads.

After the tunnel was excavated, temporary arch timber supports were installed and the tunnel was opened to traffic for a year and a half before permanent lining, paving and portals were provided. This latter work was accomplished as two separate projects. The contractor for these projects was Henry Thygesen and Co. His superintendent was C. W. Holford, and T. A. Smith was project engineer for the Bureau of Public Roads.

The tunnel section was designed to

provide a 26-ft. finished roadway between curbs and a 14-ft. minimum vertical clearance after lining and paving. Narrow sidewalks were provided along both curbs. To afford this, the excavation required 30-ft. width. The tunnel length from portal to portal is 520 ft. Prior to excavating the main bore, a pioneer bore 6 by 7 ft. was driven along the centerline of the proposed tunnel at the crest of the arch.

### Excavating pioneer bore

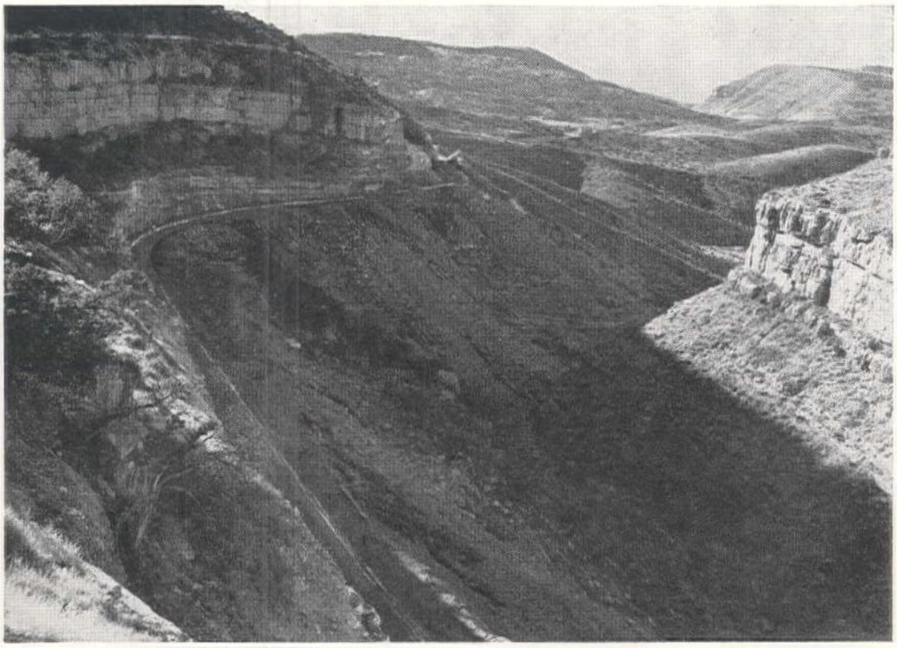
In prosecuting this work the contractor organized his forces on the basis of three 8-hr. shifts of six men each using two 3½-in. drifters mounted on a small drill standard. Thirty-five to forty holes, 4 to 6 ft. deep, were drilled for each round and loaded with about 75 lb. of 40% stick dynamite. Average advance per round in the pioneer bore was 4.5 ft.

Removal of excavated material was accomplished by a small mucking machine loading into ½-cu. yd. steel cars running on a narrow gauge track. Loaded cars rolled downgrade by gravity to the dump; empty cars were pulled upgrade to the mucker by a compressed air winch. Timbering was necessary for an intermediate 48-ft. section in the pioneer bore where fissured material was encountered. Conventional square-set timbering, using untreated native Douglas fir, was used. Work on the pioneer bore began February 28, 1947 and was completed April 18, 1947.

After completion of the pioneer bore an inspection was made by Bureau of Public Roads engineers of the rock structures encountered. On the basis of this inspection, 358 ft. of the tunnel was designated for excavation to accommodate lining. The remainder of the bore to a point 4 ft. from the east portal was designated for excavation to the neat tunnel section. Further inspections after construction permitted a reduction in the length of the tunnel that was ultimately lined.

### Completing the excavation

Excavation of the main bore was accomplished with the aid of a twin-deck drill jumbo. Six 3½-in. drifters were used, two at each level. Two 500-cu. ft. compressors supplied the air. Eighty to one hundred holes were drilled per shift, using 9- to 15-ft. steel. The longer steel was used in the more solid rock which did not require timbering. Holes were loaded with 40% stick dynamite with no springing or stemming. Shooting was accomplished with delay caps, using ten stages of delay shooting consecutively from the pioneer bore. Approximately 3 lb. of powder per cubic yard of excavation was required.



FROM ABOVE the tunnel's west portal, a bird's-eye view of a portion of the Alamogordo-Cloudcroft highway. Rough terrain is typical of south-central New Mexico.

The drilling shift, working from 4 p. m. until midnight, erected the timbering, drilled, loaded and shot the face. The mucking shift, working from 8 a. m. until 3 p. m., loaded out the muck, using a ¾-cu. yd. power shovel with a short boom and five dump trucks. At 3 p. m. the engineer marked grade and line for the next round of drilling and a small crew laid the track for the jumbo. Excavation of the main bore began on May 21 and progressed with an average advance of nine feet per day until completion on July 25, 1947. A total of 12,000 cu. yd. of tunnel excavation was required.

### Lining and paving

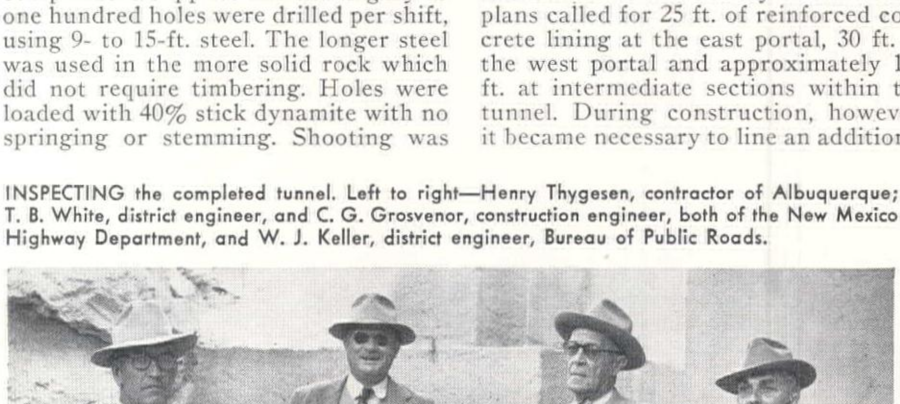
The lining and paving operations began March 21, 1949. Timber arch lining forms were fabricated in Alamogordo and hauled to the site by truck. Initial plans called for 25 ft. of reinforced concrete lining at the east portal, 30 ft. at the west portal and approximately 100 ft. at intermediate sections within the tunnel. During construction, however, it became necessary to line an additional 100 ft. of tunnel due to unstable rock conditions encountered.

The completed tunnel has a reinforced concrete lining for approximately 50% of its length, with two reinforced concrete portals. All sections of the tunnel which were not lined by reinforced concrete were provided with a pneumatically applied mortar (gunite) coat approximating 1½-in depth.

Lining operations progressed upgrade from the west portal to the east portal. An intermediate 100-ft. section, which required special treatment due to the unstable rock conditions, was the last section to receive the reinforced concrete lining in the tunnel. In this section the temporary timber arch sets were left in place and incorporated within the concrete lining. Footings were excavated to solid rock on both sides of the timber supports and the walls poured to spring line before setting the arch forms. The arch was poured in 12-ft. sections with each section being bulkheaded off and completely filled with concrete supplied by pumpcrete machine. Drains were placed in back of the lining to carry water which might seep down through the fractured rock strata. After completion of the reinforced concrete lining and all paving, all tunnel interior walls were given a final gunite coat ⅜ in. thick, using white cement to improve visibility within the tunnel and ease the transition between the tunnel and the daylight. This operation was completed on November 15, 1949. The gunite operations were subcontracted and performed by C. N. Hanes Construction Co., Denver, Colo.

All tunnel work was accomplished without accident. In one instance a cave-in occurred during lining operations and six men were entrapped by the shattered form lining for a short period of time, but were extricated without injury. The safety record for the tunnel work is a tribute to the superintendents who were in charge of construction activities.

INSPECTING the completed tunnel. Left to right—Henry Thygesen, contractor of Albuquerque; T. B. White, district engineer, and C. G. Grosvenor, construction engineer, both of the New Mexico Highway Department, and W. J. Keller, district engineer, Bureau of Public Roads.



# Field Tips for Handling and Placing of

***Experience provides the answers to such day-to-day problems on a "lightweight" job as—***

***—How to control water in the mix***
***—What methods keep the mix workable***
***—How to handle and deliver batches***
***—What precautions avoid stiffening***
***—How to get along with the inspector***


By
PAUL A. ELSNER
Chief Engineer
Lindgren & Swinerton, Inc.
San Francisco, Calif.


ALTHOUGH the advantage of lightweight aggregate in the reduction of dead loads is generally recognized, perhaps there is no place in the country where its advantages are greater than on the West Coast where earthquake protection must be provided for structures.

Like any other material just beginning to come into general use, the problems which arise in putting lightweight concrete to use in major structures are no longer problems after they have been met, recognized and mastered. Accordingly, the following information is presented not in criticism of the material but in the hope that our experiences among the pioneers in its structural use will help eliminate some of the conditions which have contributed to the difficulty and cost of handling and placing "lightweight" in its first major uses.

### Transporting aggregates

The fact that sources of supply are not yet as thoroughly developed or as wide-spread for lightweight as for rock concrete is of course a contributing factor to the cost of using the material. This necessitates careful attention to arrangements for long distance transportation of aggregates and careful scheduling and expediting to see that ample supplies are readily available for use to prevent delays in pouring.

Perhaps the most persistent day-to-day problem is the control of water in the concrete. The very nature of the material, with its many air cells, makes this control difficult under the many various conditions of temperature, time lapses for evaporation and absorption, and re-handling of the material which takes place from stockpile to final position in the forms. To trace these operations briefly on a typical job, the aggregate is stockpiled, pre-saturated, drained of excess moisture, batched, mixed, transported, dumped into a skip, hoisted, discharged into a hopper, loaded into buggies, wheeled to position on the deck, poured, shoveled into place and vibrated. During the course of this dozen or so operations, we have found that serious changes take place in the amount of free water in the mix, and consequently in the difficulty of handling the concrete. Perhaps the best way to illustrate is to follow the procedure from stockpiling to placement and describe some of the conditions we have encountered.

### How to control water content

In order to prevent the mixing water from being immediately absorbed by the aggregate, some method of presaturation is essential. In locations such as Los Angeles and San Francisco, where suppliers have set up separate facilities for handling lightweight aggregate, the metal bins equipped with sprinklers adequately take care of presaturation of the material. In locations away from such permanent and adequately equipped sources, however, presaturation represents a very real problem. The problems of pre-saturation in these areas are presented in the following remarks. Coarse aggregates and medium aggregate are not too difficult to saturate adequately, and provision must simply be made to soak the aggregate thoroughly and then to allow it to drain for approximately 8 hours before using.

The matter of saturating the lightweight sand, however, has not proven so simple. We have had as much as a 20-gal. variation in water content in successive 5-cu. yd. batches, which we have traced primarily to lack of uniform saturation of the sand. To control this condition and to obtain reasonably uniform saturation of the sand, we first attempted to puddle each square yard of the surface of sand, stockpiled about 3 ft. deep. We found that even this procedure left some dry pockets and we finally found it necessary to insert a hose into the stockpile for a period of 15 to 30 seconds in each square foot of the pile. After such treatment, the sand is allowed to drain for about 8 hours before using, and a careful visual inspection is maintained to see that sand fed to the batching plant does not appear too dry.

ENGINEERS and contractors are probably quite familiar with the subject of lightweight concrete from the standpoint of general information and design. Mr. Elsner has by-passed this phase of the subject and presents instead the thoughts and experiences of those men who are involved in the detailed down-to-earth day-to-day operations necessary where lightweight concrete is used for major building projects. His article therefore represents a valuable accumulation of grass-roots experience in the procurement, handling and placing of this promising structural material. The experience of Lindgren & Swinerton, Inc., has extended to the use of lightweight concretes using the several major types of lightweight aggregate, and has ranged from small jobs to such structures as the 22-story Standard Oil Building Annex in San Francisco (*Western Construction*—August 1950, pg. 61) and the new State Capitol Addition in Sacramento. Mr. Elsner previously discussed the same subject before the annual convention of the Structural Engineers Association of California at Coronado, Calif., October 12-14. —*Editor.*

Sand left in the bunkers shows a tendency to lose moisture more rapidly against the sides of the bunker than in the middle. This condition has caused considerable variation in the free water which must be added, especially during long or fast pours when the sand supply is drawn low in the bunkers.

Lightweight aggregates will not absorb their maximum moisture unless completely inundated. For instance a Rocklite sand which will absorb 30% moisture completely saturated will absorb a maximum of only 26% in stockpile. This condition causes the concrete first batched into a mixer to have about a 3-in. greater slump than the same concrete at the end of five minutes mixing. As previously stated, these conditions apply only where permanent well equipped mixing plants are not available.

### Handling problems

In our early experiences we found that batches caused trouble, and investigation of this condition showed that the early morning sun had heated the standing truck drums sufficiently to affect the moisture content of the first batch. The condition was remedied by simply supplying enough cold water to the drums before introduction of any concrete to reduce the temperature satisfactorily.

Slump tests taken all along the route of delivery, from the batching plant to point of deposit, show a progressive decrease in slump at each point where time elapses or where concrete is transferred from one conveyance or hopper to another, all out of proportion to the decrease in slump of standard rock concrete at the same points. This decrease in slump will average 3½ to 4½ in. for normal operations.

We have found that considerable care must be taken to see that all drums, skips, hoppers and carts used in conveying the concrete are kept at as nearly the temperature of the mix as reasonably possible. These conditions considerably facilitate the handling of the lightweight concrete.

We have found it advisable to dump an entire truck load into a receiving hopper at one time. Our best results have been obtained when the hopper contains not more than 2 cu. yd. More than this quantity tends to cause the mix to adhere to the hopper sides and to clog the opening. The same is true of deck hoppers and carts; any excessive amount or excess time may cause stiffening and clogging of the hoppers. Even in the use of elephant trunks we have several times had to remove the trunks and beat out the lightweight concrete which had stiffened sufficiently to fail to run through. We have run into extreme cases where on lowering a vibrator into an elephant trunk carrying lightweight concrete we have been unable to get the vibrator back out until we removed the concrete bit by bit.

### Precautions for placing

After being received at the point of deposit and placed in the forms, care must be taken to see that segregation does not take place. The light aggregate has a tendency to float, and even the action of a vibrator left in a wall form for as long as one minute may cause a serious rock pocket. We have found it necessary to carefully instruct our vibrator operators to keep the vibrators moving rapidly from place to place to prevent formation of pockets.

Unless lightweight concrete is extremely wet, it cannot be moved after a few minutes in the forms. It will not run, even under persuasion of a vibrator, so it is necessary to give special attention to pouring under windows and other similar different locations.

In pouring walls, stairs or beams we have found a relatively wet mix, with a slump of 5½ to 6 in. at point of deposit, vibrated lightly, to be advisable. In slabs, on the contrary, we have found it necessary to pour as stiff a mix as we could handle to prevent the fine aggregate from floating to the surface. On more than one occasion we have had to tamp the mix in order to force the aggregate back down.

This situation is accentuated when it is necessary to finish the surface of the slabs. We have found it very difficult to finish lightweight slabs without first tamping and bull-floating the concrete and then sprinkling on a dry mixture of cement and standard weight sand. We believe that separate topping should be used wherever possible.

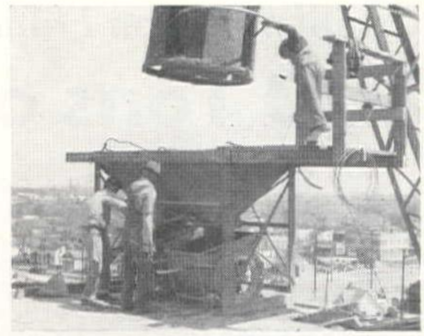
### Admix found essential

We have found the use of admix to be almost essential in making the lightweight concrete workable enough to pour satisfactorily. Because of the natural quick setting tendency of the mix, we avoid like the plague any admix that seems to accelerate the setting, and much prefer the use of an admix having a retardant action. While we recognize the value of air entraining admixes, we are not over enthusiastic about compounding the difficulties of controlling the concrete by using both lightweight concrete and one of the types of air entraining agents more difficult to control. An air entraining agent which is not difficult to control, on the contrary, aids in handling the lightweight.

One other thing in connection with the use of lightweight concrete which we have occasionally had trouble controlling is the inspector or the designer. We have chipped several loads of hardened concrete out of hoppers and other handling equipment on several occasions before we have been able to convince the designer that his mix contained insufficient water and that the material could not be handled the same as regular concrete.

To summarize and to draw a few brief pointers from our own experience, we hold the following opinions:

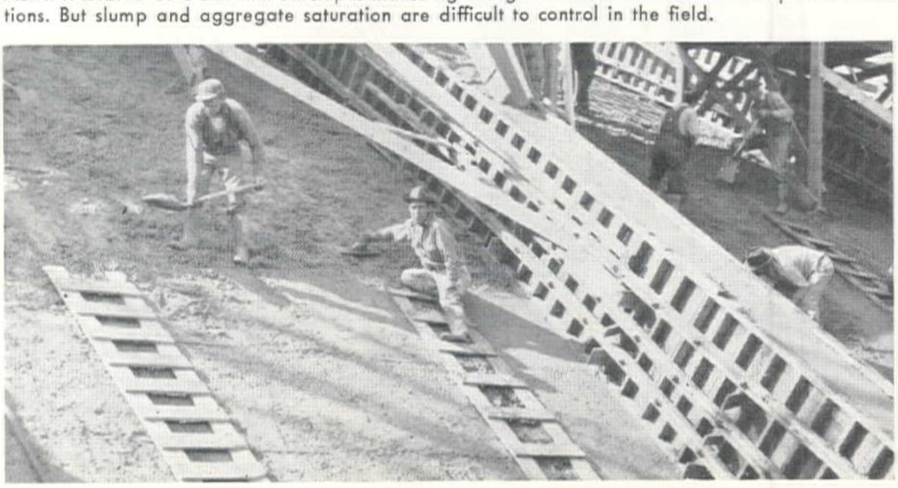
1. Lightweight concrete is not easy to handle, and deserves careful attention directed toward easier handling and placement.
2. The pre-saturating, batching and mixing of lightweight, while well taken care of in the major supply centers, is still a problem in locations not normally equipped to handle the material.
3. The free water in the concrete is quickly absorbed into the aggregate, resulting in rapid loss of slump, stiffening, and setting of the concrete.
4. Considerably more water must be used in the mix than in standard weight concrete to make adequate handling possible.
5. The use of an admix is advisable to assure workability.
6. Special care must be taken during placement to avoid rock pockets and to assure satisfactory placing in portions of the forms difficult to reach.
7. Care must be taken not to vibrate the concrete in the forms excessively to prevent segregation.
8. Satisfactory finishing of slabs is difficult, and we have found applied topping advisable.
9. Extremely lightweight concrete is more difficult to handle than concrete containing more natural sand and weighing slightly more. The breaking point seems to us to be somewhere very close to 105 lb.
10. Designers and inspectors, as well as builders, must realize the nature of the material and treat it as what it is, rather than as rock concrete.



TOP—Tendency of lightweight mix to harden fast makes special handling set-up necessary, such as this intermediate hopper arrangement.

BOTTOM—Slope of chute must be steep enough to handle sluggish mix. This chute is lined with galvanized sheet to reduce sliding friction.

ADAPTABILITY of a stiff mix on slopes makes lightweight concrete valuable under special conditions. But slump and aggregate saturation are difficult to control in the field.



## *Completing San Francisco's Big Airport Project with—*

# 800 Tons of Asphalt Paving Per Day

> FROM an initial $100,000 investment of San Francisco businessmen in 1927, the San Francisco Municipal Airport has progressed in size, stage by stage, until at the present time it ranks among the six largest in the United States. Four stages of construction have been underway since the initial developments, with their pavements of flexible coat asphalt, asphalt stabilized earth bases and macadam, until at the present time the airport represents an actual and planned investment of $50,000,000, with runway and terminal facilities double that which they were prewar. The topography of San Francisco has forced the city to go 12 mi. south into the next county to establish its airport.
>
> The new terminal to be built under subsequent contract will handle 3,000,000 revenue passengers per year (expected by 1956) with an ultimate capacity assumed at 10,000,000 per year. Traffic in air express, air mail, and air freight as well, is increasing at such a rate that parallel runways, one each for landings and takeoffs, are necessary to accommodate this heavy volume of traffic.
>
> Airport land holdings have been gradually expanded from the original 1,112 ac. in 1927 to the present 3,701 ac., giving San Francisco an airport of roughly 10% of the city's area. The airport today includes reclaimed areas raised by filling, and former swamp and tide lands filled expressly for runway extensions. This has required 19,500,000 cu. yd. of fill material, making the airport one of the largest earthmoving projects in the entire West (*Western Construction*—July 1949, pg. 65). The entire airfield sits over former tidal marsh between 30 and 80 ft. deep, and the material is a soft and compressible silty clay, with an average California bearing ratio of 3.—*Editor.*

GRADING AND PAVING, begun in 1935 and given a spurt during the wartime direction of the Corps of Engineers, is nearing completion at record breaking speed at the San Francisco Municipal Airport. Morrison-Knudsen Co., Inc., Boise, Idaho, is doing the work under a $2,595,000 contract by the San Francisco Public Utilities Commission which states that no less than 2,500 tons compacted rock base and 800 tons surface pavement must be placed each working day.

This unusual clause relating to daily progress requirements in the field is in the contract because of the great quantity of work to be done before the fall moisture appears. A minimum daily achievement is stated for both rock base and pavement, with the understanding that appurtenant work such as grading, prime and seal coating, be done as fast as is required.

Work recently completed was done to bring up to C.A.A. standards two remaining runways, 1R-19L and 10L-28R. Work on runway 28R, the instrument runway, had to be completed in 90 days. It was enlarged from 150 to 200 ft. width, 7,750 to 8,870 ft. in length. It consists of 12-in. crushed rock base and 3-in. pavement, laid at the rate of 756 sq. yd. per calendar day. In this case the prime coat was 0.4 gal. per sq. yd. of MC-1. Although SC-1 gives better penetration, it could not be used because of the speed required during construction.

### Sequence of current work

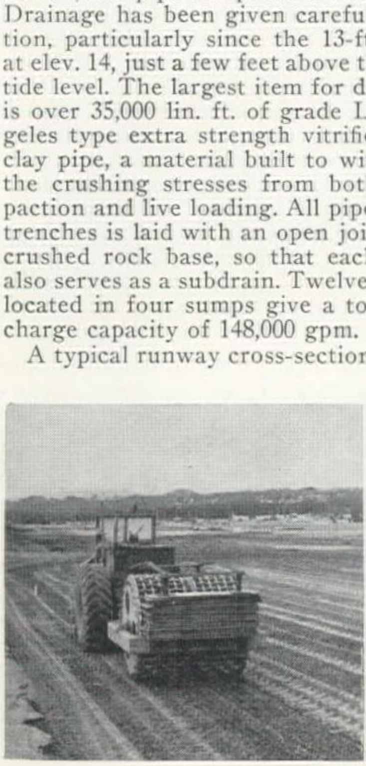
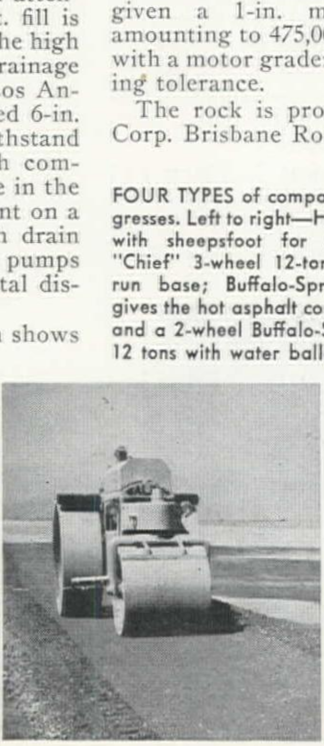
Other work such as miscellaneous paving on warm-up strips, drainage trench, and pipe completes the contract. Drainage has been given careful attention, particularly since the 13-ft. fill is at elev. 14, just a few feet above the high tide level. The largest item for drainage is over 35,000 lin. ft. of grade Los Angeles type extra strength vitrified 6-in. clay pipe, a material built to withstand the crushing stresses from both compaction and live loading. All pipe in the trenches is laid with an open joint on a crushed rock base, so that each drain also serves as a subdrain. Twelve pumps located in four sumps give a total discharge capacity of 148,000 gpm.

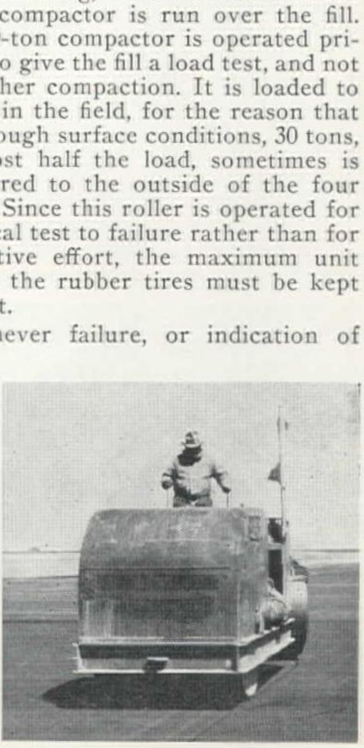
A typical runway cross-section shows a 13-ft. fill (placed in 1947) on bay mud, 12 in. of compacted crusher run base, and 3-in. asphaltic concrete pavement. The base is compacted to 97% density, which in this case is 139 of a possible 143 lb. per cu. ft. for solid rock. This high density is due to strict aggregate grading and compacting by a 12-ton 3-wheel roller. The rock is laid in 5¼-in. lifts, and compacted to 4 in. A custom-built spreader box, extra heavy and 11 ft. wide, is pushed by an HD 19 tractor. About 345,000 tons of crusher run base, plus the subsequent pavement on the contract, are being laid by five 8-ton and three 12-ton rollers. The base rock is given a 1-in. minus surface coat, amounting to 475,000 sq. yd., and bladed with a motor grader to a ⅜-in. fine grading tolerance.

The rock is procured at the Macco Corp. Brisbane Rock Co. plant, located 7½ mi. north of the airport. The plant produces aggregates from eight crushers and sand from crusher rolls.

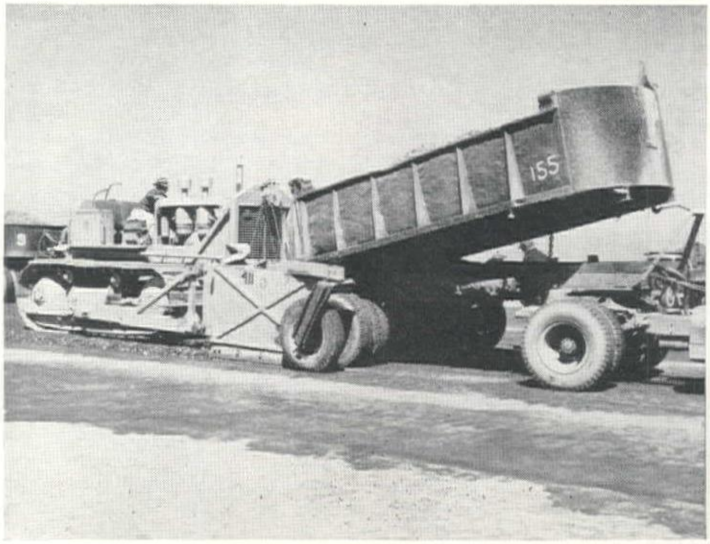
An average of 14 grid roller passes is necessary for 95% compaction. Alternating with the grid roller at the beginning of compaction is a conventional sheepsfoot tamper. The sheepsfoot is specified not only as to unit weight, but as to total number, three, of drums that must be used, each not less than 10 tons. This assures compaction in the center of each pass. The grid roller is a 32,000-lb. Hyster model, with 3½-in. spacing between grids. Following sheepsfoot and grid rolling, a 100-ton rubber tired Porter compactor is run over the fill. The 100-ton compactor is operated primarily to give the fill a load test, and not for further compaction. It is loaded to 66 tons in the field, for the reason that under rough surface conditions, 30 tons, or almost half the load, sometimes is transferred to the outside of the four wheels. Since this roller is operated for a physical test to failure rather than for compactive effort, the maximum unit load on the rubber tires must be kept constant.

Whenever failure, or indication of



**FOUR TYPES** of compactors used as paving progresses. Left to right—Hyster grid roller alternates with sheepsfoot for compacting fill; Galion "Chief" 3-wheel 12-ton roller compacts crusher run base; Buffalo-Springfield 3-drum tandem gives the hot asphalt course the "breakdown roll," and a 2-wheel Buffalo-Springfield, weighing 8 to 12 tons with water ballast, provides "finish roll."



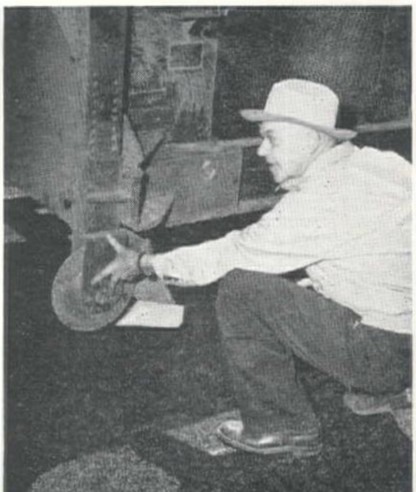
future failure, becomes evident under the heavy test load, work is stopped at that point until the cause is found. Reasons uncovered in failures to date have been either unsatisfactory drainage or material. Test core samples are taken on the spot and the faulty material excavated immediately.

The original estimate was for 450 hours on the sheepsfoot roller, and 630 hours on the grid. Because of changes in field practice, the sheepsfoot was used 600 hr., a 33% increase, and the grid roller used 980 hr., an increase of 55%. This is because more compactive effort with grid and sheepsfoot rollers is necessary due to the nature of the fill material, resulting in reduced number of hours on the rubber-tired roller.

### Borrow pit material

Over 900,000 tons imported borrow is being supplied from the nearby Millbrae pit, one of the largest open pit borrow sites in the world, for the fill on the new runway (*Western Construction*—April 1947, pg. 73). The compaction specified is 95%, measured by the AASHO T-99-38 Proctor test, modified. In this test, laboratory compaction is achieved with

WHEEL CUTTER of 12-in. diameter was rigged by contractor on side of the "finish roll" compactor to cut and trim pavement for neat construction joint.



LEFT—Rock for crusher run base is laid in 5¼-in. lifts from custom-built spreader box.

RIGHT—Adnun paver lays a blanket of hot mix.

a 10-lb. hammer, instead of 5.5 lb., through an 18-in. drop instead of 12 in., and using five equal layers instead of three, to determine 100% density rating.

When earthwork began during the war, the soils laboratory was in nearby Berkeley, in connection with the University of California. At that time, all possible borrow pits were well selected and explored, and samples were taken as deep as 150 ft. from possible sites. At Millbrae, the California bearing ratio tests show the material to be halfway between a rating of 20, the minimum specified, and 40.

### Personnel

A. O. Olsen is Chief Engineer and Manager of the San Francisco Public Utilities Commission. Construction is under the direction of H. E. Lloyd, Construction Engineer, and G. D. Burr, Design Engineer. J. E. Parks is Resident Engineer.

O. H. Tucker is Project Manager for Morrison-Knudsen Co., Inc. Superintendents include A. J. "Buck" Hope; Joseph H. Miller, paving; and F. F. Smith, pipe. Completion is scheduled for Fall, 1950, on the entire contract.

# Work on Two Cofferdams for Spillway At Albeni Falls Dam Will Start Soon

CONSTRUCTION of Albeni Falls Dam on the Pend Orielle River, 4 mi. west of Priest River, Idaho, will start about January 1, 1951 according to Lt. Col. John P. Buehler, District Engineer of the Seattle District, Corps of Engineers. Plans and specifications for the first construction contract were issued November 10 and will be opened in December.

This initial contract, estimated to cost between $500,000 and a million dollars, will include the preliminary rock excavation for the spillway dam; necessary clearing, widening, and deepening of the right or north channel which will be used for diversion purposes during construction of the spillway, and construction and unwatering of the cofferdams upstream and downstream from the spillway.

Completion of this work is scheduled for May 1, 1951 to permit immediate construction of the spillway.

The cofferdams will be of rock and earthfill construction, material to be obtained from the excavation. Approximately 180,000 cu. yd. of excavation will be required, most of which will be rock from the island in the channel.

The cofferdams will be placed in three sections. The longest will be located a short distance downstream from the axis of the dam, extending from the south abutment to the north island in mid-channel. The length of this cofferdam will be about 700 ft., and it will be constructed to the 2060-ft. elevation.

Upstream from the axis of the spillway dam another cofferdam will be placed in two sections. One section, about 200 ft. long, will extend from the south abutment out to the rock which forms the south island in the channel. The other section will be approximately 300 ft. long and will block the channel between the south and north islands. The upstream cofferdams will be built to elev. 2065 ft.

All cofferdams are designed to permit construction of the spillway throughout normal spring flood periods in the Pend Orielle River. Only floods of the 1948 and 1894 magnitude would exceed the height of the cofferdams.

The channel where the spillway dam will be located is presently about 80 ft. wide. Removal of part of the rock island in the center of the river channel will provide space for a spillway dam 472 ft. long. Ten vertical-lift type gates 40 ft. wide and 32 ft. high will be mounted between nine eight-foot wide piers and two abutment sections

# Five Easy Steps for Deciding How Many Trucks Per Shovel

***Hit-and-miss methods for choosing truck and shovel combinations can eat up the small contractor's profits—Here is a simplified and accurate method for determining the best ratio before the job gets under way***


By ARTHUR L. ROBERTS
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HOW MANY TRUCKS? Every contractor using power shovels or similar material handling equipment should ask this question every time a new job is started. Through trial and error, many now arrive at the correct combination, but by then they may be too far behind schedule or have eliminated any chance to make a profit on the job.

Determination of the correct shovel-truck ratio quickly and by more accurate means may result in more profit, better bidding, less time being required for a job and fewer trucks needed.

To illustrate how you may determine the correct shovel-truck ratio for yourself in 5 easy steps, a typical job problem is given.

The "X" Construction Company is to move dirt from point "A" to point "B" a distance of 2.6 mi. This company has one power shovel and five dump trucks. The problem is—how many of these five trucks should be put on this job for best performance both from a cost and from a time standpoint.

### Step 1—Study the Equipment

The equipment of the "X" Construction Co. is studied. We find:

1. The shovel, working at point "A" can dig and load a 3-cu. yd. dump truck in 6 min., including the time for the truck to get into position by the shovel.

2. The trucks travel 30 mph. when empty and 20 mph. when loaded.

3. The trucks require approximately 1 min. to dump their load and turn around at point "B."

4. Each truck can haul 3 cu. yd. of dirt when loaded.

### Step 2—Determine Costs

The cost to operate the shovel and each truck per hour should be determined. The following costs will be used in our example:

| | Shovel | Each Truck |
|---|---|---|
| Operating costs per hour* | $ 8.00 | $5.00 |
| Labor (operators) per hour | 2.00 | 2.00 |
| Total costs per hour | $10.00 | $7.00 |

*Includes fuel, insurance, taxes, maintenance, lubrication, depreciation, etc.

### Step 3—Analyze the Operation

Analyzing the facts and figures that we have obtained in Steps 1 and 2 we find that traveling loaded 2.6 mi. at 20 mph. plus 1 min. to dump and turn around and returning empty at 30 mph. gives us the truck-shovel charts shown by Figures 1, 2, 3 and 4. These charts show graphically the time relationship of the shovel with different combinations of trucks.

When using only one truck with the shovel, note that the shovel is idle for 14 min., while the truck goes to point "B," dumps and returns. If two trucks are used with the shovel as shown in Fig. 2 then the shovel is idle only 8 min. If three trucks are used as in Fig. 3 the shovel is idle only 2 min., while if 4 trucks are used the shovel is working continuously and each truck is idle for 4 min., or a total of 16 min. idle time as shown by Fig. 4. We will not consider 5 trucks since the shovel is still governing the output on the entire job.

Our problem may now take two different approaches: (1) the time required to move a load of material, or (2) the cost of moving a load of material.

### Step 4—The Time Approach

If time is the most important factor, then we find in our example that with one truck we move a load (3 cu. yd.) every 20 min., or 6.7 min. per cu. yd. With two trucks we haul 2 loads every 20 min., containing 6 cu. yd. of material or 3.3 min. per cu. yd. With three trucks, we move 3 loads in 20 min., or 2.2 min. per cu. yd. With 4 trucks we move 4 loads (12 cu. yd.) every 24 min., or 2 min. per cu. yd. Therefore, if we use 4 trucks we will move the material in the shortest possible time. The fifth truck would not reduce the time any further unless a second shovel was put on the job.

### Step 5—The Cost Approach

If the cost of moving material from one point to another is more important, which is the usual case, and using the same figures that were used in Step 4 we obtain:

FIG. 1—One truck leaves shovel idle.

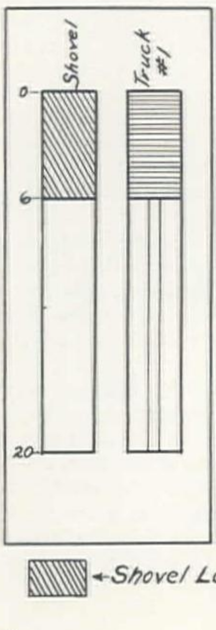



FIG. 2—Two trucks still leave idle time.

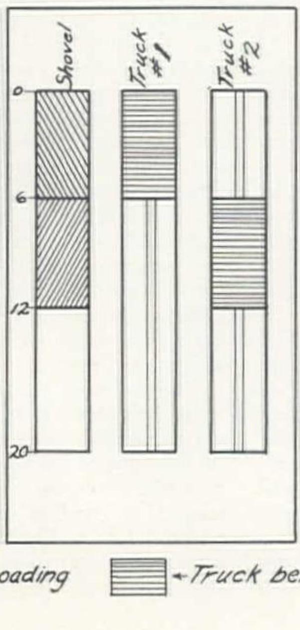



FIG. 3—Three trucks almost keep shovel busy for full cycle.

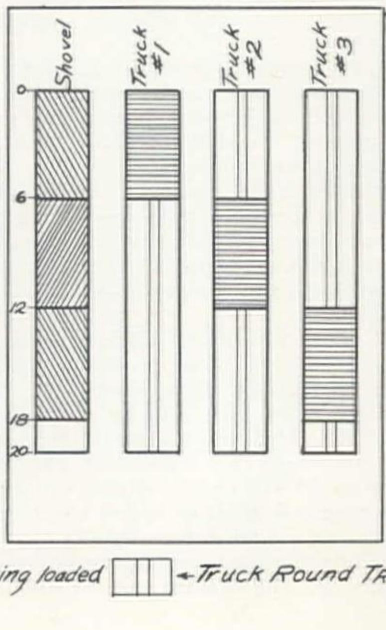
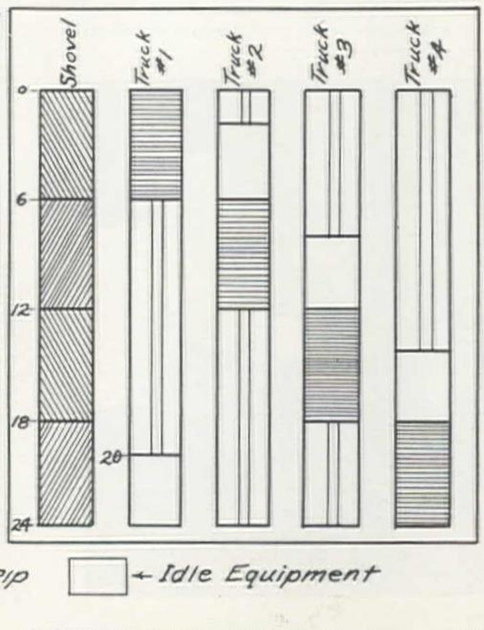
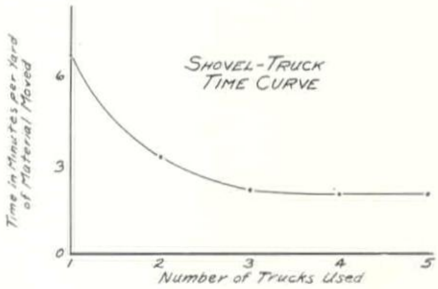



FIG. 4—With four trucks, shovel can work continuously but trucks are idle.



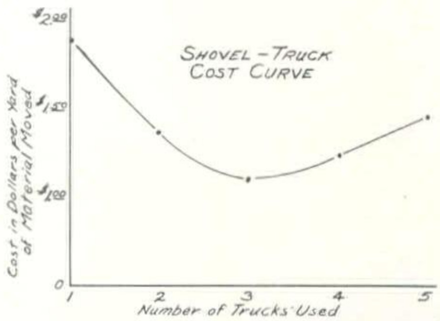




**FIG. 5—Typical truck-shovel time and cost curves. Top curve shows that 4 trucks is most desirable in this case for moving most material in a given time, but bottom curve indicates that overall costs would be less using 3 trucks.**

Using one truck

Shovel cost = 20 min./60($10.00)
= $3.33
Truck cost (1) = 20 min./60($7.00)
= $2.33
Total cost = $5.66 per load
$5.66/3 = $1.89 per yard.

Using two trucks

Shovel cost = 20 min./60($10.00)
= $3.33
Truck cost (2) = 20 min./60(2)($7.00)
= $4.67
Total cost = $8.00 for two loads
$8.00/6 = $1.33 per yard.

Using three trucks

Shovel cost = 20 min./60($10.00)
= $3.33
Truck cost (3) = 20 min./60(3)($7.00)
= $7.00
Total cost = $10.33 for 3 loads
$10.33/9 = $1.15 per yard.

Using four trucks

Shovel cost = 24 min./60($10.00)
= $4.00
Truck cost (4) = 24 min./60(4)($7.00)
= $11.20
Total cost = $15.20 for 4 loads
$15.20/12 = $1.27 per yard.

### Conclusions

From a time standpoint, 4 trucks is most desirable since with that number the most material will be moved in the shortest possible time, as shown by Figure 5.

From a cost standpoint, three trucks is the most desirable combination since the cost of all idle equipment time is at a minimum. A typical shovel-truck cost curve is shown by Figure 5.

It should be pointed out that these conclusions apply to this particular example only, and may change as costs or times vary for other jobs or other companies. A separate solution will be necessary for each new job.

# Grants for Western Airport Projects Scheduled by CAA

THE LIST of airport construction and development programs to be undertaken in the West under the Federal Aid Airport Program during fiscal year 1951 has been announced by D. W. Nyrop, Administrator of Civil Aeronautics. Projects in nine Western States (Oregon and Wyoming had no programs submitted for fiscal year 1951) represent a cost to the federal government of $4,544,692 with local or state sponsors providing an additional $3,912,330.

California is receiving the largest portion of federal aid with $2,112,833, and Arizona is next with $1,020,345. Grants in the other seven Western States are: Colorado, $595,170; Washington, $340,000; Utah, $270,355; New Mexico, $87,151; Nevada, $63,125; Montana, $43,201, and Idaho, $12,512.

The program is based upon funds provided from unexpended balances at the end of fiscal year 1950, and $21,200,000 made available for fiscal year 1951 after a reduction from the original appropriation of $36,700,000 for projects throughout the country.

The program for the nine participating Western States is tabulated below:

| Loc. and Name of Airport | Class Pres. | Class Prop. | Federal Funds | Total Funds | Proposed Work |
|---|---|---|---|---|---|
| **ARIZONA** | | | | | |
| Bisbee Douglas Int. | 6 | 6 | 14,934 | 24,550 | Paving, lighting. |
| Flagstaff Mun. | 3 | 3 | 25,184 | 41,400 | Bldgs., paving, misc. |
| Nogales International | 4 | 4 | 82,729 | 136,000 | Bldgs., prep. site, paving, misc. |
| Phoenix, Sky Harbor | 5 | 5 | 846,754 | 1,392,000 | Bldgs., paving, lighting, misc. |
| Prescott Mun. | 4 | 5 | 17,998 | 29,587 | Prep. site, paving. |
| Tucson Mun. No. 2 | 5 | 5 | 30,313 | 49,833 | Paving, lighting, misc. |
| Yuma County Mun. | 5 | 5 | 2,433 | 4,000 | Bldgs., misc. |
| **CALIFORNIA** | | | | | |
| Chico Mun. | 6 | 6 | 6,000 | 11,082 | Paving. |
| Fresno Air Terminal | 6 | 6 | 43,312 | 80,000 | Prep. site, paving. |
| Imperial County | 2 | 3 | 21,656 | 40,000 | Bldgs., prep. site, paving, misc. |
| Los Angeles International | 5 | 7 | 770,091 | 1,417,012 | Prep. site, paving, lighting, misc. |
| Monterey Peninsula | 4 | 4 | 32,000 | 59,106 | Prep. site, paving. |
| Napa County | 4 | 4 | 20,000 | 36,941 | Prep. site, paving. |
| Oakland Mun. | 5 | 5 | 200,000 | 354,000 | Paving, lighting, misc. |
| Ontario International | 5 | 5 | 40,828 | 60,000 | Paving, lighting, misc. |
| Los Angeles, Palmdale | 5 | 5 | 80,000 | 226,752 | Prep. site, paving, misc. |
| Sacramento Mun. | 5 | 5 | 27,000 | 108,000 | Land. |
| Montgomery Field, San Diego | 2 | 6 | 10,000 | 40,000 | Land. |
| Lindbergh Mun., San Diego | 8 | 8 | 108,280 | 200,000 | Bldgs., paving. |
| San Francisco Airport | 7 | 7 | 746,166 | 1,378,216 | Paving, misc. |
| Sonoma County | 4 | 4 | 7,500 | 13,853 | Paving, lighting, misc. |
| **COLORADO** | | | | | |
| Alamosa Mun. | 3 | 3 | 5,864 | 11,000 | Prep. site, paving. |
| Stapleton Airfield, Denver | 6 | 8 | 589,306 | 1,107,400 | Land, bldgs., prep site, paving, lighting, misc. |
| **IDAHO** | | | | | |
| Gooding | 3 | 4 | 12,512 | 22,500 | Paving. |
| **MONTANA** | | | | | |
| Flathead County | 3 | 3 | 21,412 | 40,000 | Paving. |
| Sunburst | 1 | 1 | 21,789 | 42,197 | Land, bldgs., prep. site, paving, misc. |
| **NEVADA** | | | | | |
| Davis Dam Airport | 0 | 1 | 6,250 | 10,000 | Prep. site, misc. |
| Elko Mun. | 4 | 4 | 17,500 | 28,000 | Prep. site, paving. |
| McCarran Field | 5 | 5 | 30,625 | 49,000 | Paving, misc. |
| Yerington Mun. | 3 | 2 | 8,750 | 17,000 | Land, prep. site. |
| **NEW MEXICO** | | | | | |
| Lea County Airport | 3 | 3 | 52,744 | 80,000 | Bldgs., paving, lighting, misc. |
| Roswell Mun. | 4 | 4 | 34,407 | 60,512 | Bldgs., prep. site, paving, lighting, misc. |
| **UTAH** | | | | | |
| Cedar City Mun. | 3 | 3 | 6,994 | 11,250 | Paving. |
| Logan Cache | 3 | 4 | 44,361 | 71,355 | Prep. site, paving, misc. |
| Robert H. Hinckley, Ogden | 3 | 3 | 19,000 | 30,561 | Paving. |
| Salt Lake Mun. No. 1 | 5 | 5 | 200,000 | 330,069 | Prep. site, paving, misc. |
| **WASHINGTON** | | | | | |
| Boeing Field, Seattle | 7 | 7 | 340,000 | 843,846 | Prep. site, paving, misc. |

## Where Western Engineering Graduates Are Finding Jobs

MOST of the men who graduated from Western civil engineering schools during the past year now have jobs, and indications are that the expectation of an over-supply of graduate engineers was unduly pessimistic.

Typical of the Western schools is the Washington State College at Pullman. The civil engineering department at WSC graduated 40 men during the past year, all of whom are now placed on jobs. The job distribution is as follows: state highway department, 16; United States Geological Survey, 7; Bureau of Reclamation, 6; municipal engineering departments, 4; Corps of Engineers, 3; graduate work, 2; Bonneville Power Administration, 1; Department of Agriculture, 1. Also typical of the other Western schools is that only nine of the graduates left the state (including 3 to Alaska and 2 to Oregon).

# 210 Ft. of Corrugated Pipe Jacked Beneath Railroad

A PIPE JACKING job that ties the Pacific Coast record for continuous length—210 ft.—has recently been completed by Stolte-Early-Harrelson, Oakland, Calif., joint-venture contractor. The work was done under unfavorable earth and rock conditions as part of the $4,800,000 contract for sections 5 and 6 of the south interceptor, East Bay Municipal Utility District, Special District No. 1. To carry water, telephone, and power lines underneath eleven tracks, including two main passenger tracks and a main freight line of the Southern Pacific, and the principal interchange track of the Santa Fe Rail traffic, the line was jacked for 210 ft. of the total 250-ft. length. During the entire job no delays or slowdown orders were needed for such well known trains as the Daylight, Cascade, and City of San Francisco.

### Grade at sea level

In addition to special jacking problems caused from length alone, the job was also tough because the grade line was practically at sea level, making it difficult to drive the bore through saturated adobe which is plentiful at the site. To complicate the work further, large granite rip-rap was encountered, which had been placed along the Bay side of the original main line by the railway many years previously to protect the roadbed from wave action.

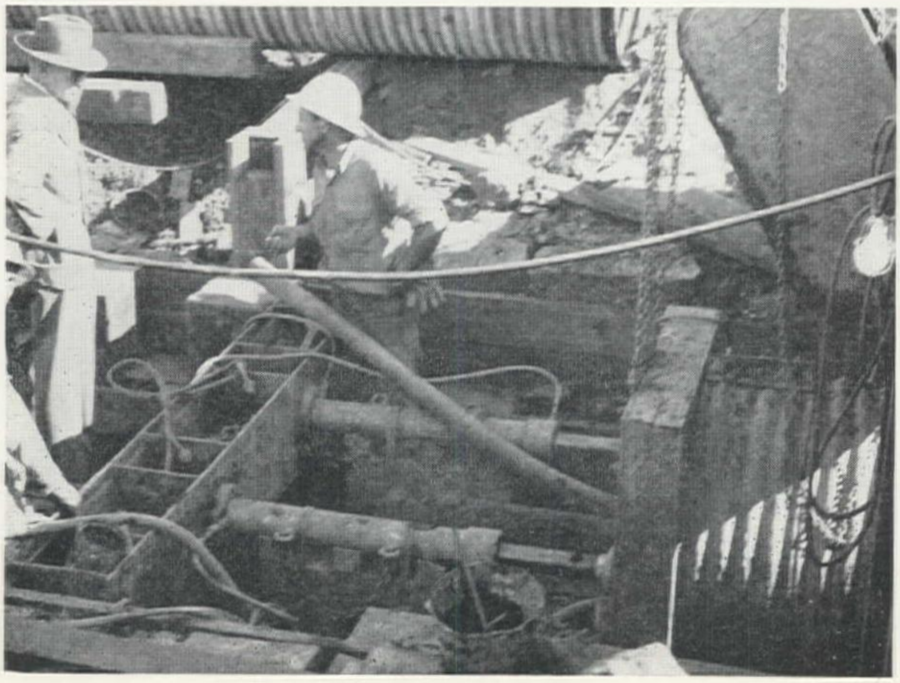
Despite these conditions, overall progress was good, and the average speed was slightly better than three-quarters of a foot per hour of working time. Under similar conditions, one foot of progress per hour of time worked is usually considered satisfactory under normal conditions. At one time, however, the progress was only two feet in two days, totaling six shifts. This occurred when the pipe was being jacked through the granite rip-rap. The procedure at this point consisted of splitting the granite slabs by the pin and feather method. Once the interfering edge of each slab was split into sizes small enough, it was removed as part of the mucking operation.

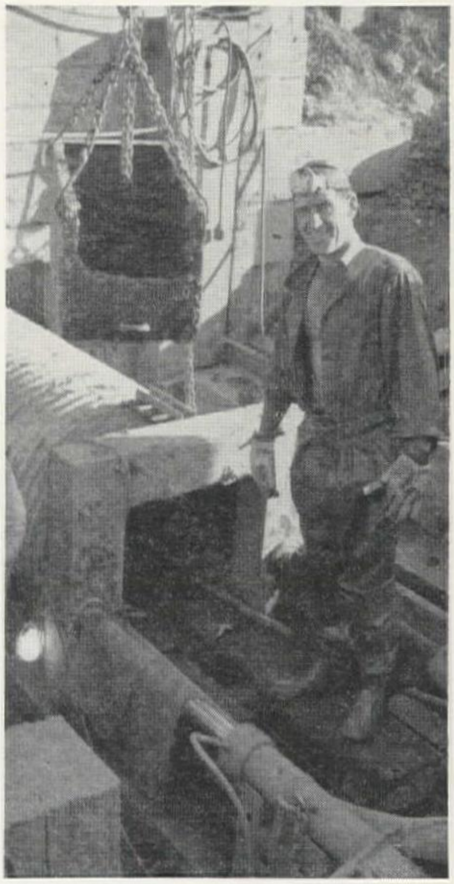
### Hydraulic rams

Satisfactory progress under the abnormal conditions was made possible by the contractor's ingenious hydraulic ram setup. Unusually careful preparation went into heavy 16- by 16-in. timber backstops, heavy lining frames, and working pit and jacking collars. A feature of the system is the manner in which two 50-ton Rogers hydraulic jacks are operated. They are supplied with pressure from the oil pump in such a manner that they can be operated together or independently on both the 30-in. power stroke and return. The contractor thus insured "fingertip" control capable of instant change, at the pressure end of the pipe (allowing easy inspection of work during its progress). The jacks were mounted on a heavily reinforced section of steel beam, in turn bucked up by the 16-in. square backstops. The backstops were placed on 4½-ft. centers, but were used also in conjunction with booster blocks 2½ ft. long to make up for the difference in ram travel. The working pit was built just long enough to handle the 20-ft. lengths of pipe. The pipe was worked entirely by hand, without cranes of any kind. It was stockpiled beside the job and handled from a timber frame equipped with hoist and tackle.

The timber frame also handled the ingenious conveyor system for removing muck, dug from the heading by one man working from the head end of the pipe. Once outside the pipe, the muck was handled by an overhead bucket. Both the practical mucking system and the hydraulic jack rigging were primarily responsible for enabling the line to be forced through soft, saturated adobe that would have almost certainly stuck a job of half the length or less, if tried after only the usual preparation.

SETUP for one foot of progress per hour. Visible are backstops, movable jacking thrust block, the hydraulic jacks and oil lines leading from jacks to oil pump.



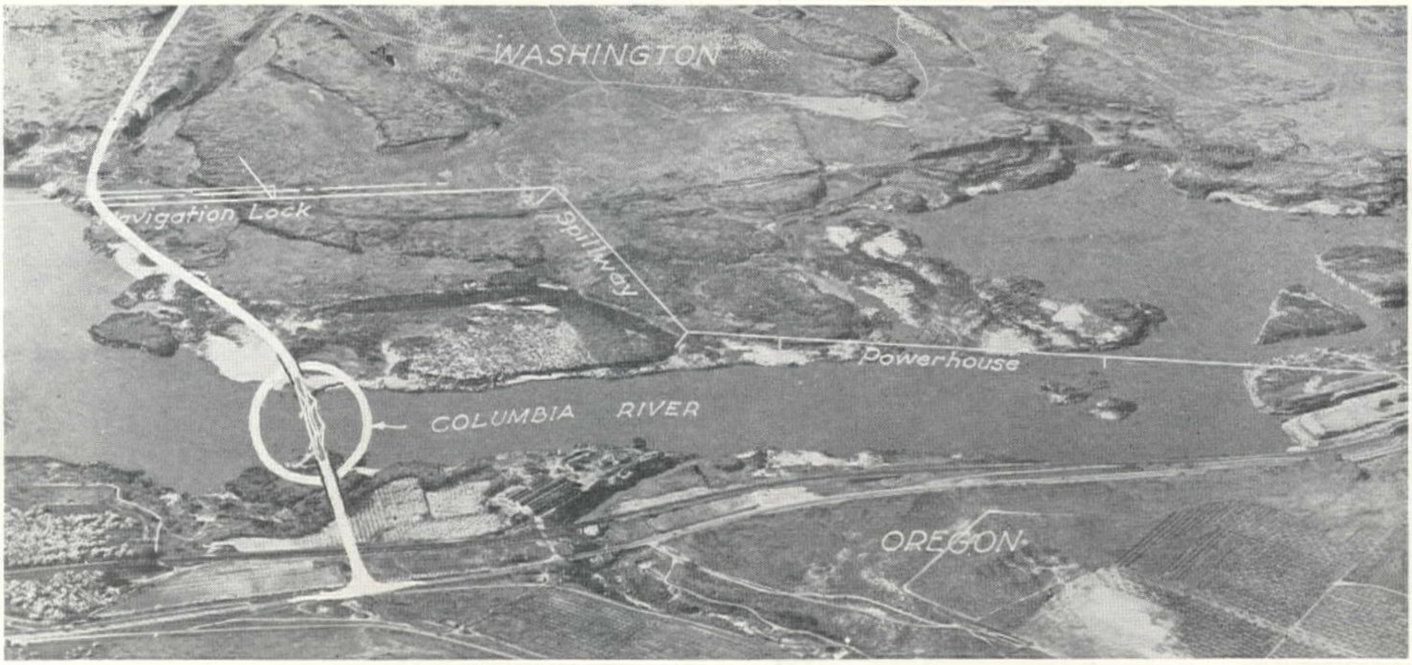


DIRT BUGGY in background was used to elevate muck from working pit. The working pit was excavated just long enough to handle the 20-ft. lengths of pipe.

The jacked pipe is 36-in. Armco asbestos-bonded asphalt coated corrugated iron pipe, 10 gage. The joints were made by field riveting. The utilities lines will be put into a concrete cover, poured by hand, since there is not enough room inside the bore to control a pumpcrete line. The concrete will be placed from the sand muck bucket shown in the picture.

### Personnel

Fred Weiss is the project engineer for the contractor, and in charge of the field procedure. Otto Bohl is resident engineer for the utility district. The main features of the East Bay Municipal Utility District project were reported in *Western Construction*—June 1950, pg. 59, and April 1949, pg. 72.




# Steel Cantilever Bridge to Replace Columbia River Ferry at The Dalles

THE FIFTH BRIDGE to cross the Columbia River between Washington and Oregon has passed the design stage and bids will be opened this month on the proposed structure. Estimated to cost $2,850,000, the new bridge is to be located at The Dalles, Ore., and will serve north-south U. S. Hwy. 97 traffic at the point where it is intersected by the Oregon Trail Hwy. and Hwy. 830 on the Washington side. At the present time, traffic is served by a ferry at the site, one of six now in operation on the river between the two states. The new bridge is to be built by Wasco County, Ore.

The structure is of conventional steel cantilever design, 2,700 ft. long including approaches of plate girder spans, and a clear span 576 ft. long over the river. It will carry two lanes of traffic at H-20 loading. Bids are being called in two parts, piers and highway approaches in one; superstructure steel and light weight concrete decking in the other. Steel construction is scheduled to begin at the north end and continue to the middle of the main span. The balance will be completed by working from the south end. An estimated saving of $100,000 is anticipated by elimination of simultaneous construction from both ends. With liberal contract time, plus additional time allowances based on time lost due to floods, the bridge is expected to be in service about July of 1952.

## Ferry purchased

Preliminary interest in the project is focused on the outstanding cooperation between the three agencies of government involved and the details of finance. Preliminary studies of the project were financed by equal loans from both states and Wasco County. Preliminary designs by the Tudor Engineering Co., San Francisco, consultant on the project, were the basis to sell revenue bonds in the amount of $2,850,000, of which the first $450,000 was allotted for the purchase of the ferry at the site, test borings, engineering and other expenses. The city of The Dalles, holder of an option to buy the ferry at $300,000, assigned its option to the sponsoring county, and the ferry has been purchased. The effect of this is to provide adequate funds for complete engineering as well as purchase of the competing ferry. The sale of bonds amounting to one and one-half times the $300,000 purchase price of the ferry is quite unusual, and based strictly upon the high earning capacity of the ferry rather than the total of its physical assets. The current substantial net earnings of the ferry are expected to continue until the bridge is opened, and are being devoted to debt retirement. During study of the project, it was determined that if for any reason the bridge was not built, the ferry would rapidly retire its own debt. Since the ferry has an established record of performance and earnings, it is not considered necessary to borrow funds equal to interest for six months, as is frequently done on a new project.

The bonds are for 25 years and pay 3½% interest. They were discounted to yield about 4%. They are revenue bonds secured solely by tolls to be collected on the ferry until the bridge is opened, and thereafter on the bridge. It is estimated that tolls will be sufficient to retire all bonds within about 13 years. Arrangement has been made so that the bond house, A. C. Allyn and Co., Chicago, may purchase an additional $500,000 in bonds if bids are higher than originally estimated.

PICTURED ABOVE—
LOCATION of the bridge (in circle) and approach routes does not conflict with location of features of The Dalles Dam as planned by Corps of Engineers. City of The Dalles is 3 mi. downstream.

## Operating costs

The estimated cost of bridge maintenance is $9,300 per year, and of operation, $40,000 per year. These costs will be paid from revenues. Under existing law, it is possible for Klickitat County in Washington to levy property tax on the Washington State portion of the bridge until 1954. If the Klickitat County tax, $23,500, has to be met, the Oregon Highway Commission has agreed to advance funds to cover the amount, and accept repayment from tolls collected after all bonds are retired.

# Highway Planning Studies Described in BPR Report

THE BUREAU of Public Roads has published a 48-page "Bibliography of Highway Planning Reports," which is now for sale by the Superintendent of Documents, U. S. Government Printing Office, Washington 25, D. C., at 30 cents a copy. Interest in highway planning, already widespread, is continually increasing both for practical application and for theoretical research. This bibliography makes available, for the first time, an extensive listing of reports on the subject.

The bibliography comprises a listing of highway planning and related reports issued during the 20-yr. period from 1930 to April 1950. Included are reports of traffic, origin-destination, location, and highway-needs studies prepared by city, county, and State agencies, and by private consultants. The reports range in scope from long-term State-wide studies to location surveys for specific routes and city traffic counts.

# CONSTRUCTION DESIGN CHART

By
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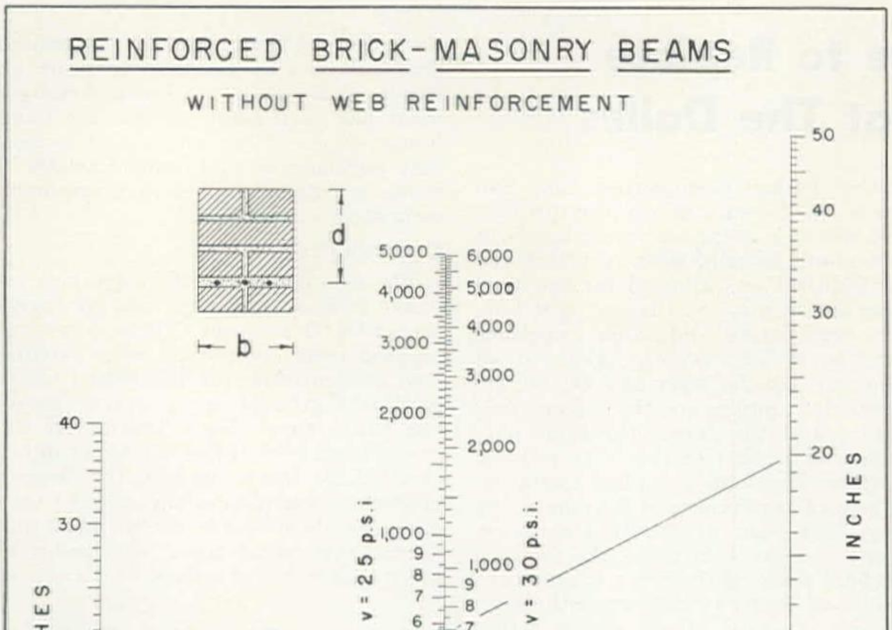
## CXXVI...Reinforced Brick-Masonry Beams Without Web Reinforcement

IT IS POSSIBLE to construct a reinforced brick masonry beam in which vertical web reinforcement is specified. In such cases, reinforcement is usually of the "Z" type stirrup. Due to the added labor cost of laying brick around the web reinforcement, I would recommend avoiding its use whenever possible.

The principal economic advantage in reinforced brick masonry beams will be found in its application to structural lintels in brick walls. In such applications there is usually an adequate sectional area so that the use of web reinforcement may be avoided if desired.

The Seattle Building Code requires the presence of an approved city inspector to supervise the construction of the reinforced brick masonry. In order to keep the additional cost of this city inspection to a minimum, the designer should include only the minimum portion of the wall for his beam. Shear will usually be the determining factor which will dictate the minimum section required.

The accompanying chart has been prepared to quickly determine the minimum section of the brick-masonry beam so that no web reinforcement is necessary. Unit shear at both 25 and 30 p.s.i. has been provided for in conformity with the Seattle Building Code allowable values when test prisms are not available. The lower value of unit shear, 25 p.s.i., is for cement-lime-sand mortar. The higher value, 30 p.s.i., is for cement-sand grout.




The chart is solved by a single straight line intersecting all scales. The thickness of the wall will usually be the beam breadth $b$, and will be pre-determined. The total end shear may be computed, and then the necessary beam section may be determined from the chart. In the June 1950 issue, a chart for balanced tensile reinforcement was presented. Thereon an illustrative problem was solved using values of $b = 13$ in., $d = 20$ in., with cement grout. On the accompanying chart I have drawn a solution line for the same beam section described above. On the scale for the total shear, $v = 30$ p.s.i., it will be noted that an end shear of 680 lb. is indicated as being permissible without web reinforcement.

In reinforced brick-masonry beams, it is customary to figure the unit shear in the same manner as in reinforced concrete beams. Substituting the values from the chart, we would then have

$$\text{Unit shear, } v = \frac{V}{b\,j\,d} = \frac{680}{13 \times \tfrac{7}{8} \times 20} = 29.9 \text{ p.s.i.}$$

which is a reasonable check on the assumed allowable limit.

I have designed the structural elements for a number of store fronts for architects wherein the conventional lintel of structural steel was omitted by placing a few small reinforcing bars in one joint and using lime-cement-sand mortar for a few courses. Invariably the result has been to the economic advantage of the building owner, a factor which should always be the immediate concern of the designer.

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STONE & WEBSTER, Incorporated, has formed a Canadian subsidiary, to be known as Stone & Webster Canada Limited. The Canadian company, with present offices at 50 King Street West, Toronto, Ont., has been organized for the purpose of making the services of the whole Stone & Webster organization available to Canadian industry. Alfred T. Krook, previously district manager of the Stone & Webster Engineering Corporation for the Southwestern area, with headquarters in Houston, Tex., has been named president.

# NEWS OF WESTERN CONSTRUCTION

DECEMBER 1950

## Concrete Lining Complete For Delta-Mendota Canal

MACHINE-PLACED concrete lining operations have been completed for the entire 97-mi. concrete-lined section of the Delta-Mendota Canal in California, principal artery of the Central Valley Project which will transfer water a total distance of 115 mi. between Tracy Pumping Plant and Mendota Pool. The canal proper now reaches as far south as Ora Loma, and only the southerly 18-mi. earth-lined section, on which construction is already well under way, remains to be completed by next July, the target date for initial integrated operation of the Central Valley Project.

Construction of the Delta-Mendota Canal was begun September 6, 1946, at its northern or Tracy end, and since that time more than 32,000,000 cu. yd. of earth have been moved and about 700,000 cu. yd. of concrete has been placed, utilizing 900,000 bbl. of cement. The quantity of earth moved is equivalent in mass to more than three times that of Grand Coulee Dam—world's largest concrete structure—and the quality of concrete placed for the 97-mi. concrete-lined portion of the canal is more than sufficient to build a sidewalk 3 ft. wide and 4 in. thick between San Francisco and New York City.

## Automatic Gaging Stations For Bonneville Reservoir

THREE water gage stations, comprising a radio network, will soon be checking the water levels in Bonneville Dam reservoir—automatically and at 10-min. intervals, according to the Corps of Engineers.

The radio network will consist of the water gage stations (each at a different location), a relay station on the side of a mountain overlooking the lake, and a pickup station at the Bonneville power house. Concrete towers, each about 50 ft. tall, will house the gaging stations. They will be erected at Stevenson, 6 mi. from the dam; at Hood River, 24 mi. away, and at Lyle, 37 mi. away. Bottoms of the towers will be lower than any expected low water stage of the lake and the tops higher than any expected low water stage. Each tower is to be fitted with a system of gears and revolving arms which will produce coded signals showing water level to within 1/100 ft.

Radio signals will be sent in this manner. A transmitter at the Bonneville powerhouse will send a tone signal to the relay station on the side of Augsburger Mountain, 15 mi. east of Bonneville. This station will relay the tone to the particular gage station which is tuned to that tone, and the signal will activate the transmitter in that station, which will then start the coding arm and send a message back to the relay station giving the water depth at that instant. When the coded signal reaches the powerhouse, it will be recorded on a chart. Then the tone will be changed slightly and the process completed with another station to catch the water depth at that point.

Bonneville will receive the exact water depths at Lyle, Hood River and Stevenson six times per hour, giving the operators of the power units in the dam a complete report every six hours on the water supply approaching the turbines and generators.

Link Radio Corp., New York, and Leopold & Stevens, Portland, were low bidders at $13,000 before the Corps of Engineers for furnishing and installing the radio and coding devices.

### "Building Tomorrow's West"

**WITH THIS ISSUE, *Western Construction* completes 25 years of serving the construction-civil engineering fraternity in the West. The January 1951 issue will be a special Silver Anniversary number with the theme "Building Tomorrow's West." Although single copies of the special number will sell for $1.00, subscribers will receive the issue at no extra charge.**

THE 1950 ANNUAL INDEX begins on page 127 of this issue. All of the editorial features pubished in the twelve issues of *Western Construction* during 1950 are indexed for easy reference. Also, unit bid abstracts are indexed by location and the type of construction involved.

### MILLIONTH CUBIC YARD OF CONCRETE PLACED AT HUNGRY HORSE

**GENERAL-SHEA-MORRISON passed a milestone in construction of the Bureau of Reclamation's Hungry Horse Dam on the Flathead River in Montana when the millionth cubic yard of concrete was placed at 4:30 p.m. on November 7. *Mel Hord*, left, assistant to the project manager for G-S-M, looks happy as he prepares to dump the illustrious bucket with the help of *E. J. Nieman*, right, field engineer for the Bureau. The event came 14 months to the day after the first concrete was placed in the dam on September 7, 1949.**

## New Cement-Mortar Lining for Old Small Diameter Pipelines

A CEMENT-MORTAR lining for old, small diameter pipe lines, that gives new pipe line performance at a fraction of new pipe line costs, is announced by Pipe Linings, Inc., newly-formed subsidiary of American Pipe and Construction Co., Los Angeles, Calif. Licensed for nationwide operations under Tate pipe lining patents, the new company has complete facilities for servicing water, gas and oil pipe lines of 4-in. diameter and larger, according to Robert C. Sargent, manager. The Centriline Corporation of New York has been licensed to handle service in the eastern part of the United States.

The work can be carried out on pipe lines in place, without discontinuing regular service, and all operations are handled by trained and experienced personnel.

Through the use of specialized, patented equipment, the process first cleans corroded matter and tubercles from inside pipe walls, and then applies a smooth cement-mortar lining to the walls. As a result, leaks are eliminated, flow coefficients are restored and pumping costs are reduced. All the advantages of concrete and steel pipe construction are obtained, including elimination of water discoloration, elimination of further cleaning for all time, and protection against bacteria.

In recent years over 1,200,000 ft. of cast-iron, wrought-iron and steel pipe have been treated with success. Installations have run all the way from a few hundred feet to many miles, and results have been uniformly good. Equipment used is portable by special trucks so that all types of locations can be handled.

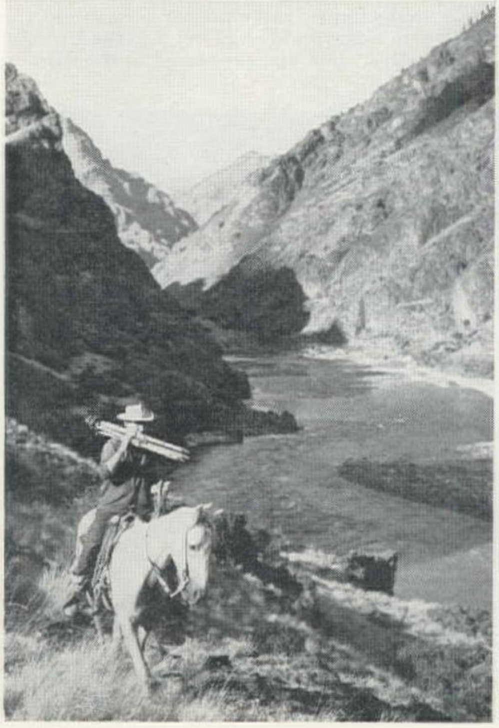
Heretofore large diameter pipes have been lined by Centriline Division of the American Pipe and Construction Co. and this work will continue to be done by the Centriline Division. Small diameter pipes have been lined for many years by Tate Pipe Linings, Inc., of Andover, Mass. Tate Pipe Linings, Inc. is in the process of dissolution, and Pipe Linings, Inc. has acquired most of its equipment and key personnel for use by the new company.

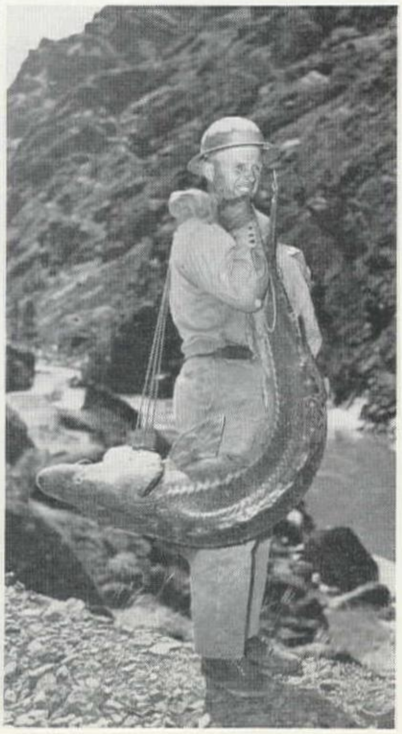
### This Month's Front Cover

PLACING the concrete lining for an irrigation ditch in the Peoria Irrigation District near Phoenix, Arizona. First operation on this job was to grade the ditch site with a bulldozer-equipped Caterpillar D6 tractor. Then the tractor pulled a pan breaker to put in the center line. Next, the ditch was excavated and formed in an average of five trips with a Fullerform ditcher, also pulled by the tractor. Final operation (see cover) was placement of the concrete lining with the tractor pulling a portable ditch form and concrete being supplied by ready-mix trucks. Average speed of the liner was ½ mi. of ditch every two hours. R. Fuller of Phoenix was the contractor on the job.

### ROUGH GOING, BUT SOME FUN ON HELLS CANYON DAM SITE SURVEY

**A SEVEN-MAN Bureau of Reclamation survey party, which has been taking topography for access roads and other purposes at the proposed site for Hells Canyon Dam on the Snake River in Idaho, has had to work in an area where even a mountain goat would feel unsafe. But the tough job has had its compensations. At left below, a dependable horse carries *Lynn Brown* and his transit to another survey point. At right, *Bob Bond* is shown displaying a 100-lb. sturgeon. The survey party cooked its own food, slept in sleeping bags and was subjected to such other everyday (in the life of a surveyor) hardships as rattlesnakes underfoot and an abundance of poison oak. The dam is planned to be 742 ft. in height—highest in the world—and in the deepest gorge in the country.**





## California Conference on Highway Problems Scheduled

MAIN EVENT of 1950 for road men from every part of California—the Third California Conference on Street and Highway Problems — has been scheduled for January 24-26, 1951, on the Berkeley campus of the University of California.

Presented by the Institute of Transportation and Traffic Engineering, University of California, the annual Conference provides officials from all levels of government and private organizations with the opportunity to discuss mutual problems and new techniques. Following the pattern developed in previous conferences, the program for 1950 will include both general and special sessions, the latter broken down as urban, county, traffic engineering, and construction and maintenance.

Chairman of the 1950 Conference is Ralph G. Wadsworth, San Francisco city engineer. The program, under development since midsummer, is being arranged to provid ample time for discussion of each major problem now confronting road men throughout the state.

Maintenance organization and planning, secondary streets, and parking are principal topics in the urban sessions. Of particular interest to county men will be discussions of road mixing, standards for subdivision streets, and financing. Engineer-contractor relations, inspection practices, yard and shop maintenance, and pavement renovation will be taken up by the construction and maintenance group. Traffic engineers will place emphasis on the applications of traffic engineering in rural counties.

The general sessions will relate current road problems to the general transportation situation, including national defense.

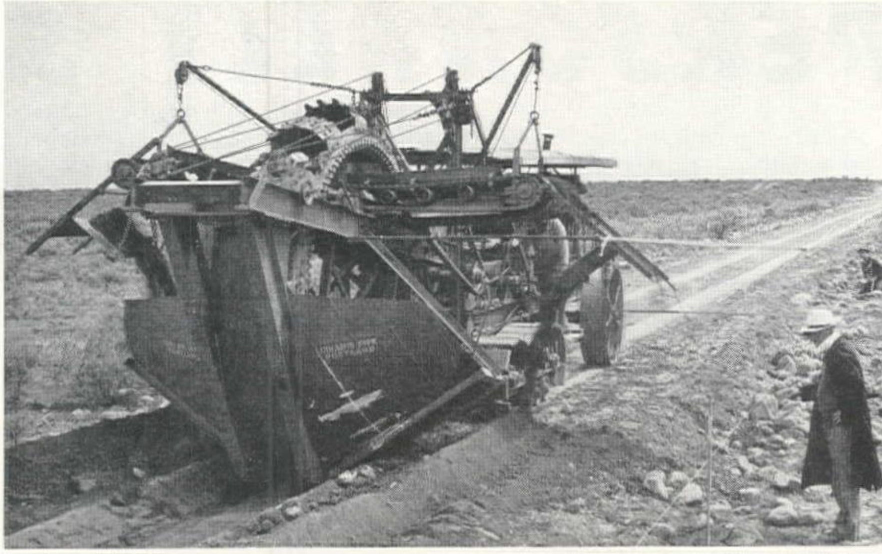
Inaugurated in 1949, the California Conference has rapidly established itself as a forum for road men throughout the state—attendance has averaged 500. An even larger registration is expected in 1951.

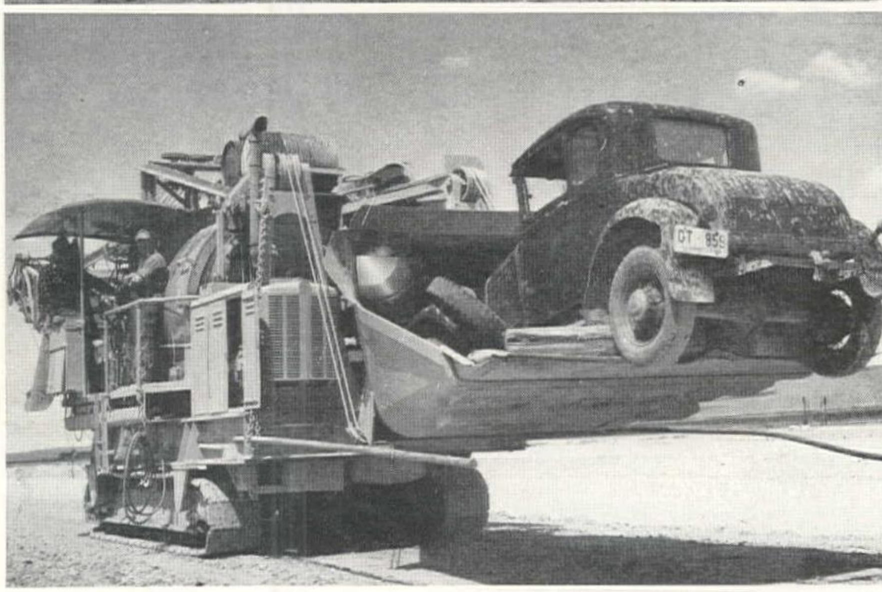
## Texas-Arizona Natural Gas Pipeline Approved by FPC

A TEMPORARY certificate has been granted by the FPC to El Paso Natural Gas Co., of El Paso, Texas, for the construction of pipeline facilities designed to increase natural gas deliveries to the Phoenix, Ariz., area. The construction program, estimated to cost $1,038,404, will include approximately 31 mi. of combination 16-in. and 10-in. line; about 11.5 mi. of 4½-in. line; approximately 5.5 mi. of 12¾-in. line; and six new city gate metering and regulating stations.

A NEW WRINKLE for housing jobs is the adaptation of this Allis-Chalmers HD-5G Tracto-shovel to handle roofing on a 100-home project near North Bend, Ore. A special fork developed by Bower-Edmonds Corp., Portland, enables the unit to hoist a half load of 16-ft. sheetings and a bucketful of asphalt shingles in one operation.

THE LARGEST suspension pipeline bridge to be erected in Southern California is shown being maneuvered into position by crews and equipment of Consolidated Western Steel Corp. A single section of 22-in. pipe 750 ft. long was hoisted into position by five cranes, working slowly and in unison. The long pipe was made by welding together a number of 30-ft. lengths. The bridge, over the Santa Ana River near Riverside, carries the last leg of the new Texas-California natural gas loop line for Southern California Gas Co.





TOP—Take a Buckeye Reel Ditcher, add a pair of wings and a few other items and you have a rig that digs small canals. That's what Collins Pipe of Portland did for this machine which is adjustable for depth, width and shape of cut. Here, the rig is digging a canal with base width of 2 ft. and bank height of 2½ ft. for a distribution system in Block 40 of the Columbia Basin Project in Washington.

BOTTOM—When *Merle Gossage*, operator of a concrete mixer on the West Canal of the Columbia Basin Project, wants to move to another part of the job, he picks up his Model A on the charging skip and treads off down the canal bank.

FIVE CONCRETE TRUSSES exposed above the building's roof provide an interesting design for the new Fred Meyer Burlingame shopping center in Portland, Ore. A total of 40,000 sq. ft. of floor space without pillars is the desirable result. Roof and ceiling are hung by rods from the bottom chord of the trusses. The trusses were lightened by use of Lite-Rock aggregate, an expanded shale produced by Empire Building Co. of Portland. Leslie Poole is the designer; A. M. Hocken of Portland is the builder.

# PERSONALLY SPEAKING

**Maurice Housecroft,** chief bridge engineer of the Utah state road commission, retired recently after serving in that capacity for over 25 years.

* * *

COREY

**Lester S. Corey,** president of the Utah Construction Co., San Francisco, has been named winner of the 11th annual non-member award for outstanding contributions to construction progress by The Moles, an association of leaders in the heavy construction industry. Award winners were announced last month at a dinner held at the Roosevelt Hotel, New York, and presentation of the plaques and citations will take place January 31 at the Waldorf-Astoria. Corey, who rose from timekeeper of his company in 1901 to its president in 1940, has been closely associated with the direction and management of the construction of such famous dams as Grand Coulee, Bonneville, Hoover, and Davis. Recently his firm was awarded a $32,000,000 contract to build Big Eildon Dam in Australia.

* * *

**Lieutenant Colonel Jackson Graham,** formerly executive of the Los Angeles District, Corps of Engineers, was appointed acting district engineer last month replacing **Brigadier General Walter D. Luplow,** who has been reassigned to command an engineer brigade at Camp Rucker, Ala. Prior to his post in Los Angeles, General Luplow was assistant chief of engineers for military operations in Washington, D. C.

* * *

**Walter F. Winters,** formerly special projects engineer at the Asphalt Institute's Denver office, was recently named chief engineer. Winters, who has had 19 years of county, city and state engineering experience in the State of Washington, now has direction of the national staff, promoting the use of asphalt and developing research on the various uses of this material.

* * *

**Frank Nash,** pioneer Alaska road engineer and for over 25 years on employee of the Alaska Road Commission, retired November 25 as district engineer in Fairbanks. In recognition of his service, he has been recommended for the meritorious service award of the Department of the Interior.

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**W. D. Frans** is the new district engineer assigned to the north central Washington district Bonneville Power Administration office. He will help direct the sale of Bonneville and Grand Coulee power. This newly-designed district was formerly a branch of the Seattle office.

* * *

More than 300 members of the San Francisco building and construction industry gathered recently at a banquet in the Fairmont Hotel to honor **Henry J. Brunnier,** San Francisco structural engineer of national reputation. Brunnier received an award as the year's outstanding member of the industry in Northern California.

* * *

**Milton Schwartz** is now resident engineer for the California Division of Highways on construction of the Salt River Bridge and approaches near Fernbridge, Calif. The new bridge is being constructed to replace one in imminent danger of collapse.

* * *

KENNEDY

The East Bay Municipal Utility District in Oakland has appointed **Robert C. Kennedy** to the post of chief engineer. In his new position he will coordinate and be responsible for the engineering functions of the district and will continue to supervise the design and construction of the sewage disposal project until its completion next year. Kennedy, who has an excellent technical background and 25 years of service with the district, joined the staff as a designing engineer and worked on the first Mokelumne Aqueduct and the Pardee Dam. He has since advanced through assistant chief engineer and assistant general manager to his present post.

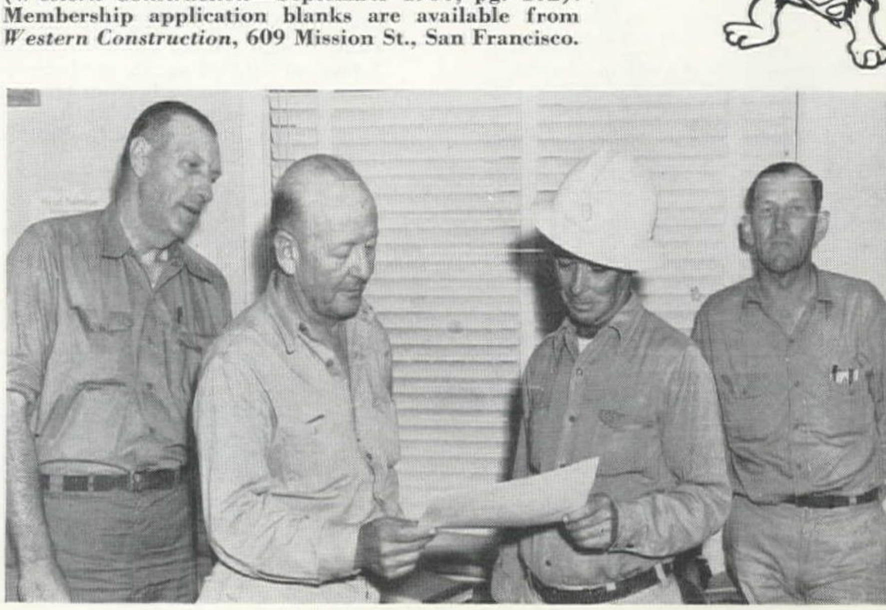
* * *

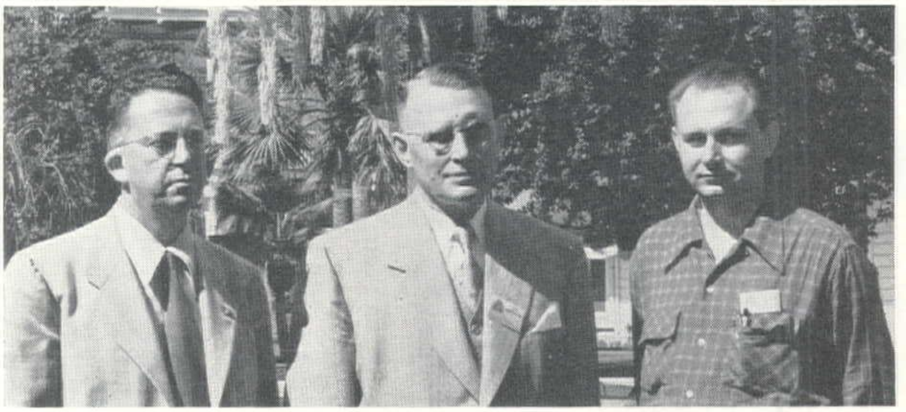
**H. A. Parker,** recently-appointed manager of Bureau of Reclamation's Columbia River District, has announced the reorganization of the Irrigation Division into the Irrigation Construction, the Project Development, and the Irrigation Operation and Maintenance divisions, with headquarters at Ephrata, Wash. Heading up the three new divisions, in the order noted above, are: **L. V. Downs,** acting supervising engineer; **W. W. Johnston,** acting supervisor; **E. H. Neal,** acting supervisor. The personnel, land, legal, supply and finance, and information sections are tentatively assigned to the Irrigation Construction Division pending transfer of district headquarters to Ephrata next spring. As development of the basin progresses—the first water is to be available for 87,000 acres in 1952—the three divisions will rise and fall in importance, according to Parker.

* * *

Two new appointments to the staff of the Western Highway Institute in San Francisco have been announced recently. **Bert Trask,** Boise, Idaho, has been named associate director and will work closely with Western state truck-

**FIRST TURTLE CLUB MEMBER to be registered in this country is *David J. Jones*, inspector for the Bureau of Reclamation on the Riverton Project, Wyoming. Jones is shown receiving his certificate and lapel pin from Project Engineer *T. A. Clark*. Safety engineers *Miller Prose*, left, and *H. P. Vogt* witness the ceremony. Jones became eligible when a hard hat saved his life (*Western Construction*—September 1950, pg. 102). Membership application blanks are available from *Western Construction*, 609 Mission St., San Francisco.**



**NEWLY-ELECTED OFFICERS of the Structural Engineers Association of California. Left to right—*Harold King*, Los Angeles, vice president; *Arthur W. Anderson*, San Francisco, president, and *Henry Degenkolb*, San Francisco, secretary-treasurer. The men were elected at the organization's 19th annual convention held at the Hotel del Coronado, Coronado, Calif., October 12-14.**

ing associations and other motor carrier organizations, and with Institute members on problems of interstate licensing of motor carriers. He has an impressive background of 20 years' experience in the highway transportation field. **Clarence G. Taylor**, Mountain View, Calif., has been named research director for the Institute. He has had a number of years of experience in editorial and research work and for the past 6 years he has been with the Washington headquarters of the American Automobile Association.

**Hugh P. Crawford,** for 3½ years field engineer for the Bureau of Reclamation on the Klamath Project at Klamath Falls, Ore., has recently joined the Columbia River Basin Project at Ephrata. He is now serving as civil engineer in the lateral design section.

**J. C. Neufeld** is the new city engineer for Lethbridge, Alberta. Neufeld, a well known civil engineer in Winnepeg and Vancouver, succeeds **James Haimes,** who retires at the end of this year.

The Structural Engineers Assn. of Oregon installed new officers at their annual dinner meeting in Portland recently. The new officers are: **R. Evan Kennedy,** president; **Guy H. Taylor,** vice president, and **James R. Griffith,** secretary-treasurer. Kennedy is an associate of the firm of Cooper and Rose, consulting engineers of Portland. Taylor is a partner in the engineering consulting firm, Moffatt, Nichol and Taylor in Portland. Griffith is Dean of Engineering at the University of Portland and is well known to readers of *Western Construction* for his Construction Design Charts which have appeared in the magazine since 1935.

At a recent meeting of the county defense council in Spokane, **Clyde J. Chaffins,** county engineer, was named civil defense director for the county.

**Peter Luiten** of Odessa, Wash., has recently retired after serving 42 years as road foreman for Lincoln County. When Luiten started with the county each township took care of its own roads, and he was in charge of one of the 6-mi. sq. areas. In these early days he won the $25 suit of clothes offered the foreman building the best half mile of road on the present Wilbur-Odessa state highway.

**R. E. McCormick** has resigned as city engineer of Great Falls, Mont., according to **Mayor Truman G. Bradford. A. J. "Jack" Richardson** was appointed acting city engineer.

**John E. Ryckman** succeeds the late **Max Stern** as information officer in Region 2 of the Bureau of Reclamation. Before joining the bureau staff, Ryckman was director of public relations for the American Independent Oil Co. at San Francisco.

**Howard Phelps,** retired Washington State College engineering professor, has been temporarily appointed county engineer for Whitman County, Wash. He replaces **Wayne Arrasmith,** who left for army duty on November 2. Prior to his position at State College, which he held for 31 years, Phelps served as city engineer for Boulder, Colo. **Peder Hemstead,** assistant engineer for several years, will be in charge of the road office.

One of the Northwest's key reclamation officials, **Wilfred L. Karrer,** transfers from the Lewiston Orchards Project in Idaho to the position of construction engineer of the Yakima Project in eastern Washington. Karrer, who has been with the Bureau of Reclamation since 1929, has served as regional engineer in the Pacific Northwest headquarters and has been with the Lewiston Orchards development since construction began in July 1947.

## OBITUARIES . . .

**Adler M. Larsen,** 52, Nevada and California building contractor, died suddenly on October 25 in Reno, Nev. In 1937, Larsen joined Norman Biltz of Reno in establishing the Sierra Construction Co.

**Walter Leonard Denison,** 54, road contractor and principal in the firm of Walter L. Denison, died at his home in Albuquerque on October 24, after an extended illness. Denison had been engaged in road construction in the Albuquerque area for 10 years and in Las Vegas prior to that.

**Lee L. Page,** 67, construction foreman with the Los Angeles County road department, died October 25.

**Gayle G. Armstrong,** principal in the firm of Armstrong & Armstrong, highway contracting firm of Roswell, N. Mex., died October 15. Long active in the national affairs of the Associated General Contractors of America, he was a nominee for the 1951 vice presidency.

**Hans Jacob Jeppson,** 86, active in pioneer transportation construction in the West, died recently in his Salt Lake home. In his youth he worked on early road and railroad construction in Utah. He also participated in freight operations with horse teams for mining companies in Butte and Helena, Mont., and took part in construction of the Canadian Pacific railroad through the Canadian Rockies.

**Edwin Erbentraut,** 55, partner in the firm of Erbentraut and Summers, San Francisco building contractors, died of a heart attack October 18 in Reno, Nev.

**Charles W. Paul,** 70, retired Denver building contractor, died on October 21. He had been active in the contracting and building business since 1903.

**E. W. Heple,** 45, prominent San Jose contractor, drowned on October 27 while expediting work on a San Jose Water Works dam project near Los Gatos, Calif. While trying to dislodge dirt and debris clogging the opening of a 700-ft. outlet pipe at the dam's base, he slipped into the mouth of the pipe and was forced through it by water pressure estimated at 8,000 lb. Heple built his firm into one of the largest bridge and road building organizations in California. Among his projects was the $500,000 concrete viaduct over the American River at Sacramento.

**Halbert Stevens Kerr,** 85, retired chief engineer for the Utah State Road Commission, died October 30 at his home in Salt Lake City. Before joining the road commission in 1917, Kerr helped pioneer the location and construction of railroads in the Intermountain West.

# SUPERVISING THE JOBS

**Edward Hauser** is job superintendent for R. J. Daum Construction Co., Inglewood, Calif., for constructing an addition to the administration building, University of California at Los Angeles. **Edward Jockola** is general foreman and **Harold Perone** is engineer on the $1,298,254 four-story, reinforced concrete and brick building.

**Jerry Fox** is superintendent for Kemper Construction Co., Los Angeles, Calif., for installing concrete lining in the 2,240-ft. horseshoe tunnel on Colorado River, Grand Valley Project, Colo. **Fargo Hodges** is walker and **Pete Peterson** is master mechanic on the $250,747 project.

**R. G. Cook** is job superintendent for Covina Construction Co., Covina, Calif., for construction of 21.5 mi. of access roads at the Naval Ordnance Testing Station, Inyokern, Kern County, Calif. **J. B. Hodges** is field office manager on the $212,000 project.

**Norman Jacobs** is job superintendent for Paul W. Larsen, Inc., Salt Lake City, Utah, for construction of a plant to generate process and heating steam at reactor testing station in Idaho, a $362,589 project.

**L. G. "Bud" Waigand** is job superintendent for Peter Kiewit Sons' Co., Arcadia, Calif., constructing the $1,259,940 concrete Salt Lake Terminal Reservoir, Provo River Project, Utah. **W. B. Whitton** is job engineer and **O. K. Hoeppner** is job office manager on the Bureau of Reclamation project.

**H. L. Gourlie** is job superintendent for Morrison-Knudsen Co., Inc., Boise, Idaho, for constructing 30 mi. of the Big Butte Springs Pipeline No. 2, which will supplement the water supply of Medford, Ore. **C. V. Johnson** is clerk on the $423,669 project.

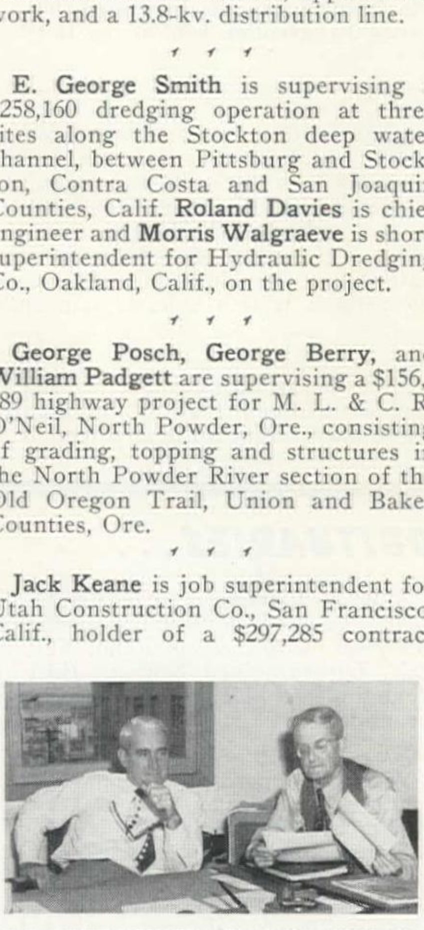
**R. E. Robertson** is job superintendent for Carl M. Halvorson, Inc., Portland, Ore., on a $800,251 highway project in Oregon. **Daryl K. Mason** is concrete superintendent, **Fred C. Peters** is engineer, and **Lee Means** is foreman on the job which consists of grading and surfacing 2.9 mi. of the Canyonville section of the Oregon Pacific Highway.

**George Waters** is project manager for Stolte, Inc., and Duncanson-Harrelson, Oakland, joint venturers on a $213,262 construction project at Delta-Mendota Canal head works, Central Valley Project, Calif. **Charlie Champion** is field superintendent; **Charlie Ballard**, carpenter superintendent; **Virgil Welton**, excavation superintendent; **Vic McFarland**, concrete superintendent; **Bill Giddings**, engineer; **Verne Barker**, master mechanic; and **Ed Ford**, accountant. The work consists of constructing a pilot fish screen structure, appurtenant work, and a 13.8-kv. distribution line.

**E. George Smith** is supervising a $258,160 dredging operation at three sites along the Stockton deep water channel, between Pittsburg and Stockton, Contra Costa and San Joaquin Counties, Calif. **Roland Davies** is chief engineer and **Morris Walgraeve** is shore superintendent for Hydraulic Dredging Co., Oakland, Calif., on the project.

**George Posch, George Berry,** and **William Padgett** are supervising a $156,089 highway project for M. L. & C. R. O'Neil, North Powder, Ore., consisting of grading, topping and structures in the North Powder River section of the Old Oregon Trail, Union and Baker Counties, Ore.

**Jack Keane** is job superintendent for Utah Construction Co., San Francisco, Calif., holder of a $297,285 contract for railroad rehabilitation at Lathrop Sharpe General Depot in San Joaquin County, Calif.



**KEY PERSONNEL ON THE BROADWAY TUNNEL JOB** (see article, pg. 63)

**ABOVE—*T. Y. Johnson*, project manager for Morrison-Knudsen Co., Inc., and *George Partridge*, resident engineer for the City of San Francisco.**

**BELOW—*Charles Ray*, assistant tunnel superintendent, and *Carl Larson*, tunnel superintendent for Morrison- Knudsen.**

**Richard Babler** and **Howard McInroe** are supervising construction of 51.7 mi. of Alaska highway for Rogers Construction Co. & Babler Bros., Portland, Ore. **Jim Folstrom** is job engineer on the $1,884,391 project which includes grading and bituminous surfacing from Big Delta to Sears Creek, Alaska.

**J. W. Harryman** is job superintendent for M. J. Brock & Sons, Inc., Los Angeles, Calif., for constructing remaining buildings and facilities at the naval reactor testing station near Arco, Idaho. **W. W. Lassetter** is field engineer on the $1,018,000 project.

Supervising construction on the $1,701,845 sewage tunnel being built by Kuckenberg Construction Co., Portland, Ore., for the city of Portland is **Lee Gordon. Merrill C. Henderson** is job engineer and **Bert Soucie** is office manager on the 2-mi. tunnel, to be known as the Grand Avenue sewage interceptor unit, which will serve the entire southeast district of Portland.

**L. R. Rieter** is job superintendent and **C. S. Muir** is general superintendent for McLaughlin, Inc., Great Falls, Mont., on a $250,812 highway project between Great Falls and Fort Benton in Cascade and Chouteau Counties, Mont. **A. R. Pearce** is foreman on the job which consists of grading, gravel, drainage, and bituminous surfacing of 10.3 mi.

**D. G. "Bob" Roberts** is general superintendent for Daum-Donaldson Construction Co., Phoenix, Ariz., for construction of a $116,370 swimming pool in Encanto Park, Phoenix.

**George K. Thatcher** is in charge and **R. R. Byerts** is assisting on the construction of a $515,000 reinforced concrete bridge on San Gabriel River Parkway in Los Angeles County. **W. E. Byerts** is in charge of purchasing for the joint venture firm of Byerts & Sons and Geo. K. Thatcher, Los Angeles, Calif.

**W. C. Treadwell** is job superintendent for Schutt Construction Co., Inc., Genoa, Wis., on a $362,999 clearing project 4.5 mi. above Detroit damsite, Ore. **Earl Sanders** and **Leonard Mosier** are assistants to Treadwell on the job, which consists of clearing two areas near the reservoir on south side of North Santiam River and on the north and west sides of Breitenbush River.

**Bert Collins** is job superintendent and **Tom Collins** is general superintendent for J. H. Welsh & Son Contracting Co., Phoenix, Ariz., on a $114,115 contract for building a water supply system. **Pete Lalande** is in charge of purchasing on the project which will serve the Arcadia


ROOM TO PASS WHILE LOADING WITH EIMCO 104 ON NARROW HIGHWAY

Improvement District and will be built on 2,400 ac. south of Camelback Mountain, Ariz.

✓ ✓ ✓

**Phil S. Johnston** is general superintendent and **George Taylor** is office manager for Skousen-Hise Contracting Co., Albuquerque, N. Mex., on it [illegible] New Mexico highway constru[illegible] ect between Dunlap and Va[illegible]

✓ ✓ ✓

**Glen H. Prosise** is supervising construction of a $150,000 drive-in theatre at Goleta, Calif., for M. J. Brock & Sons, Los Angeles, Calif.

✓ ✓ ✓

**Carl Jacobson** is general superintendent and **Gordon Wainwright** is assistant superintendent for Fisher Contracting Co., Phoenix, Ariz., on a $296,000 contract for constructing a 2,160-ft. suspension bridge across the Gila River at Gillespie Dam for the El Paso Natural Gas Co. The bridge will carry the Texas-San Francisco 30-in. gas pipeline across the river.

✓ ✓ ✓

**C. W. Miller** is supervising construc- [illegible]

**Harold C. Morton** is project manager for The Austin Co., Oakland, for constructing the $140,000 John C. Lynch Warehouse and Office Building, San Francisco, Calif.

✓ ✓ ✓

**B. M. Collins** is project manager for Collins Construction Co. on its $938,855 highway construction project between Midland and Odessa, Midland and Ector Counties, Texas. **A. C. Melton** is general superintendent and **W. H. Clem** is assistant superintendent on the job which includes grading and asphaltic concrete surfacing for a four-lane road.

✓ ✓ ✓

[illegible] **tion Co., Twin Falls, Idaho, on a highway relocation job 13 mi. north of Cascade, Idaho.**

**Ben Sloter** is supervising construction of the addition to Jordan High School, Long Beach, Calif., for Tom E. Norcross, Long Beach. **Don Redd** is project engineer on the $721,000 contract.

✓ ✓ ✓

**Glenn Veater** is general superintendent for Allison & Haney, Albuquerque, N. Mex., constructing 18 mi. of sewers, laterals, and manholes on a $192,000 contract with the city of Albuquerque.

✓ ✓ ✓

**Louis A. Wilson** is project manager and **Dick Yeager** is project engineer for Pioneer Constructors, Tucson, Ariz., on its $400,000 paving and sewer construction contract on a military housing project, Roswell, N. Mex.

✓ ✓ ✓

**F. J. "Hux" Huxtable** is general superintendent and **Joe Collins** is assistant superintendent for T-S Construction Co., Los Angeles, Calif., for constructing the May Co. Lakewood department store at Long Beach, Calif. **John Dashiell** is foreman on this $5,000,000 project.

✓ ✓ ✓

**Wes Gemmell** is job superintendent for B. C. Bridge & Dredging Co., Ltd., Vancouver, B. C., on its $3,500,000 modernization program of the No. 1 generating plant of B. C. Electric Co. **Norm Wilde** is timekeeper; **Val Bril** is powderman; **Slim Morrison,** bridgeman foreman, and **Pat Murray** is chief engineer on the project which is located at Lake Buntzen, B. C.

✓ ✓ ✓

**Frank D. Manning** is project manager, **Arthur Ellison** is general superintendent, and **Roy Franceschina** is assistant superintendent for Winston Bros., Monrovia, Calif., on the company's $1,000,000 contract for sinking two shafts for the Southwest Potash Corp. The project is located 30 mi. northwest of Carlsbad, N. Mex.

✓ ✓ ✓

**Guy H. James** is project manager and **R. E. Leech** is general superintendent for Guy H. James Construction Co., Oklahoma City, Okla., on its $1,851,726 railroad relocation job between Kopperl and Blum, Texas, on the Santa Fe track.

# BIG YARDAGE

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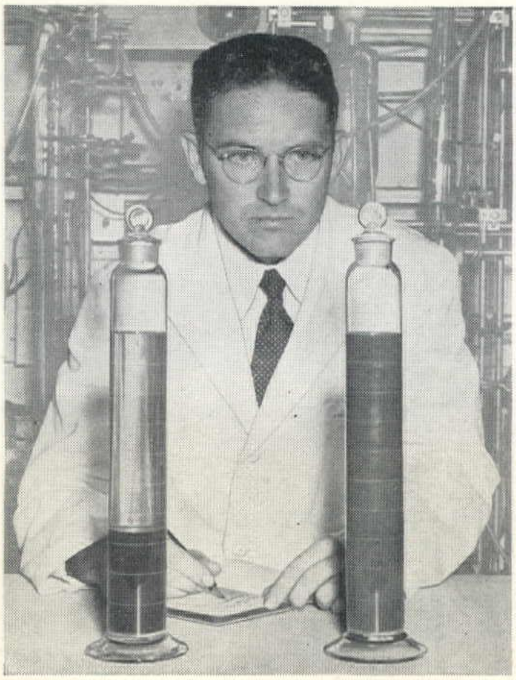

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# Contracts . . .

## A Summary of Bids and Awards For Major Projects in the West

### Arizona

$325,766—**W. J. Henson,** P. O. Box 471, Prescott, Ariz.—Low bid on 7.6 mi. grading and new alignment on Topock-Kingman Hwy.; by State Highway Commission.

$267,908—**J. & J. Construction Co.,** 1801 Petroleum Building, Oklahoma City, Okla.—Contract for 215 mi. rural distribution lines in Pima County; by Trico Electric Cooperative, Inc., Tucson.

$399,843—**Acme Materials-Daley Construction Co.,** 2400 S. 16th St., Phoenix—Low bid on 10 mi. of Phoenix-Tucson Hwy., Pima County.

$126,822—**Tiffany Construction Co.,** P. O. Box 846, Phoenix—Low bid for East Broadway Road, Phoenix, 4.5 mi. grading and surfacing; by State Highway Commission.

$284,448—**Fisher Contracting Co.,** P. O. Box 4135, Phoenix—Contract for grading and alignment on Superior-Miami Hwy.; by State Highway Commission.

### California

$363,308—**Dimmit & Taylor and T. M. Page,** Monrovia, Calif.—Low bid for 15.5 mi. surfacing and reinforced concrete bridge at Clear Creek between Democrat Springs and Bodfish, Kern County; by California Division of Highways.

$1,010,900—**Monson Bros.,** 475 6th St., San Francisco—Contract for reinforced concrete building for the Hastings College of Law, San Francisco; by the Regents of the University of California.

$946,610—**Frederickson Bros.,** 1259 65th St., Emeryville, Calif.—Contract for 4.4 mi. grading and surfacing with plant mix on cement treated base, including bridges, in Humboldt County between Robinson Ferry Bridge and Alton Grade Crossing; by Division of Highways.

$895,580—**United Concrete Pipe Corp.,** P. O. Box 425, Baldwin Park, Calif.—Contract for PCC pavement on cement treated subgrade, and construction of two bridges, between Tulare Airport and Tagus, Tulare County; by Division of Highways.

$2,871,212—**Frederickson & Watson and M. & K. Corp.,** joint venture, 873 81st Ave., Oakland—Contract for construction of PCC pavement highway and separation structures on 4.2 mi. of the Eastshore Freeway between Lewelling Blvd. and 0.1 mi. north of Oakland south city limit, Alameda County; by Division of Highways.

$533,704—**Griffith Co.,** 1060 South Broadway, Los Angeles—Low bid for 14.8 mi. graded and surfaced with road mix surfacing on imported base material between Imperial County line and 3 mi. southeast of Mecca, Riverside County; by Division of Highways.

$385,574—**K. B. Nicholas,** P. O. Box 551, Ontario, Calif.—Low bid for highway improvements in city of San Bernardino at 5th and "I" St., including structural steel railroad overhead and approach; by Division of Highways.

$191,806—**John F. Blakemore,** 902 South 5th St., El Monte, Calif.—Contract for grading and paving 3.4 mi. of state highway, including reinforced concrete slab bridge, near Hot Springs Canyon Road, Fresno County; by Division of Highways.

$277,946—**McGuire and Hester,** 796 66th Ave., Oakland—Contract for installation of Section 2 of Alameda interceptor sewer and appurtenances, Alameda; by East Bay Municipal Utility District.

$253,795—**P. and J. Artukovich Co.,** 13305 South San Pedro St., Los Angeles—Contract for Schedule I of Section 1 of the Alameda Interceptor, and Section 1-B of the South Interceptor, Oakland; by East Bay Municipal Utility District.

$1,949,000—**Louis C. Dunn, Inc.,** 799 Monadnock Building, San Francisco—Contract for construction of 22 three and four-story reinforced concrete buildings for Bernal Dwellings Housing Project, San Francisco; by the San Francisco Housing Authority.

$308,800—**J. E. Haddock, Ltd.,** 3538 E. Foothill Blvd., Pasadena—Low bid for Van Ness Ave. bridge, Hollywood Freeway, Los Angeles; by Division of Highways.

$1,508,000—**Haas and Rothschild,** 274 Brannan St., San Francisco—Low bid for construction of reinforced concrete and steel frame Public Works Building annex, Sacramento; by Division of Architecture.

$259,323—**Bosko Construction Co., Inc.,** 1728 Greenwood Ave., Los Angeles—Low bid for Valley Blvd. sewer work; by City of Los Angeles.

$272,079—**H. Earl Parker, Inc.,** 12th and F Sts., Marysville, Calif.—Contract for 2 mi. grading and surfacing of state highway near Placerville; by Division of Highways.

$184,368—**Western Construction Co.,** 307 W. Hampton Way, Fresno—Contract for additions to sanitary sewer system section 5; by City of Fresno.

### Colorado

$516,516—**Malcolm W. Larson,** 4080 Galapaga St., Denver—Low bid for construction of the 72-mi. Brighton-Hoyt-Brush 115-kv. transmission line, for the Colorado-Big Thompson Project; by Bureau of Reclamation.

$469,955—**B-Line Construction Co.,** 520 First National Bank Bldg., Oklahoma City, Okla.—Contract for construction of 108-mi. transmission line; by K. C. Electric Association, Hugo, Colorado.

$542,799—**Brown Construction Co.,** 1530 E. Abriendo Ave., Pueblo—Low bid for 4 mi. grading and structures near Clear Creek Canyon, Jefferson County; by State Highway Department.

$741,740—**Adler Construction Co.,** Dickinson, North Dakota—Contract for construction of Pole Hill Power Plant and access road, Estes Park-Foothills power aqueduct, 14 mi. west of Loveland; by Bureau of Reclamation.

$1,222,000—**Mead and Mount Construction Co.,** 240 Railway Exchange Building, Denver—Low bid for construction of brick and concrete addition to Colorado State Hospital, Pueblo.

$134,883—**Carl V. Hill,** Greeley—Low bid for 7.8 mi. surfacing and structures on state hwy. 12, Las Animas County; by State Highway Department.

### Idaho

$121,125—**Henly Construction Co.,** Lewiston—Low bid for construction of steel Priest River Bridge and approaches, Coolin Road, Kaniksu National Forest, Bonner County; by Bureau of Public Roads.

$374,198—**J. H. Wise and Son, Inc.,** 424 Broadway, Boise—Contract for construction of 909-ft. steel and concrete interstate bridge across the Snake River at Weiser; by Idaho State Highway Commission.

$1,018,000—**M. J. Brock & Sons, Inc.,** 2894 Rowena Ave., Los Angeles—Contract for office and laboratory, and sewage treatment facilities at Arco; by Westinghouse Electric Corp., for the Atomic Energy Commission.

$334,790—**Oliver, Blumhagen, Walker & Von Cannon,** Sandpoint, Idaho—Contract for clearing operations on 27.7 mi. of the Lake Pend Oreille section of the Spokane-Hot Springs transmission line; by the Bonneville Power Administration.

### Montana

$302,798—**Williston Construction Co.,** Williston, N. Dak.—Contract for 313 mi. of electric line; by Sheridan County Electric Cooperative, Inc., Medicine Lake.

$222,925—**W. D. Savalis,** Oroville, Calif.—Contract for right of way clearing in Sanders County, on Spokane-Hot Springs transmission line; by Bonneville Power Administration.

$598,713—**Dudley Construction Co.,** Great Falls—Contract for state home for the aged at Lewiston; by State.

### New Mexico

$528,489—**J. H. Ryan,** Albuquerque—Contract for concrete and steel Rio Grande Bridge, Albuquerque, U. S. 66; by State Highway Department.

$788,206—**Brown Contracting Co.,** P. O. Box 1479, Albuquerque—Contract for grading, culvert work, and two steel bridges, and asphalt pavement for 9.9 mi. of U. S. 66 between Tucumcari and San Jon; by State Highway Department.

# NEWS SUMMARY

**Note: For additional information regarding projects in this summary refer to Daily Construction News Service, date appearing at end of each item.**

**LOS ANGELES, CALIF.**—Bids to 10 a.m., Feb. 18, by Metropolitan Water District, Los Angeles, for constructing 16.3 mi. of patrol road and 1.4 mi. of stub roads adjacent thereto, along proposed route of the 230 KV transmission line for the Colorado River Aqueduct, located in SAN BERNARDINO COUNTY. Under Spec. No. 91. 2-2

**LOS ANGELES, CALIF.**—Bids to 2 p.m., Feb. 14, by Calif. Div. of Highways, L. A., for 1.1 mi. grad. and concr. paving betw. Cypress St. and South City Limits in Laguna Beach, ORANGE COUNTY, Calif., involving: 56,900 cu. yd. excavation, 1,150,000 sta. yd. overhaul, 3,900 cu. yd. struc. excav., 25,700 sq. yd. subgrade pavement, 5,110 cu. yd. 'A' concr. pavement, 940 cu. yd. 'A' concr. (curbs, gutters, sidewalks and driveway), 1,205 cu. yd. 'A' concrete (struc.), 150,000 lb. reinf. steel, 9,500 lb. misc. iron and steel, 230 lin. ft. 24-in. corr. met. pipe, 100 lin. ft. 60-in. corr. met. pipe, 15 lin. ft. 18-in. std. reinf. conc. pipe, 75 ft. 24-in. std. reinf. concr. pipe, 360 ft. 30-in. std. reinf. concr. pipe, 800 M gallons water, 900 cu. yd. salvage oil surface, 155 tons fuel oil, 18,500 sq. yd. prep., mix and shape shoulders. 1-22

**SACRAMENTO, CALIF.**—Bids to 2 p.m., Feb. 20, by Calif. Div. of Highways, Sacramento, for 0.9 mi. grading, surf. with salvaged surf. material and a bitum. tr. applied betw. 1.8 mi. and 0.9 mi. south of Fish Springs School, in INYO COUNTY, Calif. Work involves: 9,600 cu. yd. excavation, 6,200 sta. yd. overhaul, 1,800 cu. yd. imported borrow, 75 cu. yd. ditch excavation, 95 cu. yd. struc. excavation, 24 tons fuel oil SC-2 prime coat, 107 tons fuel oil SC-3 bitum. tr., 0.91 mi. mix bit. binder and salv. surfacing, 35 cu. yd. screenings seal coat, 26 lin. ft. 12" corr. metal pipe, 104 lin. ft. 24" corr. metal pipe, 38 lin. ft. rem. and salv. corr. metal pipe, 11 rem. and reset timb. guideposts, 124 timb. guideposts, 200 lin. ft. rem. and salv. guardrail, 220 M gallons water, 48 sta. finish roadway, 19 monuments. 1-29

**CARSON CITY, NEVADA**—Bids to 2 p.m., Feb. 20, by Nevada State Highway Comm., Carson City, Nev., for 28.05 mi. grading, surf. and oiling betw. Schurz and 9.6 mi. south of Fallon, Rt. 1A, Secs. A, A, Cl and C2, in MINERAL, LYON and CHURCHILL COUNTIES, Nevada, involving: 116,330 cu. yd. excav., 189,650 sta. yd. overhaul, 52,095 cu. yd. select borrow, 1,155 cu. yd. struc. excav., 28.017 mi. subgrade, 28.046 mi. fin, roadway, 97,440 tons cr. grav. or stone surf., 123 cu. yd. 'A' concrete, 97 cu. yd. 'B' concrete, 14,700 lb. reinf. steel, 36.9 M ft. BM redwood, 1,190 lin. ft. 18" corr. met. pipe, 192 lin. ft. 24" corr. met. pipe, 66 lin. ft. 30" corr. met. pipe, 108 lin. ft. 36" corr. met. pipe, 246 lin. ft. relay culvert pipe, 130 ea. monuments, 108 lin. ft. 18" concr. pipe, 514 lin. ft. 1.5x1.5-ft. lam. culvert, 80 lin. ft. 2.0x2.0-ft. lam. culvert, 140 lin. ft. 3.0x2.0-ft. lam. culvert, 34 lin. ft. 3.0x3.0-ft. lam. culvert, 514,573 gal, asphaltic road material Type SC-2, 184.71 tons asphaltic road material Type MC-2, 28.046 mi. roadmix. 2-2

**OLYMPIA, WN.**—Bids to 10 a.m., Feb. 19, by Director of Highways, Olympia, Wn., for: (1) WHATCOM COUNTY (NRM-17-D(1935) 0.3 of a mi. cement concr. paving and retopping existing pavement with asph. concrete on State Road No. 1, Mill Avenue North Revision in City of Bellingham, involving: 5,410 cu. yd. excav., 6,064 sq. yd. concr. pavement, 70 tons asphl. concrete, 1,351 lin. ft. 6" diam. pipe, and other items. (2) WHITMAN COUNTY (NRS 213-A)—1.9 mi. grading and surf. and const. tr. timber trestle 51 ft. long and a tr. pile and timber overcrossing with 60-ft. steel span, both with concr. deck, on the Inland Empire Highway-Eastern Route, Oakesdale south, involving: 55,670 cu. yd. excavation, 12,090 cu. yd. cr. stone surf. matl., 26,200 lb. struc. steel, 77 B ft. BM timb. and plank (tr), 2,120 lin. ft. tr. piling, 901 lin. ft. pipe culverts. 2-1

## BIDS RECEIVED

**LOS ANGELES, CALIF.**—Matich Bros., Elsinore, Calif., $139,804 low to Calif. Div. of Highways, Los Angeles, for 16.8 mi. grading and portions paved with concrete and portion treated with oil tr. cr. gravel or stone (plant mix) betw. 1 mi. east of Beaumont and Whitewater, RIVERSIDE COUNTY, Calif. (See Unit Bid Summary.) 1-31

**LOS ANGELES, CALIF.**—Sully Miller Contracting Co., 1500 W. 7th St., Los Angeles, $107,081 ALT. 'A' (ASPH. CONCRETE) and $115,017 ALT. 'B' (CEMENT CONCRETE), low to Calif. Div. of Highways, State Bldg., Los Angeles, for 3.7 mi. grad. and asph. concr. or Portland concr. paving betw. State St. and Los Angeles St. on Rt. 168, LOS ANGELES COUNTY, Calif. 1-31

**LOS ANGELES, CALIF.**—C. O. Sparks, 2309 E. 9th St., L .A., $2.40 per ton, low to County Bd. of Supervisors, Hall of Records, Los Angeles, for 8500 tons asph. concr. medium wearing surf. for improving Alexander Ave. from Holt Ave. to Cucamonga Ave. in cities of Pomona and Claremont, a distance of 1.88 mi. 1-22

**SACRAMENTO, CALIF.**—Geo. J. Bock & Son, 1007 South Harvard Blvd., Los Angeles, $121,722, low to Calif. Div. of Highways, Sacramento, for 3.7 mi. grading betw. Coarse Gold and Hawkins School in MADERA COUNTY, Calif. (See Unit Bid Summary.) 1-23

**SACRAMENTO, CALIF.**—Union Paving Co., Call Bldg., San Francisco, $61,735, low to Calif. Div. of Highways, Sacramento, for 1.5 mi. grading and asph. concr. paving in City of Madera, MADERA COUNTY, Calif. 1-30

**SACRAMENTO, CALIF.**—T. M. Morgan Paving Co., 472 North Barrington Ave., Los Angeles, $95,321. ALT. 'A'—ASPHALT CONCRETE and $92,485 ALT. 'B'—CONCRETE, low to Calif. Div. of Highways, Sacramento, for 0.9 mi. grading and asphalt concrete paving at north entrance to City of Redding, SHASTA COUNTY, Calif. 1-30

**SAN FRANCISCO, CALIF.**—Chas. Kuppinger, Box 356, Lakeport, $3,971, low to Calif. Div. of Highways, Dist. Engr., State Bldg., S. F., for 139.2 mi. apply Diesel oil to roadside vegetation at var. locations in SONOMA, MARIN, NAPA and SOLANO COUNTIES, Calif. 1-30

**SAN FRANCISCO, CALIF.**—Tiffany Const. Co., 535 N. 7th St., San Jose, $2,000, and Hayward Bldg. Matl. Co., Hayward, $2,000, identical low bids ot Dist. Engineer, State Bldg., S. F., for 75.5 mi. applying diesel oil to roadside vegetation at various locations in ALAMEDA, CONTRA COSTA and SANTA CLARA COUNTIES, Calif. 1-30

**SAN MARINO, CALIF.**—George R. Curtis Paving Co., 2440 E. 26th St., Vernon, $9,480 (USING 7" ASPH. CONCR. PAVEM.), low to City Clerk, San Marino, for improving San Gabriel Blvd. betw. Duarte Road and S. Gainsborough Drive. 1-11

**STOCKTON, CALIF.**—Tiffany Const. Co., 535 N. 7th St., San Jose, $2,029, low to Dist. Engr., Calif. Div. of Highways, Stockton, for 129.9 mi. applying diesel oil to roadside vegetation at various locations in SOLANO and SAN JOAQUIN COUNTIES, Calif. 1-29

**MILES CITY, MONTANA**—Northwest Roads Co., P. O. Box 5072, Portland, Ore., $143,600, low to City Clerk, Miles City, Mont., for excavation, graveling and oiling of streets in Miles City, Spec. Improv. Districts Nos. 98, 99 and 100. Oiling to be a plant mix process with combination concrete curb and gutter with alternate bid for straight curbing. 1-18

**PORTLAND, ORE.**—Bids received as follows by Oregon State Highway Comm., Portland, Ore., for: (1) UMATILLA COUNTY (NRM 40-C-1935)—Itschner & Rigdon, Barlow, Ore., $28,722, low for 1.32 mi. grad. and surf., 0.32 mi. oil mat. surf. tr. and 1.0 mi. penetra. type bitum. macad., also includes grading 0.7 mi. railway roadbed on State Hospital-Ash Street Unit, Pendleton Section of Old Oregon Trail. (2) BAKER and UNION COUNTIES (State Proj.)—All bids submitted for furn. approx. 4000 cu. yd. cr. rock in stockpiles on North Powder-Haines Rock Production project on Old Oregon Trail, have been rejected and will be readvertised. 2-2

**ALMIRA, WN.**—David H. Ryan, Coulee, Wn., $110,505, low to Bureau of Reclamation, Almira, Wn., for removal of a slide on highway and const. railroad, Sta. 1090 to Sta. 1101, at Grand Coulee Dam, Columbia Basin Proj., Wn., under Spec. No. 649-D. Work is located 22 mi. northwest of Almira, Wn. (See Unit Bid Summary.) 1-8

**MT. VERNON, WN.**—A. W. Stevens, Mount Vernon, Wn., $3,278, low to Board of County Comm., Mt. Vernon, Wn., for concrete paving omission in the Clear Lake Road, known as Secondary road project No. 18. 1-16

## CONTRACTS AWARDED

**PHOENIX, ARIZ.**—Awards as follow by the Arizona State Highway Comm., Phoenix, Ariz.: (1) COCONINO COUNTY (NRH 95-I)—To Skousen Bros., Albuquerque, N. M., $95,797 for 10 2/3 mi. grading, draining and placing base course about 28 mi. north of Flagstaff. (2) PIMA COUNTY (RH 29)—To White & Miller, Phoenix, $36.916. by Ariz. State Highway Dept., for 1.2 mi. widening and resurf. of existing conc. pav. with asph. plant mix. 1-10

**PHOENIX, ARIZ.**—To K. DeWitt, Phoenix, $16,873, by State Highway Comm., Phoenix, for furn. and placing base course in Kingman and extending N.E. approx. 23.6 mi. on Ashfork-Kingman Highway NRH 80-G. MOHAVE COUNTY, Ariz. 1-10

**PHOENIX, ARIZ.**—To R. E. Martin & Co., 304 E. Lee St., Tucson, Ariz., $22,899 to Ariz. State Highway Comm., Phoenix, Ariz., for 1 ⅓ mi. grading and draining of roadway, located approx. 35 mi. south of Safford on the Douglas-Safford road near the junction with the Bowie Road, Douglas-Safford Highway, Proj. NRS 114 (1935), COCHISE COUNTY, Ariz. 1-28

**PHOENIX, ARIZ.**—Awards as follow by the Arizona State Highway Comm., Phoenix, Ariz.: (1) YAVAPAI COUNTY (NRH 96-B)—To Pearson & Dickerson, 202 N. Central Ave., Phoenix, Ariz., $39,976 for 3 mi. grading, draining and placing aggregate base course from Cottonwood Sec. to the Verde River on Prescott-Flagstaff Highway. (2) APACHE COUNTY (NRS 113-A)—To Heuser & Garnett, 816 Allen Ave., Glendale, $33,397 for 5⅔ mi. grading, drain. and placing select material one mi. northeast of St. Johns on the St. Johns-Zuni Highway, Ariz. (3) COCHISE COUNTY (NRM 79-I)—To R. E. Martin, Phoenix, $6,533 for replacing paved dip with a concr. box and incidental work located within the city limits of Bisbee on the Benson-Douglas Highway. (4) MARICOPA COUNTY (NRM 8A)—To Phoenix, Tempe Stone Co., P. O. Box 1645, Phoenix, $8112, for widening and resurf. with cutback asph. and incidental work in Tempe and extending from 3rd St. southerly on Mill Ave. to 1st St. on the Tempe-Mesa Highway. (5) MARICOPA COUNTY (NRH 46A)—To Tanner & Hall, Phoenix, $49,505 for widening existing concrete pavement with cutback plant mix from 19th Ave. and Buckeye Road westerly 13 mi. to Agua Fria Bridge, on the Phoenix-Yuma Highway. 2-2

**LOS ANGELES, CALIF.**—To R. E. Job, 3716 N. Griffin Ave., Los Angeles, $1275.70 to City Purchasing Agent, L. A., for improving Zanja St. from 121 ft. west of Lyceum Avenue to Walgrove. 1-26

**LOS ANGELES, CALIF.**—To Oswald Bros., 366 E. 58th St., Los Angeles, $103,254 to Calif. Div. of Highways, Los Angeles, for 4 mi. grading and bitum. tr. cr. gravel or stone surf. betw. 4 mi. west of Shaver Summit and Shaver Summit, in RIVERSIDE COUNTY, Calif. 1-22

**LOS ANGELES, CALIF.**—To C. O. Sparks Co., 2309 E. 9th St., L. A., $23,526 by Calif. Div. of Highways, L. A., for 1.6 mi. grad. and asph. concr. surf. betw. San Antonio Ave. and city limits of Ontario, SAN BERNARDINO COUNTY, Calif. 1-16

**LOS ANGELES, CALIF.**—To C. O. Sparks Co., 2309 E. 9th St., L. A., $111,025 by Calif. Div. of Highways, L. A., for 5.2 mi. grad. and portions paved with asph. concr. and remainder paved with asph. concr., on Manchester Ave. betw. Artesia Ave., Buena Park, and Lincoln Ave. in City of Anaheim, ORANGE COUNTY, Calif. 1-30

**LOS ANGELES, CALIF.**—To J. L. McClain, 5850 Brynhurst Ave., L. A., $65,531 by Calif. Div. of Highways, L. A., for 0.8 mi. concr. paving betw. Calif. Avenue and Colorado Ave. in Santa Monica, LOS ANGELES COUNTY, Calif. 1-30

**LOS ANGELES, CALIF.**—To Basich Bros. Const. Co., 20550 Normandie Ave., Torrance, $214,957, by Calif. Div. of Highways, State Bldg., Los Angeles, for 3.6 mi. grading and asph. concr. paving betw. Sea Cliff and Benham in VENTURA COUNTY, Calif. (See Unit Bid Summary.) 1-30

**OAKLAND, CALIF.**—To Joe Catucci, 1212 18th Ave., Oakland, who bid .07 per cu. yd. to City Clerk, Oakland, for 12,000 cu. yd. filling in a portion of Peralta Park. 1-26

**SACRAMENTO, CALIF.**—To Hemstreet & Bell, 501 11th St., Marysville, $62,732 to the Calif. Div. of Highways, Sacramento, for 2.5 mi. grading, surf. with untr. cr. grav. and applying seal coat betw. 1 mi. east of Upper Lake and Manila Ranch in LAKE COUNTY, Calif. 1-26

**SAN FRANCISCO, CALIF.**—Award recommended to H. J. Hagen, Globe, Ariz., $110,506 by Bureau of Public Roads, San Francisco, for 2.357 mi. grading and placing selected material subgrade reinforcement on Section D of Federal Lands Highway Proj. 2, the Kingman-Boulder Dam Highway, MOHAVE COUNTY, Ariz. 1-29

**SAN FRANCISCO, CALIF.**—To Pacific Pavements Co., Ltd., 85 Barstow St., San Francisco, $2,316 to Board of State Harbor Comm., S. F., for laying asphaltic pavement on Pier 42, San Francisco. 1-19

**SAN FRANCISCO, CALIF.**—To Fay Improvement Co., Phelan Bldg., San Francisco, $2298, by Dept. of Public Works, San Francisco, for reconst. Pacific Ave. betw. Presidio Ave. and Walnut St., S. F. 2-2

**SAN FRANCISCO, CALIF.**—Award recommended to Pacific States Const. Co., 708 Call Bldg., San Francisco, $35,437, by Bureau of Public Roads, San Francisco, for 8.606 mi. surf. with cr. grav. base course on Sections A and B of Route 51, the Hoopa National Forest Highway, Trinity Natl. Forest, HUMBOLDT COUNTY, Calif. 2-2

**DENVER, COLO.**—Contracts awarded as follows by State Highway Dept., Denver, for: (1) EAGLE COUNTY (NRH 240-D)—To Switzer & Horner, Rt. 1, Box 247A, Arvada, $37,779 for 2.879 mi. gravel surf. betw. Gypsum and Eagle on State Road No. 4. (2) SAGUACHE COUNTY (NRS 389-B-1935)—To Lowdermilk Bros., 393 S. Vine St., Denver, who bid $23,504 for 1.873 mi. gravel surf. betw. Saguache and Parlin on State Highway No. 114. 1-18


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**DENVER, COLO.**—To C. A. Switzer, R. 1, Bov 247-A, Arvada, Colo., $65,216 by State Highway Dept., Denver, Colo., for 4.729 mi. grav. surf. betw. Granby and Hot Sulphur Springs on State Highway No. 2 in GRAND COUNTY, Colorado, NRH 151-D (1935). 1-28

**BOISE, IDAHO**—Awards as follow by Comm. of Public Works, Boise, Idaho, for: (1) ADA COUNTY (NRH 129-A)—To Utah Const. Co., Ogden, Utah, $52,494 for 8.162 mi. grad., drain. and surf. with cr. grav. on Payette Highway betw. Boise Valley and Spring Valley. (2) JEROME COUNTY (NRH 125-D)—To Dan J. Cavanaugh, Twin Falls, Idaho, $25,684 for 7.547 mi. surf. with cr. grav. on Sawtooth Park Highway betw. Newman's Corner and Jerome Airport. 1-7

**BOISE, IDAHO**—To G. L. Arnett, Sandpoint, Idaho, $9,061 to Comm. of Public Works, Boise, Idaho, for 1.849 mi. constructing riprap and slope protection on the Coeur d'Alene Yellowstone Trail west of Kellogg in SHOSHONE COUNTY, Idaho, Proj. NRH 73-C. 1-14

**MISSOULA, MONT.**—Ralph Davis, St. Johns, Wn., $61,327 to Bureau of Public Roads, Missoula, Mont., for 5.989 mi. grading on the Bitterroot-Salmon Highway, Proj. Nr-19-C, located in the Bitterroot Natl. Forest, RAVALLI COUNTY, Montana. 1-25

**HELENA, MONTANA**—Awards as follow by State Highway Comm., Helena, Mont., for: (1) GARFIELD COUNTY (NRH 256-G, Unit 1)—To Haas Const. Co., Helena, Mont., $64,762 for 12.685 mi. grad. and const. small drain. struc. on Sec. G of the Grass Range-Jordan Road. (2) MADISON COUNTY (NRS 281-B, Unit 1)—To Earl L. McNutt, 351½ E. Broadway, Eugene, Ore., $61,028 for 6.178 mi. grad., surf. with cr. grav. and const. small drain. struc. on Sec. B of the Twin Bridges North Section of the Vigilante Trail. (3) PRAIRIE COUNTY (NRS 302-B, Unit 1)—To E. N. Brown, Bozeman, Mont., $23,638 for 4.517 mi. grad., surf. with grav. subbase matl. and a top course of cr. grav. and const. small drain. struc. on Sec. B of the Terry-Brockway Road. (4) JUDITH BASIN COUNTY (NRS 307-B, Unit 1)—To E. N. Brown, Bozeman, Mont., $25,488 for 3.400 mi. grad., surf. with grav. subbase material and a top course of cr. grav. and const. small drain. struc. on Sec. B of the Stanford North Road. 1-28

**HELENA, MONTANA**—Awards as follow by State Highway Comm., Helena, Mont.: (1) MEAGHER COUNTY (NRS 49-C)—To Tomlinson, Arkwright Const. Co., Great Falls, Mont., $12,446 for 2.032 mi. grad., surf. with screened grav. and const. a single span 25′ tr. timb. pile trestle bridge and const. small drain. struc. on Sec. C of the County Road No. 1, about 6.9 mi. west of White Sulphur Springs. (2) STILLWATER COUNTY (NRH 109-A, Unit 4)—To Standard Const. Co., Bozeman, Mont., $71,076 for 3.022 mi. grad., surf. with grav. subbase matl., const. small drain. struc. and road mix oiling of Sec. A of the Witt Hill Road. (3) LEWIS AND CLARK COUNTY (NRH 269-A, Unit 3)—To J. C. Maguire, 208 Lewisohn Bldg., Butte, Mont., $100,961 for 18.581 mi. const. plant mix bitum. tr. cr. grav. surf. course on Sec. A of the Helena-Wolf Creek and Sec. D of the Wolf Creek-Cascade Roads. (4) FERGUS COUNTY (NRS 309-B, Unit 1)—To Haas Const. Co., Helena, $23,465 for 3.087 mi. grad., surf. with grav. subbase matl. and with a top course of cr. grav. and const. small drain. struc. on Sec. B of the Lewistown-Denton Road. 1-28

**SANTA FE, NEW MEXICO**—Contracts awarded as follows by State Highway Engineer, Santa Fe, New Mexico, for: (1) RIO ARRIBA COUNTY (NRH 100-C)—To Wheeler, Carrico & Silver, Albuquerque, N. M., $85,130 for 4.950 mi. grading, minor drainage structures, const. 3 tr. timber bridges, etc., on State Road No. 2 betw. Espanola and Chama. (2) Lincoln County (NRS 222-D)—To Wheeler, Carrico & Silver, Albuquerque, N. M., $39,628 for 5.024 mi. grading, drainage struc. and cr. grav. surf. on State Road No. 3 betw. Corona and Carrizozo. 1-22

**PORTLAND, ORE.**—To J. D. Harms, Inc., 1st Ave., S., and Hudson St., Seattle, Wn., $41,212 (USING METAL PIPE), by Bureau of Public Roads, Portland, for 2.325 mi. reconst. grading on St. Helens Highway, located in Columbia Natl. Forest, COWLITZ COUNTY, Wn. 1-9

**PORTLAND, ORE.**—To Columbia Power & Investment Co., Stevenson, Wn., $30,807 (USING CONCRETE PIPE), by Bureau of Public Roads, Portland, Ore., for 1.8859 mi. grad. and const. bridge on Randle-Yakima Highway in Snoqualmie Natl. Forest, YAKIMA COUNTY, Oregon. 1-7

**PORTLAND, ORE.**—Awards as follow by the Oregon State Highway Comm., Portland, Ore., for: (1) COLUMBIA COUNTY (NRM 173-A-1935)—To E. C. Hall, 1st Natl. Bank Bldg., Eugene, Ore., $38,835 for 0.45 mi. grading and paving on East Rainier Sec. of Columbia River Highway. Next low: Parker Schram Co., Portland, $39,729. (2) JOSEPHINE COUNTY (NRS 244-1935)—To E. C. Hall, 1st Natl. Bank Bldg., Eugene, Ore., $20,968 for 1.3 mi. grading, surf. and oil mat surf. tr. on Murphy-Grays Creek Section of Williams Secondary Highway. (3) LINCOLN COUNTY (NRM 150-B)—To E. C. Hall, 1st Natl. Bank Bldg., Eugene, Ore., $38,994 for 0.64 mi. grading, surf. and penetration type bitum. macadam; also removal of buildings from right-of-way on Toledo Section of Corvallis-Newport Highway (4) POLK and YAMHILL COUNTIES (State Proj.)—To Itschner & Rigdon, Barlow, Ore., $10,532 for furn. approx. 6000 cu. yd. cr. rock or cr. grav. in stockpiles on Grande Ronde-Sheridan Rock Prod. Proj. Salmon River and McMinniville-Tillamook Highway. 2-2

**PORTLAND, ORE.**—Contracts awarded as follows by the Oregon State Highway Comm., Portland, for: (1) UNION COUNTY (NRM & H-5 1935)—To George F. Price, Dayton, Wn., $5,957 for 0.43 mi. grad. and surf. on Elgin Sec. of Wallowa Lake Highway. (2) WASHINGTON COUNTY (NRM 183-D, 1935)—To Kern & Kibbe, 32 S.E. Salmon St., Portland, $8,737 for 0.45 mi. pavement resurf. on Second Street-7th St. Unit, Forest Grove Section of Tualatin Valley Highway. (3) WASHINGTON COUNTY (NRM 183-E, 1935)—To Kern & Kibbe, 32 S.E. Salmon St., Portland, Ore., $17,280 for 0.44 mi. pavement widening and resurf. on Range Street-5th Street Unit, Hillsboro Section of Tualatin Valley Highway. (4) WASHINGTON COUNTY (NRH 73, 1935)—To Harold Blake, 400 N. Thompson St., Portland, $64,329 for 1.1 mi. grad. and paving on Vetaw Unit, Multnomah County Line-Newberg Section of West Side Pacific Highway. 2-2

**SALT LAKE CITY, UTAH**—To W. W. Clyde & Co., Springville, Utah, $50,916 by Utah State Road Comm., Salt Lake City, for 12.367 mi. grav. surf. road betw. Levan and Gunnison, Project NRS 140-C (1935) in JUAB COUNTY, Utah. 1-19

**OGDEN, UTAH**—Wheeler & England, Moreland, Idaho, $92,663 by Bureau of Public Roads, Ogden, Utah, for 4.313 mi. grad. and surf. on Warm River-Yellowstone Highway in Targhee Natl. Forest, FREMONT COUNTY, Idaho, Proj. NR 34-A10. 1-25

**SALT LAKE CITY, UTAH**—To J. W. Whiting, Springville, Utah, $39,101 by Utah State Road Comm., Salt Lake City, for 5.372 mi. grav. surf. road betw. Pleasant Grove and American Fork Canyon, UTAH COUNTY (NRS 159, 1935). 2-2

**SALT LAKE CITY, UTAH**—To Floyd Whiting, Kaysville, Utah, $87,068 by State Road Comm., Salt Lake City, Utah, for 3.669 mi. grav. surf. road betw. Echo and Coalville and Echo Wye, SUMMIT COUNTY (NRH 60-A and 76-A). 2-2

**MT. VERNON, WN.**—To Cowan & Hubbard, Inc., 540 2nd Ave., N., Seattle, Wn., $14,368 by the Skagit Co. Comm., Mt. Vernon, Wn., for 2 mi. clearing, grading, surf. and draining and const. timber bridges on the Burlington-Butler portion of the Cascade Pass Highway, near

**CHEYENNE, WYOMING**—To J. M. Keahey, Buffalo, $36,118 by State Highway Dept., Cheyenne, Wyo., for 3.283 mi. grading, draining, base course surf. and misc. work on the Big Goose Creek Road. 1-28

**CHEYENNE, WYOMING**—Awards as follows by State Highway Comm., Cheyenne, Wyoming, for: (1) SHERIDAN CO. (NRH 28A & NRH 179A)—To H. J. Woodman, Cheyenne, $36,511 for 1.662 mi. grad., drain. base course surf. and misc. work on the Sheridan-Ranchester road. (2) NIOBRARA CO. (NRH 194E & NRH 40-R)—To Northwestern Contr. Co., Seattle, $79,049 for 17.375 mi. oil tr. by rd. mix method on the Lusk-Newcastle road. (3) WESTON CO. (NRS 278)—To Northwestern Engrg. Co., Rapid City, $24,109 (subject to approval of Co. Comm.) for 5.472 mi. grad., drain. const. 2 tr. timb. bridges and misc. work on the Upton-Sundance road. 1-28

# BRIDGES and CULVERTS

## WORK CONTEMPLATED

**PHOENIX, ARIZ.**—Plans are being prepared by State Highway Engineer, Phoenix, Arizona, for construction of an over pass on the Santa Fe Railroad at Wickenburg and for construction of a new bridge over the Hassayampa River on U. S. Highway No. 60, at Wickenburg (est. cost) $129,000. 1-22

**SAN FRANCISCO, CALIF.**—Bid calls will be issued on or about the following dates by the S. F.-Oakland Bay Bridge Office, Rm. 811, 500 Sansome St., S. F., for the following work on the S. F.-Oakland Bay Bridge: (1) Bids to be advertised about Jan. 25th to be opened about Feb. 21 for const. of a 4-lane subway under the S.P. tracks at Folger Ave., in Berkeley, inv. in the main. 16,000 cu.yd. excavation; 5,700 cu.yd. concrete; 500,000 lb. reinforcing steel. (2) Bids to be advertised about Feb. 1st to be opened about Mar. 1st for const. of distribution structure at the east end of the fill. Structure crosses over the S.P. tracks and the Keyroute Subway and affords traffic distribution off and on to the bridge from the East Shore Highway. Work involves in the main: 200,000 lin. ft. timber piles; 26,000 cu.yd. concrete; 3,000,000 lb. reinforcing steel; 2,500,00 lb. structural steel. (3 Bids to be advertised about Apr. 1st to be opened at a later date for const. of the Administration Building and Toll Plaza, to be located on the fill at the east end of the bridge. (4) To be advertised about May 1st, to be opened at a later date for all bridge lighting and other electrical work. (5) To be advertised about June 1st, to be opened at a later date for const. an overhead struc. extending from east end of disribution structure to 38th and Market Streets, Oakland. (6) To be advertised about Jan. 5th, 1936, for paving of the fill along the Key Route Mole and extending north to Ashby Avenue, Berkeley, and the paving of the Cypress Street branch and a short strip of paving from Folger Ave. Subway to 9th and Ashby Sts., Berkeley. 1-7

## CALL FOR BIDS

**LOS ANGELES, CALIF.**—Bids to 2 P.M., February 21st by Calif. Div. of Highways, State Bldg., Los Angeles, for widening reinf. concrete bridge across Malibu Creek approximately 10 miles northwest of Santa Monica consisting of 17 31-ft. 6" spans on concrete bents and abutments in LOS ANGELES COUNTY, Calif. Work involves: 500 cu.yd. structure excav.; 85 cu.yd. A concrete (foot blocks); 520 cu.yd A concrete; 36 cu.yd. E concrete (railing); 97,000 lb. reinforcing steel; 780 lb. bronze expansion plates; 3.5 M. ft. BM redwood timber (select); 250 tons asphalt concrete; 560 lin. ft. temporary railing; 1 lot miscellaneous work. 1-29

**OLYMPIA, WN.**—Bids to 10 A.M., Feb. 19th by the Director of Highways, Olympia, Wn., for bridge over Ebey Slough between Everett and Cavalero's on St. Rd. No. 15, consisting of 6,282 lin. ft. of tr. pile and timber trestle, a 240' steel span with 210' of concrete approaches, and paving with concrete and asph. concr. on the Cavalero's Corner intersection, involving: 9,280 cu.yd. excav. and gravel borrow; 4,760 cu.yd. concrete; 691,460 lb. reinf. steel; 455,000 lb. structural steel; 1,292 M. ft. BM tr. trimber and plank; 107,225 lin. ft. tr. piling; 817 sq. yd. cement concrete; 58 tons asph. concrete; 365 lin. ft. pipe culverts. 2-1

## BIDS RECEIVED

**SACRAMENO, CALIF.**—All bids rejected by Calif. Div. of Highways, Sacramento, for reinf. concr. bridge across North Fork of Feather River at Rock Creek, PLUMAS COUNTY, Calif. Low bid submitted by Peninsula Pav. Co., S.F. $63,768 (as stated issue Dec. 19). Project to be readvertised shortly. 1-16

## CONTRACTS AWARDED

**JUNEAU, ALASKA**—To Warrack Const. Co., McDowall Bldg., Seattle, Wn., $12,100 to Bureau of Public Roads, Juneau, Alaska, for constructing a 60-ft. span on concrete abutments supported by four steel girders, to have an 8" reinf. concrete floor and to be 20-ft. in width with steel guard rails, over Lemon Creek. 1-8

**PHOENIX, ARIZ.**—To Phoenix Tempe Stone Co., Box 1645, Phoenix, Ariz., $24,459 to Arizona State Highway Comm., Phoenix, Ariz. for replacing concr. dips with concr. box culverts and oil surf. approach fills at 3 separate bridge sites, one at 2¾ mi. E. of Welton; one at 4½ mi. E. of Welton; and one 2 mi. W. of Mohawk on Phoenix-Yuma Highway, YUMA COUNTY, Ariz. 1-21

**PHOENIX, ARIZ.**—To Phoenix Tempe Stone Co., Phoenix, $77,400 by Ariz. State Highway Comm., Phoenix, for const. a railroad underpass with grad. draining, and concr. pavement and cutback road mix, extending from the town of Casa Grande westerly 1 mi. in PINAL COUNTY, on Casa Grande Gila Bend Highway. 1-21

**SACRAMENTO, CALIF.**—To Campbell Const. Co., 800 'R' Street, Sacramento, $28,979 to Calif. Div. of Highways, Sacramento, for constructing overhead crossing over S.P. Co. tracks at Redding consisting of one 40-ft. steel girder span; two 30-ft. steel girder spans on concrete piers and approximately 237' timber trestle approaches in SHASTA COUNTY. 1-19

**SAN FRANCISCO, CALIF.**—To E. J. Treacy, Call Building, San Francisco, $4,026 to Dept. of Public Works, San Francisco, for making repairs to Cayuga Ave. Underpass, Mission Viaduct. 1-30

**YUBA CITY, CALIF.**—To M. A. Jenkins, 3560 'Y' Street, Sacramento, $1,744 to the Sutter County Board of Supervisors, Yuba City, Calif., for constructing the Ensley road bridge in the southern end of the County. 1-10

**DENVER, COLO.**—To Ed Selander, Greeley, Colo., $37,566 by State Highway Engineer, Denver, Colo., for const. one concrete I-beam bridge and an overhead railroad crossing located betw. Akron and Yuma on State Highway No. 54 in WASHINGTON AND YUMA COUNTIES, Colo. Proj. USPW Nos. NRS 380-D, Const. Div. No. 1 and NRS 380-E, Const. Div. No. 1. 1-28

**HELENA, MONTANA**—Awards as follows by State Highway Comm., Helena, Mont: (1) PRAIRIE CO. (NRS 302B, Unit 2)—To W. Mackin, Brockway, $7,859 for two tr. timb. pile trestle bridges; one across Brackett Creek and one across Cedar Creek on Sec. B of the Terry-Brockway Road. (2) JUDITH BASIN CO. (NRS 307B-Unit 2) —To W. Mackin, Brockway, $2,589 for const. tr. timb. pile trestle bridge across Meadow Creek and tr. timb. stockpass on Sec. B of Stanford North Road. (3) FERGUS CO. (NRS 309B-Unit 2)—To W. Mackin, Brockway, $4,205 for const. one 5-span 95′ tr. pile trestle bridge across Warm Springs Creek and one tr. timb. stockpass on Sec. B of the Lewistown-Denton Road. 1-28

**HELENA, MONTANA**—Awards as follows by the State Highway Dept., Capitol Bldg., Helena, Mont: (1) STILLWATER CO. (NRH 109A, Unit 5)—To McLaughlin Const. Co., Livingston, Mont., $9,573 for const. 3-span 96′ reinf. concr. bridge over Brown's Cr. on Sec. A of the Witt Hill Road. (2) GARFIELD CO. (NRH 256G, Unit 2)—To Inland Const. Co., 3867 Leavenworth St., Omaha, Nebr., $37,989 for const. 1 162.3′ steel and timb. bridge across Big Dry Creek and 11 tr. timb. pile trestle bridges on Sec. G of the Grass Range-Jordan Road. (3) FLATHEAD CO. (NRH 257-D, Unit 2)—To Colonial Const. Co., W. 326 1st Ave., Spokane, $443,691 for 5 tr. timb. pile trestle I-beam bridges and one concr. and steel bridge across Stillwater River; and one steel and concr. bridge across Flathead River. (4) MADISON CO. (NRS 281B, Unit 2)—To C. C. Goddard, Butte, Mont., $20,490 for 11 single span 19′ and 6 single span 25′ tr. timb. pile trestle bridges on Sec. B of the Twin Bridges N. section of the Vigilante Trail. 1-28

**MISSOULA, MONTANA**—To Colonial Const. Co., W. 326 1st Ave., Spokane, Wn., $19,862 to U. S. Bureau of Public Roads, Missoula, Mont., for const. or improv. a 3-span bridge over the east fork of the Bitterroot-Salmon Highway, FHEC 19-C1, located in the Bitterroot National Forest, RAVALLI COUNTY, Mont. 2-2

**PORTLAND, ORE.**—To McRae Bros., 614 5th Ave., Seattle, Wn., $55,349 to U. S. Engineer Office, Portland, Oregon, for constructing a bridge across the navigation canal of the Bonneville Power and Navigation Project, under Spec. No. 35-351. 1-22

**PORTLAND, ORE.**—Award recommended to Joplin & Eldon, North Columbia Blvd. and Penninsular Way, Portland, Oregon, $54,355 to Bureau of Public Roads, Portland, Ore., for const. a 3-span continuous reinf. concrete bridge over Laughing Water Creek, Mt. Rainier Natl. Park, East Side Highway, Proj. NR-5A, located in the Mt. Rainier Natl. Park, LEWIS COUNTY, Wn. 1-7

**PORTLAND, ORE.**—Contracts awarded as follows by Oregon State Highway Comm., Portland, Ore., for: (1) JOSEPHINE CO. (NRS 244, 1935)—To Tom Lillebo, Reedsport, Ore., $43,442 for const. steel bridge with composite pile trestle approach over Applegate River on Williams Secondary Highway approx. 7½ mi. south from Grants Pass. (2) MORROW CO. (NRS 246, 1935)—To O. N. Pierce, 1300 N. E. Union Ave., Portland, Ore., $13,298, for concrete bridge over Rhea Creek approx. 11 miles south from Heppner on the Wasco-Heppner Secondary Highway and grading and surf. approx. 500 ft. of approaches thereto. (3) MULTNOMAH CO. (NRS 250, 1935)—To Joplin & Eldon, Columbia Blvd. and Peninsula Way, Portland, $46,917, for bridge with composite pile trestle approaches over Columbia Slough on Vancouver Ave. outside of the North City limits of Portland. (4) UNION COUNTY (NRM&H-5, 1935)—To R. F. Nichol, Vale, Ore., $24,015, for constructing a concrete bridge over Grande Ronde River on the Wallowa Lake Highway at Elgin, NRM&H-5, Ore. (5) COOS COUNTY (NRM 41-E)—To Barham Bros., 1010 N. 18th St., Salem, Ore., $24,353, for concr. bridge over S. P. Co.'s tracks on Oregon Coast Highway at North Bend, Ore. 2-2

**CHEYENNE, WYO.**—To Northwestern Const. Co., Seattle, Wn., $48,403, by State Highway Dept., Cheyenne, Wyo., for const. two reinf. concrete culverts and one overhead crossing over the CB&Q RR on 1.662 mi. of the Sheridan-Ranchester Road in SHERIDAN COUNTY, Wyo., Proj. NRH 28A and NRH 179A. 1-28

# WATER SUPPLY SYSTEMS

## WORK CONTEMPLATED

**GROVELAND, CALIF.**—The State Div. of Water Resources has received an application from J. B. De Martini for the Town of Groveland, Calif., for 1 cu. ft. per sec. from 2 springs in Tuolumne County for domestic and fire protection purposes. Application will be assigned to an association to be formed. Work involves: 60,000 lin. ft. 6″ steel pipe. Est. cost $17,000. 2-1

**HAPPY CAMP, CALIF.**—The State Dept. of Water Resources, Sacramento has granted a permit to John Vanhoy, O. Y. Anderson, and Lester Hallford, Happy Camp, Siskiyou County, California, for 3 cu. ft. per second from Oak Flat Creek in Siskiyou County for mining and domestic purposes. Work involves: 31,680 lin. ft. earth, rock and timber ditch to be 3′ wide at top, 2′ wide at bottom and 4′ deep. 350 lin. ft. 15″ riveted steel pipe. Est. cost $10,000. 2-1

**IOWA HILL, CALIF.**—The State Division of Water Resources, Sacramento, has granted a permit to E. F. Wilkie, Iowa Hill, Placer County, Calif., for 3 cu. ft. per second from Brushy Creek, Placer County, for mining purposes. Work involves: 5,000 lin. ft. 14″ steel pipe. Est. cost $4,000. 2-1

**NEWPORT BEACH, CALIF.**—City of Newport Beach will hold a special election on Feb. 26th to vote $120,000 on bonds to finance purchase of either a 93-acre or 34-acre tract, installing a new water system including pumps, equipment, aeration plant, pipe lines and buildings. 1-31

**OCEANSIDE, CALIF.**—The P.W.A. has made a loan and grant of $63,500 to the City of Oceanside, for construction of a swimming pool. Plans and specifications are being prepared by Wm. P. Lodge, California Bank Bldg., San Diego, and Virgil Westbrook, San Clemente. Call for bids will be issued in February. 1-18

**PALO ALTO, CALIF.**—Application has been made to the California Division of Water Resources by Stanford University, Palo Alto, for diversion of water from Bear Gulch Creek. Plans and specifications are being prepared by A. L. Trowbridge, Engineer, Stanford University, and F. C. Hermann, Consulting Engineer, Merchants Exchange Building, San Francisco, for construction of a rolled earth fill dam, to be 100 ft. high, 1300 ft. crest length to create a 1733 million gal. reservoir, located on San Francisquito Creek, 1½ miles below Searsville Lake. Project would include a main pipeline from Reservoir to Junipera Serra Boulevard on the Stanford Campus. Estimated cost of the above work is $400,000. 1-18

SAN LUIS OBISPO, CALIF.—The State Division of Water Resources has received an application from the City of San Luis Obispo, Calif., for 2.32 cu. ft. per sec. from Lopez Creek, San Luis Obispo County, from Nov. 1st to April 1st and 1799 ac. ft. per annum storage for municipal purposes. Work involves: One concrete diversion dam, 55' high, 440' long on top and another concr. dam 70' high and 350' long on top. 117,000 lin. ft. 18" wood stave pipeline. Est. cost is $600,000. 2-1

VENTURA, CALIF.—The State Division of Resources has received an application from the City of Ventura, Calif., for 9800 ac. ft. per annum from Coyote Creek, Ventura County, for municipal purposes. Work involves: Earthfill dam to be 72' high, 790' long on top to be known as Hoffman Dam. Est. cost of dam $532,000. Bonds have not yet been voted. 2-1

WINNEMUCCA, NEV.—The P.W.A. has made a grant of $35,000 to Winnemucca, Nev., to aid in construction of a complete new water works system and a Diesel power plant. Bonds in amount of $306,000 have already been voted by the city. 1-21

TORREY PINES, UTAH—The P.W.A. has made a loan and grant of $17,000 to Torrey Town, Wayne County, Utah, for constructing a supply main from Holt Spring, surface reservoir and a distribution system. Work involves: 15,359 ft. 2", 5,876 ft. 3", and 3,324 ft. 4" cast iron pipe valves, hydrants, etc. 1-21

PAROWAN, UTAH—Bonds in the amount of $88,000 have been voted and call for bids will be issued shortly by the City of Parowan, Utah. for water system improvements, involving: 8,550 ft. 2-in., 12,400 ft. 4-in., 7,350 ft. 6-in., and 4,500 ft. 8-in. cast iron pipe, 12 fire hydrants, 300 water meters, valves, fittings, etc. 1-21

LA CENTER, WN.—An election will be held Feb. 13th by La Center, Wn., to vote bonds for constrction of a dam and intake on Maney Creek, a pipeline 3400 ft. long and a 100,000 gal. reservoir. 3-1

## CALL FOR BIDS

KANAB, UTAH—Bids to 10 a.m., Feb. 19th, by Town Clerk, Town Hall, Kanab, Kane County, Utah, for waterwork improvements, involving: 30,000 ft. 6" cast iron pipe; 3,300 ft. 6" C.I.P. Class 150, 5,230 ft. 4" C.I.P., 4 fire hydrants, valves and fittings. Est. cost, $40,000. 2-2

KOOSHAREM, UTAH—Bids to 10 a.m., Feb. 20, by Town Clerk, Town Hall, Koosharem, Sevier County, Utah, for waterworks improvements, involving: 12,600 ft. 4" and 7,675 ft. 2" cast iron pipe, 2 fire hydrants, valves and fittings. Est. cost, $14,800. 2-2

LEVAN, UTAH—Bids to 10 a.m., Feb. 21st (tentative date) by City Clerk, Levan, Juab County, Utah, for improvements to water works system, involving: 4,400 ft. 8", 3,800 ft. 6", 13,300 ft. 4", 7,150 ft. 3", 6,450 ft. 2" precalked cast iron pipe, 2,600 lin. ft. 6" wrapped 14 ga. steel pipe, 5 fire hydrants, fittings and valves. Est. cost, $35,000. 2-2

MONROE, UTAH—Bids to 3 P.M., Feb. 20th, by City Clerk, City Hall, Monroe, Sevier County, Utah, for waterworks improvements, involving: 4,200 ft. 8", 5,000 ft. 6", 8,750 ft. 4", 18,200 ft. 2" precalked cast iron pipe, 17 fire hydrants, valves and fittings. Est. cost, $41,300. 2-2

## BIDS RECEIVED

LOS ANGELES, CALIF.—D. A. Beck & Sons, Alta Loma, only bid submitted to Metropolitan Water Dist., 306 W. 3rd St., L. A., for drilling water wells at the Cabazon shaft of the San Jacinto tunnel, under Spec. No. 86 in RIVERSIDE COUNTY. Bids received on: Drilling three 24" dia. water wells, $31.15 per ft, total $23,829.75; furn. and inst. 225' 24" double well casing $5.39, total $1,212.75; $2.15 per hour on rental basis. 1-16

OAKLAND, CALIF.—Pacific Bridge Co., Box 87, Presidio Station, San Francisco, $12,697, low to East Bay Municipal Utility District, Latham Square Bldg., Oakland, for installing submarine pipe across Oakland Inner Harbor, under L. S. 136 1-24

SAN FRANCISCO, CALIF.—Transbay Const. Co., Pier 24, San Francisco consisting of MacDonald & Kahn Co., Ltd., Pacific Bridge Co.; General Const. Co.; J. F. Shea Co., and Morrison-Knudsen Co.. Officers: Chas. F. Swigert, Pres.; J. A. McEachren, Vice-Pres.; C. A. Shea, Secty.; Felix Kahn, Treasurer, and H. W. Morrison, Director), $3,219,965, low, to Public Utilities Comm., San Francisco, for enlargement of the O'Shaughnessy Dam by the construction of an addition to the existing dam, for the purpose of increasing the capacity of Hetch Hetchy Reservoir. The addition will raise the crest of the dam by 85.5 ft. from elev. 3726.5 to elev. 3812. Construction of a new spillway, installation of new outlet control valves and spillway gates, clearing of the reservoir area between the present and future high water surface elevations, road and trail construction and other appurtenances and incidental work are included in the required work. The 0' Shaughnessy Dam is located at the west end of the Hetch Hetchy Valley on the Tuolumne River, Tuolumne County, Calif., under H.H.W.S. Contract No. 149. (See Unit Bid Summary) 1-24

TORRANCE, CALIF.—No bids were received by the Municipal Improvement District No. 1 of City of Torrance, for a 250,000 gal. elevated steel water tank, and project will be readvertised at a later date. 1-10

TACOMA, WN.—Puget Sound Mchy. Depot, 322 1st, S., Seattle, Wn., $538,091 (ALL STEEL) low to Board of Contracts & Awards, City Hall, Tacoma, for furn. and installing Green River Gravity Pipeline Replacement. Only bid submitted on CONCRETE AND STEEL, American Concrete Pipe Co., Tacoma, Wn., $646,586.

## CONTRACTS AWARDED

DALY CITY, CALIF.—To Cement Gun Construction Co., 85 2nd Street, San Francisco, $2,748, to City Clerk, Daly City, for guniting floor and walls of water storage reservoir. 1-30

LOS ANGELES, CALIF.—To Peterson Bros., 239 Olive Street, Inglewood, $10,328, to Dist. Engineer, Calif. Div. of Highways, Los Angeles, for 5.9 mi. water pipeline to be installed on Ramona Blvd. and Garvey Ave. between Mission Road in Los Angeles and Atlantic Boulevard in Monterey Park, LOS ANGELES COUNTY, Calif. 1-7

LOS ANGELES, CALIF.—To Morrison-Knudsen Co., Title Guaranty Bldg., Los Angeles, $327,189 (SCHED. 18J-CAST IN PLACE CONCRETE SIPHONS) to Metropolitan Water Dist. of Southern Calif., L. A., for const. the Big Morongo and San Andreas siphons of the Colorado River Aqueduct—1.86 mi. long betw. 7 mi. N. and 5 mi. N.W. of Garnet, Calif., under Spec. No. 84. Est. cost of material to be furnished by District is $343,072. (See Unit Bid Summary.) 1-11

LOS ANGELES, CALIF.—To Roscoe Moss, 4360 Worth St., Los Angeles, by U. S. Indian Irrigation District, Los Angeles, for drilling, developing and testing one water well, 16" in diameter and approximately 75-ft. deep, on the Carlos Indian Reservation, Arizona, F.P. No. 199. 1-17

ROSEVILLE, CALIF.—To Western Pipe & Steel Co., 444 Market St., S. F., $12,700, by City Clerk, Roseville, for const. 1900 lin. ft. 22" pipeline between Rocklin Highw. and City Reservoir and for repairing 30" pipe at reservoir and const. a 16" by-pass 1-17

**REDMOND, ORE.**—Awards as follow by City Recorder, Redmond, Ore., for improvements to waterworks system: (1) To Kern & Kibbe, 42 S. E. Salmon St., Portland, $8915 (Sec. 2) and $21,609 (Sec. 3) for constrction work only. (2) To Hugh G. Purcell Co., Colman Bldg., Seattle, $6798 for cast iron pipe. (3) To Pacific Water Works Supply Co., Inc., Atlantic St. Dock, Seattle, $661 for wood collars, etc. (4) To R. W. Sparling, 945 N. Main St., Los Angeles, $655 for meters. (5) To Rensselaer Valve Co., Sharon Bldg., S. F., $1491 for valves. 1-31

# SEWER CONSTRUCTION

## WORK CONTEMPLATED

**COSTA MESA, CALIF.**—James L. Chase has been appointed Consulting Engineer on formation of Costa Mesa Sanitary District. 1-30

**HERMOSA BEACH, CALIF.**—City Council, Hermosa Beach has adopted a resolution setting forth the intention of the city to start proceedings to finance a municipal water system. 1-18

**LOS ANGELES, CALIF.**—War Department has granted a permit to L. W. Briggs and Jos. A. Beek to install a 6" cast iron sewer line from the southeasterly corner of Harbor Island across the channel in Newport Bay. 1-18

**LOS ANGELES, CALIF.**—War Department has granted permit to Newport Beach to install a 6" cast iron sewer main across the channel easterly to Balboa Island in Newport Bay. 1-18

**SANTA ANA, CALIF.**—Orange County Board of Supervisors, Santa Ana, has approved a $35,000 project for controlling storm waters in the Anaheim and Villa Park districts. The Anaheim project will carry storm waters to a 75-acre spreading ground in the Santa Ana River Basin; the Villa Park project will carry storm waters through Center St. to Santiago Creek. 1-31

**SEATTLE, WASH.**—Plans and specifications have been completed by City Engineer and call for bids will be issued (after plans have been approved by P.W.A. engineer) by Dept. of Public Works, Seattle, Wn., for construction of the Laurelhurst trunk and intercepting sewers. Est. cost, $325,000. 1-29

## CALL FOR BIDS

**LOS ANGELES, CALIF.**—Bids to 10 a.m., Feb. 20th, by City Clerk, City Hall, L. A., for const. a sanitary sewer, 791' long in Durango Ave., near National Blvd., involving: 566 lin. ft. 8" cem. pipe, extra strength, 225 lin. ft. 6" cem. pipe, std. str., 1 'B' manhole; 1 flushing struc., 2 manhole frame and cover sets. 1-29

**PASADENA, CALIF.**—Bids to 11 a.m., February 19th (tentative date) by City Clerk, Pasadena, for construction of a sanitary sewer in Millicent Way between El Nido Street and a point 477 ft. east, involving: 410 lin. ft. 8-in. vit. pipe, 3.5 M. brick, 3 manhole frames and covers, 1 Miller siphon flusher, 45 sacks cement, 900 sq. ft. rock and oil surf., 22 manholes, 2000 lb. GK compound. Est. cost, $1100. 1-30

## CONTRACTS AWARDED

**BRAWLEY, CALIF.**—Koebig & Koebig, Rowan Bldg., Los Angeles, have recommended to City Council, Brawley, that contract be awarded to Marko Matick, 1269 Colorado Blvd., Los Angeles, $71,970 for construction of sedimentation basins, filtration plant and changes in and around the pump house, P.W.A Project No. 5771, Unit B. 1-12

**HALFMOON BAY, CALIF.**—To Oakland Sewer Const. Co., 9915 Walnut St., Oakland, $38,252, by Secretary of Sanitary Board of Halfmoon Bay Sanitary District, for construction of a sanitary sewer system at Halfmoon Bay, Calif. 1-12

**ONTARIO, CALIF.**—Contract awarded (subject to approval of P.W.A.) to H. A. Teget, 133 Princeton Street, Ontario, Calif., $34,770 by City Clerk, Ontario, for completion of a sewage disposal plant. 1-29

**POMONA, CALIF.**—To E. L. Fleming, P. O. Box 717, Glendale, $3,385, by City Clerk, Pomona, for construction of various sanitary and connecting sewers. 1-31

# Irrigation and Reclamation

## WORK CONTEMPLATED

**BUCKEYE, ARIZ.**—The Public Works Administration has made a loan and grant of $756,000 to the Roosevelt Irrigation District, Buckeye, MARICOPA COUNTY, Arizona, for 4,911,000 sq. ft. of gunite lining in existing main canal system. Approximate cost of labor and material is $702,000. 1-21

**YUMA, ARIZ.**—Call for bids will be issued in March by the Bureau of Reclamation, Yuma, Arizona, for continued excavation on the All-American Canal from the site of the Imperial Dam and the desilting work to Laguna and in the area west of the sand hills. Bid call for construction of structures will probably be issued in April and in June bids will probably be asked for construction of the Imperial Dam and desilting works. Estimates are being completed on construction of the All-American Canal conduit through Calexico and will be presented to the Imperial Irrigation District for approval shortly. 1-25

**SUSANVILLE, CALIF.**—The State Division of Water Resources has received an application from C. M. Wickham, 4541 N. E. Sandy Blvd., Portland, Ore., for 13,000 ac. ft. per annum from Mud Springs and 7000 ac. ft. per annum from Deep Cut Creek in Lassen County, Calif., for irrigation purposes. Work involves: Earthfill dam 32' high, 500' long on top at Deep Cut Reservoir; earthfill dam, 25' high, 960' long at Mud Springs Reservoir; two earth ditches, 30,360' and 15,840' long, to be 14.2 ft. wide on top, 5 ft wide on bottom and 2.3 ft. deep. Est. cost, $45,000. 2-2

**CARLSBAD, NEW MEXICO**—Tentative plans are being made by the Carlsbad Irrigation District, Carlsbad, New Mexico, to finance construction of a new reservoir and several miles of canal lining through a P.W.A. loan. Plans and specifications and supervision of construction would be under the U. S. Bureau of Reclamation. The dam is to be located near Fort Sumner on the Pecos River and will be earthfill with tunnel spillways. Est. cost, $2,225,000. 1-25

## CALL FOR BIDS

**GUNNISON, COLORADO**—Bids to 10 a.m., Feb. 18th, by Bureau of Reclamation, Gunnison, Colo., for construction of the Taylor Park Dam, Uncompahgre Proj., located near Gunnison, Colo., under Spec. No. 594. Bids will be received on two different types of construction. Schedule 1—CONCR. ARCH DAM, and/or Schedule 2—EARTH AND ROCK FILL. SCHED. 1—CONCRETE ARCH DAM.

**FAIRFIELD, MONTANA**—Bids to 10 a.m., Feb. 28th, by Bureau of Reclamation, Fairfield, Mont., for const. earthwork and struc. for open drains, Greenfields Div., Sun River Proj. Montana, under Spec. No. 611. Work involves: 660,000 cu. yd. excav. for drains; 1,400 cu. yd. excav. for structures; 19,000 cu. yd. backfill about struc.; 160 cu. yd. concrete in struc.; 12,000 lb. reinf. bars (placing); 1,200 lin. ft. 18″ to 30″ diam. concr. pipe (laying); 5,200 ft. 15 to 30″ C.M.P. (laying). 2-2

### BIDS RECEIVED

**PHOENIX, ARIZ.**—Pleasant-Hassler Const. Co., Phoenix, Ariz., $290,614. UNIT 1; $33,805, UNIT 3; Morrison-Knudsen Co., Los Angeles, $47,285, UNIT 2; R. C. Tanner and W. E. Hall, Phoenix, $31,025, UNIT 4, and Vinson & Pringle, Phoenix, $32,701 (combined total $435,430) lowest combination of bids to Maricopa County Municipal Water Conservation District, 925 Title & Trust Bldg., Phoenix, for Construction of irrigation works from 25 to 30 miles west and northwest of Phoenix. 1-18

**MODESTO, CALIF.**—Ed. Erickson, Rt. 4, Box 744, Modesto, $30,777, low complete bid to Modesto Irrigation District, 823 11th Street, Modesto, for repair of old lining by guniting, construction of two concrete lining and reinf. concrete outlet headwalls in canals and laterals of the Modesto Irrrigation District. 1-30

**ONTARIO, OREGON**—George B. Henly, Nyssa, Oregon, $21,502, low to Bureau of Reclamation, Ontario, Oregon, for construction of earthwork and structures, North Canal, Laterals, Mitchell Butte Division, Owyhee Project, Oregon-Idaho, under Spec. No. 644-D. 1-15

**HYRUM, UTAH**—Knowlton & Rupert, Layton, Utah, $26,997, low to Bureau of Reclamation, Hyrum, Utah, for construction of a pumping plant, structures, and canal lining on the Hyrum-Menden, Hyrum Feeder and Wellsville Canals, Hyrum Project, Utah, under Spec. No. 606. 1-24

### CONTRACTS AWARDED

**ONTARIO, OREGON**—To J. A. Terteling & Sons, 2223 Fairview Avenue, Boise, Idaho, $123,894 to Bureau of Reclamation, Ontario, Ore., for const. earthwork and struc. North Canal, Sta. 2283 to Sta. 3703, Dead Ox Flat Division, Owyhee Proj., Oregon-Idaho, under Spec. No. 600. 1-24

**ONTARIO, OREGON**—To Morrison-Knudsen Co., 319 Broadway, Boise, Idaho, $232,991 by Bureau of Reclamation, Ontario, Ore., for const. earthwork, tunnels and struc., South Canal, Sta. 2 to Sta. 736, Succor Creek Div., Owyhee Proj., Oregon-Idaho, under Spec. No. 607. (See Unit Bid Summary.) 1-23

## RIVER and HARBOR WORK

### WORK CONTEMPLATED

**LONG BEACH, CALIF.**—Board of Harbor Commissioners, Long Beach, has asked City Council, Long Beach, to make available funds to finance the construction of a transit shed on Pier No. 1, Long Beach Harbor. Est. cost, $75,000. 1-31

**SANTA MONICA, CALIF.**—Call for bids will be issued shortly by City Council, Santa Monica, for 18-ft. extension to the Santa Monica Municipal Pier involving work on the lower deck of the pier, construction of a ticket office and waiting room, installation of two dolphins, and 80 50-ft. pilings. Est. cost is $1800. 1-25

### BIDS RECEIVED

**LOS ANGELES, CALIF.**—Bids received as follows by U. S. Engineer Office, 751 S. Figueroa St., Los Angeles, for furnishing for 100 hrs., plant, labor, materials and launch for 40 borings in San Diego Bay (550-acre area): Standard Dredging Co., L. A., $11.00 hr.; E. C. Lipscomb and Ed Barclay, San Diego, $17.50 hr.; Robt. T. Dawson, San Diego, $18.25 hr.; Cannon Bros., Compton, $50.00 ea. 2-2

### CONTRACTS AWARDED

**PORTLAND, ORE.**—To Winston Bros. Co. and Guy F. Atkinson Co., 1015 Porter Building, Portland, Ore., $1,493,535 (only bid submitted) to U. S. Engineers Office, Portland, Oregon, for reconstruction and repair to the outer 4700 lin. ft. link of the Columbia River south jetty. 2-1

**GALVESTON, TEXAS**—To Atlantic, Gulf & Pacific Company, 15 Park Row, N. Y., $6.84 per cu. yd., total $66,279, to U. S. Engineer Office, Galveston, Texas, for 969,000 c. yd. dredging in Brazos Island Harbor, Texas, under Cir. No. 104. 1-15

## FLOOD CONTROL WORK

### WORK CONTEMPLATED

**WINSLOW, ARIZ.**—Secretary of the Interior, Harold L. Ickes, Washington, D. C., has allotted $11,500 for the flood protection at Leupp Indian School near Winslow, Ariz. 1-19

**LOS ANGELES, CALIF.**—C. H. Howell, Albuquerque, New Mexico, has been appointed chief flood control engineer of the L. A. Flood Control District by the County Board of Supervisors, Hall of Records, Los Angeles. Samuel Fisher has been retained as Chief Dam Designer. 1-31

**SANTA ANA, CALIF.**—B. A. Etchverry, San Diego and Berkeley, has been appointed consulting engineer on Orange County flood control projects by Board of Supervisors of Orange County, Court House, Santa Ana. Project includes a dam on the Santa Ana River, etc. 1-31

### BIDS RECEIVED

**LOS ANGELES, CALIF.**—Dimmitt & Taylor, 815 E. 59th St., Los Angeles $5,691.60 to County Bd. of Superv., L. A., low, for pile and wire revetment on San Jose Creek, 2,600 ft. upstream and 2,000 ft. downstream from Mission Mill Road. 1-15

**LOS ANGELES, CALIF.**—E. G. Perham, 1128 Stearns Drive, L. A., $7,140 ($1.05 per lin. ft.), low to County Board of Supervisors, Los Angeles for 6,800 lin. ft. single pile and wire revetment on east and west banks of San Gabriel River, from Beverly Blvd. to 5,700 ft. upstream. 1-15

### CONTRACTS AWARDED

**INDIO, CALIF.**—To Breedlove Contracting Co., Transamerica Bldg., Los Angeles, $.15 per cu. yd. to Board of Trustees, Coachella Valley Storm Water District, Indio, Calif., for flood control levee in Deep Canyon to be 2,100 ft. in length. 1-19

**LOS ANGELES, CALIF.**—To J. L. McClain, 5850 Brynhurst Ave., L. A., $56,045, by Board of Supervisors, Los Angeles, for const. of a debris basin in Brand Canyon, Glendale. 1-8

# TUNNEL CONSTRUCTION

## WORK CONTEMPLATED

**LOS ANGELES, CALIF.**—Metropolitan Water District of Southern Calif., 306 W. 3rd St., Los Angeles, has suspended the contract of Wenzel & Henoch Const. Co., for construction of the 12.7 mile San Jacinto Tunnel on the Colorado River Aqueduct. The project is 17% completed. Approximately 1 of the 8.2 mi. of tunnel betw. the two shafts has been excavated. The contract price was $7,339,100 and the contract was signed March 17, 1933. 1-16

## CONTRACTS AWARDED

**DENVER, COLO.**—Contract awarded (subject to P.W.A. approval) to Utah-Bechtel-Morrison, Inc., 1st Natl. Bank Bldg., Ogden, Utah, $972,-576 by Board of Water Comm., Denver, Colo., for enlarging and lining the Moffatt Tunnel, intake shaft and wye, constructing intake works at West Portal and the outlet works at East Portal, in GILPIN and GRAND COUNTIES, Colorado. (See Unit Bid Summary.) 1-30

# DAM CONSTRUCTION

## WORK CONTEMPLATED

**VENTURA, CALIF.**—A special bond election was held Feb. 5 by the City of Ventura to vote on proposed construction of a storage dam on Coyote Creek at the Hoffman site, just below the junction of Santa Ana Creek, at an estimated cost of construction of $700,000 and $450,000 for reservoir lands. Proposed dam will be earth fill (rolled) type, 87′ high above stream bed, crest length approximately 800′, capacity 9,800 acre feet, top width 25′, slopes upstream two to one, downstream average 3¼ to 1 with 2 additional berms each 8′ wide. Upstream one-third of base will be stripped of bed rock, depth 40 or 45 ft. Concrete cutoff wall to be constructed near the upstream face. . Upstream face to be concrete paved. Outlet works to be concrete overflow (morning glory type). Reservoir will cover about 400 acres. Approximate quantities of principal items are: 200,000 cu. yd. stripping (part to go into embankment), 500,000 cu. yd. additional embankment, 3,000 cu. yd. concr. pav. upstream face, 1,000 cu. yd. concr. cutoff wall, 125 cu. yd. concr. parapet wall. 1-23

## BIDS RECEIVED

**WRANGELL, ALASKA**—A. B. Anderson, Wrangell, Alaska, $19,200, low to the City Clerk, City Hall, Wrangell, Alaska, for constructing a crib dam with dirt fill 26′ high by 200′ long at the top and 120 feet long at the bottom; also clearing of a 5-acre area. 1-10

# POWER DEVELOPMENT

## WORK CONTEMPLATED

**CALEXICO, CALIF.**—The Board of Directors of the Imperial Irrigation District, Calexico, has approved the recommendations of M. J. Dowd, Chief Engineer, to apply to the Public Works Administration for a loan of $12,000,000 to complete construction of the All-American Canal power development and distribution, and also recommendations of William S. Cone, Consulting Electrical Engineer for the Imperial Irrigation District, as follows: Construction of hydro-electric power plant at 5 drops on All-American Canal having a total capacity of 60,000 Kw. (80,000 H.P.) at total cost of $6,620,000. Expansion of diesel electric stand-by plant, now under construction at Brawley to a capacity of 15,000 Kw. (20,000 H.P.) at total cost of $1,500,000. Construction of transmission and distribut. system to completely serve the Imperial and Coachella Valleys and adjoining areas at total cost of $3,667,000. 1-25

**CRESCENT CITY, CALIF.**—Volney C. Finch, Engr., Stanford University, has been sanctioned by the Board of Supervisors to cooperate with Crescent City, Calif., to secure a site on the South Fork of the Smith River for construction of a Municipal power and light plant. 1-22

**EAGLE ROCK, CALIF.**—City Council, City Hall, Los Angeles, has approved erection of $150,000 sub-station for City Water & Power Dept. on Maywood Ave. betw. Yosemite and Fairpark, and plans are expected to start about March 1. 1-22

## BIDS RECEIVED

**LOS ANGELES, CALIF.**—Commercial Electric Co., 616 W. Ninth Street, Los Angeles, $1,920, low to U. S. Indian Irrigation Service, Los Angeles, for 4.4 mi. transmission line (6,900 volt) at San Xavier Indian Reservation, under Bid No. 122. 1-31

## CONTRACTS AWARDED

**SUMMIT, CANAL ZONE**—To C. I. Bottenfield, P. O. Box 237, Balboa, C. Z., $5,262, by Bureau of Yards and Docks, Navy Dept., Washington, D. C., for electric power line at Summit, C. Z. No. 7845. 1-31

# MISCELLANEOUS

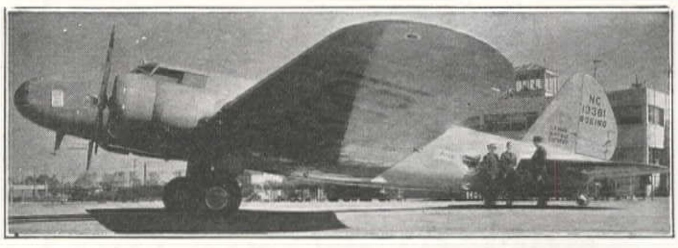
## WORK CONTEMPLATED

**COULEE CITY, WN.**—The Mason-Walsh-Atkinson-Kier Co., Coulee City, Wn., will construct 8 silos of 5,000 bbl. cement capacity to be used in concrete placing operations on the Grand Coulee Dam. Unloading equipment and blending equipment sufficient to handle 400 bbl. per hour will also have to be constructed. 2-1

## BIDS RECEIVED

**LUALUALEI, T. H.**—Industrial Piping and Engineering Co., Baltimore, Md., $19,440, low to Bureau of Yards and Docks, Navy Dept., Washington, D. C., for motor and hand-operated winches for antennas at the Naval Radio Station, Lualualei, Oahu, T. H., under Spec. No. 7801. 1-23





### CONTRACTS AWARDED

**ALAMEDA, CALIF.**—To Meyer Rosenburg, Inc., 255 Bayshore Blvd., San Francisco, $11,440 to Constructing Quartermaster, Benton Field, Alameda, for top soiling and seeding at Benton Field. 1-28

**FARALLON ISLAND, CALIF.**—To Fred J. Early, Jr., 369 Pine St., San Francisco, $3,367 to Public Works Officer, Navy Yard, Mare Island, Calif., for replacing two water tanks and supporting platforms; for providing a new water filter and a new water pump; for enlarging a bathroom in Quarters No. 6; for installing new windows in Quarters No. 3; for replacing all windows in Quarters No. 4, and for replacing or repairing wooden sidewalks, all at the U. S. Naval Direction Finder Station, Farallon Island, Calif., under Spec. No. 7757. 1-28

**FILLMORE, CALIF.**—To Fillmore Concrete Pipe Corp., Fillmore, $1,656, to Union High School District Board of Trustees, Fillmore, for removal of 10,000 cu. yd. earth from high school grounds. 1-11

**OAKLAND, CALIF.**—To Rees Blow Pipe Mfg. Co., 340 7th St., San Francisco, $2,990 to the East Bay Municipal Utility District, Oakland, for one pneumatic alum and lime conveying system complete with blower, receiving hopper, charger, 4 distributors and dust separators, pipe and fittings, FOB 22nd and Adeline Sts., Oakland, for Orinda Filter Plant, under Prop. L.S. 134. 1-24

**SALINAS, CALIF.**—To Southern Prison Co., $2,112, by County Board of Supervisors, Court House, Salinas, for furn. and installing tool resisting steel gratings for 16 windows on the 2nd floor of the Monterey Jail, Alisal and Cayuga St., Salinas. 1-22

**SAN DIEGO, CALIF.**—To V. R. Dennis Construction Co., 3911 5th Ave., San Diego, $5,970 to 11th Naval District, San Diego, for grading for and provision and installation of concrete floor pavements in two hangars, each 140 by 110 ft., with one course Portland cement, under Spec. No. 7866. 1-21

**SAN DIEGO, CALIF.**—To Kohlenberger Engineering Corp., Fullerton, Calif., $1,948, to 11th Naval District, San Diego, for refrigerating plant for storage facilities building at the Naval Operating Base (Supply Depot Annex), San Diego, under Spec. No. 7861. 1-28

**SAN LUIS OBISPO, CALIF.**—To Theo. Maino, 1424 Mill St., San Luis Obispo, $3,595 to Dist. Engineer, Calif. Div. of Highways, San Luis Obispo, for 0.6 mi. remove and dispose of trees in Montecito, SANTA BARBARA COUNTY, Calif. 1-9

**SUMMIT, CANAL ZONE**—To Industrial Piping & Engineering Co., Baltimore, Md., $18,949 to Bureau of Yards and Docks, Navy Dept., Washington, D. C., for motor and hand-operated winches for antennas at Naval Radio Station, Summit, C. Z., under Spec. No. 7800. 2-2

**ELKO, NEVADA**—To Ralph Rockwell, Elko, Nev., $4,320, to Treasury Dept., Procurement Division, Public Works Branch, Washington, D. C., for constructing new concrete retaining walls, wall copings, etc., at the U. S. Postoffice at Elko, Nevada. 1-28

**PORTLAND, ORE.**—To Helser Mach. & Marine Works, Inc., 2401 N.W. 22nd Ave., Portland, Ore., $24,106 to U. S. Engr. Office, Portland, for drydocking, cleaning and painting and making certain repairs and alterations to hull and machinery of U. S. Dredge "Clatsop." 1-7

**HONOLULU, T. H.**—To Ralph E. Woolley, Honolulu, T. H., $4,900 to Treasury Dept., Procurement Division, Public Works Branch, Washington, D. C., for installing sprinkling system at the U. S. Immigration Station, Honolulu, T. H. 2-2

**PORT ANGELES, WN.**—To Aqua Systems, 2443 3rd Ave., New York, $5,730 by U. S. Coast Guard, Washington, D. C., for gasoline fueling system at Port Angeles, Wn. 1-22

## MACHINERY and SUPPLIES

### WORK CONTEMPLATED

**INGLEWOOD, CALIF.**—City Council, City Hall, Inglewood, contemplates purchase of chlorinator and filter to install in swimming pool. SERA has approved completion of pool. This project involves $5,000 for materials and $7,000 for labor. 2-1

**ALMIRA, WN.**—Following is a list of materials, totaling an estimated cost of $25,000,000, which are to be purchased by the Bureau of Reclamation for use in construction of the Grand Coulee Dam, Grand Coulee Project, Washington: 25,000,000 lbs. reinforcing bars, 6,232,000 lbs. hydraulically-oper. gates, 45,000 lbs. control apparatus, 2,522,000 lbs. butterfly valves and mechanism, 1,000,000 lbs. bulkhead gates, 8,710,000 lbs. penstocks, 4,242,000 lbs. trash rack metal work, 1,600,000 lbs. structural steel, 375,000 lbs. miscell. metal work, 52,000 sq. ft. cork board, 20 mi. electric cable, 25 mi. metal sealing strips, 1,200,000 lbs. metal tubing, pipe and valves, 14 000 bbls. cement for bridge, 234,000 lbs. reinf. steel (bridge), 1 150-ton gantry crane, 20-ton gantry, 203,000 lbs. track rails, 1 75-ton crane, 1 10-ton crane. 1-11

### CALL FOR BIDS

**MARE ISLAND, CALIF.**—Bids to 11 a.m., Feb. 27, by Bureau of Yards and Docks, Navy Dept., Washington, D. C., for furnishing two 20-ton locomotive cranes for the Navy Yard, Mare Island, under Spec. No. 7857. Est. cost $55,000. 1-26

**DENVER, COLO.**—Bids to 2 p.m., Feb. 15, by Bureau of Reclamation, Denver, Colo., for furnishing and delivering FOB cars at factory shipping point or at Klamath Falls, Oregon, two motor-driven, vertical-shaft pumping units for use in the Melhase-Ryan sump drainage pumping plant, Klamath Project, Oregon-California, under Spec. No. 660-D. 1-25

**DENVER, COLO.**—Bids to 10 a.m., Feb. 18, by Bureau of Reclamation, Denver, Colo., for furnishing and delivering FOB cars at Almont, Colorado, 125,000 bbls. standard or modified Portland cement or 15,000 bbls. standard Portland cement in cloth sacks for the Taylor Park Dam, Uncompahgre Project, Colorado, under Spec. No. 658-D. 1-23

**DENVER, COLO.**—Bids to 2 p.m., Feb. 18, by Bureau of Reclamation, Denver, Colo., for furn. and deliv. FOB cars at factory shipping point or at Ontario, Oregon, one motor-driven, vertical-shaft, pumping unit of 5½ second-feet capacity, for the North pumping plant; and one motor-driven vertical-shaft pumping unit of 13 second-feet capacity for the South pumping plant for the Advancement District of the Owyhee Project, Oregon-Idaho, under Spec. No. 661-D. 1-25

**DENVER, COLO.**—Bids to 2 p.m., Feb. 20, by Bureau of Reclamation, Denver, Colo., for furnishing and delivering FOB cars factory shipping point or at Boulder City, Nev., one turbine gallery crane with two hydraulic jacking frames of 150 to 60 tons capacity, respectively, two 30-ton trolleys and two lifting beams, for installation in the Boulder Power Plant, Boulder Canyon Project, Arizona-California-Nevada, under Spec. No. 662-D. 1-26

**DENVER, COLO.**—Bids to 2 p.m., Feb. 25, by Bureau of Reclamation, Denver, Colo., for furnishing and delivering, FOB cars at factory shipping point OR at Boulder City, Nevada, the following under Spec. No. 663-D: 1 10" lathe, 1 24" upright drill press, 1 10" pedestal grinder. 1-31

**DENVER, COLO.**—Bids to 2 p.m., Feb. 26, by Bureau of Reclamation, Denver, Colo., for furnishing and delivering FOB cars at the factory shipping point or at Odair, Washington, one 75-ton gantry crane with one 15-ton auxiliary hoist for the storage yard at Grand Coulee Dam, Columbia Basin Project, Washington, under Spec. No. 664-D. 2-2

**RENO, NEVADA**—Bids to 10 a.m., Feb. 20, by the County Commissioners, Reno, Nevada, for: (1) Two 40 Caterpillar Tractors with Diesel or gasoline motors; (2) One 8-wheel tandem drive motor grader with motor control 39 or more H.P. motor, 10 or 12 ft. blade and scarifier; (3) One 1-ton truck, equipped with panel body (transp. 12 to 14 men). 1-25

### CONTRACTS AWARDED

**BERKELEY, CALIF.**—To Austin-Western Road Machinery Co., 435 Brannan St., San Francisco, $4,790 to City Clerk, Berkeley, for furnishing one 3-wheel road roller, weight 16,000 lbs. 1-15

**LOS ANGELES, CALIF.**—To Westinghouse Electric & Mfg. Co., 4250 S. San Pedro St., L. A., $31,715 to Purchasing Agent, Metropolitan Water Dist., L. A., for 25,000 ft. 3 cond. 2/9, 2300-volt armored cable, under Bid No. 31533, FOB Banning, Calif. 1-31

**LOS ANGELES, CALIF.**—To General Electric Co., 5201 Santa Fe Ave., Los Angeles, $13,769.78 to Purch. Agent, Metropolitan Water Dist., L. A., for furnishing 9 only 333 KVA transformers, FOB bidders shipping point for delivery to Banning under Bid No. 31241. 1-31

**LOS ANGELES, CALIF.**—To Morris Engineering Co., $11,520 (estimated total) to Metropolitan Water District, L. A., for furnishing concrete sealing compound (6000 gals.), a coal tar pitch cutback, under Spec. No. M-2035, Bid No. 30599. 1-12

**LOS ANGELES, CALIF.**—To Mueller Co., 2801 E. 12th St., L. A., $11.54, 2% 30 days, to Purch. Agent, Water & Power, L. A., for 15 water pressure regulators, 1", under Spec. 5626. 1-15

**LOS ANGELES, CALIF.**—To Atlas Powder Co., 411 W. 5th St., L. A., $7,567.77 to Purch. Agent, Metropolitan Water District, L. A., for electric exploders FOB Indio, under Bid No. 31498. 1-19

**LOS ANGELES, CALIF.**—To San Fernando Refining Co., San Fernando Road, Newhall, $10,200 to Purch. Agent, Dept. Water & Power, Los Angeles, for furnishing 510,000 gals. road oil to Dept. tanks at Remsen St. and Pendleton Ave., under Spec. No. 1586. 2-1

**LOS ANGELES, CALIF.**—Awards as follow by Purch. Agent, Dept. Water & Power, Los Angeles, fur furnishing cast iron bell and spigot 6-in. water pipe under Spec. No. 1603: (1) To National Cast Iron Pipe Co., 625 S. Western Ave., for 20,00 ft. FOB Hewitt St. Yard at $14,600; (2) To U. S. Pipe & Foundry Co., 417 S. Hill St., Los Angeles, for 30,000 ft. FOB Van Nuys Yard at $22,200. 2-1

**LOS ANGELES, CALIF.**—To Sterling Pump Co., Stockton, $2500 each to Purchasing Agent, Metro. Water Dist., L. A., for 5 vertical centrifugal pumping units, Bid No. 1956. 2-2

**LOS ANGELES, CALIF.**—Awards as follows by Board of Directors of Metropolitan Water District, Los Angeles, for furnishing and fabricating deformed concrete reinforcement bars for orders placed during the month of February, 1935, under Bid No. 31559, Spec. M-2037: To Truscon Steel Co., 5480 E. Slauson Ave., Los Angeles, 2,075 tons of rail steel at $106,476. To Security Materials Co., 916 N. Formosa, Los Angeles, 2,075 tons of rail steel at $106,476. To Soule Steel Corp., 6200 Wilmington Blvd., Los Angeles, 1,510 tons billet steel at $86,-789.90 and 170 tons of the same at $9,913.35. 1-19

**LOS ANGELES, CALIF.**—To Western Pipe & Steel Co., 5717 Santa Fe, L. A., $32,250 to Purch. Agent, Metro. Water Dist., Los Angeles, for furnishing 25,000 ft. 30-in. welded, 10 gauge, slip-joint water pipe in 24 sections under Bid No. 31615. 1-19

**MANHATTAN BEACH, CALIF.**—To U. S. Pipe & Foundry Co., 417 S. Hill St., Los Angeles, $.99 ft. to City Clerk, Manhattan Beach, for furnishing FOB trenchside 3,300 ft. 8-in. class 150, bell and spigot cast iron water pipe. 1-19

**OAKLAND, CALIF.**—To U. S. Pipe & Foundry Co., Monadnock Bldg., San Francisco, $12,340 (net) by East Bay Municipal Utility District, Oakland, for furnishing cast iron pipe under L. S. 135. 1-22

**PASADENA, CALIF.**—To U. S. Pipe & Foundry Co., 417 S. Hill St., Los Angeles, $.65 ft. for 24,000 ft. 6" water pipe and $1.85 ft. for 8,000 ft. 12" same to City Clerk, Pasadena, for furnishing cast iron pipe. 1-30

**PASADENA, CALIF.**—Awards as follow by City Clerk, Pasadena, for furnishing 3 conductor sector stranded cable. (1) To General Cable Corp., 3600 Mines Ave., L. A., $14,695 for 5,626 ft. on 19 68" reels of cable. (2) To General Electric Supply Corp., 385 E. 2nd St., L. A., who bid $12,179 for 4,623 ft. on 17 68" reels of cable. 1-30

**SACRAMENTO, CALIF.**—To Smith-Booth-Usher Co., 2001 Santa Fe Ave., Los Angeles, $2,432 by State Purchasing Agent, Sacramento, for 2 leaning wheel graders with 8-ft. blades, FOR SAN LUIS OBISPO, Calif. 1-30

**DENVER, COLO.**—Awards as follow by the Bureau of Reclamation, Denver, Colo., for furn. cylinder gate hoists and bulkhead gates for intake towers at Boulder Dam, Boulder Canyon Project, Ariz.-Calif.-Nev. Spec. 604: (1) To Consolidated Steel Corp., Ltd., 6500 E. Slauson Ave., L. A., $205,500 for cylinder gate hoists. (2) Bethlehem Steel Co., Bethlehem, Pa., $17,500 for bulkhead gates. 1-11

**DENVER, COLO.**—Awards as follow by Bureau of Reclamation, Denver, Colo., for switching equipment, oil circuit breakers, etc., under Spec. No. 589: SCH. NO. 1—To Delta Star Elec. Co., Chicago, who bid $108,430 for 2300 V. switching equipment. SCH. NO. 2—To Westinghouse Elec. & Mfg. Co., East Pittsburgh, who bid $421,452 for 287.5 K.V. oil breakers. SCH. NO. 3—To General Electric Co., Schenectady, N. Y., who bid $37,120 for 287.5 K.V. lightning arresters. SCH. NO. 4—To Bowie Switch Co., 19th and Tennessee Sts., S. F., $106,000 for 287.5 K.V. disc switches. SCH. NO. 5—To I.T.E. Circuit Breaker Co., Philadelphia, who bid $264,603 for 23 K.V. bus structures. SCH. NO. 6—To Westinghouse Elec. & Mfg. Co., East Pittsburgh, who bid $21,070 for 15 K.V.O.C.B. and reactor. 1-15

**DENVER, COLO.**—To Northern Pump Co., Minneapolis, $3,365 by Bureau of Reclamation, Denver, Colo., for high pressure rotary pumping unit under Prop. 23338-A. 1-24

**DENVER, COLO.**—Awards as follow by Bureau of Reclamation, Denver, Colo., for furn. transformers, FOB cars at factory shipping point or at Boulder City, Nev., under Spec. No. 592. (1) To Moloney Elec. Co., St. Louis, Mo., $23,916 under Sched. 2 and $6,396 under Sch. 3, FOB St. Louis, Mo. (2) To Westinghouse Elec. & Mfg. Co., $9,740 under Sch. 1, FOB Sharon or Emeryville.

# THE BUYERS' GUIDE

Refer to advertisements for address of companies listed. Advertisers index on Page 66

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(Continued on Page 62)

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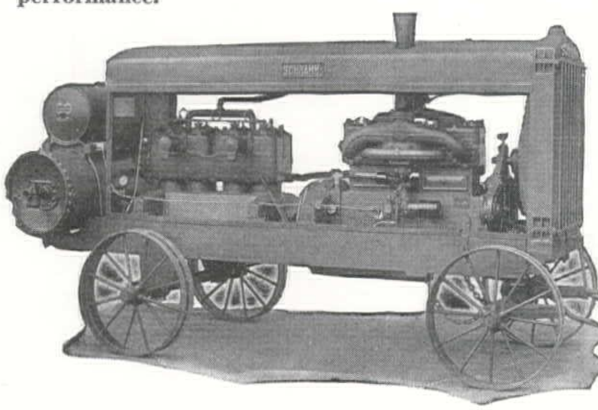

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1—Vulcan No. 2 Pile Hammer $ 250
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1—McKiernan Terry Pile Hammer No. 10, with Extra Parts $ 750
1—10 Ton Insley Steel Guy Derrick, 105 ft. Mast, with 2-Drum Hoist and 37 H.P. Motor $2000
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## OFFICIAL BIDS

UNITED STATES DEPARTMENT OF AGRICULTURE
**Bureau of Public Roads**
**Constructing Gunite Lining in Wawona Tunnel**

San Francisco, Calif., Feb. 5, 1935.

Sealed Bids will be received at the office of the Bureau of Public Roads, 807 Sheldon Building, 461 Market Street, San Francisco, California, until 2:00 o'clock p.m. on February 21, 1935, for constructing a gunite lining in the unlined portions of the Wawona Tunnel, Section A5 of Route 2, the Wawona Road, Yosemite National Park, Mariposa County, California. The principal item of work is approximately 550 cubic yards of gunite. The minimum wage paid skilled labor employed on this project shall be in accordance with the classified labor rates attached to the specifications of which the minimum is 68 cents per hour. The minimum wage paid unskilled labor shall be 60 cents per hour. The attention of bidders is especially directed to the provisions covering the **compliance with codes of fair competition**; the **subletting** and **assignment** of the contract; and to the **alternate** bids which must be submitted in case the bidder desires to offer any **foreign** articles, materials or supplies. Where copies of plans and specifications are requested a deposit of $10 will be required to insure their return. If these are not returned within 15 days after opening of bids the deposit will be forfeited to the Government. Checks should be certified and made payable to the Regional Fiscal Agent, U. S. Forest Service. Plans, specifications and proposals may be obtained at the office of the Bureau of Public Roads, 807 Sheldon Building, 461 Market Street, San Francisco, California.

C. H. SWEETSER,
District Engineer.

### NOTICE TO CONTRACTORS

Sealed proposals will be received at the office of the East Bay Municipal Utility District, Oakland, California, until 8:00 p.m., Wednesday, February 27, 1935, and will at that hour be opened for furnishing and installing an automatic fire sprinkler system complete, in the Sixteenth Street Office Building of the District.

The general prevailing rate of per diem wages in the locality in which the work is to be performed, for laborers and each craft or type of workman and mechanic needed to execute the contract, and the general prevailing rate for legal holiday and overtime work specifically set forth in the plans and specifications on file with the Secretary of the District, are referred to and incorporated herein.

Specifications (No. LS 139) may be obtained upon application at Room 1204 of the Latham Square Building, 508 Sixteenth Street, Oakland, California.

JOHN H. KIMBALL, Secretary.

Oakland, California.
February 5, 1935.



# PROFESSIONAL DIRECTORY

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