WCN-05-1936

WESTERN CONSTRUCTION NEWS

WITH WHICH IS CONSOLIDATED
WESTERN HIGHWAYS BUILDER

PUBLISHED MONTHLY
VOLUME XI, No. 5

MAY, 1936

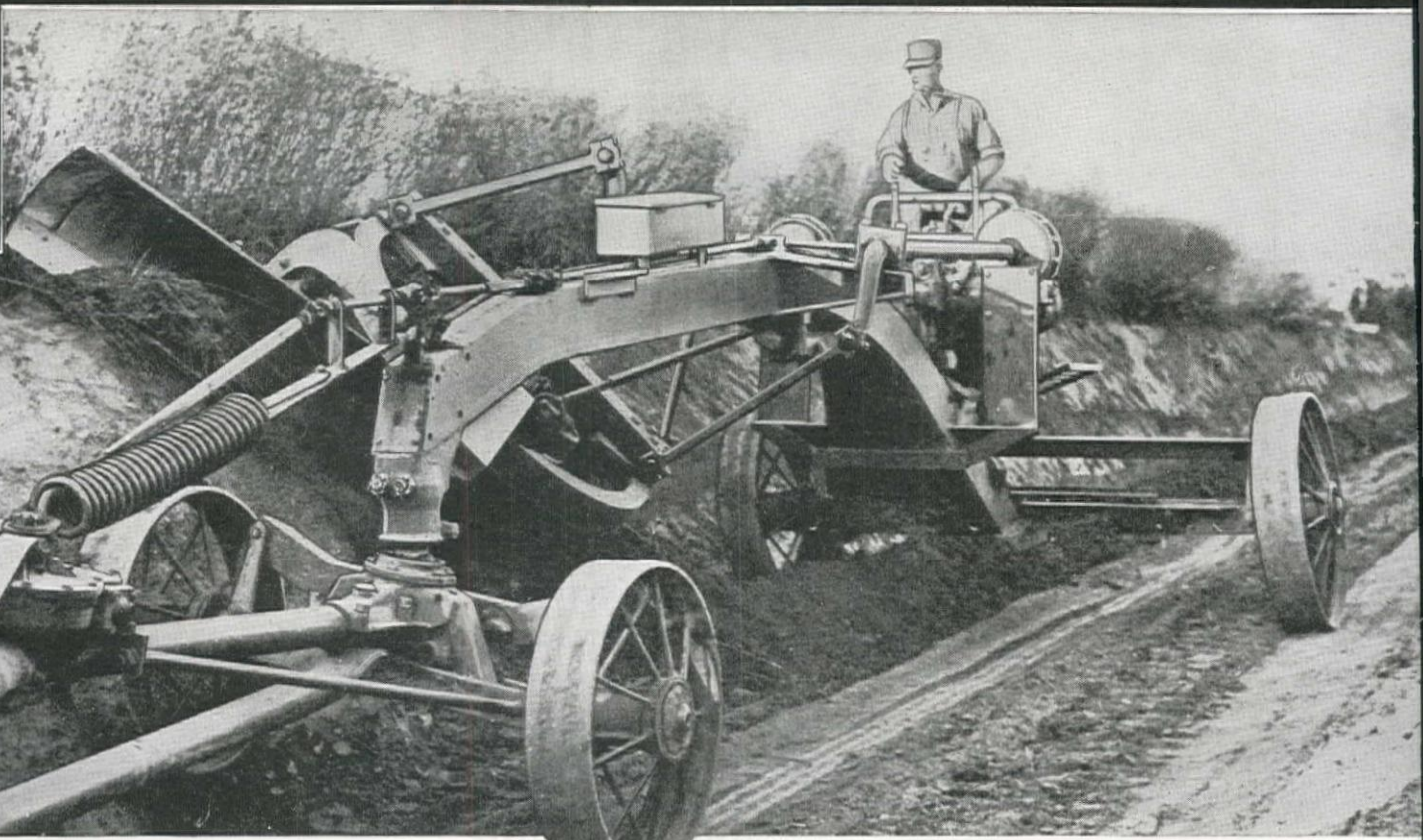
25 CENTS A COPY
$2.00 PER YEAR

IN THIS ISSUE

Riggers working on the cableway system which will handle materials for the 80-ft. raise on the O'Shaughnessy concrete dam on the Hetch Hetchy water supply system of San Francisco.

"You Can't Beat 'em"

...SAY HUNDREDS OF USERS



"THIS grader is far beyond any other," County Engineer, Ohio . . . "Handles nicely and is fast. Can do 30% more work," Contractor, Minn. . . . "Have operated graders 27 years—this is the best ever," Township Commissioner, Ill. . . . "Stronger built and has more action than any grader we have ever used," County Judge, Ark. . . . "Like the narrow frame giving better view of work and the wide range of blade adjustments and reach outside of wheels. Speed of adjustment saves a lot in a day's work," Superintendent Equipment, Mich. . . . "Has many advantages over other machines," County Surveyor, Calif. "Think it the finest machine that can be had—it is perfect," County Commissioner, Texas.

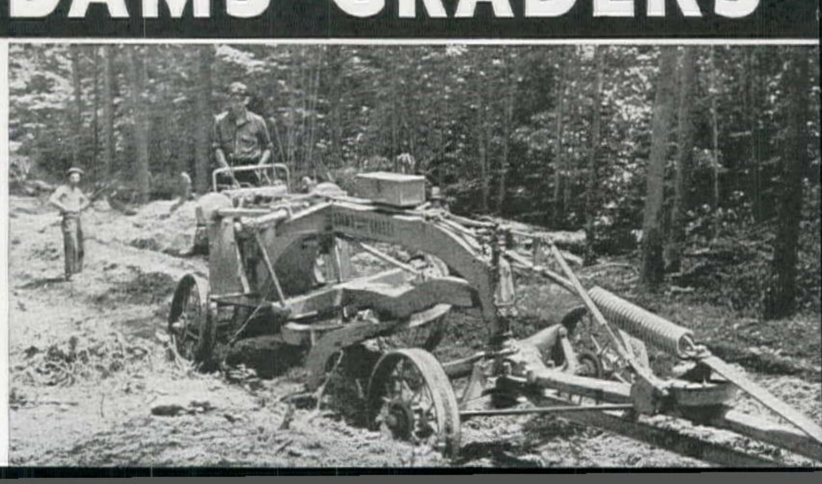
Such are the praises voiced everywhere by owners of the new-type Adams Leaning Wheel Graders. Their strength, simplicity, ease of handling and wider range of usefulness appeal at once to all practical road men. Because they do work that other graders cannot do and because they save a lot of time, do better work and increase production on any job, you will profit by putting these modern machines on your "payroll". . . Available in 12-ft. and 10-ft. sizes, with or without scarifier and with hand or power-operated controls. Write for complete descriptive catalog today.

J. D. ADAMS COMPANY

SAN FRANCISCO—LOS ANGELES—BILLINGS

Western Distributors: HOWARD-COOPER CORP., Portland, Seattle, Spokane, Twin Falls; LUND MACHINERY CO., Salt Lake City; NEIL B. McGINNIS CO., Phoenix, Ariz.; McKELVY MACHINERY CO., Denver; McCHESNEY-RAND EQUIPMENT CO., Santa Fe, N. M.

—the New-Type ADAMS GRADERS



Ten Years Ago

Items from the fifth month's issue of "Western Construction News," May, 1926.

The City of Glendale, Calif., completed its first sanitary sewer system, 18 mi. of intercepting mains being constructed together with 10 mi. of main outfall sewer to connect with the Los Angeles system, the outfall being used jointly by the two cities.

•

Rapid progress was being made on the construction of Carquinez Bridge across Carquinez Strait, San Francisco Bay. Progress was also noted on the estuary subway between Oakland and Alameda.

•

The Moffat tunnels, one a 16x24-ft. bore for a railroad line and the other an 8x8-ft. water bore, piercing the Continental Divide 50 mi. west of Denver, Colo., were reported as 75% complete.

•

Two large concrete dams in California were nearing completion. The Melones dam was being built across the Stanislaus River by the Oakdale and South San Joaquin Irrigation Districts, while the Exchequer dam of the Merced Irrigation District on the Merced River was rapidly taking final form.

•

Construction of a 220-kv. transmission line by the P. G. & E. included crossings of the San Joaquin and Sacramento rivers in California that involved record size transmission towers. One tower, 459 ft. high, was the highest transmission tower in the world at the time.

•

In erecting the four stages for First National Pictures, Inc., studios at Burbank, Calif., new records were set in the West when 56 wooden, bowstring trusses 137 ft. long and weighing 6 tons each were placed in position to support the roofs.

•

On May 17, 1926, the Douglas Memorial Bridge across the Klamath River, Calif., was dedicated. At the time of its dedication it was the largest bridge on the California State Highway system.

SUBSCRIPTION RATES

The annual subscription rate is $2 in the United States and foreign countries where extra postage is not required. To Canada and to foreign countries where extra postage is necessary the annual rate is $3. Single copies 25 cents.

WESTERN CONSTRUCTION NEWS

WITH WHICH IS CONSOLIDATED WESTERN HIGHWAYS BUILDER

J. I. BALLARD, Editor

Contents for May, 1936

ABC

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Chicago Office: 6100 N. Winthrop Ave., Stephen H. Babcock, Manager.
New York Office: 509 Fifth Avenue . . . . . Ralph H. Flynn, Manager

Please address correspondence to the executive offices, 114 Sansome Street, San Francisco

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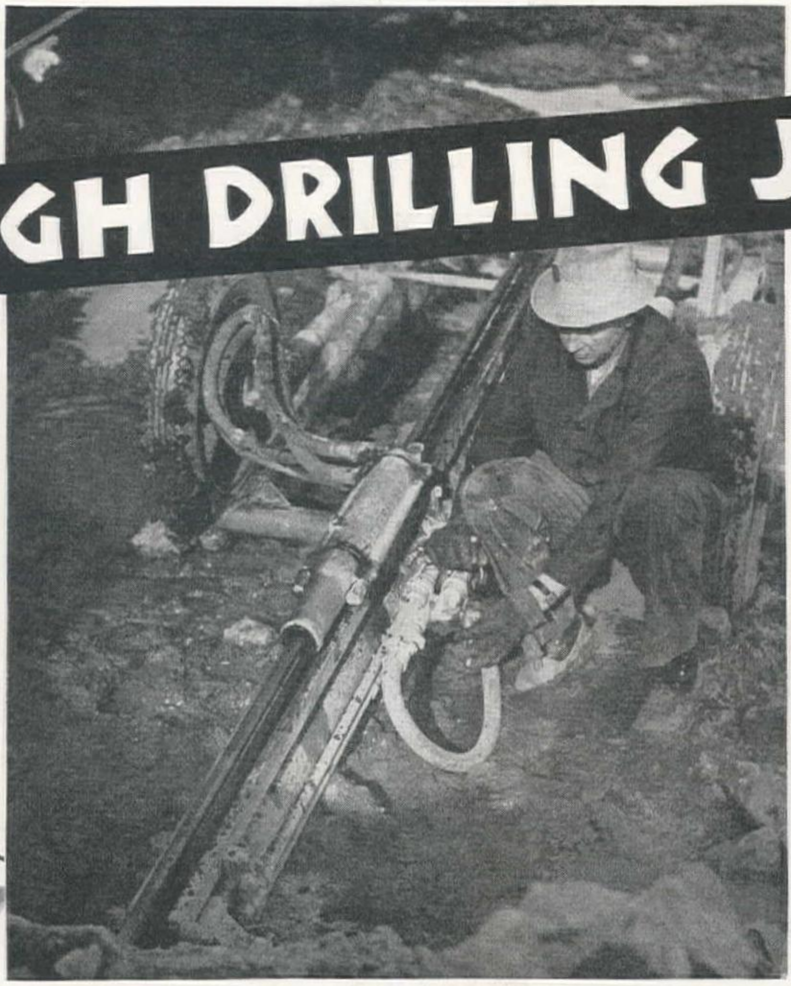
TOUGH DRILLING JOBS



In Position for Down Hole Drilling.

With Wheels Swivelled for Line Drilling.

★ THE special forte of The Cleveland DR6 Universal Drill Rig is the extra tough job, where there is a considerable depth of overburden—variable rock, soft or medium, with hard strata—or "ravelly" ground where strong rotation and blowing power are needed to get the bits out of the hole.

The Cleveland DR6 will drill holes in any direction, and at any position. While a large percentage of all wagon drilled holes are put in straight down, the DR6 is readily adaptable to drilling low, flat holes, as in the picture, which shows the rig being operated on the San Francisco Air Port Extension Project. Note the use of pneumatic tires. They facilitate moving the rig over uneven ground, and are a surprising help in keeping the bit free when drilling.

You will want to see what a Cleveland DR6 will do on your own drilling job. Our salesmen and distributors will coöperate in every possible way. Let us send Bulletin 111 which is fully illustrated with photos and drawings.

Western Branches

2001 Santa Fe Ave., Los Angeles
1417 Texas St., El Paso
41 East Broadway, Butte
501 Dooly Bldg., Salt Lake City

Western Distributors

Smith Booth Usher Company
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Arizona Tractor & Equipment Co.
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THE CLEVELAND ROCK DRILL COMPANY

3734 East 78th Street Cleveland, Ohio, U. S. A.

Cable Address: "ROCKDRILL"

LEADERS IN DRILLING EQUIPMENT

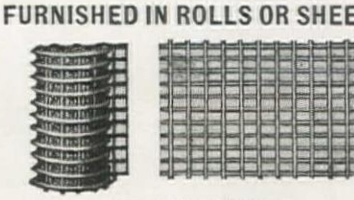
There'll be Few Detour Signs on this Highway

COMMISSIONERS, engineers and contractors know from bitter experience the high cost of maintaining detours—plus unfavorable public reaction.

American Steel and Wire Company Wire Fabric helps prevent costly traffic interruptions. For this permanent backbone of steel gives unity and rigidity—preserves the surface and reduces the tendency to crack—ties the road slab together in every direction—binds concrete into an integral mass—decreases progressive breakage—increases the useful life of highways.

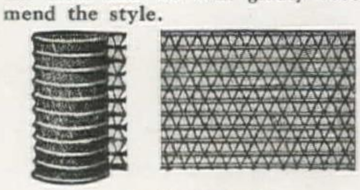
Made of cold drawn steel, closely spaced, American Steel and Wire Company Wire Fabric assures correct distribution of the reinforcement just as the engineer intended in his specifications. And, equally important, by choosing Wire Fabric made by the American Steel and Wire Company you can be sure there will be no "hitch" in getting materials—no risk of product imperfection—no profit taking delays in fulfilling the contract.

FURNISHED IN ROLLS OR SHEETS



ELECTRIC WELD

There is a right type of wire fabric reinforcement for each job — right in quality and in spacing. You can have it either in rolls or sheets. Give us the facts and we will gladly recommend the style.



TRIANGLE MESH

AMERICAN STEEL & WIRE COMPANY

208 South La Salle Street, Chicago
Columbia Steel Company, San Francisco, *Pacific Coast Distributors*

Empire State Building, New York
United States Steel Products Company, New York, *Export Distributors*

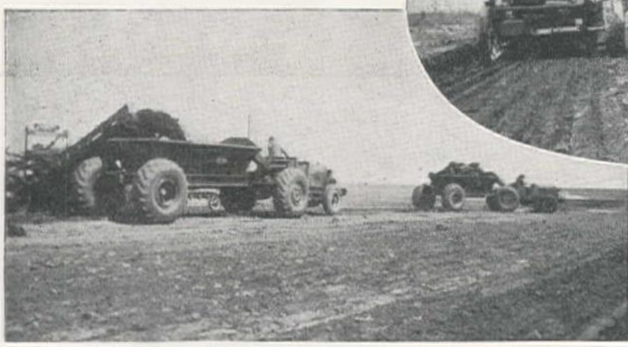
UNITED STATES STEEL

TRAC-TRUK TRIO

STAGE A STARTLING "Speed Record" ON KANSAS ROAD-WORK

Easy to Load with Grader or Shovel

Positive Traction



Greater Speed

Large Peak Loads

Fast "No Stop" Dumping

In the Far West, Mid-West—Extreme East and in between—Trac-Truks are sweeping ahead with their fast, dependable, low cost service. Here, on the Kansas road work shown—this Fleet of Three—are pouring dirt onto the fill in an almost constant stream with practically "load a minute" performance over a 600 foot haul. The usual reaction in witnessing Trac-Truk operation is expressed by the superintendent's voluntary response repeated in his own words: "A salesman can't do them justice, but to see them working proves their claims beyond any doubt".

EUCLID THE PIONEER

THE EUCLID ROAD MACHINERY CO.
CLEVELAND, OHIO U. S. A.

With
W. E. CALLAHAN
CONSTRUCTION CO.
and GUNTHER and SHIRLEY
DALLAS, TEXAS
ON THE CASPER-ALCOVA PROJECT
follow the trend
Low-cost-per-yard operation, rugged design, and sturdy construction has won for LIMA first place in the minds of contractors who demand big volume day in and day out. Contractors everywhere are turning to LIMA because of these advantages. For example, W. E. Callahan Construction Co., and Gunther & Shirley, Dallas, Texas, chose a LIMA for their excavating contract on the Casper-Alcova project in Wyoming. The job is a tough one, but their choice of a LIMA to handle the rock cuts assures them of steady production as long as the job lasts.
LIMA LOCOMOTIVE WORKS
INCORPORATED
Shovel and Crane Division
LIMA, OHIO, U.S.A
SEATTLE—H. J. Armstrong Co., 2244 First So. SPOKANE—General Machinery Co., Block Riverside. PORTLAND—Western Steel & Equipment Corp., 734 N. E. 55th. SA CISCO—A. L. Young Machinery Co., 26-28 Fremont. SALT LAKE CITY—C. H. Jones W. S. Temple St. LOS ANGELES—Smith-Booth-Usher Co., 2001 Santa Fe Ave
LIMA
SHOVELS — DRAGLINES — CRANES — CLAMSHELLS

GETS MORE DONE

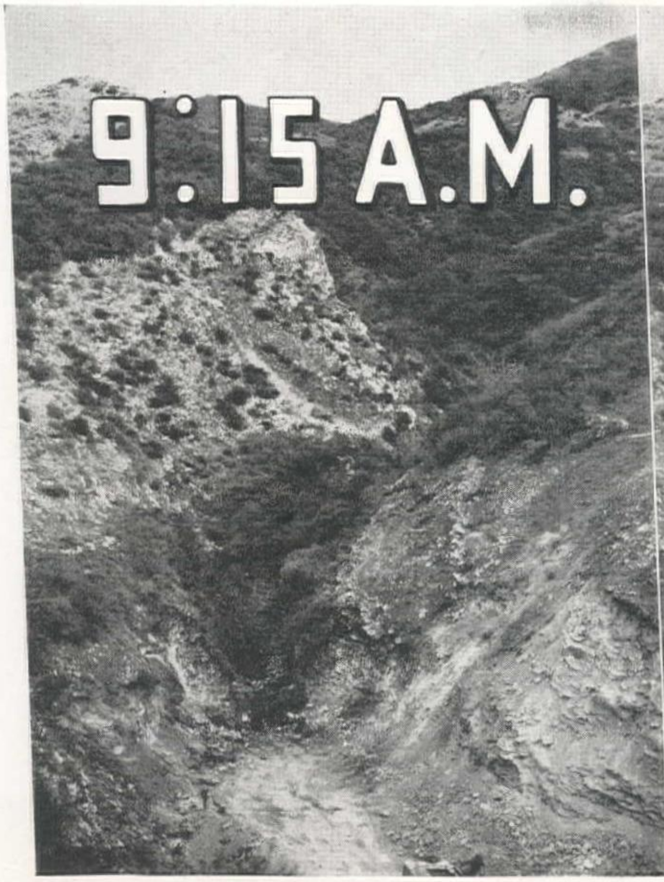
● Now you can shake off the limitations of worm-paced power! Here are tractors geared and gaited to the modern tempo for oil mixing, shoulder shaping, cleaning ditches and *all* other maintenance jobs. Unbroken speed range from less than 2 up to 13 miles an hour . . . flat-torque engine and flexible governing . . . speed that romps through a job at full capacity of the machine it pulls . . . speed that scampers to the next job, be it in the next block or the other end of the county . . . speed in steering, hitching, fueling . . . speed that makes the most of your machinery, your man-power, your budget.

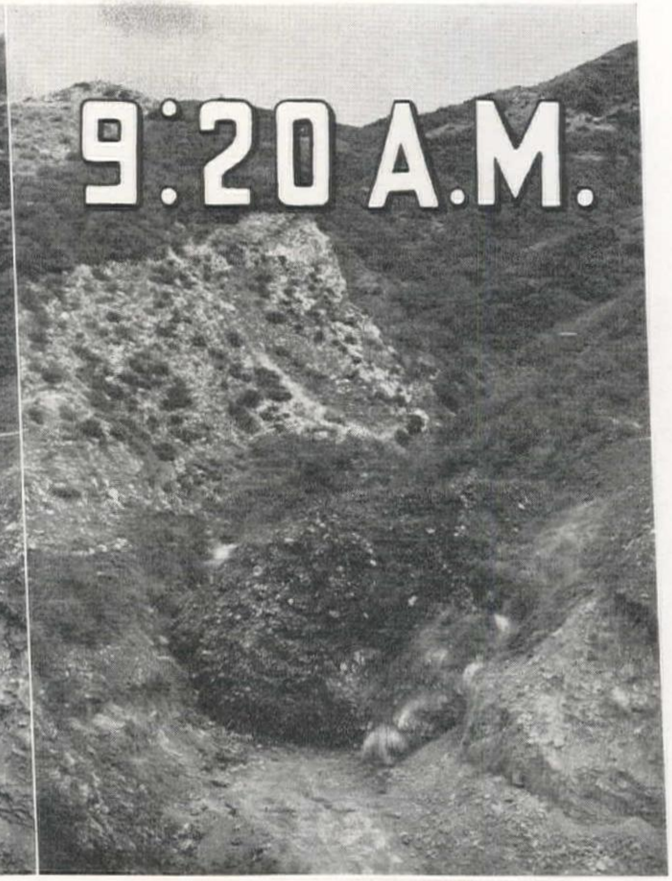
Get better acquainted with this better power for better roadways . . . better dust exclusion for longer life and lower costs . . . choice of sizes, gears, and fuels to fit *your* conditions . . . backed by a world-wide service system of dealers, distributors and factory branches. Write today for reason-why book showing mechanical design; torque, speed and fuel economy curves; specifications and options. J. I. Case Company.

CASE

J. I. CASE COMPANY, Oakland, Los Angeles, Salt Lake City, Portland, Spokane, Billings.

When writing to J. I. CASE COMPANY, *please mention Western Construction News*





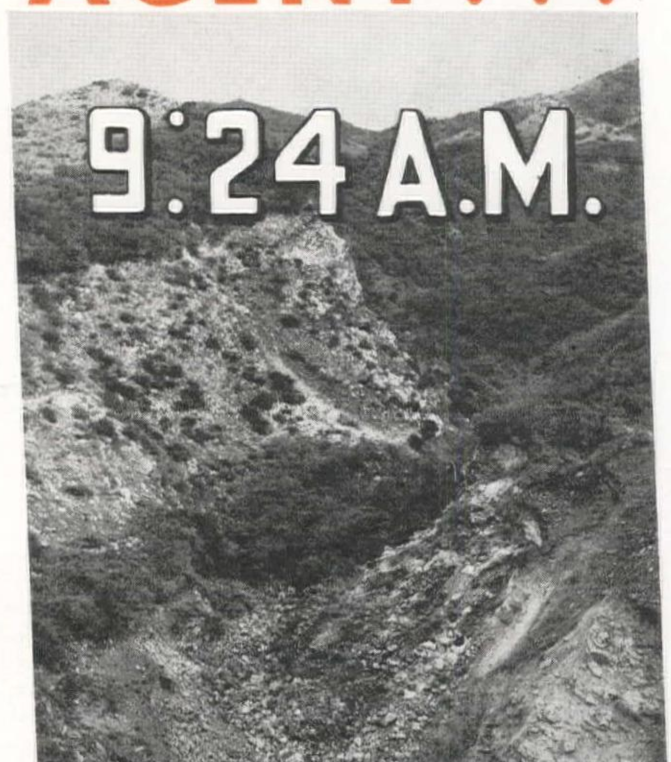
BLASTING AGENT . . .

A 9 MINUTE DEMONSTRATION BY HALAFAX EXPLOSIVES

These are pictures of a "run-of-the-mill" blast, using Halafax free flow powder. There's nothing particularly unusual or unique about them at all. Everything that the explosives engineers expected in yardage moved, the time, manner and low cost of moving it, was eminently satisfactory.

If you were actually present on this job and witnessed this or any other one of these blasts, you too would have placed your approval on Halafax because of its consistently good results. Halafax results are intimately connected to Halafax performance and Halafax economy.

This 9 minute picture demonstration doesn't reveal Halafax economy—but does portray the efficiency and dispatch with which Halafax performs. We invite you to inquire further about Halafax Explosives.



HALAFAX EXPLOSIVES COMPANY

Plant and Magazine: Saugus, California

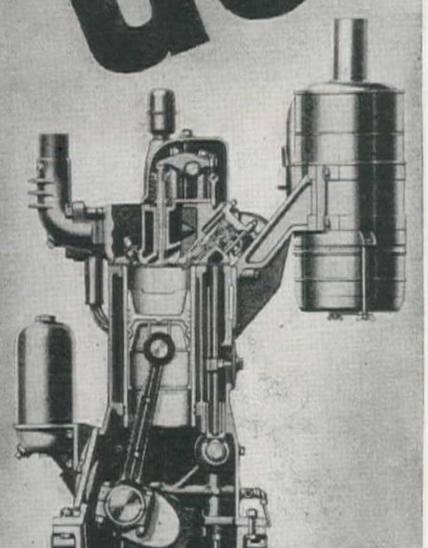
HALAFAX EXPLOSIVES

116 New Montgomery St.
SAN FRANCISCO
Phone GArfield 4795

810 South Spring Street
LOS ANGELES
Phone TRinity 8528

HALAFAX FREE FLOW

When writing to HALAFAX EXPLOSIVES COMPANY, *please mention Western Construction News*



ONLY ALLIS-CHALMERS GIVE

CONTROLLED IGNITION

In the Controlled Ignition Oil Tractor, Diesel fuel oil is injected into the combustion chamber at 60° before top dead center—which provides ample time for thorough mixing with the air. At exactly the proper point, this mixture is ignited with a spark. Because the *ignition point is controlled*—there is no danger or chance of power-wasting pre-ignition. This improved system is *not* dependent on split-hair adjustments; the vibration problem is eliminated; heavy, unbalanced parts are unnecessary; power and weight are *balanced* for maximum performance. Only the *Controlled Ignition* Oil Tractor has these advantages.

CONTROLLED *Instant* STARTING

Regardless of weather, the Controlled Ignition Oil Engine starts easily and instantly. There is no need for complicated, expensive starting devices. Two or three upward pulls of the crank—or a push on the starter—and away she goes. Time saved in starting is time for useful work. Only Allis-Chalmers gives you this advantage.

ALLIS-CHALMERS *Controlled Ignition* **OIL TRACTORS**

TRACTOR DIVISION—MILWAUKEE, U. S. A.

YOU THESE IMPORTANT ADVANTAGES

CONTROLLED INJECTION OF FUEL


CONTROLLED FUEL INJECTION


PROPER MIXING BEFORE IGNITION


SPARK IGNITION—COMPLETE, INSTANT COMBUSTION

An accurate charge of fuel is sprayed (not squirted) into the combustion chamber — regardless of load or throttle setting. Simplest fuel pump built — serviced without special tools; separate, individual unit for each cylinder. New type injector permits accurate measuring at idle speed. Nozzle valve protected from heat of combustion chamber.

CONTROLLED AIR-FUEL RATIO

Just the right amount of air for efficient combustion of fuel at *all* loads and *all* speeds. Correct air-fuel ratio *eliminates* an excess of air at idle speed — which would lower exhaust temperatures *at the expense of power.*

Now you can have fuel economy without the handicaps of high compression ignition. Now you can burn low cost Diesel fuel oil and—*in the same tractor*—you can enjoy the advantages of simple, instant starting... easy, inexpensive servicing... unexcelled lugging ability... freedom from vibration "whip"... without heavy, expensive parts and hair-line adjustments. All this at low first cost and unequalled economy of operation. Only the A-C CONTROLLED IGNITION OIL TRACTOR gives you this combination of vital advantages.

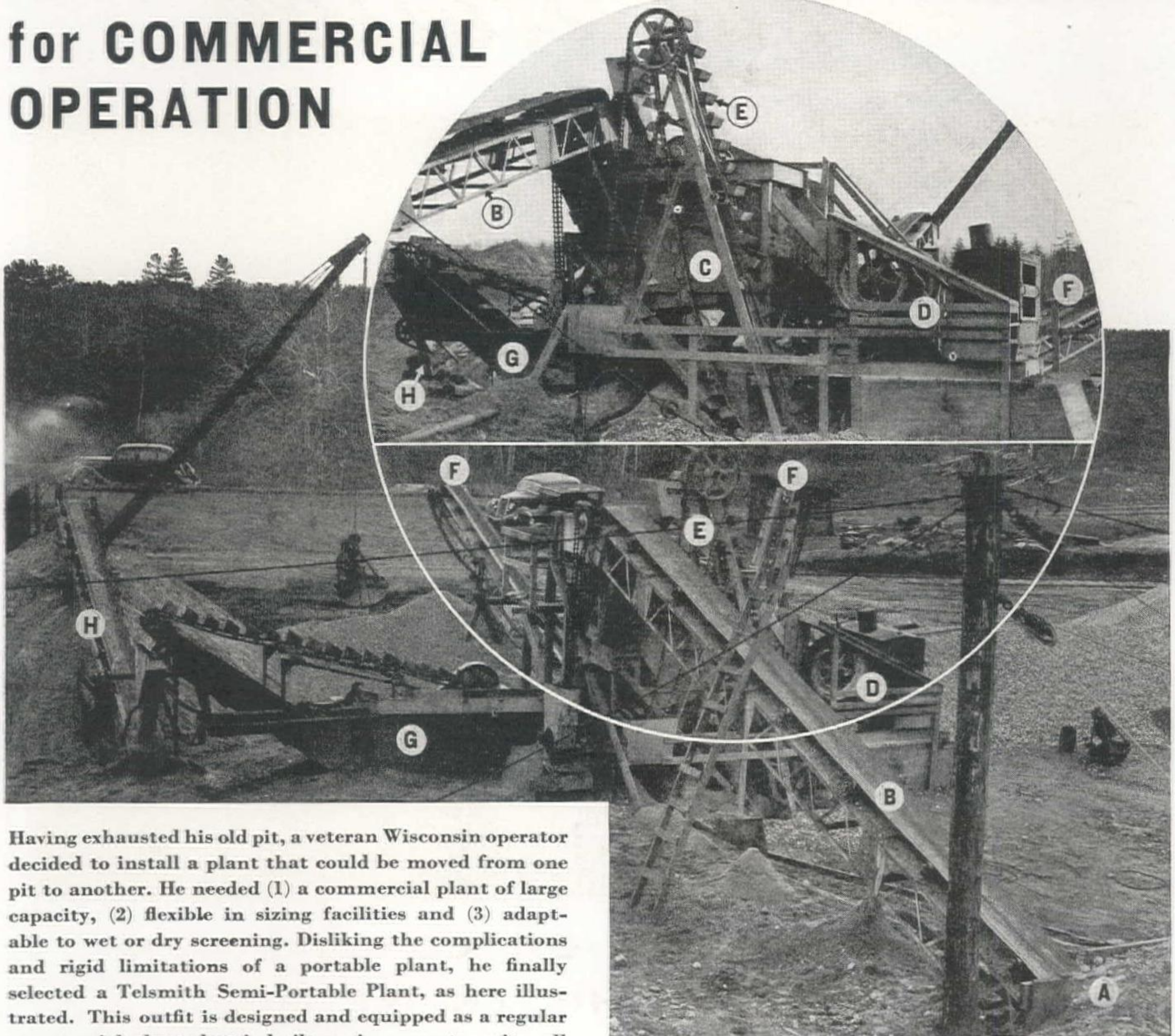
WHAT PERCENTAGE OF YOUR DOLLAR GOES FOR LAY-UP LOSSES?

The larger and more expensive your tractor — the greater your loss per hour when the tractor is down for repairs. Allis-Chalmers tractors reduce lay-up losses in two ways: (1) Lower investment per tractor (2) Controlled Ignition assures dependable performance.

FACTORY BRANCHES: 2533 Peralta St., Oakland, Calif.; 1305 S. E. Union Ave., Portland, Ore.; 602 First Ave., Pocatello, Ida.; 25th and Fourth Ave., Billings, Mont.

A SEMI-PORTABLE GRAVEL PLANT

for COMMERCIAL OPERATION



Having exhausted his old pit, a veteran Wisconsin operator decided to install a plant that could be moved from one pit to another. He needed (1) a commercial plant of large capacity, (2) flexible in sizing facilities and (3) adaptable to wet or dry screening. Disliking the complications and rigid limitations of a portable plant, he finally selected a Telsmith Semi-Portable Plant, as here illustrated. This outfit is designed and equipped as a regular commercial plant; but is built up in separate units, all readily movable by truck. No unit weighs over 7 tons. It can be operated as a dry screening plant during cold weather—handles big tonnages—makes three sizes—produces aggregate passing state highway specifications.

Telsmith builds rock crushing and gravel washing plants of all sizes—portable, semi-portable and stationary—varied to suit local conditions. The plant here described is but one example of Telsmith engineering, service and equipment. If interested in semi-portable plants for quarry or gravel plant use, send for Bulletin SG-30, covering semi-portable outfits. Just off the press and chockful of valuable information. No obligation.

A drag scraper brings the pit material to a 20 ft. x 3 ft. 4 in. Telsmith Portable Plate Feeder (A) which delivers to a 20 in. x 42 ft. Telsmith Portable Conveyor (B) discharging on a 3 x 8 Telsmith Triple-Deck Pulsator (C) where the water is added. All oversize goes to a 9 x 30 Telsmith-Wheeling roller bearing Jaw Crusher (D); and, after crushing, is returned to this screen by a Telsmith Chain Elevator (E) with 12 in. buckets. The Pulsator makes two sizes of gravel which are carried to stock piles by two 16 in. x 33 ft. Telsmith Portable Belt Conveyors (F). Water sprays above screen thoroughly rinse the gravel before going to conveyors. Sand passing third deck of screen is flumed to 30 in. x 16 ft. Telsmith Sand Drag (G), which, after scouring and dewatering, discharges to a 16 in. portable conveyor (H) and thence to stock pile. A 65 hp. gas engine with clutch and V-rope drive operates complete plant. Finished products are loaded into railroad cars or trucks by crane with clamshell bucket.

G1-36

SMITH ENGINEERING WORKS, 4010 N. HOLTON STREET, MILWAUKEE, WIS.

General Machinery Co. • Clyde Equipment Co. • Clyde Equipment Co.
Spokane, Washington • Seattle, Washington • Portland, Oregon
Jenison Machinery Co. • General Machinery Co. • California Equip. Co.
San Francisco, Calif. • Butte, Montana • Los Angeles, Calif.
Associates in Canada: Canadian Ingersoll-Rand Co., Ltd.
Montreal, Toronto, Winnipeg, Vancouver.

TELSMITH

The Same *Strength of Character* *in Half-Ton and Big Six-Wheeler* International Trucks

Many of the toughest hauling assignments in the world fall to *International* Six-Wheel Trucks. The contractor knows from experience that he can count on Internationals for power, stamina, and economy. He knows that International service will keep them on the job. Whatever his work —from building a dam to mastering the remotest oilfield—he feels *safe* with Internationals.

You are in a special class if you use trucks like these, but no matter what your hauling requirements, *any* International will give you ***heavy-duty stamina in proportion.*** There is *extra* all-truck value in all the 28 International models, down to the Half-Ton chassis priced at $400 f.o.b. factory.

Write for the 32-page catalog on the International Six-Wheelers—the Half-Ton folder —or information on any intermediate size. The nearest Company-owned branch or International dealer is at your service.

INTERNATIONAL HARVESTER COMPANY
(INCORPORATED)
606 S. Michigan Ave. Chicago, Ill.

Illustration: *International Dual-Drive Six-Wheel Truck, Model C-55-F, maximum carrying capacity 23,000 lbs. International Six-Wheelers, Dual-Drive and Trailing-Axle, range from 11,400 lbs. up. Wheelbase lengths 168 to 244 in., permitting bodies for a wide variety of application.*

INTERNATIONAL TRUCKS

YOU, TOO, CAN SAVE WITH THIS TRIPLE PROTECTED TRUCK TIRE

"Toughest job there is for tires!" That's what loggers will tell you about their operation. Trucks have to fight their way through cut-over-timberland, plow through sand and swamps in the south, find a foothold on icy hills in the north. Many a logging truck never sees a highway! All carry heavy, swaying loads that murder ordinary truck tires.

That's why dollar-minded loggers everywhere choose Goodrich Silvertowns. These tires are Triple Protected. They're made especially for the world's toughest hauling jobs. They ask no favors. Need no "second chances" to make good.

It's because Goodrich Truck Tires have a new invention built into the sidewall—a 3-way check against blowouts and breaks. This protection actually checks 80% of premature failures! It makes tires wear longer. It cuts down on delays—saves on repair bills. No wonder loggers choose Goodrich.

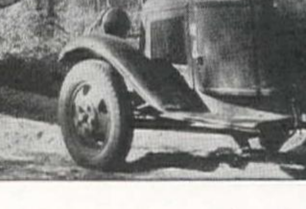
Whether it's a load of logs—or pork—or paper—whether you travel country roads or broad highways, the same Triple Protection that makes Goodrich Tires stand up in the lumber industry will make them stand up longer for you.

HOW TRIPLE PROTECTION WORKS

1 PLYFLEX—distributes stresses throughout the tire—prevents ply separation—checks local weakness.

2 PLY-LOCK—protects the tire from breaks caused by short plies tearing loose above the bead.

3 100% FULL-FLOATING CORD—eliminates cross cords from *all* plies—reduces heat in the tire 12%.



Goodrich *Triple Protected* Silvertowns

SPECIFY THESE NEW SILVERTOWN TIRES FOR TRUCKS AND BUSES

When writing to THE B. F. GOODRICH CO., *please mention Western Construction News*

Since 1931, Indianapolis has forged steadily ahead toward the completion of a farsighted program of street modernization. Over 250,000 square yards of new concrete resurfacing and widening are now in service.

TRAFFIC on streets such as this is measured in millions of car miles annually—and millions of car stops. Time after time every motorist stops and starts in response to signal lights, stop signs, traffic interruptions and emergencies. The ability to make these stops swiftly, surely, with least possible skidding or slipping, is an essential of safety.

Concrete streets have a uniformly *gritty surface* that offers maximum traction under any weather conditions. Tires grip and hold; skidding is reduced to a minimum.

The even contour of concrete streets adds further to their safety, and concrete's light-gray matte surface improves visibility at night.

A lift to your safety program is the priceless "plus" value of concrete—the pavement that costs the least to build and maintain for a given load carrying capacity—the pavement motorists and taxpayers overwhelmingly prefer.

PORTLAND CEMENT ASSOCIATION

Dept. I5-3, 816 W. Fifth St., Los Angeles, Calif.
Dept. N5-2, 564 Market St., San Francisco, Calif.

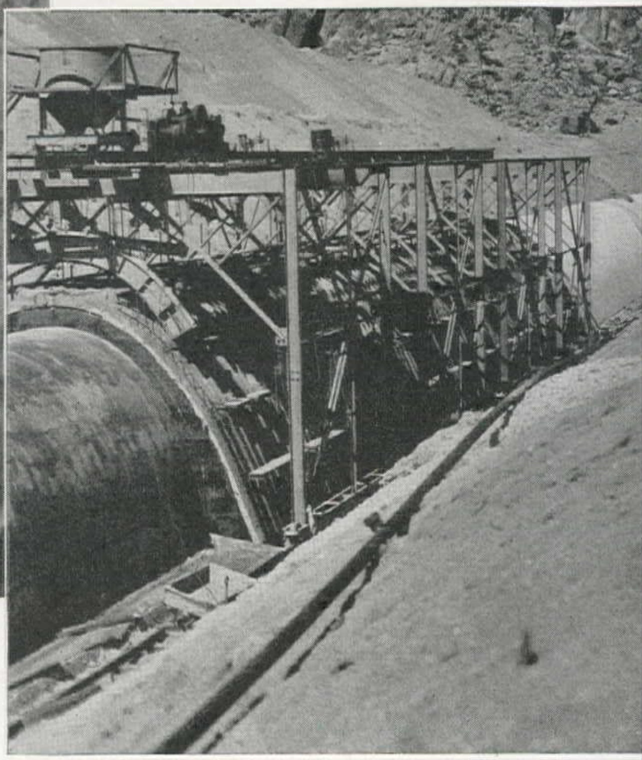
When writing to PORTLAND CEMENT ASSOCIATION, *please mention Western Construction News*

Barrett

CONCRETE CURING COMPOUND

THE TECHNICAL SERVICE BUREAU

of The Barrett Company invites your consultation with its technically trained staff, without cost or obligation. Address The Technical Service Bureau, The Barrett Company, 40 Rector Street, New York.



Easy to handle . . . economical . . . and lastingly protective

Barrett Concrete Curing Compound was developed by America's oldest and most experienced manufacturer of coal-tar products. It provides an effective, economical and easy-to-handle concrete cure for use where water curing is difficult or expensive. It retards evaporation of water, permits proper hydration of cement, and supplies a tough, durable surface coating that protects against abrasion and active water. For complete information and prices, wire or write.

FIELD SERVICE

Skilled Barrett field men will gladly work with you, combining their special knowledge and experience with your familiarity with local conditions.

THE BARRETT COMPANY

40 Rector Street **New York, N. Y.**

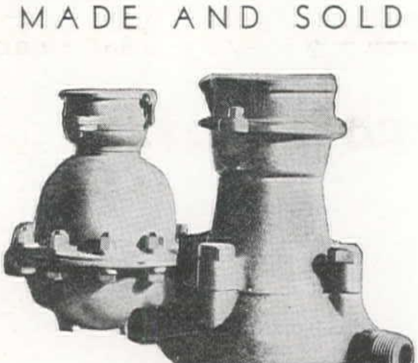
Only QUALITY *can "take it"!*

. . . ten . . . and OUT! They drag him to his corner, work over him—but it's no use. He's through as a fighter; he's scrapped . . . because only QUALITY can take it! A fighter and a Water Meter have this in common: both must have what it takes to take punishment.

No matter how much you save on the first cost of any Water Meter, if it hasn't QUALITY in materials and construction put into it by a reputable maker, it's a bad bargain. Trident and Lambert Water Meters have this Quality. It shows up in low maintenance, sustained accuracy. "Old Man Deterioration" never counts ten over these meters . . . because new interchangeable parts wipe out the wear of years, fitting easily into the oldest models, whose basic design will never become obsolete. We manufacture a type of water meter for every service. Neptune Meter Company (Thomson Meter Corp.), 50 West 50th Street (Rockefeller Center), New York City . . . also . . . Neptune-National Meters, Ltd., Toronto, Canada.

THE SYMBOL SUSTAINED ACCURACY

OVER 6 MILLION MADE AND SOLD



Trident & Lambert Water Meters, Split Case type, for installation where frost is not apt to cause damage.

Trident
and Lambert WATER METERS

HORTON TANKS

now completing

185 Years

of cumulative service for

California Water Service Co.

WITH properties extending along the West Coast from Hillsboro, Oregon, on the north to Belvedere, California, on the south, the California Water Service Company has probably encountered as wide a variety of problems as will ever come up in rendering water service. That elevated storage has been used extensively is an indication of the advantages it offers.

The experience of the California Water Service Company with Horton elevated steel tanks began more than thirty years ago. Since then, this company has continually expanded and improved its facilities with additional tanks specially designed and erected by us until now a cumulative service record totaling 185 years stands as a testimonial to *satisfactory service.*

Like the California Water Service Company, our experience, also, has been gained through contact with a wide variety of problems, not only in building steel water storage tanks, but in fabricating and erecting tanks, vats, bins, etc., for every purpose. Write our nearest office for estimating data and quotations.

CHICAGO BRIDGE & IRON WORKS

San Francisco	1013 Rialto Bldg.	Dallas	Dallas Athletic Club Bldg.	Cleveland	Rockefeller Bldg.
Los Angeles	1414 Wm. Fox Bldg.	Houston	2919 Main Street	New York	165 Broadway Bldg.
Birmingham	1500 North Fiftieth Street	Tulsa	Thompson Bldg.	Philadelphia	1700 Walnut Street Bldg.
Chicago	Old Colony Bldg.	Detroit	Lafayette Bldg.	Boston	Consolidated Gas Bldg.

***Plants at* BIRMINGHAM, CHICAGO *and* GREENVILLE, PA.**

WESTERN CONSTRUCTION NEWS
WITH WHICH IS CONSOLIDATED WESTERN HIGHWAYS BUILDER

May, 1936 Vol. II, No. 5

J. I. BALLARD, Editor
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Still Building Railroads!! The West Is Still Young

RECENT award of a contract for the construction of a 110-mile railroad extension on the Santa Fe System in Colorado emphasizes the point that even this fundamental service is not completed in the West, although we are already beginning to get into some of the refinements of metropolitan facilities, sanitary improvements and super-highways in our construction activity. Naturally, railroad construction no longer occupies the position of prominence it held during the last generation, but the place of this pioneer form of community development has been replaced with the need for water supply and irrigation projects, sanitation and the building of other supplemental transportation facilities. The net change has been an increase and not a decline in the volume of construction. Work may be increasingly varied as the growth of the West becomes stabilized, but it will not diminish in the coming years.

For example, the early requirements for dams, aqueducts and roads involved only small units. Today, the West has grown into the need for such units as Boulder Dam, the Colorado River Aqueduct and the super-highway routes, typified by the route between Seattle and Tacoma. Meantime, western engineers and contractors have made the necessary advances in design technique and field performance. Capabilities in construction have held the stride with the needs of the West. As the influx of population continues the resources and facilities to support the greater concentrations of people will demand increasing volume and variety of work.

Further, the present large projects must be considered only the framework for detail improvements which will be added as required. Such an undertaking as the Grand Coulee project will see a continuing construction program in small scale community facilities.

Yes, the West has made rapid strides since the days when railroad work was the backbone of construction activity. However, it is reassuring to find that even in this fundamental facility there remains work to be done. It is an indication that in all the other branches the surface has only been scratched.

Just a Thought

LOS ANGELES holds, and is establishing, some traffic accident records which indicate a serious problem in the adequate control of motorists and pedestrians. At the same time the city has gone to rather extreme lengths in training its citizens to an accentuated sheep-like docility in obeying traffic signals in the downtown area. Observation indicates that many pedestrians acquire the habit of waiting at the corner for the gong, and then marching blindly across the intersection depending entirely on stop-light as their guardian. Drivers look for lights and not for people as a guide in driving. Is it possible that we are bringing up a generation of pedestrians who have been coddled into depending on bells and whistles for protection at intersections, and are gradually losing their self-reliance and natural caution in caring for themselves on ordinary streets and highways? Also, is the next generation of drivers being reared to consider a green light a complete release from all other responsibility or concern for people on the street? It is an impossibility to have all streets and highways operated with complete pedestrian control and this separating of the sheep from the goats on some intersections and letting them commingle at others has its psychological hazards.

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Not Bound by Precedent

DISREGARD for established precedent has come to be one of the characteristics of engineering thinking in the West. This was reëmphasized recently when an engineer with western training returned after several years in the East and was able to point out distinct differences. In the East there is a proneness to attempt to select an accepted plant or method which may be modified or adapted to meet the new design problem; a corresponding reticence exists in the trying of a new method or principle. In the West, on the other hand, there is a definite inclination to attack every problem with all the technical information available, and find the best solution without particular concern for precedent. Advances in engineering design and construction methods will continue to be Western, as a result of this characteristic.

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Land for Big Projects At No Inflated Value

PROVEN AGAIN, in a decision handed down by a Spokane Federal court in a Grand Coulee Condemnation suit, was the ruling that a property owner in such a suit is entitled only to the reasonable value of the property at the time of condemnation, and it is not enhanced by any use to which the condemnor may put the property. The suit, involving 240 ac. of semi-arid grazing land on which is located the gravel pit for the 30,000,000 cu. yd. of material to be excavated and processed for Grand Coulee dam construction, was settled for approximately the same amount ($3,500) offered by the Government prior to condemnation, and one-fourth the amount requested by the owner. Although the defendant claimed the Government made a large saving because of the quality and proximity of the gravel deposit the court held that the Government had condemned land, not gravel. Previous U. S. Supreme Court decisions provide that an owner should suffer no loss, but is entitled to no gain.

In this, as in every other condemnation suit by state and Federal agencies, litigation is nearly always settled on the basis of what the loser has lost, not what the taker has gained. Only by this interpretation can projects of greater magnitude be carried on to successful conclusion. Almost invariably in condemnation proceedings, the property owner is awarded the same price as first offered by appraisers and engineers. Although litigation sometimes cannot be avoided, presentation of conclusive evidence of fair appraisals and adequate review of court rulings under similar circumstances (before rather than during a trial) might prove to the uninformed or grasping property holder the futility of seeking court redress. Although the engineer, who is notoriously weak in legal maneuver, generally looks on the legal profession as rather an odious one, it might be suggested that adequate training in law be given to the engineer-appraiser—for self protection.

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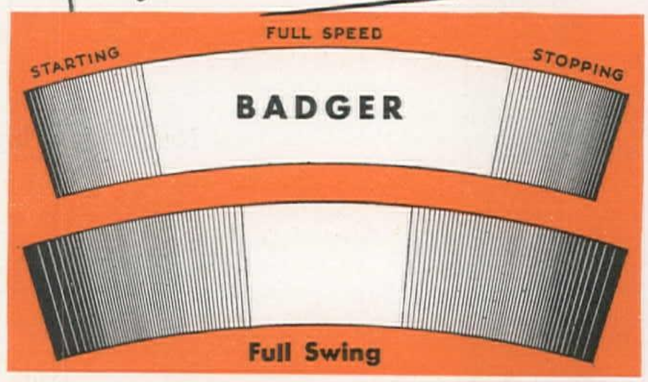

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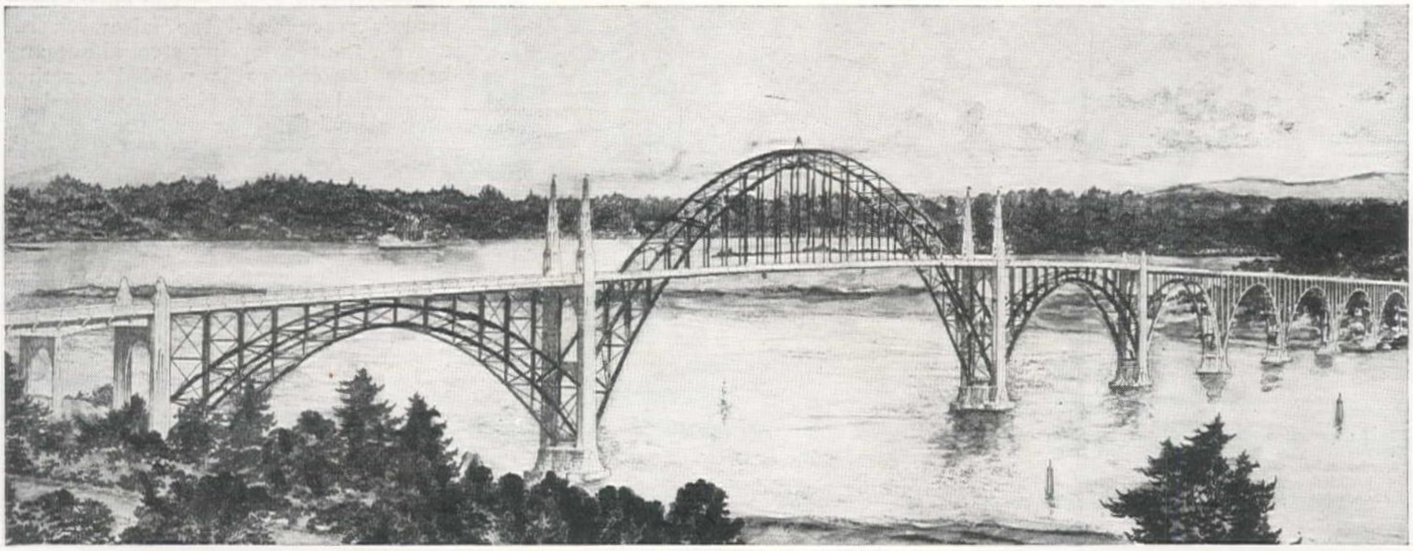


Building the Yaquina Bay Bridge On the Oregon Coast Highway

Erection of a 600-ft. steel arch without falsework features construction on the most unusual of the five bridges being built to eliminate ferries on this major route

By M. E. REED
Resident Engineer Inspector
Public Works Administration
Newport, Ore.

FEATURING the erection of a 600-ft. main steel arch span using cable tie-backs and no falsework, the Yaquina Bay Bridge, being built by the Oregon State Highway Commission across the entrance to Yaquina Bay, is the most interesting of the five structures which will replace ferries on the Oregon Coast Highway. This bridge is located at Newport, about 155 mi. south of Astoria. The highway (U. S. 101) follows the coast from Astoria to the California line and crosses five important waterways, which are being bridged in an extensive construction program already reviewed in *Western Construction News*, January, 1934, and August, 1935. A grant from the Public Works Administartion has aided in financing these projects. With a cost of $1,380,000, the Yaquina Bay Bridge is not the largest of the five, but it is the most unusual in design and engineering features.

The outstanding feature of the bridge is the 600-ft. steel arch spanning the navigation channel; the vertical clearance is 133 ft. above mean sea level, permitting free access of coast-wise vessels to the harbor. This central arch rises 250 ft. at the crown and is flanked by 350-ft. steel deck arches on either side. The approach on the north side is a concrete viaduct, 284 ft. long with a 4% grade from the high bluff to the center of the 600-ft. span at El. 138.3. On the south side are five concrete deck arches decreasing in span from 265 ft. to 160 ft. over the waterway, and connecting with the south approach by 600 ft. of concrete viaduct.

The total length of bridge is 3,260 ft. Width of roadway is 27 ft. and there are two 3½-ft. sidewalks. Concrete railing is provided on both the concrete and steel structures. The deck slab on the steel spans is 6 in. thick, increased to 6½ in. on the concrete arch spans and 7½ in. on the concrete viaduct approaches.

Foundation construction

All major piers, except Piers 1 and 2, rest on pile foundations. Pier 1, which is at the north end of the 350-ft. span is placed on a shale rock footing at El. —5. Pier 2 also rests on this same rock formation at El. —50, and was designed to be constructed in the dry. It was thought that steel sheet piling for a cofferdam could be driven into the soft rock sufficiently to permit unwatering. The cofferdam was constructed with 36-lb. steel sheet piling penetrating to El. —55. It had been pumped down to El. —48 when a "blow" under the sheet piling flooded the cofferdam, and washed out one corner to El. —56. The force of the water bent the piling inward about 6 ft. It was then decided to clean out the crib to bed rock and pour a concrete seal up to El. —26. This work was carried out, the crib was then unwatered, and the pier constructed in the dry.

Pier No. 3, carrying the south end of the 600-ft. arch, also was the cause of considerable delay. This pier was designed to rest on 667 timber piles driven to cut-off elevation with a subaqueous hammer. A steel sheet cofferdam was constructed, with piles driven to refusal at about El. —55. The bottom of the concrete base was to have been at El. —50.

After sand and gravel had been excavated with a clam shell dipper to about El. —48, it was discovered that there was a flow of sand from a quicksand stratum. For months, efforts were made to get the bottom down to the

Final connection of the lower chord member of the main arch. Details of the box type chord members are shown. This closure was effected by lowering the two halves of the arch by means of the cable tie-backs.

designed depth, but without success, and finally the seal was poured at an average depth of El. —47.8. All sheet piling will be left in place, and cut off under water near the natural bed of the bay, eliminating the possibility of scour if, in the future, the depth of the channel is increased. The top of the seal as poured, is at El. —31. After unwatering, the pier was constructed in the dry.

All other footings across the bay section were constructed on pile foundations driven inside sheet steel cofferdams, which were sealed with concrete in the usual manner, with no exceptional difficulties. The viaduct piers, except in a few cases, rest on pile foundations, cut off below the water level. Piers 9, 10, 11, and 12, are on spread footings; as are the footings for the north approach viaduct. The south plaza rests on precast concrete piling.

Fender piling

A rather unusual type of treated piles is being used to protect the channel piers. In place of the customary creosote treatment, the piling is treated with a solution of mineral salts composed of 8 oz. of white arsenic, and 12 oz. each of copper sulphate and zinc sulphate, per cu. ft. of timber treated. The solution is forced into the butt ends of the piling under about 6 lb. pressure. It takes six days for the solution to saturate the sap wood of a 75-ft. pile. The treatment plant is easily transported on two trucks, and the method is particularly applicable where creosote treatment plants are distant from the job. The cost per foot for the treatment is about 28c per lin. ft. of pile. The treatment has been under observation for several years and appears to be effective against toredo and limnora.

Concrete structures

No unusual methods of construction were used for the concrete portions of the bridge. Forms, wherever possible, were fabricated in sections on the framing platform and erected by means of a gantry derrick. Where concrete surfaces are exposed, the forms were lined with plywood. This reduced the cost of finishing concrete surfaces, and the results on this bridge are most satisfactory.

The concrete mixing plant is mounted on a large barge. It consists of a 1-cu. yd. Koehring mixer and a Butler batching scales, with necessary hoppers and hoisting buckets. Sand and gravel are shipped by rail to the end of track at Yaquina, 5 mi. east of Newport, where the aggregates are transferred to barges by means of Link Belt conveyor. Cement is handled in a covered barge. Sand and gravel are transferred from barges to the mixing plant by a clam shell hoist on the mixing barge. Channel piers were poured direct from the mixing plant moored alongside.

Concrete for all other structures is hauled in small trucks to the point of pour, and either dumped direct into the forms or dumped into a large spout bucket which was hoisted and dumped by means of the traveling gantry. All concrete was thoroughly vibrated by air driven machines, with excellent results. Three per cent of diatomaceous silica, by weight, is added to all concrete.

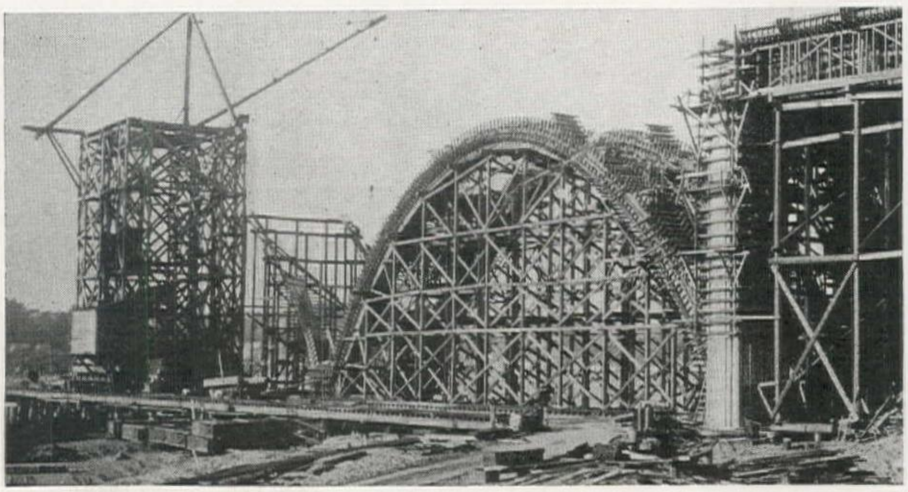
All concrete arches are designed as continuous arches but constructed as three-hinge arches by interposing "Consideré" concrete hinges at the crown and skewbacks. During construction, these hinges carry the entire weight of the structure. After the entire dead load is placed and the falsework removed, the reinforcing steel above and below the hinges is welded together by special welding plates attached to each reinforcing bar and the arch rib section completed to its full size with 5,000-lb. concrete. This method of construction eliminates all negative moments in the arch, and permits of a more economical design. The plan of the skewback hinge for the 265-ft. arch is shown in the accompanying illustration. The section of the arch at the skewback is 5 ft. by 6 ft. 6 in. This area is reduced by the hinge to 1 ft. 1½ in. by 3 ft. 9 in. To carry the excessive load at the hinge, the reinforcement is made up of sixteen 1⅛-in. bars, seven ½-in. rods and two 1-in. rods welded to spirals having 1¼-in. pitch. Area of steel at the hinge is 23 sq. in. on the 265-ft. arch.

Pier and column surfaces are broken by scoring strips and web walls between main pier columns are cut away in the form of gothic arches. Concrete railings are made up of precast pilasters topped with cast-in-place railing. Expansion joints in the concrete deck are effected by means of cast chromium steel rollers riding on chromium steel plates set in the floor beams and stringers.

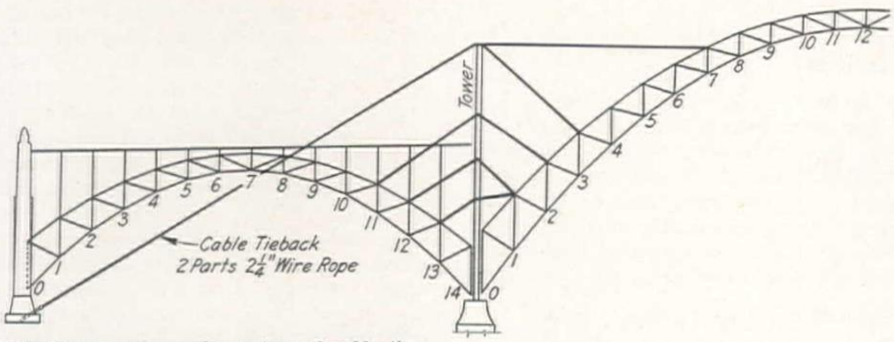
Pier design

Main piers are of reinforced concrete design, cored out to reduce volume of concrete. The main channel piers, carrying the 600-ft. and 350-ft. steel arches, are 30 ft. 9 in. by 54 ft. at the base, tapering to 18 ft. by 54 ft. at El. 15, which is the spring line of the arches. At this elevation the pier columns above the base are 7x15 ft. tapering to 7x10½ ft. at the roadway. Columns are connected by 1½-ft. web walls. Pylons at each end of the 600-ft. arch

Concrete sections of the bridge, including arches and viaduct, were built with the aid of a timber gantry built on two flat cars. These cars operated on tracks built on a pile trestle extending along the west side of the site. A stiff-leg derrick with a 63-ft. boom was mounted on the top of the 60-ft. gantry. Hoists were located on a lower deck.



Closing member of the bottom chord of the main span going into position. This arch is 250 ft. high at the crown, and spans the navigation channel at the entrance to Yaquina Bay.



This diagram shows the system of cable tiebacks used to erect the central span illustrated at the top of the page.

extend 40 ft. above the roadway for ornamental effect. They are pierced at the sidewalk elevation for pedestrians.

Concrete arches

The concrete deck arches spring from the pier foundations at El. 15. The longest arch is 265 ft. and the section at spring line is 5 ft. x 7 ft. tapering to 5 ft. x 4 ft. at the crown of the arch. Arch reinforcing steel is made up of fourteen 1-in. bars top and bottom with ⅝-in. hoops spaced on 1½-ft. centers. Arches are tied together with six cross struts, having a central section of 2x4 ft. and flaring at each end to a section 2x6 ft. at the arch rib connection.

Main Arch Span

The outstanding feature of the bridge is the 600-ft. semi-through, steel arch span. Spaced 30 ft. apart, the arch trusses rise 226 ft. 1 in. from center of ends pins to crown. The vertical distance from enter of end pin to center of top chord at the spring line is 50 ft. This dimension reduces to 15 ft. at the crown of arch (panel point 12). Elevation of top of arch at center of span is 246 ft. above mean sea level; elevation of deck slab is 138 ft. at center of arch. Chords of arch are of the box type, 18¾x26 in. Chord members are of silicon steel. Carbon steel is designed for 20,000 to 24,000 lb. and silicon steel from 27,500 to 33,000 lb. depending on location.

Floor system

Floor beams are 36-in. (150 lb.), of silicon steel, connected at each end to vertical 10-in. I-bars, to which are fastened the cantilever sidewalk brackets. These 10-in. I-bars extend above the sidewalk elevation and connect with the main hangers, by means of 3-in. cast chromium steel pins. The hangers, 8-in. (40 lb.) eyebars, are suspended by 3-in. pins and two 1¼x10½ in. connecting plates, to the lower chord at each panel point. These hangers were not fabricated until the exact length was determined in the field after the steel arch was swung free from all supports. It was found, however, that the arch was so true to the theoretical design that the hangers could have well been shipped at the same time as the arch steel.

Floor stringers are 16 in. (36 lb.) silicon steel I-bars spaced 4 ft. 3 in. with 10-in. cross braces at each panel point and at mid-panel points. Stringers are spliced at mid-panel points rather than over floor beams. Rivets for main members are ⅞ in. and ¾ in. for bracing.

Two side arches

The two 350-ft. side arches have a vertical distance of 38 ft. from center of end pins to center of upper chord, and the corresponding dimension at the crown is 13 ft. Chords are of the box type with a section of 18x24 in. for the bottom chord and 18x12 in. for the top chord. Chord members of 350-ft. arches are of carbon steel.

The deck is carried by 14x18-in. spandrel columns, direct connected to top chord, and 10x27-in. silicon steel floor beams. Longitudinal floor stringers are 16-in. silicon steel, cross connected with 10-in. members. Sidewalk brackets are fastened by splice plates to the ends of the floor beams.

Erection of steel arch spans

The contractor used a rather novel method of erecting the steel spans.

The two end panels of the 350-ft. side arches were erected on timber bents at the second panel points, as the lower chords were in two-panel lengths. At panel points 4 and 10 were erected exceptionally heavy timber bents on pile footings. These bents were made up of eight logs, securely braced and topped by 16 in. x 16 in. x 30-ft. caps on which were placed one 50-ton, one 75-ton and one 100-ton jack, for adjustment of the height of arch, at the closure. These log bents were 70 ft. from bottom of sill to top of cap, and required 85-ft. logs. No difficulty was encountered in adjusting the height and distance at the closure of the 350-ft. spans.

As the main 600-ft. span of 24 panels was over the navigation channel, false work could not be used, except at the sides. The contractor chose to use no falsework at all, but to hang each half of the arch, pivoted on the anchor pins. The system was simpler and very effective. Two 1⅜x5-in. eyebars were anchored in the bases of piers 1 and 4. To these anchors were fastened two-part 2¼-in. cables, extending over temporary timber towers to connection with the 600-ft. span at panel points 3 and 10, as described later on. These cables carried turnbuckles for adjustment of lengths.

Panels 1, 2, and 3; also 24, 23, and 22 were hung from the 350-ft. spans by two-part ⅞-in. cables to each panel point. The towers at Piers 2 and 3 were then erected to their full height of 213 ft., and capped with steel plates to which were fastened the anchor cables leading to piers 1 and 4; also the cables to panel points 7 and 21, where they were fastened to specially designed gusset plates at the upper chord. Adjustment of lengths were made on the channel side by means of two 4-sheave blocks, and four double-sheave blocks continuously reeved with 1-in. plow steel cables and turnbuckles for equalization of loading.

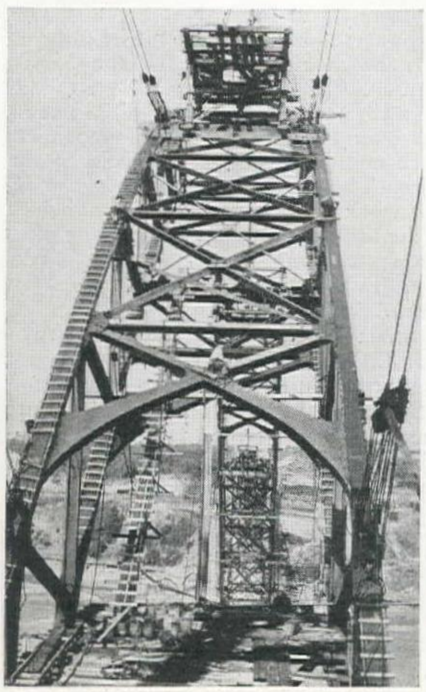
When panel points 7 and 17 were reached, a second set of 2¼-in. cables was run from the top of the tower to special gusset plates at the upper chord. Adjustment of these cables was made possible at this point by means of two 4-sheave blocks, and four double 18-in. sheave blocks, through which were reeved 1-in. cables with adjustment turnbuckles. These cables were made continuous with the cables leading to panel points 3 and 10, to equalize all loads on the 2¼-in cables.

Closure of the 600-ft. span was made on March 10, without any difficulty. The half spans were erected about 6 in. high and were lowered into place by means of the 1-in. connection lines leading to donkeys at each end.

Erection of steel in the central 18 panels of the 600-ft. arch, was carried out by means of stiff-leg travelers carried on the top chords, and operated by hoists located at piers 2 and 3. Steel was delivered on barges held in position by anchors. Erection of 600-ft. arch trusses began on Dec. 12, 1935, and was completed (not including suspended floor system) on March 15, 1936.

All labor has been supplied by the National Reëmployment Service, under the regulations of the National Industrial Recovery Administration. In general, labor has been supplied when requested, and of average efficiency.

Cable tie-backs for erecting the 600-ft. main span extended from the side piers over the towers to connections shown. Closure was made by slacking off on these cables after the two sides had been erected about 6 in. above final grade.



Fender piles were treated with a solution of mineral salts, forced into the butts of the piles with a 6-lb. pressure. Using the rubber pressure caps shown, six days are required for the solution to saturate the sap wood of a 75-ft. pile. Cost of treatment was 28c per lin. ft.

Quantities

Structural steel has been furnished by the Virginia Bridge & Iron Co., from their Memphis, Tenn., and Birmingham, Ala., plants. Cement is furnished by Oregon Portland Cement Co., of Oswego, Ore. Reinforcing steel is from Soule Steel Co., and the Truscon Steel Co., Portland, Ore.

Estimated quantities and bid prices:

Excavation	19,830 cu. yd.	$ 8.75
Foundation piling	82,250 lin. ft.	.50
Treated piling	22,600 lin. ft.	.75
Concrete piling	1,880 lin. ft.	3.25
Seal concrete	6,695 cu. yd.	17.75
Concrete (various classes)	21,388 cu. yd.	
Steel reinforcement	2,140,000 lb.	.045
Cast chromium steel	19,200 lb.	.35
Carbon structural steel	2,685,000 lb.	.073
Silicon structural Steel	1,125,000 lb.	.0765
Concrete railing	6,708 lin. ft.	5.00

Personnel

Yaquina Bay Bridge is one of five bridges being built by the Oregon State Highway Commission; R. H. Baldock is state highway engineer, and C. B. McCullough is assistant state highway engineer in charge of bridges. These bridges are under one docket (982 Ore.) of the Public Works Administration, with a 30% grant, only.

C. C. Hockley is acting state director for the PWA, and R. H. Corey, state engineer inspector. The writer, Paul E. Lattner, and Curtis E. Stewart were resident engineer inspectors, and Don Smurthwaite, chief clerk.

The highway commission is represented by Glen S. Paxson, acting state bridge engineer, and Alvert Skelton, division engineer, with Ray A. Furrow, resident engineer, and Ivan P. Merchant, principal assistant engineer.

Gilpin Construction Co.—General Construction Co. are general contractors, with Otto Hermann, superintendent, and A. B. MacEachern, assistant superintendent. Tom H. Orme is engineer for the contractor and R. P. Stockwell, office manager. The bid price was $1,357,587.

F. L. Holser & Co., Inc., have the sub-contract for steel erection; William Kelly, Sr., is general superintendent, and M. Miller, superintendent.

Work was begun Aug. 1, 1934, and will be completed about Aug. 31, 1936. The estimated total cost of bridge including inspection is $1,380,457.

April Awards of Bureau of Reclamation

Twenty-four contracts totaling $1,304,970 were awarded during April in connection with the Bureau of Reclamation construction program.

In addition, bids were under consideration preparatory to the award of contract for several large construction jobs, including Caballo dam on the Rio Grande River in New Mexico, and Arnold dam on the Colorado River of Texas Project.

The number of those employed on construction sites by the Bureau of Reclamation at the close of April was 13,302 against 12,382 at the end of March. The employment total will continue to grow as newly started construction advances and new jobs are begun.

Grand Coulee dam is furnishing employment to the most men of any of the projects. At present there are 4,750 employed there, an all-time high for the project.

One feature of the Bureau's activities in April was the letting of the first contract on the Central Valley Project in California. The contract, however, was not large. It was for excavation for further and more detailed investigation of the Friant Dam site, and it was awarded to the Youdall Construction Co. of San Francisco on its bid of $16,125.

Record Multiple Arch Dam To Be Built in Arizona

Bartlett dam on Verde River will be 270 ft. high and provide 200,000 ac. ft. of storage — Bid opening scheduled for May 16

THE Bartlett dam, which will provide additional storage for the Salt River Irrigation Project in Arizona, will be constructed with federal WPA funds by the Bureau of Reclamation. The opening of bids for the construction contract was originally set for April 7, 1936, but later was changed to May 16. It is expected that field operations will be under way by the middle of June.

Purpose

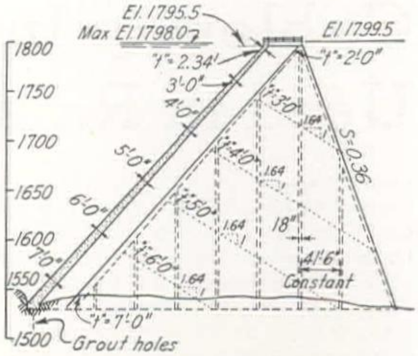
Highly cultivated areas in the lower end of the Salt River Irrigation Project, Ariz., have been dependent for years on a water supply by pumping from underground sources. The water table has dropped so rapidly during the recent cycle of short water years that not only is the expense of pumping becoming a burden but the adequacy of the supply is endangered. The Bartlett dam will create a reservoir with a storage capacity of 200,000 ac. ft., which will be sufficient for the irrigation of these lands by gravity flow as well as for the irrigation of about 6,300 acres on the Salt River Indian Reservation.

Dam site

The dam site, 54 mi. by road northeast of Phoenix, Ariz., is located on the Verde River about 25 mi. north of its confluence with the Salt River, on which stream the Roosevelt and other storage and power dams have been constructed in the past for the Salt River project. The bedrock at the site is predominantly a pink, hard, and fine-grained though somewhat jointed granite, generally underlain by a gray granite of similar characteristics, both of which formations have been determined by core drilling to be highly satisfactory for the foundation of a concrete dam. The profile of the site is broadly U-shaped, thus dictating the construction of a gravity type structure, or a multiple arch, the latter being chosen after comparative estimates indicated a lesser cost.

Design of dam

The dam, having a maximum height of about 270 ft. from the lowest point of foundation to its top, and a crest length of 750 ft., will consist of ten heavily reinforced concrete arches supported by nine hollow, reinforced concrete buttresses and a short concrete gravity section at each abutment. The axis of the dam corresponding to the springing lines of the arches at their top elevation will be laid out on a radius of 1,379.7 ft. The maximum arch section at lowest elevation will have a thickness of 7 ft. which will verge to 2 ft. 4 in. at the top elevation. The arches will rise at the crown section on a slope of 42° from vertical. The hollow of the buttresses will have a constant width of 8 ft. between buttress walls. The latter will be constructed in 40-ft. sections separated by 18-in. contraction joints which will be filled with concrete after shrinkage of the concrete in the adjacent sections.



Maximum section of the dam showing the principal dimensions.

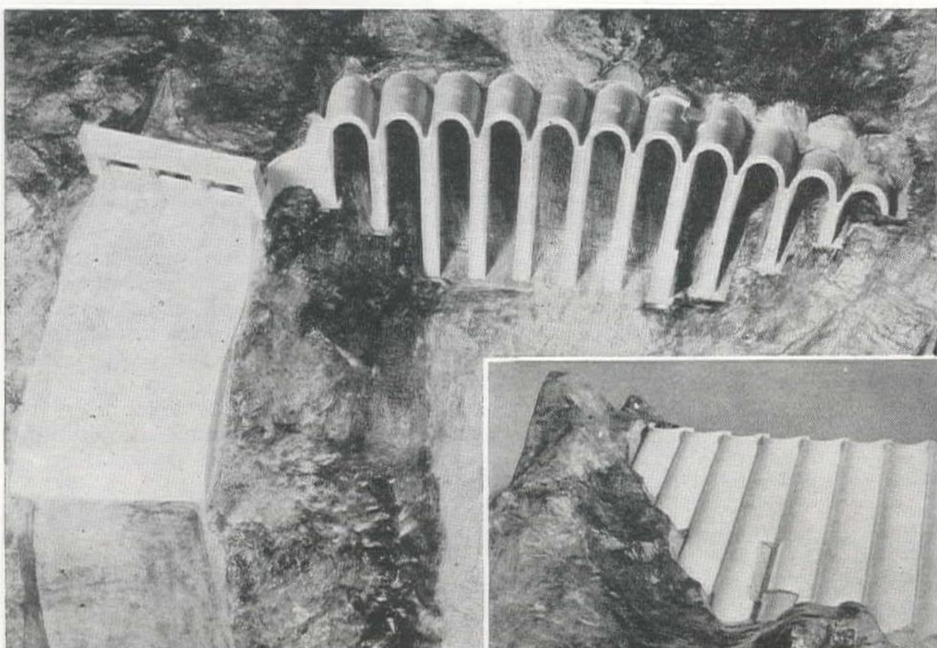
Spillway and outlet works

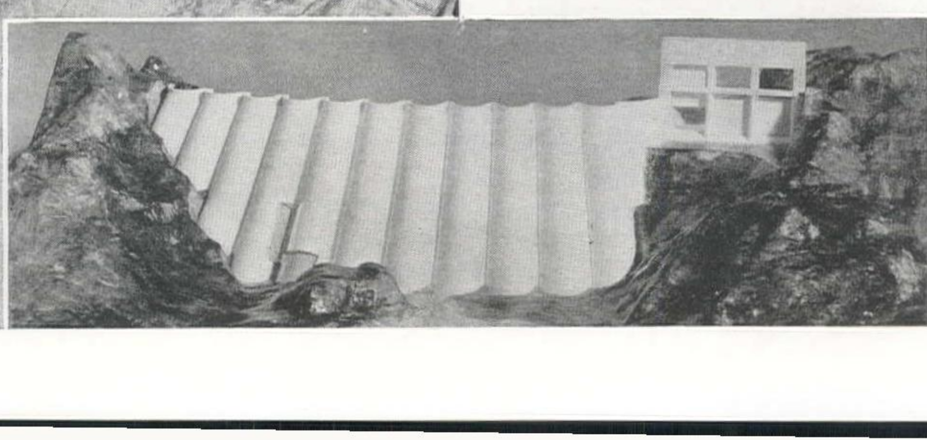
The spillway, with a capacity below freeboard of 175,000 sec. ft., will consist of a curved concrete-lined, superelevated channel, 170 ft. in bottom width, constructed adjacent to the dam in the right abutment. Reservoir overflow will be controlled at the spillway inlet by three 50-ft. square, fixed-wheel, structural-steel gates, the operating mechanisms for which will be installed in a concrete house directly above the gates.

The lower or sluice-gate outlets will be provided by three metal conduits embedded in mass concrete at the base of one of the arches. The discharge will be controlled by a 6-ft. by 7-ft. 6-in. high pressure, hydraulically operated, slide gate installed near the downstream end of each conduit. The upper outlets will consist of two 72-in. diameter plate-steel pipes installed vertically one above the other in the hollow of one of the buttresses, the flow through the outlet end of each pipe being regulated by a 66-in. needle valve. Trash-rack structures will be provided at the inlets of both outlet works.

Quantities

The principal estimated quantities involved for the completed construction are: 320,000 cu. yd. of all classes of excavation; 29,000 lin. ft. of grout holes; 45,000 cu. ft. of pressure grouting; 160,000 cu. yd. of concrete; and 8,700,000 lb. of various types of metal work.





Two views of a model of the Bartlett dam built by the Bureau of Reclamation showing the general layout of the structure.

Cableway Installation of Unique Design Used in Raising O'Shaughnessy Dam

Unusual location problems solved—Traveling towers eliminated —Two auxiliary cables and carriages used to swing fall line over entire area of dam

By R. S. SMILIE
Cableway Engineer, San Francisco

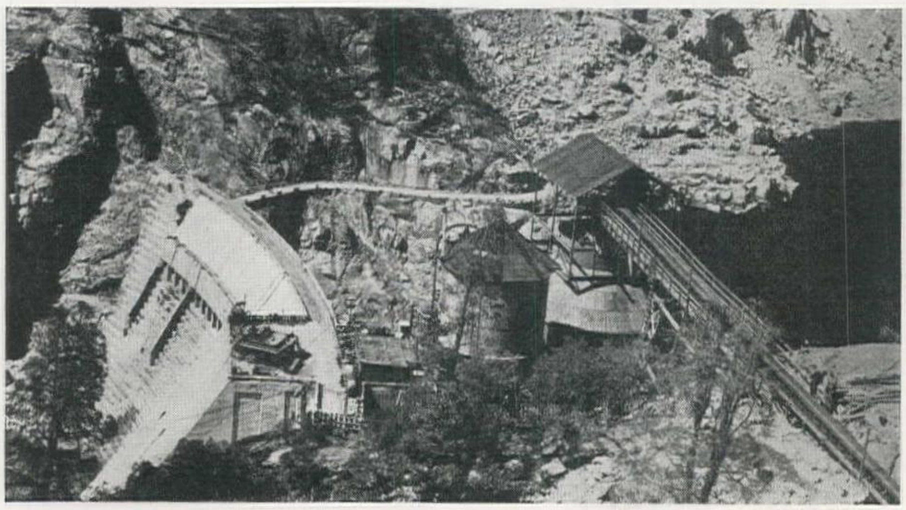
UNUSUALLY difficult location conditions at the O'Shaughnessy Dam and restrictions against unsightly rock cuts imposed by the National Park Service, have resulted in the installation of a construction cableway of unprecedented design for the present work of adding 80 ft. to the structure. The canyon is spanned by a fixed 20-ton cableway with the unique supplementary feature of two parallel auxiliary cables and carriages used to swing the fall line up or downstream, to cover the entire area of the dam. Carriages on the three cableways run from lines on adjacent drums at the main hoist and always travel together, under the control of one operator. All machinery is installed in the hoist house at the head tower and operating speeds are similar to standard installations.

The Hetch Hetchy water and power development is being carried out under the direction of the San Francisco Public Utilities Commission. The present project consists of raising the existing O'Shaughnessy Dam about 80 ft. to provide additional storage which will be of particular value in extending the power output of the system throughout the low flow season. O'Shaughnessy Dam was built in 1919-1923 and has a height of 344 ft. above bottom of cut-off wall. At the time of the original construction the foundation was excavated and built to provide for the ultimate height.

In 1934, a $3,500,000 PWA loan and grant was made for the enlargement of this structure, which will involve about 95,000 cu. yd. of rock excavation, 250,000 cu. yd. of concrete, and 425 tons of reinforcing and anchor steel. Contract for this work was awarded in February, 1935 (unit bids in *Western Construction News*, February, 1935), to the Transbay Construction Co. on a bid price of $3,219,965.

Operations up to the present time have consisted of organizing the camp, constructing tramways for bringing sand and coarse aggregate to the site from two different areas, opening up the rock quarry, excavating the abutment areas for the raise, and constructing the concreting plant and cableway system. Concrete placing was scheduled to begin about May 1.

The topography of the site makes the installation of an ordinary cableway very difficult and costly because: (1) the small area on the south side must be reserved for the screening and aggregate plant, while the north side of the site is an almost vertical rock cliff; (2) the dam is located in Yosemite National Park and the National Park Service is opposed to large unsightly cuts in the granite walls of the canyon, which would be necessary to provide runways for a traveling tail tower. Further, even if a traveling tower were possible, its construction would be very costly requiring both extensive rock cuts and trestles. The necessity for placing the screening, batching and mixing plant on the south side, where it occupies most of the available space, presented a serious problem for any cableway tower on that side of the site.



General view of O'Shaughnessy dam showing steep rocky site, with top of the concrete plant in foreground.

In the construction of cableways where it is necessary to cover an area outside of the narrow strip under a fixed cable, the introduction of traveling towers and trackways is the usual procedure. These installations may have traveling towers at both ends on parallel tracks or a fixed tower and a radial traveling tower at the other end. Frequently, the topography of dam sites is both rocky and precipitous and the necessary fills and trestles for the traveling towers seriously increase the cost of the installation. Frequently, the sides of the canyon above the dam make it impossible to install trackways and traveling towers with a reasonable investment. It was this type of situation which was faced by the contractors on the present additional work on O'Shaughnessy Dam.

Main control block and fall block showing control lines to the up- and downstream control cables. The fall lines run through the control block, as shown, to the main cable carriage.

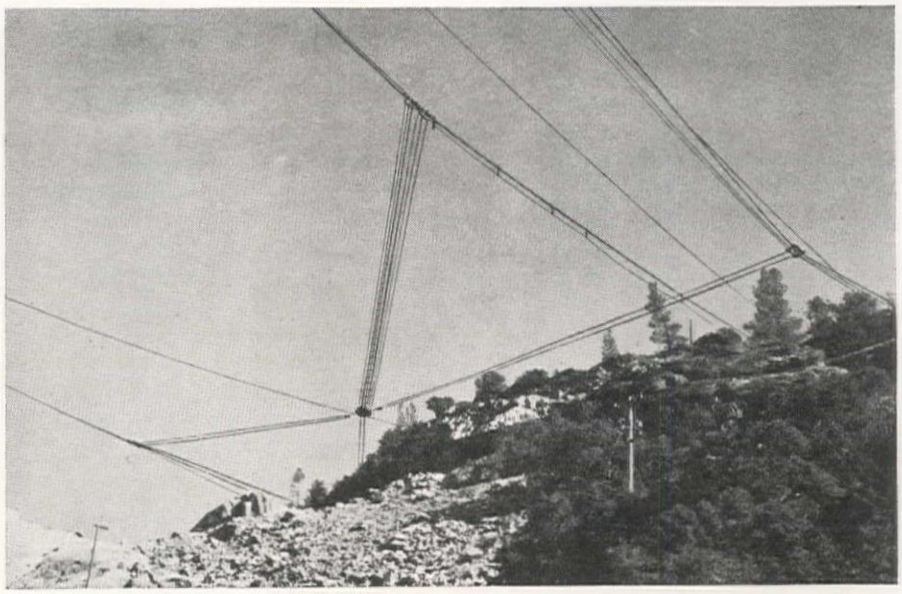
Cableway design

The cableway which has been installed at the O'Shaughnessy Dam was designed by the writer to overcome some of the problems mentioned above. The 20-ton fixed cableway of 1,790-ft.

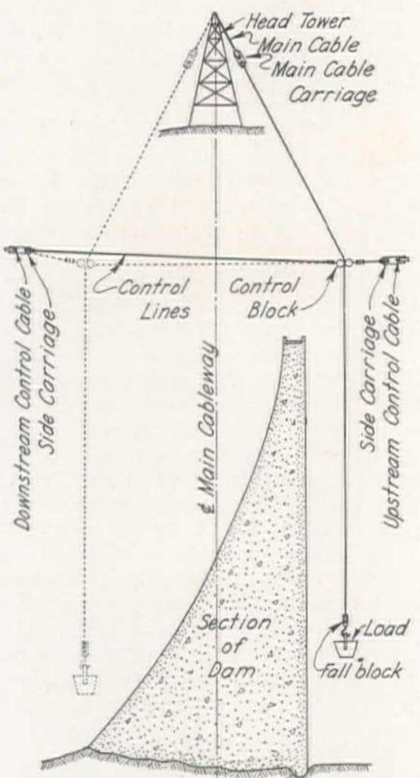
span is of standard design, high above the operating area. Two side auxiliary cables were installed parallel to the main cable at a distance of about 150 ft. up and downstream and 200 ft. vertically below the main cable. The main cableway has a double carriage and a 4-line lead and control block suspended by pennants.

The two auxiliary cables are equipped with carraiges which travel from head to tail tower in the same relative position and at the same speed as the main carriage. Lines from the auxiliary cables are used to swing or "drift" the fall lines (passing through the control block) and the fall block either up or downstream to take in the entire area of the dam.

The fall lines reeve through the control block which is completely fair-



Arrangement of the three cables—NOTE relative position of: (1) main cable carriage, (2) control block, (3) two auxiliary cable carriages and (4) side control lines.



Diagrammatic sketch showing method of drifting the fall block and load up- or downstream from the main cable, by means of the two auxiliary cables.

leaded with large roller bearing sheaves and rollers. This permits the fall block and its load to be raised or lowered to any desired position in the area.

Lines from the main carriage and the two auxiliary carriages run on adjacent drums at the main hoist. In this way, the three carriages travel abreast in a line normal to the main cable. Further, the two auxiliary carriages are at a level which is approximately the same as the suspended control block. From these side carriages the bight of the control line leads horizontally to the sheaves at the side of the control block. The head-tower ends of these control lines are continuous and lead to an endless drum hoist operated like a moving-tower hoist. When this hoist is operated, one control line pulls or drifts the control block downstream (or upstream) as the other control line pays out.

When the required downstream lead or drift is obtained, the control block is held stationery and the fall block and its load is lowered to the dam. A heavy counterweight at the tail-tower end of the control lines maintains a tension on the system and holds the control block stable. This feature eliminates any pitching or swaying when the system is being operated.

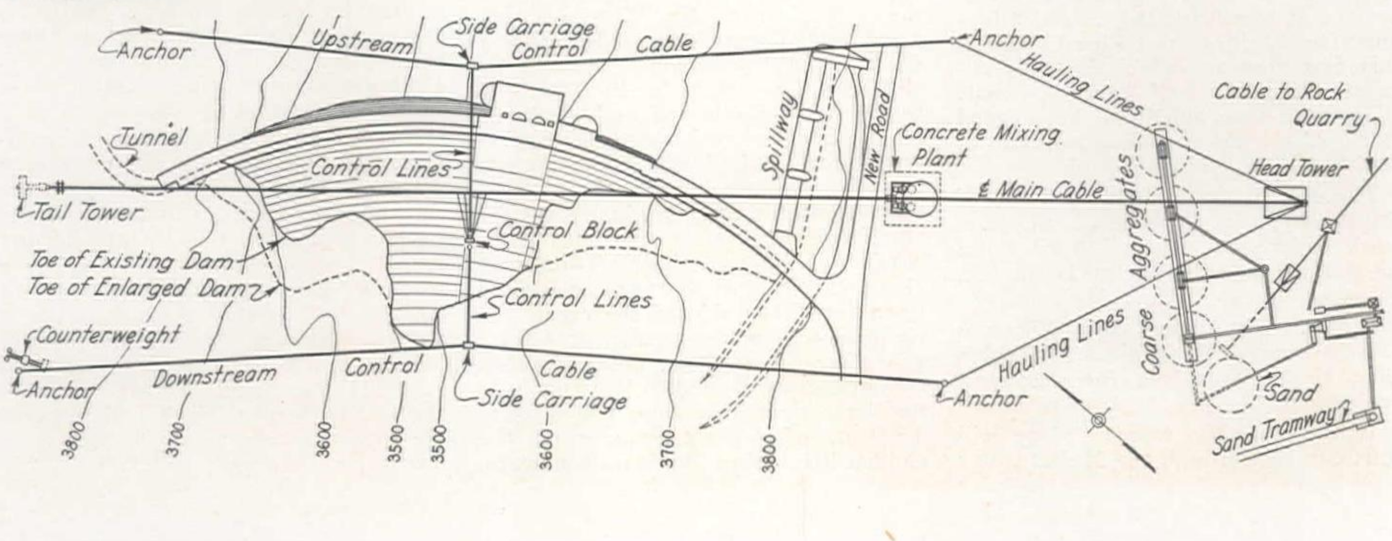
All of the machinery is installed in the hoist house at the head tower. Operations are controlled by one operator who manipulates the usual numbers of levers common to a cableway system with one moving tower. The cableway may be operated either from the hoist house in the head tower or by remote control from some point over the dam.

The traveling speed of the carriages on the cableways is the usual 1200 ft. per minute and the hoisting speed is 250 ft. per minute.

The cableway was used in the erection of the concrete mixing plant which is located directly under the main cable at the south end of the site. Concrete from this mixing plant will be delivered directly into the cableway buckets which stay on the hook. No shuttle cars are used in this transportation system. From the road, which extends by the mixing plant, steel, forms, and other materials are picked up by the cableway. During the excavation of the abutments, the cableway brought out all of the rock in skips and delivered it to truck hoppers on the upper levels from where it was hauled to the disposal areas.

In this initial operation of the cable-

General plan showing arrangement of the cableway installation in relation to the dam site and the concreting plant.



way, it was demonstrated that the system was not hard on the lines and that cableway operators could handle it efficiently and spot the load and hook where it was wanted. They were soon able to operate the system with the same head and tail tower speed as an ordinary moving tower installation, but with more rapid up and downstream movement.

The writer has secured patents covering all features of this cableway system.

The project is being carried out by the Hetch Hetchy department under the general direction of L. T. McAfee, chief engineer and manager; L. W. Stocker is chief civil engineer. J. H. Ryan is construction engineer and Harry Lloyd is assistant construction engineer. Operations of the Transbay Construction Co. are under the supervision of Ralph Keenan, general superintendent. Charles Mullin is job superintendent. R. B. Muse is chief engineer and took some of the pictures used in the article and the unusual photograph shown on the front cover.

Intermountain News.....

A BRIEF which has a far-reaching effect on transmountain diversion all over the West was sent to President Roosevelt late in April by Congressman Lewis of Colorado. It contends that the administration's national water plan involving study of every major drainage basin in the country should not place any legal obstacle in the way of transmountain diversion. The president's program, while not providing for study of transmountain diversion itself, will provide full information on the possibility for such work in the future. Lewis sought to convince the president that justifiable diversions from one watershed to another have always been sustained by western water law and that the Roosevelt program should tie in with this experience.

The proposed Grand Lake diversion job was still under discussion in April as different legislative factions battled over it in Washington. Agreement between eastern and western slope interests has so far been impossible to attain. However, backers of the plan still believe that difficulties will eventually be ironed out.

Waterworks construction

Several waterworks projects have gotten under way in the intermountain states. Work was resumed April 21 on an $800,000 PWA waterworks project at Sheridan, Wyo. The Pittsburg-Des Moines Steel Pipe Co. holds this first contract which includes excavations, tanks and concrete work. Bids were scheduled to be opened April 22 on about $700,000 worth of additional work on this project.

The Northwest Construction Co. of Rapid City was scheduled to start work before the end of April on a $36,000 waterworks job at Dundance, Wyo.

Work was to start April 27 on a $30,000 waterworks project at Garden City, Utah. This is a force account project.

Water from the western slope will start coming through the Moffat water tunnel some time in June if present progress continues. Lining of the tunnel was about 75% complete by the middle of April. About 9,100 cu. yd. of concrete remained to be poured to complete the remaining 3,682 ft. of tunnel lining.

Denver activity

Work is progressing rapidly on the new west side filter plant in Denver. The reinforced concrete, clear water reservoir is about 80% complete, while the skin coat for the settling basins is finished. The city also advertised for bids on the new Ralston Creek reservoir on April 14. Bids will be opened on May 12 and work is expected to get under way around June 1. The dam, of the earth-fill type, will be 185 ft. high, about ¼ mi. long at the top, 25 ft. in crest width, and 950 ft. in base width. The reservoir will impound about 12,600 ac. ft. of water. Water from the reservoir will flow through a 940-ft. tunnel, 6 ft. in diameter, into a 54-in. pipeline which will conduct it to the new filter plant.

Before the end of the summer, the City of Denver will probably have completed the extension of Speer Boulevard from South University to South Colorado Boulevard, with 40-ft. roadways on both sides of Cherry Creek. Plans call for continuation of the extension to the Cherry Creek flood control dam near Sullivan next year. The city has acquired practically all the land necessary for the extension to Colorado Boulevard and workmen on the Cherry Creek channel improvement are also building the two roadways in conjunction with the channel improvement work. Original plans for the creek improvement called for a 200-ft. right-of-way with an 80-ft. creek channel. When roadways were decided upon for either side of the creek, the rights-of-way were extended to 400 ft., providing for a 120-ft. creek channel.

Work was expected to be under way not later than May 1 on widening of 1,509 ft. of concrete paving on the Golden Road from Sheridan Boulevard, west, out of Denver. The contract was awarded in April to the Monarch Engineering Co. with a low bid of $126,605. The contract calls for a 40-ft. roadway.

Miscellaneous

The Public Service Co. of Colorado will shortly spend $1,200,000 for an additional reserve generating capacity of 34,000 h.p. in the company's Valmont steam plant near Boulder, it was announced early in April. About a year will be required for the job. The company has just completed improvements at the Boulder hydroplant in Boulder Canyon at a cost of about $287,000.

Mayor Benjamin F. Stapleton of Denver has received assurance from Congressman Lawrence Lewis that a federal survey of the proposed Blue River project will be started as soon as snow conditions permit. The Bureau of Reclamation was allotted $100,000 for this work in February. The Denver water board has already spent $97,000 on preliminary surveys.

A united effort to obtain federal funds for water conservation and flood control projects throughout the West was urged late in April by Lyman H. Brooks, Jr., acting WPA administrator in Wyoming, in a letter sent to thirteen other WPA administrators in the West and Middle West. Brooks declared that some federal agency now in existence should continue to be supplied with funds for water conservation and flood control work on projects smaller than those now carried by the Bureau of Reclamation. He referred to projects ranging from $50,000 to $500,000 in cost. He pointed out that for various reasons the WPA is now unable to do much of this work and that the PWA or some other similar agency should have a chance to go on with this work on a permanent basis. He declared that there is danger of such work being curtailed unless the West exercises the utmost vigilance.

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Northern California Structural Engineers Meet

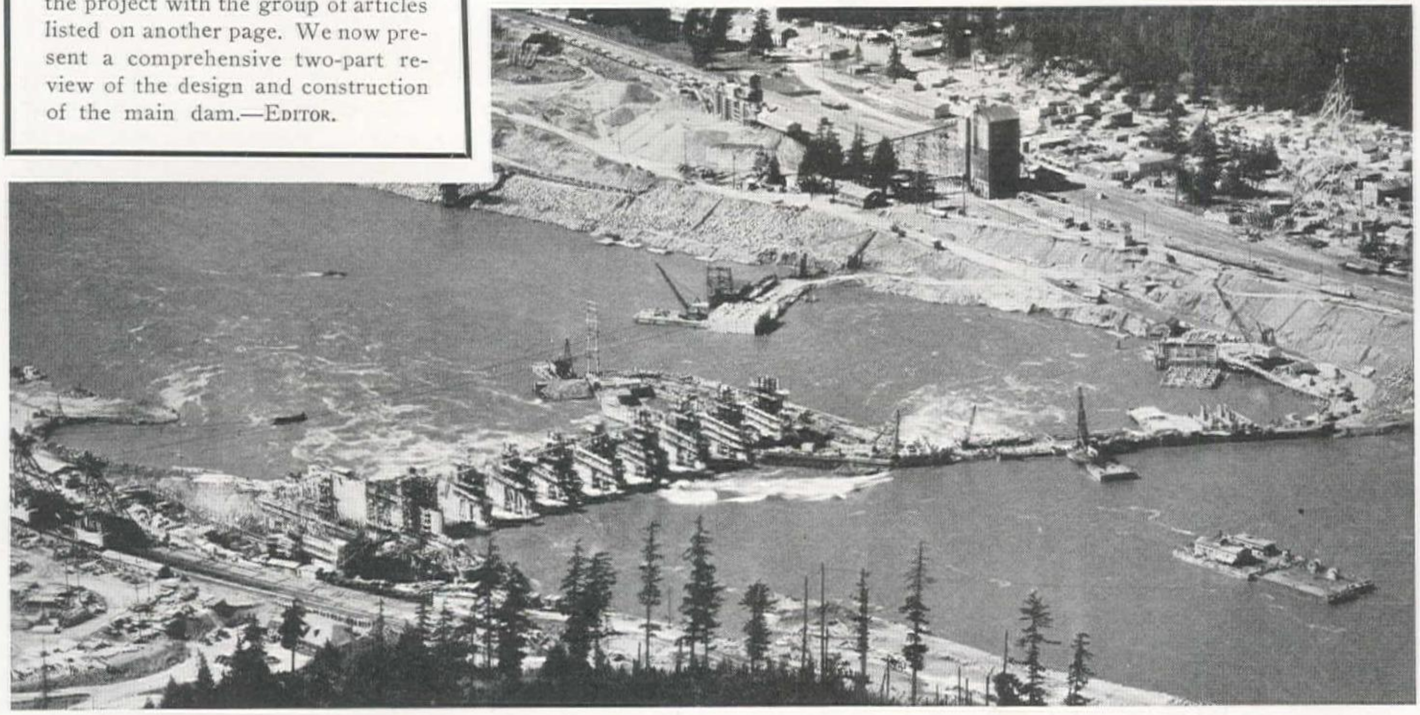
Following an excursion to the United States Mint Building now under construction, the Structural Engineers' Association of Northern California held its regular dinner meeting, April 14. The dinner was followed by an illustrated talk on "Bridges," by F. W. Panhorst, acting bridge engineer, California Division of Highways.

Mr. Panhorst reviewed the organization and operations of the bridge department, pointing out that both design and construction of bridge structures are carried out by his department, as distinct from the procedure in some states where only the design work is done by the bridge department and construction is left to the district offices. His talk included remarks on recent timber construction, concrete arches and steel designs and stressed the details which were of interest to structural engineers.

Outstanding among the several major construction projects now under way in the West is the Bonneville power and navigation development being built by the U. S. Engineers on the Columbia River about 40-mi. above Portland. The undertaking naturally divides itself into two major units: (1) the main spillway dam in the north channel and (2) the powerhouse and ship lock in the south channel. Since bids were opened in 1934, *Western Construction News* has covered both divisions of the project with the group of articles listed on another page. We now present a comprehensive two-part review of the design and construction of the main dam.—EDITOR.

BONNEVILLE MAIN DAM

A two-part review of the design and construction methods and the laboratory and field technique for handling 600,000 cu. yd. of concrete



I—Construction Procedure Reviewed

Features of timber-crib cofferdam program, dam design, foundation, grouting and gates—Summary of costs and equipment

By B. E. TORPEN
Construction Engineer
Bonneville Project

THE MAIN DAM of the Bonneville power and navigation project on the Columbia River about 40 mi. above Portland is a concrete gravity structure about 1,100 ft. long, equipped with eighteen spillway gates designed to pass an estimated flood peak of 1,200,000 sec. ft. The head on the dam will vary from 75 ft. at low water stage to 30 ft. during floods. This structure, which will cost $16,749,000, is located in the north (Washington) channel while the other major feature of the project being carried out by the Corps of Engineers, is the powerhouse and the navigation lock in the south (Oregon) channel. Previous articles on preliminary phases of this major western project which have appeared in *Western Construction News* are noted in the accompanying table. This article deals with the general design features and the construction procedure on the main dam, and is followed by a review of the concreting operations and the concrete technology.

Soundings in the North Channel

The original north channel of the Columbia River at the site for the spillway dam was 800 ft. wide by 50 ft. deep with a flow of 100,000 sec. ft. (exceeded 75% of the time). The river bed was strewn with boulders up to 30 ft. in diameter and lead line soundings proved inaccurate by 5 to 10 ft. and failed to disclose the size and shape of the boulders. A 32x80-ft. steel barge was rigged up with a head frame to steady four sounding roads of 3-in. extra heavy pipe on 4-ft. centers. These rods were operated by a three-drum hoist, and to prevent bending in the 8-ft. per sec. current, were housed in a 6-in. extra heavy pipe casing extending to within 10 ft. of the bottom and anchored upstream to the barge with a stay line. A second three-drum hoist controlled the anchor lines and the barge could be spotted very accurately and quickly to a tag line acros the river on coördinate points. The base for a 60x60-ft. crib could be sounded on 4-ft. centers each way in one day with the crew of ten men. As many as 300 soundings have been made in one 8-hr. shift. When boulders were encountered, the soundings were taken at 2-ft. centers. Soundings were read by this rod method to tenths of a foot in 60 ft. of water, and check soundings always showed a high degree of accuracy.

In the center of the channel bed rock was relatively high, under only a few feet of gravel and boulders. A 5-yd. dipper dredge removed most of the overburden and some bedrock pinnacles. Near each shore the rock dipped and the overburden depth increased to 50 ft. The dredge could reach only to elevation minus 30, so the shore legs

Inside the unwatered south cofferdam for the main spillway dam. An idea of the tremendous size of the cribs may be obtained from this view.

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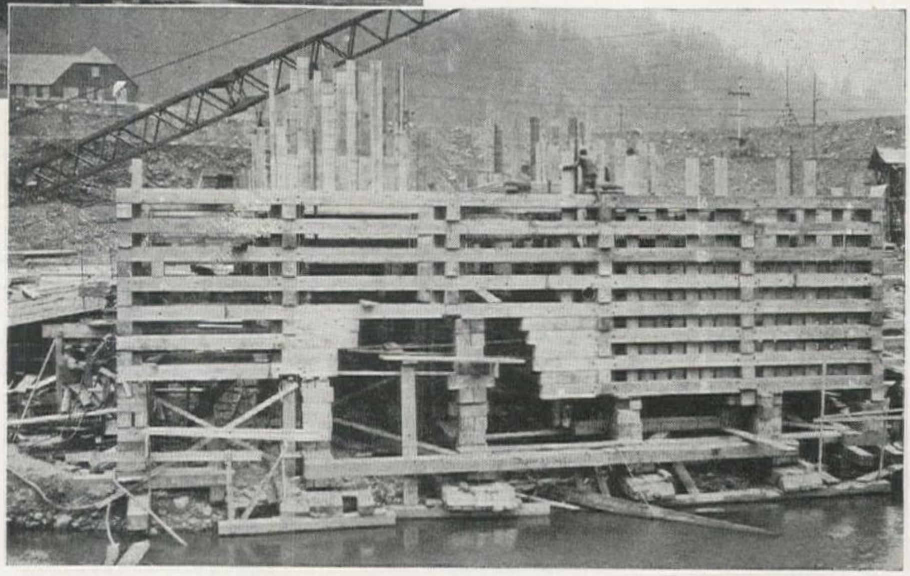


Special sounding equipment determined the topography of the excavated river-bed, 1-ft. contours were plotted and the cofferdam crib base then constructed to conform to the river bottom at the point where the particular crib was to be located. This kept leakage to a minimum.

of the cofferdam rest on 10 to 20 ft. of overburden. After the largest boulders were drilled and shot, the dredge cleared off the material. Final soundings were then taken. One-foot contours were plotted from the soundings and the bottoms of the cofferdam cribs designed to fit.

Cofferdam program

The cribs were built of 12x12-in. timbers, drift bolted; vertical timbers were bolted in the corners. Diagonals braced the timbers to which the four holding attachments were bolted—each attachment designed for a 200,000-lb. pull. More than 10,000,000 F.B.M. were used in the cofferdams.

Cribs were constructed on ingenious launching ways which were controlled by cables supported by piling, so that they could be lowered as the crib was built up, and each crib launched by simply lowering the ways. Towed to position, the cribs were built up to full height. Four weight pockets were then filled with bank run materials from common excavation and the crib seated firmly on the river bottom. In case of trouble, inspection was made by divers.

Dryside pockets were filled to a depth of 10 ft. with rock to provide drainage, and all the other pockets were filled with bank run, except the wetside row which was left open until the interlocking steel sheet piling had been driven. This row was then filled with impervious materials. In general the steel piling was driven 3 ft. into the bed rock. A 6-in. deck was boat-spiked to the top timbers and strapped down with cables to withstand overtopping by the flood. Cribs varied in size from 40x60 ft. by 40 ft. high near the shore, to 80x60 ft. by 75 ft. high in the deepest part of the channel. For more details on this cofferdam design and construction see *Western Construction News,* January, 1935.

After the flood receded in August, 1935, to the top of the cribs at El. 92, several 200 h.p. pumps were installed, and the 8-acre enclosure unwatered. Seepage was about 100 sec. ft. at first, but sealing operations, and toe and shore fills of impervious materials reduced this materially. For weeks the seepage averaged only 17 sec. ft.

The south cofferdam was constructed first, and to date, the excavation there has been completed, the concrete base is placed to El. —8, the piers carried up above flood level with structural steel to the completed deck level, the south coffer removed, and the north coffer completed and ready for the June-July flood.

This fall after the floods have receded, the north half of the river bed will be unwatered, and the north half of the dam completed.

The third and final step will be the placing of bulkheads between the piers of the south half, and bringing the ogee section up from El. —8 to the crest at El. 24.

Main dam design

The main dam at Bonneville is a concrete gravity section resting on "Eagle Creek" bedrock at El. —50; the crest of the ogee spillway is at El. 24, and the deck of the dam at El. 95. Tailwater will vary from El. 5 to El. 85, and the head on the dam will vary from 75 ft. at low water to 30 ft. during floods. Due to the narrow channel and the necessity of providing spillway capacity of 1,200,000 sec. ft. (the maximum recorded flood), the gates were made 50 ft. deep by 50 ft. wide with heavily reinforced piers only 10 ft. wide to conserve space. The piers are from 70 to 120 ft. high, and encase structural steel towers which anchor the heavy gate track beams.

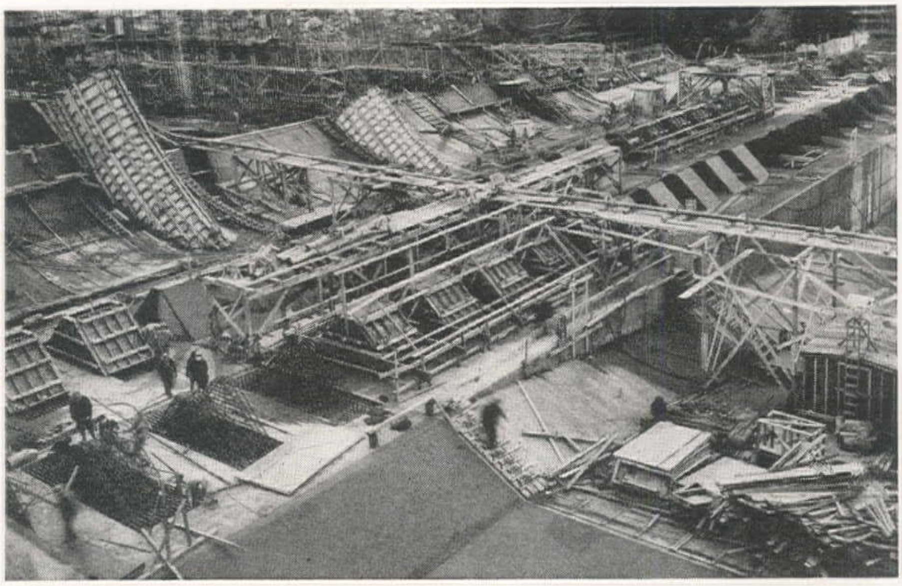
The dam apron is at El. —16, and its reinforced surface is broken by 6x14x6-ft. sloping baffles of reinforced concrete in two rows, staggered, to break up the high velocity of floods, and produce a standing wave on the apron. Baffles were selected after exhaustive tests on models at the hydraulic laboratory in Portland. Incidentally, hydraulic models were very largely used to determine crib construction and closure, cable strains, revetment, channel enlargement, and to solve all kindred problems.

A secondary apron of reinforced concrete 6 ft. thick and 77.5 ft. wide placed directly on the rock, downstream from the main apron, as a further protection to the foundations.

Inspection galleries traverse the gravity section, and foundation drilling and grouting were carried on from the upstream gallery. Grout outlet boxes were placed on the upstream wall of the cut-off trench to be grouted to reduce seepage if this joint should open

MAJOR ARTICLES ON THE BONNEVILLE PROJECT

Unit Bid Figures



A feature of the downstream apron is a special baffle deck supporting two rows of 6 x 14 x 6-ft. reinforced concrete sloping baffles on a staggered spacing. The purpose of these baffles is to dissipate the high velocities of floods. The large amount of reinforcing steel used in each baffle is seen in the left foreground.

up. A 2x2-ft. gravel filled drain runs the length of the dam about 15-ft. downstream from the main gallery, with pipe outlets to the gallery to reduce uplift under the dam.

Grouting

Grout holes extend 50 ft. below the 10-ft. deep cut-off trench and are spaced at 5-ft. intervals. Holes were drilled and grouted 20 ft. apart at first; then the intermediates at 10 ft.; finally, where warranted, the 5-ft. spaces were drilled and grouted with 5 to 1, or 3 to 1, mortar, at 100 lb. pressure. From 1 to 375 sacks of cement were required per hole, with an average of 25.

Contraction joints in the main dam, provided at 60-ft. intervals, are placed midway between the piers, and extend from bedrock to the ogee crest. Shear keys equal to one-half the area are provided and grout boxes are placed at 10-ft. centers to facilitate grouting of these joints after the dam has cooled.

Geology and foundations

The "Eagle Creek" bedrock is made up of three different rock types: (1) conglomerates of rounded, andesitic pebbles up to 6-in. in diameter in a matrix of rock fragments, sand, and clay-like material, derived from the original material by hydration; (2) sandstone composed of angular mineral and rock fragments, and united with the same matrix; and (3) the so-called "bentonite," composed largely of this clay-like hydration product but usually with more or less admixed sand. There is a wide variation and gradation, but all types are well consolidated, and have a hardness between that of sandstone and shale. Upon exposure, the bedrock begins to dry out and scale after a few hours.

The crushing strength averages 800 lb. per sq. in., and should be adequate as the dam load is uniformly about 100 lb. per sq. in., due to a wide section with the resultant force passing through the base very close to the center of the section. The dip of the rock is about 3½ deg. southeast, or upstream, which is favorable to prevent sliding and shear.

The specifications require the bedrock to be kept wet after trimming, and concrete to be placed upon it within 48 hr. to prevent deterioration. About 10 ft. of rock was excavated over the whole area with cut-off trenches upstream and downstream. The base was explored to a depth of 50 ft. with 3-ft. calyx drill holes, and in general displayed no marked weakness. Under blocks 17 and 18 at El. —80, there was a 3-ft. shear zone of soft material which was considered dangerous for sliding. The cut-off trench was enlarged there and extended down through the seam and filled with reinforced concrete to develop enough shear to prevent sliding.

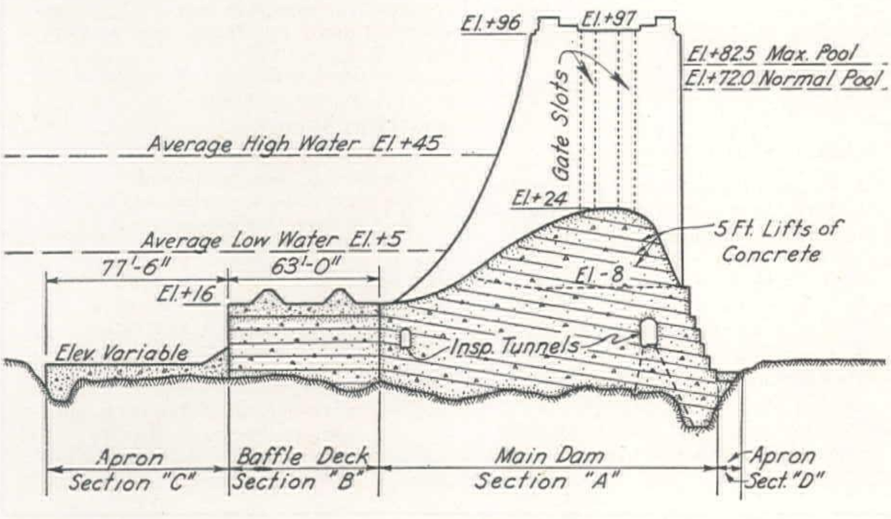
With 18 spillway gates, the dam is 1,090 ft. long, including a reinforced fishway structure 60 ft. wide at each end, beyond which a reinforced concrete wall extends into each abutment for a cut-off. A reinforced concrete wall extends upstream to guide the waters into the spillway gates and to protect the backfill from scour. The wall is on a slope and is supported by counterforts 150 ft. high resting on a continuous reinforced slab 6 ft. thick placed on bedrock.

Gates

Of the 18 spillway gates, three at each end are 60 ft. high above the crest of the spillway, and will be operated only to pass extreme floods. The 12 middle gates are 50x50 ft., and weigh 550,000 lb. each. The water load on each gate is 4,000,000 lb., and the coefficient of friction between the guide and wheel was assumed to be 1.5% for design purposes. Tests on the wheel assembly, however, gave the low coefficient of 0.5%, which gives the 350-ton cranes a comfortable margin of safety. For convenience of operation, the gates are divided into two sections which may be lifted separately or together. The track plate is of nickel steel, and the tolerance in alignment is 0.01-in. per 5 ft. of length. Each gate has 24 roller bearing wheels, 27 in. in diameter with 10-in. face width, each weighing more than a ton, and designed to carry a load of 200,000 lb. The total weight of the gates is about 10,000,000 lb., and probably constitutes the largest single group ever built for a dam.

Excavation

A large part of the 1,800,000 cu. yd. of common excavation for the main dam resulted from the narrowness of the site. Space for sufficient spillway and channel width was achieved by excavating into the banks about 250 ft. on each side. The material was rather gravelly with many large boulders, many of which were drilled and shot. Subaqueous excavation was accomplished by an 8-yd. Monighan dragline with 150-ft. boom loading into 25-yd. Le Tourneau buggies. Two to 5-yd. shovels, and 8-yd. trucks were used on



A typical cross section through the main spillway dam. Each block is constructed in four sections; the main dam, the baffle deck, the downstream apron and the upstream apron. In most cases concrete is poured in 5-ft. lifts at 72-hr. intervals.

ESTIMATED QUANTITIES AS OF APRIL 1, 1936

No.	Items	Unit	Est. Units 1936	Average Price	Estimated Amt. 1936	Original Est. 1934
1	Earth excavation (all kinds)	Cu. Yd.	1,800,500	$0.7043	$1,268,200	$1,319,000
2	Rock excavation	Cu. Yd.	334,200	2.2286	744,700	915,000
3	Backfill, levees, etc.	Cu. Yd.	625,000	0.3206	200,300	272,500
4	Rock revetment	Cu. Yd.	116,500	1.811	210,900	170,000
5	Cofferdam excavation	Cu. Yd.	78,000	4.80	374,400	72,000
6	Cofferdam lumber	M Ft. B.M.	10,500	105.00	1,102,500	750,000
7	Cofferdam crib fill	Cu. Yd.	225,000	0.75	168,800	135,000
8	Steel sheet piling	Sq. Ft.	141,000	2.28	321,800	207,000
9	Toe and shore fill	Cu. Yd.	250,000	0.30	75,000	60,000
10	Cofferdam removal	Cu. Yd.	236,000	1.20	283,200	216,000
11	Pumping	Ac. Ft.	60,000	6.00	360,000	360,000
12	Concrete Class A (main dam)	Cu. Yd.	82,935	11.00	912,300	495,000
13	Concrete Class A (fishways)	Cu. Yd.	82,450	12.00	989,400	600,000
14	Concrete Class A (architectural)	Cu. Yd.	2,300	30.00	69,000	45,000
15	Concrete Class B	Cu. Yd.	374,500	4.60	1,722,700	2,300,000
16	Reinforcing steel	Lb.	32,000,000	0.048	1,536,000	576,000
17	Structural steel	Lb.	7,207,200	0.0854	615,500	345,200
18	Overhaul	Sta. Yd.	22,000,000	0.0125	275,000	25,000
19	Rehandled material	Cu. Yd.	400,000	0.40	160,000	
20	Miscellaneous				168,000	109,950
	Total—Contract				$11,557,700	$8,972,650
	Other Items					
1	Gates and cranes				1,500,000	
2	Design and supervision				1,440,000	
3	Prelim. exploration, etc.				800,000	
4	Work orders, force acct., etc.				575,000	
5	Cement				877,000	
	Approximate Total Cost of Main Dam (only)				$16,749,700	

Organization Personnel

The dam employs about 1,500 men working on a 3-shift basis. Edgar F. Kaiser is general manager for the Columbia Construction Co., and C. P. Bedford is general superintendent. Government forces include: O. C. Hartman, engineer; three associate engineers as supervisors; four survey parties; and numerous inspectors.

Corps of Engineers Staff

Design and construction of the Bonneville Project has been performed by the Portland Division of the Corps of Engineers, U. S. Army. Col. T. M. Robins is division engineer; Lieut. Col. C. F. Williams, district engineer, with headquarters in Portland; and Capt. J. S. Gorlinski is resident engineer at Bonneville. Civilian engineers connected with the work are: C. I. Grimm, head engineer; A. E. McKennett, principal engineer; and R. R. Clark, design engineer.

The consulting board included J. P. Hogan, L. F. Harza, Louis C. Hill, Dr. C. P. Berkey and the late D. C. Henny. Dr. E. T. Hodge and C. P. Holdredge are geologists for the project, and J. C. Stevens is consultant on hydraulic models with A. J. Gilardi in charge of the tests.

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the general excavation and rock excavation. Details of this excavating equipment are given in the table on this page.

Fishways

Salmon fishing on the Columbia River is an important industry, and every effort has been made to facilitate the migration of fish over the dam. Designs have been approved by state and national fish and game commissions, and the installations include elaborate fish ladders and hydraulic elevators of great size. These structures alone cost more than $2,000,000.

Quantities

Preliminary plans were issued and construction work begun on the Bonneville Dam with very limited exploratory data. Further studies, changed conditions, and changes in fishway designs resulted in a considerable increase in quantities above the original estimates as may be seen by the accompanying table.

Equipment

The Columbia Construction Co. holds the general contract for building the dam and has assembled about $1,000,000 worth of equipment, some of the principal items of which are indicated in the table on this page.

MAJOR UNITS OF EQUIPMENT

1—8-cu. yd. electric Monighan dragline.
1—5-cu. yd. Burrard steam dipper dredge.

SHOVELS AND WHIRLEYS

1—75-B electric Bucyrus-Erie, 2½ yd.
1—48-B Diesel Bucyrus-Erie, 2 yd.
1—43-B Diesel Bucyrus-Erie, 1¾ yd.
1—16-B gas Bucyrus-Erie crane.
1—Marion dragline, 5 yd.
1—Marion electric, 3½ yd.
1—Marion electric, 2½ yd.
1—P. & H. Diesel shovel, 1 yd.
1—10-ton electric American whirley.
2—Electric Wiley whirleys.

TRACTORS—Caterpillar Diesel tractors

11—75 h.p., 2—95 h.p., 1—60 h.p., 1—40 h.p.

LeTourneau excavation buggies—8-25 cu. yd.

TRUCKS AND CARS

2—12-yd. International dump trucks.
11—8-yd. International dump trucks.
3—3-ton International flat rack trucks.
3—9-yd. G. M. C. dump trucks.
6—1½-ton Ford flat rack trucks.
14—½-ton Ford pickups.
6—Chevrolet sedans.

2—McKiernan-Terry pile hammers.
2—Vulcan pile extractors.
18—Hoists of various sizes: Ingersoll-Rand, Washington, American and Clyde.

2—20-ton cableways—2,025-ft. span—Tail tower height 225 ft.—Two traveling head towers of 90-ft. height—Designed for 8-yd. concrete buckets.
4—4-yd. Smith concrete mixers, with 10-h.p. Westinghouse motors.
2—8-in. double-acting Pumpcrete machines—Chain Belt Co.
41—Pumps of various sizes and descriptions, mostly electric and gas-driven. Ingersoll-Rand, Rex, Byron-Jackson and Cameron.

CONCRETE RAILWAY

1—10-ton Davenport gas-electric locomotive.
3—80-h.p. electric locomotives—Manufactured by Six Companies Inc.
2—8-yd. concrete cars — Manufactured by Pacific Car & Fdry. Co.
1—Diesel Industrial Brownhoist locomotive crane.

COMPRESSORS

1—300-h.p. Ingersoll-Rand.
1—150-h.p. Ingersoll-Rand.
5—Ingersoll-Rand electric.
2—Gardner-Denver electric.
1—Kellogg.

WELDERS

10—300-amp. Lincoln electric.
3—P. & H. Hansen electric.
2—General Electric.

DRILLS

1—Ingersoll-Rand Calyx core drill—36-in. core—50-ft. depth.
Various small Ingersoll-Rand drilling tools.

II—Concreting Technique

Review of materials, mixing plant and placing—Design of mixes and laboratory testing procedure

By IRWIN E. BURKS
Chief Concrete Technician
U. S. Engineer Department

THE volume of concrete in the Bonneville Project totals about 1,000,000 cu. yd. Of this total amount about 600,000 cu. yd. are in the main spillway dam and connecting fishways and the remainder is in the power house, navigation lock, railroad and highway, and miscellaneous structures. For the main spillway dam and connecting fishways portland-puzzolan cement was specified, while in all other concrete structures a standard portland cement conforming to Federal Specifications SS-C-191 is used. This article pertains only to that section of the work in which portland-puzzolan cement is used.

Portland-puzzolan cement

Investigations made prior to the beginning of concrete work in the main spillway dam indicated the probability of cracks in the more massive sections if the construction was carried out under conditions of ordinary practice, using portland cement of normal chemical composition. The investigations also indicated that a portland-puzzolan cement, made by intergrinding portland cement clinker with 25% of a calcined puzzolan, possessed distinct advantages over ordinary portland cement in: (a) greater workability, (b) less water gain, (c) greater impermeability, (d) more rapid rate of heat hydration at the early ages but lower ultimate heat, and, (e) greater resistance to the action of aggressive waters.

Aggregates

The most desirable location for a concreting plant near the damsite was on the Washington shore of the Columbia River. This was due to the congestion of transportation and construction facilities on the opposite or Bradford Island shore, where work was already under way on other phases of the project. These features indicated the necessity for locating a suitable source of aggregate supply on the Washington shore. Investigations and search for suitable sand and gravel deposits was started early in 1935 and took in the country between Vancouver, Wash., and a point about 75 mi. up-river from the damsite. After several locations had been investigated and rejected, a satisfactory sand pit was located in the hilly district just north of Bingen, Wash., and a suitable gravel bar was discovered on Rabbit Island which is located in the Columbia River about 5 mi. above The Dalles, Ore.

The Bingen sand is a sedimentary deposit and the quantity available is practically unlimited. The deposit is highly stratified and it was necessary to develop a working face of from 30 to 50 ft. in order to obtain uniform grading. The pit is within a half-mile of the S. P. & S. tracks at Bingen, Wash., where a loading ramp was constructed. Sand is loaded at the pit with a ¾-yd. shovel and hauled to Bingen in 3-yd. trucks. The railroad haul to the damsite is 26 mi.

The Rabbit Island gravel deposit is also on the S. P. & S. railroad and is 54 mi. up-river from the damsite. At one time it was an island bar in the Columbia but at present is joined to the Washington mainland and is accessible by road and rail. The natural grading of the gravel varies over a rather wide range for different areas of the deposit. However, this is overcome by loading from the locations containing the sizes required to keep the stock piles at the aggregate plant in proper balance. The raw material carries an average of about 22% of fine sand (90% passing No. 28 sieve) which blends nicely with the coarser sand from the Bingen deposits and results in a very satisfactory finished product.

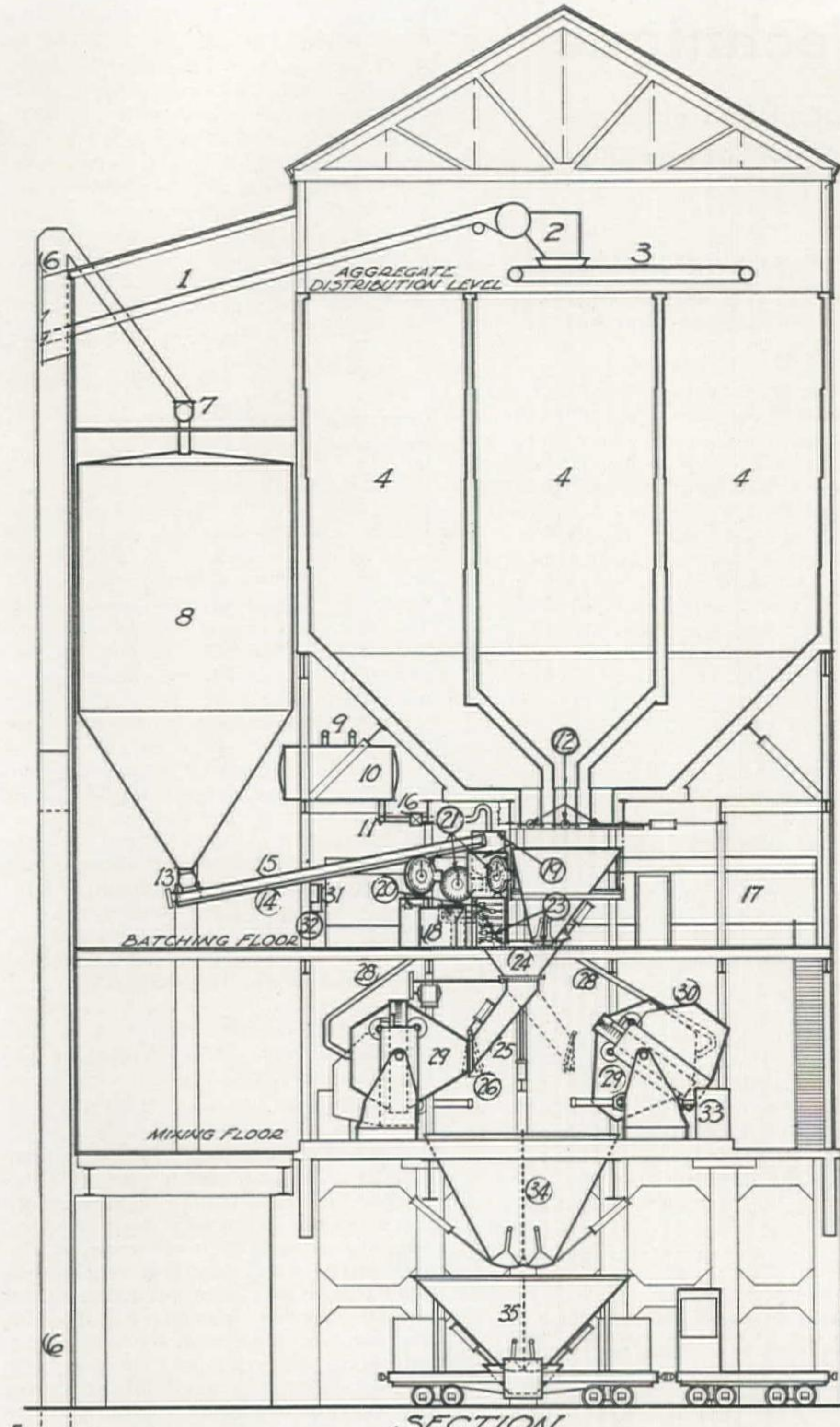
Compacting of concrete was accomplished with various types of pneumatic vibrators. Four of these types are being used in this illustration.

Concreting plant and placing methods

The aggregate plant and central mixing plant are at North Bonneville, Wash., and are located between the main line of the S. P. & S. railroad and the Columbia River and just west of the north end of the spillway dam. The general arrangement of the plant is best understood by a study of the plant diagram shown in an accompanying illustration.

The central mixing plant has a capacity of about 240 cu. yd. per hr. at 3-min. mixing time, through four 4-yd. mixers. The batching of sand and four different sizes of gravel is accomplished by cumulative weighing in a single hopper, while the cement and water are batched by weight in individual hoppers. The aggregate scales have a capacity of 6,000 lb. and a separate beam for each material. The cement and water scales have a 3,000-lb. capacity and a single beam for each unit. The entire system is automatic and all operations, such as the weights of different materials, consistency of concrete, mixing time, etc., are graphically recorded.

The concrete is delivered to hopper cars at the plant and hauled by electric locomotives over standard gauge track to the cableway loading dock which is situated approximately on the axis of the dam. At the dock the cars discharge into concrete buckets of 8 cu. yd. capacity which are carried to the point of placement by two 25-ton cableways. The cableway span is about 2,025 ft. from the fixed tail-tower on the Washington shore to the movable head towers on Bradford Island. For heavy mass work on open sections the 8-yd. buckets dump directly into the forms. For smaller sections and heavily reinforced work the buckets dump into Pumpcrete hoppers. From this point concrete is conveyed by pipe line to the point of placement. Chutes and "elephant trunks" are also used in certain locations which are inaccessible by any other practicable method. The puddling and compaction of concrete in the forms is accomplished by pneumatic vibrators which operate at about 9,000 r.p.m. at 80 lb. air pressure. From 2 to 5 machines are used by each concrete gang—the number depending on the rate of delivery of concrete, the consistency, and the type of section being placed.



In cross section the main dam is divided into four construction blocks. These four divisions are clearly indicated in the accompanying illustration. With but few exceptions all sections are carried up in 5-ft. lifts with an interval of 72-hr. between lifts.

Specifications for concrete and aggregates

The specifications for the project require that the cement shall be furnished by the Government. The usual requirements for quality of aggregates are included and the separation of sizes specified to be as given in the following:

Designation	Size (Square Openings)
Sand	0 to ¼ in.
No. 1 (Pea)	⅜ to ¾ in.
No. 2 (Medium)	¾ to 1½ in.
No. 3 (Coarse)	1½ to 3 in.
No. 4 (Cobbles)	3 to 6 in.

The compressive strength of the concrete for various parts of the structure is required to be in accordance with the following:

Class	Location	Compressive Strength lb. per sq. in. (at 28 days)
A	Mass sections and thick footings	2,000
B	Medium heavy walls, piers, etc.	3,000
C	Slabs, beams, baffles, wearing surfaces	4,000

While the specifications require accurate control of the quantity of mixing water and provide for adjustments to compensate for moisture in the aggregates, the amount of mixing water may be varied within a reasonable range to obtain concrete of proper consistency. The value of plastic consistencies is recognized and the slump is limited to 3 in. for mass concrete and 6 in. for thin reinforced walls and slabs and in locations where placing is difficult.

A CROSS-SECTION through the concrete mixing plant for the main dam at Bonneville. Principal features of this installation are indicated in the following legend which refers to numbers appearing on the drawing.

1—Belt conveyor from aggregate stock bins.
2—Terminal hopper of aggregate conveyor.
3—Reversible-radial-belt conveyor.
4—Nine 200- cu. yd. aggregate bins.
5—Screw conveyor from cement unloading hopper.
6—Bucket elevators-double lift-cement.
7—Screw conveyor distributing cement to silos.
8—Three cement storage silos 2,000 bbl. each.
9—Water supply from tank and heating boiler.
10—Four 1,500 gal. batching water tanks.
11—Water lines-tanks to batchers.
12—Twelve aggregate batcher charging gates.
13—Four rotary cement feeders.
14—Two screw conveyors for fast cement batching.
15—Two screw conveyors for slow cement batching.
16—Two water batching valves.
17—Electric switch and control panels.
18—Operators control panel.
19—Two each accumulating weighing batchers.
20—Two each scale beam weight controls.
21—Two each accumulating scale dials.
22—Six materials batch weight recorders.
23—Six batcher discharge gates and operating units.
24—Two batch hoppers-dry materials.
25—Two swivel mixer charging chutes.
26—Closure collars and operating units.
27—Two swivel water charging units.
28—Four mixing water lines to mixers.
29—Two pairs 4 cu. yd. "Smith" tilting mixers.
30—Electric mixer driving units.
31—Mix consistency meters and recorders.
32—Mix timers and meters.
33—Mixer tilting units.
34—Two double concrete hopper units.
35—Electric "dinkey" unit transportation to cableways.

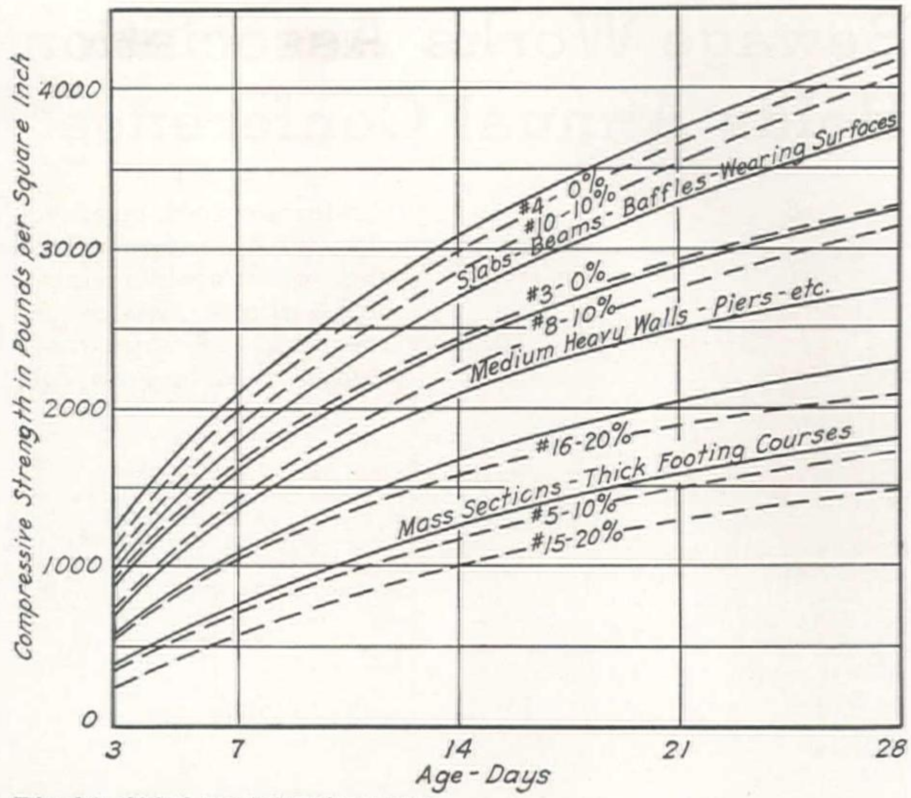
TABLE I—PROPORTIONS OF MIX AND BATCH QUANTITIES FOR VARIOUS TYPES OF CONCRETE

Mix No.	Class Symbol	C/F Bbl./ Cu. Yd.	Sand/Gravel Ratio	Water Cement Ratio	Slump (Field)	Mixer Batch (Lb.) Cement	Sand	Gravel	Water	Yield (Cu. Yd.)
1	BM-0	2.71	100-0	0.80	10″	2040	4410	....	1080	2.00
3	B-2	1.37	40-60	0.90	4″	2070	5310	7950	1240	4.02
4	A-2	1.55	40-60	0.80	5″	2390	5300	7970	1260	4.09
5	C-3	0.97	35-65	1.10	3″	1480	5100	9460	1080	4.07
8	B-3	1.20	35-65	0.90	3″	1830	4940	9160	1090	4.05
10	A-3	1.44	35-65	0.80	3″	2180	4740	8800	1160	4.04
15	C-4	0.87	30-70	1.15	3″	1360	4530	10560	1040	4.14
16	C-4	1.00	30-70	1.00	2½″	1520	4400	10270	1010	4.06

Mixture design

Laboratory experiments to determine the best combination of materials to use to produce concrete of the required strength and other properties were begun as soon as the source of aggregates was definitely decided and a supply of the portland-puzzolan cement was available. A sufficient number of test pits were dug at Bingen and Rabbit Island to develop the average grading and other physical characteristics of the sand and gravel. From the information thus obtained the permissible range in gradation for the fine and coarse aggregate was established. The grading of the finished sand was required to fall within the definite limits indicated. Previous experiments had proved that in any combination of coarse aggregate the proportions of different sizes could be manipulated within a certain range without effecting the strength of the concrete and with only slight influence on the cement factor. In order to conform as nearly as possible with the natural grading of the run-of-pit gravel and thus avoid waste of material, three grading curves were established for each of the three combinations of sizes. The maximum size of gravel to be used in any part of the concrete work is specified by the Government but any one of the three combinations indicated on the charts, reproduced in the illustration shown, may be used with the maximum size specified.

With the characteristics of all materials established, the first step in mixture design is the calculation, in accordance with the fineness modulus method, of the proportions of cement and fine and coarse aggregate to produce the strength of concrete and the consistency desired. The various ingredients are put together in the calculated amounts and mixed in ¾-yd. mixer at the laboratory. The resulting concrete is examined and its workability and texture judged by its appearance and the effort required to puddle and mold it into test specimen forms. Corrections in workability are made by arbitrary manipulation of the proportions of the sand and gravel and the approach to ideal workability is made in trial steps without changes in the amount of cement and water. When the proper proportions have been worked out by trial, the yield, cement factor, and density are calculated according to the absolute volume of materials and these figures checked by actual measurements. Check batches are mixed on separate days and from 30 to 40 specimens are made for strength test for each class of concrete. With the basic mixtures developed, attention is turned toward the mechanics of using them in the contractor's mixing plant. Tables are set up which give the amount of the various ingredients for a full mixer batch, and charts showing the strength of the various mixes at different ages are prepared in order that the proper class of concrete for particular sections may be conveniently selected. A rather large number of concrete samples are taken during the early stage of production in order to check the strength of plant mixed concrete with the designed strength and also to develop a strength curve for the early ages.

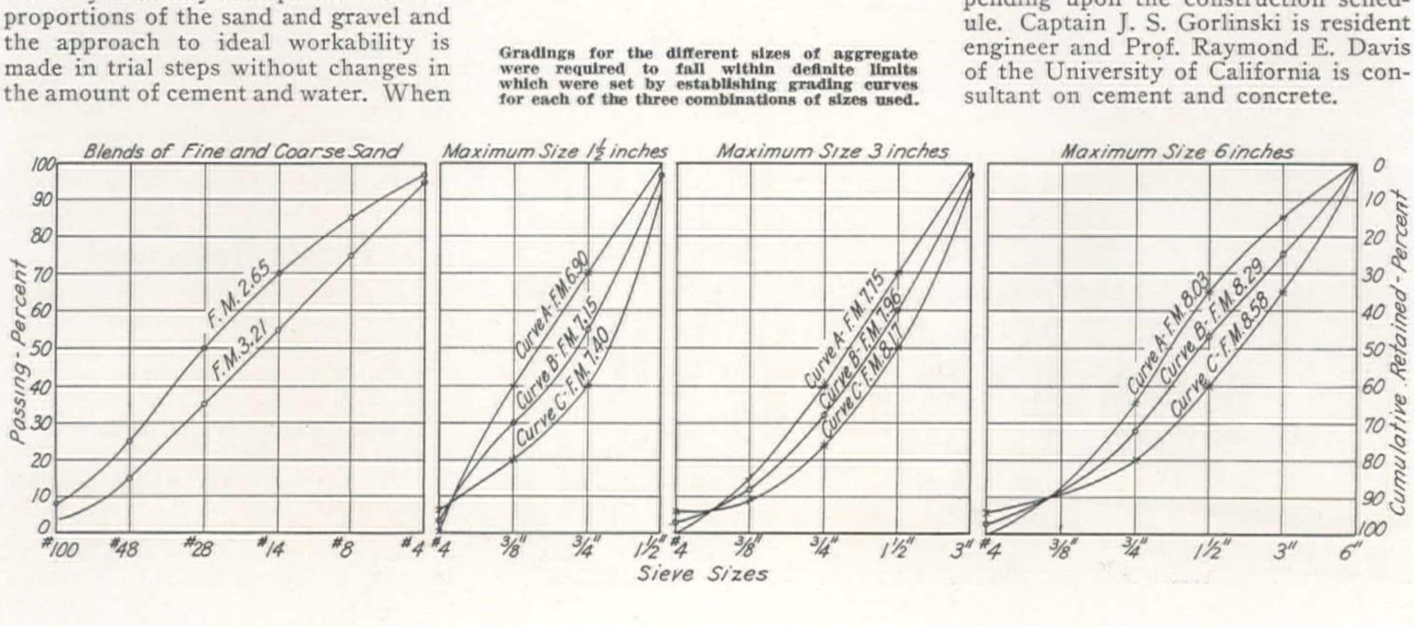


Using data obtained from test specimens made when designing the various mixes by trial, curves of compressive strength vs. age are drawn. These charts are of great value in selecting the type of concrete to be used for various sections of the dam.

Inspection organization

The inspection and control of all concreting operations on the entire project is handled by a separate organization known as the Concrete Division which reports directly to the resident engineer through the chief concrete technician. The work of the department includes the approval of design and the inspection of all plant operations, the inspection of materials, and the mixing, transportation, placing and curing of concrete. From twenty to fifty inspectors are employed depending upon the construction schedule. Captain J. S. Gorlinski is resident engineer and Prof. Raymond E. Davis of the University of California is consultant on cement and concrete.

Gradings for the different sizes of aggregate were required to fall within definite limits which were set by establishing grading curves for each of the three combinations of sizes used.



Sewage Works Association Holds Annual Conference

California group approves plan for operators' school and voluntary licensing—Eight plants visited and described—Annual merit award goes to Palo Alto

ACTION pointing definitely toward the establishing of an annual short course of instruction for sewage plant operators and the initiating of voluntary registration for plant operators featured the eighth spring conference of the California Sewage Works Association held in Ontario, April 24 and 25. With a registration of 115 and an attendance reaching about 140, the meeting was one of the most successful held by the association and indicated an expanding interest in the organization and its program. The regular fall meeting will be held in conjunction with the California League of Municipalities in Santa Monica in September.

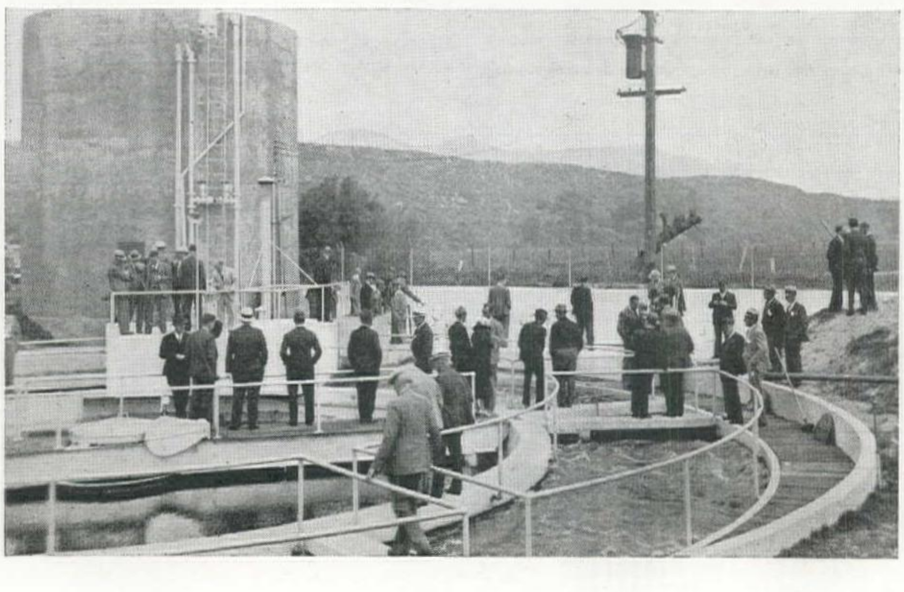
Both mornings were devoted to visits to local treatment plants, followed by the description of these plants and their operations as part of each afternoon program. Plants visited were: Pasadena, Whittier, Pomona, Ontario, San Bernardino, Redlands, Colton, and an orange pulp dryer installation in Ontario.

Committee reports

Following a year's study, the committee on the desirability of establishing a school for operators, Harold F. Gray, chairman, reported that personal contacts on the part of the committee, among operators and city officials, indicated interest in the subject sufficient to recommend the starting of such an annual school and the definite fact that from 20 to 25 operators could be expected to attend the first school. Further, the committee believed that action on the instituting of voluntary licensing would provide additional interest in the school.

Definite recommendation of the committee included: (1) establishment of a school for sewage plant operators, (2) first school to be held in Southern California, near Los Angeles, and then alternating with Northern California, (3) time should correspond with the spring or fall meeting of the association, (4) registration fee should not exceed $10, (5) the association should contribute financially, if possible, (6) sponsorship needed further study, (7) the course of instruction should be thoroughly practical. The committee asked that a new committee be appointed to study the important subject of curriculum and teachers. The amount of work left to be done indicates that it will be difficult to get the plan ready for the coming fall meeting. Recommendations of the committee were approved by the convention.

Following the adoption of a resolution approving the principle of voluntary registration of operators at the meeting last fall, the committee, A. C. Beyer, chairman, studied the subject in detail and rendered a report which included a definite classification to be followed in the issuing of licenses. Using the size of community as a basis (5,000, 100,000, and more than 250,000 population) operators would be licensed separately for: (1) plants providing complete treatment, laboratory, etc., (2) plants providing intermediate treatment and (3) all plants (regardless of population) providing only for screening. Provisions in the report including the usual "grandfather clause," examinations in the future, annual license fee of $1. Discussion included the desirability of having such terms as "operator" and "experience" better defined. The report was accepted and a new committee will study the subject further, probably coödinating its work with that of the new committee on the operators school.



Group inspecting the activated sludge plant at Colton on the second morning trip of the conference. The visits also included the plants at San Bernardino, Redlands, Pasadena, Whittier, Pomona and Ontario.

President Rawn adds footage to his pictorial history of the inspection trips of the Association.

The report of the safety committee, on regulations for working in sewers, with special reference to gaseous conditions was read and approved. T. F. Eastman is chairman.

Award of merit

The committee on the annual award of merit, presented to the plant which has been outstanding for operating efficiency and results during the past year, considered three reports and gave the award to Palo Alto, with honorable mention to Whittier. J. F. Bxybee is city engineer of Palo Alto and Jack Kimball is plant operator.

The award committee, consisting of Prof. C. G. Hyde and Prof. Leon B. Reynolds, which has served for several years, asked to be replaced by a rotating committee consisting of the plant operators or responsible official from the cities receiving the last three awards. This plan will be considered in detail by the executive committee.

Plants Reviewed

Interesting statements made by plant operators concerning the plants visited during the caravan trips on the two forenoons are summarized in the following.

Whittier plant—M. R. Bowen, city engineer. This Imhoff tank and trickling filter installation which handled an average flow of 1.2 m.g.d. had operating costs of $7,546 for 1935 and a revenue of about $2,000 obtained by the sale of dried sludge and the chlorinated effluent for irrigation. Screenings are incinerated.

Pomona plant—F. C. Froehde, city engineer. This 10-yr. old Tri-City plant of the activated sludge type has an average flow of 1.16 m.g.d. The chlorinated effluent is sold for irrigation of walnut and avocado groves and this has presented a peculiar problem because of the boron content in the effluent, coming from the borax wash water of an orange packing house. The situation has been met by getting the packing house to dispose of this wash water separately. Operating costs in 1935 were $6,555 or a gross figure of $15.60 per million gal. Revenue from effluent was $900 and the sale of dried sludge amounted to $658, which two sources of revenue reduced the gross cost of treatment by about $4 per million gallons.

Ontario plant—Austin Burt, city engineer. This activated sludge plant with separate sludge digestion and gas collection has been operating lately to reduce the B. O. D. of 261 in the raw sewage to 7.3 in the final effluent, a reduction of 97.2%. The dissolved oxygen in the effluent over the weir is running about 4.36 to 4.68 p.p.m. The possibility of selling effluent for irrigation involves the installation of a 50 h.p. booster pump, but is being considered. As an experiment to test the possibility of increasing gas production in the digester, orange pulp from a local processing plant was added directly to the digester and raised the production from 18,000 to 41,000 cu. ft. per day, although the heat value dropped from 640 to 550 B.t.u. Air consumption in the activated process amounts to about 1.9 cu. ft. per gal., or a cost of about $1.75 per million gal.

San Bernardino plant—L. A. Hosegood, assistant water superintendent. Odor nuisance is the most serious problem at this Imhoff tank—trickling filter installation. Prechlorination 1 hr. back from the plant, is followed by chlorination before filtering and final chlorination of the effluent. The location of the plant near the town and a main highway aggravates the odor nuisance problem. The plant handles about 2.94 m.g.d. and the total operating cost during the past eleven months has been $12.15 per million gallons. During the same period the revenue from the sale of dried sludge has been $10.49 per m.g. Labor costs at the plant were $5.40 per m.g. and chlorine cost is $3.39 per m.g.

Colton plant—Ezra West, plant operator. This recent plant, built by PWA financing, is of the activated sludge type with separate sludge digestion. Started in June, 1935, the average flow has been about 500,000 g.p.d. Labor costs have been about $12 per m.g. and power $7 per m.g.

Review of papers presented

The revolutionary "Heat Exchange Process Utilized in Incineration of Stack Gases," which has recently been installed at the Pasadena plant, was reviewed in a paper by A. W. Wyman, plant superintendent. This installation resulted from the cost of incinerating the gases which came from the sludge drying process. This deodorizing was costing about $6,650 per year, almost as much as the $7,000 cost for sludge drying. Incinerated gases were wasted in a tall stack. Briefly, the new process consists of using two heat-transfer towers filled with 6 to 8-in. rock to conserve the heat formerly wasted in incineration.

Exhaust gases from the drying operation are first past through a spray tower to remove dust and then are admitted at the base of the first heat exchanger where they pass over the hot rocks (previously heated) and are raised to a temperature of nearly 1,200° F. so that only a very small amount of fuel gas is necessary at the burners in the top of this stack to complete combustion. In fact, only the pilot light has been required, after the plant began operation. From the top of the first tower the burned gas passes down and then up through the second tower to heat the rock for the second phase of the cycle. When this second tower is heated, a signal in the plant rings and the flow in the towers is reversed; this takes place about every 40 min.

The installation has been most successful in the elimination of the odor nuisance and has greatly reduced gas incineration costs. Fuel gas cost for a similar period, under the old and new incineration system, has been reduced from $2,431 to only $412, which in terms of tons of dry sludge fertilizer is a cost reduction of from $2.24 to $0.36 per ton. The cost of the installation was less than $20,000.

Prof. C. G. Hyde, Univ. of California, presented a review of data from the meetings of the New York State Sewage Works Association and the sanitary section of the Am. Soc. C. E. which he attended in New York City, January, 1936. He reported on the problems of the Federation of Sewage Works Association, the question of garbage disposal with sewage and other current matters of interest.

At the dinner meeting the speaker was George Hjelte, superintendent of playgrounds for the City of Los Angeles, who talked on "Beach and Shore Pollution." He outlined the value of the Southern California beaches as recreational areas and then discussed beach pollution with special emphasis on oil waste and only passing reference to sewage contamination.

"Experiences with Digester Foaming" by H. E. Schlenz, secretary, Pacific Flush Tank Co., started a live discussion on this subject. Causes of foaming noted by Mr. Schlenz were: (1) excessive loading, (2) sudden change in the ratio of raw to digesting sludge, (3) objectionable organisms, (4) introduction of objectionable waste products, (5) change in pH, (6) scum of high surface tension and viscosity, (7) change in characteristics of raw sludge, and (8) improper or inadequate gas vents. His remarks enlarged on these causes and indicated that generalized statements and solutions are impossible because of the complexity of the individual problems and the "temperamental" nature of all types of biological digestion.

Discussion brought out the necessity of getting at the fundamental cause of the foaming, rather than merely getting rid of the existing accumulation. The effect of changes in temperature was discussed, with wide variation of opinion. At the Whittier plant all foaming problems were solved with the installing of a grease removal unit. On the other hand, Mr. Schlenz contended that grease should be looked upon as one of the regular products to be handled by the digester, and the digester should be designed and operated to take care of such wastes.

Failure to design with sufficient capacity was mentioned. Several suggested the best remedy was to have large capacity digester units and then "let it foam." Opinion indicated the subject was one of the most trying for designers and operators.

Visit to orange pulp dryer

The orange pulp dryer at an Ontario extract plant (visited on one of the field trips) was described by Wm. B. Senseman, Combustion Engineering Corp., who described how this local installation had developed data which had resulted in the present sludge dryers recently started at the Calumet treatment plant in Chicago. The machine is a flash-dryer, adapted to this type of service. He stated that in the Chicago installation, the fuel value in the dried sludge will be sufficient to permit it to be burned without additional fuel.

Unusual problems of infiltration at Newport were reviewed by R. L. Patterson, city engineer. A considerable part of the sewer lines in this beach town lies below sea level, and as a result of poor construction and the earthquake of 1933 there has developed a very serious infiltration of salt water, amounting to almost 50% of the total flow. Treatment is carried out in a small Imhoff tank and although there appears to be no particular disturbance of digestion on account of the salt water, the increased flow raises the velocity through the plant with resulting decrease in the removal of solids. Sewer repair and possibly a new disposal plant are the remedies.

Mr. Patterson also outlined the use of the Scott-Darcey process for H_2S control. He reported no particular difficulty in the installation, but stated that fish cannery wastes were so prominent that fish odors were almost more of a problem than H_2S.

Officers

A. M. Rawn is president of the California Sewage Works Association; E. A. Reinke and R. F. Goudey, vice-presidents, and F. D. Bowlus (202 Law Building, Los Angeles), secretary.

Study of Clay Soil Foundation Problems Based on Cyclic-Load Field Tests

Natural clay soils vary widely in structure, consolidation and sand and moisture content—Definite classification of characteristics, in relation to bearing value, cannot be developed—Reactions to load established by field tests

By HYDE FORBES
Engineering Geologist
San Francisco

THE best general index to the characteristics of a soil is found in its geological history, which includes its origin, method of deposition, and age. This index is a guide to its structure and density. Clay soils as they occur in nature are of a wide variety in geologic origin and method of deposition. However, structure, consolidation, sand and moisture content vary so widely, even in clays having the same origin and being similarly deposited, that a definite classification covering all the characteristics of clay soil cannot be developed. Furthermore, clay soil close to the surface, as in building foundations, is influenced so greatly by moisture and temperature changes that the physical behavior of the clay cannot be fixed except in relation to specific conditions and their probable changes within certain limits.

Character of clays

Clay soil is generally considered to include the mixed grained natural material consisting of particles from 1 mm. to 0.0005 mm. in diameter, carrying a small percentage of chemical colloids in some instances, being unctuous to the touch, rubbery in consistency, and readily identified as cohesive and plastic. The prime factor controlling the behavior of a clay soil is its moisture content, its compressibility being dependent upon its moisture, absorptive and retentive capacity, and the action of the contained moisture. Stability under load is attained when an equilibrium between load, moisture content, and compressibility is reached. Any change in this equilibrium produces unstability. Settlement of clay surfaces under load is a function of the drainage of moisture from the clay as shrinkage in consolidation occurs with drying. This process, however, is extremely slow because clay gives up its moisture reluctantly. Complete drainage and shrinkage to the solid state is never accomplished under ordinary building loads in the time involved in load tests. Absorption with swelling takes place when a clay soil, with a moisture content well below its moisture equivalent, is flooded, unbalancing the equilibrium between load, moisture content and compressibility and rendering the material unstable.

Four clay soils have been selected to illustrate a method of determining: (1) the behavior of clay soils under load, (2) the affect of certain factors, and (3) the analysis followed in assigning a bearing capacity which will provide a sufficient factor of safety under possible change in conditions. They have been chosen from a group of ten soils upon which field load tests have been performed in the San Francisco Bay region during the past several months. The soil bearing or load tests have been made by means of a gas actuated hydraulic jack, with some patented features, constructed by Abbot A. Hanks, Inc., testing engineers of San Francisco, with whom the writer is associated in foundation investigations. The machine, used in the tests was described and illustrated in *Western Construction News*, March, 1936, and the method of test was reviewed in the April issue.

Table I presents the physical characteristics of the clay soils involved in the load tests, each being designated by a letter A to D.

Soil A is generally termed a clay loam. The soil mat contains numerous sand and gravel stringers which facilitate drainage; a lense 5½ ft. in thickness underlays 8½ ft. of clay

TABLE I—PHYSICAL CHARACTERISTICS OF CLAY SOILS IN LOAD TESTS

Soil Designation	A	B	C	D
Geologic origin	Alluvial	Alluvial—Modified	Marine	Residual—from Serpentine
Method of deposition	Stream flood overflow	Accumulation through cultivation	Tidal Flat Accumulation	Disintegration and Decomposition
Grain Distribution:				
Grit and coarse sand	20% by weight	4.5% by weight	10% by weight	22% by weight
Fine sand and silt	50% by weight	13.5% by weight	40% by weight	71% by weight
Clay and colloidal	30% by weight	82.0% by weight	50% by weight	7% by weight
Chemical colloids	Small percentage	Organic matter present	Not present	7%
Color	Light brown	Black	Bluish-black	Greenish-gray
Consistency	Compact	Adobe—crumbly	Rubbery	Rubbery to unctuous
Moisture retained before test	24.7% by weight	19.4% by weight	18.7% by weight	23.2% by weight
Atterburg Test on Particles: Moist. equiv.	25.0%	24.4%		25.2%
Atterburg Test on Particles: Plastic limit	36.0%	24.0%		29.0%
Atterburg Test on Particles: Liquid limit	51.0%	50.0%		41.0%
Drainage facilities	Good under-drainage	Poor under-drainage	No drainage	No drainage
Height above water table	8 ft.	10 ft.	Artesian water at depth	Below water-bearing sand
Final moisture content	21.8% by weight	21.9% by weight	16.7% by weight	20.0% by weight
Compressed to elastic state	At 4,000 lb. per sq. ft.	At 1,500 lb. per sq. ft.	In its natural state	At 750 lb. per sq. ft.
Compressed to plastic state	At 13,000 lb. per sq. ft.	At 3,500 lb. per sq. ft.	At 2,250 lb. per sq. ft.	At 1,000 lb. per sq. ft.
Compressed to liquid state	Not reached	Not reached	Not reached	At 2,250 lb. per sq. ft.
Depth of bearing plate	5 ft. 1 in. below surface	3 ft. 6 in. below surface	4 ft. 6 in. below surface	8 ft. below surface
Area of bearing plate	2 sq. ft.	2 sq. ft.	2 sq. ft.	2 sq. ft.
Shape of bearing plate	Round—19 in. dia.	Round—19-in. dia.	Round—19-in. dia.	Round—19-in. dia.
Size of test pit	Round—24-in. dia.	Round—24-in. dia.	Round—24-in. dia.	Round—24-in. dia.

soil at the test pit location. The percentage of fines, consisting of rock flour, mineral binder, and colloidal clay particles (30% by weight) makes this soil compact.

Soil B consists of an adobe clay derived from shale bedrock and washed into a topographic gulley. It has been modified by vegetation and cultivation to a depth of 6½ ft. below the original ground surface. The high clay content (82% by weight) gives it a high moisture absorptive and retentive capacity.

Soil C is a marine clay encountered under 4½ ft. of artificial fill near the 1868 San Francisco Bay shore line. Its method of deposition makes it a compact homogeneous body.

These three soils had been protected from rainfall penetration and evaporation by concrete floors or other surfacing before being excavated for testing. The moisture content before the tests was due to absorption and retention rather than penetration of rainfall.

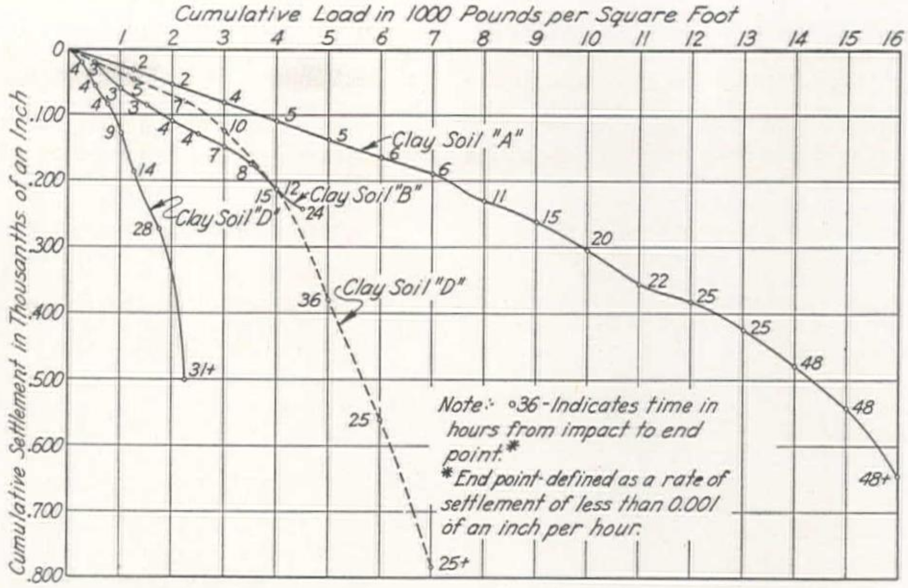
Soil D is a residual clay, being the product of disintegration and decomposition of serpentine rock over which it lies in place. In the state tested it was not in contact with water and the overlying sand contained less than 5% moisture by weight. Subsequent to the test it was flooded and absorbed sufficient moisture to become fluid.

Certain laboratory tests of the dry or powdered soil were made as a guide in the analysis of the observations obtained in load tests on the clay soils. These laboratory tests necessarily did not take into account the soil structure, surrounding and underlying conditions, and the changes in soil structure which occurred under load. However, tests for Atterburg plastic and liquid moisture limits of the powdered dry soil, shrinkage, etc., do disclose physical properties of the constituent particles exclusive of soil structure. For that reason they are of value in the interpretation of field bearing tests for the determination of compressibility, elasticity, plasticity or stability, which are functions of both the physical characteristics of the soil particles and the soil structure at natural soil moistures.

Table II presents data on the behavior of the clay soils under cyclic loading, indicating: (1) the development of resistance as the soil structure approaches maximum consolidation, (2) the degree of elasticity obtained, and (3) the change from the elastic to plastic state as the load is developed.

All measurements in the table are in inches and hours and, in order to have a comparable basis, the figures indicate settlement or rebound of the soil surface at an end-point where the rate of movement is just less than 0.001 in. per hr.

Soil load tests performed in this manner are primarily consolidation tests, in that the settlement of the loaded surface is a measure of the consolidation the stressed material undergoes.



Time—load—settlement curves for the four clay soils discussed. The physical characteristics of these soils are listed in Table I, and the detail data on the curves is given on Table II on the next page.

Correlated with laboratory determination of the physical characteristics and moisture content of the soil before and after loading they constitute permeability tests. Continued through a sufficient range of loads, these tests result in the determination of the compressive strength and resistance of the soil to load. This type of information cannot be obtained by single load or continuous load increment tests.

It is necessary, however, to carry on the tests in the field upon the undisturbed soil, with the load imposed vertically on the soil column, under the constant observance of an operator, and using complete cycles of stress; *i. e.*, loading, release to zero load, and reloading with the same load, at each load increment to successfully record the complete stress-strain reactions of the soil. In such tests stress is controlled in the load applied, relieved, or varied; strain is measured as settlement in relation to stress and time.

The accompanying curves are a graphical presentation of the cumulative increments of settlement under original compression as tabulated in Table II. The time-load-settlement observations tabulated and plotted reveal the amount of compression the soil undergoes and the rate at which the compression proceeds. The pressure distribution and the behavior of clay soils under load are most difficult to predict and only through such field load tests can this be observed.

Soil A—Alluvial

Soil A compacted under load to 2,000 lb. per sq. ft. Settlement occurred rapidly as the soil particles were brought to firmer bearing against each other, the total rebound was slight and no increase in settlement was observed upon recompression. Under 2,000 to 7,000 lb. loads, settlement progressed in pace with the development of load, the material became more consolidated with a consequent reduction in voids. There was an increase in the amount of rebound and some additional settlement upon recompression occurred but in pace with that which would have occurred under continuous loading for the full time interval.

The soil structure was resisting the stress and there was a margin of bearing capacity available. At 8,000 lb. load a readjustment occurred allowing an increase in settlement increment which may be attributed to the development of channels for drainage as the end point was not reached until the eleventh hour and recompression loss more than doubled. The final moisture content was about 3% less than the initial moisture content.

A new resistance developed under the new condition, as shown by the fact that the rate of settlement retarded with no marked increase in settlement during recompression. This condition obtained up to the 12,000 lb. load. Between 13,000 and 16,000 lb. loads, settlement continued longer, the end point being reached at twice the time interval, and the increment in settlement per increment of load increased rapidly. Settlement upon recompression after rebound increased materially, the soil having reached its plastic state. At a 16,000 lb. load the material around the bearing plate exhibited heaving and marked deformation. Expansion was rapid and rebound considerable upon release of that load, and upon recompression settlement recurred at a more rapid rate not reaching the end point in 48 hr.

Soil B—Alluvial—modified

Similarly soil B compacted, through a reduction of void space without rearrangement of particles upon rebound under load to 1,000 lb. per sq. ft. with no observable additional settlement upon recompression. Settlement increased under loads of 1,500 to 3,000 lb. keeping pace with the development of load, indicating the development of resistance as the soil consolidated in structure. Elastic rebound increased and the loss in settlement upon recompression remained constant and slight.

At a 3,500 lb. load, settlement increments increased upon original compression and recompression and there was no margin of safety in the bearing capacity of the soil. The elastic limit and plastic state was reached at that point and elastic rebound decreased thereafter. The time required to reach end point doubled at 4,000 lb. load. While the 4,500 lb. load was being applied rain water from a storm entered the pit and was absorbed by the compressed material causing it to swell. The final moisture content showed an increase of 2.5% over the initial content, accounting for the lesser increment in settlement.

Soil C—Marine

Soil C was compressed, drained, and consolidated under load to 2,250 lb. per sq. ft. The increments in original settlement at each load increment did not increase greatly, the time required to reach, end point increased slightly, and the additional settlement upon recompression after rebound to end point was less than 0.01 in. The elastic limit of the soil is shown to be reached at the 2,250-lb. load.

Under higher loads to 7,000 lb., plastic deformation was effected. The time required to reach end point increased and settlement increments under both original compression and recompression nearly doubled with each load increment. The moisture equivalent of this material was not determined as the orientation of the clay particles are responsible for its moisture retention and disturbed samples are not comparable. The extent to which the soil deforms plastically is shown by the progressively greater settlement under original and recompression load applications. At the 7,000-lb. load, this deformation took the form of unrestrained flow not reaching end point in 25 hr.

Soil D—Residual, from serpentine

Soil D has a very low supporting value. Consolidation for its moisture content was effected under load to 750 lb. per sq. ft. in comparatively short time intervals, 4 hr. for each load increment of 250 lb., with fairly uniform increments of original settlement and no measurable additional settlement in recompression. This proved to be the elastic limit of the soil. Under loads from 1,000 to 2,250 lb., the soil suffered visible plastic deformation and at the 2,250-lb. load flowed with little restraint. Equilibrium between compressibility moisture content and load under which the clay remained stable was reached at 750 lb. with a compressive settlement of less than 0.1 in.

Changes in soil structure

The change in soil structure under load is apparent from the figures in Table II.

Soil A compacted under original load impacts to a 4,000-lb. load and under that load consolidation accounted for 59% of the settlement and elastic compression 41%. The soil, therefore, was consolidated to an elastic state. This relation of elastic compression to total compression remained practically constant up to the 8,000-lb. load increment. The soil then became somewhat plastic but the readjustment in soil structure developed new resistance.

The relation reduced slightly under the 8,000-lb. load (40%) and continued to be reduced under load to 13,000 lb. (38%) but not critically until the 14,000-lb. load was applied. The plastic state was definitely reached at the 14,000-lb. load and the yield point in the case of this soil was taken at the critical load of 13,000 lb. under which the soil started to deform plastically. Recommendation was made that the soil be not loaded in excess of 8,000 lb. per sq. ft. under any rigid or concentrated semi-rigid type of foundation.

TABLE II—BEHAVIOR OF CLAY SOILS UNDER CYCLIC LOAD TESTS

Cumulative Load Lb. per Sq. Ft.	Increment of Settlement* Per Increment of Original Load (Inches)				Hours to Reach End Point for Each Load Increment				Total Rebound Under Zero Load (Inches)				Increase in Settlement On Recompression Under Same Load (Inches)				Elastic Compression in % of Total Original Compression			
	A	B	C	D	A	B	C	D	A	B	C	D	A	B	C	D	A	B	C	D
250				.021				4				.020				0				
500		.019	.021	.037		3	3	4		.018	.018			0	0					
750				.026				4				.052				.007				62
1,000		.041		.043		3		9		.020				0+				33		
1,250	.031		.024	.060	2		5	14	.008		.032	.096	0		.005	.023	26		71	51
1,500		.029				3				.031				.009				35		
1,750				.089				28				.145				.066				52
2,000	.025	.019			2	4			.020	.042			0	.007				39		
2,250			.034	.227			7	31+			.058	.190			.008	.152			73	38
2,500		.020				4				.055				.009				43		
2,750																				
3,000	.026	.020	.046		4	7	10		.033	.069	.083		.002	.006	.016		40	47	66	
3,500		.027				8				.082								47		
4,000	.029	.036	.092		5	15	12		.045	.099			.003	.024	.022		41	45		
4,500		.032				24				.118				.032						
5,000	.025		.165		5		36		.056		.168		.004		.026		41		45	
5,500																				
6,000	.029		.179		6		25		.067				.005				41			
7,000	.025		.224		6		25+				.288				.037				29	
8,000	.040				11				.092				.011				40			
9,000	.033				15															
10,000	.041				20				.117				.016				39			
11,000	.034				22				.130				.022				38.5			
12,000	.044				25				.145				.023				38			
13,000	.044				25				.163				.034				38			
14,000	.054				48				.160				.036				33			
15,000	.061				48															
16,000	.085				48+				.198				Not reached				32			

*Taken as additional settlement up to a time when the rate is just less than 0.001=in. per hr.—referred to as "end-point."

Soil B compacted under load increments to 3,500 lb. at which 53% of the settlement was attributable to consolidation and 47% to elastic compression. The plastic state was reached at that load and under 4,000-lb. load a decrease in relation of elastic rebound to total settlement was recorded. Compression of this partially saturated clay soil was effective in driving out some water and reducing the volume of voids, but in the compressed state it has a high affinity for water and the lesser increment of settlement and higher rebound under the 4,500-lb. load was due to reabsorption of more than 3% moisture by weight.

The yield point for this soil was assigned from the test results under the moisture conditions tested at 3,500 lb. per sq. ft. It was designated an unsatisfactory foundation material, approved only with recommendations as to protection from moisture penetration or flooding and the adoption of a safety factor of two if individual footings in a semi-flexible foundation were to be used. A uniformly loaded mat foundation is better adapted to such a soil.

Soil C was deposited as fine material in quiet marine waters. The sorting and orientation of particles so accomplished provided a high degree of compaction. At a load of 1,250 lb. consolidation accounted for but 29% of the settlement and elastic compression 71%. The soil, as found, had been drained to a moisture content of 18.7% by weight under its overburden load. In this condition it was compact and elastic. Further drainage of 2% of its retained moisture accompanied consolidation under load to 2,250 lb. To that load the amount of elastic rebound increased and the increase in settlement under recompression was very slight. Elastic compression at that load equalled 73% of the full compressive settlement, and the elastic limit was reached. Thereafter the soil was in its plastic state and the relation of elastic rebound to total settlement decreased. At a 7,000-lb. load, settlement in elastic compression was but 29% of the total settlement which is indicative of plastic deformation and flowage from beneath the bearing area. The yield point for the soil was taken at slightly in excess of the 2,250-lb. load.

The soil tested was part of a thick, homogeneous clay blanket extending over the building site and under San Francisco Bay beyond the sea wall. It overlaid a sand and gravel alluvial deposit which contained ground water confined and under head. Tidal changes, twice daily, loaded and unloaded the clay which acted as a diaphragm over the ground water and such deflections were noted in the test observations.

Supplemental test at 4,000 and 5,000-lb. loads at 9 ft. below ground surface showed the supporting value at that depth to be greater than that indicated by first test load, because of the restraint offered by the overburden to deformation and flow. The latter test indicated the 5,000-lb. load to be that at which deformation and progressive settlement began at twice the depth. It was recommended that 2,500 lb. per sq. ft. load be designated the yield point and if a higher load be desired with footings carried to a greater depth, a foundation design allowing uniform load and perfect flexibility be adopted.

Soil D contained the smallest percentage of the finest material of those considered but retained a larger percentage of moisture (although not in contact with water), due to its content of chemical colloids. It started to settle immediately under load of 250 lb. per sq. ft. Loss of volume due to drainage under the test plate resulted in 38% of the total settlement at 750-lb. load with 62% as elastic compression. The increment in settlement under the 750-lb. load was less than that under the 500-lb. load. This is attributed to the development of tensile strength in the soil pressure bulb due to the colloidal and moisture content as well as resistance due to compression.

At 1,250-lb. load settlement in elastic compression was equal to but 51% of the total settlement, indicating lateral displacement. This occurred as plastic deformation which was observable in the partial remoulding of the soil in shape around the test plate. At 1,750-lb. load the relation still held, but at 2,250 lb. the tensile strength was destroyed through rupture indicated by cracks in the heaving soil and shearing on the perimeter of the bearing plate. All resistance was overcome, allowing the soil to flow without restraint. The yield point of this soil was fixed at 750 lb. per sq. ft. with the proviso that drainage facilities be installed to prevent free water from contacting the clay soil and that the foundation design give perfect flexibility.

Conclusions

The tests upon these four types and conditions of clay, in themselves, are inconclusive except as a general guide and as to the definition of a safe bearing value for the particular soil tested. Even then questions arise as to what allowance must be made to cover possible future changes in conditions. For instance, what will be the behavior of the clay when dried out under load through slow drainage with time, or when in contact with water, in relation to that observed in a given state of natural moisture in place under field test? The test observations, however, do add to experience and warrant the discussion of the impressions gained.

The reactions established by test are: (1) the load stress under which the clay soil suffers volume change (settlement) due to compaction and drainage, (2) the consolidation and elastic compression relation of the soil, (3) the plastic deformation of the soil when the stress causes a change in shape exhibited by surface upheaval of unloaded areas, and (4) the load stress in excess of the resistance or confining influence of the surrounding body of soil at which actual displacement or flowage occurs. An important factor upon which definite behavior of clay soils under building load depends is the confining influence of the surrounding body of soil. Where clay soils of low permeability become plastic, within the range of ordinary building load pressures, the settlement should be relative to that of the adjacent areas.

Tension is found to develop in deformation, in the case of moist plastic soils, which contributes to their strength or resistance to load. Under this tension the soil heaves or stretches until its surface cracks, the soil structure is ruptured, restraint is overcome with flow taking place from under load. This is of common occurrence when fills are placed on tidal marsh clays. The cracking of the heaving soil in such instances destroys cohesion and opens up the soil. In building foundations the stress imposed should be low enough to prevent flowage but there is no reason why such a soil cannot be loaded uniformly on perfectly flexible foundations to the point where the bearing capacity is the combined strength in compression and tension, and settlement be equal with consolidation due to drainage over a long period of time.

The tests define the bearing capacity limit per unit area under natural moisture conditions, which value is of important consideration in the actual design of foundations. Foundation bearing tests for important structures founded on clay should be made, in connection with exploratory borings, at different depths below ground surface and with different size of plates. Then the degree of confinement offered by the overburden and adjacent loading can be determined. With these data available the amount and rate of settlement can be related to the difference in moisture content of the soil before and after loading in approximating the amount of shrinkage and time required, under prevailing conditions, before the clay will be drained to a solid state, if ever. Also, from this same data, the total settlement expected during construction and the time over which measurable settlement will occur can be predicted.

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Ely C. Hutchinson Joins J. G. White Company

Ely C. Hutchinson, formerly editor of the McGraw-Hill Co. publication *Power*, has joined the staff of the J. G. White Engineering Corporation of New York.

Mr. Hutchinson has had a wide experience in the installation and operation of hydro-electric plants and for many years was connected with the Cramp-Morris Industrials, Inc., and was president and general manager of the Pelton Water Wheel Company of San Francisco from 1926 to 1929. He was also president of the Edge Moor Iron Co. of Edge Moor, Del.

Mr. Hutchinson is a member of the A. S. M. E., A. S. C. E., International Electrotechnical Commission, and was a member of the American Committee to the Power Conference in Berlin.

Water Conservation in the Is Accomplished by Rolled

Falling water level threatens rich agricultural area in California—Six dams built to conserve flood flows for underground storage—3,500,000 cu. yd. of fill handled by tractor-scraper units

By FRED H. TIBBETTS
Chief Engineer
Santa Clara Valley Water Conservation District

THE Santa Clara Valley Water Conservation District is an area of about 130,000 acres, constituting most of the level floor of the main portion of Santa Clara Valley, a southerly extension of San Francisco Bay. Within its boundaries are five municipalities, including the City of San Jose. Nearly all of the balance of the district is under intensive cultivation, mostly deciduous fruits and vegetables.

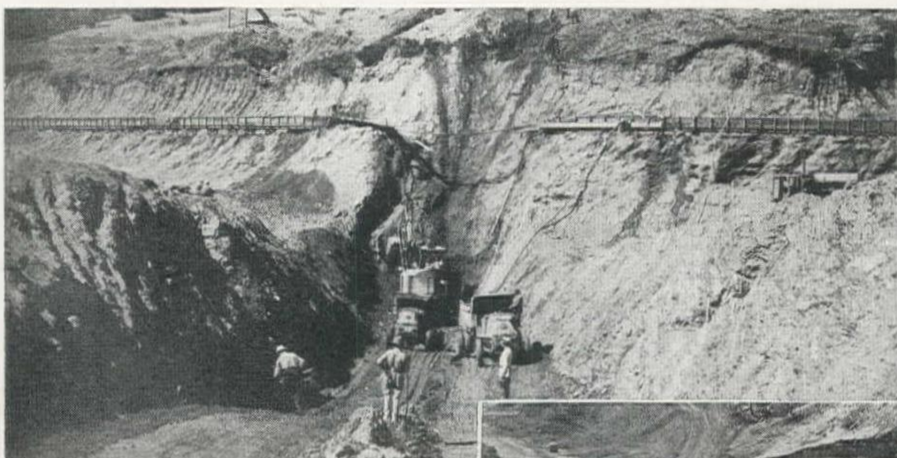
The land is irrigated from about 3,000 pumping plants. During the last two decades the water table has dropped over 100 ft.; water users have been compelled to periodically deepen their wells and to provide heavier pumping equipment. The cost of the additional equipment, as well as the additional lift, was becoming so burdensome that agricultural credit was being impaired. Remedial measures were undertaken during the last two years to conserve the wasted stream flow, as under natural conditions about two-thirds of the runoff from the surrounding mountains was wasted during short periods of floods into San Francisco Bay. The remaining one-third, constituting the main source of replenishment of the underground water storage, had been proven insufficient.

Work, now under construction, consists of dams and detention reservoirs on the main streams to hold back the flood water until the floods can be released under control at rates so reduced that the streambeds can absorb the flow and pass it into underground storage. The natural percolation or absorption capacity of the streams is also artificially increased by "percolation dams": light structures which cause a greater area of streambed gravel to be submerged with moderate creek flows, and by "off-channel" streambed percolation or diversion of stream flows into receptive gravel areas distant from the streams. With the facilities now under construction, it is estimated that about two-thirds of the total runoff can be utilized and one-third wasted, reversing the present conditions of one-third used and two-thirds wasted, and hence doubling the useful supply.

The first season's operation, even with the two largest reservoir units incomplete and operated at reduced capacity, has already raised the water levels in the main floor of the valley about 13 ft. (April 1, 1936, as compared to April 1, 1935). The last two seasons are about average seasons, and the water appears to be coming up about twice as fast as it had been going down.

Much the largest of the surrounding water sheds, supplying about two-thirds of the total runoff onto the valley floor, is that of the Coyote River. Over two-thirds of the wastage was from this river. Over half of the valley had been pumped below sea level and, hence, it had become necessary to build a large reservoir on the Coyote River, the principal source of wastage, if the splendid orchard and garden development of this particularly favored section were to be even kept alive.

The geological formations are very old, deeply weathered, faulted and broken, two of the major breaks in the surface topography of California, the San Andreas and Hayward faults, running along the two opposite edges of the valley. The Coyote River had worked itself into the Hayward fault, and the foundation conditions for the construction of a large earthfill dam, which had to be built somewhere straddling this fault line if agriculture was to be preserved in the valley, had become about as poor as it would be possible to imagine. The final design of the Coyote dam, under the advice and final approval of many eminent engineers and geologists employed both by the State Engineer and by the district, is what is believed to be an earth-



Deep cutoff trench excavation at the Coyote dam which was built over the Hayward fault. Back-fill consisted of the most impervious type of clay material.

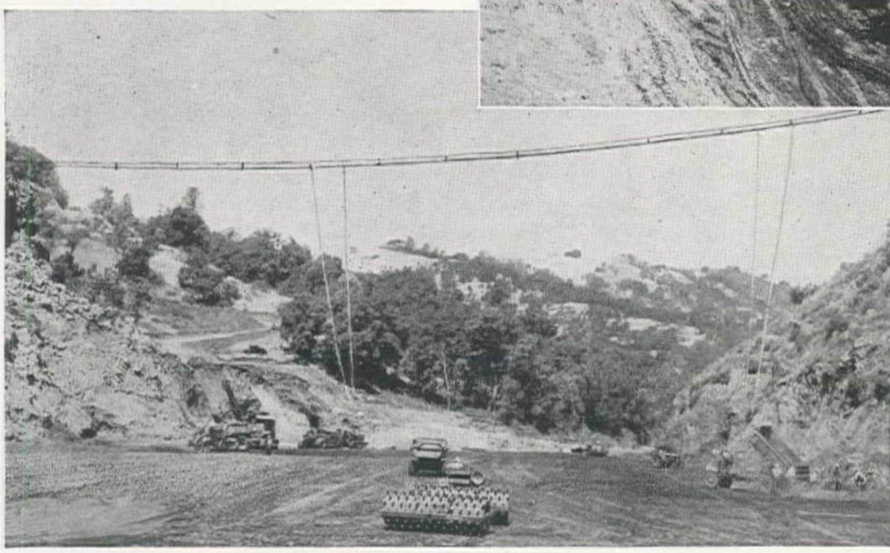
Typical earth-moving methods (Almaden dam) showing the Caterpillar tractors and LeTourneau Carryall scrapers used to handle most of the fill.

Santa Clara Valley Earthfill Dams

quake proof dam. Otherwise, it would certainly be called a freak design and an extravagant design.

At the foundation of this dam, straddling the Hayward fault, there is not a fault line—there is hardly anything but faults. The dam is not at the damsite but is up in the reservoir. In the middle of the structure is a first class earth dam of about standard proportions, except that the bottom goes deeper and the top goes higher than customary. On either side of the earth dam is a gravel dam from 10 ft. to 120 ft. in thickness, and outside of these gravel blankets there is a heavy rock-fill blanket about the same size, both upstream and downstream. The idea is that if the reservoir is full and the dam soaked, and an earthquake stretches it lengthwise or crosswise or both, the gravel will fall into the cracks and prevent the water from going through. The rock will hold the gravel; both of them will hold the center earth dam; and the earth dam will hold the water. The whole scheme will probably work safely through all the earthquakes that may occur for at least as long as it takes the reservoir to silt so full that it will no longer hold any water.

Typical dam site conditions (Stevens Creek dam) showing the earth-moving equipment bringing fill to be rolled in 6-in. layers.



On the Coyote dam the contractor carried the water pipes for the sprinkling supply on overhead cables to eliminate interference with the earth-moving equipment.

Foundation preparation

Foundation preparation consisted of stripping the sites of perishable material, followed by the excavation of all pervious material from under the impervious (upstream) sections of the dams. A cut-off trench was excavated into impervious material near the center of the impervious upstream section. Cut-off trench back-fill and impervious portion of the dam consist of material high in clay content.

At the Calero dam, a 40-ft. width of 25-ft. steel sheet piling was provided across a weak section of the foundation near the right abutment. At Almaden dam, seams in the cut-off trench were grouted to insure a seal. Excavations for the cut-off trenches at all dams except Coyote and Almaden were made mainly with LeTourneau scrapers. The steeper and deeper trenches were excavated with power shovels.

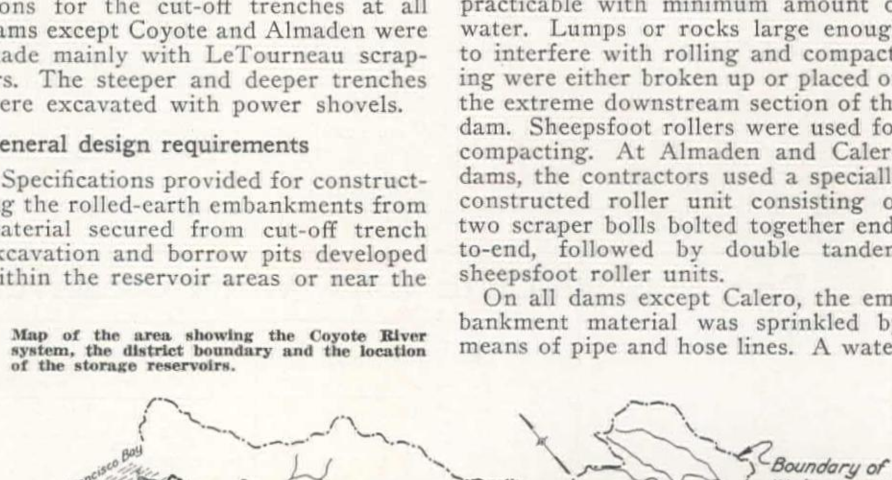
General design requirements

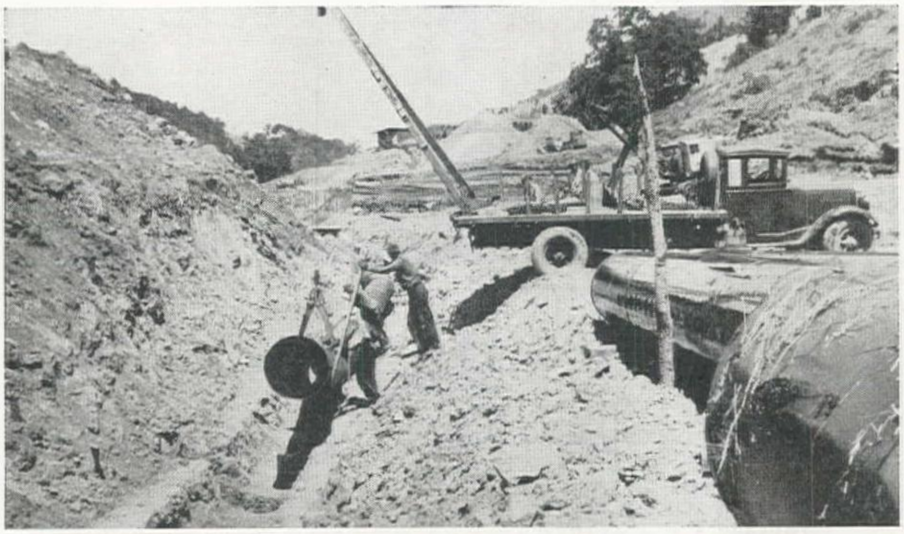
Specifications provided for constructing the rolled-earth embankments from material secured from cut-off trench excavation and borrow pits developed within the reservoir areas or near the sites. Material excavated from the spillways was also used in the embankments. The back-fill for the cut-off trenches contained the highest clay content material. The impervious portions of the dams consist of selected fine material, and downstream sections were constructed of coarser and relatively more previous material.

All embankment material was placed and rolled in horizontal layers, which were not to exceed 6-in. in thickness, measured after compacting. Each layer was rolled to make the densest mass practicable with minimum amount of water. Lumps or rocks large enough to interfere with rolling and compacting were either broken up or placed on the extreme downstream section of the dam. Sheepsfoot rollers were used for compacting. At Almaden and Calero dams, the contractors used a specially constructed roller unit consisting of two scraper bolls bolted together end-to-end, followed by double tandem sheepsfoot roller units.

On all dams except Calero, the embankment material was sprinkled by means of pipe and hose lines. A water

Map of the area showing the Coyote River system, the district boundary and the location of the storage reservoirs.





Outlet works consisted of steel pipes, jacketed with poured concrete, placed in trenches excavated into the foundation material.

truck was used at Calero. At Coyote dam, an overhead 3-in. pipe line was suspended across the canyon on a cable and four pendant hose lines were used from this overhead pipe for sprinkling.

Field and laboratory tests were made continuously to check the moisture in the embankment, suitability of materials and the compaction. The methods developed and used by Mr. Proctor of Los Angeles were used. The usual tests for steel and concrete were made.

Almaden dam

Almaden dam, located near the town of New Almaden (see map), is of typical rolled earth-fill design and creates a reservoir of 2,000-ac. ft. capacity. The dam is 105 ft. high, has 2.5 to 1 slopes on both upstream and downstream faces, and a crest width of 20 ft. The upstream slope is protected by a 4-in. slab of reinforced concrete poured on an 8-in. layer of gravel. This facing slab has contraction joints at 16-ft. spacing in each direction, with a weep hole in the center of each 16-ft. square slab.

Foundation stripping was almost all done with a 1½-yd. Northwest shovel. Waste material was hauled by Autocar and White trucks to a dump upstream from the dam. The cut-off trench under the upstream impervious section of the dam was excavated in the streambed by dragline, and on the sides of the canyon with the shovel.

The sub-contractors on the stripping were Poulos & McEwen of Sacramento. John Collins carried out a subcontract for the 320,000 cu. yd. of embankment, using two 12-yd. Le Tourneau Carryall scrapers, four 8-yd. Carryall scrapers, two LeTourneau bulldozers, one rooter for loosening material in the borrow pits, three Caterpillar diesel 75's, and three Caterpillar diesel 50's. On this dam about 75% of the earth-fill was handled with this equipment.

The contractor used a 1.5-ton Ford truck for delivering dry concrete materials from a batching bunker to a 1-yd. paving mixer. Concrete for the 9-in. reinforced concrete jacket placed around the 36-in. welded steel outlet pipe, for collars on this pipe and for the outlet and inlet structures was deposited direct from the mixer. This was also the method used for placing most of the 8-in. reinforced concrete lining of the spillway. Mixed concrete for the face slab was hauled in a special 2-yd. cylinder, mounted on a Caterpiller tread and hauled by a Caterpillar diesel 35.

Calero dams

Two dams were required to create the 9,500-ac. ft. Calero reservoir—the second largest of the five reservoirs built in the present program. These structures are of similar design to the Almaden dam, with the same general slopes, crest width, outlet through the main dam and 4-in. reinforced concrete face slab. The cut-off trenches were excavated in the main with Le Tourneau Carryall scrapers. Some shovel and truck work was required in the extreme bottom of the cut-off trench of the main dam and on the cut-off trench near the top of the abutments.

Stripping was carried out with tractors and scrapers, and the same type of equipment was used to place the entire embankment. This dirt-moving equipment included: nine Caterpillar diesel 75's, two Caterpillar diesel 50's, seven LeTourneau 12-yd. Carryall scrapers, one 8-yd. Carryall scraper, LeTourneau bulldozers and rooters, and one 2-section LeTourneau sheepsfoot roller with 8-roller units.

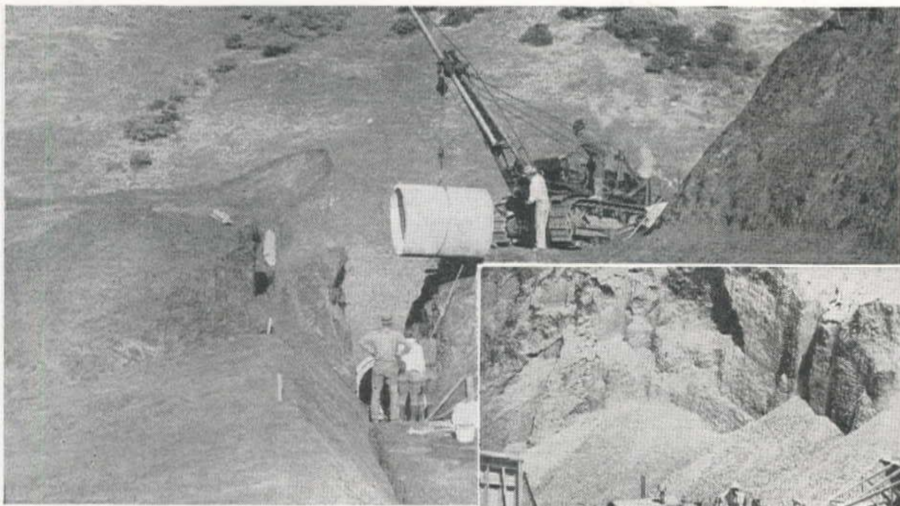
Other equipment required for this work included the same units for concrete work used at Almaden. The same general methods for concreting at Almaden were used at the Calero dams and spillway. Three 750 kw. Kohler lighting plants, mounted on trucks supporting towers to support flood lights, illuminated the work in addition to lights on the tractors. There was one 310-ft. Ingersoll-Rand Compressor on this job.

Fill was placed at a rate of about 6,500 cu. yd. per day, with the dam rising at a rate of about 2 ft. per 24 hr.

Data on Santa Clara Valley Water Conservation District Reservoirs

	Almaden-Calero Unit (One Contract): Almaden	Almaden-Calero Unit (One Contract): Calero	Coyote	Guadalupe	Stevens Creek	Vasona
Crest length (feet)	460	840	990	650	1,000	1,000
Height above streambed (feet)	105	90	120	129	120	30
Crest width (feet)	20	20	100-160	20	20	20
Base width (feet)	545	495	945	650	620	153
Capacity of spillway (sec. feet)	7,000	5,000	33,000	6,000	10,000	12,600
Outlet pipe diameter (in.)	36	36	50	36	50	42
Outlet pipe length (feet)	690	450	900	690	680	20
Capacity of reservoir (acre feet)	2,000	9,500	30,000	3,500	4,000	750
Cubic yards of fill	422,000	722,000	1,200,000	612,000	567,000	62,000
Cubic yards of concrete	3,400	4,000	4,000	5,800	5,700	2,300
Tons of steel	140	166	125	146	200	170
Contractor	McDonald & Bohnett	McDonald & Bohnett	Macco Construction Co.	A. Teichert & Son	McDonald & Bohnett	Carl N. Swenson Co.
Subcontractors	John Collins; Poulos & McEwen	....	....	....	Crow Bros.	Willard & Biasotti; Paterson & Rider
Contract awarded	Dec. 31, 1934	Dec. 31, 1934	April 17, 1935	March 13, 1935	Dec. 31, 1934	Oct. 31, 1934
Final cost	$235,881.69	$233,404.65	$674,958.19*	$237,173.10	$223,117.53	$115,356.33
Contract accepted	March 10, 1936		**	Dec. 3, 1935	Dec. 8, 1935	Aug. 6, 1935
Resident engineer	J. Winter Smith	R. P. Bryan	G. W. Hunt	T. D. Sawyer	Frank W. Moore	J. Winter Smith
Contractors' superintendent	Chas. Potter	Chas. Potter	Ben Wells	Ed. Hullin	Chas. Potter	Chas. Bundy

**Completion date set ahead to allow use of stored water.
* Estimated.



On the 4.5-mi. Almaden-Calero conduit there were four inverted siphons built by the American Concrete & Steel Pipe Co. These siphons were of 36-in. diameter and the longest was 870 ft. The view shows pipe laying operations.

Loading fill for the Coyote dam by 2½-yd. Northwest shovel into 25-yd. LeTourneau buggies pulled by Cletrac diesel 80 tractor. About 40 per cent of the 1,100,000 cu. yd. of fill in this structure was handled by this type of equipment.

Work was carried on in four 6-hr. shifts per day on the basis of a 30-hr. week.

Almaden-Calero conduit

Included in the contract of McDonald & Bohnett for the Almaden-Calero unit was a 4.5-mi., 100-sec. ft. canal from Almaden reservoir to Calero reservoir. The canal has a 6-ft. bottom width and 4.5-ft. depth with 1:1 side slopes, and was excavated mainly in the side hill by first excavating a bench with a 1½-yd. Northwest shovel and later excavating the canal prism with a trench hoe attachment. Poulos & McEwen of Sacramento were subcontractors on the excavation. This organization used two 310-ft. Ingersoll-Rand compressors for its jackhammers, three 3-yd. Autocar trucks, two Caterpillar diesel 50's, one with bulldozer, and one 8-cu. yd. LeTourneau Carryall scraper. The American Concrete and Steel Pipe Co. had the sub-contract for four 36-in. reinforced concrete inverted siphons on this conduit. The longest of these siphons is 870 ft.

Coyote dam

The 120-ft. Coyote dam—largest in the district's program—creates a reservoir of 30,000-ac. ft. capacity. It is situated about 6 mi. east of the town of Morgan Hill. The Coyote dam differs in design from the others, having a central impervious section of rolled earth, 2:1 side slopes and a 60-ft. crown. Flanking each side of this are gravel fills 120 ft. thick at the base and 10 ft. thick at the top. Over this gravel on both sides of the dam are rock-fills, not yet completed. The rock-fills have the same thickness as the gravel. The slopes on both front and back of the dam average about 1 on 3.5. The crown width is 100 ft. except at the west end which is 160 ft. The dam is built upstream and flanking the upstream sides of the natural abutments.

The Coyote dam and spillway is under contract to the Macco Construction Co. of Clearwater, Calif. About 40% of the 1,100,000 cu. yd. of earthfill was moved with buggies and tractors. The earth and rock-moving equipment included five 25-yd. LeTourneau buggies, two LeTourneau bulldozers, one 6-section and one 2-section sheepsfoot roller, three Cletrac diesel 80's, two Caterpillar diesel 75's, two Caterpillar 60's and one Allis-Chalmers Model L tractor with bulldozer.

Several of the 25-yd. buggies were worked under two Northwest shovels with 2½-yd. buckets. Other excavating equipment included one Thew 1¼-yd. shovel, one 450-ft. Ingersoll-Rand compressor, one Gardner-Denver 450-ft. compressor and one 220-ft. Rix compressor, fifteen Mack trucks and five International trucks. All concrete was handled with two 2-yd. transit mixers.

The dam is complete except for about 80,000 cu. yd. of rock facing and completion of the reinforced concrete spillway lining. Construction has been suspended temporarily until the water in the reservoir which is nearly full may be lowered. Work will be resumed about Sept. 1, 1936.

Guadalupe dam

The Guadalupe dam is of the same general design with a height of 129 ft. above streambed and a crest length of 650 ft. A. Teichert & Son handled about 80% of the earth for this dam with tractors and Carryall scrapers. The balance was hauled with trucks loaded with a P. & H. 1½-yd. shovel. The equipment used included four 12-yd. LeTourneau Carryall scrapers, one heavy-duty rooter, one LeTourneau bulldozer, two 2-section sheepsfoot rollers and seven Caterpillar diesel 75's and one 310-ft. Ingersoll-Rand compressor.

Stevens Creek dam

Stripping and foundation excavation for the 120-ft. Stevens Creek dam, which is of similar design, was done by McDonald & Bohnett, of San Jose, who employed both Carryall scrapers and dragline. Placing of the embankment was sub-contracted to Crow Brothers, who moved the earth with

Differing from the other structures, the Vasona dam includes a 210-ft. section of reinforced concrete buttress type spillway dam with radial gates.

Carryall scrapers and tractors. This was an exceptionally fine set-up for dirt moving as borrow pits were available at all four corners of the embankment and the material was a gravelly clay formation which worked well. Seven 12-yd. LeTourneau Carryalls, two LeTourneau bulldozers, one heavy-duty rooter, four 2-section sheepsfoot rollers and nine Caterpillar diesel 75's and one Caterpillar 60 were used. The dragline used by McDonald & Bohnett in foundation excavation was a 1½-yd. Northwest.

Vasona dam

The Vasona dam consisted of two 28-ft. levees with a center section 210 ft. long of reinforced buttress type spillway dam with radial gates. The levees at each end of the spillway section were of rolled fill: clay on the upstream sections and gravel fill for the downstream sections. The fill materials were moved from the borrow pits with two 8-yd. LeTourneau Carryalls drawn with Caterpillar diesel 75's. The earth work on the dam was sub-contracted to Geo. R. Paterson and E. H. Rider of Stockton. Carl N. Swenson, of San Jose, the general contractor, constructed the spillway section and gates and a 2.5-mi., 75 sec. ft. canal leading northwesterly from Los Gatos Creek and terminating in San Tomas Creek. The canal excavation was sub-contracted by Biasotti, Willard and Biasotti of Stockton, who used a 1½-yd. Northwest dragline.

Personnel

The District's organization and officers are as follows: S. D. Farrington, president and director, and directors: Wm. F. Noethig, R. P. Van Orden, J. Fred Holthouse, Harry G. Mitchell, Reginald L. Parry, S. W. Pfeifle. Leroy Anderson is secretary of the district, Herbert C. Jones, attorney, Fred H. Tibbetts, chief engineer.

Colorado Highway Program

AFTER months of negotiation for a federal loan of $25,000,000, Governor Johnson finally dropped this plan and had a special session of the State Legislature provide for the issuance of 25 million dollars worth of revenue anticipation warrants, all or part of which will be sold shortly and the cash made available for the beginning of construction work on what will probably be the most extensive highway program in Colorado's history. It is probable that from 10 to 12 million dollars from this fund will be used in 1936. The state is also expected to have a grant of $2,300,000 in Federal aid money, which, matched with a like amount of state money, will provide an additional $4,600,000.

Whether the entire 25 million dollar warrant issue will be sold now depends on the condition of the security market. The original plan was to sell only 10 million dollars worth of these warrants but the market has been so favorable that the governor is now considering sale of the complete issue. Bids will probably be taken on the entire issue and the partial one and a decision based on the results. A decision on the matter is expected by May 1. If the entire issue is sold, it is possible that more than the originally planned 10 million amount will be spent this year. Meanwhile, the state highway department and the highway advisory board have formed the skeleton of a tentative program. It will be submitted to the governor for approval by about June 1.

Definite plans have been completed for the launching of a million dollar oiling program by about May 15. The plan is to oil at least 500 mi. of road this summer, using six crews. The exact cost and number of miles will depend on the projects definitely selected.

It has also been decided, as one of the first steps in the program, to widen the present Denver-Littleton highway from 14 ft. to 40 ft. and straighten the road through Littleton. This road is one of the oldest paved highways in the state and one of the most heavily traveled. The old pavement, now in bad condition, will be covered and new strips laid on either side. Estimated cost is $300,000.

Most of the year's work, according to present plans, will be concentrated on four major east and west highways and one north and south route on the western slope. The east and west roads scheduled for attention are: U. S. 160, running from Springfield west to Durango; U. S. 40, running through Cheyenne Wells, Denver, Steamboat Springs and Craig; U. S. 24, running from Burlington westward across the state to Grand Junction; U. S. 50, running through Lamar, Pueblo, Gunnison, and Grand Junction.

The western slope road, which is expected to open up a new avenue of heavy traffic, will run from the Wyoming state line through Grand Junction and Durango clear to the New Mexico line.

Important new roads planned this year are: one through the Arkansas River canyon on U. S. 50 between Salida and Canyon City, estimated cost $1,000,000; one through Glenwood Canyon on U. S. 24, cost approximately $1,000,000; completion of the Big Thompson Canyon road on U. S. 6 between Fort Collins and Granby at about $800,000 and an entirely new road on U. S. 160 over Wolf Creek pass at an estimated cost of $2,000,000. The latter would extend between Del Norte and Durango.

This 1936 program will be far more extensive than that of 1935. Last year the budget amounted to $6,971,000, of which $2,900,500 represented federal aid funds. By borrowing the $25,000,000 through the issuance of revenue anticipation warrants, the state will get the money immediately—there was considerable question as to when the Federal funds would be available—and at a much lower rate of interest than would otherwise be possible.

Major Ralph O. Baird, recently appointed highway "expediter" by Governor Johnson, will aid Highway Engineer C. D. Vail in speeding the work once the program gets under way.

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Gila Project Contracts Total $955,000

CONTRACTS for the construction of a 17-mi. section of the gravity main canal of the Gila Federal Reclamation project in Arizona have been awarded on bids totaling $955,175. The work was divided into four schedules.

Boyce and Igo, of Baton Rouge, La., were awarded the contract on a bid of $273,600 for Schedules 1 and 4, Schedule 1 consisting of excavation of a 26,450-ft. section at the head of the canal near Imperial Dam and Schedule 4 consisting of excavation of a 52,460-ft. section east of Yuma, Ariz. The Mittry Brothers Construction Co. of Los Angeles was awarded the contract for Schedules 2 and 3, each of which include excavation of a tunnel as well as excavation of segments of the canal. Their bid was $681,575 for this work.

The successful bids were the lowest for the work involved of 21 submitted to the Bureau of Reclamation at its Yuma, Ariz., office, February 27. Work will be begun by the end of April and the contractors must complete their jobs in 800 calendar days.

These are the first contracts let in connection with the Gila project, the construction of the first unit of which was authorized by the President when he approved an allotment for it of $2,000,000 of work relief funds. The first unit consists of 150,000 ac., nearly all of which is public land, in the desert east of Yuma. There are a total of about 600,000 ac. which eventually can be irrigated in this project. Water will be taken from the Colorado River at Imperial Dam, which also will serve as a diversion point for the All-American Canal in Southern California.

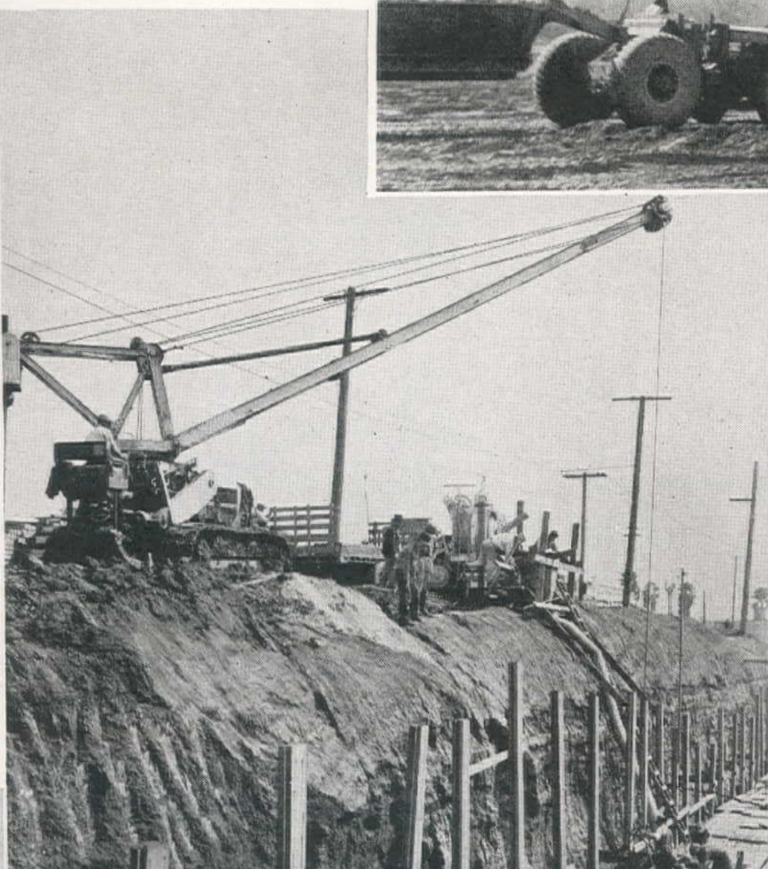
The gravity main canal will be excavated to a bottom width of 22 ft., except at the sites of wash crossings and other permanent structures where it will be excavated to the full 100-ft. width necessary when all the units of the Gila project are completed.

The two tunnels involved in this contract will be 1,790 ft. and 4,110 ft. long, respectively. They will be 20 ft. in diameter, a size sufficient to carry all the water which will be needed for the ultimate development.

New Methods are Featuring Work on Western Projects

For the first time in the West, tractors with rubber-tired wheels and trailers are being used on a large earth-moving project. George W. Condon Co., Omaha, Neb., is using Euclid Trac-Truk equipment to handle 2,000,000 cu. yd. of material for the desilting works at the head of the All-American Canal. A fleet of seven 8-yd. units is loaded (right) by an Adams elevating grader pulled by an Allis-Chalmers oil tractor. A similar fleet of five 6-yd. Trac-Truks is loaded by a 2½-yd. Northwest shovel.

Heavy excavation (above) starts at the site of the Seminoe dam in Wyoming with a 4-yd. Bucyrus-Erie electric shovel. The contract is held by Morrison-Utah-Winston-Lawlar Co. J. H. Warner is resident engineer for the Bureau of Reclamation.



On the extensive flood control work being carried out by the U. S. Engineers on the Los Angeles County Flood Control project, this Bucyrus-Erie (CT-50) loadmaster (left) handles brick from stockpile to bottom of trench. The work involves 5½ mi. of 12-ft. diameter storm drain in Kenter Canyon near Santa Monica.

Use of a LeTourneau Pushdozer (below) by D. McDonald of Sacramento, on his 430,000 cu. yd. American River levee job, is an important factor in securing fast and full loading of the 12-yd. Carryalls. The units are hauled with Caterpillar diesel 75's.

Quinn Robbins Co., on an Idaho highway job near Emmett, is using one of the new model LeTourneau Angledozers for moving sidehill cut as shown below. This mounting places all stress on the track frame of the tractor, rather than on the motor frame.

The 12-yd. dragline buckets (below) used in excavating the All-American Canal, handles the engineer's automobiles without any crowding.

Western Highway Officials Meet in Phoenix, Ariz.

Annual convention has good attendance of engineers and commissioners from all states in the West —State planning surveys discussed

WITH an attendance of more than one hundred, the Western Association of State Highway Officials held its annual meeting in Phoenix, Ariz., April 29 and 30; registration indicated official representation from all but one of the eleven western states and Texas, in addition to a representative group from the Bureau of Public Roads and the National Forest Service. At the close of the session the following officers were elected for the coming year: President, R. H. Baldock, State Highway Engineer of Oregon; vice-president, Harry Hopkins, Chairman of the California Highway Commission; secretary-treasurer, K. C. Wright, chief engineer of the Utah State Road Commission.

Resolutions adopted by the convention urged the passage of the pending highway appropriation bill in Congress, reëmphasized the stand of the Association against diversion of gas tax funds, urged that more funds be made available by the Federal government for the completion of highways through the national forests of the West, and pointed out that the increasing number of highway accidents must not be charged directly to highway design and construction when they frequently result from the non-observance of automobile driving precautions on the part of the motor-vehicle operators.

Opening session

At the opening session the roll call indicated official representatives from every member state except Montana, and the newest state of the Association—Texas—was represented by Gibb Gilchrist, state highway engineer, and president of the American Association of State Highway Officials. Headed by L. I. Hewes, deputy chief engineer of the U. S. Bureau of Public Roads, with headquarters in San Francisco, and R. E. Toms of the Washington office, the B.P.R. delegation included several district engineers and other officials from the western region.

The meeting was presided over by President Preston G. Peterson, Chairman of the Utah Road Commission. His remarks stressed the regional character of highway problems in the west and indicated the continuing need for the present organization in the study of highway management, design and construction in the public-land states. Mr. Peterson pointed out that sections of the Federal highway system extending through national forest constitute the weakest link in the main highway routes through the west, and although the Federal Aid System in Utah will be completed within five years under the present program, the roads through the national forests in that state will not be finished for eighty years unless appropriations are increased.

Following the usual addresses of welcome and responses, the convention listened to a forceful address by Willard Chevalier, vice-president of the McGraw-Hill Publishing Co., and president of the American Road Builders Association, on "Highway Development at the Crossroads." Tracing the history of highway development through (1) the "Good Roads" era, (2) establishment of the Federal Aid System, (3) the development of highway design and construction into a definite science, and (4) the establishment of the gas tax principle for highway financing, Col. Chevalier reviewed in some detail the situation during the past few years when highway construction has been taken out of the field of recognized engineering procedure and been transformed into an agency devoted to unemployment relief and made-work. It was his firm belief that the time has arrived when our national and state highway programs must be removed from the category of unemployment relief and returned to the status of legitimate engineering and construction development. Among the phases of present highway development which need extensive study at this time are: (1) the underlying economics of integrated highway transportation, (2) methods of conserving present investments in our highway systems, (3) logical extension of present systems with the development of new routes to meet future traffic needs, (4) increasing the safety of highway transportation, and (5) education of the public to a proper appreciation of highway problems. One of the important means of bringing about this public recognition of the importance of motor transportation and highway development in our national affairs is the establishing of a common understanding among all of the industries and agencies which have a common interest in motor-vehicle transportation. This group is far more extensive than is evidenced at first glance and includes a long series of industries and individuals from the producers of raw materials to the proprietors of filling stations and garages. Based on this broad conception of the highway transportation industry, it represents work for about one-tenth of our national population. In closing, the Colonel urged the necessity for returning highway construction to a sound basis in securing the most of the public's money by the use of the contract system and the corresponding efficiency of mechanized operations.

Highway financing was reviewed in a paper by Gibb Gilchrist, state highway engineer of Texas, who traced the development of local bond issues common 15 years ago, through the state bond issues, Federal participation and the present principle of the gas tax. He referred to the special problems incurred by the public-land states of the West because of the major national highway routes which extend over land which is outside of the jurisdiction of these states. Further, many of these western states are thinly populated and have long distances to be traversed by these important highway lengths. Highway financing, in the opinion of Mr. Gilchrist, has about completed a cycle, through local, state and Federal agencies and, if we are not to return again to a demand for local financing of farm-to-market roads, the states must begin to take over and operate the present local road systems.

State planning surveys

In the interest of standardizing the state highway planning work in the West, a committee had studied the subject and reported with three definite recommendations. The committee defined public roads, for the use of the road inventory as: "Public roads shall include all roads or highways under the jurisdiction and control of the Federal government, state highway departments and counties, townships or special road districts and all other roads which, in the opinion of officials, should be included in this classification. Such other roads as are not under such jurisdiction that in the opinion of the state managers of the planning surveys of the several states deem advisable to include, on the basis of being general-use roads."

On the subject of the scale of the inventory maps, "the committee recommended the scale of 1 in. to the mile, except in metropolitan areas when 2 in. to the mile or larger may be used if desired. In thinly populated areas, the scale may be reduced to ½ in. to the mile, but should never be less than ¼ in. to the mile."

On the subject of the classification of roads for the purpose of estimating necessary improvements, the committee divided roads into three types: 4-lane highways, 2-lane highways, and single-lane highways. The committee recommended against more than 4 lanes of pavement, in favor of the building of parallel roads in such cases where traffic requirements are in excess of 4-lane requirements. Under the classification of 2-lane highways, "the bulk of the highway mileage," the committee further divided the classification into 9 divisions for each of the subheads "flat, rolling, and mountainous," based on such features as safe speed, width of surfacing, curvature, and grade. The committee recommended the use of spirals on all curves of more than 2 deg. in open or rolling country. Further, the committee recommended that all groups be super-elevated adequately for designed speeds with a measure of 1¼ in. per ft. of roadway width with an allowance of 0.3 for the skid factor.

After some discussion of the technical points in the recommendations, which brought out the point that the committee was to continue and could modify its conclusions if necessary, the report and recommendations were adopted.

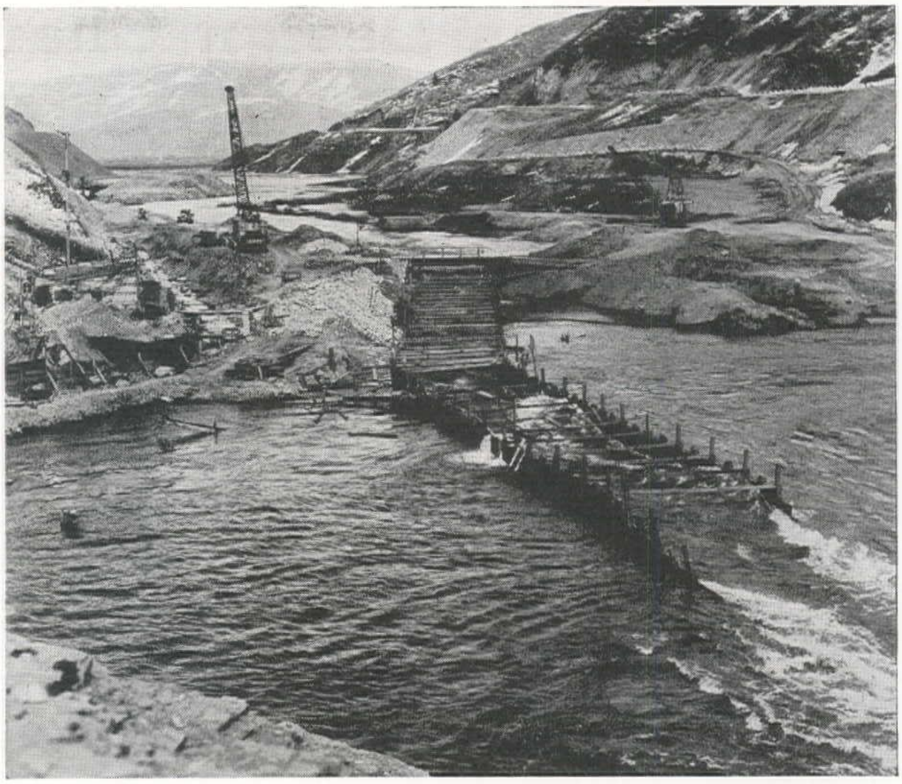
L. I. Hughes, deputy chief engineer of the U. S. Bureau of Public Roads, reviewed the design and construction of the national highway system now being built in Germany.

Highway management

The broad aspects which should control the vision and the plan of state highway departments were reviewed in a paper by R. E. Toms from the Washington office of the Bureau of Public Roads. After reviewing the establishment and growth of state highway departments, Mr. Toms pointed out the need for appreciating broad policies and charting long distance courses for highway development programs. Road revenues must be intelligently divided in the interest of the greatest common good and the present road inventory should be of particular value in this connection. The present trend is toward state control of all public roads, and the expansion of the state systems makes the problem more complex because available funds must be allocated with the greatest care.

Mr. Toms used the phrase "lazy engineering" to typify highway design which tends to overlook matters of appearance and safety when these elements could be improved with only a moderate amount of thought and very little additional cost. He concluded by pointing out that highway design and construction have now passed into the field of established technique, but the problems of highway management are in their infancy and will be one of the major considerations for state highway departments during the next years.

"Arizona Subgrade Studies and Their Relation to Oil Roads" was reviewed in a paper by J. W. Powers, materials engineer of the Arizona Highway Department. He pointed out the fact that the state's first use of oil surfacing began in 1928; all of the emphasis was placed on the oil mat and no attention was paid to the sub-base. This situation began to change about 1931-32 and since then there has been an increasing amount of study and testing in the design and construction of the foundation and sub-base courses for Arizona highways. In addition to laboratory tests on characteristic Arizona material, the field program includes test pits for an examination of materials for the various projects to determine the suitability of local materials.



Pine View Dam Site Flooded on Ogden River in Utah

Construction operations at Pine View dam on the Ogden River about 8 mi. north of Ogden, Utah, have been delayed due to unprecedented high water last month. The maximum discharge recorded during the flood was 3,700 sec. ft., the largest since 1921.

Preliminary to the completion of the diversion tunnel, the contractor has been using a 3,000-sec. ft. wooden flume 22 ft. wide and 8 ft. deep to carry the river. On April 13 the flood over-topped this diversion flume and washed out the downstream half below the cutoff trench. The illustration shows the portion of the flume still intact on April 24. The flooding of the cutoff trench and foundation excavation will probably delay placement of the rolled-earth embankment material until about July 1. Meanwhile excavation and concreting operations are continuing on the spillway, gate chamber, and diversion tunnel.

New Adit Access at San Jacinto Tunnel

TO PROVIDE more working faces in the driving of the San Jacinto Tunnel on the Colorado River Aqueduct project, the Metropolitan Water District has started an inclined adit which will cut the tunnel line approximately half way between the Potrero and Cabazon shafts. The section east from the Potrero shaft, between the shaft and the new adit location, includes the most difficult ground on the entire project, with a combination of heavy flows of water and shattered heavy material.

Portal for the new adit will be in Lawrence Canyon about 4 mi. from the district field headquarters at Banning. Field work on the adit started March 23. It will be about 1 mi. long on a 25% grade. Upon reaching the tunnel line, according to present plans, the driving from the adit may be advanced by the pioneer tunnelling method, using cross-cuts to the main tunnel from a small preliminary bore driven at one side of the main line.

The distance between the Potrero and Cabazon shafts is 32,620 ft. Driving has advanced 2,034 ft. east from the Potrero shaft and 8,803 ft. west from the Cabazon shaft, according to the last report from the district. During the month of March, the advance east from the Potrero shaft totalled only 23 ft.

The 3 mi. section from the Potrero shaft to the west portal was recently completed, and there remains less than 2,000 ft. to be driven from the Cabazon shaft to the east portal.

The driving of the San Jacinto tunnel is being carried on by the forces of the Metropolitan Water District. Work is now under the direct supervision of B. C. Leadbetter. C. R. Rankin is tunnel consultant for the San Jacinto operations. F. E. Weymouth is general manager and chief engineer of the Metropolitan Water District. J. L. Burkholder is assistant general manager and Julian Hinds is assistant chief engineer.

Field superintendents on the work are: Potrero shaft—A. L. Simpson, who was formerly with Dixon, Bent & Johnson on the Pasadena tunnel; Lawrence adit—Neil O'Donnell, who has been superintendent for the district on the Coachella Division at Fargo Camp; West Portal—Charles F. Thomas, Jr., from the Coachella Division of the district operations; Cabazon shaft—Frank Laird remains as superintendent.

Construction Design Chart

VIII. Spans for Form Joists: Flexure

By JAMES R. GRIFFITH
Professor of Structural Engineering
Oregon State College

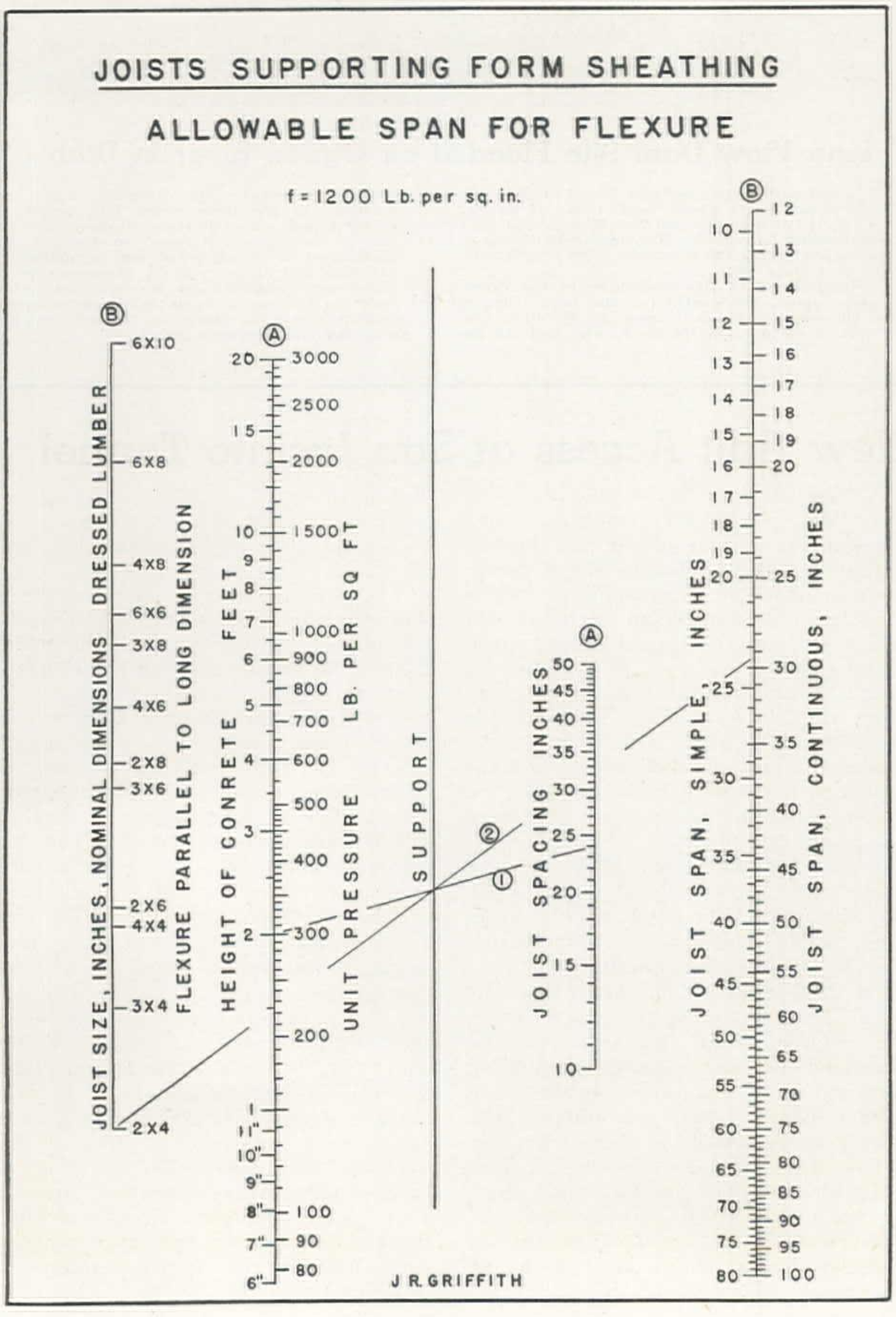
THERE are devious ways of supporting slab joists and wall studs for concrete forms, some of which are:

Slab Joist Supports
- Shores directly under joists
- Girts, which are in turn supported by shores

Wall Stud Supports
- Twisted wires, when the appearance of cut wires is of no consequence, as in the case of foundation walls
- Whaling strips, single or double, which are held by pencil rod ties

Regardless of what method of support is used, the allowable span of the joist or stud must be determined. In the determination of the allowable span for joist or stud, the same three factors (flexure, shear, and deflection) should be investigated as in the case of the sheathing.

The accompanying chart is the first of three which, for joists and studs, parallel the three used for investigating the sheathing. The same assumptions have been made as to the moment and shear in continuous beams, and the same allowable stresses have been used as in the case of sheathing.



For a solution of the accompanying chart it is necessary to have two lines intersecting on the "SUPPORT." One line is drawn between the (A) scales, and the other between the (B) scales. The following problem will serve to illustrate its use.

Let us assume that a concrete foundation wall 8 ft. high above the footing is to be poured in two lifts, each lift in an 8-hr. day shift. It will be still further assumed that due to the setting of the concrete the maximum pressure head from the fluid concrete will be 2 ft. Reasonable assumptions must be made with regards to the effective height of the concrete producing lateral pressure. Otherwise some very unreasonable results may be obtained. There are too many variables to permit an accurate determination of this effective height of concrete, some of which are: temperature, consistency of concrete, rate of pour and method of compacting, vibrating or hand spading. If a thin wall is to be poured in sections so that the rate of deposition will exceed the rate of setting, it may be necessary to use a relatively high effective height of concrete.

By referring to the charts in the February, March and April issues, the allowable span in the sheathing can be determined. On the basis of 1-in. dressed sheathing being used, the following values were obtained:

Stress Condition	Allowable Span of Sheathing
Flexure	24 in.
Shear	28 in.
Deflection	25 in.

From this it will be seen that the proper spacing of studs, for the given assumptions, is 24 in.

Assuming that 2x4 dressed studs with twisted wire ties are to be used, the allowable spacing of the ties has been determined on the accompanying chart. Line (1) has been drawn from the 24-in. spacing of studs found necessary above, and the 2-ft. height of concrete assumed to be effective. Line (2) has been drawn through the intersection of line (1) on the "SUPPORT" and the stud size 2x4. On the right hand scale it will be seen that the allowable span, or spacing of the ties, is 29 in. when the spans are continuous over more than two supports. Provision has been made on the chart for either continuous or simple spans.

For a check solution of this problem

Total span load, $W =$

$$2 \times 300 \times \frac{29}{12} = 1{,}450 \text{ lb.}$$

Moment, $M =$

$$\frac{W\,L}{10} = \frac{1{,}450 \times 29}{10} = 4{,}210 \text{ in. lb.}$$

Sec. Mod., $S = 3.56$ $\quad 2 \times 4$ (S4S)

Extreme fiber stress, $f =$

$$\frac{M}{S} = \frac{4{,}210}{3.56} = 1{,}180 \text{ lb. per sq. in.}$$

Program for A. W. W. A. Convention

National water works meeting will be held in Los Angeles June 8–12

THE American Water Works Association will hold its annual National Convention in Los Angeles, Calif., from June 8-12. The California Section of the A. W. W. A. will consolidate its seventeenth annual meeting with that of the national association.

A special "California Day" at the Los Angeles convention has been designated by the national body at which papers by prominent California water works engineers will be presented.

Frank A. Barbour, Boston, Mass., is president of the national association. H. A. Norman is president of the California Section, R. F. Brown, vice-president, and J. E. Phillips (P. O. Box 240, Arcade Annex, Los Angeles), secretary-treasurer. Headquarters of the convention will be at the Biltmore Hotel.

A brief summary of the program of the convention follows:

June 7—Meeting of the National Board of Directors in the evening.

June 8—The morning session will be devoted to committee reports. President Frank A. Barbour will officially open the convention (11 a. m.) and conduct a brief business meeting. The afternoon will be devoted to technical sessions. The Plant Management and Operation Division will meet under the direction of Chairman William W. Hurlbut, water distribution engineer, Bureau of Water Works & Supply, Dept. of Water & Power, Los Angeles, Calif., while the Water Purification Division meeting will be presided over by its chairman, Albert E. Berry, director of Sanitary Engineering Division, Ontario Dept. of Health, Toronto, Canada.

Among the papers to be presented at the latter meeting are the following:

Methods of Testing and Significance of Boron in Water Supplies.
Ray L. Derby, assistant sanitary engineer, Bureau of Water Works & Supply, Dept. of Water & Power, Los Angeles, Calif.

Methods of Testing and Significance of Fluorine and Fluorides in Water Supplies.
Joseph M. Sanchis, chief chemist and bacteriologist, Bureau of Water Works & Supply, Dept. of Water & Power, Los Angeles, Calif.

Plankton and Insect Larvae Control in California Waters.
Gerald E. Arnold, water purification engineer, San Francisco Water Dept., Millbrae, Calif.

The annual directors' meeting of the California Section, A. W. W. A., will be held early in the evening to be followed by an informal reception.

June 9—**California Day**—The main session will be devoted to presentation of papers by water works engineers of California. A parallel session of the Water Purification Division will be held on this day also. Papers to be presented at the main session include:

Romance in the Development of Los Angeles' Water Supply.
H. A. Van Norman, chief engineer and general manager, Bureau of Water Works & Supply, Dept. of Water & Power, Los Angeles, Calif.

Benefits Accruing from the Hetch Hetchy Project, San Francisco Water Supply.
N. A. Eckart, general manager and chief engineer, Water Dept., San Francisco, Calif.

Discussion: George W. Pracy, superintendent, Water Dept., San Francisco, Calif.; Frank E. DeMartini, sanitary engineer, San Francisco.

Progress on the Colorado River Aqueduct of the Metropolitan Water District of Southern California.
Franklin Thomas, vice-chairman, board of directors, Metropolitan Water District of Southern California, and Professor of Civil Engineering, California Institute of Technology, Pasadena, Calif.

Features of Equipment and Design of Pumping Stations on the Colorado River Aqueduct.
Max Spillmann, chief engineer, Worthington Pump & Machinery Corp., Los Angeles, Calif.

Discussion: Robert L. Daugherty, Professor of Mech. and Hyd. Engineering, California Institute of Technology, Pasadena, Calif.

The Dual Usage of Water for Domestic and Irrigation Purposes.
J. B. Lippincott, consulting engineer, Los Angeles, Calif.

Experience in Ground Water Depletion by Unregulated Pumping.
William W. Brush, Editor, "Water Works Engineering," New York.

The Value of and Methods Used in Artificial Storing of Ground Water by Spreading.
D. A. Lane, assistant engineer, Bureau of Water Works & Supply, Dept. of Water & Power, Los Angeles, Calif.

Developments in the Program of Conservation of Water Resources as a Federal Measure: On Stream and Ground Water Control and on Hydrologic Data.
Abel Wolman, chief engineer, State Dept. of Health, Baltimore, Md.

Discussion from the California point of view.
C. G. Gillespie, chief, Bureau of Sanitary Engineering, State Dept. of Public Health, Berkeley, Calif.

The afternoon session of the Water Purification Division will be devoted to a symposium on filtration. A list of papers to be presented follows:

Mixing.
Carl M. Hoskison, chief engineer, Sacramento Filtration Plant, Calif.

Coagulation.
Kenneth W. Brown, sanitary engineer, California Water Service Co., Stockton, Calif.

Filtration Without Preliminary Coagulation.
Joseph D. DeCosta, sanitary engineer, East Bay Municipal Utility District, Oakland, Calif.

Filter Design as Related to Operation.
Harry N. Jenks, consulting sanitary engineer, Berkeley, Calif.

The Maintenance of Filtration Plant Equipment.
John Perhab, superintendent of water purification, Beverly Hills, Calif.

June 10—Following a meeting at the Los Angeles Breakfast Club the main session will convene to hear a symposium on the cost of tuberculation.

Note: The regular business meeting of the California Section will be held at 4:30 p. m.

June 11—A joint session of the General Membership and Water Purification Divisions will be held in the morning as will a session of the Finance and Accounting Division. The Plant Management and Operation Division will meet in the afternoon. A superintendents' round table discussion will be held at this session.

June 12—An all-day bus trip for inspection of the Los Angeles water works will take place.

Entertainment

Monday, June 8

6:30 Dinner. "Service des Eaux."
9:00 Reception and dance. Informal. Rendezvous.

Tuesday, June 9

7:00 All-Division dinner. Informal. Biltmore Bowl.

Wednesday, June 10

8:00 a. m. Breakfast at the Los Angeles Breakfast Club. Golf tournament. Excursion.
9:00 p. m. Smoker. Ladies invited. Rendezvous.

Thursday, June 11

12:30 Luncheon. Finance and Accounting Division.
7:00 Dinner dance. Informal. Biltmore Bowl.

Grand Coulee Operations Accelerated to Rapid Pace

Concreting at 6,000 cu. yd. per day—Second mixing plant ready—East side excavation advanced—Gravel pit handling 12,000 cu. yd. per day—Bridge pier repaired

THE past month has been one of accomplishment in every phase of the work now going on at the Grand Coulee dam site. Concrete is being placed at the rate of nearly 6,000 cu. yd. per day. To date, approximately 350,000 cu. yd. of concrete have been placed in the west enclosure. Block 40 has been poured up to El. 970, and no more concrete will be placed in this section until the high construction trestle has been built out to this block. Concreting and clean up operations have been expedited during the last month by the addition of another whirley on the high trestle. There are now three whirleys and three hammerhead cranes in use on the construction trestles.

The wooden crib in the bucket section of block 40 has been completed and filled with gravel and sand. The top of the crib is at El. 950. Block 39, just west of block 40, will be poured to El. 1,000, and the crib in its bucket section carried up to the same elevation.

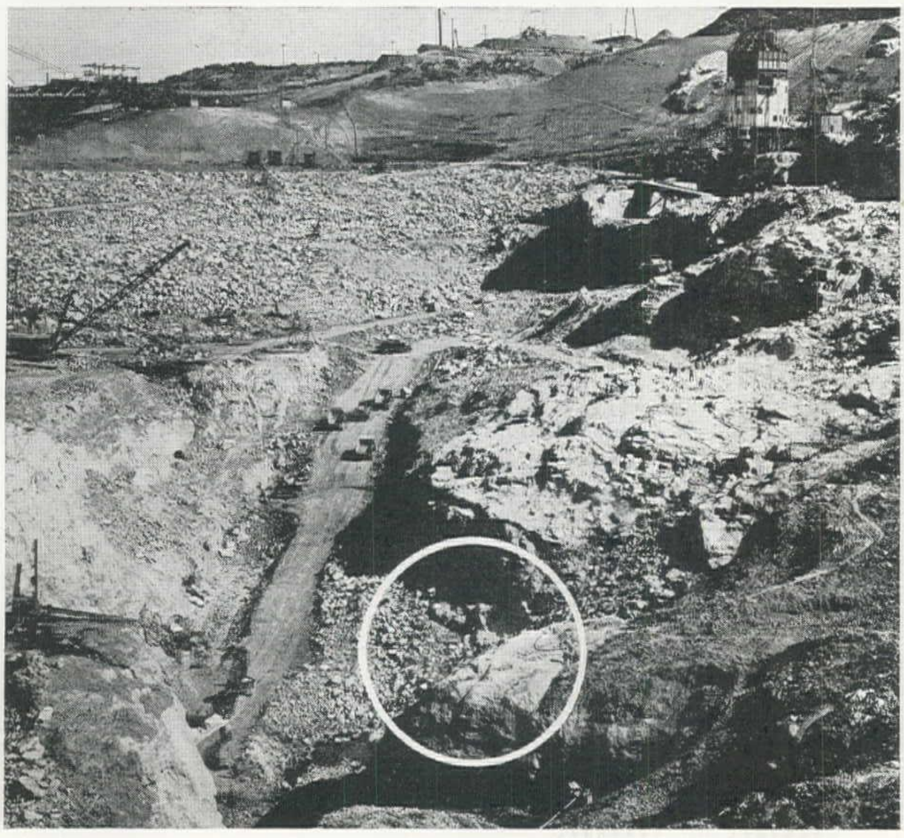
Common excavation has been completed in the west enclosure, and the remaining bedrock is being prepared for concrete.

Over 40,000 cu. yd. of sand and gravel have been placed between block 40 and the cofferdam to serve as a stabilizer during high water. Later this material will be used to fill the crib in the bucket of block 39.

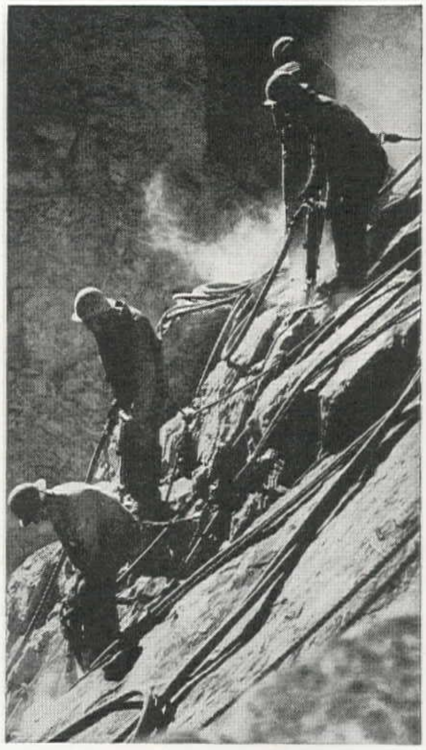
On the east side of the river, rock work is progressing on the abutment and foundation. About 2,500 cu. yd. per day are moved out of the pit. Placing of rip rap on the east tailrace slope is nearly complete. Rip rap has also been placed on the earth berm behind the east cofferdam to prevent washing when the pit is flooded by high water.

The east mixing plant is now ready for operation. The aggregate conveyor from the live storage piles to this plant and the pipe line from the cement silos have been completed. All of the footings for the upstream construction trestle have been poured on the east abutment and steel erection is well under way. Bents for the high trestle falling in the crevasse will be some 240-ft. high.

The slide in the east forebay area continues to be a source of trouble. For the past four months, the MWAK Co. has been working in the bottom of the east side crevasse attempting to prepare it for the placing of concrete. Since the frost went out of the ground the latter part of February, minor slides have fallen into the crevasse from the forebay slopes at about the same rate that the company has been able to remove the dirt. April 18, practically all previous clean-up operations in the bottom of the crevasse were undone when a slide of about 10,000 cu. yd. occurred, filling the bottom of the crevasse with mud and water. The east forebay slope which was originally excavated on a 2:1 slope and later modified to take care of earlier slides, now resembles the irregular face of the spoil-bank in Rattlesnake Canyon. Slipping planes extend beyond the top of the original slope and there are vertical breaks of 20 ft. in many places. Underground springs, sloping bedrock forming the southeast side of the crevasse and the unusual depth of the cut, which is about 220 ft. vertically from top to toe of slope, may be named as contributing factors in causing the slide. Since the last slide, excavation in the bottom of the crevasse has been suspended and will probably not be resumed again until after high water.



Preparation of foundation rock on the east side of the river. The second mixing plant is shown under construction. A detail of the drilling operations indicated in the circle is shown in other illustration on this page.



Jackhammer men with safety belts working on the rock face shown circled in the other picture.

Two electric shovels are now working in the gravel pit, turning out about 12,000 cu. yd. of raw stock per day. Due to the high percentage of fines, it is necessary to waste about 50% of the material that comes from the pit. The collapse of a steel truss, used in carrying sand from the blenders to the aggregate plant storage piles, caused several days delay in the production of sand. Concreting was not affected by this mishap, however, due to the large quantity of sand that is maintained in the live storage piles.

Temperatures above normal throughout the northwest during the latter

Steel sheet pile cofferdam and excavation operations used in bringing the east pier back to plumb.

part of April indicate an early high-water level in the Columbia River. Heavy precipitation on the water sheds last winter will probably cause a higher flood water than last year. However, the unusually dry spring will detract from the normal runoff.

The Pomeroy Construction Co. is making satisfactory progress on the repair of the east pier of the government highway bridge. Sliding earth behind the 146-ft. pier had pushed it 9½ in. out of line at the top. In order to repair the pier, 27 ft. 8 in. by 58 ft. 8 in. at the base, a 110-ft. diameter sheet steel cofferdam was driven around it. Earth inside the enclosure was then excavated and the piling braced with welded I-beam whalers, spaced at 7½ ft. at the top, with the spacing decreasing toward the bottom to resist the greater earth pressures. As the excavation was carried on, timber bracing was put in from the cofferdam wall to the pier. As the earth pressure behind the pier was relieved, it gradually settled back into place. The timber bracing was kept wedged, and the center expansion joint in the bridge blocked to hold the pier. Cables fastened to the bridge were also used to pull the pier back into place.

Near the bottom of the excavation quicksand was encountered which made it necessary to drive a 98-ft. cofferdam inside the original one. A 4½-ft. concrete cap was used to seal the offset.

Rock was reached March 18, at El. 870. Inspection of the foundation of the pier showed that it had not been damaged, and that the pier had merely pivoted about its base. By the time bedrock around the pier had been cleared, the pier was back in place. Keyways were cut in the bedrock and the sides of the pier, and concrete poured inside the 98-ft. enclosure up to El. 886. At this elevation, vertical forms were erected tangent to the upstream and downstream sides of the pier, forming an enclosure with two straight sides, connected with two arcs of sheet steel piling. From El. 886 to El. 946 the new brace footing will be on a 1:1 slope on the river side of the pier. The concrete behind the pier will not be battered and will be poured up to El. 946. At present about 4,000 cu. yd. of concrete have been placed. A total of 8,800 cu. yd. will be required. This repair job, estimated to cost nearly $300,000, is being done on a cost plus basis by the Pomeroy Co. At the present rate of progress, the job will be completed in about one month.

Western Water Storage Increases

FEDERAL reclamation reservoirs, today contain 10,016,359 ac.-ft. of stored water, according to reports of the Bureau of Reclamation.

The survey was made as various other areas in the West and Midwest which are without water storage facilities reported fears of damaging droughts this summer.

"The amount of water stored on reclamation projects today is more than twice that stored on the same date last year," John C. Page, acting reclamation commissioner said. "It represents an increase of a million ac.-ft. during March and is additional evidence that 1936 will be a good year on the Federal projects, all of which are now assured of an ample water supply."

Although sufficient water now is stored in these reservoirs to cover the State of Connecticut to a depth of about 3 ft., the 10,016,359 ac.-ft. total today is not all that will be available for the 1936 irrigation season.

The great Owyhee reservoir, created by construction of Owyhee dam for the new project of that name on Oregon-Idaho border, filled for the first time.

Personally speaking. . . .

Charles L. Nellor of Portland has been appointed manager of the Port of Dalles, Ore.

•

Carl Nyman, engineer of Price, Utah, has been appointed engineer of Carbon County, Utah, to succeed E. O. Andersen who recently resigned.

•

Charles H. Lee, consulting hydraulic engineer of San Francisco, has been appointed chief water supply and sanitary engineer for the coming San Francisco World's Fair.

•

S. N. Jacobsen has been appointed a member of the executive committee of the Intermountain Branch, A. G. C., Salt Lake City, Utah, to fill the vacancy caused by the death of J. W. Whiting.

•

Donald M. Baker, consulting engineer of Los Angeles, Calif., has been appointed regional coördinator for the Natural Resources Committee. His work will involve supervision of the present water resources investigations.

•

Keith Bahrenburg has resigned as engineer in the Wyoming State Highway Department in order to accept a position with an Omaha contracting company. J. J. Swanson of Cheyenne will succeed him.

•

Russell C. Booth, has moved from his position as division engineer of Division 1 on the Colorado River Aqueduct to division engineer of Division 4, which carries with it the title of general superintendent on the Coachella tunnels on the district opera-

RUSSELL C. BOOTH

tions. Mr. Booth succeeds B. C. Leadbetter who has become construction superintendent on the San Jacinto tunnel. Further recent changes in the engineering staff of the Metropolitan Water District noted in the current edition of the *Aqueduct News* are W. E. Whittier who succeeds Mr. Booth as division engineer of Division 1, moving from Division 2. John Stearns remains as division engineer of Division 3. Supervision over Division 2, is to be split between Mr. Whittier and Mr. Stearns.

●

Roy E. Ramseier of Berkeley, a graduate of the University of California in May, 1935, and formerly employed by the Alameda County Mosquito Abatement District, has been appointed sanitary engineer for Imperial County, Calif.

●

C. P. Dexter, assistant engineer of the Washington state public service department, has recently been named chief engineer of this department to succeed James W. Carey, who resigned to take a PWA position.

●

G. W. Thompson is resident engineer and C. E. McGrath, assistant resident engineer for the California Division of Highways on the construction of the East Tracy Overpass at Tracy, Calif. Mr. Thompson is also resident engineer for the state on the Charter Way Subway construction at Stockton, Calif. E. W. Gustafson is assistant resident engineer on this job.

●

C. Clarke Keely, civil engineer, has opened an engineering office in Los Angeles, Calif. During the past decade Mr. Keely has been associated with such organizations as Stone & Webster, the Metropolitan Water District, the Associated Telephone Co., the Los Angeles Bureau of Power and Light and the General Telephone Service Corp. of New York.

●

Albert J. Evers of Ashley and Evers, San Francisco architects, formerly chief supervising architect of the Northern Calif. Division, FHA, has been named as chief specification writer for the coming San Francisco World's Fair. **G. F. Ashley,** a graduate of the University of California in 1908, and a practicing architect for many years, has been appointed to succeed his former partner, Mr. Evers, as chief supervising architect of the Northern Calif. Division, FHA.

Superintendents on the Job . . .

Fred Brunskoll will be in charge of construction of the tunnels on the Waldo approach to the Golden Gate Bridge. Contract for this job is held by T. E. Connolly of San Francisco, who will take an active part in directing the work.

●

V. H. Thomas will be general superintendent in charge of the $109,508 contract recently awarded the W. E. Callahan Construction Co. of Los Angeles for constructing 156 mi. of high tension power transmission line from Boulder Dam to Prince Sub-station in Lincoln County, Nevada.

●

K. H. Mead will be superintendent on the $278,250 contract held by the Marinap Corp. for furnishing and placing a 3 mi. rock-fill retaining wall around the Exposition site north of Yerba Buena Island in San Francisco Bay.

●

C. B. Gilger is superintendent in charge of the $202,819 contract awarded Granfield, Farrar & Carlin of San Francisco for 3.1 mi. of grading and concrete paving in Santa Barbara County, California.

●

Carl Herziger is superintendent for Lindgren & Swinerton, contractors of San Francisco, on their contract for construction of the East Tracy Overpass at Tracy, Calif. This work is being done under the supervision of the California Division of Highway.

●

E. D. Brown is superintendent for Harold Blake of Portland, Ore., on the $124,640 contract recently awarded Mr. Blake for bituminous surfacing of 4.93 mi. of the Klamath Falls-Weed Highway in Oregon. Joe Blickle is assistant superintendent on the job.

●

Frank Darling is general superintendent and **H. Erickson,** construction superintendent for the Pacific Bridge Co. of San Francisco, on bridge construction over the San Joaquin River at the Maze Road Extension south of Stockton.

●

L. E. Dixon and **F. H. Strobecker** are manager and general superintendent, respectively, on the $819,315 contract for construction of the Eagle Mountain Pumping Plant on the Colorado River Aqueduct awarded the L. E. Dixon Co. of Los Angeles.

●

N. W. Axline is superintendent on a $244,610 contract held by O. F. Fisher of Phoenix, Ariz., for 15½ mi. of road work on the Showlow-Springerville Highway in Arizona. Mike Miller is assistant superintendent and J. Greer Thompson is engineer.

●

Ben F. Wells will be superintendent on the $770,204 contract held by the Macco Construction Co. of Clearwater, Calif., for 3½ mi. of grading and surfacing on the Waldo approach to the Golden Gate Bridge. O. W. Tucker will be engineer and cost accountant.

●

L. M. Robinson is general superintendent for the Dodge Construction, Inc., contractors of Fallon, Nev., on construction of an overpass and bridge crossing over the Humboldt river and Western Pacific Railroad tracks at Winnemucca, Nev. **H. S. Thompson** is superintendent and **Chas. Petersen** structural foreman for this same company on another overpass being built across the W. P. R. R. line at Dumphy, Nev. **Dan Indermuhl** is resident engineer for

J. H. Ryan (right) is construction engineer in direct charge of the present work of raising the O'Shaughnessy dam on the San Francisco Hetch Hetchy water supply system. L. T. McAfee is chief engineer and manager of the Hetch Hetchy project. Harry Lloyd (left) is assistant construction engineer.

the Nevada State Highway Department on this job.

•

Fred Jenkins and **Tom Wilcox** are field superintendent and assistant field superintendent, respectively, on the $270,105 contract recently awarded the American Concrete & Steel Pipe Co. of Tacoma, Wash., for 16,596 ft. of 48-in. lock-joint concrete pipe for the City of Tacoma. W. E. Roberts is welding superintendent and Gordon Duncan, concrete superintendent for the plant work.

•

J. P. Gilmore will be general superintendent in full charge of construction of 111.2 mi. of main track railroad line between Boise City, Oklahoma, and Los Animas, Colo., on a contract recently awarded Sharp & Fellows Contracting Co. of Los Angeles, Calif., by the Atchison, Topeka & Santa Fe railway System. **L. B. Webb** will be line auditor. Headquarters for the job will be established at Springfield, Colo. Several other assistants are to be chosen from the contractor's staff. All field construction is supervised by **H. J. Gannon,** vice president of Sharp & Fellows.

•

Otis Swearinger, Dave Wheeler and **Reuben Haffner** are superintendents on three highway contracts in Montana recently awarded the Tomlinson-Arkwright Construction Co. of Great Falls, Mont. Mr. Swearingen is in charge of a $168,135 contract for 12 mi. of highway grading surfacing, etc., on the Lewiston-Grass Range road. Mr. Wheeler is supervising a $114,775 contract for 5.3 mi. of grading, surfacing, etc., on the White Sulphur Springs-Harlowtown Road. This job includes construction of two timber bridges. Mr. Haffner is directing the work on an $85,255 contract for 7.1 mi. of regrading, etc., on the Sun River Road.

•

Otto Parlier is the **superintendent** for J. F. Knapp of Oakland, Calif., on two grade crossing structures being built by this company in connection with the East Bay approaches to the San Francisco Bay Bridge.

On the first of these jobs the San Pablo Underpass below Adeline, Peralta, and San Pablo streets on the middle approach, Mr. Parlier is being assisted by George Laird, contractor's engineer; Sam Rogers, excavation foreman; Carl Durant, concrete foreman; Henry Kreuzer, carpenter foreman; Jack Meyers, carpenter foreman; L. C. Bustrack, timekeeper. On the second contract, the El Cerrito Overpass across the Southern Pacific Railroad tracks west of El Cerrito, on the north approach, the following men are assisting Mr. Parlier: William Jagger, assistant superintendent; K. Dunlop, general foreman; Wayne Phillips, concrete foreman; C. G. Quisenbery, carpenter foreman.

Obituaries . . . . .

Silas B. Mason, nationally known contractor and board chairman of the Mason-Walsh-Atkinson-Kier Co., died on April 14 at the Mason City, Wash., hospital, after suffering a stroke while at work in his office at Grand Coulee dam. Mr. Mason was 56 years old. Besides heading the MWAK Co., general contractors for Grand Coulee dam, Mr. Mason was also chairman of the board for Mason & Hanger Co., Inc., Mason & Walsh Co., and the Silas Mason Co. The firm of Mason & Hanger is one of the country's oldest construction firms. Mr. Mason has been connected with such projects as the New York subway system, Fulton St. East River tunnels in New York, the construction of the piers for the George Washington bridge.

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Leonard J. Butler, 23, civil engineer in the government erosion control service, was killed on April 7 when he slipped from the top of Gibraltar Dam in Santa Barbara County, Calif.

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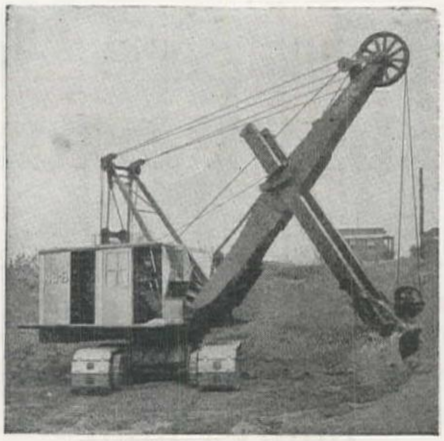
Fremont Morse, 79, retired commander of the U. S. Coast Guard, past president of the Astronomical Society of the Pacific, member of the A. A. A. of S. and an important figure in geodetic surveying work in Alaska, died at his home in Berkeley, Calif., on April 7.

New Materials and *Equipment* . . . . .



New Bucyrus-Erie Excavator

Introduced by Bucyrus-Erie at the 1936 Road Show held in Cleveland, the 48-B is the newest addition to this company's line of excavating machines. Instantly responsive to the operator's will, the hoist, crowd, and swing motions have been coordinated and balanced for the fastest possible digging cycle.

The new 48-B is easily converted as shovel, dragline, clamshell, or lifting crane. The dragline-crane boom is built of alloy-steel angle chords with welded tubular cross bracing and is available in lengths from 50 to 100 feet. The high A-frame with special dragline boom-suspension tackle reduces stresses on the boom and lessens the weight at the boom point.

There is a choice of three mountings—standard, oversize, and special oversize. Slide-in cats permit quick shipment on a single car without dismantling.

One hundred twenty-eight anti-friction bearings assures minimum wear on all moving parts and less frequent adjustments. Centrally located shipper shaft; twin, 42-inch, live sheaves; arc-welded outside dipper handles; and a positive chain crowd are some of the other outstanding features, plus the introduction of Perma-Speed control, a new development in smooth and accurate controlling of clutch and brake.

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New Compressor Delivers 420 Cubic Feet

Answering the need for a portable air compressor which can deliver an exceptionally large amount of air, and yet effect substantial fuel savings, the Gardner-Denver Company has just announced its ABH 420-D two-stage, water-cooled compressor with "Caterpillar" D-13,000 Diesel engine.

This compressor delivers 420 cu. ft. of actual air per minute, according to Gardner-Denver officials, who say that, on less than 6 gallons of 6-cent fuel oil, it will operate at full capacity for one hour. The length of the portable compressor, over all, is 16 ft. 7 in. A total weight of the machine is 18,000 pounds.

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Jaeger Mixers Improved

Fast charging and discharge speeds with smooth operation plus modern, compact, streamlined designs, including two-wheel pneumatic tire mounting for 3½S, 7S, and 10S mixers, are features announced by The Jaeger Machine Company in its 1936 line of concrete mixers.

For bridge building, curb and gutter and general construction work, the manufacturer recommends the advantages of the 2-wheel 10S and 7S Speed King models of the type pictured. Heavy 6- and 8-ply industrial pneumatic tires are used, two

TOUGH RUBBER★ MEANS LONG LIFE FOR DUMP TRUCK TIRES

GOODYEAR DUMP TRUCK ALL-WEATHER TIRES ARE BUILT FOR MORE MILES OF DEPENDABLE SERVICE

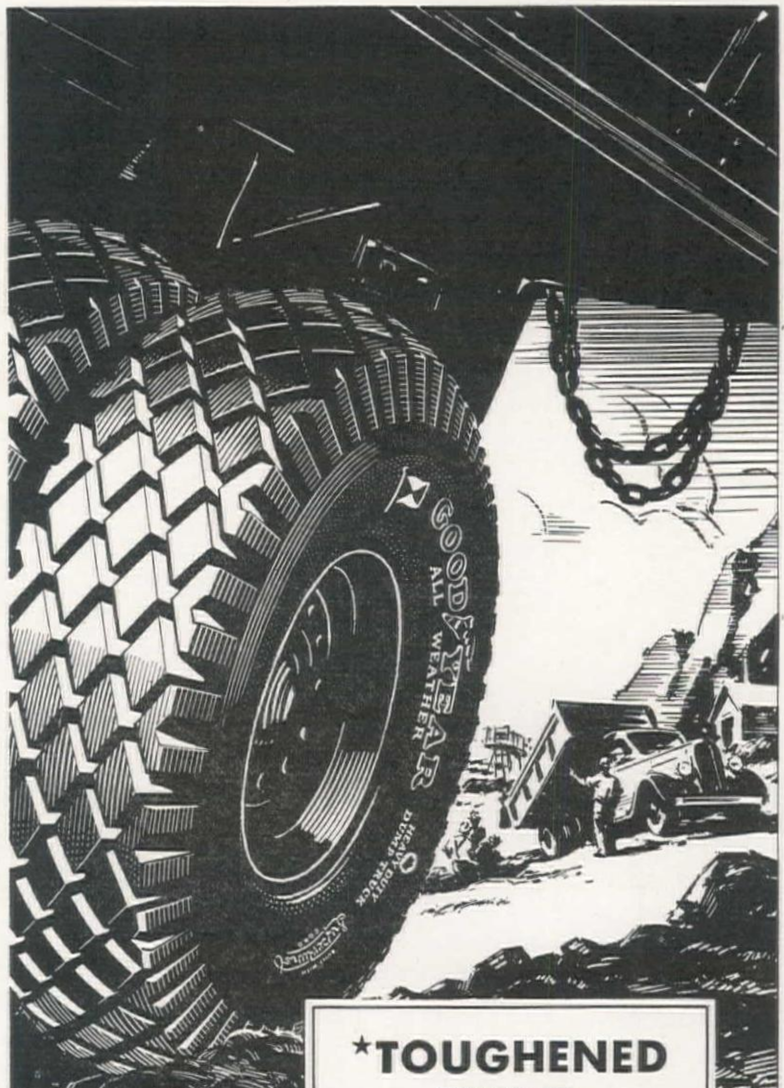
Tough rubber? Yes! Goodyear Dump Truck All-Weather Tires are built with chemically-toughened rubber in both body and tread. That means strength, durability—longer, more dependable, more economical tire service on your dump trucks.

But that's only one reason why these Dump Truck All-Weather Goodyears will bring you better tire performance. Look at these features: That famous All-Weather tread that grips and pulls on any road or in any ground. Heavy, tough sidewall bars provide added traction in ruts and protection from cutting and scraping on sharp rocks and rough surfaces. Supertwist Cord for greater body strength. Extra-Strong Bead construction for heavy, swaying loads. Pima Cotton, the longest cotton fibre grown.

You have to see—and try—these Goodyear Dump Truck All-Weather Tires to appreciate them. Once you put them on your dump trucks you'll know what we mean when we say—They're MONEY SAVERS.

GOODYEAR K-RIMS *make tire changing easy—give added strength and safety—save time and money.*

THE GOODYEAR TIRE & RUBBER CO., INC., AKRON, OHIO



★TOUGHENED RUBBER

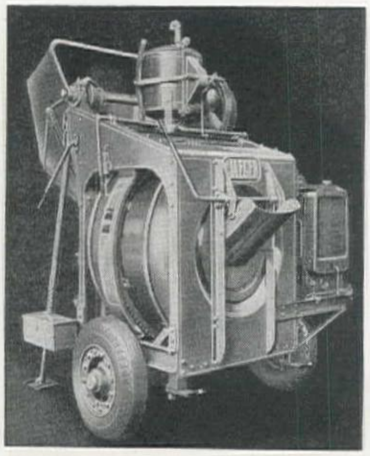
Rubber in both body and tread of Goodyear Dump Truck All-Weather Tires is chemically-toughened to resist heat, for longer wear, for greater blow-out protection.

And because the inner plies of Goodyears are built with Supertwist Cord, Goodyear engineers are able to put into them a greater amount of chemical toughening.

In Goodyears there's blow-out protection in EVERY ply.

GOODYEAR TRUCK TIRES

money savers



of these tires being said to provide double the load carrying ground contact obtained with four of the solid or high pressure tires on which mixers of this size are customarily mounted. Pneumatics, with Timken bearing axle, make it possible to trail these Speed Kings behind light trucks at speeds up to 35 miles an hour, it is stated.

Streamlined tilting mixers are offered in 3½S to 7S sizes, featuring the "Dual Mix" drum with "V" bottom on all models, a pneumatic tired 3½s trailer, and a popular priced 5S size with 2-wheel trailer mounting and end discharge adapted for work in congested streets. Jaeger non-tilting units are being built in 7S to 56S sizes.

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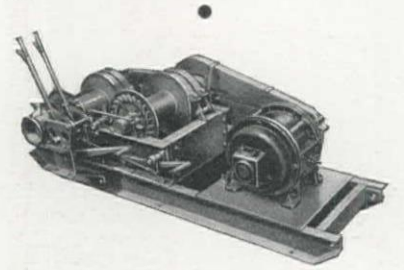


All-Steel Contractors Hoist

The Ramsey Machinery Company, 1626 N. W. Thurman St., Portland, announce the Ramsey all-steel contractors' hoist, single and double drum, powered by either gas or electric motors.

It is claimed by the manufacturer that the clutch (pats. pend.) will transmit double the load of the old type clutches of the same diameter. As there is no end thrust resulting from engagement of the drum, wear to working parts and loss of power through friction is reduced to a minimum.

This hoist was designed especially for the building contractor, for hoisting concrete skips, material cages, erecting steel, etc. It is, however, well fitted for other hoisting service, such as drop-hammer pile driving, dragline scraper operation, or any hoisting or pulling job that comes within the limits of its hoisting and cable capacities.

The Model A hoist is rated at 4,000 lbs. on a single line, with the drum full of cable, and is furnished with gas engines up to 30 H. P. or electric motors up to 20 H. P. The cable capacity of the drums are 475 ft. of ½-in. line on either drum.

UNIT BID SUMMARY . . .

Note: These Unit Bids Are Extracted from Our Daily Construction News Service

Dam Construction. . . . .

El Paso, Texas—Government—Caballo Dam—Rio Grande Project, New Mexico

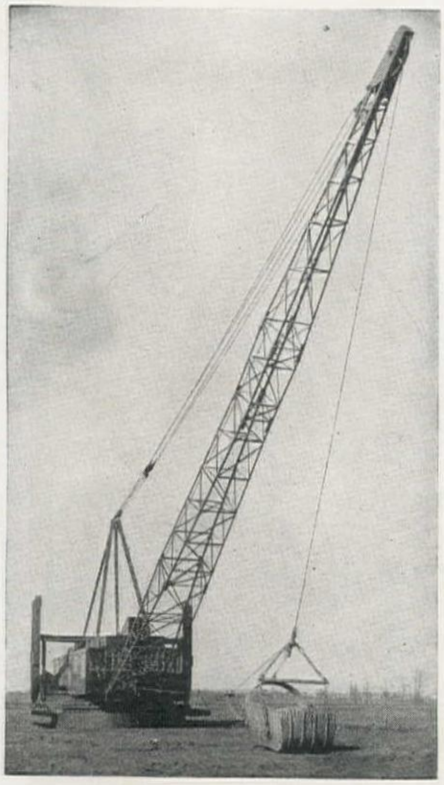
Contract awarded to Mittry Bros., 5531 Downey Road, Los Angeles, $957,270 low to Bureau of Reclamation, El Paso, Texas, for construction of the Caballo Dam, Rio Grande Project, New Mexico, Texas, under Spec. No. 672. Work is located near Hatch, New Mexico. Bids from:

(A) Mittry Bros., L. A. .... $ 957,018
(B) Martin Wunderlich Co. 1,046,899
(C) Peter Kiewit Sons Co. 1,065,842
(D) Macco Const. Co. and Emsco Derrick & Equip. 1,106,251
(E) Lewis Const. Company and Bodenhamer Const. Co. 1,132,745
(F) S. J. Groves & Sons Co. 1,182,835
(G) Hallett Constr. Co. 1,235,022
(H) Utah Const. Co., Morrison-Knudsen Co. and Paul J. Tyler 1,253,641
(I) J. P. Shirley $1,272,353
(J) Lee Moor & Lee Moor Const. Co. 1,292,128
(K) Robert E. McKee 1,298,063
(L) Hinman Bros. Const. Co. and Ed H. Honnen 1,303,853
(M) Callahan Const. Co. 1,314,282
(N) Walsh Const. Co. 1,549,227
(O) Boyce and Igo 1,552,250
(P) J. C. Maguire Const. Co., Lawler Corporation 1,605,902
(Q) Benjamin Foster Co., Inc. 1,618,509

		(A)	(B)	(C)	(D)	(E)
(1)	L. S. diversion and care of river and arroyo	$9,000	$10,000	$10,000	$12,500	$3,500
(2)	1,000 cu. yd. exc. strip. sand and grav. dep.	.35	.79	1.00	.13	.16
(3)	50,000 cy. exc. strip. borrow pits	.15	.12	.20	.14	.26
(4)	212,000 cy. stripping embankments	.30	.17	.25	.30	.31
(5)	36,000 cy. exc. for tunnel inlet and outlet	.50	.25	.25	.42	.90
(6)	7,000 cu. yd. exc. in tunnel and shaft	13.00	7.00	10.00	8.85	11.00
(7)	260,000 cu. yd. exc. for spillway	.25	.35	.30	.41	.52
(8)	65,000 cu. yd. exc. for emb. toe drains	.35	.25	.30	.46	.20
(9)	150 cu. yd. exc. for conc. cut-off wall	3.00	4.00	3.00	1.95	6.00
(10)	130,000 cu. yd. exc. for arroyo div. canal	.20	.25	.22	.35	.26
(11)	7,000 cu. yd. exc. for highway	.24	.25	.22	.26	.20
(12)	900 cu. yd. exc. for highway bridge	.50	1.50	1.50	1.00	1.10
(13)	35,000 cu. yd. exc. com. borrow pits	.20	.23	.22	.25	.22
(14)	1,000,000 cu. yd. exc. com. borrow pits, main dam	.20	.19	.22	.22	.24
(15)	150,000 cu. yd. exc. rock, borrow pits	.60	.70	.55	.50	.60
(16)	3,500 cu. yd. exc. rock, borrow pits	.75	.70	1.50	.50	.70
(17)	1,200 cu. yd. furn. surf. matl. highway	2.00	1.00	2.00	1.30	1.00
(18)	28,000 cu. yd. backfill	.50	.60	.50	.50	.40
(19)	1,130,000 cu. yd. earthfill in embankments	.06	.09	.06	.121	.065
(20)	130,000 cu. yd. rockfill on downstream	.12	.30	.25	.12	.08
(21)	15,000 cu. yd. grav. blanket, main dam emb.	.60	.75	.60	1.10	.90
(22)	30,000 cu. yd. riprap on upstr. slope	.25	.40	.35	.50	.40
(23)	17,000 cu. yd. cobble and coarse grav. and rock	.20	.20	.35	.26	.50
(24)	5,500 cu. yd. dumped riprap in spillway	.20	.40	.35	.26	.50
(25)	240 lin. ft. constr. 18" sewer pipe drains	1.00	.60	1.40	1.00	1.00
(26)	2,000 lin. ft. 12" same	.70	.50	1.05	.85	.80
(27)	4,000 lin. ft. 8" same	.50	.40	.98	.75	.50
(28)	2,000 lin. ft. 6" same	.50	.35	.70	.65	.50
(29)	70 lin. ft. 4" same	.40	2.00	1.40	1.30	2.00
(30)	250 lin. ft. drilling weep holes	1.00	1.00	1.40	.70	.60
(31)	2,000 ft. drill grout holes, 25' deep	.60	.50	.70	1.00	.80
(32)	2,000 ft. same, 25' deep	1.00	.75	1.40	2.60	1.00
(33)	2,000 lb. install grout pipes and fitgs.	.12	.20	.14	.10	.20
(34)	3,000 cu. ft. pressure grouting	1.10	.50	1.12	1.65	1.25
(35)	600,000 lb. dr. steel sheet piling	.01	.02	.017	.03	.025
(36)	275 cu. yd. conc. in ebm. cut-off	10.00	13.00	17.20	10.40	10.00
(37)	175 cu. yd. concr. in trash-rack	16.00	20.00	24.50	16.30	18.00
(38)	1,450 cu. yd. conc. in tunnel lining	30.00	16.00	18.00	21.85	15.00
(39)	1,170 cu. yd. conc. in gate chamber	18.00	17.00	20.00	15.65	20.00
(40)	3,500 cu. yd. conc. in floors	6.50	11.00	8.00	7.00	8.00
(41)	7,150 cu. yd. conc. in spillw., etc.	7.00	14.00	13.50	7.00	12.50
(42)	250 cu. yd. conc. in control hse., etc.	30.00	21.00	19.40	19.75	20.00
(43)	2,000 cu. yd. conc. in parapet and curb	5.00	13.00	10.00	10.75	10.00
(44)	320 cu. yd. conc. bridge piers	10.00	16.00	20.80	13.00	15.00
(45)	100 cu yd. conc. bridge slab	30.00	17.00	23.00	21.00	20.00
(46)	1,580,000 lb. placing reinf. bars	.01	.015	.0182	.015	.0125
(47)	1,000 cu. yd. dry rock paving	3.00	3.00	2.80	2.50	2.00
(48)	60 cu. yd. grouting paving	6.00	5.00	3.00	2.50	4.00
(49)	1,500 lin. ft. inst. metal seal. stp.	.30	.25	.14	.25	.25
(50)	50,000 lb. furn. and inst. stl. tun. plates	.09	.07	.09	.06	.06
(51)	3,000 sq. yd. specl. fin. conc. surf.	.50	.50	.56	.60	.50
(52)	5 sq. yd. tool fin. conc. surf.	5.00	4.00	1.40	5.00	2.00
(53)	L. S. control flume and valve houses	800.00	1,000	700.00	500.00	2,000
(54)	60,000 lb. inst. trash-rack metalwk.	.03	.015	.015	.02	.03
(55)	300,000 lb. inst. gates and cond. lin.	.03	.02	.038	.02	.02
(56)	8,000 lb. instl. control apparatus	.08	.10	.04	.04	.05
(57)	233,000 lb. inst. radial gates and opr.	.01	.02	.039	.02	.04
(58)	75,000 lb. inst. 30" outlet pipe	.03	.04	.02	.01	.05
(59)	14,000 lb. inst. metal spiral stairw.	.05	.08	.04	.04	.05
(60)	10,000 lb. install pipe handrails	.05	.05	.025	.04	.05
(61)	105,000 lb. install struc. stl. bridge	.015	.015	.015	.03	.01
(62)	20,000 lb. install miscel. metalwork	.05	.04	.03	.05	.07
(63)	200 ft. inst. elec. metal conduit	.50	.25	.30	.25	.75
(64)	Lump sum install electric conduit	215.00	1,000	700.00	250.00	500.00

	(F)	(G)	(H)	(I)	(J)	(K)	(L)	(M)	(N)	(O)	(P)	(Q)
(1)	$7,500	$19,180	$20,000	$40,000	$60,000	$25,702	$8,000	$24,000	$10,000	$15,000	$5,000	$20,000
(2)	.60	1.50	.30	.30	1.00	.22	.25	.25	.30	.26	.235	.50
(3)	.25	.50	.30	.25	.03	.18	.35	.25	.30	.20	.205	.22
(4)	.25	.09	.30	.25	.155	.24	.20	.25	.35	.45	.37	.29
(5)	.50	.09	.30	.50	.39	.53	.30	.40	.85	.50	1.14	1.00
(6)	10.00	14.08	8.00	7.00	10.10	10.00	10.50	8.64	11.00	8.00	17.00	6.00
(7)	.55	.48	.49	.45	.53	.50	.46	.35	.65	.32	1.13	.65
(8)	.50	.45	.40	.35	.30	.43	.25	.53	.50	.55	.66	1.15
(9)	5.00	1.50	6.00	5.00	2.15	2.00	10.00	2.84	4.00	2.00	3.67	4.20
(10)	.25	.15	.27	.30	.26	.31	.28	.25	.35	.30	.40	.31
(11)	.30	.15	.28	.40	.36	.45	.30	.34	.60	.50	.50	.56
(12)	1.00	.50	1.50	1.50	.86	.90	1.50	1.56	3.00	2.00	1.50	4.20
(13)	.23	.15	.28	.30	.21	.28	.25	.35	.35	.30	.30	.22
(14)	.23	.13	.27	.23	.185	.26	.28	.29	.325	.32	.31	.24

(15)	.95	.70	.80	.90	.64	.82	.81	.92	1.00	1.50	1.00	1.19
(16)	1.25	1.00	1.00	1.50	.93	1.20	1.00	1.50	1.05	2.00	1.00	1.19
(17)	2.25	1.00	1.75	1.50	1.33	1.80	1.00	1.00	2.75	2.00	1.25	1.54
(18)	.30	.50	.35	.60	1.08	.70	.50	.80	.70	.70	.34	.77
(19)	.05	.16	.08	.11	.14	.08	1.05	.09	.12	.10	.085	.10
(20)	.20	.30	.30	.30	.22	.35	.50	.17	.30	.30	.25	.28
(21)	.75	1.00	.50	1.00	.96	.80	.40	.75	1.00	.60	.25	.91
(22)	.50	.20	.40	.50	.29	.40	.50	.65	.30	1.25	.50	.50
(23)	.25	.20	.30	.25	.29	.40	.40	.45	.30	1.25	.36	.35
(24)	.50	.20	.90	.75	.36	.70	.20	.90	.40	1.00	.54	.35
(25)	1.50	1.70	1.75	1.20	1.00	.90	1.00	1.27	1.40	3.00	1.38	1.40
(26)	1.00	1.11	1.00	.90	.66	.70	.80	1.12	1.00	2.00	.88	1.26
(27)	.75	1.25	.75	.90	.77	.65	.60	1.05	.80	1.50	.68	1.12
(28)	.60	.92	.60	.80	.40	.60	.50	.98	.50	1.50	.68	1.05
(29)	2.00	3.65	.80	1.50	1.50	1.30	.40	2.12	1.50	1.50	2.22	1.40
(30)	1.00	1.00	.70	.70	.36	1.20	1.50	.98	.75	1.00	1.00	2.80
(31)	.50	.60	.70	1.50	.72	.60	2.00	1.27	1.00	1.00	1.00	2.80
(32)	1.00	1.00	1.75	2.00	2.15	1.00	3.00	2.83	2.30	1.50	1.50	4.20
(33)	.10	.11	.10	.20	.36	.15	.10	.20	.15	.15	.15	.14
(34)	.50	1.14	1.15	1.50	1.32	.90	2.00	1.27	1.00	3.00	1.00	2.10
(35)	.025	.06	.035	.03	.055	.035	.015	.03	.025	.02	.05	.02
(36)	9.00	23.96	12.50	15.00	23.90	11.50	15.00	12.37	14.00	20.00	20.00	20.00
(37)	10.00	21.22	26.00	25.00	30.50	16.00	20.00	25.50	24.00	25.00	30.00	24.00
(38)	20.00	28.34	14.00	12.00	45.00	24.00	20.00	15.60	14.00	20.00	25.00	30.00
(39)	11.00	20.86	18.00	9.00	27.00	16.00	20.00	22.70	17.00	20.00	25.00	30.00
(40)	10.00	7.52	7.50	8.00	7.40	8.10	11.00	7.80	10.00	15.00	8.00	9.00
(41)	11.00	9.94	15.00	14.00	15.00	13.80	15.00	14.20	19.00	15.00	12.00	24.00
(42)	11.00	27.23	30.00	25.00	27.00	18.00	30.00	24.10	30.00	30.00	30.00	25.00
(43)	10.00	16.35	15.00	12.00	8.00	16.40	12.00	15.50	17.00	15.00	5.00	30.00
(44)	11.00	20.99	16.00	17.00	14.60	14.50	16.00	15.60	12.00	20.00	20.00	20.00
(45)	12.00	40.07	28.00	17.00	18.60	18.50	20.00	20.90	25.00	22.00	30.00	25.00
(46)	.02	.03	.0175	.02	.01	.0175	.0125	.02	.017	.02	.015	.02
(47)	1.25	1.89	1.333	1.50	1.50	.70	2.00	2.82	1.50	2.50	2.50	3.00
(48)	2.00	2.69	2.666	2.00	1.50	.80	6.00	5.66	1.90	5.00	6.50	3.50
(49)	.30	.50	.30	.35	.36	.38	.20	.56	.50	.70	.25	.28
(50)	.08	.10	.07	.06	.01	.10	.08	.10	.10	.10	.03	.35
(51)	1.00	.90	.60	1.00	.60	.50	1.00	.92	.60	.75	.40	.70
(52)	5.00	11.00	3.00	5.00	1.50	2.50	5.00	2.83	3.00	.20	2.00	1.50
(53)	1,000	585.00	1,200	1,500	750.00	350.00	1,000	2,000	1,000	1,500	750.00	350.00
(54)	.05	.04	.015	.03	.03	.03	.02	.03	.03	.03	.03	.07
(55)	.05	.04	.02	.03	.03	.035	.03	.04	.04	.03	.03	.07
(56)	.10	.10	.08	.10	.09	.08	.10	.10	.10	.04	.03	.07
(57)	.05	.05	.025	.04	.03	.04	.03	.05	.03	.04	.03	.10
(58)	.05	.04	.02	.08	.03	.045	.02	.05	.05	.03	.03	.06
(59)	.05	.04	.05	.08	.08	.06	.10	.04	.05	.05	.03	.06
(60)	.05	.05	.08	.10	.10	.06	.10	.05	.15	.08	.03	.10
(61)	.04	.05	.02	.02	.03	.03	.02	.025	.017	.03	.015	.04
(62)	.10	.06	.08	.10	.06	.07	.10	.11	.10	.08	.05	.10
(63)	.25	.45	.20	.40	.30	.53	.20	.35	.40	.25	.50	1.50
(64)	750.00	465.58	200.00	1,000	1,436	500.00	1,000	425.00	800.00	2,500	500.00	700.00



New Type Walking Dragline

The Page Engineering Company of Chicago announce a new type walking dragline machine built in sizes ranging from 2½ to 20 cubic yards and known as their series "600." The series "600" machines are supplementary to other Page walking, crawler, and truck type draglines.

The new series "600" Page walkers are of the two-shoe type. By means of a direct drive from the engine to the cranks attached to the side mounted shoes, movements are made, lifting and sliding the machine for a step of six feet. Steps are automatic, at the rate of three per minute. The complete walking mechanism is based on a simple crank action principle which offers no limitations as to the size and weight machine it will handle. When the machine is digging, the shoes are held well above the ground by an automatically set brake.

Advantages claimed for the series "600" Page walker are its complete movability in any direction; the medium speed, horizontal Page Diesel engine; the large base or tub thus giving ample footing for working even on the softest ground; high fairlead which saves wear on cable; high swinging hoist and load speeds.

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Esco Opens New Branch

Electric Steel Foundry Co. has opened a new branch office at 699 Second St., San Francisco. H. D. Robb, in charge of construction and contractors' equipment, was formerly vice-president of Intermountain Equipment Co., Boise, Idaho. James B. Winn, is office manager.

All Esco products, Speeder shovels, Sullivan air tools, and American Cable Co.'s wire rope are to be handled from this address.

River and Harbor Work.....

San Francisco, Calif.—Government—Stone Retaining Wall

Contract awarded to Marinap Corporatoin, 503 Market St., San Francisco (consisting of Basalt Rock Co., Blake Bros. Co., Daniel Contracting Co., and Hutchinson Co.), $278,250, by U. S. Engineer Office, San Francisco, for furnishing and placing approx. 209,000 tons stone in a 3-mile retaining wall around the Exposition site of Yerba Buena Island. Bids from:

(1) Marinap Corp. (SCH. "A")..........$278,250
(2) Marinap Corp. (SCH. "B").......... 278,250
(3) Healy Tibbets (SCH. "A").......... 323,150
(4) George Pollock Co. (SCH. "A")....$344,000
(5) George Pollock Co. (SCH. "B").... 361,850
(6) Engineer's estimate.......... 295,850

SCHEDULE "A"—25,000 tons per month	(1)	(2)	(3)	(4)	(5)	(6)
61,000 tons furn. & place Class "A" rock	1.75	1.75	1.95	2.20	2.25	1.91
58,000 tons furn. & place Class "B" rock	1.25	1.25	1.55	1.60	1.70	1.21
90,000 tons furn. & place Class "C" rock	1.10	1.10	1.27	1.30	1.40	1.21

SCHEDULE "B"—same as above except is for placing 40,000 tons per month.

Street and Road Work .....

Los Angeles, Calif.,—State—Grading and Surfacing—Riverside County

Contract awarded to Oswald Bros., 366 E. 58th St., Los Angeles, $156,069, by California Division of Highways, Los Angeles, for 11.7 mi. grading and road mix surface treatment applied between Box Springs and 3 miles east of Moreno, RIVERSIDE COUNTY, Calif. Bids from:

(1) Oswald Bros., Los Angeles..........$156,069
(2) V. R. Dennis, San Diego.......... 162,151
(3) Wood & Bevanda, Stockton.......... 174,291
(4) C. W. Caletti & Co., San Rafael.... 185,121
(5) Daley Corp., San Diego..........$192,705
(6) Mundo Engr. & Sander Pearson...... 197,036
(7) Gibbons & Reed, Burbank.......... 199,775
(8) J. E. Haddock, Ltd., Pasadena........ 201,462

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
8,380 M gals. water	$1.60	$.85	$2.00	$1.00	$1.00	$1.25	$1.25	$1.50
239,400 cu. yd. roadway excav.	.23	.19	.22	.34	.30	.25	.33	.24
13,000,000 sta. yd. overhaul	.0018	.0033	.003	.0015	.003	.004	.003	.004
7,400 cu. yd. struc. excav.	1.00	.30	.70	1.00	1.40	1.25	1.00	1.25
624 sta. finish roadway	3.00	$10	5.00	6.00	5.00	5.00	4.00	$10
2,050 tons liq. asph. SC-2	8.50	9.00	8.25	$10	8.00	8.50	9.00	8.50
200,000 sq. yd. prepare mix & shape rdb.	.0375	.04	.045	.06	.045	.05	.05	.06
210 tons liq. asph. 90-95 seal ct.	$18	$20	$15	$15	$17½	$16	$18	$19
2,500 tons screen seal coat	2.00	2.50	2.50	2.50	2.00	3.00	2.50	2.90
46,700 lb. reinforcing steel	.05	.04	.05	.05	.05	.06	.05	.05
515 cu. yd. "A" conc. struc.	$19	$17½	$16	$17½	$20	$18	$20	$18
48 lin. ft. 8" corr. metal pipe	.35	.30	1.00	.70	.25	.40	.25	.30
2,158 lin. ft. 24" corr. metal pipe	.40	.50	1.00	.70	.50	.50	.40	.40
1,774 lin. ft. 36" corr. metal pipe	.50	.75	1.00	1.30	.75	.60	.50	.50
284 lin. ft. 48" corr. metal pipe	.75	1.50	1.00	1.50	1.50	.70	2.00	.70
160 ft. 75" multiplate CMP 410-18	$14	$17	$15	$20	$30	$16	$18	$17
1 each spillway assembly	5.00	$20	$20	$12½	$15	$15	$15	$15
170 each guideposts	2.00	1.50	2.00	1.50	2.50	3.00	1.60	2.50
155 each culvert markers	2.00	1.50	2.00	1.50	2.50	3.00	1.60	3.00
4.3 mi. new property fence	$525	$350	$400	$400	$500	$550	$425	$600
20 each drive gates	$15	$15	$17½	$10	$15	$30	$15	$15
186 each monuments	2.50	2.00	2.00	3.00	2.50	3.00	2.50	3.00
50 cu. yd. remove concrete	2.50	1.50	2.00	2.00	2.50	3.00	3.00	5.00

Atlas announces . . .

a NEW NAME and IMPROVED FORMULAS for semi-gelatin type explosives

GELODYN

ATLAS GELODYNS offer, to a high degree, the advantages of bulky ammonia types with those of the dense plastic true gelatin dynamites. Atlas Gelodyns represent a midway combination of some of the virtues of these two types that proves valuable in many operations.

New Atlas manufacturing developments have produced improved Atlas Gelodyns. They are more bulky than true Gelatin types and the user benefits by higher cartridge count. Their high cartridge strengths thus effect economies in use. The high moisture resistance of Atlas Gelodyns makes them suitable for wet locations where ordinary dynamites could not be effectively used. They are sufficiently plastic to be retained when pressed into upward pitching boreholes.

The properties of Atlas Gelodyns suggest their advantageous use for many highway, construction and mining jobs. Let the Atlas representative tell you more about these improved semi-gelatin explosives.

ATLAS POWDER COMPANY

THE GIANT DIVISION

Everything for Blasting

Seattle, Wash. Portland, Ore. Spokane, Wash.

San Francisco, California
Cable Address—Atpowco
Wilmington, Del.

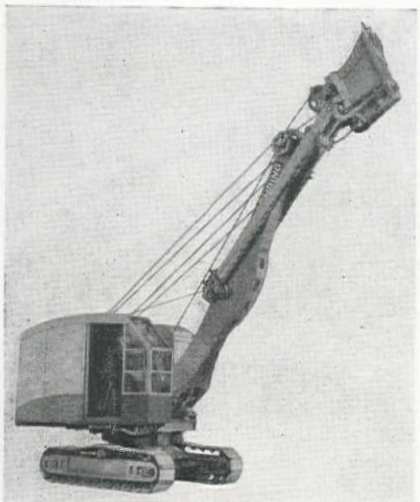
Los Angeles, Calif. Salt Lake City, Utah Butte, Mont.

ATLAS EXPLOSIVES

CHEMICALS ATLAS EXPLOSIVES

Other Offices:

Allentown, Pa.	New York, N. Y.
Boston, Mass.	Philadelphia, Pa.
Denver, Colo.	Picher, Okla.
Houghton, Mich.	Pittsburg, Kansas
Joplin, Mo.	Pittsburgh, Pa.
Kansas City, Mo.	St. Louis, Mo.
Knoxville, Tenn.	Tamaqua, Pa.
Memphis, Tenn.	Wilkes-Barre, Pa.
New Orleans, La.	Wilmington, Del.



Koehring Model 251

The Koehring ⅝ Yard Model 251 shovel, dragline, crane, trench hoe, is a high-speed, light-weight machine, designed according to the latest developments. Koehring heavy duty construction has been employed througout. High strength special steel is combined with welded construction and simplified design to effect a substantial decrease in weight. It has high speed with operating ease.

The 251 is fully convertible, with a ¾ yard rating as a crane or dragline. Attachment changes are easily and quickly made on the job. A simple gear shift provides two selective swing speeds to synchronize with the arc of swing and height of lift for increased output. Two traction speeds give greater power in tough going and faster speed in easy traveling. Positive steering for any angle is easily accomplished from the lever position in the cab.

Convenient and free accessibility of all parts is claimed to be a time-saver when adjustments are necessary. Each shaft can be independently removed. Drums are equipped with quickly removable barrels.

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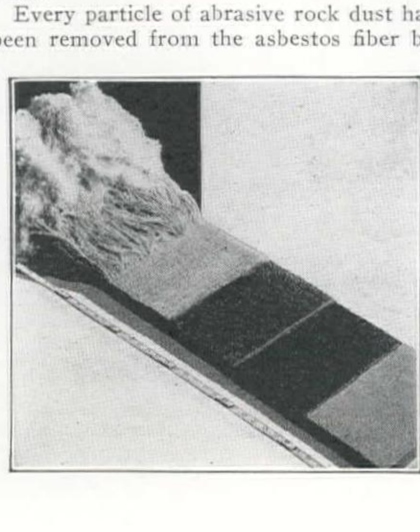
Gatke Deep-Well Woven Brake Lining

An improved woven brake lining is announced by the Gatke Corporation, developed especially for severe service conditions to afford safer handling of excessive loads and eliminate brake-flange wear.

Every particle of abrasive rock dust has been removed from the asbestos fiber by



Sacramento, Calif.—State—Grading, Tunnel and Paving—Marin County

Contract awarded to T. E. Connolly, 461 Market St., S. F., $587,917, by Calif. Div. Highw., Sacramento, for 0.3 mi. grad. appr. and roadway tunnels with conc. lining and paving betw. Sausalito and Golden Gate Bridge in MARIN CO. Bids from:

(1) T. E. Connolly, S. F. $587,917
(2) Jahn & Bressi, L. A. (irreg.) 655,632
(3) Utah Const. Co., Winston Bros. and Paul J. Tyler, S. F. 654,255
(4) L. E. Dixon Co., Bent Bros., and Johnson, Inc., L. A. $665,428
(5) Guy F. Atkinson Co., S. F. 669,066
(6) MacDonald & Kahn Co., Ltd. 723,848
(7) George Pollock and Youdall Co. 743,765

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
1,900 M gallons water	.70	1.00	1.00	.50	.50	2.50	.50
60,000 cu. yd. roadway excavation	.60	.50	.60	.55	.50	.40	.50
9,000 cu. yd. struc. excavation	1.00	1.50	1.20	1.25	1.20	2.00	1.50
51,000 cu. yd. tunnel excavation	4.40	4.50	5.20	5.00	5.65	5.86	5.50
600,000 sta. yd. overhaul	.005	.005	.008	.005	.005	.02	.01
750 cu. yd. pavement sub-base	2.00	2.25	2.00	3.57	2.00	3.50	3.50
1,050 cu. yd. "A" concrete (pav.)	9.80	11.00	11.00	10.00	10.00	11.50	12.00
2,800 cu. yd. "A" concrete (struc.)	12.70	20.00	17.00	22.00	16.00	17.00	16.00
175 cu. yd. "A" concrete (curbs & sidew.)	17.00	15.00	17.00	15.00	11.00	16.00	14.00
200 ft. conc. tunn. lining, Sec. "A"	$220	$250	$210	$226	$200	$250	$335
800 ft. conc. tunn. lining, Sec. "B"	$165	$195	$175	$176	$175	$200	$245
370,000 lb. reinf. steel (pav. & struc.)	.055	.06	.05	.052	.04	.055	.05
1,400 ea. pavement dowels	.40	.15	.20	.50	.25	.30	.30
1,000,000 lb. struc. steel	.0575	.065	.06	.07	.07	.06	.055
3,300 lb. cast iron	.15	.20	.12	.10	.10	.15	.15
2,020 ft. 8" perf. metal underdrain	1.00	.50	.90	.30	.25	.40	.25
180 cu. yd. rockfilling material	2.00	2.00	1.80	4.00	2.50	3.50	2.00
60 ft. 18" corr. metal pipe	1.50	1.00	1.70	1.00	.60	1.00	1.00
1,200 ft. 2" steel pipe (weepers)	.25	.50	.60	.30	.30	.50	1.00
700 ft. 4" cast ir. soil pipe (weepers)	.30	1.00	1.00	.80	1.00	1.20	1.00
350 ft. 6" cast ir. pipe	1.00	3.00	1.50	1.00	3.00	1.50	1.50
450 ft. 8" cast ir. pipe	1.30	5.00	2.20	1.60	4.00	1.80	2.00
150 ft. 12" cast ir. pipe	2.25	7.00	3.80	2.60	7.00	3.00	2.50
4,300 lb. copper strips	.35	.40	.35	.30	.70	.50	1.00
1 lot lighting equipment	$3,200	$3,000	$3,500	$3,500	$3,000	$3,000	$4,000

Phoenix, Ariz.—State—Grading and Paving—Apache, Navajo and Gila Counties

Contract awarded to O. F. Fischer Construction Co., 516 S. 7th St., Phoenix, $244,610, by Arizona State Highway Comm., Phoenix, for 15½ mi. grading, draining roadway and placing of A, B, C, about 27 mi. east of Showlow and extending easterly on the Showlow-Springerville Highway, WPH 105-C, APACHE, NAVAJO and GILA COUNTIES. Bids from:

(1) O. F. Fisher Const. Co., Phoenix $244,610
(2) Ken Hodgman, Pasadena 266,730
(3) Packard Cont. Co., Phoenix 277,832
(4) Skousen Bros., Albuquerque $316,329
(5) Pearson & Dickerson, Prescott 320,471

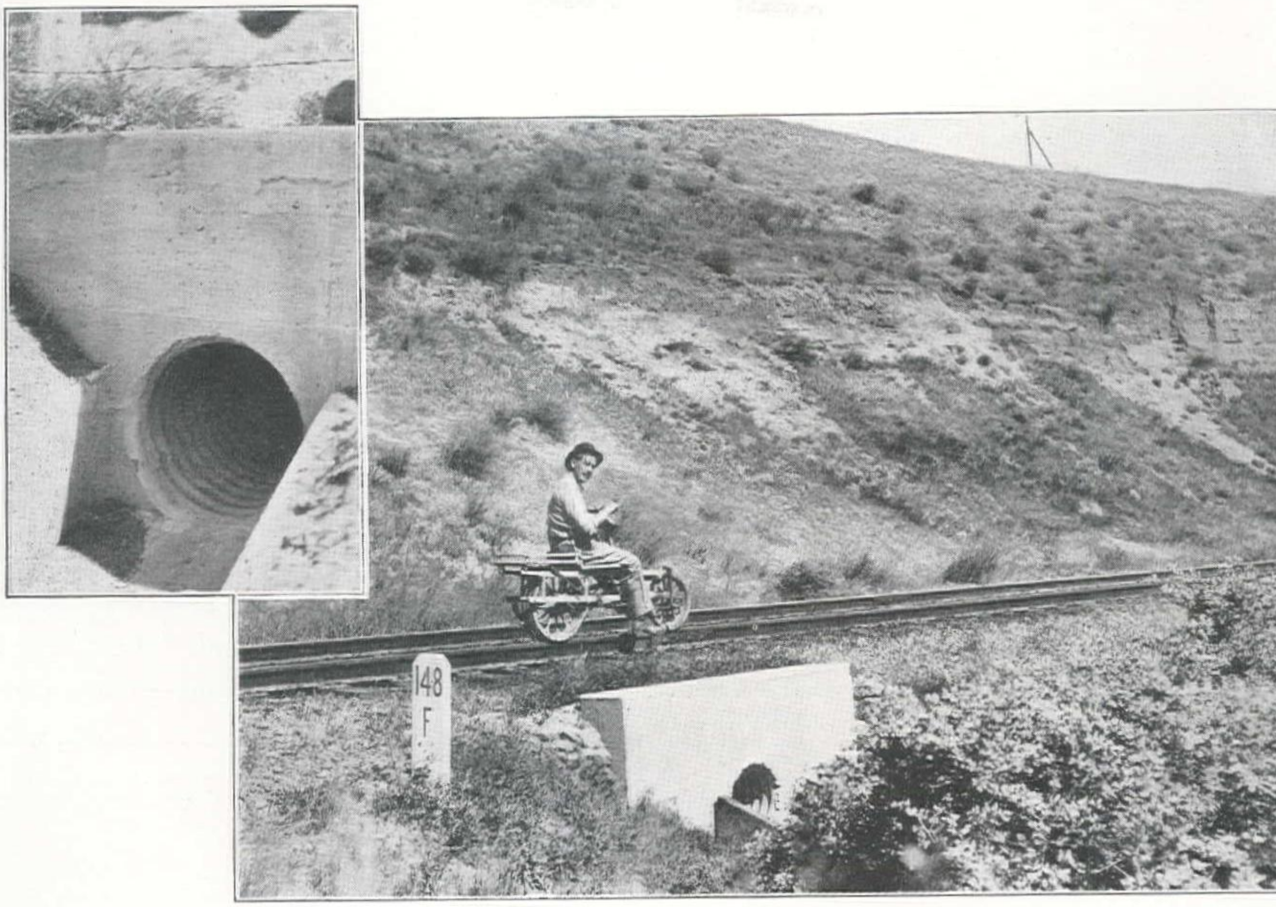
	(1)	(2)	(3)	(4)	(5)
114,765 cu. yd. roadway excav.	$.32	$.68	$.55	$.74	$.75
1,377 cu. yd. drainage excav.	.62	.35	.63	.58	.75
1,834 cu. yd. structural excav.	1.35	1.25	1.38	2.50	3.00
92,130 sta. yd. overhaul	.02	.03	.045	.03	.05
6,815 cu. yd. mi. earthwork haul	.19	.30	.39	.32	.45
201,843 cu. yd. imported borrow	.18	.14	.17	.18	.20
215,285 cu. yd. mi. borrow haul	.19	.15	.185	.20	.20
48,293 tons aggr. base course	.75	.59	.83	.70	.80
1,587 cu. yd. "A" concrete	25.00	25.00	23.00	30.00	24.00
173,154 lbs. reinf. steel	.055	.06	.05	.065	.06
86,850 lbs. structural steel	.08	.08	.07	.07	.07
252 lin. ft. 18" corr. metal pipe	2.00	2.00	1.90	2.50	2.00
1,134 lin. ft. 24" corr. metal pipe	3.00	3.00	2.50	3.25	3.00
628 lin. ft. 36" corr. metal pipe	4.50	6.00	5.10	5.00	4.00
84 lin. ft. 42" corr. metal pipe	6.00	8.00	6.05	7.50	7.00
148 lin. ft. 48" corr. metal pipe	7.50	12.00	7.25	12.00	12.00
50 lin. ft. rail bank protection	4.49	3.00	3.15	5.00	5.00
27 cu. yd. dry rubble masonry	11.34	5.00	15.00	2.00	7.00
7,300 lin. ft. grader ditches	.02	.04	.04	.10	.10
163,820 lin. ft. standard line fence	.06	.08	.065	.08	.08
6 each standard wire gates	7.50	10.00	5.00	10.00	10.00
2 each cattle guard	260.00	350.00	300.00	400.00	550.00
3,424 lin. ft. road guard	1.00	1.00	1.00	1.00	1.50
350 each guide posts	2.00	2.50	2.75	2.00	2.50
99 each right-of-way markers	2.50	2.50	2.40	3.00	3.00
1,560 M gals. sprinkling	2.50	3.00	6.50	5.00	3.50
778 hours rolling	3.00	3.50	2.50	5.00	4.50
2,000 cu. yd. stripping pits	.24	.45	.25	.20	.35
7,550 lin. ft. crown ditches	.025	.06	.04	.10	.25
1,500 ton stock aggr. base course	.75	.45	.87	.54	1.00

Boise, Idaho—State—Grading—Lewis County

Contract awarded to Morrison-Knudsen Co., Boise, Idaho, $164,121 by Commissioner of Public Works, Boise, Idaho, for 5.767 mi. const. roadbed and drainage struc. on the Lewis and Clark Highway between Greer and Pardee in LEWIS COUNTY, Idaho. Bids from:

(1) Morrison-Knudsen Co., Boise $164,121
(2) James Crick, Spokane 170,902
(3) Goodfellow Bros., Inc., Wenatchee 188,224
(4) Colonial Const. Co., Spokane 214,455
(5) F. H. DeAtley & Co., Lewiston $215,584
(6) Myers & Goulter, Seattle 221,984
(7) Utah Const. Co., Ogden 266,795
(8) Engineers' estimate 178,442

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
200,000 cu. yd. solid rock excavation	.58	.50	.62	.70	.70	.80	1.00	.60
45,000 cu. yd. common excavation	.24	.50	.62	.70	.70	.30	.30	.30
26,600 cu. yd. backfill	.22	.50	.10	.30	.30	.30	.40	.25
2,000 cu. yd. struc. excav. for culvert	1.25	2.00	1.50	2.00	1.50	3.00	3.00	1.25
200 cu. yd. struc. excav. for bridge	4.00	8.00	10.00	5.00	5.00	5.00	5.00	2.00
65,000 sta. yd. overhaul	.02	.02	.0125	.02	.03	.02	.02	.04
57,000 mi. yd. haul	.10	.10	.125	.15	.12	.20	.20	.18
296 cu. yd. "A" concrete	27.00	30.00	28.00	30.00	35.00	25.00	30.00	30.00
36,000 lb. reinforcing steel	.06	.08	.06	.06	.08	.06	.08	.08
680 lb. cast steel	.18	.20	.20	.25	.10	.50	.20	.20
560 lb. structural steel	.08	.20	.10	.10	.10	.10	.10	.15
70 cu. yd. handplaced riprap	2.00	5.00	5.00	2.50	6.00	5.00	2.00	3.50
240 lin. ft. 12" corr. metal pipe	1.30	1.25	1.10	1.00	1.50	1.25	1.50	1.30
1,480 lin. ft. 18" corr. metal pipe	1.90	2.00	1.40	1.50	2.00	1.70	2.00	1.70
380 lin. ft. 24" corr. metal pipe	2.75	3.00	2.40	2.50	2.00	2.50	3.00	2.50
54 lin. ft. 30" corr. metal pipe	3.50	4.00	3.20	3.00	3.00	3.15	3.80	3.50
250 lin. ft. 36" corr. metal pipe	5.20	5.00	5.00	4.20	4.00	5.00	5.00	5.00
180 lin. ft. 60" corr. metal pipe	12.00	9.00	10.00	9.00	10.00	13.00	11.50	10.00
130 lin. ft. 78" corr. metal pipe	18.00	16.00	20.00	15.00	15.00	20.00	18.00	20.00
L. S. move grade	75.00	$100	$100	$150	50.00	50.00	50.00	50.00
2 each project markers	4.50	5.00	10.00	15.00	10.00	5.00	10.00	8.00
150 each right-of-way markers	3.00	3.00	3.50	2.00	3.00	2.00	3.00	4.00



Time Brings Change . . . but Little Change in ARMCO Corrugated Culverts

(18" Armco Culvert placed in service under a transcontinental railroad in California in 1909 is shown when new in the larger photograph. The smaller photograph shows that there has been practically no change after 27 years.)

Armco Corrugated Culverts installed twenty and thirty years ago are still giving the same dependable service as when new. That's your assurance that the Armco Culverts you install this year will give the same kind of long, economical life. For complete details, write—

CALIFORNIA CORRUGATED CULVERT CO.
Berkeley Los Angeles

THE R. HARDESTY MANUFACTURING CO.
DENVER, COLO.
Salt Lake City, Utah Pueblo, Colo.
Missoula, Mont. Sidney, Mont. Boise, Idaho

WESTERN METAL MFG. CO.
Box 1585 Phoenix, Ariz.

PURE IRON CULVERT & MFG. CO.
2321 S. E. Gladstone Street, Portland

WASHINGTON CORRUGATED CULVERT CO.
Formerly the
Spokane Culvert & Tank Co.
Seattle Incorporated 1910 Spokane
H. H. HAZELWOOD, Representative
P. O. Box 777, Olympia, Wash.

a special Gatke process. To provide additional protection against scoring, soft zinc alloy wire is combined with the abrasiveless asbestos fiber. Special looms are used to weave the material into a unified mass with no layers to strip or peel.

This tightly woven material is thoroughly saturated with a high-heat-resisting frictional compound of infusible resins. Baking, calendering and hydraulically compressing forms the material into a dense, compact structure that is impervious to oils, water, and grease, and sufficient flexibility to conform with various brake-flange diameters, all sizes up to 14 ins. wide by 1¼ ins. thick are made.

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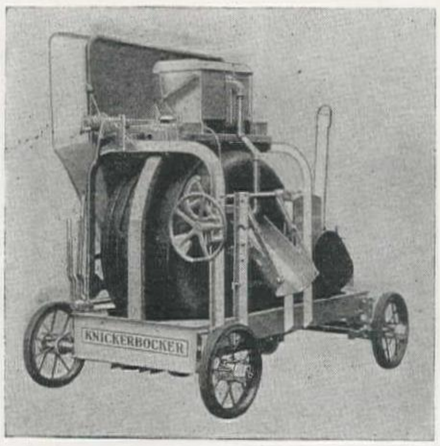

Advanced Mixers

Working with construction engineers and with contractors, the Knickerbocker Company, Jackson, Michigan, have developed the 1936 Knickerbocker mixers, in which are embodied fundamental design features dictated by the quality and speed of mix requirements. A larger diameter of drum provides better mixing action.

This larger drum diameter makes possible drum openings larger than on any other mixer of the same rated capacity, it is claimed. The larger charging opening speeds loading as the charge enters the drum quickly, without choking. This fast charging is facilitated by a wide-throated loading skip that raises to a 60-deg. pitch. The load slips from the skip easily, eliminating the necessity of skip-pounding. Thus in the operating cycle of loading-mixing-discharging, the time for charging is reduced. The discharge opening is also larger than on previous models, permitting quick discharge.

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All-Purpose Saw

The new Models GL and GM DeWalt cutting machines, suitable for handling wood, metal, or stone, are a new developmen, announced by Star Machinery Co., 1714 First Ave. South, Seattle.

The new DeWalts are suitable for wood cutting, metal cutting, brick and stone cutting; they adjust readily for all operations and cut above the work table, with tools driven direct from the motor shaft. The new machines are designed for accurate cutting, and the yoke-motor-arbor

Portland, Oregon—Gov't—Grading and Tunnel—Multnomah County

Contract awarded to Orino, Birkemeier & Saremal, Bonneville, Oregon, $196,947 by Bureau of Public Roads, Portland, Oregon, for const. or improving the Columbia River Highway, Grading and Tunnel project 28-A, Natl. Forest Road project, located in the Mt. Hood Natl. Forest, MULTNOMAH COUNTY, Oregon. Bids received from:

(1) Orino, Birkemeier & Saremal..........$196,947
(2) Colonial Const. Co., Spokane.......... 213,466
(3) Malcom & Bell, Portland.......... 235,443
(4) P. L. Crooks & Co., Inc., Portland..$249,840
(5) Joplin & Eldon, Portland.......... 250,040
(6) Morrison-Knudsen Co., Inc., Boise.. 260,187

	(1)	(2)	(3)	(4)	(5)	(6)
4 acres clearing	200.00	500.00	125.00	400.00	400.00	500.00
3 acres grubbing	200.00	400.00	125.00	400.00	400.00	200.00
32,000 cu. yd. excavation	.40	.60	.72	.80	.50	.70
1,200 cu. yd. struc. excavation	1.50	2.00	3.00	1.50	2.50	2.50
2,500 cu. yd. borrow excavation	.30	.60	.45	.60	.80	.60
5,000 sta. yd. overhaul	.03	.05	.02	.02	.03	.03
14,000 cu. yd. mi. overhaul	.20	.17	.25	.20	.25	.25
837 lin. ft. tunnel excavation	85.00	95.00	101.00	130.00	110.00	125.00
40 sq. yd. paved inlets Type 2	2.00	4.00	4.00	5.00	4.00	2.00
30 MFBM untr. timb. tunnel lining	50.00	60.00	70.00	70.00	75.00	70.00
40 MFBM untr. timb. temporary bridge	50.00	75.00	60.00	70.00	70.00	100.00
2,830 cu. yd. "D" concrete	22.50	20.50	23.50	18.00	26.00	24.00
186,000 lb. reinforcing steel	.05	.05	.05	.05	.055	.055
320 cu. yd. cement rubble masonry	12.00	18.00	18.00	25.00	27.00	25.00
400 lin. ft. 12" corr. metal pipe	1.50	1.40	1.50	2.00	1.75	1.25
400 lin. ft. 18" corr. met. pipe, dipp & paved	2.00	2.00	2.00	3.00	3.50	2.00
5 cords wood packing	10.00	15.00	16.00	20.00	15.00	10.00
200 cu. yd. loose riprap Type 2	2.50	2.00	2.00	3.00	2.00	2.00
100 cu. yd. handlaid rock embankment	3.50	3.50	4.00	10.00	7.00	4.00
860 lin. ft. 8" porous tile underdrain	.75	.50	.60	1.00	.90	1.00
100 lin. ft. 8" perf. corr. metal pipe	1.35	1.00	2.50	2.00	2.00	1.00
100 lin. ft. 10" perf. corr. metal pipe	1.50	1.15	2.50	2.00	2.40	1.20
240 sq. yd. 6" cement rubble tunnel and girder facing	12.00	9.00	20.00	25.00	15.00	12.00
90 cu. yd. arch ring stone & pylon masonry	30.00	45.00	50.00	50.00	60.00	60.00
3 ea. grading with frames	75.00	100.00	75.00	30.00	100.00	20.00
2,680 sq. yd. cement concrete paving	2.00	2.20	2.75	3.00	2.48	2.50
L. S. lighting system	$6,000	$6,500	$7,000	$4,000	$7,200	$6,500
125 lin. ft. undergr. service and pole riser	2.50	2.00	2.00	4.00	1.80	2.50
L. S. force account items	$5,000	$5,000	$5,000	$5,000	$5,000	$5,000

Sacramento, Calif.—State—Grading and Surfacing—Marin County

Contract awarded to Macco Const. Co., 915 Paramount Blvd., Clearwater, $770,204, by Calif. Div. Highways, Sacramento, for 3.4 mi. grad. and surf. with pl. mix surf. on cr. run base betw. Waldo Point and Golden Gate Bridge, MARIN CO. Bids from:

(1) Macco Const. Co., Clearwater..........$770,204
(2) Guy F. Atkinson Co., S. F.......... 828,875
(3) D. McDonald, Sacramento and MacDonald & Kahn Co., Ltd., S. F... 836,584
(4) Jahn & Bressi, L. A.......... 871,534
(5) Martin Wunderlich, Jeff. C.......... 892,908
(6) Eaton & Smith, S. F.......... 930,885
(7) Bodenhamer Const. Co., Oakland, and D. H. Ryan, San Diego....$ 943,241
(8) John Collins and Granfield Farrar & Carlin, S. F.......... 948,994
(9) Daley Corp., San Diego.......... 1,116,581
(10) Utah Const. Co., Winston Br. and Paul J. Tyler, S. F.......... 1,196,892
(11) Geo. Pollock Co., Sacramento...... 1,374,712

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
178 sta. clr. & grubbing	$75	30.00	$60	$25	$15	$60	$20	$100	$90	$60	$50
33,000 M gallons water	1.00	.40	1.00	.40	.40	.50	1.00	.30	.55	.70	.25
1,752,700 cu. yd. rdw. exc.	.294	.335	.298	.35	.33	.378	.335	.395	.44	.47	.56
13,100,000 sta. yd. overhaul	.002	.002	.005	.003	.0025	.004	.0075	.003	.005	.008	.01
12,500 cu. yd. struc. excav.	1.00	.80	1.30	.75	1.00	1.00	.50	1.00	1.50	.90	2.00
178 sta. finish roadway	5.00	5.00	5.00	$15	$10	$10	5.00	10.00	$20	$10	$25
35,000 tons cr. run base	1.25	1.92	1.80	2.00	2.12	1.75	2.00	1.75	2.35	2.00	1.80
95 tons liq. asph. MC 2 P. C.	$16	18.20	$20	$18	$18½	$18	$18	18.40	$15	$20	$18
15,000 tons min. agr. pl. mix	2.00	2.44	2.05	2.60	2.50	2.00	3.00	2.10	2.60	2.40	2.50
750 tons liq. asph. MC 5 E. H.	$15	15.50	$18	$16	$15	$15	$16	16.10	$17½	$20	$17
1,100 tons screen. seal coat	1.50	2.70	3.00	2.75	2.50	3.00	2.65	2.30	2.25	2.50	2.75
70 tons liq. asph. MC 3 seal coat	$16	18.20	$20	$20	$18½	$18	$18	18.38	$15	$20	$20
160 tons liq. asph. SC1A or SC2 sl ct	$10½	13.50	$16	$14	$12	12.60	$11½	11.50	$10	$16	$15
46,000 lb. reinf. steel (str.)	.055	.04	.05	.07	.05	.0455	.05	.05	.0475	.05	.05
475 cy. "A" conc. (struc.)	$20	16.00	$17	$20	$20	$13	$20	18.00	$16	$17	$18
3,200 cy. rubble masonry	7.50	9.50	$11½	7.00	$12	7.50	$12	8.00	$14	$11	$16
3,992 ft. 8" cor. met. pipe, 16 ga.	$1	.15	.25	.30	.50	.50	.25	.35	.25	.90	.30
900 ft. 12" C. M. P., 16 ga.	.50	.20	.30	.50	.50	.50	.30	.37	.35	1.10	.40
480 ft. 15" C. M. P., 16 ga.	.55	.25	.35	.50	.50	.75	.40	.42	.40	1.30	.45
3,050 ft. 18" C. M. P., 16 ga.	.75	.35	.40	.75	.60	.75	.50	.47	.50	1.70	.50
2,100 ft. 24" C. M. P., 12 ga.	.90	.40	.60	1.00	.65	1.25	.75	.55	.60	2.40	.55
930 ft. 30" C. M. P., 10 ga.	1.25	.50	.80	1.50	.75	1.50	1.00	.68	1.00	3.50	.60
8,180 ft. 8" perf. met. underdr.	$1¼	.15	.25	.30	.60	.25	.30	.35	.25	.90	.30
1,440 cy. rockfilling matl.	2.00	1.75	2.00	1.75	2.25	3.50	2.00	1.50	2.50	1.80	5.00
100 ft. 6" vitr. pipe	.40	.25	.50	1.00	.50	.75	1.00	1.00	1.00	.70	.70
31 spillway assemblies	$10	5.00	$10	5.00	3.00	2.50	5.00	8.00	3.00	$15	$10
500 guideposts	2.00	2.00	2.00	3.00	2.00	1.50	1.50	2.25	2.00	2.50	3.00
5 mi. standard fence	$700	$500	$600	$600	$700	$500	$600	$500	$635	$500	$600
2 mi. special fence	$6000	$5000	$4300	$2000	$8000	$5000	$6000	$5000	$5000	$5700	$5000
20 fence gates (std.)	$13	15.00	$15	$30	$90	$14¼	$20	15.00	$15	$15	$15
12 fence gates (special)	$80	60.00	$65	$100	$100	$58½	$60	60.00	$60	$70	$60
100 monuments	3.00	3.00	3.00	5.00	2.00	3.00	2.50	2.00	3.00	3.00	3.00
225 cy. remove concrete	2.00	3.00	2.00	4.00	3.00	2.50	4.50	6.00	6.00	2.50	4.00

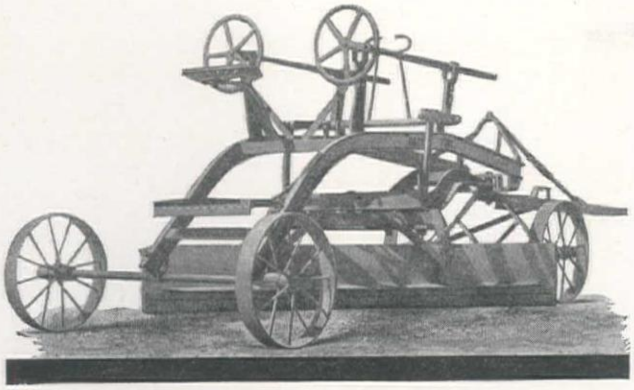
Bridges and Culverts . . . .

Sacramento, Calif.—State—Undergrade Crossing—Alameda County

Bodenhamer Construction Co., 1101 75th Ave., Oakland, Calif., $214,065, low to Calif. Div. of Highways, Sacramento, for an undergrade crossing under S. P. and W. P. railway tracks at San Leandro St., in Oakland, ALAMEDA COUNTY, Calif. Bids from:

(1) Bodenhamer Const. Co., Oakland....$214,065
(2) Eaton & Smith, San Francisco.......... 220,233
(3) J. F. Knapp, Oakland.......... 226,375
(4) Heafey Moore and E. T. Lesure......$229,738
(5) McDonald & Kahn Co., Ltd., S. F... 232,769
(6) Barrett & Hilp, S. F.......... 233,981

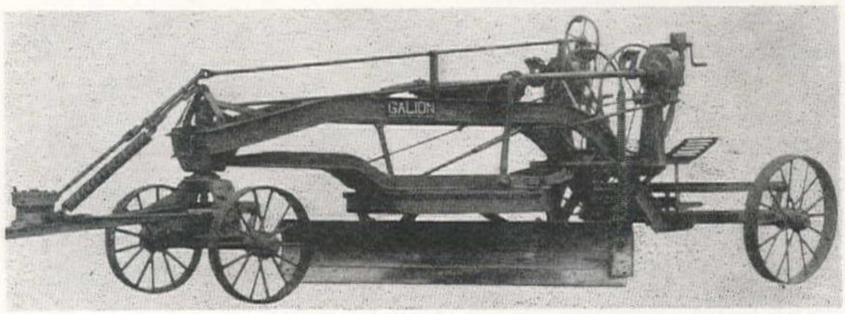
	(1)	(2)	(3)	(4)	(5)	(6)
5,000 cu. yd. remove bitum. macadam	1.00	.50	1.00	.50	.50	.40
500 cu. yd. remove concrete	3.00	1.00	1.00	2.00	1.50	1.25
100 M gallons water	2.00	1.00	2.00	2.00	2.50	1.00
26,000 cu. yd. roadway excavation	.75	.50	.75	.75	.72	.60
2,000 cu. yd. structure excavation	1.50	1.25	2.00	2.00	1.85	1.25
100 cu. yd. selected imported borrow	1.50	3.00	1.50	1.25	2.50	2.00
1 ton grade "E" asphalt (membrane seal)	50.00	25.00	40.00	45.00	62.00	32.00
7,000 sq. yd. subgrade (pavement)	.10	.12	.15	.15	.15	.15
30 sta. finish roadway	10.00	10.00	10.00	10.00	12.00	12.00



The Galion "Pony" Grader (left) designed for light grading and maintenance work. It is exceptionally light but ruggedly constructed, and was designed especially for animal operation.

From the Smallest to the LARGEST

There is a Galion Pull Type Grader of the exact size to meet any requirement you may have.



Galion No. 110 Leaning Wheel Grader with Manual Operation

From the small "Pony" Grader, weighing in at 1,395 pounds (upper left) . . . to the big and heavy No. 14 Grader, weighing in at 14,000 pounds (below) . . . there is a Galion Pull-type Grader of the exact size and weight to meet any requirement calling for this type of equipment.

Designed to meet the need for sturdy, light, general purpose machines, Galion Straight Wheel Graders are strong and heavy enough for moderate ditching and grading work, yet light enough for general maintenance work. Their design embodies all the exclusive Galion features found in the larger machines. Sizes of Galion Straight Wheel Graders range in weight from 1,395 to 4,500 pounds.

The Galion line of Leaning Wheel Graders provides a wide range of sizes (ten sizes ranging in blade lengths from 7 ft. to 14 ft.) to meet every grading requirement. All sizes are supplied with the famous Galion E-Z Lift gearing which has won for them the reputation of being the easiest operating graders ever built.

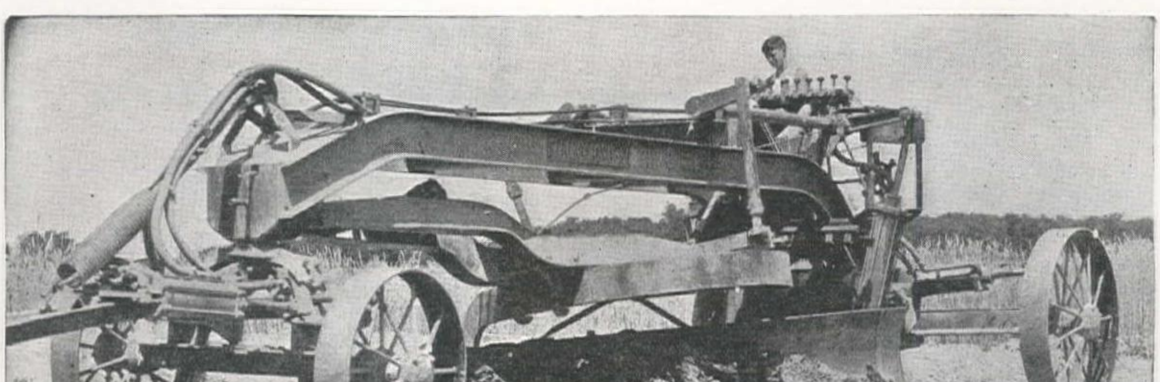
Hydraulic Control is available on all the larger sizes of Galion Leaning Wheel Graders using 9, 10, 12 and 14 foot moldboards. An efficient Scarifier can also be furnished for any Galion Grader.

There is a Distributor near you . . . Write him for complete information.

The Galion Iron Works & Mfg. Co.

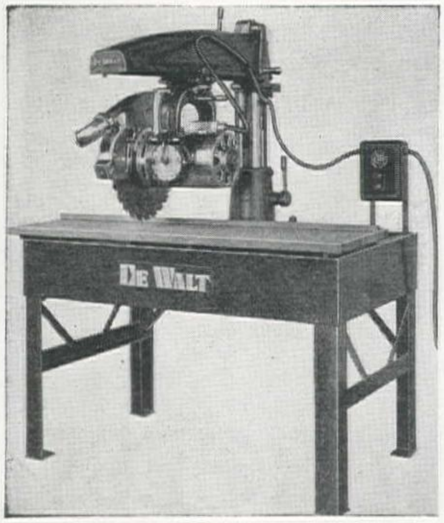
Galion, Ohio

The heaviest Galion Leaning Wheel Grader (right) is the No. 14, weighing approximately 14,000 lbs. Equipped with 14 ft. moldboard and Hydraulic Control. Can be furnished with manual control.



GALION ROAD MACHINERY:

- Motor Patrol Graders
- Pull Type Graders
- Road Rollers
- Shoulder Maintainers
- Patch Rollers
- Spreaders
- Rooters
- Drags



carriage rolls on eight ball bearings, increasing speed and ease of operation. The DeWalt is adaptable to work in small operating areas. In addition to being a cutoff saw, it will bevel cutoff, miter, rip, rout, etc.

These machines are constructed in a complete range of sizes, from ½ H. P. for handling the lighter materials, up to 25 H. P. for heavy timber cutoff work.

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Unitair Compressors Described

Sullivan Machinery Company announces a new bulletin on their line of Unitair compressors, a two-stage, completely air-cooled, V-type, single acting stationary compressor, incorporating advanced features in compressor design.

Available in four sizes to 400 C. F. M. displacement and for any kind of drive: built-in electric motor; direct connection or V-belt drive from motors and gasoline, distillate or Diesel power units.

Bulletin 88-0 is available by writing Sullivan Machinery Company, Dept. 21, Michigan City, Indiana.

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New Dragline by Marion

For long working range in the 2½ to 3 cubic yard capacity class, The Marion Steam Shovel Company, Marion, Ohio, presents a Marion clutch-type machine, Type 39-A, designed especially as a dragline, and recognized as the largest excavator in its price class. Equipped with an 85-foot boom, it will readily handle the capacity of 2½ cubic yard Page R. C. bucket, or a 3 cubic yard bucket with an 80-foot boom.

Widespread crawlers provide very low-ground pressure. These crawlers measure 40 inches by 19 feet 9½ inches. They are of the self-cleaning, non-clogging type, featured on all clutch-type machines built by Marion.

Other outstanding features of the new Marion Type 39-A Dragline include: hook rollers, to relieve center pin stress; anti-friction bearings throughout; and all-welded underframe construction of the new type. It is powered with either gas or Diesel engine.

3,000 tons crusher run base	2.00	2.00	2.00	3.00	3.00	2.75
1,900 tons mineral aggregate (plant mix)	3.00	2.75	3.00	3.50	4.00	4.50
100 tons liq. asphalt SC-2 (plant mix)	20.00	12.00	15.00	10.00	12.00	18.00
12 tons liq. asphalt SC-2 (prime coat)	25.00	15.00	15.00	20.00	18.00	16.00
10 tons liq. asphalt MC-3 (seal coat)	25.00	22.00	25.00	25.00	30.00	16.00
100 tons stone screenings (seal coat)	3.00	3.00	2.50	3.00	4.00	2.75
9 tons asphalt concrete (Type C surface)	10.00	5.00	10.00	10.00	12.00	6.00
1,100 cu. yd. "A" concrete (pavement)	10.00	10.15	10.00	11.50	12.50	16.00
2,700 ea. pavement dowels	.30	.25	.25	.25	.25	.30
840,000 lb. reinforcing steel	.05	.045	.0425	.05	.048	.045
3,800 cu. yd. "A" concrete structure	16.00	16.50	16.00	14.80	16.85	16.00
130,000 lb. structural steel	.055	.065	.06	.07	.07	.07
1,800 lb. misc. steel	.07	:25	.20	.20	.22	.25
330 cu. yd. "A" concrete (slope paving)	12.00	19.50	16.00	16.00	15.50	16.00
104 lin. ft. 12" corr. metal pipe	1.50	3.00	1.50	3.00	1.25	3.50
900 lin. ft. 8" perf. metal pipe	1.00	1.25	1.20	2.00	1.00	1.50
110 lin. ft. 8" vitrified pipe	.75	.60	.75	1.00	.80	1.30
1,650 lin. ft. 12" vitrified pipe	1.00	1.00	1.25	1.00	1.00	2.00
500 lin. ft. 15" vitrified pipe	1.50	1.60	1.75	1.50	1.50	2.50
1,350 lin. ft. 18" vitrified pipe	2.00	2.25	2.25	2.00	2.00	3.00
240 cu. yd. rock filling material	1.75	3.00	2.50	3.00	3.00	4.00
1,050 cu. yd. "A" concrete, curbs and gutters	12.00	16.70	16.00	16.00	13.00	16.00
190 cu. yd. "A" concrete, sidewalk	12.00	16.70	16.00	16.00	15.50	16.00
350 lin. ft. laminated guard railing	1.00	1.25	1.50	1.20	2.50	1.50
30 ea. guide posts	1.00	3.00	2.00	2.00	3.70	1.50
3,050 lin. ft. pipe handrail	2.00	4.50	3.50	4.00	3.70	4.00
2,240 lin. ft. 30" wire mesh	.35	1.00	.30	1.50	1.85	1.10
1,300 sq. yd. painting concrete surfaces	.50	.20	.15	.20	.16	.30
0.97 mi. traffic stripe painting	30.00	100.00	$100	55.00	$100	$100
0.65 mi. curb stripe painting	50.00	100.00	$150	75.00	$100	$100
900 lb. sheet copper	.60	.40	.30	.50	.62	.60
13 ea. concrete manholes	175.00	90.00	$125	80.00	75.00	$150
4 ea. lampholes	100.00	15.00	25.00	25.00	12.00	40.00
1 lot electrical equipment	$6,350	$5,100	$6,500	$6,000	$6,930	$5,500
1 lot pumping equipment	$2,600	$2,300	$2,500	$3,300	$2,543	$2,000
1 lot miscellaneous work	$1,500	$5,000	$9,000	$2,000	$1,545	$3,200

Santa Fe, New Mexico—State—Overpass and Approaches—Bernalillo County

Contract awarded to W. E. Bondurant, Roswell, New Mexico, $334,450, by State Highway Comm., Santa Fe, New Mexico, for 0.263 mi. constructing an overpass and approaches, located in BERNALILLO COUNTY, within the municipality of Albuquerque, Proj. WPGM 242-A. Bids from:

(1) W. E. Bondurant, Roswell $334,450
(2) Sharp & Fellows, Los Angeles 340,204
(3) Ed. H. Honne, Colorado Springs 352,162
(4) F. D. Shufflebarger, Albuquerque 358,212
(5) Kiewit & Sons & Co., Omaha $361,802
(6) New Mexico Construction Co., Albuquerque 401,432
(7) Engineer's estimate 372,652

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
6,456 cu. yd. excav. unclass.	$1.00	$.55	$.58	$1.55	$1.35	$.85	$1.50
13,462 ¼ mi. yd. haul	.08	.05	.05	.043	.05	.06	.06
1,588 sq. yd. concrete pavement	1.60	2.14	2.20	2.25	2.25	2.30	2.50
14,290 sq. ft. fabric reinf. (pavem.)	.05	.035	.04	.035	.035	.03	.05
397 lin. ft. longitudinal center jt.	.20	1.50	.12	.125	.15	.15	.20
52 cu. yd. concr. curb & gutter	$17	$18	$22	23.85	$25	$19	$19
2,961 cu. yd. "A" concrete (substruc.)	$20	17.75	19.50	17.80	19.50	22.00	19.00
1,628 cu. yd. "A" concrete (superstruc.)	$20	22.10	19.00	21.25	19.50	26.80	20.00
1,019,804 lb. reinforcing steel	.04	.042	.0425	.045	.05	.044	.046
1,674,000 lb. structural steel	.053	.055	.058	.062	.055	.062	.06
35 lin. ft. reinf. conc. pipe, 24"	4.00	4.50	4.00	5.35	5.25	4.50	4.00
196 lin. ft. reinf. conc. pipe, 30"	6.00	6.50	6.00	7.35	6.50	6.00	4.50
46,640 lin. ft. treated timber piling	1.00	.95	1.05	1.00	1.06	1.25	1.20
190 sq. yd. conc. blanket bank protect.	2.00	2.50	4.00	2.45	2.25	2.70	2.50
97 lin. ft. trench under drain	3.00	1.00	2.00	.20	2.00	.90	.30
2 each bronze plate proj. marker	25.00	50.00	25.00	25.00	15.00	15.00	10.00
3,569 sq. ft. concrete sidewalk	.20	.35	.20	.21	.20	.30	.20
2,115 lin. ft. ornamental steel handrail	6.00	7.00	5.00	5.65	6.50	4.60	5.50
36 ea. ornamental light standard	60.00	$123	70.00	71.00	72.50	70.00	90,00
7,210 lin. ft. lead covered cond. cable	.20	.22	.20	.18	.25	.18	.20
3,480 lin. ft. galv. elec. conduit	.50	.55	.50	.53	.40	.50	.60
577 cu. yd. removal roadway pavem. curbs	1.00	2.50	3.50	2.50	3.00	6.00	3.00
Lump sum, removal of existing viaduct	3,000	4,000	9,000	3,600	8,000	16,000	8,000

Carson City, Nev.—State—Concrete and Steel—Washoe County

Contract awarded to J. F. Knapp, 1401 Park Ave., Oakland, $153,351, by Nevada State Highway Comm., Carson City, Nev., for const. concrete and steel underpass and a concrete and steel bridge on Alameda and Wells Avenue, approx. 0.31 mi., in Reno, WASHOE COUNTY, Nev. (WPGM 141-B). Bids from:

(1) J. F. Knapp, Oakland $153,351
(2) I. Christensen, Reno 161,396
(3) George French, Jr., Stockton 163,892
(4) Isbell Const. Co., Reno $168,055
(5) Pacific Const. Co., Reno 177,734
(6) Engineers' estimate 170,213

	(1)	(2)	(3)	(4)	(5)	(6)
402 lin. ft. remov. curb and gutter	.15	.25	1.00	.25	.50	.25
L. S. remove bridge	$5,000	$4,800	$5,500	$5,250	$7,000	$5,000
8,458 sq. ft. remove pavement	.05	.10	.15	.20	.15	.20
26,446 cu. yd. roadway excavation	.50	.60	.70	.45	.40	.45
1,224 cu. yd. select borrow	.75	.50	.60	.70	.50	.50
2,335 cu. yd. struc. excavation	3.50	3.00	5.00	3.00	2.00	3.00
5,031 sq. yd. subgrade	.20	.03	.08	.05	.10	.03
0.31 mi. finish roadway	500.00	800.00	800.00	$1,000	500.00	$1,000
1,320 cu. yd. cr. grav. or stone surf.	1.50	1.30	1.50	1.25	1.25	1.25
242 cu. yd. cr. gr. or st. surf. (footpaths)	2.00	1.75	2.00	2.00	2.00	2.00
39 tons asph. rd. matl. SC-2	20.00	22.00	16.20	18.00	25.00	20.00
3 tons asph. rd. matl. MC-2	40.00	30.00	50.00	45.00	40.00	27.00
2 tons emuls. asph. penetration	40.00	30.00	60.00	40.00	40.00	26.00
5,031 sq. yd. roadmix	.10	.07	.10	.06	.06	.06
11,225 sq. ft. pavement (patches)	.12	.20	.10	.08	.30	.65
3,135 cu. yd. "A" concrete	18.00	19.00	18.00	21.00	22.00	21.00
270 cu. yd. "A" conc. (curb, Gutters & sidew.)	18.00	15.00	24.00	16.50	16.00	16.00
271 cu. yd. "D" concrete	20.00	22.00	26.00	22.70	22.00	23.00
1,466 lin. ft. concrete rail	3.00	3.50	3.00	4.00	3.00	4.00
330,500 lb. reinforcing steel	.045	.05	.0425	.05	.06	.05
391,000 lb. structural steel	.06	.065	.06	.07	.08	.065
70 lin. ft. 8" corr. metal pipe	1.25	1.00	1.50	1.30	1.00	1.00
104 lin. ft. 12" corr. metal pipe	1.50	1.35	1.70	1.60	1.50	1.50
1,034 lin. ft. 8" perf. underdrain	1.25	1.15	1.45	1.35	1.50	1.10
118 lin. ft. 10" perf. underdrain	1.50	1.20	1.60	1.35	2.00	1.25
2,300 lb. casting	.12	.16	.11	.09	.15	.15
150 lin. ft. pipe rail	3.00	1.10	1.50	3.50	3.00	1.00
1,000 sq. ft. 3-ply waterproofing	.50	.60	.15	.50	.50	.50
800 cu. yd. ballast	.90	1.50	1.75	1.21	1.50	.75
L. S. lighting equipment	$3,000	$3,250	$2,800	$2,725	$3,000	$2,500
L. S. miscellaneous	$3,000	$2,250	$1,500	$3,500	$3,500	$3,000

Larsen Named Coast Manager of Wickwire Spencer

H. A. Larsen, formerly manager of structural products division on the West Coast for the Wickwire Spencer Steel Co., 41 West 42nd St., New York, has been appointed Pacific Coast sales manager for all of the company's products. Larsen will make his headquarters at the San Francisco office, 101 Townsend Street.

Larsen was graduated from the University of Michigan in 1906. His coast experience began in 1908; in 1917 was made vice-president of L. A. Norris Company, with whom he had been connected for several years. Larsen's services with Wickwire Spencer dates back to 1922 when he was made manager of structural products for the Pacific Coast territory; but in 1924 resigned to again rejoin this company in 1934, as manager of structural products.

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Asphalt Institute Chairman

Lawrence Wolff, assistant manager of fuel oil and asphalt sales, Union Oil Company of California, was appointed chairman of the board of directors for 1936 by the Pacific Coast division of the Asphalt Institute, during its fifth annual meeting in San Francisco. Mr. Wolff succeeded J. A. Blood of Standard Oil Company. J. F. McSwain, Shell Oil Company, and K. E. Kneiss, Associated Oil Company, were appointed secretary and treasurer, respectively, for the same period.

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Ruckstell Bay District Offices

Ruckstell California Sales Co. has just been established at 3521 Chestnut St., Oakland, Calif. This newly formed company will handle the sales of Eaton Ruckstell Axles for Ford and Chevrolet trucks. George W. Williams and A. G. Herring of the O. R. Peterson Co., Inc., of San Francisco are the sole owners. The latter company controls the sales of Ruckstell in Northern California and Western Nevada.

Water Supply Systems. . . . .

San Francisco, Calif.—City—Excavation and Embankment—Sunset Reservoir

Contract awarded to Piombo Bros. & Co., 1571 Turk St., San Francisco, Calif., $238,121, by Public Utilities Commission, San Francisco, for excavation and embankment of Sunset Reservoir in area of 24th to 28th Streets, and Ortega to Quintara Streets, S. F., under S. F. W. D. Contract No. 110. Bids from:

(1) Piombo Bros. & Co., S. F. $238,121
(2) David H. Ryan, San Diego 246,866
(3) Barrett, Hilp, and Macco, Clearwater 280,321
(4) Sibley Grading & Teaming Co. 291,897
(5) Charles L. Harney, S. F. 294,707
(6) Guy F. Atkinson, S. F. $325,746
(7) D. McDon. & McDon. & Kahn, S. F. 366,595
(8) Geo. Pollock, Sacramento 383,861
(9) Bayshore Const. Co., S. F. 398,616

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
68,000 cu. yd. excav. & plac. in embankm. and resvr.	.18	.15	.125	.16	.20	.28	.27	.25	.27
186,000 cu. yd. exc. for resv. & disp. of sur. material	.25	.27	.33	.30	.30	.40	.27	.50	.42
114,000 cu. yd. rem. overburden	.18	.13	.15	.125	.20	.23	.293	.33	.26
115,000 cu. yd. exc. & plac. clay sand or other than rk	.23	.27	.26	.29	.28	.30	.31	.33	.40
90,000 cu. yd. exc. & plac. clay sand fr. Balboa Res.	.57	.45	.65	.75	.65	.68	.70	.75	1.00
47,000 cu. yd. exs. & plac. rock	.42	.60	.70	.30	.70	.40	.95	.60	.64
600 hrs. prov. & opr. blade grd.	5.00	7.00	6.00	5.00	6.50	6.50	8.00	7.50	6.00
500 hrs. prov. & opr. harrows	4.75	6.00	4.50	5.00	6.25	6.00	8.00	5.00	6.00
2,650 hrs. prov. & opr. tamp. roll.	5.50	5.00	6.00	5.00	6.50	6.50	8.00	6.00	6.00
1,050 hrs. prov. & opr. pwr. rollers	3.50	2.50	3.50	4.00	4.50	6.00	8.00	5.50	5.00
3,150 cu. yd. exc. & backf. trench	.60	.50	.60	3.00	1.00	3.00	4.25	3.50	3.30
259 cu. yd. exc. & backf. trench	1.50	.70	1.20	8.00	2.50	3.60	6.00	10.00	5.00
3,750 cu. yd. str. exc.	.40	.50	1.00	2.50	1.00	1.50	1.10	2.50	3.00
4,100 cu. yd. exc. for dr. trench	.40	.60	.30	2.25	.70	1.25	3.80	1.00	1.85
2,740 lin. ft. frn & inst. 6" pipe	.30	.20	.40	.15	.30	.40	.30	.50	.30
1,660 ft. frn. 8" tile dr. pipes	.40	.30	.50	.23	.45	.75	.40	.60	.40
4,100 cu. yd. frn. & plc. gravel	2.20	3.00	3.00	2.75	2.60	2.50	4.00	3.00	3.00
8,900 cu. yd. frn. & spr. soil	.60	.60	.90	1.00	.64	1.00	1.25	1.50	1.10
800 cu. yd. conc. work	14.00	16.00	16.50	$18	16.50	15.00	15.25	15.00	20.00
108,000 lb. rein. steel	.04	.06	.045	.05	.05	.04	.045	.05	.045
15,000 lb. frn. & insta. misc. metal	.065	.14	.12	.15	.18	.15	.15	.10	.25

Bridges and Culverts

Portland, Ore.—State—Overcrossing—Multnomah County

Hoffman Const. Co., 715 S. W. Columbia Blvd., Portland, $410,212 low to Ore. State Highway Comm., Portland, Ore., for const. an overcrossing over the S. P. R. R. on Union Ave., on the East Portland-Oregon City Highway in the City of Portland, MULTNOMAH COUNTY, Ore. (WPGM 168-D and WPMH 168-H). Bids from:

(A) Hoffman Const. Co., Portland $410,212
(B) Pacific Bridge Co., Portland 412,939
(C) F. J. Kernan, Portland 433,899
(D) Parker Schram Co., Portland 441,517
(E) Guy F. Atkinson Co., Portland 444,547
(F) Warren Northwest, Inc., Portland.. 445,501
(G) Kern & Kibbe, Portland 454,109
(H) Gilpin Const. Cor., Portland $454,535
(I) P. L. Crooks & Co., Inc., Portland 459,128
(J) O. R. Wayman, Portland 465,512
(K) Guthrie-McDougal Co., Portland.... 488,696
(L) Joplin & Eldon, Portland 490,764
(M) Malcom & Bell, Portland 492,936

(1) L. S. Clear and grub
(2) 1,700 ft. remove RR tracks
(3) 2,200 cy. trench exc. 0-5'
(4) 1,300 cy. trench exc. 5-10'
(5) 200 cy. trench exc. 10-15'
(6) 20 cy. trench exc. 15-20'
(7) 17,900 cy. excavation
(8) 20,200 cy. common borrow
(9) 10,500 sta. yd. overhaul
(10) 35,200 mi. yd. truck haul
(11) 9,000 sq. yd. remove pavem.
(12) 4,600 sq. yd. remove sidew.
(13) 6,200 lin. ft. remove curbs
(14) 2,300 ft. 6" por. drain tile
(15) 1,250 ft. 6" sewer pipe
(16) 390 ft. 8" pipe under pave.
(17) 3,130 ft. 8" sewer pipe
(18) 380 ft. 10" sewer pipe
(19) 480 ft. 12" sewer pipe
(20) 33 ea. spec. sec. 8" pipe
(21) 8 ea. spec. sec. 10" pipe
(22) 10 ea. spec. sec. 12" pipe
(23) 110 cy. rock backfill
(24) 43 ea. conc. catch inlets
(25) 13 ea. conc. manholes
(26) 430 cy. conc. curbs
(27) 4,100 sq. yd. conc. sidewalks
(28) 400 sq. yd. conc. aprons
(29) 2,800 cy. grav. subbase
(30) 550 cy. rock base
(31) 640 cy. coarse rock
(32) 220 cy. fine rock
(33) 230 cy. sand
(34) 330 cy. sand cushion
(35) 50 cy. filler
(36) 50 mi. yd. haul filler
(37) 750 bbl. cement
(38) 950 cy. conc. pavement
(39) 23,700 sq. yd. conc. pavement
(40) 3,000 ft. ¾" exp. joints
(41) 1,300 ft. ½" expan. joints
(42) 12,700 ft. contract. joints
(43) 13,100 ea. dowels
(44) 30,600 lb. tie bars, etc.
(45) 1,550 tons "A" asph. conc.
(46) 400 tons "B" asph. conc.
(47) 9,300 sq. yd. surf. fin. coat
(48) L. S. pier protection islands
(49) L. S. connect Ross Is. Bridge
(50) 6,900 cy. struc. excav.
(51) 300 cy. str. exc. below el.
(52) 33,000 ft. treated piling
(53) 8,000 cy. "D" concrete
(54) 1,600,000 lb. reinf. steel
(55) 5,800 ft. conc. handrail
(56) L. S. elect. wiring & fixtures

	(A)	(B)	(C)	(D)	(E)	(F)	(G)	(H)	(I)	(J)	(K)	(L)	(M)
(1)	$8,000	$2,000	$5,000	$2,500	$4,000	$6,000	$1,500	$5,000	$12,000	$1,750	$5,000	$1,350	$2,500
(2)	1.00	1.00	.50	.35	.20	.65	.15	.35	1.00	1.00	.40	.90	.65
(3)	.75	1.75	.80	.75	1.15	1.00	.80	.50	1.00	1.00	1.75	.80	1.00
(4)	1.00	1.75	1.00	1.25	1.75	1.65	1.25	.75	1.50	1.50	3.00	.95	2.00
(5)	2.00	2.00	1.75	2.25	2.25	2.00	3.00	2.00	3.00	2.00	7.50	1.30	3.00
(6)	3.00	3.00	3.00	3.00	5.00	3.00	4.00	3.00	5.00	3.50	12.00	2.00	4.00
(7)	.38	.48	.40	.50	.25	.40	.40	.75	1.00	.48	.55	.34	.50
(8)	.33	.37	.35	.30	.20	.25	.40	.40	.50	.40	.35	.34	.30
(9)	.03	.02	.02	.015	.01	.04	.02	.02	.03	.025	.03	.02	.02
(10)	.15	.19	.10	.15	.12	.15	.20	.20	.15	.20	.25	.15	.20
(11)	.60	.25	.40	.40	.50	.50	.30	.35	.30	.60	.35	1.00	.30
(12)	.30	.12	.15	.15	.10	.30	.25	.30	.15	.10	.35	.60	.12
(13)	.10	.08	.10	.05	.06	.12	.12	.15	.10	.12	.15	.07	.08
(14)	.35	.15	.20	.15	.25	.22	.30	.25	.50	.17	.20	.30	.35
(15)	.50	.45	.50	.35	.40	.45	.45	.45	.70	.38	.57	.40	.50
(16)	1.00	1.50	1.00	1.50	1.60	2.00	1.25	.60	2.00	1.50	3.45	1.45	1.50
(17)	.60	.60	.60	.50	.50	.65	.52	.50	.80	.50	.70	.45	.60
(18)	.90	.85	.80	.70	1.00	.85	.65	.65	1.00	.65	.85	1.00	.75
(19)	1.10	1.10	1.25	.90	1.25	1.15	.90	.90	1.50	.85	1.12	1.30	1.00
(20)	2.00	4.80	2.00	2.15	.50	1.30	1.80	2.00	3.00	2.00	3.90	2.40	2.00
(21)	2.50	6.75	2.50	3.00	1.00	1.90	2.55	3.00	5.00	2.50	4.55	3.00	2.50
(22)	3.00	8.65	3.50	4.00	2.00	2.70	3.50	5.00	7.00	3.50	5.50	5.00	3.25
(23)	2.50	2.00	2.00	2.40	1.00	2.70	2.00	2.50	5.00	3.00	2.00	2.50	2.00
(24)	20.00	16.50	40.00	17.50	20.00	35.00	20.00	16.00	30.00	26.00	16.00	18.00	16.50
(25)	$100	80.00	80.00	75.00	$100	90.00	85.00	85.00	$100	90.00	85.00	$170	80.00
(26)	18.00	15.50	15.00	14.00	12.00	16.00	13.00	12.00	17.00	15.25	13.00	13.50	15.50

(Continued on Page 48)

ESCO

Reproduction from front cover of
COLORADO AQUEDUCT NEWS
Published by the METROPOLITAN WATER DISTRICT OF SOUTHERN CALIFORNIA

Over SIXTY dragline buckets manufactured by FIVE different factories are in use on this particular job

FORTY of these buckets are ESCO BUCKETS

There must be a reason why 75% of all dragline buckets on the Los Angeles Aqueduct are ESCO buckets.

"If every contractor knew what every *ESCO* owner knows," *this proportion* would, no doubt, obtain on *all* large dragline jobs in the West.

MANUFACTURED BY

ELECTRIC STEEL FOUNDRY CO.

Twenty-fourth and York Streets PORTLAND, OREGON Phone BEacon 6344

BRANCHES

SEATTLE
A. L. BIBBINS, Manager
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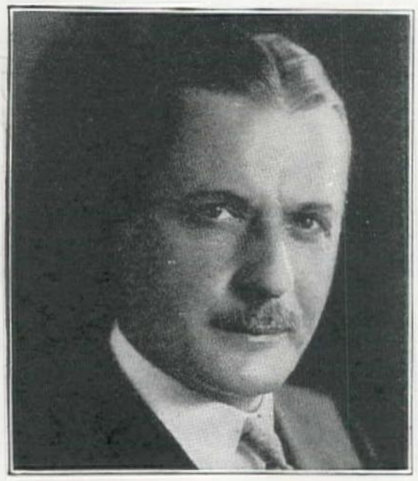
Phone ELiot 4161

DENVER
WILLIAM A. JENKINS, Manager
1701 Fifteenth Street
Phone CHerry 3184

SAN FRANCISCO
H. D. ROBB, Manager
699 Second Street
Phone GArfield 8121

Southwestern District Branch—NORMAN W. MILLS, District Manager, 2205 Santa Fe Avenue, Los Angeles, California
Phone JEfferson 4191

AGENTS—Harron, Rickard & McCone Co., San Francisco and Los Angeles; Neil B. McGinnis Co., Phoenix, Arizona; R. L. Harrison Co., Albuquerque, N. M.; National Equip. Co., Salt Lake City, Utah; Intermountain Eqpt. Co., Boise, Ida.; Tri-State Eqpt. Co., El Paso, Tex.



Kauffmann Again Heads Link-Belt

At the annual meeting of shareholders, March 24, Alfred Kauffmann was elected president of Link-Belt Company. Kauffmann succeeds George P. Torrence, whose resignation as president and director of the company was accepted by the board recently.

Alfred Kauffmann started with the company thirty-five years ago as a draftsman. He was president of the company from 1924 to 1932, and has been a director since 1922.

The four board members elected to fill the terms expiring this year include B. A. Gayman, president of Link-Belt Company, Pacific Division, with headquarters at San Francisco, who has been associated with the company for thirty-nine years.

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Hercules Equipment Receives Boulder Dam Award

One of the outstanding engineering and constructural achievements of the decade—completion of Boulder Dam—was signalized last week by Six Companies, Inc., making acknowledgment of coöperative aid which they had received from outside sources.

The Hercules Equipment and Rubber Company of San Francisco, B. F. Goodrich Company distributor, last week received "an appreciation of service achievement" from Six Companies, Inc., for the supplying of Goodrich hose and supplies over the five-year construction period. Over seventy miles of Goodrich air hose, water hose, steam hose, cement placement hose, cement grouting hose, welding hose, and refrigeration hose, were supplied to Six Companies by the Hercules Company.

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Macwhyte Opens Branch

To better serve their customers in the Northwest, the Macwhyte Company, Kenosha, Wis., has just announced the completion of a new branch and warehouse building at 1603 N. W. Fourteenth Ave., Portland, Ore.

The new warehouse was specially constructed to provide the most modern facilities for handling wire rope. W. J. Brett, factory representative for the Macwhyte Company in the Northwest, will make his headquarters here.

(27)	1.10	1.35	1.25	1.25	1.50	1.30	1.40	1.50	1.50	1.30	1.50	1.45	1.35
(28)	1.60	1.75	1.80	1.85	1.75	2.00	2.00	1.60	2.00	1.70	1.75	1.84	1.75
(29)	1.40	1.08	1.50	.75	1.25	1.00	.80	1.15	1.30	1.20	1.25	1.10	1.08
(30)	2.50	2.20	2.00	1.85	2.00	1.50	1.50	1.80	2.50	2.40	1.75	2.00	2.20
(31)	2.50	2.20	2.50	2.15	3.00	2.00	1.50	3.00	2.00	2.40	2.70	3.00	2.20
(32)	2.50	2.20	2.50	1.85	3.50	1.70	1.50	3.00	2.00	2.40	2.70	3.00	2.20
(33)	1.70	1.10	3.00	2.50	3.50	.65	1.00	3.00	2.00	1.25	3.00	2.00	1.10
(34)	1.20	1.10	1.50	1.00	1.50	.90	1.00	1.70	2.00	1.20	1.70	1.00	1.10
(35)	.50	.40	.50	.75	.50	.50	.65	.25	1.00	.45	.50	.50	.40
(36)	.20	.20	.15	.20	.50	.25	.20	.25	.50	.22	.25	.15	.20
(37)	3.00	4.80	3.50	3.10	2.50	2.90	3.00	2.50	5.00	4.50	2.50	4.80	4.80
(38)	2.50	10.85	12.00	10.00	10.00	8.50	9.00	11.00	10.00	15.00	9.00	11.00	10.85
(39)	1.80	1.75	1.85	1.70	1.70	1.60	1.85	1.68	2.00	1.80	1.68	1.84	1.75
(40)	.22	.18	.18	.15	.12	.18	.18	.12	.20	.15	.12	.15	.18
(41)	.17	.12	.15	.10	.10	.12	.15	.12	.20	.12	.10	.12	.12
(42)	.03	.03	.03	.02	.06	.05	.03	.05	.05	.03	.05	.03	.03
(43)	.16	.16	.18	.15	.15	.12	.15	.20	.20	.14	.15	.15	.16
(44)	.05	.05	.05	.04	.044	.04	.05	.04	.05	.045	.04	.055	.05
(45)	5.50	5.50	6.00	5.35	5.00	5.25	4.50	6.00	6.00	5.75	5.85	5.50	5.50
(46)	5.50	5.75	6.00	5.50	5.00	5.25	4.50	6.00	6.00	5.75	6.15	5.50	5.50
(47)	.05	.05	.05	.05	.05	.05	.05	.05	.10	.05	.06	.05	.05
(48)	$4,500	$500	$3,000	$3,750	$6,300	$8,000	$4,000	$4,000	$4,000	$7,800	$5,000	$3,960	$5,800
(49)	$900	$400	$500	$1,000	$2,000	$3,000	$250	$1,000	$2,000	$2,500	$1,000	$400	$1,000
(50)	2.00	1.75	2.00	2.50	1.25	1.70	2.00	2.00	2.00	2.75	3.50	4.50	4.00
(51)	3.00	2.50	4.00	3.00	3.00	2.30	4.00	5.00	5.00	3.00	7.00	9.00	7.00
(52)	.90	.75	1.05	.90	.90	.85	1.00	.75	.90	.85	.85	.85	.85
(53)	17.00	19.00	18.00	19.75	22.50	20.00	21.84	20.50	18.00	19.25	23.00	22.80	23.45
(54)	.04	.04	.045	.045	.042	.045	.0403	.045	.04	.0475	.0425	.04375	.045
(55)	4.00	3.10	4.00	5.00	3.50	5.00	4.97	5.00	4.50	5.00	4.75	4.70	5.00
(56)	$6,000	$6,400	$6,000	$7,400	$8,000	$7,000	$9,000	$7,000	$7,000	$7,040	$7,000	$7,000	$7,000

Los Angeles, Calif.—State—Steel and Conc. Bridge—San Diego County

C. W. Wood, Box 49, Stockton, Calif., $175,529, low to Calif. Division of Highways, State Bldg., Los Angeles, for steel deck truss bridge with concr. deck across Santa Margarita River, about 2½ mi. north of Oceanside, consisting of two 167 ft. 6" spans, two 67 ft. cantilever spans and two 20 ft. 6" plate girder approach spans, in SAN DIEGO COUNTY. Bids from:

(1) C. W. Wood, Stockton..........$175,529
(2) B. O. Larsen, San Diego.......... 181,063
(3) Dimmit & Taylor, L. A.......... 222,900
(4) Shofner & Gordon, L. A.......... 233,081
(5) Pacific Bridge Co., S. F..........$236,377
(6) J. E. Haddock, Ltd., Pasadena.......... 251,861
(7) V. R. Dennis Constr. Co.......... 295,693

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
4,000 cu. yd. struc. excav. piers	3.00	2.50	12.50	7.00	12.75	19.00	25.00
275 cu. yd. struc. excav. abutm.	1.00	2.00	.50	1.28	2.00	1.50	3.00
170,000 lb. reinforcing steel	.04	.045	.05	.07	.06	.045	.05
900 cu. yd. "A" conc. ftg. blocks	12.50	18.00	9.00	35.00	16.00	14.50	20.00
765 cu. yd. "A" conc. piers	15.00	22.00	20.00	30.00	20.00	18.50	23.00
825 cu. yd. "A" conc. abutm., etc.	18.00	22.00	25.00	25.00	22.00	23.50	27.00
1,205,000 lb. structural steel	.078	.07	.075	.065	.08	.078	.075
39,000 lb. struc. steel, furn. and fabric.	.06	.05	.055	.048	.06	.06	.06
14,120 lb. cast alloy steel	.15	.15	.15	.15	.15	.155	.20
44,000 lb. steel rail	.18	.16	.15	.14	.18	.14	.20
2,500 lb. steel rail, furn. and fabric.	.17	.14	.13	.12	.16	.13	.18
18,245 ft. furn. untr. D. F. piles	.33	.35	.35	.45	.45	.32	.40
1,140 ft. furn. tr. D. F. piles	.72	.60	.70	.85	1.00	.72	.90
308 ea. drive D. F. piles and tr. pile	10.00	17.00	32.00	50.00	18.00	22.00	35.00
85 cu. yd. gravel blanket	3.00	2.00	3.00	6.00	5.00	4.00	5.00
160 lin. ft. temporary rail	1.00	2.00	1.50	1.25	2.00	1.00	3.00
1 lot miscellaneous work	$1,000	$2,000	$600	$1,589.75	$1,000	$1,500	$2,500

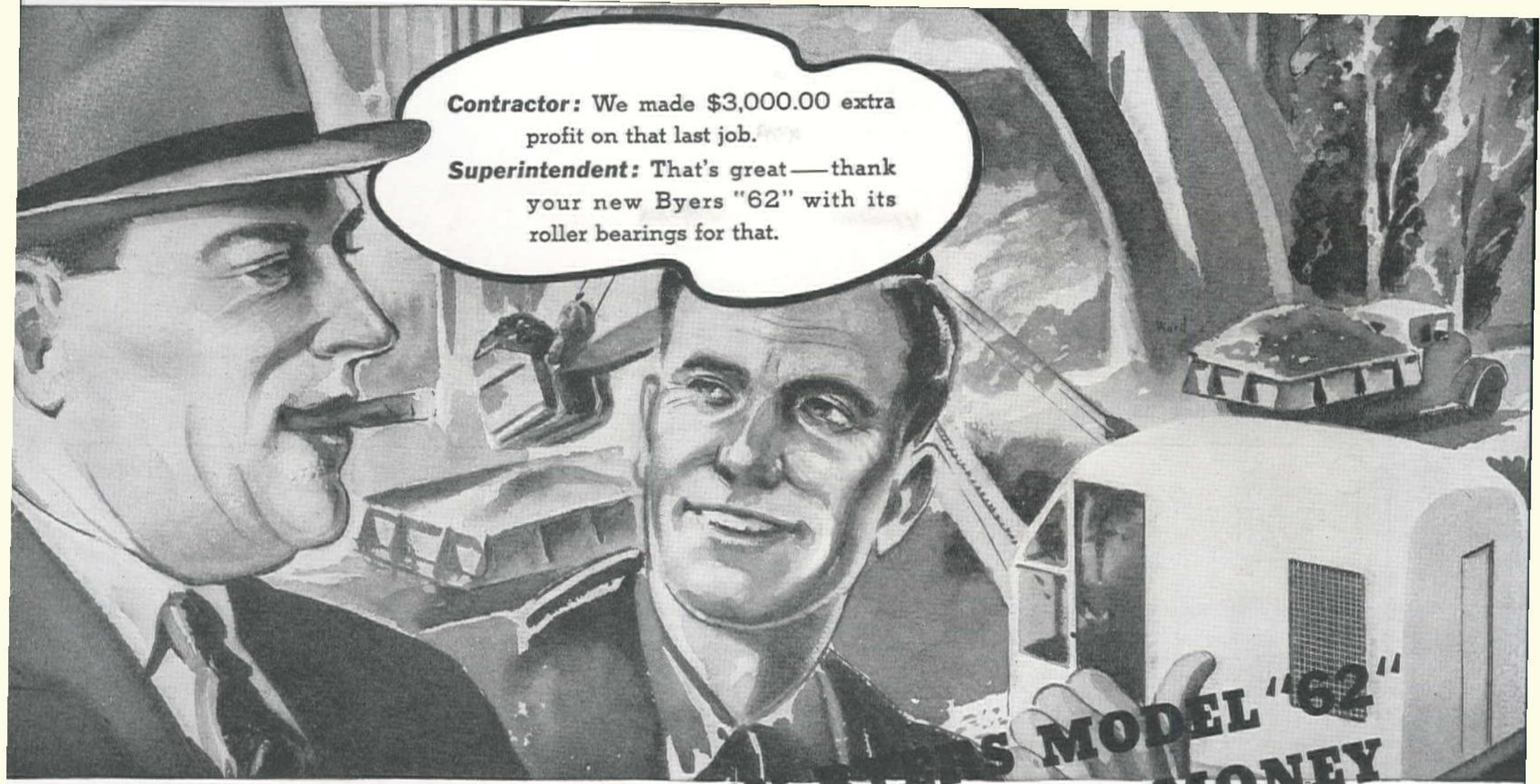
Irrigation and Reclamation . .

Yakima, Wn.—Government—Earthwork, Canal Lining, etc.—Yakima Project

J. A. Terteling & Sons, 2223 Fairview Ave., Boise, Idaho, $275,213 low to Bureau of Reclamation, Yakima, Wn., for const. earthwork, canal lining, and structures, Sta. 313-00 to Sta. 576-81.5, Yakima Ridge Canal, Roza division, Yakima project, Washington, under Spec. 675. Bids from:

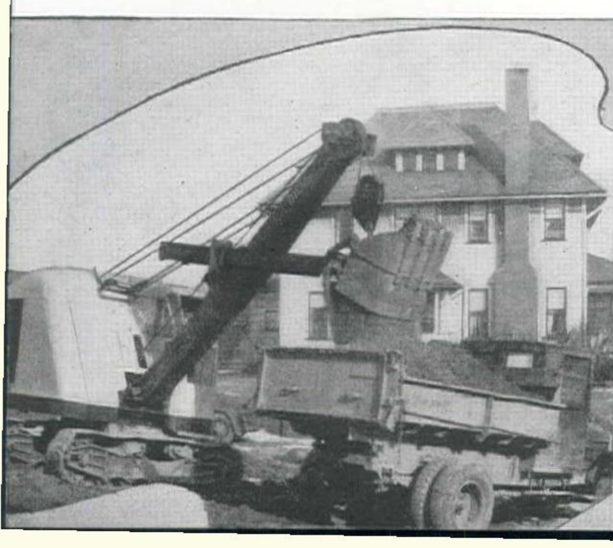
(1) J. A. Terteling & Sons..........$275,213
(2) Morrison-Knudsen Co., Inc.......... 288,552
(3) L. Romano Engrg. Corp.......... 292,895
(4) Martin Wunderlich Co.......... 298,902
(5) Guthrie-McDougall Co..........$311,947
(6) P. L. Crooks & Co., Inc.......... 323,280
(7) F. J. Kernan, North Portland.......... 329,542
(8) Barnard-Curtiss Co., Minneapolis..........341,781

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
387,000 cu. yd. canal exc. Class 1	.125	.125	.19	.125	.10	.13	.14	.095
293,000 cu. yd. canal exc. Class 2	.125	.125	.20	.135	.24	.20	.20	.30
50,000 cu. yd. canal exc. Class 3	.60	.60	.50	.60	.60	.60	.40	.70
15,000 cu. yd. exc. core banks	.15	.20	.20	.30	.20	.30	.15	.20
160,000 sta. yd. overhaul	.02	.02	.01	.02	.03	.02	.01	.04
5,500 cu. yd. struc. exc. Class 1	.30	.25	.40	1.00	.20	.80	.40	.50
3,800 cu. yd. struc. exc. Class 2	1.00	.50	.60	1.20	.50	.80	.50	1.00
100 cu. yd. struc. exc. Class 3	1.00	1.00	3.00	4.00	2.50	2.50	1.00	1.00
800 cu. yd. exc. chan. & dikes, Cl. 1	.30	.20	.40	.35	.20	.80	.25	.20
600 cu. yd. exc. chan. & dikes, Cl. 2	.30	.30	.60	.50	.50	.80	.60	.40
100 cu. yd. exc. chan. & dikes, Cl. 3	.30	1.00	3.00	1.50	2.50	2.50	.60	1.00
24,000 cu. yd. compact embankment	.17	.25	.25	.20	.12	.25	.30	.55
6,000 sq. yd. prepare foundation	.60	.60	.50	.75	.60	.50	.20	.47
82,000 sq. yd. trim canal sec. (earth)	.25	.25	.05	.10	.15	.20	.10	.24
4,500 cu. yd. backfill about struc.	.20	.30	.25	.30	.15	.50	.30	.20
2,600 cu. yd. puddle or tamp backf.	.40	.30	.50	.60	.40	.50	.30	.55
1,100 cu. yd. concrete (struc.)	14.50	15.00	10.00	15.00	16.00	25.00	20.00	18.00
9,770 cu. yd. concrete (canal lin.)	7.50	8.75	6.00	10.00	9.50	9.00	8.00	7.80
1,200,000 lb. place reinf. steel	.015	.015	.03	.015	.02	.01	.05	.012
100 sq. yd. dry-rock paving	1.00	2.00	2.00	2.00	2.00	3.00	4.00	1.50
2,000 cu. yd. gravel blanket	1.00	1.50	.50	.75	.60	1.60	2.00	1.75
400 ft. lay 12" concrete pipe	.50	.50	.10	.50	.40	1.00	.30	.60
40 MFBM erect timber (struc.)	15.00	25.00	20.00	50.00	25.00	50.00	30.00	25.00
14,000 ft. const. 6" underdr. (uncem. jt.)	.50	.40	.10	.30	.20	.25	.15	.75
2,800 ft. lay 6" vitr. pipe (cem. jt.)	.50	.40	.15	.40	.25	.50	.15	.55
3,700 lb. inst. gates & gate hoists	.03	.05	.10	.06	.05	.10	.25	.05
150 lb. inst. rungs, valve & connec.	.05	.10	.20	.20	.08	.40	.25	.10



ROLLER BEARINGS IN BYERS MODEL "62" SAVE TIME AND MONEY

Thirty-two Timken tapered roller bearings used to mount the crowd, travel and swing clutches and main deck shafts of the Byers "62" brings new shovel profits. Gone are worn-out bushings with their expensive replacement delays. Gone, too, are grabbing, chattering clutches. Power is increased 10 to 15% where it's needed—in the clutch, which speeds up swing, crowd and travel operations, thus insuring greater yardage. ● The new fully enclosed, roomy, steel cab on Byers "62" is designed to save operator's time and speed up his work. The independent cable or chain crowd—power trip—moulded friction clutch linings—and two speed travel are features that make the Byers "62" a real money maker. . . . Send today for the descriptive literature and prices.



REPRESENTATIVES IN WESTERN STATES

Edw. R. Bacon Co., San Francisco, Calif. . . Smith, Booth, Usher, Los Angeles, Calif. . . Service Equipment Company, Inc., Seattle, Wash. . . Arnold Machinery Company, Inc., Salt Lake City, Utah . . Western Road Machinery Co., 83 S. E. Belmont St., Portland, Ore. . . Rocky Mountain Equipment Company, Denver, Colo. . . Sheehan & Co., El Paso, Texas.

BYERS MACHINE CO.

RAVENNA, OHIO

CONSTRUCTION

. . . . a news summary

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

304 mi. 6 in., 8 in. and 10 in. welded steel oil pipeline betw. Caliola and Martinez for Shell Oil Co., L. A. Work to start soon. Estimated cost $4,500,000.

Dam, pipeline and pumps for W. A. Peters, Jerome, Idaho, est. cost $400,000.

Rolled embankment Judson Reservoir Dam for Calif. Water & Telephone Co., National City, Calif. Bids about June 1.

Earthfill dam on Boca site of Little Truckee River, Nevada, for Bureau of Reclamation. Bids soon. Est. cost $1,000,000.

Dredging and wharf for Redwood City, Calif. $260,000 bond election June 2.

Steel floating drydock for U. S. Navy Dept. at Pearl Harbor, T. H. Bids soon. Est. cost $10,000,000.

21 mi. sewers for Willow Glen, Calif. Est. cost $300,000.

CALLS FOR BIDS

Multiple arch type Bartlett Dam for Bureau of Reclamation, Phoenix. Bids to May 16.

Emergency gate shafts for Fort Peck Tunnels for U. S. Engineer Office, Kansas City, Mo. Bids to May 21.

BIDS RECEIVED

Caballo dam, New Mexico, for Bureau of Reclamation, El Paso, low—Mittry Bros., L. A., $957,270.

Wharves at Yerba Buena Shoals for S. F. Pub. Utilities Comm., low bid—Healy Tibbitts Const. Co., S. F., $331,600.

1 steel dredge for U. S. Engr. Office, S. F., low bid—Bethlehem Steel Co., S. F., $647,000.

Reinf, conc. Macy St. Subway for Los Angeles, Calif., low bid—Bent Bros., Inc., L. A., $274,378.

Steel and conc. bridge across Santa Margarita River for Calif. Div. of Hgwys., L. A., low—C. W. Wood, Stockton, $175,529.

14,950,000 lb. steel plate lining for Fort Peck Tunnels for U. S. Engr. Office, Kansas City, Mo., low—Chicago Bridge & Iron Works, Chicago, $908,960.

Overcrossing in Portland for Ore. State Highway Comm., low bid—Hoffman Const. Co., Portland, $410,212.

Earthwork and canal lining, Yakima Proj. for Bur. of Reclamation, Yakima, low—J. A. Terteling & Sons, Boise, $275,213.

CONTRACTS AWARDED

0.3 mi. grading and conc. lined tunnel and conc. paving betw. Sausalito and G. G. Bridge for Calif. Div. of Highways, to T. E. Connolly, S. F., $587,917.

3.4 mi. grade and surf. betw. Waldo Pt. and G. G. Bridge for Calif. Div. of Highways, to Macco Const. Co., Clearwater, $770,204.

10.2 mi. grade and asph. conc. pave betw. Corning and Proberta for Calif. Div. of Highways, to Peninsula Paving Co., S. F., $218,181.

209,000 tons stone for Exposition site, by U. S. Engr. Office, S. F., to Marinap Corp., S. F., $278,250.

Sunset Reservoir in S. F., by Pub. Utilities Comm., to Piombo Bros., S. F., $238,121.

15.5 mi. grading, etc., on Showlow-Springerville Highway, for Ariz. Highway Comm., to O. F. Fisher, Phoenix, $244,610.

365,000 bbl. cement for Hamilton & Arnold dams, by Bureau of Reclamation, Denver, to Republic Portland Cement Co., San Antonio, $835,160.

Sheet piling retaining wall for Long Beach, to R. E. Campbell, L. A., $398,527.

11.735 mi. grade and surf. on Lewiston-Grass Range Road for Mont. State Highway Comm., to Tomlinson-Arkwright Const., Great Falls, $168,135.

Postoffice at Missoula, Mont., for Treas. Dept., Public Works Branch, Wash., D. C., to A. D. Belanger & Co., Seattle, $494,138.

Concrete and steel underpass and bridge in Reno, for Nevada State Highw. Comm., to J. F. Knapp, Oakland, $153,351.

8.286 mi. grading, etc., on Rt. 85, betw. Hatch & Las Cruces, for New Mexico Highway Dept., to A. O. Peabody, Las Cruces, $192,297.

Overpass and approaches in Albuquerque for New Mexico Highway Dept., to W. E. Bondurant, Roswell, $334,450.

10.233 mi. grading and surf., etc., on Rt. 66, betw. Gallup and Las Lunas, for New Mexico Highway Dept., to Skousen Bros., Albuquerque, $275,126.

Steel and conc. undercrossing at Oregon City, for Oregon State Highway Comm., to Parker Schram, Portland, $289,416.

Grading and tunnel on Columbia River Highway, for Bureau of Public Roads, Portland to Orino, Birkemeir & Saramel, Portland, $196,947.

Street and Road Work . . . . .

CALL FOR BIDS

LOS ANGELES, CALIF.—Bids to 2 p. m., May 21, by Calif. Div. of Highways, L. A., for: (1) VENTURA COUNTY—Grade and concrete and asph. conc. pav. roads within grounds at Camarillo State Hospital, involves: L. S. clear and grubb; 6,000 cu. yd. roadway excav.; 8,100 sq. yd. prepar. subgrade; 1,110 ton asph. conc. leveling course; 610 ton asph. conc. type B surf. crs.; 100 cu. yd. A conc. pavement; 240 cu. yd. A conc. curbs and gutters; 1,800 lb. misc. iron and steel. (2) SAN BERNARDINO and RIVERSIDE COUNTIES—19.4 mi. plain mix surf. slow curing type and seal coat applied at various locations,

involving: 337,600 sq. yd. asph. paint binder; 16,000 ton plant mix surface; 176 ton asph. emulsion seal coat; 1,040 cu. yd. sand seal coat. 4-28

LOS ANGELES, CALIF.—Bids to 2 p. m., May 21, by Calif. Div. of Highways, Los Angeles, for 6.8 mi. shoulders, plant mix surf. on bitum. macadam, betw. Castaic School and Piru Creek, LOS ANGELES COUNTY, Calif., involving: 4,200 cu. yd. roadway excavation; 3,800 ton broken stone; 700 ton key rock; 135 ton asph. cement grade E; 12 ton asph. emulsion 90-95 prime-c.; 3,200 ton plant mix surfacing. 4-28

LOS ANGELES, CALIF.—Bids to 2 p. m., May 21, by Calif. Div. of Highways, Los Angeles, for 9.8 mi. concrete pavement widening betw. Seal Beach and Newport Beach, ORANGE COUNTY, Calif., involving: 1,150 m. gals. water; 48,000 cu. yd. roadway excavation; 5,220,000 sta. yd. overhaul; 63,000 sq. yd. subgrade pavement; 518 sta. finish roadway; 2,160 ton mineral aggreg. plant mix; 115 ton liq. asph. MC-5 or extra heavy; 590 ton liq. asph. SC-2 rd. mix. surf.; 49,000 sq. yd. prep. mix and shape shldrs.; 12,390 cu. yd. B conc. pavement; 48,000 lb. reinf. steel; 25,500 ea. pavement dowels; 26,000 sq. yd. asph. paint binder. 4-28

LOS ANGELES, CALIF.—Bids to 2 p. m., May 21, by Calif. Div. of Highways, Los Angeles, for 1.3 mi. grade and conc. pavement, about 2.2 mi. west of Indio, RIVERSIDE COUNTY, Calif., involving: 69 sta. clear and grubb; 1,000 m. gals. water; 7,500 cu. yd. roadway excavation; 47,000 sta. yd. overhaul; 2,600 cu. yd. imported borrow; 13,400 cu. yd. imported selected matrl.; 15,300 sq. yd. prepare subgrade; 111 ton liq. asph. SC-2; 12,700 sq. yd. prepare mix and shape shoulders; 3,110 cu. yd. A conc. pave.; 6,200 pav. dowels; 11,500 lb. reinf. steel; 11 monuments; 7,600 sq. yd. salvage and stockpile detours. 4-28

SACRAMENTO, CALIF.—Bids to 2 p. m., May 20, by Calif. Div. of Highways, Sacramento, for 9.1 mi. of grade and bitum. treatment, selected material surface betw. 2 mi. south of Rush Creek and 2 mi. north of Leevining, MONO COUNTY, Calif., involving: 70 acres clear and grubb; 5,400 m gals. water; 96,300 cu. yd. roadway excavation; 117,000 sta. yd. overhaul; 1,800 cu. yd. structural excavation; 1,200 cu. yd. ditch excavation; 19,500 cu. yd. type "A" imported borrow; 19,500 cu. yd. type "B" imported borrow; 482 sta. finish roadway; 225 ton liq. asph. SC-2 prime coat; 21,500 ton selected material surfacing; 950 ton liq. asph. SC-3 bitum. treat. 4-28

SACRAMENTO, CALIF.—Bids to 2 p. m., May 20, by Calif. Div. of Highways, Sacramento, for 5.6 mi. grade and apply. penetration oil treatment betw. 4 East of Beckwourth & Ede's Ranch, in PLUMAS COUNTY, Calif., involving: 450 m. gals. water; 40,600 cu. yd. roadway excavation; 177,000 sta. yd. overhaul; 12,650 cu. yd. imported borrow. 4-28

SACRAMENTO, CALIF.—Bids to 2 p. m., May 20, by Calif. Div. of Highways, Sacramento, for 24.6 mi. apply roadmix surf. treatment to shoulders and portions to be surf. with armor coat, betw. the westerly boundary and 4 mi. east and betw. Yetten and Lemon Cove, TULARE COUNTY, Calif., involving: 500 tons liq. asph. SC-2; 87,000 sq. yd. prep. mix and shape shoulders; 175 ton liq. asph. 90-95; 3,500 ton screenings. 4-28

SAN DIEGO, CALIF.—Bids to 2 p. m., May 19, by District Engineer, Calif. Div. of Highways, San Diego, for 23.8 mi. liquid asphalt to be furnished and applied to existing roadbed, between Araz and Yuma and between Seeley and Calexico, IMPERIAL COUNTY. 5-2

PROVO, UTAH—Bids to 10 a. m., May 20, by City Recorder, Provo, Utah, for street paving district No. 25-A, being in the northeast portion of Provo City, involving: 4,000 ton natural rock asphalt; 950 bbl. bitum. material, type MC1. 5-2

SOUTH BEND, WN.—Bids to 2 p. m., May 18, by Pacific County Comm., South Bend, Wn., for improvement of Secondary Road Proj. No. 28, involving: 8.8 acres clearing and grubbing; 20,923 cu. yd. excavation and conc. pipe. 4-30

TACOMA, WN.—Bids to 10 a. m., May 18, by County Comm., Tacoma, Wash., for 0.645 mi. concrete paving on the Wood-Bonney Road near Sumner, Washington. Estimated cost $12,500. 5-1

BIDS RECEIVED

LOS ANGELES, CALIF.—Oilfields Trucking Co., Box 751, Bakersfield, $13,081, low to Calif. Div. of Highways, Los Angeles, for 27.6 mi. roadmix surf. tr. betw. Temescula River Bridge and southerly boundary betw. Sage and 4.2 mi. south of Hemet in RIVERSIDE COUNTY, Calif. 4-30

LOS ANGELES, CALIF.—R. A. Gibbs, 1501 W. Mission Road, Alhambra, Calif., $10,163, low to Board of Public Works, Los Angeles, for improvement of the east side of Vermont Ave., from 79th St., to Manchester Ave. 4-30

SAN LUIS OBISPO, CALIF.—Lambs Transfer Co., 828 Cowles St., Long Beach, $12,038, low to Dist. Engineer, San Luis Obispo, for 40.6 mi. liq. asph. furn. and applied to existing roadbed, between one mi. east of Pozo and Kern County line, SAN LUIS OBISPO COUNTY. 4-29

MARYSVILLE, CALIF.—E. F. Hilliard, 1355 43rd St., Sacramento, Calif., $10,297, low to Calif. Div. of Highways, Marysville, for 48.2 mi. applying oil tr. betw. Downieville and Rt. 83; betw. 7.1 mi. north of Truckee and 5.7 mi. north of Nevada-Sierra County line; and between Sierraville and Calpine, in SIERRA and NEVADA COUNTIES, California. 4-27

PORTLAND, ORE.—Bids received as follows by Oregon State Highway Comm., Portland, Oregon, for: (1) MULTNOMAH COUNTY (NRS 250)—Harold Blake, 400 N. Thompson St., Portland, $21,376, low for 0.48 mi. paving on Vancouver Ave. Extension, Columbia Blvd. to Union Ave. in City of Portland. (2) WASHINGTON COUNTY (WPSO 293)—Saxton & Looney and J. S. Risley, 324 Henry Bldg., Portland and J. C. Compton, McMinnville, Ore., $56,483 (TAR), low for 1.25 mi. grading, 1.25 mi. surf., 5.79 mi. resurf. and 7.05 mi. oil mat surf. tr. on Balm Grove-Forest Grove Sec. of Gales Creek County Road. (3) UMATILLA COUNTY (WPH 42)—James Crick, 3104 N. Monroe St., Spokane, $81,930, low for 7.56 mi. grading on East Unit, Stanfield-Pendleton Hill Sec. of the Old Oregon Trail. 4-20

EPHRATA, WN.—Leo J. Lavin, Coulee City, Wn., $14,204, low to County Comm., Ephrata, Wn., for 4.03 mi. grading and surfacing on the Wilson Creek-Bartline road. 4-24

CONTRACTS AWARDED

PHOENIX, ARIZ.—To Arizona Sand & Rock Co., Box 1522, Phoenix, Ariz., $92,603, low to Ariz. State Highway Comm., Phoenix, Ariz., for 14.4 mi. grading, draining and oil processing by roadmix method from the town of Casa Grande northeasterly to the junction with the Phoenix-Tucson Highway near Sacaton, on the Casa Grande-Sacaton Highway, WPMH 122 and WPSS 122, PINAL COUNTY, Ariz. 4-4

PHOENIX, ARIZ.—To Lee Moor Contracting Co., 807 Basset Tower, El Paso, Texas, $64,938, by Arizona State Highway Comm., Phoenix, Arizona, for 3 mi. grading, draining, furnishing and placing aggr. base course and asph. surf. treatment about 40 mi. southeast of Holbrook, on the Holbrook-St. Johns Highway, APACHE COUNTY, WPH 6-B. 5-1

PHOENIX, ARIZ.—To Tiffany Const. Co., Safford, Arizona, $117,170, by State Highway Comm., Phoenix, for 3.9 mi. grad. draining over a new location, which extends from the Florence-Superior Highway, on the Mesa-Superior Highway, PINAL COUNTY, WPH 7. 5-1

PHOENIX, ARIZ.—To Arizona Sand & Rock Co., P. O. Box 1522, Phoenix, $17,600, by Arizona Highway Comm., Phoenix, for widening and resurfacing present pavement and incidental work located in Phoenix on West Van Buren St., on the Phoenix-Tempe Highway, NRM 30-B, MARICOPA COUNTY. 4-11

PHOENIX, ARIZ.—To O. F. Fisher, Phoenix, $244,610, by Arizona Highway Comm., Phoenix, for 15½ mi. grading, draining roadway and placing A.B.C. about 27 miles east of Showlow and extending easterly on the Showlow-Springerville Highway, WPH 105-C, APACHE, NAVAJO and GILA COUNTIES, Ariz. (See Unit Bid Summary). 4-11

PHOENIX, ARIZ.—To Jack Casson, Phoenix, Ariz., $74,968, by Bureau of Public Roads, Phoenix, Ariz., for 9.141 mi. placing crushed rock base course on all of Route 8, Hermit Rest and the headquarters service roads and parking areas in Grand Canyon Natl. Park, COCONINO COUNTY, Ariz. 4-9

PHOENIX, ARIZ.—To J. A. Casson, Phoenix, $64,733, by Arizona State Highway Comm., Phoenix, for 0.4 mi. grading, draining roadway and placing concrete pavement and plant mix extending from the new underpass westerly on 16th Street, on the Benson-Douglas Highway, COCHISE COUNTY, Project FA 79-J, Sch. 1. 4-8

GLENDALE, CALIF.—To P. J. Akmadzich, 3028 Gilroy St., Los Angeles, $11,700, by City Clerk, Glendale, for improvement of Brand Blvd. from a point just south of Windsor Road to the southerly city limits. 4-25

LOS ANGELES, CALIF.—To Geo. Herz & Co., Platt Bldg., San Bernardino, $53,710, by Calif. Div. of Highways, Los Angeles, for 0.7 mi. grading and placing mix surface at Little Mt. entrance to San Bernardino, SAN BERNARDINO COUNTY, Calif. 4-2

LOS ANGELES, CALIF.—To Matich Bros., Elsinore, $93,423, by Calif. Div. of Highways, Los Angeles, for 5.1 miles grading and concrete paving between Santa Ana River and Alabama Street, in SAN BERNARDINO COUNTY, Calif. 4-2

LOS ANGELES, CALIF.—To Basich Bros., 20550 Normandie Ave., Torrance, $47,000, by Calif. Div. of Highways, L. A., for 0.1 mi. widened with concr. pav. and shoulders treated with liquid asphalt betw. Lancaster & Kern County, LOS ANGELES COUNTY, Calif. 4-3

LOS ANGELES, CALIF.—To Oswald Bros., 366 E. 58th St., Los Angeles, $156,069, by Calif. Div. of Highways, Los Angeles, for 11.7 mi. grading and roadmix surface treatment applied betw. Box Springs and 3 miles east of Moreno, RIVERSIDE COUNTY, Calif. (See Unit Bid Summary). 4-6

LOS ANGELES, CALIF.—To Southern California Roads Co., 31445 E. 25th St., Los Angeles, $83,547, by Board of Supervisors, Los Angeles, for 0.66 mi. grading, concrete paving, sewers and curbs and gutters in Sunset Blvd., from Horn Ave., to easterly city limits of Beverly Hills. 4-8

LOS ANGELES, CALIF.—Awards as follow by Calif. Div. of Highways, Los Angeles: (1) ORANGE COUNTY—To C. O. Sparks, 2309 E. 9th St., L. A., $23,924 for .4 mi. to be paved with asph. concr. in City of Orange on Chapman Ave. and Glassell St. adjacent to the plaza. (2) RIVERSIDE COUNTY—To Mittry Bros., 5531 Downey Road, L. A., $44,090 for 6.9 mi. const. storm protection drainage system betw. Bendels Corner and Imperial County line. 4-11

MARYSVILLE, CALIF.—To Lee J. Immel, 1031 Evelyn Ave., Berkeley, $8,300, by Dist. Engineer, Calif. Div. of Highways, Marysville, for 36.7 mi. applying penetr. oil tr. betw. Rt. 15 and Rumsey; Forest Ranch and Lomo; Yolo-Colusa County Line and Grimes; and betw. Placerville and Georgetown in COLUSA, YOLO, BUTTE, and EL DORADO COUNTIES, Calif. 4-17

SACRAMENTO, CALIF.—Contracts awarded as follows by Calif. Div. of Highways, Sacramento, for: (1) TEHAMA COUNTY—To Peninsula Paving Co., 9 Main St., S. F., $218,181 for 10.2 mi. grad. and asph. conc. pav. betw. Corning and Proberta. (See Unit Bid Summary). (2) MODOC COUNTY—To Fredericksen & Westbrook, Lower Lake, Calif., $28,407, for 6.0 mi. grad. and penetr. oil tr. betw. Juniper Creek and Alturas. (3) ALAMEDA COUNTY—To L. C. Seidel, 680 14th St., Oakland, $28,727 for 0.3 mi. grad. and concr. paving betw. Folger Ave. Underpass and 9th St. 4-29

SACRAMENTO, CALIF.—To Macco Const. Co., 915 Paramount Blvd., Clearwater, Calif., $770,204, by Calif. Div. of Highways, Sacramento, for 3.4 miles grading and surf. with plant mix surf. on cr. run base betw. Waldo Point and Golden Gate Bridge in MARIN COUNTY, Calif. (See Unit Bid Summary). 4-22

SACRAMENTO, CALIF.—To T. E. Connolly, 461 Market St., San Francisco, $587,917, by Calif. Div. of Highways, Sacramento, for 0.3 mi. grading approaches and roadway tunnels with concrete lining and paving betw. Sausalito and Golden Gate Bridge in MARIN COUNTY, Calif. (See Unit Bid Summary). 4-22

SACRAMENTO, CALIF.—To C. W. Caletti & Co., Box 243, San Rafael, Calif., $226,015, by Calif. Div. of Highways, Sacramento, for 8 miles grading and oiling between Kelshaw Corner and Coarse Gold in MADERA COUNTY, Calif. 4-17

SACRAMENTO, CALIF.—To S. M. McGraw, 425 Lexington Ave., Stockton, $23,675, by Calif. Div. of Highways, Sacramento, for 4.1 mi. surfacing with plant mix surf. and const. shoulders between County Road to Byron and easterly boundary in CONTRA COSTA COUNTY, Calif. 4-6

SACRAMENTO, CALIF.—To Fredericksen & Westbrook, Lower Lake, Calif., $25,400, by Calif. Div. Highw., Sacramento, for 5.1 mi. grad. and surf. with rdmix. surf. between Adin & Rush Cr. in MODOC COUNTY, Calif. 4-10

SACRAMENTO, CALIF.—To Heafey-Moore Co., 344 High St., Oakland, $15,864, by City Clerk, Sacramento, for resurfacing "J" Street, Alhambra Blvd. to 46th St. 4-24

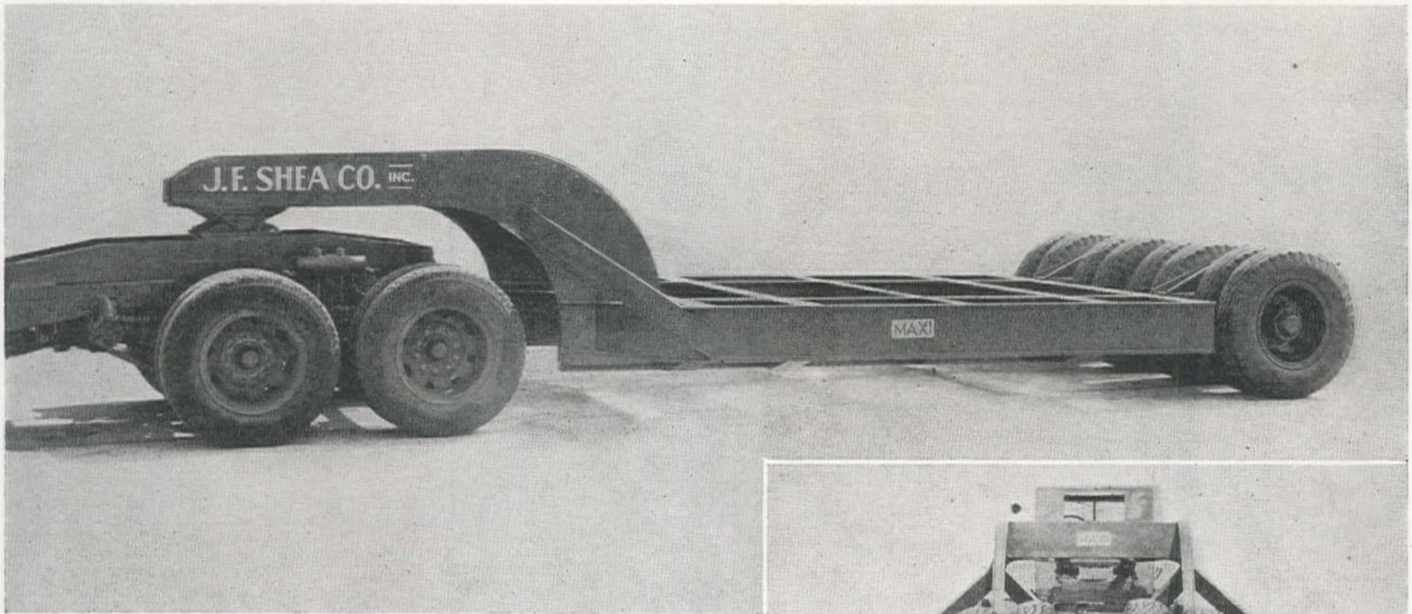
SAN DIEGO, CALIF.—To Regal Oil Co., San Diego, $10,032, by Dist. Engr. Calif. Div. of Highways, San Diego, for 35.9 mi. penetr. oil treatment on shoulders at various locations in SAN DIEGO COUNTY, Calif. 4-29

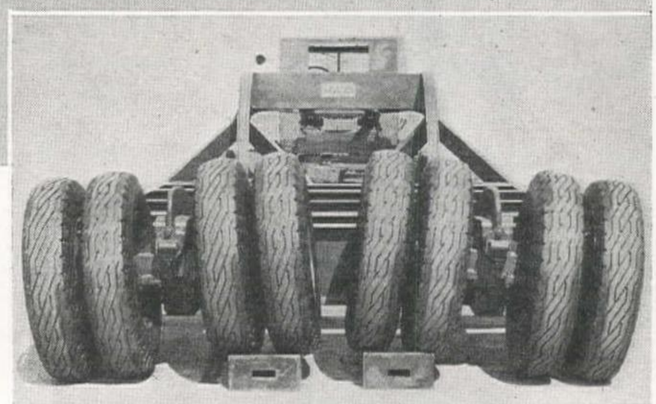
SAN FRANCISCO, CALIF.—To A. G. Raisch, 1 deHaro St., S. F., $65,336, by Dept. Pub. Wks., S. F., for 0.81 mi. widening and reconst. 8th St. betw. Market and Townsend Sts., in San Francisco. 4-8

SAN JOSE, CALIF.—To Earl W. Heple, 494 Delmas Ave., San Jose, $9,648, by County Clerk, San Jose, for improv. Ruby Ave. between Flint Ave. and Norwood Ave. in Superv. Dist. 2. 4-13

SAN JOSE, CALIF.—To Union Paving Co., Call Bldg., S. F., $28,410, by County Clerk, San Jose, for improv. Saratoga Avenue from Stevens Creek Rd. to Prospect Ave. in Super. Dist. No. 4. 4-27

Specialized Transportation by "MAXI"





These Trailers Were Designed and Built for J. F. SHEA CO. by SIX WHEELS Inc. (MAXI)

These trailers embody certain features that are vitally necessary to the successful transportation of extremely top-heavy and bulky loads.

Tires and wheel bearings are readily accessible by simply removing axle assembly which is pivoted on a heavy pin that may be extracted by simply removing one bolt and jacking up the frame five inches. Pivotal connections of frame to axle permit free oscillation under all road conditions.

Bring Your Transportation Engineering Problems to Us

We design and build all types of special and heavy duty trucking equipment to suit the individual requirements. *Maxi* transportation engineers are at your service to help in solving your trucking problems.

Write for the well-illustrated, attractive folder

SIX WHEELS INCORPORATED

1223 Santa Fe Avenue
Los Angeles, California
Telephone TRinity 9188

SANTA CRUZ, CALIF.—To L. C. Karstedt, 16 Wall St., Watsonville, $8,640, by County Clerk, Santa Cruz, for 30-ft. roadway and timber bridge on E. Cliff Drive between 21st and 26th Avenue. 4-23

STOCKTON, CALIF.—To John Hachman, P.O. Box 206, Stockton, $17,322 (using plant mix wearing surface and gravel base by Mr. Yancy Smith, care of George E. Crane Co., 30 So. Joaquin St., Stockton, for constructing streets, curbs and gutters in the Westmoor Subdivision, in Stockton. 5-1

DENVER, COLO.—To H. I. Gardner, 1128 Grand Ave., Glenwood Springs, Colo., $29,070, by State Highway Dept., Denver, for 0.993 mi. grav. surf. betw. Placerville and Ridgway on State Highway No. 62, WPSS 394-B in SAN MIGUEL COUNTY, Colo. 4-6

DENVER, COLO.—To C. A. Switzer, Rt. 1, Box 326, Arvada, Colo., $112,-240, by State Highway Engineer, Denver, Colo., for 1.870 mi. gravel surf. betw. Gunnison and Cimarron on State Highway No. 6 in GUNNISON COUNTY, Colo. FAP 260-D. 4-11

DENVER, COLO.—To Dudley Stone Products, Inc., 2101 San Diego St., El Paso, Texas, $58,156, by Bureau of Public Roads, Denver, Colo., for 18.575 mi. const. or improving project FHEC 37-C-3 of the James Canyon Forest Highway, located within the Lincoln Natl. Forest, New Mexico. 4-13

DENVER, COLO.—Awards as follow by State Highway Engineer, Denver, Colo., for: (1) JEFFERSON COUNTY (FAP 81-D)—To Monarch Engrg. Co., P. O. Box 1196, Denver, Colo., $126,605, for 1.509 mi. concr. paving located westerly from Denver city limits on St. Highw. No. 2. Next low: Western Pav. Con. Co., Denver, $135,943. (2) OTERO COUNTY (WPMH 22, 22B&267-F)—To A. L. Cook, Ottawa, Kansas, $5,408, for 0.523 mi. landscaping westerly from La Juanta on State Highway No. 6 and No. 12. 4-20

BOISE, IDAHO—To Clifton & Applegate, Hutton Bldg., Spokane, Wn., $64,629, by Comm. of Pub. Works, Boise, Ida., for 1.604 mi. grad., etc., on the Coeur d'Alene Valley Highway, Cave Lake-Medicine Lake section in KOOTENAI COUNTY, WPSS 179-C, Idaho. 4-6

BOISE, IDAHO—To Olof Nelson, Box 413, Logan, Utah, $47,075, by Comm. of Public Works, Boise, Ida., for 5.378 mi. grading, etc., 7 timb. bridges and cr. grav. surf. on the Teton-St. Anthony Road in FREMONT COUNTY, Ida. (WPSO 217-A, WPMS 217-B). 4-6

BOISE, IDAHO—Awards as follow by Comm. of Public Works, Boise, Ida., for: (1) CAMAS COUNTY (WPH 127-C)—To Triangle Const. Co., Boise, $53,576 for 7.942 mi. const. roadbed and drainage struc. includ. 4 timber bridges on the Idaho Central Highway from Corral to Fairfield. (2) LEWIS COUNTY (FAP 137-A)—To Morrison-Knudsen Co., Boise, Idaho, $164,121, for 5.767 mi. const. roadbed and drainage struc. on the Lewis and Clark Highway betw. Greer and Pardee. 4-13

BOISE, IDAHO—Awards by Comm. Pub. Works, Boise, for: (1) ADA COUNTY (WPSO 224)—To Nick Burggraf, Inc., and J. W. Brennan, Idaho Falls, Ida., $59,730, for 8.143 mi. grad., drain and surf. with cr. grav. on highway betw. Whitney School and Meridian-Kuna Highway. (2) ADA COUNTY (MISC. PROJ. 637)—To Quinn-Robbins Co., Inc., Boise, Idaho, $6,600 for 4,000 cu. yd. crushed grav. surf. in stockpiles at Oasis and N. Y. Canal on Old Oregon Trail. 4-27

BOISE, IDAHO—To Morrison-Knudsen Co., Boise, Idaho, $61,760, by Comm. of Public Works, Boise, Idaho, for 8.390 mi. crushed gravel leveling course, a plant mix bitum. mat and crushed gravel shoulders on North and South Highway from Cambridge to the Adams County line, in WASHINGTON COUNTY, Ida. State Aid Proj. 62-AB. 4-28

HELENA, MONTANA—To Nolan Bros., 18 N. 2nd St., Minneapolis, Minn., $34,540, by State Highway Comm., Helena, Montana, for 6.637 miles surfacing, bituminous treated by roadmix method on U. S. Highway No. 10 in WIBAUX COUNTY, Montana Project FAP 35 & 61. 4-6

HELENA, MONTANA—Awards as follow by State Highway Comm., Helena, Mont., for: (1) LEWIS and CLARK COUNTIES (FAP 77-C)—To Warren Northwest Co., P. O. Box 5072, Portland, $92,599, for 4.899 mi. regrad., surf., const. small drainage struc., etc., on Sec. "C" of Helena-Townsend Road. (2) FLATHEAD COUNTY (FAP 98-A)—To J. L. McLaughlin, Great Falls, Montana, $55,920 for 6.621 mi. placing additional gravel subbase matl. and Grade "A" top course cr. grav. roadmix oil tr. of surf. course, etc., on Sec. "A" of the Whitefish-Olney Road. (3) FERGUS COUNTY (FAP 229B & 235B)—To Tomlinson-Arkwright Const. Co., Great Falls, Mont., $168,135 for 11.735 mi. grad., surf., etc., on Secs. B&E of the Lewistown-Grass Range Road; also 0.308 mi. surf. with cr. grav. and roadmix oiling road approaches to overcrossing of the C. M. St. P & P Railway Co.'s tracks 2 mi. west of Lewistown, Montana. (4) FERGUS COUNTY (WPSO 342)—To Thos. Staunton, Great Falls, Mont., $34,720 for 3.114 mi. grad., surf., const. small dr. struc., etc. on Lewistown-Denton Road. (5) MEAGHER COUNTY (FAP 8-F, Units 1 & 2)—To Tomlinson-Arkwright Const. Co., Great Falls, Mont., $114,775 for 5.332 mi. grad., surf., small drain. struc. and const. 2 tr. timber bridges on Sec. F of White Sulphur Springs-Harlowtown Road. (6) BEAVERHEAD COUNTY (WPSO 344)—To Woodward Const. Co., Chinook, $42,500 for 2.624 mi. grad., surf., etc., on the Dillon-Twin Bridges Road. (7) ROSEBUD COUNTY (WPSO 362)—To Inland Const. Co., 3867 Leavenworth St., Omaha, Nebr., $44,207, for 2.587 mi. grad., surf., etc., on Colstrip-Lame Deer Road. (8) CASCADE COUNTY (FAP 10, Unit 6)—To Tomlinson-Arkwright Const. Co., Great Falls, Mont., $85,255 for 7.087 mi. regrading, surf. with grav. subbase matl., etc., on the Sun River Road, also widen bridge. 4-6

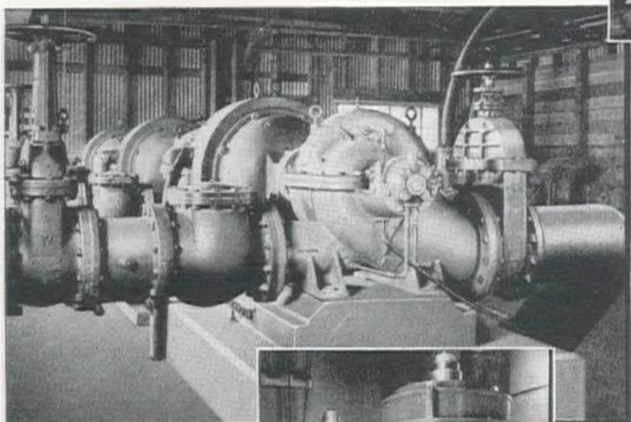
CARSON CITY, NEVADA—Awards as follow by Nevada State Highway Comm., Carson City, Nev., for: (1) NYE COUNTY (WPSS 2)—To Dodge Const. Inc., Fallon, $7,410 for 3.12 mi. cr. grav. or stone surf. betw. Tonopah and 3 mi. E. Rt. 4, Sec. A1. (2) LINCOLN COUNTY (St. Proj.)—To Geo. French, Jr., Box 107, Stockton, $21,172 for 12.25 mi. asph. rdmix. surf. betw. Alamo and Crystal Springs, Rt. 7, Sec. B1. (3) NYE COUNTY (FLH 3G)—To Geo. French, Jr., Box 107, Stockton, $32,841 for 24.21 mi. asph. rdmix. surf. betw. 3 mi. N. of Springdale and 6 mi. S. of Stonewall Pass, Rt. 5, Sec. H2, J, K1. (4) MINERAL COUNTY (FAP 97C)—To U. B. Lee, 1059 Carpenter Ave., San Leandro, $27,280 for 20.86 mi. asph. roadmix surf. betw. Coaldale and Rhodes, Rt. 3, Secs. F & A1. 4-15

CARSON CITY, NEVADA—To Isbell Construction Co., P. O. Box 2351, Reno, Nevada, $56,174, by Nevada State Highway Comm., Carson City, Nevada, for 7.44 mi. cr. gravel or stone surf. betw. a point approx. 8 mi. southeast of Browns to a point approx. 0.6 mi. southeast of Browns (Geiger Grade) Rt. 17, Sections A, A2, A3 in STOREY and WASHOE COUNTIES, Nevada. 4-28

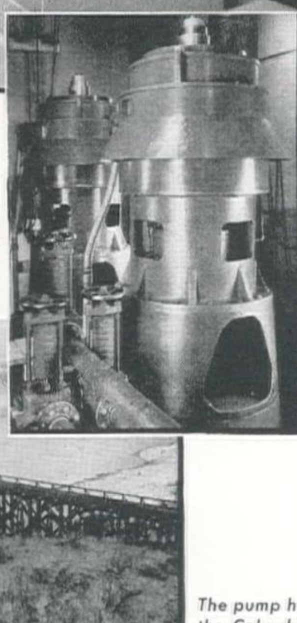
SANTA FE, NEW MEXICO—Awards as follows by State Highway Engr., Santa Fe, N. M., for: (1) McKINLEY COUNTY (WPGH 27)—To Skousen Bros., Albuquerque, N. M., $93,270 for 5.465 mi. grading, surf. minor drainage structures, culverts, etc., on U. S. Highway Route 66, betw. Gallup and Los Lunas. (2) McKINLEY COUNTY (FAP 75 and 27)—To Skousen Bros., Albuquerque, N. M., $275,126 for 10.233 mi. grading, surf., minor drainage structures, concrete box culverts, steel bridge and miscell. constr. on U. S. Highway Route 66, betw. Gallup and Los Lunas. (3) ROOSEVELT COUNTY (NRH 89 and NRM 89)—To Davies & Sons, Fort Sumner, New Mexico, $82,115 for 5.321 mi. grading and minor drainage structures, box

WORTHINGTON PUMPS SERVE BIG AGGREGATE PLANT *at Grand Coulee*

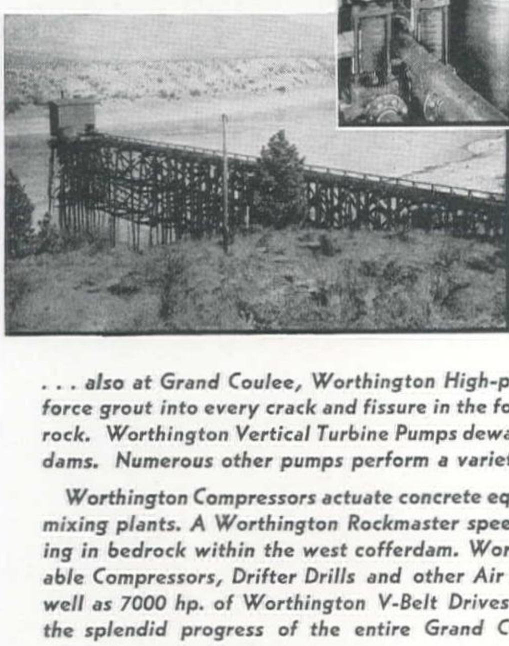
General view of the M-W-A-K Aggregate Plant, for which Worthington Pumps furnish 25,500 g.p.m.



These three Worthington Centrifugal Pumps recirculate 18,000 g.p.m. against a 170' head



Two of three Worthington Deep Well Turbine Pumps ... each pumping 2500 g.p.m. against a total head of 670'



The pump house on the Columbia river

. . . also at Grand Coulee, Worthington High-pressure Pumps force grout into every crack and fissure in the foundation bedrock. Worthington Vertical Turbine Pumps dewater the cofferdams. Numerous other pumps perform a variety of services.

Worthington Compressors actuate concrete equipment at the mixing plants. A Worthington Rockmaster speeded the drilling in bedrock within the west cofferdam. Worthington Portable Compressors, Drifter Drills and other Air Equipment, as well as 7000 hp. of Worthington V-Belt Drives contribute to the splendid progress of the entire Grand Coulee Project.

WATER... 25,500 gallons every minute, is required to make M-W-A-K Company's mammoth Aggregate Plant work. A veritable deluge constantly pouring over the screen areas, accelerating the screening process and washing out the silt and excess fines... this water must be brought from the Columbia River half a mile away and 670 feet below. Any interruption to the supply would immediately reduce operating efficiency and might cause a complete shutdown of the entire plant.

Here, as elsewhere throughout this project, the contractors have selected Worthington to meet their pumping requirements. Three Worthington Deep Well Turbines, each of 2500 g.p.m. capacity and powered with a 500 hp. electric motor, lift water 70 feet from the river to the pump house on the trestle, forcing it another 600 feet vertically to a 100,000 gallon fresh water tank near the screen house. Clarified water from the screen house is recirculated by three Worthington Centrifugal Pumps, each powered by a 300 hp. electric motor and rated at 6000 g.p.m. against a 170-foot head.

The confidence placed in Worthington equipment by M-W-A-K Company is a tribute of which this organization is proud. You too can depend upon Worthington service for your jobs, large or small... and Worthington distributors can help you with your equipment problems.

THE WORTHINGTON COMPANY, Incorporated

SEATTLE SAN FRANCISCO LOS ANGELES EL PASO

A. C. HAAG & COMPANY, Portland
STAR MACHINERY COMPANY, Seattle
GENERAL MACHINERY COMPANY, Spokane
WESTMONT TRACTOR & EQUIPMENT CO., Missoula
GARFIELD & COMPANY, San Francisco

COLLIER TRACTOR & EQUIPMENT COMPANY, Reno
GARLINGHOUSE BROTHERS, Los Angeles
CONTRACTORS EQUIPT. & MACHY. CO., San Diego
VANDERCOOK COMPANY, Sacramento
BURTON BROTHERS, Rosamond
ARIZONA MACHINERY COMPANY, Prescott

A-36166

WORTHINGTON

When writing to Worthington Pump & Machinery Co., *please mention Western Construction News* culv., two course surf., rock asph. surf. crs. and misc. construction between city limits of Elida and extending north on U. S. Highway Route 70, towards Portales. 4-29

SANTA FE, NEW MEXICO—Awards as follow by State Highway Engineer, Santa Fe, New Mexico, for: (1) TORRANCE COUNTY (WPMH 53)—To Henry Thygesen, Albuquerque, $56,665 for 8.195 mi. grading, minor drain. struc., one concrete box culvert and misc. const. on U. S. Highway Rt. No. 60, between Encino and Vaughn. (2) DONA ANA COUNTY (Proj. 107-D)—To A. O. Peabody, Las Cruces, N. M., $192,-297 for 8.286 mi. grading, minor drain. struc., 6 multiple span concr. box culverts, 1 steel & conc. bridge, base and course surf., top course surf. and oil processing and misc. const. on U. S. Highway Rt. 85, betw. Hatch and Las Cruces. (3) COLFAX COUNTY (WPH 93-B)—To Henry Thygesen, Albuquerque, N. M., $137,618 for 7.259 mi. grading, draining, etc., and miscellaneous construction on U. S. Highway Rt. 64-87 between Raton and Capulin, New Mexico. 4-10

PORTLAND, ORE.—To Consolidated Highway Co., Inc., Portland, $104,394 (TAR) by Oregon State Highway Commission, Portland, Oregon, for 1.5 mi. grading and 6.2 mi. surf. and oil mat surf. tr.; also furn. cr. matl. in stockpile on Toledo-Simpson Creek Sec. of Corvallis-Newport Highway. 4-18

PORTLAND, ORE.—Awards as follow by Oregon State Highway Comm., Portland, Oregon, for: (1) MULTNOMAH COUNTY (FAP 171-A)—To Theo. Arenz & Ore. Contr. Co., 10509 N.E. Sandy Blvd., Portland, $116,734 for 3.46 mi. regrading and paving on Columbia-County Line-Portland Sec. of Columbia River Highway. 4-18

PORTLAND, ORE.—Awards as follow by the Oregon State Highway Comm., Public Service Bldg., Portland, Oregon, for: (1) UNION and WALLOWA COUNTIES (State Proj.)—To Harold Blake, 400 N. Thompson St., Portland, Ore., $33,675 for 22.49 mi. oil mat surf. tr. on Elgin-Rock Creek Sec. of Wallowa Lake Highway. (2) COLUMBIA COUNTY—To Babler Bros., 2407 N.W. 28th Ave., Portland, $24,052. (Tar) for 11.61 mi. oil mat surf. tr. on Mist-Pittsburg Sec. of Nehalem Secondary Highway and Mist-Clatskanie Secondary Highway. 4-20

PORTLAND, ORE.—Awards as follow by Oregon State Highway Comm., Portland, Ore., for: (1) COLUMBIA COUNTY (St. Proj.)—To Saxton & Looney and J. S. Risley, 324 Henry Bldg., Portland, $27,194 for 11.16 mi. cr. rock resurf. and furn. cr. rock in stockpile on Mist-Pittsburg Sec. of Nehalem Secondary Highway. (2) MARION COUNTY (St. Proj.)—To A. J. Anderson, 436 Water St. Salem, $12,964 for const. a 48x96-ft. 2-story frame shop bldg. on Oregon State Highway Comm. prop. E. of city limits of Salem. (3) UNION COUNTY (NRH 139-C)—To Hart Const. Co., La Grande, Ore., $3,742 for 5.19 mi. wind-break planting on Hot Lake-La Grande Sec. of Old Oregon Trail. 4-20

PORTLAND, ORE.—Awards as follow by Oregon State Highway Comm., Portland, Oregon, for: (1) MULTNOMAH COUNTY (WPSO 297)—To Jacobsen-Jensen Co., 517 N.E. Stanton St., Portland, $31,749 for 1.99 mi. asph. concr. paving on 162nd Avenue-Gresham Road section of Glisan St. (2) DOUGLAS COUNTY—To Warren Northwest, Inc., P. O. Box 5072, Portland, Ore., $63,755 for 8.0 mi. grade widening, cr. grav. surf. and oil mat surf. tr. on Reedsport-Wilson Ranch Section of Umpqua Highway (State Proj.) (3) JEFFERSON COUNTY (State Proj.)—To McNutt Bros., 351½ E. Broadway, Eugene, Ore., $16,870 for 6.83 mi. grading on Agency Plains-Madras Sec. of Warm Springs Highway (WPGS 197-C). (4) LINCOLN COUNTY (WPH 133-A & WPH 133-C)—To Consolidated Highway Co., Inc., Portland, Ore., $75,767 for 0.64 mi. grading, 0.56 mi. bitum. macad. surf. and furn. cr. rock in stockpile on approaches to Yaquina Bay Bridge on Oregon Coast Highway. 4-18

PORTLAND, ORE.—To McGeorge Gravel Co., Marshfield, Ore., $21,384, by Oregon State Highway Comm., Portland, Ore., for: 7,200 cu. yd. stockpiling crushed gravel or crushed rock on Myrtle Point-Bandon Rock Production Project, (State Project) in COOS COUNTY, Ore. 4-27

PORTLAND, OREGON—To Orino, Berkemeier & Saremal, Portland, Ore., $196,947, by Bureau of Public Roads, Portland, Oregon, for const. or improving the Columbia River Highway, Grading and Tunnel project 28-A, Natl. Forest Road project, located in the Mt. Hood National Forest, MULTNOMAH COUNTY, Oregon. 4-28

SALT LAKE CITY, UTAH—To W. W. Clyde & Co., Springville, Utah, $76,700, by Utah State Rd. Comm., Salt Lake City, for 1.766 mi. conc. pav. from Beaver, south, BEAVER COUNTY, FAP 82-D and 99-A.C. 4-25

SALT LAKE CITY, UTAH—Awards as follow by Utah State Road Comm., Salt Lake City, Utah, for: (1) SANPETE COUNTY (WPMS 195-A&WPSO 195-B)—To A. O. Thorn, Springville, Utah, $40,782 for 5.337 mi. const. grav. surf. road betw. Mayfield and Gunnison. (2) PIUTE and GARFIELD COUNTIES (WPH 19-D & G)—To Floyd S. Whiting, Kaysville, Utah, $39,698 for 2.193 mi. const. gravel surf. road in Circleville Canyon on U. S. 89. 4-18

SALT LAKE CITY, UTAH—Awards as follow by Utah State Road Comm., Salt Lake City, Utah, for: (1) DUCHESNE COUNTY (FAP 110-A)—To Reynolds-Ely Const. Co., Springville, $105,380 for 8.835 mi. pl. mix. surf. road betw. Duchesne and Fruitland. (2) SALT LAKE COUNTY (WPMH 119-C)—To Ryberg Bros., Terminal Bldg., S. L. C., $36,845 for 3.006 mi. conc. pipe dr. betw. Salt Lake City and Murray. (3) UINTAH COUNTY (WPH 10-C-D-E)—To Northwestern Engr. Co., Rapid City, S.D., $28,822 for 9.263 mi. Nat. rock asph. road betw. Ft. Duchesne and Half Way Hollow. 4-4

ASOTIN, WN.—To Triangle Const. Co., 1220 Ide St., Spokane, Wn., $31,938, by County Comm., Asotin, Wn., for improv. by grading, etc., 7 mi. of the Peola Road betw. the J. W. Houser Ranch and the County Line. 4-13

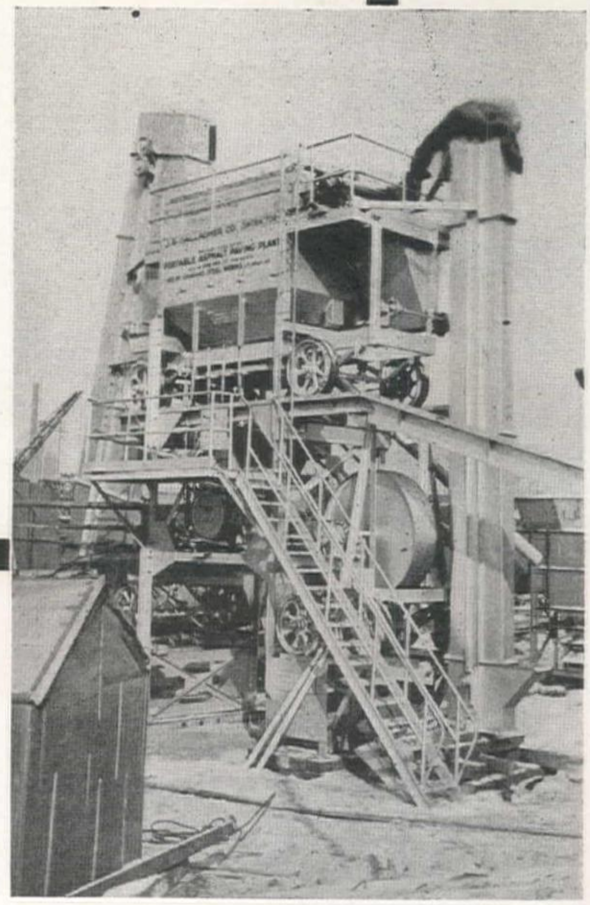
ELLENSBURG, WN.—To Thos. Scalzo, 1829 Lane St., Seattle, Wn., $35,755, by County Commissioners, Ellensburg, Wn., for 6.75 mi. grading and surfacing on the Parke Creek-Johnson Creek loop. 4-17

GOLDENDALE, WN.—To Anderson Const. Co., 3132 N.E. 69th St., Portland, $16,977, by County Clerk, Goldendale, Wn., for 3.676 mi. grad., drain. and surf. and const. 36-ft. timber span bridge on Bickleton-Cleveland Road, Secondary Road Project No. 22. 4-14

OLYMPIA, WN.—Awards as follows by the Director of Highways, Olympia, Wn., for: (1) CLALLAM, GRAYS HARBOR and KITSAP COUNTIES—To Washington Asphalt Co., 220 W. Hudson St., Seattle, $51,870 for 2.9 mi. paving and const. sidewalks and shoulders on State Roads No. 9 and 21, Firest St. betw. Lincoln and Race in Port Angeles; city sts. in Hoquiam, city sts. in Aberdeen, Sixth St. in City of Bremerton. (2) LEWIS COUNTY—To Hendricks & Co., Chehalis, Wn., $39,945 for .5 mi. clearing, grading, and const. timber deck truss bridge on County Road, Morton to Beary Canyon. (3) SPOKANE COUNTY—To Triangle Const. Co., 1220 Ide St., Spokane, $16,687 for .02 mi. grading, surf. and const. undercrossing of O.W. RR and N. tracks on Darknell Road in County Road. (4) KING COUNTY—To J. B. Covello, 1510 Sturgus Ave. So., Seattle, $153,718 for 2.25 mi. paving, sidewalks and const. trestle on County Road, Black River Junction to Renton. (5) KING COUNTY—To General Const. Co., 3840 Iowa Ave., Seattle, $99,493 for 0.26 mi. approaches and railroad overcrossing at Black River Junction. 4-23

You'll Bid

Lower on Road Jobs with this Plant . . . .



There are a number of definite reasons why the Standard Portable Asphalt Paving Plant will cut your costs on any paving job.

Months of time are not spent in erecting this plant, for it is *completely* sectionalized; each section mounted on wheels for instant erection. The remarkable speed of assembly is almost unbelievable. In transportation, the Standard Portable Plant is as easily hauled to the job as a truck.

One-man *positive* control and operation, too, shares honors in cost cutting. No maintenance crew is needed to see that proper adjustments are made. Output remains constant, with production at peak speed at all times, for the reliability of Standard allows 24-hour, worry-free operation.

Only in the Standard plant can you get *all* these features. Take advantage of the savings offered. A demonstration will convince you.

STANDARD *Portable* ASPHALT PAVING PLANT

The plant shown above was recently delivered to J. F. Gallagher Company, in Chicago. It's just one of four that has been sold since the first of the year. Everywhere, contractors are building their roads to this Standard quality . . . evidenced by Standard's leadership in sales.

STANDARD STEEL WORKS

5001 Boyle Avenue **Los Angeles, California**

When writing to STANDARD STEEL WORKS, *please mention Western Construction News*

OLYMPIA, WN.—To H. P. Dorsey, 2006 State St., Bellingham, Wn., $30,390, by County Comm., Olympia, Wn., for 7.81 mi. grading and surfacing of Boston Harbor Road, the Calvin Mason Road, and the Shincke Road, known as Secondary Road Project No. 14. 4-10

CHEYENNE, WYOMING—Awards as follows: by State Highway Comm., Cheyenne, Wyo., for: (1) SUBLETTE COUNTY (WPH No. 50)—To Taggart Constr. Co., Cody, Wyo., $61,624, for 1.543 mi. grad., drain., const. 3 tr. timb. bridges and 1 reinf. conc. culvert on the Jackson-Big Piney Road. (2) PARK COUNTY (WPSO 279-A)—To Taggart Constr. Co., Cody, Wyo., $82,294, for 4.720 mi. grading, draining, base course surfacing, const. 1 tr. timber bridge and 1 reinf. concrete culvert on the Garland-Byron Road. 4-27

Bridges and Culverts . . . . . .

BIDS RECEIVED

PHOENIX, ARIZ.—Tanner Construction Co., 10 Outwest Bldg., Phoenix, $103,995, low to Arizona State Highway Comm., Phoenix, for construction of a reinf. concrete subway under the A.T.&S.F. Railway tracks located at Winslow, on the Winslow-Pine Highway, WPGM 107, NAVAJO COUNTY. 5-2

YUMA, ARIZ.—David H. Ryan, 1615 Fern St., San Diego, $155,447, low to Bureau of Reclamation, Yuma, Ariz., for const. a railroad bridge on Station 1029, a highway bridge at Station 1035, and the Araz Wash overchute at Station 1042 of the All-American Canal, Boulder Canyon Project, Arizona-California-Nevada, under Specification No. 665. Work is located about 6 miles northwest of Yuma, Ariz. 4-17

LOS ANGELES, CALIF.—Bent Bros., Inc., 418 S. Pecan St., Los Angeles, $274,378, low to Board of Public Works, L. A., for const. of the Macey Street subway, to be reinforced concrete, 2-hinge arch type, 68 ft. wide, 505 ft. long and with 17 ft. central height clearance. 4-8

LOS ANGELES, CALIF.—Clyde W. Wood, P. O. Box 49, Stockton, $175,-529, low to Calif. Div. of Highways, Los Angeles, for const. a steel deck truss bridge with concr. deck across Santa Margarita River about 2½ mi. north of Oceanside, consisting of two 167 ft. 6 in. spans, two 67 ft. cantilever spans and two 30 ft. 6 in. plate girder approach spans in SAN DIEGO COUNTY, Calif. 4-30

SACRAMENTO, CALIF.—Bodenhamer Construction Co., 1101-75th Ave., Oakland, Calif., $214,065, low to Calif. Div. of Highways, Sacramento, for an undergrade crossing under S.P.&W.P. Railway tracks at San Leandro St., in Oakland, ALAMEDA COUNTY, Calif. (See Unit Bid Summary.) 4-29

SACRAMENTO, CALIF.—Poulos & McEwen, 2522 17th St., Sacramento, $61,728, low to Calif. Div. of Highways, Sacramento, for overhead crossing over tracks of Great Northern Railway, consisting of a steel and timber struc. with concr. deck and approx. 0.54 mi. grading and road mix surface roadway in LASSEN COUNTY, Calif. 4-29

PORTLAND, ORE.—Hoffman Const. Co., 715 S.W. Columbia Blvd., Portland, $410,212, low to Oregon State Highway Comm., Portland, Ore., for const. an overcross. over the Southern Pacific RR on Union Ave. on the East Portland-Oregon City Highway in the City of Portland, MULTNOMAH COUNTY, Oregon, (WPGM 168-D and WPMH 168-H). (See Unit Bid Summary.) 4-27

CONTRACTS AWARDED

PHOENIX, ARIZ.—To Vinson & Pringle, 919 E. Madison St., Phoenix, $38,839, by Ariz. State Highway Comm., Phoenix, for removal of conc. bridge and constr. concrete bridge, etc., about 1.4 mi. west of Douglas at White Water Creek, COCHISE COUNTY, FA 79-J. 5-1

LOS ANGELES, CALIF.—To Jacobson Bros., 3338 Madera Ave., Los Angeles, $18,974, by Board of Supervisors, Los Angeles, for constructing a 248 ft. steel concrete and wood viaduct on Soledad Canyon Road over the Southern Pacific Railway. 4-29

SANTA CRUZ, CALIF.—To L. C. Karstedt, 16 Wall St., Watsonville, $12,283, by County Clerk, Santa Cruz, for a 12'x98' culv. in Eureka Canyon on Corralitos Creek. 4-7

DENVER, COLO.—To Larson Const. Co., 1902 Blake St., Denver, $198,-419, by the State Highway Dept., Denver, Colo., for a bridge with grav. surfaced approaches on 0.331 mi., located south of Colorado Springs on State Highway No. 1 in EL PASO COUNTY, Colo., FAP 118-R & ERP No. 6. 4-27

HELENA, MONTANA—Awards as follow by State Highway Comm., Helena, Mont., for: (1) SILVER BOW COUNTY (WPGH 70-A)—To The Lawler Corp., Lewisohn Bldg., Butte, Montana, $92,210 for const. concr. and steel underpass crossing of the B.A.&P. Railway Co.'s tracks at Rocker, Montana, together with grading, surf., etc., on 0.156 mi. (2) FLATHEAD COUNTY (WPGH 377)—To Massman Const. Co., New York Life Bldg., Kansas City, Mo., $118,137 for const. steel and concr. viaduct across the tracks of the Great Northern Railway Co. at the city Whitefish, together with grading, surfacing with gravel subbase material and with a roadmix oil tr. cr. grav. top course and const. small drain. struc. on 0.329 mi. of approaches. 4-6

CARSON CITY, NEV.—To Dodge Const., Inc., Fallon, Nev., $55,669, by Nevada State Highway Commission, Carson City, Nev., for const. concr. and steel overpass over Western Pacific RR in Winnemucca and 0.037 mi. approaches, Rt. 8, Sec. A1, HUMBOLDT COUNTY, Nevada. 4-8

CARSON CITY, NEV.—Awards as follow by Nev. State Highway Comm., Carson City, Nev., for: (1) WASHOE COUNTY (WPGS 141)—To J. F. Knapp, 1401 Park Ave., Oakland, $92,496 for conc. and steel underpass on W. 2nd St. near Reno, approx. 0.254 mi. (2) WASHOE COUNTY (WPGM 141B)—To J. F. Knapp, 1401 Park Ave., Oakland, $153,351 for concr. and steel underpass and a conc. and steel bridge on Alameda and Wells Ave., approx. 0.31 mi. in Reno. (See Unit Bid Summary). 4-15

CARSON CITY, NEV.—To Dodge Const., Inc., Fallon, Nev., $66,846, by Nevada State Highway Comm., Carson City, Nev., for concr. and steel bridge and 0.048 mi. approaches at Winnemucca, Rt. 8, Sec. A1 in HUMBOLDT COUNTY, Nev. 4-8

SANTA FE, NEW MEXICO—To W. E. Bondurant, Roswell, N. M., $304,-046, by State Highway Comm., Santa Fe, N. M., for 0.263 mi. constructing an overpass and approaches, located in BERNALILLO COUNTY, within the municipality of Albuquerque, N. M., WPGM 242-A. (See Unit Bid Summary). 4-10

PORTLAND, ORE.—Awards as follow by Oregon State Highway Comm., Portland, Oregon, for: (1) CLACKAMAS COUNTY (WPGM 132-F&WPMH 132 F)—To Parker Schram, 515 Couch Bldg., Portland, $289,416 for const. steel and concr. undercrossing to carry SP Co.'s tracks over the Pacific Highway at Oregon City. (2) DESCHUTES COUNTY (WPGM 123-I)—To P. L. Crooks & Co., Inc., Henry Bldg.,

Portland, $76,476 for const. reinf. concrete undercrossing to carry the Oregon Trunk Railway tracks over Franklin Ave. (The Dalles-California Highway in Bend.) 4-20

PORTLAND, OREGON—Awards as follow by Oregon State Highway Comm., Portland, for: (1) DOUGLAS COUNTY (WPGH 78-E)—To Mountain States Const. Co., Eugene, $32,960 for concr. viaduct over S.P. Co.'s tracks on the Pacific Highway near Green Station, approx. 4 mi. southerly from Roseburg. (2) JEFFERSON COUNTY (WPGS 197-C)—To James Crick, 3104 N. Monroe St., Spokane, Wn., $67,285 for const. concrete viaduct over Union Pacific RR Co.'s tracks on the Warm Springs Highway approx. 1¼ mi. N. from Madras. 4-18

SALT LAKE CITY, UTAH—To Strong & Grant, Springville, Utah, $80,789, by Utah State Road Comm., Salt Lake City, Utah, for const. a steel I-Beam and concrete overhead structure and 4.4 miles approaches crossing the L. A. and S. L. Railroad in MILLARD COUNTY, WPGS 204-A and WPGM 204-A, WPSS 204-B and WPSO 204-C, in Utah. 4-18

Water Supply Systems......

WORK CONTEMPLATED

WOODLAKE, CALIF.—The Woodlake Utility District, Woodlake, Calif., voted favorably for $32,000 in bonds to finance construction of a new water supply system. L. H. Gadsby, 714 N. Willis St., Visalia, is Engineer. 4-21

JEROME, IDAHO—Application has been filed with the Idaho Dept. of Reclamation by W. A. Peters, Jerome, Idaho, for three permits to divert 12,000,000 gal. underground water to private use. The site of the diversion will be 1½ mi. north of the Twin Falls-Jerome Bridge. Work involves six miles of cast iron or steel pipeline and four or six pumping units. Total estimated cost is $400,000. 4-9

CALLS FOR BIDS

FONTANA, CALIF.—Bids to 1:30 p. m., June 18, by Fontana Union Water Co., Fontana, for one 3,000,000 gal. reinf. concrete reservoir, circular ring tension type. 4-28

OAHU, T. H.—Bids to 11 a. m., June 3, by Bureau of Yards & Docks, Navy Dept., Washington, D. C., for water supply, tunnel, and pipeline at the Aiea Naval Reservation, Oahu, T. H., under Spec. No. 8139. Work includes excavation; concrete work; pumping equipment; piping; electrical work; sheet metal work; fencing; and macadam paving. Est. cost $100,000. 4-10

BIDS RECEIVED

SACRAMENTO, CALIF.—Campbell Const. Co., 800 "R" St., Sacramento, Calif., $124,331, low to City Clerk, Sacramento for const. a filtered water reservoir at the city filtration plant. 4-24

CONTRACTS AWARDED

MARE ISLAND, CALIF.—To Permutit Co., 442 4th Ave., N. Y., $6,280, by Bureau of Yards & Docks, Navy Dept., Washington, D. C., for 2 water tr. systems, a continuous blowdown system and chemical feeding system for Navy Yard, Mare Island, under Spec. 8092. 4-13

SAN FRANCISCO, CALIF.—To Piombo Bros. & Co., 1571 Turk St., San Francisco, Calif., $238,121, by Public Utilities Comm., San Francisco, for excavation and embankment of Sunset Reservoir in area of 24th to 28th avenues and Ortega to Quintara streets, San Francisco, under S.F.W.D. Contract No. 110. (See Unit Bid Summary). 4-22

SAN FRANCISCO, CALIF.—To Eaton & Smith, 715 Ocean Ave., S. F., $18,461, by Dept. Public Works, S. F., for const. fire cisterns (Group No. 5) for Auxiliary Water Supply for fire protection. 4-24

CALIENTE, NEVADA—To Mullins & Wheeler, 22½ E. 1st So., Salt Lake City, Utah, $14,153, by City Clerk, Caliente, Nevada, for construction of extensions to water distribution system and drilling a well. 5-2

JEFFERSON, OREGON—To West Coast Const. Co., Lloyd Bldg., Seattle Wn., $14,303, by City Recorder, Jefferson, Oregon, for improvement of the water system and reservoir of the city of Jefferson, including all material and appurtenances. 4-13

MANSFIELD, WN.—To Pittsburgh Des Moines Steel Co., Des Moines, Iowa, $5,438, by Town Clerk, Mansfield, Wn., for steel standpipe, 18 ft. diam., 70 ft. high, with concrete foundation. 4-20

Sewer Construction ....

WORK CONTEMPLATED

BAKERSFIELD, CALIF.—Board of Supervisors, Court House, Bakersfield, will hold a hearing June 1 on the proposed Arvin Sanitary Dist. Estimated cost $100,000. 4-30

MENLO PARK, CALIF.—Bonds in amount of $28,000 were carried by Menlo Park Sanitary Dist., Menlo Park, to help finance const. of sanitary sewers. Total cost to be $108,000, balance to come from WPA. 4-22

WILLOW GLEN, CALIF.—City Engineer, H. N. Bishop, has submitted an estimated cost of $300,000 to the City Council, Willow Glen, Calif., for const. about 21 miles of sewers to connect with the San Jose system at 5th and Rosa streets. Estimated work involves: 111,000 lin. ft. sewer pipe, est. $111,000; 36,000 sq. ft. pav. patching, est. $18,000; 2,000 sewer laterals, est. cost $50,000; Pumps, est. cost $16,000. 4-6

BIDS RECEIVED

LOS ANGELES, CALIF.—Bids received as follows by Board of Public Works, City Hall, Los Angeles, for reconst. of the Ocean Outfall Sewer at Hyperion. Bids from: Hull-Smale & Ramage, $26,400; Merritt Chapman & Scott, $44,578; ALTERNATE, $24,440. 4-9

CONTRACTS AWARDED

LAGUNA BEACH, CALIF.—To J. L. Kruly, 1759 N. Eastern Ave., Los Angeles, $82,609, by City Clerk, Laguna Beach, for construction of sewers in lateral sewer District No. 3. 4-14

LAGUNA BEACH, CALIF.—To Nick Chutuk, 4915 West Blvd., Los Angeles, $34,393, by City Clerk, Laguna Beach, for constructing sewers in lateral sewer District No. 2. 4-14

STOCKTON, CALIF.—To W. J. Tobin, 3701 Balfour Ave., Oakland, $27,675, by City Clerk, Stockton, for constr. extensions to trunkline sewers. 4-30

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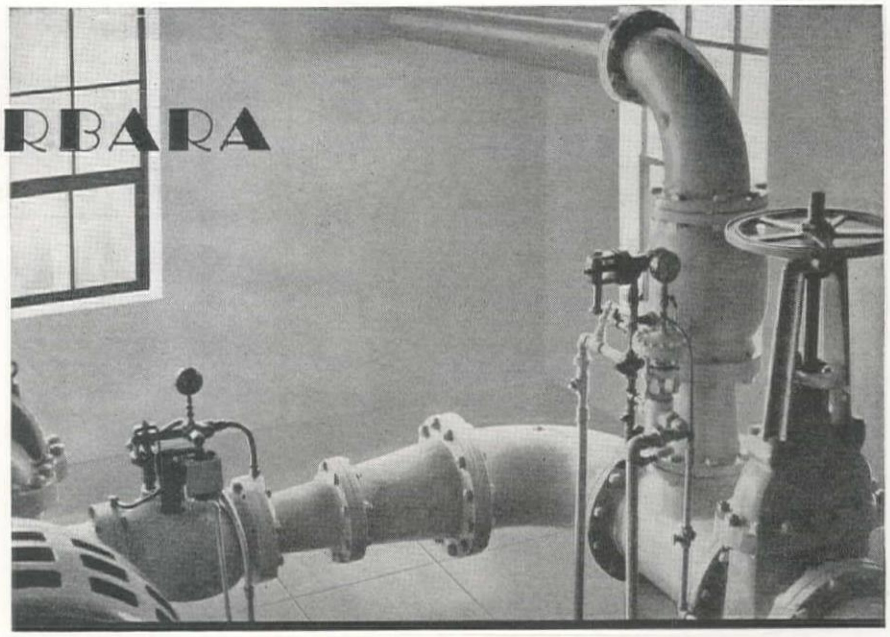

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PELTON

VALLEJO, CALIF.—To R. R. Carlson, Weber Ave. & "E" St., Stockton, $29,357, by City Clerk, Vallejo, for storm sewers in Virginia St., betw. Marin and Branciforte and in Sonoma St., betw. Virginia and Maryland streets. 5-1

SEATTLE, WN.—To Queen City Const. Co., 603 18th Ave., So., Seattle, $72,444, by Board of Public Works, Seattle, for const. of Beacon Ave.; et al., drainage system in area between Airport Way and 13th Ave., So., from Atlantic St. to Bay View St. 4-27

River and Harbor Work. . . . .

WORK CONTEMPLATED

REDWOOD CITY, CALIF.—Bond election will be held June 2, by Redwood City, Calif., to vote $200,000 in bonds to help finance the dredging of a channel and construction of a wharf. $160,000 additional to be obtained from the PWA. 4-29

PEARL HARBOR, T. H.—Call for bids will be issued in the early part of the summer of 1936 by the Bureau of Yards & Docks, Navy Dept., Washington, D. C., from Pacific Coast concerns exclusively for construction of a steel floating drydock for Pearl Harbor, T. H. at an estimated cost of $10,000,000, under Spec. 8228. The structure will displace 32,000 tons, have 175-ft. beam, approximately 1,000 ft. long. 4-24

CALLS FOR BIDS

BALBOA, CANAL ZONE—Bids to 11 a. m., June 9, by the Bureau of Yards & Docks, Navy Dept., Washington, D. C., for a reinforced concrete wharf, bituminous macadam road, and water and electrical services at the Naval Ammunition Depot, Balboa, C. Z., under Spec. 7820. Est. cost $450,000. 4-23

BIDS RECEIVED

SAN FRANCISCO, CALIF.—Healy Tibbitts Constr. Co., 64 Pine St., S. F., $331,600, low to Public Utilities Comm., S. F., for 1 wharf for passengers (3 slips) and one freight wharf (1 slip) at Yerba Buena Shoals, under Contract No. 2. 4-29

SAN FRANCISCO, CALIF.—Malott & Peterson, 3221 20th St., S. F., $25,371, low to Public Utilities Comm., S. F., for P & B process covering of untreated piles in ferry slips on Yerba Buena Shoals in S. F. Bay under Contract No. 4. 4-29

CONTRACTS AWARDED

LONG BEACH, CALIF.—Contract awarded (subject to P.W.A. approval) to R. E. Campbell, 711 Central Bldg., Los Angeles, $398,527, by City Clerk, Long Beach, for a reinf. concrete sheet piling retaining wall and miscell. construction on Naples Canal, Rivo Alto Canal and Alamitos Bay. 4-1

OAKLAND, CALIF.—To Duncanson Harrelson Co., deYoung Bldg., San Francisco, $10,876, by Port of Oakland, for a steel sheet pile bulkhead wall at the Quay wall, Inner Harbor, and at the Oil Pier, Outer Harbor. 4-21

SACRAMENTO, CALIF.—To R. L. Oakley, 10782 Willworth Ave., Los Angeles, and J. P. Immel, P. O. Box 192, Ventura, Calif., $106,461, by U. S. Engineer Office, Sacramento, for setting back, raising and strengthening the existing levee and const. new levee along the westerly side of the Sacramento River from a point opposite Wohlfrom Bend to the ferry just northerly of Princeton, Calif., a distance of approx. 7.5 mi., under Cir. Prop. 1105-36-148. 4-24

SACRAMENTO, CALIF.—To Macco Const. Co., 815 Paramount Blvd., Clearwater, Calif., $135,576, by U. S. Engineer Office, Sacramento, for setting back, raising and strengthening the existing levee and const. new levee along the easterly side of the Feather River in Reclamation District No. 784 from a point about 1.7 mi. below Eliza Bend Pump to the upper end of Starr Bend, a distance of approx. 4.0 mi. Upper or northerly end of the work is about 6 mi. southerly from Marysville. 4-3

SAN FRANCISCO, CALIF.—To Marinap Corp., 503 Market St., San Francisco, $278,250, by U. S. Engineer Office, San Francisco, for furnishing and placing approx. 209,000 tons stone in a 3-mile retaining wall around the Exposition site of Yerba Buena Island. (See Unit Bid Summary.) 4-11

VANCOUVER, WN.—To Geo. H. Buckler & Co., Lewis Bldg., Portland, Oregon, $275,400, by Port of Vancouver, Wn., for const. a pier, 810 ft. long by 191 ft. wide on which will be constructed a warehouse 740 ft. long by 120 ft. wide. 4-4

Irrigation and Reclamation . .

CALLS FOR BIDS

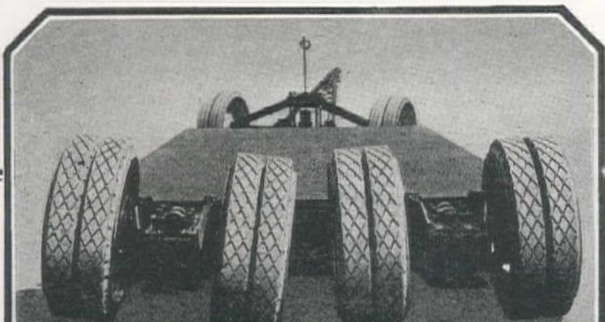
ONTARIO, ORE.—Bids to 10 a. m., May 21, by Bureau of Reclamation, Ontario, Oregon, for construction of structures, North canal laterals 45.4 to 49.4-0.4, Dead Ox Flat div., Owyhee project, Oregon-Idaho, under Spec. No. 791-D, work located near Ontario, Oregon. Involving: 1,850 cu. yd. structure excavation; 2,100 cu. yd. backfill; 540 cu. yd. concrete structures; 1,500 sq. yd. dry-rock paving; 28,500 lb. reinforcement steel; 1,760 lin. ft. 15 in. to 36 in. conc. pipe; 8,500 lb. gates and gate hoists; 2.0 M ft. b.m. erect. timber struc. 5-1

ONTARIO, ORE.—Bids to 10 a. m., May 20, by Bureau of Reclamation, Ontario, Ore., for constr. structures, North Canal laterals, N. C. 43.2 system, Dead Ox Flat Div., Owyhee project, Oregon-Idaho under Spec. No. 790-D. Work is located near Ontario, Ore., and involves: 2,250 cu. yd. structure excavation; 1,000 cu. yd. backfill; 820 cu. yd. conc. (structures); 1,000 sq. yd. dry-rock paving; 62,000 lb. place reinforcing steel; 420 lin. ft. lay 15 in. and 18 in. conc. pipe; 3,000 lb. install gates and gate hoists. 5-1

BIDS RECEIVED

MISSOULA, MONT.—Ralph Davis, Conner, Mont., $47,467, low to Bureau of Reclamation, Missoula, Mont., for constructing structures and canal lining for main canal and earthwork and structures for laterals and O'Keefe Wasteway, Frenchtown Proj., Montana, under Spec. No. 679. 4-28

AUSTIN, TEXAS—Bids received as follows, by the Bureau of Reclamation, Austin, Texas, for const. the Arnold Dam and power plant and proccessing of sand and cr. rock for the Arnold and Hamilton dams, Colorado River project, Texas. Work is located west of Austin and



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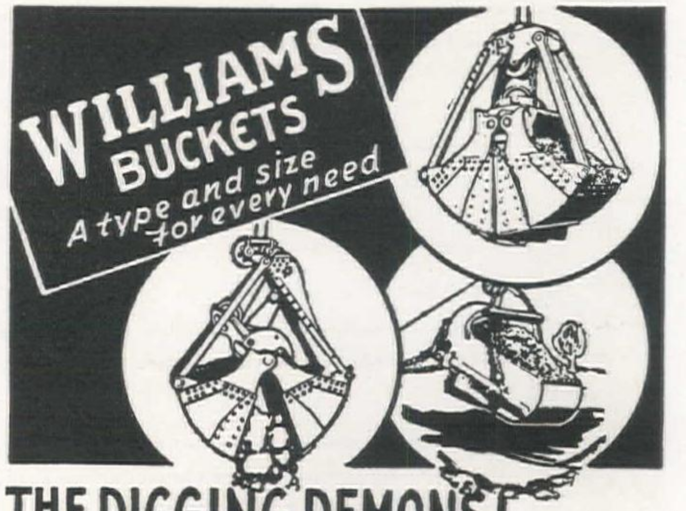

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Birmingham New York Chicago Pittsburgh Detroit Mexico City near Burnet and Kingsland, Texas, under Spec. 673: SCH. 1—Arnold Dam and Power Plant (concr. gravity dam.) Morrison-Knudsen Co., Boise, $782,773. SCH. 2—Arnold Dam and Power Plant (concr. slab and buttress dam.) Case Const. Co., 905 Westminster St., Alhambra and Bent Bros., 418 S. Pecan St., Los Angeles (low), $940,839. SCH. 3—Processing sand for Hamilton Dam and Arnold Gravity Type Dam. Austin Bridge Co., 1813 Clarence Street, Dallas, Texas (low), $102,000. SCH. 4—Processing sand for Hamilton Dam and Arnold Slab and Buttress Dam. Austin Bridge Co., Dallas, $83,200. SCH. 5—Processing cr. rock for Hamilton Dam and Arnold Gravity Dam. Austin Bridge Co., Dallas, $346,120. SCH. 6—Processing cr. rock for Hamilton Dam and Arnold Slab and Buttress Dam, Austin Bridge Co., Dallas, $259,590. 4-17

EL PASO, TEXAS—Mittry Brothers Const. Co., 5531 Downey Road, Los Angeles, $957,270, low to Bureau of Reclamation, El Paso, Texas, for const. of the Caballo Dam, Rio Grande project, New Mexico-Texas, under Spec. 672. (See Unit Bid Summary.) 4-3

YAKIMA, WN.—J. A. Terteling & Sons, 2223 Fairview Ave., Boise, Idaho, $275,213, low to the Bureau of Reclamation, Yakima, Wn., for const. earthwork, canal lining, and structures, Sta. 313-00 to Sta. 576-81.5, Yakima Ridge Canal, Roza division, Yakima project, Washington, under Spec. 675. (See Unit Bid Summary.) 4-14

CONTRACTS AWARDED

CALDWELL, IDAHO—To J. A. Terteling & Sons, 2223 Fairview Ave., Boise, Idaho, $19,186, by Pioneer Irrigation District, care of Fred L. Evans, Secretary, 718 Arthur St., Caldwell, Idaho, for constructing five drainage ditches and appurtenances, under Docket No. 2364 R. 5-2

ONTARIO, ORE.—To Geo. B. Henly, Nyssa, Oregon, $5,995, by Bureau of Reclamation, Ontario, Oregon, for constructing earthwork on North Canal Laterals, Dead Ox Flat Division, Owyhee Project. 4-3

AUSTIN, TEXAS—To Brown & Root, Inc., Austin, Texas, $38,507, by Bureau of Reclamation, Austin, Texas, for construction of the north dike at the Hamilton Reservoir, Colorado River project, Texas, under Spec. 770-D. 4-18

Dam Construction . . . .

WORK CONTEMPLATED

FALLON, NEVADA—Water users of the Truckee-Carson Irrigation District and the Washoe County Water Conservation District have approved by vote, the Truckee River agreement for upstream storage on the Little Truckee River. Plans and specifications are being completed by the Bureau of Reclamation, Denver, and call for bids will be issued in about 30 days for const. of an earth fill dam at the Boca site on the Little Truckee River. Estimated cost $1,000,000, which has been alloted by the P.W.A. to the Bureau of Reclamation. 4-10

CALLS FOR BIDS

PHOENIX, ARIZ.—Bids to 10 a. m., May 16, by U. S. Bureau of Reclamation, Producers Bldg., Phoenix, Ariz., for construction of the Bartlett Dam, Salt River Valley project, Arizona, on the Verde River, about 35 miles from Phoenix, under Spec. No. 674. Dam will be multiple arch type, approx. 240 ft. high; 950 ft. long; 200,000 ac. ft. storage capacity. Work is to start in 30 days, and be completed in 800 days. Work involves the following principal items: 135,000 cy. com. excav. (open cut); 185,000 cy. rock excav. (open cut); 1,000 cy. backfill; 1,000 cy. rock fill; 8,000 cy. conc. (buttress ftgs. and cutoffs; 120,500 cy. conc. (buttr. and arches in dam); 12,400 cy. mass concrete in dam; 13,700 cy. concr. (spillway struc.); 5,410 cy. concr. (other parts of dam); 45,000 cu. ft. pressure grouting; 29,000 lin. ft. grout holes (drill); 5,500,000 lb. reinforcement bars (place); 3,000 lin. ft. drain pipe (place); 3,191,300 lb. gates, valves, and other metalwork (install.) 4-27

NATIONAL CITY, CALIF.—Plans and Specifications were ready for distribution May 10, and bids will be received about June 1 by the California Water & Telephone Co., 19 West 9th St., National City, for construction of the Judson Reservoir Dam and appurtenant works. The dam is to be rolled embankment type with a maximum height of 60 ft. and a crest length of 690 ft., involving: 1,000 cu. yd. strip dam found. wasted mtl.; 4,000 cu. yd. same, reused material; 3,000 cu. yd. stripping for borrow pits; 850 cu. yd. excav. for outlet tower and pipe, overflow struc. and pipe, spillway structures and pipes; 600 cu. yd. backf. for outlet tower and pipe, overflow struc. and pipe and spillway structures and pipes; 82,000 cu. yd. earthfill in embankment; 4,500 cu. yd. cobble blankets on dam; 170 cu. yd. all concrete work; 250 bbl. furnishing cement; 13,000 lb. pl. reinf. stl. and reinf. mesh; 270 ft. 24-in. x ¼-in. weld. stl. outlet pipe; 115 ft. 18-in. x No. 10 ga. welded steel overflow pipe; 885 ft. 24-in. x No. 10 ga. same, spillway pipes; 2 24-in. gate valves; L.S. install. derrick comp. with 1,500-lb. right-hand winch with chain and hook; 5,000 lb. placing all steel, other than above mentioned; 1,000 sq. ft. painting metal work; 4,500 cu. yd. canal excavation. 4-24

VENTURA, CALIF.—Bids to 10 a. m., May 18, by Board of Supervisors, Ventura, for constr. of Bradley Road Debris Check Dam, Unit No. 4, about 4 miles north of Somis, involving: 52 cu. yd. concrete, Class "A"; 25 cu. yd. excav.; 800 cu. yd. backfill; 3,116 lb. reinforcing steel. 4-27

CONTRACTS AWARDED

SACRAMENTO, CALIF.—To Youdall Const. Co., 215 Market Street, San Francisco, who bid $16,125 to the Bureau of Reclamation, Sacramento, for excavating for investigation of Friant Dam site, Central Valley Project, Calif., under Specification No. 775-D. 4-22

Railroad Construction . . . . . .

CONTRACTS AWARDED

LOS ANGELES, CALIF.—To Shannahan Bros., 6181 Eastern Ave., Los Angeles, $71,870. ALTERNATE by Harbor Commission, Los Angeles, for constructing a standard gauge railroad track, including grading, track laying, trestle constructing, paving, etc., under Spec. 946. 4-2

LAS ANIMAS, COLO.—To Sharp & Fellows Contracting Co., 108 W. 6th St., Los Angeles (price not stated) by the Atchison, Topeka & Santa Fe Railway System, Railway Exchange Bldg., Chicago, for construction of 111.2 miles main track railroad line between Boise City, Oklahoma, and Las Animas, Colorado. Work involves: 750,000 cu. yd.

common excavation; 109,000 cu. yd. loose rock excavation; 390,000 cu. yd. solid rock excavation; 3,000,000 cu. yd. embankment; 5,000 lin. ft. pile and frame trestles; 450 MFBM creos. wooden boxes; 220 lin. mi. right-of-way fence. 4-22

Tunnel Construction . . . . . .

CALLS FOR BIDS

YAKIMA, WN.—Bids to 10 a. m., May 28, by Bureau of Reclamation, Yakima, Washington, for constr. Tunnel No. 1, station 59-38 to station 102, Yakima Ridge Canal, Roza Div. Yakima Proj., Wn., work located near Yakima, Spec. No. 682. Involving: 8,390 cu. yd. open-cut excavation; 49,100 cu. yd. tunnel excavation; 75 cu. yd. backfill; 150 cu. yd. conc. (portal struc. and transi.); 12,200 cu. yd. tunnel concrete; 600 cu. ft. pressure grouting; 15,000 lb. place reinforcing steel; 45,000 lb. furn. and install. permanent steel tunnel supports; 15 M ft. b.m. furnishing and erect. permanent tunnel timbering; 40,000 lb. furn. and install. steel tunnel liner plates; 2,235 lin. ft. 6 in. to 10 in. tunnel drains; 300 lin. ft. drill grout holes. 5-1

Pipeline Construction . . . . . .

WORK CONTEMPLATED

LOS ANGELES, CALIF.—Plans and specifications are being completed and call for bids will be issued in about 30 days, to be opened later by Shell Oil Co., care of Mr. J. U. Stair, 1008 W. 6th St., Los Angeles, for several separate contracts in connection with construction of about 304 mi. of new oil pipeline. Work involves: 90 mi. 8 in. and 10 in. line between Bakersfield and Caliola. 180 mi. 10-in. line between Caliola and Martinez; 44 mi. 6-in and 8-in. gathering lines; 4 pumping stations and pumps between Caliola and Bakersfield; Re-equipment of pumping stations between Caliola and Martinez. The Shell Oil Co. will purchase the pipe (about 25,000 tons) direct and separate contracts will probably be let for laying each different section of the pipeline and for welding and for the const. of the pumping stations. Total estimated cost $4,500,000. 5-2

Power Development . . . .

WORK CONTEMPLATED

FALLON, NEVADA—Truckee-Carson Irrig. Dist., Fallon, Nev., voted $125,000 in bonds to finance purchase and install. of a Diesel hydro-electric plant at Lahontan, Nevada. 4-9

CONTRACTS AWARDED

PIOCHE, NEVADA—To W. E. Callahan Const. Co., 206 So. Spring St., Los Angeles, $109,508, by the Lincoln County Power District No. 1, Pioche, Nev., for const. only of 156 mi. of high tension power transmission line, wood pole H frame type const., from Boulder Dam, Nevada, to Prince Sub-station, near Pioche and for const. of 60 mi. of wood pole type feeder lines in LINCOLN COUNTY, Nevada. 4-13

Lighting Systems. . . . .

CONTRACTS AWARDED

SAN FRANCISCO, CALIF.—To Globe Electric Works, 15th and Mission streets, San Francisco, $7,044, by Dept. of Public Works, San Francisco, for installing lighting system on 8th Street between Market and Townsend St. 4-25

Miscellaneous. . . . .

WORK CONTEMPLATED

SAN FRANCISCO, CALIF.—Plans and specifications are being completed by W. P. Day, Works Director, for San Francisco Bay Exposition, Inc., Financial Center Bldg., San Francisco, and call for bids will be issued by the Public Utilities Commission, City Hall, San Francisco, for the following work in connection with the Exposition, to be located on the Yerba Buena Shoals site. (1) Bids about July 1 for two permanent airplane hangars, estimated cost $685,300. (2) Bids about August 1 for permanent airport terminal building, estimated cost $715,300. (3) Bids about September 1 for five major exhibit buildings, estimated cost $1,399,607. (4) Bids about September 1 for a ferry terminal building, estimated cost $274,900. (5) Bids about September 1 for paving walks, driveways, estimated cost $441,400. 4-10

Machinery and Supplies . . . .

BIDS RECEIVED

FORT PECK, MONT.—Chicago Bridge & Iron Works, 37 W. Van Buren St., Chicago, $908,960, low to U. S. Engr. Office, 707 Postal Telegraph Bldg., Kansas City, Mo., for furnishing all labor and materials for construction of 14,950,000 lb. steel plate lining for Fort Peck Tunnel No. 1. 4-24

CONTRACTS AWARDED

DENVER, COLO.—To Republic Portland Cement Co., San Antonio, Texas, $835,160, by Bureau of Reclamation, Denver, Colo., for furn. and deliv. F.O.B. cars ship. pt. or F.O.B. cars at Beverly, Texas, 20,000 bbl. std. cement in bulk; 5,000 bbl. std. cement in cloth sacks; 290,000 bbls. modified or std. Portland cement in cloth sacks, and 50,000 bbl. modified or std. cement in bulk, for the Hamilton Dam and the Arnold Dam, Colorado River project, Texas, under Spec. 766-D. 4-9

PORTLAND, ORE.—To General Electric Co., Schnectady, New York, $77,280, by U. S. Engineer Office, Portland, Oregon, for designing, manufacturing and delivering 2,400-volt metal-clad switchgear for the powerhouse station service system at Bonneville, Oregon, under Invit. No. 694-36-264. 4-9

EQUIPMENT and MATERIALS SECTION

This is a directory of products made by manufacturers whose advertisements appear in *Western Construction News*. If you do not find what you want, write for further information to *Western Construction News*, 114 Sansome Street, San Francisco, California.

Acetylene
Air Reduction Sales Co.

Ammonia, Anhydrous
Barrett Co., The
Great Western Electro-Chemical Co.

Ammoniators
Wallace & Tiernan Co., Inc.

Angledozers
Le Tourneau, Inc., R. G.

Asphalt
Asphalt Institute, The
Associated Oil Co.
General Petroleum Corp. of California
Shell Oil Company
Union Oil Company

Asphalt Paving Plants
Foote Co., Inc., The
Iowa Manufacturing Co.
Madsen Iron Works
Standard Steel Works

Automotive Accessories
Goodrich, B. F. Co., The

Backfillers
Austin-Western Road Machinery Co.
Buckeye Traction Ditcher Co.
Bucyrus-Erie Company
Caterpillar Tractor Co.
Lima Locomotive Works
Link-Belt Company
Northwest Engineering Co.
Thew Shovel Co.

Batchers, Concrete Aggregates
Western Pipe & Steel Co.

Batteries, Storage
Goodrich, B. F. Co., The

Bearings, Roller
Timken Roller Bearing Co., The

Belting, Conveyor
Goodyear Tire & Rubber Co.

Belting, Transmission
Goodrich, B. F. Co., The
Pioneer Rubber Mills

Bins, Storage and Hopper
Chain Belt Co.
Chicago Bridge & Iron Works
Western Pipe & Steel Co.

Bits, Rock Drilling
Bucyrus-Erie Company
Chicago Pneumatic Tool Co.
Timken Roller Bearing Co.

Blades, Grader and Scraper
Adams, J. D. Co.
Allis-Chalmers Mfg. Co.
Austin-Western Road Machinery Co.
Caterpillar Tractor Co.
Galion Iron Works & Mfg. Co.

Blasting Caps, Electric
Atlas Powder Co.

Blasting Machines
Atlas Powder Co.

Blasting Supplies
Apache Powder Co.
Atlas Powder Co.
Halafax Explosives
Hercules Powder Co.
Trojan Powder Co.

Brake Lining
Johns-Manville Corp.

Bridges, Concrete
Portland Cement Association

Buckets, Excavating
Bucyrus-Erie Co.
Electric Steel Foundry Co.
Industrial Brownhoist Corp.
Northwest Engineering Company
Page Engineering Company
Wellman Engineering Co.

Buckets, Automatic
Page Engineering Company

Buckets, Dragline
Page Engineering Company

Buildings, Concrete
Portland Cement Association

Bulldozers
American Tractor Equipment Co.
Austin-Western Road Machinery Co.
Bucyrus-Erie Company
Caterpillar Tractor Company
Le Tourneau, R. G., Inc.

Cable, Highway Guard Rail
American Cable Co., Inc.
Broderick & Bascom Rope Co.
Columbia Steel Co.
Leschen, A., & Sons Rope Co.

Cables, Power
Roebling's John A., Sons Co.

Carbide
Air Reduction Sales Co.

Cars Tunnel and Mine
Madsen Iron Works

Castings, Electric Steel, Alloy or Manganese Steels
American Manganese Steel Company
Electric Steel Foundry Co.
Madsen Iron Works
United States Steel Corp.
Utility Trailer Mfg. Co.

Castings, Special
Cast Iron Pipe Research Association

Caustic Soda
Great Western Electro-Chemical Co.

Cement, Portland
Pacific Portland Cement Co.
Portland Cement Assn.

Cement, "24" Hour
Pacific Portland Cement Co.

Cement, Waterproof
Pacific Portland Cement Co.

Chemical Precipitation of Sewage
Wallace & Tiernan Co., Inc.

Chemicals
Barrett Co., The
Great Western Electro-Chemical Co.

Chlorinators
Wallace & Tiernan Co., Inc.

Chlorine
Great Western Electro-Chemical Co.

Clarifiers, Sewage
Dorr Company, Inc., The

Clarifiers, Water
Dorr Company, Inc., The

Clips, "Blueclad"
Roebling's, John A., Sons Co.

Coatings, Pipe
Barrett Co., The
General Paint Corp.

Compressors, Air
Caterpillar Tractor Co.
Chicago Pneumatic Tool Co.
Gardner-Denver Co.
Ingersoll-Rand Co.
Sullivan Machinery Co.
Worthington Pump & Machinery Co.

Control Equipment, pH
Wallace & Tiernan Co., Inc.

Conveyors, Belt
Iowa Manufacturing Co.
Pioneer Gravel Equipment Mfg. Co.
Smith Engineering Works
Stephens-Adamson

Couplings, Hose
Cleveland Rock Drill Co., The

Cranes Diesel Electric, Gas and Steam
Austin-Western Road Machinery Co.
Bucyrus-Erie Company
Byers Machine Co.
Caterpillar Tractor Co.
Industrial Brownhoist Corp.
Koehring Co.
Le Tourneau, R. G., Inc.
Lima Locomotive Works, Inc.
Link-Belt Company
Marion Steam Shovel Co.
Northwest Engineering Co.
Thew Shovel Company

Crushers and Crushing Plants
Austin-Western Road Machinery Company
Caterpillar Tractor Co.
Iowa Manufacturing Co.
Pioneer Gravel Equipment Mfg. Co.

Culverts
Austin- Western Road Machinery Co.
California Corrugated Culvert Co.
Cast Iron Pipe Research Association
Hardesty Mfg. Co.
Johns-Manville Corp.
Pure Iron Culvert & Mfg. Co.
Toncan Culvert Manufacterers' Association
Washington Corrugated Culvert Co.
Western Pipe & Steel Co.

Curing Compounds, Concrete
Barrett Company, The

Derricks and Derrick Fittings
Clyde Sales Company
LeTourneau, Inc., R. G.

Diggers, Clay
Cleveland Rock Drill Co., The

Diggers, Pneumatic
Cleveland Rock Drill Co., The

Diggers, Trench
Cleveland Rock Drill Co., The

Dippers, Power Shovel
American Manganese Steel Co.

Dirt Hauling Equipment
Koehring Company

Ditchers
Buckeye Traction Ditcher Company
Northwest Engineering Co.

Dragline Excavators and Draglines
Harnischfeger Corp.
Koehring Company
Northwest Engineering Co.
Page Engineering Co.

Drifters
Cleveland Rock Drill Co., The

Drill Bits, Detachable
Ingersoll-Rand Company
Sullivan Machinery Co.
Timken Roller Bearing Co.

Drill Rigs
Cleveland Rock Drill Co.,The

Drills, Blast Hole
Bucyrus-Erie Company

Drills, Diamond
Chicago Pneumatic Tool Co.
Sullivan Machinery Co.

Drills, Hammer
Cleveland Rock Drill Co., The

Drills, Rock
Chicago Pneumatic Tool Co.
Cleveland Rock Drill Co., The
Gardner-Denver Company
Ingersoll-Rand Company
Sullivan Machinery Company
Worthington Pump & Machinery Co.

Drills, Wagon
Cleveland Rock Drill Co., The
Sullivan Machinery Co.

Drills, Water Well
Bucyrus-Erie Company

Dumptors
Koehring Company

Dumptors and Trail-Dumps
Koehring Company

Dynamite
Apache Powder Company
Atlas Powder Company
Halafax Explosives
Hercules Powder Company
Trojan Powder Company

Electrical Wires and Cables for all Purposes
Roebling's, John A., Sons Co.

Elevating and Conveying Equipment
Austin-Western Road Machinery Company
Fuller Company
Industrial Brownhoist Corp.
Link-Belt Company
Smith Engineering Works

Elevating Graders
Caterpillar Tractor Company

Elevators, Belt
Smith Engineering Works

Enamels, Pipe Line
Barrett Co., The

Engines, Diesel, Gasoline and Steam
Case, J. I., Company
Caterpillar Tractor Co.
Chicago Pneumatic Tool Co.
General Motors Truck Co.
International Harvester Co.
Northwest Engineering Co.
Page Engineering Co.
Worthington Pump & Machinery Co.

Engines, Truck Replacement
Cummins Engine Company

Equipment, Rebuilt
(See Opportunity Section)

Equipment for Rent
(See Opportunity Section)

Equipment, Used
(See Opportunity Section)

Excavating Machinery, Diesel, Gas and Electric
Harnischfeger Corp.

Excavating Machines
Page Engineering Company

Excavators
Caterpillar Tractor Co.
Koehring Company

Excavators, Ditching and Trench
Austin-Western Road Machinery Co.
Buckeye Traction Ditcher Co.
Bucyrus-Erie Company
Byers Machine Co., The
Industrial Brownhoist Co., The
Lima Locomotive Works, Inc.
Link-Belt Company
Marion Steam Shovel Co.
Michigan Power Shovel Co.
Northwest Engineering Co.
Thew Shovel Company

Excavators, Dragline
Austin-Western Road Machinery Co.
Buckeye Traction Ditcher Co.
Bucyrus-Erie Company
Byers Machine Co., The
Industrial Brownhoist Corp.
Lima Locomotive Works
Link-Belt Company
Marion Steam Shovel Co.
Northwest Engineering Co.
Thew Shovel Co.
Wellman Engineering Co., The

Explosives
Apache Power Company, Inc.
Atlas Powder Company
Halafax Explosives Company
Hercules Powder Company
Trojan Powder Company

Feeders, Aggregate
Smith Engineering Works

Feeders, Chemical
Wallace & Tiernan Co., Inc.

Fence Posts
United States Steel Corp.

Fence, Wire
United States Steel Corp.

Ferric Chloride
Great Western Electro-Chemical Co.

Fittings, Hose
Cleveland Rock Drill Co., The

Fittings, Pipe
Crane Company

Fittings and Accessories, Wire Rope
Roebling's, John A., Sons Co.

Flooring, Rubber Tile
Goodrich, B. F. Co., The

Flotation Reagents
Great Western Electro-Chemical Co.

Flumes, Metal
California Corrugated Culvert Co.
Hardesty Mfg. Co.
Pure Iron Culvert & Mfg. Co., The
Toncan Culvert Manufacturers' Assn.
Washington Corrugated Culvert Co.
Western Pipe & Steel Co.

Forms, Concrete
Western Pipe & Steel Co.

Galvanometers
Atlas Powder Co.

Gas Masks
Wallace & Tiernan Co., Inc.

Gasoline
Associated Oil Company
General Petroleum Corp. of California
Shell Oil Company
Union Oil Co. of California

Gates, Discharge
Fuller Company

Gates, Sluice
Crane Company

Gauges
Sparling R. W.

Generator Sets
Harnischfeger Corp.

Generators, Diesel, Electric
Caterpillar Tractor Co.
Fairbanks, Morse & Co.

Generators, Electric
Fairbanks, Morse & Co.
General Electric & Co.
Master Vibrator Company

Generators, Turbine
Pelton Water Wheel Co.

Governors, Turbine
Pelton Water Wheel Co.

Graders, Leaning Wheel, Motor Driven, Elevating
Adams, J. D., Company

Graders, Road
Allis-Chalmers Mfg. Co.
Austin-Western Road Machinery Co.
Caterpillar Tractor Co.

Gravel Plant Equipment
Austin-Western Road Machinery Co.

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Guard Rail Cable
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Air Reduction Sales Company

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Caterpillar Tractor Company
Chain Belt Company
Chicago Pneumatic Tool Co.
Clyde Sales Co.
Harnischfeger Corp.
Industrial Brownhoist Corp.
Northwest Engineering Co.
Ramsey Machinery Co.
Wellman Engineering Co., The

Hoppers, Steel
Standard Steel Works
Western Pipe & Steel Co.

Hose, Air, Steam, Water and Suction
Chicago Pneumatic Tool Co.
Cleveland Rock Drill Co., The
Firestone Tire & Rubber Co.
Goodrich, B. F. Co., The
Goodyear Tire & Rubber Co., Inc.

Hydrants, Fire
Ludlow Valve Mfg. Co., The
Pacific States Cast Iron Pipe Company

Joints, Asphalt and Cork
Johns-Manville Corp.

Lighting Plants
Harnischfeger Corp.

Liner Plates
Western Pipe & Steel Co.

Loaders
Bucyrus-Erie Co.

Loaders, Log
Bucyrus-Erie Co.

Loaders, Power, Truck and Wagon
Austin-Western Road Machinery Co.
Galion Iron Works & Mfg. Co.

Lubricants, Oils and Greases
General Petroleum Corp. of California
Shell Oil Company
Union Oil Company of Calif.

Lubricants, Wire Rope
Leschen, A., & Sons Rope Co.

Lumber, Creosoted
Baxter, J. H. & Co.

Lumber, Termite, Decay and Fire-Repellant
Baxter, J. H. & Co.

Lumber, Zinc-Chloride and/or Chromated Zinc-Chloride Treated
Baxter, J. H. & Co.

Lye
Great Western Electro-Chemical Co.

Maintainers, Road
Adams, J. D. Company
Caterpillar Tractor Co.

Meters
Crane Company
Neptune Meter Co.
Sparling, R. W.

Mixers, Bituminous
Foote Company
Koehring Company

Mixers, Concrete
Chain Belt Company
Jaeger Machine Company
Koehring Company
Western Pipe & Steel Co.

Mixers, Paving
Foote Company
Koehring Company

Mixing Plants
Koehring Company

Motors, Electric
Fairbanks, Morse & Co.
General Electric Co.
Lincoln Electric Co.

Motors, Electric, Squirrel Cage, Slip Ring
Harnischfeger Corp.

Mowers, Highway
Case, J. I. Co.

Mud-Jacks
Koehring Company

Oil, Diesel
General Petroleum Corp. of California
Shell Oil Co.

Oil, Fuel
General Petroleum Corp. of California

Oils, Truck and Bus
General Petroleum Corp. of California

Oxygen
Air Reduction Sales Co.

Paint, Zone Marking
General Paint Corp.

Paints, L & S Portland Cement
General Paint Corp.

Paints, Protective
Barrett Co., The
General Paint Corp.
Goodrich, B. F. Co., The

Pavements, Concrete
Portland Cement Assn.

Pavers, Bituminous Retread
Adams, J. D. Co.
Foote Company

Paving Breakers
Chicago Pneumatic Tool Co.
Cleveland Rock Drill Co., The
Gardner-Denver Co.
Ingersoll-Rand Co.
Worthington Pump & Machinery Co.

Paving Mixers
Koehring Co.

Penstocks
Chicago Bridge & Iron Works
Western Pipe & Steel Co.

Petroleum Products
General Petroleum Corp. of California

Pile Drivers
Bucyrus-Erie Co.
Clyde Sales Co.
Harnischfeger Corp.
Industrial Brownhoist Corp.
Ingersoll-Rand Company
Lima Locomotive Works, Inc.
Northwest Engineering Co.

Piling, Creosoted
Baxter, J. H., & Co.

Pipe, Asbestos Cement
Johns-Manville Corp.

Pipe, Cast Iron
Crane Co.
Pacific States Cast Iron Pipe Co.
U. S. Pipe & Foundry Co.

Pipe, Cast Iron for Industrial Purposes
Cast Iron Pipe Research Association

Pipe, Concrete
American Concrete & Steel Pipe Co.

Pipe Fittings and Accessories
Pacific Pipe Company

Pipe, Hume Centrifugal Concrete
American Concrete & Steel Pipe Co.

Pipe, Lock Joint Reinforced Concrete
American Concrete & Steel Pipe Co.

Pipe, Rental for Construction Lines
Pacific Pipe Co.

Pipe, Riveted Steel
Western Pipe & Steel Co.

Pipe, Rubber Lined
Goodrich, B. F., Co., The

Pipe, Sewer and Storm Drain
American Concrete & Steel Pipe Co.

Pipe, Steel
Crane Co.
Pacific Pipe Co.
United States Steel Corp.
Western Pipe & Steel Co.

Pipe, Steel Riveted and Welded
Chicago Bridge & Iron Works

Pipe, Water
Cast Iron Pipe Research Association

Pipe, Welded Steel
California Corrugated Culvert Co.
Crane Co.
Hardesty Manufacturing Co.
Pacific Pipe Co.
Toncan Culvert Manufacturers' Association
Washington Corrugated Culvert Co.
Western Pipe & Steel

Plank, Asphalt Bridge
Johns-Manville Corp.

Powder
(See Explosives)

Power Control Units
Le Tourneau, Inc., R. G.

Power Units
Cummins Engine Co.
International Harvester Co.

Pressure Regulators
Air Reduction Sales Co.

Pumps
Chain Belt Co.
Fairbanks, Morse & Co.
Ingersoll-Rand Co.
Layne & Bowler Corp.
Pelton Water Wheel Co.
Worthington Pump & Machinery Co.

Pumps, Deep Well
Pomona Pump Co.

Pumps, Drainage
Pomona Pump Co.

Pumps, Dredging
American Manganese Steel Company

Pumps, Turbine
Pomona Pump Co.

Reinforcing, Steel Bar and Fabric, for Concrete
United States Steel Corp.

Reservoirs, Steel
Pittsburgh-Des Moines Steel Co.

Rheostats for Electric Blasting
Atlas Powder Co.

Rims
Firestone Tire & Rubber Co.

Rippers
Adams, J. D. Co.

Roadbuilders
Caterpillar Tractor Co.

Road Machinery
Adams, J. D. Co.

Road Materials
Barrett Company, The

Roadmix Plants
Iowa Manufacturing Co.

Road Oils
Asphalt Institute, The
Associated Oil Co.
Union Oil Co. of California

Rollers, Compacting
American Tractor Equipment Company

Rollers, Road
Austin-Western Road Machinery Co.
Galion Iron Works & Mfg. Co.

Roofings
Barrett Co., The

Roofs, Built-Up
Johns-Manville Corp.

Rope, Wire
American Cable Co.
Broderick & Bascom Rope Co.
Leschen, A., & Sons Rope Co.
Roebling's, John A., Sons Co.

Rubber Goods, Mechanical
Goodyear Tire & Rubber Co.
Pioneer Rubber Mills

Scales
Fairbanks, Morse & Co.

Scales, Recording
Wallace & Tiernan Co., Inc.

Scales, Weight Printing
Fairbanks, Morse & Co.

Scales, Wheelbarrow
Fairbanks, Morse & Co.

Scarifiers
Adams, J. D. Co.
American Tractor Equipment Co.
Austin-Western Road Machinery Co.
Caterpillar Tractor Co.
Galion Iron Works & Mfg. Co.
Le Tourneau, R. G., Inc.

Scrapers
Adams, J. D. Co.
Austin-Western Road Machinery Co.
Caterpillar Tractor Co.
Le Tourneau, R. G., Inc.

Scrapers, Carryall
Le Tourneau, R. G., Inc.

Screens, Sand and Gravel
Austin-Western Road Machinery Co.
Dorr Co., Inc., The
Iowa Mfg. Co.
McLanahan & Stone Corp. Mfg. Co.
Pioneer Gravel Equipment
Smith Engineering Works

Screens, Sewage
Dorr Co., Inc., The

Screens, Vibrator
Iowa Mfg. Co.

Second Hand Equipment
(See Opportunity Section)

Sewage Disposal Equipment
Chain Belt Company
Dorr Co., Inc., The
Link-Belt Co.
Wallace & Tiernan Co., Inc.

Sewers
Cast Iron Pipe Research Association

Sharpeners, Drill
Bucyrus-Erie Co.
Gardner-Denver Co.
Ingersoll-Rand Co.
Worthington Pump & Machinery Co.

Sheets, Corrugated Asbestos
Johns-Manville Corp.

Shovels, Power
Austin-Western Road Machinery Co.
Bucyrus-Erie Co.
Caterpillar Tractor Co.
Harnischfeger Corp.
Industrial Brownhoist Corp.
Koehring Co.
Lima Locomotive Works, Inc.
Link-Belt Co.
Marion Steam Shovel Co.
Michigan Power Shovel Co.
Northwest Engineering Co.
St. Louis Power Shovel Co.
Thew Shovel Co.

Shovels, Truck
Michigan Power Shovel Co.

Slings, Wire Rope and Grommet
Roebling's, John A., Sons Co.

Smokestacks
Chicago Bridge & Iron Works

Snow Plows
Caterpillar Tractor Co.

Sockets, "Bludclad No-Pinch"
Roebling's, John A., Sons Co.

Standpipes
Chicago Bridge & Iron Works

Steel, Abrasion Resisting
Electric Steel Foundry Co.

Steel, Drill
Cleveland Rock Drill Co., The
United States Steel Corp.

Steel, Reinforcing
United States Steel Corp.

Steel, Sheet-Galvanized Corrugated
Toncan Culvert Manufacturers' Assn.
United States Steel Corp.

Steel, Structural
Western Pipe & Steel Co.

Steels, Paving Breaker
Cleveland Rock Drill Co., The

Stoves, Construction Camp
Madsen Iron Works

Surfacers, Concrete
Mall Tool Co.

Swimming Pool Equipment
Wallace & Tiernan, Co., Inc.

Tampers, Backfill
Cleveland Rock Drill Co., The

Tanks, Elevated
Chicago Bridge & Iron Works

Tanks, Elevated Steel
Pittsburgh-Des Moines Steel Co.

Tanks, Metal
Chicago Bridge & Iron Works
Pittsburgh-Des Moines Steel Co.
Western Pipe & Steel Co.

Tanks, Oil
Chicago Bridge & Iron Works

Telemeters
Wallace & Tiernan Co., Inc.

Terracers
Adams, J. D., Co.

Testing Outfits, Chlorine and pH
Wallace & Tiernan Co., Inc.

Tires, Dump Truck
Goodyear Tire & Rubber Co.

Tires, Road Machinery
Goodyear Tire & Rubber Co.

Tires, Wheelbarrow
Goodyear Tire & Rubber Co.

Tires and Tubes
Goodyear Tire & Rubber Co.

Tools, Pneumatic
Chicago Pneumatic Tool Co.
Gardner-Denver Co.
Ingersoll-Rand Co.
Worthington Pump & Machinery Co.

Tractors, Diesel and Gasoline
Allis-Chalmers Mfg. Co.
Case, J. I., Co.
Caterpillar Tractor Co.
Cleveland Tractor Co., The
International Harvestor Co.
Reo Motor Car Co.

Trailbuilders
Caterpillar Tractor Co.
Le Tourneau, R. G., Inc.

Trail-Dumps
Koehring Co.

Trailers, Semi-Trailers
General Motors Truck Co.
Le Tourneau, R. G., Inc.
Six Wheels, Inc.
Utility Trailer Mfg. Co.

Trailers, Four-Wheel
Six Wheels, Inc.
Utility Trailer Mfg. Co.

Trailers, Heavy Duty
Wellman Engineering Co., The

Trailers, Six-Wheel
Six Wheels, Inc.
Utility Trailer Mfg. Co.

Trenching Machines
Harnischfeger Corp.
Northwest Engineering

Truck Cranes and Clamshells
Harnischfeger Corp.

Truck Third Axles
Utility Trailer Mfg. Co.

Trucks, Motor and Dump
General Motors Truck Co.
International Harvester Co.
Reo Motor Car Co.

Trucks, Tank
Reo Motor Car Co.

Turbines
Pelton Water Wheel Co.

Turbines, Steam
General Electric Co.

Valves
Crane Co.

Valves, Air
Cleveland Rock Drill Co., The

Valves, Gas Control
Wallace & Tiernan Co., Inc.

Valves, Gate
Crane Co.
Ludlow Valve Mfg. Co., The
Pelton Water Wheel Co.

Valves, Rubber Lined
Goodrich, B. F. Co., The

Vibrators, Concrete
Electric Tamper & Equipment Co.
Mall Tool Co.
Master Vibrator Co.

Wagons and Trailers
American Tractor Equipment Co.
Caterpillar Tractor Co.
Le Tourneau, R. G., Inc.

Washers, Sand and Gravel
Smith Engineering Works

Waste, Industrial, Treatment
Dorr Company, Inc., The

Water Purification Apparatus
Wallace & Tiernan Co., Inc.

Water Treatment Equipment
Dorr Company, Inc., The

Water Wheels
Pelton Water Wheel Co.

Water Works Equipment
Wallace & Tiernan Co., Inc.

Welders, Gas and Electric Driven
Harnischfeger Corp.

Welding and Cutting Equipment
Adams, J. D., Co.
Caterpillar Tractor Co.
Lincoln Electric Co., The

Welding and Cutting Equipment, Gas
Air Reduction Sales Co.

Welding Electrodes
Harnischfeger Corp.

Welding Machines, Electric Arc
Air Reduction Sales Co.

Welding Rods and Wire
Adams, J. D., Co.
Air Reduction Sales Co.
American Manganese Steel Co.
General Electric Co.
Lincoln Electric Co., The
Roebling's, John A., Sons Co.

Whirleys
Clyde Sales Company
Northwest Engineering Co.
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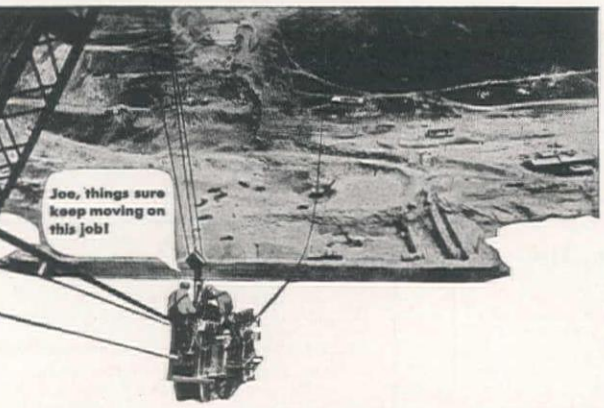

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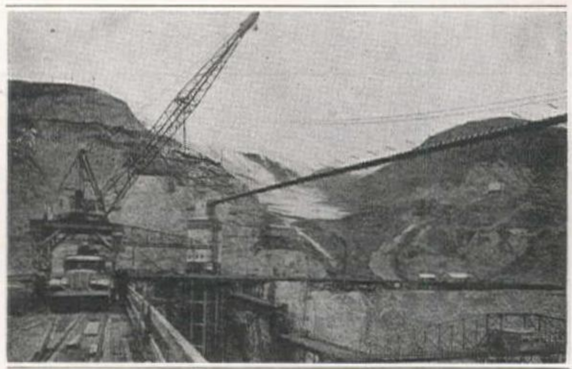

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OPPORTUNITY SECTION

OFFICIAL BIDS

UNITED STATES DEPARTMENT OF AGRICULTURE
Bureau of Public Roads

Bituminous Treatment of Sections Almanor National Forest Highway

San Francisco, California, May 5, 1936.

Sealed Bids will be received at the office of the Bureau of Public Roads, Federal Office Building, Civic Center, San Francisco, California, until 2:00 o'clock p. m. on May 26, 1936, for bituminous treatment (light surface application) of Sections A and B of Route 20, the Almanor National Forest Highway, Plumas National Forest, Plumas County, California. The length of the project is 6.285 miles, and it involves major items of approximately 159 tons liquid asphaltic road material Type M. C.-1; 84 tons liquid asphaltic road material Type M. C.-2 or M. C.-3; 660 cubic yards disintegrated granite screenings. The minimum wage paid labor employed on this project shall be in accordance with the classified labor rates attached to the specifications of which the minimum is $1.00 per hour for skilled labor, 68 cents per hour for intermediate labor, and 60 cents per hour for unskilled labor. The attention of bidders is especially directed to the provisions covering 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 Treasurer of the United States. Plans, specifications and proposals may be obtained at the office of the Bureau of Public Roads, 807 Sheldon Building, 461 Market Street, until May 9 and thereafter at the Federal Office Building, Civic Center, San Francisco, California.

C. H. SWEETSER,
District Engineer.

UNITED STATES DEPARTMENT OF THE INTERIOR
Bureau of Reclamation

Construction of Tunnel No. 1 Yakima-Ridge Canal

Washington, D. C., April 28, 1936.

Sealed bids (Specifications No. 682) will be received at the office of the U. S. Bureau of Reclamation, Yakima, Washington, until 10 a. m., May 28, 1936, and will at that hour be opened for furnishing labor and materials and performing all work for the construction of Tunnel No. 1, Station 59-38 to Station 102, Yakima-Ridge canal, Roza division, Yakima project, Washington. The work is located near Yakima, Washington. The principal items and estimated quantities of work involved are as follows: 8,390 cubic yards of all classes of open-cut excavation; 49,100 cubic yards of excavation in tunnel; 75 cubic yards of backfill; 150 cubic yards of concrete in portal structure and transition; 12,200 cubic yards of concrete in tunnel; 600 cubic feet of pressure grouting; placing 15,000 pounds of reinforcement bars; furnishing and installing 45,000 pounds of permanent steel tunnel supports; furnishing and erecting 15 M ft. b.m. of permanent timbering in tunnel; furnishing and installing 40,000 pounds of steel tunnel liner plates; constructing 2,235 linear feet of 6-inch to 10-inch diameter tunnel drains; and drilling 300 linear feet of grout holes. This invitation for bids does not cover the purchase of materials which are to be furnished by the Government. Materials to be furnished by the contractor, and those furnished by the Government are described in the specifications which will be a part of the contract. The work shall be commenced within thirty (30) calendar days after date of receipt of notice to proceed and shall be completed within five hundred and seventy (570) calendar days from the date of receipt of such notice. Bid security in an amount not less than 10 per cent, performance bond not less than 50 per cent and payment bond in the sum of one half of the total amount payable by the terms of the contract will be required. Liquidated damages for delay will be one hundred dollars ($100) per day. No charge to prospective bidders for copies of the specifications and drawings; to others $1.00, not returnable. For particulars, address the Bureau of Reclamation, Yakima, Washington; Denver, Colorado; or Washington, D. C.

JOHN C. PAGE,
Acting Commissioner.

OPPORTUNITY SECTION

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