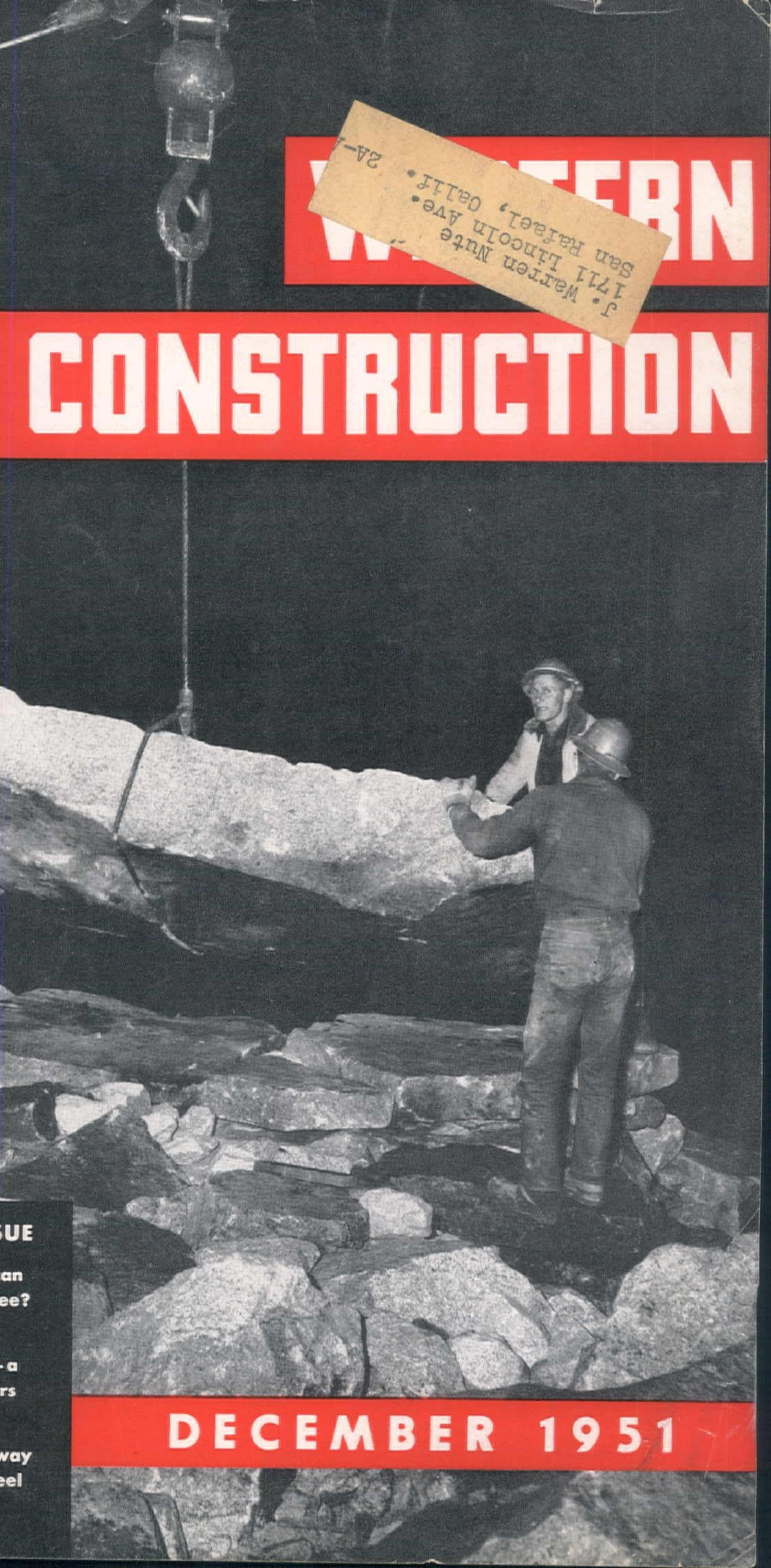
WESTERN
CONSTRUCTION
J. Warren Nute
1711 Lincoln Ave.
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DECEMBER 1951

EFFICIENCY UP...

COSTS DOWN

...when you use Texaco air compressor oil

EFFICIENT, economical air compressor operating requires an oil that is *exactly right* for your particular operating conditions. To meet this requirement you have only to use the recommended Texaco air compressor oil. A Texaco Lubrication Engineer will gladly help you.

—Under normal conditions, a Texaco *straight mineral* air compressor oil will assure clean operation, minimum wear, lower maintenance costs.

—Under conditions causing rust in cylinders, coolers, lines and receivers, a Texaco *rust-inhibited* air compressor oil will keep compressors and systems rust-free whether running or not.

—Where service conditions are extremely severe, a Texaco *heavy-duty* air compressor oil will prevent harmful formations of carbon and sludge.

—To combat excessiv
tions, a Texaco *compou*
wear at a minimum.

Call in a Texaco Lub
about the Texaco Simpl
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Lubricants. A time-savi
nearest of the more tha
in the 48 States, or write
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LONGER DRILL LIFE, mo
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TEXACO REG. T. M.

TEXACO Lubricant

FOR ALL CONTRACTORS'

TUNE IN ... TEXACO STAR THEATER starring MILTON BERLE on television every Tuesday night. METROPOLITA

REPEAT ORDERS are the best indication of preference!

26

TWENTY-SIX Northwests with an outfit like Winston Brothers Co. of Minneapolis, Minn. and Los Angeles, Calif.! Not all one size—not all the same type—not all on the same class of work!

Winston Brothers have used Northwests for years on every class of work from easy digging to the hardest kind of rock excavation.

Winston Brothers know what Northwest performance is and Northwest performance and output are two of the reasons why Winston Brothers have placed *twenty-five* repeat orders over the years for Northwest equipment. Northwest repeat orders from successful contractors are a guide you can't afford to overlook. They are proof positive of the kind of operation you want for profit.

You'll be surprised at how easy it is to plan to have a Northwest. Talk it over with a Northwest man. He'll be glad to give you full details.

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135 South LaSalle Street,
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buys their TWENTY-SIXTH
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Successful Contractors stay successful with good equipment

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WESTERN CONSTRUCTION

Volume 26 **DECEMBER 1951** Number 12

ARTICLES

DEPARTMENTS

FRONT COVER

NIGHT CREW SWINGS a 12-ton rock into place as Utah Construction Co. builds placed rock layer on upstream face of Pacific Gas and Electric Company's rock-fill Bear River Dam. The quarrying and rock placing operations will be reviewed in *Western Construction* for February 1952.

Photo by Robin Dager, Field Editor, Western Construction.

Construction and Civil Engineering Publication of the West

★

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B.F.Goodrich

This tire has a built-in rock-absorber

LAMBERT BROS., INC., of Knoxville, Tennessee, are engaged in quarrying operations in Tennessee, North Carolina, Georgia and Virginia. Trucks used in their operation travel in and out of the quarries, carrying heavy loads of dynamited limestone to the crusher. Pictured is one of the dump trucks at the Shepherd, Tennessee branch of the company (above), equipped with B.F.Goodrich Universal tires. Through the use of these tires the company says that better traction is obtained and that they hold as well in one direction as in the other. And the special construction provides unusual bruise resistance when travelling over rocks.

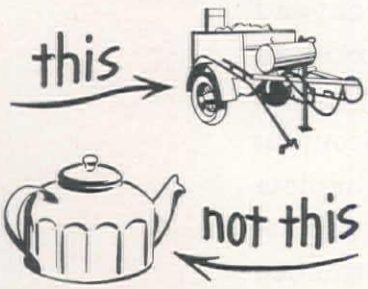
BFG Universals are ideal for toughest off-the-road service. They turn in top performance records even where rock, shale, stumps, ruts and other hazards are tire threats. Wedge-shaped tread resists cuts. Sidewalls are reinforced with tough, extra-thick rubber. The backbone, or body, of the tire is protected by the patented *nylon shock shield*. It acts as a shock-absorber—or "rock-absorber". And *here's* where you get extra bruise resistance. Strong, live, elastic nylon cords are built in between the tread rubber and the cord body. Under impacts of any kind, these cords work together, absorbing and distributing the shocks.

This feature is found in all BFG tires of 8 or more plies at *no extra cost*. *Double* nylon shock shield is used in Universals of sizes 11.00 and larger.

B. F. Goodrich tires are built for *every* type of on or off-the-road operation. No matter what your specifications may be, you'll find that your local B.F. Goodrich dealer can show you the way to longer and better tire service. *The B. F. Goodrich Company, Akron, Ohio.*

RESEARCH KEEPS
B.F.Goodrich
FIRST IN RUBBER

For road repairs, you need the right kind of kettle



Same way with trucks. Get one that fits the job!

Thrifty power for rugged jobs... with dependable DODGE "Job-Rated" TRUCKS

Give a Dodge "*Job-Rated*" truck the rough treatment your job demands . . . and watch it perform with *low-cost dependability* year after year!

Plenty of thrifty power! For example, 2½-ton models have a rugged, powerful engine that's rated at 114 h.p. And, to assure even greater power with top economy, high-tonnage models (2¾-ton and up) are offered with twin carburetion and exhaust system.

But that's not all! Back a Dodge into a tight spot—see how easily and sharply it turns, how easily the steering wheel turns! New worm-and-roller steering gears on many models are just one of many reasons why Dodge "*Job-Rated*" trucks are easier to handle.

Then consider advantages like the new moistureproof ignition system and new high-torque capacity starting motor—and you'll know why new Dodge "*Job-Rated*" trucks are more dependable, even in the worst weather.

You'll save in many ways with a truck that fits your construction operation—a Dodge "*Job-Rated*" truck. Talk it over with your friendly Dodge dealer *soon!*

How Dodge trucks are "*Job-Rated*" for the construction business

A Dodge "*Job-Rated*" truck is engineered *at the factory* to fit a specific job . . . save you money . . . last longer.

Every unit from engine to rear axle is "*Job-Rated*"—factory-engineered to haul a specific load over the roads you travel and at the speeds you require.

Every unit that SUPPORTS the load—frame, axles, springs, wheels, tires, and others—is engineered right to provide the strength and capacity needed.

Every unit that MOVES the load—engine, clutch, transmission, propeller shaft, rear axle, and others—is engineered right to meet a particular operating condition.

"Job-Rated" TRUCKS DO THE MOST FOR YOU

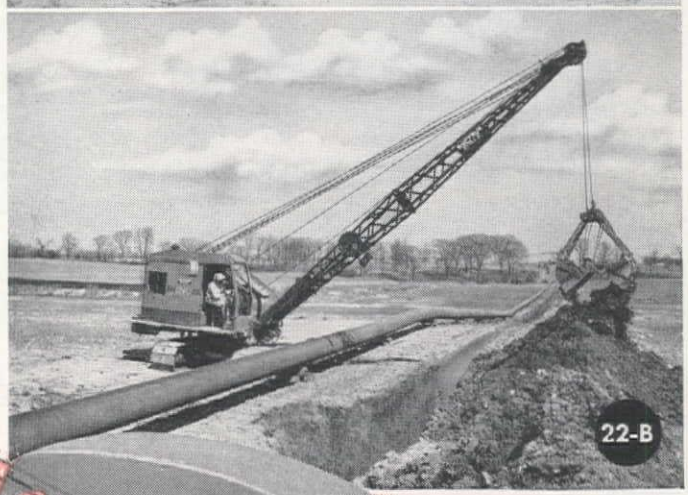
It's Always 'Full Speed with the Busy BUCYRUS ERIE

FOR excavator service that combines dependability with speed, economy and efficiency, you'll find contractors all over the country prefer Bucyrus-Eries. Long experience has shown them that Bucyrus-Eries are reliable performers at any task — with easy convertibility that means the right front-end equipment for every job. They know, too, that unexcelled Bucyrus-Erie design provides the right combination of power, strength and responsive control that spells big, low-cost output — shift after shift, year after year. Choose from the complete Bucyrus-Erie line of ⅜- to 4-yard gasoline, diesel and single-motor electric excavators for "full speed ahead" performance on your shovel, crane, dragline, clamshell or dragshovel jobs!

Bucyrus-Erie Company South Milwaukee, Wisconsin

275ES1C

Ahead' Line



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WORLD'S LEADING TRUCK SHOVEL

THE ONE AND ONLY "QUICK-WAY"

Reg. U. S. Pat. Off.

QUICK-WAY truck shovels can be found "on the job" in every one of the 48 states and in 65 foreign countries as well.

Yes . . . *QUICK-WAY* . . . the original and always the standard among truck shovels, demonstrates its versatility and adaptability, as well as its superb engineering and long-lasting construction, in Alaska and the Amazon, Great Britain and British Columbia.

Abroad, as well as at home, *QUICK-WAYS* get to and from the job faster. They're on the job more, because they're "between location" less. And *QUICK-WAYS* are quickly converted in minutes from shovel to scoop, dragline, trench-hoe, crane, clamshell, pile driver or backfiller. And most important of all, *QUICK-WAYS* are built for long, hard service with quality materials and superior workmanship. They're truly an investment in profits.

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TRUCK SHOVEL CO.

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"QUICK-WAY" TRUCK SHOVEL CO.
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Please send me complete details on "QUICK-WAY" truck shovels — four different models for large jobs and small.

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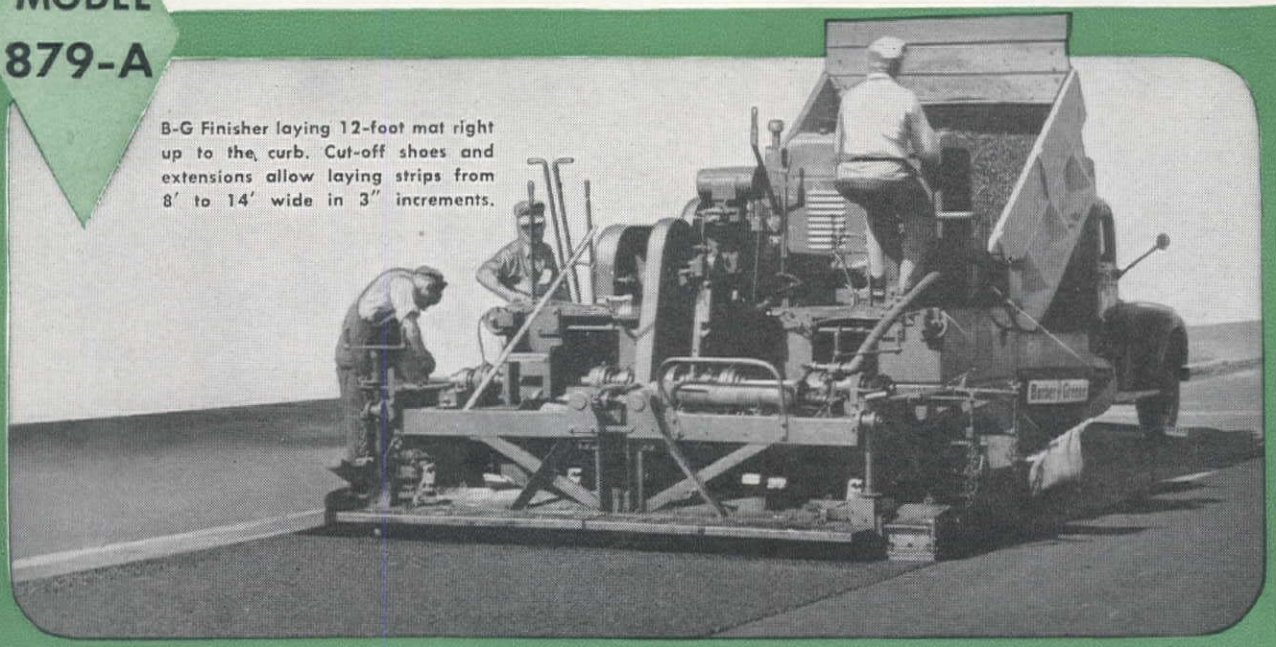
Barber-Greene

TAMPING-LEVELING FINISHER

MODEL 879-A



B-G Finisher laying 12-foot mat right up to the curb. Cut-off shoes and extensions allow laying strips from 8′ to 14′ wide in 3″ increments.

SPREADS material evenly

COMPACTS to uniform density

LEVELS automatically without forms

Unequaled method for properly laying a smooth, level surface for paving streets, highways, runways, parking lots, tennis courts and similar jobs.

The world's most widely used paving machine: gives superior performance in laying every type of surface — hot or cold — from clay stabilized gravel to high-type sheet asphalt.

Tamps, levels and strikes off simultaneously: *automatically* measures the correct amount of *compacted* material, produces a level surface that is maintained under rolling and traffic.

Compacts material as it is being laid: while it is hot and workable — assures a superior surface of uniform density, even when laid over an irregular subgrade.

Whether paving over new subgrade or resurfacing existing pavement, the B-G leveling principle assures a smooth, ripple-free surface without the need of forms . . . abrupt changes in subgrade cannot change the grade line of the mat.

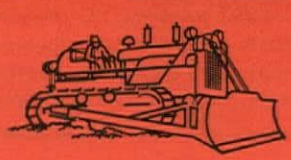
High capacity with low maintenance: saves truck time, reduces the amount of rolling required and size of crew.

See your Local Distributor:

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

"We Take All The

THE BIG RED CHAMP—the International TD-24—cuts a new railroad bed near the foot of loose talus slopes, but high enough to be safe above water level when the nearby Columbia River backs up behind the new McNary Dam.



TOUGH JOBS"

One man and his Big Red TD-24 handle hardest assignments for western contractor

Out on the big Union Pacific relocation job north of the McNary Dam site, Cardon & Cox—subcontracting for Utah Construction Co.—have an International TD-24 shuttling back and forth from one end of their section of the project to the other, doing the hardest jobs wherever they may be.

TD-24 operator Wilbur Strootman says, "We take all the tough assignments, and do them faster and better than any other tractor on the job. This TD-24 is the best tractor I've ever been on. I really go for it."

Here are five big reasons why—five advantages that make the Big Red TD-24 the work champ of the world:

TD-24 Power—148 maximum drawbar horsepower, more than any other crawler on the market.

TD-24 Speed—8 forward speeds, 8 reverse. Moves loads faster, gets back faster for a faster work cycle.

TD-24 Operation—Synchromesh transmission, you shift "on-the-go." And you go up or down one speed without declutching.

TD-24 Steering—Fingertip steering for pivot turns, feathered turns, turns with power on both tracks.

TD-24 Starting—Quick push-button starting in any weather.

Want to know more? Ask a friend who owns a TD-24. And ask your International Industrial Distributor both about the TD-24 and about his fast field service and complete shop facilities. You'll be a TD-24 man from then on in!

INTERNATIONAL HARVESTER COMPANY, CHICAGO 1, ILLINOIS

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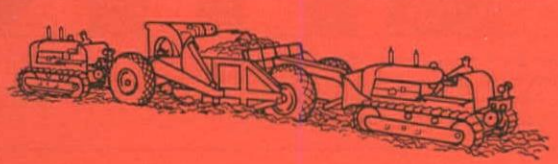
INTERNATIONAL

POWER THAT PAYS

INTERNATIONAL POWER PAYS OFF ON THIS BIG RAILROAD RELOCATION PROJECT

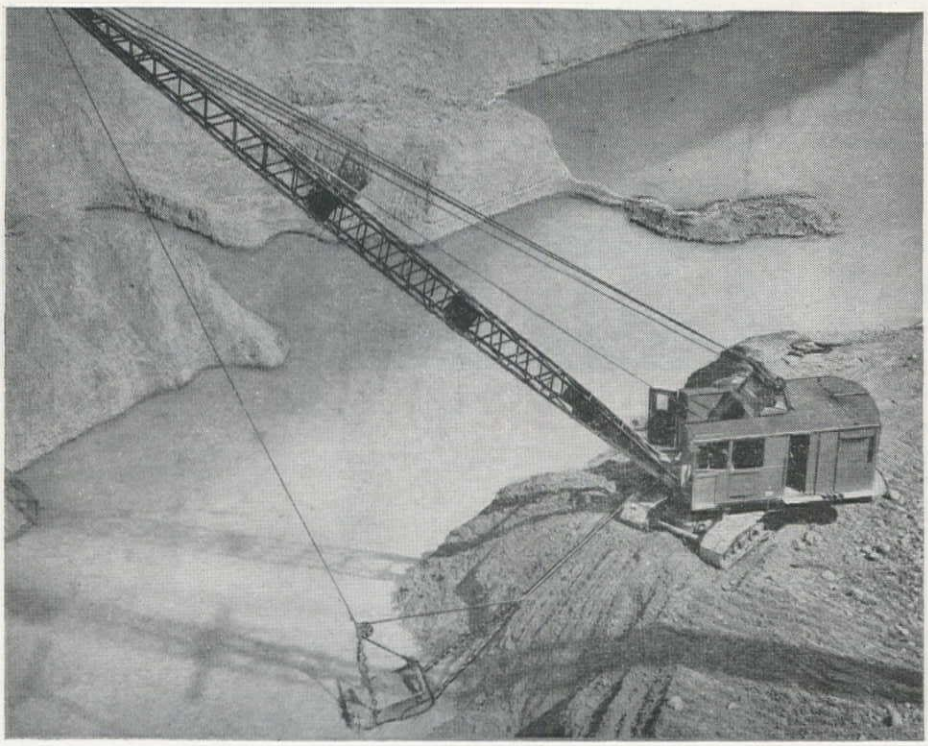


WIRE ROPE

You'll save time and cut costs with ROEBLING rope

FAST OPERATION AND DOLLAR SAVINGS are more important than ever in excavating and construction. One sure way to save time and expense is to specify Roebling Preformed "Blue Center" Steel Wire Rope. Here's a tough rope that stands up under shocks, strains and high speeds. Its preforming always assures maximum handling ease, better spooling and much smoother performance on the job.

Roebling makes a full line of wire rope. Have your Roebling Field Man recommend the *right* ropes for your equipment. And for longest life, get his advice on the correct use of wire rope. It is based on experience with thousands of installations. John A. Roebling's Sons Company-San Francisco-Los Angeles-Seattle.



ROEBLING ALL-PURPOSE SLINGS with the Tapered Sleeve Splice come to you ready for the job. They cost less than tucked splices . . . have the full strength of the rope. Send for the full story.

ROEBLING

Atlanta, 934 Avon Ave ★ ***Boston,*** 51 Sleeper St ★ ***Chicago,*** 5525 W. Roosevelt Rd ★ ***Cincinnati,*** 3253 Fredonia Ave ★ ***Cleveland,*** 701 St. Clair Ave, N.E. ★ ***Denver,*** 4801 Jackson St ★ ***Detroit,*** 915 Fisher Building ★ ***Houston,*** 6216 Navigation Blvd ★ ***Los Angeles,*** 216 S. Alameda St ★ ***New York,*** 19 Rector St ★ ***Odessa, Texas,*** 1920 E. 2nd St ★ ***Philadelphia,*** 230 Vine St ★ ***San Francisco,*** 1740 17th St ★ ***Seattle,*** 900 1st Ave, S. ★ ***Tulsa,*** 321 N. Cheyenne St ★ Export Sales Office, ***Trenton, N. J.***

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1 Greater Stability

gives you a higher ratio of lifting capacity in relation to gross weight . . . lets you work faster!

2 More Modern Features

true tractor-type crawlers . . .
low pressure hydraulic control . . .
live roller circle . . .
all-welded construction . . .

3 Unexcelled Service

Genuine P&H parts stocked by dealers . . . backed by nation-wide network of warehouses to keep your jobs on the move.

P&H

POWER SHOVELS and CRANES
4490 W. National Ave.
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HARNISCHFEGER CORPORATION

NOW P&H services the West From the West!

The new P&H Pacific Division inaugurates local manufacture and assembly of many famous P&H products — provides bigger parts stocks — better service than ever. Headquarters in Los Angeles.

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Packs a payload dirt cheap!

Boss truck of tough hauling jobs is International.

This has been true for 19 straight years. One reason is—Internationals pack bigger payloads for less money.

You can prove it just by counting the number of Internationals used by people in your business. Their records show International Trucks cost less to own and operate.

Why is this true?

Because International Trucks are available in 115 basic models, thousands of variations—you don't have to buy more truck than you need. And you never get less truck than you need.

What about the driver?

A driver takes better care of a truck he likes. He likes the new Internationals. He likes the Comfo-Vision Cab—"the roomiest on the road." He enjoys new riding comfort, improved visibility, greater ease of handling. He enjoys so many features that make his job easier, it's no wonder he likes International Trucks.

No wonder, either, that he makes them pay off on the job. Teamed with a new International Truck he makes the effort that can keep your hauling costs *dirt cheap*. Why not see your International Truck Dealer or Branch and find out how you can keep your hauling costs down with Internationals.

International Harvester Builds McCormick Farm Equipment and Farmall Tractors... Motor Trucks... Industrial Power... Refrigerators and Freezers

INTERNATIONAL HARVESTER COMPANY • CHICAGO

INTERNATIONAL TRUCKS

"Standard of the Highway"

BUCKETFUL

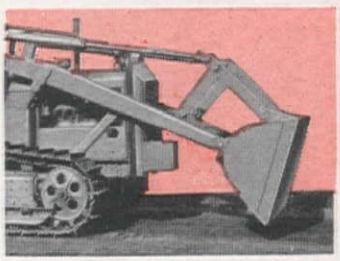
of Cost-Cutting Features

When it comes to cutting loading costs . . . stepping up profits, the Oliver Model "B" Crawler and Ware Loader is "loaded" with *plus* features.

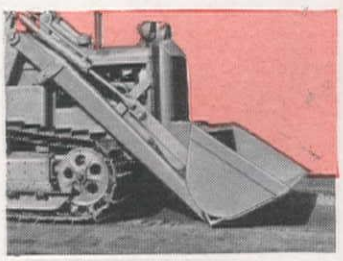
Take the hydraulically controlled bucket, for example. 110° bucket rotation and 28° "tilt back" give you a full bucket every time. "Breaking out" action is 3 times the lifting effort of the loader . . . a particularly important advantage when loading out hard-packed material or for stripping operations. Bucket level is automatically maintained when lifting load, preventing wasteful spillage. You can control speed of discharge . . . fast or slow, easily and gently. And, even with the "tilt back" action, you still have a 32° (from vertical) dump angle . . . a control range no other loader can match. You get bigger loads . . . *faster!*

The Oliver-Ware "B" loader was designed and built exclusively for Oliver Model "B" tractors. Its ideal fit with the tractor eliminates unneeded dead weight and assures maximum stability for the entire unit. The Oliver semi-rigid axle allows limited oscillation of the track, eliminating the possibility of track-frame distortion. A hydraulic shock absorber smooths out pressure surges . . . prevents damage to loader and tractor parts.

For complete information on how the Oliver-Ware Model "B" tractor loader can cut costs for you, see or write your Oliver Industrial Distributor.



Plenty of power, plus the wide angle of bucket rotation, assures faster, more positive digging. 28° "roll back" assures maximum break-out action for a full bucket every time.

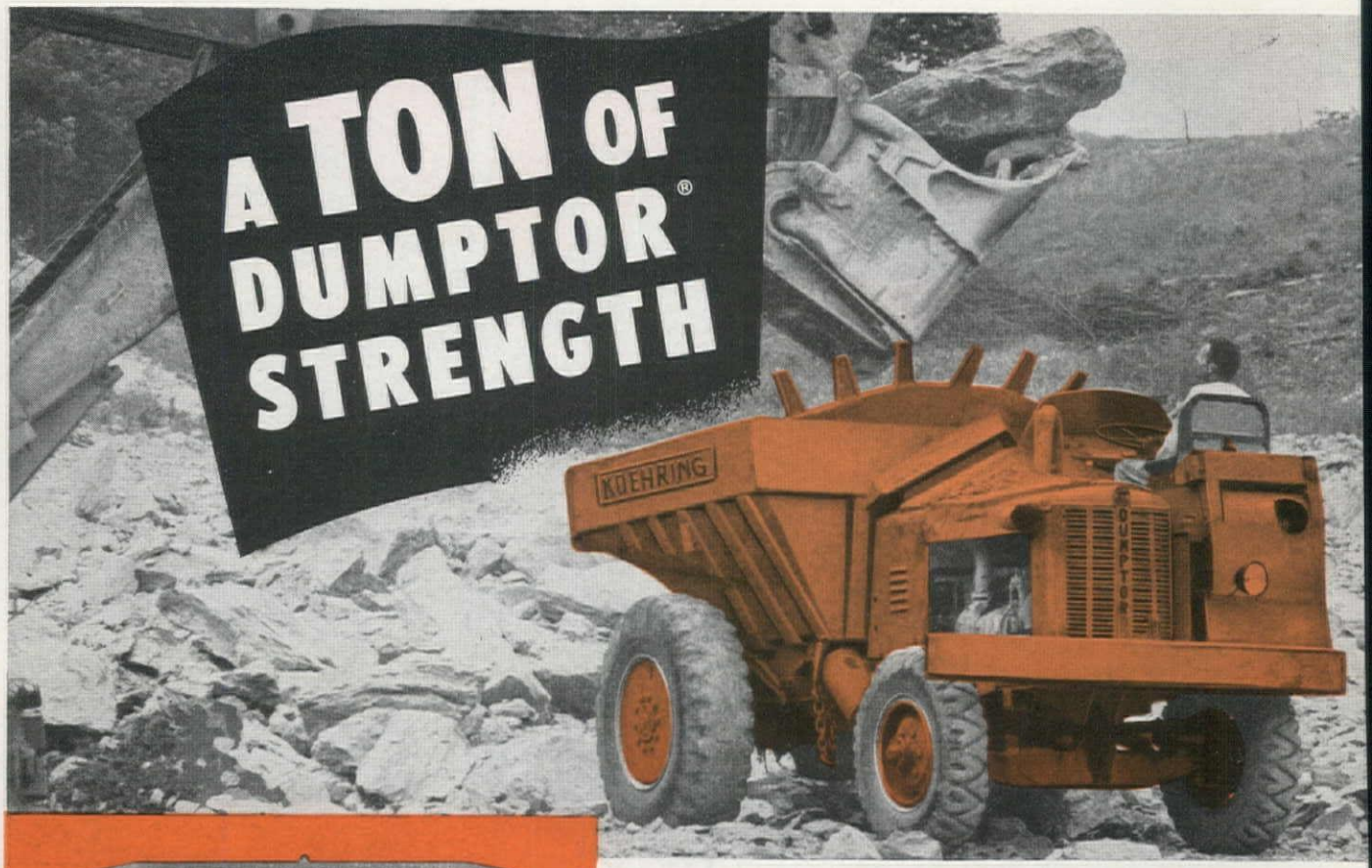


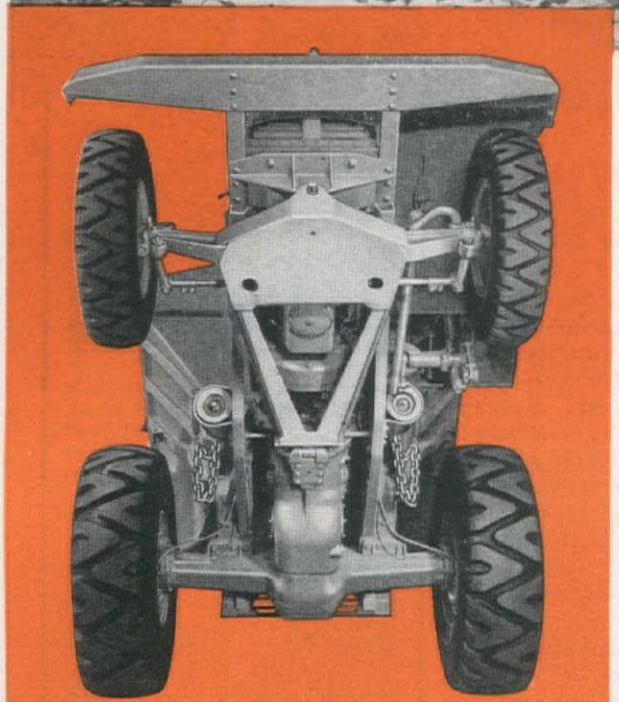
THE OLIVER CORPORATION

THE OLIVER CORPORATION

State of Arizona: Guerin Implement Co., Phoenix, 1401 S. Central St. *State of California:* Gustafson Tractor Co., Eureka; Mechanical Farm Equipment Dist., Inc., San Jose; Ashton Implement Co., Salinas; Comber & Mindach, Modesto; Cal-Butte Tractor Company, 820 Broadway, Chico; Tractor & Equipment Co., San Leandro; Flood Equipment Co., Sacramento; W. J. Yandle Co., Santa Rosa; Jim Ingle Co., Fresno, Hanford, and Tulare; Oliver Implement Co., Bakersfield and Shafter; Turner & Chapin, Whittier and Covina; Condosta Tractor Company, Colton. *State of Washington:* Inland Diesel & Machinery Company, Spokane; Pacific Hoist & Derrick Co., Seattle and Puyallup; Melcher-Ray Machinery Co., 202 East Alder Street, Walla Walla; Central Tractor and Equipment Co., Wenatchee. *State of Oregon:* Loggers & Contractors Machinery Co., Portland and Eugene. *State of Idaho:* Idaho Cletrac Sales Co., Lewiston and Cottonwood; Engineering Sales Service, Inc., Boise. *State of Montana:* Western Construction Equipment Company, Billings and Missoula. *State of Nevada:* B & M Tractor & Equipment Corp., 1420 S. Virginia St., Reno. *State of Utah:* Arnold Machinery Company, Inc., 433 W. Second South Street, Salt Lake City 1. *British Columbia:* Pacific Tractor & Equipment, Ltd., 505 Railway Street, Vancouver. *Alaska:* Herning Equipment Company, Box 1792, Fairbanks.

A TON OF DUMPTOR® STRENGTH





There's no "soft spot" on Dumptor's underside. One-piece, heavy cast steel housing protects drive axle and enclosed chain drive. Wishbone supports skid pole and shields the radius rod and engine crank case. Oscillating steering axle is supported by wishbone frame, wishbone oscillates with axle.

for every ton of payload

Dumptors stand up under the severest shocks of shovel-loading 1½ to 2½ yards of rock at a pass because they're built extra tough for rock handling. There's more than a ton of net vehicle weight for every ton of payload.

All-welded body sides, ends and bottom are heavily reinforced with 4" channel ribs. More than triple strength has been built into the bottom . . . seasoned 1⅝" oak timbers are securely bolted between two layers of 5/16" steel plate. Steel-oak-steel construction cushions shocks of rock loading. Free-swinging kick-out pan adds another tough 3/16" high manganese steel plate for extra protection.

Rugged main frame, 8" ship-channels, heavily trussed . . . one-piece steel drive-axle housing and transmission case . . . 4" chrome steel drive axles . . . and cast alloy steel "I" beam steering axle add extra strength to Dumptor chassis.

Heavy-duty construction like this assures you that Koehring 6-yard Dumptors stand up under your toughest assignments, that there will be little down time with Dumptors on your job.

CK223

KOEHRING HEAVY DUTY

SEE YOUR KOEHRING DISTRIBUTOR FOR COMPLETE FACTS

American Machine Co., *Spokane, Washington*
Pacific Hoist & Derrick Co., *Seattle, Washington*
Columbia Equipment Co., *Boise, Idaho, Portland, Oregon*
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McKelvy Machinery Co., *Denver, Colorado*
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JOHNSON Lo-Bin BATCHER

LO-BIN holds 8, 20, or 30 tons...

is easily charged by front-end tractor loaders. 8-ton Lo-Bin is only 7½' high; flared extension panels give 20-ton capacity at 8½' height, 30-tons at 9½' height. Furnished with 2, 3 or 4 compartments, up to 4 weigh beams, 22 or 44 cu. ft. weigh hoppers. Hopper rides out beyond end of track, dumps directly into mixer skip. Serves 28-S, 16-S, 11-S, 6-S mixers. Also furnished with bulk cement compartment arranged for 2 or 3 aggregates, 1 cement. Easily dismantled and moved by dump truck. Optional: wheels, pneumatic tires, tow-bar. Ask about Johnson mix plants, buckets, bins, silos.

AMERICAN MACHINE COMPANY	Spokane
BOW LAKE EQUIP. CO., INC.	Seattle
CRAMER MACHINERY CO.	Portland
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PARSONS TRENCHLINERS®

221 digs 16" to 36" wide, 8'-6" deep

. . . has 15 digging feeds, 3 bucket line and conveyor belt speeds, 4 travel speeds . . . plus full reverse of all operations for undercutting sidewalks, sewers, old mains, or making vertical set-ins. Shiftable boom cuts within 10" of side obstructions. Easy-in, easy-out "Tap-In" teeth assure top digging production in all soils. 1-minute, power-shift conveyor discharges either side, maintains constant height for loading trucks. Long, wide crawlers, well ahead of boom, have only 7 lbs. per sq. in. ground pressure. See us for more facts on this and on 4 other Parsons Trenchliners.

AMERICAN MACHINE COMPANY	Spokane
PACIFIC HOIST & DERRICK CO.	Seattle
COLUMBIA EQUIPMENT CO.	Boise, Portland
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KWIK-MIX 16-S DANDIE® and MOTO-BUG®

16-S is interchangeable side to end

. . . axles are quickly changeable on square frame for side or end discharge. 16-S also has: adjustable skip shaker with contact at each side of skip . . . heavy cast-steel drum heads with machined roller paths . . . coil spring mounting . . . automatic water system . . . 8-second discharge with tilted Flow-Line Chute. Tower attachment available. Also: 3½-S, 6-S, 11-S; bituminous and plaster-mortar mixers.

MOTO-BUG . . . labor-saving 10 cu. ft. power wheelbarrow (illustrated) has full power forward and reverse, climbs 20% ramps fully loaded. Operator rides on step.

AMERICAN MACHINE COMPANY	Spokane
PACIFIC HOIST & DERRICK CO.	Seattle
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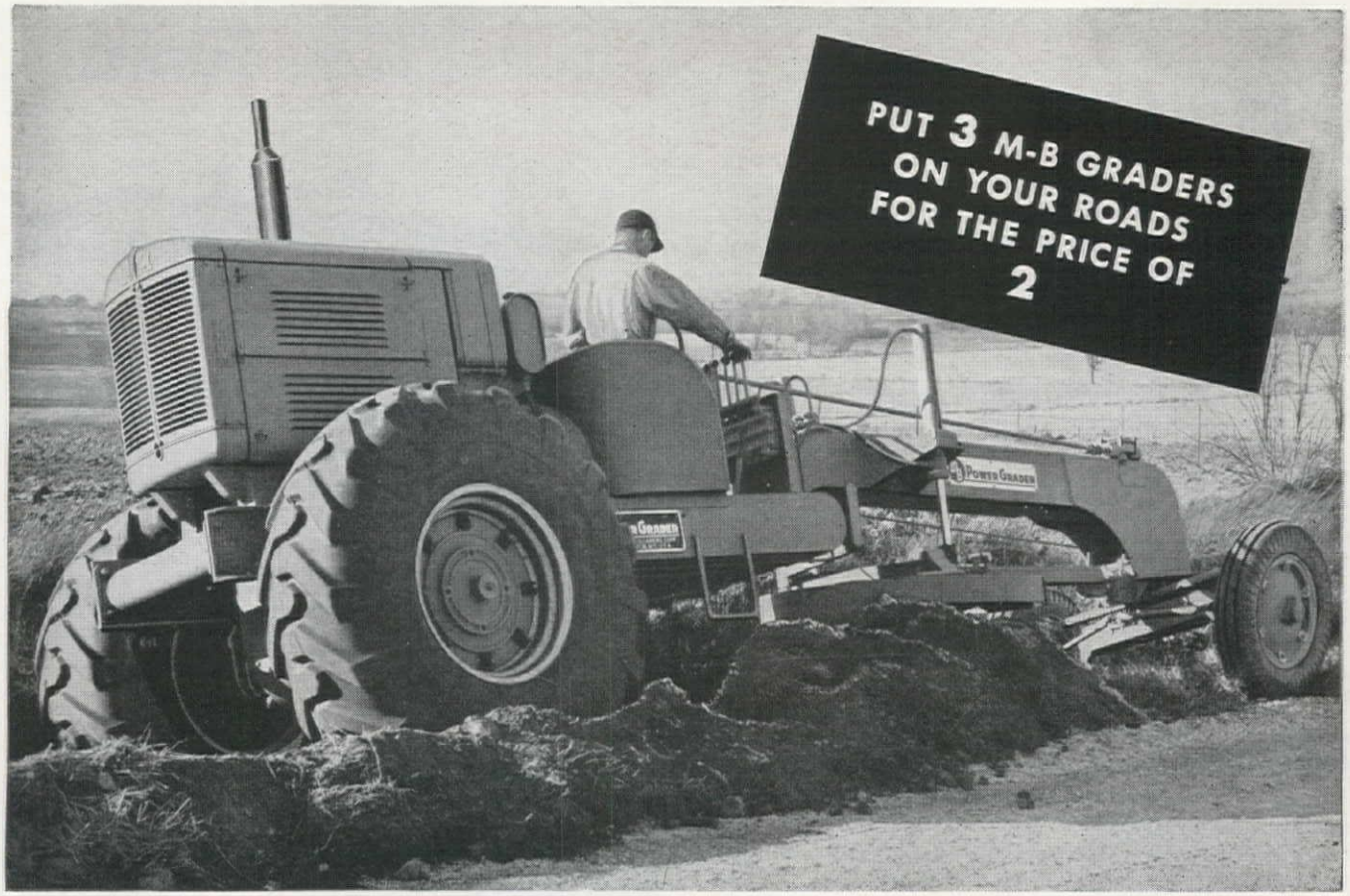
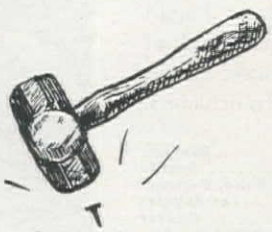


HANDLE THE VITAL 90% OF YOUR WORK

Actual field studies reveal that over 90% of a grader's time is spent on ditch to ditch operation; only 5% on cutting banks, another 5% on oil mix and odd jobs. So why pay for heavy duty, high priced graders with features that are useable only 5 to 10% of the time. The M-B 501 will handle V or flat bottom ditching; 2:1 backslopes; grading, scarifying, light oil mixing, snow plowing — the vital 90% of your work.



You wouldn't drive a tack with a sledge hammer. So why use large, heavy, expensive motor graders to handle the average type of work. More and more public bodies are stretching their road dollars by purchasing fleets of *three* M-B 501 motor graders for the same price as *two* large graders. They can thereby work on more sections of road at the same time, maintain more miles of road per day, reduce travel time to and from jobs and maintain roads more frequently. Larger motor graders can then be released for the heavy jobs.

The M-B, No. 501 will fit your exact requirements. 17,500 lbs. of weight, 50 H.P. engine, and more traction than any other grader in its class. Send for literature today.

MEILI-BLUMBERG CORPORATION

1633 WISCONSIN STREET • NEW HOLSTEIN, WISCONSIN

EDWARD R. BACON CO. — San Francisco, Sacramento, Fresno, Oakland, Stockton, California	CASEY METCALF MACHINERY CO. — Los Angeles, California
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HOWARD-COOPER CORP. — Seattle, Washington	SAWTOOTH CO. — Boise, Twin Falls, Idaho
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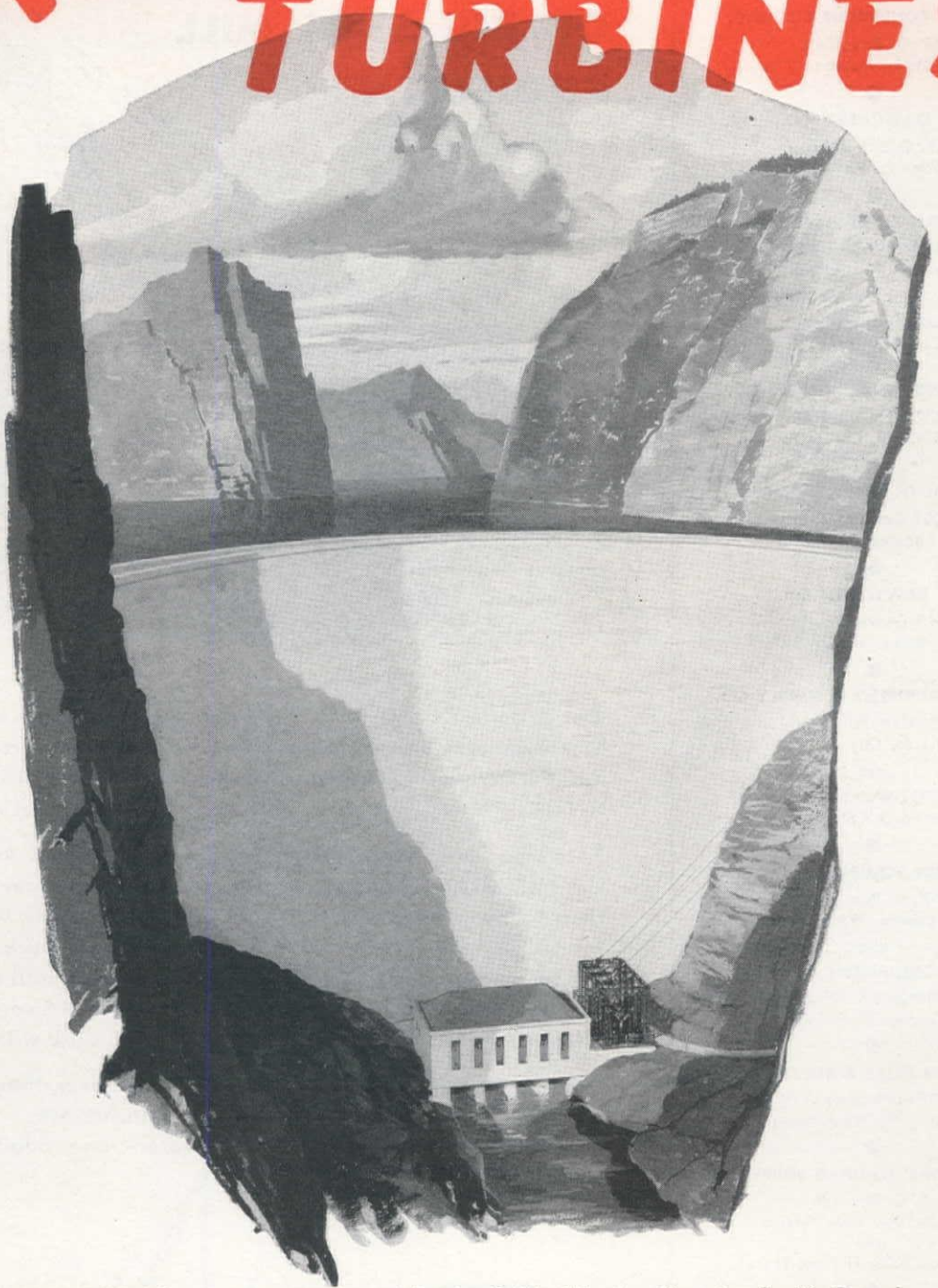
FRANCIS TURBINES



SUPPLYING a fundamental need in the field of hydraulics, the Smith-Francis Turbine has been in the forefront of the industry for many years. It is ideal for that long range of heads existing between the lower medium and very high. Completely described in a new Bulletin No. 152—just off the press! Write for your copy NOW!

S. MORGAN SMITH CO., YORK, PENNA.

POWER by SMITH

SEE YOUR

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WORKS BOTH ENDS

ON BIG STEEL MILL PROJECT...

Get it done . . . and fast! That's the "word" at the site of U. S. Steel Company's new Fairless Works. And that's the reason James Armour Excavating Company is using two MICHIGAN Truck Cranes to handle and distribute materials at this huge steel mill project.

Here's just one example cited by operator Randall Auer: One of the MICHIGANS transferred pipe from a freight car to a truck, then followed the truck to a spot half-a-mile away where it unloaded the pipe. It then accompanied the empty truck back to the car for another load. The process was repeated until all the pipe had been removed from the car. Only MICHIGAN'S *speed and mobility* made it possible to work both ends of this job with one crane.

When *you* need an excavator-crane that has everything you want *plus* speed and mobility, investigate MICHIGAN . . . most complete line of ⅜-yard and ½-yard excavator-cranes available. Write for full details.

MICHIGAN POWER SHOVEL COMPANY

430 Second Street, Benton Harbor, Michigan, U. S. A.

Big Producers!

NEW "CAT" DW20 TRACTOR AND W20 WAGON
NEW "CAT" DW21 TRACTOR AND NO. 21 SCRAPER

THESE power twins are the largest earthmovers ever engineered by "Caterpillar." They combine high speeds with high capacities to meet today's demands for increased production for both civilian and military needs. They give construction men the choice of two or four wheels in husky hustlers built to stand up under the toughest going.

For big production on long hauls, you can't beat the 4-wheel "Cat" DW20 with its top speed of 26.6 m.p.h. The DW20 offers two matched trailer units. The W20 Wagon—heaped capacity, 25 cu. yds. And the No. 20 Scraper—heaped capacity, 19½ cu. yds. The DW20 is also available with the No. 20S Bulldozer.

For big production on jobs best suited to 2-wheel rigs, you've got the edge with the "Cat" DW21. Trailing the No. 21 Scraper, which has a heaped capacity of 19½ cu. yds., its top speed is 20 m.p.h.

Both these speedy giants are powered by the new 6-cylinder "Cat" Diesel Engine, producing 225 HP. available at the flywheel. For complete data, see your "Caterpillar" dealer. Under today's conditions, it's a good move to talk over your requirements *now* with him. He's as close as your phone for service or information—call him today!

CATERPILLAR, SAN LEANDRO, CALIF.; PEORIA, ILL.

CATERPILLAR
REG. U. S. PAT. OFF.

DIESEL ENGINES • TRACTORS • MOTOR GRADERS
EARTHMOVING EQUIPMENT

The A-B-C of Bucyrus-Erie Hydraulic Dredge Leadership

Analysis

Bucyrus-Erie studies your requirements from every angle — water conditions, type of material to be handled, desired capacity, maximum and minimum digging depths, distance to spoil area, available power, etc. Specifications are then drawn to fit these conditions.

Building

Bucyrus-Erie hydraulic dredges are built to provide an extra margin of strength and dependability above the user's minimum requirements. Bigger, stronger cables, larger diameter drums, deeper and stronger hulls, extra tough alloy steels — these are but a few of the places where Bucyrus-Erie gives added measure for better dredge performance.

Control

From drawing board to delivery, Bucyrus-Erie dredges are built under *one-company* responsibility and control. Casting, metal-hardening, machining, assembling and testing are done in Bucyrus-Erie's own shops — by skilled workmen with years of dredge experience. When you get a Bucyrus-Erie dredge — hydraulic, dipper or placer — you can rest assured it's the dredge for your job. 39D51

Bucyrus-Erie Company • South Milwaukee, Wisconsin

BUCYRUS ERIE

It takes more than machines!

It takes more than machines to tackle the tough road-building job known as the Dublin Section of the Highway 50 Freeway, 23 miles east of Oakland. It takes teamwork...the kind that the Fredrickson & Watson Construction Co. of Oakland know they could count on from the General Petroleum Lubrication Engineers who've been working side by side with them on other rugged highway jobs.

With more than 850,000 yards of fill to move, F. & W.'s equipment has been running on precise schedules... their DW-20 "Jeeps" make a 4½-mile round trip every 20 minutes, picking up and depositing their haul. And with each load weighing more than 31 tons, there's no room for fuel shortages or lubrication failure.

According to company president Oscar Fredrickson, "G. P.'s lube engineering has saved us lots of time and money... no wonder we like to do business with them."

You'll feel that way, too, with General Petroleum's qualified representatives on your team providing you with proven Delvac lubricants plus the added know-how which will help keep your equipment operating at peak capacity. Get in touch with your G. P. Contractors Representative today!

Up a hill on the way to the dirt pit is a Caterpillar DW-20. The 4½-mile trip is made every 20 minutes.

Fredrickson & Watson superintendent Bob Calou (second from right) and assistant superintendent Gordon Johnson (left) talk over lubrication problems with G.P.'s Walt Cooley and Nick Buchanan (right).

Mobiloil

3-210

GENERAL PETROLEUM CORPORATION

—converting nature's gift to better living.

A "North Country" trapper...like Cast Iron Pipe...has STAMINA*!

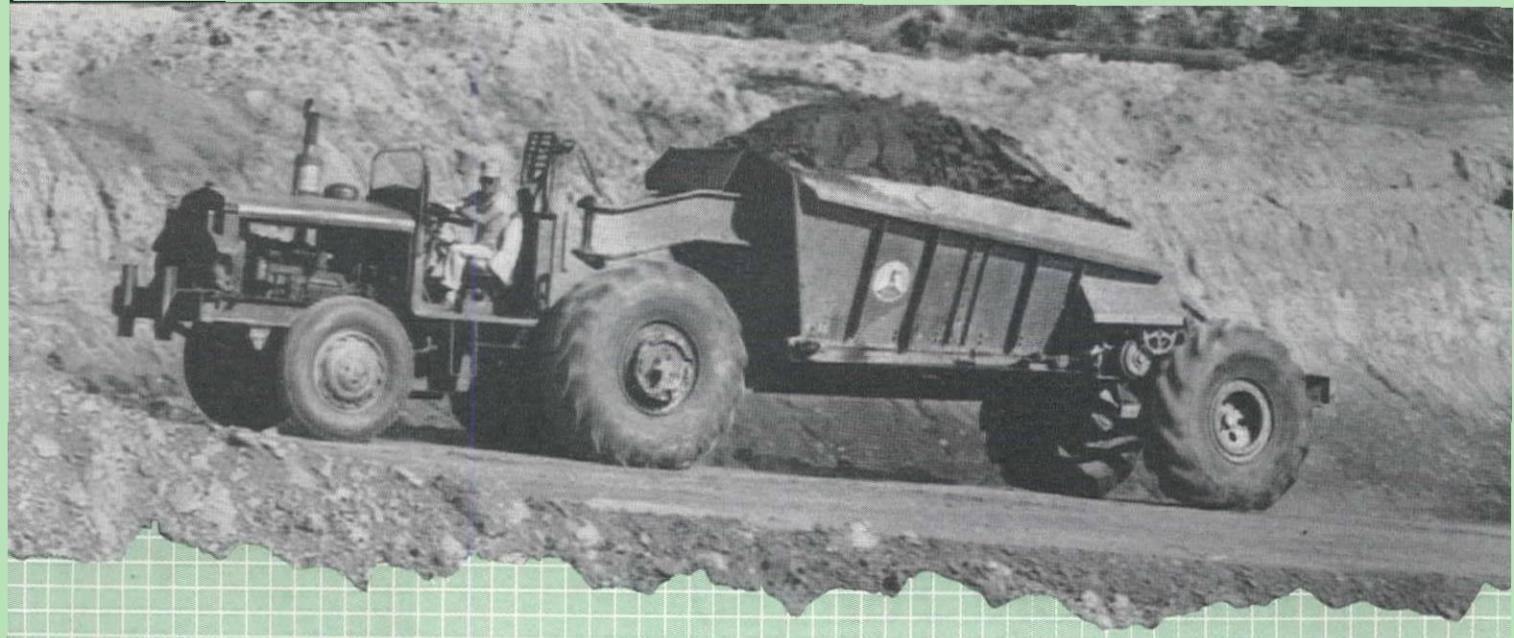
Trekking long distances in the frozen North, on a trapline or behind a dogsled, demands stamina! And, just as surely, pipe *must* have stamina to serve for a century or more as cast iron water and gas mains are doing in more than 30 cities in the United States and Canada. In the generations since these gallant old mains were installed, horse-drawn vehicles have given way to multi-ton trucks and buses. Under the streets crowded utility services have been constructed. Yet cast iron pipe has withstood the resultant traffic-shock and beam-stresses because of its shock-strength, beam-strength and crushing-strength. *No pipe, deficient in any of these strength-factors of long life, should ever be laid in paved streets of cities, towns and villages.*

CAST IRON PIPE ®

SERVES FOR CENTURIES

* In a 340-mile midwinter race against death to bring serum to Nome, Alaska, a dog-team and driver covered more than 90 miles in a single day—a feat still remembered after 25 years.

Cast Iron Pipe Research Association, Thos. F. Wolfe, Managing Director, 122 So. Michigan Ave., Chicago 3.



More Production... at LESS COST

EUCLID
THE PIONEER

PROVED on hundreds of off-the-highway construction and industrial jobs, and in open pit mines and quarries, "Eucs" have the capacity and speed to move more loads faster and at lower cost.

There is a Euclid model for every off-the-highway hauling requirement. Rear Dump "Eucs" of 10 to 34 ton capacity have travel speeds up to 36.3 m.p.h. and are powered by diesel engines of 125 to 400 h.p. Bottom-Dump Euclids range in capacity from 13 to 25 cu. yds., have top loaded speeds up to 34.4 m.p.h., and diesel engines of 190 to 300 h.p.

The Euclid Scraper has proved its dependability and efficiency on the construction of roads, levees, airports and in open pit mining. The Euclid Loader, teamed with the Euclid Bottom-Dump, has set records for low cost earth moving on a wide range of jobs.

You get more production at less cost with Euclids. Call your Euclid Distributor for help with your off-the-highway hauling problems, or write for information on the complete line of Euclid equipment.

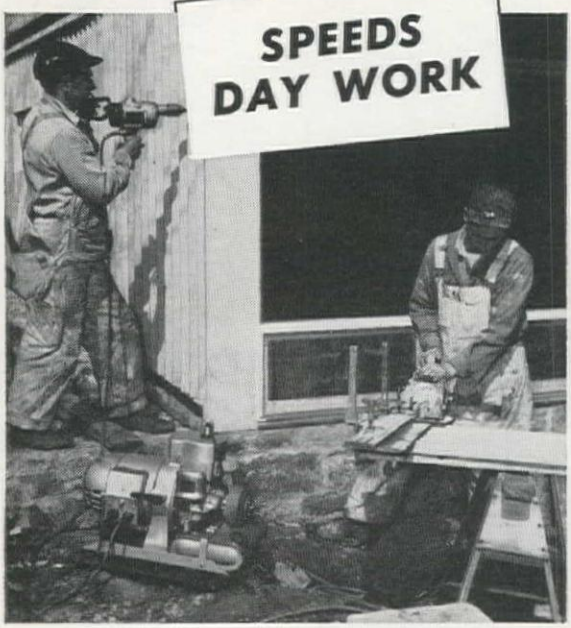
The EUCLID ROAD MACHINERY Co., CLEVELAND 17, OHIO
CABLE ADDRESS: YUKLID — CODE: BENTLEY

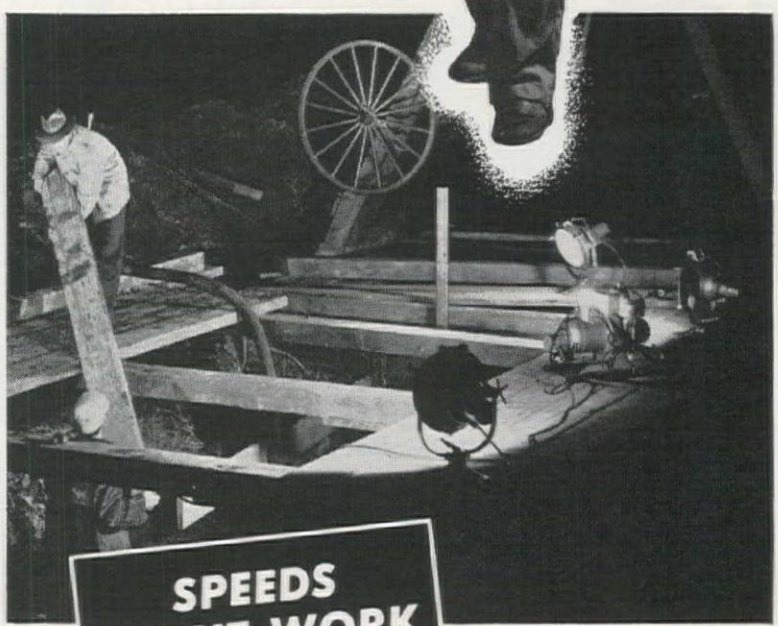
EUCLIDS *Move the Earth*

A HOMELITE GENERATOR

Will Work For You Right Around the Clock

Hours don't mean a thing to a Homelite Carryable Generator. It will work for you, save for you . . . sixty minutes an hour, twenty-four hours a day.





With a Homelite Carryable Gasoline Engine Driven Generator, you get plenty of power to operate time-saving, cost cutting electric tools. Yes, and you can get this power instantly. No delays for power installation. No long, troublesome, power-hungry cables. One man can carry it any place you need it and it will operate continuously without trouble, in any kind of weather.

In addition to operating electric tools, you can operate brilliant floodlights with a Homelite Carryable Generator. On night work, you can speed operations and make it safer for your men. One Homelite Generator will run several floodlamps, giving you bright, flickerless light over a large area . . . any area on any part of your job.

Manufacturers of Homelite Carryable Pumps • Generators • Blowers • Chain Saws

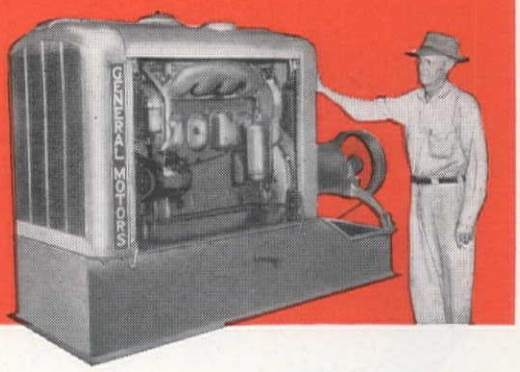
PERFORMANCE · DEPENDABILITY · SERVICE

Ask for a free demonstration of Homelite Carryable Generators. Write today.

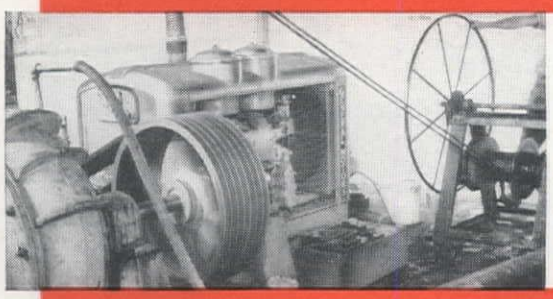
HOMELITE CORPORATION

1312 RIVERDALE AVENUE • PORT CHESTER, N. Y.

FASTER PUMPING Lower Costs with GM DIESEL POWER



Dawes Silica Mining Co., Inc., of Thomasville, Georgia uses four GM Diesel engines on sand pumping barges. Typical of their equipment is this 4-cylinder GM which replaced a competitive make Diesel. It is hooked up to a Georgia Iron Works 6" pump that lifts sand from the Ochloknee River and discharges it 1500 feet away at a total rise of 64 feet. Normal production for a 10-hour day amounts to 500 tons at a total fuel cost of only $6.25.



Davenport Sand Co., Inc. of Davenport, Florida replaced another make of Diesel with a 6-cylinder GM engine and production shot up 20%. Dredging at 60 foot depth with a 6" pump, this unit averages 90 yards of sand per hour with a fuel cost of less than one cent a yard. Low initial cost, high power-to-weight ratio and extreme compactness were factors that influenced Davenport's switch to GM Diesel power.

Brandenburg Bros., of Bellwood, Nebraska, uses a 4-cylinder GM Diesel on an American 6" pump. The Diesel replaced a gasoline engine and pumps 25 to 30 yards of sand and gravel per hour from a maximum depth of 20 feet to a bin 22 feet above water line. Engine uses 3 gallons of Diesel fuel per hour as against 5 gallons of gasoline with old engine. Owner reports GM Diesel started in spring at first touch of starter button after being on open raft all winter.

YES, indeed, GM is the Diesel sand and gravel operators prefer because it packs more power in less space—starts at the press of a button—uses fewer gallons of low-cost fuel—and keeps running month after month with minimum attention. For the complete story of this modern two-cycle Diesel power, see your GM Diesel distributor or drop us a line.

ANSWER THE CALL CIVIL DEFENSE

DETROIT DIESEL ENGINE DIVISION

SINGLE ENGINES...*Up to 275 H.P.* **DETROIT 28, MICHIGAN** MULTIPLE UNITS...*Up to 800 H.P.*

GENERAL MOTORS

GM GENERAL MOTORS DIESEL POWER

DIESEL BRAWN WITHOUT THE BULK

prevents wear on seats of

CHAPMAN

Tilting-Disc CHECK VALVES

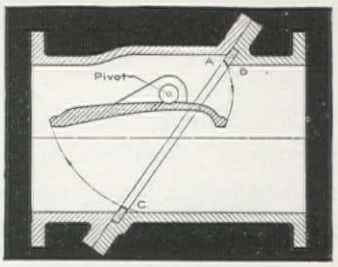
Here's the check valve with the balanced disc which is cushioned to a quick and quiet closure by the flow of gases or fluids as you can see in the cross-section at the right.

This smooth action prevents undue wear on seats, hinge pins and bearings . . . *and on your maintenance budget!* For there's no loosening of lines by vibration, no opened joints or ruptured pipes.

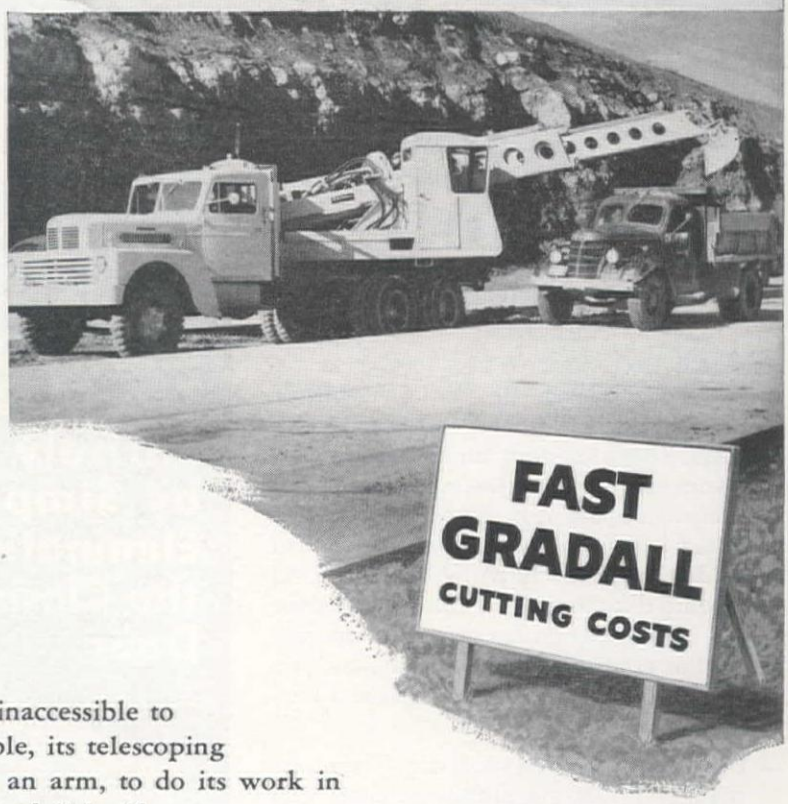
What's more, head losses are 65% to 80% less than conventional swing-type checks. Available in iron or steel in all standard pipe sizes. Get the complete story on this and other cost-cutting features of Chapman Tilting-Disc Check Valves, in the latest bulletin, No. 30. Send for your copy now.

THE CHAPMAN VALVE MFG. CO.

INDIAN ORCHARD, MASSACHUSETTS



Cross-section of the Chapman Tilting-Disc Check Valve illustrating the way that the balanced disc is supported on the pivot, with arrows showing the travel of the disc. A feature of the design is that the disc seat lifts away from the body seat when opening, and drops into contact when closing, with no sliding or wearing of the seats.



Are you satisfied with your present hand labor costs? If you're like most construction men, your answer is probably an emphatic "NO"!

Hand labor *is* expensive—because it's *slow*.

But that's *not* the situation when you put a Gradall on the job!

The operator works with large tools, quickly changed for each particular job. He moves large quantities of earth rapidly, with such precision that clean-up hand labor is practically eliminated.

And the Gradall works in "tight" places inaccessible to other machines. Mounted on a 360° turntable, its telescoping boom "reaches out", twists and turns like an arm, to do its work in confining areas not much larger than the Gradall itself. And it's always "ready to go"—ready immediately to be driven to the next job at truck speed.

Cut your construction costs on many jobs, such as trenching, excavating, ditching, backfilling, grading, and pavement removal. Arrange a field demonstration with your Gradall Distributor today.

SALES & SERVICE:

COLUMBIA EQUIPMENT CO. • *Portland, Ore.* • *Boise, Idaho* • *Seattle, Wash.*
BROWN BEVIS CO. • *Los Angeles 58, Calif.*
ARIZONA EQUIPMENT SALES, INC. • *Phoenix, Arizona*
CONTRACTORS MACHINERY CO. • *San Francisco 7, Calif.*
WESTERN CONSTRUCTION EQUIPMENT CO. • *Billings, Montana*

Gradall®
DIVISION OF WARNER & SWASEY *Cleveland*

GRADALL—THE MULTI-PURPOSE CONSTRUCTION MACHINE

Faster Digging Teeth ...for Less Money

...to fit all dippers and buckets

Now stocked by dealers in every major city in the United States and Canada, *ESCO* adapters and box-type points will put speed in your digging and give you lower cost per yard.

ESCO adapters, which take the strain and shock of digging, are

Cast of shock and wear resisting alloy steel.

Heat treated for greater toughness and wear.

ESCO box-type points fit the adapters perfectly, and are held securely in place by rubber plugs and alloy steel pins. Points are

Self-sharpening design, with flame hardened tips.

Quickly changed.

Stocked in four basic widths, with a variety of shapes for special purposes.

Available Now

ESCO bulletin 187, "*ESCO* Box-Type Points and Adapters", tells the whole story of these cost-cutters. Get your copy from your nearest *ESCO* dealer, or send us the filled-in coupon.

ESCO

Dippers, Hoe Dippers, Dragline and Coal Loading Buckets

ELECTRIC STEEL FOUNDRY

2163 N. W. 25th Avenue, Portland 10, Oregon

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IN CANADA — ESCO LIMITED, VANCOUVER, B. C.

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Representatives in all Major Cities

ELECTRIC STEEL FOUNDRY
2163 N. W. 25th Avenue, Portland 10, Oregon

Please send me a copy of Bulletin 187, "*ESCO* Box-Type Points and Adapters"

Name_____

Company_____

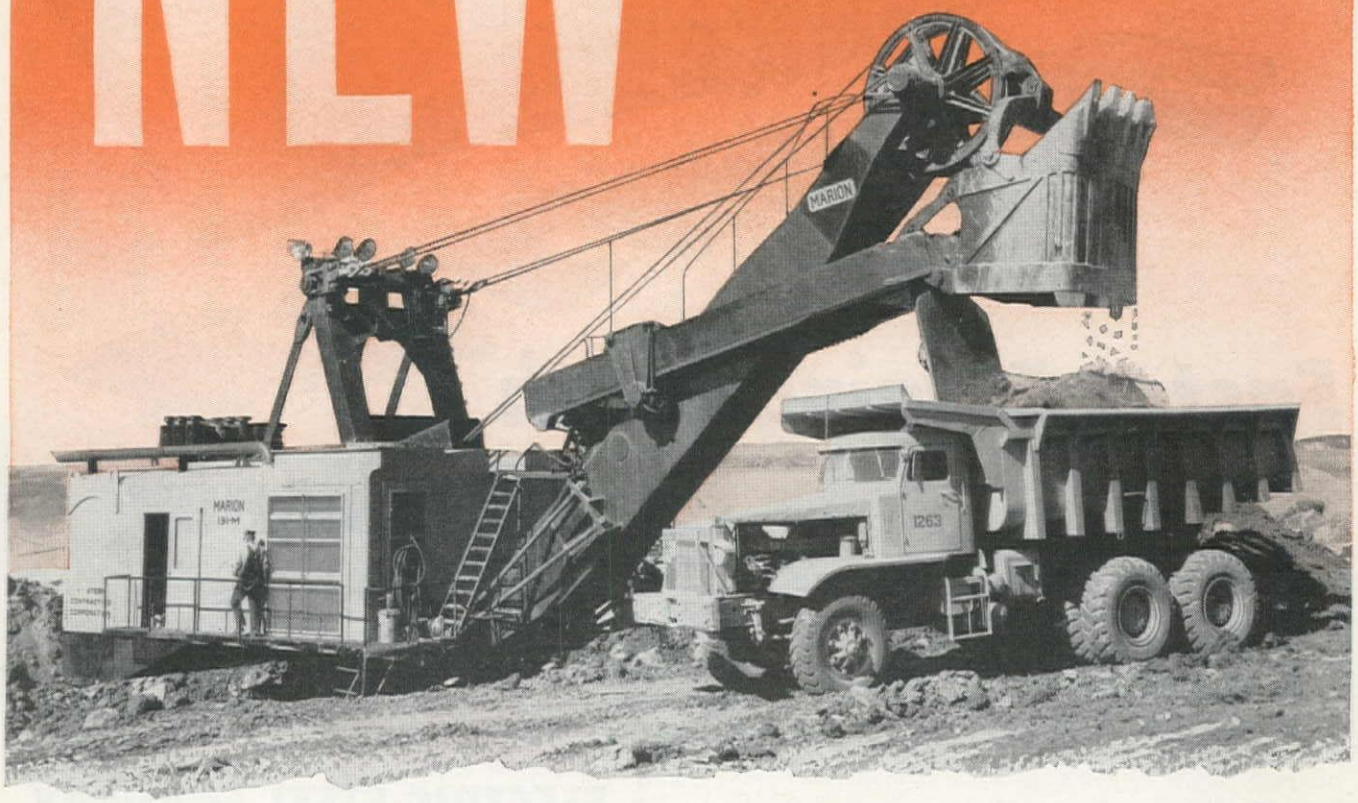
Address_____ Zone_____

City_____ State_____

NEW

THE WORLD'S BIGGEST LOADING SHOVEL

MARION 191-M
10 cubic yards



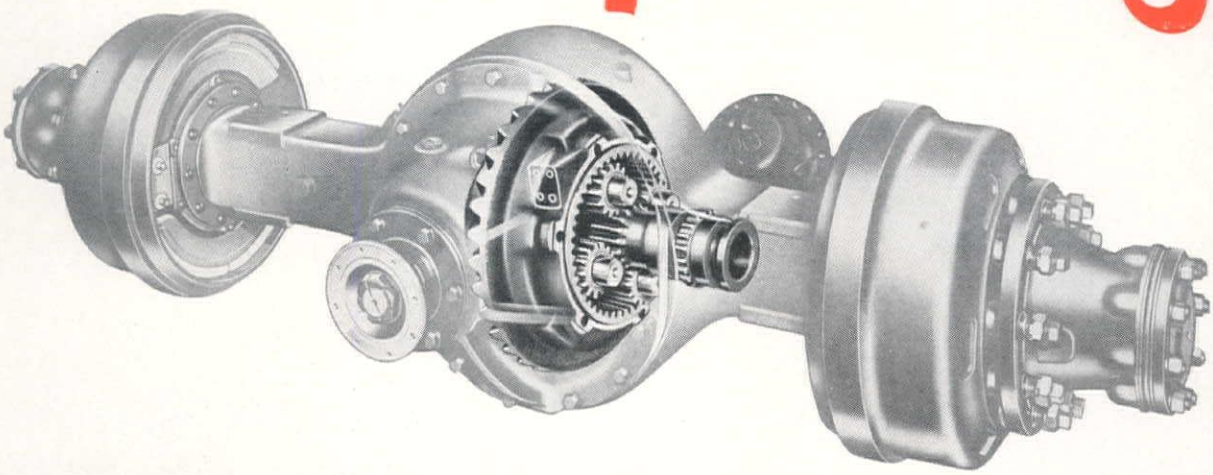
- Loads trucks in the 50-ton class in 3 or 4 passes to meet big haulage problems.
- Big enough to load gondola rail cars quickly.
- Greater travel speed and maneuverability than most of smaller machines.
- All-electric or diesel electric power; Ward-Leonard control on both.
- A 10 cu. yd. heavy-duty shovel with small-machine cycle time.
- Largest two-belt crawler shovel built.

MARION POWER SHOVEL CO.
MARION, OHIO, U. S. A.

OFFICES AND WAREHOUSES IN ALL PRINCIPAL CITIES

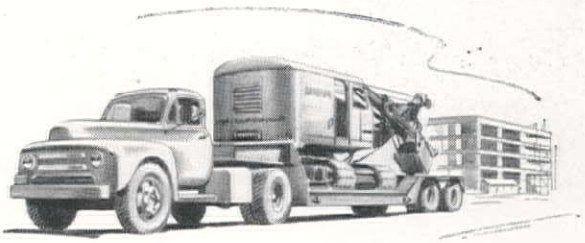
from 3/4 cu. yd. to 45 cu. yds.

Planetary Gearing



saves stress & wear- adds to axle life!

WITH Eaton's planetary construction, gear tooth loads are distributed over four "planet gears," holding stress and wear on any one gear tooth to a minimum. These four gears are completely locked out in the high speed range. In the low speed power range, they rotate at slow speeds. The result is quiet operation; easy, clash-free shifting at all truck speeds; minimum wear; materially longer axle life. The rugged planetary design and forced flow lubricating system—both exclusive Eaton features—enable Eaton 2-Speeds to set unequalled life and performance records. Your truck dealer will explain how Eaton 2-Speeds also reduce stress and wear on the engine and power transmitting parts—how they help your trucks haul more, faster, longer, at lower cost.



Axle Division
EATON MANUFACTURING COMPANY
CLEVELAND, OHIO

EATON
2-Speed Truck
AXLES

PRODUCTS: Sodium Cooled, Poppet, and Free Valves • Tappets • Hydraulic Valve Lifters • Valve Seat Inserts • Jet Engine Parts • Rotor Pumps • Motor Truck Axles • Permanent Mold Gray Iron Castings • Heater-Defroster Units • Snap Rings Springtites • Spring Washers • Cold Drawn Steel • Stampings • Leaf and Coil Springs • Dynamatic Drives, Brakes, Dynamometers

Guard Your Family STRIKE BACK!

GIVE to Conquer Cancer

IF SOMEONE IN YOUR FAMILY HAD CANCER, you would do anything . . . everything that would help. And today there is so much that you can do to help. Tens of thousands of families just like yours meet cancer every year and triumph over it. But we are still losing too many men and women we love.

Doctors can now cure half of those who develop cancer if the disease is diagnosed in its early stages. Yet in 1950 some 210,000 families lost a father, a mother or a child to cancer. Many of them—probably 70,000—could have been cured.

To save more lives, we all must help.

Your gift to the Cancer Crusade will help guard your family by providing more research, more life-saving education, more training for scientists and physicians, more equipment, more services for those already striken with the disease.

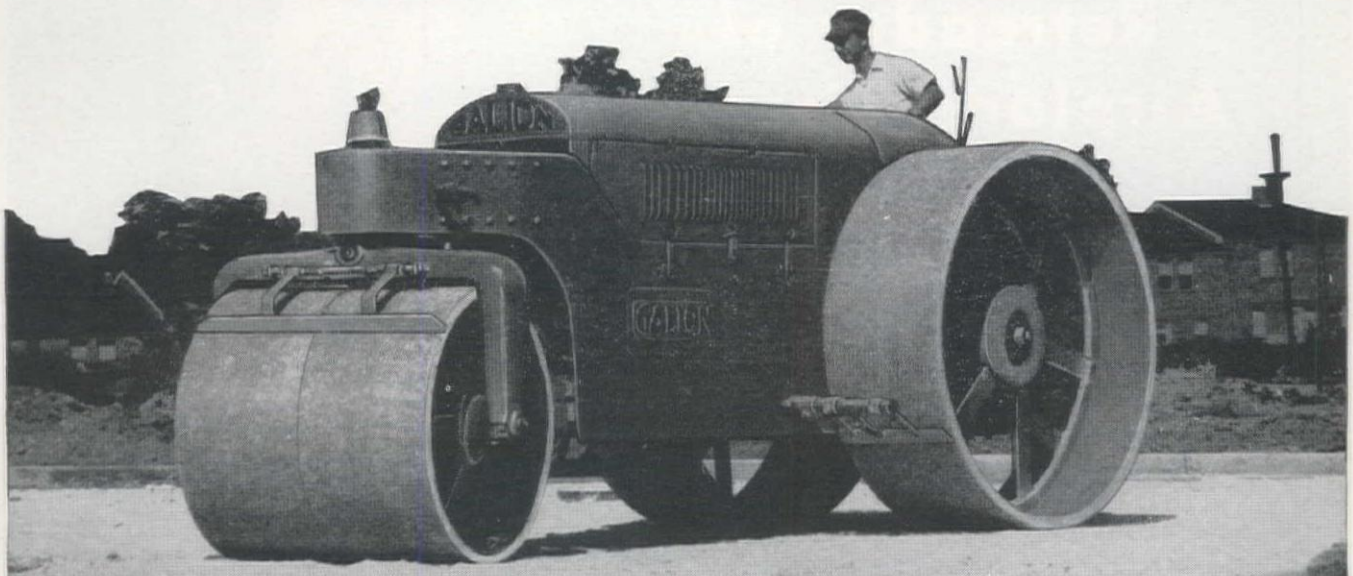
Cancer is man's worst enemy. Striking back at cancer costs money. Any contribution is welcome but, the fight against this major threat deserves major support: dollars—tens—twenties —hundreds of dollars. Will *you* help?

AMERICAN CANCER SOCIETY

RUGGED
GALION 3-WHEEL ROLLERS

The Galion "CHIEF" has long been recognized as the leader in the field of heavy rollers for rugged primary compaction work. Made in 10 and 12 ton sizes. The smaller size "WARRIOR" roller is available in 6, 7, and 8 ton sizes.

Both the "CHIEF" and "WARRIOR" rollers are available with cast non-ballastable rolls or steel variable weight ballastable rolls.



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Tuscon.....F. RONSTADT HARDWARE CO.

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UTAH:
Salt Lake City 1.....ARNOLD MACHINERY COMPANY

WASHINGTON:
Seattle.....NELSON EQUIPMENT COMPANY
Spokane.....MODERN MACHINERY CO., INC.
Portland, Oregon.....NELSON EQUIPMENT COMPANY

WYOMING:
Cheyenne.....CHEYENNE TRUCK EQUIP. CO.

GALION
ESTABLISHED 1907 **MOTOR GRADERS · ROLLERS**

THE GALION IRON WORKS & MFG. CO., General and Export Offices — Galion, Ohio, U. S. A.
Cable address: GALIONIRON, Galion, Ohio

LONGEST WEARING OFF-THE-ROAD RETREADS

by World's Largest Retreader of Airplane Tires

In heavy construction and other off-the-road hauling, Thompson *Special Purpose* Retreads are specially designed for longest wear and greatest traction. Their unique design permits reversing of the tire for uniform wear. Equal traction is provided either forward or backward . . . whether through mud, snow, sand or gravel . . . over rocks or along highways. Lugs and running ribs have the correct slope to prevent undercutting when the tire is heavily loaded.

Spot repair costs are practically non-existent with Thompson retreads because the new rubber extends far down the sidewalls to replace most all of the old scuffed rubber.

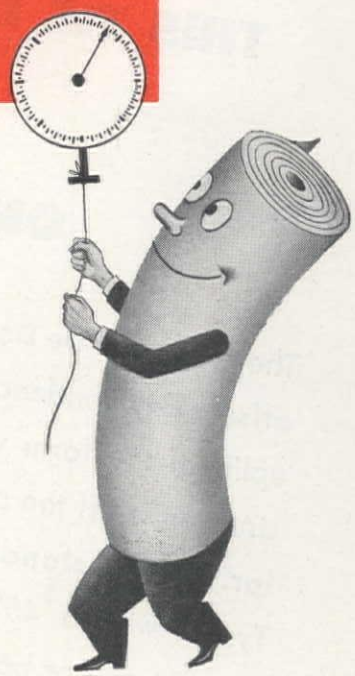
Retreading quality of the standard required by the world's leading airlines is a Thompson exclusive in the retreading of off-the-road tires. *Contact Thompson for prompt and efficient service.*

THOMPSON *Special Purpose* RETREADS

THOMPSON *Aircraft Tire* CORPORATION

18th and Minnesota Streets • San Francisco 7, California • MIssion 7-7320

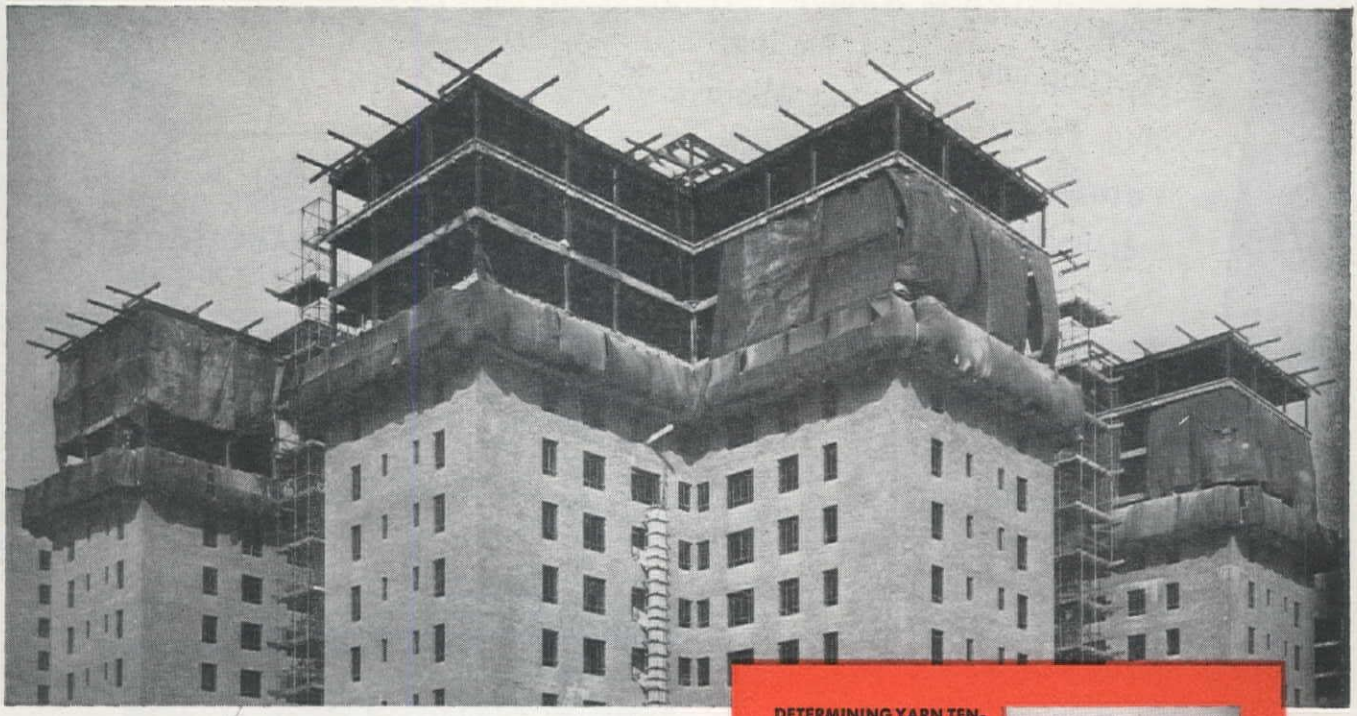
UNIFORMITY
Makes the Big Difference in TARPAULINS



MT. VERNON EXTRA

Gives You Greater Fabric Uniformity

The greater uniformity of Mt. Vernon Extra Duck assures you the two most important qualities you want in tarps—top protection and top wear. You'll find your repair and replacement costs reduced considerably.



Mt. Vernon-Woodberry Mills

TURNER HALSEY
COMPANY
Selling Agents
40 WORTH ST. · NEW YORK

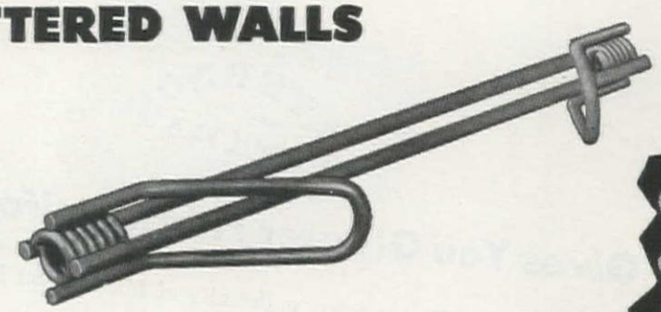
Branch Offices: Chicago • Atlanta • Baltimore
Boston • Los Angeles • Akron

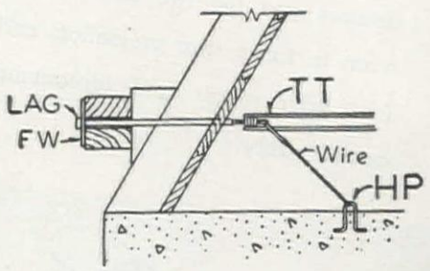
DETERMINING YARN TENSILE STRENGTH WITH 300-LB. VERTICAL TEST. One of a series of comprehensive laboratory controls throughout production to assure uniformity in all Mt. Vernon-Woodberry products.

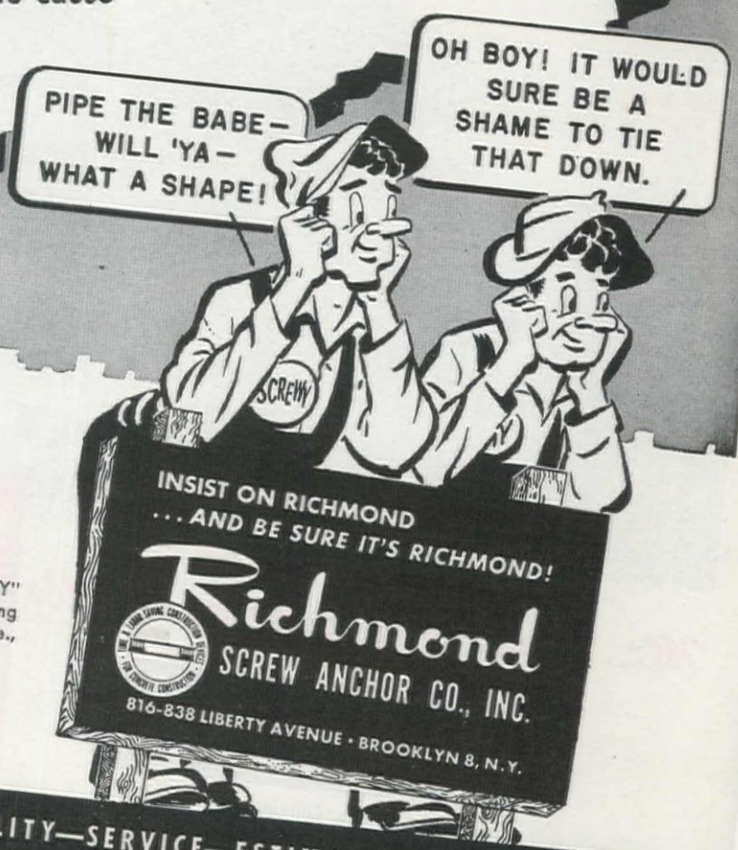
ENGINEERED TYING DEVICES, ANCHORAGES and ACCESSORIES for CONCRETE CONSTRUCTION

THIS TIE DOWN TYSCRU PREVENTS UPLIFT ON BATTERED WALLS

The Richmond Tie Down Tyscru offsets any tendency towards uplift of the form where construction is off the perpendicular. It is a standard 2-strut Tyscru with a 45° Tie Down Loop at one or both ends. The loop is wired to a Hairpin or Ty-Loop imbedded in the footing. Particularly useful where extreme batter tends to cause an uplift in the form.

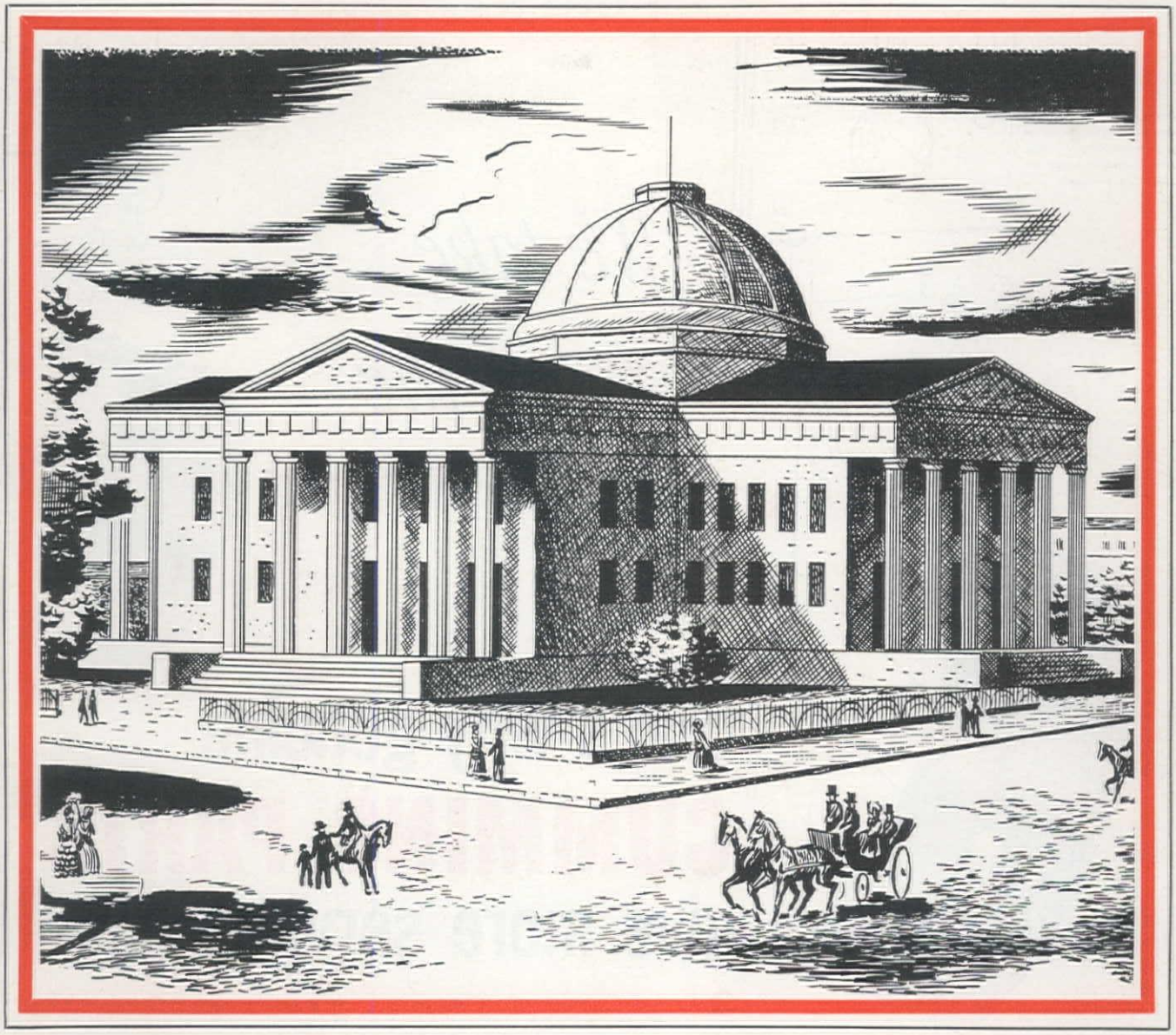






Get your "Screwy" or "TY" button—write to A. H. Pilling at Richmond, 816 Liberty Ave., Brooklyn 8, N. Y.

RICHMOND KNOW-HOW—DEPENDABILITY—SERVICE—ESTIMATES & JOB PLANNING



The old courthouse in St. Louis as it looked 100 years ago

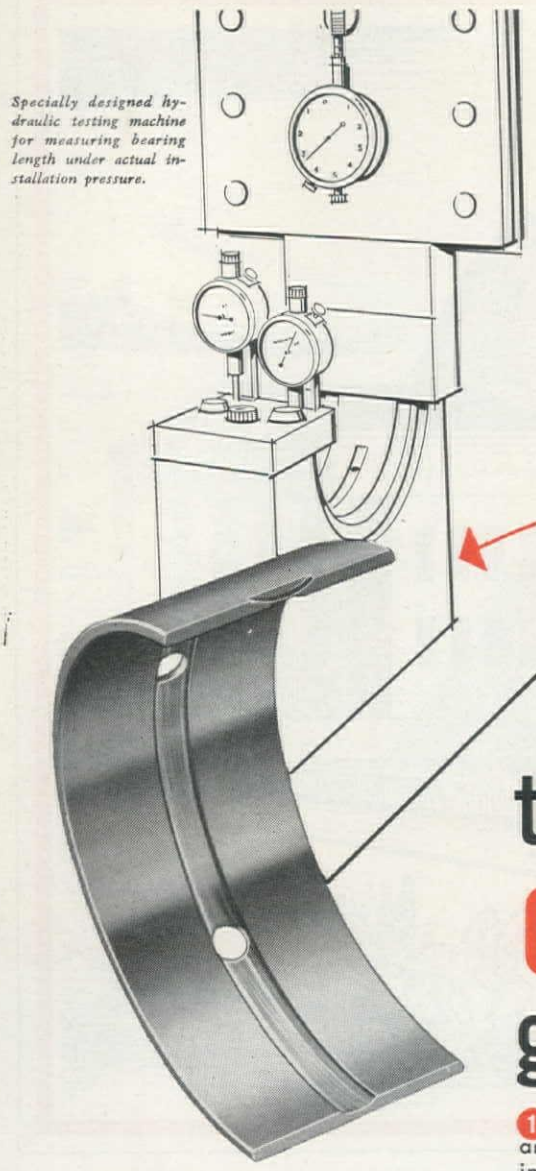
St. Louis, Missouri has a cast iron water main in service that was installed more than 100 years ago. That is not surprising as St. Louis is one of our oldest cities, founded by the French and taken over by the U. S. A. with the Louisiana Purchase. Yet this old main is still withstanding the traffic shock and beam stresses imposed by multi-ton trucks and congested underground utility services in a great manufacturing city. More than thirty other American cities have cast iron water and gas mains in service that were installed over a century ago—indisputable testimony to the strength factors of long life inherent in cast iron pipe.

United States Pipe and Foundry Company, General Offices, Burlington, N. J. Plants and Sales Offices Throughout the U. S. A.

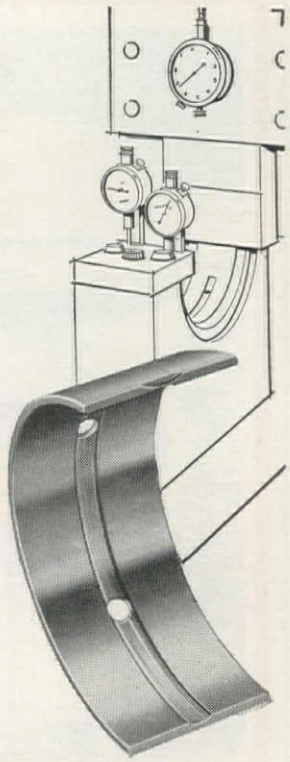
U.S. cast iron PIPE

FOR WATER, GAS, SEWERAGE AND INDUSTRIAL SERVICE

NUMBER TWELVE OF A SERIES



Specially designed hydraulic testing machine for measuring bearing length under actual installation pressure.



We take *twice* the *care*

that's why genuine CUMMINS® PARTS give more service!

Diesel power by CUMMINS

CUMMINS Dependable DIESEL

TRADEMARK REG. U.S. PAT. OFF.

1 Genuine Cummins replacement parts are identical to the parts originally used in building Cummins Diesels. They're manufactured to the same minute tolerances and top-quality standards typical of precision aircraft engine parts. Some parts are manufactured especially for us by carefully selected suppliers. Then, Cummins technical men work almost continually, right in the suppliers' plants, to assure these parts being made exactly to our specifications. *Each part* must meet these rigid requirements before it leaves the supplier.

2 Cummins' own laboratory tests metal samples—and often every individual piece—from each shipment, to make sure that all parts meet highest metallurgical standards. And to make *twice-certain*, each part must pass a final quality inspection before it is offered for sale to you. It's this kind of *extra* care that insures more miles and more years of service from Genuine Cummins Parts.

CUMMINS ENGINE COMPANY, INC. · COLUMBUS, INDIANA

Export: CUMMINS DIESEL EXPORT CORPORATION • Columbus, Indiana, U. S. A. • Cable: CUMDIEX

SAN FRANCISCO, Watson & Meehan: 1960 Folsom St., San Francisco 3, California, Tel. Market 1-8930. *Branch:* 248 Palm Ave., Fresno 3, Calif. *Authorized Sales & Service:* Connell Motor Truck Co., Stockton, Calif.; Frank J. Coyle, Sacramento, Calif.; Connell Motor Truck Co. of Redding, Calif.; Fred E, Barnett Co., Eureka, Calif.; Nevada Transit Co., Reno, Nevada . . . **LOS ANGELES, Cummins Service & Sales:** 1661 McGarry St., Los Angeles 21, California, Tel. Prospect 1026. *Branch:* 401 Golden State Highway, Bakersfield, Calif. *Authorized Sales & Service:* Leo's Diesel Service, Blythe, Calif.; Smith's Diesel Sales, Colton, Calif.; Rhyne's Automotive Service, El Centro, Calif.; F. R. Laux Diesel Service, San Diego, Calif.; Newton Automotive Service, Baker, Calif.; San Luis Truck Co., San Luis Obispo, Calif.; Hanson Equipment Company, Santa Maria, Calif. . . . **BOISE, Cummins Diesel Sales of Idaho, Inc.:** 1204 Front St., Boise, Idaho, Tel. 3783 . . . **SPOKANE, Cummins Diesel Sales, Inc.:** South 155 Sherman St., Box 2185, Spokane 5, Washington, Tel. Madison 0101 . . . **DENVER, Cummins Diesel Sales of Colorado, Inc.:** 2450 Curtis St., Denver 5, Colorado, Tel. Acoma 5933. *Branch:* 628½ West Yellowstone Highway, Casper, Wyo. . . . **BILLINGS, Cummins Diesel Sales of Montana, Inc.:** 4322 State St., Billings, Montana, Tel. 8904 . . . **SEATTLE, Cummins Diesel Sales of Washington, Inc.:** 2520 Airport Way, Seattle 4, Washington, Tel. Main 7160. *Authorized Sales & Service:* Kenny's Cummins Diesel Service, Aberdeen, Wash.; Yakima Commercial Company, Yakima, Washington; Motor Service & Machine Works, Ketchikan, Alaska . . . **PHOENIX, Cummins & Moran:** 1350 North 22nd Ave., Phoenix, Arizona, Tel. 8-2668. *Branch:* 1921 North Broadway, Albuquerque, New Mexico. *Authorized Sales & Service:* Cooper Tractor Service, Yuma, Arizona; Stirling Diesel Service, Las Vegas, Nevada; Willis Diesel Engine Service, El Paso, Texas . . . **PORTLAND, Cummins Diesel Sales of Oregon, Inc.:** 1225-1235 Southeast Grand Ave., Portland 14, Oregon, Tel. East 7146. *Branch:* 731 Garfield St., P. O. Box 367, Eugene, Oregon. *Authorized Sales & Service:* Diesel Sales & Service, Inc., Grants Pass, Oregon . . . **SALT LAKE CITY, Cummins Intermountain Diesel Sales Company:** 1030 Gale Street, Salt Lake City, Utah, Telephone 9-3768. *Authorized Sales & Service:* Wally's Chevron Truck Service, Cedar City, Utah; Automotive Body and Machine Co., Idaho Falls, Idaho; Frontier Service Station, Rock Springs, Wyoming.

(10-8R1)

EFFICIENCY IN LOADING

Your loading job can be efficient. The Eimco 104 will dig, carry and load at a much faster rate than other types of equipment.

Consider the savings in time and maintenance in this straight line loading. Consider the heavy duty construction of this machine — built to load rock — but equally efficient in easy loading materials.

The Eimco 104 loads at the rate of 4 to 6 yards per minute in rock or 6 to 8 yards per minute in lighter material.

Write today for more information on this efficient loading unit.

EIMCO

THE EIMCO CORPORATION

The World's Largest Manufacturers of Underground Rock Loading Machines

EXECUTIVE OFFICES AND FACTORIES — SALT LAKE CITY 10, UTAH, U. S. A.

BRANCH SALES AND SERVICE OFFICES:

NEW YORK, 51-52 SOUTH STREET • CHICAGO, 3319 SOUTH WALLACE STREET
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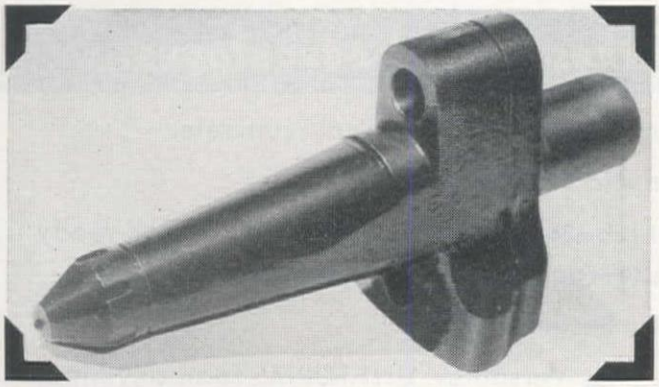
EL PASO, TEXAS, MILLS BUILDING • BERKELEY, CALIFORNIA, P. O. BOX 240
KELLOGG, IDAHO, 307 DIVISION ST. • LONDON W. 1, ENGLAND, 190 PICCADILLY

IN FRANCE: SOCIETE EIMCO, PARIS, FRANCE
IN ENGLAND: EIMCO (GREAT BRITAIN) LTD., LEEDS 12, ENGLAND
AGENTS IN ALL PRINCIPAL CITIES THROUGHOUT THE WORLD

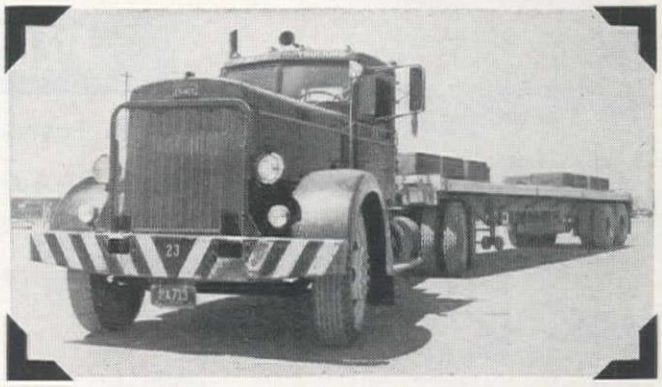
STANDARD ENGINEER'S REPORT

DATA	
PRODUCT	Standard Diesel Fuel
UNIT	50 Cummins diesels — 275, 200, 165 H.P.
CONDITIONS	Fast highway freight service
LOCATION	Pittsburg, Calif. to Los Angeles
FIRM	J. A. Nevis Trucking Pittsburg, Calif.

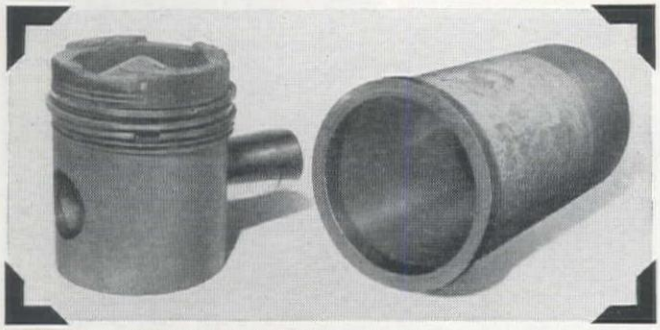
100,000-mile service period average for injectors!



THIS INJECTOR is exactly as it came out of an H165 Cummins truck engine for the first time, after 115,000 miles of operation on Standard Diesel Fuel. The engine was running good and all injectors functioning properly when the truck came in for general overhaul. Burning Standard Diesel Fuel, the more than



50 engines in the J. A. Nevis Trucking fleet go an average of 100,000 miles before injector cleaning is required. "With Standard Diesel Fuel, we've had as much as 6 years of good service from injectors", says Geo. Rabideau, Shop Foreman. "It gives us better all-around service than any other brand."



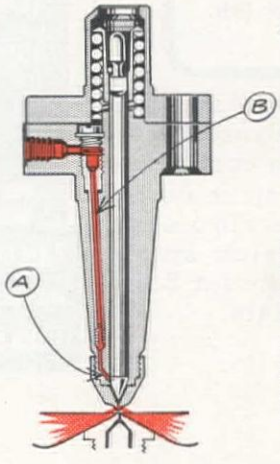
RPM DELO SPECIAL LUBRICATING OIL in crankcases of J. A. Nevis' diesels also gives outstanding service. This assembly was in one of the truck engines for 110,000 miles and was replaced only because of mechanical problems not connected with lubrication. Taper in the sleeve was only 0.003. Rings were all good and machined marks on the piston skirt still intact.

STANDARD DIESEL FUELS
RPM DELO
LUBRICATING OILS

TRADEMARK "RPM DELO" REG. U.S. PAT. OFF.

REMARKS: Standard Diesel Fuel and RPM DELO Oil work together to develop the highest efficiency in diesel engines. The fuel is made to exact specification; the oil contains compounds to keep engines clean and prevent wear.

How Standard Diesel Fuel cuts repairs and ups engine efficiency



A. Cleanliness, and viscosity within correct limits prevent wear of fuel parts.

B. Low pour-point assures free flow in all temperature conditions.

Proper ignition qualities and controlled distillation range provide even burning and sustained power with minimum combustion shock, quick starting and smooth idling.

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

STANDARD OIL COMPANY OF CALIFORNIA

UNI-FORMS give you all the advantages of:

WOOD FORMS
- Nailing Surface
- Good Concrete Finish
- Easy Replacement

STEEL FORMS
- Mechanical Assembly
- Rigidity
- Long Life

PLUS these added advantages:

1. Fastest method of forming any concrete.
2. Automatic Accuracy.
3. Fast job starts—UNI-FORMS reach the job ready to use—no delays—no idle men or equipment.
4. Easier to handle.
5. Versatile—UNI-FORMS form anything.
6. Lowest initial cost... lowest maintenance cost... per sq. ft. of form area.

UNI-FORMS:

- A complete concrete forming system—everything furnished.
- Require alignment and bracing on 1 side only.
- Use less lumber than any other method of forming.
- Cut Form Costs—on every job.

RENTED... SOLD

More than 10,000,000 sq. ft. of UNI-FORMS now being used by the nations leading contractors. Get full details on this modern, easy to use concrete forming system today. Write for Bulletins and data.

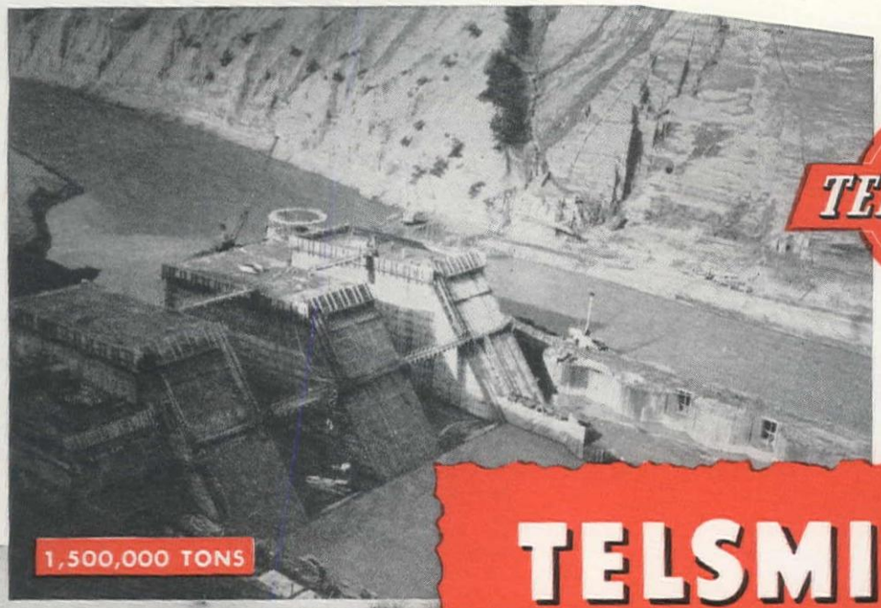
Universal FORM CLAMP CO.

Concrete Form Specialists Since 1912

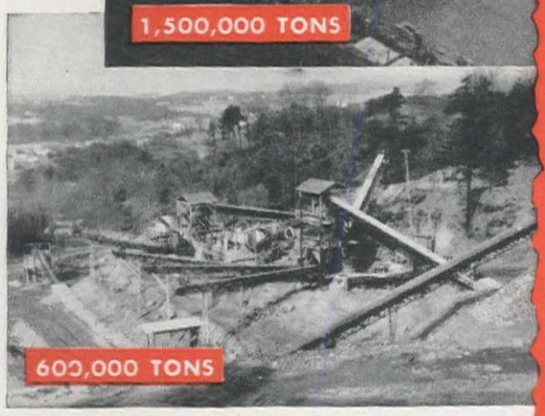
General Offices and Factory • 1236-38 NORTH KOSTNER • CHICAGO 51, ILLINOIS • CAPITOL 7-1600

West Coast Branch and Warehouse:
2051-59 Williams Street, San Leandro (San Francisco), Calif.
***Phone:* Lockhaven 2-2051, Enterprise 1-0132**

Service Wherever You Build... Coast-to-Coast



Mount Morris Dam, N. Y. The 300-350 tons per hour rock crushing plant is Telsmith designed and equipped.



Philpott Dam, Va. Here, too, the crushing-screening equipment is Telsmith.

TELSMITH® EQUIPMENT FOR DAMS

● Huge dam projects and Telsmith Aggregate Plants go together. Many dam builders call in Telsmith engineers for consultation as to the proper plant layout and the right equipment to use. Then Telsmith makes the detailed drawings for the erection of the plant and furnishes most of the machinery. Telsmith designed plants have proven their efficiency on many large projects and Telsmith equipment has a world-wide reputation for the production of low-cost aggregate. The ruggedness of Telsmith equipment is strikingly demonstrated by long life in severest service, on successive projects. After producing 1,500,000 tons of aggregate at Center Hill Dam, the same Telsmith equipment is now turning out about the same amount of aggregate at Buggs Island Dam.

Save time and money. Consult Telsmith Engineers. Ask for Bulletin 266. MP-8

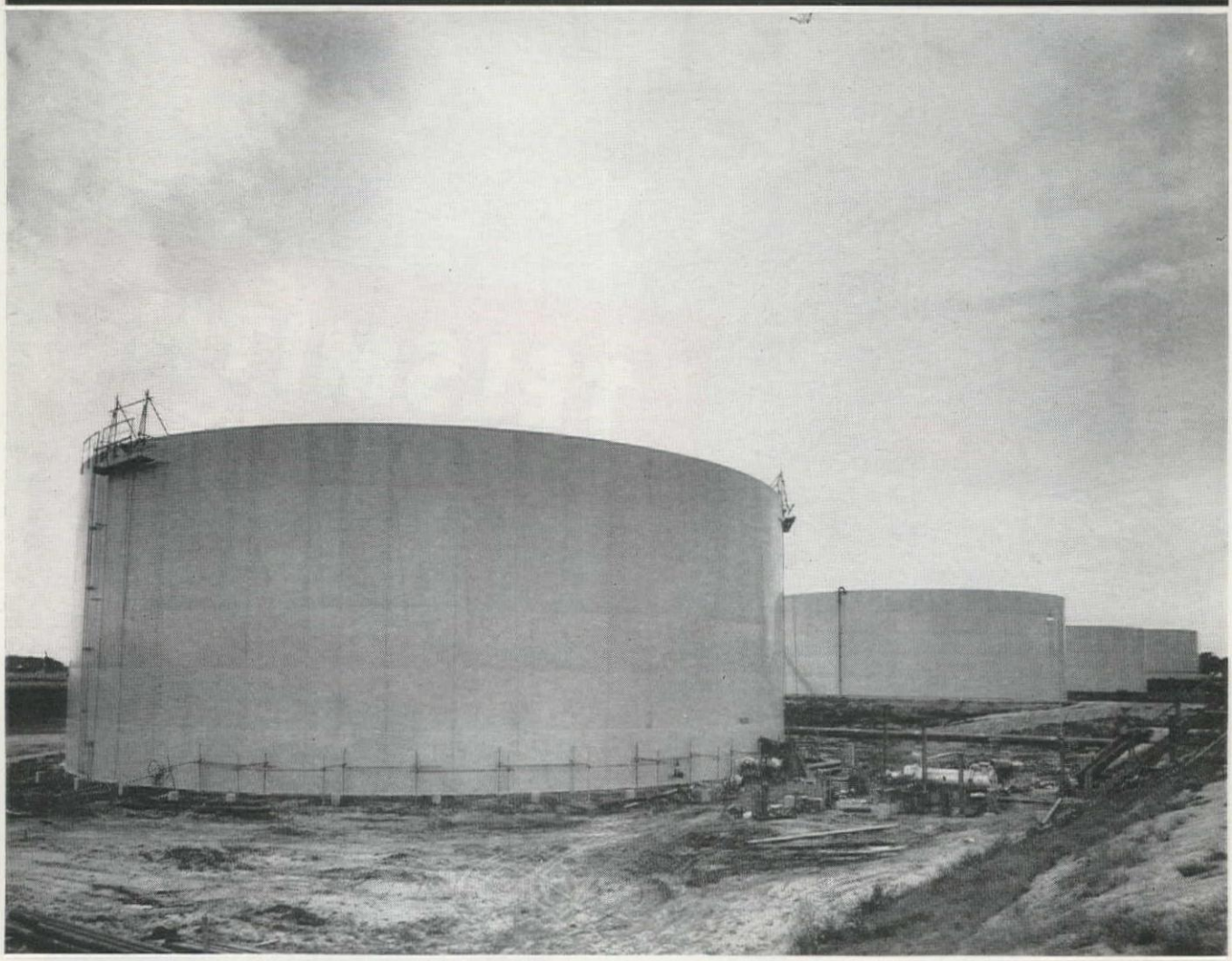
OTHER DAMS BUILT WITH TELSMITH EQUIPMENT

- Alatoona Dam, Georgia
- Boysen Dam, Shoshoni, Wyo.
- Buggs Island Dam, Virginia
- Carpenter Dam, Arkansas
- Cascade Dam, Washington
- Center Hill Dam, Tennessee
- Clark Hill Dam, Augusta, Ga.
- Conowingo Dam, Conowingo, Md.
- Dale Hollow Dam, Tennessee
- Davis Dam, Nevada
- El Presidente Dam, Mexico
- Fort Gibson Dam, Oklahoma
- Grand Coulee Dam, Washington
- Kortes Dam, Wyoming
- Norfork Dam, Arkansas
- South Holston Dam, Tennesse
- Watauga Dam, Tennessee

MINES ENGINEERING & EQUIPMENT CO.
369 Pine Street • SUtter 1-7224
SAN FRANCISCO 4, CALIFORNIA

Manufactured by SMITH ENGINEERING WORKS, MILWAUKEE 12, WISCONSIN

HORTON TANKS store fuel oil for Pacific Gas and Electric Company



The four 120,000-bbl. Horton flat bottom fuel oil storage tanks illustrated above are located at the Pacific Gas and Electric Company's new 30,000 Kw. steam power plant at Moss Landing, California. The Moss Landing station is a relatively new addition to the vast P. G. & E. power system which is completing a huge expansion program to provide more and better service throughout the Pacific Coast region.

For liquids of low volatility, such as fuel oil, Horton flat-bottom tanks with cone roofs offer economical storage. They are built in accordance with API specifications to fit your needs.

Horton oil storage tanks are of welded steel construction. This means smooth, clean surfaces with no pockets or corners to gather dirt and water to cause corrosion. Welded steel construction also means easier maintenance and inspection. Regular painting keeps Horton tanks in excellent condition. Maintenance and repair costs are kept to a minimum.

We have an office located in a city near YOU for your convenience. Write for complete information and quotations.

HORTON

WELDED STEEL STORAGE TANKS

CHICAGO BRIDGE & IRON COMPANY

Plants in Birmingham, Chicago, Salt Lake City, and Greenville, Pa.

Atlanta 3.....2183 Healey Building	Los Angeles 17..1544 General Petroleum Building
Birmingham 1.....1598 North Fiftieth Street	New York 6.....165 Broadway Building
Boston 10.....201 Devonshire Street	Philadelphia 3.....1700 Walnut Street Building
Chicago 4.....McCormick Building	Salt Lake City 4.....555 West 17th South Street
Cleveland 15.....Guildhall Building	San Francisco 4.....1569—200 Bush Street
Detroit 26.....Lafayette Building	Seattle 1.....1355 Henry Building
Houston 2.....National Standard Building	Tulsa 3.....Hunt Building
Havana.....402 Abreu Building	Washington 6, D. C.....1103 Cafritz Building

WESTERN CONSTRUCTION

December 1951 Vol. 26, No. 12

JAMES I. BALLARD . . . . . Editorial Director
JOHN J. TIMMER . . . . . Managing Editor

Steel—Is the picture changing?

STEEL CONTINUES to be the most active subject of discussion for the construction industry. There has been no recent change in the "official line" which states that demand far exceeds production, and no appreciable change in this situation will develop until the middle of next year. However, there is evidence of contradictions which tend to discount this position. Those actually ready to buy steel find that the supply may be better than admitted officially, and that restrictions are more artificial than actual.

Contractors, in many ways, are closer to the facts of the situation than the awarding agencies. The former are actually out in the market-place with cash in hand trying to buy steel, while the latter are more concerned with their allocations, quotas and the ritual of red-tape. In the market for reinforcing steel, for instance, buyers find much more evidence of supply than NPA allotments will release for sale. They are even reporting cases of suppliers getting in touch with NPA representatives asking how they can arrange to sell more steel. Of course, it is easy to say that these are isolated cases of burdensome inventories, but no supplier is going to sell himself out of business unless he has fairly good assurance that he can replenish his stock. Possibly these orders on the local level include a factor of duplication that will be squeezed out with surprising results. It is easy to remember only a few years ago when most people had two or three requests for a new car on order, and such duplication did not show up in any official report of the backlog of orders, either.

Behind the present situation in steel are two factors which may account for the present restrictions, even though they tend to be secondary causes. First, certain non-ferrous metals, notably copper, are critically short, and the curtailment of steel for non-military use is being tied to the available supply of these metals. Any sudden increase in steel allotments would carry along with it a demand for more of these metals. Hence, such an artificial shortage of steel could be justified, but a true and simple explanation would be preferred to double talk. The second and more intangible possibility is that the estimated national supply-and-demand situation was a bad guess from the start—it has happened before, as in the Gano Dunn report—and now it is a matter of saving face. Any serious discrepancy between an original estimate and today's situation would be admitted with reluctance, but since the revision would be favorable for all it would obscure the error of the past.

In all, fragmentary evidence indicates that the steel situation is somewhat more favorable than the paper work would show. It could take a turn for the better well ahead of the official estimate of easement in supply.

Keep up the demand for steel

WITH THE POSSIBILITY of a quicker change in the steel picture for the better, there is good reason to maintain the rate of contract awards as positive evidence of the steel requirements of the construction industry. It is this type of tangible and pressing evidence from the industry that will not only procure a fair share of steel as fast as it becomes available, but also will tend to keep the construction industry out of a slump during the ultimate transition from defense to normal types of work. If the contracting agencies start to reduce the volume of awards which are advancing through the bidding stage, because of the present day restrictions, it will show NPA a lesser demand. This could result in release of the first available steel to other users. Demand, and demand alone will be the most important factor as to which industry gets the first increase.

Obviously, legal problems are involved as to time and financial commitments. Public agencies are not permitted to make awards where delays are obvious and indefinite. But it is backlog of demand, even though awards have necessary restrictive clauses, that will be the proof that construction has an urgent need for steel.

A highway commission for Colorado

COLORADO CONTINUES to move ahead with substantial plans for a revision of its state highway organization as a prerequisite for an expanded, long-range highway construction program, possibly based on bond issue financing. An important feature of the department rearrangement would be to initiate a commission form of control. This would replace the one-man rule which has been a well-known part of Colorado highway affairs since the days of Charles Vail.

The establishment of a commission appears to have adequate support, but the present plan has one definite fault. In an effort to provide political equilibrium the proposal calls for an eight-man commission, designed to represent the geographical areas of the state. The concept of the commission is fundamentally wrong and can only lead to sectionalism and local pressures to influence the orderly advance of the highway program. When it is generally understood that members actually represent a section of the state many advantages of the system are lost. The commission for Colorado could best be a three, or not more than five-man body selected to direct the highway program for the benefit of the state as a whole. The appointment of outstanding citizens—obviously, any governor would tend to spread such selections throughout the state—familiar with the state and its needs is the first essential for success of commission control. Then, if this commission makes proper use of the factual information now available in Colorado on highway needs, the groundwork will be laid for the start on a long range program.

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with the NEW "111"

Production is higher
Upkeep is lower
Push Buttons do the work

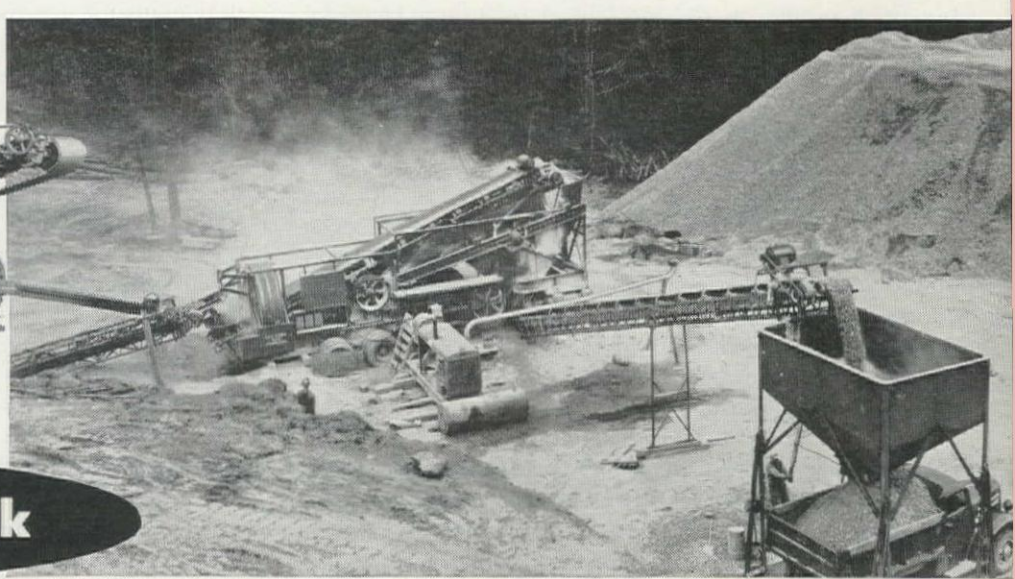
Michigan Gravel

Production is higher—because each unit has its own electric motor drive; thus operates at top speed and efficiency at all times.

Upkeep is lower—because drives are simple and have few parts.

Push buttons do the work—the man on the platform starts and stops the feed and delivery conveyors, and has other units under complete control.

Primary Breaker units are made in several sizes; this one has a 3' x 10' apron feeder, 20" x 36" jaw crusher, power unit and delivery conveyor—all mounted on pneumatic tires.



Carolina Rock

The high production "111," with its 10" x 36" jaw and 40" x 24" roll crushers, is equally at home in gravel and rock. On this quarry job, production is still further increased by using a Primary Breaker unit with 32" x 40" jaw crusher (not visible in the photograph) to reduce the oversize to about 5 inches.

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During the present national emergency, civil engineers have a special responsibility in reducing man-power spent in maintenance of structures and conserving the nation's metallic resources by considering all possible means of . . .

SAVING STEEL with CATHODIC PROTECTION

By
JOSEPH P. COLLOPY
Member, National Association of Corrosion Engineers
Cody, Wyoming

DURING THE PRESENT national emergency a high premium has been placed on steel, and its conservation becomes a responsibility of all engineers. Corrosion is not only a major factor in destroying the metal now in service, with resulting need for replacement, but also results in the long-range depletion of the nation's supply of this important resource. The cost of corrosion to this nation has been estimated at more than $5,000,000,000 per year. Indifference, combined with ignorance, on the part of many civil engineers must be overcome if this wastage is to be reduced.

Protection of steel that is in contact with moist ground or water by cathodic means is not new, and the record of many successful applications demonstrates its effectiveness. Why, then, is this scientific and well tested method for saving steel not put to greater use? Those who have worked with this means of protection ask this natural question. One of the most logical answers would appear to be the fact that civil engineers do not have an interest in matters involving electrical theory. Since the principles governing cathodic protection are electrical, these engineers do not consider it to be within their field of concern.

Whereas this system of protection is primarily electric, its significance is so great today that a brief review of methods and results should be again brought to the attention of civil engineers.

What is cathodic protection?

Cathodic protection consists of impressing electromotive forces on an underground or submerged structure through auxiliary anodes with respect to the adjacent soil or electrolyte. This electromotive force may be derived from: (1) rectified alternating current, (2) generated direct current or (3) galvanic means.

The word corrosion signifies destruction of metal by chemical or electrochemical action. The purely chemical action is generally insignificant. When corrosion is taking place, current is flowing from one point of the submerged metal (the anode) into the electrolyte (surrounding soil or water) and back to the metal at some other point—the cathode. Where the current flows from the metal, it pulls small portions of metal along with it. When cathodic protection is applied, a counter potential is built up that will either reduce or reverse this current.

When the impressed or counter potential is derived from an external source of power, an anode is placed in the electrolyte at the proper location in respect to the metal to be protected (cathode), and the positive lead attached to this anode. The negative lead is attached to the cathode. The source of potential in many installations is a low-voltage rectifier with enough capacity to supply a few milli-amperes for each square foot of surface to be protected.

If the source of impressed potential is galvanic in origin, an anode commercially available or secured from scrap is placed in the electrolyte at the proper location. This anode, which must be high up in the electromotive series such as

PICTURED AT TOP OF PAGE—

Replacing a corroded water line which began to leak shortly after installation represents a waste of metal and man-hours. No leaks have developed after installing cathodic protection to this hydraulic structure.

magnesium, zinc or aluminum, is connected to the cathode in a manner to fit the design. Thus is devised a short-circuited primary cell with the protective current passing through the electrolyte from the anode to the cathode. These anodes may even be made of ordinary pieces of scrap from such sources as crashed aeroplanes. However, the most convenient anodes are a commercial product made of magnesium in various shapes such as cylinders and ribbons, and are capable of solving many varied problems of corrosion.

Corrosion is expensive

The cost of corrosion to this nation is extremely high. Although many attempts have been made to estimate the amount no one seems satisfied that the proper answer has been reached. Most estimators agree that it is well above 5 billion dollars a year. The countless scrap piles that dot our landscapes offer mute evidence that the amount must be high. Corrosion cannot be eliminated entirely but it can be reduced. Indifference and ignorance pertaining to the cost of corrosion seem to be the main forces to be combated if interest is to be increased in regard to this evil.

It has been estimated that for every dollar invested in the cathodic protection of buried pipe lines there is a saving of from $8 to $10. Recent observations indicate that installations around diversion dams and clarifiers can produce even higher savings. The same can probably be said of other applications.

Those who have worked with cathodic protection are subject to increasing bewilderment as to why it is not put to greater use. Although the electrical network provided by a corroding surface may be considered a complex system of electromotive forces, resistances and currents, this should not stop civil engineers from understanding and applying the effective antidote of cathodic protection.

Applications

Some of the engineering structures where cathodic protection can be used to advantage are:

1—Municipal
- a. pipe lines
- b. storage tanks
- c. water treatment and sewage disposal plants.

2—Highways
- a. culverts
- b. siphons
- c. drains
- d. bridge piers.

3—Power and irrigation works
- a. gates
- b. piping
- c. misc. steel fabrication.

4—Manufacturing and commercial plants
- a. piping
- b. hot water plants
- c. tanks, etc.

Examples

The water of the lower Colorado River has long been known for its corrosive properties. One of the largest installations subject to this water is Imperial Dam with its one-half million square feet of submerged steel surface. It has been conservatively estimated that maintenance costs of this installation have been reduced more than $75,000 by installing an impressed voltage system of cathodic protection. The installation cost of this system was $3,500, with an annual energy charge of $365.

In other installations, the isolated steel structures in irrigation distribution systems have been protected by galvanic currents produced by magnesium anodes.

Many cathodic protection systems have been installed to prevent the ravages of sea water upon steel installations near docks and wharves. Installations are gradually being made to protect industrial and domestic equipment such as boiler feed systems and hot water heaters. REA and public utility systems covering rural areas have hastened cathodic protection systems, both on farms and in rural processing plants.

Cathodic engineers, aided by calculations from known data or field tests, are able to pre-determine the functioning of a system prior to installation.

Cathodic protection is one step

It is not the intention of this article to advocate the replacement of inhibitors and protective coatings by cathodic protection. With proper attention given to corrosive problems, the use of all methods of prevention would be greatly increased. Metal submerged in an electrolyte of corrosive nature should in general be given a good protective and insulating coating at the time of installation. In some instances, an effective cathodic protection installation without this protective coating would be too expensive. One supplements the other.

As an example, if a gasoline storage tank is given a good protective coating and buried in the ground the chances are it will not be dug up and recoated from time to time. It will be left there until it is corroded through or its use in that location is no longer required. The same is true with the bottom of a large storage tank. With cathodic protection these units could be made to last indefinitely.

Not a cure-all

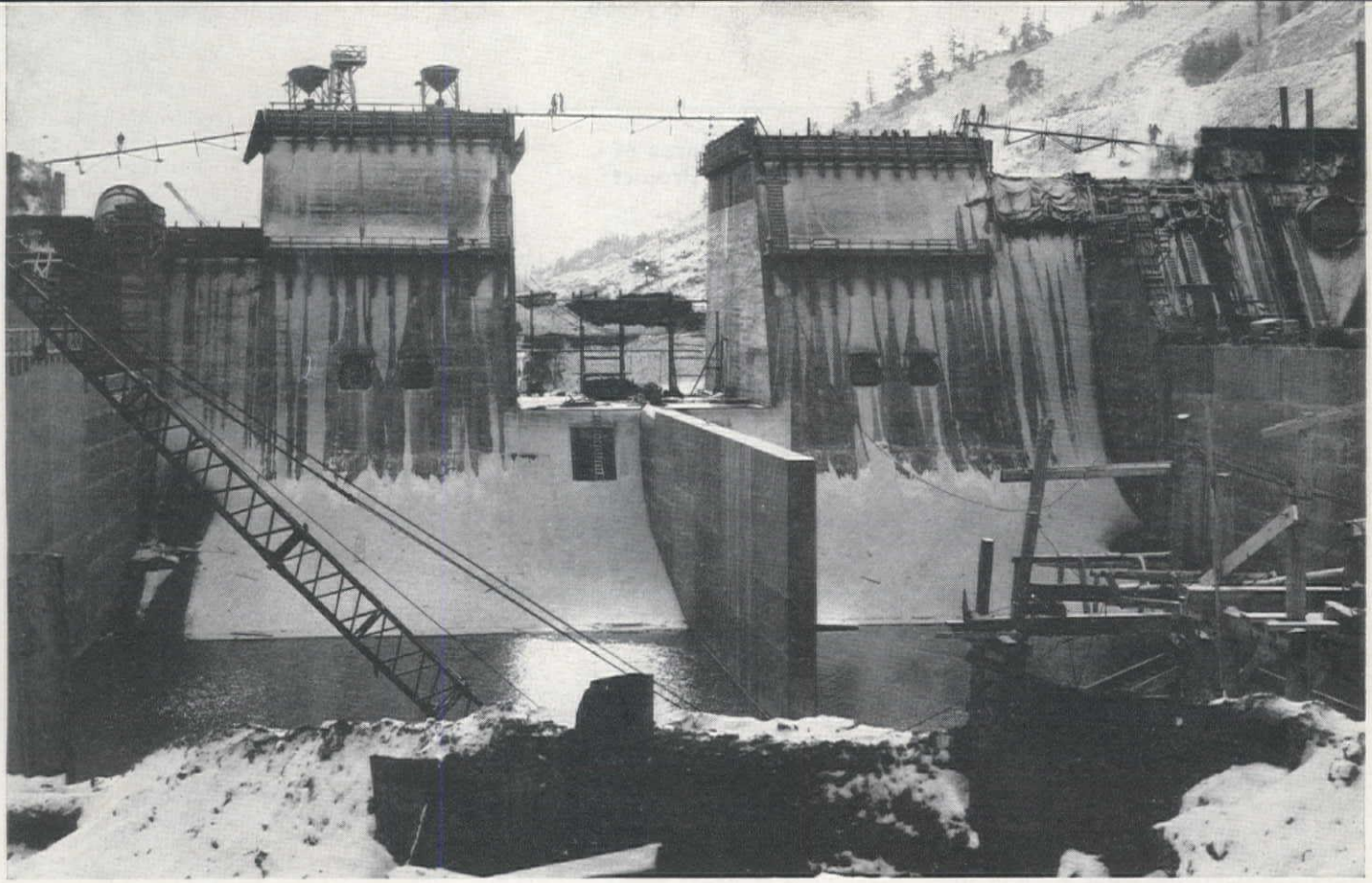
There are some instances where a cathodic system has not been worked out for the protection of corroding submerged metal. A good example is the inside of small diameter pipes. However, work is under way toward the solution of such problems. Cathodic protection is not effective against corrosion caused by sprays or atmospheric conditions.

There are instances where cathodic protection may have been harmful to a portion of the structure, but these are believed to be only remote cases that could be corrected by design. Such a condition could arise where direct current is flowing along a submerged pipe or rail, with the sections separated by an insulating coupling. Corrosion is apt to appear at the point where the current leaves the pipe to go around the coupling. A correction can be made by bridging the insulating coupling by a good conductor.

An effective way to help

Corrosion is aiding the depletion of the world's supply of metal. It absorbs the nation's manpower in replacement work and at the same time hinders the production of our factories, power plants and irrigation systems. Large quantities of steel are constantly going into the design of various structures in an effort to allow for corrosion. It appears that in the proper use of cathodic protection, engineers have at their command an effective way of aiding the nation during the present shortage of steel.

MAGNESIUM ANODES, shown lifted out of the water, are protecting the metal in this gate on an irrigation canal.



With second-stage diversion works completed —

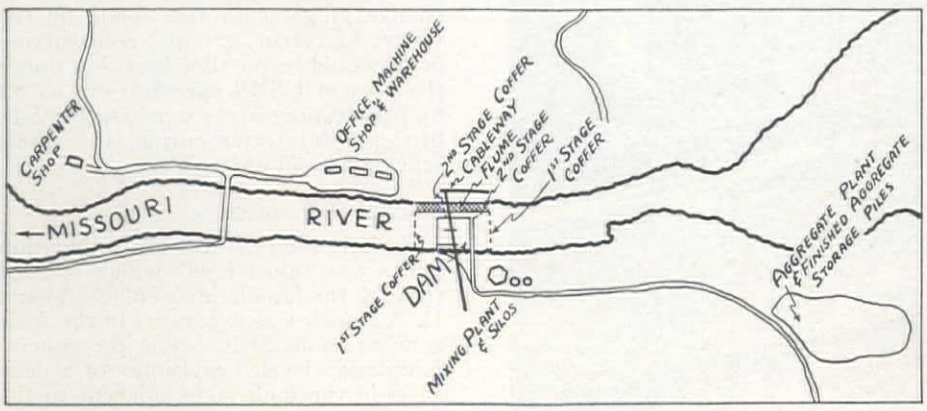
Canyon Ferry stops for winter

Following serious problems with diversion during the 1950 season, the 1951 operations on this Missouri River project near Helena, Mont., included placing 140,000 cu. yd. of concrete before early cold closed down the job

By L. P. SOWLES
Project Manager
Canyon Constructors
Helena, Montana

DURING THE 1951 season placement of about 140,000 cu. yd. of concrete in the Canyon Ferry Dam project and the completion of the second-stage diversion works made possible the removal of the first-stage cofferdams and the flume which carried the Missouri River past the dam site during the last two years. Work has been under way on this important Bureau of Reclamation project since the contract was awarded to Canyon Constructors in April 1949. The project is located on the upper Missouri River about 18 mi. east of Helena and the development represents an important part of the program for the Missouri River Basin. This article reviews the methods and construction progress of the last two seasons.

SKETCH of major elements of construction plant, including aggregate preparation, mixing and cableway for placing concrete. The river flows north about 18 mi. east of Helena.



General

Canyon Ferry Dam is of straight gravity section, containing almost 400,000 cu. yd. of concrete. The dam is to be 212 ft. high according to original plans and will have a crest length of about 1,000 ft. The reservoir capacity will be slightly over 2,000,000 ac. ft. representing a highly efficient dam site in providing almost 5 acre-feet of storage per cu. yd. of concrete in the dam. Prior to the award of the major contract the Bureau had located and substantially completed the government camp about 1 mi. from the site, and 9 mi. of county road had been relocated above high-water line of the reservoir.

During the 1949 season the contractor erected buildings at the site, constructed a timber pile bridge for a temporary river crossing, began work on an aggre-

gate processing plant and built the cofferdams and flumes for the initial river diversion.

This flume was placed in operation Nov. 27, 1949, and almost immediately the job was shut down for the winter in early December. When the work of the 1950 season was started, operations were concentrated on the un-watering of the site and excavation for the dam and power plant foundation. Concurrently, installation of the contractor's plant for concrete production was carried forward.

Leak under sheet piling

On June 10, 1950, undue scour of the flume inlet approach caused leakage under the sheet piles which served as the upstream cofferdam cut-off. The leakage increased and washed out the sheet pile cut-off wall under the flume floor upstream. This break created a flow estimated at about 90 sec. ft. which flooded the dam excavation area and stopped all excavation operations. Mobile equipment and pumps were saved for later use, but a Marion 362 Dragline was caught in the rush of gravel and it was submerged in the hole with no part of its boom showing.

The flood of 1950 passed about 18,000 sec. ft. through the flume without further difficulty, but there was considerable damage to the rip-rap and sheet pile cut-off walls protecting the flume outlet through the lower cofferdam. Due to the upstream inflow, the level between the cofferdams rose higher than the tail water level of the river and produced outflows through the downstream sealing. The effect of this particular outflow seemed to be concentrated under the flume outlet downstream.

This flow apparently displaced the downstream protective wall and permitted displacement of the sand and gravel around the wooden piles which supported the flume itself. Immediate steps taken to repair the diversion works consisted of placing large rock around the eroding areas at the flume outlet and casting in by dragline rock and fines to replace materials eroded at the flume inlet. Fortunately, a suitable granite quarry of massive stones was available adjacent to the old Canyon Ferry Dam and the contractor reopened this quarry for the production of rock and protective rip-rap and hauled it some 5 mi. around the mountain. Repairs of a more permanent nature were deferred until the 1951 season.

Dewatering of the flooded excavation area was accomplished by using the same Layne-Bowler deep-well type pumps that had been previously installed for pumping the water from the bottom of the excavation. These were mounted on a bridge framework using Navy pontoons. A timber frame supported the discharge pipe as the level of the water lowered. Excavation of the material that had been carried in and the clean-up of the rock proceeded first in the dam and then in the spillway area, until the entire area was prepared for concrete.

Concrete placement in the dam began on September 13 in block 13 and continued as rapidly as consolidation grouting and foundation preparations for concrete could be brought up to standards. Concreting operations proceeded through the summer and fall until a winter blizzard occurring on November 7 stopped dam concrete operations for the season.

Winter protection

A winter protection plant had been constructed based on some 600 boiler horsepower for steam supply to be utilized behind tarpaulins hung around the forms on high blocks and for furnishing steam to unit heaters in enclosed areas on certain dam blocks and spillway apron blocks. Heat loss calculations and enclosure plans were predicated on temperatures of 10 to 15 deg. below freezing. The first storm that hit carried temperatures considerably below zero and with it the loss of many men for warmer climes. Difficulties in air and water piping and the cleanup using air and water were so insurmountable due to the extreme low temperatures that the entire winter concreting operation for the dam concrete had to be abandoned. The proposed winter concreting and protection program was based on the urgent need to regain the time lost by the flood of the excavation area, and with the hopes that it would advance the date when diversion could be made from first stage to second stage in the 1951 working season.

When the weather moderated after the first nip, several pours were made in the spillway apron in small blocks under protection. This was accomplished by completely housing an apron block under tarpaulins and heating by means of unit heaters as soon as the concrete was placed. However, the last pour was made on December 1, when the mercury again dropped below zero to such an extent that any further concreting operations were out of the question. The contractor had expected that by making the necessary provisions for winter protection plant and protective measures, similar progress to that made by the many Canadian groups constructing dams would be possible here, but under the present USBR specifications as set up for cleaning up by washing the 5-ft. lifts and for water curing, the whole scheme proved unfeasible.

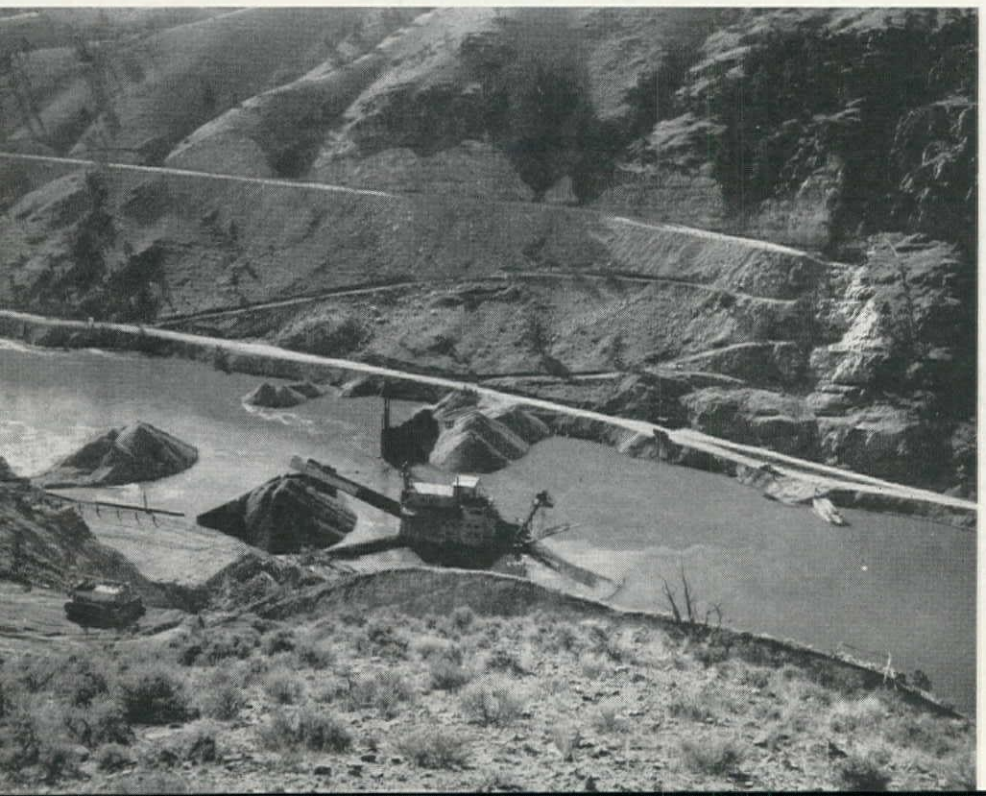
Start of 1950 season

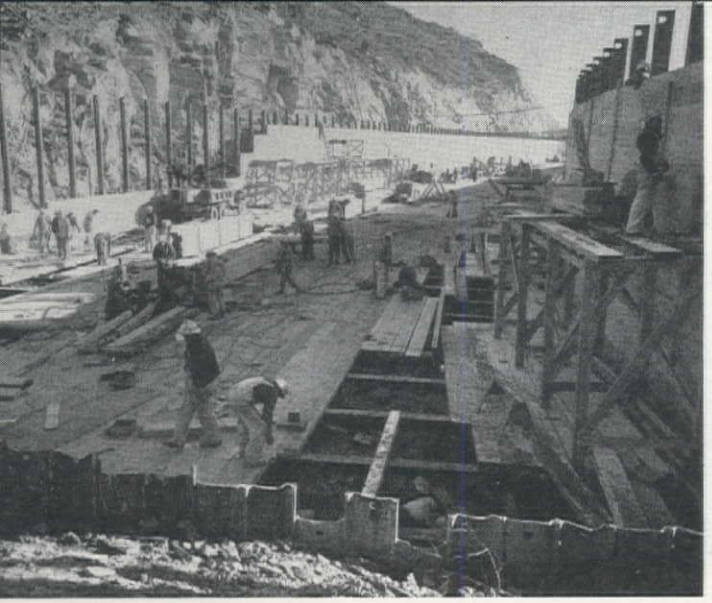
Early in the 1950 season a foundation fault was uncovered which passed through the foundation of blocks 14 and 15. A trench was excavated in the fault zone to some 20 ft. below the general foundation level. Provisions for a deep shaft in the fault zone adjacent to the

Principal features of Canyon Ferry Project

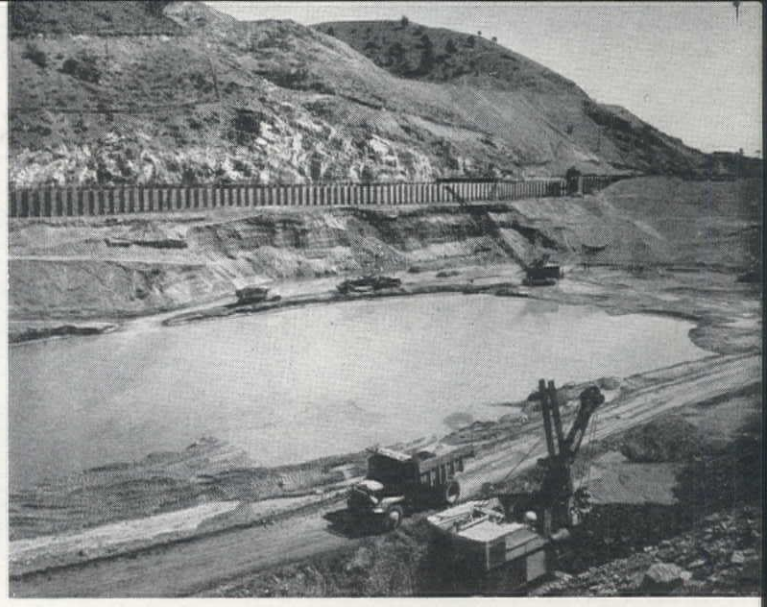
Dam:		
Height (total)	(ft.)	212
Crest length	(ft.)	1,000
Elevation of crest	(ft.)	3,808
Spillway gates (4)	(ft.)	34 x 51
Excavation (earth)	(cu. yd.)	267,000
Excavation (rock)	(cu. yd.)	90,000
Concrete (total)	(cu. yd.)	455,000
Reinforcing steel	(lb.)	4,500,000
Reservoir:		
Storage	(ac. ft.)	2,050,000
Area	(ac.)	35,200
Length	(mi.)	24
Runoff:		
Drainage area	(sq. mi.)	15,860
Annual flow (avge.)	(ac. ft.)	2,450,000
Maximum record	(ac. ft.)	4,650,000
Flood flow record	(sec. ft.)	33,300
Power plant:		
Penstocks (3)	(ft. diam.)	13.5
Generators (3)	(tot. kw.)	50,000
Output	(kw-hr)	285,000,000

EARLY EXCAVATION in streambed featured a gold dredge to strip overburden which was used for cofferdams as well as concrete aggregate. Abutment excavation was under way on the far side of the river. The diversion flume was built on the near bank of the stream.



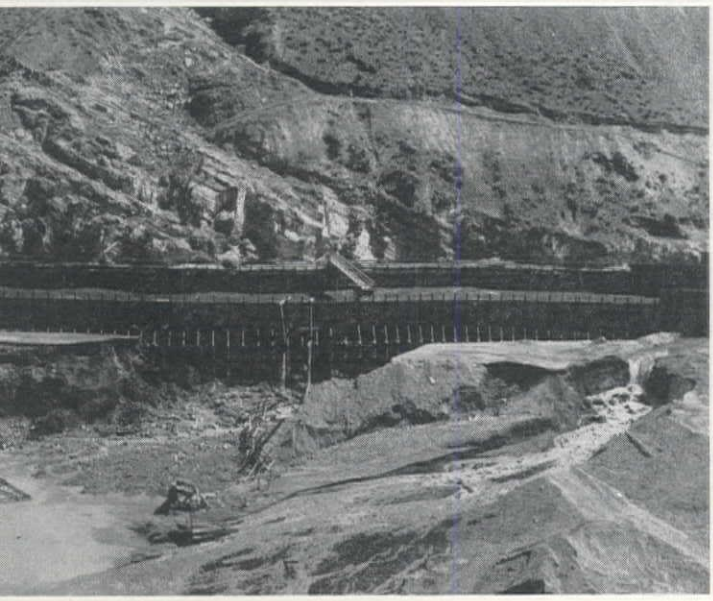


PLACING 4-in. planking on the floor of the diversion flume, which was about 1,000 ft. long and 65 ft. wide. Placed in operation late in 1949, just before the winter job shut down.

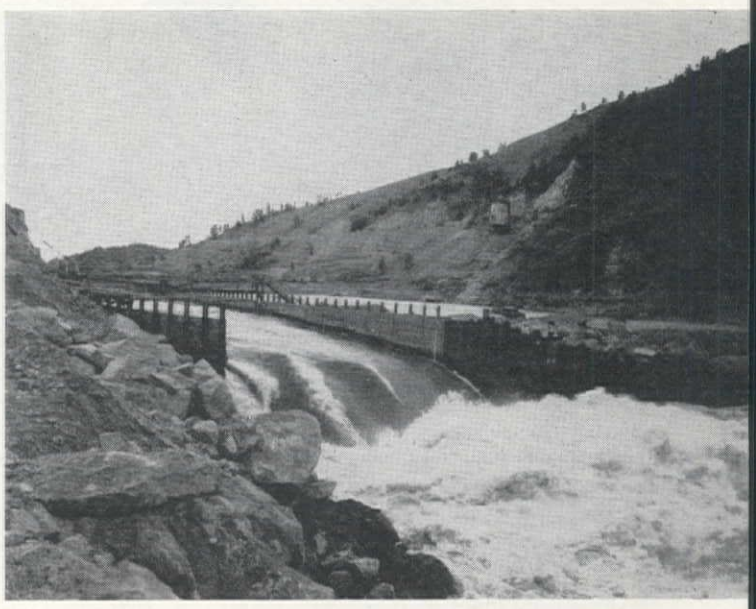


FLOW of the river being carried in flume on the far side of the excavation, with upstream cofferdam at the right. Note the dragline, in connection with view at lower left.

ON JUNE 10, 1950 the upper end of the flume was undermined and a flow estimated at 90 cfs. was flooding the excavation. Note boom of dragline.



OUTLET end of the flume during same flood which peaked at 18,200 cfs., and was the maximum flow during the 1950 season.



upstream face of the dam were made in the early pours of concrete over the foundation fault. During the winter, the shaft head frame was housed in. The shaft excavation was completed to the bottom, drilling and grouting of the shaft walls and installation of grout pipe were completed so that the concrete back-fill was completed by the time the weather moderated last March to an extent to permit reopening of concrete placement on the dam and spillway apron.

Flume repairs in 1951

Prior to the 1951 flood peak flume repairs under the upper and lower end of the flume were accomplished by excavating access ways to the washed out areas under the flume by "sapping" methods and the cut-off wall supported by concrete placed by the pumpcrete method along these narrow passages. The repair at the outlet of the flume was accomplished by pumpcrete placement of a concrete bulkhead between the pile rows adjacent to the downstream end of the flume. Approximately 1,000 cu. yd. placed in this manner stabilized the lower end so that only minor repairs were required to minimize the surging of the water under this end of the flume with a maximum discharge of some 16,000 sec. ft.

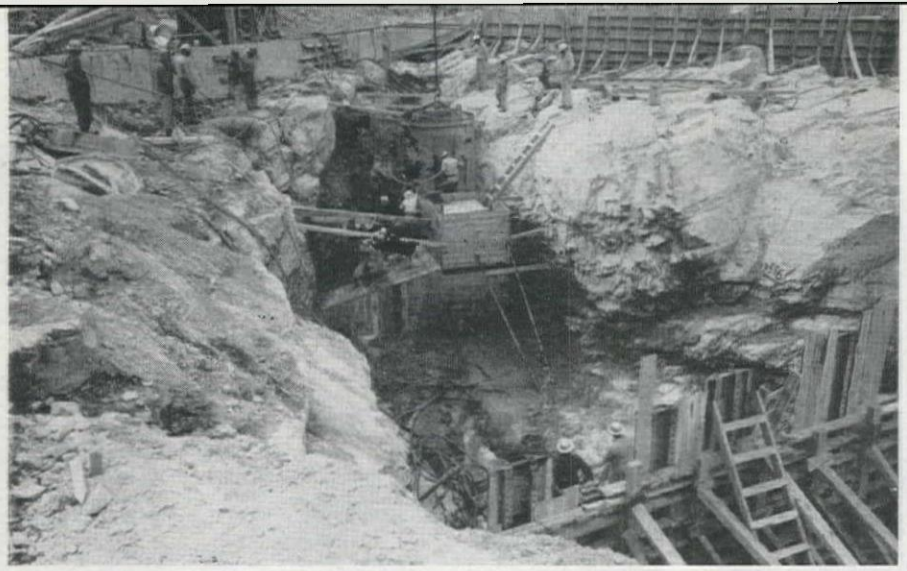
The inlet apron of the flume was covered with concrete to prevent further erosion. The contractor cut the flow of the Missouri River by applying the flash boards to the Old Canyon Ferry Dam which stored water and passed only such a low flow as to make this repair possible.

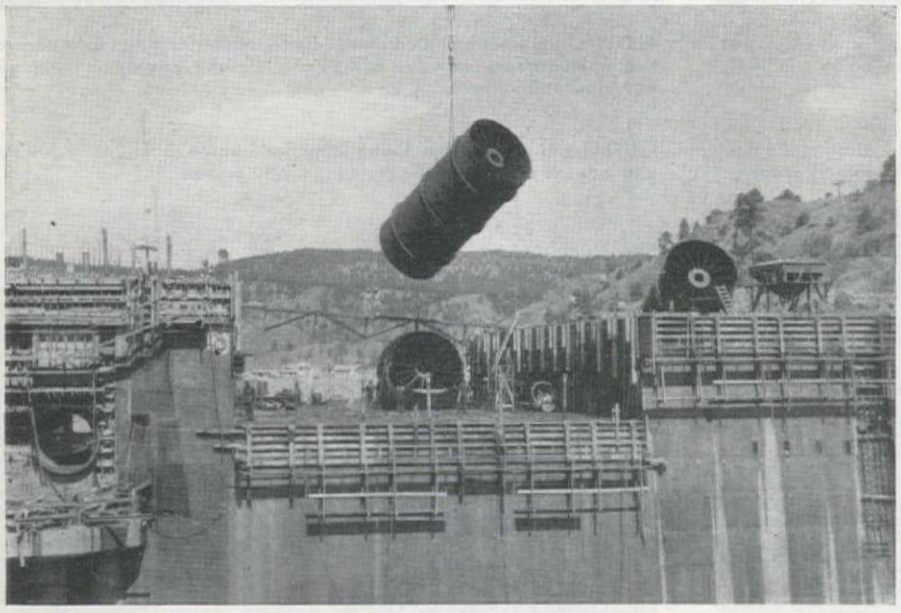
Flume repairs were further simplified by the high degree of cooperation received from the Montana Power Co., which depressed the water surface of Lake Hauser to permit better access under the downstream end of the contractor's flume.

During the 1951 working season, the contractor raised the blocks in the main dam from elevation 3620 to elevation 3700 in seven monoliths of the dam. Canyon Ferry Dam has all the pertinent works that a large project has in the way of penstocks, trashracks, river outlets, foundation access, and control cable, galleries, air vent ducts, and pump intake pipes. Consequently, the contractor was obliged to operate for many weeks with difficult structural details in every block. This consequently reduced the mass concrete placement production rate which is the necessary requirement for the rapid rise and successful completion of any dam structure.

Accomplishments of 1951

However, Canyon Constructors did complete during the 1951 working season the construction of the spillway apron, left and right retaining walls and the initial concrete in the powerhouse required before diversion. It was necessary as a part of the support for the diversion wall to place unit No. 3 of the powerhouse substructure completely encasing the draft tube to the base ele-





A FAULT (top) uncovered passing through the rock under two blocks was trenched out an added 20 ft. in depth and shaft forms installed for a deep concrete cutoff of the fault at the upstream face.

SECTION of 13.5-ft. diameter penstock (bottom) being swung into place by the cableway. Three of these penstocks serve the plant located at the downstream edge of the dam.

vation supporting the scroll case. The power plant will ultimately contain three vertical shaft hydroelectric generators of 16,667 kva. capacity.

Penstocks carrying water to the power plant were completely installed in blocks 14 and 15 during this work season. The penstocks are made of ½-in. steel plate, 13 ft., 6 in. in diameter. Pipe was delivered to the contractor assembled, requiring only field circumferential joint welding. The penstock for block 16 is required to be placed during the next working season.

Cofferdams for second stage

During this period, the contractor also completed the cofferdams within which the second stage contract work will proceed. The upstream works consist of a concrete arch abutted on block 15 and the rock wall of the canyon with a gravity abutment in the flume section. This arch is approximately 78 ft. high and has a 90-ft. radius. The downstream second stage cofferdam in an earth fill with a single line sheet pile cut-off sealed to the right retaining wall and against rock on the bottom and the right side adjacent to the flume. At the completion of this work, the contractor removed the pumps upstream and down and allowed the excavation and the completed works to be covered. The contractor then began the removal of the downstream sheet piles for the first stage cofferdam and the removal of the cofferdam fill. The diversion will be completed with removal of the upstream cofferdam fill material and the pulling of that sheet pile cut-off wall. The flume will be dismantled and right abutment excavation completed. A portion of the upstream arch gravity abutment remains to be completed above the low water level in the area where the flume presently carries the Missouri River.

Concrete delivery from the mixing plant to the placing point in the dam is made by a well car and dinkey serving a 20-ton cableway. Concrete is handled in 8-cu. yd. single compartment air-operated Gar-Bro buckets. For special mixes in difficult pours concrete is delivered in 6-cu. yd. hand-operated Blaw-Knox roller gate buckets.

For the spillway apron and retaining walls, concrete was hauled in two 2-cu. yd. buckets on a truck from the mixing plant to the apron. Placement in the form was made by crawler crane.

The cableway used at Canyon Ferry Dam was transferred from Angostura Dam, having previously served at Shasta Dam, Parker Dam and Boulder Dam. It is powered by a Lidgerwood 500-hp. three-drum cableway hoist. The cableway arrangement is a radial tower layout having a radius point at a tunnel anchorage in the rock above the left abutment and a 78-ft. traveling tower on a 550-ft. long runway above the right abutment of the dam. The cableway span is approximately 1,340 ft., the track cable is a Leschen 3⅛-in. 6 x 67 long lay cable.

Concrete mixing plant

The Canyon Ferry mixing plant was also transferred from Angostura Dam. The plant is a Johnson concentric zone plant with a 300-yd. bin and batchers and control system arranged for charging four two-yard Koehring mixers equipped with Claggett consistency meters.

Aggregate for the concrete in the dam is produced at a plant designed especially for Canyon Constructors by the Conveyor Company of Los Angeles. The plant has a capacity of approximately 450 tons per hr. and is equipped with screens and sand manufacturing and blending equipment to produce aggregates to meet the U. S. Bureau of Reclamation specifications. Aggregates and sand are stockpiled over two reclaiming tunnels whose belt conveyors deliver the materials to a truck receiving hopper along the road to the dam. The materials are trucked 1 mile from the aggregate plant to the mixing plant hopper. All coarse aggregates are rescreened at the top of the mixing plant with two Symons double deck screens to minimize degradation. This is now a standard requirement for USBR jobs.

The Canyon Ferry Dam is a project of the U. S. Bureau of Reclamation, a part of the upper Missouri River Basin development. The structure is designed under the direction of L. N. McClellan, Chief Engineer in Denver. Field supervision is provided by Wm. P. Price, Jr., as construction engineer; Gordon Manly, Field Engineer; Byron David, Chief Inspector; P. M. Schwartz, Office Engineer.

Contractors' personnel

Canyon Constructors is a joint venture group formed for the construction of Canyon Ferry Dam: Brown & Root, Inc., Houston, Texas; Griffith Company, Los Angeles; Wunderlich Contracting Company of Omaha, Nebraska; J. C. McGuire & Company of Los Angeles. J. C. Maguire is the job sponsor. Joe Shirley is the sponsor's job representative; L. P. Sowles, project manager; R. R. Murdoch, office manager; K. E. McDougal, construction superintendent; D. E. Coleman, assistant superintendent; Clarence Estes, master mechanic; Gale Hedrick, carpenter superintendent; Lex Foresee, chief electrician; Clyde Sheppard, rigging superintendent, and Orville Yancey, aggregate plant superintendent.

CONFUSION in CONCRETE

The ideal in mix design fluctuates from dry concrete to wet, and then back to dry again; but the practical man's problem remains the same. "One of the greatest needs in the concrete construction industry is a 'superman' who can and will restate, in readily understandable terms, the basic principles of concrete fabrication"

By GEORGE CONAHEY
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The opinions and assertions contained in this article are those of the writer and are not to be construed as official or reflecting the views of the Navy Department or Naval Service at large; furthermore, the opinions and recommendations advanced by the writer are not necessarily those of the Bureau of Yards and Docks, since the methods to be used for determining the aggregate grading and measuring "workability" of concrete are open for discussion.

IN A RECENT ISSUE of *Western Construction* (April 1951, p. 119) it was noted that at the open discussion meeting at the San Francisco convention of the American Concrete Institute, the concrete research men were not fully able to explain to the concrete field men the new information that had been developed regarding concrete mixes. In the September issue the editorial "The Designer's Responsibility" again emphasizes lack of understanding in the application of the fundamentals for designing concrete mixes. It appears from these editorials that there is a lack of appreciation of the value that can be derived by designing the concrete mixtures to suit conditions on a particular project. This article is written to stimulate discussion of the problem.

Workability defined

Apparently many designers do not recognize the importance to good construction, especially good concrete work, of using concrete that is "workable" for proper placing under job conditions. In this article, a workable concrete means one that is so proportioned and mixed that it can be put into the forms with a **reasonable** amount of work. After placing, it will have at least a film of moisture and no visible voids on the surface, with good bond to the reinforcement; no surface voids will show when the forms are removed. The "workability" of concrete is determined by aggregate character and grading as well as water and cement content.

Theory

Theoretically, the drier the concrete is mixed the greater the resulting strength. Practically, if the concrete is mixed so dry that it cannot be worked into place without air voids, the resulting structural unit will be weaker than if it were made of a concrete of a much lower theoretical strength. Most experienced designers recognize that the lower strength brought about by the use of a little more mixing water is much less than the loss of strength due to air voids or "honeycomb" resulting when the concrete is so dry it cannot be put into place. All the early reports of tests in designing concrete mixtures, beginning with Fuller and Thompson's report in the ASCE *Proceedings* of 1907, Professor Abrams' *Bulletin No. 1*, and Professor Talbot's *Bulletin No. 137*, point out this fact. The authors of more recent reports have apparently accepted this information as general knowledge, and so do not emphasize it.

Abrams' water-cement ratio theory is based on the use of a concrete that is wet enough to be workable or "go into place under job conditions," but not wet enough so the aggregates will segregate. Expressed another way for usual construction work, the Law is effective if the slump of the mixed concrete is a measurable amount, not zero but less than 8 in.

Concrete made and used for structural purposes containing five or more sacks of cement per cu. yd. and made with reasonably well-graded aggregates, having a slump of not more than 7 in., has an excellent record for weather resistance, fire protection, structural strength and architectural appearance. Many laboratory technicians raise their hands in holy horror when concrete mixes with 6- or 7-in. slumps are mentioned, let alone used.

Specifications state too much

Many designers and specification writers make an error in trying to tell the contractor both what is required on the job and how to perform the work. The designer may select a water-cement ratio that will give the strength desired on the project. Then he will specify a cement factor that will be too low or proportions so lean that the concrete will not be wet enough to be workable when mixed. The determination of the results required on a project is the designer's job. The method of producing those results should be left to the contractor as his problem. The designer should retain the right to review the methods and concrete proportions to be used on the work. The designer should keep in mind that concrete having a **correctly** measured slump of 5 to 7 in. will not segregate or develop laitance on the surface of most structural units. In high thin sections, concrete of this wetness can be used to start the work and then drier mixes used to prevent water gain in the forms. In slabs with a small amount of reinforcing or in large concrete sections drier concrete mixes can be used and vibrated into place properly. On large dams, concrete mixed to have very little or just a measurable slump has been successfully used with special large vibrators.

The slump test was developed to measure the wetness or consistency of concrete back in the 1920's. It is not a measure of the workability except as that property is changed by a change in the water content. During the 1920's much structural concrete was placed by means of chutes. The concrete was made with an excessive water content. Slumps of concrete, on jobs being built by reliable, respectable and responsible contractors, were often in excess of 10 in. The slump would have been greater except that 1½-in. aggregates were used. As a result of the field tests made by the Joint Committee, the need for weighing the aggregate and controlling the mixing water to obtain quality concrete was shown. Since that time the use of dry mixes of concrete has at times been over-emphasized and the importance of proper grading of aggregate has often gone unmentioned.

The Bureau of Public Roads conducted a series of tests and found that non-vibrated concrete for highway slabs should be mixed with not less than a 3-in. slump. These early tests were made before concrete finishers with vibrator attachments were developed. The development of vibrator equipment permits the use of drier mixes but how much drier is open to question.

Local problems

There is another item that affects concrete making on the Pacific Coast. Many of the rivers in the Western states are relatively short and the sand deposits along them are often deficient in the smaller sizes; i.e., particles passing the 50- and 100-mesh sieve. Modern sand washing equipment often removes these small amounts of fine particles along with the clay and other undesirable materials. The more recent publications regarding concrete aggregate grading seem to have missed a point in not emphasizing the importance of these small particles and their effect upon the workability of a concrete. Their great importance was pointed out by Fuller and Thompson, later confirmed by the tests of Pierson and Hitchcock of the Bureau of Standards, and are mentioned but not emphasized in the publications of the Portland Cement Association.

The introduction of air entraining cements and admixtures has reduced or eliminated some of the poor working qualities of harsh sands. These also permit using less sand in the concrete mixes under certain conditions. The extent to which the quality of sand can be reduced, when these materials are used, is often miscalculated or not properly understood.

A broad view

Now available is an excellent review and presentation of many theories and formulae for proportioning concrete and grading aggregates and methods of measuring "consistency" and "workability." The title of the publication will scare some people away from it. It is "The Predetermination of Water Requirement and Optimum Grading of Concrete," by Niels M. Plum, a civil engineer of the Danish National Institute of Building Research, Copenhagen.

In the prefatory note the author, among other things, states:

"Numerous authorities consequently have issued recommendations for selection of aggregate and concrete gradings, but even the best of them which take into account the effect of particle shape of the solids and of the compacting method, do not clearly state whether their recommendations are aiming at:

Maximum strength,
Maximum density,
Most economical strength, or
Most economical density.

"A thorough study of the existing literature in an attempt to find sufficient existing data, on which the relations could be based, soon revealed that although a lot of data was compiled by many authorities, none of this data was based on sufficiently precise definitions of:

the grading principles,
the term workability,
the particle shape.

"In fact the author feels that his method has rather limited application in practice. The paper is primarily intended as a theoretical contribution to throw further light on the many laws governing the capricious material of concrete and dedicated to the relatively few, who are interested in such theoretical concrete research."

It is to be regretted that more researchers do not come up with the same conclusion as expressed by Mr. Plum in the last paragraph quoted above. If more of the laboratory men could be given a broader viewpoint, some of the things that have happened in the past would not happen in the future. Commercial interests have developed many new ideas. Many of the good ones have been developed by further experimentation and have advanced our use of concrete. A few others equally good have been relegated to the scrap heap because they appeared to reflect upon the commercial interests of someone else. Too often the attitude is taken that the developer of the new idea is unintelligent with canine ancestry, and his father a bachelor.

History

A short review of the history of cement and concrete making should be pertinent. The modern use of cement in construction is usually considered to have started when civil engineer John Smeaton in 1756 repaired the foundations of the Eddystone Lighthouse. At that time no hydraulic cements were available that could be used for this type of construction with satisfactory results. Smeaton developed a hydraulic cement that would set and harden under water by roasting certain natural rocks at a higher temperature than was used to burn limestone to produce quicklime. Later research showed these rocks were composed of argillaceous, calcareous and siliceous materials. In 1824 Joseph Aspdin, a stone mason of Leeds, England, obtained a patent for making a hydraulic cement by roasting an artificial mixture or argillaceous and calcareous materials. He called it Portland cement because when hardened it resembled the famous building stone from the Isle of Portland. Portland cement manufacture began in England during the following year. In 1867 Jean Monier received a patent for the construction of flower pots, pipes and tanks made of concrete and reinforced by a wire net. He later obtained a patent for the use of reinforced concrete in bridge construction.

Hydraulic cement manufacture began in the United States in 1818 in connection with the construction of the Erie Canal. A natural cement was produced by calcining either a natural argillaceous limestone or a magnesium limestone without the admixture of other materials. Records indicate portland cement was first imported into the United States in 1865. There is some dispute regarding the date when portland cement was first manufactured in the United States, but it is now generally accepted to be 1871 when production started in the Pennsylvania Lehigh Valley district. Until 1897 more portland cement was imported than was manufactured here but from that date imports have fallen off rapidly and domestic manufacture has increased not only to replace foreign cement but to take the place of many other cements used in building construction.

Efforts to find the best materials and proportions to be used to make the best concrete seem to have originated in France. In 1897 R. Feret advanced the theory that the strength of concrete was determined by a ratio of the amount of cement to the voids in the concrete. Construction men continued to make and use the material with results that varied widely. In 1901 Messrs. Fuller and Thompson began their studies of concrete that resulted in the publication in 1907 of the "Laws for Proportioning Concrete."

These laws emphasized the importance of using properly graded aggregates and relatively dry mixes to produce maximum density in the concrete. Construction men could understand these laws and for several years appear to have tried to follow them. This was apparently the first of the periods when dry concrete mixes were accepted and used. Placing dry concrete mixes is difficult and expensive. After observing structures in service over a period of years, construction men learned that there were some other laws that had effect on their structure other than those expounded by Fuller and Thompson. Towers and chutes were also developed that would permit the transportation of the concrete from the mixer to the forms at a very low cost. For economical operation of the chutes, very wet mixes of concrete were required.

Wet concrete

The use of chutes ushered in a period of "wet" mixed concrete. The construction industry was apparently in confusion. Some structures were pointed out as good examples of "wet" concrete and others as good "dry" concrete, with many of both being pointed out as bad examples by each school of thought. This condition brought about the development of the slump test to measure the "consistency" or relative water content of the concrete. Practical men had previously developed methods of their own to estimate or measure this property. The method most often used was that of observing the concrete in the mixer or in the buggies. A good mixer man would look into the mixer and, by observing the manner in which the concrete splashed, estimate its wetness with reasonable accuracy. The concrete foreman often estimated the wetness or "slump" from the manner in which the stones would float on the surface during its "buggy ride" to the forms. He also estimated the need for change in proportions of fine and coarse aggregates by the way the concrete would run into and fill the buggy.

This wet cycle in concrete history, and its confusion, spurred many laboratories, material suppliers, equipment manufacturers, and construction men to seek the correct answers to the problems of determining the proper materials to be used and method of fabricating good concrete. This research work resulted in the publication of many technical reports. Wig, Williams and Gates reported that all materials being used in the concrete should be under rigid inspection, the mix used should have relatively high

density, and the concrete should be "cured" or kept wet for best results. Abrams, in his report, showed that the strength and other desirable properties of concrete were determined by the ratio of mixing water to the amount of cement used in the mixture. This law was shown to hold regardless of the grading of the aggregates. Mr. L. N. Edwards presented a paper at the ASTM convention of 1918 which showed that the strength of a concrete or mortar was determined by a relation between the amount of cement and surface area of the aggregates used in the mixture.

Theory put to test

The Joint Committee on Concrete of the technical societies had tests made of concrete being used on construction work. They reported that it was feasible to apply the water-cement ratio theory to make better concrete and improve structural practices. Talbot and Richart expounded the theory that "the strength of the concrete varies with the ratio of the amount of cement used in a unit of volume of concrete to the voids in this volume, and the strength may be taken to be a function of this cement-voids ratio." A few years after this, W. A. Slater showed that, within the realm of concrete used on construction work, the theories of Abrams and Talbot and Richart for all practical purposes gave the same results. Then McMillan summarized and condensed the water-cement ratio philosophy of mixing concrete into one handy volume. Very little effort was apparently made in any of these reports to analyze the results with an intent of comparing their own theories with the theories advanced by others or the results obtained by concrete fabricators on construction work. The outstanding exception is the work of Slater who did try to reconcile the different theories and express the results so men making concrete could use them.

Art or science

In spite of all this effort, concrete making has not been reduced from an art to a science. The art of making good concrete could be improved if someone could and would summarize all the information and restate the principles in the manner and form used by Fuller and Thompson. A question may illustrate the point. When using the same sand and a well-graded coarse aggregate, why is a 1:3 mortar weaker than a 1:5 (1:2:4) concrete? The answer that would be given would depend on the theory studied by the person answering. The answers might be as follows:

1. It requires more cement to make the mortar of equal strength because the aggregate is graded to only the ¼-in. maximum size.
2. The mortar mix is less dense than the concrete, so for equal amount of cement the mix of greatest density will be stronger.
3. The mortar requires more water in proportion to the cement to mix it properly or a higher water-cement ratio is used.
4. The cement-voids ratio is lower, so the mortar mix is weaker.
5. The surface area of the aggregate in the mortar is greater in proportion to the cement used, so the mortar is weaker.
6. The field man has two answers, either of which is practically correct. His first answer: "Sand kills cement"; so when extra sand is added in place of coarse aggregate, the mortar mix is weaker. The other answer: "The strength of a concrete is determined by the strength of the mortar"; a 1:2 mortar is stronger than a 1:3 mortar.

Choose your answer

Another point is this, if a research man is asked the question: What is the best grading for concrete sand? He will quote a set of figures as the sieve analysis of the material. Such a set of figures can be found in any concrete specification.

Ask an intelligent, well informed, practical concrete maker the same question, and his reply will be about as follows: Concrete sand should nearly all pass the No. 4 sieve, be well graded, have 50% passing the No. 20 sieve and 20% passing the No. 50 sieve with a little "powder" and some "goom" in it. That "goom" is the item that has seldom, if ever, been recognized by the research men. It refers to that intangible property of "stickiness," "gumminess," or "cohesiveness" needed for good working qualities. Good concrete has been made without "goom," but when it is present, "bleeding" and "sand streaks" will not appear on the surface.

Summary

In spite of the different points of view of the research man, the cement manufacturer, the aggregate producer, the structural engineer and the concrete constructor, the art of concrete making has advanced. Better and more uniform cements of higher quality and strength are available. Better aggregates are on the market even if the mechanical equipment does wash all the "goom" and too much of the "powder" out of the sand. The concrete constructor will soon make the uninformed designer pay the price for his impracticable specifications. This should result in making the present dry-concrete period a short one. The past history of concrete making has not always been easy going. There will be some new and some old problems in the future; but don't forget: progress has been and is being made.

In conclusion, it is suggested that the concrete research men state the purpose of their recommendations and define their terms, so that results can be compared with future investigations. This should permit an investigator like Mr. Plum to find a base from which he can start a new research program to develop new information, rather than require him to start at the very beginning.

One of the greatest needs in the concrete construction industry is a "superman" who can and will summarize all information and restate, in readily understandable terms, the basic principles of concrete fabrication. The value, use and meaning of the grading indices "surface modulus" and "fineness modulus" are often not understood by research men. They are meaningless to field men. These terms are much used to the confusion of both groups. The statement of principles must be in words that are easily understood and in a form for ready reference. "Workability" should be given an acceptable definition that research men and field men both agree is correct.

It should be recognized by all that relatively wet concrete is needed for most structural purposes. Relatively dry concrete can be used for mass construction.

If this "dream" could be accomplished, then it might be possible to provide a correct interpretation of research results to the men making concrete on those small jobs referred to in the editorial. At least, the engineers and concrete field control personnel at central proportioning or ready-mix concrete plants can use it to advantage and improve their methods of proportioning concrete.

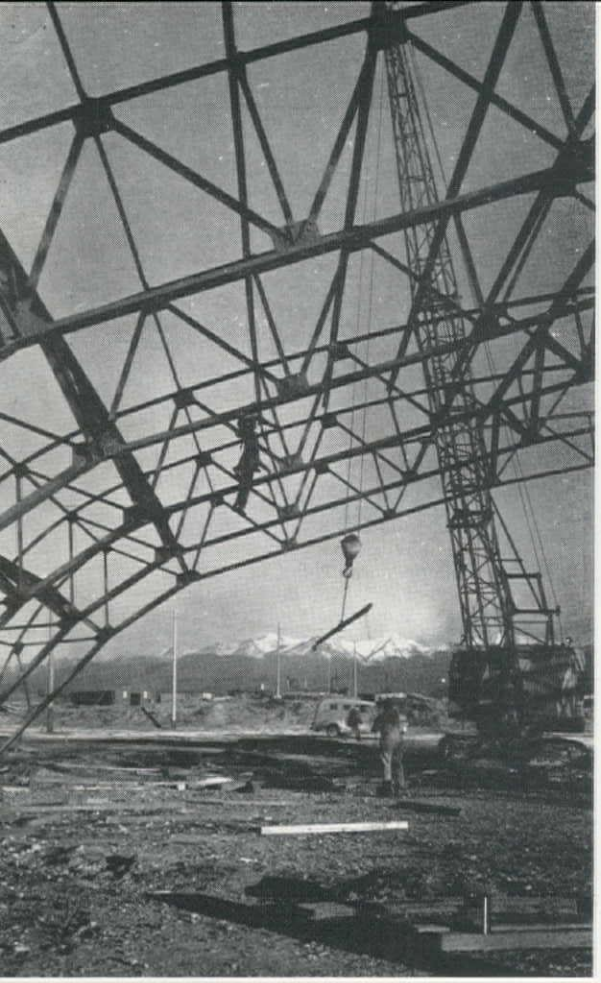
The author is qualified . . .

GEORGE CONAHEY

FOR THIRTY YEARS George Conahey has been closely associated with concrete technique, beginning with his work on a crew employed by the Joint Committee in 1922, which made field tests subsequently reported by Slater and Walker in volume 51 of the ASCE *Proceedings*. In 1925 he was a research associate at the Bureau of Standards, and a joint author with G. A. Smith of the paper "A Study of Some Methods of Measuring Workability of Concrete," ACI *Proceedings*, 1928.

In 1937 he supervised the proportioning, mixing and placing of concrete on the David W. Taylor Model Basin at Carderock, Maryland. This work included the concrete for the first "three-hinged" concrete arch built in the United States. During World War II he was in the Civil Engineer Corps of the Navy. One of his assignments was to supervise the proportioning of concrete used in the concrete floating drydocks.—Editor.

A BIBLIOGRAPHY of reports concerning theoretical principles for proportioning materials in concrete, including those cited by Mr. Conahey, appears on page 82.



Alaskan weather conditions dictated field modifications to the design of this . . .

BUTLER "PACKAGED" HANGAR

← *For speed, trusses were assembled on the ground and erected by this crane-rigged P & H Excavator*

By
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Corps of Engineers

AS ALASKA GROWS in United States strategic significance, so does the volume and variety of military construction there. Though much of this is currently of a permanent nature, techniques of advance base construction are not neglected. This article describes the erection in Alaska of an aircraft hangar designed for the speed of assembly required in building an advance base.

Evolved during World War II, the Butler three-hinged arch hangar was used extensively for accommodation of fighter craft and medium bombers in operational theaters having a temperate climate. Of prime importance now is its adaptability for use in Arctic regions. In the described operation, several variations were imposed on the original "packaged" Butler design, in particular that of installing full insulation. Other variations were suggested by the circumstances of the job that might be incorporated in future structures.

Description

This hangar is 129 ft., 9½ in. wide between bearing pad pins, and 160 ft. long as defined by eight 20-ft. bays between trusses. Channel and H-beam purlins are at 4 ft., 9 in. centers, and the entire frame is covered by lap-joint sheet metal secured with ¼ x 11-in. and ¼ x 14-in. lead-head clinch nails at channel and H-beam purlins, respectively. All structural field connections are bolted, using ⅝-in. and ¾-in. bolts. The completed hangar has a crown pin height of 32 ft.

Equipment used on the structural erection consisted of one P & H excavator with a 65-ft. boom, one Koehring shovel with a 50-ft. boom and a 15-ft. job-made jib, two 7½-ton Roadmaster cat-cranes with 35-ft. booms, and two compressors to power the impact wrenches.

Prior to the arrival of steel, foundations were prepared, consisting of 4-in. concrete leveling pads to receive 6 x 6-ft. steel bearing pads. This work, including backfill, and also trenching necessary for tie rods across the hangar below grade, was done before the ground froze. Alaskan weather was to be an added difficulty on this job, undertaken during November and December: stockpiled steel had to be covered with tarpaulins to avoid icing, erected steel had to be swept clean of newly fallen snow each morning to prevent accidents, crews were "grounded" by storms on two occasions, mastic used in roof sheathing had to be artificially warmed, and winds complicated handling of the large 12-ft. sections of roofing.

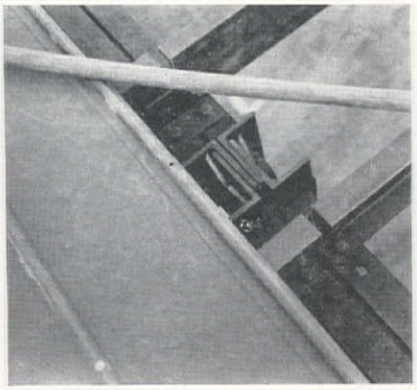
Work organization

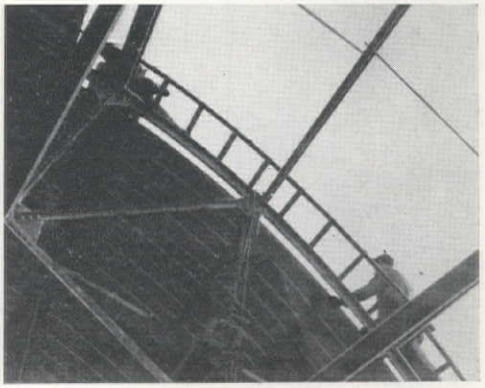
Job personnel were split into two units, composed both of soldiers and civilian workers, in order to make the most of experienced men, including one steel foreman among the soldiers. As it turned out, rousing competition developed between the two crews and materially shortened the job. The key to speed was prefabrication; hence, part of each crew was assigned to assembling the K-braces required in each bay, and also the ridge sections. Another group assembled trusses, each of which had been shipped in six sections; and three men aided this work by straightening members that had been bent in transit. Working primarily with the P & H and one Roadmaster, four remaining men commenced erection.

In order to eliminate unnecessary guying, it was decided to assemble the first bay on the ground. This was accomplished by setting each half truss in its hinge using a small rod as a temporary pin, placing the center hinge on temporary shoring (approximately 18 in. above grade), and supporting each truss section with two temporary A-frames of scrap lumber. The bay was then filled in with all members up to and including the first purlin past the top K-brace. The opposite half-bay was treated the same, with the exception that fewer purlins were used due to the smaller capacity and reach of the Roadmaster cat-crane. All diagonal bracing was placed before raising the half-bays.

When both sections were ready, the P&H excavator picked up and rotated the heavy section until the bottom pins of each half-truss were made. The Roadmaster rig then picked up and rotated the other half-bay and made the pins on that side. The center pin connection was then made and the bay completed by the P&H.

All center connections were made by bolting the hinge-and-pin assembly to





DETAIL of bottom pin connection (left) shows bearing plate, and tie rod leading to opposite end of truss. Crown-pin connection (center) was assembled on one truss section, joinery made by bolting angles to opposing section. At right, curved ladder was built on the job, rode on rollers engaging purlin flange as roofers laid curved sheets on steep sides of hangar.

one of the half-trusses, connection being made by guiding the holes with a spud wrench and making the bolt, instead of the more difficult pin, connection on the opposite half-truss.

Assembly technique

By the time the first bay was filled in, most of the remaining trusses were assembled and ready to go. The P&H picked up a truss half-section, and the lower pin was slipped into place. The Roadmaster then filled in all K-braces, working inside the bay. When the last brace was made, the Roadmaster took the load at the top brace, cutting the P&H free. The P&H then picked up the opposite half, and the lower pin and center connections were made as before. As soon as all pin connections were made, the Roadmaster was cut loose to fill in the remaining K-braces. Following this, it was used to pile the next bay's K-braces and purlins while the P&H completed the filling in. This procedure was followed throughout.

Two men did all the connecting, while two men laid out purlins, made the hitches, and handled the tag line. After the connections were made, a crew of four to eight men completed the bolting, and a crew of soldier-laborers did all the sag rod work.

Truss assembly was speeded by the use of impact wrenches. Connections of K-brace to truss were speeded by attaching the lugs of one bottom leg to the truss when it was assembled and attaching the remaining lug connections to the other bottom leg of the K-brace.

All channel purlins had one-hole connections. In order to speed erection of this item, one lug was bolted to the leading end of each, thereby allowing the connector to use his spud wrench in making the two-hole connection of lug to truss.

The time of erection for the frame of this hangar, from assembling K-braces to completion of the superstructure, was slightly over four days. We are certain that this could have been bettered had the work been done in summer instead of during the months of November and December.

Roofing

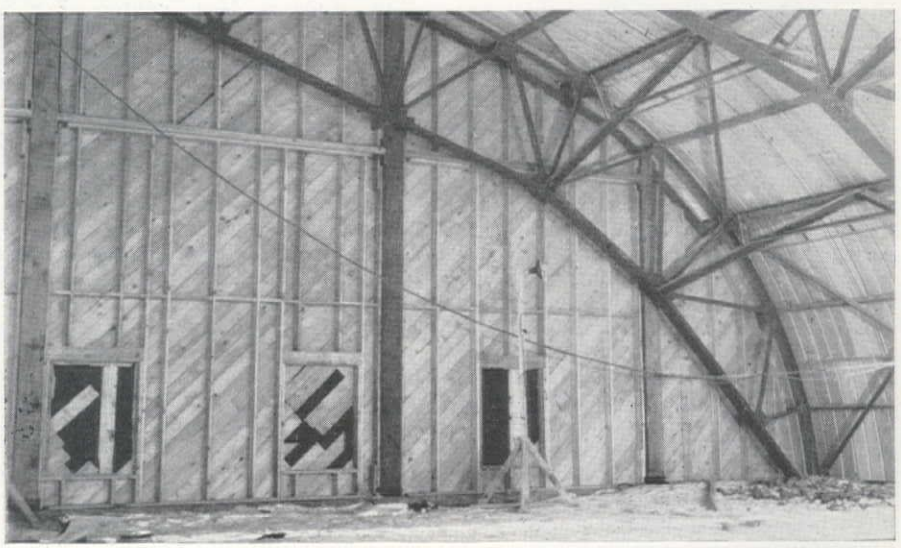
The method used by sheet metal crews in applying skin on the hangar was to run the crown course and one course on each side first, starting at one end of the building and running to the other end. Care was taken that the sides of the sheets were parallel to the trusses when starting. This alignment had to be watched at all times or trouble would develop as work progressed down the side of the building.

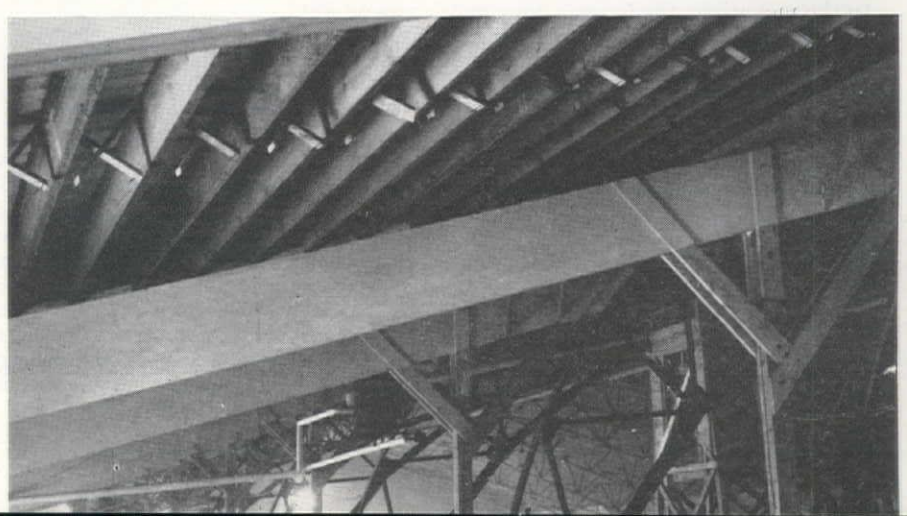
When the three top courses were finished work was continued on either side, running three more courses of flat iron. This completed, three courses of curved sheets finished each side.

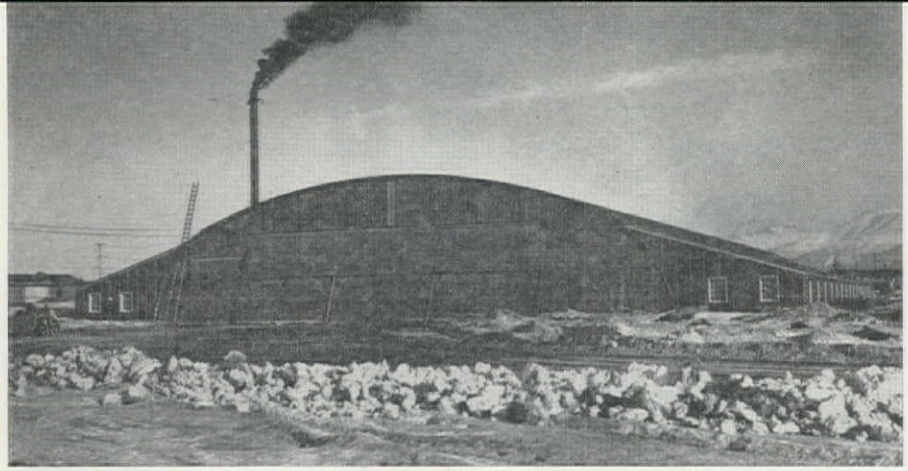
The tools needed by the bucker were a hammer, punch, automatic nut gun, and pliers. The sheeter used a hammer, punch, and Yankee automatic screwdriver (large size). Mastic guns and mastic were furnished with the building.

By using four needle bars with kick planks, an area 36 x 20 ft. was roofed from one setup. With this amount of scaffold it was best to use three buckers working from the bars and three sheeters working from the roof. The sheeter set the sheet in place and put the bolt through; the bucker started a nut on the bolt and held it while the sheeter screwed it tight with an automatic screwdriver. When all the bolts in the

FULL INCLOSURE of hangar necessitated framing in rear wall. Wood sheathing was covered by building paper outside, and insulation board inside. Bottom picture shows heavy framing of shed-roof shop additions, including 2 x 8-in. ceiling joists on laminated plywood girders. Girders were cantilevered from columns at right to connection with sloping hangar sides.







COMPLETED HANGAR reveals treatment given "over-designed" doors. Too large for opening provided, they were allowed to rest at this angle, and triangular wall sections sealed extreme ends.

sheet were drawn up, the bucker punched a hole through the head of the sheet along the high side of the purlin. The sheeter then shoved a lead-head clinch nail through the hole and held the head down tight while the bucker clinched the end of it around the purlin.

The man landing the sheets was responsible for applying the mastic in the proper place as the sheets were hoisted on the roof. One man would pack the sheets to the sheeters; also the nuts, lead-head clinch nails, etc. Tubes of mastic were kept in a warm pot, as it was very hard to press out of the gun when it was cold.

When applying the curved roofing sheets, it was impossible for the sheeters to work from the roof itself. To meet this situation a curved, light steel ladder was fabricated. Having rollers that rode the bottom flange and two hooks that hooked over the H-beam at the break in the hangar curvature, this ladder permitted easy access for the roofing crew at all points.

Door design difficulty

In this theater of operations it was found necessary to pave the hangar floor and to have doors installed instead of using the canvas inclosure furnished. These doors had to be specially designed for this type hangar; therefore, the Butler Manufacturing Co. contracted with the McKee Door Co. to design and fabricate them. McKee Co. went ahead with its design on the assumption that finished grade would be through the centerline of the base hinge pins. Such an assumption precluded the fact that half the diameter of all tie rods would show above the floor and that each of four turnbuckles would project above grade about 2½ in. Obviously, this would be undesirable.

In the meantime, the hangar floor had been paved using a fill of 7 in. above the centerline of tie rods and a 6-in. concrete slab, making a total difference of 13 in. between actual conditions and those assumed by McKee. Consequently, when the actual door hanging started, there arose quite a field problem!

Door installation

From the accompanying photograph it can be seen that the doors, when closed, rest at an angle. In remedying this, the only field changes necessary were to cut two triangular frames to conform with the new angle and to reframe the two small side doors. To close the gap between the large door and the end doors, a channel was welded to the latter. (To eliminate the above field changes in subsequent construction, it was decided to slope the hangar floors, starting 10 ft. behind the door truss, far enough to obtain the elevation assumed by McKee. Therefore, the doors went in exactly as the designer intended, and another problem was met and solved.)

The erection of the doors themselves was improved over McKee's instructions, that the entire door structure be erected piece by piece. It was found faster and easier to assemble and square the door frames on the ground and erect them in one piece. The remainder of the erection followed the book.

The back end of the hangar was framed in using four 8 x 8-in., and four 8 x 12-in. columns approximately 16 ft. on centers, three 2 x 8-in. stiffeners, 2 x 8-in. studs at 24-in. centers, 2 x 8-in. blocking, 1-in. diagonal sheathing, and 15-lb. building paper. The tops of columns and the stiffeners were framed into the end truss; column bases were bolted to footings in a continuous footing wall.

Insulation

The entire hangar was insulated with ¾-in. insulation board. This was placed along the top chord by means of 2 x 2-in. backup strips fastened to the purlins by job-made plywood purlin clips. To speed this phase of the work, a traveling jig was made, conforming to the contour of the hangar arch, wide enough to fit easily in a 20-ft. bay, and long enough to permit insulation of an entire half-bay from one position. By means of casters, this jig could be moved to each bay in succession and half the hangar insulated as it moved in, and the other half as it moved out.

Timesavers

A Clark Dock Loader was used to expedite the moving of this jig, various assemblies of scaffolding, lumber, crates of door parts, etc. Another timesaver was a telescoping electrician's ladder, which could reach any point in the hangar. Installation of lights and conduit, adjustment of door operating machinery, and various inspections were performed from this ladder rather than from relatively cumbersome scaffolding.

To gain extra work space, shed-roof shops were added to the hangar, extending the entire length of each side and 25 ft. wide throughout. The roofs of these lean-to structures were supported by laminated plywood girders, each 35 ft., 5 in. long, 2 ft. deep, spaced 20 ft. apart.

In order to give ample headroom in the shops, the four lower purlins were removed from each truss bay, except at end bays, which were completed with all bracing. Structural support for the plywood girders was provided by 3 x 8-in. wood columns. These were placed to give a 25-ft. span across the shop area, with the remaining length of roof girder —11 ft., 5 in.—cantilevered to its point of non-structural contact with the curved hangar truss. This design was used to minimize any stress developed by the unequal thermal properties of wood and steel.

Purlins were 2 x 10-in. members spaced at 12-in. and supporting 1-in. sheathing. Curved sheet metal roofing eliminated from the hangar by construction of the shops was flattened for use on the shop roofs. Shop walls, framed of 2 x 6-in. studs on 24-in. centers, were covered with 1-in. sheathing and 15-lb. building paper.

Conclusions

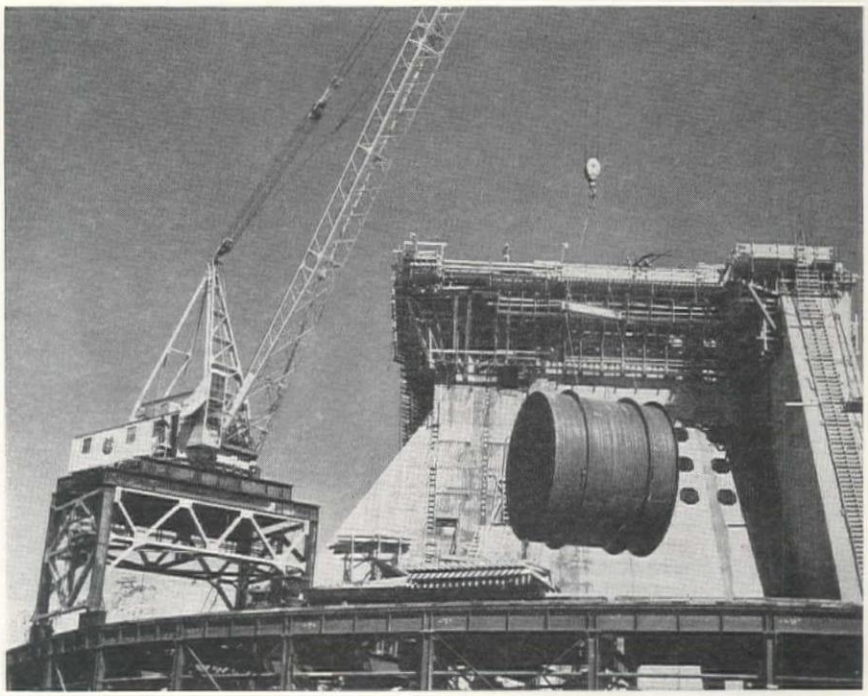
This type of hangar is well designed for its intended function, in the intended temperate areas. It is the writer's belief, however, that much is lacking in the original design to make it suitable for this frigid zone. In particular, the need for heating buildings in Alaska suggests the use of insulation throughout. No provision was made in the Butler design or fabrication to facilitate this major item. Also, it would have been advisable to furnish the materials for inclosing the rear end of the hangar.

In the future the item of door design should be more thoroughly investigated for economy and ease of erection as well as the conservation of material. It is believed that plywood-frame sliding doors, with wood-frame door inclosures, manually operated, would serve satisfactorily. Also, the possibility of making overhead doors out of wood or aluminum should not be overlooked. The foregoing suggestions pertain mainly to hangars to be erected in frigid zones and to those intended to be more or less permanent.

A word of warning

In conclusion, it should be stressed that caution must be used when handling the members of this type hangar. It must be remembered that a high design stress was allowed, directly contributing to small steel sections. During actual erection, little is to be feared from crimping the steel; however, when shipping, loading, or unloading this material, it is very easy to bend up the truss sections by picking up too many at a time or stacking them too high. Allowance must be made for the fact that they are not as rugged as the usual "peacetime" trusses and should be handled accordingly. With this in mind, the erector will find that the Butler three-hinged arch hangar will furnish ideal erection conditions as well as a good, structurally sound building.

To accommodate differential anchorage settlement in poor foundation material, as well as temperature effects, these Davis Dam penstock sections were provided with expansion joints to permit lateral as well as longitudinal movement. Here is a complete review of the . . .



Design, fabrication and installation of 22-ft. diameter penstocks

By

P. J. BIER

Head, Penstock and Pipe Section
Bureau of Reclamation
Denver, Colorado

WHEN IT IS NECESSARY to support large water conduits on unstable foundation, one is confronted with the problem of designing the conduits so that they will adjust themselves to displacements in that foundation. To support a rigid 22-ft. diameter penstock on such a foundation would be extremely risky, as differential settlements between intake structure and power plant or anchors would jeopardize the safety of the penstocks.

Such a problem arose in connection with penstocks at Davis Dam where, during the excavation, it became apparent that the foundation was not as stable as expected from indications of exploratory test holes. The foundation was found to be of rock that was jointed and crossed by numerous faults and clay seams requiring special treatment. Consequently, penstocks were designed that consisted of individual pipe sections connected with flexible watertight joints.

Description of the project

Davis Dam, located on the Colorado River about 67 mi. below Hoover Dam, was constructed by Utah Construction Co. for the Bureau of Reclamation to regulate the fluctuating releases from Hoover Dam. The project consists of a large earth- and rock-fill dam, a concrete spillway and intake structure, a powerplant with switchyard and some 900 mi. of transmission lines. Work at Davis Dam was reviewed in *Western Construction* for December 1949, pp. 51-53.

Power is generated by five 45,000-kva., 3-phase, 60-cycle alternating-current generators connected to 62,500-hp. reaction turbines operating under a normal net effective head varying from 110 to 130 ft. Each turbine is served by an individual 22-ft. diameter welded plate-steel penstock equipped with combined deflection and expansion joints. These joints are designed to permit both vertical and horizontal movements produced in the line by differential settlement and temperature variations, respectively.

Penstock specifications

Only two earlier penstocks on Reclamation projects equal or exceed the diameter of those at Davis Dam. These are the 30-ft. penstocks at Hoover, and the 22-ft. penstocks at Parker, both on the Colorado River. The flexible joints, however, are the largest ever built for any Reclamation pipeline.

The Davis penstocks were designed for a maximum static head of 134 ft., plus a water-hammer head of 53 ft., or a total head of 187 ft. measured at the center of the downstream end of the pipe. Water-hammer was computed on the basis of a gate-closure time of 4 sec. from full gate. Steel plate of firebox quality, ASTM Designation A 285-46, grade B, was selected for the penstocks. This type and grade of steel has a minimum tensile strength of 50,000 psi., and a minimum yield point of 27,000 psi. Being of low carbon content with a maximum of 0.22%, the steel has good welding qualities, assuring ductile welds.

A design stress of one-half the minimum yield point, or 13,500 psi., was used. Based on this design stress and using a joint efficiency of 90%, as all welds were to be radiographed, a maximum plate thickness of 1 in. was required at the downstream ends of the penstocks. The plate thickness at the upstream ends was computed at ⅝ in.; however, a ¾-in. thickness was used to satisfy requirements of rigidity during fabrication and handling, in accordance with the formula

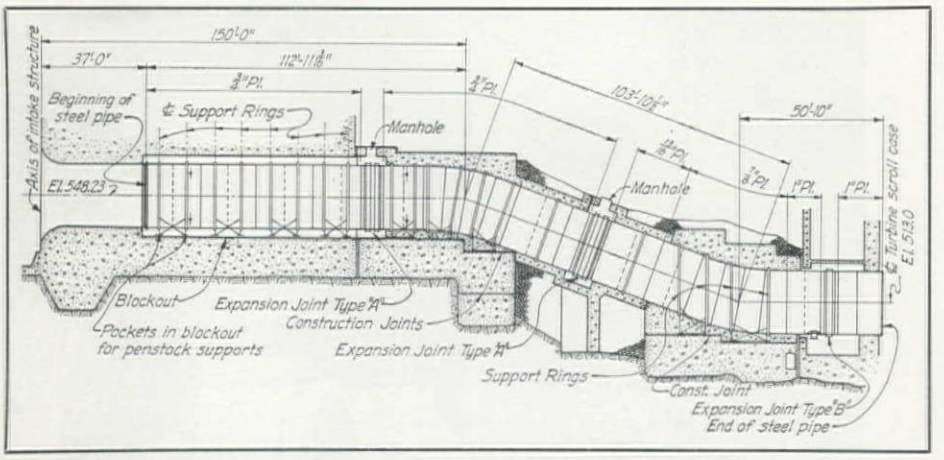
$$t_{\text{min.}} = \frac{D + 20}{400},$$

where D represents the pipe diameter in inches.

The five penstocks vary in length from 175 to 305 ft., approximately, including the intake transition which is formed in the concrete. Each penstock intake is

PICTURED AT TOP OF PAGE—

WHIRLEY of Utah Construction Co. swings penstock section toward position at intake structure. Pipe was fabricated at local yard of subcontractor Southwest Welding & Manufacturing Co.



TYPICAL PROFILE, Penstock 1, shows succession of joints between tangent sections. Anchors act independently, separated by 1 and 2-in. contraction joints.

controlled with a hydraulically-operated fixed-wheel gate and is protected against the inflow of floating matter by a trashrack. The downstream ends of the penstocks were provided with make-up sections which were fitted between penstocks and turbine-scrollcase extensions after both installation of the penstock and installation and pressure testing of the scrollcase. As the scrollcase (or spiral case) is of riveted plate-steel construction, a riveted joint was also used between the penstock and scrollcase extension. This joint is double-riveted with an outside butt strap. The specifications provided that each scrollcase was to be subjected to water pressure of 55 psi. during its encasement in concrete. A hemispherical bulkhead was bolted to the end of the scrollcase extension for that purpose. Installation of the downstream expansion joint and two pipe courses, including the make-up section, was delayed until the bulkhead had been removed. The rivet holes in the downstream end of the make-up section, joining the scrollcase extension, were drilled in place using the predrilled butt strap as a template. Rivets with heads countersunk on the inside were used.

Each penstock was provided with an 18-in. drain nozzle near the downstream end for draining the line during shutdowns or when desired to inspect the interior of the pipe. Manholes were not provided in the penstocks as access can be had through manholes in the turbine scrollcases. Piezometer connections for use during turbine-performance tests were placed in each penstock.

Joint analysis

In the development of a flexible watertight joint, a rubber-seal design was first attempted, but there was some doubt whether fabric-reinforced rubber of sufficient strength could be produced to carry the pressure and retain the desired flexibility. Further studies indicated that this could be remedied by providing a steel housing for the rubber joint which would carry the load transmitted from the rubber seal. Discussions with rubber companies, however, showed that the fabrication of rubber-seal joints would, because of the requirement of costly presses, be impracticable. It was therefore decided to replace the rubber-type deflection joints with more conventional steel expansion joints provided with stuffing boxes for the packing.

In addition to foundation displacements due to direct load it was necessary also to consider movements due to temperature changes and water pressure against the upstream face of the intake structure. The water pressure tends to produce rotation in the downstream toe of the intake, moving the embedded penstock with it. Computations based on a low modulus of elasticity of 50,000 psi. for the inferior foundation material, indicated a possible vertical movement of 0.76 in. at this point. The horizontal movement was estimated at 0.64 in.

Joint design

When properly packed, these joints are expected to remain watertight during the anticipated displacements. Each joint consists of two heavy inner sleeves, the outer sleeve, and two stuffing boxes. All inner sleeves are nickel-clad on the outside to prevent corrosion and "freezing" of the joint. The thickness of the nickel cladding is 5% of the plate thickness. The outer sleeve is stiffened with ring girders to preserve the circularity of the assembly. By welding retainer rings to the inside of the outer sleeve, two stuffing boxes were formed, each of which accommodates four or more rings of lubricated long-fibre flax packing. Packing glands provided with closely spaced stud bolts are used to compress the packing and maintain watertightness. Ladder rungs were welded to the stiffener rings of the outer sleeve to make the joints accessible for repacking or for compressing the packing.

Two types of deflection joints, designated as Type A and Type B, were provided (see illustration). The Type A joint has a comparatively long outer sleeve to permit large movements, while the Type B joint has a shorter sleeve to accommodate smaller movements. Each long joint is fabricated with two pipe stops which are streamlined with an annular plate welded between, and the enclosure grouted. The short joint has a centering rib only. Push-off bolts for removing the glands when repacking becomes necessary were furnished with the joints. All welds in the sleeves and packing glands that are in contact with each other or with the packing material were required to be ground flush. As all deflection joints were to be enclosed in concrete chambers, it was necessary to make them accessible from the top through manholes.

Bends

Penstock 1 consists of three tangent sections connected with bends. The upstream tangent section is supported on the concrete backfill in the "blockout" of the intake structure, and the central and downstream sections are supported on concrete anchors. Penstocks 2, 3, and 4, consisting of two tangent sections, were provided with two deflection joints each; and Penstock 5, being the shortest, has only one deflection joint, located near the turbine end of the penstock.

All bends were designed with 70-ft. radii and small deflections between individual segments to reduce hydraulic losses. With the exception of one vertical bend in Penstock 1, all are combined bends to take care of both vertical and horizontal deflections in the line. Hydraulic forces at bends are resisted by heavy reinforced concrete anchors placed at these points.

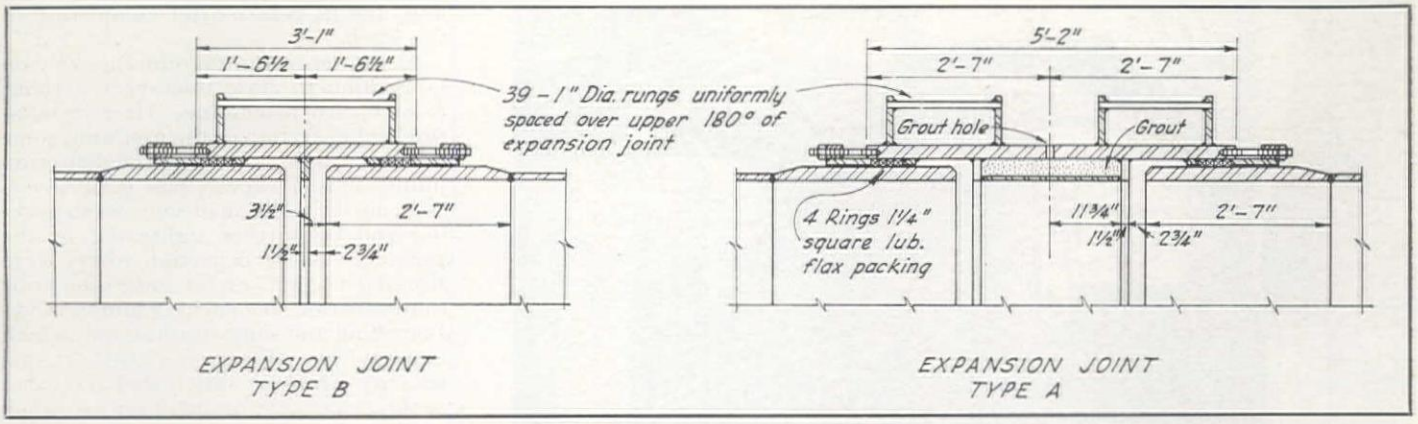
Penstock fabrication

The penstocks were furnished under a separate contract, but for installation by the general contractor, Utah Construction Co. Three bids were received in March 1948 for furnishing the penstocks, including the welding and radiographing of the field-girth joints. A total weight of 3,220,000 lb. of steel was involved. The bids varied from $935,000 to $1,078,000, low bid being submitted by Southwest Welding and Manufacturing Co. of Alhambra, Calif., which was awarded the contract.

Due to the large size of the penstocks, making shipment by rail impossible, most of the fabrication work was performed in a well-equipped field-fabricating plant erected by the fabricator near the dam. The fabricating plant included storage space for incoming material and for completed sections, concrete-working platforms, and handling equipment consisting of a 50-ton stiffleg derrick with 130-ft. mast and 100-ft. boom. A special cross bar was used to facilitate the handling of material. Automatic and manual welding equipment, and structures for overhead welding of girth seams were also provided.

The plates, upon receipt from the mill, were rolled into arc sections, three to a circle, with edges prepared for field welding. This was done at the contractor's home plant in Alhambra. Deflection joints were fabricated in sections for shipment to the field plant and reassembly and completion at that plant. Upon arrival at the field-fabricating plant, the material was stored until needed, as shown in Figure 8. The rolled plates were first welded into pipe courses 10 feet long, then two courses were welded into erection sections 20 ft. long.

All welding, wherever practicable, was performed on automatic welding machines, using the Unionmelt process.



TWO TYPES of joint design are shown here, intended for varying degrees of expected displacement in penstocks. Note magnitude of possible take-up.

The first pass was deposited from the inside of the pipe, followed by a pass from the outside. Girth joints on the outside were welded from an enclosed overhead structure, rotating the pipe section during welding. The circularity of the pipe sections during fabrication and welding was preserved by means of 6-arm spiders with adjustable wedge ends. All spiders were left in place until the stiffener rings had been welded to the pipe. These rings were placed at appropriate points along the penstocks to keep the pipe sections circular during handling and erection. They were also used for attachment of temporary structural-steel supports. All stiffener rings were of 1 x 10-in. size and were welded to the pipe manually using two continuous fillet welds. During the welding of longitudinal joints, the plate edges were kept in alignment with curved-alignment jigs 6 ft. long having the same radius as the outside of the pipe. These were clamped to the outside of the pipe during welding.

"Blockouts"

As the penstocks were not available when concrete placement was in progress at the lower levels, 28-ft. octagonal blockouts were provided in the intake structure. This made it possible to install the penstocks at a later date. All blockout openings were reinforced with two lines of hoop steel to take care of rim stresses in the concrete.

The installation work, consisting of handling, placing, welding, painting, excavation and concrete work was divided between the pipe fabricator and the general contractor. After loading by the pipe fabricator, penstocks were hauled from the fabricating plant to the dam by the general contractor using a special trailer. Each pipe section was lifted from the trailer by a whirley crane, then transferred to a special car running on tracks in the penstock blockout, or placed on temporary supports along the profile.

Installation

First the section was placed in approximate position, then the structural-steel supports welded to the stiffener rings, after which the section was placed to final grade and alignment. After final placement of a section, the penstock fabricator aligned the pipe edges, tacked and welded the girth joint, and radiographed the welds. Welding of the field girth joints was performed manually, using Fleetweld No. 5 electrodes. The weld metal was deposited from the inside of the pipe in the lower half of the joint and from the outside of the pipe in the upper half of the joint, the plate edges having been prepared accordingly. After backgouging the root of the deposited weld metal, a backing layer was applied. All intermediate weld passes were thoroughly peened. Prior to radiographic inspection weld irregularities and projections in excess of ⅛ in. were ground down to improve radiographic contrast in the films.

Concrete

Installation proceeded in the downstream direction, the pipe being supported on the structural-steel supports until concrete was placed around the pipe and at the supports. Concrete in the blockouts was placed by a pumped-concrete line connected to a double-acting pumping machine. Conventional placement methods by means of elephant trunks were also used at the downstream portion of the blockout for Penstock 1. Uplift or lateral movement due to concrete placement in the blockout was prevented by steel struts installed between penstock and blockout. Concrete of 4-in. slump using 2½-in. maximum aggregate was placed. Not reinforced, this backfill concrete was consolidated by means of internal vibrators.

After the concrete in the blockout was placed and had set sufficiently, it was backgrouted from the inside of the penstock. This was accomplished by means of soundings on the inside to detect hollow spots, which were pressure-grouted through tapped holes provided where required. Backfill concrete in the blockout openings was, in addition, backgrouted at its contact surface with the original intake concrete. This was accomplished by means of grout pipes embedded in the backfill during placement.

Anchors

Concrete anchors were constructed in two stages. The first-stage concrete, consisting of the base, was placed to a level to accommodate the structural-steel supports during installation. After installation of the pipe, concrete was placed for the upper portions of the anchors covering the pipe. All anchors were reinforced for the computed loads. Between anchors and deflection-joint chambers the pipe was encased with reinforced concrete. Prior to encasement, the pipe shell was coated with an asphaltic compound to protect the steel against corrosion if water should seep in from the outside.

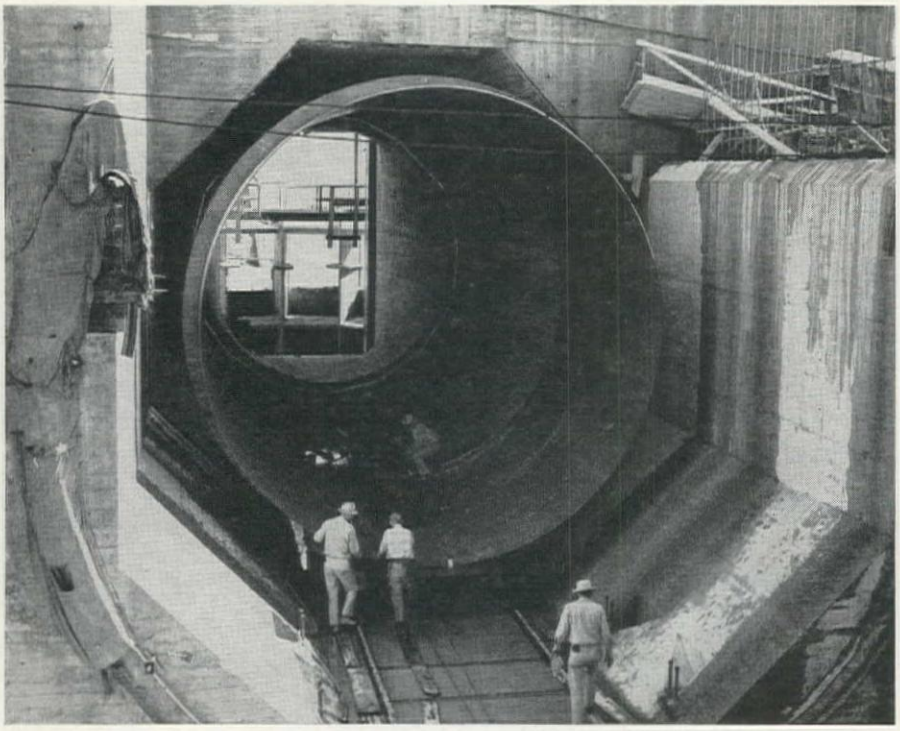
The various concrete structures were separated by contraction joints and were placed independently of each other. These joints were 2 in. wide in locations with large displacement and 1 in. wide where smaller displacements were anticipated. To prevent the seepage of surface water through these contraction joints, they were sealed off with two rings of rubber water stops placed around the pipe. The space in the contraction joints was filled with cork board to prevent dirt and other foreign matter from entering and making the joints inoperative.

After the penstocks were completely installed and all concrete placed and backgrouted, interior surfaces of the penstocks were cleaned by sandblasting and painted with one coat of coal-tar primer, followed by a coat of coal-tar enamel applied hot with hand daubers. This coating was tested by electrical flaw detectors, and defective areas were repaired and retested. The upstream sections of the penstocks, embedded in the blockout concrete and in the anchors, were cleaned on the outside prior to encasement but were not coated.

Tests and inspections

The penstocks were designed and constructed essentially in accordance with the provisions of the 1943 edition of the API-ASME Code for the Design, Construction and Repair of Unfired Pressure Vessels for Petroleum Liquids and Gases. All welding operators were qualified in accordance with American Welding Society standards. Control of production welding was maintained by production test plates prepared for every 200 ft. of welded seam; also by radiographic inspection, with X-ray, of all butt-welded joints.

All shop and field work was closely followed by government inspectors, who also reviewed all radiographs and determined unacceptable defects requiring repairs. Such defects were removed by chipping or flame gouging and were replaced by sound welds. The repair welds were re-radiographed to determine the



OCTAGONAL "BLOCKOUT" formed in intake structure is fitted with first penstock section. Notice concrete transition in background, pipe supports in foreground. Blockout was later backfilled, vibrated and grouted with penstock under pressure.

adequacy of the repairs. All radiographic films were marked in accordance with marking diagrams furnished by the penstock fabricator, and were filed for future reference as required by the code.

Service record

At the time the penstocks were designed, there was some doubt regarding the watertightness of such large deflection and expansion joints. It was felt that machining should be resorted to in order to obtain close tolerances between sliding surfaces. This, however, proved to be impracticable: the large size of the joints made rail shipment impossible if machined at production centers where boring mills of the required size would be available. Machining at the site of installation, on the other hand, was not feasible as it would require the transportation and erection of a heavy boring mill, and its return after completion of the work.

It was necessary, therefore, to rely on fabrication to close tolerances without resorting to machining. After installation and operation of the first unit, some leakage was discovered in the deflection joints. This, however, was easily overcome by the addition of some fresh packing and by further tightening of the packing. As the deflection joints were stored in the hot sun for some time prior to installation, the packing lubricant became fluid and some of it ran out, which impaired the efficiency of the original packing. This was anticipated and extra packing was kept on hand for use when needed. Operating experience to date indicates that the deflection joints are of sound design and have been fabricated within the required tolerances to provide efficient service. They are subject to periodic inspection, however, to detect any leakage which may develop as a result of displacements in the foundation and supports.

Personnel

The principal design work was done by F. Heidinger and C. H. Whisler, under the direction of the author, and the general supervision of J. K. Richardson, Head, Mechanical Branch. All design work is under the general direction of W. H. Nalder, Chief Designing Engineer. The field work was first in charge of H. F. Bahmeier, Construction Engineer, who in 1950 was succeeded by J. R. Walton. H. E. Williams is project manager for Utah Construction Co. The field work of Southwest Welding and Manufacturing Co. was in charge of R. Garrity. Principal inspection of welds was done by Victor Barth, Bureau welding inspector.

Bid schedule for Alaska Corps of Engineers' projects

THE LISTING of proposed construction to be undertaken for the Alaskan Command during the 1952-1953 season has been released by Colonel L. E. Seeman, Alaska District Engineer.

Advertisements will be issued soon in preparation for the 1952 season. Since the establishment of the Alaska District in April, 1946, a total of approximately $237,000,000 has been expended for construction activities up to August 31, 1951. The 1951 fiscal year expenditure was approximately $55,000,000. A total of $42,500,000 has been obligated on contracts awarded during the first quarter of fiscal 1952.

The current listing is brought out to inform contractors and suppliers as to the type of projects, the location, and the tentative timing of the proposed bid opening dates. The exact dates will be announced at the proper time through routine notices from the Alaska District Engineer's Office.

There are seventy-six projects proposed, estimated at about $117,000,000 for the Alaskan Air Command and $51,000,000 for the U. S. Army in Alaska. The forty-four projects slated for the Fairbanks area include twenty-three for Eielson Air Force Base. For January 1952, proposed bid openings are for a communications facility, locomotive shed, parking apron, and a 3-mi. access road. For February there are 258 units of 8-family housing and utilities, 9,600 lin. ft. of railroad trackage, automotive maintenance facilities, a parachute loft and shop, a non-commissioned officers' club, a 300-seat chapel, a vehicle servicing facility, and an officers' mess. For March, there is a 6,000-sq. ft. bakery including utilities, a heat and power plant extension, and an outside utilities and roads project. For April there is an extensive utilities project.

There are twenty-one projects for Ladd Air Force Base. Proposed for January 1952 bid openings are a communications facilities, an automotive maintenance shop, and a standby heat and power plant. For February there is an electronics building. For March there are outside utilities, addition to the POL system, tactical troop facilities, 240 units of 8-family housing, and a heat and power plant extension.

The twenty projects slated for the Anchorage area include twelve for Elmendorf Air Force Base. Proposed for January 1952 bid opening is a motor vehicle warm storage building at Anchorage. Also at Anchorage there are eight projects slated for Fort Richardson. For January 1952, a quartermaster warehouse, and an ammunition storage area. For February, another ammunition storage, a refrigerated warehouse, and a community center building.

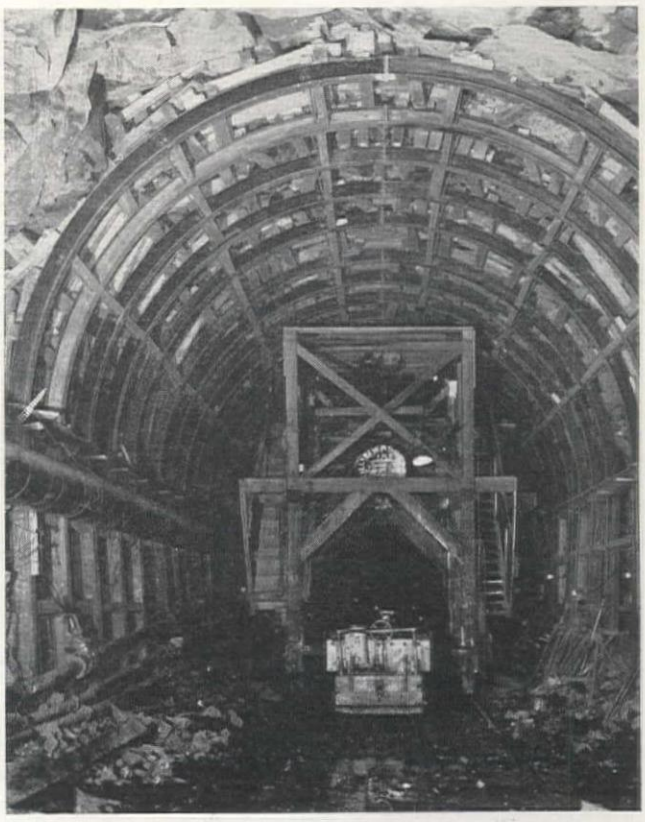
For Big Delta there is a bid opening proposed for January for new permanent station facilities. For Naknek there are bid openings proposed for March for miscellaneous temporary cantonment reconstruction, and for reconstruction of airfield pavements. For Whittier there is an opening proposed in March for a utilities project. Also proposed for March is a POL pipeline.

In addition, there are a number of projects remaining from the 1951 program such as the military installation at Kenai, in which readvertisement is expected. Also approximately $1,400,000 of construction for the Signal Corps' Alaska Communications System through Alaska is to be undertaken.

Last of two installments—

MODERN TUNNELING PRACTICE

Last month the author discussed the elements of drilling, mucking and hauling. This last installment covers the problems of supports, lining and elemental geology.



A TIMBERING JUMBO in a large tunnel operating on wide-spread rails and constructed so that tunneling equipment can pass underneath without interference. Can be used for vertical switching of empty cars.

By
RUSH T. SILL
Consulting Engineer
Ruscardon Engineers
Los Angeles, California

ROCK PRESSURES, requiring support in a tunnel, are caused by faulting, folding, shearing, or fracturing of the rock mass or by chemical decomposition of individual mineral constituents, or by swelling ground containing clays, shales, etc., or metamorphosed rock masses. Another type of ground encountered is volcanic ash or glacial morainal material, through which part of the Gorge tunnels, north of Bishop, California, have been driven.

The rock load on timbers represents the height of the rock mass which tends to drop out of the roof before arching action takes place. Weak rock should be supported as soon as possible after the mucking of a round is completed, for rock in which there has been no movement is easier to support than ground given a chance to adjust itself against the timbers.

As soon as the timbers can be placed, back packing of the voids with timber or rock should be carefully done so that the rock pressure is transferred to the timbers to prevent the rock mass from moving. The pressure due to large voids between the timber and the rock mass increases the length of the period of load increase and the amount of load increase if the rock is allowed to move.

Whereas the size of the tunnel to be driven will be controlled by its use, the shape will be controlled by the character of the rock encountered. Tunnels in rock are generally designed with a semi-circular arch and vertical side walls. If the ground is soft or heavy and horizontal pressures must be resisted, then a horseshoe type or circular section must be used.

The horseshoe-shaped timbering represents a compromise between the straight sides and the circular section, and is preferred to a circular section because with a flat bottom it gives more working space. The circular section with the curved sides and invert by arch action resists the greatest pressures and is used to resist earth pressures in cohesionless or plastic materials.

In the late twenties, wood formerly used in the support of tunnels gave way to H-section steel-beam rib sets formed to the shape of the tunnel. For ease in transportation and handling, these steel sets are formed in two halves, which are then bolted together securely at the center of the arch.

Steel sets:

(1) Increase the speed of tunnel driving by reducing the cross section and the yardage of excavation and concrete.

(2) Are placed wholly within the designed concrete as a part of the permanent lining, and they carry a part of the tension set up by internal water pressure.

(3) Can be erected by fewer, less skilled men and in a fraction of the time a timber set can be erected.

(4) Are placed inside of the design line, requiring no additional excavation.

A tunnel requiring an 8-in. steel rib set to support the load would require a 12- to 16-in. timber set, which would in turn require 12 to 16 in. of additional excavation all around the periphery of the tunnel.

Where the ground is heavy and the roof, and possibly the sides, will not stand without support until a set can be placed after a round is shot, spiling consisting of 4 x 6-in. or 6 x 8-in. timber may be driven from the underside of the second set back from the face and over the first set in the face until it spans to the next set to be placed.

If the face will not stand without support, breast boards may be necessary. The breast boards are supported by timber bracing from the last set. To advance the face the top board is removed first and the ground dug out and the board replaced. The lower breast boards are successively removed until the full face has been advanced. It may be necessary to repeat this operation until the face has been advanced far enough to permit the set to be placed.

In soft ground the tunnel may be supported by liner plate. These are segments of curved steel plate, of the proper gauge, bolted together to form a circle or ring which is also bolted as placed to the last ring. These liner plates are flanged on the sides and ends and when bolted together give a continuous

support for the tunnel. The advantage of liner plate in soft, running or swelling ground is that, using breast boards, only an area large enough to allow one segment to be placed has to be opened up at a time.

Concrete lining

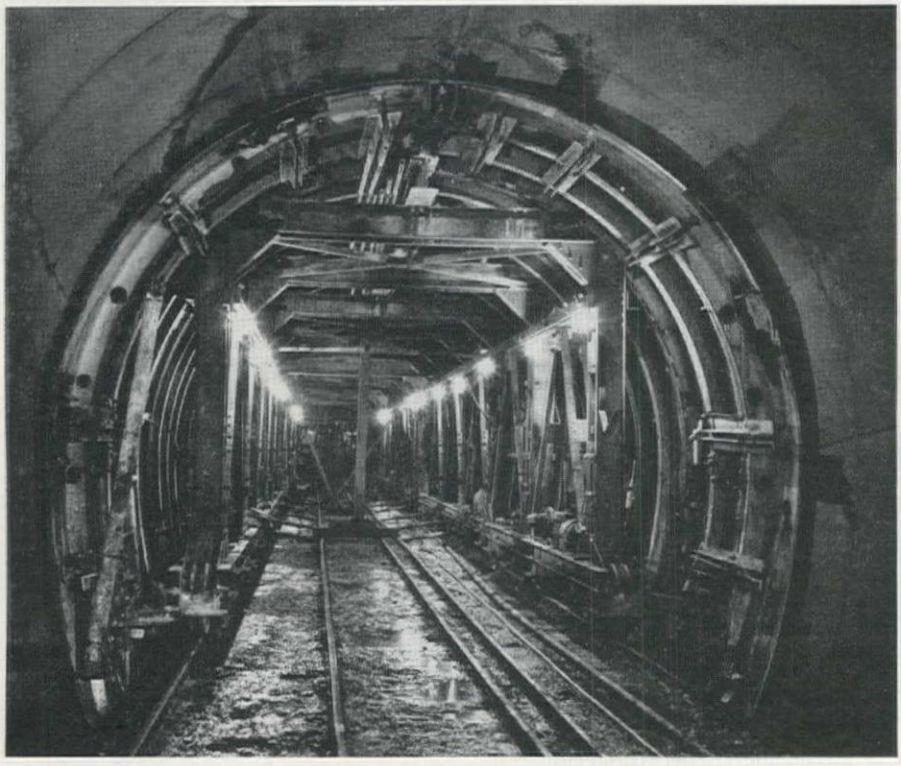
A geological study should detail observed rock defects, classified as blocky, seamy, squeezing or swelling ground, from which the engineer can make an estimate of the possible magnitude of the load, and estimate the thickness of the concrete lining required after the rock has adjusted itself to its new pressure conditions.

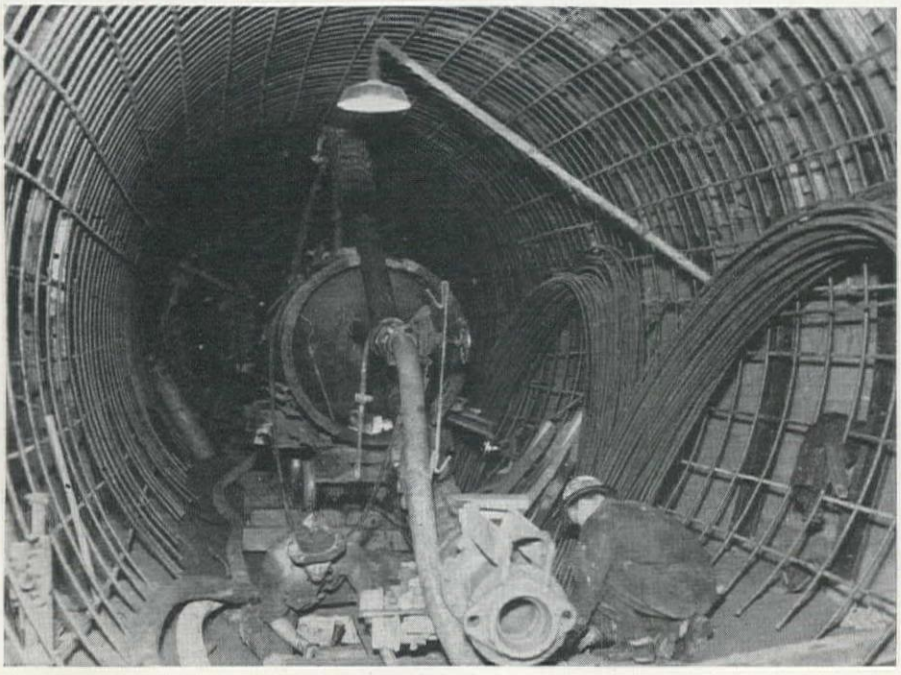
A rule of thumb determination of the thickness of the concrete lining of a tunnel is 1 in. of concrete for 1 ft. of tunnel diameter. The use of steel rib sets and reinforcing steel will reduce the thickness of concrete but the use of reinforcing steel solely to reduce the thickness of concrete is usually not economical.

To illustrate the methods and sequence of placing concrete lining in a horseshoe-shaped tunnel, details will be described on a 5,740-ft. length of tunnel in the Los Angeles area. With a finished diameter of 12 ft., the bore has a gross area of 111 sq. ft., tunnel excavation of 7.2 cu. yd., and a concrete lining of 2.48 cu. yd. per lin. ft. of tunnel.

The invert was lined with 17 in. of concrete and the horseshoe arch and walls were 14 in. thick. The concrete was reinforced by 6-in., 20-lb. H-beam sets on 5-ft. centers, and by ¾-in. and 1-in. reinforcing steel placed on 5½-in. centers and tied to 1-in. steel on 17-in. centers horizontally, placed around the circumference of the tunnel.

COLLAPSIBLE STEEL FORMS (top) carried on a jumbo moving on rails are used in concrete lining the arch and side walls. They are lowered, pulled in at the bottom and moved ahead. The invert is poured last. With reinforcing steel in place (bottom) this section is ready for the forms to be moved into position. Concrete may then be pumped or placed pneumatically behind the forms.





Truck-mixed concrete

Transit-mix concrete was delivered to the collar of a shaft and dropped down an 8-in. pipe into a 4-cu. yd. concrete car at a station 160 ft. below. The concrete as delivered at the collar of the shaft had a 5½-in. slump, and at the pumpcrete machine the slump was 4½ in.

Due to areas of squeezing ground the tunnel was concreted in sections. First section of the invert to be poured was 500 ft., followed by arch construction.

A 4-cu. yd. bottom-dump concrete car was pushed up an inclined track above a troughing belt upon which the concrete was dumped and fed into the hopper above a pumpcrete machine. From the pumpcrete machine the 6-in. delivery pipe rose at an angle of 22½ deg. to the top of the tunnel, turned horizontally and extended 200 ft. on rollers suspended by chains from the 6-in. H-beam sets. A 120-cu. ft. compressor was connected through a receiver into the 6-in. discharge line between the pumpcrete machine and the inclined pipe, and a quick-opening manually-operated air valve was used to slug the concrete into the forms.

In constructing the invert, three distinct operations were carried on simultaneously beneath the 200-ft. string of overhead concrete discharge pipe. While one crew was pouring concrete from the elephant trunk at the end of the discharge pipe, another crew just to the rear was tying the reinforcing steel, while behind this crew, a third crew was removing the track and mucking and fine-grading the bottom.

Invert at 220 ft. per day

These coordinated operations enabled the pouring of 220 ft. of invert a day. In concreting the arch and side walls, the discharge line was shortened to 80 ft., which was extended through a shallow trough at the top of the steel forms and withdrawn as concreting proceeded. Here, air was used to slug the concrete into the forms. The trough left a slightly rounded downward bulge in the roof of the arch running the entire length of the tunnel.

All pouring of concrete was done on the day shift; the reinforcing steel, all of which was shaped inside the tunnel, was tied on the swing shift, while the graveyard crew took down the 80-ft. collapsible steel form for the walls and arch. This was mounted on a jumbo, and was cleaned, oiled and moved ahead into position, completing an 80-ft. cycle a day, or a daily pour of about 200 cu. yd. When the side wall and arch forms were positioned, they rested on the previously poured invert.

Elemental geology

Ground and water conditions are the big hazard in tunnel driving; and the more complete the information provided for the contractor, the less guess work and risk and the lower the bid.

After a tentative location of the tunnel has been decided upon, a thorough and detailed surface geological study and survey should be made by a competent geologist. All rock formations along the center line of the tunnel must be noted, as to strike, dip and character, together with any faults, fractures, shear system or other rock weaknesses.

After this surface geological study has been made, the sub-surface conditions must be determined with much care and in the greatest detail to ascertain the character of the underlying rock, together with the water conditions.

Consolidated or metamorphosed sediments and volcanic rocks are usually tested by pits, shafts, tunnels, diamond-drills, and Calyx shot-bit core-drills. Diamond and Calyx drill-cores give a continuous, accurate, and permanent record for determining the nature, extent, and structure of the rock drilled. Diamond drill-cores vary in diameter from ⅞ to about 4 in., and Calyx cores vary from 4 to about 8⅝ in. in ordinary exploration drilling.

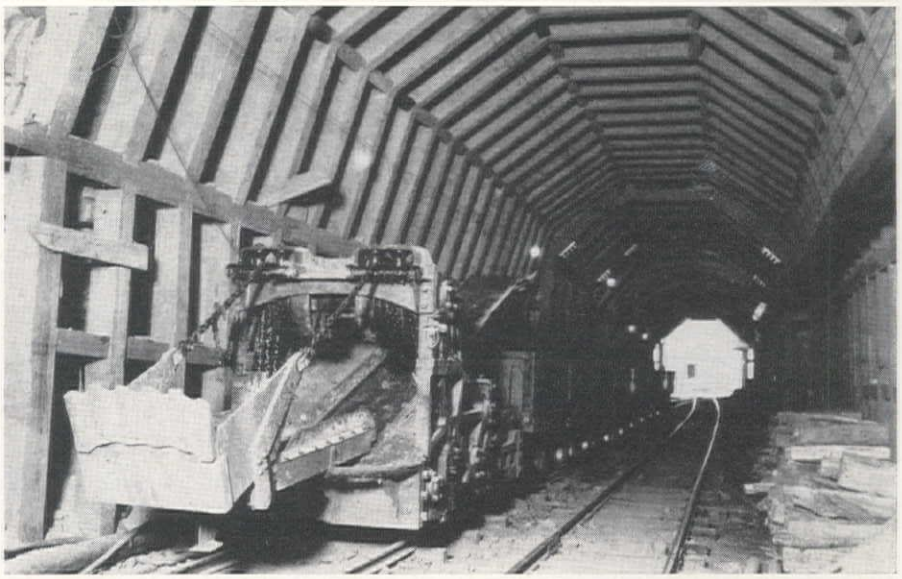
In core-drilling, the larger the diameter of the core removed, the easier it is to interpret the geologic structure encountered and the greater will be the core recovery. Seldom will the length of the core recovered represent 100% of the hole drilled. Core recovery should run about 40% in shale, 75% in sandstone, 60% in limestone and 80% in igneous rocks.

To attempt to visualize the character of that portion of the material for which no core is recovered, and upon this inadequate information make an assumption that any weakness later discovered can be remedied, is hazardous and may lead to serious difficulties and involve a greatly increased cost of construction.

Rock types

The rocks which are likely to be encountered in tunnels are many and varied, but if classified according to the ways in which they come into existence they fall into three major classes:

1. Igneous rocks, formed by the solidification of molten rock matter, as exemplified by the rocks formed by the cooling of lava poured out from a volcano, or the granites and allied rocks which were cooled and crystallized at depth under great pressure and are now exposed by erosion or faulting.
2. Sedimentary rocks, most of which are formed by their constituent minerals settling as sediment from a body of water or moved by wind or water.
3. Metamorphic rocks, which are formed from pre-existing rocks by developing new characters as the result of pressure, heat or other geologic agents acting on them in the earth's crust.



THIS TYPE of tunnel support in heavy timber, so familiar for years, has generally been replaced in modern practice by steel H-beam sets shaped to the tunnel section.

The igneous rocks are of two types: (1) those formed beneath the surface by slow cooling and solidification of liquid rock material deep beneath the earth's surface and exposed to view by long-continued erosion or by faulting, of which granite and diorite are the most abundant examples, and (2) those effusives formed on the surface from molten lava forced up from depth. Typical lavas are rhyolites, andesites and basalt. Igneous rocks are characteristically massive and irregular in their original form. Lava flows and ash beds are an exception, as they have some degree of layering, although this original structure is usually less regular than in sedimentary beds.

The black, stream-like masses of volcanic rock so prominently displayed in Owens Valley, California, are basalt flows. The basic basalt lava when ejected flows like water, which accounts for the long, narrow snake-like deposits seen in Owens Valley, and the flat-topped mesa so common in the Southwest.

Mono Craters near Mono Lake in eastern California are of the acid or rhyolitic type of rock. Acid lavas are not fluid as ejected, but are stiff and stringy, as cold molasses, building up into steep craters. In the Mono Craters, where lava was extruded at intervals along a prominent fault, many craters formed a steep narrow mountain range some 10 to 12 mi. in length. The highest peak is about 3,500 ft. above the plane upon which it was formed.

Sedimentary rock

Sedimentary rocks are those loose, incoherent and highly porous sediments laid down in water, or wind- or ice-laid and subsequently converted into rocks by compaction, welding of adjacent grains, or by deposition of cementing material in the pore spaces, and by physical and chemical changes. These rocks underlie 80% of the area of the United States. They are of great practical interest because they contain coal, oil and gas, and many other mineral supplies, notably the sedimentary iron ores, the most valuable of metallic resources. They also contain most of the fossil evidence from which the geologic history of the earth is determined.

The most conspicuous feature of sedimentary rocks is their layered or stratified structure. Each layer is separated from the bed below it, and the one above it, by distinct surfaces along which it parts readily, known as bedding or stratification planes.

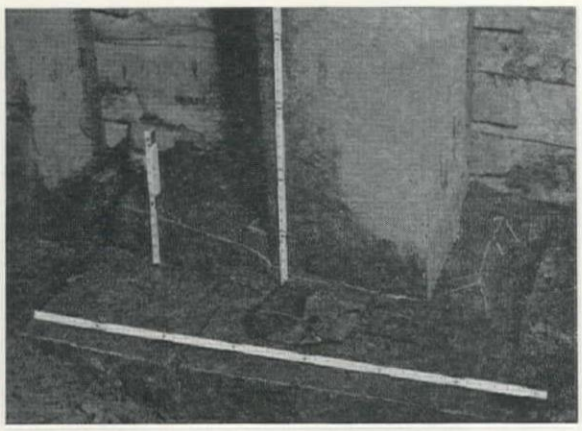
Sedimentary strata at the time they were originally laid down were horizontal—level—or nearly so. If the strata today are horizontal, we say they are undisturbed. If they dip, they have been deformed by movements of the earth's crust.

In conglomerates and breccias, the fragments cemented together range from pebbles a fraction of an inch in diameter to boulders many feet in diameter. The fragments in a conglomerate may consist of rock of only one kind, or of many kinds.

Sandstones are composed of cemented sand grains consisting of quartz. Shale is a clay which has been consolidated by the weight of overlying sediments.

Limestones are the consolidated equivalent of calcareous mud, calcareous sand, or of accumulation of shell fragments, or a combination of all three. Limestone under certain conditions is soluble in surface waters. Solution cavities and our large caverns are formed by the solution of the limestone by underground waters.

Metamorphic rocks are volcanic or sedimentary rocks which have been changed in texture or composition after their induration or solidification, these changes being produced by exterior agencies, especially deformation and rise of temperature. The most important agencies are heat, moisture and pressure. By heat and pressure, as the result of burying at depth, shales are changed to slate, a dense, fine-textured metamorphic rock, and limestone is changed to marble. Quartzite is metamorphosed quartz sandstone formed by the deposition of secondary silica between the



HEAVY GROUND carried by 18 x 18-in. post produces load which is crushing the timber foot blocks.

original quartz grains of the sandstone. Coal may be formed if trees and other carbonaceous matter were present.

Tuff, volcanic breccia and the finer volcanic ash are explosive products of volcanic action which have accumulated on land and in the seas.

Faulting

The main processes that cause rock weakness are faulting, folding, fracturing, shearing and chemical decomposition of rock masses. In faulting, the movement which produces displacement along a fracture of adjacent rock masses and the crushing of the material between the walls of a fault may extend over a great width, producing soft ground and excessive water and gas. The Tecolote Tunnel near Santa Barbara has passed through a fault zone 2,000 ft. wide in which was encountered gas, soft ground and water. In the San Jacinto Tunnel, the Metropolitan Water District encountered faults that flooded the workings, bringing in large amounts of crushed fault material.

Jointing in igneous rocks is caused by contraction in the cooling of the igneous material during or shortly after solidification from a liquid state. Large intrusive masses of granite and similar rocks are characteristically cut by joint planes that divide them into large blocks.

Gorge tunnel faults

A typical example of wide-spread shearing in a rock mass is seen in the Gorge tunnels north of Bishop, Calif. Owens Valley, lying between the Sierra Nevada on the west and the White Mountains on the east, during the elevation of these mountain ranges, has been subjected to great pressure, and the valley is a mosaic of faults. This crushing has developed two prominent, almost vertical shear systems in the vicinity of the tunnels, one striking northwesterly and the other northeasterly. The shear planes are closely spaced and where they intersect in the back of the tunnel the rock is much fractured into blocks which drop out when the round is blasted and overbreak develops.

On the west side of the tunnels the rock breaks to these intersecting shear planes producing a columnar structure. On the east side of the tunnels the round breaks to the northeasterly shear plane which enters the wall at a low angle, resulting in overbreak. Near the surface, waters entering the faulted, fractured or sheared rock decompose the rock, increasing the rock weakness.

The pink or flesh-colored orthoclase feldspar of the granite and the white plagioclose feldspar of the diorite are easily altered to clays and other minerals, some of which may be removed, the remaining altered rock masses producing soft, heavy ground in tunnel driving.

In sedimentary rocks, elevation, folding and faulting contribute to the weakness of these rocks. Joint systems, generally composed of two sets of planes intersecting at a large angle, are nearly always present. These, combined with the natural bedding planes, divide stratified rocks into a series of closely fitting blocks, weakening the rock and making it difficult to support in tunnel driving or to break near the pay line.

Hazards of tunnel driving are increased by the movements in and the deformation of rock masses. It is the duty of the geologist to study and point out the approximate location of the different types of rock, together with areas of weakness caused by fault zones and shear and joint systems, so that the engineer can design the proper shape of tunnel, type of timbering, and thickness of lining.

Test road in Arizona for trucks

A REPRESENTATIVE FLEET of International trucks is now logging 34,000 mi. per week over 22 mi. of test road recently completed at the International Harvester Co. proving ground near Phoenix, Arizona. Newest addition to the course, which is designed to duplicate every kind of road surface and alignment, is a 7¼-mi. loop of 28-ft. pavement that includes a "dead flat" straightaway and a long 9% grade.

After four years of test use by International's industrial power division, makers of tractors and construction equipment, road facilities of the proving ground have been taken over by the company's motor truck division, which is operating from 25 to 30 trucks on a 'round-the-clock test schedule. Driving conditions either engineered in proving ground roads or available a few hours away include altitudes from 1,200 to 10,000 ft., temperatures over a 100-deg. range up to 118 deg. F., "the most abrasive" dusts in the U. S., mud baths, excessive grades—20% to 60%—for off-highway trucks, and racking turns.

Operated by a staff of 50, the testing program includes complete maintenance facilities which are also observed for the serviceability of equipment used. Machine shop, chassis and engine dynamometers, hydraulic lifts, and a 60,000-lb. capacity scale are also included. Directed by the company engineering headquarters at Fort Wayne, Ind., the program utilizes trucks drawn at random from International production lines, and also trucks of competitive manufacture.

An interesting sidelight to the proving ground operation is the design and construction of the new pavement. This loop was laid out and built by the company, using International equipment to construct cuts and fills. The fill material, 875,000 cu. yd. of caliche and rock, was placed dry and compacted pneumatically. The first moisture introduced was that applied by the paving contractor, Tanner Bros., Heuser and Garnett Construction Co. of Phoenix, to a 6-in. subgrade placed on the fill and itself compacted. A compaction averaging 94% was achieved. The test pavement, designed by Johannessen and Girand, consultants, is a 2-in. bituminous surface intended to bear load weights of 22,000 lb. per axle and withstand speeds to 90 mph. This pavement is being observed for its action under traffic by several state and federal highway agencies.

A TRUCK FLEET of International Harvester Co. driven around-the-clock is tested under all types of conditions from abrasive dust to mud. Wheeled outriggers on truck below prevent it from turning over during a fast "figure 8" test.

Report on a Traylor TY

AFTER 10 years hard service

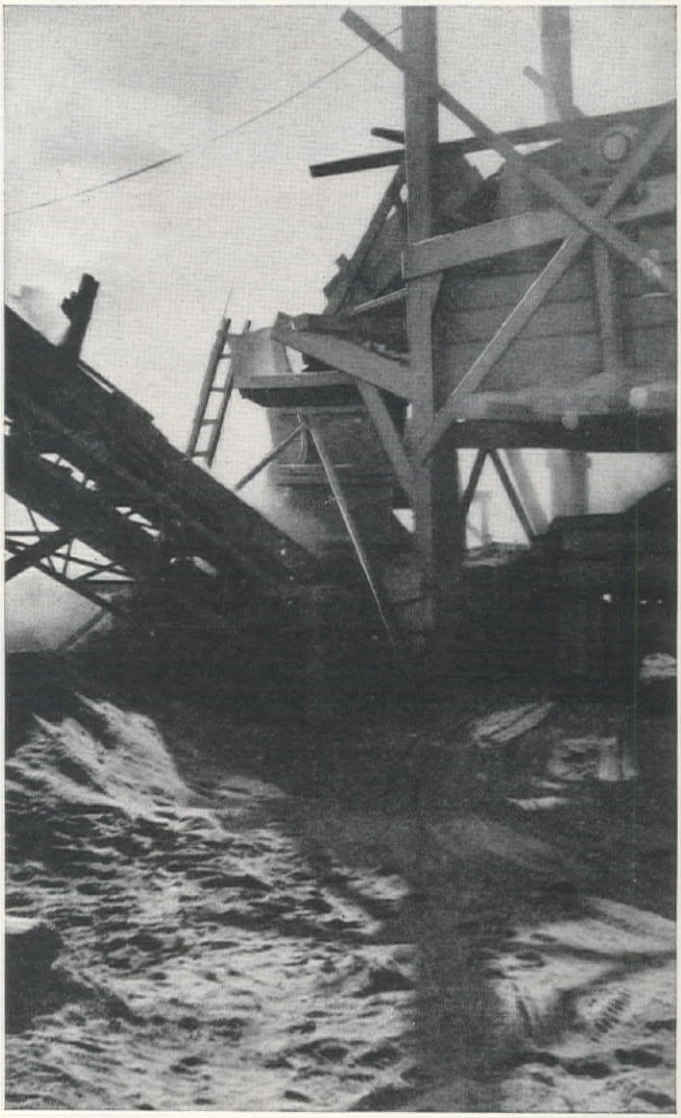
Working on quarry rock the Traylor TY has

INCREASED PRODUCTION APPROXIMATELY 30%

cut maintenance costs . . . produced a better product

for **EDWIN C. GERBER**
OREGON CITY, ORE.

This 10 year old 3′—0″ Traylor TY is shown producing aggregate on a job for the Oregon State Highway Department. This is typical of the rugged service the crusher has seen over the last 10 years. A Traylor TY's compact design and wide range of reduction makes it extremely adaptable for a wide variety of secondary crushing operations. Like so many other Traylor TY users, you too will profit by the operating economy and efficiency of a Traylor TY Reduction Crusher. Get the facts from your Traylor distributor today.



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TRAYLOR ENGINEERING & MANUFACTURING CO.
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A TRAYLOR LEADS TO GREATER PROFITS

Enters field in '48 . . .

On this 4200′ cycle, 6 "C's" delivered about 62 loads per hour . . . their total production per 8-hour day was 5020 pay yards of sandy clay.

With 3 pushers in cut, Tournapulls loaded in either direction, rarely had to wait while crawlers turned and spotted. Occasionally, the pushers also helped load contractor's 5 Carryalls or pulled his 3 LeTourneau Rooters.

Constant grading and sprinkling kept haul roads in excellent condition . . . allowed "C's" to average 10.4 m.p.h. on 2100′ haul (which included 1050′ down 4 to 5% grades, 1050′ up 5 to 8% grades).

Tournapull Carryall Rooter—Trademark Reg. U. S. Pat. Off. P22B

Arizona — Phoenix
ARIZONA EQUIPMENT SALES, INC.

California — Los Angeles, Bakersfield
CROOK COMPANY

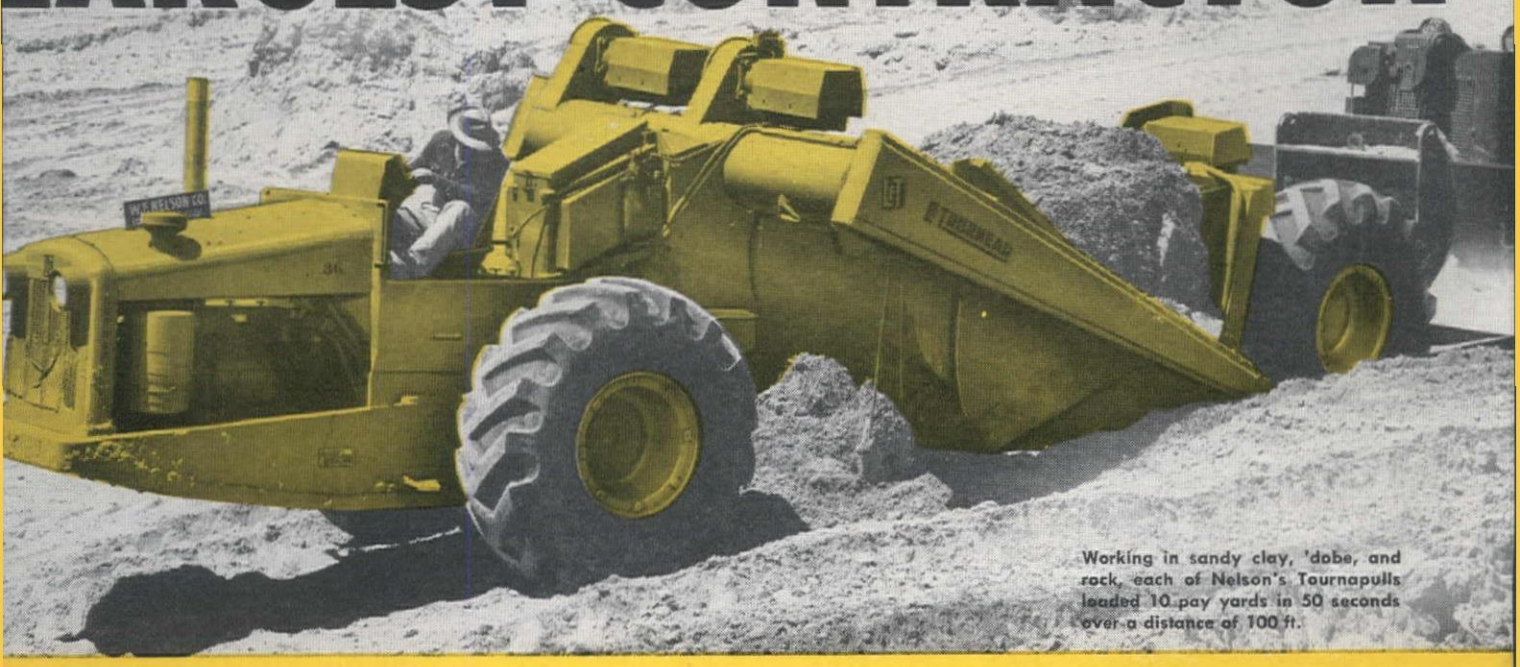
Idaho — Pocatello
J. K. WHEELER MACHINERY CO

California — Oakland
BAY CITIES EQUIPMENT, INC.

Colorado — Denver
COLORADO BUILDERS' SUPPLY CO.

Montana — Helena, Billings
MONTANA POWDER & EQUIP. CO.

today, is San Diego's LARGEST CONTRACTOR



Working in sandy clay, 'dobe, and rock, each of Nelson's Tournapulls loaded 10 pay yards in 50 seconds over a distance of 100 ft.

W. F. Nelson Co. of San Diego, California, bought their first dirtmoving rigs in 1948. For a year or so, they handled small jobs, gradually building their equipment fleet and their capacity for larger contracts. Today, the company owns nearly $1,000,000 worth of equipment, is San Diego's biggest and one of California's most successful dirtmovers. Cost-conscious and production-minded, Owner W. F. Nelson recently modernized this fleet with the most advanced, rubber-tired rigs . . . and sets up his jobs to get maximum yardage output with high speeds on rubber. For example:

Speeds 6,000,000 yd. housing job with 6 electric-control Tournapulls

On 6,000,000-yd. leveling and grading job for Redwood Villages subdivision in San Diego, the company brought in 76 pieces of equipment, assigned the bulk of the yardage to 6 new C Tournapulls. To take full advantage of the "C's" 35 m.p.h. speeds, haul roads were continually maintained and sprinkled. Rocky sections of the cut were rooted for fast loading . . . 3 pushers were on constant loading duty . . . and the "C's" were often loaded in opposite directions so that pusher deadhead time was held to a minimum.

625 pay yards hourly on 2100′ haul

Under these "speed-up" conditions, each Tournapull delivered 10 to 11 loads per hour over a 4200′ cycle. Loads averaged 10 pay yards in sandy clay, 'dobe, and river-bottom rock. Nelson's own production records show a combined output for the 6 Tournapulls of 502 loads, 5020 pay yards, per 8-hour shift.

This steady big-yardage output, day after day, speaks well for the company's proper care and use of their Tournapulls . . . and proves, too, that these fast, electric-control "C's" have what it takes to give a *new* lowest-net-cost-per-yard. Take it from owner Nelson, "Tournapulls are among the finest earthmoving machines ever made . . . they're *very* economical!"

CONSTRUCTION DESIGN CHART

CXXXVIII . . . Unit bond stress in reinforced concrete

By
JAMES R. GRIFFITH
Seattle, Wash.

THE CHOICE of bar sizes in a reinforced concrete beam depends upon more factors than only the required sectional area to resist the tensile stresses. In fact it is almost impossible to cause a reinforced concrete beam to fail by tensile stresses in the reinforcing.

Unit stress in the concrete surrounding the bars is called bond stress. Conventional computation is by the formula

$$u = \frac{V}{\Sigma_o j d}$$

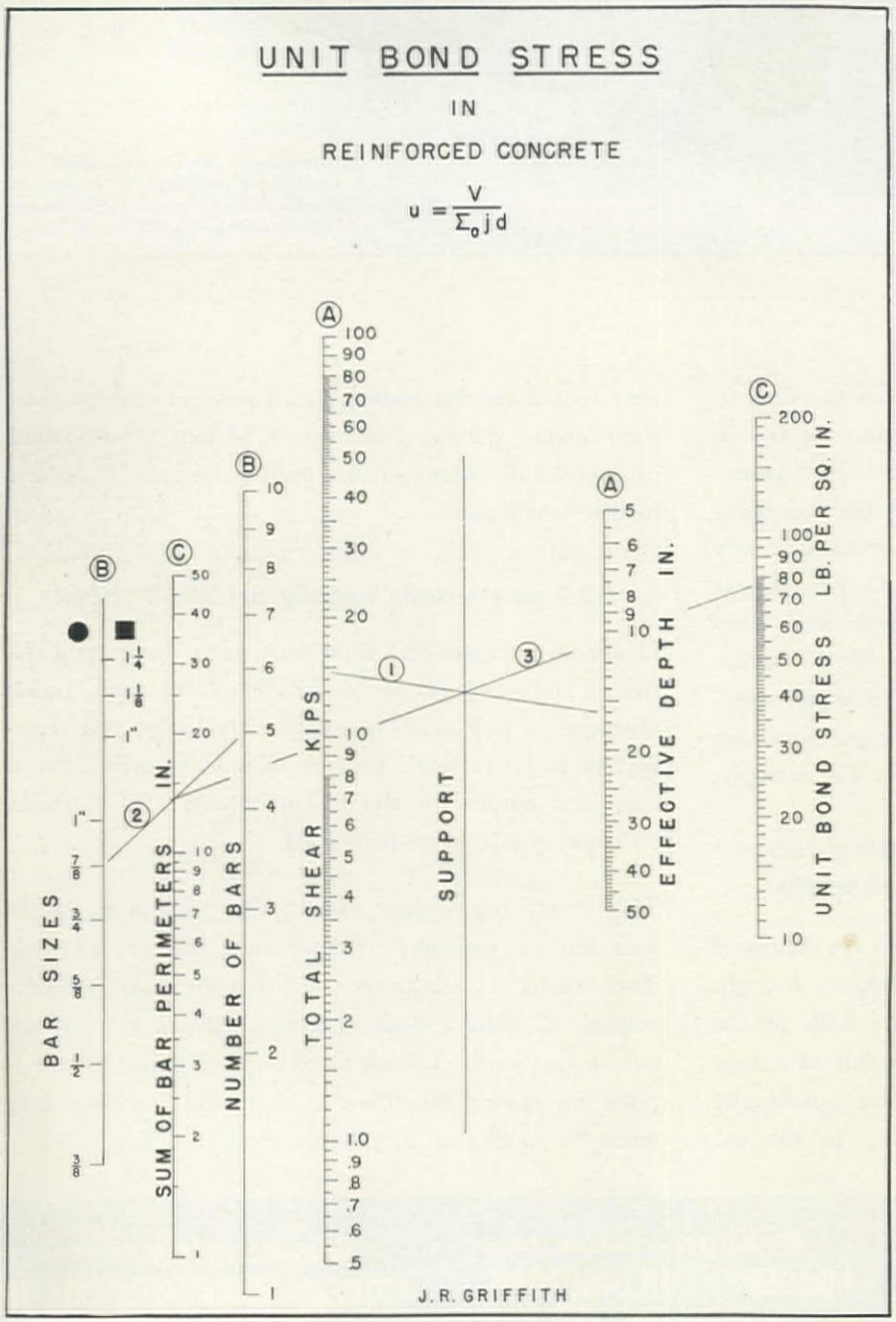
u = Bond stress per unit of surface area of the bar

V = Total shear at section in question

Σ_o = Sum of the perimeters of the bars

d = Effective depth of the beam, or depth from the compression face of the beam to the center of the longitudinal reinforcement

j = Ratio of distance between the centroid of the compression and centroid of the tension, to depth (d). This is usually taken as $j = 7/8$ in the computation.



The allowable unit bond stress is a function of the ultimate strength of the concrete, the type of reinforcement, and the type of anchorage. The ACI Building Code[1] permits an allowable bond stress in beams, slabs, and one way footings, varying from 80 psi. to 188 psi. The lower value is for plain bars used with concrete having an ultimate strength of $f'_c = 2{,}000$ psi. The higher value is for deformed bars in concrete designed for an ultimate strength of $f'_c = 3{,}750$ psi.

The accompanying chart has been designed to solve the formula for unit bond stress by the use of three straight lines. In reality, the chart is composed of three 3-variable alignment charts, superimposed so that certain scales are in common use. Solution lines should be drawn between pairs of scales: A-A, B-B, and C-C. The necessary three solution lines have been drawn on the chart for the following assumed conditions:

Effective depth of beam, $d = 16$ in.

Total shear on section, $V = 14.8$ kips

Reinforcement, five 7/8-in. round bars

Solution line (1) has been drawn between the values of (V) and (d), on the (A) scales. Solution line (2) has been drawn between the (B) scales with the number of bars and size of reinforcement as variables, thereby giving the sum of the bar perimeters. The scale showing the sum of the bar perimeters is but an intermediate support and all units could have been omitted as it is but a means to an end. Solution line (3) has been drawn from the intersection of line (2) on the scale for sum of bar perimeters, through the intersection of line (1) and the "Support." On the scale for the unit bond stress will be noted a value of $u = 77$ psi.

Referring to standard tables we find that the sum of the bar perimeters for five 7/8-in. round bars is $\Sigma_o = 13.7$ in. Then substituting in the formula for unit bond stress, we have

$$u = \frac{V}{\Sigma_o j d} = \frac{14{,}800}{13.7 \times 7/8 \times 16} = 77.3 \text{ psi.}$$

[1] *Building Regulations for Reinforced Concrete*, American Concrete Institute.

HOW IT WAS DONE . . .

Sled-hopper for gutter paving gives semi-finished surface

THIS RIG, built by Fredrickson & Watson, is towed by a transit-mix truck, using chain led to bumper extension. With it, concrete for freeway gutters near Oakland, Calif., is poured, compacted, and semi-finished in one easy operation.

Night work speeds progress on sewer job

BY WORKING between 2:30 and 6:30 a. m., Kemper Construction Co. of Los Angeles beat two construction problems in its recent installation of 21-in. vitrified clay pipe by-passes around gauging station locations of the Los Angeles trunk sewer on U. S. Highway 101.

To avoid traffic congestion caused by a half-million people daily, the night hours were selected by Kemper for conducting an otherwise conventional job. The choice was made also in consideration of the fact that lowest sewage flows occur during the early morning hours, thereby simplifying the task of hooking up the completed by-passes to the trunk.

The two stations by-passed on the $17,000 project will afford accurate measure of trunk sewer inflow to and outflow from Santa Monica, thereby providing that city with a basis for payment of sewage fees for its contribution to the Los Angeles disposal system.

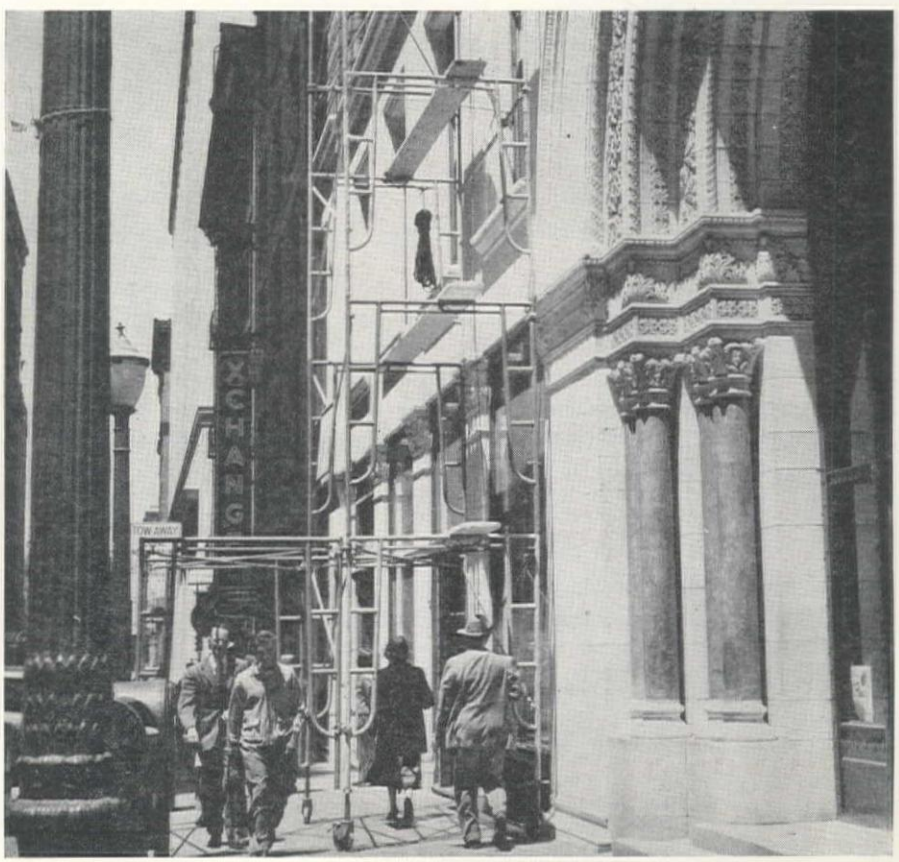
Cut costs with wheeled scaffold

USE OF ROLLER-MOUNTED steel scaffolding is cited by J. D. Tucker & Sons as a means to cut 25% to 40% from the cost of exterior work on buildings up to four stories high. For waterproofing the marble facade of San Francisco's Mills Building, the contractor used a 32-ft. high assembly of Beatty Safway scaffold end frames and cross braces, with base frames mounted on screw-jack casters.

This tower, giving access at four working levels to over 250 sq. ft. of wall area, was constructed in about half an hour. Tucker estimated that conventional wood scaffolding would have cost three times as much in construction time, and as much as 20% more in material costs. Steel elements are rented from the Beatty Co., and erection and dismantling done by that company's crews.

For extra base weight and stability, as well as pedestrian protection, the lower course of the rolling scaffold is assembled with extra increments extending completely over the sidewalk. Open end frames of the Beatty design permit pedestrian passage clearance 4 ft. wide and 8 ft. high. For adaptability to San Francisco's hills, the base frame screw jacks give 18 in. of adjustment.

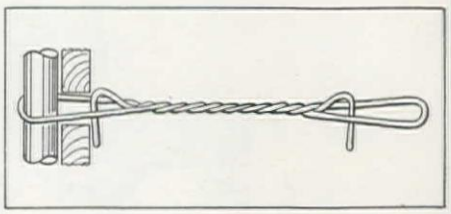
On high building jobs the swing scaffold is still the most practical, but for low-height jobs Tucker finds too much time is lost in shifting and dropping a swing scaffold.



LIGHT STEEL scaffold has open frames that give clearance and double as ladders.

New form system saves time, saves lumber

A COST-CUTTING IDEA for concrete form work that developed into a manufacturing business is the Gates concrete form tie, a combination tie and spreader that does away with walers, drilling for she-bolts, and other time-consuming details of form construction. The new tie is made of twisted wire with a loop at each end; length between loops varies for wall thickness, from 6 to 60 in.



In use, the tie is fitted between the boards of forms as they are built, the loop being long enough to project outside the form. Spreading action is gained from wire ends themselves, barbed outward from the base of each loop to bear on the interior faces of both inside and outside wall forms. Placed directly in a vertical line as the form is built, the projecting tie loops then receive a metal rod that acts as a vertical waler. A single conventional timber waler is generally sufficient to stiffen the form.

Requiring a minimum use of nails, the Gates form tie system simplifies form stripping and permits more economic re-use of form lumber. Stripping of the ties themselves is done simply by clipping the loops to free the rods.

Depending on the height and frequency of pours in forms tied by the Gates system, horizontal spacing of ties and rods varies from 16 to 24 in. Spacing of studs, also affected by lengths of form sheathing, may likewise vary, up to 12, 14, or 16 ft.

Steel-cable belting splice for field use

FOR SPLICING steel-cable conveyor belting, The B. F. Goodrich Co. has patented a new field-or-factory method that insures equalized cable tension in the finished splice, and thereby straight-tracking operation of the belt. Economy of the splice has been proved in laboratory tests that show it to be as strong as the belt itself.

In making the splice, rubber and fabric are stripped from the belt and the cable ends exposed. These cables are cut in a staggered pattern and fitted with tubular crimp connectors. After only a light crimping, the splice is stressed to even the cable lengths; the connectors are then locked to the cables by a final crimping. For completion of the splice, rubber and fabric are rebuilt around the cables and the splice cured in tension with a conventional vulcanizer.

For field use, special crimping and stripping tools supplement the usual facilities for repair of conveyor belting.

NEWS OF WESTERN CONSTRUCTION

DECEMBER, 1951

Steel shortages delay Idaho's Weiser Bridge

CRITICAL DELAYS in steel deliveries will probably postpone completion of the Weiser bridge on the Snake River in Idaho, according to Earle V. Miller, state highway engineer. Without delivery of the steel, work will not be completed until the summer or early fall of 1952.

Shortages were not expected to delay construction at Pasco on either the Columbia or Snake River. The steel for the span over the Snake River is already on hand, while work on the first three spans of the bridge across the Columbia River is almost complete.

William A. Bugge, Washington state highway engineer, announces selection of the site of a new West Bridge at Aberdeen. This project will not be started until the latter part of 1952, and it is hoped that the steel shortage will not be as critical.

THE 1951 ANNUAL INDEX begins on page 111 of this issue. All of the editorial features published in the twelve issues of *Western Construction* during 1951 are indexed for easy reference. Also, unit bid abstracts are indexed by location and the type of construction involved.

Palisades damsite open to prospective bidders

ANTICIPATING A CALL for bids next February, the Bureau of Reclamation has released a request that prospective bidders on the construction of Palisades Dam in eastern Idaho inspect the site this fall before the snow flies. The request was also directed to those bidding late last month on the power and outlet tunnel excavation, which will proceed during the winter.

The fight for funds to commence work on the $76,600,000 project was led by Idaho's congressmen, who saw $2,000,000 authorized late in the recent legislative session. Prior activity at Palisades Dam was financed by a $3,470,780 appropriation in 1945; this work has been completed.

The tunnel contracts to be worked this winter total 2,650 ft. of 31-ft. bore involving over 68,000 cu. yd. of excavation. The completed project—in 1955—will be the biggest earthfill dam ever built by the Bureau and the tenth largest in the world, containing over 13,500,000 cu. yd. of embankment material.

Situated on the Snake River, 44 mi. east of Idaho Falls, Palisades Dam will have four generators with a total output of 114,000 kw.

OWENS GORGE TUNNEL DRIVING PROJECT IS COMPLETED

A TOUGH JOB of tunnel driving came to an end near Bishop, Calif., when Tunnel No. 1 of the Los Angeles Department of Water and Power's Owens Gorge hydroelectric project was holed through. This six-mile bore was the longest and most difficult of the $43,000,000 project's four tunneling operations. Joint venturers (Guy F. Atkinson Co., Bressi and Bevanda Constructors, Inc., David A. Gordon and A. Teichert & Son) used two headings on this job. Below, left to right, are: *William C. Mason, T. J. Driscoll, Bill Jensen* and *Kenneth Tinker* shortly after the holing through. This is a Los Angeles Department of Water and Power photograph.

Lake behind McNary puts Senate behind the 8-ball

A LOT OF DAMMED UP feelings are being aired in the North Central Oregon area these days, and the state senate is discovering that it is difficult to stop a flood of municipal pride.

When McNary Dam is completed a huge reservoir will be formed behind it and all the neighboring villages want to be in on the christening. The senate gave its approval to the name "Lake Umatilla." This idea was not well received by residents of Wallula, who think that their town's name should be vested upon the man-made lake.

Now the City of Hermiston enters the race with a plea for the personal touch. The Chamber of Commerce rushed a resolution to the senate offering the name of E. P. Dodd, justice of the peace and early pioneer, as a suitable lake namesake. Anyone thought of Lake McNary?

NEXT MONTH, the editors of *Western Construction* will survey 1951 and 1952—the achievements of one and expectations of the other—in terms of conditions imposed by a nationwide defense effort. Included will be progress reports on current major construction, note of significant developments in methods and materials, and a glimpse of some engineering eventualities that bid to hold for the West its preeminent position in U. S. construction.

USBR calls bids on major Western projects

BID CALLS were expected last month from the Bureau of Reclamation on several major Western projects. Calls were to go out November 15 for construction of a 1,150-ft. long, 31 ft. in diameter power tunnel and 1,500-ft. long, 31-ft. diameter power tunnel from Palisades Dam. Work will be located on the south fork of the Snake River in Bonneville County, Idaho. Open cut excavation for the upstream portals of the power and outlet tunnel is also included.

Bids were invited November 2 for construction of pumping plants about 16 mi. south of Othello, Wash., on the Columbia Basin project. Three outdoor-type pumping plants and 2,200 ft. of unlined lateral are involved in this construction.

Another phase of the Columbia Basin project was the subject of bid calls when the Bureau invited bids November 23 for construction of 19 mi. of unlined Potholes East Canal, 470-cfs. capacity, including concrete chute and stilling pool. This construction, which also included 8 concrete checks and construction of Pasco wasteway turnout and chute, is located near Ephrata, Wash.

Calls were issued for raising and widening the 18-mi. reservation levee, Colorado River Front Work and Levee System Project, Ariz. Included in this project is the construction of drainage culverts and rip-rapping levee slopes. Work will be located near the City of Yuma.

Cal. Structural Engineers elect '52 officers

CULMINATION of the Yosemite convention in October of the Structural Engineers Association of California was its election on October 13 of new officers

Left to right: *Walter Buehler*, vice president; *Donald Shugart*, president, and *Lewis Osborn*, secretary-treasurer.

for the coming year. President-elect is Donald F. Shugart, 1951 incumbent of the Southern Association. Incoming vice president and secretary-treasurer are Walter Buehler and Lewis K. Osborn.

In addition to conducting technical sessions, the Association discussed the steel shortage as it affects school construction in California and passed a resolution urging "steps toward alleviating this condition through a more equitable allocation of critical materials for educational needs."

Following the completion of business and technical sessions, the annual convention featured a field trip to Hetch Hetchy Reservoir.

Bridges to be moved from behind Hungry Horse

THREE BRIDGES, which would be flooded by the rising water level behind Hungry Horse Dam, will be dismantled and salvaged, according to the Bureau of Reclamation.

Delory and Son, Coram, Mont., bid $8,580 for dismantling and removing the bridges across Graves Creek and across the South Fork of the Flathead River near Graves Creek. The bridge across Wheeler Creek will be removed by J. H. Trisdale on his bid of $2,000. Contract specifications call for completion of all work involved in dismantling and moving the Graves Creek and South Fork bridges by May 15, 1952. Movement of the Wheeler Creek bridge must be completed by June 15, 1952. Storage of 1,000,000 acre-feet of water in the Hungry Horse reservoir by the end of 1952 spring run-off will inundate the three bridge sites. All three bridges will be stored for future use in bridge construction in the area.

Power project in B. C. gets under way

THE WANETA PROJECT, a $30,000,000 power development in British Columbia, is getting under way on the Pend'Oreille River as an advance force of 350 men clears access routes and the dam site for the project owner, Consolidated Mining & Smelting Co. of Canada, Ltd.

Located near Trail, B. C., the concrete dam will rise 210 ft. from the river channel and create a reservoir 6 mi. long for operation of a 200,000-hp. hydroelectric plant that is expected to overcome existing winter power shortages that have cut production in smelting plants.

The original power installation, expected to be in operation by 1954, may be augmented in the future by two additional units for which provision has been made in the project design.

An eventual work force of 1,000 men will be required to conduct operations of the contractor, Northern Construction Co. & J. W. Stewart, Ltd., of Vancouver, under project manager S. W. Leggat. Consultant on the project is Stone & Webster Canada, Ltd.

Last pipe section in for Alameda Interceptor job

THE LAST SECTION of pipe for section 3 of the Alameda Interceptor, a part of the $23,500,000 publicly-owned sewage disposal system now under construction by East Bay Municipal Utility District, is now in the ground.

This segment of the large interceptor will intercept wastes from the sewerage lines of the City of Alameda. P. & J. Artukovich, Los Angeles, Calif., is the contractor.

Completion of disposal system and its operation will put an end to the unpleasant odors along the Oakland Estuary and the East San Francisco Bay cities shores.

Section 5, a relatively small segment of the Alameda intercepting line, is still to be completed, and a contract was recently awarded to Stolte, Inc., Oakland, Calif., firm, for this part of the system. Rapid progress is being made on this final phase of construction.

The Dalles Dam construction starts next spring

CONSTRUCTION on The Dalles Dam, a Corps of Engineers project on the Columbia River, is expected to begin next spring with the letting of a contract for underwater excavation for cofferdam, powerhouse, and approach channel. Authorized in 1950, the project will get under way with a $4,000,000 appropriation; completion in 1957 will cost an estimated $348,370,000.

Principal Corps personnel so far assigned to the job include H. B. Elder, resident engineer from Nashville, Tenn., and P. M. Othus, a special civilian assistant who will negotiate a settlement with local Indians over fishing rights to be impaired by dam construction.

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NEWS IN BRIEF

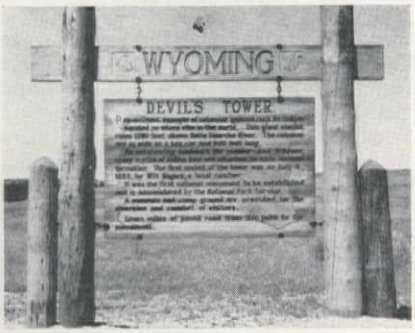
Huge housing plan for Colo. Air Force Base

A $3,500,000 housing project for the officers and men at Lowry Air Force Base, Colo., is being planned by the Burns Realty Co. of Denver.

The 384-unit project would be located west of the base and consist of 48 separate two-story buildings. The Burns Construction Co. would build the project. Financing would be from the Federal Housing Authority.

Disposition of the units would be on a half-and-half basis between officers and enlisted men. Lowry Plaza would be the name given the super housing project.

HISTORIC HIGHWAY MARKERS



In the interest of tourists driving the Wyoming highways, these new markers are being installed at the rate of ten each year by the Wyoming Highway Dept. The messages, carved in wood on the 48-in. by 72-in. markers, indicate points of historic and geographic significance. Fifteen markers are now in place and five more are on the way.

English firm low on Lookout Point work

ENGLISH ELECTRIC CO., Stafford, England, underbid three American firms on a contract for supplying three generators (42,222 kva.) and appurtenances at Lookout Dam.

The English firm's $2,226,030 bid bettered those of General Electric Co. ($2,292,760), Westinghouse Electric Corp. ($2,324,000) and Allis-Chalmers Manufacturing Co. ($2,331,823).

Delivery of the British-made equipment, however, was a qualification of the bid. The delivery would be about one year behind Corps of Engineers' scheduling in the bid invitations.

More water for San Diego

THE FORCE OF GRAVITY is scheduled to get a helping hand from San Diego, Calif. Water is to be pumped down from the city's supply at San Vincente Reservoir.

Three Worthington centrifugal pumps will be used to boost the flow from 45- to 55-million gallons daily, and a $100,000 plant will be constructed to supply water directly to the country's second largest naval base.

Expansion of local naval facilities in addition to a thriving aircraft industry make it necessary to increase the water supply flow by 20%.

Blue flash . . . equipment ahead!

MONTANA is joining several other states in the marking of winter maintenance equipment on highways. Flashing blue lights ahead indicate that snow plows or sanding equipment are in operation on the highways.

The flashing blue light signal was adopted on the recommendation of the American Association of State Highway Officials. Winter maintenance equipment of the Montana State Highway Commission will be outfitted with two-way flashing blue lights to warn motorists. Blue and white posters will be distributed to service stations, hotels, etc., to urge cooperation of motorists in the safety program.

Alaskan roadsides reserved

"KEEP OFF the roadsides" in Alaska. Secretary of the Interior Oscar L. Chapman has reserved all land within 300 ft. of the Alaska highway and varying footage on all other roads in the Territory, for eventual highway purposes.

This means that the land is removed from appropriation under public land laws, although the land within 100 ft. of feeder roads will be reserved by easement.

Tribute paid to Andrew Weiss

Editor, *Western Construction:*

I wish to call your attention to a death notice in the October issue of *Western Construction.* I am referring to the notice regarding my friend and former boss, Andrew Weiss. I was associated with Mr. Weiss on the North Platte project, Bureau of Reclamation, in Wyoming and Nebraska for about 15 years and was with him in Mexico for three years.

The news item is quoted, "Weiss' career included service with the Bureau of Reclamation as Assistant Engineer on canal and reservoir projects in Nebraska and Wyoming. In 1924, Weiss became Director of Reclamation Economics, a position he held for two years before returning to the field, as Resident Engineer on Mexican projects."

I do not think the notice gives just credit to a man who gave his whole life to engineering and accomplished much more than the "usual run" of engineers.

He spent 17 years from 1907 to 1924 as Project Manager (not Assistant Engineer) in charge of the design, construction, and operation of the North Platte irrigation project for the U. S. Bureau of Reclamation, involving many miles of canals and several storage reservoirs. Following two years as Assistant Director of Reclamation Economics, he went to Mexico as Resident Engineer for the J. G. White Engineering Corporation on construction of two large irrigation projects for the Mexican government. For the past 20 years he was consulting engineer for the Mexican National Commission of Irrigation. In this capacity he was instrumental in the development of many irrigation projects in that country. At its fall meeting in 1948 the Board of Directors of the American Society of Civil Engineers, in recognition of his outstanding accomplishments in the engineering field, authorized the award of honorary membership in the Society to Mr. Weiss.

I have given you this information so that you may make some correction in the notice given in the October issue.

With best personal regards.

R. B. DIEMER
Assistant General Manager
and Chief Engineer
Metropolitan Water District
of Southern California.

Group urges laws to halt Arizona water losses

LEGISLATION to curb Arizona water losses is urged by the Arizona Resources Council. The Council, which is changing its name to the Arizona Water Conservation Association, suggests a law to start a planned conservation program.

If such legislation were passed, over 10,000 mi. of dirt canals and laterals, and ditches would be hard-lined to partially stop seepage losses.

Estimates indicate that water losses average 40% in the Salt River Valley system of canals and laterals and another 30% is lost through ditches and fields. Reservoirs and piping systems would be built to catch run-off water.

Clinton S. Anderson is the new chairman of the group's board of directors.

Confusion in concrete

. . . continued from page 59

Bibliography

The following list of reports contains theoretical principles for proportioning materials for concrete:

Abrams, Duff A. "Design of Concrete Mixtures." *Bulletin No. 1,* Structural Materials Research Laboratory, Lewis Institute, Dec. 1918.

Edwards, L. N. "Proportioning the Materials of Mortars and Concretes by Surface Areas of Aggregates." *Proceedings, ASTM,* vol. 18 (1918), part 2, p. 235 ff.

Fuller, W. B., and Thompson, S. E. "The Laws of Proportioning Concrete." *Proceedings, ASCE,* vol. 33 (1907), no. 3, p. 222 ff.

McMillan, F. R. *Basic Principles of Concrete Making.* New York: McGraw-Hill Book Co., 1929.

Pearson, J. C., and Hitchcock, F. A. "A Penetration Test for the Workability of Concrete Mixtures." *Proceedings, ASTM,* vol. 23 (1923), part 2, p. 276 ff.

Slater, W. A. "Designing Concrete for High Strength, Low Permeability and Low Shrinkage." *First Communications of the New International Association for Testing Materials;* Zurich, 1930.

Slater, W. A., and Walker, Stanton. "Report on Field Tests of Concrete Used on Construction Work." *Proceedings, ASCE,* vol. 51 (1925), p. 3 ff.

Talbot, A. N., and Richart, F. E. "The Strength of Concrete, Its Relation to the Cement, Aggregates and Water." *Bulletin No. 137,* Engineering Experiment Station, University of Illinois, 1923.

Wig, R. J., Williams, G. M., and Gates, E. R. "Strength and Other Properties of Concrete as Affected by Materials and Methods of Preparation." *Technologic Paper No. 58,* U. S. Bureau of Standards, June 1916.

Proposed hospital sites studied by Navy officers

A TOUR of inspection of possible sites for the construction of a $3,800,000 U. S. Naval Hospital in Southern California was undertaken by 11th Naval District officers. Rear Adm. Paul M. Albright, Comdr. Woodrow M. Brown and Capt. J. B. Butler were the inspecting officers. All three sites considered are government-owned, but the party seemed to favor the location at Haster's Field near Garden Grove. Reeves Field at Terminal Island and Whites Field at Ft. MacArthur were the other two sites under consideration.

CALENDAR OF MEETINGS

December 11 — Seattle Chapter of AGC, annual meeting, at Construction Center offices, Seattle.

December 15 — Nevada Chapter of AGC, annual meeting, at the Chapter rooms, Professional Bldg., Reno.

December 18—San Francisco Section ASCE, annual meeting, at Engineers Club of San Francisco.

January 10—San Diego Chapter of AGC, annual meeting, at San Diego (address of chapter 455-6 Spreckels Bldg., San Diego).

January 11-12 — Intermountain Branch of AGC, annual convention, at Salt Lake City (address of branch, 430 South Main St., Salt Lake City).

January 11-12 — Montana Building Chapter of AGC, annual meeting, at Florence Hotel, Missoula, Mont.

January 11-12 — Montana Contractors' Association, annual meeting, at Florence Hotel, Missoula, Mont.

January 21-24 — American Road Builders' Association, 50th anniversary convention, at Houston, Texas.

January 25—Central California Chapter of AGC, annual meeting, at the St. Francis Hotel, San Francisco.

February 6-8—California Conference on Street and Highway Problems, fourth annual conference sponsored by the Institute of Transportation and Traffic Engineering, University of California. To be held on the Los Angeles campus of the University of California.

February 27, 28—American Concrete Pressure Pipe Association, annual convention and meeting, at Drake Hotel, Chicago, Ill.

February 28, 29, March 1—American Concrete Pipe Association annual convention, at Drake Hotel, Chicago, Ill.

March 3-5—American Concrete Agricultural Pipe Association annual convention and meeting, at The Brown Palace Hotel, Denver.

ENGINEERS ON THE MOVE

Arthur S. Horner, A. S. Horner Construction Co., Denver, Colo., at the mid-year board meeting of The Associated General Contractors of America, Inc., was nominated for the 1952 presidency of the association. Elections are held annually in December.

* * *

George Egan leaves his position as engineer of design for the Nevada Department of Highways to become technical adviser for the Western Highway Institute. He has been employed by the highway department since 1922, except for about a year when he served as an engineer for the Bureau of Public Roads on the Alcan highway. **Alfred G. Kinne** succeeds to the post left vacant by Egan, and **James D. Wallace, Jr.,** takes over Kinne's former position as right-of-way engineer.

* * *

Charles A. Bissell, regional engineer for the Bureau of Reclamation at Boulder City, Nevada, is retiring after 34 years with the federal agency. He has been regional engineer in charge of the design and construction division since 1944. **J. P. Jones** is appointed acting regional engineer.

* * *

Robert R. Williams, who has been in charge of the Bureau of Reclamation Parker Dam power project at Phoenix, Arizona, has left for Monrovia, Liberia, on a one-year Point Four assignment to investigate possible hydroelectric power development sites on the St. Paul River. While in Liberia, he will serve as advisor to the Liberian Department of Public Works on hydroelectric power matters.

* * *

Robert W. Brumback, Bureau of Reclamation employee at Wellton, Ariz., received the Department of Interior's Distinguished Service Award for his rescue of a father and two sons in the Gila Canal early this year. Brumback was passing the canal in his car when he saw that the father and two boys, unable to swim, were in the canal. He plunged in to aid the trio, pulled them to a sand ridge and completed the rescue with the aid of companions on the bank.

* * *

New Western area vice president of the American Public Works Association is **Milton Offner,** secretary, Board of Public Works, Los Angeles, Calif.

* * *

Gerald E. Arnold becomes director of the Water Resources Division of the National Production Authority. He succeeds **Harvey S. Howe,** who returns to Lock Joint Pipe Co. after organizing the Water Resources Division while on leave from his firm. Arnold comes to NPA from San Diego, Calif., where he was assistant city manager and later director of the Water Department. Arnold's experience in the water resources industry includes work in construction of facilities, manufacture of components, operation of municipal plants, private irrigation and flood control operations and supervising of governmental utility activities. He was headquartered in San Francisco, Calif., during the war years, first as senior sanitary engineer with the U. S. Public Health Service, and later with the Office of Civilian Defense where he was in charge of security matters in the utilities industry in the 11 Western States. Arnold is president of the San Diego Section of the ASCE.

* * *

Robert M. Shillito, who served as special assistant to the late California Director of Public Works, **C. H. Purcell,** resigns his post to accept an executive position with the San Francisco Chamber of Commerce.

* * *

William G. Balmer, surveyor with the Bureau of Reclamation, retires from the service with an honor award and an outstanding record of accomplishment behind him. Balmer, 77, located and built railroad lines from Alturas, California, to Klamath Falls, Ore., and participated in the building of Shasta and Keswick dams on the Sacramento River in Northern California.

* * *

Bechtel

Stephen D. Bechtel, president of The Bechtel Corporation, San Francisco, Calif., will receive The Moles award for 1952. The Moles is a New York association of tunneling and heavy construction men which each year presents awards for outstanding service in the construction industry. Presentation of the award will occur at the annual award dinner at the Waldorf-Astoria Hotel in New York on February 6, 1952. Bechtel's firm is engaged in international heavy construction.

* * *

Cecil E. Rhodes, district engineer on special projects for the Asphalt Institute, Denver, Colo., is now director of pavement inspection and testing, Twelfth Naval District. Rhodes has his new headquarters at the District Public Works Office in San Francisco, Calif.

* * *

Joseph M. Cunningham becomes manager of operations for the B. C. Bridge & Dredging Co., Ltd., Vancouver, B. C. Cunningham was formerly vice president of James Stewart & Co. of New York, Chicago and Dallas.

M-K ENGINEERING STAFF AT C. J. STRIKE DAM

Morrison-Knudsen Co., Inc., engineering staff during construction of the C. J. Strike Hydroelectric Development for the Idaho Power Co. near Mountain Home, Idaho, included: back row left to right, *William F. Farley*, field engineer; *James P. Duggan*, office engineer; *William W. Cochran*, chief-of-party; *Russell E. Martin*, material engineer; *William Stewart*, cost engineer, and *William A. Abrahamson*, project engineer. In the front row, left to right are: *Sidney Shoemaker* and *Leo C. Huber*, equipment checkers; *Lloyd Smith*, chainman; *Thomas J. Randolf*, field engineer, and *Edwin F. Thorsten*, chief-of-party. The C. J. Strike project was reviewed in *Western Construction*, November, p. 61, and other personnel pictures appeared in the November issue, p. 113.

DEATHS

Roy Stein, 62, president of Stein Bros. General Contracting Co., died October 16 in Eugene, Ore.

* * *

Joseph P. Walsh, 64, owner of Walsh Construction Ltd., Vancouver, B. C., and Seattle, Wash., died in a New Westminster Hospital recently after a year's illness.

* * *

Fred L. Nelson, 70, retired building contractor, died October 17 in Los Angeles, Calif.

* * *

Olof Nelson, 84, president of the Logan, Utah, construction firm which bears his name, died October 16 at a Logan hospital.

* * *

Francis G. Harris, 62, contractor, died October 7 in Denver, Colo. Harris' firm was headquartered in Bennett, Colo.

* * *

Howard W. Bliem, 61, chief of the electrical specifications section of the Bureau of Reclamation, died October 8 in Denver, Colo.

* * *

Stuart F. Kimball, 43, general superintendent for Union Sand and Gravel Co., died October 18 in Spokane, Wash. Kimball was killed instantly in an accident from the gravel-loading machinery on the job.

* * *

John B. Sanks, 62, retired city engineer of La Habra, Calif., died September 29 while on vacation in Albany, Ore. At the time of his death, Banks was a consulting engineer to the city council.

* * *

Robert Herrick, 28, contractor, died October 21 in Butte, Mont., from injuries received in an automobile accident.

* * *

Lee Callahan, 85, retired building contractor, died October 22, in his Los Angeles, Calif., home.

* * *

John J. Pionke, 43, construction company executive, died October 22, in Los Angeles, Calif.

* * *

Leonard H. Duffin, 38, owner of Duffin Bros. Construction Co., died in Hollywood, Calif., of a heart ailment. Duffin was a native of Eureka, Utah.

* * *

Arthur D. Stauffer, 51, structural engineer and vice president and secretary of T-F Construction Engineers, died October 28 in Los Angeles, Calif.

* * *

James P. McDonnell, 61, construction engineer, died October 3, in Los Angeles, Calif., where he had been a resident for 40 years.

SUPERVISING THE JOBS

Roy F. Kees is general superintendent for Peter Kiewit Sons' Co. and Coker Construction Co. on this combination-company's contract for shaft enlargement at the Westvaco Chemical Division plant in Green River, Wyo. Kees is being assisted by **Ray S. Stidham.** Shaft foremen are: **James Womack, W. F. Landis** and **H. J. Thomas. Frank J. Weibel** is master mechanic

* * *

George Stover is job superintendent for R. P. Shea Co. on construction of a steel stringer bridge and approaches across the New River at Seeley, Calif. **Bill Silberburger** is general superintendent and **W. O. Thompson** is project manager. **John Silberburger** is job engineer on the $343,507 contract.

* * *

The construction of 22 mi. of State Highway 18 in Union County, N. Mex., is being supervised by **Jack Evans.** Wheeler & Trotz has the $235,820 contract.

* * *

William Short is job superintendent for Cahill Construction Co. on the general construction of Bret Harte School in San Francisco, Calif. **E. A. Larkin,** vice president of the construction firm, is general superintendent on the $1,017,568 job.

* * *

Harold Prosser is general superintendent for Donald M. Drake Co. on construction of concrete foundations on buildings at the Wenatchee, Wash., plant site of Aluminum Corporation of America. **Lyle Ewing, Joe Lang, Tom Ostrum** and **Huck Moyer** are assistants. **Larry Bernardi** is construction manager on the $2,500,000 project.

* * *

Fabrication of penstocks for C. J. Strike Dam, Mountain Home, Idaho, is being supervised by **O. H. Rogers.** Steel foremen are **Leo Franzmathes** and **James E. Turner. W. M. Beurskens** is welding superintendent on the $750,000 Idaho Power Co. project. **David J. Powels** is job engineer.

* * *

On the Clark Fork River in Idaho where Morrison-Knudsen Co., Inc., is erecting Cabinet Gorge Dam, **H. B. Buckert** is general superintendent. **John R. Barry** is administrative superintendent and **Jim Raftery** is assistant superintendent. **Bob Test** is plant and equipment superintendent and **T. Bailey Lee** is excavation superintendent. **E. (Fitz) Fitzgerald** is tunnel superintendent and **Grant Ferre** is swing shift superintendent. **John F. Donovan** is safety superintendent. Other superintendents are **Jack Gray, John Taylor, E. G. Phillips, Jiggs Bodenhammer, Eddie Bryan** and **Dutch Lytel.** Foremen include: **A. D. Tyron, W. E. Frank, Ray Powers, P. G. McNeese** and **N. C. Burgess.**

* * *

***Bill Perry* is general superintendent for Gus J. Benton on the Geiger Field job in Spokane, Wash. (See item below.)**

Construction of an alert hangar and taxiway at Geiger Field near Spokane, Wash., is under the supervision of **Bill Perry. Charles Smith** is steel foreman and **George Roos** is plumbing foreman. **Gus J. Beuten** has the $500,000 contract on the Corps of Engineers project.

* * *

In Laurel, Mont., where Refinery Engineering Co. is constructing a fluid catalytic cracking unit and revamping the existing unit, **Lundy A. Walker** is general superintendent and **Jack C. Knight** is his assistant. **A. E. Banks** is pipe superintendent, **V. E. Wachholtz** is carpenter foreman and **Lee R. Pruitt** is boiler foreman, along with **R. E. McBride. D. D. Pruett** is labor foreman. **R. N. Ewing** is ironworker foreman on the job. Farmer's Union Central Exchange, Inc., is the owner.

* * *

Ernest Everman is general superintendent for Allison Honer Co. on construction of a Bank of America building at Newport Beach, Calif. Raymond Concrete Pile Co., subcontractor, has **George C. MacNeilage** as superintendent.

* * *

John Redford and **Bob Burch** are assistant superintendents for J. E. Haddock Engineers, Ltd., on construction at the Inyokern, Calif., U. S. Naval Base. **Guy Gaul** is building superintendent and **H. G. Epps** is heavy equipment superintendent. **George Bronaugh** is project manager.

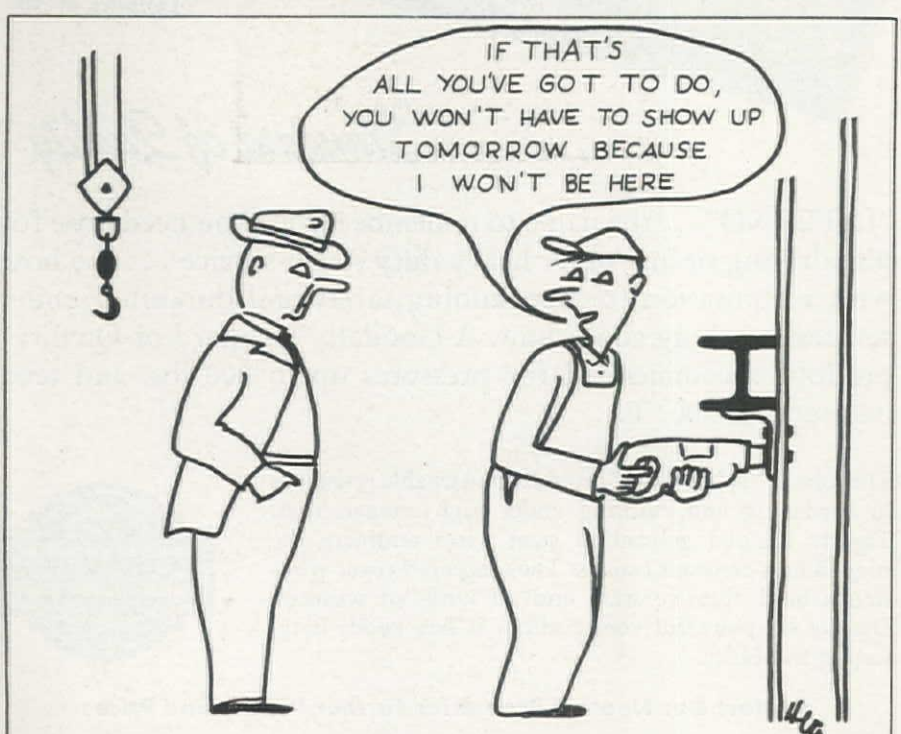
* * *

Construction of the $270,000 Greenwood Elementary School in Montebello, Calif., is under the supervision of **Sam Upton, Jr.** Sam Upton is contractor.

* * *

E. Stinsen is general superintendent for Fredericksen & Kasler on the $2,007,473 highway job on U. S. 66 in California. **Frank Muren** is structural super-

Down-time Dopes . . . . . by Anderson



"Anonymous" suggested this month's "down-time dope" in view of the fact that construction workers are becoming more and more independent with increasing labor shortages.

If you have a pet "down-time dope," write Editor, *Western Construction*, 609 Mission St., San Francisco 5, Calif., and we'll be glad to immortalize him in a cartoon in one of the next issues. You'll receive credit for this idea.

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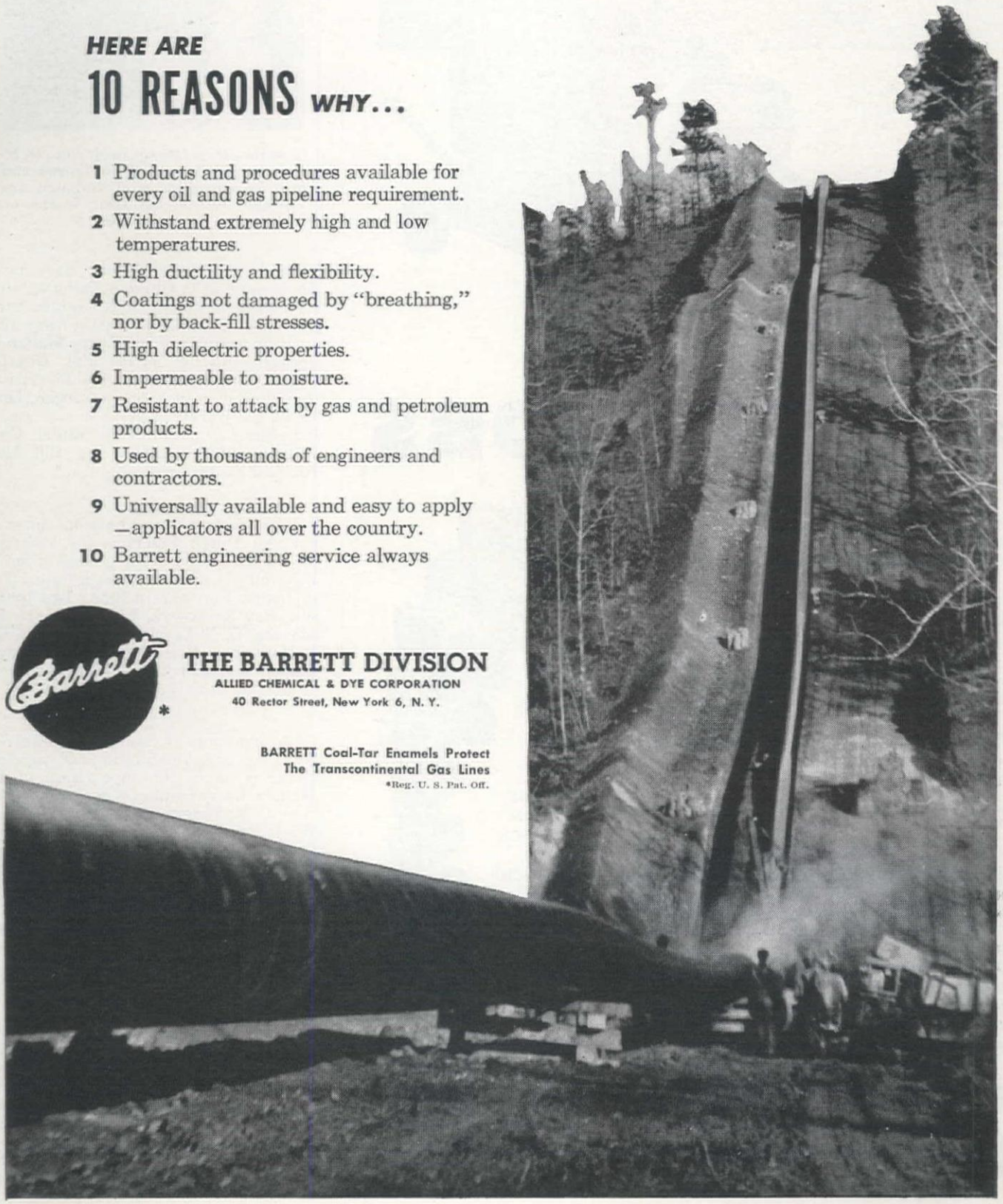

Barrett*

THE BARRETT DIVISION
ALLIED CHEMICAL & DYE CORPORATION
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BARRETT Coal-Tar Enamels Protect
The Transcontinental Gas Lines
*Reg. U. S. Pat. Off.

intendent and **Homer Ford** is carpenter superintendent. **George Bell** is plant superintendent and **Al Hodges** is pipe fitter superintendent. **L. J. Grey** and **Wes Grey** are superintendents and **Slim Ransdell** is master mechanic. **E. A. Bannister** is job engineer.

L. to R.—*D. J. Powels*, proj. eng., *O. H. Rogers*, genr'l supt., *J. E. Turner* and *Leo Franzmathes*, steel foremen for Chicago Bridge and Iron Works on C. J. Strike dam penstocks.

At Fairchild Air Force Base near Spokane, Wash., where S. Birch & Sons Construction Co. and McLaughlin, Inc., are working on a $2,051,000 runway and taxiway paving project, **Larry Mahan** is general superintendent and **Charlie Ptacek** and **Slim Reiter** are his assistants. Foremen include: **Jim Egan, Don Egan,** and **Jim Davis.** Asphalt and crushing plant key men are: **Al Miller, Carl Kilman, John Clayton** and **Bill Ille. Richard Foster** is job engineer.

John Heskart is general superintendent and **Dutch Peters** is his assistant on the $3,850,000 construction of spillway and structures at Albeni Falls Dam in Idaho. Foremen include: **Les Johnson, Ray Roskowyk, Lew Lloyd, H. E. Stevens, G. L. Lamb, G. A. Peoples, O. J. Hammons, Bertil Wiberg** and **Floyd Banks.** Donovan-James, a joint venture, is contractor on the project.

Construction of Southern California Gas Co.'s new building in Los Angeles, Calif., is under the supervision of **E. Jackola. Larry Gordon** is carpenter foreman, **C. R. Yeager** is labor foreman and **W. J. Penrose** is office manager. R. J. Daum Construction Co. holds the contract.

On the construction of Boysen Dam near Shoshoni, Wyo., **George Piedmont** is superintendent for Morrison-Knudsen Co., Inc. **B. (Woody) Williams** is project manager and **R. R. King** is job engineer.

Construction of the State School for the Deaf, Riverside, Calif., is under the supervision of **E. W. Kind, Jenne Dykstra** is field superintendent and **James Hastings, A. W. Kyle** and **A. L. Cabbasier** are carpenter foremen. Allison Honer Co. is beginning work on the project which will cost approximately $3,000,000.

ENGINEERS ON THE MOVE

. . . Continued from page 84

Fred W. Clayton, recently with Earl & Wright, consulting engineers of San Francisco, and previously consulting engineer of Reno, Nevada, left on October 30 to take over field responsibility for the construction of an airport at Rangoon, Burma. Knappen, Tippetts, Abbett Engineering Co., a consulting firm of New York and San Francisco, has the contract with the Burma Government for engineering on the project. Current operations are designed to extend through the dry season for the next six months.

* * *

Hal W. Hunt, until recently executive engineer for the Western Foundation Corp. in New York City, is now resident engineer for Frederic R. Harris, Inc., consulting engineers of New York City, in charge of extensive pier improvement for the Port of Portland. The work will include a sheet pile bulkhead, a 1,000-ft. concrete deck pier, buildings, and rehabilitation of two floating drydocks. Work is expected to occupy about eighteen months and engineering headquarters are at Swan Island.

* * *

Arthur L. Williams becomes assistant engineer of design and construction for Los Angeles, Calif., Department of Water and Power. Williams was formerly head of the distribution and transmission design section.

* * *

Joseph W. Monroe, former civil engineer with the City and County of San Francisco, Calif., is now a Second Lieutenant serving as a bridge unit commander with the 773rd Engineer Panel Bridge Company near Heidelberg, Germany.

* * *

E. J. Palmer becomes acting supervisor of operations and development work for the Big Horn district of the Bureau of Reclamation. Palmer replaces **Neff Tippets,** who resigns to enter private business in Laramie, Wyo.

* * *

Pioneer Construction Co., Inc., is a new firm recently incorporated in Albuquerque, N. Mex. Officers of the new venture are: **John J. Emmons,** president; **G. E. Tatman,** vice president, and **M. D. Hatley,** secretary.

* * *

New assistant city engineer in Springfield, Ore., is **Bill Williams.** He succeeds **Bob Fryback,** who is now with the Lane County engineering department.

* * *

William J. Fox is the new county engineer and surveyor of Los Angeles County, Calif. Fox was formerly chief engineer of the county Department of Building and Safety. Fox succeeds **C. E. Arnold,** who retires.

CONTRACTS

A Summary of Bids and Awards For Major Projects in the West

★★

Alaska

$718,913—**Peter Kiewit Sons' Co.,** 1024 Omaha National Bank Bldg., Omaha, Neb.—Low bid for construction of a remote receiver facility for Ladd Air Force Base; by Corps of Engineers.

$3,932,000—**Valle-Sommers Co.,** Box 4906, Interbay Station, 407 Third Ave. W., Seattle, Wash.—Low bid for construction of the 70-bed Alaska Native Service Hospital, Bethel; by Bureau of Indian Affairs.

$1,131,000—**J. B. Warrack Co.,** Securities Bldg., Seattle, Wash.—Low bid for construction of a car and coach stop; by the Alaska Railroad.

Arizona

$186,890—**C. W. Smith, DBA, Dorrington Steet Metal Works,** 1319 Twenty-second St., Denver, Colo.—Low bid for metalwork, heating and ventilation systems and piping for Davis Dam Power Plant; by USBR.

California

$168,085—**Affiliated Engineers & Contractors, Inc.,** Chamber of Commerce Bldg., Sacramento—Low bid for construction of a sewage treatment plant at Columbia Historic State Park; by State Division of Architecture.

$576,262—**Guy F. Atkinson Co.,** 10 W. Orange Ave., South San Francisco—Award for relocation of roads, fences, etc., Naval Air Station, Moffett Field; by Twelfth Naval District.

$762,411—**Ball & Simpson,** 685 Delaware St., Berkeley—Low bid for 8.0 mi. of grading and surfacing with imported base material with the upper portion bituminous surface treated, between 0.5 mi. south of Isabella and 3 mi. west of Weldon in Kern County; by State Division of Highways.

$217,256—**Ball & Simpson,** 685 Delaware St., Berkeley—Low bid for 6.4 mi. of grading and surfacing roadway with road-mix surfacing, between Glacier Lodge and 4 mi. west of Big Pine, Inyo County; by State Division of Highways.

$101,048—**Baun Construction Co.,** 324 Princeton Ave., Fresno—Low bid for 3.6 mi. of grading, placing untreated rock base and plant-mix surfacing between Selma and Fowler in Fresno County; by State Division of Highways.

$733,740—**L. A. & R. S. Crow,** 2226 N. Rosemead Blvd., El Monte—Low bid for construction of Glen Anne Dam, Cachuma Project; by USBR.

$141,305—**L. A. & R. S. Crow,** 2226 N. Rosemead Blvd., El Monte—Low bid for 3.0 mi. of grading on Calf Canyon-Huer Huero Rd., San Luis Obispo County; by State Division of Highways.

$733,740—**L. A. & R. S. Crow,** 2226 N. Rosemead Blvd., El Monte—Award for construction of Glen Anne Dam, Cachuma Project; by USBR.

$206,228—**Charles J. Dorfman,** 124 N. La Brea St., Los Angeles—Low bid for sanitary sewers northeast of San Jose; by Santa Clara County Sanitary District 2.

$584,512—**Erickson, Phillips & Weisberg,** 2341 Telegraph, Oakland—Low bid for widening about 14 concrete bridges and about 0.3 mi. of roadway; resurfacing with plant-mix surfacing, between Deer Creek Overflow and Mill Race Creek; by State Division of Highways.

$125,311—**Norman I. Fadel,** Box 206, North Hollywood—Low bid for redecking 30 timber trestle bridges with reinforced concrete slabs, plank floors and plant-mix surfacing, San Bernardino County; by State Division of Highways.

$445,987—**Charles L. Harney, Inc.,** 575 Berry St., San Francisco—Low bid for paving Sloat Blvd. between Junipero Serra Blvd. and Great Highway, San Francisco; by State Department of Highways.

$349,825—**Lord & Bishop,** P. O. Box 812, Sacramento—Low bid for constructing an underpass and a bridge and rough grading

about ¼ mi. of city streets on J St. and over J St., Sacramento; by State Division of Highways.

$1,012,374—**The Harvey Nickols Co.,** 926 E. Slauson St., Los Angeles—Low bid for construction of Downey Junior High School, Downey; by Downey High School District.

$1,031,625—**Riley-Stoker Corp.,** 510 W. 6th St., Los Angeles—Low bid for furnishing, erecting and installing a steam generator and appurtenant work in Pasadena; by City of Pasadena.

Colorado

$210,330—**Colorado Constructors, Inc.,** 725 W. 39th Ave., Denver—Low bid for Carter Lake pressure conduit, Estes Park-Foothills power aqueduct, Colorado-Big Thompson Project; by USBR.

$125,833—**Sturgeon Electric Co., Inc.,** 2124 Broadway, Denver—Low bid for Estes-Pole Hill transmission line, Colorado-Big Thompson Project; by USBR.

Idaho

$314,276—**Quinn Robbins Co., Inc.,** 703 S. 16th St., Boise—Award for 3.9 mi. of highway construction on the Boise-Stanley Highway, Ada County. Work includes crushed rock surfacing; by State Department of Highways.

Montana

$3,286,000—**The Harsh Investment Co.,** 374 S.W. Morrison St., Portland, Ore.—Award for construction of a 400-unit housing project at Great Falls Air Force Base; by Corps of Engineers.

$304,004—**Hilde Construction Co.,** 3810 Seventh Ave., Great Falls—Award for 4.8 mi. of grading, gravel surfacing and road-mix oil treatment on Roundup-Grass Range Highway, Fergus County; by State Highway Commission.

$241,454—**Nilson-Smith Construction Co.,** P. O. Box 1147, Great Falls—Contract awarded for construction on Great Falls—South Highway in Cascade County; 10.2 mi.; by State Highway Commission.

$445,822—**W. P. Roscoe Co.,** 511 N. 26th St., Billings—Contract awarded for construction on the Cascade-Ulm Loop Rd. in Cascade County; 648-ft. structural steel and concrete bridge over the Missouri River; by State Highway Commission.

Nevada

$447,097—**Young & Smith Construction Co.,** 204 Beason Bldg., Salt Lake City, Utah—Award for highway construction on U. S. 91, south of Las Vegas to a point near Oakey Blvd. in Las Vegas, Clark County; by State Department of Highways.

New Mexico

$203,456—**Henry Thygesen & Co.,** P. O. Box 876, Albuquerque—Low bid for 2.9 mi. of graded 28-ft. bituminous surfacing on the Luna Junction-So. Boundary Gila National Forest, Grant County; by BPR.

Oregon

$186,000—**Berger Engineering Co.,** 3236 Sixteenth, S.W., Seattle Wash.—Low bid for three penstock gates for Lookout Point Dam; by Corps of Engineers.

$669,982—**Berke Bros.,** 7923 N.E. Halsey, Portland—Low bid grading and paving the Reedsport-Winchester Bays Section of the Oregon Coast Highway; by State Highway Commission.

$848,815—**Gibbons & Reed Co.,** 259 W. 3rd S. St., Salt Lake City, Utah—Low bid for grading and paving the Warren Creek-Viento Section of the Columbia River Highway in Hood River County; by State Highway Commission.

$1,447,754—**Gibbons & Reed Co.,** 259 W. 3rd S. St., Salt Lake City, Utah—Low bid for bridge construction, grading and paving the Gorton Creek-Warren Creek section of the Columbia River Highway in Hood River County; by State Highway Commission.

$886,583—**Carl M. Halvorson, Inc.,** 218 Builders Bldg., Portland—Low bid for grading and paving the Warren Creek-Viento section of the Columbia River Highway, Hood River County; by State Highway Commission.

$682,725—**State Construction Co.,** 1750 19th Ave. S., Seattle, Wash., and **Walter McCray,** 308 S.W. 22nd St., Mercer Island, Wash.—Contract awarded for Willamette River crossing sewer project; by City of Portland.

Utah

$1,300,000 approx.—**Richard R. Fairless & Assoc.,** 551 Union Pacific Annex Bldg., Salt Lake City—Award for construction, management and finance for Wherry Housing units, Desert Chemical Depot; by Corps of Engineers.

$294,565—**Gibbons & Reed Co.,** 259 W. 3rd So., Salt Lake City—Award for 9.4 mi. of road-mix bituminous surfacing on SR 48, Midvale-Copperton, Salt Lake County; by State Road Commission.

$3,889,000—**Ketell Construction Co.,** 320 Board of Trade Bldg., Portland, Ore.—Award for construction, management and finance of Wherry Housing units in "E" Area, Dugway Proving Grounds; by Corps of Engineers.

$142,327—**Floyd S. Whiting,** P. O. Box 158, Murray—Low bid for 1.8 mi. of construction on the Zion-Bryce Canyon National approach road in Dixie National Forest; by BPR.

Washington

$1,342,265—**Roy T. Earley Co.,** and **Anderson Bridge Construction Co.,** 321 Middle Waterway, Tacoma—Award for construction of an industrial waterway bridge; by City of Tacoma.

$201,660—**General Construction Co.,** 4850 N.W. Front Ave., Portland, Ore.—Low bid for construction of Naselle River Bridge on Primary State Highway No. 12, Pacific County; by State Department of Highways.

$827,781—**K. L. Goulter & Co.,** 1900 Magnolia Blvd., Seattle—Award for 3.6 mi. of highway construction on Primary State Highway No. 2, Summit to Olallie Creek, King County; by State Dept. of Hwys.

$114,283—**L. E. Hoback & R. H. Sussex,** P. O. Box 1, Bellingham—Award for 11.0 mi. of construction on Elliot Rd. and Boerr Rd., Grant County; by State Dept. of Hwys.

$810,000—**L. H. Hoffman,** P. O. Box 2028, Portland, Ore.—Low bid for construction of outside utilities and miscellaneous work at Hanford; by AEC.

$1,598,362—**Long Construction Co., Inc.,** P. O. Box 1291, Billings, Mont.—Low bid for earthwork, lateral lining, pipe lines and structures, Potholes East Canal laterals, Columbia Basin Project; by USBR.

$424,051—**Matt Malaspina & Co.,** 1901 23rd Ave., So. Seattle—Low bid for construction of the west trunk sewer in Lake City sewer district; extension of the line to Northgate; by Lake City Sewer District.

$305,984—**C. J. Montag & Sons,** 7805 N.E. Halsey St., Portland, Ore.—Award for work on the S. P. & S. Railway Undercrossing in Vancouver, Clark County; by State Department of Highways.

$297,170—**Northwest Construction Co.,** 3950 Sixth Ave., N.W., Seattle—Low bid for 3.0 mi. of highway construction on Morton South, Primary State Highway No. 5 and SSH 5-L, Lewis County; by State Department of Highways.

$135,074—**J. A. Park,** Yakima—Award for construction of pumping plants along the left bank of the Columbia River near Pasco; by Corps of Engineers.

$284,144—**Port Construction Co.,** P. O. Box 868, Port Angeles—Award for bridge and access road construction, the Columbia-Olympic transmission line; by BPA.

$548,970—**P. C. Saddler,** Room 108, Exchange Bldg., Wenatchee—Award for 2.6 mi. of highway construction in Monitor vicinity, P. S. H. No. 2, Chelan County; by State Department of Highways.

Wyoming

$166,388—**Peter Kiewit Sons' Co.,** P. O. Box 875, Sheridan—Award for 6.2 mi. of grading, draining, crushed gravel base course, two 3-span treated timber bridges, Kaycee-Barnum Rd., Johnson County; by State Highway Department.

$297,459—**Knisely-Moore Co.,** Box 77, Douglas—Award for 8.4 mi. of grading, draining, one slab span bridge and one double culvert, Lance Creek-East Rd. Junction with U. S. 85 West in Niobrara County; by State Highway Department.

$207,028—**J. H. & N. M. Monaghan & Assoc. Cos.,** Rt. 1, Derby, Colo.—Award for 1.2 mi. of grading, draining, base course surfacing and plant-mix surfacing, Casper; by State Highway Dept.

$315,519—**Sharrock and Pursel,** P. O. Box 316, Casper—Low bid for earthwork and structures, Means Canal and Big Sandy Channel Change, Eden project; by USBR.

$421,109—**Strong Company,** Springville, Utah—Low bid for 6.7 mi. of construction on the Wind River Route, Teton National Forest; by BPR.

$139,093—**Taggart Construction Co.,** P. O. Box 560, Cody—Award for 7.1 mi. of grading, draining, base course surfacing including bridge, Ethete Rd., Fremont County; by State Hwy. Dept.

UNIT BID PRICES

Selected Bid Abstracts for Typical Western Projects

Bridge and Grade Separation . . .

Grading, road-mix surfacing and concrete box girder bridge in Utah

Utah—Sevier County—State. L. A. Young Construction Co., Richfield, with a bid of $241,810, was low before the State Road Commission for construction of the Richfield-Vermillion section of highway No. 89, 6.4 mi. of 3-in. road-mixed bituminous surfacing and construction of 1 concrete box girder bridge. Unit prices were as follows:

(1) L. A. Young Construction Co. $241,810
(2) W. W. Clyde & Co. 249,320
(3) R. M. Jensen 272,081
(4) LeGrand Johnson 273,307
(5) L. T. Johnson Construction Co. $276,098
— Reynolds Construction Co. 279,766
— Whiting & Haymond, Contractors 298,734
(6) Engineer's estimate 268,984

		(1)	(2)	(3)	(4)	(5)	(6)
285,000	gal. bitum. matl., Type MC-3	.125	.13	.12	.13	.13	.13
37,000	gal. bitum. matl., Type MC-1 or MC-2	.125	.14	.13	.135	.13	.14
31,500	gal. bitum. matl., Type RC-4	.14	.14	.14	.14	.13	.15
315	gal. bituminous additive	2.00	2.00	2.05	.30	3.00	2.25
1,350	ton cover material	3.00	3.00	3.00	2.75	3.50	2.50
22,500	ton cr. rk. or cr. grav. surf. crse. (top course)	.60	.75	.73	.75	.58	.68
24,000	ton cr. rk. or cr. grav. surf. crse. (bottom crse.)	.60	.75	.69	.70	.58	.65
6.650	mi. scarifying and mixing	900.00	900.00	800.00	900.00	750.00	800.00
160,000	cu. yd. unclassified excavation	.20	.20	.24	.22	.24	.25
1,110,000	sta. yd. overhaul, Class "A"	.01	.01	.01	.015	.015	.01
340,000	yd. mi. overhaul, Class "B"	.12	.10	.125	.13	.13	.12
3,500	1,000-gal. watering	1.00	1.00	1.50	1.50	1.50	1.00
2,500	hr. rolling	3.00	4.00	4.50	4.50	4.50	5.00
39	lin. ft. 12-in. concrete pipe	2.60	2.40	2.55	2.40	2.50	2 40
260	lin. ft. 15-in. concrete pipe	3.30	3.00	3.25	3.00	4.00	3.00
583	lin. ft. 18-in. concrete pipe	5.60	4.00	4.80	4.00	5.00	3.90
801	lin. ft. 24-in. concrete pipe	6.00	5.50	6.30	5.35	6.00	5.25
205	lin. ft. 30-in. concrete pipe	9.00	8.00	8.95	7.55	8.50	7.85
120	lin. ft. 36-in. concrete pipe	12.00	11.30	12.00	12.00	12.00	11.20
552	lin. ft. C. M. pipe arches 29-in. x 18-in.	6.00	5.50	5.25	5.35	6.00	5.30
202	lin. ft. C. M. pipe arches 36-in. x 22-in.	7.00	6.70	7.25	6.75	7.50	6.40
104	lin. ft. C. M. pipe arches 43-in. x 27-in.	11.00	10.75	11.00	10.50	11.00	10.20
13	lin. ft. 24-in. C.G.M. pipe	7.00	5.20	5.00	5.20	6.50	5.00
269	cu. yd. concrete, Class "A"	48.00	55.00	58.00	65.00	70.00	70.00
750	lb. structural steel	1.00	.40	.50	.35	.60	.25
42,800	lb. reinforcing steel	.12	.15	.135	.135	.14	.12
1,700	cu. yd. excavation for structures	1.00	1.50	2.00	2.00	1.50	1.50
2,350	cu. yd. channel excavation	.40	.40	.70	.75	1.00	.50
15,000	lin. ft. right-of-way fence, Type "A"	.22	.22	.26	.25	.25	.25
20,000	lin. ft. right-of-way fence, Type "B"	.30	.24	.31	.32	.33	.30
30	ea. 14-ft. gates	40.00	35.00	46.00	32.00	45.00	35.00
36	ea. guide posts	8.00	6.00	5.00	6.00	6.50	6.00
Lump sum,	furnish water equipment	500.00	$2,000	$1,100	500.00	500.00	$3,500
Lump sum,	furnishing construction signs	600.00	500.00	500.00	500.00	500.00	500.00
70	ea. right-of-way markers	10.00	5.00	6.50	6.00	6.00	5.00
2	ea. F.A.P. markers	20.00	25.00	25.00	25.00	25.00	20.00
225	cu. yd. excavation for structures	1.00	1.50	2.00	3.00	1.50	4.00
153	cu. yd. concrete, Class "A"	50.00	55.00	58.00	65.00	70.00	65.00
28,900	lb. reinforcing steel	.12	.15	.135	.135	.14	.14

Rebuilding small timber bridge in Washington

Washington—Pacific County—State. General Construction Co., Portland, Ore., with a bid of $201,660, was low before the State Department of Highways for 0.3 mi. of highway construction on Primary State Highway No. 12, known as the Naselle River Bridge. Unit prices were as follows:

(1) General Construction Co. $201,660
(2) David Nygren 233,220
(3) H. P. Palmberg $259,256

		(1)	(2)	(3)
33	M.B.M. timber and lumber (salts treated) in place	390.00	450.00	450.00
481	M.B.H. timber and lumber (creosote treated) in place	330.00	390.00	432.00
1,560	lb. structural carbon steel in place	1.00	.50	.40
Lump sum,	removing portions of existing structure	$22,500	$25,000	$30,000
Lump sum,	surfacing bridge deck	$6,000	$5,000	$6,000

Highway and Street . . .

Crushed rock surfacing on 3.4 mi. in Idaho

Idaho—Kootenai County—State. Materne Bros., Spokane, Wash., with a bid of $82,529, was low before the State Department of Highways for construction of a roadway and a crushed rock surface on 3.4 mi. of the Worley West Road from Worley westerly. Unit prices were as follows:

(1) Materne Bros. $82,529
(2) Carbon Bros. 83,712
(3) Engineer's estimate $82,736

		(1)	(2)	(3)
51,400	cu. yd. unclassified excavation	.30	.35	.45
250	cu. yd. excavation for structures	3.00	2.50	2.50
1,860	yd. mi. haul	.30	.30	.30
1,290	M. gal. watering embankments	2.00	1.00	2.00

910	M. gal. watering base and surface courses	2.00	2.00	2.00
37	day rolling power roller	40.00	45.00	40.00
65	day rolling tamping roller	50.00	55.00	40.00
90	cu. yd. mechanical tamping	2.50	2.50	3.00
115	lin. ft. small ditches	.50	.15	.30
8	sta. obliteration of old road, Class 2	20.00	15.00	25.00
16,900	ton cr. rock base course 2-in. max.	1.20	1.25	1.00
19,700	ton cr. rock surface course ¾-in. max.	1.25	1.30	1.25
500	lin. ft. 12-in. pipe culverts	3.50	2.80	2.00
800	lin. ft. 18-in. pipe culverts	4.50	3.50	3.25
210	lin. ft. 24-in. pipe culverts	6.00	3.80	4.75
42	lin. ft. 30-in. pipe culverts	8.50	7.00	6.50
64	lin. ft. 36-in. pipe culverts	11.00	9.00	7.50
54	lin. ft. 42-in. pipe culverts	14.00	12.00	10.00
100	lin. ft. 48-in. pipe culverts	18.00	18.00	11.00
36	lin. ft. salvage 18-in. CM pipe	2.00	1.50	2.00
24	lin. ft. salvage 24-in. CM pipe	2.50	1.50	2.00
60	lin. ft. salvage 30-in. CM pipe	3.00	2.00	3.00
28	lin. ft. salvage 48-in. CM pipe	4.00	2.50	4.00
1	ea. project markers	25.00	10.00	25.00
81	ea. right-of-way markers	8.00	6.00	6.00

Seal coat on existing bituminous surface

Arizona—Gila County—State. H. J. Hagen, Globe, with a bid of $27,068, received a contract from the Department of Highways for construction on three highway sections, Superior-Miami Highway, Miami-Globe Highway and Globe-Salt River Highway. Work includes furnishing and applying a seal coat to about 15 mi. of existing bituminous surface. Unit prices were as follows:

(1) H. J. Hagen.....$27,068 (2) Fisher Contracting Co.....$29,136

		(1)	(2)
1,162	ton cover matl. for seal coat (Type A) (CIP including rolling)	7.00	8.25
1,232	ton cover matl. for seal coat (Type B) (CIP including rolling)	7.00	7.50
130	ton petroleum fuel oil for seal coat (Grade SC-2) (CIP)	35.00	35.00
144	ton emulsified asphalt for seal coat (Grade A) (CIP)	40.00	40.00

Grading, cinder surfacing and concrete bridge

Oregon—Klamath County—State. Leonard & Slate Oregon, Ltd., and E. C. Hall Co., joint venturers, Portland, with a bid of $495,810, were low before the State Highway Commission for construction of the Rocky Creek-Wocus Marsh section of Klamath Lake Secondary Highway. Unit prices were as follows:

(1) Leonard & Slate Oregon, Ltd.....$495,810 (3) K. L. Goulter & Co.....$613,690
(2) J. W. Briggs..... 531,218

		(1)	(2)	(3)
	All specified, clearing and grubbing	$65,000	$81,000	$90,000
	All specified, roadside cleanup	$70,000	$6,000	$10,000
500	cu. yd. trench excav., unclassified	4.00	10.00	3.00
300,000	cu. yd. general excav., unclassified	.66	.81	1.00
79,000	cu. yd. special borrow excav., unclassified	.60	.70	.50
5,500	cu. yd. canal excav., unclassified	.50	1.00	.40
900,000	yd. sta. short overhaul	.02	.015	.02
29,700	cu. yd. sta. long overhaul	.60	.50	.50
12.27	mi. finishing roadbed and slopes	$1,000	500.00	$1,000
1,650	lin. ft. 18-in. concrete pipe	4.00	4.67	4.00
200	lin. ft. 24-in. concrete pipe	5.50	6.00	6.25
310	lin. ft. 36-in. concrete pipe	12.00	10.75	12.00
330	lin. ft. 24-in. extra str. concrete pipe	6.50	7.00	7.00
600	lin. ft. 18-in. corrugated metal pipe	4.00	4.50	4.50
20	lin. ft. 36-in. corrugated metal pipe	15.00	12.00	15.00
360	lin. ft. 72-in. arch-type corrugated metal pipe	35.00	30.00	40.00
44,200	cu. yd. cinders in surfacing	.85	.75	1.00
1,300	M. gal. sprinkling	3.00	3.00	3.00
7	M.F.B.M. treated lumber in place	300.00	300.00	400.00
2,730	lin. ft. furnish treated piling	2.00	2.00	2.00
35	only drive piles	100.00	60.00	200.00
210	cu. yd. Class "A" concrete	85.00	65.00	80.00
50,000	lb. metal reinforcement	.14	.13	.14
70	cu. yd. Class "A" concrete in box culverts	70.00	65.00	80.00
9,500	lb. metal reinforcement in box culverts	.15	.13	.14

Miscellaneous . . .

Hauling and stockpiling crushed rock

Oregon—Lane County—State. E. H. Itschner Co., Molalla, with a bid of $46,695, was low before the State Highway Commission for rock production on the Vida-Bellknap Springs section of the McKenzie Highway. Unit prices were as follows:

(1) E. H. Itschner Co. .....$46,695 (3) Vernie Jarl $51,072
(2) E. C. Hall Co. 48,179

		(1)	(2)	(3)
4,840	cu. yd. ¾-in. - ½-in. crushed rock in stockpile	2.50	2.54	2.80
4,840	cu. yd. ½-in. - ¼-in. crushed rock in stockpile	2.50	2.54	2.80
2,420	cu. yd. ¼-in. - No. 10 crushed rock in stockpile	2.50	2.54	3.00
76,300	yd. mi. hauling crushed rock, pile measure	.15	.15	.16
	All specified, settling basin	$5,000	$6,000	$4,500

Aerial topographic survey of highway route

Washington—King County—State. Aero Service Corp., Philadelphia, Penn., with a bid of $4,296, was low before the State Department of Highways for an aerial topographic survey of the Renton vicinity of Secondary State Highway No. 2-A in King County. Unit prices were as follows:

(1) Aero Service Corp. .....$4,296 (3) Gardner & Hitchings, Inc. $5,293
(2) Pacific Aerial Surveys, Inc. ..... 4,692 (4) Fairchild Aerial Surveys, Inc. 6,382

		(1)	(2)	(3)	(4)
4.75	sq. mi. one set of topographic maps	894.00	950.54	$1,085	$1,338
2	sets only stereoscopic contact prints	20.00	58.50	50.00	12.00
2	only photo-index maps	5.00	30.00	20.00	1.25

NEW LITERATURE

1201

Enlarged edition of book on modern concrete placement

Those who are familiar with this splendid reference book will be interested in the new and enlarged edition published by **Autolene Lubricants Co.** The book contains the latest technical information and field use tips on air-entrained concrete. Photographs of concrete construction projects are a valuable addition to the book. Here is question and answer information about air-entrainment techniques and Protex air-entraining solutions. Actual test pictures of concrete with and without Protex air-entrainment solutions appear in the book along with informative graphs and charts.

1202

100 pages of welding repair problems and procedures

"1951 Data File of Defense and Maintenance-Conservation Welding Problems" is offered by **Eutectic Welding Alloys Corp.**, in an effort to solve increasing problems caused by shortages of materials. The plastic-bound data file contains well over 100 pages of illustrated technical data on maintenance and repair welding problems and procedures. A portion of this material consists of issues of the company's war-time maintenance and production tips magazine, "The Welder," containing valuable information on metal-joining procedures perfected during the past war. Included, also, are data sheets and information on a full line of over 160 different Eutectic Low Temperature welding alloys and latest developments in this field.

1203

Techniques of aerial surveys and maps from photographs

This booklet is designed to show the advantages of aerial photogrammetry which can save time and money on engineering projects. The booklet points out the practicality of surveying from the air on ordinary jobs as well as on those where the terrain is so rugged that other means are inadvisable. The photogrammetric process (taking measurements from photographs) is explained and illustrated in the beginning of this booklet. A discussion of the types of cameras used for various types of assignments is included. The booklet then explains the selection of maps and photographs available from aerial surveys and uses for each type. This is a concise explanation of a very interesting process offered free by **Abrams Aerial Survey Corp.**

1204

Pocket-size card gives spec numbers for reinforcing bars

Convenient, compact and easy to read, this new specification card on fabricated reinforcing bars is now available from **Bethlehem Pacific Coast Steel Corp.** The card utilizes a color-marking system to designate specification numbers. The color chart is on one side and a table of size, weight in lb. per ft., area and perimeter of Standard A305 concrete reinforcing bars appears on the other side. Color marking simplifies locating fabricated bars for placing in the field and the colors do not wash off. Here is an offer of a great deal of information in a small package.

1205

Latest excavator improvements

Latest advancements made on the Koehring Model 304 excavator and its attachments are described in a new catalog just issued by **Koehring Company.** Illustrations and drawings, 117 of them,

are included depicting the design, construction, work capacity and wide application of this excavator. In addition to action photographs of the excavator, there is a selection of machine part pictures. Line diagrams illustrate the direct flow of power in the Model 304. Information is included on the attachments available with the excavator.

1206

Motor scraper memo

A 16-page catalog has been issued by **LaPlant-Choate Manufacturing Co., Inc.,** describing its TS300 motor scraper. Construction features of the high-speed, rubber-tired, self-propelled earthmover are explained in the catalog. Individual photographs of the various component parts of the machine are included along with a large two-page picture of machine with complete specifications included.

1207

"The Dependable Diesel"

Some readers are already familiar with this magazine published by **Cummins Engine Co., Inc.** This issue contains 24 pages of actual case histories on Cummins diesels in a variety of applications. The magazine is interesting reading and the photographs spotlight diesel applications and production. The versatility of the diesel engine and its many applications shown here make this worthwhile reading.

1208

Rent steel sheet piling

A new 8-page illustrated brochure listing advantages of renting steel sheet piling and listing engineering details of interlocking sections is offered by **L. B. Foster Co.** Bulletin F-160 contains specifications for piling sections, as well as corners and connections. Data are also given on pile hammers and extractors available. The booklet is fully illustrated.

1209

Motor grader operator's guide in colored "Cat" comic book

Motor grader operators won't want to miss getting a copy of this latest **Caterpillar Tractor Co.** release. In 12 pages of colorful cartoon illustrations with captions, the motor grader operator will find a lot of valuable information and

many important tips on the operation of his machine. The machine is first diagrammed and explained and then put through its paces on a great variety of operations. This is "how-to-do-it" information at its best with each operation carefully explained and illustrated.

Literature briefs . . .

1210

DRIVESHAFTS of the **Morse Chain Co.** are well described in a new bulletin just issued by the firm. The Morse Radial and Universal Driveshafts are featured and complete data and specifications are given.

1211

ROCK BIT DATA—For help in lowering rock bit costs and attaining greatest possible drilling speed, **Timken Roller Bearing Co., Rock Bit Division,** offers a free booklet packed with the latest rock bit data.

1212

FLUID FACTS—"Hot News for Cold Engines" is a little booklet which gives the low-down on Chevron Starting Fluid for gasoline and diesel engines. This **Standard Oil Company of California** release tells you where the starting fluid should be applied in different types of engines.

1213

SCALES, ANYONE? — This contractor's scale, built to be moved as one unit, has its story, capacities and platform sizes set down in illustrated literature offered by **L. R. Murphy Co.**

1214

PAVING PLANT PAY—You can save money by using these rugged, simply designed paving plants explained in a catalog issued by **Standard Steel Corp.**

1215

TIMBER TRUSS TALK—Details on the fabricated timber trusses and other structural wood products produced by **Weyerhaeuser Sales Co.** are contained in a catalog issued by the company.

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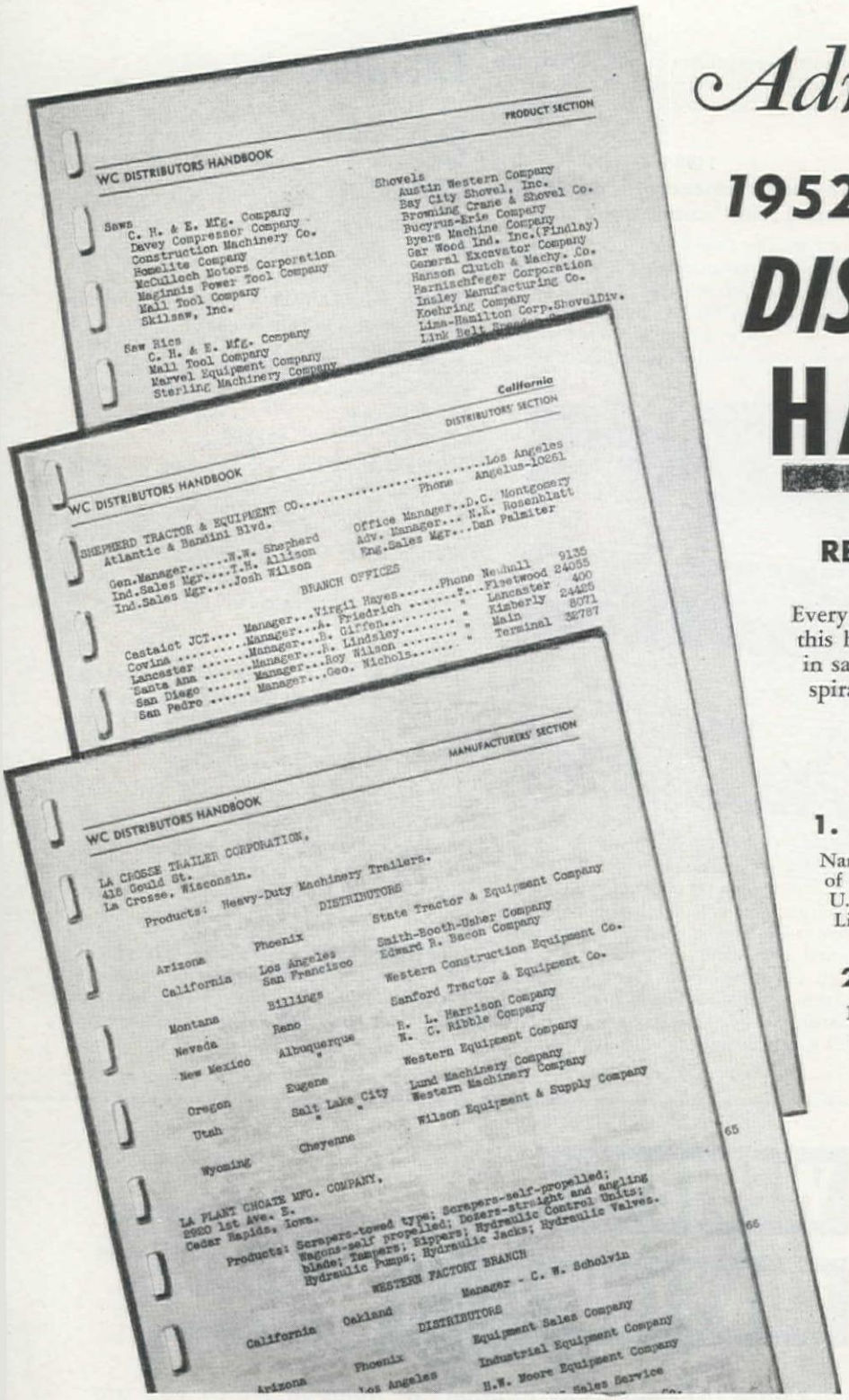

Typical pages, actual size, to show type of content.

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1216

VERSATILE VIBRATORS—For a great variety of uses such as municipal paving and highway widening and patching, these vibrators are well suited. **Electric Tamper & Equipment Co.** offers a pocket-size guide describing the entire line.

1217

BUCKET BRIGADE—Complete information and specifications on this line of buckets and grapples by **The Owen Bucket Co.** is contained in the catalog made available by the company.

1218

TUNNEL LINERS—**The Commercial Shearing & Stamping Co.** suggests you use Commercial tunnel supports wherever earth must be supported. The booklet offered tells you why you should.

1219

VIBRATOR LINE—The complete line of gasoline and electric vibrators from **Stow Manufacturing Co.** is described in a catalog loaded with specifications. Accessories are also outlined.

1220

PUMPING PATTER—The new contractor's pump bulletin, 8-CP-11 is now available from **Gorman-Rupp Co.** It explains why there is a pump to solve your problem.

1221

NEED A TRUCK MIXER?—A new bulletin tells the story of the Hi-Lo Truck Mixer, manufactured by **Concrete Transport Mixer Co.** A way is explained to meet load limitations with high capacity at low cost.

1222

ASPHALT PLANTS—100 ton per hour performance and other features worth investigation are contained in a catalog about Cummer Asphalt Plants issued by **The F. D. Cummer & Son Co.**

1223

POURING FROM POWER-CARTS—The speed and efficiency of these Gar-Bro power-carts is discussed by the **Gar-Bro Manufacturing Co.** in Bulletin 83, just issued by the firm.

1224

DRAGLINE BUCKET FACTS—A descriptive bulletin on Wellman dragline buckets is now available. **The Wellman Engineering Co.** explains how it is possible to get more yardage per day.

1225

PORTABLE ASPHALT PLANTS — These portable asphalt plants are highly recommended for city and state repair jobs. Read all about their convenience in the **White Mfg. Co.** catalog.

1226

BUDA BULLETINS — Dependability and efficiency in action with Buda earth drills—bulletins and data issued by **Buda Co.** tell you the straight story.

1227

WIRE ROPE, PARDNER? — Details on how to make your investment in wire rope count for a great deal are contained in bulletins issued by **Union Wire Rope Corp.** Draglines, slings, chokers, rotary line, etc., have their stories told in booklet form.

1228

V-BELT FASTENERS — You can make up V-belt drives for many applications by reading the facts on V-belt fasteners and V-belting in rolls. **Flexible Steel Lacing Co.** tells you all about them in bulletin V-211.

1229

FORM TYING FORMULA—Universal form ties and accessories are fully described in a catalog available from **Universal Form Clamp Co.** The catalog contains specifications and illustrations.

1230

NEED NEW CLUTCH PLATES?—**S. K. Wellman Co.** has a set of booklets for you that give in handy ready-reference form information on ordering replacement clutch plates, facings and brake linings for all the major lines of equipment.

1231

WELDING WELL-DONE—Lessons and studies in structural arc welding can be obtained by engineers and designers from **Lincoln Electric Co.**

1232

SCREEN OPERATION — The story on trouble-free operation of vibrating screens is well told in a catalog issued by **Screen Equipment Co., Inc.**

NEW EQUIPMENT

More information on any of the items in this section may be obtained by using the coupon on page 97.

1233

Seepage and erosion in ditches checked with prefab asphalt membrane lining

Irrigation canal liner, produced by **Owens-Corning Fiberglas Corp.**, is a Fiberglas-reinforced prefabricated asphaltic membrane lining for installation on bottoms and sides of

most types of canals and lateral ditches. The liner can be applied any time during the year and can be stored indefinitely. Can be installed by two men and a crew of four to six men can apply from 200 to 300 sq. yd. an hour under normal conditions. "Three things made this new lining possible: (1) the fact that the same soil which is removed from the canal as it is being smoothed and graded, can be used as a cover to hold the membrane in place, (2) the development of special asphaltic materials which have a long life, are tough, easy to handle in cold weather, and do not soften in hot weather and (3) simplicity of construction," according to a statement by the Bureau of Reclamation.

1234

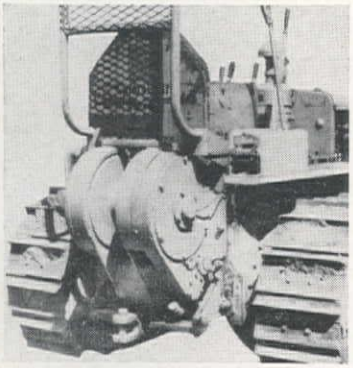
Plastic cement compound won't deform or swell during welding operations

"Form-A-Jig" is said to be a swift, simple, inexpensive substitute for a metal jig, ideal for assembling small lots where there is not time for elaborate jig construction. It will hold parts for welding, brazing and soldering and can be used to hold broken sections together for tool salvage and similar maintenance. Can be used for shielding or protecting from flame at any time, for working with heat-treated or enameled sections, or as a mold for low-melting metals such as Babbitt, solder, lead, aluminum, etc. Won't soil the metal or mar the surface. Easy to use with fingers or tools. **Eutectic Welding Alloys Corp.** is the manufacturer.

1235

High-speed winch designed for use on lightweight free-spooling tractor

This new winch can be mounted on either seat or fender tank type Caterpillar D4 tractors. The tool will lift, pull, do crane work, light pile driving, ground skidding logs, bundling pulp logs, skidding bundled pulpwood and can be used for "feeder cat" work in logging. An important new application possible with the HySpeed Winch is the method of forming and transporting bundles of pulpwood logs. It will form pulpwood logs into tight bundles and then the same D4 tractor can ground skid the bundle to the landing. Manufactured by Hyster Co.



1236

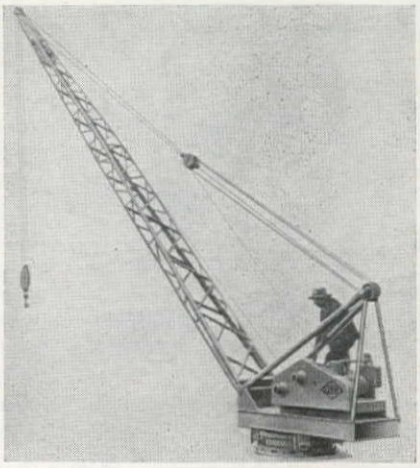
All steel, all aluminum hopper units lead to increased economies

These all steel and all aluminum hopper units now being manufactured by **Gar Wood Industries, Inc.**, range in size from 10 cu. yd. to 20 cu. yd. They are available either as full trailer or semi-trailer and full-trailer trains. Various designs as to material for hauling bulk cement, ore, aggregates, etc., are available. Because of the light weight of the unit it handles easily, and in operation permits carrying extra weights per load of crushed stone, screening, hot mix and cutbacks.

1237

Full-revolving steel derrick with gasoline or electric power

Having a short tail swing of but 5 ft., 6 in., and requiring no stifflegs or guy lines, this derrick occupies a minimum



of ground space which permits it to be set up and operate in congested areas. The rotating structure which supports the boom and boom supporting members also supports the hoisting machinery. This helps provide counterweight for additional stability when swinging loads. The complete rotating structure is centered on a cast steel turntable by means of a bronze bushed center pin and is supported by 4 double tapered, antifriction bearing rollers. Boom lengths of 20, 30 or 40 ft. are available with load capacities from 2,000 lb. at 40-ft. radius to 10,000 lb. at 10-ft. radius. **Clyde Iron Works, Inc.,** is the manufacturer.

1238

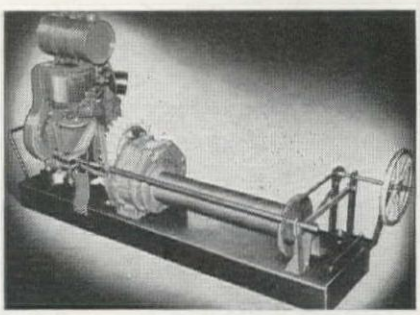
Foaming and dispersing agent for air-entrained concrete

Foamasol, made by the **Onyx Oil & Chemical Co.,** is a new dispersing agent for air-entrained concrete which insures greater resistance to freezing and thawing and gives for better dispersion of cement in mixes. Better workability is provided by this agent and segregation is reduced. The preparation is a ready-to-use concentrate in liquid form.

1239

Friction brake now governs hoisting tower power units

This centrifugal governing friction brake, designed for WACO portable elevator and material hoisting tower



power units, is a built-in brake which acts to govern platform descending speed and automatically checks the free-

fall speed of a 1,500-lb. load at 100 ft. per minute. The "slow-up" brake device has a braking surface of 33 sq. in., and is contained in an aluminum-magnesium housing with a high heat dispersion factor. Power units are interchangeable 6-hp. gasoline or 3-hp. electrical units. The new brake is made by **Wilson-Albrecht Co., Inc.**

1240

Why fight rust when you can smother it?

The difficult task of removing rust before painting need not bother those who use OSPHO, a carefully balanced formula of Orthophosphoric (H_3PO_4) and Dichromate ($Na_2Cr_2O_7$) with extenders and wetting agents. This preparation is being used successfully to prime rusted surfaces. Manufactured by **Rusticide Products Co.**, OSPHO is not a paint, but a metal primer. All that needs to be done in the preparation is the scraping of the rusted surface with a wire brush. OSPHO is then applied, allowed to dry and covered with paint. The application of OSPHO to rust causes rust to change from iron oxide to iron phosphate and therefore rust action is halted and moisture and oxygen can not penetrate the paint which attaches itself tightly to OSPHO.

1241

Air compressor designed for heavy construction uses

This new compressor is rated at 365 cu. ft. of air per minute at 100-psi. pressure. It utilizes a 165-hp. model HRBI-

600 Cummins diesel for its power plant. Engine operating speed of the diesel-compressor unit is 1,240 rpm. The **Jaeger Machine Co.'s** compressor and the Cummins diesel are mounted on structurally welded main frames. The heavy duty wagon has an "auto-steer" front axle, and can be hauled safely at 35 mph. over rough roads. Length of the complete rubber-tired unit is 12 ft., 3 in. It is 5 ft., 10½ in. wide and 6 ft., 9 in. high. The machine weighs 8,500 lb.

1242

Utility submersible pumps beat tough drainage jobs

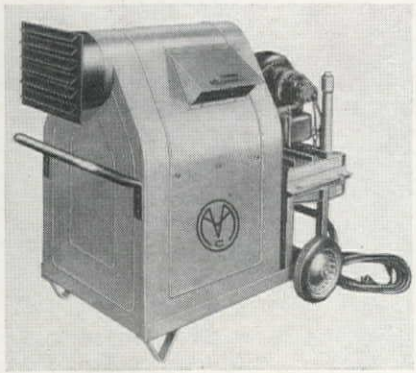
Unique design and extreme compactness give this pump a head start on beating tough drainage jobs. In actual on-the-job tests, costs were cut by the different design of the submersible pump. It requires only 110-volt power to operate and weighs only 50 lb. It has an exclusive switch construction and the motor is hermetically sealed and run in

oil. The pump is ⅓-hp. motor driven and can take rugged treatment. The size does not mean that these small pumps will burn out easily since the oil-filled housing construction dissipates the heat, eliminating burn-out possibilities. **Kenco, Incorporated** is the manufacturer.

1243

Super space heater has 200,000 Btu output per hour

These heaters provide instant heat as they require no warm-up period. The hot air output is about 10,000 to 12,000 cfm., and the air is directed downward toward the floor by special louvres. This space



heater burns kerosene or No. 1 or No. 2 oil at the rate of about 1½ gal. per hour. The burner unit is approved by the Underwriters Laboratories and the entire heater has been tested and approved for general use in a ventilated area. The Master Hot-R-Nell Space Heater is ideal for heating of equipment or working areas. Can also be used for spot heating and drying construction work. Mounted on rubber-tired wheels, the unit weighs only 265 lb. Manufactured by **Master Vibrator Co.**

1244

Spray gun application on snow plow wings and moldboards

Snow-Rem liquid snow plow wax is now available in a new spray grade for fast application. The spray grade possesses a high Carnauba wax content and new silicone resins which are reputed to produce a smoother, longer lasting water-resistant surface. This helps prevent piling up of snow and eliminates costly delays necessitated by "clearing" or breakdowns from overloading. Manufactured by **Speco, Inc.**

1245

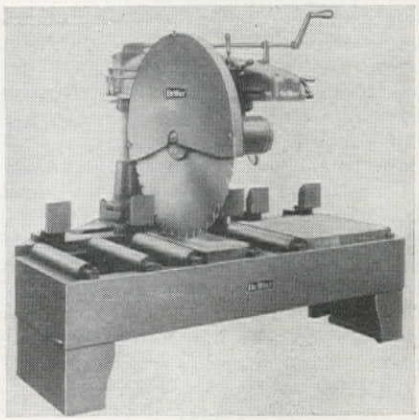
Graph paper for curve plotting in engineering analysis

Dylewski ARKTAN is a new arctangent coordinate graph paper for engineers involved in curve plotting and statistical analysis. Form 1235 has one arctangent scale and one linear scale. Form 1236 has double arctangent coordinates. Each form is available on 8½ x 11 tracing paper, $1.00 per package of 20 sheets. Use of arctangent coordinates permits the plotting of uninterrupted curves of data having values ranging from plus infinity to minus infinity and including zero as well. Most asymptotic functions become approximately linear in this coordinate system. Typical examples of applications are the plotting of reactance functions, radioactive decay curves, and heating and cooling curves. Extrapolation to zero and infinity and interpolation are easily accomplished. **Orbit Electric Co.** is the manufacturer.

1246

Timber cutter cuts 12 x 18 timbers in cross cut position

This timber cut, which can cut 12 x 18-in. timbers in the cross cut position and 12 x 12-in. timbers in the 45-deg.



miter position, is going on the market. The cutter is powered by a 10-hp. direct-drive motor, and manufactured by **DeWalt Inc.** Features include a rigged arm and column, operating levers located

within easy reach of the operator, and a segmental back guide that permits rapid change-over from cross cutting to mitering. A 36-in. diameter saw blade operating at 1,800 rpm. is the standard blade used on this timber cutter.

1247

New hoisting tower comes in double- or single-well unit

In approximately 2½ hours, three men can erect this hoisting tower. The unit features remote or pre-set platform control—similar to the Waco Portable Elevator—and the double-well tower is designed for simultaneous loading and unloading at top or bottom of alternate wells. Other features include a "slow-up" brake on the power mechanism to govern platform descending speed, and a safety slack brake which sets automatically in case of failure in the hoisting rig. Powered by interchangeable gasoline or electric power units with hoisting speeds of 100 to 110 ft. per min., respectively, each tower has a capacity of 1,000 lb. Hoisting mechanism, consisting of cage (or cages), base with motor mount and cathead pulleys, is available as a package unit, or the complete tower may be purchased. **Wilson-Albrecht Co., Inc.** is manufacturer.

1248

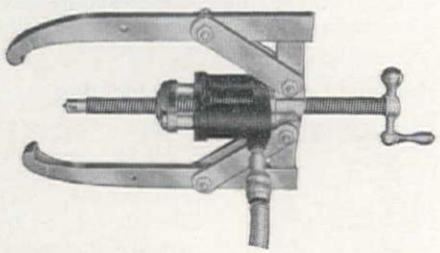
This leveler likes work with the building trades

Carpenters, masons, plumbers and other trades in the construction field were kept in mind when this new leveler was designed by **Hydrolevel.** It takes only one man to establish level lines with accuracy based on a hydrostatic principle rather than on delicate adjustments. The tool is made from aluminum and plastics and designed for long use. Liquid medium is easily visible since clear plastic is used. No delicate parts.

1249

Three popular sized pullers can be used hydraulically

Owatonna Tool Co. announces that three of the most popular sizes of the OTC Grip-O-Matic Pullers can now be used with the new OTC Power-Twin



Hydraulic Puller. Slight changes make this increased utility possible. Pullers No. 1003L, 1003½-L and 1003½ can be changed over to hydraulic power. The versatile Power-Twin Puller speeds up the work, eliminates torque and takes the hard work out of all pulling jobs. Remote control feature adds safety to the operations. Power-Twin Ram can easily and quickly be detached from the Grip-O-Matic Puller and used just as effectively on OTC Push-Pullers or on a bench or pedestal press.

NEWS of DISTRIBUTORS AND FACTORY BRANCHES

New Murphy Diesel distributor

North Jones, Western district representative for Murphy Diesel Engineering Co., announces the appointment of Industrial Engine Service, 5315 Valley Blvd., Los Angeles, Calif., as an exclusive sales, parts and service dealer on its equipment. Los Angeles, Orange, San Bernardino and Riverside counties will be served by the new dealer. Ed Anglemyer, George Rice and Lee Stewart are key men at Industrial Engine Service.

Westerners visit Schramm, Inc., factory

Larry Kean, sales manager, and Ray Milbrath, service manager of Schramm, Inc., San Francisco, Calif., have just returned from a trip to the factory.

Sioux Equipment distributor

Sioux Road Equipment, Inc., Sioux Falls, S. Dak., is now distributor for *Wooldridge* earthmoving equipment. In addition to the high-speed Terra Cobra self-propelled scraper, the firm now provides sales and service facilities for the Terra Cobra Wagon, Wooldridge tractor-drawn scrapers, rippers, bulldozers, trail-builders, and power control units. G. E. FISCHER is president of the S. Dak. firm, C. L. VADER is general manager, and H. D. POSEY is sales manager.

Hunter gets new post with Harnischfeger

Hunter

Paul H. Hunter will take charge of large excavator sales in the San Francisco, Calif., territory of Harnischfeger Corporation, Milwaukee, Wis. Hunter will headquarter in San Francisco, but will be active as sales engineer in the entire eleven Western States. He will work directly with the recently created Pacific Coast Division in Los Angeles, Calif. Hunter is a specialist in the operation and application of P & H large excavators, including both friction machines and electric shovels.

Coast Equipment Co.'s new home

Coast Equipment Co., San Francisco, Calif., moves to larger and more modern offices at 444 Eighth St.

Merrill-Brose headquarters

New facilities for the Merrill-Brose Co., Oakland, Calif. The firm is Northern Calif. distributor for International Harvester.

Sales rep. for The Tractor Sales Corp.

Donald Moore becomes the national sales representative for the Everett Trencher, McGee Scraper and Angle Dozer, distributed by The Tractor Sales Corp., Los Angeles, Calif. Moore was formerly assistant sales manager of The Skyline Corp., Wichita, Kan.

Portland Cement Assoc. chief dies

Sheets

Frank T. Sheets, president of the Portland Cement Association, died November 2 in Chicago, Ill. Sheets was well known in engineering circles and as a former president of the American Association of State Highway Officials and the former Director of Highways for the State of Illinois.

"Cat" distributor in southern N. Mex.

Alvin Hall Machinery Co. is now a Caterpillar Tractor Co. distributor in

southern New Mexico. The new firm will occupy facilities formerly used by Tri-State Equipment Co., El Paso, Tex. Alvin G. Hall is president of the new distributorship and C. E. Jones will be general manager.

Caterpillar district rep. in Northwest

Ralph E. Ehni becomes district representative for Caterpillar Tractor Co.'s Western sales division. He will work with dealers in Boise and Lewiston, Idaho; Pendleton and LaGrande, Ore., and Walla Walla, Wash. Ehni will headquarter in Walla Walla.

Ehni *Mordini*

Mordini in new Northwest sales position

Waldo Mordini joins the sales staff of Interstate Tractor and Equipment Co., Portland, Ore. Mordini comes to his new position from Caterpillar Tractor Co., where he was a service representative. Interstate is a Caterpillar distributor handling logging, roadbuilding and farm equipment from 8 locations in Oregon and southwest Washington. New addition to the board of directors of Interstate Tractor is Ralph P. Stratford, managing partner of the public accounting firm of Stratford, Visse & Co.

H. Tom Lynn of Gar Wood Industries dies

H. Tom Lynn, district sales manager for the Findlay Division of Gar Wood Industries, Inc., died October 4 in Berkeley, Calif. Lynn had been with the firm for over 25 years, during which time he held the positions of office manager of the San Francisco, Calif., branch and later sales manager.

Le Tourneau distributor

Bay Cities Equipment Co., Oakland, is the new Northern California distributor for Le Tourneau, Inc.

Plywood Corp.'s S. F. Manager

JACK KAEFER is appointed San Francisco, Calif., branch manager of *United States Plywood Corp.* He was formerly a salesman for the San Francisco branch.

NEWS of MANUFACTURERS

Lincoln Eng. Co. elects Meikle president

L. L. Meikle becomes president of Lincoln Engineering Co. of California. He will supervise the entire West Coast Division, comprising the states of California, Nevada, Oregon, Washington and western Idaho. Meikle joined Lincoln of California in 1939 and has been general manager since 1941.

Industrial Wire Products moves office

Industrial Wire Products Corp. of Los Angeles, Calif., and San Francisco, Calif., moves its head office to a new building at 5649 Alhambra Ave., Los Angeles. The new site contains over three acres. Executive offices are located in the firm's new two-story warehouse building which contains over 40,000 sq. ft. Earl R. Potter is the newly elected president and general manager.

New drill bit line manufactured

Mackintosh-Hemphill Co., manufacturer of rolls and machinery for the iron and steel industry, enters a new field through formation of the Drill Bit and Tool Division. A new line of forged steel disposable bits is being marketed throughout the heavy construction industry by contractor and mine supply houses. Drill Bit and Tool Co., a wholly-owned subsidiary, will be responsible for the marketing of the new line. The "DBT Throaway" bit is a one-pass bit, made to be thrown away when worn out.

Fair heads "Cat" board of directors

Fair

Harry H. Fair, San Francisco, Calif., becomes chairman of the board of directors of Caterpillar Tractor Co. He succeeds the late C. L. Best. Fair's association with Caterpillar dates back to the formation of the company. He was a stockholder and director of the Best Tractor Co. in 1918, one of the constituents of Caterpillar. A. W. Brawner was elected to the board at the same meeting.

Hinmon asst. mgr. J-M pipe dept.

Don L. Hinmon is now assistant manager of the *Johns-Manville* Transite Pipe Department. In 1945 Hinmon was appointed Transite Pipe staff manager for the Los Angeles, Calif., Industrial Products Division. He leaves the post of manager of the aviation industry section of the Special Industries Department to assume his new duties.

Barnes Mfg., Shasta Pump merge

The merger of *Barnes Manufacturing Co.* of Mansfield, Ohio, manufacturer of pumps and water systems, with *Shasta Pump Co.* of Oakland, Calif., has been announced. *Barnes-Shasta Pump Co.* will be the name of the new wholly-owned subsidiary. J. E. Piccardo, former president of Shasta Pump Co., becomes operating vice president of the newly formed Barnes-Shasta Pump Co. The man who will coordinate the sales activities of the new firm will be William Stillwell. He has been West Coast manager for Barnes Manufacturing Co. Stillwell will carry full responsibility for all sales of the newly formed firm in the Western States.

Bond is Nordberg divisions sales manager

Jack B. Bond, district manager, Crusher and Process Machinery Divisions of Nordberg Manufacturing Co. since 1949, is now sales manager for these divisions. Harold N. Propp will replace Bond as district manager. Nordberg also announces that Howard M. Zoerb, formerly chief engineer of the Crusher Division, will now serve as administrative manager. E. F. Zillman becomes coordinator of Crusher Process and Machinery Sales.

Bond

Coffing

Coffing sales vice president

J. R. Coffing is the new vice president in charge of sales, advertising and general office administration for Coffing Hoist Co. Coffing moves up from the position of general sales manager.

Minneapolis-Honeywell in Denver

Assuming the duties of industrial manager of the Denver, Colo., office for *Minneapolis-Honeywell Regulator Co.*, Brown Instruments Division, is W. J. Blackburn. He succeeds Donald W. Larcen, who was recalled to active military duty.

Owen is Hyster's Western mgr.

New Western Division service manager for *Hyster Company* is Allen G. Owen. Owen has been with Hyster since 1937 in assembly and in the service department. In his new post, Owen will cover all of the U. S. and Canada west of the Rockies, as well as Alaska.

Symons Clamp plant nears completion

Completion of the *Symons Clamp & Mfg. Co.'s* new 30,000 sq. ft. addition is near at hand. The new building, adjoining the present factory at 4259 W. Diversey Ave., Chicago, is of modern design with a 240 x 116-ft. interior. There is a continuous concrete floor and a steel frame roof supporting a U. S. Gypsum slab.

Space is sold as advertisers' inches. All advertisements in this section are ⅛ in. short of contracted space to allow for borders and composition.

CLASSIFIED SECTION

Rates are $6.50 a column inch. Copy should be sent in by the 10th of preceding month if proofs are required; by the 15th if no proofs are required.

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By C. W. Lindgren, 2nd Printing

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239' WF 36" Rolled Girder Highway Bridge with 26' clear roadway and 3' 2" sidewalk. Consisting of ten (10)—90' 5/8" x 12" x 36", 150# WF Rolled Girders, five (5) 60' 5/8" x 12" x 36", 150# WF Rolled Girders, complete with 12" and 18" WF floorbeams, pilecaps, stiffeners, stringers, etc. 90' Girders now in use in temporary bridges over the L. A. River at Woodman Ave. and Van Nuys Blvd., available for delivery January 1952. This Bridge originally built in 1940 by the City of Los Angeles at Moorpark St. and The Los Angeles River. All materials may be inspected at 4851 Van Nuys Blvd., Sherman Oaks, California. Original plans available. Design load—H20.

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3—DW20 Caterpillar Tractors with No. 20 Scrapers complete. Less than 500 hours. New in August. 21-C Series. Can be seen at Brawley, California, or mail bids to KUHN & LANE, Brawley, California.

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The Euclid loader and the bottom dump Euclids are in excellent condition.

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The end dump Euclids have been reconditioned and will give a lot of good service to the purchaser.

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