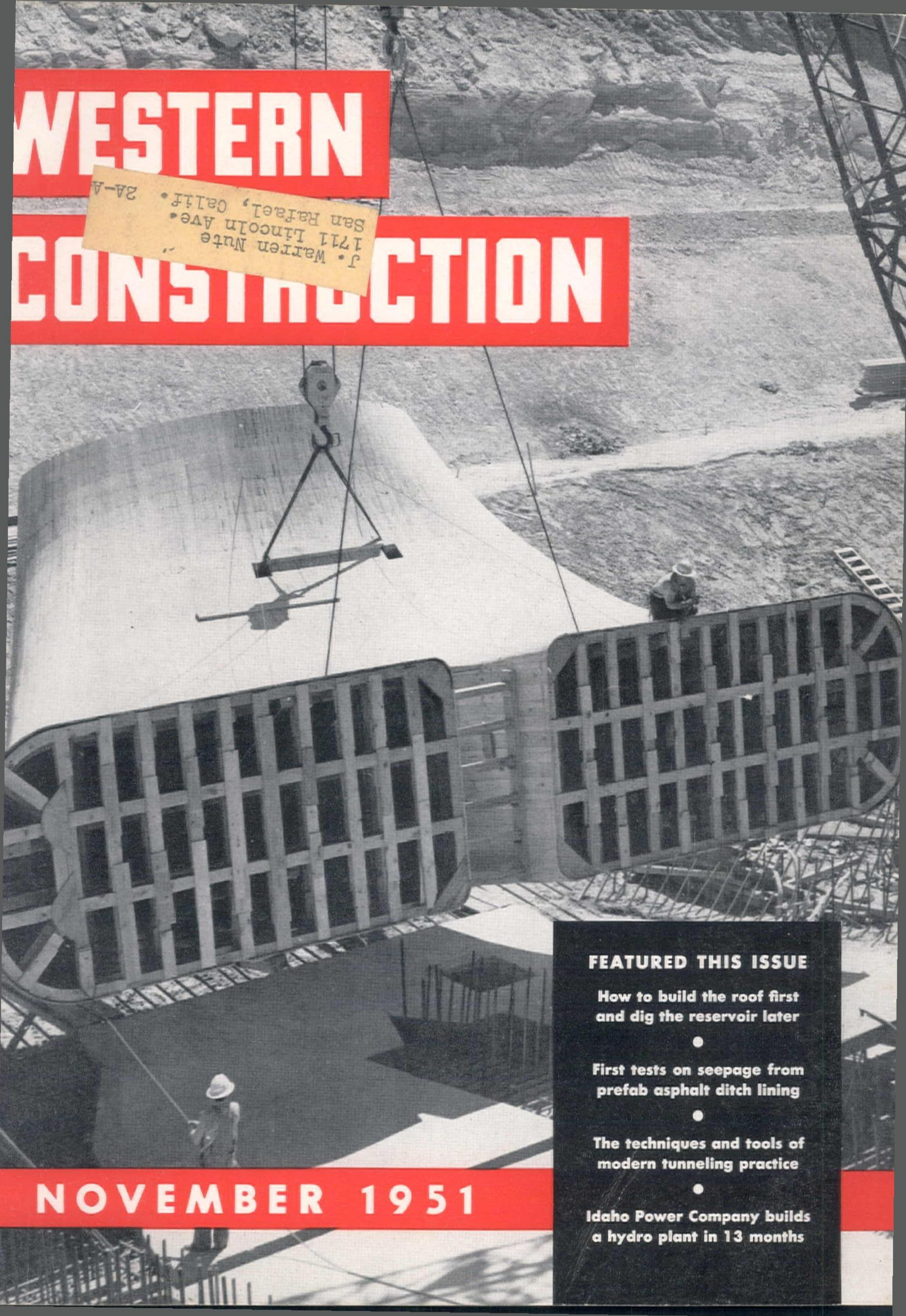
WESTERN CONSTRUCTION



FEATURED THIS ISSUE

How to build the roof first and dig the reservoir later

First tests on seepage from prefab asphalt ditch lining

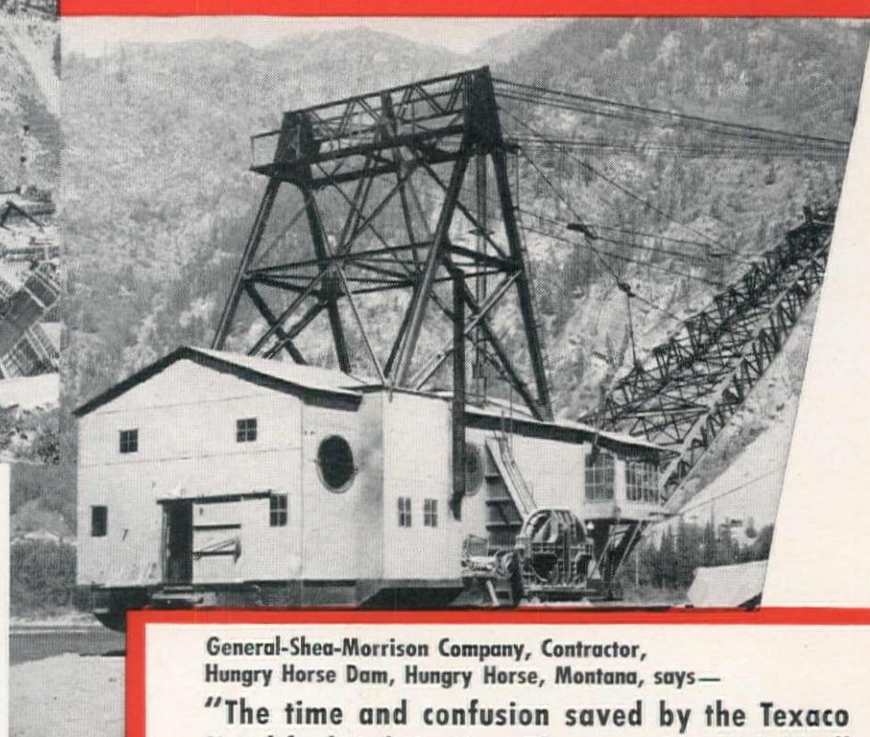
The techniques and tools of modern tunneling practice

Idaho Power Company builds a hydro plant in 13 months

NOVEMBER 1951

"AT HUNGRY HORSE ONLY 6 TEXACO PRODUCTS HANDLED ALL OUR MAJOR LUBRICATION"

BUILDING HUNGRY HORSE DAM, HUNGRY HORSE, MONTANA: Equipment used included 24 Diesel-powered Euclids, each of which has logged a quarter-million miles on this assignment; 9 Caterpillar tractors; 5 Northwest shovels; 27 International Harvester trucks; 8 Reo 55-passenger buses—plus numerous Chicago Pneumatic and Gardner-Denver air compressors and Chicago Pneumatic rock drills, as well as 2 Lidgerwood Cableways and 2 Washington Cableways.



General-Shea-Morrison Company, Contractor, Hungry Horse Dam, Hungry Horse, Montana, says—

"The time and confusion saved by the Texaco Simplified Lubrication Plan are incalculable."

"Not only is it more economical to use a small number of lubricants," says General-Shea-Morrison Company, "but there is little chance of error in application. The Texaco Lubricants used at Hungry Horse Dam were a big factor in keeping our equipment on the job and keeping our maintenance costs low."

Products Used in Texaco Simplified Lubrication Plan

1. ENGINE LUBRICATION: Use *Texaco Ursa Oil X★★*. Fully detergent-dispersive, keeps heavy-duty gasoline and Diesel engines clean, keeps harmful deposits from forming, guards against wear, rust, corrosion. Reduces maintenance costs and fuel consumption. **2. CHASSIS LUBRICATION:** Use *Texaco Marfak*. It's tough, longer lasting. Won't jar or squeeze out, protects against dirt, rust, wear. *More than 400 million pounds sold.* **3. WHEEL BEARING LUBRICATION:** Use *Texaco Marfak Heavy Duty*. Seals out dirt and moisture, seals itself in, assuring longer bearing life, safer braking. No seasonal change required. **4. CRAWLER TRACK LUBRICATION:** Use *Texaco Track Roll Lubricant*. Gives long-lasting protection against dirt, water, wear. Reduces maintenance costs. **5. AIR COMPRESSOR LUBRICATION:** Use recommended Texaco air compressor oils. There is one exactly suited to your operating conditions. **6. ROCK DRILL LUBRICATION:** Use *Texaco Rock Drill Lubricant EP*. "Extreme pressure" properties give superior protection against wear. Guard against rust whether drills are running or idle.

Follow the Texaco Simplified Lubrication Plan for greater savings and convenience. A Texaco Lubrication Engineer will gladly help you. Just call the nearest of the more than 2,000 Texaco Distributing Plants in the 48 States, or write The Texas Company, 135 East 42nd Street, New York 17, N. Y.

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FOR ALL CONTRACTORS' EQUIPMENT

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WESTERN CONSTRUCTION

Volume 26 NOVEMBER 1951 Number 11

ARTICLES

DEPARTMENTS

FRONT COVER

THROAT SECTION FORM for powerhouse draft tube was swung into place last May by a Northwest 95 crane as Morrison-Knudsen Co., Inc., speeded construction of Idaho Power Company's C. J. Strike hydroelectric development in southern Idaho. For complete review of the project, see page 61.

Photo by Gailen Soule, Idaho Power Co.

The Construction and Civil Engineering Publication of the West

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Published Monthly by
KING PUBLICATIONS
609 Mission Street
San Francisco 5, Calif.
Telephone YUkon 2-4343

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The annual subscription rate is $4 in the United States and countries in the Pan American Postal Union. To Canada, England, Australia and New Zealand, $5 per year; all other countries, $11 per year. Single Copies, 35c

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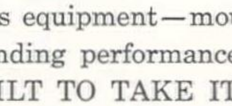
. . . Each combination designed, manufactured and serviced as a UNIT

Four great names in the industry — BAKER, CARCO, GAR WOOD, TRACTOMO-TIVE — now bring you the finest selection and the most up-to-date equipment ever built for crawler tractors. Developed in full cooperation with Allis-Chalmers, this new line is matched to the new A-C tractors . . . makes it possible for you to handle a wider variety of jobs faster, easier and at lower cost.

The design of this equipment — mounted and drawn — takes full advantage of the balance and outstanding performance capacity of the tractors. Each unit, like the new tractors, is BUILT TO TAKE IT, EASY TO OPERATE, EASY TO SERVICE, and *most important,* DESIGNED FOR TODAY'S JOBS.

Years Ahead



Each of the new Allis-Chalmers crawlers provides a new yardstick for rating tractors. Each sets new standards for performance, strength, servicing, operation.

HD-5	40.26 drawbar hp. 11,250 lb.
HD-9	72 drawbar hp. 18,800 lb.
HD-15	109 drawbar hp. 27,850 lb.
HD-20	175 net engine hp. 41,000 lb.

Hydraulic Torque Converter Drive

see your ALLIS-CHALMERS dealer

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186 or 122 h.p.
speeds to 19 m.p.h.

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28 to 35 m.p.h.

TOURNAROCKERS**
rear-dump haulers
9, 18, 35, 50 tons.

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bottom-dump haulers
18, 27, 39½-yds.

Bay Cities Equipment, Inc. represents LeTourneau in California from Monterey and Fresno Counties north. Their territory includes 38 of the state's 58 counties.

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7 and 15-ton
lift capacities

CRAWLER-DOZERS
Bulldozers for D8, HD19
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CARRYALL* SCRAPERS
capacities from 4
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for all types of tractors
with cable PCU's

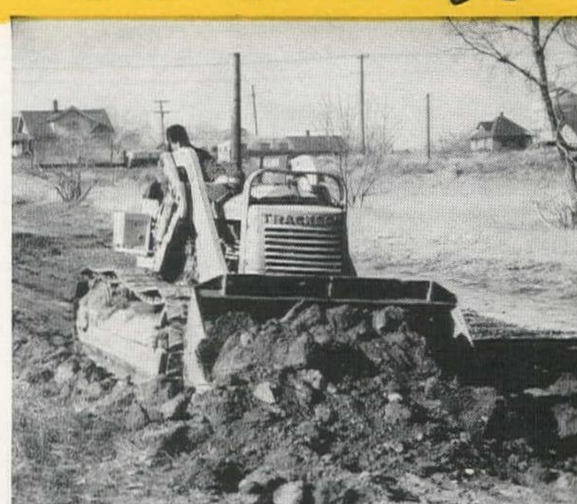
DIGS AND LOADS

135 CUBIC YARDS PER HOUR!

■ Every 26 seconds, this **T4 TRAXCAVATOR** digs into rocky, in place gravel . . . comes up with a heaped bucketful . . . pivots . . . dumps, cleanly and accurately, into trucks . . . spins and tracks back to the bank for another load. In 60 minutes this versatile worker has dug and loaded 135 cubic yards!

In any material—clay, shale, shot rock, loam, caliche, tough soil—**TRAXCAVATORS** turn in big production at low cost. Their workability is not tied down to one job—they can dig, load, grade, backfill, excavate, remove snow—with the same high-speed.

Put **TRAXCAVATOR** speed—power—economy, to work on your jobs for greater profits. Your TRACKSON-"Caterpillar" Dealer will give you full information on the features of the tractor-shovel teammate of "Cat" Diesel Tractors, will show you the model that fits your needs. Capacities range from ½ to 4 cu. yds. Or write **TRACKSON COMPANY, Dept. WN-111, Milwaukee 1, Wis.**



Above—Hydraulic **HT4 TRAXCAVATOR** *grading a street in Minneapolis, Minnesota.*

TRACKSON
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Send for your easy-to-use Velvetouch Catalogs today

Here's your answer to the job of ordering replacement clutch plates, facings and brake linings. These catalogs give you, in handy ready-reference form, all the information you need to quickly select and specify the Velvetouch parts you want.

They're individualized catalogs . . . one for Caterpillar equipment, one for LeTourneau, one for Allis-Chalmers, and one for International . . . so that you don't have to plow through dozens of unrelated listings to find the items you require.

Just fill-in and mail the coupon, and we'll send your copies at once . . . together with a brief, interesting story explaining why Velvetouch all-metal clutch plates, facings and brake linings are "standard equipment with the leaders!"

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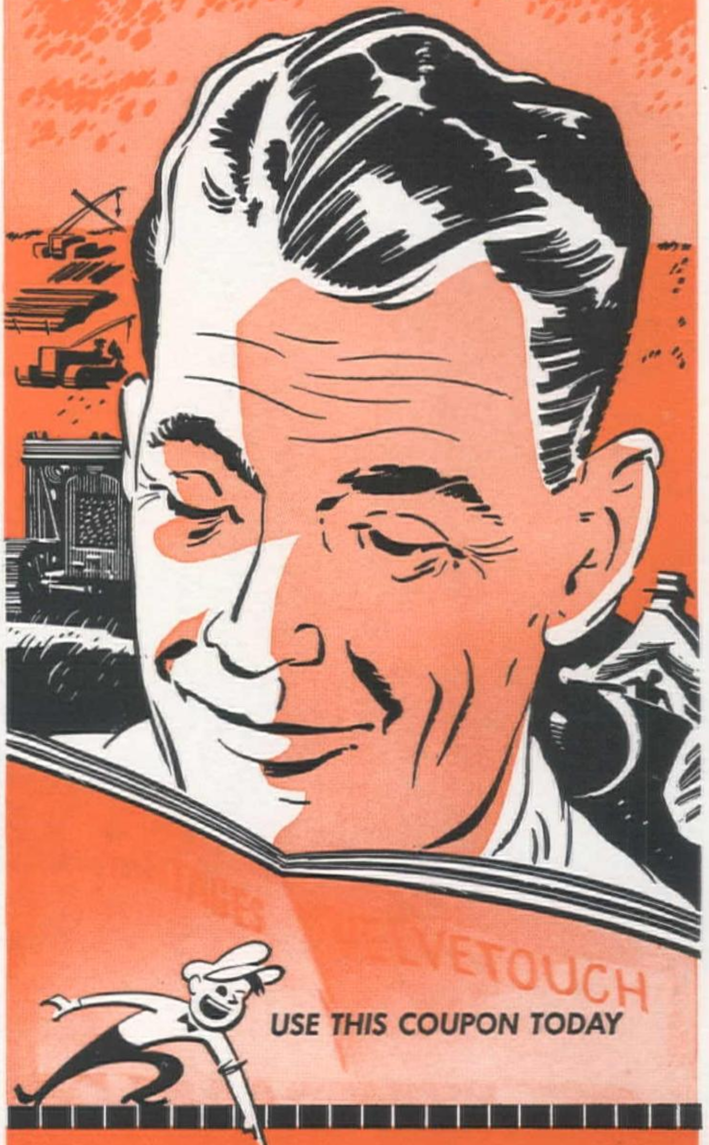

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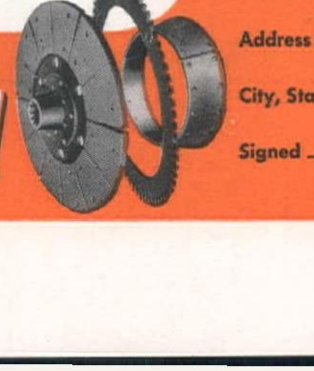

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From Boulders

ONE OF SIX INTERNATIONAL TD-24s WORKING ON U.S. 99

to Boulevard

A. Teichert & Sons tackle huge highway job on U. S. 99 in California mountains

Fifty miles north of Los Angeles, A. Teichert & Sons are changing the face of California to modernize the main road to San Francisco.

They're digging into the rough, rocky hills with six Big Red TD-24s . . . charging in with International power to move over a million yards of boulder-filled earth—doze out cuts down to 350 feet deep—reroute a creek channel to eliminate present bridges—turn today's three-lane U. S. Highway 99 into a four-lane traffic-separated super-highway.

Teichert chooses TD-24s for the job because they're the Champs for this grueling, heavy-duty work. Here's why:

TD-24 Power—148 maximum horsepower at the drawbar, more than any other crawler on the market. Moves more dirt per hour.

TD-24 Speed—8 forward speeds, 8 reverse. Moves loads faster, gets out and gets in again 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.

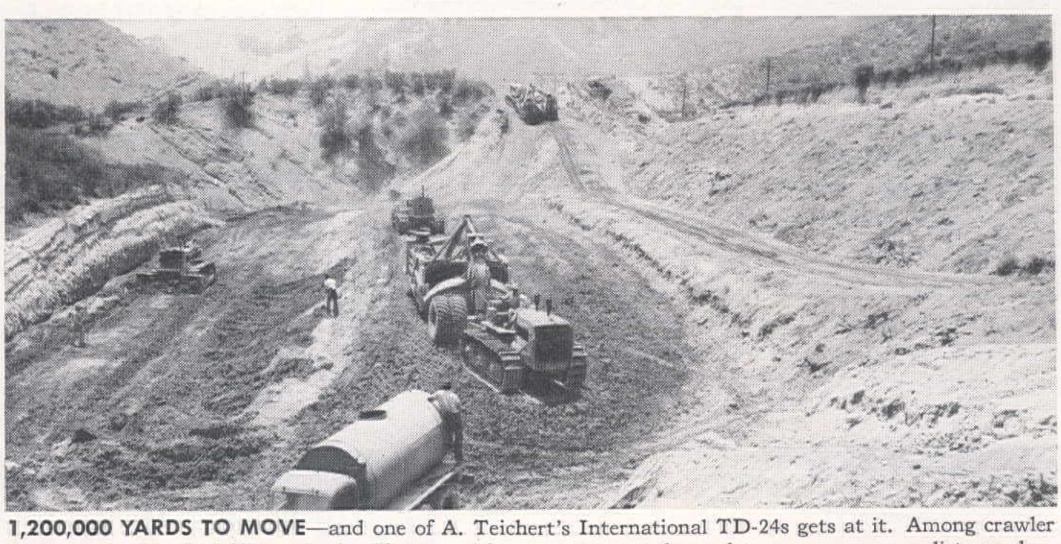
TD-24 Steering—Fingertip steering for pivot turns, feathered turns, turns with power on both tracks.

TD-24 Starting—Push-button starting in any weather.

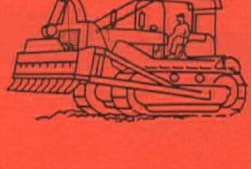
Ask your International Industrial Distributor for details on the TD-24. Consider his on-the-job service and complete shop facilities, at your call through the years ahead. Get the whole low-down! You'll be a TD-24 man from then on in!

International Harvester Company, Chicago 1, Ill.

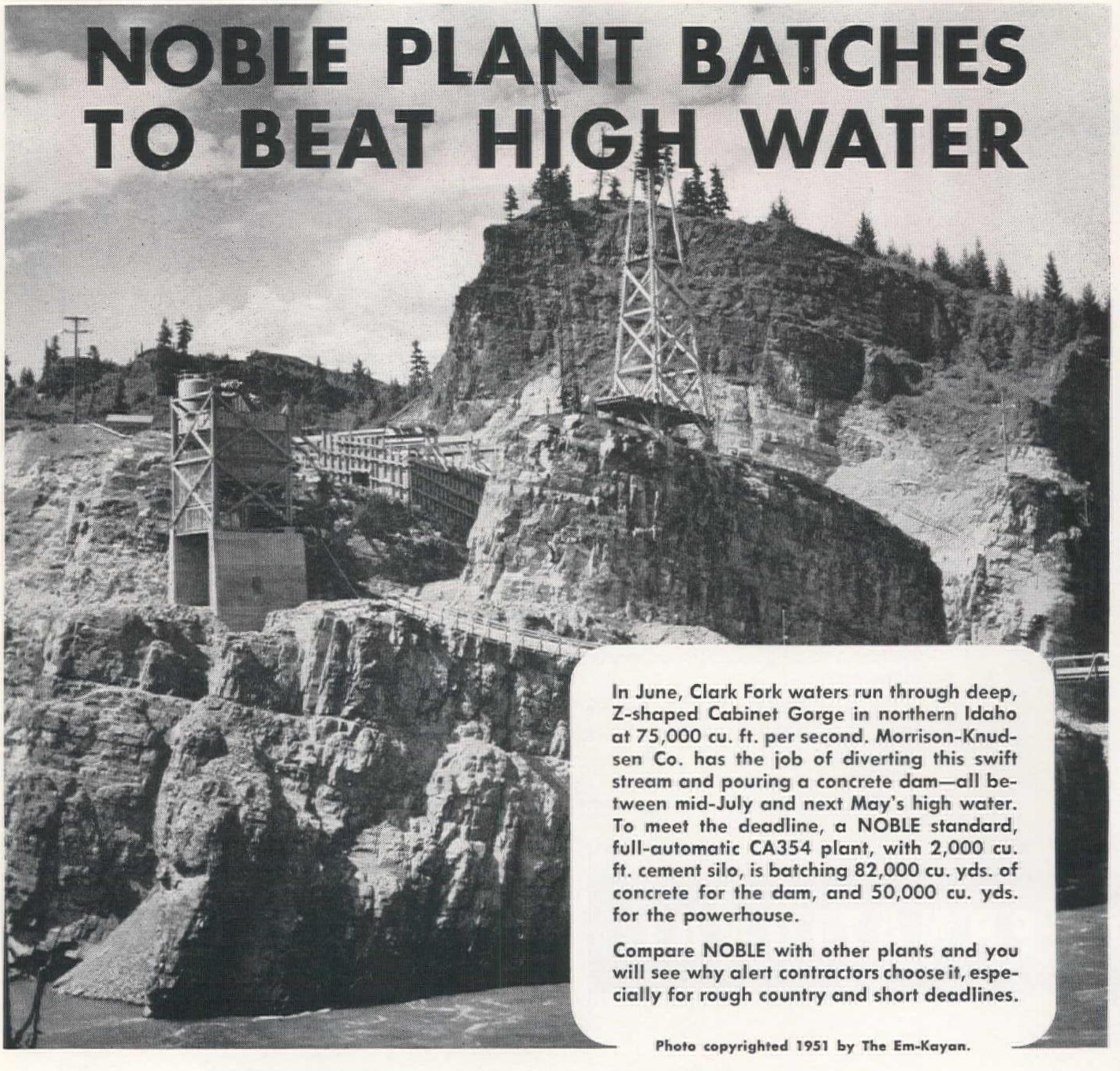
INTERNATIONAL — INTERNATIONAL HARVESTER — POWER THAT PAYS



1,200,000 YARDS TO MOVE—and one of A. Teichert's International TD-24s gets at it. Among crawler tractors, the Big Red TD-24 is the Champ, with more power and speed to move more paydirt per day.



NOBLE PLANT BATCHES TO BEAT HIGH WATER



In June, Clark Fork waters run through deep, Z-shaped Cabinet Gorge in northern Idaho at 75,000 cu. ft. per second. Morrison-Knudsen Co. has the job of diverting this swift stream and pouring a concrete dam—all between mid-July and next May's high water. To meet the deadline, a NOBLE standard, full-automatic CA354 plant, with 2,000 cu. ft. cement silo, is batching 82,000 cu. yds. of concrete for the dam, and 50,000 cu. yds. for the powerhouse.

Compare NOBLE with other plants and you will see why alert contractors choose it, especially for rough country and short deadlines.

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CHECK THESE 4 POINTS

Accurate Weigh—NOBLE's exclusive photo-relay control of cement weighing is unaffected by heat or humidity; no leaking to run up costs; no underweighing to get you in trouble with inspectors.

Ease and Cost of Erection—Shop fitting, plus all-welded center section (pioneered by NOBLE) with automatic batching controls and motor switches in place, insure quick, low-cost erection.

Savings in Cement and Time—Central cement compartment premixes cement with aggregate, reduces mixing time, eliminates dust and cement loss.

Quick Service—NOBLE parts and service are within a few hours of any Western job or plant, ready to help you with erection, batching and repair problems.

SIZES TO FIT ALL NEEDS

We can design a plant to fit your exact needs — usually from standard units at stock model prices. Wire, write or phone NOW. No obligation.

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CEMENT AND AGGREGATE BATCHING PLANTS . . . BULK CEMENT PLANTS . . . AGGREGATE BINS AND CEMENT SILOS . . . STEEL FORMS FOR CONCRETE CONSTRUCTION JOBS . . TUNNEL AND DRILL JUMBOS CONVEYORS AND ELEVATORS . . WEIGH METERING DEVICES

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Look at the record! Of the thousands built, 9 out of 11 Euclids are still in use today. That's proof that "Eucs" have the rugged strength and staying power to give profitable performance year after year under a wide range of operating conditions.

You can profit by the experience of Euclid owners. Over 60% of all "Eucs" sold are repeat orders! Leading contractors and industrial users buy Euclids because they are designed and built for heavy off-the-highway hauling. They're job proved for high production at the lowest cost per ton or yard moved.

Rear-Dump Euclids of 10 to 34-ton capacities have loaded top speeds up to 35.7 m.p.h., with diesel engines of 125 to 400 h.p. Bottom-Dump "Eucs" range in capacity from 13 to 25 cu. yds., have diesel engines of 190 to 300 h.p. . . . top loaded speeds up to 34.4 m.p.h.

Write for information on the complete line of Euclid earth moving equipment or call your Euclid Distributor today.

The EUCLID ROAD MACHINERY Co.
Cleveland 17, Ohio

CABLE ADDRESS: YUKLID — CODE: BENTLEY

EUCLIDS *Move the Earth*

EUCLID THE PIONEER

700,000 yds. for Montana

. . . being moved by C TOURNADOZERS and 3 electric-control C TOURNAPULLS

J. Neils LUMBER CO., Libby, Montana, keeps a fleet of LeTourneau rubber-tired dirtmovers busy building truck roads and railroad grades on their extensive logging properties. On their latest project — a 20 to 34-ft. wide road and parallel railroad spur line near Rexford — Neils is using 3 electric-control C Tournapulls, a C Tournadozer, an FP Carryall, and a tractor-dozer to move an estimated 800,000 cu. yds. of hardpan clay, rock, sand and gravel. The road will be used by the company to remove 100 million ft. of timber under government contract . . . then will revert to the United States Forest Service, which is engineering and supervising its construction.

741 pay yds. hourly on 600′ cycle

Checked recently on a typical short, 300-ft., one-way haul, each of the high-speed Tournapulls was making 26 trips per hour. Loads in alluvial sand and gravel with Tournadozer as pusher, averaged 9½ pay yards each . . . load time varied from 35 to 50 seconds

***New*...** C Tournapulls now have 18-ton Carryall increasing capacity to 15 yards. Prime movers with Tournamatic constant-mesh transmission and torque converters are also now available, as well as the "Roadsters" with their heavy-duty, sliding-gear transmission. Performance figures reported here were made with earlier 13.5-yard Roadster units.

Arizona — Phoenix
RIZONA EQUIPMENT SALES, INC.

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CROOK COMPANY

Idaho — Pocatello
J. K. WHEELER MACHINERY CO.

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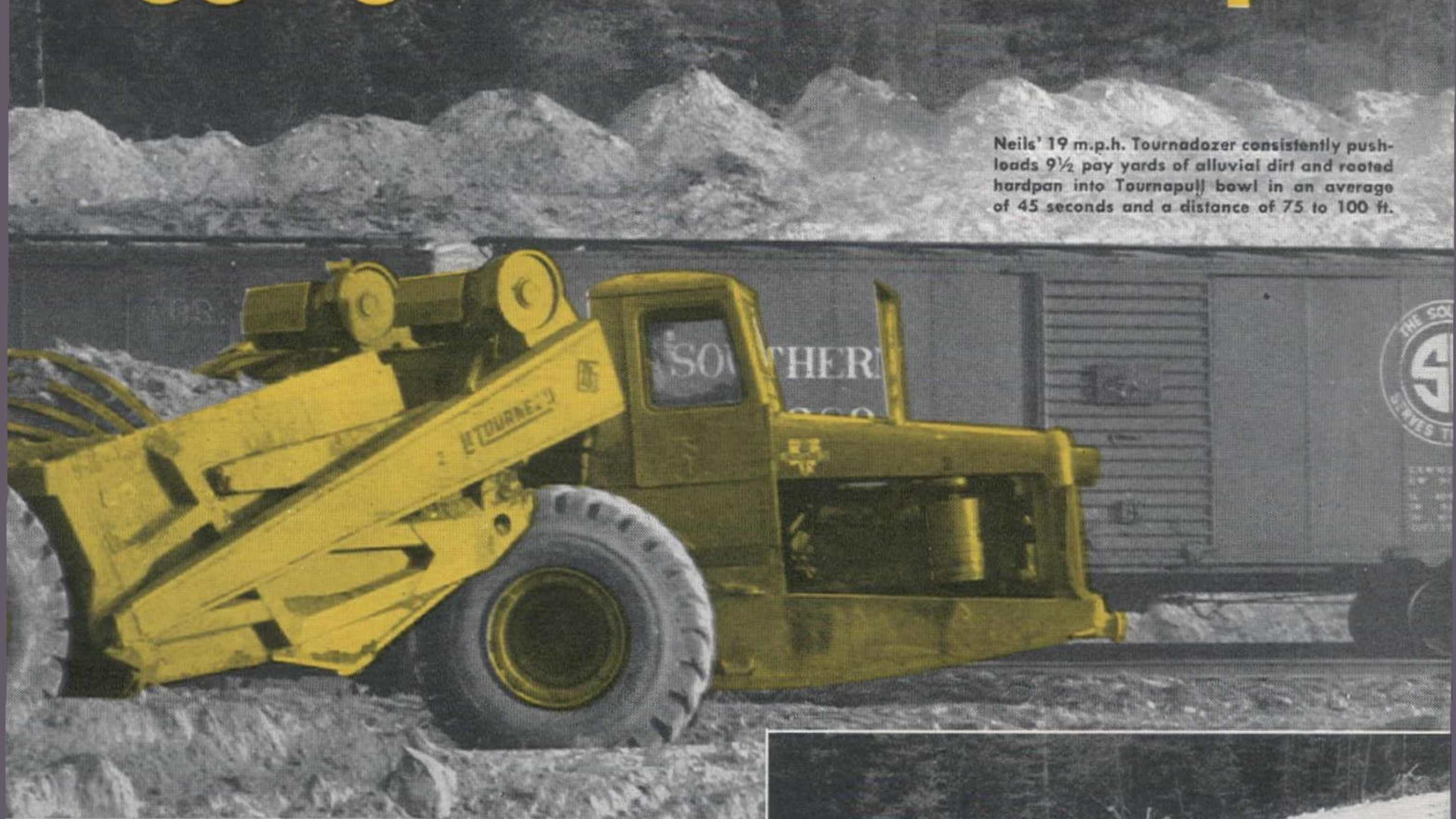
logging road and rail spur



Neils' 19 m.p.h. Tournadozer consistently push-loads 9½ pay yards of alluvial dirt and rooted hardpan into Tournapull bowl in an average of 45 seconds and a distance of 75 to 100 ft.

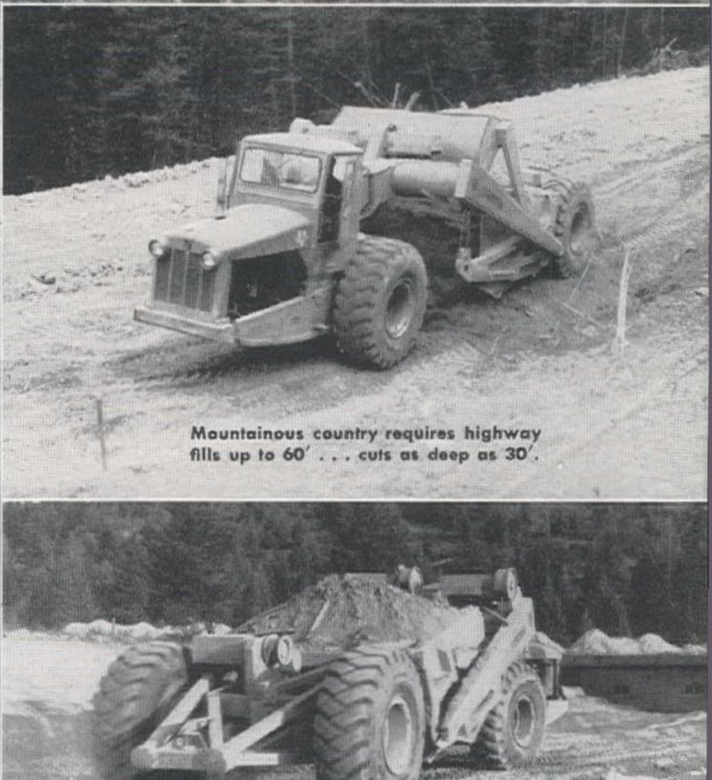
... spread time from 10 to 15 seconds. Unit production: approximately 247 pay yards hourly.

369 pay yds. hourly on 2000′ cycle

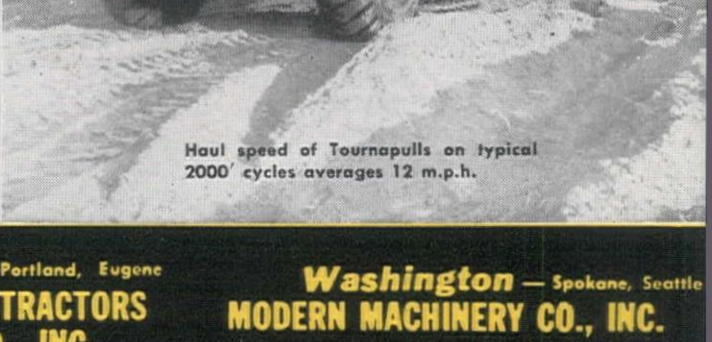
Performance of Tournapulls has been equally good on longer hauls. Over 1000 ft. of rough road, each "C" regularly completes 13 trips per hour. Loads in hard-packed gravel, again obtained with Tournadozer as pusher, also average 9½ pay yards. Cycle time of 4.4 minutes includes ¾ minute to load and 25 to 30 seconds to spread in thin, accurately-controlled layers over 100 to 125-ft. distances. Output on the 2000-ft. cycle: 123 yards per unit per hour.

Get all the facts

See for yourself what modern Tournapulls and Tournadozers can do in all kinds of materials... and weather... over any length haul. Ask your LeTourneau Distributor for a demonstration of the dirtmoving abilities of these machines, or ask him for job-proved facts and figures on work like yours.



Mountainous country requires highway fills up to 60′ . . . cuts as deep as 30′.



Haul speed of Tournapulls on typical 2000′ cycles averages 12 m.p.h.

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SIERRA MACHINERY COMPANY

New Mexico — Albuquerque
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Utah — Salt Lake City
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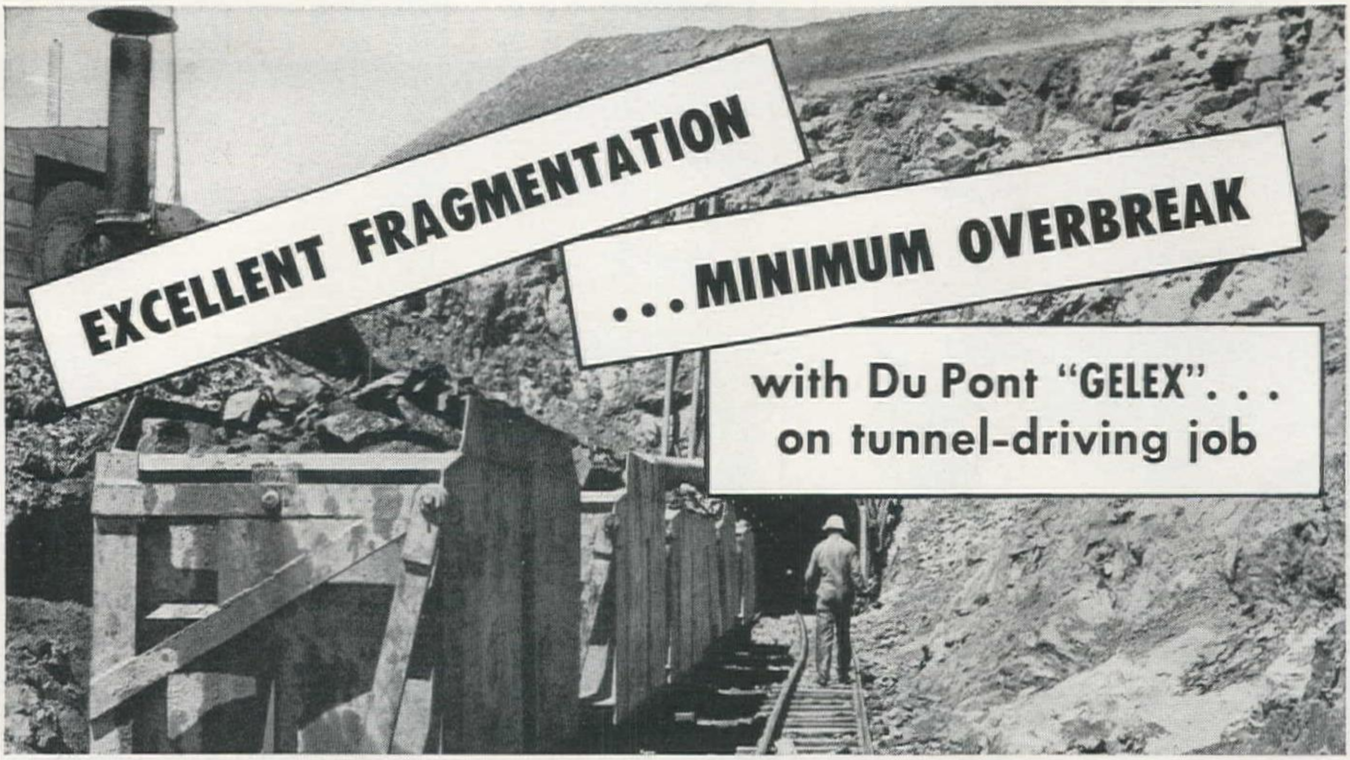
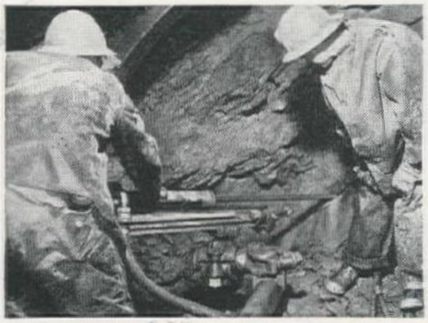
Washington — Spokane, Seattle
MODERN MACHINERY CO., INC.

Wyoming — Casper
COLORADO BUILDERS' SUPPLY CO.



1. EAST PORTAL, BALD MT. TUNNEL—a part of the Colorado Big Thompson Water Diversion and Irrigation Project, Loveland, Colo.—on which the contractor, Winston Bros., of Minneapolis, is using Du Pont "Gelex" and Du Pont "Series B" Delay Electric Blasting Caps exclusively.



2. DRILLING—38-hole, 7-foot round used in driving 12′ x 12′ horseshoe-shaped tunnel 6,750 feet through mountain.

3. LOADING "GELEX" IN FACE—cohesive and water-resistant, "Gelex" is ideal dynamite for this type of work.

4. CONNECTING UP THE ROUND with Du Pont "Series B" Delay Electric Blasting Caps. Contractor speaks highly of their dependability and performance.

5. READY FOR MUCKING after shot. Excellent fragmentation and little overbreak of schist keep job moving along on fast schedule.

The cohesiveness, water-resistance, efficiency and good fumes of "Gelex" have earned wide recognition with tunnel men everywhere. Ask any Du Pont Explosives representative for further information about Du Pont "Gelex" and "Series B" Delay Electric Blasting Caps. E. I. du Pont de Nemours & Co. (Inc.), Explosives Department, Wilmington 98, Delaware.

DU PONT EXPLOSIVES

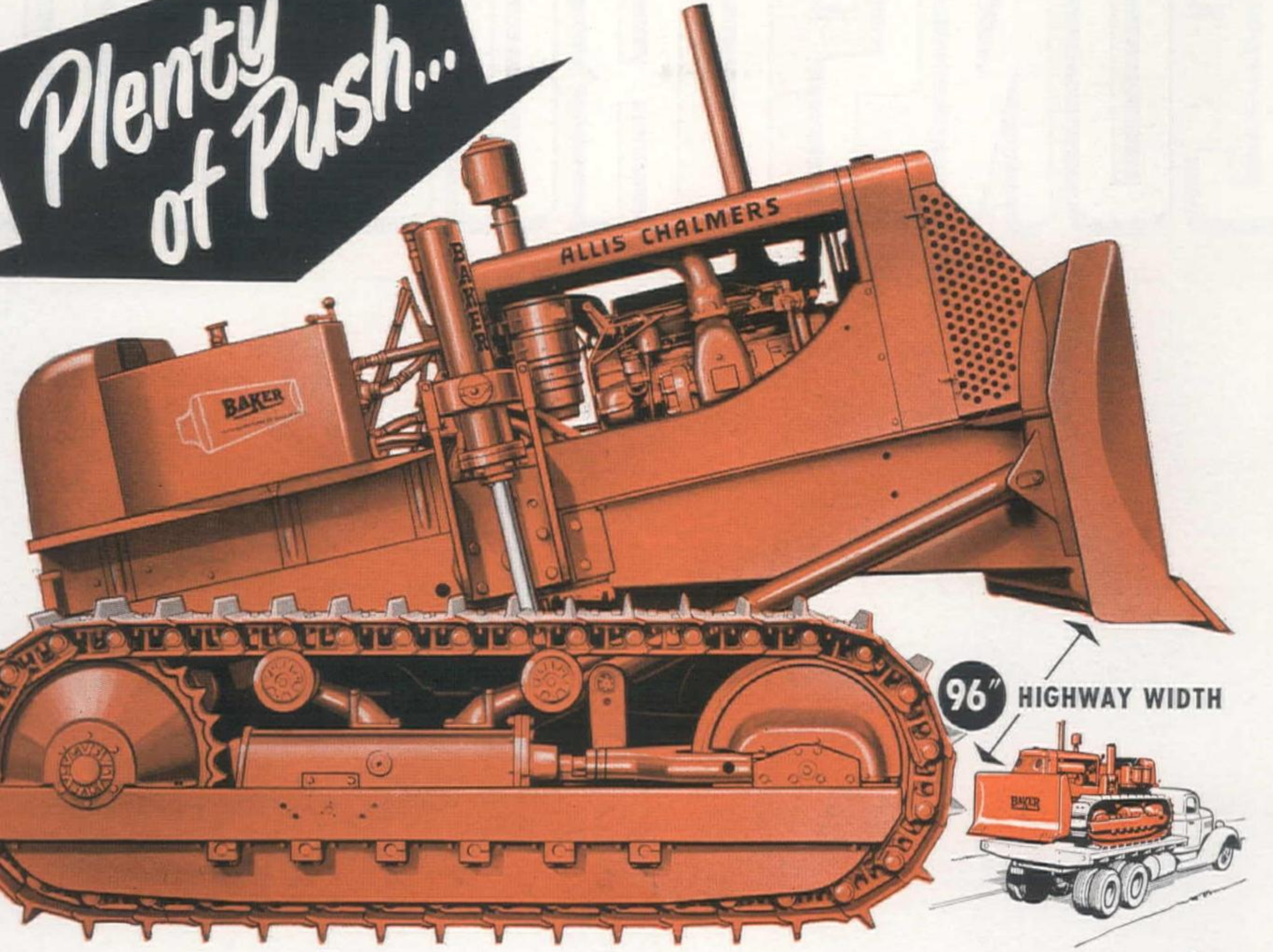
Blasting Supplies and Accessories

DU PONT

REG. U. S. PAT. OFF.

BETTER THINGS FOR BETTER LIVING . . . *THROUGH CHEMISTRY*

Plenty of Push...



...but NO Push Beams!

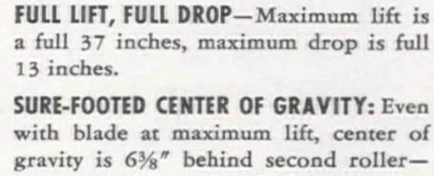
Push beams are eliminated *entirely* in the revolutionary new *highway wide* Baker 9-X 'Dozer. Bulldozer and engine frame form an integral unit. Blade responds instantly through double-acting cylinders, which raise and lower tractor-dozer unit. And tying it all together, making it work, is an entirely new design in *stabilizer bars* and *horizontal bearings.*

Here are some of the advantages for many jobs:

HIGHWAY WIDE: Width only eight feet—96 inches—exactly the same as standard highway trailers. Haul the Baker 9-X anywhere, anytime, *day or night,* with NO SPECIAL PERMIT.

PLENTY OF PUSH: Mounted right on an Allis-Chalmers HD-9, the moldboard is 6 inches higher than standard blades to provide almost same blade area, for plenty of push, plenty of capacity—with the famous Baker "move-more-dirt" moldboard curve.

IN FAST, OUT FAST: Steeper angle of approach on the blade because of close coupling. You can get in fast, out fast,



with the Baker 9-X Dozer. Makes it the ideal unit for jobs like slush pits; *makes it the most practical dozer* of all for small-home basements.

FULL LIFT, FULL DROP—Maximum lift is a full 37 inches, maximum drop is full 13 inches.

SURE-FOOTED CENTER OF GRAVITY: Even with blade at maximum lift, center of gravity is 6⅜" behind second roller—not more than a few inches ahead of center of gravity in unmounted tractor. YOU CAN LEAVE BLADE ON FOR DRAW BAR WORK.

LIGHTER: Takes 1,150 lbs. less steel to build . . . costs less to buy. See the new, revolutionary *highway wide* Baker 9-X Bulldozer—another triumph of Baker, Allis-Chalmers engineering cooperation, at your Baker, A-C dealer.

UNLIMITED

DEMANDS LOW-COST AGGREGATE

OVER $56½ billion backlog is practically unlimited construction! Think of the aggregate needed . . . of the equipment you'll need to produce your share, and keep costs low!

Whether your job calls for 60 tons an hour . . . *or 600* . . . there's a Cedarapids aggregate plant that will turn out the exact quantity and quality you need, at the lowest possible cost per ton.

As a typical example, check the figures of this Concrete Materials & Construction Co. plant, with the Cedarapids 5050 Double Impeller Impact Breaker . . .

- √ **Originally scheduled to produce 400 tons per hour.**
- √ **600 tons per hour daily average maintained!**
- √ ***724 tons per hour peak production average!***

And here's why you get such low production costs with Double Impeller Impact Breakers . . .

- √ ***Maximum*** **output of cubical shaped aggregate required in so many specifications.**
- √ **Approximately 50% less contact of stone on metal, because such a high percentage of material is broken in suspension.**
- √ **You get an extremely high ratio of reduction at extremely low power costs.**
- √ **You save on your plant investment because you can eliminate much accessory equipment such as secondary crushers, conveyors, hoppers, screens, elevators, etc.**

Get ready for your share of the big jobs ahead with a Cedarapids Double Impeller Impact Breaker in your plant. "Construction Unlimited" means OPPORTUNITY UNLIMITED for you when you're prepared for bonus production. You can get very prompt delivery on all four sizes of Double Impeller Impact Breakers. See your Cedarapids distributor today for a profitable future.

14,472 TONS! PEAK DAY PRODUCTION FOR THIS CEDARAPIDS DOUBLE IMPELLER IMPACT BREAKER

HERE'S real tonnage! Concrete Materials & Construction Company put through 14,472 tons of aggregate on their peak day, when the surge pile was down and plenty of trucks were available for feed. More and more contractors are depending on Cedarapids Double Impeller Impact Breakers for the bonus production necessary to meet today's unlimited demands for low-cost aggregate!

AVERAGE DAILY PRODUCTION 600 TONS PER HOUR!

Cedarapids

Built by IOWA

Headquarters for

COST-REDUCING EQUIPMENT

U. S. Pat. Nos. 2373691
2486421
Canadian Pat. No. 439371

IOWA MANUFACTURING COMPANY

Cedar Rapids, Iowa, U.S.A.

Barber-Greene

MODEL 374

HEAVY-DUTY LONG-REACH 150 TO 425 TONS/HR. PORTABLE CONVEYOR

ONE MAN

high-capacity loading, unloading, stockpiling of all bulk materials

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

Only the Timken Company offers all 3 rock bit types and a complete rock bit engineering service!

WHATEVER your drilling conditions, there's a Timken® rock bit to meet them. And the Timken Rock Bit Engineering Service will help you pick it out! This service is the only *complete* rock bit engineering service offered by any rock bit manufacturer, because only the Timken Company makes *all 3* rock bit types:

1 MULTI-USE. Gives lowest cost per foot of hole when full increments of drill steel can be drilled and when control and reconditioning of bits are correct.

2 CARBIDE INSERT. For drilling extremely hard and abrasive ground, small holes, extra deep holes. Holes go down faster, bit reconditioning is simplified.

3 ONE-USE "SPIRALOCK". To use where reconditioning is not feasible. Gives lowest unit cost of the three. "Spiralock" union holds bit on dependably, permits easy removal.

Our rock bit engineers have been solving rock bit problems for the past 18 years. So whether you're looking for lower bit cost, lowest cost per foot of hole drilled, greatest possible drilling speed, or any other advantage, let us help you get it. The Timken Roller Bearing Company, Rock Bit Division, Canton 6, Ohio. Cable address: "TIMROSCO".

FREE BOOKLET! *Shows full line of bits with detailed descriptions, plus other useful rock bit data. Write for your copy.*

TIMKEN ... your best bet for the best bit ... for every job

TRADE-MARK REG. U. S. PAT. OFF.

It's 'Top

That Makes

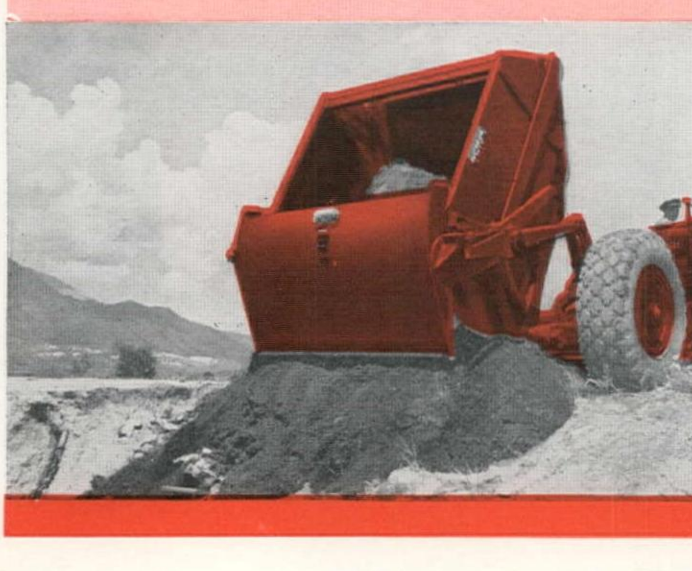
★ This TD-6 bulldozer handles dozens of odd jobs on a construction site. Here it builds a ramp for a housing project in Brooklyn, N.Y.

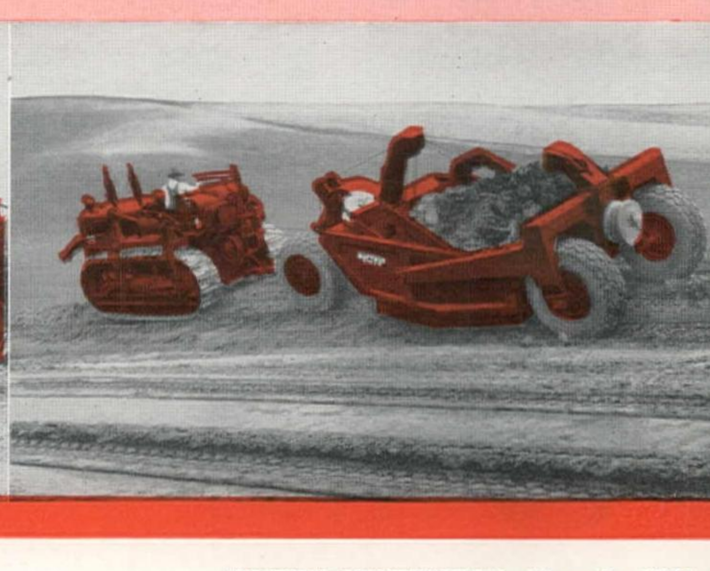
★ Real estate development is speeded by this TD-18 Bullgrader, shown building a boat channel near Sarasota, Fla.

★ Ability to dump well back of its wheels is a feature that means safe, sure dumping for this G-58 two-wheel scraper, working near Colorado Springs, Colo.

★ Full visibility and precision control contribute to peak efficiency on this TD-9 Dozer-Shovel, stockpiling sand at East Hampton, L.I., N.Y.

★ Fast loading and easy dumping, with Bucyrus-Erie's exclusive two-part hinged apron, makes this S-91 scraper an ideal tool for road building in Nebraska.





Performance Stars Like These!

HYDRAULIC BULLDOZERS
CABLE BULLGRADERS
RIPPERS
DOZER-SHOVELS
TWO-WHEEL SCRAPERS
GRUBBERS
POWER CONTROL WINCHES
HYDRAULIC BULLGRADERS
FOUR-WHEEL SCRAPERS
CABLE BULLDOZERS
TAMPING ROLLERS

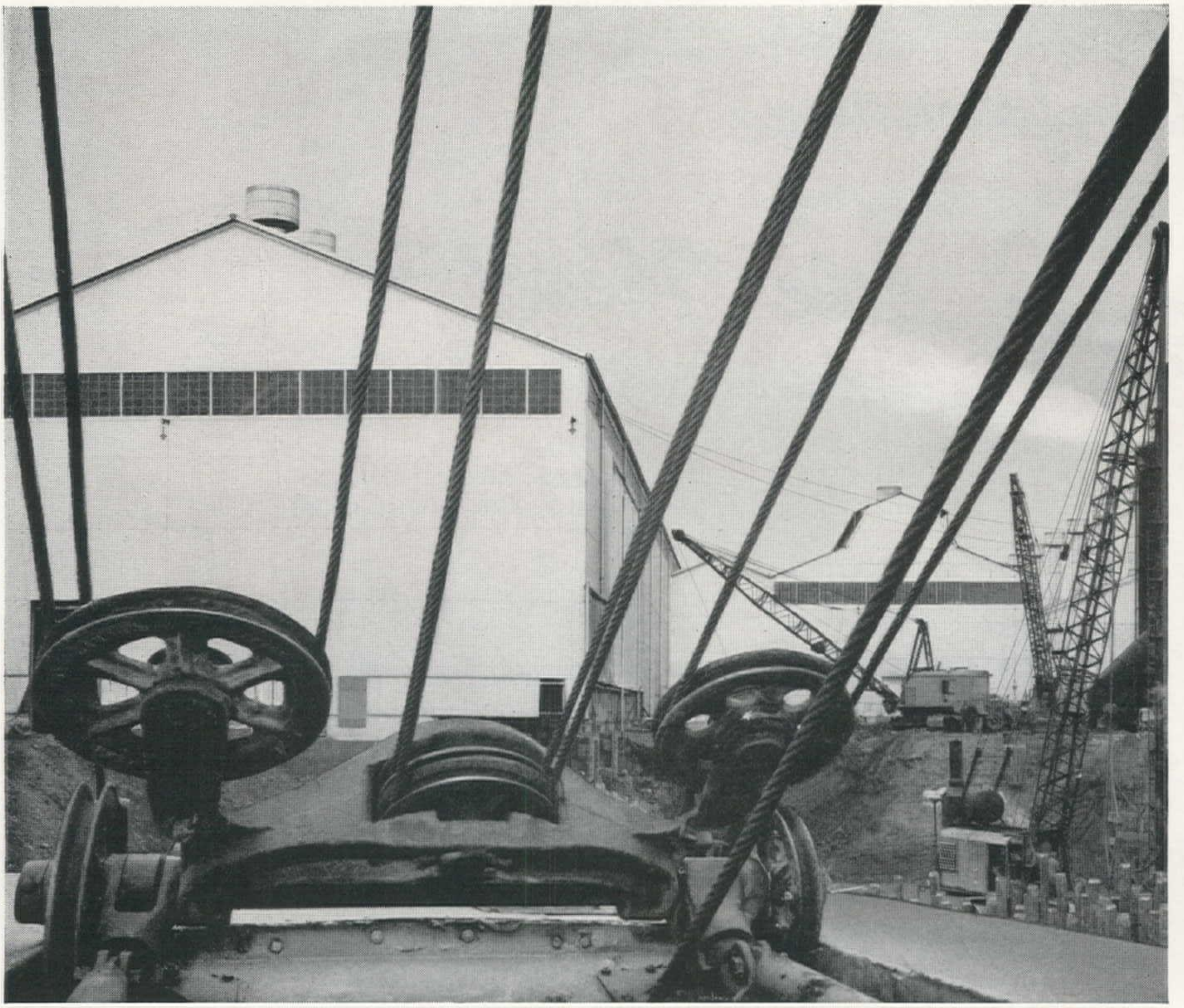
FOR the dependable, stand-out performance that means high output every shift, low-cost operation and most efficient use of tractor power, look to the stars in Bucyrus-Erie's line of tractor equipment. They're better because they're designed *with* and *for* International industrial tractors . . . engineered from the ground up to put more tractor horsepower to effective use, to retain the tractor's own operating characteristics, to prevent undue wear and maintenance on tractor parts. As a result, Bucyrus-Erie tractor equipment enables you to do *more* work per tractor horsepower. And Bucyrus-Erie quality construction, high-grade materials and craftsmanship mean long, reliable, profitable service. Ask your International Industrial Tractor Distributor for complete details!

277T51C

SOUTH MILWAUKEE **BUCYRUS ERIE** WISCONSIN

See

Your International Industrial Tractor Distributor



"Tiger Brand gives longer service because it resists vibration fatigue at rope terminals and tangent points on sheaves," writes Mr. J. H. Pomeroy, San Francisco general contractor. "Thanks to skilled operators and conscientious inspectors, we've been able to eliminate accidents, keep expenses down and cut down on rope replacements."

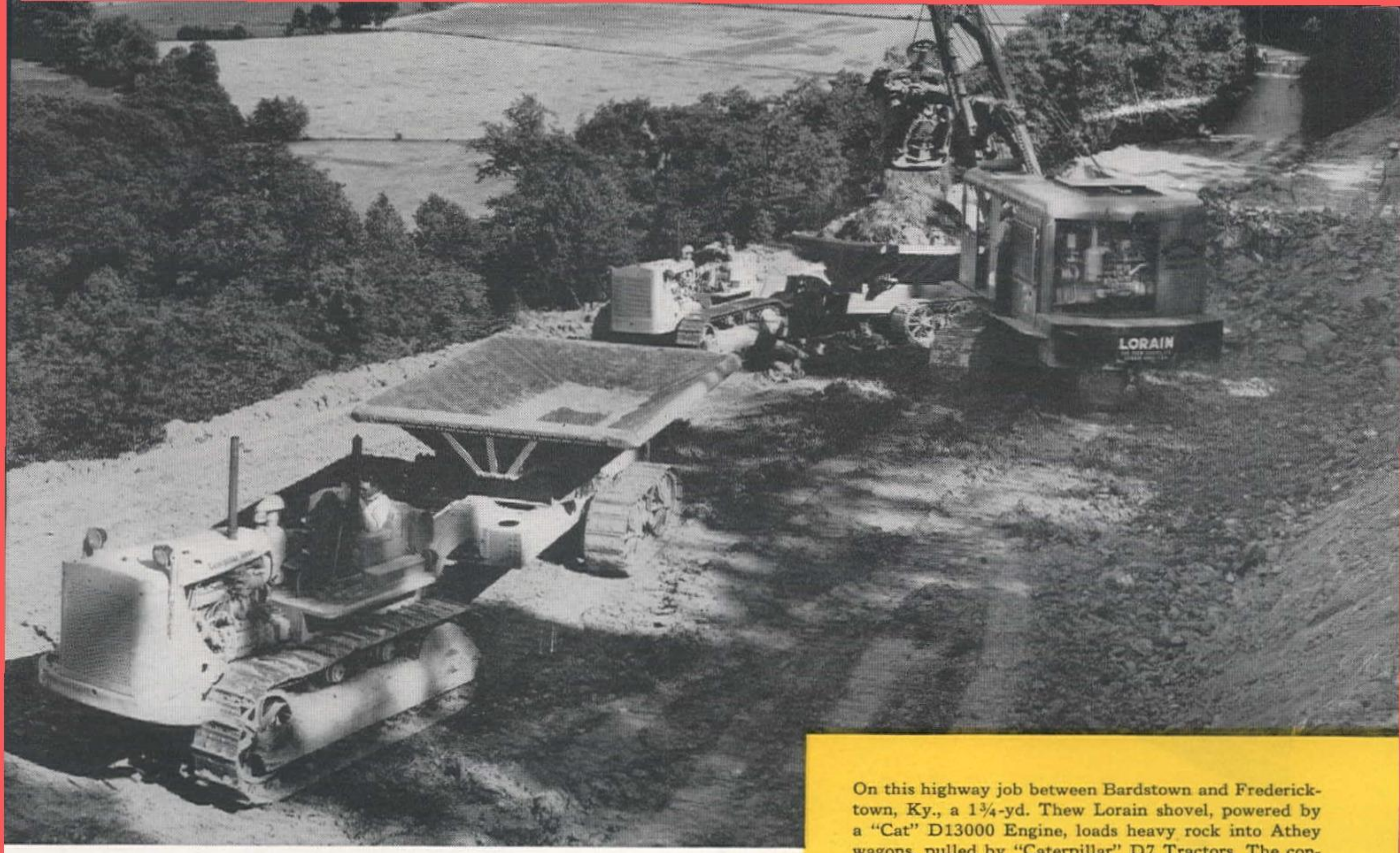
How San Francisco contractor gets longer rope life with Tiger Brand

On any equipment...for any job you handle...rely on tough American Tiger Brand, the wire rope that's rigidly controlled by United States Steel from raw ore to finished product. To get all the stamina engineered into it, you're welcome to the services of a Field Specialist. For free consultation, contact your Tiger Brand distributor or write Columbia Steel Company, Room 1422, Russ Bldg., San Francisco 4.

USS

U·S·S TIGER BRAND Wire Rope

UNITED STATES STEEL



On this highway job between Bardstown and Fredericktown, Ky., a 1¾-yd. Thew Lorain shovel, powered by a "Cat" D13000 Engine, loads heavy rock into Athey wagons, pulled by "Caterpillar" D7 Tractors. The contractor is W. C. Snyder, Danville, Ky.

There's a big job ahead

How your equipment stands up in the months ahead has a real bearing on America's fight to be strong and stay free. A vital part of that effort is the $12,000,000,000 worth of earthmoving and road building needed this year. And we're entering a period that will separate "the men from the boys" in the field of construction machinery.

Military needs and Defense Rated Orders are taking their share of "Caterpillar" production. Shortages of steel and other materials add to the difficulty of supplying the demand for new machines. This means that *present equipment must be kept in use.*

"Cat" Diesel Engines, Tractors, Motor Graders and Earthmoving Equipment are built with the stamina to serve you long and faithfully. But *how* long is up to you and the operation and maintenance you give them. Good care pays off.

You can add many hours to equipment life if you follow sound maintenance practices. Anticipate your parts needs *before* wear goes beyond repair. Talk it over with your "Caterpillar" dealer. He is qualified to give competent opinion. If a part is not readily available, he has the tools and knowledge to rebuild many worn parts — and keep your machinery on the job.

CATERPILLAR TRACTOR CO. • San Leandro, Calif.; Peoria, Ill.

You're the Doctor

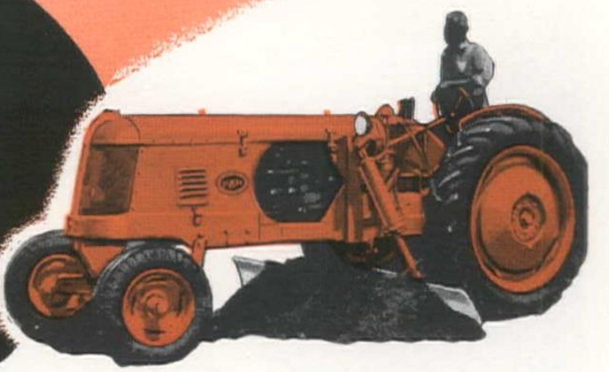
Don't let your engine overheat. Maintain the cooling system, keeping it free of scale, rust and sediment. Use soft or treated water and, when freezing temperatures exist, protect your engine with anti-freeze. Clean the radiator periodically, removing foreign matter from the core by brushing or washing. Use chemical flushing solutions. Prevent engine troubles which come with overheating. Consult your Operator's Instruction Book.

CATERPILLAR

REG. U. S. PAT. OFF.

DIESEL ENGINES
TRACTORS
MOTOR GRADERS
EARTHMOVING EQUIPMENT

Some of the Jobs HUBER MAINTAINERS Are Doing



NATIONAL GOVERNMENTS

Grading and maintenance work on highways and secondary roads in national parks, reservations, national public lands.

STATES

Highway grading and maintenance service of many kinds including berm grading, mowing, ditch cleaning, etc.

COUNTIES

Highway and secondary road grading and maintenance work. Counties owning attachments keep HUBERS busy every month of the year.

MUNICIPALITIES

Street and alley grading and maintenance; every type of maintainer attachment is in municipal service.

TOWNSHIPS

Townships charged with road maintenance are among favorite users of Huber Maintainers for grader and maintenance work.

PUBLIC GROUNDS

Parks, playgrounds, conservation areas, publicly-owned beach areas need and use HUBERS for grader and maintenance service.

OIL FIELDS

HUBERS are at work in the oil fields, grading and maintaining off-the-highway roads and building dams around oil wells and storage tanks.

CEMETERIES

Cemeteries keep HUBERS busy every month, grading and maintaining drives, mowing, developing new grounds, removing snow, patching pavements, etc.

AIRPORTS

HUBERS are tailor-made for airport service, grading unpaved areas, patching paved areas, mowing, removing snow, towing planes, etc.

LOGGING

Grading and maintaining logging camp roads, mowing, bulldozer service.

INDUSTRIES

Many industrial users include factories with sizeable grounds and miles of roadways; lift loader widely used for cleanup work around factory sites.

MINES

Grading and maintenance of roadways; broom widely used around strip mines to sweep coal veins before removal.

ESTATES & RANCHES

Grading and maintenance of roadways; lift loader for cleanup; mower widely used.

RACE TRACKS

Grading and maintenance of track and of surrounding roadways and grounds.

CONTRACTORS

Contractors, large and small, in all kinds of contract work, are enthusiastic HUBER users. They like versatility of HUBERS, ability to move rapidly from one job to another.

HUBER MANUFACTURING COMPANY — MARION, OHIO, U. S. A.

Represented by

Lee & Thatro Equipment Co.	Los Angeles 21, Calif.
Jenkins & Albright	Reno, Nevada
Contractors' Equipment & Supply Co.	Albuquerque, New Mexico
Feenaughty Machinery Co.	Portland 14, Oregon
Feenaughty Machinery Co.	Boise, Idaho
Feenaughty Machinery Co.	Spokane 2, Washington
Feenaughty Machinery Co.	Seattle 4, Washington
Casson Hale Corporation	Hayward, Calif.
Foulger Equipment Co., Inc.	Salt Lake City 8, Utah
The Colorado Builders' Supply Co.	Denver 9, Colorado
The Colorado Builders' Supply Co.	Casper, Wyoming
Montana Powder & Equipment Co.	Helena, Billings, Montana
The O. S. Stapley Co.	Phoenix, Arizona

Service records like this

Why Genuine Wrought Iron Lasts

This notch-fracture test specimen illustrates the unique fibrous structure of genuine wrought iron—which is responsible for the high corrosion resistance of the material. Tiny threads of glass-like silicate slag, distributed through the body of high-purity iron, halt and disperse corrosive attack, and discourage pitting and penetration. They also anchor the initial protective scale, which shields the underlying metal.

In the pipe lines serving the Department of Agriculture's new National Arboretum, Washington, D.C., durability was safeguarded in a *time-proven* way, by installing genuine wrought iron pipe. The main illustration above shows a section of 4" Galvanized Byers Wrought Iron pipe being placed in the outer garden plots which surround the new research center. This material, in 1½" and 2" sizes, was also used for underground utilities covering the laboratories and greenhouse group.

The soundness of this selection is supported by many unusual service records established by genuine wrought iron pipe. For instance—the insert photograph shows a section of 44" O.D. genuine wrought iron pipe, installed by the San Francisco Water Department in 1885, being removed for cleaning. Close examination revealed that the pipe was in first-class condition with not a single hole or thin place after its many years of service.

If you are planning a new or replacement underground pipe installation, keep in mind that this service presents a double corrosive threat—inside attack from the water; outside attack from the soil. The only practical solution is in the use of a corrosion-resistant material. And keep in mind too, that Byers Wrought Iron pipe has rolled up some of its most impressive records in this service . . . which we will be happy to show you.

You'll find a comprehensive review of underground problems—and their successful solution—in our bulletin, WROUGHT IRON FOR UNDERGROUND SERVICES. Write for a copy.

A. M. Byers Company, Pittsburgh, Pa. Established 1864. Boston, New York, Philadelphia, Washington, Atlanta, Chicago, St. Louis, Houston, San Francisco. Export Division: New York, N. Y.

BYERS

CORROSION COSTS YOU MORE THAN WROUGHT IRON

WROUGHT IRON

TUBULAR AND HOT ROLLED PRODUCTS

ELECTRIC FURNACE QUALITY ALLOY AND STAINLESS STEEL PRODUCTS

LOOK TO P&H FOR THE BIG 3

1 ***Greater Stability***

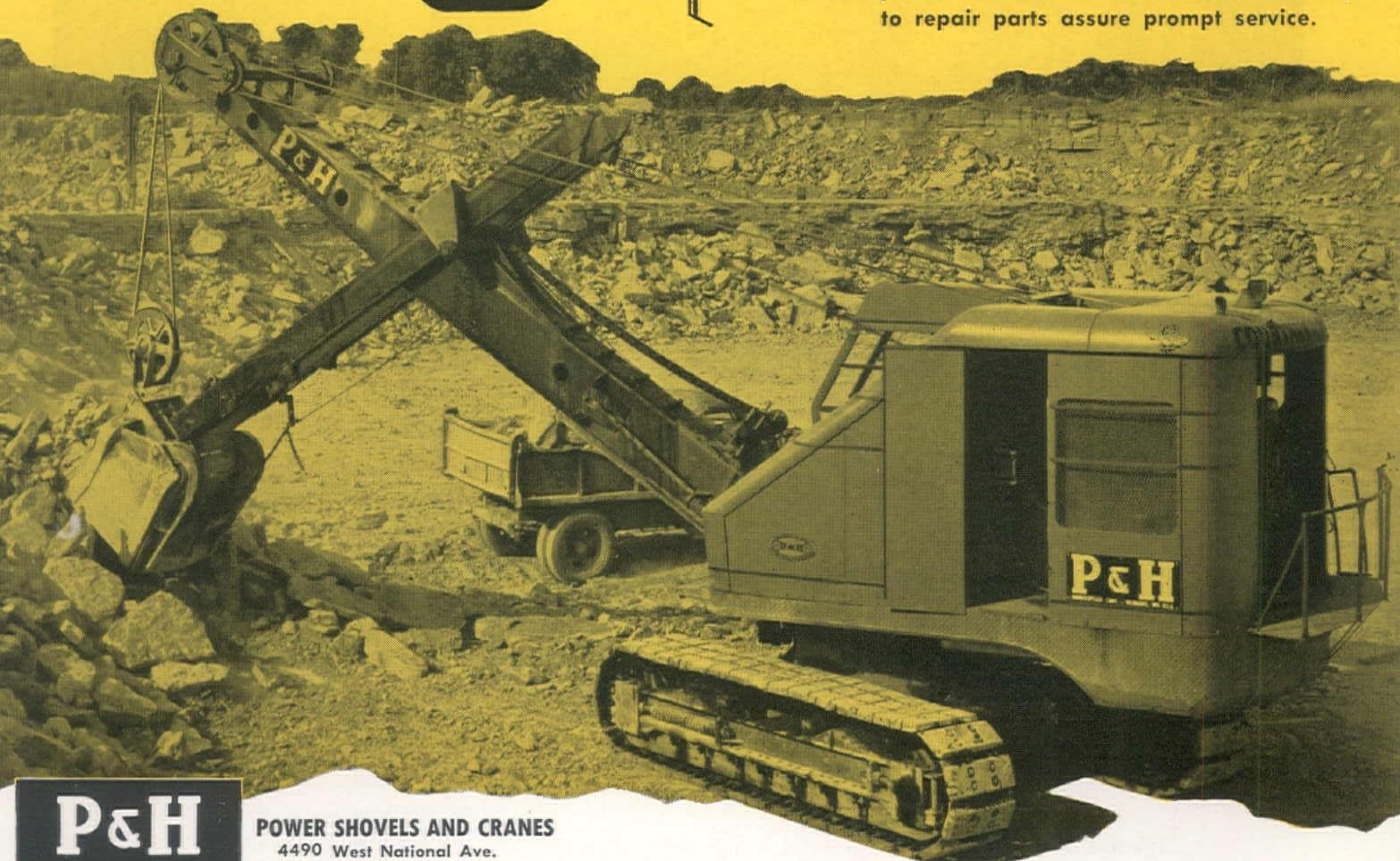
gives you more digging power at the tooth point — without tipping strain.

2 ***More Modern Design***

True tractor type crawlers reduce maintenance; *live roller circle* gives livelier swings; *low pressure hydraulic control* is faster, smoother; *all-welded construction* means greater strength.

3 ***Better Service***

Adequate dealer parts stocks are supplemented by 20 strategically located branch offices and warehouses. One complete plant and warehouse devoted exclusively to repair parts assure prompt service.



P&H POWER SHOVELS AND CRANES
4490 West National Ave.
Milwaukee 14, Wis.

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.

See your P&H Dealer

EL CENTRO, California .... Purdy-Holmquist Co., 1275 Main Street
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REEDLEY, California .... Allied Equipment Company, 1230 "G" Street
LOS ANGELES 21, California .... Lee & Thatro Equipment Co., Inc., 820 Santa Fe Ave.
PHOENIX, Arizona .... Arizona Equipment Sales, Inc., 2750 Grand Ave.
RIO VISTA, California .... Berglund Tractor & Equipment Co.
SACRAMENTO, California .... Sacramento Valley Tractor Co., 1901 Broadway
SAN DIEGO 13, California .... *Southern Equipment & Supply Co., 2025 East Harbor Drive
ESCONDIDO, California .... Southern Equipment & Supply Co., 301 W. Grand
EUREKA, California .... *Riley Logging Supply Co., 1034 Broadway
CRESCENT CITY, California .... Riley Logging Supply Co., Highway "Y"
RENO, Nevada .... Jenkins & Albright Mack Truck Sales, 1131 W. 4th Street
PORTLAND 14, Oregon .... *Loggers & Contractors Machinery Co., 240 S. E. Clay Street
EUGENE, Oregon .... Loggers & Contractors Machinery Co., 540 Filmore Street
SALT LAKE CITY, Utah .... Western Machinery Company, 748 West 8th, South
SEATTLE 8, Washington .... Bow Lake Equipment Co., Inc., 300 Michigan Street
SEATTLE 4, Washington .... Glenn Carrington & Co., 91 Columbia Street
SPOKANE 15, Washington .... F. M. Viles & Co., Inc., N. 1107 Freya

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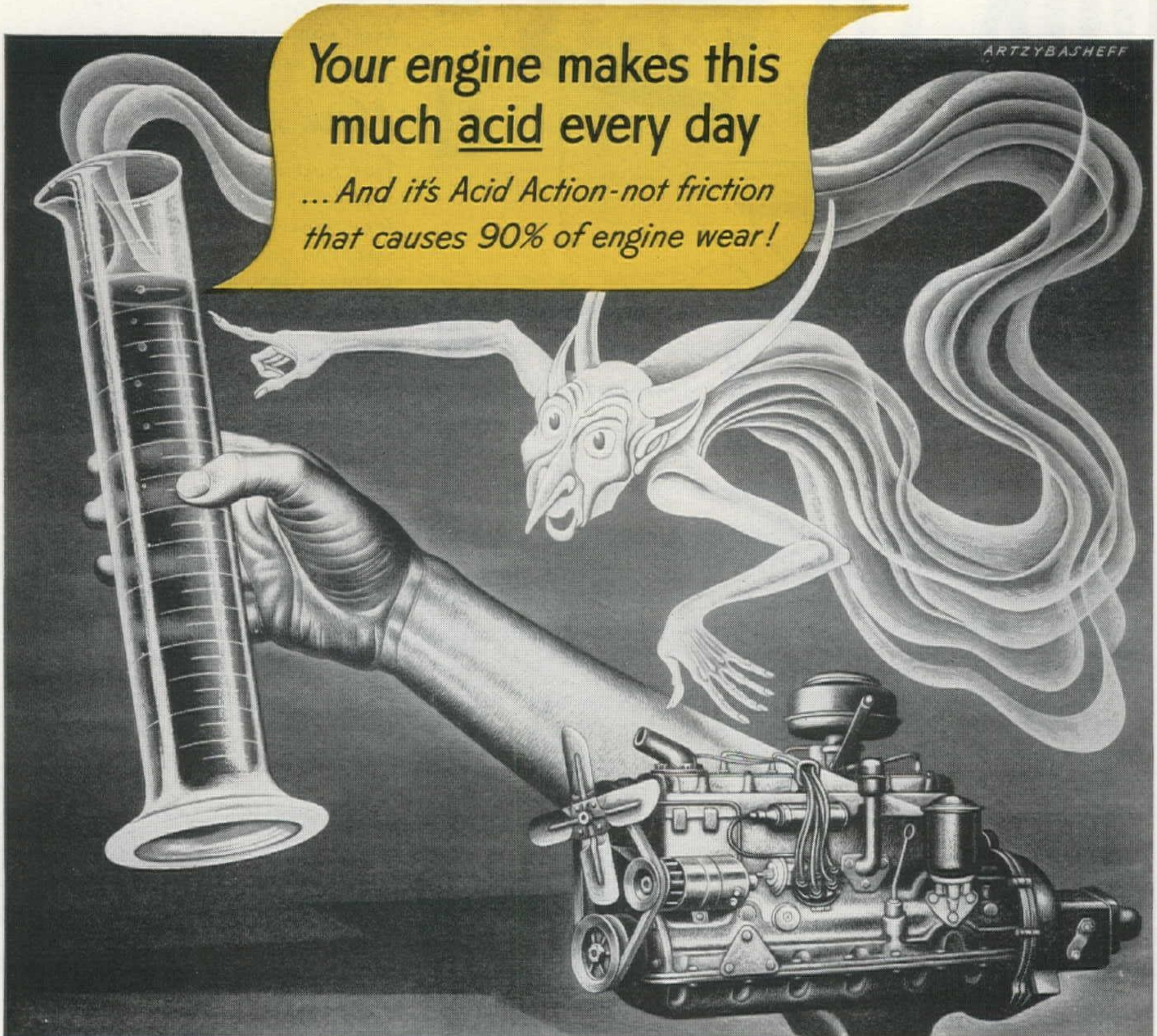
WER SHOVELS • CRAWLER AND TRUCK CRANES • OVERHEAD CRANES • HOISTS • ARC WELDERS AND ELECTRODES • SOIL STABILIZERS • DIESEL ENGINES • PRE-FAB. HOMES



NEW *alkaline* Shell X-100 Motor Oil neutralizes Acid Action

It's not *friction* but *acid action* that causes 90% of engine wear! To neutralize the harmful effect of the pint or more of acid formed in average daily driving, Shell Research has produced an *alkaline* motor oil—Shell X-100. Fortified with alkaline "X" safety factors, it neutralizes the acid action, prolonging your engine's life.

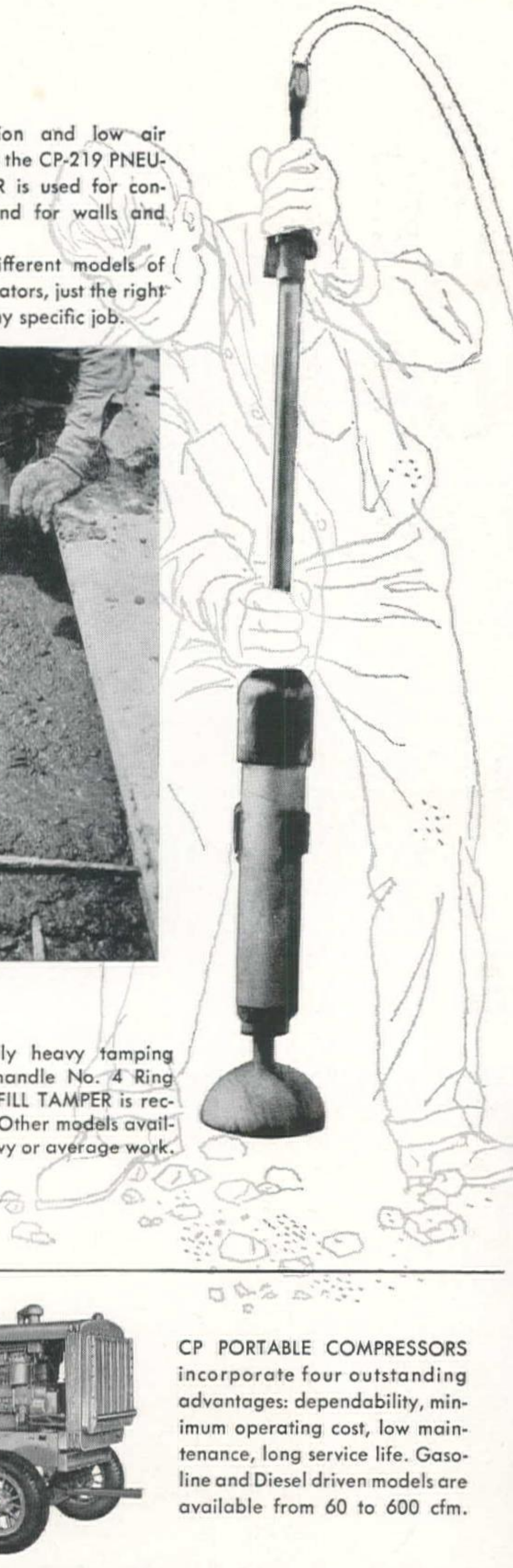
In addition, this new premium heavy duty motor oil possesses cleaning factors which help prevent deposits that would foul your engine.

Shell X-100 is the finest motor oil money can buy. Let your Shell dealer give your engine the protection of this new alkaline Shell X-100 Motor Oil today.

It's Incomparable

Economical one-man operation and low air consumption are secured when the CP-219 PNEUMATIC CONCRETE VIBRATOR is used for concrete 3" slump and over, and for walls and columns under 15" thick.

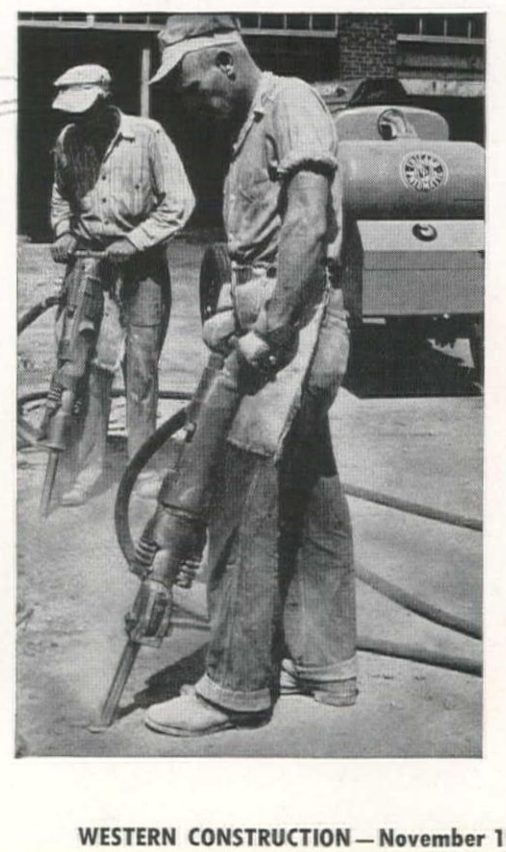
With a choice of seven different models of CP Pneumatic and Electric Vibrators, just the right vibrator can be selected for any specific job.

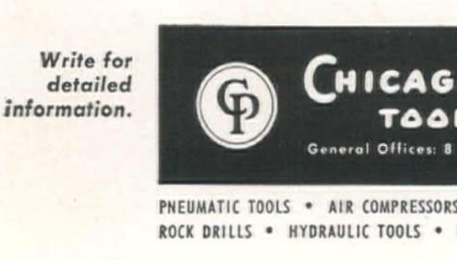


MEETS DEMANDS OF TOUGHEST JOBS

For especially heavy tamping the easy-to-handle No. 4 Ring Valve BACKFILL TAMPER is recommended. Other models available for heavy or average work.

In the world's largest line of DEMOLITION EQUIPMENT there is a CP tool for every type of demolition work. Five models range from the lightweight CP-111 (25 lb. class) to the heavy-duty CP-117 (80 lb. class).





CP PORTABLE COMPRESSORS incorporate four outstanding advantages: dependability, minimum operating cost, low maintenance, long service life. Gasoline and Diesel driven models are available from 60 to 600 cfm.

Write for detailed information.

CHICAGO PNEUMATIC TOOL COMPANY

General Offices: 8 East 44th Street, New York 17, N. Y.

PNEUMATIC TOOLS • AIR COMPRESSORS • ELECTRIC TOOLS • DIESEL ENGINES
ROCK DRILLS • HYDRAULIC TOOLS • VACUUM PUMPS • AVIATION ACCESSORIES

Described as the world's most modern soap, detergent and edible products plant, the new Lever Brothers Company plant in Los Angeles consists of six separate reinforced concrete and steel buildings which cover over one-third of the 30-acre tract. Over 1,200,000 square feet of concrete in the project were formed against ⅝"-thick Exterior plywood concrete form panels. Walls were cast against built-up form sections made by nailing panels across 2x4 studs, 12" o.c., backed by 2x4 walers, 24" o.c. Fluted effect on the building was achieved by fastening tapered 1½"-deep wood strips, 6" o.c., to plywood form face. Concrete floor slabs were poured on plywood forms braced with 2x6 and 2x8 joists, supported by 4x4 shores. Bechtel Corporation, Engineers-Constructors is responsible for the complete construction of the project including design and procurement and installation of the structure and process equipment. Welton Becket and Associates served as architectural consultants.

On New Lever Brothers Company Plant—

Plywood Forms Specified For Smooth, Fin-Free Concrete And Overall Job Economy

BECAUSE of the great amount of concrete work involved, Bechtel Corporation, designers and builders of the giant Lever Brothers Company soap and detergent plant, planned the structure with special form problems and their solutions in mind.

Plywood concrete form panels were chosen for two reasons: first, because they would create the smooth, fin-free surfaces required to carry out the design of the structure; and second, because the panels were ideally adapted for fabrication into cost-cutting built-up form sections which could be slipped up the building intact as work progressed.

According to Bechtel engineers, "plywood's performance was satisfactory in every respect. The panels created smooth, even-textured concrete, helped reduce formwork time and costs."

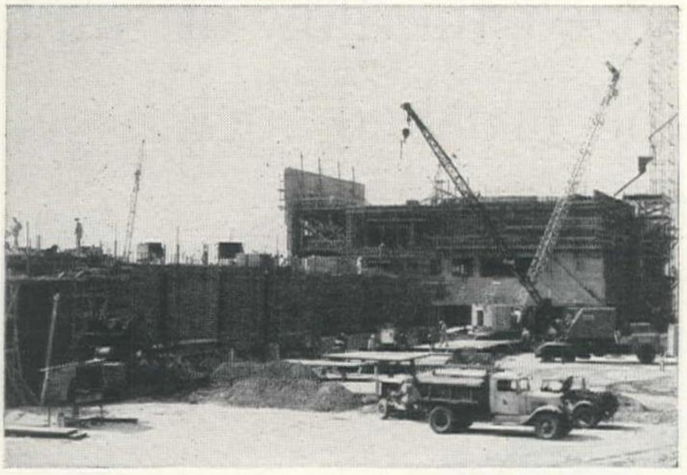
One more example of this fact: industrial structure or public building . . . apartment or heavy construction project—Douglas fir plywood forms do a *better* job, *faster*, *more economically*.

Douglas Fir

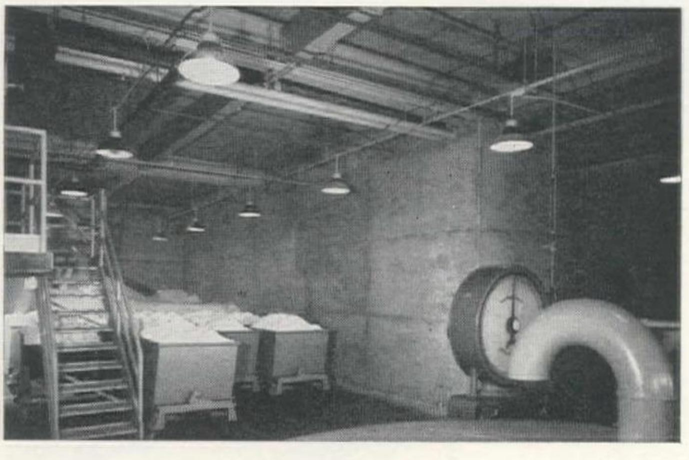
Plywood

AMERICA'S

Contractors Record 8 to 10 Re-Uses From Plywood Concrete Form Panels



Built-up plywood form sections, 16′ long and 20′ high, were used to form the front walls of the three main buildings. Length of these form sections was determined by the 16-foot spacing of concrete pilasters. On the ends of the building (above, right) forms were 90′ to 120′ long. To relieve the monotony of the otherwise plain surfaces on the ends of the structure, wood molds were placed on the form face to create a striking fluted effect. Single pull hand winches spaced about every 15 feet were used to raise forms after each pour. Form sections were re-used to job completion—about 8 to 10 re-uses for the plywood, according to the contractors. View below shows interior of Lever plant. So smooth were plywood-formed interior walls and ceilings that those in processing units required no additional finishing.



Large, Light, Strong Real Wood Panels

For additional data on Douglas fir plywood for concrete form work, write (USA only): Douglas Fir Plywood Association, Tacoma 2, Washington. Of particular interest are two booklets: "Concrete Forms of Douglas Fir Plywood" and "Handling PlyForm".

BUSIEST BUILDING MATERIAL

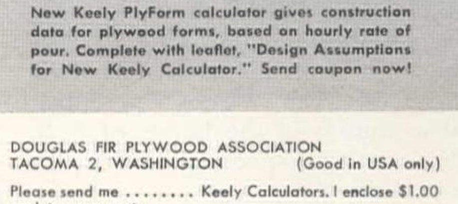
For Smooth, Fin-Free Concrete Surfaces...

®PLYFORM

Concrete Form Panels

GENUINE DOUGLAS FIR PLYWOOD
PLYFORM
CONCRETE FORM PANEL
INTERIOR-TYPE GRADE B-B
D.F.P.A. INSPECTED

Smooth, fin-free surfaces . . . ease of handling . . . strength, rigidity, tightness . . . superior nail holding qualities . . . cost-cutting re-use factors —these are primary advantages of Plyform®. Highly moisture-resistant glues used in Ply-Form panels permit multiple re-use (as many as 10 to 15 are not unusual). For the greatest possible panel re-use, however, specify Exterior-type EXT-DFPA® Concrete Form grade of Douglas fir plywood—bonded with completely waterproof phenolic resin adhesive. For special architectural concrete, requiring the finest possible finish, the architect or contractor may specify Exterior-type or Interior-type Douglas fir plywood in grades having "A" face veneer—or one of the new plastic-surfaced panels.



Yours for $1

New Keely PlyForm calculator gives construction data for plywood forms, based on hourly rate of pour. Complete with leaflet, "Design Assumptions for New Keely Calculator." Send coupon now!

DOUGLAS FIR PLYWOOD ASSOCIATION
TACOMA 2, WASHINGTON (Good in USA only)

Please send me .... Keely Calculators. I enclose $1.00 each to cover costs.

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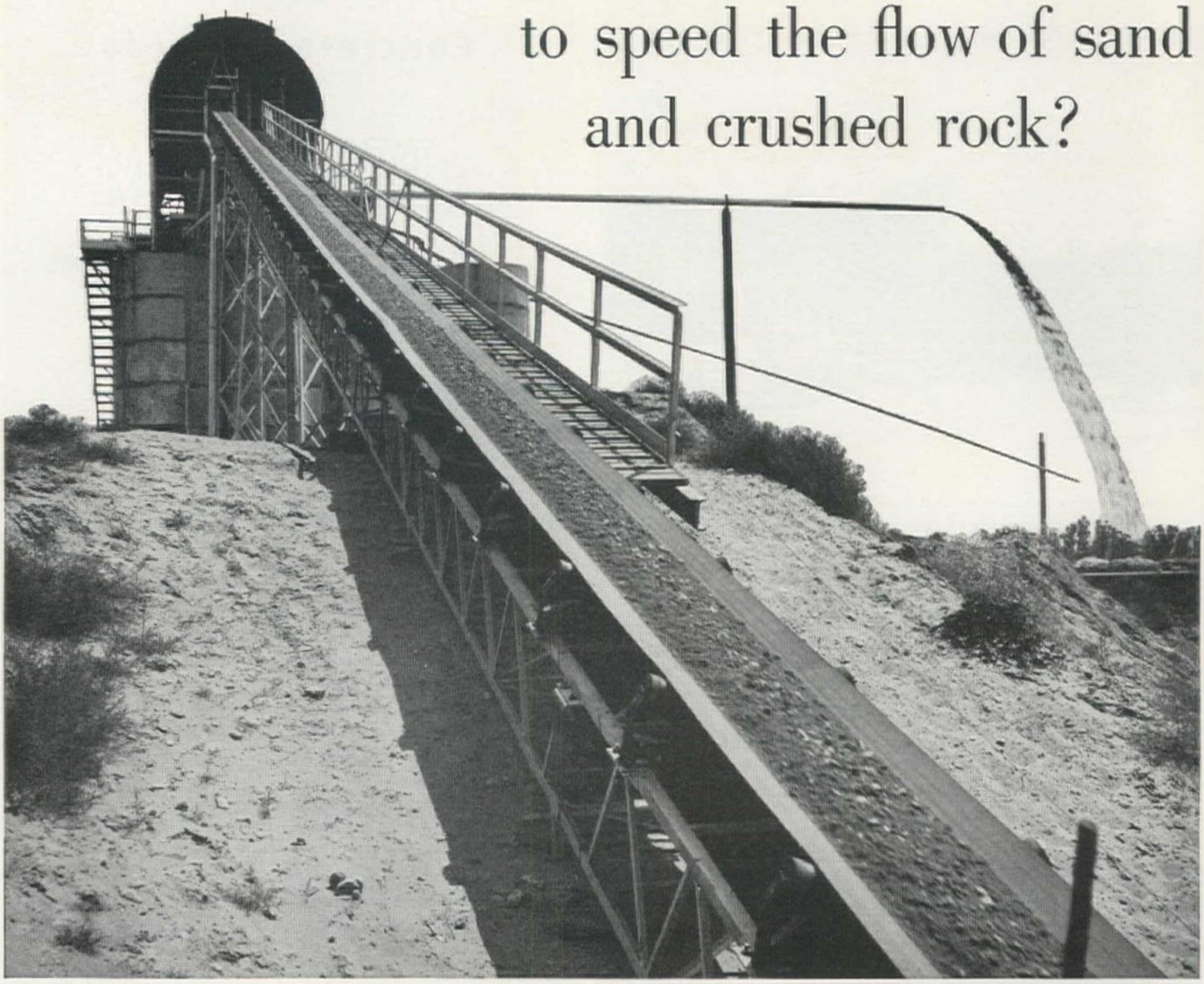
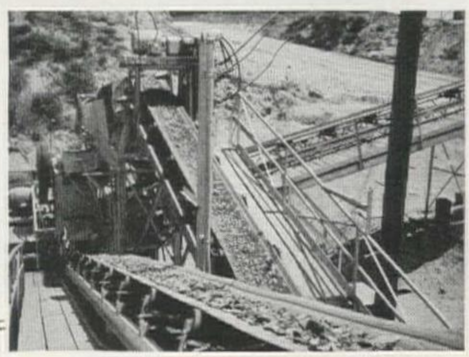
What's U. S. Rubber doing to speed the flow of sand and crushed rock?



Throughout this quarry, many sizes of U. S. Giant Conveyor Belts are transporting pit-run sand and crushed rock. These conveyors go uphill, downhill, and on the level. They never get tired, are never hampered by the weather or their rough, heavy cargo.

"U. S." moves bulk materials at minimum costs because "U. S." scientific testing and rigid inspection assure maximum operating efficiency. Whatever your belt problem, put it in the hands of U. S. Rubber's belting specialists. Write to address below.

PIT-RUN SAND conveyed by U.S. Giant Conveyor Belt. Crosswise flexibility of "U.S." belts assures proper training.



TWO VIEWS of other U.S. Giant Conveyor Belts transporting crushed rock through the various stages of processing.

PRODUCTS OF

U.S. RUBBER

SERVING THROUGH SCIENCE

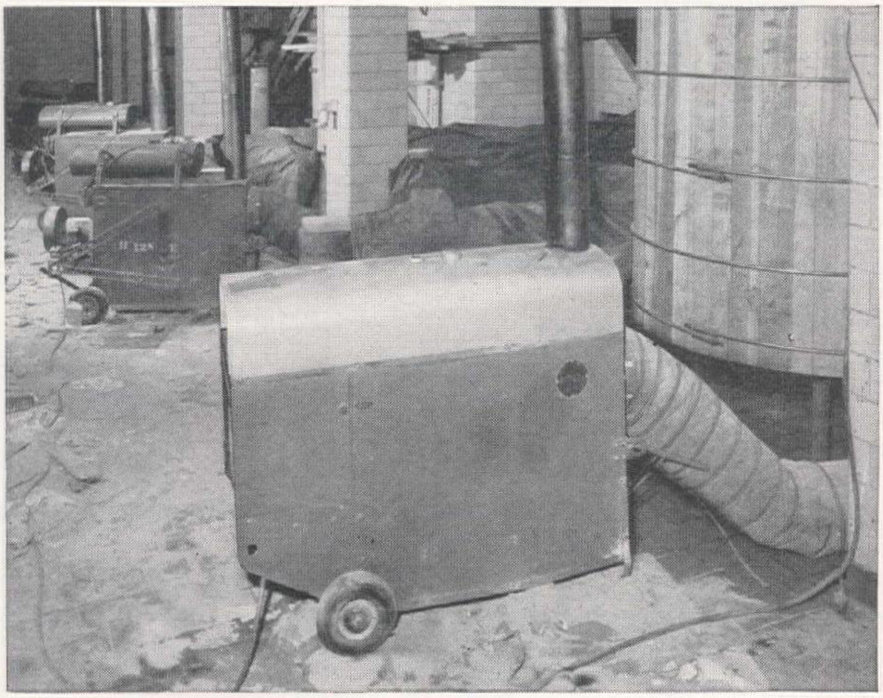
UNITED STATES RUBBER COMPANY

MECHANICAL GOODS DIVISION • ROCKEFELLER CENTER, NEW YORK 20, N. Y.

Heat-YES! Fumes-NO!

WHEN YOU INSIST ON

Herman Nelson *Safe Portable Heaters*



HERMAN NELSON DE LUXE I
Electric motor powered
Uses kerosene for heating fuel
280-450,000 BTU capacity
Automatic temperature control

HERMAN NELSON ECONOMY MODEL
(Priced lower for the smaller jobs)
Electric motor powered
Uses kerosene for heating fuel
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Costs but 19c per hour to operate

HERMAN NELSON STANDARD MODEL
Gasoline engine powered
Uses gasoline for heating fuel
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Completely self-contained

WHEN you count the cost of unsafe heating methods on construction jobs you'll make one choice. Only Herman Nelson offers "sealed flame" protection from insidious carbon monoxide. You can keep construction going ahead right through frigid winter months when you operate portable heaters. But you can't get top production from expensive skilled workmen who are partially "knocked out" by hazardous fumes.

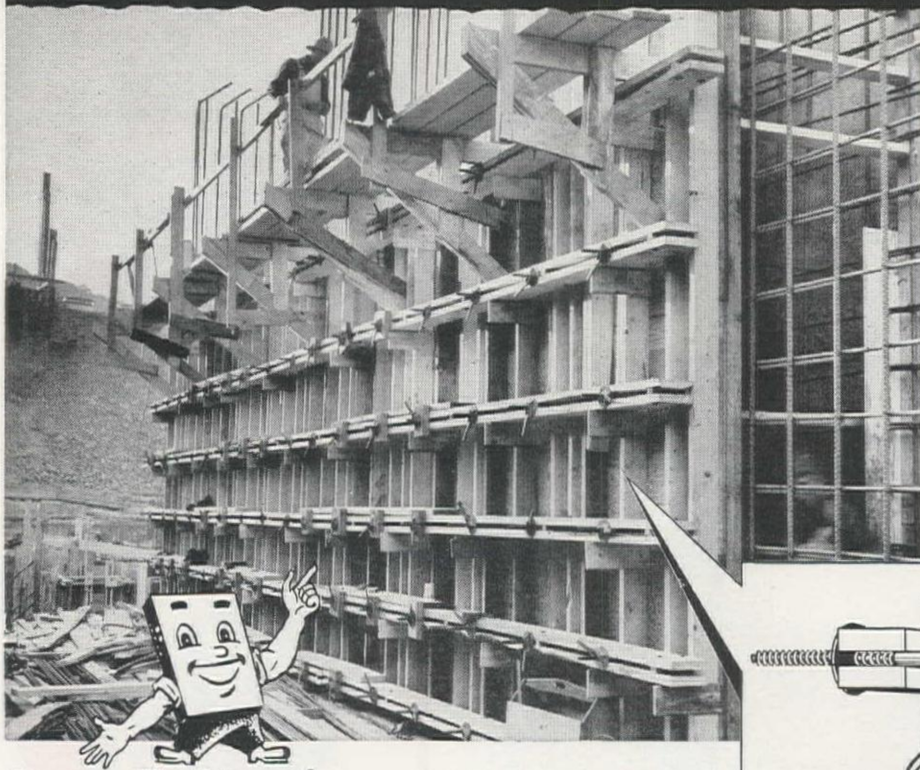
Make certain you have all-winter, all-weather protection on your jobs. Plan to own and operate Herman Nelson Portable Heaters. *For the best deal, deal now.* See your nearest Herman Nelson distributor, or write Dept.WC-11.

Today's Best Buy is Better Air!

AAF herman nelson moline illinois

HERMAN NELSON
Division of **AMERICAN AIR FILTER COMPANY, INC.**
MOLINE, ILLINOIS

UNIVERSAL Spirolocs
HEAVY DUTY TIES
FASTEST—SAFEST—LOWEST COST



UNIVERSAL Spirolocs—heavy duty Form ties...*Permanent, reuseable equipment*... fast acting Acme threads...washers and stud rods last indefinitely; only *inexpensive* threaded tie rods expended.

Spirolocs provide fast erection...easy stripping... available in various time-saving combinations to fit the exact needs of your job.

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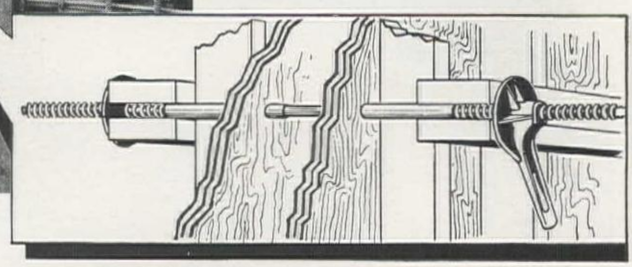

Greater Tie Strength
For less money with Spirolocs

5,000# Ties with ⅜-Tie Rods
9,000# Ties with ½-Tie Rods
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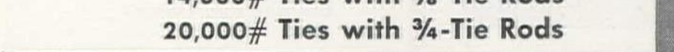
20,000# Ties with ¾-Tie Rods

SPIROLOC CONE NUT ASSEMBLY



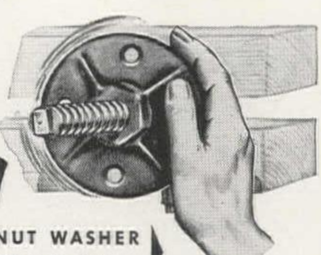
The only fast acting form Tie with an absolutely positive spreader...assures smooth surfaced, watertight walls.

Write for complete details on SPIROLOCS and ask for catalog describing Universal Form Tying Accessories.

Spirolocs are Furnished with either Handle or Nut Type Washers

THE HANDLE WASHER
SLIP IT ON

SPIROLOCS IN ACTION



THE NUT WASHER
SPIN IT ON

Universal FORM CLAMP CO.
Concrete Form Specialists Since 1912

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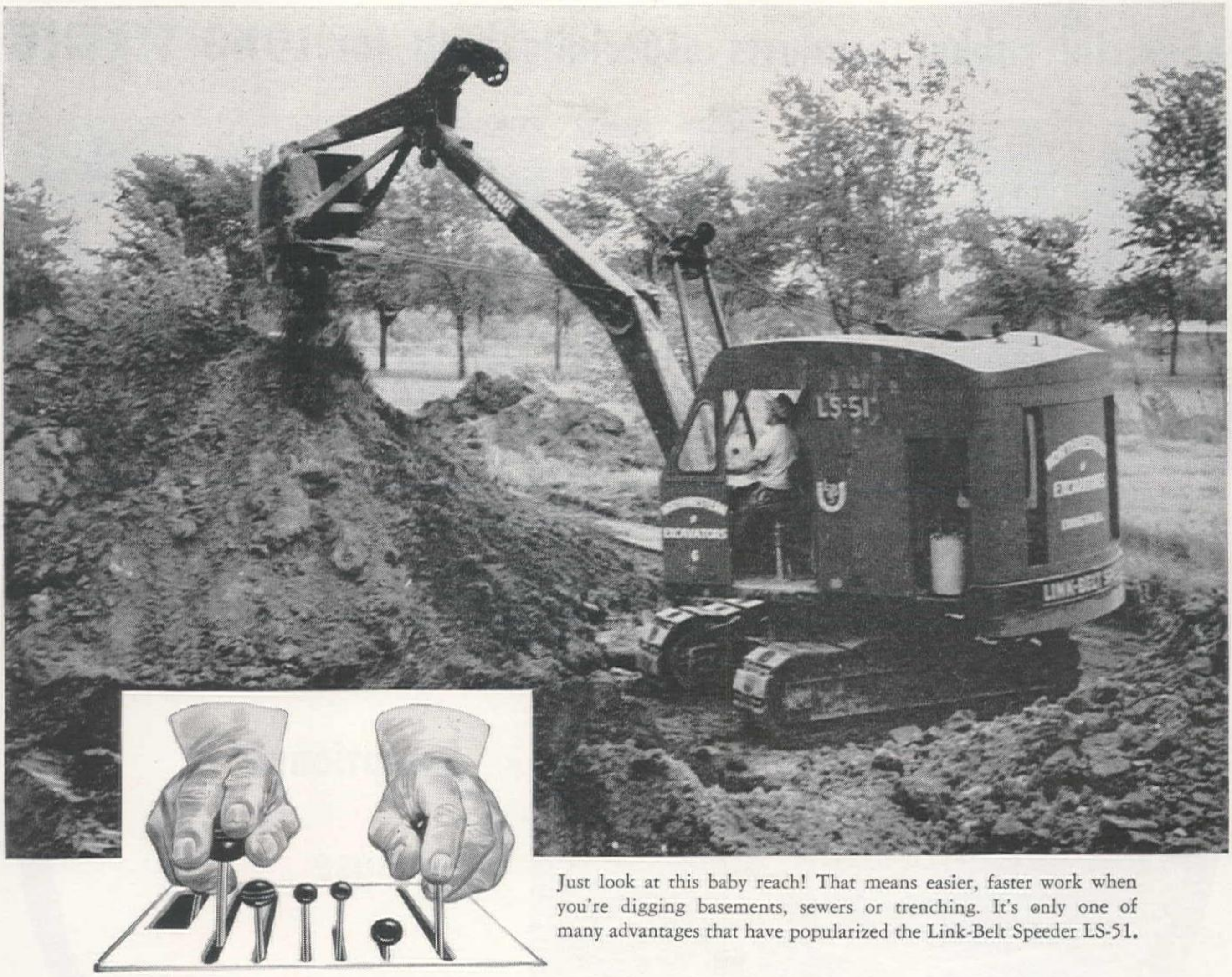
Phone: Lockhaven 2-2051, Enterprise 1-0132

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



Just look at this baby reach! That means easier, faster work when you're digging basements, sewers or trenching. It's only one of many advantages that have popularized the Link-Belt Speeder LS-51.

AT YOUR FINGER TIPS...

up to 25% increased output

WITH SMOOTHER, EFFORTLESS *Speed-o-Matic* CONTROLS

LINK-BELT SPEEDER

Fingers instead of muscles do the control work on the Link-Belt Speeder LS-51. That's why operation of this Shovel-Crane is faster, surer, and easier. You get time-saving precision, too . . . "pin-point" placement of bucket, shovel or hoe, without drag, lag, jerk or jump. Control is perfect . . . you "feel" the load every inch of the way.

Operators praise the ease Speed-o-Matic power-hydraulic controls provide. Say they keep fresher, more alert even during long overtime. This pays off in greater output . . . up to 25% and more, and the kind of profits you like to see.

Introduced 15 years ago, Speed-o-Matic power-hydraulic controls have proved their superiority under toughest field conditions. They are typical of the many advanced features, such as the optional independent swing and travel, which make the LS-51 the standout performer of the ½-yard field. Other Link-Belt Speeder models are available in shovel capacities up to 3 yards; cranes up to 60 tons, in crawler, truck and wheel-mounted types. Each model is fully and quickly convertible to all Shovel-Crane attachments. Prompt service is provided by a nation-wide network of factory-trained distributor servicemen.

Depend on Link-Belt Speeders for more work, more kinds of work, more of the time. See our distributor, or write

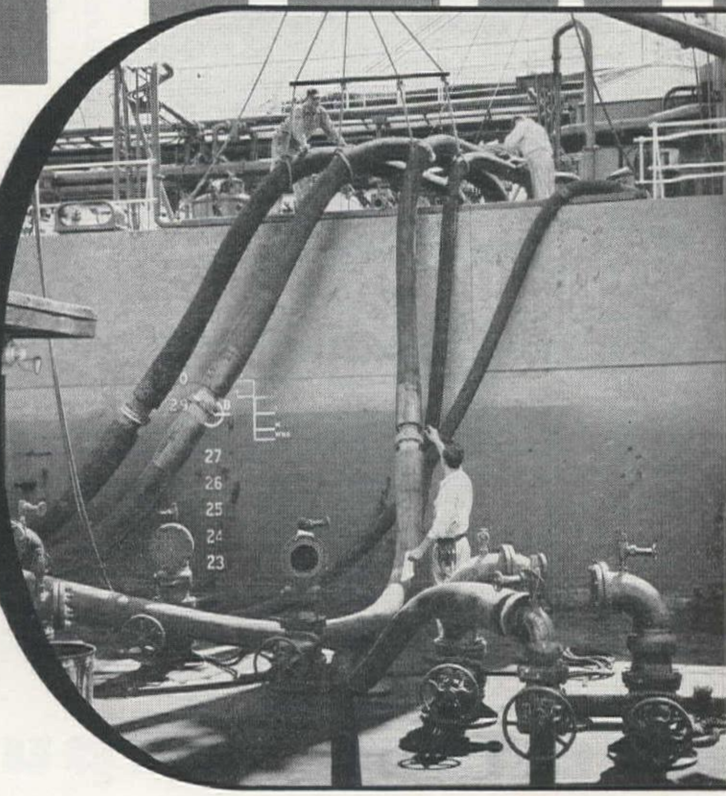
LINK-BELT SPEEDER
CORPORATION

12,636

Builders of the most complete line of shovels, cranes and draglines
CEDAR RAPIDS, IOWA

Industrial rubber products especially built for LONG SERVICE

PIONEER



Cooperation produced this exceptional oil hose

Standard of California tanker being loaded through Pioneer Oil Suction and Discharge Hose.

Most of America's best products spring from an interchange of ideas between the *user* and the *manufacturer*. Pioneer Oil Suction and Discharge Hose is the result of many years cooperation between engineering departments in the oil industry and our own laboratory and factories. This hose, as now used by Standard of California, for example, gives far longer service and helps speed tanker loading up to 20,000 barrels an hour!

Whether you want an industrial rubber product built to your specifications, or need the recommendation of experienced technicians, call on Pioneer Rubber Mills. Apply Pioneer's engineering experience and building facilities to the industrial rubber products you use, and you will get the *extra* service that Pioneer customers know so well. Just call your nearest Pioneer representative.

"How to LENGTHEN the life of industrial rubber goods"

This booklet gives you hundreds of down-to-earth suggestions on how to get better service from all kinds of industrial rubber products. You'll profit from the subject matter, and you'll be amused by the colorful illustrations. Whether you are yet a Pioneer customer or not, just drop a post card asking for "Lengthen Life" booklet. Address: Pioneer Rubber Mills, 345-353 Sacramento Street, San Francisco 11, California.

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FIGHTING HEART

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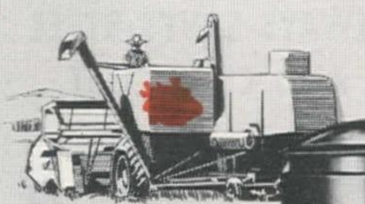
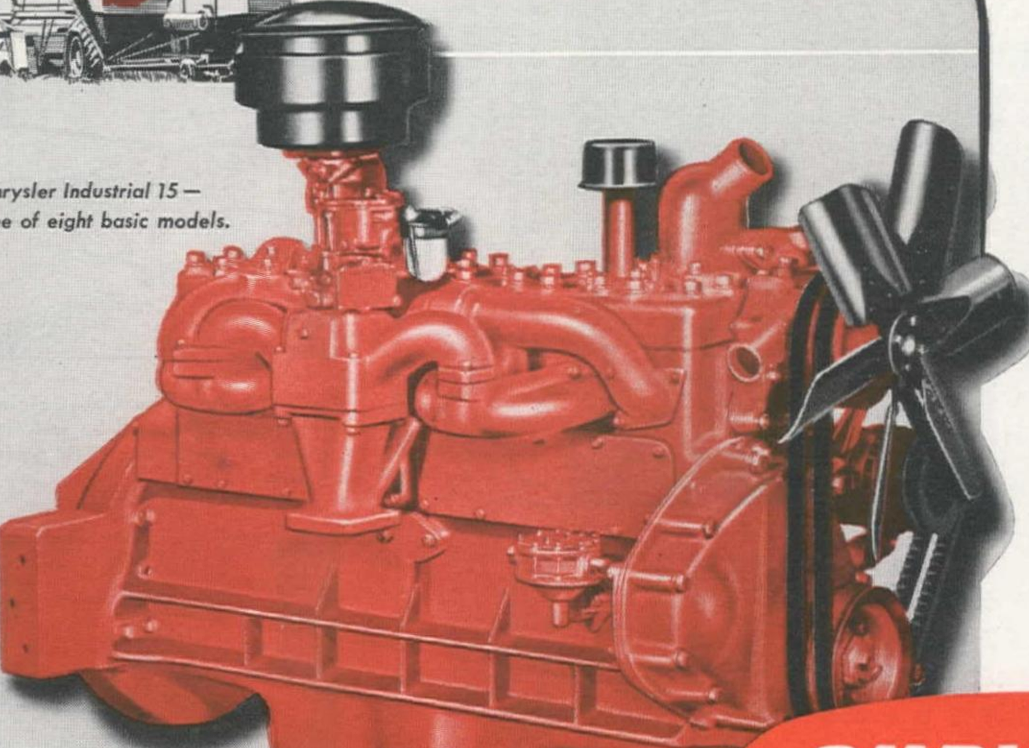


equipment!



Chrysler Industrial 15 — one of eight basic models.

CHRYSLER-BUILT INDUSTRIAL ENGINES ARE THE SOURCE OF POWER FOR:

Ditching Machines
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Original equipment manufacturers the nation over install Chrysler Industrial Engines in their equipment because Chrysler-built means better performance... rugged dependability... trouble-free operation... longer operating life, service everywhere.

Continuous Chrysler research in higher alloy steels and famed Chrysler engineering have produced an industrial engine capable of sustained high speeds with less wear... an engine that costs less to operate, less to maintain.

A letter of inquiry will bring you a qualified Chrysler engineer. Address: **Industrial Engine Division, Chrysler Corporation, Detroit 31, Michigan.**

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ARE YOU GETTING SAVINGS LIKE THESE?

Here's a contractor who *is*... with a MICHIGAN Truck Excavator-Crane.

On the Elk River Bridge Project, Garrett & Farris Company of Knoxville, Tennessee, uses it's MICHIGAN to pour concrete .. strip forms ... charge the batcher ... excavate for pier foundations ... load materials at a rail siding four miles distant and unload back at the job ... sort pilings and supply the pile driver ... position the pile puller when needed ... all in a day's routine.

And look at some of the savings:

ONLY 3 MEN NEEDED ON BATCHING AND POURING.

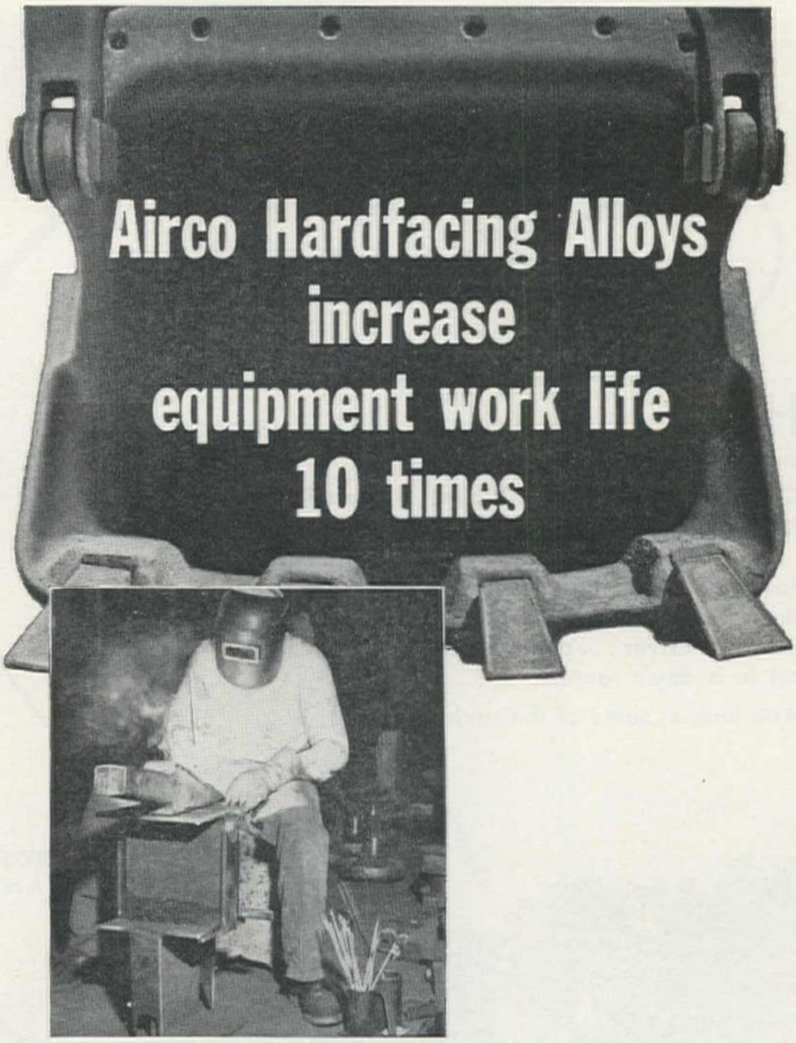
A HALF-HOUR JOB THAT FORMERLY TOOK HALF A DAY . . . here the MICHIGAN reduces labor costs 80%.

75% MAN-POWER SAVINGS BY HANDLING STRIPPED FORMS with the MICHIGAN.

When it's versatility and savings you want ... investigate MICHIGAN ... you'll agree it's your best buy!

MICHIGAN POWER SHOVEL COMPANY

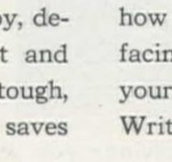
430 Second Street, Benton Harbor, Michigan, U. S. A.



Airco Hardfacing Alloys increase equipment work life 10 times

Worn machinery and equipment need no longer mean costly replacements. Today, surfaces rebuilt with Airco Hardfacing Alloys add many months to equipment life and, in many cases, improve the operating characteristics.

For example, a large contracting firm found that hardfaced manganese bucket teeth last two to six times longer than untreated teeth. Using Airco Self-Hardening Alloy, they lay a stringer bead along the edges of the bucket teeth. This alloy, designed to counteract impact and abrasive wear because of its tough, homogeneous characteristics, saves thousands of dollars in equipment work life.



But this is only one of the many Airco Hardfacing Alloys used in their welding shop to save time, trouble and money. They follow a conscientious program of hardfacing . . . a program that helps prolong equipment work life and prevents costly "down-time."

You, too, can enjoy these same time and money savings. Your nearby Airco office will gladly show you how these cost-saving Airco Hardfacing Alloys will help you with your particular problem. Write today.

AIR REDUCTION PACIFIC COMPANY

A Division of Air Reduction Company, Incorporated

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Western Headquarters for Oxygen, Acetylene and Other Gases . . . Carbide . . . Gas Welding and Cutting Machines, Apparatus and Supplies . . . Arc Welders, Electrodes and Accessories

other AIRCO hardfacing alloys

AIRCOLITE No. 59 . . . For reclaiming bucket teeth and lips used in sand and gravel pits—dredge screens—pulverizer hammers—mixer blades, this cast alloy rod is recommended for application where abrasion resistance is particularly important. Deposit acquires a high polish in service, and maintains its high hardness at temperatures up to 800°F. Applied electrically or by gas process. Deposits test from 54-59 on Rockwell "C" scale.

AIRCOLOY No. 6 . . . For refacing exhaust diesel valves on "cats"—cranes—pumps and shovels, Aircoloy No. 6 gives excellent corrosion resistance . . . retains hardness and impact and abrasion resistance at temperatures above 700°F. . . . test from 43-47 on Rockwell "C" scale. While recommended for application by gas process, rods suitable for AC or DC electric application are available.

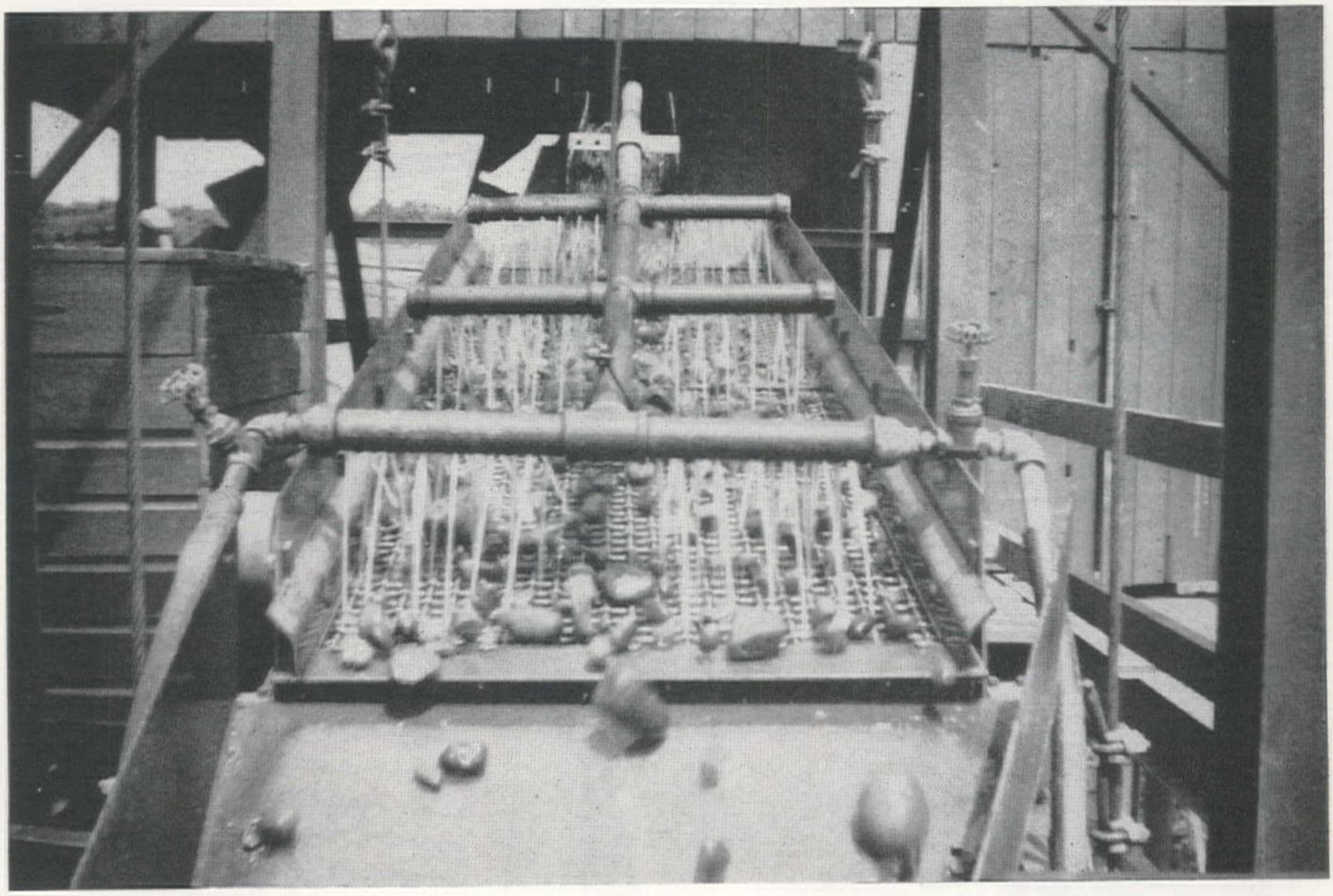
AIRCO TUNGTUBE . . . When building up grader blades—road plows—dredge pump cutters—scarifier teeth—churn drills, use tungsten carbide particles encased in a steel tube for application by either oxyacetylene method or electric arc—AC or DC. Used as a diamond substitute for earth removal and drilling operations. Hardness of tungsten carbide particles are over 80 Rockwell "C".

★ ★ ★

Air Reduction supplies Oxygen, Acetylene and other industrial gases . . . Calcium Carbide . . . and a complete line of gas cutting machines, gas welding apparatus and supplies, plus arc welders, electrodes and accessories. Ask us about anything pertaining to gas welding and cutting and arc welding . . . we'll be glad to help you.

"Paid For Itself On One Job!"

SAYS SYRACUSE SAND & GRAVEL CO., INC. OF THIS SECO VIBRATING SCREEN



More Proof for Top Tonnages and Smooth, Trouble Free Operation . . . *You're Ahead with a SECO*

About a year ago, the 3½ deck Seco pictured above was put into operation at the Nedrow, New York plant of the Syracuse Sand and Gravel Company, Inc. It replaced a 4′ x 20′ revolving screen. Here is an on-the-job report in the words of Harold Green, plant superintendent:

"Since installing the new screen, our production has increased about one-third and we are also able to produce one more grade of material which is in good demand, and was unobtainable with the revolving screen.

"We figure the screen paid for itself on one job, as we were able to meet specification on an abrasive sand that we could not have bid on, had we been using the old equipment.

"We are very pleased with the screen and to date, other than changing screens, we have not had a wrench on it."

It makes sense to find out how you can make more dollars out of your production, too! Send for Seco catalog No. 203 today!

SECO

TRUE CIRCULAR ACTION

VIBRATING SCREENS

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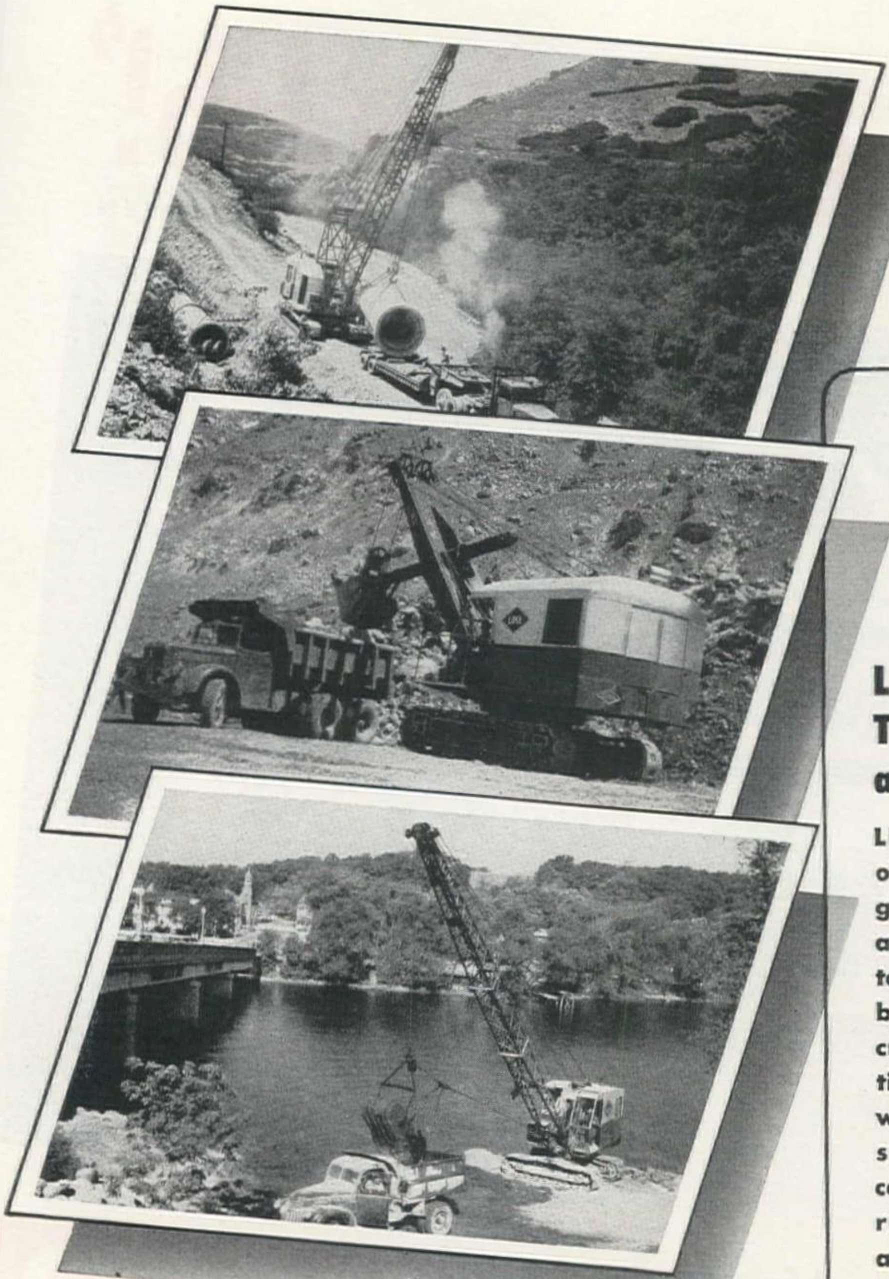
One of America's Leading Makers of Vibrating Screens Exclusively



LIMA

CAPACITIES
CRANES-Up to 110 TONS
SHOVELS-¾ Yds. to 6 Yds.
DRAGLINES-Variable

LIMA Rubber Mounted TRUCK CRANES in 20 and 35 Tons Capacity

LIMA rubber-mounted cranes offer you the added benefits of greater mobility, less travel time and better maneuverability. Rotating assemblies have the same basic features as corresponding crawler machines, with alterations adapting them to truck or wheel mounting. With outriggers supported, they provide extra capacity; are ideal for operations requiring constant movement around the job, for small scattered jobs, or remotely located.

FIRST BY COMPARISON

LIMA Shovels, Cranes and Draglines have always stood alone by comparison because they are engineered and built to give every user the best value for his investment. Their high productivity, versatility and money-saving features keep down-time to a minimum and output at a maximum.

Investigate LIMA shovels, cranes and draglines. See for yourself how they help you get greater production at lower cost. *Baldwin-Lima-Hamilton Corporation, Lima-Hamilton Division, Lima, Ohio, U. S. A.*

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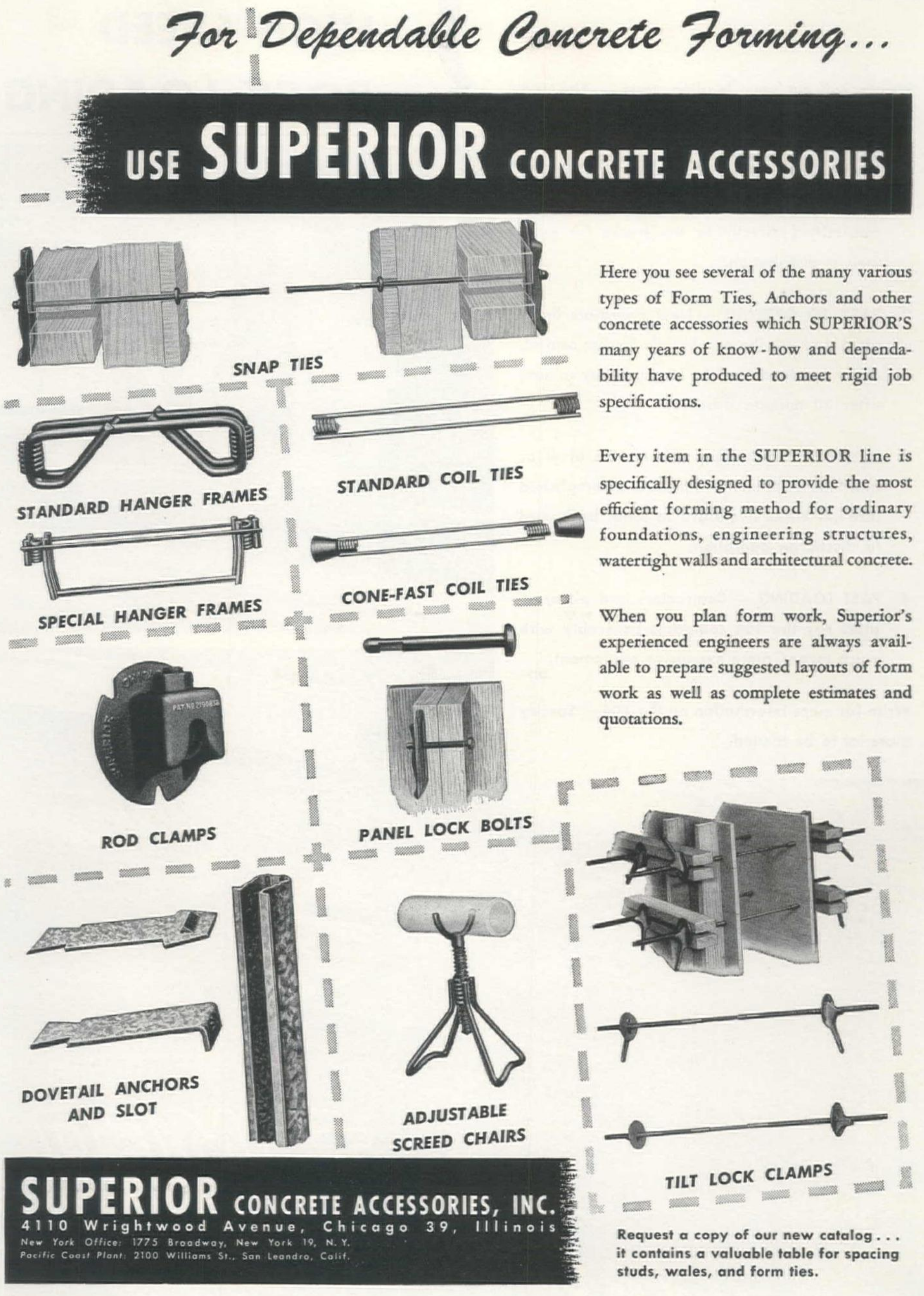
BALDWIN-LIMA-HAMILTON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USE SUPERIOR CONCRETE ACCESSORIES
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STANDARD HANGER FRAMES
STANDARD COIL TIES
SPECIAL HANGER FRAMES
CONE-FAST COIL TIES
ROD CLAMPS
PANEL LOCK BOLTS
DOVETAIL ANCHORS AND SLOT
ADJUSTABLE SCREED CHAIRS
TILT LOCK CLAMPS
Here you see several of the many various types of Form Ties, Anchors and other concrete accessories which SUPERIOR'S many years of know-how and dependability have produced to meet rigid job specifications.
Every item in the SUPERIOR line is specifically designed to provide the most efficient forming method for ordinary foundations, engineering structures, watertight walls and architectural concrete.
When you plan form work, Superior's experienced engineers are always available to prepare suggested layouts of form work as well as complete estimates and quotations.
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Request a copy of our new catalog . . . it contains a valuable table for spacing studs, wales, and form ties.

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FOR LOW COST HIGH SPEED ROCK LOADING

Eimcos will cut your loading costs — The 104 has the following advantages:

1. **HEAVY-DUTY CONSTRUCTION** — The 104 loader is unit constructed and all loads are transmitted directly to the tracks for even weight distribution.

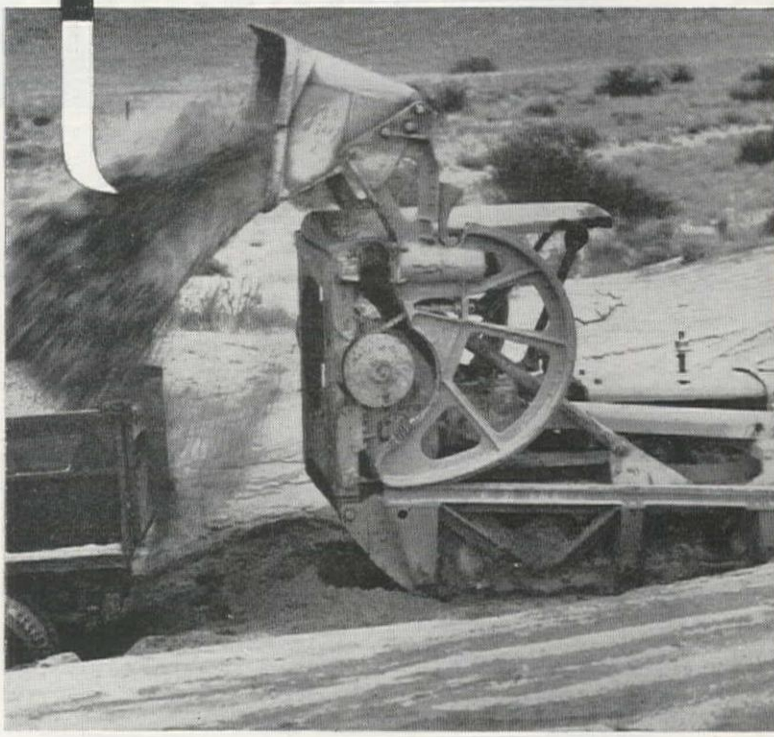
2. **EASY TO OPERATE** — New operators learn quickly to use the one handle bucket control. Many are loading 8 to 10 yards per minute after 30 minutes practice.

3. **LOW MAINTENANCE** — Elimination of wear and tear on rollers and track is accomplished through Eimco's forward to load, backward to discharge operation.

4. **FAST LOADING** — Contractors and pit operators say the 104 compares favorably with much larger, more expensive equipment.

Write for more information on the 104 — Specify material to be loaded.

A345



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- TRANSMISSION BELTING
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- INDUSTRIAL MOLDED PRODUCTS
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- CUSTOM-BUILT RUBBER PRODUCTS For All Industries

American's industrial rubber products are designed for the specific job. Resulting in . . .

LONGER LIFE · LESS FREQUENT REPLACEMENT and ECONOMY

There is no substitute for *experience* in acquiring the "know-how" to recognize industrial problems and manufacture the right product for the specific job. That's why so many industrial users of mechanical rubber goods have been American Rubber Company customers for nearly half a century.

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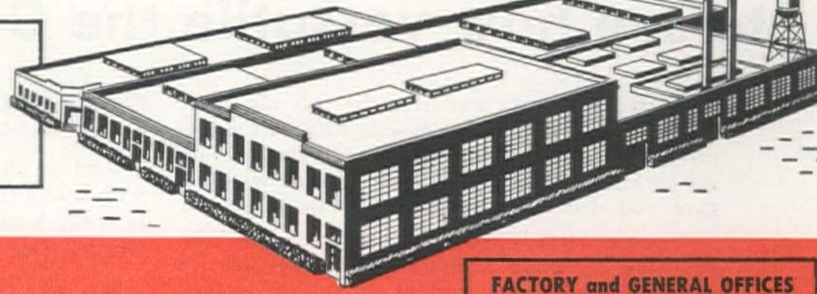
Having a close-at-hand factory is one of the vital reasons why so many western manufacturers are permanent American customers. American's Oakland factory is centrally located and quickly accessible to all western industry. Expanded facilities plus expert technicians make American *the* key plant west of the Mississippi.



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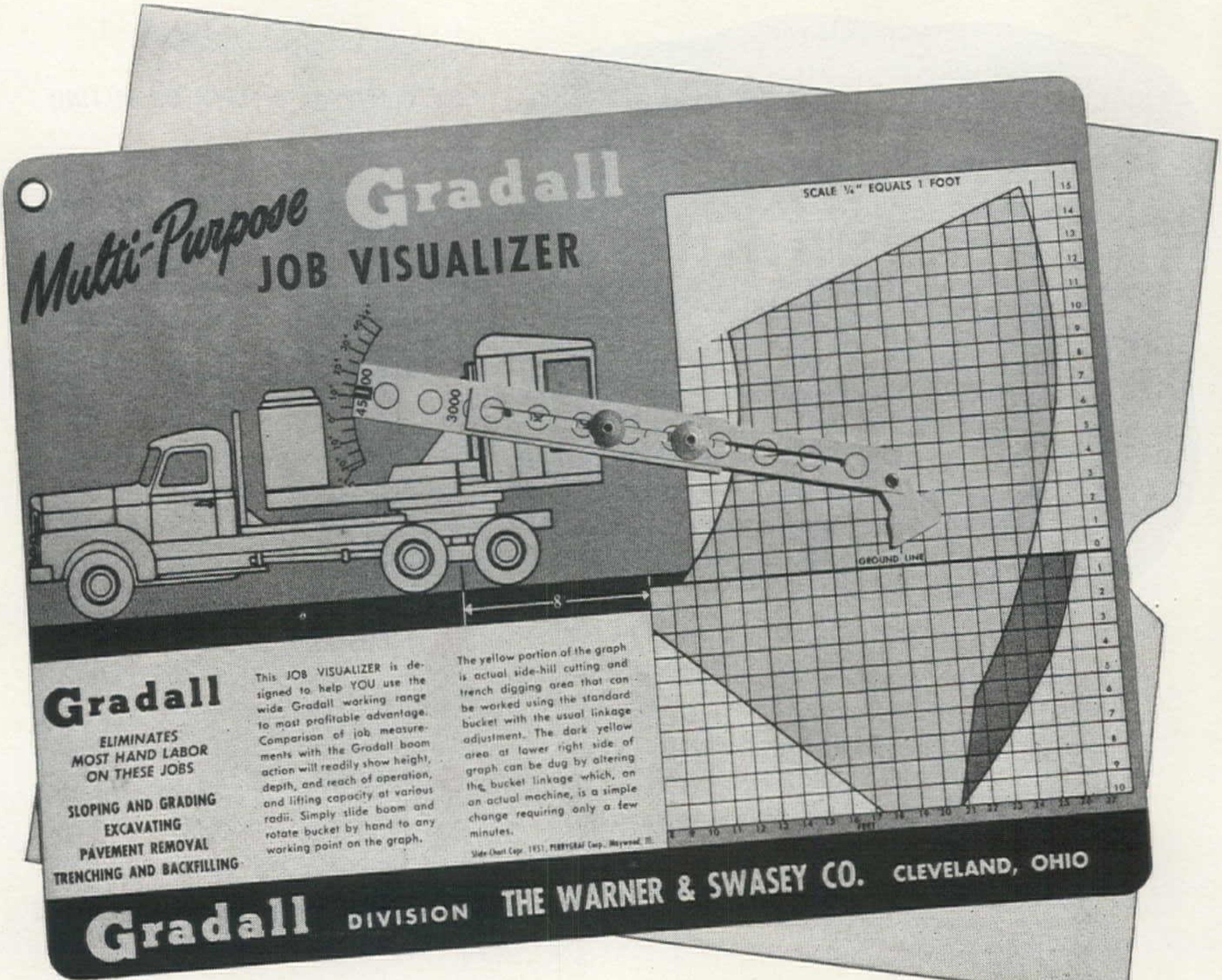
THE AMERICAN RUBBER MANUFACTURING COMPANY



Send for this "JOB VISUALIZER"
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YOURS FOR THE ASKING, the job visualizer shown above tells you exactly what this multi-purpose construction machine can do. In addition, the back side of the job visualizer, not shown here, gives you operation dimensions and specifications.

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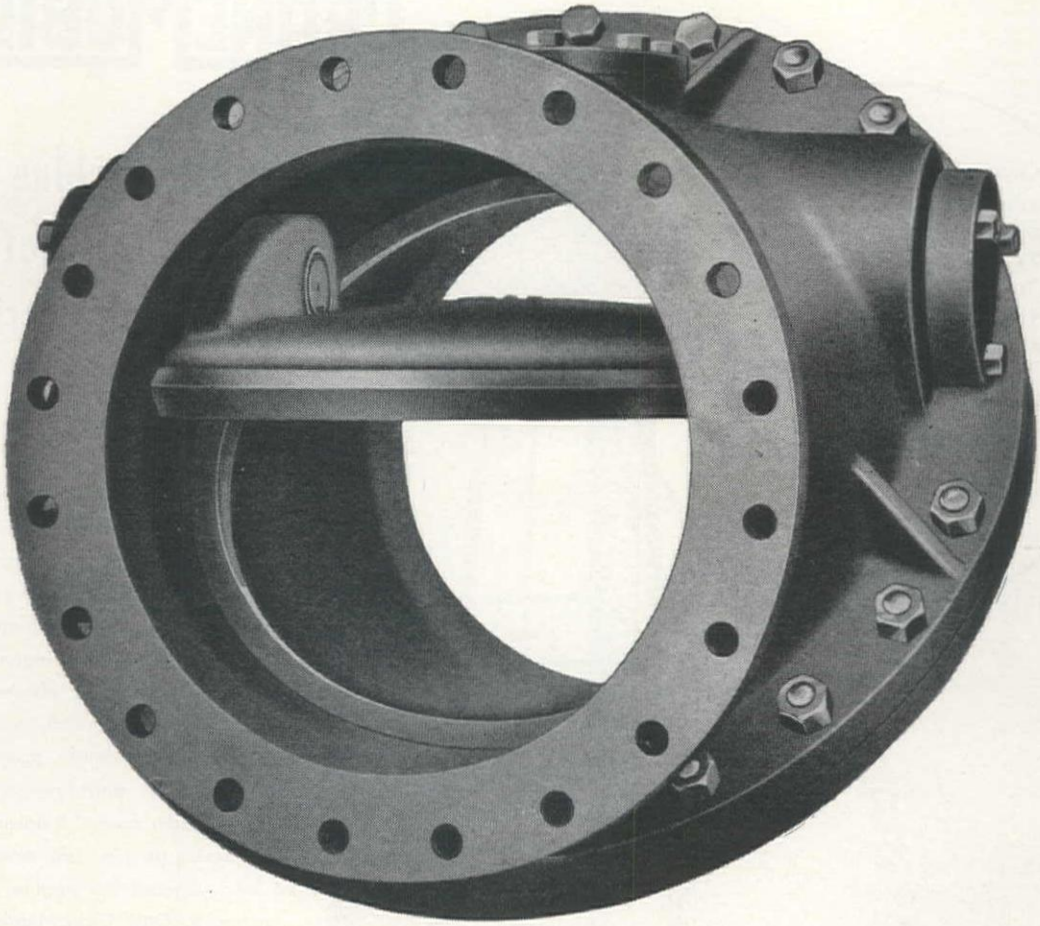
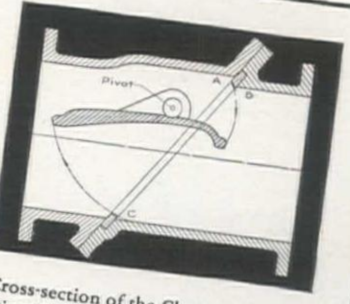


CHAPMAN

TILTING DISC CHECK VALVES

Cut Maintenance Costs

with Cushioned-Closing



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.

There's less wear on seating surfaces, hinge pins and bearings with the cushioned closing action in a Chapman Tilting Disc Check Valve. No destructive slamming. No fatiguing flutter. No vibration of pipe lines or adjacent structure — nor danger of opening pipe joints or rupturing pipe lines. Just a quick and quiet closure that cuts maintenance costs.

And what's more, the balanced streamlined discs in Chapman Tilting Disc Check Valves ride smoothly on the stream—reduce head losses 65 to 80% over conventional swing type checks. You'll want to know more about this maintenance-saving, more efficient check valve. Write today for engineering data, Bulletin #30.

THE CHAPMAN VALVE MANUFACTURING COMPANY
INDIAN ORCHARD, MASSACHUSETTS

BAY CITY CRANEMOBILE

Pacific Crane and Rigging, Inc. of Los Angeles uses a BAY CITY CraneMobile with 140′ of boom and jib to speed erection of a water tank for the Chicago Bridge and Iron Works at the new plant of the Western Wax Paper Co.

A great machine for profitable erection and rigging work

High lifts and heavy lifts on all sorts of difficult erection and construction jobs are handled with speed, precision and power with a BAY CITY. The CraneMobile is a finely engineered combination of rugged truck and versatile crane, built as a unit by BAY CITY to give you an integrated and balanced crane. A great many BAY CITY features combine to make CraneMobile an efficient powerful unit for materials-handling and erection work. An independently operated power boomhoist raises and lowers boom and load only under power. A power load lowering device permits safe, accurate lowering of loads against the engine and crane machinery. Only CraneMobile gives you the balance and stability for heavy lifts, the precision control for delicate operations high in the air, and the extra strength and weight that mean dependable performance and extremely long life.

BAY CITY SHOVELS, INC.
BAY CITY, MICHIGAN

194

CHECK LIST

- *20-25 Ton Capacity*
- *Pin-Connected Boom*
- *Hi-Collapsible Gantry*
- *Independent Power Boom Hoist*
- *Precision Power Load Lowering*
- *Removable Counterweight*
- *Specially Designed Carrier*
- *High Road Speeds*

Husky carrier, specially designed and built by BAY CITY, takes CraneMobile right to the job at speeds up to 35 miles an hour. Frame is heavily cross-braced to withstand the stress and strain of heavy swinging loads and long booms. Available in 6 x 4 and 6 x 6 drive with tandem axles. Complete with all accessories including many BAY CITY extras that are standard equipment. Five models to meet most every job requirement.

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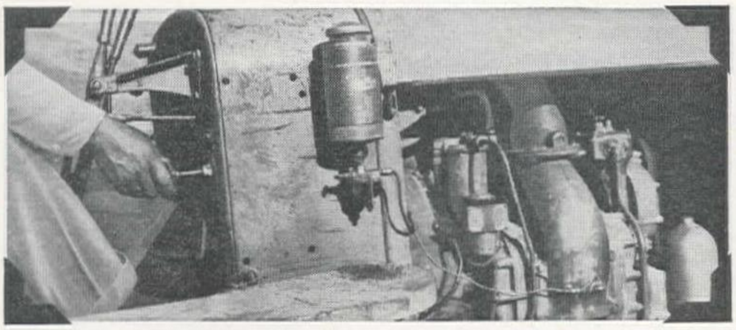
Western Machinery Company
124 E. Buchanan Street

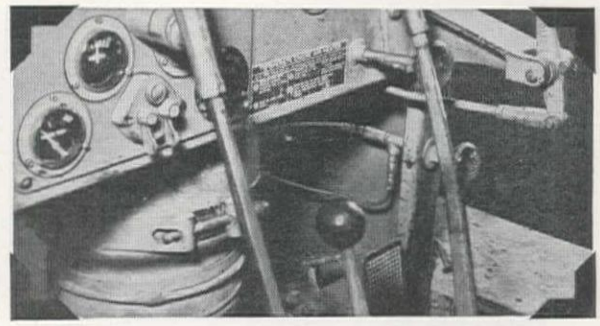
STANDARD ENGINEER'S REPORT

DATA

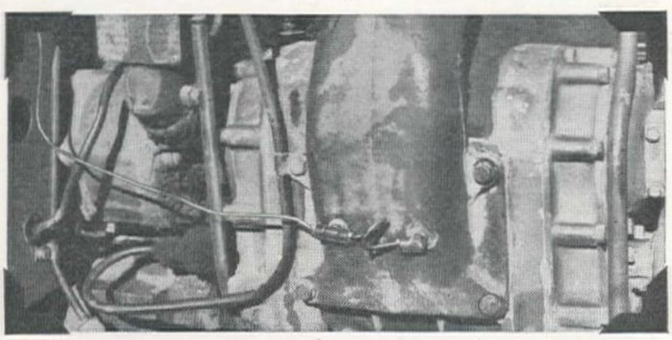
PRODUCT: Chevron Starting Fluid
UNITS: A. C. diesel engines HD-7 tractors
CONDITIONS: 25° below zero weather—parked in open shed
EQUIPMENT: Permanent primer with atomizers on blower
FIRM: John W. Graves Heppner, Oregon

Engine starts on first turn at 25° below zero!



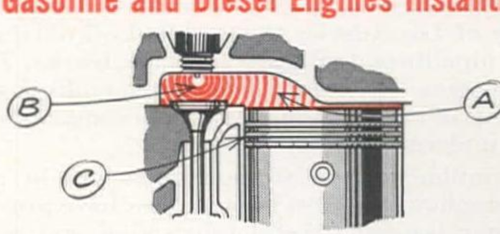


CHEVRON STARTING FLUID started this engine instantly every time during a severe Oregon winter, even when the tractor had been idle for several days in temperatures down to 25° below zero! John W. Graves, owner, says, "Power in the starter battery would last only for two or three revolutions of the engine,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



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

How CHEVRON Starting Fluid Starts Gasoline and Diesel Engines Instantly



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

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

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

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

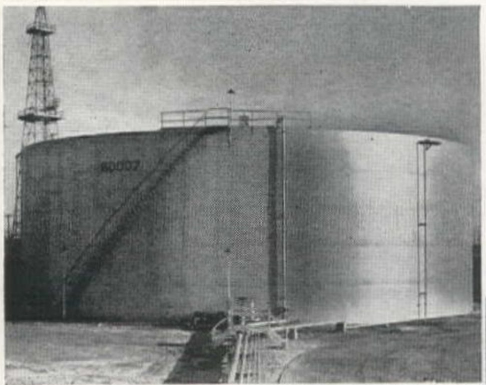
CHEVRON STARTING FLUID

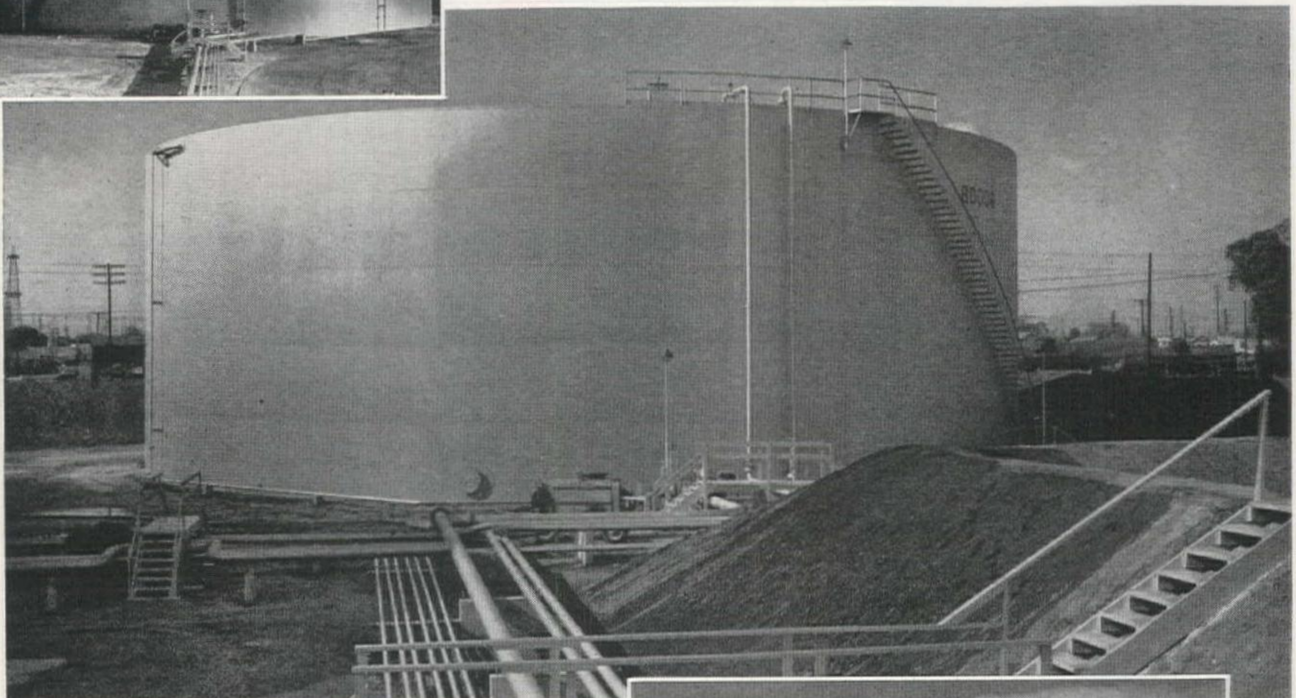
TRADEMARK REG. U.S. PAT. OFF

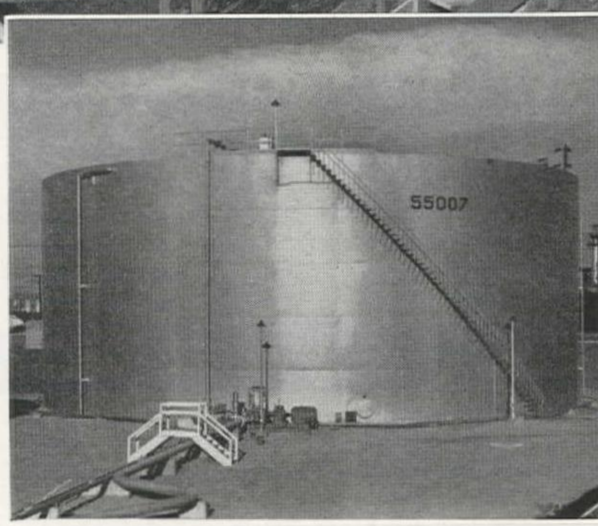
STANDARD TECHNICAL SERVICE checked this product performance. For expert help on lubrication or fuel problems, call your Standard Fuel and Lubricant Engineer or Representative; or write Standard Oil Company of California, 225 Bush St., San Francisco.

STANDARD OIL COMPANY OF CALIFORNIA

Municipal Fuel Oil Needs Supplied by New HORTON TANKS







The accompanying views show three of five Horton tanks which were recently installed by the Department of Water and Power of the City of Los Angeles to store fuel oil obtained via pipe lines, tank cars and tank trucks. The oil is then transferred from these tanks to the points of ever-growing municipal consumption by underground lines.

Similar Horton storage tanks are in use throughout the West because they have proven longer lasting. Careful fabrication and erection methods have made this important difference. Every Horton structure is the product of years of specialized experience.

Horton tanks and other fabricated steel plate structures can be built, to exacting specifications, for any use. Write our nearest office for more information or quotations. There is no obligation on your part.

Upper left............................*80,000-barrel Horton tank*
Center..................................*80,000-barrel Horton tank*
Lower right..........................*55,000-barrel Horton tank*

HORTON

WELDED STEEL STORAGE TANKS

CHICAGO BRIDGE & IRON COMPANY

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

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

WESTERN CONSTRUCTION

November 1951 Vol. 26, No. 11

Toward unity in building codes

PROGRESS IN BUILDING DESIGN and construction is customarily far in advance of building codes. A reasonable lag between all technical improvements and those which receive recognition in official codes is necessary and in the interest of public safety. Too often, however, the interval is prolonged far beyond the period required for technical study and testing. This additional time represents an economic loss.

Forces which tend to accentuate this unnecessary delay include: (1) political forces and pressure groups in a municipality which are always testing their strength in connection with changes in city regulations, (2) reluctance on the part of representatives of accepted materials or equipment to give ground to competition that would be aided by any change, and (3) differences which exist between the several accepted model codes. This last factor provides grounds for debate, delay and stalling.

Today there are four major codes that have received broad acceptance throughout the nation. One of these is a product of the West, being the Uniform Building Code developed by the Pacific Coast Building Officials Conference. Its first edition appeared in 1927, making it the second major code contribution, following the father of them all—A Recommended National Building Code, put out by the National Board of Fire Underwriters about 1905. Admitting the detail differences that must distinguish codes suitable for cities of varying size and location across the country, there are many advantages to be secured from reconciling basic differences in the four codes and working toward a final standard. Uniformity makes for economy in building and design.

For about two years a joint committee, including representatives from the major code groups, and other technical organizations, have been at work in an endeavor to reconcile these gradually decreasing differences. The constructive work of this committee will approach what could ultimately be a national model building code. Representatives of the Pacific Coast Building Officials Conference are serving on this important committee.

Code elements which are relatively non-controversial, and matters involving administration should be brought to uniformity without too much difficulty. Such features as relate to the acceptance of new materials and methods of construction will involve more work in reconciliation. Lastly, there will always exist the procedural problem for keeping the code up to date. However, the advantages that will result from even a generalized model code of national acceptance represent an objective worthy of the hard work of the committee.

Water is too expensive to waste

VALUE OF WATER IN THE WEST continues to increase as demand mounts toward the ceiling of available supply. There is a corresponding need for saving at every stage of development, delivery and use. This is particularly true where irrigation water reaches the smaller laterals and the farmer's ditches. Practically all of these are unlined, with seepage losses high. The situation, and the interesting practical engineering problems involved, have prompted several articles in recent issues of *Western Construction* describing the relatively new procedure of placing an asphaltic-membrane lining in ditches, and particularly the special use of a prefabricated membrane in smaller ditches.

Here is a procedure which may require further refinement, but one which holds much promise as representing an economical as well as practical means of saving an important amount of valuable water. As used today the lining involves the applying of membrane and placing a back-fill of dirt for protection. Disadvantages obviously include the cost for the over-excavation and future weed growth in this backfill. Possibly the final answer might provide a design to include the membrane topped with a layer of gunite to secure strength and protection from puncture without backfill and a stop for weed growth.

Up to the present time the many installations have been based on meager data with regard to effectiveness. In this issue, for the first time, information is presented on the results obtained from tests on the reduction of seepage losses.

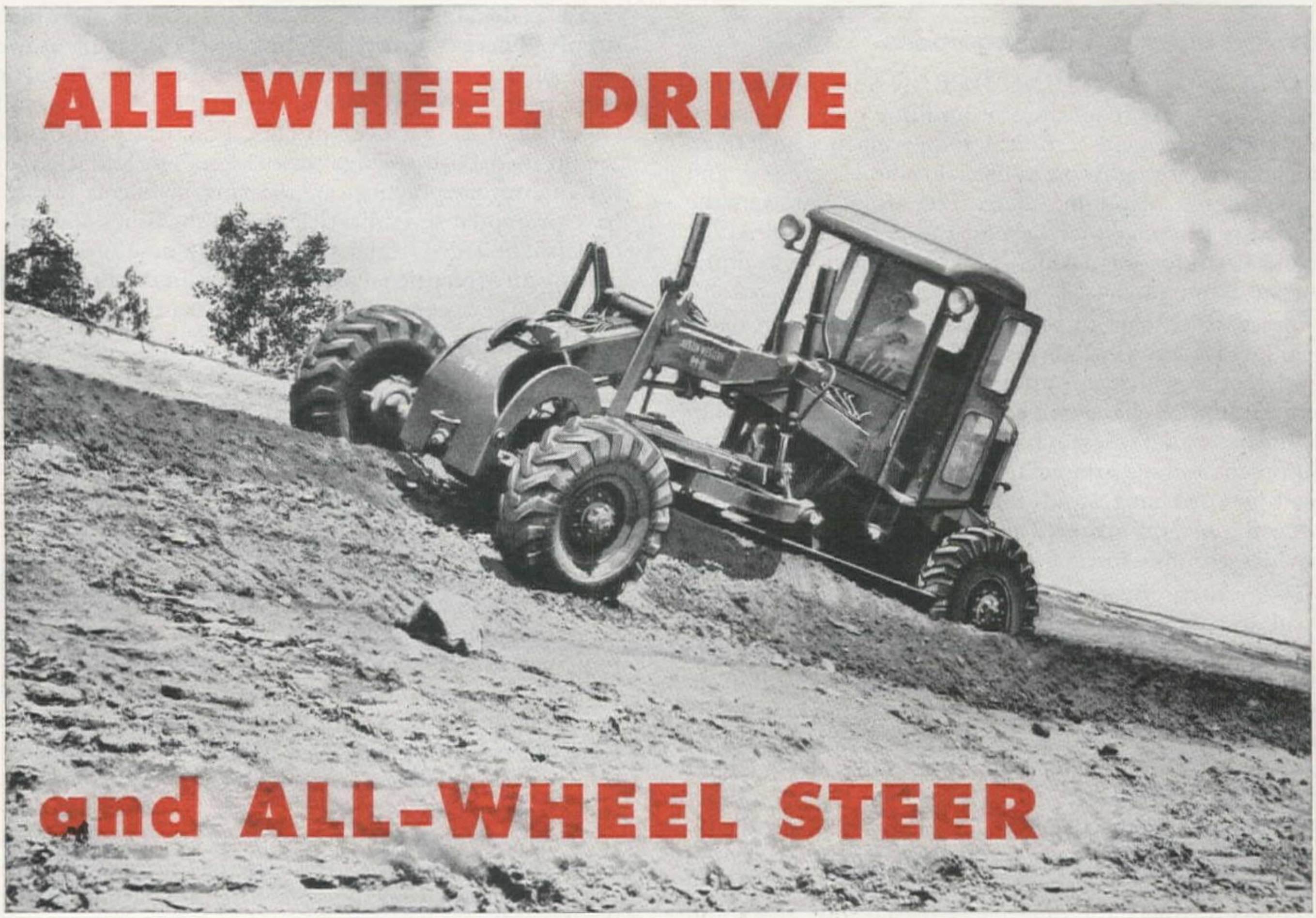
In general terms, the figures indicate that the seepage losses from a ditch with this type of lining are less than 10% of the loss from the same ditch operating in an unlined condition. Immediately an actual figure is available on which to calculate the value of such a lining in terms of water saved. The test results may serve to accelerate this new development for the conservation of valuable irrigating water.

AED recognizes the Regional West

FOR THE FIRST TIME the members of the Associated Equipment Distributors in the eleven Western States have met in conference to review their common problems—both current and long-range. This recognition of regional problems among those who sell and serve the contractors and other users of equipment is in line with the Western meetings of other groups in this broad industry. Common denominators of interest extend through most technical and business problems with corresponding value in an interchange of ideas. The AED conference held at Sun Valley could well be the beginning of periodic meetings of AED members of the West to their own advantage and for the good of the entire construction industry.

Like Thanksgiving Day and Turkey...

they Go Together



Sure-footed as a mule...the A-W Power Grader

Ride it down with the grader . . . that's the way to slope a bank! Keep the blade down under the frame where it belongs . . . where it will run smooth and true.

You can do it with an Austin-Western Power Grader, thanks to exclusive All-Wheel Drive and All-Wheel Steer. The live power in the front drivers grips the bank; the rear wheels are steered uphill, and the machine works steadily along the face of a slope too steep for an ordinary grader to negotiate.

Yes—All-Wheel Drive and All-Wheel Steer work together as a team to really go places and do things. We'd like to tell you the whole story . . . it's a good one.

AUSTIN-WESTERN COMPANY · *Subsidiary of Baldwin-Lima-Hamilton Corporation* · **AURORA, ILLINOIS, U.S.A.**

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CALIFORNIA—SMITH BOOTH USHER COMPANY..........Los Angeles 54
COLORADO—LIBERTY TRUCKS & PARTS COMPANY..........Denver 1
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MONTANA—WESTERN CONSTRUCTION EQUIPMENT CO..........Billings
MONTANA—WESTERN CONSTRUCTION EQUIPMENT CO..........Missoula
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WASHINGTON—COLUMBIA EQUIPMENT COMPANY..........Seattle
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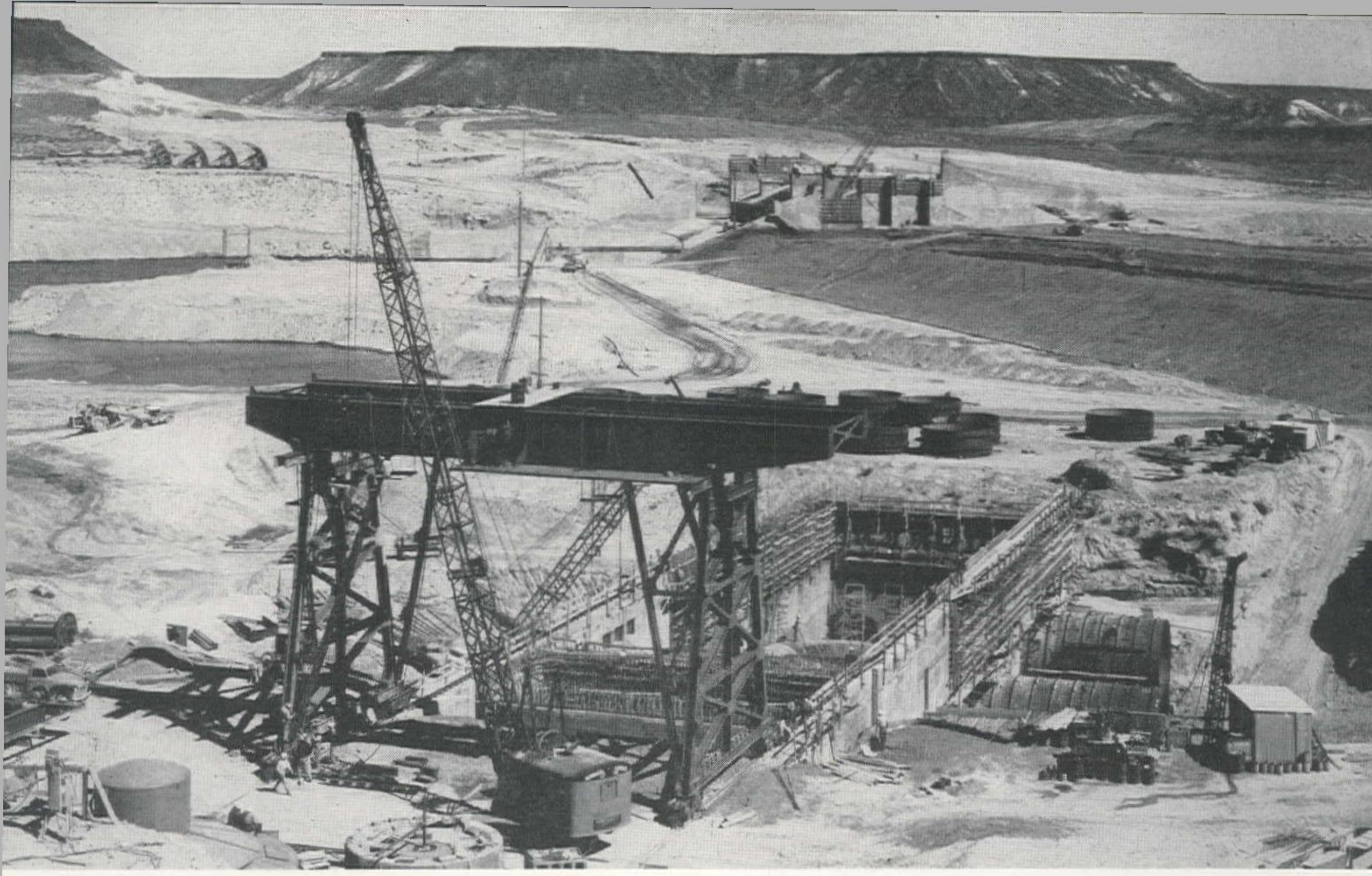
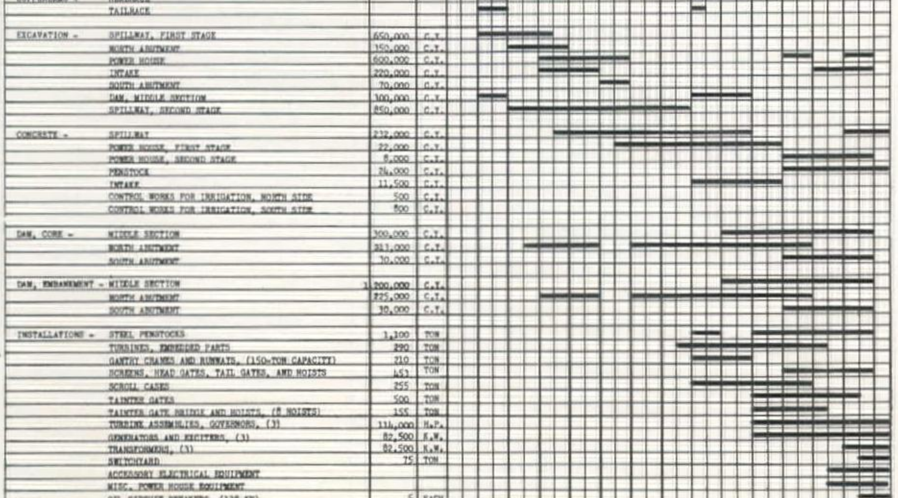


Idaho Power Co. combats the Northwest "brown-out" with a—

Hydro plant built in 13 months

Ample working space (above) and tightly overlapping construction schedule (chart below) helped the crews of Morrison-Knudsen rush completion of the $20,000,000 C. J. Strike development in a broad valley of the Snake River



POWER GENERATION within about thirteen months after construction work started was the aim of Idaho Power Company in the construction of its $20,000,000 C. J. Strike Hydro-Electric Development. This aim is soon to be realized. The work involves a 3,220-ft. earthfill dam, with a concrete spillway and a powerhouse with three 30,000-kva. generating units. This high speed schedule of construction was necessary to keep pace with a load growth on the company's lines which, percentage-wise since 1942, is the greatest among all power suppliers of the Pacific Northwest.

The contractor, Morrison-Knudsen Company, Inc., has followed a tight construction schedule. It has taken full advantage of the ample working area, and this has allowed several operations to be carried out simultaneously in bringing to completion this project on the Snake River about 60 mi. southeast of Boise, Idaho.

The C. J. Strike Hydro-Electric Development—named for the late president of the company—is the sixth plant in the Idaho Power Company's postwar expansion program designed to meet ever increasing power demands in the area. At the end of the war the company was producing power at a rate of 105,000 kw., and this has been stepped up to a current output of 285,000 kw. With the addition of the power to be generated at the C. J. Strike plant, the output will total 375,000 kw.

The site for this project is located about 23 mi. south and west of Mountain Home, where the Snake River occupies a relatively broad valley flanked by steep bluffs formed by ancient lava flows on the north bank and by a silt clay formation on the south bank. Normally the river flows in a 600-ft. width of channel with a wide flood plain on either side. By locating both the spillway and the powerhouse on these flat areas at some distance from the channel it was possible to work in-the-dry on the powerhouse and spillway, and secure river diversion with minimum construction time and effort. This design also enabled work to advance on several major points of attack without delay or interference. By designing the concrete spillway to include ten openings at an elevation below the streambed, it was possible to divert the river, after the spillway had been completed above this grade, and move into the channel with simple dirt cofferdams above and below the works.

Stiff schedule

As a construction job the work has been primarily excavation, placing fill, concrete structures, installation of machinery and the usual secondary operations necessary in a hydro-electric project. However, the job has been pushed at such high speed that those connected with the project consider the construction schedule to be as tough as any that could be found. To date, as the project enters the final stages, the schedule has been strictly adhered to.

In establishing the schedule, the engineers of Idaho Power Company built it around information received from the manufacturers as to their shipping promises of the major units of equipment to be installed. After receiving definite delivery dates for these items they expedited delivery of the smaller pieces so that the work of installing them could dovetail properly within the schedule. For instance, the installation of the turbines required that the gantry crane be in place, and to have the gantry crane in place it was necessary to have the powerhouse structure at final elevation to start turbine installation, the first of which was received in ten months.

With the delivery dates established for all equipment, the Morrison-Knudsen Company and Idaho Power Company forces made up a detailed schedule to have necessary elements of construction completed in the proper time and order. It was decided that the required early completion could only be accomplished by saturating the area with a mass of large equipment and construction tools, and carrying out the operation on two 10-hour shifts six days a week to get maximum use of this equipment. For the earth-moving work the yardage that would have to be moved each day to meet the schedule was determined, and the amount and type of equipment moved onto the job was governed by this yardage.

Working from isometric drawings the concrete structures were laid out somewhat like building blocks and estimates prepared on how many yards of concrete each block would require, and how soon a subsequent lift could be placed. Working further from the blocks, the amount of concrete that would have to be placed each day to meet the delivery schedules was estimated and these figures were used to determine the list of concrete placing equipment that would be used.

As job conditions were not really adaptable to cableway operation, it was decided that a fleet of mixer trucks would transport concrete from a central batching plant and placing would be carried out by crane.

Construction procedure

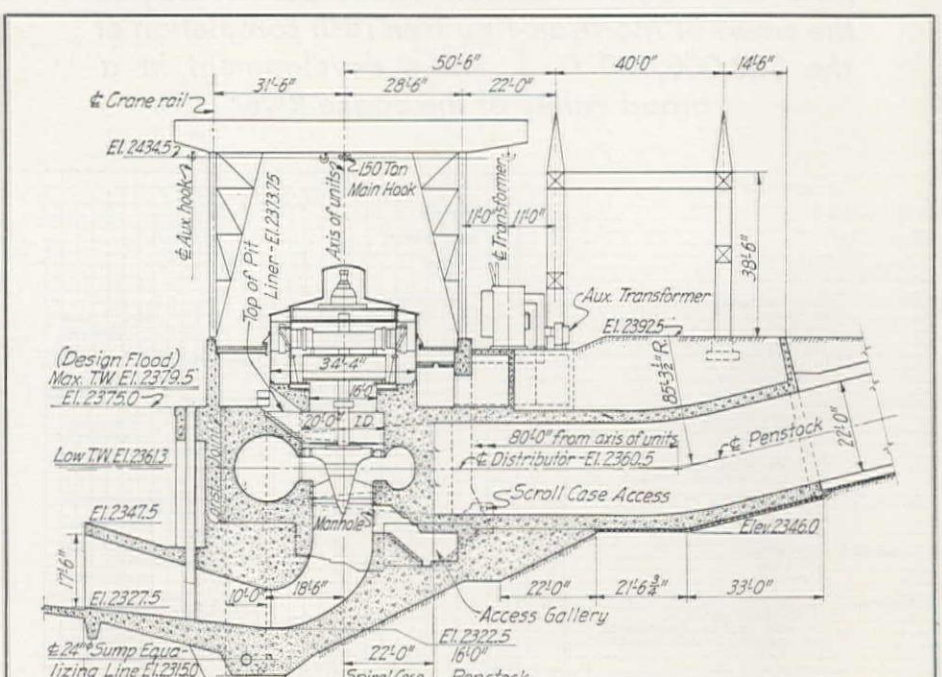
Construction work started at the spillway on Dec. 4, 1950, and the work on the powerhouse began Feb. 15, 1951. Prior to first-stage excavation for the spillway, an 8-mi. access road had been pushed through to the site and work started on a permanent bridge across the river below the dam site. The construction camp had also been set up. The general plan was to get concrete work on the spillway started as early as possible to permit diverting the river through the ten rectangular openings by July. All of this early work on the spillway was carried out in-the-dry. Simultaneously, initial work was carried out on the head and tail cofferdams. The second stage spillway excavation, to provide for diverting the river, started about a month after the first stage began, and was completed in time for the diversion on July 9.

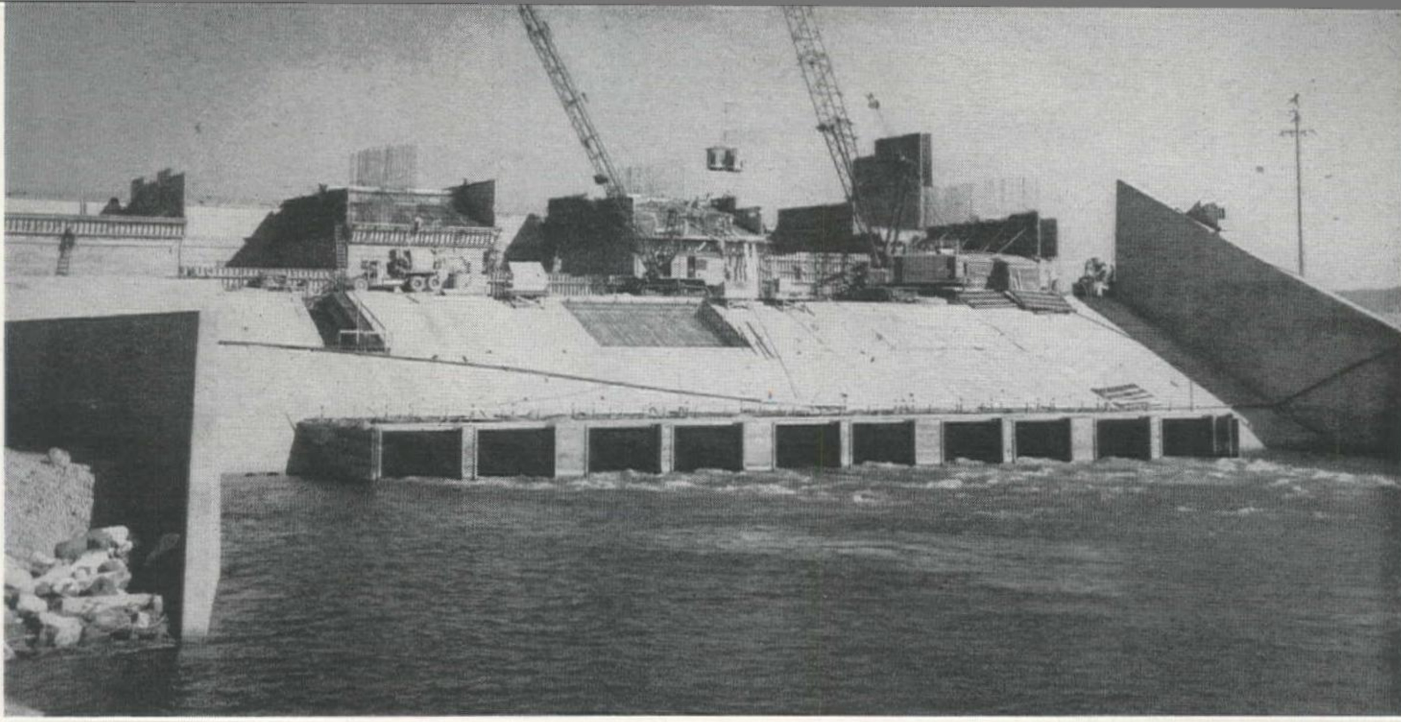
When spillway excavation was well under way, by mid-February, some of the equipment was shifted to the intake and powerhouse sites to prepare these areas for their respective structures. Excavation on the north abutment was carried along during early excavation work.

PRINCIPAL FEATURES AND DIMENSIONS

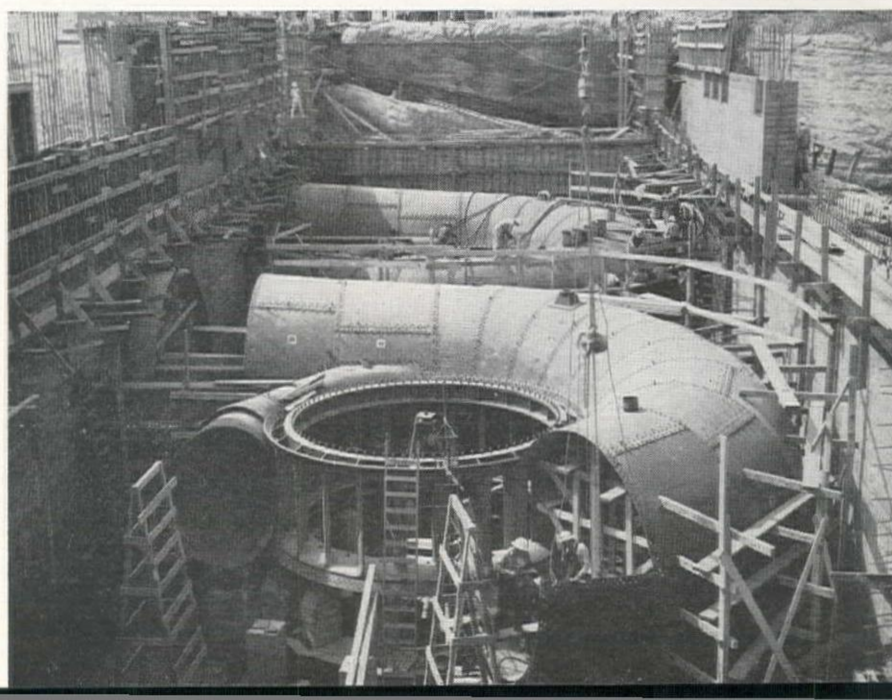
Dam:	
Total length, including 364 ft. of spillway..(ft.)	3,220
Maximum height.......(ft.)	132
Volume of fill....(cu. yd.)	2,000,000
Volume of excavation for project.......(cu. yd.)	3,000,000
Storage capacity of reservoir above maximum drawdown ....(ac. ft.)	37,000
Spillway:	
Design capacity (sec. ft.)	100,000
Tainter gates (10)....(ft.)	22 x 32
Openings for diversion (10) (subsequently plugged) ....(ft.)	10 x 15
Length of paved apron ....(ft.)	300
Powerhouse:	
200 ft. long by only 60 ft. wide.	
Height of building from bottom of excavation ....(ft.)	80
Installed capacity..(kw.)	90,000
Size of penstocks (ft. diam.)	22
Static head ....(ft.)	90
Crane capacity ....(tons)	150

UNIQUE DESIGN of the C. J. Strike powerhouse reduced construction time, and costs. Downstream wall is closer to turbines to provide a narrower structure.





TEN OPENINGS in bottom of spillway (above) were used for diverting river. Structure grows as cranes place concrete brought by steady stream of transit-mix trucks. At right, third form for powerhouse intake is swung into position. Fabrication of scroll case in narrow powerhouse is seen at bottom of page.



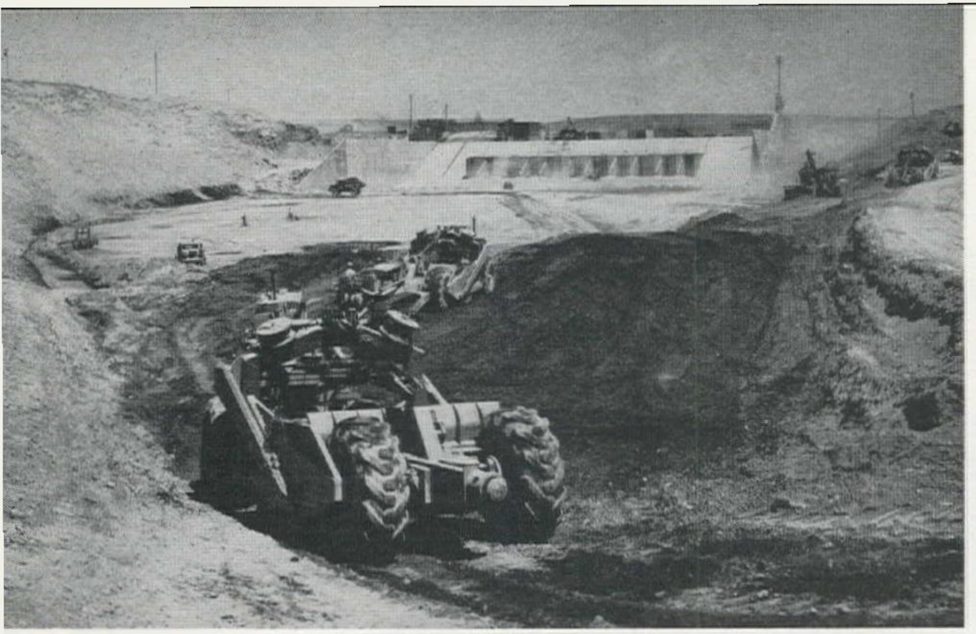
Concrete operations began at the spillway in mid-February, immediately following completion of first stage excavation. Concrete placing for the powerhouse began in mid-April and for the intake structure about the first of July. The second stage concrete work for the powerhouse and penstock installations began Sept. 8.

As soon as the river diversion was carried out through the lower part of the spillway, cofferdams were completed and work started on the embankment for the middle section of the dam. Work on the north abutment had been started previous to the diversion and work on the south abutment began the first of October.

Installation of equipment began with setting in the embedded parts of the turbines in mid-June by portable crane, and the remainder of the installations followed in order. Generators were supplied by General Electric Company. The 150-ton gantry crane was built by Bedford Foundry. The 22-ft. diameter steel penstocks were fabricated and placed by Chicago Bridge & Iron Company. Turbines were supplied by Newport News Shipbuilding and Drydock Company.

Powerhouse design

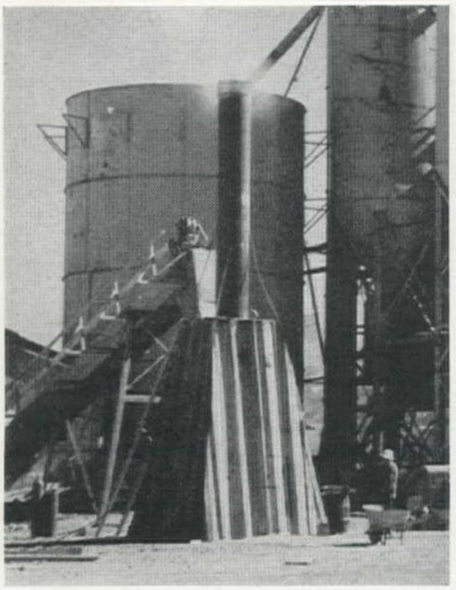
Time of construction and cost of the powerhouse at C. J. Strike have been cut by a departure from the more standard powerhouse design (see cross-section drawing). While in length the structure is standard for the three turbines it will contain, the width has been reduced by the elimination of the usual wide room extending between the downstream crane wall and the end of the draft tubes. In effect, the downstream wall of the powerhouse will be about



EARLY LAST SPRING the spillway structure (background above) rose on dry land as a fleet of Terra Cobras carried out excavation for downstream channel. Box-like openings in bottom of spillway were used for the July 9 diversion. Excavated material that could be re-used in embankment was stockpiled.

BOTTOM-DUMP Euclids momentarily gang up on loading shovel (above) as they helped maintain the 18,000-cu. yd. per day earthmoving schedule. Bottom-dumps were used primarily to transport material for the upstream and downstream shells of the embankment.

UNIQUE FEATURE for emptying cement sacks at batch plant included inclined shaker that shook sacks thoroughly as they were carried to the incinerator below.



the same distance from the turbines as is the upstream wall.

Instead of providing a separate draft tube gate crane for handling the gates used in unwatering the turbines, these gates have been set back closer to the turbines and an overhang on the main gantry crane will serve as the gate crane. Also, the gates are set in the middle of the draft tubes instead of being located at the downstream end, as is conventional design. When necessary, the entire area from intake to draft tube can be unwatered by lowering head and draft tube gates and pumping from a sump into which the water drains from the enclosed sections.

The separate scroll case manway has also been eliminated and access to the scroll case is provided by a hatch that enters each penstock just above the connection to the scroll case. A small access gallery leads to this hatch from a point near the turbines. The tailrace extends from the draft tube outlet to the river on a five-to-one slope for a distance of approximately 250 ft. and an additional distance of approximately 700 ft. at an average depth, of excavation, of 23 ft.

A unique feature of C. J. Strike development relates to the generator construction which is designed to avoid operating problems such as outages and excess maintenance costs that result from the effects of alkali-aggregate reaction in the surrounding concrete. In previous hydro-electric plants the Idaho Power Company has experienced these problems resulting from concrete expansion at generator settings that necessitated the re-aligning of large units.

At the C. J. Strike project the first precaution has been to use low-alkali cement because tests showed the aggregate to be somewhat contaminated with reactive constituents. As a further and more definite remedy, to avoid future difficulties in misalignment from "growing" concrete, the total weight of each generator is supported on a single foundation (see powerhouse drawing).

Unique generators

These generators are unique in that the two important components—the stator and the lower bearing bracket, supporting rotating parts—are not directly installed in concrete, but are connected with a steel member, integrally built base ring and sole plates, that not only make distortion difficult within the generator's internal assembly, but also provide for easy correction should any distortion develop between generator and turbine. This design, it is believed, will virtually eliminate heavy maintenance and major outages that could be caused by misalignment.

By this design, which provides for supporting the entire machine in one place, any movement or shift under final load would affect the entire machine and not any individual part. Correction for such shifting is simplified by steel chocks installed between the load and the foundation plates. These chocks can be moved and machined to new dimensions for correction of any vertical displacement.

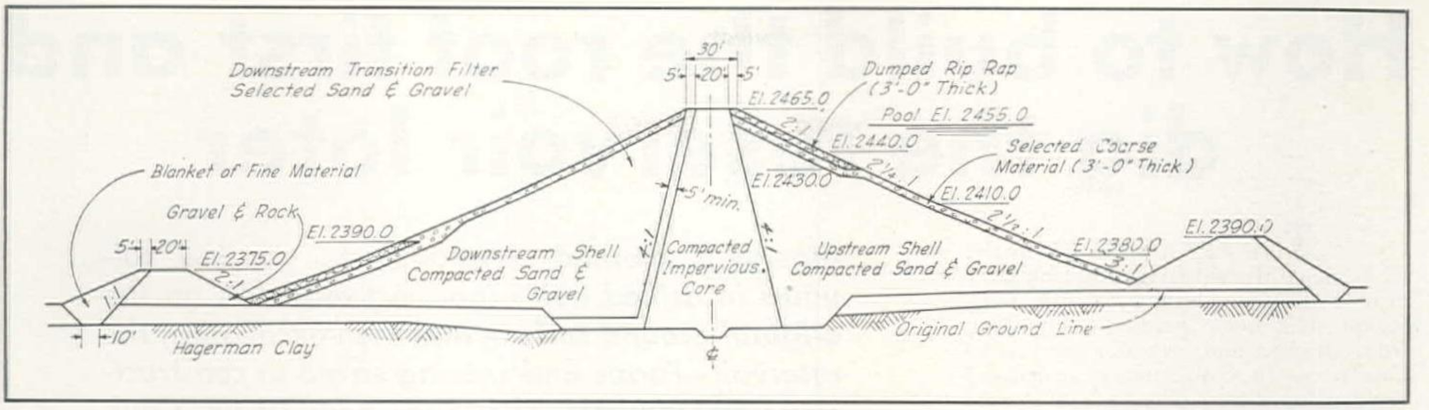
Spillway

The spillway, which is now about 90% completed, will contain 210,000 cu. yd. of concrete and cover nearly four acres. It is designed for a capacity of 100,000 cfs. Tests of a prototype at the Polytechnic Institute, Worcester, Mass., showed it to have a safe and satisfactory operation at 140,000 cfs. Eight tainter gates will control the flow, each with a 12,500-cfs. capacity. Three will be controlled automatically, and all can be operated locally.

The 324-ft. width of spillway structure is designed with seven keys parallel to the axis of the dam. Five of the keys are 7 ft. deep and 5 ft. wide, with the key along the downstream face extending to a depth of 15 ft. Sheet piling was driven to a depth of 10 ft. below the bottom of the keys, and around the stilling basin. No seepage is anticipated beneath the spillway; however, reverse filters were installed. Similar keys were also established beneath the intake.

During excavation for the spillway and placing of concrete only a small amount of pumping was needed for water control. One 8-in. pump working half-time was sufficient.

A large portion of the 1,300,000 cu. yd.



EMBANKMENT cross-section shows material zones in the 3,220-ft. long earthfill portion of the C. J. Strike hydro development.

of material excavated from the spillway was stockpiled for later re-use as random and core material for the earthfilled dam.

Stilling basin

The bottom of the stilling basin will be approximately 30 ft. below the level of the average tailwater. Energy dissipation will be about 900,000 hp. at a discharge of 100,000 cfs. Concrete baffles are provided in the bottom of the basin, and an apron of rock riprap extends 100 ft. downstream. It has a thickness of 12 ft. next to the concrete and 4 ft. at the lower end.

General concreting

Plans for concrete production were based on the speed of form erection and placing of reinforcing steel at spillway and powerhouse. Forms were fabricated well in advance of needs, but not so far as to develop warping. Lifts of concrete generally varied from 5 to 17 ft. Three classes of concrete were used in the structures: (1) All exposed surfaces generally are 4,500-lb. concrete; (2) areas where strength was required but without exposure to freezing, thawing or water action were of 3,000-lb., and (3) the inside mass concrete for the spillway is 1,000-lb.

Protex air entraining agent was used in concrete for the spillway to add workability and reduce bleeding. A Pozzolith admixture, to aid in reducing segregation and to permit use of less water as well as increased workability, was used in the powerhouse construction. Concrete was cured by water and exposed surfaces generally were given a three-day curing. While this is somewhat less than usual, the quality obtained will provide more than adequate strength to support or withstand the designed loads.

Sack shaker

One of the interesting features of the concrete operations is an ingenious combination of a rotary saw and a shaking conveyor, similar to that found on a potato harvester, to open and shake cement from the sacks. Cement is brought to the site in sacks and stored in warehouses. Conveyors passing down the centers of the warehouses are loaded by hand and the sacks move up to a room attached to the batching plant.

As the sacks enter this room they fall from the end of the conveyor and pass over rotary saws which slice them open. The saw section is enclosed in a sheet metal tunnel to hold the cement dust. From the saw the sacks, now dumping their contents, fall onto a shaking conveyor that vibrates them thoroughly as it carries the sacks to an incinerator. In handling 1,000 sacks per hour the rig requires two or three men loading the conveyor in the warehouse, an operator, and one man stationed at the shaking belt to flip any sacks that may have landed on the belt upside down.

Earthfill section

The dam is being built on highly consolidated river bottom silt that has an 86 to 88 lb. per cu. ft.-density in its natural state and contains but a small amount of clay. Excavation for the structures was carried down until the material exposed was satisfactory for supporting the load. Excavation was necessary only under the impervious core section, the material at original ground line being suitable to support the shell.

The earthfill dam has an impervious core with sides on a 1:4 slope, supported by a shell of pervious random material on both upstream and downstream sides. The downstream shell has a 5-ft. thickness of transition filter material next to the core.

The dam area contained ample supplies of native material for embankment and a suitable deposit of concrete aggregates was located a short distance from the site. Preparation and transporting of aggregate to the batch plant were done under subcontracts.

When possible the general construction program provided for stockpiling suitable excavated material for later use in the embankment. During later stages of the work, material was moved directly from borrow pits to the embankment. About 80% of the core material was obtained during excavation for the dam and structures. Earth moving was planned and carried out at the rate of 18,000 to 20,000 cu. yd. per day.

During excavation of the spillway, material was pushed into the channel, increasing the distance of the spillway site from the river to about 300 ft., and decreasing the width of the river to about 300 ft. Suitable material was stockpiled on top of this extension. After the diversion was made and the cofferdams were in place, a cut was made through the center of this stockpile, parallel to the axis of the dam, to permit excavation for the central core. Spoil material was dumped on the outside of the cofferdams. This operation provided a place to waste material as well as giving additional support for the dam.

Material in the borrow pits, which are an average of 3,500 ft. from the embankment, is varied in composition with strata of cemented gravel running through it. The unsuitable material was stripped off and wasted. Rubber-tired scrapers were used to move the bulk of the material. For short hauls to the embankment, as well as for stripping work, the contractor used track-tractors and scrapers. Bottom dump units are used for hauling coarser material for the upstream shell.

Concluded on page 132

Equipment that has speeded the C. J. Strike project

CRANES AND SHOVELS

- Manitowoc 4500 combination.
- Bucyrus-Erie 54-B combination.
- Northwest 95 dragline.
- Northwest 80-D shovel (2).
- Northwest 6 shovel and dragline.
- Lorain truck crane.
- Handicrane.
- Swing crane mounted on International truck.
- Olson stiffleg with Clyde hoist.

EARTHMOVING EQUIPMENT

- 5 Terra-Cobras (Scrapers with own power equipment. 14.2 cu. yd. struck).
- 4 Wooldridge scrapers, 15 cu. yd.
- 3 Euclid 16-yd. rear dumps.
- 3 Euclid 13-yd. bottom dumps.
- 1 Caterpillar DW-20 scraper (16 cu. yd.)
- 11 D-8 Caterpillar tractors for scrapers, rippers and dozers.
- 2 Caterpillar motor graders.
- 1 Wooldridge ripper.
- 1 Rome combination ripper and disc harrow.
- 4 Two-drum sheepsfoot rollers.
- 1 50-ton pneumatic compactor.

TRUCKS AND VEHICLES

- 7 Euclid mixer trucks.
- 4 White mixer trucks.
- 32 International dump trucks.
- 1 Ford dump truck.
- 4 Flat-bed trucks.
- 1 Euclid tank truck.
- 1 International water truck.
- 2 Service trucks, one for greasing, one for tires.
- 11 Pickups.
- 2 Sedans.
- 2 Station wagons.
- Dodge command truck.

INCIDENTAL EQUIPMENT

- 2 500-cfm. Ingersoll-Rand compressors.
- 1 315-cfm. Ingersoll-Rand compressor.
- 1 856 Joy compressor.
- 2 Ingersoll-Rand wagon drills.
- 9 Welding machines.
- 1 5-kw. Kohler gas-driven lighting plant.

How to build the roof first and dig the reservoir later

Ingenious method developed for pouring columns in drilled holes, pouring roof slab on the original ground surface and then excavating the reservoir—Forms and shoring saved in constructing 1,500,000 gal. of storage near Tustin, Calif.

By
C. R. BROWNING
Consulting Civil Engineer
Tustin, Orange County
California

THE AREA SERVED by the El Modena Mutual Irrigation Company near Tustin, in Orange County, California, has been gradually changing from orange and avocado groves to homesites. In consequence a demand has developed for a change from the old existing gravity irrigation pipe and riveted steel pipe system of water delivery. Residents wanted not only a domestic water supply under pressure, but one conveyed through closed lines free of contamination.

Within the 600-ac. service area the land varies in elevation from 275 to 525 ft. above sea level, and includes five distinct knolls and intervening valleys. The first problem was to select a site for a storage reservoir which would provide sufficient pressure for the highest point in the area to be served. A location was chosen outside the area, and the site was to be donated, provided the reservoir would be constructed below ground surface.

Savings by building backwards

Pouring the concrete roof slab on the ground and then excavating the 115 x 135-ft. reservoir to a depth of 19 ft. was the unique method used to cut costs for this 1,500,000 gal. of storage. This method involved drilling holes and pouring the concrete columns, followed by pouring the roof slab on the ground, and finally excavating under this roof. The entire procedure saved forms and shoring. The contract for $45,970 was carried out by the Mathews Construction Co., Alhambra, Calif., and Robert Peterson, owner of the company, furnished many of the ideas incorporated into the design and construction of the reservoir.

To meet these conditions and stay within the budget set up for the reservoir the writer and Robert Peterson, owner of the Mathews Construction Co., general engineering contractors, Alhambra, Calif., studied the site, the geology, and various ideas for cutting costs. The rock formation of the district is sedimentary. However, there are many dikes of intrusive magma cutting through the planes of stratification of the shale. In some places the dikes widen out, forming laccoliths following the bedding planes of the shale. These laccoliths vary in horizontal area from a few feet to several hundred feet. The reservoir area is in a depression between two hills, which indicated a rock formation which had eroded; therefore, probably free from dikes or laccoliths.

Mr. Peterson suggested leveling off the area of the reservoir and constructing the roof first on the ground, thus saving forms and shoring, and later forming the reservoir by mining. To fit the site I determined on rectangular shape 115 by 135 ft., and 19 ft. deep, with 1 to 1 slopes on the reservoir. Floor and sides were to be lined with 3 in. of gunite reinforced with 4 x 4-in. 10-gauge mesh. Net reservoir capacity was 1,500,000 gal.

Detail plans were prepared (see accompanying drawing) with columns on 20-ft. centers and a stub wall about 3 ft. high for perimeter bearing of the roof. The roof slab was designed with drop panels at each column crown. Columns extend 3 ft. below the finished grade of the floor of the reservoir and have a footing twice the area of the column diameter. The roof has a finished slope of 6 in. in 115 ft. for drainage of rainwater and the floor of the reservoir slopes in all directions to the inlet-outlet pipe to facilitate draining and cleaning.

When bids were called for there were five bids ranging from low of $45,970 to $81,250 for high. Mr. Peterson's company and the California Gunite Co. were low bidders. Peterson as subcontractor handled the reinforced concrete and earth work and the California Gunite Co. did the reservoir lining. The bid price included 2,000 ft. of access road in the hills. Therefore the cost of the reservoir was about 3¢ per gal.

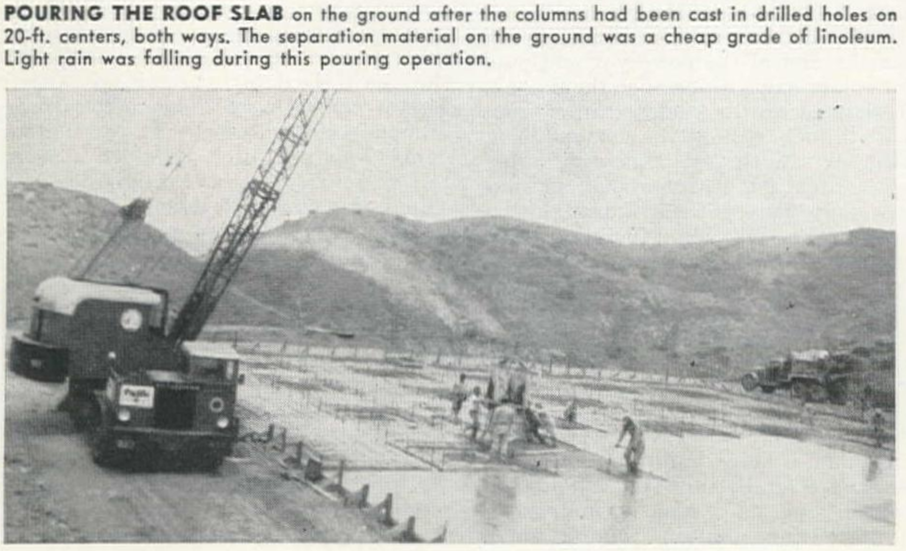
Construction procedure

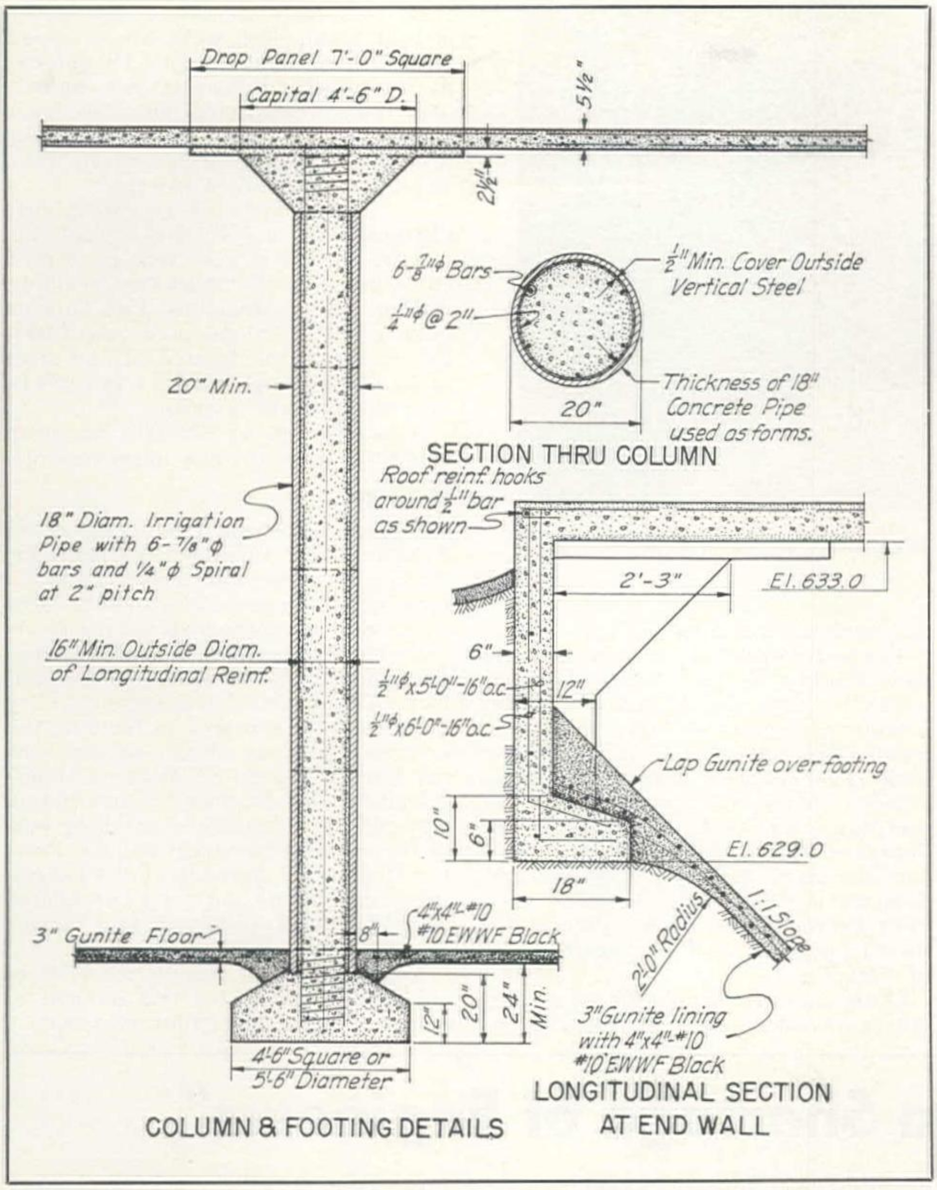
The site was leveled to grade, including the drainage slope for the roof. Holes were then bored for the columns with a rotary auger making a 30-in. hole belled out at the bottom for the footing. Afterward a man was lowered to clean out all loose earth. Finally, a nail and tin shiner was centered in the bottom of the hole to assist in spotting the reinforcing cage.

In boring the holes the rock was found to be shale which had been subjected to so much heat that it did not break along laminations but more in a jigsaw puzzle pattern. The heat had changed the shale so that along the bedding planes it had the appearance of vitrified clay tile. In only six of the 30 holes was hard rock encountered, and that only 2 to 4 ft. near the surface where a sandstone stratum was burned so that it was almost like glass.

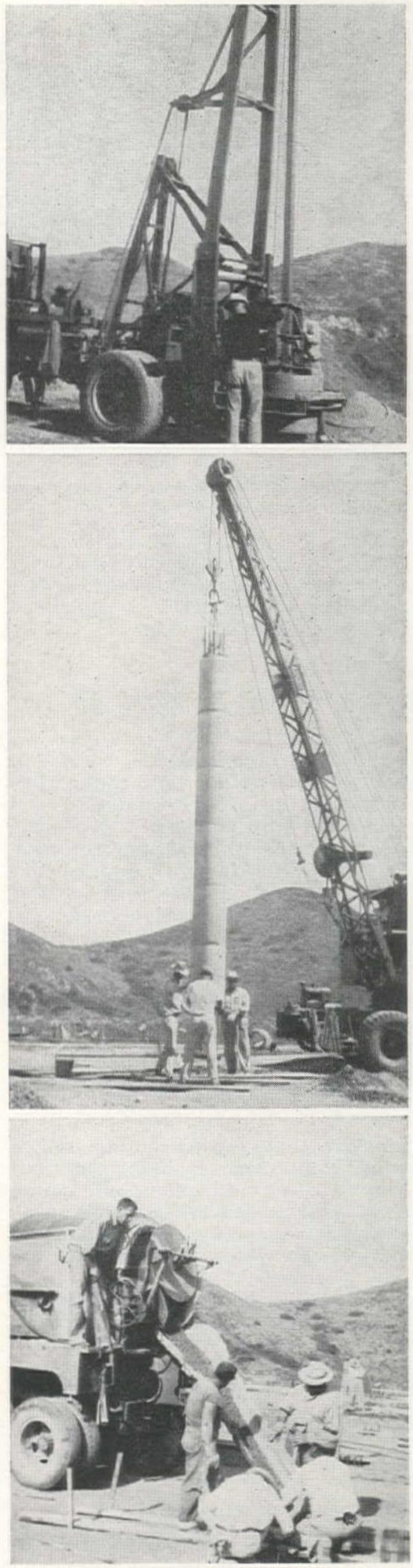
The reinforcing cages of the columns were then assembled using 18-in. dia. concrete irrigation pipe as a form. (I would not recommend irrigation pipe as forms again because of difficulty in alignment.) These assembled columns of steel cage and pipe were lowered into the holes and centered by use of an elec-

POURING THE ROOF SLAB on the ground after the columns had been cast in drilled holes on 20-ft. centers, both ways. The separation material on the ground was a cheap grade of linoleum. Light rain was falling during this pouring operation.





STRUCTURAL DETAILS OF THE RESERVOIR BUILT FROM THE ROOF DOWN



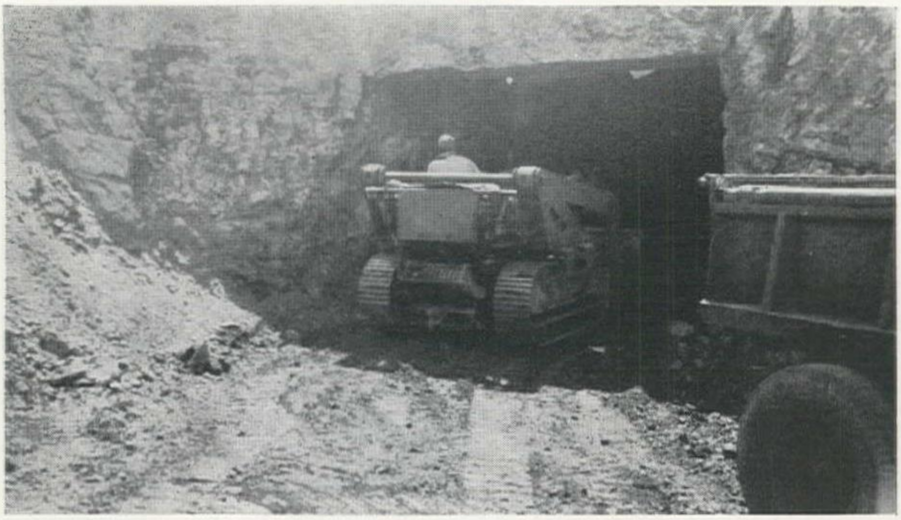
THREE STEPS IN BUILDING THE COLUMNS: (top) drilling the 30-in. diameter holes to a depth of about 20 ft. belled out for the footing; (center) lowering the reinforcing cage in its concrete pipe form; (bottom) pouring the column up to the level of the drop panel.

tric light and the shiner in the bottom. The outside pipe forms stopped at the bottom of the floor grade but the steel extended to the bottom of the hole. The footing was then poured and after 24 hr. the space between the form and the rock wall of the bored hole was filled with sand. Later the columns were poured up to the bottom of the column crown leaving the steel to extend up to the drop panel of the roof.

After the columns were finished, the 3-ft. high stub wall was constructed along the perimeter with additional columns for bearing on each side of the portal openings to be used for the subsequent excavation of the reservoir. The wall was formed and poured in a 3-ft. wide trench excavated with a trenching machine. The next operation was to level and fine grade the ground for the roof and lay the separation medium, which was a cheap grade of wall linoleum. The roof-slab reinforcing steel was then placed and the roof was poured incorporating two 6-in. vents and a 4 x 4-ft. hatch. The roof pour was made in 6½ hr. by using a truck crane on each side of the reservoir, handling a 1-yd. bottom dump concrete bucket. Two finishing crews were used and every 15 min. a 4-cu. yd. mixer truck was spotted for each crane.

As soon as the roof was poured the contractor moved in a Bay City ⅝-yd. shovel and started the excavation for the portal along the alignment of the inlet-outlet pipe. By the time he had started excavating under the roof the concrete had reached a test strength of 3,000 lb. A 13-ft. cut was made in the first lift, which was about the limit of the Drott 1½-yd. hydraulic loaders mounted on Allis-Chalmers HD7 tractors. The loader buckets were equipped with teeth.

It was soon found that it would be necessary to open up another adit because of the gas from the loaders and trucks. This possibility had been provided for by constructing the stub wall with two bearing columns on the opposite side of the reservoir from the main adit. In addition to the two adits, an exhaust fan was kept in operation all the time. The two loaders kept five small dump trucks going continuously even though the longest haul was not more



START OF DIGGING the reservoir under the roof. This loader is excavating an adit to provide access to the main body of earth.

than 600 ft. Loaders excavated the slopes to a rough grade except in the corners where columns interfered and hand work was necessary.

Trimming and lining

As soon as the excavation was completed, neat trimming of slopes and floor was started. The inlet-outlet pipe was laid in a 6-ft. deep trench and encased in 12 in. of concrete. The portals were then backfilled with selected material and compacted with air tampers inside the reservoir and with sheepsfoot rollers in 6-in. lifts outside the reservoir. The gunite crew moved in and seven days after they had completed the slopes and floor, the reservoir was filled with water.

The water distribution system for the new County Water Works District, which replaces the Mutual Irrigation Company, consists of 46,000 ft. of 4, 6, 8 and 12-in. welded steel 12-gauge pipe with spun concrete lining and gunite exterior coating to protect against soil corrosion. Pipe was supplied by the Southern Pipe & Casing Co. of Azusa. Installation of the pipe, irrigation and domestic meters, and all necessary work in connection therewith was done under contract by the A. B. C. Construction Co. of Paramount.

Source of water supply for the service area is two deep wells 2 mi. from the district located in the Santa Ana River coastal basin. Both wells are equipped with turbine pumps, each 1,150-gal. capacity, powered by natural gas engines. The 18-in. welded steel pipe line from the wells to the service area is not a new line but was lined with concrete four years ago by the Tate process.

This pipe line from the wells discharges into a 700,000-gal. coal tar enamel-lined steel tank with cone roof constructed by the Southwest Welding & Mfg. Co. of Alhambra. Two booster pumps, one of 450-gal., and one of 900-gal. capacity, are located at the steel tank. These pumps lift the water 250 ft. into the concrete reservoir.

A bond issue of $260,000 has been voted to pay for the new improvements.

Personnel

Edward Peterson, civil engineer of Arcadia, Calif., furnished the plans for the concrete reservoir. Robert Peterson furnished many of the fundamental ideas which developed the plan for the reservoir. Frank Freeman, Walt Smith and Bill Morrison are co-owners of the California Gunite Co. of Los Angeles. They financed and associated in building the reservoir. Success of the project was due largely to John E. Hawkins, superintendent for Mathews Construction Co., and his ingenuity in handling out-of-the-ordinary construction jobs. Bertran Drilling Co. bored the holes for setting the columns and the Consolidated Rock Products furnished the transit-mix concrete.

Robert Peterson and the writer have applied for patent for this method of constructing concrete roof reservoirs.

"A Helluva Shortage of Engineers"

IN A *Fortune* magazine article headed "A Helluva Shortage of Engineers," Lawrence P. Lessing recently detailed past causes, present dimensions and future solutions of that shortage, which finds U. S. technology crying for 60,000 engineers. As production continues to climb, biggest demand is for chemical, electrical, automotive, petroleum, and mechanical engineers; but no classification is in surplus.

Nationwide figures delineating the situation were obtained from a survey by the Engineers Joint Council, representing the American Society of Civil Engineers and four other societies. The shortage exists despite 1950's all-time high graduation of 52,000 engineers, and after placement of 38,000 graduates in 1951.

"Gregory Peck" engineers

Basis of the current trouble seems in part the low birth rate of depression years, but more particularly results from improper evaluation of the engineer's status in the nation's economy over many decades. Most recently, the war years and even the present emergency have seen little planning to train and conserve engineering talent. Cited are indiscriminate selective service policies, a six-year lapse in maintenance of the scientific establishment developed during the last war, and civil misconception of the engineer's role, especially by draft board personnel handling deferments. "The stock engineering figure . . . is Gregory Peck in shiny boots and whipcord breeches, waving his arm over a transit."

Lessing's presentation traces the origins of all civil(ian) engineering branches and effectively shows the relationship they bear to their antecedent crafts. This relationship, now largely transcended in execution of complex industrial empires and huge construction projects, still taints the profession in its striving for equality with the recognized three—divinity, law, and medicine. Yet the engineering profession has been the signal contributor to an unsurpassed living standard that finds the U. S. achieving about half the world's production.

Current necessity is beginning to change national thinking, Lessing points out, and further groundwork is being performed by the some 70 engineering societies, acting singly and together in an effort to see engineering attract more than 3% of the secondary-school population. Most persuasive voices seem to be those of the National Society of Professional Engineers and the Engineers Joint Council, which seek to enhance professional standing through promotion of better public relations, acceptance of an ethical code, and more active community citizenship of engineers.

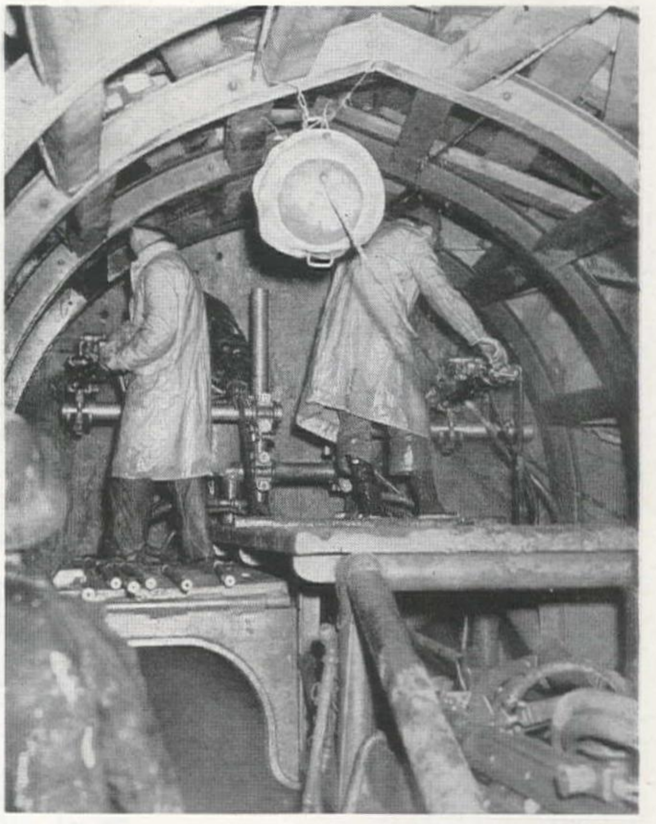
Needed: a new idea of progress

Lately, E. J. C. has been called upon by the National Security Resources Board to perform continuing study of the professional engineering shortage. It also seeks to reverse the present downward trend in engineering school enrollments, which is nonetheless certain to aggravate production troubles until after 1954, when presently enrolled small classes move into the profession. Major selling point seems to be the engineer's constructive role in the betterment of man's civilization. Consciously or unconsciously, people of the U. S. are seen by Lessing to have tired of the "mechanical riot, the overpowering complexity and potential destructiveness of science."

"These are not the ends to fire the imagination of youth. Some rehabilitation of the idea of progress is needed—a vast technical program for raising the living standards of neglected countries, for instance, to offset the vast military build-up—if science is not to wither and endanger the life of society."

First of two installments—

MODERN TUNNELING PRACTICE



AT THE FACE in a typical Western tunnel with a column-and-arm type jumbo mounting two drills worked from the platform. Steel-rib supports and other features of modern tunneling practice are shown here.

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

MOUNTAINS are the natural road-blocks of all forms of transportation. As a result tunnel driving is one of the major types of construction activity in these Western states. From the days when the Central Pacific was piercing ridges to reduce distance and grade on the first transcontinental railroad to the multi-mile bores of today which carry aqueducts through entire ranges, tunneling has challenged the skill and energy of Western engineers and contractors.

This article describes the procedure, equipment and methods of modern tunnel driving from drilling to the placing of the concrete lining. It concludes with some basic facts on the geological considerations that affect tunnel design and underground operations.

Drills and drilling

Probably no modern tool undergoes as much punishment as a rock drill. Although it must be designed and built for rugged service, it is a precision machine. Hammer machines, striking 2,200 blows a minute, made their appearance about 1912, replacing piston drills, but they did not come into general use until some years later. The Ingersoll-Rand 3½-in. automatic hammer drill came into general use about 1936.

The introduction of hammer drills and other powerful drilling tools made the earlier steels obsolete. Development of stronger steels was required to withstand the severe impact and fatigue of high-frequency blows of about 198 ft. lb. of energy per blow, with the drills striking between 1,800 and 2,200 blows per minute. Modern high-grade drill steel is capable of being hardened to produce tough yet abrasion-resisting cutting edges on a bit which is forged integral with the rod. It also possesses tough fatigue-resisting shanks and bit connections. However, it must be remembered that bad alignment, unnecessary vibration because of a poor set-up, or an improper rate of feed, will result in a high breakage rate per foot of hole.

Pneumatic drills are designed to operate at air pressures ranging between 80 and 105 psi. Working at lower pressures

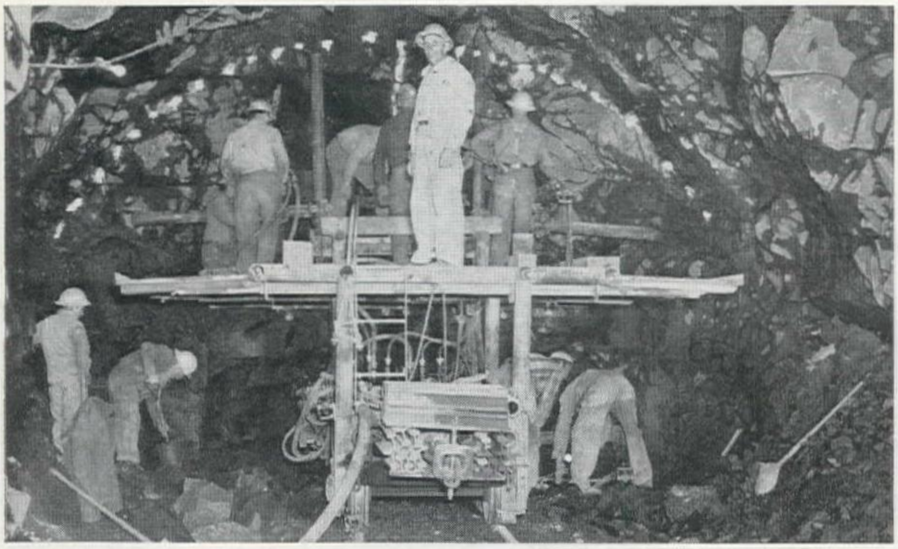
IN THE WEST everyone doing engineering or construction work should be familiar with the general principles and operations required in modern tunnel driving. It is not essential that every engineer or contractor become an expert. But from irrigation works to highways, and from power development to municipal improvements, there is always the possibility that a tunnel may provide a logical solution to an engineering problem.

Likewise, every contractor will encounter plans and specifications that require some type of underground work where a knowledge of tunnel procedure will be of help in considering any bid on the work. To be familiar with equipment, operations and methods should be a part of the basic knowledge for those in the construction industry.

To provide concise information on this subject, with the fundamentals discussed and the details omitted, *Western Construction* presents this authoritative summary in a two-part article, where the author starts with the basic tools used in underground work and advances through a description of the operations of loading, hauling, setting temporary supports and placing permanent lining, common to rock tunneling practice in the Western States.

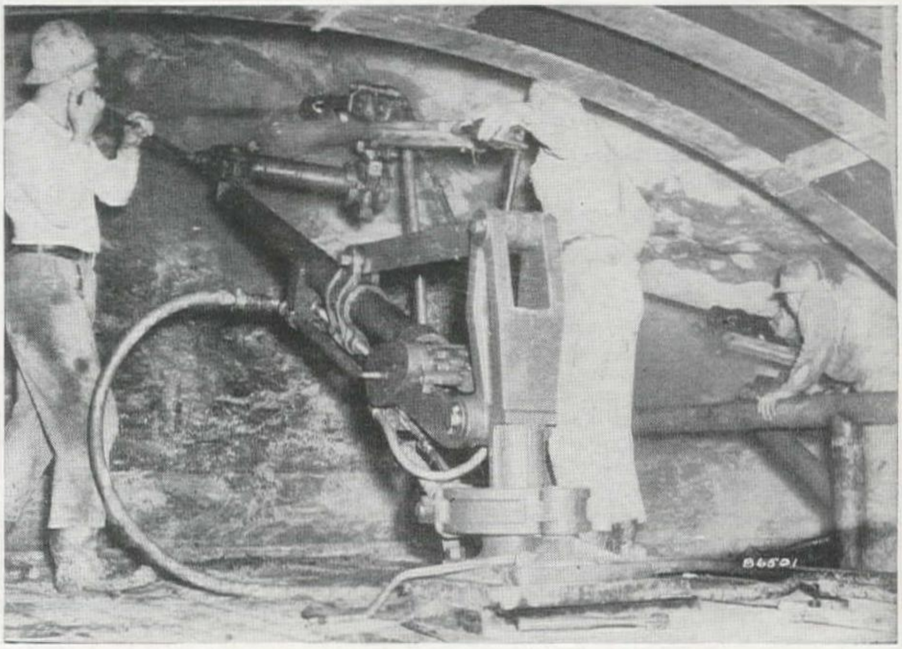
A concluding section outlines the types and characteristics of rocks commonly encountered, and presents a brief refresher on the features of geology most frequently encountered.

Obviously, this brief summary is not intended for the tunnel-driving expert. It will provide basic information for those who should be advised in a general way on this important phase of Western construction practice.—Editor.



TRACK-MOUNTED JUMBO (left) in large heading with drills mounted above and below platform. Center-line and outline of the tunnel have been indicated by paint daubs to assist in spotting holes.

LATEST DEVELOPMENT IN DRILLING equipment is powered-boom mounting for drills (below) that eliminates the time and labor required to handle heavy drills on arms or columns. Simple controls can spot the boom in drilling position in seconds. Holes are quickly and accurately spotted. An Ingersoll-Rand boom is shown in operation.



results in the drill rod absorbing hammer energy and the rod is literally shaken to pieces. Working at high air pressure increases drilling speed at the expense of drill rod and bit life.

Types of bits

The types of bits forged on the steel and in common use two or three decades ago were: (1) cross bit, (2) rose or six-point bit, (3) variable-X bit, (4) double-arc bit, (5) single-wing Carr bit, (6) Z bit, and others. The cross bit was finally adopted and is in universal use today. Within the last few years a satisfactory detachable bit, which screws on to the threaded drill steel, has come into great favor. This is made as a multi-use bit, which gives the lowest cost per foot of hole when reconditioning of the bit is correctly done. The one-use or throw-away bit is used where reconditioning is impracticable or undesirable and the rock is only medium hard.

The carbide-insert bit with inserts of tungsten carbide is used for drilling hard, abrasive ground and will drill hundreds of feet of rock with practically no loss of gauge. Smaller holes are drilled with the carbide-insert bit because it does not lose its gauge. Also, deeper holes can be drilled with longer feeds, at greater drilling speeds, and with smaller machines using as much as 40% less air. Drill maintenance is reduced 30%. Because of the smaller hole, the powder fits the hole better and up to 30% less powder can be used to break the ground.

Drill mountings

Drills were first mounted on tripods, later on bars, columns and arms. Then the drill jumbo was introduced and gradually increased until it has reached a size mounting 35 drills in driving some of the large tunnels.

When the drill jumbos were taken off rails and mounted on rubber tires it started a new trend in drill rigs and tunnel driving. In tunnels of 12-ft. diameter, two drills are mounted below the platform and three drills mounted on the platform of the jumbo. The drills below the platform drill the lifters, the lower side relief and trim holes and possibly two of the lower cut holes. The three drills mounted on the platform drill the cut holes and the upper relief and trim holes.

There have recently been introduced air- and hydraulic-powered boom jumbos with centralized controls, equipped with a positive lock for maximum rigidity and flexibility. Simply turning a handy lever raises the boom to any drilling position in a matter of seconds, by means of an air motor. Properly directed and accurately spaced holes result in more efficient rock breakage. With the boom jumbo no time or labor is lost in handling heavy drills on columns and arms.

The Frazier and Davis Construction Co., in driving the Neversink Tunnel on the new Catskill project, designed two large drill carriages which mounted five drills, two below and three on the platform. On air-powered booms they drilled approximately 40 holes about 9½ ft. deep in 1½ hr., in graywacke, sandstone and shale. A boom-mounted drifter in the rear of the jumbo puts in plug holes for securing and supporting air and water lines and knocks off projecting rock.

Synchronizing drilling with other operations

Tunnel driving today is so planned that each step in the operation, including setting up, drilling, loading, blasting, mucking and transporting the rock, is timed to produce a smooth operation. The supporting equipment, mucking

About the author . . .

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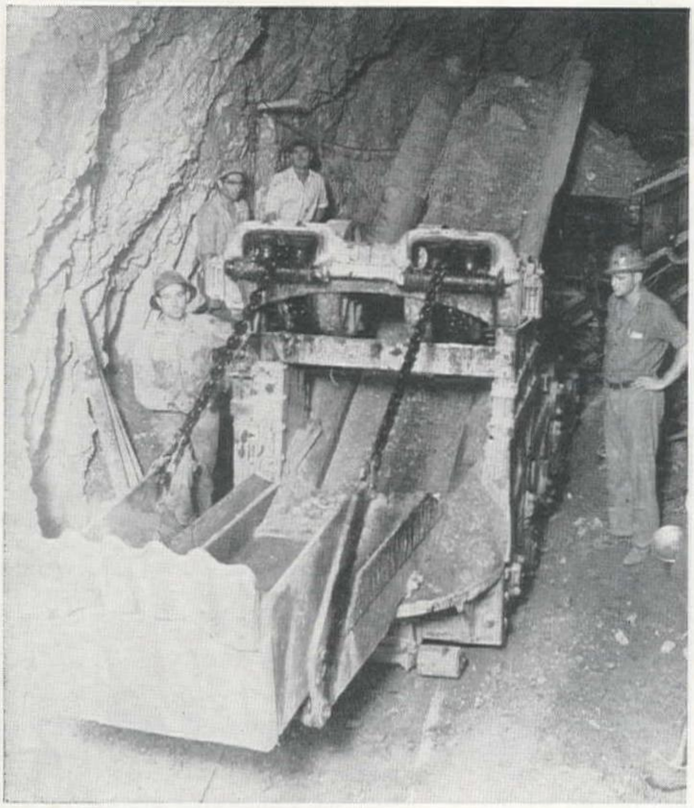
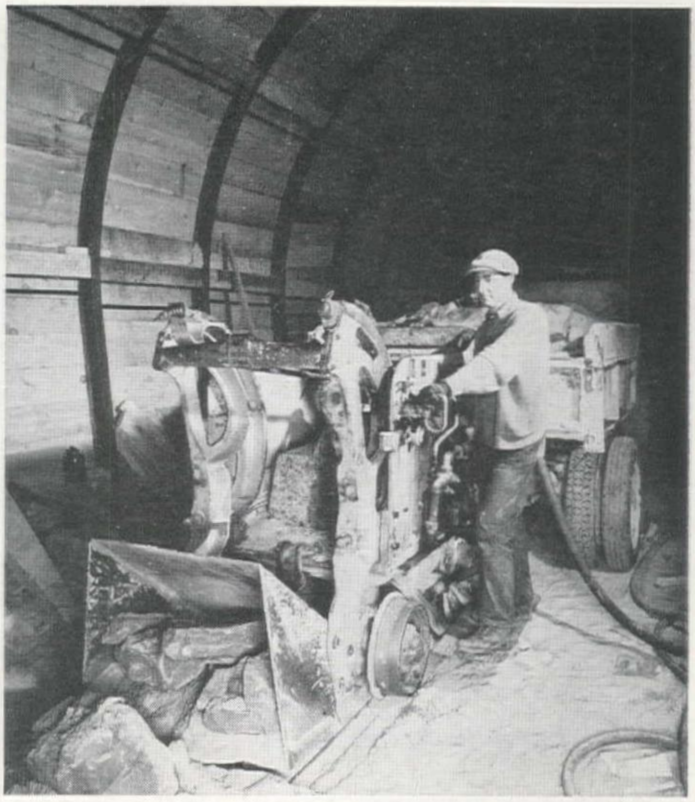
 

TWO COMMONLY USED MUCKING MACHINES: (left) a Conway Mucker loading cars in a tunnel driven several years ago and (right) an Eimco Loader working in a heading where the material was mucked directly in a truck for removal.

machines, compressors, battery locomotives and cars, ventilation, water and air line and pumping equipment, must be of a capacity to do the amount of work required of them in the planned cycle.

Tunnels are generally classified as:

Large, 19 to 35 ft. high; 16 ft. or more wide.

Medium, 10 to 19 ft. high; 12 to 16 ft. wide.

Small, up to 10 ft. high; up to 12 ft. wide.

The remainder of this discussion will be confined to medium-size tunnels, as many of the water tunnels driven in the West today are horseshoe or circular section of 10 ft. to 10 ft., 6 in. inside of the concrete, which means that the excavation is more or less 12 ft. in diameter.

The rates of advance in these tunnels will depend upon the rock encountered, water conditions and the efficiency of the drill mountings. This efficiency can be expressed as the per cent of actual drilling time to the total overall drilling time. The present trend is toward longer shells and drill feed length to reduce the number of changes. The following table will show the drilling efficiencies in using columns and arms compared to the boom mounting:

Feed Length	Column and Arm Type	Boom Type
36 in.	39%	40%
48 in.	40%	50%

The practical unit of advance or depth of round will depend upon whether the rocks encountered are crushed, fractured, decomposed or unaltered without excessive fracturing. The percentage of excavation overbreak beyond the pay lines or the excess percentage of concrete required is a function of the skill and judgment used in placing the proper number of holes and the quantity of explosives used.

Few shifters or drill crews are capable of off-hand spotting the holes and drilling an effective round. An excellent method to aid in spotting the holes in the face is to use a template of a lightweight material which can be set up at the face and the pay line painted on the rock and the location of the holes to be drilled spotted by dabs of paint.

It is always advantageous to know the character of the rock some distance ahead of the working face. An exploratory or feeler hole drilled in the face of the tunnel to a depth of 25 ft. or more, depending upon the ground, will disclose excessive amounts of water or of soft or changed rock conditions. This gives an opportunity to grout off large flows of water and stabilize the ground before the tunnel reaches the trouble zone.

The distance advanced per round will depend largely upon the effectiveness and number of "cut holes" drilled. The cut holes, usually 10 to 12 in number, are so angled as to meet at the center line of the tunnel at the depth of the round to be drilled, in a "V," hammer, or pyramid shaped cut. The relief and trim holes are usually drilled parallel to the line of the tunnel, and should be so spaced that there is not too much rock to be broken by each hole. When the round is shot the cut-holes take out a V- or wedged-shaped cut. Then the relief holes are shot, followed by the outside trim holes which shape the tunnel up.

A certain amount of progress is set up in the bidding of a tunnel job and the specifications set pay lines to which the owner will pay for excavation and penalties for over-break.

Progress in tunnel driving should be established in the planning and programing of the cycle of operations, so that drilling, loading holes, blasting, ventila-

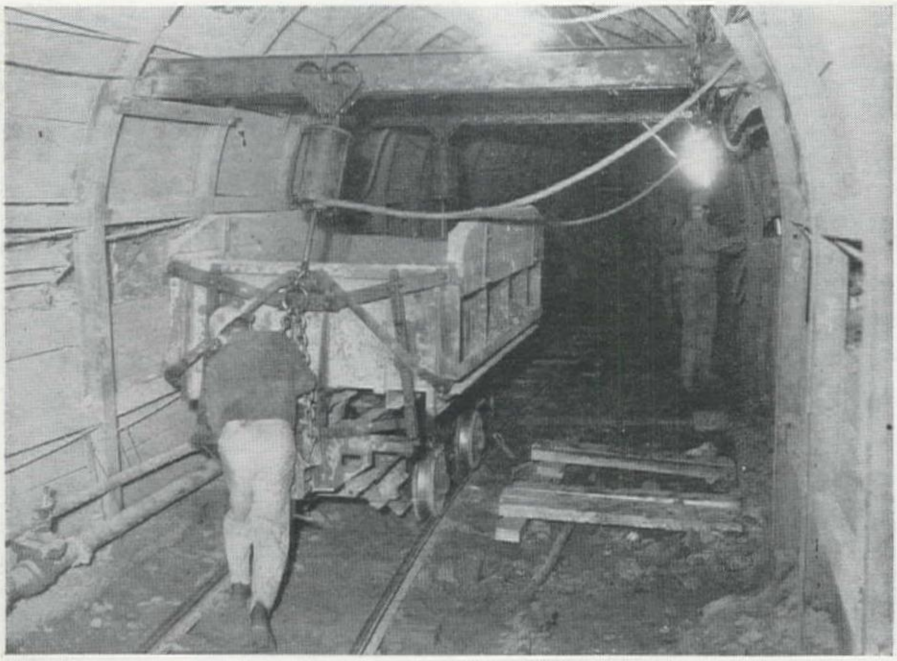
SIGNIFICANT PAGES FROM TUNNEL DRIVING HISTORY

1820—One of the first American tunnels for the Schuylkill Canal at Auburn, Pa. Hand drilling with 6- or 8-lb. double-jack hammers, holes loaded with gunpowder and broken rock mucked by hand into cars pulled by mules.

1850—During the preceding 30 years, railroad building resulted in a rapid increase in number and length of tunnels. Gunpowder was on its way out as an explosive and power drilling was in the experimental stage. Hand mucking and mule-hauling were standard.

1860—Work was active on the 4.75-mi. Hoosac Tunnel on the Boston to Albany railroad and was the proving ground for the first practical tryout for dynamite and power drills.

1900—Power drills for tunnel driving were ponderous machines; one with a 3¼-in. piston weighed 325 lb. Steel was heated on hand-operated forges and sharpened by blacksmiths using hand-held dollies. Hammer-type power drills appeared about 1912.



CHERRY-PICKER INSTALLATION in small tunnel, using air cylinders and dollies on I-beams to raise and shift car to side of tunnel. This is one of the common means of transferring empties in the train during mucking operation.

tion, loading and hauling and setting up again, is timed to produce a smooth cycle. The number of cycles will depend upon the kind and condition of the rock encountered, water conditions, and other factors.

The progress that can actually be made in driving a tunnel depends largely upon the time required to remove the muck. This in turn is dependent to some extent on the speed with which the air at the face can be changed and the smoke removed after each blast.

The ventilation equipment should provide approximately 4,000 to 5,000 cu. ft. of air per min., and the installation might consist of two 2,400-cfm. blowers, both blowing (or exhausting after blasting) through the same pipe—20- to 22-in. diameter No. 14 gauge black iron pipe—under normal operating conditions. To remove the smoke and fine dust, the velocity of the air in the tunnel face to the exhaust pipe should be from a minimum of 75 to 100 ft. per min., while in the exhaust pipe the flow of the air is from 2,000 to 2,200 cu. ft. per min. The value of two blowers is that in the event one should be out of service, the other would provide 60% of the air for a short time so that drifting operations would not be halted. The blowers should be of the positive displacement, single-stage type, with a sea level rating of 3.0 lb. gauge pressure, equivalent to 2.3 lb. gauge discharge pressure at 7,000 ft. elev.

Mucking

In a medium-size tunnel 10 ft. to 12 ft. finished diameter, using a 24-in. gauge track of 40-lb. rails, a type 50-B Conway shovel powered with a 60-hp. motor is most commonly used. With a 6-ft. boom, the clean-up width at track level is 14 ft., 4 in., the minimum tramming (forward and backward) height is 7 ft., the operating height is 9 ft., 8 in., the width is 51 in., and the length is 30½ ft. The shovel weighs 27,000 lb., has a dipper capacity of 81 cu. ft. The belt is 28 in. wide and operates at a speed of 250 ft. per min. The forward operating speed is 176 ft. per min., and the reverse speed is 120 ft. per min., with a minimum discharge height of 6 ft., 10 in.

To handle the empty cars to the shovel and remove loaded cars, several systems of car change have been developed. The California Switch is widely used, consisting of a portable combination of a double siding and switch, 90 ft. or more long laid over the main track. This allows the main track to remain undisturbed while the portable track is moved to the proper place to accommodate a car change. The loaded car is handled from the shovel by a locomotive, and an empty car from the siding is placed behind the shovel by a second locomotive.

The "cherry picker" was used extensively many years ago and consisted of a bar jacked against the walls of the tunnel. Connected to a saddle that rode on this bar, an air hoist lifted the car and set it to the side of the drift, allowing the loaded cars to pass on the track.

In a 12-ft. tunnel a 24-in. gauge track of 40-lb. rails, laid on 6 x 6-in. ties 4 ft. long spaced at 24- to 30-in. centers, will give good service when the wheel load does not exceed 7,700 lb. A 24-in. gauge track is usually used in tunnels from 8 to 14 ft. wide, and 36-in. gauge in larger tunnels.

Cars and hauling

The cars, one-side dump, with roller bearings, should have a height as great as will clear the mucking machine and a capacity of 50 to 110 cu. ft. Cars usually have a width of about twice the gauge of the track and a length equal to twice the wheel base.

In tunnel hauling, the number of cars making up the train will depend upon the weight of the locomotive on the wheels. If we assume the weight of locomotive and batteries at 14,000 lb., the tractive effort would be 20% of 14,000 or 2,800 lb. If the cars weigh 2,600 lb. empty and 10,600 lb. loaded, and we assume train friction at 30 lb. per ton for track resistance and 20 lb. per ton starting resistance, the gross load that could be handled would be 2,800 ÷ 50 = 56 tons, including the locomotive; therefore 56 tons minus 7 tons (weight of locomotive) = 49 tons gross load. If the car and load weighs 5.3 tons, then 49 ÷ 5.3 = 9, the number of loaded cars that could be handled by this locomotive.

If, under the same conditions as above, cars are to be moved up a 1% grade, then the train friction would be 30 + 20 + 1% of 2,000, a total of 70 lb. Therefore, 2,800 ÷ 70 = 40 tons, including the weight of the locomotive, could be handled. Further, if the loaded car's weight is 5.3 tons, then the number of cars in the train would be 40 minus 7 ÷ 5.3 = 6 cars.

Pumping

Both the amount of water and tunnelling conditions will determine the method of handling the water. The contractor has a choice of a wide variety of sizes and types of pumps to be used in the installation of his pumping plant arrangement.

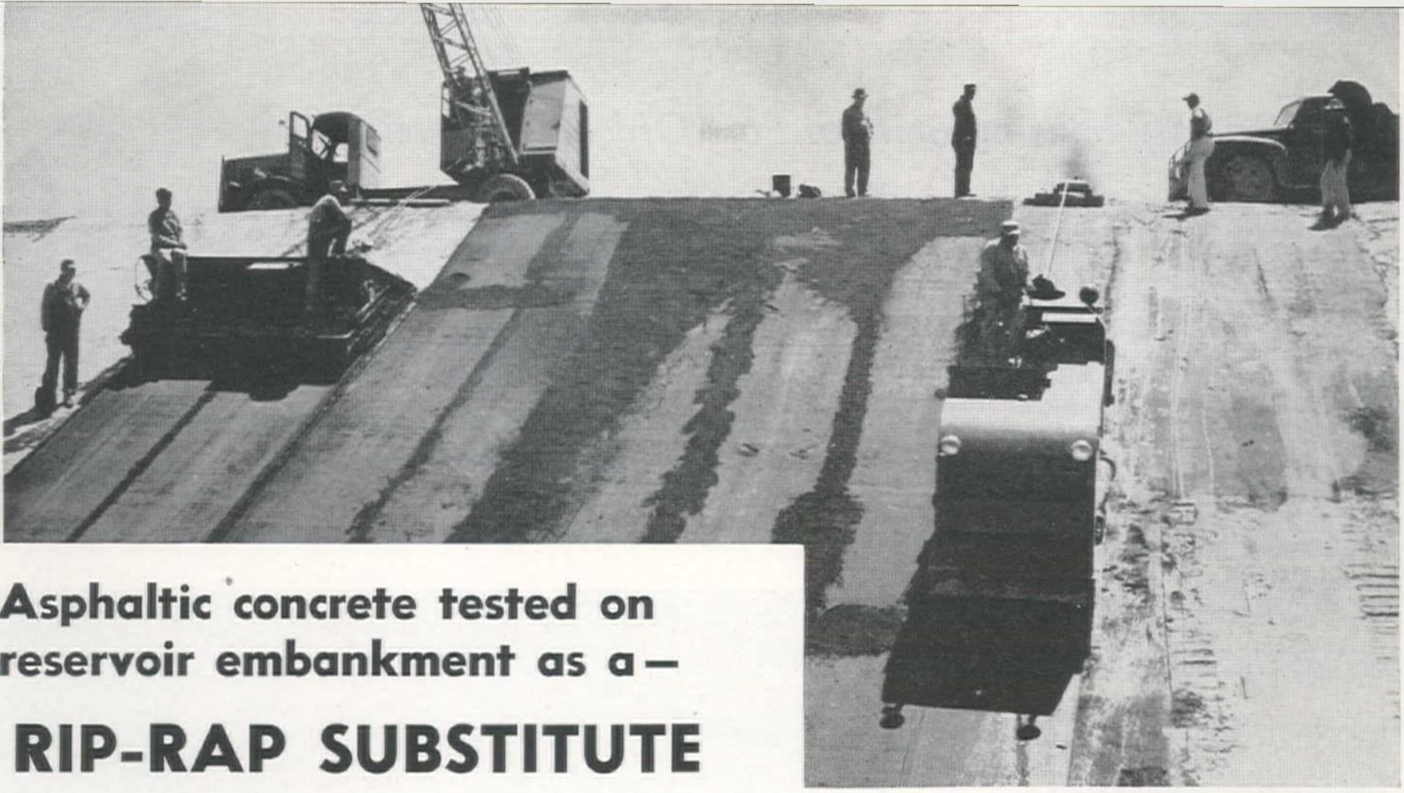
In the heading, water from the drills, seepage, etc., is usually picked up by an air-driven centrifugal sump pump, using air at about 80 psi. pressure and pumped back to a sump pit in order to settle out some of the fine rock particles which are so abrasive to pumps and pipe lines. Here the water is picked up by the permanent pumping plant and pumped to the second or more sumps at intervals of 1,000 to 1,500 ft. along the tunnel. Centrifugal pumps for permanent pumping plant installations are usually motor-driven and may be either single- or multiple-stage, depending upon the head.

The second and concluding installment of

MODERN TUNNELING PRACTICE

will appear in the December issue of *Western Construction*. A brief outline of operations discussed in next month's installment is as follows:

- Tunnel supports, both timber and steel, in rock and soft ground.
- The techniques and equipment for concrete lining.
- How to foresee and handle water.
- A classification of rock types and their characteristics.
- Tunneling through fault zones.



Asphaltic concrete tested on reservoir embankment as a—

RIP-RAP SUBSTITUTE

IS THERE an economical substitute for rock rip-rap on earth dams? Several years of experiment in the laboratories of the Bureau of Reclamation in Denver have been devoted to finding a suitable answer to this question. Early this year the experiments moved into the field when the Bureau awarded a contract for a full-scale test program at Bonny Dam in Colorado (*Western Construction*—May 1951, p. 100).

The test embankment section was constructed on the Bonny reservoir shore, about two-thirds of a mile upstream from the dam.

Under a $82,890 contract awarded March 12 to Northwestern Engineering Co. of Denver, the section was constructed to provide the following characteristics: (1) an earth embankment approximately 740 ft. long with a height of 25 ft. and 2:1 slope constructed to the same specifications and by the same methods as an actual earth dam; (2) half of the slope surfaced with a 3-ft. thickness of soil-cement; (3) asphaltic concrete on the remaining slope placed in thicknesses varying by 3-in. increments from 6 to 18 in.

Design and construction of the soil-cement test section was described on pp. 76, 77 of the August 1951 issue of *Western Construction*. The following description will be confined to design and field operations for the asphaltic surfacing.

The asphaltic concrete was placed in five 40-ft. wide vertical panels with panel thicknesses of 6, 9, 12, 15 and 18 in. respectively. Sand and gravel for the mix was pit-run material obtained near the dam site. Typical grading of the aggregate was as follows:

Sieve size	% passing
¾	100
#4	92
#10	77
#40	35
#200	4

A 40-50 penetration asphalt was proportioned at about 8% of the dry weight of the aggregate. The mix was produced near the site in a Pioneer portable plant, with the mix leaving the plant at 300 deg. F.

First portion of the asphaltic layer was placed using a conventional finishing machine, followed by a cable-assisted 8-ton tandem roller for compaction to minimum 90% density. This procedure was discontinued when it was found that the finishing machine could not control thickness of the material on the 2:1 slope. Therefore, since other equipment was not readily available, the contractor devised a slip-form or spreader box which placed the asphaltic facing in 10-ft. wide lifts of 3- to 4-in. thickness.

SPREADER BOX being filled from truck. Two rollers in rear of box assisted in controlling the thickness of the spread layer and in giving a light initial compaction to the mix.

The mix was placed vertically, beginning at the bottom of the slope. Placement of the lifts normal to the embankment axis was necessary because of the variable thicknesses specified.

The spreader box was pulled up the slope and controlled by cables connected to a dragline-mounted winch at the top of the embankment. The box was filled from trucks lowered by cables from a tractor.

Rolling of each successive lift was carried out by the 8-ton tandem roller. Main reason for the thin lifts was to allow compaction by the roller, since thick lifts would have cracked seriously under rolling unless the mix was allowed to become cold, in which case satisfactory density could not have been obtained. Rolling of the thin lifts after the surface temperature of the mix had dropped to about 150 deg F. made it possible to achieve better than the required 90% density.

Work on the experimental facings has been completed, and water is being maintained in the Bonny Dam reservoir to about two-thirds of the height of the test section. The section is located so that prevailing winds will cause considerable wave action against the facings, and the area is subject to severe winter weather. Suitability of the two types of facings will be studied in respect to resistance to effects of wave action, freezing and thawing, saturation, reservoir draw-down and all other extreme service conditions to which slope protection is subjected.

Cost comparisons of the two types of materials are inconclusive because of the relatively high costs of moving in special types of equipment where these costs could not be prorated to other work. However, merits of the two types of material will be considered after observation of their behavior during a prolonged period of service rather than on the unit costs of this test installation.

Based on experience from construction of Bonny Dam, where 500,000 tons of rock and gravel was shipped by train and truck for a distance of 175 mi. to be used as rip-rap, possible savings from the use of substitute materials could have amounted to more than $1,000,000. On future earth dams proposed for construction in the Missouri Basin states, all at sites remote from rip-rap sources, the Bureau estimates that several million dollars may be saved if an economical substitute can be found.

500 concrete housing units at Fort Ord erected using—

Assembly-line precast panels

Casting plant of Normac produces 126 panels daily, as crews in 400-ft. shed (below) prepare rail-borne forms for pouring with lightweight pumice concrete—Steam curing speeds work, prevents storage problem—Goal is four units per day

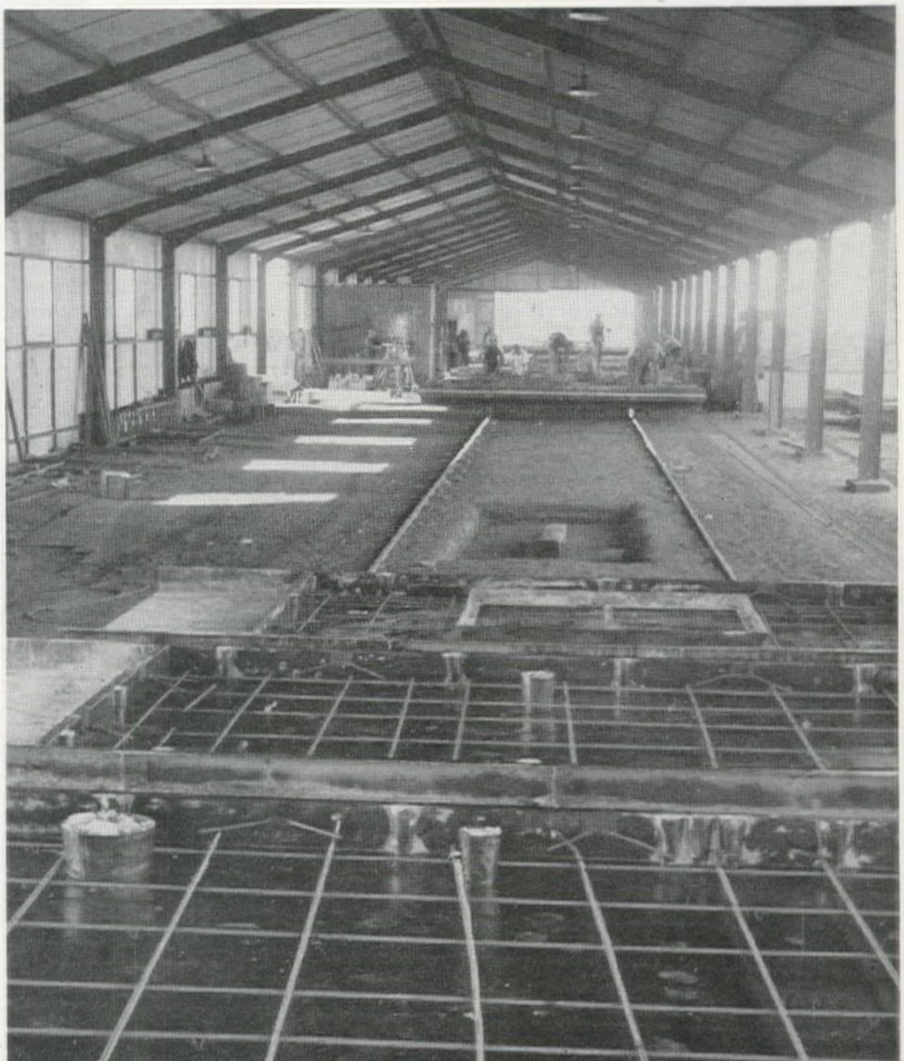
THE ASSEMBLY-LINE technique now being employed by Normac, Inc., in building 500 housing units for Army personnel at Fort Ord, Calif., represents still another method of precast concrete construction. Previous articles in *Western Construction* have described methods of erecting and assembling precast panels and structural members for light industrial buildings (May 1951, pp. 74-75; August 1951, pp. 84-85; October 1951, pp. 70-71). In all cases, the precasting was conducted at the erection site, mostly on the prepared interior floor slab.

The system used by Normac, however, was developed as an economical means of mass producing the variety of panel designs required for domestic construction over a 150-acre site. Focal point of this project is its casting plant, where rail-borne cars form the casting beds and are drawn through the component operations that culminate in delivery of steam-cured concrete panels that are fully reinforced and fitted with all necessary assembly inserts, plumbing, and electrical conduit.

Project organization

To cost about $4,500,000, the project is being built by Likins-Foster & Associates, prime contractor, with Federal funds furnished under the Wherry-Spence Housing Act. Subcontractors engaged in the principal work at Fort Ord are Normac, Inc., of Huntington Park, Calif., casting and building the houses to completion, and Granite Construction Co. of Watsonville, Calif., furnishing both rock and lightweight pumice concrete and installing streets and utilities. The pumice aggregate, one of the stronger lightweight aggregates, is being supplied by the Crownite Corporation of Los Angeles. Operations commenced on April 5, 1951, when graders began leveling the casting plant site. Panel and slab casting, now over 30% complete, began on July 14. The contractors are scheduled to "walk away" next June.

In planning panel production, a casting sequence had to be determined for the 800-odd designs involved. The apparent assembly-line ideal, that of casting all panels of one design in a single continuous operation, was infeasible as it would effectively curtail erection schedules. It would also present a storage problem. Nevertheless, some line had to be drawn between this ideal and the random production of panels needed to form 365 separate houses and duplex structures of 8 basic floor plans encompassing 19 variations. A workable compromise has resulted in a schedule of casting and erecting two structure types at a time. Currently the third and fourth are in progress, with houses of these types in all stages of construction scattered over the tract.



The sequence of work at the casting plant is established in an arrangement of four parallel rail facilities of 10-ft. gauge, each about 230 yd. long, with transfer tracks across both ends. At present, 114 cars operate on these tracks, being moved by manpower or electric winch through an entire circuit daily in production of 126 steam-cured panels. The most southerly track is sheltered and partially enclosed by a shed for 400 ft. of its length. In this shed, progressively from west to east, are located the points of application of various component production operations.

First step is form cleaning, performed by a power broom that brushes the 10 x 20-ft. steel car bed to a high gloss after its previous use. The car is then attacked by a form crew that installs steel channels 6 in. deep to define the panel's thickness and overall dimensions. (Some panels, described later, are 5 in. thick.) For quick work, transverse form members are bolted down through previously drilled holes in the casting surface. Tongues on the ends of longitudinal members engage slots in the transverse members and are wedged in place in the manner of conventional form clamps. Spray application of form oil is next.

A succeeding crew spots inserts within the form as necessary to provide for erection and subsequent assembly. These inserts and their locations will be described in connection with erection procedures in succeeding paragraphs. The panel continues to take shape in the following operation, that of laying out electrical conduits and plumbing inserts specified. With steel door and window frames that come next, a wall panel is readily recognizable, 8 ft., 2 in. high and of variable length.

Panels reinforced

Final assembly to be placed is reinforcing steel. Prefabricated mats of ½-in. bars at 16-in. centers in both directions go into roof slabs, with an additional reinforcement of No. 4 steel mesh provided for cantilevered exterior overhangs. Wall panels are fitted only with ½-in. and ⅝-in. bars that completely encircle door and window openings. Leaving the shed, the car is moved eastward and under the concrete conveyor.

Transit-mixed lightweight pumice concrete supplied by Granite Construction Co. is delivered from an earthen ramp into a hopper beside the tracks. Below this hopper hangs a belt conveyor, the entire frame of which is accommodated for transverse movement on two I-beam rails spanning above the casting cars. The conveyor operator, riding this rig, effects the pour of one panel in two passes, the car being shoved a half-length as the conveyor "retracts" between passes. The concrete is vibrated at this time, and is then struck off with a vibrating screed.

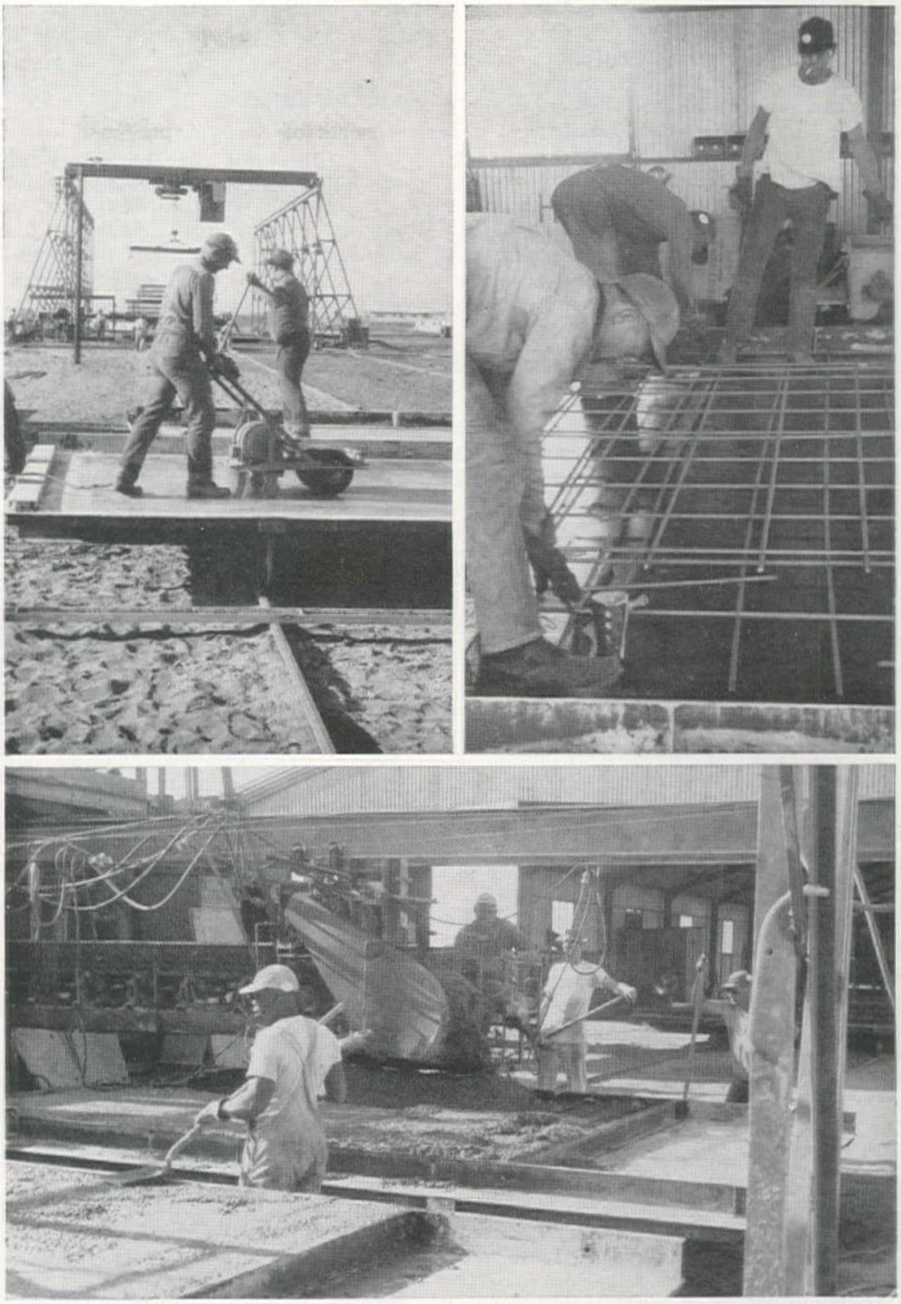
Reason for the use of lightweight is its low thermal conductivity, which will prevent sweating and provide a well-insulated, comfortable house. Its weight of about 75 lb. per cu. ft. has materially aided both casting and erection operations, though it has not been used as a means of reducing the quantity of reinforcing steel. The 1,500-psi. compressive strength specified is in all cases achieved, usually exceeded. Panels range in weight from about 1 to 2½ tons.

Break in routine

Sole deviation from the casting procedure occurs in treatment of carport roof slabs, which need not incorporate the low thermal conductivity quality of lightweight pumice concrete. These panels are of 2,500-psi. rock concrete. While formed in the normal sequence at the casting plant, they are not poured from the conveyor, but from transit-mix trucks driven into the yard alongside tracks leading to the curing ovens.

The newly-poured panels reach these tracks via the easterly transfer track, just beyond the concrete conveyor. Winches located at this point and elsewhere in the yard are used to warp the loaded cars through remaining phases of treatment. Three sets of tracks lead into the 22 x 220-ft. curing sheds, one track being completely loaded with about 22 cars before the next is used.

Concrete finishers perform their work along these tracks, applying float or broom finishes depending on the intended use of the panels and slabs. Also at this time roof-slab lifting inserts, to facilitate handling by cranes, are positioned. Consisting of short pieces of bent reinforcing steel tipped with threaded cylinders, these inserts have previously been placed in the empty form and fitted with telltale wires to the form edge for locating later. They are now turned to an upright, projecting position, one near each corner of the panel.



FIRST AND LAST STEPS of casting plant operation are seen at upper left, as power broom cleans form cars upon their return from panel stripping by girder crane in background. Successive crews on assembly line ready the forms for casting. At upper right, reinforcing steel is placed in a roof slab. Note insert in foreground, providing hole for eventual assembly bolt. East of the assembly shed (lower picture), form cars roll under traveling concrete conveyor, are poured in two passes, using lightweight pumice concrete.

Panel curing

Although casting and finishing are carried out only by a day shift, steam curing must be on a 24-hour basis to effect the desired curing time and clear the tracks of 114 carloads in preparation for another day's work. The steam curing sheds, framed up of 2 x 3's, are sheathed inside and out with 3/16-in. Transite board, with 2 in. of loose rock wool insulation between. These sheds develop 150-deg. F. water vapor which, maintained over a 10½-hr. period, is the equivalent of 7 days open-air curing. This practice makes for speed in the overall operation, and gets around an otherwise difficult storage and multiple-handling problem.

Beyond the curing sheds, cars proceed to the westerly transfer track, where they are shunted back to the "main line" again. At this point, the southwesterly corner of the yard, is situated a girder crane operating above several bays in which semi-trailers are spotted for loading. Roof slabs are handled flat, being stripped from forms and picked up by hooks engaging eyes threaded into each of the lifting inserts. Wall panels, not so heavily reinforced, must be protected from bending stress in their erection to vertical position at this time. To perform this function, a tilting device located between the tracks tilts the entire car through 90 deg. of arc, permitting point pick-up of a panel by means of inserts in its edges. The panel is prevented from slipping during this tilting by one form member, which remains bolted to the car as others are stripped to expose the lifting inserts. These panels are then stacked vertically in frames built on the semi-trailer beds, much in the manner of plate glass.

Panel production

The circuit of the casting plant is completed with this operation, and the empty cars are returned for cleaning and re-use. All walls and partitions are assembled from the precast panels, except for abutting wardrobe closet walls, carport storage walls, and walls separating kitchens from bathrooms. All panels, interior and exterior, are 6 in. thick except for walls adjacent to carports; these are 5 in. thick. Each house utilizes an average of 45 panels in its construction; each duplex structure, 60. At the rate of 114 cars per 9-hr. day, carrying a total of 126 panels at present, the project is staying well within its construction schedule.

Erection technique

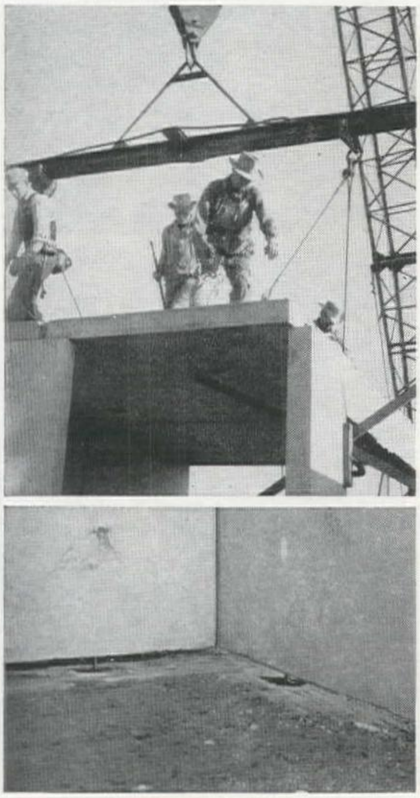
Out in the tract, erection is handled by a single crew and 25-ton truck crane supplied by trailer-loads of panels stacked along their operational route. Throughout the tract, footings for all units have already been poured of standard 2,500-psi. rock concrete. A feature of the erection procedure is its manner of avoiding extensive bracing for newly-erected walls. Basically, this involves commencing erection at the corner of a building, and bracing only the first panel before turning the corner with a second panel, which is then tied securely to the first.

The brace used is composed of three 2 x 8-in. wooden members, articulated with hinges to form an adjustable triangle. The base of the triangle is placed on the natural ground surface outside the footing and anchored by two bolts driven into the soil through holes in the base. One side, hinged to the base, is plumbed above the footing and the wall panel aligned against it. The third side of the triangle, roughly its hypotenuse, is hinged at one end to the plumb side, its other end being jammed against the base and held by an adjustable cleat. When the wall panel is snug against this brace, or a pair of them, it is secured by means of C-clamps and timbers placed as necessary in openings or at panel edges.

Assembly inserts

Inserts of many types cast into the panels now come into use for leveling wall panels on footings, for securing panels to each other and to the footings, and for bolting roof slabs in place. Leveling inserts consist of threaded sleeves cast into the bottom edges of wall panels; they receive bolts that are run down as necessary to maintain the panel at the desired height above the footing.

This gap, 1¼ in. minimum, is determined by instrument survey of the footing conducted as follows, prior to arrival of the erection crew. The high point on the footing is determined, and an increment of 1¼ in. added to it, the resulting elevation being the standard for the bottom edge of all panels to be erected. Subsequent rod readings, taken on steel bearing plates cast into the footing at regular intervals, establish the distance between panel and footing at each point. This increment, chalked beside each bearing plate, constitutes the bolt setting, in inches, that should be established before placing the panel into position. In this manner, panels are very nearly correct as first placed and need only minor adjustment later on, when welders complete the joinery by tacking the panel bolt heads to the bearing plates in the footing.



ERECTION CREWS (top) make fast work of positioning a carport roof slab handled by 25-ton truck crane. Slabs are seated on sponge rubber seals nailed to top of wall, are later bolted down and grout poured to make reinforced joint. Bottom, interior view at corner shows leveling bolts that support panels on footing until connection is welded and gap gunited. Steel bearing plates are cast in footing. Floor slab will completely cover gap.

Also cast into the panels, and essential to their connection, are pieces of angle iron, set flush at panel corners where needed, and anchored by means of short lengths of reinforcing rod welded to their under sides. Where these flush inserts oppose each other, at panel joints and partition intersections, they are welded together. The seal between panels is a corrugated strip of stainless steel that engages opposing slots in the panel edges.

Erection summarized

In summary of wall erection and joinery: leveling bolts in panels are tacked to bearing plates in footings, adjacent panels are tacked at flush inserts in panel corners and sealed by a corrugated metal strip. These vertical joints are further sealed outside by caulking, and inside by placement of metal strips that are jammed into place and held by an expanding connector. Final sealing around the footing follows roof placement. At that time the interior floor slab is poured to a point above the gap between panel and footing. An insulating strip placed vertically against the inside surface of the wall panel establishes a joint between the two concrete surfaces and prevents outflow under the panel. Then, from the outside, the gap itself is gunited and a smooth concrete surface built between footing and wall exterior.

Roof joinery

After erection of wall panels, two parallel strips of sponge rubber are nailed to the top edge of all walls to receive and seal the roof slabs. The tie between these members, roof and walls, is effected by bolts that drop through holes provided in the slabs and are run down in threaded inserts cast in the top of wall panels. Grout is then poured around these bolts, giving a reinforced connection. The tie between adjacent roof slabs is similar to that between wall panels. As before, the joint is dressed outside by caulking, and inside by installation of a metal molding.

Structural assembly of the house is now complete. Outside there remains the application of three layers of felt, tar and gravel to the roof; and paint to the exterior walls. Inside, doors and windows are hung in the steel and aluminum casements that have been cast into place. Interior finish is composed of a texture coat on walls and ceiling, completely covering metal moldings and central heating ducts. Floors are covered with asphalt tile or wood parquet flooring.

Personnel

For Likins-Foster & Associates, C. Z. Woodworth is project manager, and H. L. Dauberman is office engineer. For Normac, Inc., Adolf Brandt is general superintendent, with Carl Lundquist coordinating casting plant and erection schedules. Normac casting plant superintendent is John "Blacky" Enos, field superintendent is Sam Laughlin, and erection superintendent is Duane Armsbury.

Prefab asphalt canal lining reduces seepage loss by 92%

By C. C. WARNICK
Engineering Experiment Station
University of Idaho

Tests conducted jointly by the Idaho Experiment Station and the Bureau of Reclamation on small laterals show that the loss before lining was almost 13 times greater than after placing the buried membrane.

IN JUNE 1950 the Engineering Experiment Station of the University of Idaho and Region I, United States Bureau of Reclamation, began a cooperative study of linings for controlling seepage losses in irrigation canals. This investigation is a part of the comprehensive lower-cost canal lining program of the Bureau of Reclamation and one of the projects of the special research program of the University of Idaho. The main purpose of the project is to gather and evaluate information on: (1) canal lining materials, (2) methods of placing linings, (3) permanency of linings, and (4) methods of measuring canal seepage losses.

The first year of study centered around field experiments with buried prefabricated-asphalt linings in short sections of small canals. Two test sections were installed on the Black Canyon Unit, Payette Division of the Boise Project and one section on the system of the Post Falls Irrigation District.

The first section on the Black Canyon Unit near Caldwell, Idaho, is in a lateral of the "C" Line East Canal that contours along a steep hillside through very sandy soil. The bottom width of the lateral is about 3 ft. The second test section on the Black Canyon Unit is in a sublateral of the Willow Creek Pump Lateral. The section is in soil that is characteristically loam but underlain with gravel stratum. The test section at Post Falls, Idaho, runs through a very gravelly soil and has irrigated crops on each side of it.

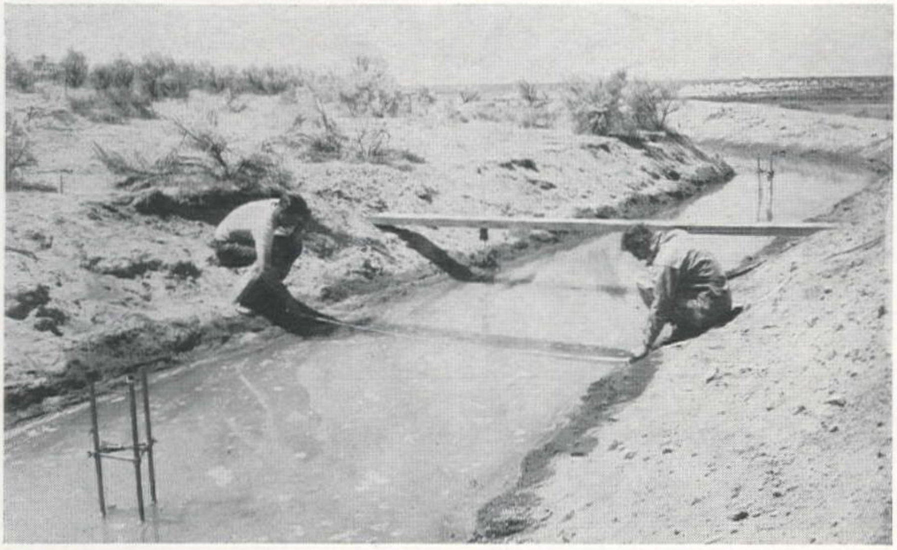
Control testing

Before the test sections were lined, measurements of seepage loss were made in each section. Ponding tests and seepage meters were used to measure these losses. The ponding tests were made by isolating a length of the lateral with canvas dams placed at each end of the test section. Volumetric loss from the total wetted area of the test section was found for a specific period of elapsed time by noting the drop in the water surface as shown by a hook gauge, and by measuring the width of the water surface at marked intervals along the isolated section. Average rate of seepage loss was found by dividing the volumetric loss by the total wetted area and the elapsed time.

Seepage loss using the seepage meter was found by installing meters in the bottom of the canal at intervals along the test section. The rate of seepage was found at these locations by measuring the amount of water that percolated through an open-bottomed cylinder that was pushed into the canal bottom. The confined area inside the seepage cup or open-bottomed cylinder was exactly 2 sq. ft. A submerged plastic bag filled with water and connected by a hose to the seepage cup furnished the supply of water.

During operation, water that seeped through the confined area of the canal bed was continually replenished by water from the water bag. Thus, by weighing the water bag at timed intervals, the rate of loss was determined. Results indicate that the seepage meters always gave a lower rate of loss than by the ponding method (see tabular summary of seepage losses).

Lining material used in all three test



TAKING MEASUREMENTS (above) of width of water surface during a ponding test with seepage meters in operation. This same section of canal was tested later after the buried membrane lining had been placed.

LINING A TEST SECTION (right) with prefabricated asphalt sheets. Working in August, the daytime temperatures were high and the lining was pliable, conforming to ground surface.

SUMMARY OF SEEPAGE LOSSES

Location of Test Section	Length of Section (Feet)	AVERAGE SEEPAGE LOSS — UNLINED — Ponding: cu. ft. per sq. ft. per 24 hrs.	Ponding: cfs. per mile	Meter: cu. ft. per sq. ft. per 24 hrs.	Meter: cfs. per mile	LINED — Ponding: cu. ft. per sq. ft. per 24 hrs.	Ponding: cfs. per mile
Lateral 9.9 "C" Line East Canal Black Canyon Project (11.0 cfs. during test)	300	0.54	0.25	0.363	0.203	0.056	0.031
Lateral 0.1-1.0 Willow Creek Pump Lateral, Black Canyon Project (10.0 cfs. during test)	150	0.72	0.37	0.28	0.15	0.040	0.021
Kulm Lateral Post Falls Irrigation District (4.0 cfs. during test)	200	0.74	0.24	—	—	—	—

sections was developed by Owens-Corning Fiberglas Corp. and the Kerr-McGee Oil Industries. The membrane lining, trade-named Fiberglas Canal Liner, consists of an 11-mil. thick Fiberglas mat coated with filled asphalt cement containing diatomaceous earth, slate flour, and asbestos fibers, with a softening point of approximately 220 deg. F. The liner varies in thickness from 1/8 to 3/16 in., and comes in rolls 36 in. wide and 36 ft. long. Both sides of the asphalt are liberally dusted with mica, which very effectively prevents sticking in the rolls. The rolls were packaged in a heavy wrapping paper and had a 3-in. heavy cardboard core.

Placing lining

After the control tests of seepage were completed and the farmers' immediate demand for water was satisfied, the water was turned out of the lateral to permit placing of the lining. A dragline was used to over-excavate the test section to 12 in. below grade with 1¾ to 1 side slopes. Hand-finish grading was kept to a minimum. Following along behind the dragline, the liner was laid by hand (see illustration) in strips across the canal, starting at the downstream end of the section.

At one place in one of the test sections near Caldwell, a 36-ft. length of the section was lined with the strips parallel to the centerline. This proved more difficult because three men could not place the liner on a warm day without it sagging on the slopes. To keep the liner from sliding down the slopes, each strip was anchored at the top of the joint with "L"-shaped wire fasteners fabricated from No. 10 gauge wire.

At the joints the liner was lapped about 3 in. and cemented together with an RC-1 cutback asphalt. The liquid asphalt was applied with a spouted sprinkler can equipped with a sponge-rubber squeegee.

Placing earth cover

The lining was placed at all three test sections during the latter part of August. Temperatures were above 100 deg. during some of the time the liner was being placed. These temperatures made the liner very pliable so that it conformed smoothly at the joints with very little wrinkling. In placing the earth cover, some difficulty was experienced in keeping the lining from sagging on the side slopes under the impact of the earth striking the membrane. By confining the backfilling operation to the cool early morning hours when the liner was less pliable, it was possible to place the cover with little difficulty.

Placing of the cover material was accomplished with the dragline, and in all cases the original excavated material was used for cover. The usual procedure was to cast the bucket load against the opposite bank from the dragline while operating and pull back earth from there to the opposite side. Cover depth was about 12 in. Cost figures indicate this type of buried membrane lining can be installed in small quantities at a cost of about $1.25 per sq. yd.

Losses after lining

When the lining work was finished, the laterals were filled with water and time allowed for the cover material to become saturated and stabilized. Then the test sections were again isolated by putting in canvas dams. At the ends of the lining, care was taken to be sure the canvas was placed directly in contact with the membrane and sealed with mud to be sure leakage from the ends was eliminated. A number of ponding tests were then run to find the seepage loss under the lined condition.

The table below indicates results of the pretesting of seepage and the seepage loss after lining. Briefly, the figures presented in the tabulation show that the lining reduced the seepage loss from 0.54 to 0.056 cu. ft. per sq. ft. per 24 hr. in one test, and from 0.72 to 0.040 in the second, as determined by ponding. The average of these figures indicates that seepage was reduced 92% by the application of the lining. Or, the unlined section had seepage losses about 13 times higher than the lined section.

Future work

During the summer of 1951, the experimental sections were again tested for seepage loss and samples are to be removed at the end of the irrigation season to inspect the condition of the joints and the prefabricated material itself. In addition, an experimental test canal has been built to study other types of linings. A correlation between field permeability measurements and seepage losses from unlined canal sections is being sought.

This cooperative project is a continuing study that will permit a careful testing of lining materials and methods of measurement directly concerned with canal conveyance losses. Construction work on this project was done by the Operations and Maintenance Branch of the Bureau of Reclamation, at Notus, Idaho. J. V. Walker, D. W. Applegate, and R. J. Abbey represented the Bureau of Reclamation on the study, giving supervision and technical assistance.

Hells Canyon Dam recommended

ANOTHER STEP to relieve the power-hungry Pacific Northwest has been taken in a recommendation by the Department of the Interior that multi-purpose Hells Canyon Dam be authorized for construction on the Snake River, along the Oregon-Idaho boundary. Further support for the authorization is based on a Presidential Economic Report last January that estimated an additional 4,000,000-kw. power load to be imposed by defense efforts in the atomic energy, aluminum and chemical fields.

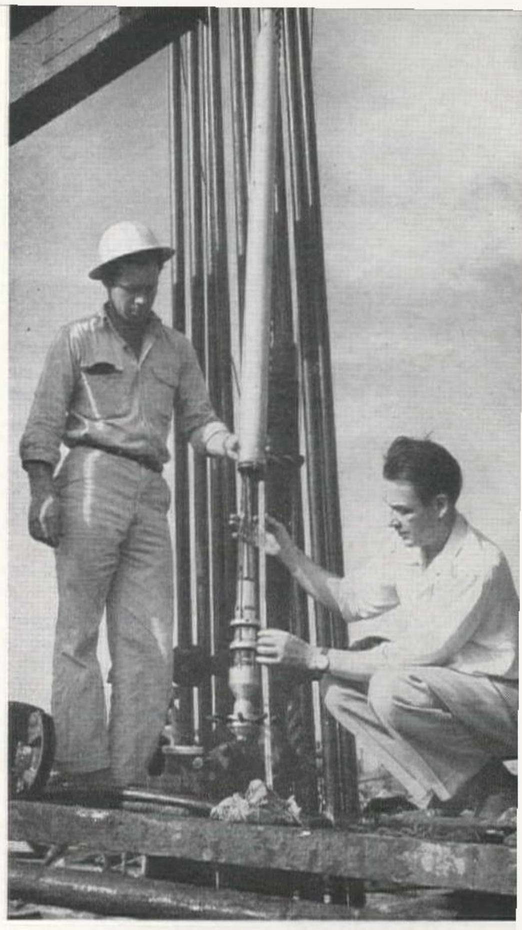
To have a capacity of 900,000 kw., the Hells Canyon power plant would produce 688,000 kw. at the dam site. Flow regulation by the dam would allow generation downstream of 432,000 kw., while integrated operation of other Northwest power plants would permit a credit of 310,000 kw. to the Hells Canyon development. The total power provided would amount to 1,430,000 kw.

The site is a steep canyon in which the 740-ft. concrete arch dam would impound a reservoir of 4,400,000 acre-feet. Time for construction of the $356,810,000 dam is estimated as eight years under normal circumstances. However, an expedited schedule would permit first power generation in four years and 1,000,000 acre-feet of storage in five years. An item of $8,000,000 to initiate construction is included in the President's budget proposals for fiscal 1952.

Recommended at the same time is construction of the Scriver Creek power features of the Payette unit of the Mountain Home division of the Snake River Reclamation Project. These features would produce an additional 88,000 kw. of power. However, it is noted that the Payette unit as presently defined, is not economically feasible, inasmuch as its complete construction would require outside financial assistance beyond the power revenues of the Scriver Creek facilities. A basin-wide system of pooling reclamation benefits would permit a favorable ratio of benefit to cost, but such a system is not yet in effect.

A pipe poses for its picture

This deep-tube camera, developed for photographic inspection of oil wells as shown here, was used in California to locate leaks in the outlet pipe of Suttenfield Dam



By G. M. NORRIS
Flood Control Construction Superintendent
Division of Water Resources
State of California

THE PROBLEM presented by a leaking outlet pipe buried in the body of an earthfill dam was solved in an ingenious manner by engineers of California's Division of Water Resources last spring through use of an oil-well exploratory camera to locate the leak. Scene of the work was Suttenfield Dam at the Sonoma State Home, an earthfill structure built in 1939 to a height of 50 ft. and raised during the past year to a crest height of 76 ft. by Carl C. Harmeling of Stockton.

Undertaken to double the reservoir capacity, from 300 to 600 acre feet, the new construction was commenced in July 1950 and was scheduled for completion by the end of the year. However, early and continuing rains forced interruption of the work until the spring of 1951. Due to the necessity for maintaining water in the reservoir at all times, enlargement could be had only by blanketing the downstream face. Material used was obtained at borrow pits near the site, where it was wetted, disked, and mixed prior to short-haul transport to the dam. There it was dumped and compacted, using a sheepsfoot roller. The project also entailed construction of a new spillway and raising the existing outlet gate tower in the reservoir.

Problem is a pipe

Suttenfield Dam impounds a storage reservoir that is supplied not by tributary inflow above the site but, rather, by pumpage from a stream below. Water so received is later released through the same pipe for use in various facilities of the State Home. Thus, inlet and outlet pipe are one; here it is termed the outlet pipe.

The original outlet pipe, embedded beneath the existing embankment, was of 12-in. diameter, reinforced concrete manufacture, and was encased in 6 in. of reinforced concrete to resist possible distortion and fracture at its joints when subjected to settlement forces of the then-new fill above. Composed of 8-ft. lengths totaling about 304 ft., this outlet had mortared joints throughout, and was laid on a gradient of 3.7%.

The connecting length of new outlet pipe, laid beneath the extended downstream face of the dam, was of 12-in. diameter welded steel with Dresser couplings. This pipe, placed in October 1950, was also encased in 6 in. of reinforced concrete. It is significant also that, to avoid effects of fill settlement, this pipe was laid on undisturbed material in a shallow trench excavated after stripping of the new embankment area. Gradient of the new pipe line, less than the old, was 2.7%.

At the time operations were suspended last fall, this outlet was complete and in operation, its final connection to the local distribution system fully effected. Also, it had by that time been buried under more than half of the projected new embankment.

Throughout the winter and early spring, 1951, the State Home water system was in normal use, with the new outlet pipe functioning as intended.

Leak develops

On April 19, 1951, construction work having commenced again, job personnel observed an extensive wet streak on the downstream dam face. Located about 30 ft. up the slope, the dampness stretched horizontally across the fill, and included spots of perceptible leakage. After three days, during which the phenomenon was under constant observation, all leaks had stopped except one, located almost directly above the outlet pipe. Rough measurements at this time indicated a flow of about 150 gpm. The effluent was clear, however; proof of no serious erosion inside the fill.

In an attempt to determine the leak source, the outlet gate in the reservoir was closed. With this action the leak ceased, showing conclusively that the outlet pipe had suffered some degree of fracture, somewhere in its 420-ft. length. But where? and of what nature? and from what cause? Inspection of a 12-in. pipe buried under a dam, and with that pipe encased in concrete, posed a problem.

THESE MEN engineered the photo-inspection at Suttenfield Dam for the Division of Water Resources: the author (right) and John R. Brannen, resident engineer for alterations at the dam.

At this point, it was recalled that photography had been used by the petroleum industry for oil-well inspection and study. Whether the equipment there employed, specially designed as it was for vertical bores, could be adapted to this virtually horizontal alignment was unknown.

Correspondence established that, although most oil-field camera use is restricted to photographing instrument readings within atmospheric pressure chambers, one special instrument had been built that gave some promise. It had been developed by William E. Crane of the Deep Tube Photo Service in Long Beach, Calif., to photograph both minute and major changes in deep casings that had been crushed or otherwise damaged in the subsidence of Terminal Island. Since this camera would operate horizontally, Crane's organization was retained to conduct a photo-inspection of the Suttenfield Dam outlet pipe.

Camera operation

The deep-tube camera is encased in a cylindrical pressure shell 8 ft. long and of 3.12-in. diameter. Within the shell are two separate battery packs, a 2,200-volt electronic condenser pack, a film transport mechanism, and an extreme wide-angle (98 deg.) lens situated at one end, behind an optical glass port. The light source, a tiny gaseous discharge tube, is supported 8 in. forward of the glass port by three thin struts of spring steel.

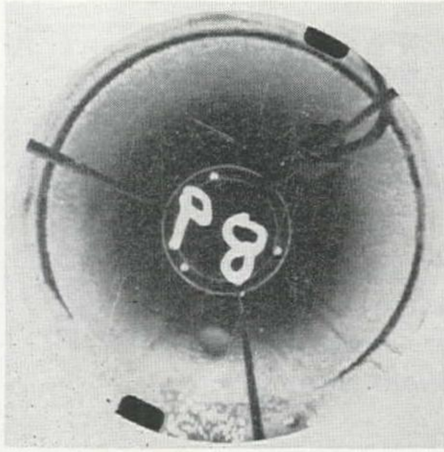
Key to the camera's operation is this electronic tube, which, in addition to illumination, provides rheostatic control. At the dam this tube was set to fire at 50-sec. intervals in synchronization with the film-winding mechanism. With a flash duration of 1/30,000 sec., the camera requires no shutter.

Using 16-mm. film having 250 frames, the camera can photograph 117 ft. of bore in a single operation, recording 8 lin. in. per exposure and allowing sufficient overlap to insure full coverage and permit ready correlation and interpretation of adjoining frames. The record can be produced as conventional enlarged prints. In this case, however, the Division specified a positive film record, to be viewed in a microfilm reader.

Upon Crane's arrival at the work site on April 30, the camera was fitted with special supports to maintain it centrally in the 12-in. bore to be photographed. For this purpose, a series of five pieces of narrow spring steel were fastened at both ends of the camera. Being somewhat longer than the camera, they bowed out from it. Two circumferential bands were connected among these longitudinal springs to prevent movement that might permit the camera to be damaged against the interior of the pipe.

Camera installation

In oil wells the camera is normally suspended by piano wire from a gasoline-driven winch equipped with an accurate footage counter. At the dam, however, movement was to be manually controlled by hand winch from the outlet gate tower in the reservoir. To "thread" this 420-ft. "needle eye" with a pulling line, engineers secured a wooden croquet ball to a length of cord and dropped it into the pipe, releasing a very small flow of water simultaneously. The ball floated through the pipe and was recovered below the dam, where sufficient disassembly of the pipe had been performed to admit the camera. A length of ⅛-in. high tensile aircraft control cable was subsequently pulled through by means of the cord.



SAMPLE PHOTO of outlet pipe shows joint, obscured in invert by flow of infiltrated water.

Voice communication by walkie-talkie radio was established between the gate tower and the downstream toe of the dam, and the camera fastened to the ⅛-in. cable, to be dragged "upstream" in the pipe. Increments of movement were to be determined by the winch crew and checked by personnel below the dam using a surveyor's tape fastened to the camera. A second length of cable was also secured downstream for recovering the equipment. Timing was to be controlled by observation of the flash accompanying each picture. A stop watch was eventually to be necessary when the flashes became invisible.

With all in readiness, the photography began, being limited to the old length of reinforced concrete outlet pipe placed in 1939. Two trial runs were necessary before the correct film emulsion and lens opening were determined. Sample pictures of each trial were speedily developed, using darkroom facilities happily available at the State Home.

After photographic conditions had been satisfactorily established, work proceeded at a good pace, and the entire 304 ft. of concrete pipe photographed in 34 working hours over a period of five days. Two runs were made each day, with time out for laboratory processing at noon and night. More than 1,500 exposures were made on over 65 ft. of film, including positioning, identifying, and testing shots. The record delivered to the Division of Water Resources totaled 728 positives.

Photo interpretation

The problem now was one of interpretation of the results. Crane could offer only limited assistance, for the interior of a 12-in. concrete outlet pipe under a dam bears but slight resemblance to that of an oil-well casing. Distortion in the photograph was the first point to be realized. As accompanying illustrations show, the camera records a cylindrical section 8 in. long on a flat piece of film; as a result, portions of the pipe nearest the lens appear greatly enlarged at the outer circumference of the picture, while portions of the pipe only 8 in. ahead of the lens appear contracted at the picture center. The illusion is that of looking through an entire pipe many

Installation of welded steel liner cures leaks at Suttenfield Dam

ALTHOUGH THE NATURE and extent of leaks in the outlet pipe of Suttenfield Dam had been determined by photo-inspection, final treatment of those leaks raised a new problem as it was decided to install a continuous welded steel liner throughout the 420 ft. of both old and new outlet sections.

The 3.7% slope of the old outlet and the 2.7% slope of the new resulted in an abrupt change in gradient of 1.0%, thereby complicating the selection of a standard-diameter liner. In solution of this latter problem graphic methods were employed, the question being similar to that of determining the length of truck which can complete a right-angle turn between streets of given widths!

Careful plotting of outlet pipe profiles at the point of gradient change was followed by superposition of a template representing 8-in. steel liner. A limiting length of liner was thereby found that would touch the inverts in each outlet section, and also the top of the outlet at the bend. Deflection computations followed, based on the action as a simply supported beam of such a length of 8-in. pipe ¼ in. thick. These computations showed that the pipe's deflection due to its own weight at least equaled the angular change in outlet gradient; that is, the axis of the liner increment at each end would be parallel to the outlet gradient.

For installing the new liner, a ⅝-in. cable was threaded through the outlet pipe to a hand winch on the outlet gate tower, and the downstream end made fast to a conical nose piece designed for connection to the liner. A final precaution taken was to apply tractor roller grease to each piece of pipe as it was welded to the ever-increasing length and hauled into place.

Following placement, lead seals were placed around the liner at up- and downstream ends. The annular space between the liner and the existing outlet pipe was then filled with cement grout placed by customary methods. The grout used varied in consistency from beginning to end of the operation. At first proportioned 2:1, water and cement, for greater flowability, it was later made ½:1 as the space became filled. The only pressure used was that necessary to overcome the 13-ft. difference in elevation between ends of the outlet pipe. Care was taken not to aggravate existing leaks in the old pipe or to start new ones.

Removal of equipment and reassembly of connections between the outlet pipe and the distribution system of the State Home completed the entire job. The results appear completely satisfactory in this case, though it is realized that more strict requirements for pipe capacity elsewhere render this installation a rather special solution of the problem.

feet long, its opposite end a pinpoint.

Notwithstanding this distortion, certain features were readily identifiable and provided a basis for further interpretation. Vertical displacement between adjacent pipe lengths was evidenced by a broadening at top or bottom of the dark circle in the photograph indicative of a joint. Broadening at the top indicated that the pipe in the foreground was higher than that in the background, upstream from the camera. This condition was often accompanied by obvious ponding of water in the upstream pipe against the dam formed by displacement of the downstream section. Similar broadening at other points on the joint circle indicated varying degrees of displacement in other directions.

This displacement was found throughout the pipe but was in no case greater than that normally created during the process of placement. In regard to other forms of deformation or failure, the photo-inspection revealed no evidence of longitudinal cracking, nor of collapse. Most significant, there were no abrupt changes in gradient, as from fill settlement. The concrete encasement had apparently functioned to protect the pipe; but, nevertheless, the pipe had leaked.

Leaks apparent

And the leaking continued, its direction of flow now reversed, while the photo-inspection was in progress. Many pictures showed water dripping into the outlet pipe at joints, water draining from the saturated fill above. Such was the source of flowing water apparent in the accompanying illustrative photos. This water could have had its origin either as normal embankment seepage from the upstream face, or as leakage from the pipe when in operation now returned in the absence of operating hydraulic head upon the system. Regardless, these joint leaks unmistakably existed despite the concrete encasement, and were the only leaks discovered.

The only practical remedy seemed to be that of lining the outlet with continuous steel pipe. For hydraulic reasons it was decided to do this throughout the pipe, a decision that introduced the new problem of designing a liner that would negotiate the abrupt change in gradient between old and new sections. The manner of solution and the resulting installation are described elsewhere on these pages.

Conclusions

Though not universally applicable, the described method of photo-inspection is believed noteworthy as it bears on the maintenance and repair of hydraulic structures. Obstacles to the use of equipment furnished by the Deep Tube Photo Service were rapidly overcome, and five days' work then provided an accurate record of conditions within the 304 ft. of 12-in. pipe.

The work was conducted under the general direction of the author, with John R. Brannen as resident engineer at Suttenfield Dam. William E. Crane directed the photographic operation, assisted by Ronald Bishop.

Proposed parking structure straddles bridge approach

CLEAR PLASTIC scale model built by Portland traffic engineer Fred Fowler fits ramp system of new Morrison St. bridge "to a T". (Photo by The Oregonian.)

AS THE CITY of Portland, Oregon, moves toward construction of its new high-level vehicular Morrison Street Bridge across the Willamette River, Traffic Engineer Fred T. Fowler has come up with the results of a two-year study aimed at more efficient use of the land to be acquired for construction of the bridge approach system.

Reasoning that use of the new bridge might well aggravate Portland's existing shortage of 7,000 downtown parking spaces, Fowler has designed an automobile parking structure five stories high that would straddle the bridge approaches and provide space for 3,000 cars. In order to illustrate his plan for various civic groups and to prove its feasibility, Fowler has built a clear-plastic scale model of the structure, showing just how its T-shape would completely envelop both main ramp and auxiliary clover-leaf interchanges leading to river-front arterials. Covering more than four city blocks, it permits traffic access at all levels.

Cost of this unique solution to a major parking problem is presently seen to be $3,000,000, although it might be built in successive stages. Funds voted for construction would be repaid from revenues of the enterprise operating the garage, which would include automobile service facilities as well as parking.

Overall dimensions of the reinforced concrete structure are 400 x 720 ft. In the interest of economy, it is planned as a relatively simple structure of columns and decks, with all sides open. Overall height is 40 ft.

Essentially simple in its plan, and readily adaptable to stage construction, this type of parking structure appears to be one that might find use in many Western urban areas, where expensive rights-of-way have been acquired for freeways.

Original fill sinks and swims, so—

"Struts" stabilize highway over mud

Steady settlement of highway embankment placed over an 80-ft. depth of mud drops roadway below high water level—Counterweight fills and raised embankment placed at controlled rate for lowest construction and maintenance costs

By PERCY A. MAIN
Assistant Highway Engineer
California Division of Highways

TO STABILIZE an existing highway fill which crosses a filled bay of an adjacent lake, and to raise the roadway above normal high water level, a "strut" fill has been built by the California Division of Highways during the past two construction seasons.

Located near Upper Lake in Lake County, Calif., this section of California Highway 20, which extends between Williams and a junction with U. S. 101 north of Ukiah, crosses the low-lying terrain which is drained by Bachelor Creek. Bachelor Creek, in turn, empties into nearby Scotts Creek. During periods of high run-off, water backs up in Scotts Creek and floods this low area. During maximum floods the area is covered to a depth of 14 or 15 ft., or to elev. 1339 at the highway crossing, thereby forming Tule Lake and inundating the highway.

After the water in Tule Lake recedes to its normal level in the late spring, the local reclamation district pumps the balance of the water into adjacent Clear Lake to permit the low area to be farmed.

History

The original highway was constructed across the low creek valley in 1922 and, when completed, had a surface elevation of 1335, which was approximately 10 ft. above the ground surface. Between 1922 and 1950 the fill subsided continuously (about 5 ft. during this period). This vertical settlement was accompanied by considerable lateral displacement in the surrounding mud.

In order to eliminate this flooding of the road and its resultant closure to traffic during winter storms, requiring the detour of traffic over a county road and adding 1.6 mi. to the route, a decision was made to remedy the situation by raising the grade to an elevation above high water. To accomplish this would require raising the old fill approximately 12 ft. Construction to this grade would require an increased fill of approximately 17 ft. total height above the adjacent ground surface.

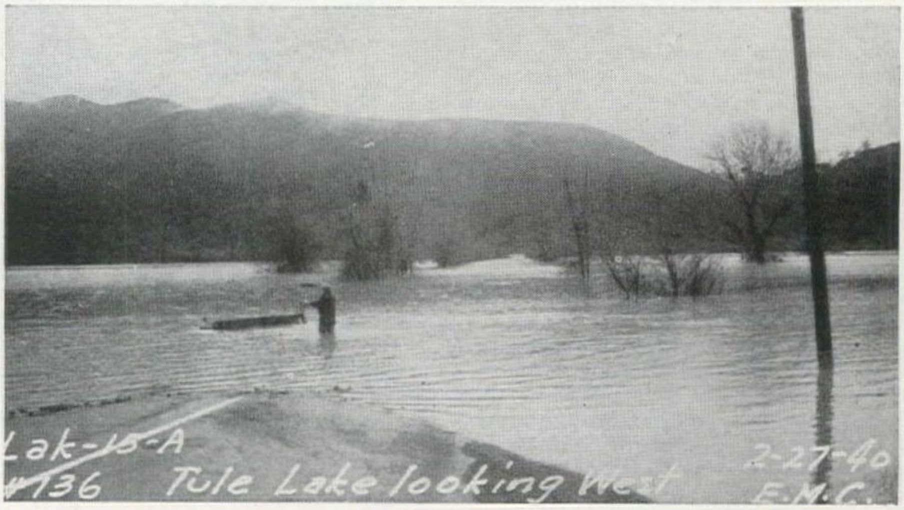
The unstable character of the foundation soil was evidenced by the continuous settlement of the relatively low existing embankment. An investigation was made to determine the feasibility of the proposed fill and the stabilization treatment necessary to obtain a stable roadbed.

Stability tests

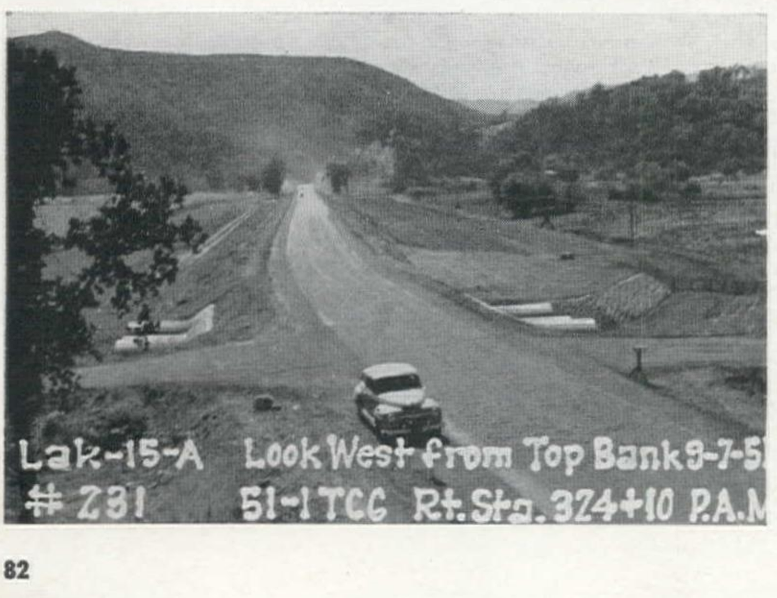
Four power borings were made in depths varying from 67 to 100 ft. Moisture and density determinations were made on all retained cores, and numerous grain size analyses were made. Consolidation and shear tests were made on undisturbed samples taken at various depths.

These test data were used in analyzing the stability of the foundation soil, computing settlement and comparing various methods of fill treatments.

Borings indicated that Tule Lake is a filled bay of Clear Lake with soft, gray silty clay extending to a depth of approximately 85 ft. This soft mud is underlain by relatively firm material, ranging from clayey sand to gravel.

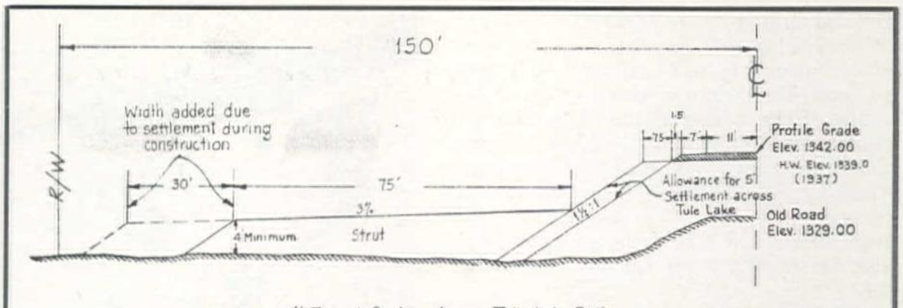


FIVE-FOOT SETTLEMENT in 30 years of fill across dry arm of lake resulted in roadway being completely submerged during periods of high water (above).



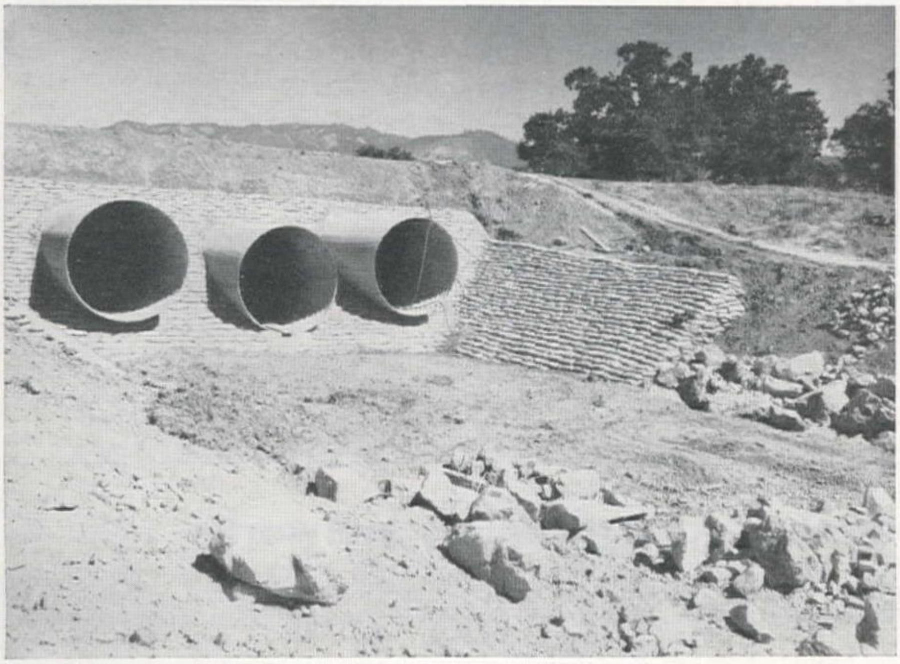
NEW ROADWAY (left) is now 12 ft. above former grade and 17 ft. above adjacent ground level. Strut fills extend about 105 ft. from edge of embankment.

TYPICAL SECTION across lake bottom shows amount of fill placed for roadway prism embankment and struts. Sudden unexplained subsidence indicated by settling platforms at one station resulted in decision to widen strut fills to right-of-way lines.



½ Typical Section Across Tule Lake Bottom

STAGGERED 108-IN. CULVERTS at east end of fill allow passage of flood waters. Rip-rapping consists of sacks filled with sand and cement.



The moisture content of the silty clay varied from 63% to 86% in the cores tested, with unit wet weights of from 88 to 112 lb. per cu. ft.

Following is a description and comparison of the several alternate methods of embankment construction with special consideration of the probable subsequent stability and subsidence of the fill.

(a) Construction of embankment without any treatment and with no counterweight struts was considered to be unsafe. The computed factor of safety would be less than unity, and fill failure during construction could be expected. Such a design was not considered feasible.

(b) The analyses indicated that, by carefully controlling the rate of embankment placement and by constructing counterweight or "toe support" fills, it might be possible to construct the fill without excessive lateral displacement of the underlying mud. However, the computed factor of safety was approximately unity so that the fill would have to be brought up slowly. The subsequent settlement would continue for many years, and after about five years would be sufficient to necessitate additional fill if the grade line were to be kept above high water.

(c, d) Construction of a fill with sand drains to a depth of 50 ft., without or with counterweight strut fills, would entail costs which would be prohibitive. The subsequent settlement would be much less than for the embankment without sand drains; the subsidence due to consolidation of the foundation soil after construction would probably be less than 2 ft. in ten years, so that no major reconstruction would be required to maintain the grade above high water for ten years or so.

(e) The other alternative studied was sand drain treatment for the full depth of mud. To minimize the danger of fill failure during construction by lateral displacement of the fill, a counterweight fill was included in this design. The subsidence due to consolidation after construction would be relatively slight, probably less than a foot in the first ten years and almost negligible thereafter.

Design selected

Considering all the factors, it was concluded that the design for minimum ultimate cost of construction and maintenance would be the construction of the embankment to a nominal height above high water with no special treatment except the counterweight fills and controlled rate of placement. Additional increments of embankment and surfacing would be necessary at intervals of perhaps five years in order to maintain a grade above high water, but would eventually reach stability.

After these studies of foundation stability, fill settlement and economic comparisons, a decision was made to construct an embankment and toe support fill without foundation treatment (see typical cross-section), with careful control of rate of fill placement. The drainage structures were to be placed on a blanket of gravel. Although this method would require periodic additions to the fill as settlement occurred, economic comparisons indicated it would be cheapest in over-all ultimate cost.

Stability safeguards

Before the fill was started, 4 x 4-ft. timber settling platforms with ¾-in. vertical pipe indicators were placed at three locations on the center line of the old fill and on the original ground 105 ft. right and left of center line. Iron pins were driven in the ground at 50-ft. intervals out to 250 ft. from center line. Elevations were taken of these points daily, and settling or heaving was noted.

In order to guard against a too rapid placing of the fill that would result in an accumulation of pore pressure in the underlying soil, wellpoints were installed at depths of 14, 30, and 45 ft. below original ground line. These wellpoints were placed at the right toe of the old fill and connected by copper tubing to pressure gauges placed outside the limits of the road fill.

The pressure registered on these gauges was recorded daily and plotted on a chart. The chart was important, as the rate of change was probably more significant than the actual value.

The rate of fill placement was further controlled by a clause in the specifications specifying that not more than one 8-in. lift be placed in any 24-hour period.

The contractor started placing the embankment on June 15, 1950, and the rough grading was completed on October 3, 1950, with 120,000 cu. yd. of embankment used in the fill.

The counterweight or strut fills were constructed first, leaving the old roadway for the use of traffic. After the strut fills were completed, traffic was routed over the left strut, and the main roadway prism was constructed as specified. A total lift of 0.75 ft. of imported base was placed between October 4 and 13, 1950. A total of 0.50 ft. of road-mixed imported base cement (2%) treated was placed between October 16 and November 4, 1950. One-half inch of road-mixed surfacing was placed November 24 and 27, 1950, as a maintenance course for the wet winter suspension period.

The balance (2½ in.) of road-mixed surfacing was placed June 11, 1951.

The behavior of the pressure gauges was in some respects disappointing or at least difficult to interpret.

The wellpoints as stated above were placed at depths of 15, 30, and 45 ft. The 30- and 45-ft. depths were selected because of the width of the fill which, including the struts, was 250 ft. It was assumed that the bulb of pressure caused by the weight of fill would extend to approximately 50 ft. during the construction of the struts and to a considerably lesser depth for the balance of the fill.

The pressures measured for the 30- and 45-ft. depth confirmed the original assumption; however, significant pressures were never obtained on the 15-ft. depth.

The failure to record any pressure at the 15-ft. depth is hard to explain in view of the plastic flow which occurred, particularly at station 316+50. The increased rate of settlement at this location was accompanied by heaving at 150 ft. from center line. Further evidence of plastic flow was lateral movement of the newly constructed property fence and cracks which appeared in the strut fill.

Additional wellpoints which were installed as a check on the original installation indicated no pore pressure.

The settling platforms indicated that the mud subsided at a uniform rate as was originally estimated with the exception at center line station 316+50 between August 29 and 31, 1950, 1.3 ft. subsidence was recorded. This sudden subsidence at this one station has gone unanswered, as it cannot be correlated with any sudden change in pressure gauge readings or in heave point readings.

V. M. DWYER, left, superintendent for the contractor, and Percy A. Main, author of this article, confer during construction of the strut fill. Mr. Main acted as resident engineer on the project.

When this sudden subsidence occurred, a decision was made not to place any more embankment across the unstable area until September 18, 1950, and then to widen the strut fills to the right-of-way lines before the roadway prism embankment was completed. The strut fill embankments were completed on September 26, 1950, and the roadway embankment on September 30, 1950.

Between June 6, 1950, and October 14, 1950, while embankment was being placed, a maximum subsidence of 4.3 ft. was recorded at center line station 316+50.

Between October 14, 1950, and May 29, 1951, (date of last elevation taken), the embankment has subsided a maximum of 2.3 ft., or a total of 6.6 ft.

Personnel

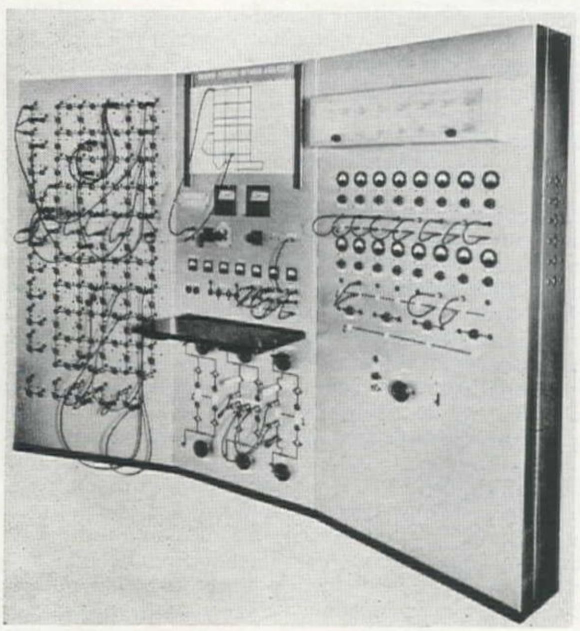
The project was carried out in District I, California Division of Highways; A. M. Nash, district engineer; C. P. Sweet, district construction engineer; W. R. Lovering, district materials and testing engineer. Field operations were under the immediate direction of Percy A. Main, resident engineer.

The contract was carried out by Contractor M. W. Brown of Redding, Calif., on a bid of $191,432.60. V. M. Dwyer was the contractor's superintendent.

An electrical analyzer for pipeline networks

COMPUTATION of the probable flow and pressure of water in each pipe of a pipe network system may be quite laborious. Because of this fact, studies of water distibution systems often have been hindered. A direct-reading electric analyzer is now available which eliminates all calculations beyond a simple change of scale. The first analyzer was invented and designed by Malcolm S. McIlroy, now at Cornell University. The Standard Electric Time Company undertook the manufacture and sale of the McIlroy Pipeline-Network Analyzers. The first production unit has gone to the Division of Industrial Research, State College of Washington, Pullman, Wash. There it will be available to industry and municipalities for analysis of pipe-network systems.

Previous attempts have been made to develop electrical analyzers to solve network problems but since the volt-ampere characteristic of an ordinary resistor is very different from the nonlinear head loss-flow characteristics of a pipeline, the earlier attempts involved trial and error procedures. The McIlroy Network Analyzer employs nonlinear resistors which represent pipelines in an analogous electrical circuit so that a rational law or acceptable empirical formula relating head loss to flow rate is properly simulated by the relation between voltage across the resistor and current through it. Once the analogous network is set up on the electrical circuit, flow rates and pressures may be read directly from the appropriate meters. The nonlinear resistors have the general appearance of a light bulb. Intensity of light emitted from each resistor varies as the voltage (analogous to head loss) across it so that a glance at the resistor panel serves as a rapid guide in spotting portions of the network that need to be improved.



THE BRAINS of the McIlroy Network Analyzer are composed of complex circuits housed behind this control panel, upon which hydraulic pipeline networks may be simulated electrically. The first production unit is in laboratory service at Washington State College, Pullman, Wash.

A summary of the advantages of the direct-reading analyzer are listed below.

1. No guesses of values of flow rates or head losses, followed by successive approximations, are involved.
2. Only those values actually needed are recorded.
3. Changes to represent alternative plans of constructing or operating a network can be made readily, and their effects quickly visualized and evaluated.
4. Solutions automatically balance with accuracy suitable for engineering work.
5. Solutions are rapid, and the probability of human error is minimized.

Inquiries about the analyzer at Washington State College should be addressed to: Division of Industrial Services, The State College of Washington, Pullman, Wash.

New San Francisco aqueduct features 800 ft. of—

Concrete-steel-lined pressure tunnel

Only tunnel of new Bay Division conduit is lined with 91-in. steel pipe encased in concrete—Pipe in turn receives cement-mortar Centrilining for complete protection

CENTRIFUGAL APPLICATION of cement-mortar lining to 810 ft. of 91-in. welded steel pipe last August virtually completed construction of the Stanford Tunnel, final link in the 33.8-mi. all-land length of San Francisco's third Bay Division pipeline of the Hetch Hetchy Aqueduct. Except for connections between sections of the pipe laid under three separate contracts for the San Francisco Water Department, completion of this tunnel brings to an end major construction on the current water supply project, expected to be in operation late this year. (*Western Construction*—September 1951, p. 101.)

Location of the tunnel is Stanford University property, just south of Palo Alto, California. Other construction by United Concrete Pipe Corp. on this $2,098,832 contract included placement of 7.1 mi. of 72-in. reinforced concrete pressure pipe and 1.0 mi. of 73-in. cement-lined steel pipe, extending from Stanford Tunnel to Pulgas Tunnel near Crystal Springs Reservoir, end of the project. Progress of the tunnel construction was marked by (1) excavation of the 120-in. bore, (2) installation of 91-in. I.D. welded steel pipe, (3) backfill with concrete using a Kemper Concrete Placer, and (4) Centrilining operations by American Pipe & Construction Co.

Excavation

Tunneling commenced on September 5, 1950, with placement of the first tunnel set at the east portal. A deep-cut approach trench adjacent to the portal had already been excavated; together with a corresponding trench at the west portal, this represented 90 ft. of the 810-ft. section classified as a tunnel, but was actually outside of the 720-ft. bore. Due to inadequate space for dumping spoil at the west portal, operations were conducted entirely from the east.

At various times, one-, two-, and three-shift operations were carried on. These consisted, underground, of an eight-man crew made up of 1 shifter, 3 or 4 miners, 1 motor operator, 1 mucking machine operator, and 1 compressor operator. Progress was achieved through use of pneumatic spades, with resort in many places to drilling and blasting. For the latter method a drill jumbo was used, mounting 2 air drills. Ground conditions varied as the tunneling went forward: on one day 8 holes were shot in the bottom of the face (sandstone) and the top (clay) spaded out. Three days later, 14 6-ft. holes were drilled and blasted, using 30% Atlas powder, two sticks per hole.

By November, driving operations were pretty much down to normal routine. A complete round cycle was averaging about 5½ hours, and the tunnel had advanced 219 ft. Material encountered consisted largely of sandstone and a carbonaceous shale known as gouge, necessitating continuous installation of 4-in. H-beam sets at 4- and 5-ft. centers. These sets were prefabricated in two pieces, placed on 4 x 12-in. wood foot blocks, and bolted together to shore the horseshoe tunnel section. Spreaders were 4 x 6-in. timbers laid between the foot blocks. Lagging and spiling as necessary completed the tunnel shoring.

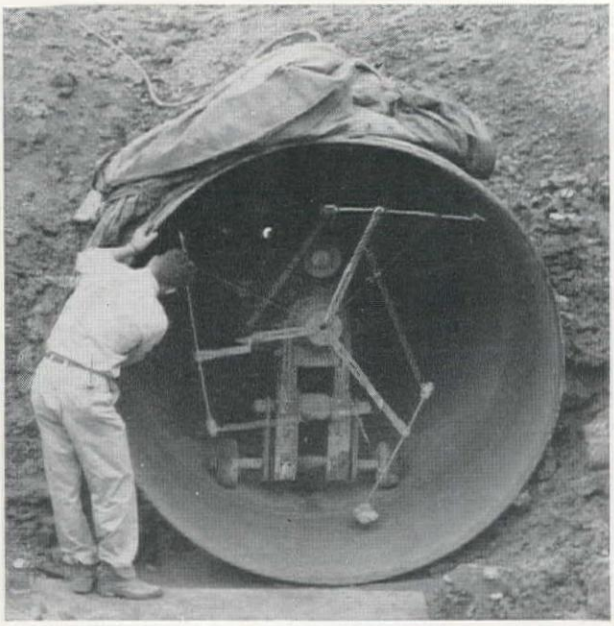
Cycle time

Weather conditions outside and ground conditions inside the tunnel slowed operations considerably toward the end of November. As shoring requirements became more rigid the cycle time increased, now averaging about 7½ hours, as follows: blast at 9:00, place crown bars at 9:30, commence mucking at 10:10, place steel at 2:50, commence drilling at 3:30, finishing at 4:30. Shooting at 8:30 the following morning completed the cycle.

Excavated material was handled by a ¼-cu. yd. air mucker into ⅞-cu. yd. tilt-dump cars. These operated in trains of four, moved by a 3,000-lb. electric locomotive, and traveled on 20-lb., 24-in. gauge track spiked to the tunnel-set spreaders. In normal operation, four empties were pushed in to the heading, where the lead car was loaded. The train was then pulled to the outside switch and the loaded car shunted to the rear of the string of empties. This operation, repeated three times, completed loading of the cars, after which all cars were dumped and returned to the tunnel.

The last rib set was placed on March 6, 1951, ending the tunnel driving. A stope was run 8 ft. up to the surface at that point: the tunnel was holed through, and surface excavation from the west only remained. A total of 751 ft. had been driven, some of which was later daylighted. Average advance had

IN PREPARATION for pipe placement, tunnel crews check and re-align rib sets near west portal. Tunneling was last major construction on the new pipeline, which will add 76 mgd. to San Francisco's water supply when service starts late this year.



CENTRILINING MACHINE began at west portal and worked east, applying $1/2$ in. of mortar to pipe surface. Tunnel is 90-in. I.D. after lining, has capacity of two 72-in. pipes, providing for future expansion of system.

been 6 ft. per day for 125 working days, involving placement of 159 steel sets.

Pipe placement

Following a month spent making minor adjustments in the tunnel grade and retimbering a few spots, pipe installation and concreting was commenced. Steel pipe for lining the tunnel was delivered in 24-ft., 4-in. sections, having 6-in. butt straps tack-welded at one end to form the bell. Of 91-in. inside diameter, the pipe was fabricated of $3/8$-in. plate.

A special rail dolly 20 ft. long was used to haul lengths of pipe into the tunnel. A jacking arrangement between frame and axles of the dolly permitted raising or lowering the pipe 10 in. This made it possible to place the pipe on its supports in the tunnel and then "retract" the dolly for removal from under the cylinder. Pipe position was determined by supports previously located by a plywood template and secured by welding. When two lengths of pipe were in position, their joint was welded from the inside in two passes, a sealer bead and a cover bead.

Coincident with pipe placement, but two lengths (48 ft.) behind it, concrete encasement was poured between the liner and tunnel walls. Computed concrete quantity was 1 cu. yd. per lin. ft. of tunnel, but in actuality this ran to 1.3 cu. yd. The Kemper Placer used in the operation was supplied with concrete from local transit-mix plants and propelled in and out of the tunnel by electric locomotive.

Concreting

Capacity of the placer in its cylindrical hopper was 2.3 cu. yd., which was dispensed in 42 sec. During a day's work 65 cu. yd. was placed, on an average, just the amount to encase the previous day's installation of liner pipe. The $6\frac{1}{2}$-sack mix used incorporated 1-in. aggregate as a maximum, was held to a 4-in. slump, and developed a 28-day compressive strength ranging from 3,600 to 4,000 psi.

With the pipe in position for encasement, sacked sand was packed around as a bulkhead. All pours were completed to this bulkhead, leaving an irregular vertical joint for the adjoining pour. Concrete from the Kemper Placer dropped by gravity into a 6-in. discharge line, through which it was forced by air pressure. At the pour, the end of this line was kept buried at least 6 ft. in the concrete to prevent segregation of the mix. During simultaneous pipe installation, the concrete discharge line was supported by C-clamps and chain from the steel ribs of the tunnel arch. After pipe cylinders were in place, the discharge line was cradled between steel rods welded to the cylinders.

In one month the entire pipe was encased in concrete totaling 1,000 cu. yd. Steel rib sets and rails were left in the tunnel, but about 85% of wood shoring was removed. Even so, voids remained at some 12 locations, which are later to be grouted from within the pipe, by means of 2-in. holes drilled through the pipe and its encasement to admit the grout.

Centrilining

Centrilining of the tunnel was carried out by American Pipe & Construction Co., Western licensee for the process, in the latter part of August. Often used in the rehabilitation of old pipe (*Western Construction*—November 1950, pp. 65-67; May 1951, pp. 72-73), the Centriline process is only now being applied to new construction.

The machine used in the operation cast the mortar from a head revolving about 3,400 rpm., and moved slowly along the pipe to bring a set of three revolving trowels into contact with the fresh mortar. The 5-cu. ft. capacity of the machine was supplied from the tunnel portal by an electrically operated buggy pushing a wheeled trough. Handling at the scene of the work was by shovel labor.

On this job, a mortar mix was used having proportions of 3 sacks cement to 5 of sand and 1 of pozzolan for workability. Sand was No. 0 Monterey, passing 24 mesh. It was mixed in a 10-cu. ft. non-revolving drum mixer mounted in a semi-trailer, which also carried the necessary motor-generator equipment and provided transportation and storage of mortar constituents. From the mixer, mortar was discharged through an access port near the portal into the waiting buggy, which transported it to the work. At the Centrilining machine, three men worked to complete the operation—one controlling the machine and two supplying it with mortar from the stockpile maintained by continued buggy trips.

Trowel finish

Trowel arms of the machine were counter-weighted and fitted with springs to give a finished thickness of lining of $1/2$ in. This was generally achieved, despite the pipe being as much as 3 in. out of round in places. Lineal rate of travel of the machine, 14 in. per min., was geared to trowel revolution, $5\frac{2}{3}$ rpm., to give an overlap of trowel operation. The first two trowels spread and smoothed the mortar, the third was edged to leave a minimum trace from its passage over the lining surface.

Lining problems

Four hours were required for the mortar to set up, after which pointing up could be conducted at joints and other irregularities in the Centrilined pipe. Prior to that time the lining was very "touchy": a handscratch would destroy the arch action which in part supported the lining, resulting in extensive caving of the fresh mortar.

A particular difficulty encountered in this work was the varying moisture conditions that occurred within the pipe. These were caused by external air temperature and humidity, and the nature and extent of material overlying the pipe (only earth in open-cut portions of the pipe). Pipe "sweat" materially affected the mortar moisture content and necessitated rigid inspection, a difficult thing due to the inaccessibility of newly lined areas. Main indication of too damp a mix was a tendency for it to slump in long horizontal ridges following troweling. Control of water in the mixing operation, therefore, had to be flexible. In the main, water content was determined by the mixer operator from experience, and varied to fit the occasion as the engineer directed.

Personnel

Result of the entire work is an impervious pressure conduit composed of welded steel pipe $3/8$ in. thick encased in 10 in. of concrete and lined with $1/2$ in. of cement mortar. In its construction, personnel for the San Francisco Water Department have included Carl A. Lauenstein, construction engineer; Fred H. (Pat) Kernan, senior inspector, and J. H. Robinson, inspector on the job. Max Sandri is job superintendent for United Concrete Pipe Corp., under general superintendent Hal Pope. For American Pipe & Construction Co., J. W. Thompson was general superintendent and John Gay, job superintendent.

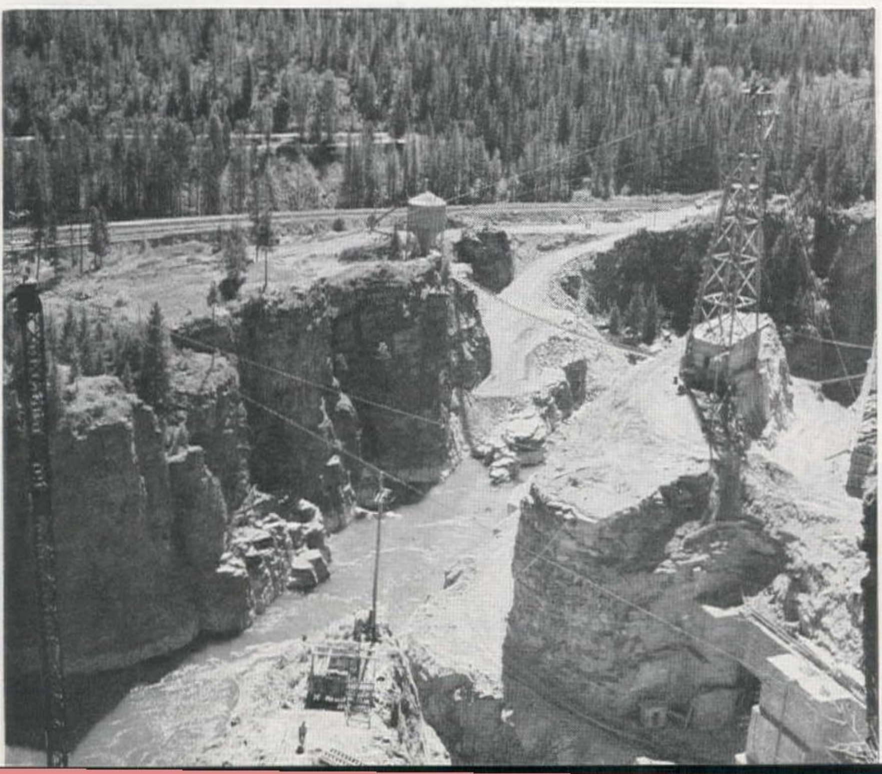
ONE BIG SHOT

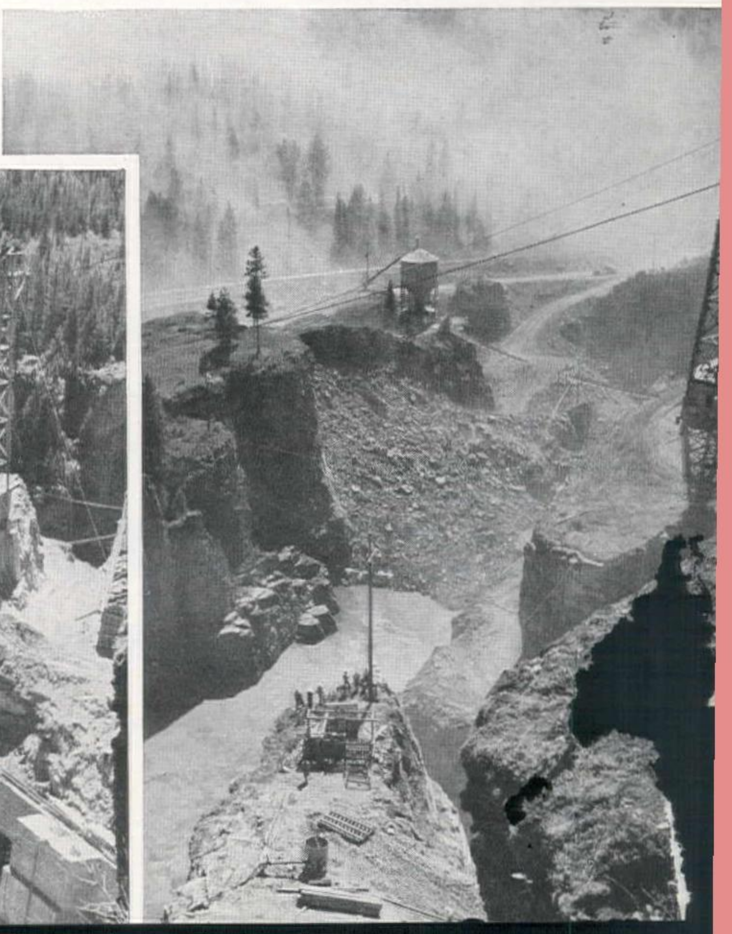
Here is the blast at Cabinet Gorge which created a cofferdam at one stroke last August, clearing the way for construction of Cabinet Gorge Dam for Washington Water Power Co. on the Clark Fork River in Idaho. Pictures were taken by Morrison-Knudsen's project manager, John R. Barry.

THE BLAST ITSELF has roiled the river several hundred feet upstream (foreground) and clouds of dust and smoke spout from shattered rock as an entire cliff is sundered by 65,000 lb. of dynamite. This was the culmination of weeks of work drilling over 400 ft. of coyote holes which, properly loaded and shot, would drop the rock squarely into the swift current, effectively damming flows up to 25,000 cfs.

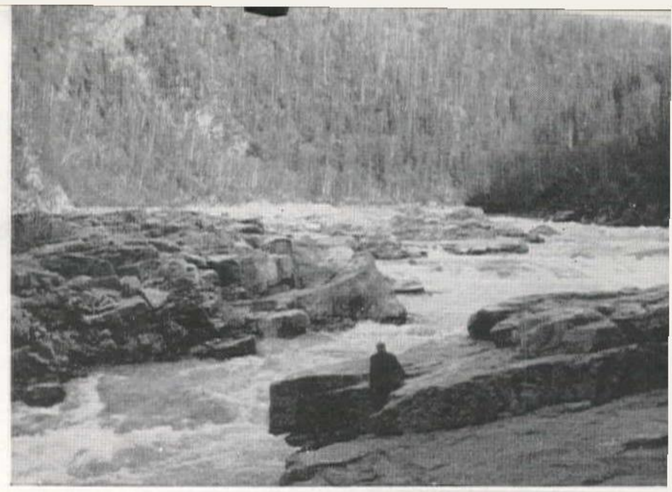
AFTER the dynamite has done its work, success of the powder crews is marked by the rising level of the river, halted in its course by the mass of rock that here fills its channel. Two additional cofferdams were later placed, triple sealing the canyon to prevent seepage and permit construction of the 170-ft. concrete arch dam.

BEFORE the blast, the Clark Fork River swirls through Cabinet Gorge as men of Morrison-Knudsen, dam builders for Washington Water Power Co., prepare to harness its energy for production of 200,000 kw. in Idaho's largest hydroelectric power plant.





Alaska damsite survey ends in "shipwreck"



Rugged reaches like this along the Susitna River were reconnoitered by Reclamation surveyors before boats were lost on fourth day

THE STORY OF a survey crew stranded six days in the Susitna River valley of Alaska provides a guarantee that civil engineering still finds frontiers. It all happened a year ago when, following the loss of boats and equipment in rough water, four Bureau of Reclamation men and their guide fished with paper-clip hooks for nearly a week before rescue by an Air Force helicopter.

Purpose of the ill-fated expedition was reconnaissance of hydroelectric sites along a 120-mi. reach of the Susitna River northeast of Anchorage. Daryl Roberts was party chief; Ade Jaskar, geologist; Terrence Robbins, instrument man; Harry Johnson, rodman; and Frank Swanda, guide. They were outfitted for detail studies including, if possible, contour profiles. Flown in to Denali, an old gold camp, they shoved off downstream on July 10, 1950, their 2,200 lb. of gear stowed in two 15-ft. aluminum boats, each powered by a 10-hp. outboard engine.

Shipwreck

During the first two days they covered 37 mi. of desolate river country and reconnoitered two possible dam sites, though it was often necessary to drag the boats over sand bars that filled the channel. On the third day they encountered rapids and, finally, a series of surging swells that swamped the boats in short order, pitching the men into the swift, icy current. For two hours they battled continuing rapids, eventually abandoning the boats and gaining shore some two or three miles downstream. Only their life jackets had saved them. Among the five men, sole casualties were a bruised elbow and a cut hand.

Searching the sloping beach they recovered miscellaneous food and equipment from the lost boats—waterproofed matches, a tarpaulin, four sleeping bags, a fishing pole and line (but no other tackle), a musette bag, some flour, butter, powdered milk, and a can of salted peanuts. Plenty of driftwood enabled them to set up camp and start a fire. Salvaged survey rods and orange life jackets laid out in an X formed a distress signal.

In the meantime, the meager assortment of salvaged rations was insufficient. On the second day the party rodman, Harry Johnson of Juneau, got an idea while watching Jaskar unpack his musette bag to dry its contents. Taking the paper clips that fell from it, he collected a pair of suitable rocks and set about forging fishhooks. Using half a clip for each, he straightened the wire, formed an eye, then pounded the other end flat. After sharpening the flattened portion, he added a barb by carefully bending back a sliver partially cut from it.

With Johnson's hooks, and with leaders made from blasting wire, the men went fishing. Using horseflies and, later, fish eyes for bait, they landed 13 grayling during the afternoon. During the remaining days they caught a total of 74 fish, providing an adequate, if monotonous diet.

DARYL ROBERTS and Ade Jaskar are able to smile after aerial rescue from Susitna canyon.

Salvage possibilities were pretty well exhausted after the first two days, though various items were recovered from time to time, among them two mosquito nets, a jacket, 30 gal. of gasoline, and seven packages of thoroughly **rehydrated** noodle soup! The third day, then, saw Roberts and Jaskar, party chief and geologist, set off downstream to explore and conduct such reconnaissance as possible.

For two days these men studied and sketched Vee Canyon, one of the known sites previously located by aerial survey and included in the itinerary of the trip. By July 17, Jaskar was becoming ill; he had subsisted for two days on salted peanuts. To make matters worse, the weather that day brought with it a hailstorm that drove the men to shelter, preventing them from signaling to search parties that were then in the air.

These rescuers, however, also had their troubles. Edwin Stewart of the Bureau and Gene Lush, an Anchorage pilot, had sighted boat wreckage on a Susitna sand bar from their helicopter several miles downstream. While landing for closer inspection their plane was wrecked, and there were now three widely separated groups of marooned men in the Susitna canyon.

On July 18, the 10th Air Rescue Squadron was called in. Using a C-47 as search plane, followed by an Air Force helicopter to effect a rescue, the new effort paid off, as Lush and Stewart were sighted within a few hours. Location of Roberts and Jaskar soon followed, and these men directed the Air Force to the three party members remaining upstream at the "shipwreck" camp. During the following day, repeated helicopter trips ferried all the castaways to a nearby lake, whence a float plane took them to Anchorage.

Unfortunately, the survey work remained largely undone, and a helicopter expedition was undertaken in September to complete it. Intended as a two-day trip, this one lasted four as Roberts and Jaskar, survivors already of a shipwreck, now became marooned in an aerial accident. This time they were separated from each other by deep Vee Canyon, for a prior landing had deposited Roberts and William Weber, a mechanical engineer, on a high cliff to perform on-the-spot reconnaissance. Jaskar and the pilot, Jack Zimmerman, were unhurt in their subseqent crash landing, and a hike of several miles downstream brought them to an abandoned trapper's camp and food cache. Weber and Roberts, situated on the left bank of the river, as two months before, struck out upstream and reached the original shipwreck camp, where they settled until rescued four days later.

Happy ending

Already convinced of the hazards and expense of surface exploration, Roberts and his colleagues dismissed the second accident as bad luck. Later surveys were conducted successfully, using the helicopter to gain points of interest, where the men could study the geology, do their instrument work, and take notes and photographs. As a result of these contributions by Roberts and his men, Vee Canyon has been established as a feasible hydroelectric site.

In recognition of the men's service on this voluntary work, the Bureau promoted Roberts, Weber, and Stewart. The remaining men, including those who subsequently left the Bureau employ, received medals and certificates from the Secretary of the Interior.

Southern California Edison plans $50,000,000 power development

SOUTHERN AND CENTRAL California's electric power supply is scheduled to get another boost. The Southern California Edison Co., continuing its 40 years of water-power development of the Big Creek-San Joaquin River area in Fresno and Madera counties, is now planning two additional major projects.

The company has filed applications with the Federal Power Commission for licenses to build two storage reservoirs and a new powerhouse at a total cost of about $50,000,000. The newest Edison High Sierra construction program follows the completion in July of the Big Creek No. 4 power plant on the San Joaquin River in Madera County (*Western Construction*—April 1951, pp. 70-75), which added 84,000 kw. of generating capacity, and the start of construction on the Etiwanda steam station in San Bernardino County, to add another 250,000 kw.

The new projects known as Vermilion Valley and Mammoth Pool reservoirs, will be within the Sierra National Forest but not in the so-called "primitive area."

Present Edison facilities in the Big Creek-San Joaquin River area include six powerhouses, three major reservoirs—Shaver, Huntington and Florence lakes—and thirteen major dams, providing a total generating capacity of 523,000 kw. The new projects will be integrated with this system.

According to the company's application to the FPC, the two major dams will create reservoirs with a total capacity of 248,000 acre-feet. Vermilion Valley reservoir, to be created by a dam across Mono Creek in Fresno County, will have a gross capacity of approximately 125,000 acre-feet. The dam, with a crest length of 4,350 ft. and a height of 160 ft. above stream bed, will provide additional regulation and storage of water from the Mono Creek watershed for use in the Edison's Big Creek plants throughout the area. Most of the storage would be held for hydroelectric use only in exceptionally dry years. Additional water will thus be made available for irrigation in the San Joaquin Valley under such critical conditions. Operation of this reservoir alone will, it is estimated, result in an annual average gain of about 122,000,000 kw-hr from presently existing Big Creek powerhouses, and in a very dry year will increase the total dependable capacity of these powerhouses by as much as 440,000,000 kw-hr.

Mammoth Pool Dam is planned to be located across the San Joaquin River in Fresno and Madera counties above the Edison Big Creek Plant No. 8. The dam, with a crest length of 980 ft. and height above stream bed of 315 ft., will create a reservoir with gross capacity of 123,000 acre-feet. The proposed powerhouse, with 126,000-kw. generating capacity, would be constructed 7 mi. downstream from the dam.

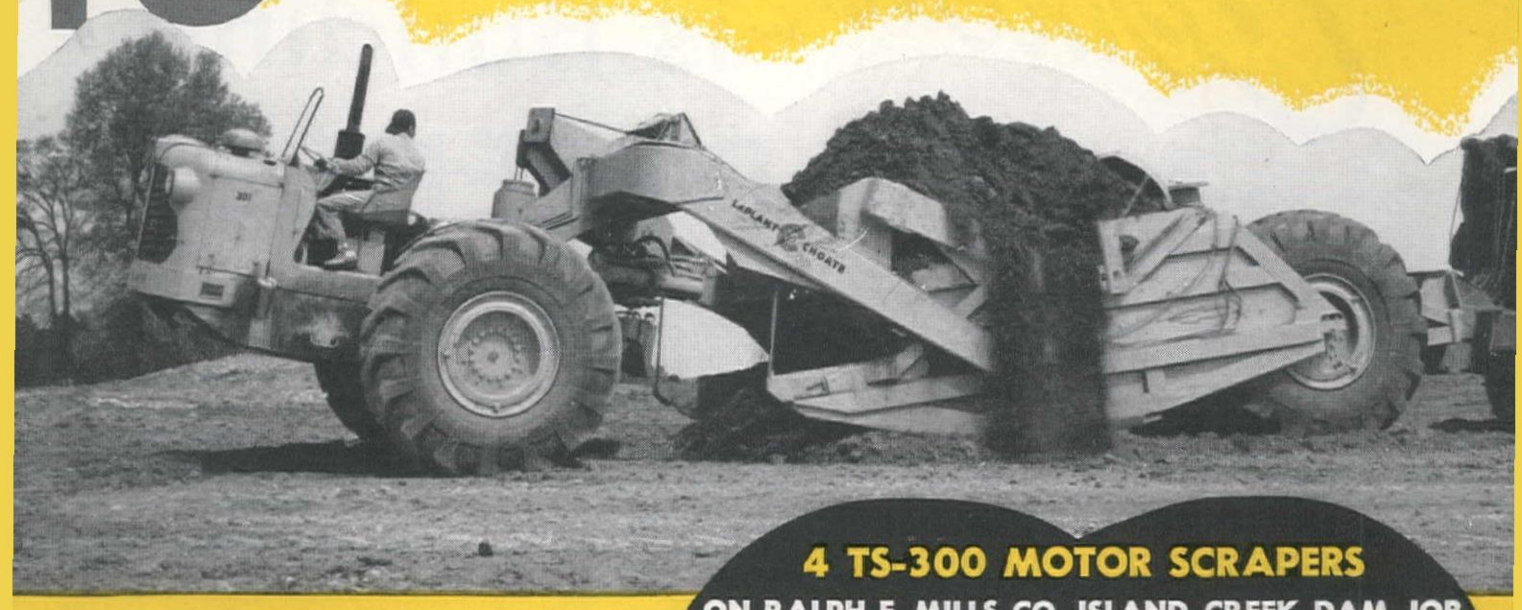
Two diversion dams, one across Rock Creek and one on Ross Creek, will divert these streams into the 20-ft. diameter, 40,000-ft. long Mammoth Pool tunnel, which will carry water to the penstocks and thence to turbine-driven generators in the powerhouse.

When this construction is completed a large part of the run-off of the upper San Joaquin River and tributary streams will flow into the Mammoth Pool reservoir for regulation, storage and release for use through the Mammoth Pool powerhouse and Big Creek powerhouses Nos. 3 and 4 farther downstream. It is estimated that the electric energy generated at Mammoth Pool powerhouse will average 550,000,000 kw-hr per year, and the additional water made available for use at Big Creek powerhouses Nos. 3 and 4 will result in an annual average gain of 86,000,000 kw-hr from those powerhouses.

It is estimated that the new reservoirs and powerhouse, together with the average increase of output of existing powerhouses, will result in an annual average gain at Big Creek of 758,000,000 kw-hr. More kilowatt hours of electricity per unit of water are generated at Big Creek than at any other hydroelectric development in the world—in falling 6,000 ft. through the power plants it is the hardest working water on earth.

18 MPH AVERAGE HAUL SPEED

ON ADVERSE GRADES



4 TS-300 MOTOR SCRAPERS

ON RALPH E. MILLS CO. ISLAND CREEK DAM JOB

• • • • • •

5000-ft. haul with 6 to 7% adverse grades
Each unit averages 90 pay yards per hour
14 pay yards average load for each rig
AVERAGE HAUL SPEED—18 MPH!

HIGH speed on the tough jobs!

That's one of the many LaPlant-Choate Motor Scraper advantages earning money for Ralph E. Mills Co., Inc. of Salem, Virginia. On their Island Creek Dam contract, they are working four TS-300 Motor Scrapers eleven hours a day, six days a week to move 625,000 yds. of silty clay . . . *and maintaining an 18 mph haul speed average on 6 to 7% adverse grades!*

Combine this high-speed Motor Scraper performance with the big 17.5-yd. heaped capacity and big power that's *useable* in the pit and on the fill, as well as on the grades . . . add Motor Scraper dependability that keeps these units on the job hour after hour, day in and day out . . . and you'll see why more and more contractors are choosing LaPlant-Choate Motor Scrapers to set the profit pace on the toughest jobs.

WATCH THE HIGH-SPEED PERFORMANCE OF LPC MOTOR SCRAPERS WORKING NEAR YOU

Get in touch with your nearest LaPlant-Choate distributor. He'll be glad to tell you where you can see TS-300 Motor Scrapers in action . . . watch their speed and power on the job . . . get facts and figures from the men who own and operate them. Ask your LPC distributor to explain *all* the features that make TS-300 Motor Scrapers first choice with so many cost-conscious contractors. And — while you're at it — ask him to give you all the facts on the TS-200, the speedy, powerful Motor Scraper in the 9 to 12 yard class. Stop in or phone today!

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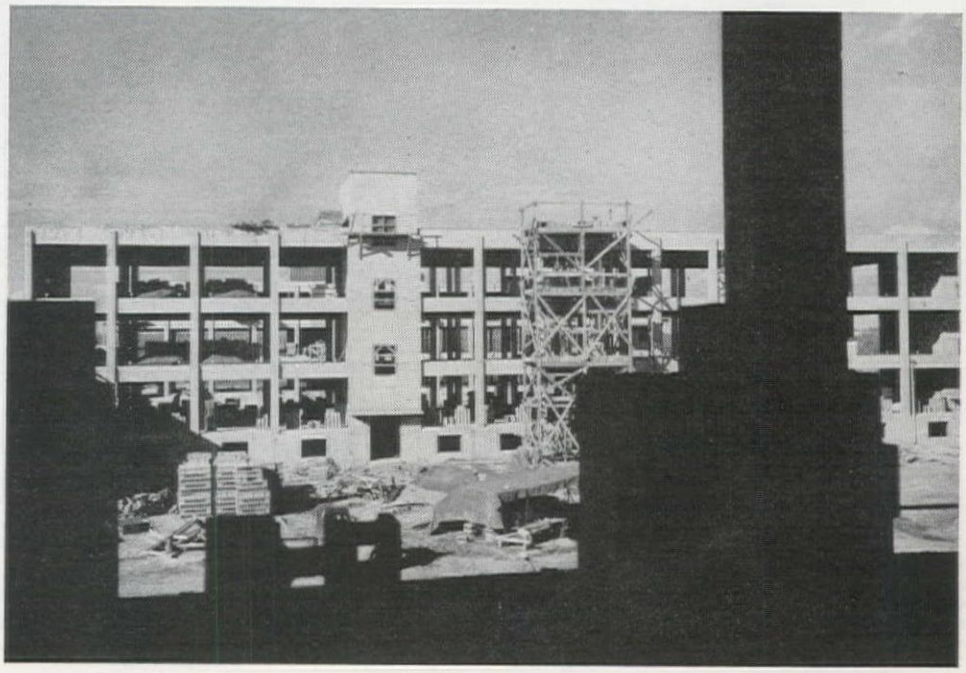

New barracks under construction at West Coast Defense installation. Reinforced concrete structural frame, roof and floor slabs, concrete block curtain walls, are made with PERMANENTE CEMENT. (U. S. Army Photo.)

The present unsettled conditions of world politics seem to indicate the long-time maintenance of an expanded military establishment—therefore the Armed Services have chosen concrete as the basic building material for their tremendous construction program.

Millions of barrels of PERMANENTE CEMENT are being used in building the great defense installations throughout the Pacific Defense Area.

PERMANENTE CEMENT COMPANY'S 7,000,000 barrel annual production capacity—its modern storage and distribution facilities, situated in every major population center along the Pacific Coast, and in Alaska and Hawaii—have made PERMANENTE the most important single factor in supplying cement for the Armed Services' West Coast construction program.

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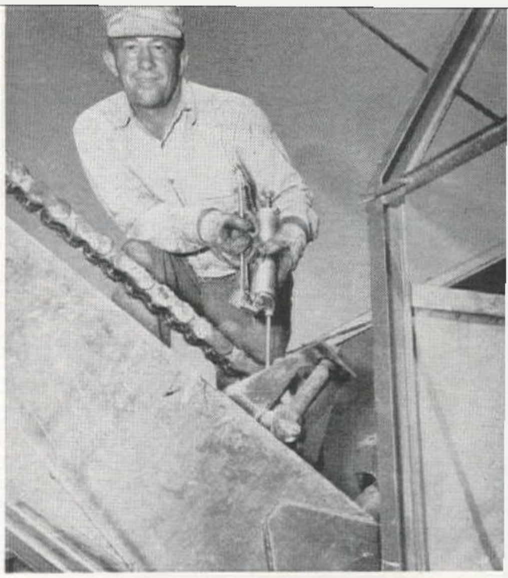
Power cranes and shovels —

A maintenance memo

By A. E. YORK
Service Manager
Link-Belt Speeder Corp.



Henry Hein of Billings, Mont., lubricates machine operated for Barry O'Leary, Inc.

THE UNPRECEDENTED call for new power cranes and shovels during the defense emergency has also accelerated demands upon equipment already in use. As long as the present shortage of new equipment for normal civilian requirements exists, it becomes increasingly vital to keep existing equipment in the best operating condition. In times like these, delays and shutdowns become especially costly, and can usually be prevented by planned care and preventive maintenance.

The most important periods in the lifetime of a crane or shovel come when they are first placed in service, and the period immediately following when the customer is becoming accustomed to the machines. That's why it is essential that this piece of expensive equipment be started off properly bv qualified servicemen. And the qualification of the servicemen is the responsibility of the dealer selling the equipment.

Proper instruction covering all adjustments, care and points of lubrication is important at the time of delivery. Since there will always be a labor turnover, it is essential that operating instructions be handed down from one operator to another in the event that the employee originally familiar with operating instructions leaves for another job.

Too often, a new shovel or crane is deadlined because of improper care and lubrication after the machine has left the factory. In many cases the problem of too much grease is almost as serious as too little lubrication. Since the danger connected with lubricating certain points is covered at the time of delivery, the customer should see that the information reaches the proper personnel.

Lubrication

Systematic care and maintenance can usually be developed by following carefully the manufacturer's operating and instruction manuals. This includes not only proper care and lubrication, but also keeping the machine clean, and making regular periodic inspections of the equipment—inspections which will reveal necessary normal adjustments, and which will assure the proper replacement of parts at the right time.

In the case of old equipment, certain steps should be taken to prolong the natural life of the machine. A few precautions can greatly extend the time between major overhaul jobs.

Lubricants, motor oils and greases should conform to manufacturer's recommendations, and should be products of reputable firms. Regular intervals of lubrication will eliminate the "guesswork" concerning the number of hours worked. Manufacturer's charts on seasonal changes in viscosity should be followed closely.

One important detail to remember is the periodic examination of lubrication tubes. Too often it has been discovered too late that a grease tube has failed or become clogged, and that grease was not reaching its intended goal. When that happens, some bearing will fail for lack of grease, which may also result in damage to a shaft or other important part. Replacing such shaft or part is often difficult and may result in a long, costly shutdown which could readily have been prevented by careful maintenance.

Inspection

Clutches should be inspected closely to make sure they are maintained in good condition and adjustment. It should be determined whether or not the clutch is wearing properly. Linings should be examined closely and kept clean and free from grit and other foreign particles to eliminate scoring of drums. Center pins should be checked and tightened as needed. Drive chains should be kept in adjustment, and sprocket chains examined for undue wear. Bushings should be watched to avert shaft scoring. Engine filters must be changed at specified intervals to safeguard the power plant of the machine.

Good maintenance also entails the advance ordering of needed parts. Many parts, such as linings, cables, dipper and bucket teeth, and the like, are essentially wearing parts, and must be replaced periodically. It is essential that such parts be kept on hand for quick and convenient replacements. There are also other parts that, from experience, should be kept on hand to avoid costly shutdown and delays when such replacements are needed. By periodic and systematic inspections, it is also possible to anticipate other required replacements, and to have such parts on hand to install at the most convenient time. This is especially important now when replacement parts may not be available as quickly as in normal times, and when uninterrupted operation is more important than ever.

Overhaul

Periodic cable inspection is vital in all machines. A frayed cable should be promptly replaced, particularly if it is a load-carrying cable. Although it may be subjected to little actual running wear, the boom hoist cable—which is a load-carrying cable—also should be inspected frequently, since its failure could well result in serious damage or even personal injury. In these inspections, all cable connections should also be checked.

Overhaul jobs, which in normal times may have been undertaken without too much forethought, assume major proportions in times of emergency such as the nation is currently undergoing.

First step in such an overhaul job must be to determine the extent of the job. This calls for a detailed study and examination. Ordering additional material after the original order has been sent in can be avoided by making a careful first estimate. Definite shipping dates should be received. Better yet, no equipment should be disassembled until all material is on hand. Not too infrequently, a small item out of a large order can tie up a major repair job because of some supplier's inability to live up to a promise.

Local facilities for the job to be done must be explored to make certain the job can be completed in the least possible time. If local sources prove inadequate, improvisations can usually be made. Often it is wiser to move the equipment nearer to the proper facilities for repair and overhaul.

Rebuilt parts

With the present material shortage at hand, consideration should be given to rebuilding parts, especially those which can be welded to return to original dimensions. Track sprockets, track rollers, track shoes—all can be rebuilt with hard surface rod to extend the life of these parts. Bores that have been worn oversize can frequently be welded and rebored to standard size so as to make future replacements easier. Shafting—depending upon application—can sometimes be metal-sprayed satisfactorily. When possible, a plating process should be used to salvage shafts.

Complete overhaul jobs, if properly planned, can be accomplished with a minimum amount of down-time even considering the present scarcity of material.

Proper equipment maintenance is doubly important in such a situation as the nation is facing today. With material shortages and replacements parts harder to obtain, it is vital that existing equipment be carefully serviced to provide longer life and a resultant better performance.

CONSTRUCTION DESIGN CHART

By
JAMES R. GRIFFITH
Seattle, Wash.

CXXXVII . . . Columns of Douglas Fir

THE CHART herein presented is similar to the one published in the May 1951 issue except for the value of the allowable compression parallel to the grain. The formula recommended[1] for the solution of long columns, wherein values of $(\frac{L}{d})$ are greater than

$$K = \frac{\pi}{2}\sqrt{\frac{E}{6C}} \text{ is}$$

$$\frac{P}{A} = \frac{\pi^2}{36}\frac{E}{(L/d)^2}$$

In the previous chart on this subject we had a value of $K = 25.6$, while in this case it is $K = 23.4$. Thus a change of grade results in a change of range for the application of the long column formula. On the other hand it will be noted that the long column formula is independent of the allowable compression parallel with the grain. The principal advantage in the use of timbers of higher strength is thus only in the intermediate and short column ranges.

I have drawn a solution line on the accompanying chart for the assumptions:

Douglas fir column
$E = 1{,}600{,}000$ psi.
Size 6 x 10 S4S
Length 9 ft., 6 in.

Since the actual sectional dimensions of a 6 x 10 S4S is 5½ x 9½, we then have

$$\frac{L}{d} = \frac{9.5 \times 12}{5.5} = 20.7$$

The solution line has been drawn from a dressed 6 x 10 to a value of $\frac{L}{d} = 20.7$. On the central scale will be noted a total allowable load of 50 kips.

Since the value of $\frac{L}{d} = 20.7$ is less than the value of $K = 23.4$, the formula for intermediate columns must be used. Thus we have

$$\frac{P}{A} = C\left[1 - \frac{1}{3}\left(\frac{L}{Kd}\right)^4\right]$$

$$= 1200\left[1 - \frac{1}{3}\left(\frac{20.7}{23.4}\right)^4\right]$$

$$= 955 \text{ psi.}$$

The sectional area of the column is

$$A = 5.5 \times 9.5 = 52.3 \text{ sq. in.}$$

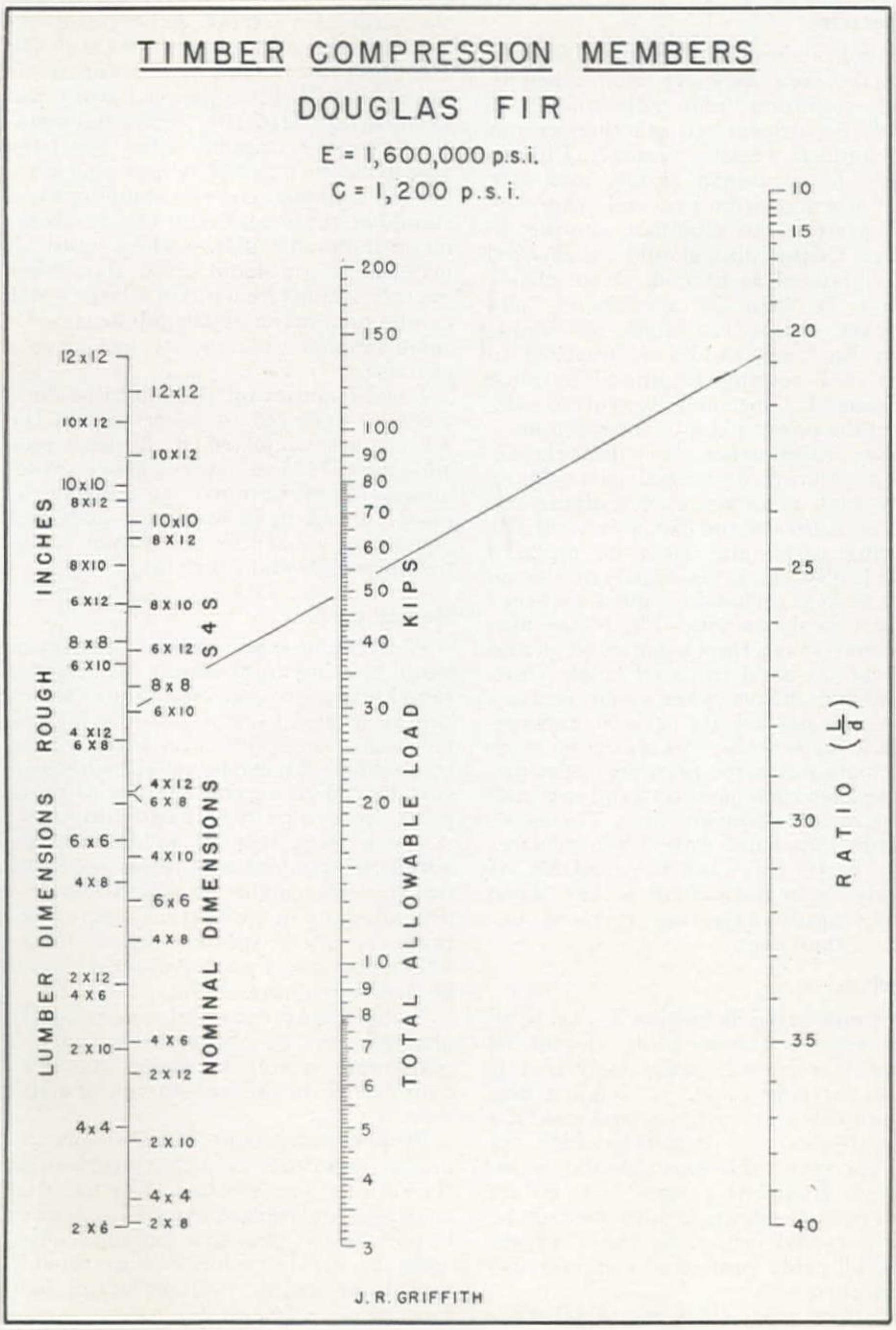
Thus the total allowable column load is

$$P = 52.3 \times 955 = 50{,}000 \text{ lb.}$$

Which checks the value found on the chart.

Attention is called to the fact that for values of $\frac{L}{d}$ of 10 or less, the allowable unit stress $\frac{P}{A}$ is equal to the basic allowable compression parallel to the grain for the specified grade of lumber.

[1] West Coast Lumbermen's Association.



Moving 878,000 cu. yd. on a highway job—

Scrapers make dirt pay on long hauls

PROVING that scrapers are satisfactory earthmovers when long hauls are involved, efficient use of this machinery is being made on an 878,000-cu. yd. earthmoving job for construction of a four-lane divided highway east of Hayward, Calif.

Working on a $1,380,000 contract for the California Division of Highways, Fredrickson & Watson Construction Co., Oakland, is using seven of the relatively new Caterpillar DW-20 rubber-tired tractors and scrapers which, along with five Caterpillar DW-10 tractor and scraper units, are moving an average of 5,000 cu. yd. per day on hauls averaging up to two miles in length. From August 15, when the job began, to October 5, (during which two full holidays occurred) a total of 175,000 cu. yd. of earth was moved. The work was carried out on an 8-hr. day, 5-day week basis.

As rainfall commonly occurs in the Hayward area about the first of November to make earthmoving virtually impossible, the contractor divided the job into two sections. The east section is being completed this season and work on the west section will be carried out next year.

A cut-and-fill job

Specifications call for a roadway 106 ft. wide and containing two 24-ft. wide pavements of 8-in. portland cement concrete separated by a 36-ft. divider. The divider will be at the same elevation as the pavements. Subgrade is a 12-in. layer of imported borrow spread and rolled on top of fill, with the top 4 in. of the imported material to be processed as cement-treated base. Shoulders, 8 ft. wide, will be covered with both plant mix and penetration asphalt. The inner 5 ft. will have the plant mix, and the outer 3 ft. will have penetration asphalt.

Earthmoving work on the job is primarily cut-and-fill. Material being moved is a soft sandstone that has about a 10% swell factor. No wasting was necessary during work on the east section and only a small amount of wasting is contemplated on the west section.

The material is being placed on the fill in 6-in. lifts, bladed with an Allis-Chalmers AD-4 motor grader and compacted with sheepsfoot rollers.

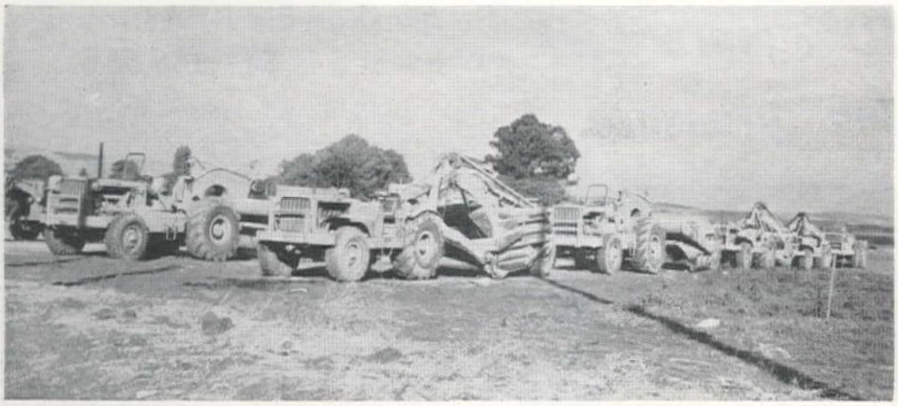
Special sheepsfoot roller

In addition to four standard sheepsfoot compactors pulled in tandem by one tractor, a double unit fabricated in the Fredrickson & Watson shops is also used. Weighing 15,500 lb., it is just within highway load limits and can be moved with ease by a truck and semi-trailer. Requiring its own towing tractor, it consists of two 5-ft. diameter drums each 5 ft. in length and connected endwise to form a single unit (see illustration). A special yoke that attaches to the towing unit is so designed to provide clearance

TRAVELING at speeds up to 24 mph., a new DW-20 dumps a load representing 18 cu. yd. of compacted fill. On 2-mi. haul units averaged about three trips per hr.

AFTER SCRAPERS dump their load on the fill, Allis-Chalmers AD-4 moves over course to spread material before compaction by sheepsfoot rollers.

WEIGHING 15,500 lb., sheepsfoot unit made in contractor's shop is just within legal load limit for hauling by semi-trailer over highway when moving from job to job.



AT THE END of each day all earthmoving equipment is placed in three rows for efficient servicing. Two men and a grease truck, working through the night, pass up and down between the rows carrying out the lubrication work.

of tractor treads when the vehicle is making sharp turns. The "feet" are 9 in. long and made from ¼-in. AR plate pressed and welded to shape.

Fills averaged about 4 ft. in depth. One large fill near the center of the east section, necessary to establish the desired grade near the base of a hill, is 40 ft. in depth and contains about 200,000 cu. yd. of material. Earth for this fill was moved from atop a hill near the center of the project, involving a haul of about ½ mi. No particular moisture problem was encountered during the fill work. To maintain an optimum moisture the contractor used four water wagons (4,500-, 3,400-, 3,300-, and 2,800-gal. capacities).

Earthmoving machinery

To estimate the job the contractor determined the total yardage to be moved, and then figured the number of yards that would have to be moved each hour to bring the job to completion within the allotted time. From this figure the equipment list was determined.

Generally rated at 15 cu. yd. struck and 18 cu. yd. heaped, the capacity of the DW-20 units has been increased to 18 cu. yd. struck and 23 cu. yd. heaped with the adaptation of boards, 1 ft. high, attached at the top of the sides and tailboard. This was feasible because rapid loading of the relatively soft material would cause a quantity of earth to flow over the tailboard. Average load hauled by these units represents about 18 cu. yd. of compacted fill. Load of the smaller DW-20 units results in about 10 cu. yd. of compacted fill.

Traveling at speeds up to 25 mph., the large units have been loading, making a 2-mi. haul, and returning to the loading location at the rate of about three trips per hour. Shorter hauls, of course, result in more trips per hour. The five DW-10 units in the earthmoving fleet were equipped with standard Super C LeTourneau scrapers converted and adapted for use with four-wheel tractors.

The highway roadbed, where the lanes carrying westbound traffic will be, was used as haul road. Containing only one wide angle curve and a short detour around the bridge it permitted equipment to move at maximum speeds. The numerous trips of the heavy units provided considerable compaction and also provided themselves with a solid haul road. The haul route was kept in good condition to permit the high speeds and to conserve tires.

Cuts

The main cut was near the center of the entire project and yielded about 300,000 cu. yd. for fill in the east section. In the cut four track tractors acted as pushers for the 12 scrapers. Due to the long hauls involved, each pusher could satisfactorily take care of three scrapers. Two of the push tractors were equipped with rippers and when not engaged in loading scrapers carried out necessary ripping operations. Amount of ripping varied and the areas requiring it were spotted. Often when one of the tractors with a ripper would be pushing a scraper and another tractor would be standing by, the ripper would be set and the tractor standing by would move in behind it and push it while the tractor pulling it would continue to push the scraper.

Equipment down-time on the job was negligible and all pieces and units were given a thorough lubrication each night. For efficient lubrication work all major equipment was brought to a central location and lined up in three rows. Working throughout the night two grease monkeys with one grease truck would pass back and forth between the rows of equipment with each man greasing equipment on one side of the grease truck. However, pusher tractors were not brought to the central location but were greased in the cut where they were working.

Other work

In addition to earthmoving, the project includes construction of two reinforced concrete bridges, installation of 2,000 lin. ft. of 48-in. concrete pipe, 688 lin. ft. of double 72-in. concrete pipe, and 500 lin. ft. of 18-in. concrete pipe. Excavation for pipe trenches was carried out with a Northwest 25 shovel with 2-yd. bucket. Sonotubes, lightweight circular fibre tubes, were used in forming bridge columns.

Personnel

Ed Carlstad is resident engineer for the California Division of Highways.

CONFERRING at the Dublin job are (from left): Ed Carlstad, resident engineer, Robert Callou, superintendent for the contractor and Arch Walsh, Construction Engineer, District IV, California Division of Highways.

Robert Callou is superintendent for Fredrickson & Watson Construction Co. Other key men for the contractor are Tom Bond, office manager; Glen Spears, bridge foreman; Lawrence Walker, labor foreman, and Gordon Johnson and Ed Killing, grade foremen.

USBR experts provide help for India

HYDRAULIC engineering talent developed to solve Western water problems is going East under terms of an agreement recently signed by representatives of the United States and Indian governments. Actually, advisory work and services for the Indian Waterpower, Irrigation, and Navigation Commission will be conducted by Bureau of Reclamation engineers at the Denver, Colorado, headquarters of the Bureau.

Providing that all expenses be borne by the Indian government and that no work conflict with conduct of U. S. reclamation programs, the agreement is the first of its type between this country and a foreign power. Typical services will cover analysis of technical data submitted by India, testing of construction materials, construction and testing of hydraulic models, and advisory work. There is no provision for project construction, or for preparation of project designs and specifications.

Already this year, under an earlier informal agreement, Bureau engineers performed studies for the Indian government in connection with its construction of Kosi Dam in southeastern Nepal. Upon completion, Kosi Dam will be the world's highest, having a crest height of 785 ft.

Alaskan Eklutna tunnel award is $17,348,865

A CONTRACT for construction of a four mile long, 9-ft. transmountain water diversion tunnel and other facilities in Alaska on the Eklutna Project to provide defense and industrial electric power for the Anchorage area, has been awarded by the Bureau of Reclamation to Palmer Constructors, of Omaha, Nebraska, on a low bid of $17,348,865. The successful bidder is a three-firm organization including Peter Kiewit Sons, Coker Construction Co., and Morrison-Knudsen Co., Inc. The price is nearly four million dollars less than a low bid received last June, when a $21,321,695 offer was rejected by the Bureau.

It is the first major contract ever awarded by the Bureau for construction work on a reclamation project outside the mainland of the United States, although smaller contracts previously had been let for housing and electric transmission lines for use in connection with the Eklutna Project. Complete unit bid prices, along with a more detailed description of the project, are presented on page 120 of this issue.

Work starts

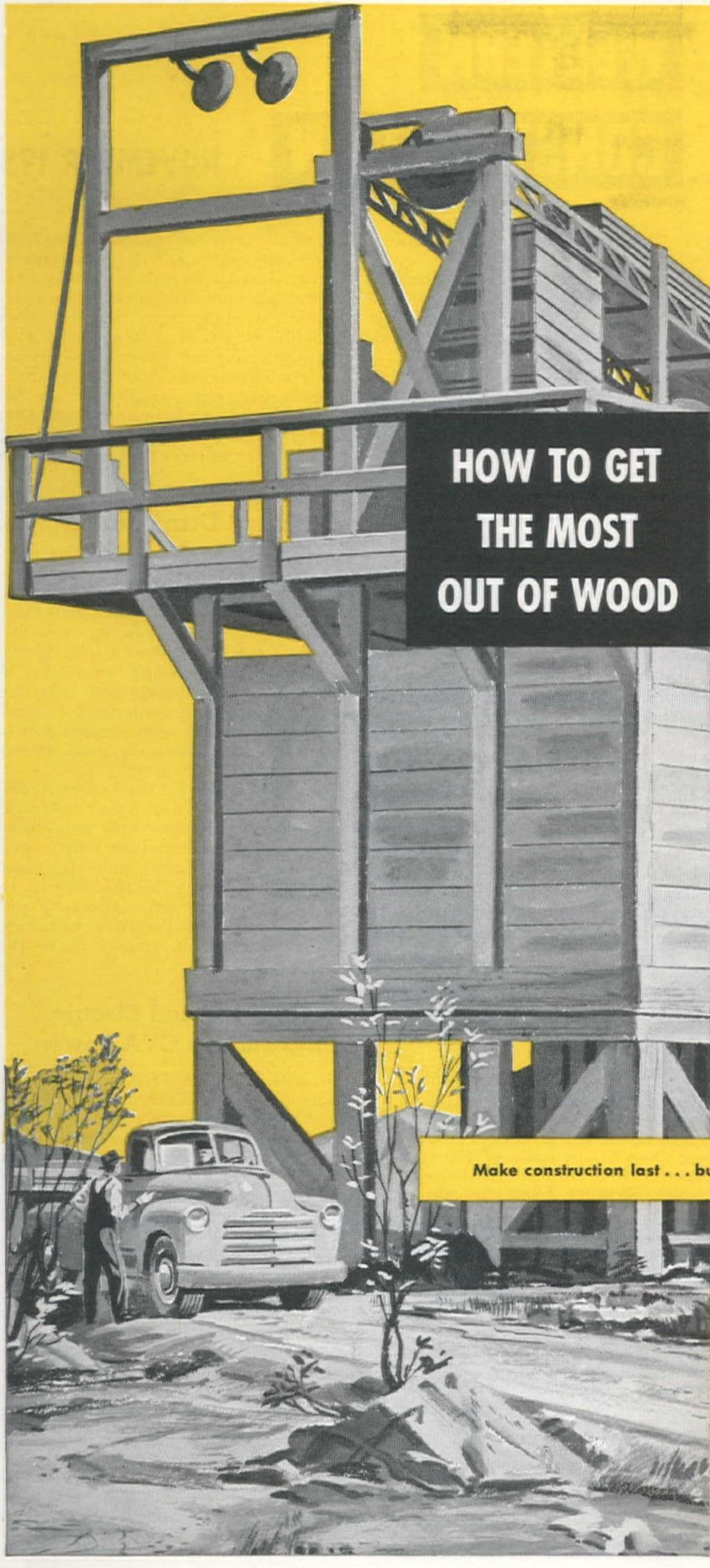
Under the contract, work must be begun on the tunnel in 30 days, and completed in 1,050 days. Besides the tunnel, which will be driven through Goat Mountain to Knik Arm, an inlet of the sea, the schedule also calls for the construction of a 9-ft. diameter concrete gate shaft, a concrete surge tank 30 ft. in internal diameter, and a penstock tunnel, with installation of a steel penstock varying from 7 ft., 6 in., to 6 ft. inside diameter. The contractor also must make some alterations to existing Eklutna Dam.

The power development in the region revolves around diversion of Eklutna Creek, situated about midway between Anchorage and Palmer. A glacier retreating up Eklutna Valley left a natural dam across the creek, creating Eklutna Lake, 7 mi. long and 200 ft. deep. Power will be produced by means of a tunnel through a narrow mountain which intervenes between lake and sea, a penstock down the mountainside and a power plant at tidewater. The plant will be on the Anchorage-Palmer Highway near Milepost 34, with capacity of 30,000 kilowatts.

Just the beginning

The project is the first of a much larger plan for development of water resources in the fast growing and promising railbelt, which extends from Seward through Anchorage and the Matanuska Valley and over the Alaska Range into Fairbanks. Hydroelectric power capacity of the Eklutna project will be completely taken as soon as it is finished, probably in 1955, and studies are now under way to augment the system with water resources development on the Kenai Peninsula and Susitna River.

Byron G. Felkner is construction engineer for the Bureau of Reclamation on the Eklutna Project.



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NEWS OF WESTERN CONSTRUCTION

NOVEMBER 1951

$150,000,000 powerhouse proposed at Grand Coulee

REQUIRING A MILE of hard-rock tunneling around the site of Coulee Dam, a third powerhouse costing $150,-000,000 has been proposed to augment the dam's power output by 750,000 kw. Engineering studies by the Bureau of Reclamation would need to be approved by both Congress and the President, adds the plan's proponent, Rep. Henry Jackson of Washington, who hopes for favorable findings and the start of construction a year from now.

Final installation of the 18th generating unit was completed at the world's largest hydroelectric power plant in August of this year. Water to operate the six new generators is available now in normal spring and summer spills, but will be firmed by completion of other projects currently under construction on upstream tributaries. Among these are Albeni Falls, Libby Dam in Montana, and Arrow Lakes reservoir in British Columbia.

Site proposed for new Portland-Vancouver link

JOINT STUDIES by the highway commissions of Oregon and Washington have defined the site for a proposed new bridge linking Portland and Vancouver, to be 83 ft. downstream from the present bridge. As presently planned, the bridge will connect Interstate Avenue in Portland with a new freeway through Vancouver.

Freedom of river navigation would be retained by the lift span design, estimated to cost $6,455,000. The 3,587-ft. crossing would carry three 12-ft. traffic lanes.

Snowpack surveys may be by remote control method

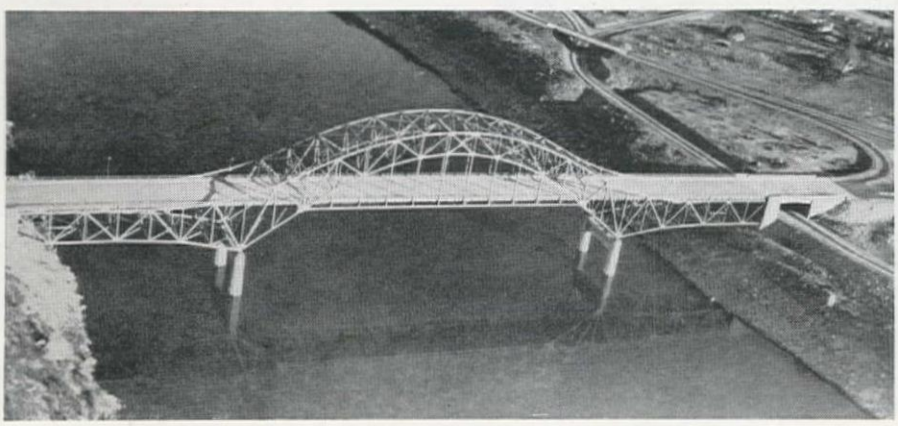
SURVEYING SIERRA snowpacks from an armchair may become a reality for government personnel engaged each winter in a continuing inventory of the Sierra Nevada snowpack water content. Bidding to replace teams of skiers presently doing the work by measurement and core samples is an atomic-age assembly including radioactive cobalt, a Geiger counter, and a high-frequency transmitter.

Experiments with such equipment were successfully conducted at Donner Summit last winter under the Cooperative Snow Investigation program of the Corps of Engineers and the Weather Bureau. Presence of a cobalt sample at ground surface triggers a Geiger counter suspended overhead, the rate of counter clicks reflecting water content of the intervening depth of snow. To water resources personnel, it is this variable water content, and not the depth of snow, that provides a measure of coming spring runoff into the streams and rivers of California.

Essential link between the counter and the snow laboratory is provided by a radio transmitter which automatically sends out calibrated Geiger counter signals at predetermined intervals. These signals are normally received by an automatic recording device, but the system includes means of "calling up" a given station by dialing a number. This procedure closely parallels the means of monitoring river conditions in the Sacramento and San Joaquin valleys, where water stage recorders are fitted with similar transmitters as a flood warning system.

COLUMBIA RIVER SPAN WINS "BEAUTIFUL BRIDGE" AWARD THIS YEAR

PICTURED BELOW is the Columbia River Bridge at Wenatchee, Wash., which has received a steel plaque from the American Institute of Steel Construction. The bridge was designated by the Institute as the most beautiful bridge opened to traffic in the United States during the year 1950 among those having spans of 400 ft. or more. George Stevens, bridge engineer, Washington State Department of Highways, was the designer and American Bridge Co. was the fabricator. Contractor was the General Construction Co. of Seattle.



McNary Dam needs another 1,000 men

AN ADDITIONAL 1,000 men are sought by McNary Dam Contractors, Inc., as construction activity expands to utilize a total of 3,500 men. The $60,000,-000 contract is presently on a 6-day, 24-hr. basis, as excavation and concreting of 12 powerhouse units move toward a peak that will see simultaneous pouring operations in power units, dam, spillway, and fish ladders.

In preparation for the expected influx of workers, a 400-unit trailer village has been set up, complete with utilities, and about 40 houses have been built in nearby towns of Umatilla and Hermiston. Except for short layoffs during bad weather, the contractor expects to maintain the augmented work force for over a year. Completion date for the work is August 1, 1954.

Pacific Gas and Electric buys surplus CVA power

SURPLUS ELECTRIC POWER from operation of the Central Valley Project in California will be purchased by the Pacific Gas & Electric Co. under terms of a 10-year contract executed last month by the Company and the Bureau of Reclamation. The new agreement supersedes previous day-to-day purchases by the Company made since early in 1949.

Under the new contract, 300,000 kw. of dependable capacity are initially involved. Charges applying to PG&E purchases are as follows: demand charge $0.75 per kw., 4 mills per kw-hr for the first 130 kw-hr, 3 mills per kw-hr for the next 130, and 2 mills per kw-hr for the balance. A reciprocal agreement for furnishing standby power in emergencies is included.

PG&E must apply to the California Public Utilities Commission for authorization to comply with the contract terms. If such authorization is withheld for nine months, the contract is void.

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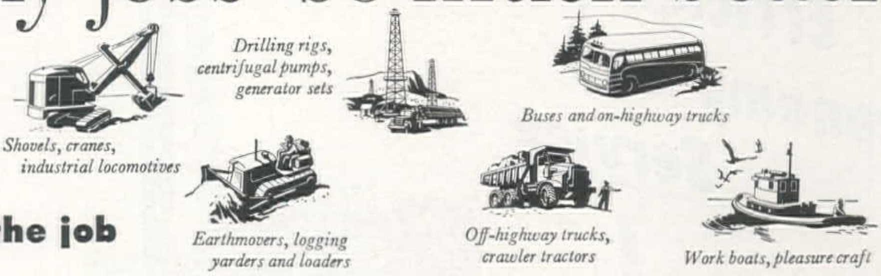

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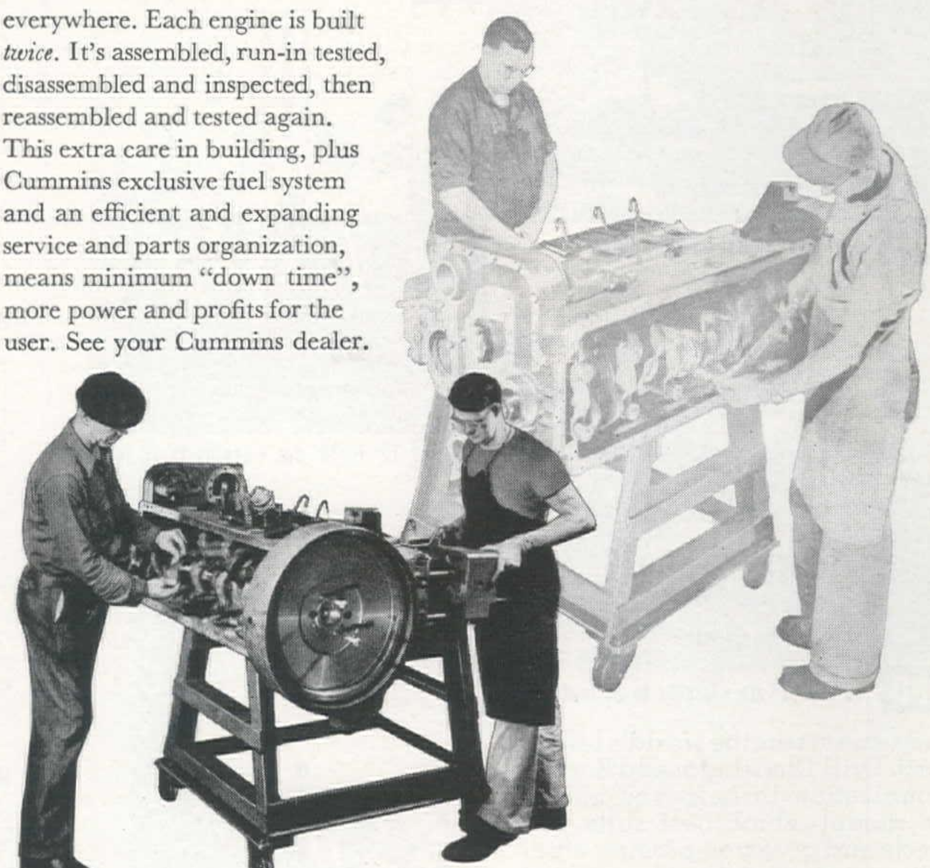

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SAN FRANCISCO, Watson & Meehan: 1960 Folsom St., San Francisco 3, California, Tel. Market 1-8930. *Branch:* 248 Palm Ave., Fresno 3, Calif. *Authorized Sales & Service:* Connell Motor Truck Co., Stockton, Calif.; Frank J. Coyle, Sacramento, Calif.; 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)

NEWS — IN BRIEF

S. F. transbay crossing proposed

A SOLID FILL crossing of the San Francisco Bay between San Francisco and Alameda, Calif., gained new supporters when it was announced that this type of project could be considered a national defense project.

Vital defense classification would mean that a government loan could be obtained through the Reconstruction Finance Corp. The proposed earth fill would be ½ mi. wide and thus provide an excellent escape route from San Francisco in the event of an enemy attack.

A structural steel span across the Bay would be delayed, according to Representative Franck Havenner, because necessary amounts of steel would not be available for at least two years. Havenner based his information on conversations with National Production Authority officials.

Corps of Engineers spokesmen announced that the solid fill structure with openings to permit tidal entrance in the south bay portions, could receive the necessary certification as essential if California, with San Francisco's approval, sought approval of the plan. There was no immediate indication that this action was contemplated.

Bridges open under new management

SEPTEMBER 12 marked the date for the official transfer of the San Mateo-Hayward Bridge and the Dumbarton Bridge from the present private owners to the State of California.

Tolls set by the Toll Bridge Authority went into immediate effect and are now identical on both bridges. State highway engineers' recommendations were followed by the Authority in setting the new toll schedule. Passenger cars are charged 35 cents to cross the structure instead of the previously required 50 cents. Commercial vehicles are charged on the gross weight principle.

Record MWD deliveries to So. Cal.

SOUTHERN CALIFORNIA, which frequently breaks records, chalked up another one recently on its use of Colorado River water. In 24 hours, 330,000,000 gal. of water found their way into homes and industries from the Metropolitan Water aqueduct system.

Leading the parade of consumers during the 24-hour period were the City of Los Angeles and the San Diego Water Authority. Each of these locations accounted for approximately 1/5 of the record-breaking total. Los Angeles, Orange and San Diego counties get their water from the aqueduct. The record was credited to a hot spell that pointed up the area's low groundwater supplies and its increased number of users.

SEAOC convenes in Yosemite

THE STRUCTURAL ENGINEER'S Association of California held its annual convention in Yosemite Valley on October 11, 12 and 13, with a large attendance. The convention was attended by representative structural engineers from all portions of California and by structural engineers from other states. The meeting consisted of reports from standing committees and technical discussions, followed by social activities.

Technical portions of the program dealt with "Wood Diaphragms", "Observations on Engineering Technique" and "Advances in Structural Engineering Technique in Structural Steel". There were also papers entitled "Observations on Structural Engineering in Europe" and "Report of the Column Research Council of the Engineering Foundation".

Arthur W. Anderson of Oakland, Calif., was president of the convention and Henry J. Degenkolb was secretary-treasurer.

THESE MEN planned annual meeting of SEAOC. From left: Jesse Rosenwald, State Director for No. Cal.; C. R. Graff, convention chairman; Henry J. Degenkolb, Sec'y.-Treas. of association; Arthur W. Anderson, President.

Prospectus to attract Alaska bidders

A 1952-53 PROSPECTUS of construction by the Corps of Engineers in Alaska is being prepared for the purpose of further arousing bidding interest among contractors of the United States. At present, construction information is released through normal journalistic and radio channels, whereas the new publication will stress an appreciation of construction conditions in the Territory.

The Alaska District technical information office has declared that "Stateside contractors should understand that most construction problems, peculiar to Alaska by reason of climatic conditions, have been solved during the past four years of the current building program."

Among the projects currently under way, involving 51 contractors and over 7,800 men, are Whittier, Ladd, Eielson, and Elmendorf Air Force Bases, and Fort Richardson. In addition, the Bureau of Reclamation has recently let over $17,000,000 in a contract for construction of the Eklutna Tunnel.

Albuquerque hikes power production

THE FIRST of three new generating plants went into construction near Albuquerque, N. Mex., recently. The new plant is part of the $10,500,000 expansion program of the Public Service Co.

The first plant is going up on a 22-ac. site near Santa Fe Tie plant and should be completed within a year. Construction will commence on the second plant as soon as the first is completed. Total cost of the first two plants will be $6,000,000.

The expansion program includes construction of a third plant in 1954. This will cost $4,500,000 and develop 30,000 kw. The first two plants will each develop 20,000 kw.

Construction of the plants is aimed at meeting the needs of a population expected to reach 70,000 in 1960. At the present time the firm serves 42,000.

ENGINEERS ON THE MOVE

Pecos H. Calahan is named executive secretary of the Bay Counties Civil Engineers & Land Surveyors Assn., Inc. Calahan has been, successively, assistant secretary and executive secretary to the California State Board of Registration for Civil and Professional Engineers since the inception of the Act, retiring in 1950. He is presently secretary of the California Legislative Council of Engineering Organizations. In his new appointment, his duties will include coordination of the Association's activities, particularly stressing public relations.

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Robert M. Haynie becomes a general partner in the Haas Construction Co., according to announcement made by **Edward Thompson Haas,** head of the firm. Haynie is well known in the construction industry, and for the past four years has been connected with the contracting firm of Swinerton & Walberg Co. Haas Construction Co. traces its beginnings back to 1898 and was the predecessor firm to the partnership of Haas & Rothschild now in process of dissolution. **Leo S. Gosliner,** chief estimator for the dissolved partnership, remains with the Haas organization.

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Davis

Clarence C. Davis is the new resident engineer at Lookout Point Dam, now under construction on the Middle Fork Willamette River, Ore. Davis, formerly resident engineer at Detroit Dam on the North Santiam River, replaces **Robert E. Lee** who becomes chief of the supervision and inspection branch of the construction division of the Walla Walla District Corps of Engineers. **Ray Overholser,** who has been assisting Davis at Detroit Dam, will succeed him as resident engineer.

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J. E. Hergert, construction industries executive, is now field representative for the Southern California Chapter of the Associated General Contractors. One of his main duties will be to maintain contact with public officials and awarding agencies in the territory. Hergert was formerly manager of the Montana Contractors' Associations, and prior to that, assistant manager of the AGC Chapter in Seattle, Wash. The chapter also announces the appointment of **George Cox** to head the chapter's legal department which will interpret government rules and regulations for the members.

Hergert *Cox*

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New addition to the engineering staff of K C Construction Co., Denver, Colo., is **Karl Dreher.** Dreher had previously been with the Bureau of Reclamation for 15 years.

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Harold E. Dyer, Ephrata employee of the Bureau of Reclamation is one of five career men from the Western States to be chosen from the Bureau for an intensive administrative training course in the Washington office of the Department of the Interior. Dyer is from

Region 1, which covers the Pacific Northwest.

S. W. Epperson, bridge designer with the Wyoming State Highway Department, with more than 34 years of service with the department is retiring with the distinction of having the longest consecutive employment record of any department employee.

Byrne

Wayne S. Byrne, who served as construction engineer at Bonny Dam from September 1947 to July 1949, resigns from the Bureau of Reclamation to become chief engineer for the Utah Construction Co. on the Big Eildon Project, 88 mi. from Melbourne, Australia. (See *Western Construction*—August 1950, p. 68.)

After 20 years of service with the government, Bernard F. Jakobsen, 70-year-old civil engineer, retired recently. For the past 16 years he has been employed by the Corps of Engineers in the Los Angeles office, and since 1938, in the San

***Col. Donald S. Burns*, Corps of Engineers, congratulates *B. F. Jakobsen* upon his retirement from the South Pacific Division after 20 years of service.**

Francisco, Calif., office. Jakobsen's long career began with the U. S. Reclamation Service on Roosevelt Dam in Arizona from 1907 to 1912. From 1912 to 1936 he worked on both as a design engineer and consultant on many dam and power projects in the West. He has twice received the Norman Medal, highest award of the American Society of Civil Engineers, as the result of his authorship of technical papers. In June, 1948, Jakobsen was a member of the U. S. delegation representing the State and War Departments to the Internation Congress on Large Dams in Stockholm, Sweden, and the International Conference on Soil Mechanics and Foundation Engineering held in Rotterdam.

Truman Bowen of Bowen & McLaughlin, contractors of Phoenix, Arizona, is honored with the American Legion Luke-Greenway Post's outstanding employer award for his fine recognition of the physically handicapped in hiring and training disabled war veterans.

Fred A. Warren, who retired from the Bureau of Reclamation, Coulee Dam, Wash., April 30, was honored with the Department of Interior's Honor Award for Meritorious Service. Warren was cited for his work as general foreman of construction and railroad superintendent at Coulee Dam.

Clay H. Southworth, a pioneer in Western reclamation, is retiring. He started his reclamation career even before the Bureau of Reclamation was inaugurated, as reclamation investigator of the old geological survey, and planned the Bureau's first project, the Truckee-Carson project in Nevada. He has been with the Indian Service for the past 30 years. Since 1946 he has been in Phoenix, Arizona, as head of the Southwest area irrigation division.

Clyde H. Spencer, construction engineer for the Bureau of Reclamation at the Hungry Horse project is the recipient of a Department of the Interior efficiency award in recognition of his outstanding contribution to efficiency and economy in construction of the big northwestern Montana dam. Spencer started first with the Bureau in 1919 on the Riverton, Wyoming, project.

Phil J. Divver, superintendent of public works and grounds, Marysville, Calif., received one of the American Public Works Association's Samuel A. Greeley awards for long and distinguished service in the field of public works.

Robert F. Blanks leaves his position as chief, research and geology division, Bureau of Reclamation, Denver, Colo., to become vice president and general manager of Great Western Aggregates,

Blanks

Inc., a wholly-owned Ideal Cement Co. subsidiary. Blanks is well known in the fields of civil engineering, research and concrete design. He will lend his outstanding experience to Great Western Aggregates, Inc., which is engaged in studying aggregates of all kinds for the benefit of the cement business. Blanks will assume direction of a research program which is already in progress at the firm. In the past, Blanks has served as chairman of the Council on Research in Reinforced Concrete and as president of the American Concrete Institute.

Campbell Brown is named assistant manager of Intermountain Branch, Associated General Contractors in Salt Lake City, Utah. Brown has considerable experience in connection with construction and subcontracting companies in the Intermountain area. He succeeds **Melbourne Russell,** resigned.

Maurice D. Glessner recently retired as a construction engineer from the Corps of Engineers. He began his Government service with the U. S. Geological Survey in 1907 at Sacramento, Calif., and after an absence of 44 years, during which he worked in Alaska, Canada, Mexico, Central and South America as well as the United States, he returned to Sacramento this year and ended his Government career at the point of its beginning.

Charles W. Thomas, head of the hydraulic investigations group at the Bureau of Reclamation laboratories in Denver, Colo., arrived in France early in October to begin a year of advanced research at the University of Grenoble, working toward a doctorate in hydraulic engineering. He will specialize in water measurement.

Charles A. Bissell, after 34 years of service with the Bureau of Reclamation, retires as regional engineer in charge of design and construction in Region 3. Bissell will be succeeded by his assistant, **J. P. Jones.** Bissell has provided technical direction and supervision for the construction of Davis Dam on the Colorado River, over 1,500 mi. of transmission lines and attendant facilities, the Coachella division of the All-American Canal system in Southern California, and much of the Gila Project in Arizona.

Bissell

A new partnership, **Rothschild, Raffin & Weirick,** is the successor to **Haas & Rothschild,** general contractors. **Robert B. Rothschild, Jr.,** licensed engineer, was managing partner of the old firm, which built in excess of $20,000,000 worth of buildings, sewage plants, canals, bridges, etc. **Bennett L. Raffin,** licensed engineer, comes from Barrett & Hilp, where he has been for the past five years. **L. Don Weirick** served as general superintendent for Haas & Rothschild during most of the years of its existence. Headquarters for the new partnership will be at 274 Brannan St., San Francisco, Calif.—the same location occupied by the previous firm.

CALENDAR OF MEETINGS

November 23-24—Arizona Society of Professional Engineers will be host to the annual gathering of engineers from the Founder societies, **ASCE, ASME,** and **AIEE,** at a dinner to be held at the Hotel Westward Ho in Phoenix on November 23. On the following night, a barbecue dinner and square dance party will be held for the engineers and their wives.

November 24—Arizona Section, ASCE, fall meeting, at Adams Hotel, Phoenix.

November 30-Dec. 1—Northern California Chapter of AGC, annual business meeting and banquet, at Palace Hotel, San Francisco.

December 3—Denver General Contractors Association, annual meeting, at Denver.

December 7 — Spokane Section, ASCE, annual meeting, at the Davenport Hotel, Spokane.

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).

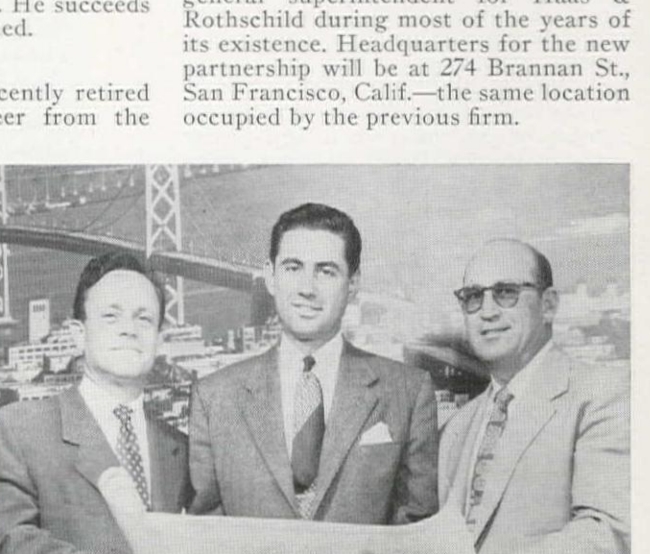
January 11-12 — Montana Building Chapter of AGC, annual meeting, at Florence Hotel, Missoula, Mont.

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.



Left to right: *R. B. Rothchild, Jr., Bennett L. Raffin* and *Don Weirick,* partners in the new construction firm which bears their names. See item on this page.

DEATHS

David Holden, 54, Redwood City, Calif., contractor, died July 29 in a plane crash near Willits Airport.

Martin Wyneken, 72, retired bridge engineer, died July 11 in Los Angeles, Calif.

Harlow M. Kimball, 71, retired Los Angeles City and County civil engineer, died July 22 in Los Angeles.

Harrison Angel, 82, retired building contractor, died July 25 after a long illness in Salt Lake City, Utah.

Harry Carlock, 68, civil engineer, died August 28 in Phoenix, Ariz. Carlock had been a former County engineer in Maricopa County.

Franklin W. Murphy, 73, retired building contractor, died in Los Angeles, Calif.

Ryan

Walter J. Ryan, consulting engineer with offices in Tacoma, Wash., died suddenly at the age of 69. He was very active in the American Society of Civil Engineers and at the time of his death was Director of District 12. He had helped in the organization of the Tacoma Section and served as its president in 1933. Ryan was with the Weyerhaeuser Timber Co. from 1914 to 1947. He was especially interested in development of the proper use of timber as a structural material.

George D. Ramsay, recently appointed city engineer of South Pasadena, Calif., died of a heart ailment in Los Angeles at the age of 53.

Chester E. McChesney, 65, an engineer with the California State Highway Department for 33 years, died recently at Los Angeles. He had been retired since 1948.

Thomas R. Beeman, 70, died of a heart attack in Pittsburgh, Pa. He had been city engineer of Seattle at one time and had also served as county engineer of King County, Wash. He was in Pittsburgh as head of the relocation branch of the Corps of Engineers.

Stewart S. Mullen, 61, well known Seattle building contractor, died suddenly in Fairbanks, Alaska. The firm, S. S. Mullen, Inc., which he headed, had recently started work on an apartment building in Fairbanks and Mullen had been there about a month when he died.

Henry A. Kerton, construction superintendent for the Los Angeles County Forestry Department, died recently in Los Angeles, where he had resided for over 40 years. He was 64.

Watson T. Blight, after an illness of two months died recently in Colorado, where he was born and spent his entire life. His first professional service was with the Bureau of Reclamation, where he was employed during the construction of the Uncompahgre Project. The balance of his professional career, with the exception of four years, was spent in the office of the Colorado state engineer, where he was employed in various capacities for over 20 years. He was office engineer at the time of his death. For a number of years he was acting secretary of the State Board of Examiners for Engineers and Land Surveyors of Colorado.

John A. Dildine, resident of Fallon, Nev., for fifty years, died in a local hospital recently. He was in the contracting and building business at the time of his death.

SUPERVISING THE JOBS

Walter Cooper is general superintendent for Clyde W. Wood & Sons, on construction of Lauro Dam, part of the Cachuma Project near Santa Barbara, Calif. **Ralph Pugh** is grade foreman, **George W. Fox** is concrete foreman, and **Carroll E. Warren** is labor foreman. **D. Camron** is master mechanic on the $723,512 project.

Construction of Bear River Dam, 45 mi. north of Jackson, Calif., is being supervised by **Ben Arp** with **James F. Wise** as his assistant. **B. O. Sandberg** is master mechanic and **Robert K. Ames** is project manager. The Utah Construction Co. holds the contract for this job, which will cost approximately $5,000,000. For the Pacific Gas & Electric Co., owner, **J. E. Cooney** is superintendent of construction and **George Thacher** is resident engineer.

Pete Hansen is night superintendent and **Herb Alexander** is assistant master mechanic. **John Parsons, Sam Martinelli** and **E. M. Shireman** are quarry foremen. **Al Melcher** is concrete superintendent and **Herb Gallagher** is concrete foreman. The special rock placing on the upstream face of the dam gets the attention of **John Armelin, John Williams** and **C. A. Stokes. Tom Armitage** is rigger superintendent. Engaged in drilling and blasting are: **Virgil Moss, Glen Lowery, Maurice Ball, Vernon Johnson, Bill Collins** and **S. C. Hinton. H. J. Domogalski** is office engineer.

Don Winniford is general superintendent for Thomas Construction Co. on construction of a bridge and approaches at Consumnes River, 5 mi. west of Plymouth, Calif. **Thomas Stewart** is assistant superintendent on the $191,000 job.

Construction of a State Highway in Santa Barbara County near Summerland, Calif., by Griffith Company is being supervised by **George Griffith. E. A. Jackson** is foreman on the $1,023,000 job. Office manager is **J. E. Snider.**

Construction of an earthfill dam on the Boise River, southeast of Boise, Idaho, is being supervised by **H. B. Shannon** with **Albert Zaretzka** as his assistant. Martin Green Construction Co. has the subcontract from joint venturers, Morrison-Knudsen Co., Inc., J. A. Terteling & Sons, Inc., Macco Corporation and Puget Sound Bridge & Dredging Co. **Russell C. White** is master mechanic and **Charles M. Harold, Gerald C. Lenig** and **Willard E. Parker** are foremen. **Harold B. Smith** is material coordinator. This is a Corps of Engineers project.

H. Spinks is rigging superintendent and **Carl Newell** is carpenter superintendent for Al Erickson & Co. on construction of a box girder bridge in Sacramento, Calif.

The construction of Harry Wirtz School in Downey, Calif., by Stiglbauer Bros. is being supervised by **R. T. Greer. Earl Ferre** is superintendent for the firm on construction of a school in Paramount, Calif. **Bob Dalke** is supervising construction of additions to the Catholic Church in Downey.

Construction of a T-beam bridge about 5 mi. north of Ione, Calif., on the Placerville Rd., is being supervised by **Gerold Bing. Eric F. Nordlin** is resident engineer and **Raymond Whitaker** is his assistant.

In Salt Lake City, where Wunderlich-Curlett & Tompkins is constructing a $7,898,000 Veterans' Administration Hospital, **Floyd Sims** is general superintendent with **Foy Hodges** as his assistant. **Carol Wilson** is concrete equipment superintendent, **Cliff White** is steel foreman, and **Clarence Stanley** is carpenter foreman. **Frank Mower** is labor foreman, **Joe Fiedler** is shop foreman and **S. R. Williams** is brick foreman. **K. S. Carter** and **Percy Keate** are other key men on the job.

Fay Ramsey is superintendent for Hilde Construction Co. on the construction of the Belgrade-West Highway in Gallatin County, Montana. **John Hunter** is grade foreman on the $135,606 project.

Railroad relocation and overpass construction on State Highway No. 3 in Wallula, Wash., is being supervised by **M. F. Moulton.** J. A. Terteling & Sons, Inc., is contractor on the $510,276 job. **George Grant** is resident engineer.

Construction of grandstand and club house facilities for the Thoroughbred Racing Association in Las Vegas, Nev., is being supervised by **Roy Abel, Jr.,** for the Bruce McNeil Contracting Co. **T. A. Sullivan** is carpenter foreman, **Frank Starke** is labor foreman and **Kay Nielson** is roofing foreman on the $2,500,000 job.

N. F. Hinkle is general superintendent for Electrical Constructors on the erection of a tower and electrical work at Hoover Dam in Boulder City, Nev. **Al Hillis** and **W. S. Grey** are electrical

Continued on page 120

Down-time Dopes . . . . by Anderson

J. JOHNSTON, superintendent on highway work in Alaska, suggested this month's "down-time dopes".

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 the idea.

On the job with 16 contractors at Dugway Proving Grounds

SOME 16 WESTERN CONTRACTING FIRMS are currently speeding completion of an estimated $29,000,000 construction program to provide a permanent location for the Chemical Corps at the Dugway Proving Ground near the southern edge of the Great Salt Lake, about 80 mi. southwest of Salt Lake City.

The work, which is being carried out under the direction of the Corps of Engineers, Salt Lake Area, involves rehabilitation of a camp built in 1943 and construction of permanent concrete and steel buildings that will house scientific equipment, laboratories, and testing facilities necessary for the Chemical Corps work. The project was reviewed in *Western Construction*, July, 1951.

About one-third of the present construction activity, representing about $10,000,000 in contracts, centers in Easy Area on the eastern margin of the proving ground. Here various administrative offices, shops, community structures such as post exchange, hospital and school, and living quarters for military and civilian personnel are being built. Plans for the area include construction of a 400-unit Wherry housing project for which bids were taken in May, the work held in abeyance pending resumption of Wherry activity.

Electrical, water and sewerage facilities are being provided for Easy Area, as well as to serve the rest of the project. Necessary roads connecting the various areas have been constructed and a paved runway for aircraft has been provided. Construction work in areas other than Easy Area consists primarily of the erection of structures to house various laboratories and testing facilities.

CORPS OF ENGINEERS: In direct charge of operations at Dugway is **Lt. Col. Harold S. Gould** who succeeded **Col. H. G. Gerdes** as Area Engineer, Salt Lake Area, on September 21. Directing Corps of Engineers activities at the Dugway site is **John L. Trebilcock**, resident engineer. Project engineers for the various areas and general construction work are, **Sterling F. White, M. D. Tanielian, Lamar Smith, Harold Vosse, W. R. Wayman, H. B. Baddley, E. B. Harris**, and **Ralph B. Northrup. J. W. Blickensderfer** is office engineer.

JACOBSEN CONSTRUCTION CO., Salt Lake City, was among the first contractors to begin operations at Dugway. They have completed erection of Butler buildings in Fox Area to serve as camp for the construction workers. Erection of the camp buildings, including 10 barracks, mess hall, recreation building, 100,000-gal. steel water tank and a 200-unit trailer camp, was carried out on a $799,772 contract. This firm also holds a $2,544,000 contract for construction of laboratory buildings and utilities in Baker Area. Western Steel Co., Salt Lake City, was supplier of the steel buildings.

MOORE & ROBERTS AND B & R CONSTRUCTION CO., San Francisco (joint venture) are slightly ahead of schedule on their $4,250,000 contract for construction of 11 buildings in Easy Area.

The buildings presently under construction in Easy Area are primarily steel pan-and-joist constructed reinforced concrete frames with masonry block walls. The masonry block work is being done under subcontracts as is electrical, plumbing, heating, painting, and roofing work. Forms for the buildings were job-fabricated and the general practice is to re-use forms as many times as possible. In some instances, for column work, etc., forms have been re-used as many as five times.

With a Noble batch plant Model CA 154 that has an output of 100 cu. yd. per hr., Moore & Roberts and B & R not only have sufficient concrete to meet their own needs but are able to act as concrete suppliers for several other contractors at the project. Other equipment includes a Mixermobile, three transit-mix trucks, four dry-batch trucks, and a Hyster fork lift for handling forms and lumber. About 300 men are employed on the job.

William Backstrom is project manager for the two firms, with **Gerry Haskell** acting as general superintendent. Assistant project manager and assistant general superintendent are **Larry Singleton** and **George Dugan**, respectively. Other key men on the job are: **E. A. Higgins**, engineer; **John C. Whitman**, office manager; **A. E. Currier, Paul Haney** and **Lee C. Bean**, building superintendents. Foremen on the job are: **Angelo Manzo, R. F. Ashley, K. E. Larson**, and **P. A. Petersen.**

CAHILL & MOONEY CONSTRUCTION CO., Billings, Montana, are following standard building practices for construction of 11 buildings and one flagpole on a $2,467,550 contract in Easy Area.

These structures, 9 single-story and 2 two-story buildings, will also be reinforced concrete frame with masonry block walls. Blocks are being raised in 5-ft. lifts and then filled with loose-fill perlite or crushed lava. **Ralph E. Child**, Springville, Utah, is subcontractor for the masonry block work. Other work—electrical, plumbing, heating, painting and roofing—is also being done on subcontracts.

Unless unforseen delays occur, Cahill & Mooney expect to complete the buildings by the end of this year. Equipment on the job includes a Northwest 25 shovel, Wagner Scoopmobile, Caterpillar DF-9 with dozer, four trucks and the usual complement of smaller tools.

General superintendent for Cahill & Mooney at Dugway is **A. F. Carlson. Frank Despens** is assistant superintendent, with **Gene Bales** as estimator and **Pete Petersen** as office manager. Foremen on the job include **Carl Schmidt, Jess Brown, Al Staker, Max Gamman, Bill Petersen, Dan Stanis** and **Jim Hebbdan.**

RALPH E. CHILD, Springville, Utah, holds a prime contract for construction of an elementary school to serve the planned family village, in addition to subcontracting block work for Cahill & Mooney. Construction of the school began on August 3 and is scheduled for completion on February 2, 1952.

Child will batch his own concrete using a machine of his own design and manufacture that contains a Rex mixer and Gar-Bro bucket. A truck-mounted Quickway crane will be used for placing concrete.

Elmer Olson is superintendent under the direction of **Ralph E. Child. Robert Hall** is project engineer.

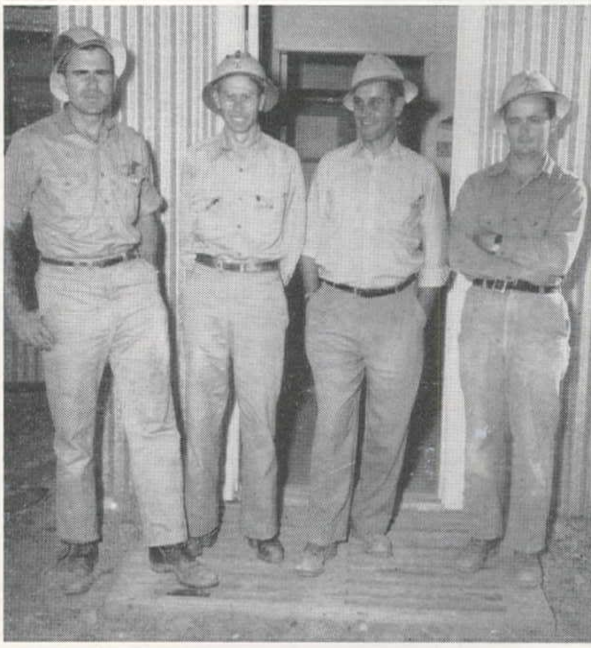
CHRISTIANSEN BROS., Salt Lake City, are in the final stages of construction of a machine shop and other buildings in Easy Area. Completion of their contracts, totaling $1,303,395, has been delayed due to delay in arrival of machinery to be installed in the structures.

To provide concrete for their buildings Christiansen Bros. set up a small plant consisting of a CMC batcher with a ½-yd. Jaeger mixer. A Wagnermobile was used to feed the plant hopper and Whiteman power buggies were used to deliver the mix. As was the practice of the other prime contractors, plumbing,

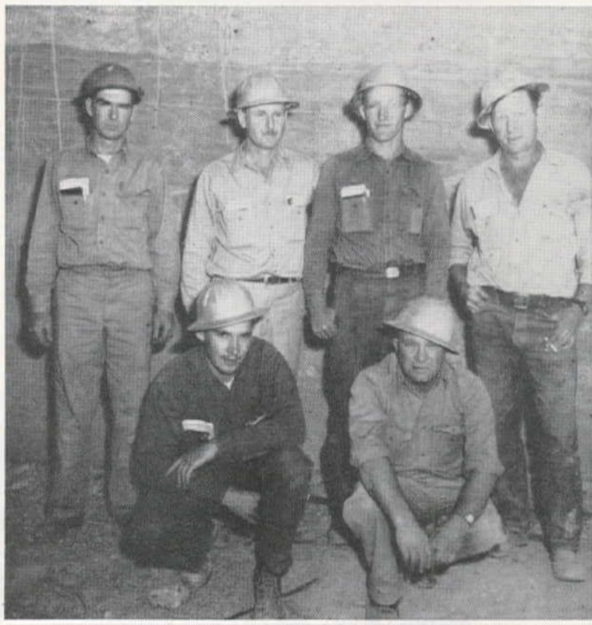
Continued on page 114

Some of the key men responsible for the C. J. Strike Hydro Plant

Constructing a hydro project in a little over 13 months requires a high-ball operation. Unfortunately, all the key men working to bring about power generation in so short a time cannot be shown. Night shifters were in bed and most of those on the job got away so fast the photographer couldn't catch them. The project is reviewed on pages 61-65.



Top man for Idaho Power Co. at the job site is *Fred McCormick* (third from left), assistant to the superintendent of power plants. Ably assisting him are detail engineers, left to right, *Gailen B. Soule*, *Gomer Condit* and *M. C. Welsh*.



Keeping things going at the spillway for M-K are, standing, left to right: *Ray E. Willis*, millwright foreman; *Jack C. Barker* and *Henry L. Weech*, carpentry foremen; and *John Schell*, concrete foreman. Kneeling are *Leon D. Stoddard*, carp. fore., and *Willard H. Heasley*, labor fore.

Left: *R. C. Lowerie*, Idaho Power resident engineer.

Right: M-K concrete superintendent *James W. Rutherford*.

Below: standing, left to right: *G. M. Zapp*, carp. fore.; *W. M. Mosher*, labor fore.; *G. C. Patheal*, carp. fore.; *Lloyd Condit*, carp. supt.; *W. A. Denton* and *Dean Straw*, excav. fore. Kneeling are *Roy J. Rasmussen*, elec. supt., and *Harry A. Woodall*, excav. supt.

Below: standing, left to right: *Ray Clayton*, carp. fore.; *Walter A. Caster*, labor fore.; *Roger C. Thomas*, carp. shop supt.; *D. C. Thomas*, asst. proj. mgr.; and *Wm. A. Abrahamson*, proj. engr. Kneeling is *Roy C. Bassett*, pile fore.

On the job at Dugway

. . . Continued from page 112

heating, carpentry, electrical and masonry work was let on subcontracts.

Wally Christiansen is construction superintendent with **Simon Christiansen** filling the post of project engineer. Other members of the firm, **Walter** and **Ralph Christiansen** are carrying out other functions such as purchasing, securing personnel, and expediting material.

COX AND COLTHARP, Rangeley, Colo. (joint venture), hold a contract for sub-grading and placing gravel on 8 mi. of road and are supplying other contractors with aggregates. An easily worked pit about 3 mi. from Easy Area is their source of material, and they use a Pioneer portable plant for the processing. They have been manufacturing three sizes of gravel and two types of sand, for concrete and mortar. Material is brought from the pit by tractor and scraper and after passing through the plant is stockpiled until needed. A Traxcavator is used to load their fleet of 14 trucks. Other equipment includes three Caterpillar blades, Lima 34 shovel, and five tractors.

The operations are under the joint direction of **Leslie Cox** and **W. H. Caltharp, Jr. Harvey Bowers** is office manager.

JOSEPH K. THAYN, Salt Lake City, is currently completing an $853,196 contract for installation of water and sewerage facilities. The installation includes sewage collection system and treatment plant with digester, settling tanks and appurtenant machinery; and water storage tanks, distribution system and treatment works. A $160,937 contract for other work was completed by the firm last year.

Wallace Thayn is project manager for Joseph K. Thayn at Dugway. **Noel Gold** is project engineer and **Lowell Brown** is plumbing superintendent. **Jay Erickson** and **Charles Hindes** are carpentry and pipe foremen respectively.

C. L. ELECTRIC CO., Pocatello, Idaho, are completing a $310,283 contract for an electrical transmission and distribution system at Dugway. **Rex Lanham** is superintendent, with **Harry Dewey** serving as project engineer. **Willard Issacson** is carpentry foreman, and **Ken McKay** line foreman.

TRIANGLE BUILDING CO., Twin Falls, Idaho, is just getting well underway on construction of four buildings in Easy Area on a $962,219 contract. Buildings include a hospital, attendants' dormitory, and two other structures. On a joint venture with DAVID M. SWEENEY they are constructing three buildings in Dog Area on a $340,134 contract.

John B. Johannesen is general superintendent for both firms at Dugway, with **F. J. Clark** assisting in the post of general foreman. **R. K. Hawkins** is office engineer. Other key personnel include **LeRoy Butt, Vincent Golob** and **A. O. Radford.**

Other contracts held for work at Dugway include:

OLOF NELSON CONSTRUCTION CO., Logan, Utah, access road construction, $617,002; M. J. BROCK & SONS, INC. and R. J. DAUM CONSTRUCTION CO. (joint venture) buildings, Able Area, $1,382,133; TOLBOE & HARLIN CONSTRUCTION CO., Salt Lake City, construction in Dog and Charlie areas, $1,300,000 (approx.).

Work recently completed at Dugway includes: Construction and paving of roads and runways, W. W. CLYDE CO., Springville, Utah, $1,444,705; Installation of transformers and switch gear, WESTINGHOUSE ELECTRIC CO., $343,731; ½-mi. square grid, WHEELWRIGHT CONSTRUCTION CO., $253,230; Phase I rehabilitation, STOLTE, INC., Oakland, Calif., $277,117; Phase III rehabilitation, TOLBOE & HARLIN CONSTRUCTION CO., $117,485; Laboratory remodeling, OLSON CONSTRUCTION CO., $128,751; and paving and grading Granite Peak road, GERMER, ABBOTT & WALDRON CO., $185,947. Much of this work has been finished since the many projects were last reviewed in *Western Construction.* Completion dates for the work still under way extend well into next year.

CONTRACTS

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

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Alaska

$1,068,870—**S. Birch & Sons, C. F. Lytle Co.,** and **Green Construction Co.,** joint venturers, 208 Central Bldg., Seattle, Wash.—Low bid for surfacing the Girdwood-Anchorage highway, Section D; by Alaska Road Commission.

$8,493,313—**Peter Kiewit Sons' Co.,** 1300 Aloha St., Seattle, Wash.—Contract awarded for construction of outside utilities at Ladd Air Force Base; by Corps of Engineers.

$1,069,000—**Kuney, Johnson Co.,** 235 9th Ave., Seattle, Wash.—Low bid for construction of Alaskan Communications facilities at Fairbanks; by Corps of Engineers.

$183,524—**Joe Lundberg Construction Co.,** 3220 E. Republican St., Seattle, Wash.—Low bid for construction of a water supply dam in Petersburg; by Alaska Public Works, Office of Territories, Department of Interior.

$199,139—**Munter Construction Co.,** 1428 Joseph Vance Bldg., Seattle, Wash.—Contract awarded for clearing of transmitter and receiver sites at Elmendorf and Ft. Richardson; by Corps of Engineers.

$398,854—**Valley Construction Co.,** 7722 Rainier Ave., Seattle, Wash.—Low bid for extension of sewers and water mains in Anchorage; by Alaska Public Works Commission.

Arizona

$172,641—**Wallace & Wallace,** P. O. Box 470, Phoenix—Low bid for construction of the Salt River Valley-Junction F. H. 9, to be 3.3 mi. in length in Gila County, Tonto National Forest; by Bureau of Public Roads.

California

$321,818—**J. R. Armstrong,** 400 Central Ave., El Cerrito—Contract awarded for grading and surfacing 3.6 mi. of State Sign Route 21 between 3.5 mi. south of Danville and Concord, Contra Costa County; by State Division of Highways.

$1,017,568—**Cahill Construction Co.,** 206 Sansome St., San Francisco—Contract awarded for general construction of Bret Harte School, Hollister and Griffith Sts., San Francisco; by City, Department of Public Works.

$1,138,000—**Louis C. Dunn,** 3101 Wilshire Blvd., Los Angeles—Contract awarded for construction of a 1-story, steel aircraft building, Unit 2, El Segundo; by Douglas Aircraft Co., Inc.

$2,551,228—**Fredrickson & Watson Construction Co.** and **M & K Corp.,** 873 81st Ave., Oakland—Low bid for grading and paving 3.9 mi. on Eastshore Freeway between Jackson St. and Lewelling Blvd., and constructing highway separation structures, Alameda County; by State Division of Highways.

$2,381,815—**Griffith Co.,** 1060 S. Broadway, Los Angeles—Contract awarded for construction of a state highway in Los Angeles County, on Ramona Freeway, between 8th St. and .1 mi. east of Jackson Ave., about 1.7 mi. long, to be graded and paved with portland cement concrete and 4 bridges and a pedestrian undercrossing to be constructed to provide a 6-lane divided highway with frontage roads; by State Division of Highways.

$3,040,415—**Gunther & Shirley Co.,** 714 W. Olympic Blvd., Los Angeles—Contract awarded for construction of aircraft maintenance hangar, Miramar; by Eleventh Naval District.

$881,730—**Lowrie Paving Co., Inc.,** 1755 Evans Ave., San Francisco—Contract awarded for paving aprons, taxiways and miscellaneous work at San Francisco Airport; by Public Utilities Commission.

$277,850—**McGuire & Hester,** 796-66th Ave., Oakland—Low bid for construction of the West Central drainage project in San Mateo; by City of San Mateo.

$1,160,099—**Oberg Bros. Construction Co.,** Box 640, Inglewood—Low bid for construction of a state highway in Los Angeles County, on Harbor Freeway at 7th, 8th and 9th Sts. in Los Angeles, and 6 reinforced concrete box girder and slab bridges to be constructed along with the grading and paving of city streets; by State Division of Highways.

$526,731—**Oswald Bros.,** 366 E. 58th St., Los Angeles—Contract awarded for construction of a state highway in Los Angeles County on Hawthorne Ave. between 174th St. and 137th St., about 2.5 mi. in length to be graded and surfaced with plant-mixed surfacing; by State Division of Highways.

$1,618,800—**J. A. Payton and Bent Construction Co.,** 5359 Valley Blvd., Los Angeles—Contract awarded for construction of a state highway in San Diego County, between Buena Vista Lagoon and ¼ mi. south of Mission Ave. in Oceanside, about 21 mi. in length to be graded and paved with portland cement concrete and a reinforced concrete bridge and grade separation structures to be constructed; by State Division of Highways.

$1,056,885—**A. G. Raisch and Lew Jones Construction Co.,** P. O. Box 458, San Rafael—Contract awarded for construction of highway ramps, a frontage road, and highway roadbeds; widening an existing reinforced concrete bridge and installing highway lighting facilities on U. S. 101 between Myrtle Ave. in San Rafael and California Park Overhead; by State Division of Highways.

$343,507—**R. P. Shea Co.,** P. O. Box 218, Indio—Low bid for construction of a state highway in Imperial County, across New River, at Seeley, a steel stringer bridge to be constructed and approaches to be graded and surfaced; by State Division of Highways.

$543,017—**H. W. Ruby,** 2851 Northrup Ave., Sacramento—Low bid for construction of 13 bridges and approaches at various locations on U. S. 99 between Oroville Wye and 0.3 mi. south of Chico, Butte County; by State Division of Highways.

$1,025,281—**Carl N. Swenson, Inc.,** 1095 Stockton Ave., San Jose—Contract awarded for construction of foundations for a supersonic wind tunnel at Moffett Field; by National Advisory Committee for Aeronautics Ames Laboratory.

$3,500,000—**Swinerton & Walberg Co.,** 225 Bush St., San Francisco—Contract awarded for construction of a paper converting plant in San Leandro. ($3,500,000 includes the construction of the plant and the equipment to be installed); by Crown Zellerbach Corp.

$192,881—**C. B. Tuttle Co.,** 268 Belmont Ave., Long Beach—Low bid for construction of a state highway in San Bernardino County, between Barstow and Amboy, 48 timber trestle bridges to be redecked with reinforced concrete slabs, plank floors and plant-mixed surfacing; by State Division of Highways.

$3,661,000—**Ford J. Twaits Co.,** 449 S. Beaudry St., Los Angeles, **Morrison-Knudsen Co., Inc.,** 411 W. 5th St., Los Angeles, and **Macco Corp.,** 14409 S. Paramount Blvd., Paramount—Low bid for construction of launching facilities and miscellaneous buildings, Point Mugu; by U. S. Naval Air Missile Test Center.

$646,206—**United Concrete Pipe Corp.,** Box 425, Baldwin Park—Low bid for grading 3.3 mi. of roadbed for a 4-lane divided highway on the West Sacramento Freeway, between Yolo Causeway and 0.8 mi. west of Tower Bridge across the Sacramento River at Sacramento; by State Division of Highways.

$729,505—**E. L. Yeager,** P. O. Box 87, Riverside—Low bid for construction of a state highway between Antelope Rd. and Rte. 64, about 10.5 mi. in length, to be graded, imported base material to be placed and a portion to be cement treated and surfaced with plant-mixed surfacing; by State Division of Highways.

Colorado

$825,279—**Adler Construction Co.,** P. O. Box 595, Loveland—Low bid for construction of Rattlesnake Dam, Estes Park-Foothills Power Aqueduct, Colorado-Big Thompson Project; by Bureau of Reclamation.

$194,416—**Brown Construction Co.,** 17 Belle Aire Rd., Colorado Springs—Low bid for construction of a state highway between Rio Blanco and Rifle on State Highway 13, Garfield County, to be 6.4 mi. in length; by State Highway Department.

$240,000—**C. L. Hubner Co.,** 4000 York St., Denver—Low bid for construction of the Marvine-Phippsburg route in Rio Blanco County, White River National Forest, to be graded 26 ft. with base surfacing of 22 ft.; by Bureau of Public Roads.

$160,653—**James B. Kenney, Inc.,** 3233 Osage St., Denver—Low bid for construction of a state highway in Aurora, east from the E. city limits of Denver on State Highway 8 in Adams and Arapahoe counties, to be 1.1 mi. in length including gradation structures and asphalt paving; by State Highway Department.

$1,023,000—**A. A. & E. B. Jones,** 682 Wyandot St., Denver—Contract awarded for general construction of a 2-story, brick Merrill Junior High School, Denver; by School District 1.

$103,781—**San Ore Construction Co.,** McPherson, Kansas—Low bid for construction of a state highway from south city limits, Burlington, south on State Highway 51 in Kit Carson County, to be 5.4 mi. of stabilization structures and oil process surfacing; by State Highway Department.

Idaho

$119,950—**Goodwin Construction Co.,** Hopkins Bldg., Box 791, Blackfoot—Contract awarded for construction of a 278-ft. bridge and approaches on 0.6 mi. of the Ora Rd. west of Ashton in Fremont County; by State Department of Highways.

Montana

$614,682—**Stanley H. Arkwright, Inc.,** 1200 Sixth Ave., Billings—Contract awarded for construction of Pompey's Pillar-Hysham highway in Yellowstone County, to be 11.9 mi. of grading, gravel surfacing, plant-mixed oil and small drainage structures; by State Highway Commission.

$748,463—**S. Birch & Sons Construction Co., McLaughlin-Lane Co.,** joint venturers, 314 Ford Bldg., Great Falls—Low bid for construction of an aircraft refueling system and additions to bulk fuel storage at Great Falls Air Force Base; by Corps of Engineers.

$402,051—**Glenn Geery, Inc.,** 302 Wilma Bldg., Missoula—Contract awarded for construction of the Garrison-Northwest section of the Bearmouth-Deer Lodge Rd. in Powell County; to be 6.3 mi. of grading, gravel surfacing and bituminous surface treatment and draining; by State Highway Commission.

$537,945—**Peter Kiewit Sons' Co.,** P. O. Box 875, Sheridan, Wyo.—Low bid for grading and surfacing roads in Roosevelt County; by State Highway Commission.

$340,503—**Albert Lalonde Co.,** Sydney—Contract awarded for construction of the Glasgow-Opheim highway in Valley County, to be 11.1 mi. grading, gravel surfacing, road-mixed oil, and small drainage structures; by State Highway Commission.

$116,639—**McKinnon-Decker Co.,** 1520 Hauser St., Helena—Contract awarded for construction on the Ledger-East and West Road in Pondera County; to be 6.5 mi. of grading, gravel surfacing and small drainage structures; by State Highway Commission.

$198,448—**McKinnon-Decker Co.,** 1520 Hauser St., Helena—Contract awarded for construction on the Drummond-Lelmville Rd., Powell County; to be 6.8 mi. of grading, gravel surfacing and small drainage structures; by State Highway Commission.

$205,001—**McKinnon-Decker Co.,** 1520 Hauser St., Helena—Contract awarded for construction of the Garrison-Northwest section of the Bearmouth-Deer Lodge Rd. in Powell County, to be 2.0 mi. in length; by State Highway Commission.

$117,903—**G. E. Marshall,** P. O. Box 217, Melstone—Contract awarded for construction of the Glendive-Richey highway in Dawson County, to be 10 mi. of grading, gravel surfacing and the construction of small drainage structures; by State Highway Commission.

Nevada

$530,136—**Isbell Construction Co.,** P. O. Box 2351, Reno—Contract awarded for construction of a portion of the State Highway System in Washoe County, from Sparks to Vista, to be 3.1 mi. in length; by State Department of Highways.

New Mexico

$118,655—**Brown Construction Co.,** P. O. Box 1479, Albuquerque—Contract awarded for construction of a highway in Hidalgo County on the Lordsburg-Animas Rd., to be 9.1 mi. in length; by State Highway Department.

$288,094—**Brown Construction Co.,** P. O. Box 1479, Albuquerque—Contract awarded for construction of a highway in Eddy County along the Artesia-Carlsbad Rd., to be 3.2 mi. in length; by State Highway Department.

$125,195—**G. I. Martin,** 520 Tulane, Albuquerque—Contract awarded for construction of a highway in Chaves County northeast of Roswell to be 4.0 mi. in length; by State Highway Department.

$316,221—**G. I. Martin,** 520 Tulane, Albuquerque—Contract awarded for construction of a highway in San Juan County, along the Bloomfield-Blanco Rd., to be 6.4 mi. in length; by State Highway Department.

$308,837—**D. D. Skousen,** 201 Springer Bldg., Albuquerque—Contract awarded for construction of a state highway in Colfax County on the Springer-Colmor Rd., to be 6.2 mi. in length; by State Highway Department.

Oregon

$1,821,465—**Guy F. Atkinson Co.,** 806 Cascade Bldg., Portland—Low bid for grading and paving the Wygant Park-Hood River section, Hood River County; by State Highway Commission.

$669,982—**Berke Brothers,** 7923 N.E. Halsy, Portland—Low bid for construction of the Reedsport-Winchester Bay section of the Oregon Coast Highway, to be 3.7 mi. of grading and paving; by State Highway Commission.

$203,433—**Excavators, Inc.,** 621 Ninth St. N., Seattle—Low bid for construction of bridges and access roads, Columbia-Olympia line, Marion County; by Bonneville Power Administration.

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

$848,815—**Gibbons & Reed Co.,** 259 W. 3d South St., Salt Lake City, Utah—Low bid for grading and paving of the Warren Creek-Viento section of the Columbia River Highway, along 1.84 mi.; by State Highway Commission.

$452,383—**R. A. Heintz Construction Co.,** 211 N.E. Columbia Blvd., Portland—Low bid for grading and cinder surfacing of 12.2 mi. of the Rocky Creek-Wocus Marsh section of the Klamath Lake Secondary Highway; by State Highway Commission.

$689,468—**R. A. Heintz Construction Co.,** 211 N.E. Columbia Blvd., Portland—Low bid for construction of the Gilchrist-Willamette Junction unit of the Lapine-Diamond Lake Junction section of The Dalles-California Highway, about 14 mi. south of Lapine, including 12.4 mi. of grading and 12.4 mi. of paving, plus construction of 100-ft. reinforced concrete logging road separation structures; by State Highway Commission.

$238,645—**Heavy Hauling Co.,** Astoria—Low bid for grading and paving along 2.1 mi. of the Bay City-Tillamook highway in Tillamook County; by State Highway Commission.

$361,905—**Power City Electric Co.,** N. 920 Howard St., Spokane, Wash.—Contract awarded for construction of Bandon-Port Orford and Port Orford-Gold Beach 115-kv. line, Coos and Curry counties; by Bonneville Power Administration.

$682,725—**State Construction Co.**, 1750 19th Ave. S., Seattle, Wash., and **Walter McCray**, 308 S.W. 22nd St., Mercer Island, joint venturers—Low bid for construction of the Willamette River crossing of the City Sewer Project; by City of Portland.

Utah

$294,565—**Gibbons & Reed Co.**, 259 W. 3rd So., Salt Lake City—Low bid for construction on State Route No. 48, Midvale-Copperton, Salt Lake County, to be 9.4 mi. in length, road-mixed bituminous surfacing applied; by State Road Commission.

$1,058,950—**Olson Construction Co.**, P.O. Box 89, Salt Lake City—Contract awarded for general construction of a senior high school in Granite Park, Salt Lake City; by Granite School District.

$181,829—**Parson & Fife Construction Co.**, Box 563, Brigham City—Contract awarded for construction on U. S. 91, Riverdale-Grant Ave., in Weber County, to be 1.0 mi. long with 3-in. plant-mixed bituminous surfacing on a concrete base; by State Road Commission.

$1,353,107—**G. A. Whitmeyer & Sons Co.**, P. O. Box 857, Ogden—Low bid for the general construction division work of a high school in Ogden; by Board of Education.

$241,810—**L. A. Young Construction Co.**, Richfield—Low bid for construction of the Richfield-Vermillion highway in Sevier County, to be 6.4 mi. in length; by State Road Commission.

Washington

$957,580—**Agutter Electric Co.**, 952 E. Seneca, Seattle—Low bid for construction of aircraft refueling systems at McChord Air Force Base; by Corps of Engineers.

$1,342,265—**Anderson Bridge Construction Co.** and **Roy T. Earley Co.**, joint venturers, 4130 S. Adams, Tacoma—Low bid for construction of the Port Industrial Waterway Bridge and approaches in Tacoma; by City Board of Contracts and Awards.

$795,387—**Collins Concrete and Steel Pipe Co.**, 3841 N. Columbia Blvd., Portland—Low bid for schedules 1 and 2, construction of Babcock Pumping Plant and West Canal laterals, Columbia Basin Project; by Bureau of Reclamation.

$571,065—**Fiorito Bros.**, 1100 Leary Way, Seattle—Contract awarded for construction on Primary State Highway No. 1, Centralia south, Lewis County, to be 2.4 mi. in length; by State Department of Highways.

$159,287—**Fiorito Co.**, 844 W. 48th St., Seattle—Contract awarded for construction on Primary State Highway No. 2, Mercer Island Grade Separation, King County, to be .3 mi. in length; by State Department of Highways.

$260,023—**The Harrison Bros. Co.**, 225 Wakefield Dr., Tacoma—Contract awarded for construction on Primary State Highway No. 5, Alder to Elbe, Pierce County, to be 5 mi. in length; by State Department of Highways.

$237,439—**Intermountain Plumbing Co.** and **Henry L. Horn**, Moses Lake—Low bid for construction of a lateral system west of Connell in the Columbia Basin Project; by Bureau of Reclamation.

$1,467,865—**Peter Kiewit Sons' Co.**, 1300 Aloha St., Seattle—Low bid for construction of Pasco levees along the left bank of the Columbia River in the vicinity of Pasco, Franklin County, to be approximately 6 mi. in length; by Corps of Engineers.

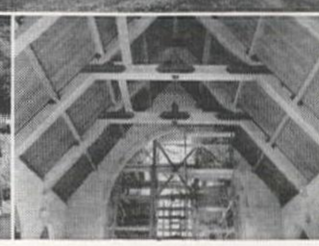
$278,781—**Long Construction Co., Inc.**, Box 1291, Billings—Low bid for Lake Lenore pumping plants Nos. 1 and 2 and intake and connecting channels, Columbia Basin Project; by Bureau of Reclamation.

$501,225—**Osberg Construction Co.**, 1132 N. 128th St., Seattle—Low bid for clearing Ross Reservoir in Seattle; by City of Seattle.

$406,768—**C. E. Oneal**, P. O. Box 270, Ellensburg—Contract awarded for construction of Primary State Highway No. 2, Snoqualmie Pass to Hyak, King and Kittitas counties, to be 2.5 mi. long; by State Department of Highways.

$263,006—**Strong & Macdonald, Inc.**, 4045 Ruston Way, Tacoma—Contract awarded for construction on Primary State Highway No. 5, Fern Gap north, Lewis County, to be 1.5 mi. in length; by State Department of Highways.

$1,884,787—**United Concrete Pipe Corp.**, P. O. Box 425, Baldwin Park, Calif.—Low bid for construction of irrigation canals for Block 49 southwest of Othello. Job includes construction of approximately 46 mi. of unlined irrigation ditches, nearly 16 mi. of concrete-lined laterals, and approximately 6 mi. of 12- to 42-in. precast concrete pipe lines, Columbia Basin Project; by Bureau of Reclamation.



SUPERVISING THE JOBS . . .

. . . Continued from page 110

foremen, **E. L. Ferguson** is steel foreman and **Bill Thornton** is ground foreman on the $1,500,000 Bureau of Reclamation project.

Construction of an electrical service building at Hoover Dam, Boulder City, Nev., is being supervised by **Tex Gineski** for Elliott & Gist. **George M. Olsen** is carpenter foreman, **C. S. McCullough** is labor foreman along with **George W. Brown**, and **Jess Hoops** is general foreman on the Bureau of Reclamation project.

Construction of a bridge over the Sioux River, between Lincoln County, S. Dak., and Sioux County, Iowa, is being supervised by **A. Miller. C. Bidwell** is project manager for Dave Gustafson & Co., Inc., on the $87,449 project for the S. Dak. State Highway Commission.

Construction of Greenback Lane from Orangevale to Folsom, in Sacramento County, Calif., is under the supervision of **Rudy Klotz. Mike Hothman** is assistant superintendent for J. R. Reeves, contractor. J. R. Reeves has **Bill Herzog** in charge of railroad and road construction for the new Proctor & Gamble plant in Sacramento.

Ernest Lunstad is general superintendent for Gyrion Construction Co. on the erection of the Trinity Lutheran Church and Parsonage in Kalispell, Mont. **Fred Gyrion, Sr.** is project manager on the $87,594 job.

Construction of 24.5 mi. of road along the upper half of the 34 mi. long Hungry Horse Reservoir is being supervised by **Fred Hoops** for the Hoops Construction Co. **Joe Akins** is grade foreman, **D. W. Brimhall** and **Jack Purcell** are in charge of clearing and **Tom M. Dunn** is job engineer.

Building construction for the Montana State College in Bozeman is being supervised by **Robert Corrigan** for I. M. Johnson, contractor. The contract price is $63,878.

On the John J. Swigart Co. job on State Highway 99 at Indio, Calif., now nearing completion, **"Duke" Jones** is general superintendent and **W. H. Irwin** project manager.

Thomas Paul is directing all operations for Peter Kiewit Sons' Co. on the March Field air strips contract at Riverside, Calif. **Herb Studer** is project manager, assisted by **John Alltucker**. The following superintendents are on the job: dirt, **Lonnie Lawler**; asphalt, **Tom Kelly**; utility, **Ed Olcott**; street, **Homer Olson**; concrete, **Clark Tope. S. J. Hanby** is master mechanic. **Gill Purdy** is office engineer; **Bill Roche**, field engineer and **Paul Eller**, planning engineer.

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UNIT BID PRICES

Selected Bid Abstracts for Typical Western Projects

Tunnel . . .

Intake structure, excavation, concrete and steel placement, penstock, dam alterations, gate installation for Eklutna Tunnel

Alaska—Eklutna Project—Bureau of Reclamation. Palmer Constructors (Morrison-Knudsen Co., Inc., Peter Kiewit Sons' Co. and Coker Construction Co., joint venturers) with a bid of $17,348,865 (Schedule 1) and $16,419,440 (Schedule 2), were low for construction of Eklutna Tunnel. Work includes excavation and disposal of deposits on the lake bottom of material "A" which overlays deposits material "B"; construction of trashrack, transition, and bulkhead sections of intake structure, including the necessary excavation; furnishing and placing a sand and gravel subbase, furnishing and placing sand and gravel backfill; construction and installation of a 9-ft. diameter precast conduit, including the necessary excavation; furnishing and placing a sand and gravel subbase; furnishing and placing sand and gravel backfill; construction of a 9-ft. internal diameter concrete-lined tunnel; construction of a 9-ft. diameter concrete gate shaft; construction of a concrete surge tank, 30 ft. in internal diameter; construction of a penstock tunnel and installation of a steel penstock varying from 7-ft. 6-in. inside diameter to 6-ft. inside diameter; alternations to existing Eklutna Dam, including earthwork, riprap, sheet piling, and repairing existing timber trestle. Unit prices were as follows:

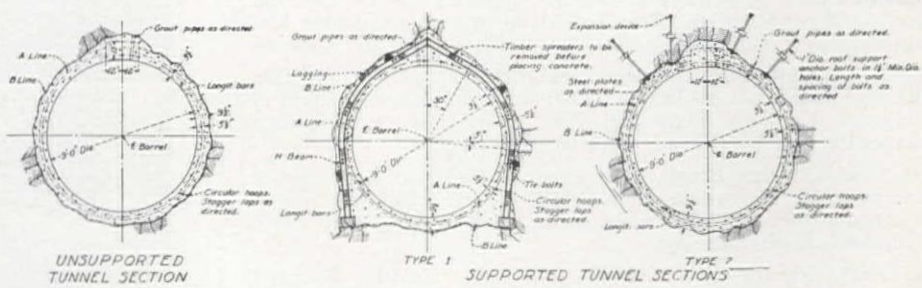
(1) Palmer Constructors $17,348,865
16,419,440

(2) Grafe-Callahan Construction Co., Rhodes-Shofner Construction Co., Inc., D. G. Gordon $17,776,596
16,391,192

(3) The Utah Construction Co. $19,249,774
17,052,570

(4) Wm. A. Smith Contracting Co. of Missouri, Brown and Root, Inc. $22,586,725
19,348,700

(5) Engineer's estimate $18,175,568
15,687,384



SCHEDULE NO. 1—TUNNEL WITH INTAKE AT ELEVATION 794.00

	(1)	(2)	(3)	(4)	(5)
205,000 cu. yd. excav., open cut, for inlet, first 205,000 cu. yd.	3.00	2.20	5.50	2.25	3.25
205,000 cu. yd. excav., open cut for inlet over 205,000 cu. yd.	.60	.80	1.00	1.15	1.00
Lump sum, constr. and installing intake trashrack section	$150,000	$180,000	$310,000	$750,000	$230,000
Lump sum, constr. and installing intake transition section	$37,000	$71,500	$95,000	$750,000	$80,000
Lump sum, constr. and installing intake bulkhead section	$27,000	$50,000	$70,000	$700,000	$45,000
225 lin. ft. furn. and install. 9-ft. diam. precast conduit	$1,500	$1,092	$2,000	$3,000	$1,400
711.5 lin. ft. constr. tunnel betw. Sta. 20+00 and Sta. 27+11.50	$1,500	$1,092	$1,774	$3,000	$1,800
21,000 cu. yd. excav., in open cut, for gate shaft	5.00	7.20	1.00	2.75	3.00
920 cu. yd. excav. for gate shaft	400.00	325.00	174.00	240.00	125.00
5,700 cu. yd. excav. for surge tank	120.00	75.00	82.50	16.00	80.00
82,500 cu. yd. excav., in tunnel	80.00	86.85	82.00	75.00	71.00
3,600 cu. yd. excav. in inclined penstock tunnel	250.00	180.00	257.00	110.00	73.00
200 cu. yd. excav. for tunnel enlargement	87.50	200.00	119.00	115.00	100.00
1,000 cu. yd. backfill about intake struct.	12.00	62.50	9.00	9.00	8.50
1,415,000 lb. furn. and installing perm. steel tunnel supports	.25	.27	.51	.45	.30
615 M.b.m. furn. and erect. perm. timbering in tunnel	400.00	465.00	632.00	900.00	400.00
11,800 lin. ft. furn. and installing tunnel roof support bolts	4.00	9.00	5.00	4.60	4.00
10,000 lin. ft. drilling feeler or pilot holes ahead of tunnel excavation	10.00	8.00	3.00	7.60	3.50
2,500 lin. ft. drilling grout holes	10.00	5.50	3.95	7.60	6.00
7,500 lb. furn. and placing grout pipes and connections	1.00	2.10	2.00	4.50	2.00
25,000 cu. ft. pressure grouting	6.00	15.00	6.00	6.00	5.00
100 M. gal. pumping first 100 million gal. of drainage water from tunnel at any rate	$5,000	$3,000	$2,000	$4,600	$9,000
600 M. gal. pumping drainage water from tunnel at the rate of 0 to 2 million gal. per 24 hr.	100.00	385.00	150.50	160.00	$1,800
200 M. gal. pumping drainage water from tunnel at the rate of 2 million and 1 gal. to 4 million gal. per 24 hr.	100.00	550.00	158.50	150.00	$2,500
100 M. gal. pumping drainage water from tunnel at the rate of over 4 million gal. per 24 hr.	100.00	$1,100	158.50	150.00	$3,350
390 cu. yd. concrete in gate shaft	100.00	170.00	266.00	300.00	145.00
1,235 cu. yd. concrete in surge tank	100.00	170.00	173.00	220.00	115.00
25,610 cu. yd. concrete in tunnel lining	75.00	85.00	80.20	150.00	82.00
3,450 cu. yd. concrete around penstock	75.00	85.00	67.00	150.00	80.00
52,280 bbl. furn. and handling cement	12.00	12.50	15.30	15.50	10.00
5,651,000 lb. furn. and placing reinf. bars	.25	.20	.322	.28	.25
1,281,000 lb. installing penstock	.25	.30	.255	.40	.20
24,000 lb. installing frames and guides for bulkhead and fixed-wheel gates and hoist support beams	.25	.32	.40	.40	.35
41,000 lb. installing fixed-wheel and bulkhead gates	.25	.32	.20	.22	.23
21,000 lb. installing fixed-wheel and bulkhead gate hoists	.25	.32	.24	.40	.30
2,250 lb. installing apparatus and piping for bulkhead and fixed-wheel gates	.50	.60	1.00	1.70	.80
14,000 lb. installing gate shaft and surge tank metalwork	.50	.40	.40	1.20	.45

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7,200 lb. furn. and erecting structural steel in surge tank roof	.50	.51	.40	1.20	.32
20 sq. ft. furn. and installing steel swinging door	15.00	50.00	20.00	6.00	15.00
910 lin. ft. placing rubber water stop	5.00	4.40	3.00	5.00	4.40
300 cu. yd. excav., stripping borrow areas and surfaces of dam embankment	4.00	8.35	2.50	5.00	2.00
500 cu. yd. earth-fill embankment for dam	2.00	9.50	3.00	5.00	1.95
60 cu. yd. sand and gravel blanket under riprap	5.00	20.00	6.00	8.00	6.00
2,000 cu. yd. riprap	10.00	8.85	10.00	10.00	7.50
Lump sum, constr. of anchor and extension to existing sheet-steel piling	$12,000	$23,600	$15,000	$20,000	$12,000
750 lin. ft. furn. and driving timber piles	5.00	10.85	7.00	10.00	6.00
Lump sum, moving deck of existing trestle	$7,480	$19,000	$10,700	$5,000	$9,500
SCHEDULE NO. 2—TUNNEL WITH INTAKE AT ELEVATION 842.68					
122,000 cu. yd. excav., open cut, for inlet channel	2.00	1.00	1.10	2.50	1.80
208,000 cu. yd. excav., open cut, for intake struct., inlet conduit, tunnel intake portal, and gate shaft	5.00	4.00	3.00	3.00	2.85
250 cu. yd. excav. for gate shaft	400.00	200.00	174.00	200.00	110.00
5,200 cu. yd. excav. for surge tank	120.00	75.00	82.50	18.00	80.00
84,200 cu. yd. excav., in tunnel	85.00	86.85	87.55	90.00	70.00
3,850 cu. yd. excav. in inclined penstock tunnel	250.00	180.00	257.00	125.00	73.00
200 cu. yd. excav. for tunnel enlargement	80.00	200.00	119.00	120.00	100.00
1,100 cu. yd. backfill over inlet conduit	10.00	2.50	3.50	9.00	1.85
150 cu. yd. backfill about intake structure	10.00	15.00	3.50	9.00	2.00
1,479,000 lb. furn. and installing perm. steel tunnel supports	.25	.27	.51	.50	.30
680 M.b.m. furn. and erect. perm. timbering in tunnel	400.00	465.00	630.00	900.00	400.00
9,300 lin. ft. furn. and installing tunnel roof support bolts	4.00	9.00	5.00	4.70	4.00
10,000 lin. ft. drilling feeler or pilot holes ahead of tunnel excav.	10.00	8.00	3.00	7.80	3.50
2,500 lin. ft. drilling grout holes	10.00	5.50	3.95	7.80	6.00
7,500 lb. furn. and placing grout pipes and connections	1.00	2.10	2.00	4.70	2.00
25,000 cu. ft. pressure grouting	6.00	15.00	6.00	6.20	5.00
100 M. gal. pumping first 100 million gallons of drainage water from tunnel at any rate	$5,000	$3,000	$2,000	$4,600	$8,000
600 M. gal. pumping drainage water from tunnel at the rate of 0 to 2 million gal. per 24 hr.	100.00	385.00	158.50	160.00	$1,630
200 M. gal. pumping water from tunnel at the rate of 2 million and 1 gal. to 4 million gals. per 24 hr.	100.00	550.00	158.50	150.00	$2,390
100 M. gal. pumping drainage water from tunnel at the rate of over 4 million gal. per 24 hr.	100.00	$1,100	158.50	150.00	$3,260
230 cu. yd. conc. in intake struct. and inlet conduit	250.00	170.00	266.00	600.00	125.00
130 cu. yd. concrete in gate shaft	100.00	170.00	266.00	460.00	155.00
1,150 cu. yd. concrete in surge tank	100.00	170.00	173.00	225.00	115.00
25,370 cu. yd. concrete in tunnel lining	75.00	85.00	80.20	156.00	82.00
3,610 cu. yd. concrete around penstock	75.00	85.00	67.00	156.00	80.00
52,320 bbl. furn. and handling cement	12.00	12.50	15.30	15.50	10.00
4,990,000 lb. furn. and placing reinf. bars	.25	.20	.362	.30	.25
1,469,000 lb. installing steel penstock	.25	.30	.255	.39	.20
5 M.b.m. furn. and erect. timber in trashrack struct.	500.00	700.00	700.00	900.00	645.00
24,000 lb. installing frames and guides for bulkhead and fixed-wheel gates and hoist support beams	.25	.32	.40	.39	.35
41,000 lb. installing fixed-wheel and bulkhead gates	.25	.32	.20	.25	.23
21,000 lb. installing fixed-wheel and bulkhead gate hoists	.25	.32	.24	.39	.30
2,250 lb. installing control apparatus and piping for bulkhead and fixed-wheel gates	.50	.60	1.00	1.70	.80
14,000 lb. installing gate shaft and surge tank metalwork	.50	.40	.40	1.25	.45
7,200 lb. furn. and erect. struct'l steel in surge tank roof	.50	.51	.40	1.25	.32
20 sq. ft. furn. and installing steel swinging door	15.00	50.00	20.00	8.00	15.00
7,000 cu. yd. riprap	10.00	7.50	9.00	9.00	7.50
875 lin. ft. placing rubber water stop	5.00	4.40	3.00	5.00	4.40

Sheffield Tunnel excavation, tunnel supports, concrete, grout, metalwork, access shafts on Cachuma Project

California—Cachuma Project—Bureau of Reclamation. A. J. Cheff Construction Co., Seattle, Wash., with a bid of $855,472, was low before the Bureau of Reclamation for construction of Sheffield Tunnel, South Coast Conduit, Carpenteria Section, Cachuma Project; including general excavation; excavation for enlargement of tunnel; disposal of materials from tunnel excavation; drilling feeler or pilot holes; tunnel supports; steel rib tunnel supports; concrete in tunnel lining; lines and grades for tunnel construction; draining; lighting and ventilating tunnels; drilling grout holes; pipes for grouting; pressure grouting; weep pipes in tunnel lining, drilling through weep pipes; concrete in cut and cover sections and access shaft structures; miscellaneous metalwork, etc. Unit prices were as follows:

(1) A. J. Cheff Construction Co. .... $ 855,472
(2) Kuckenberg Construction Co. 918,980
(3) Peter Kiewit Sons' Co. 946,185
(4) R. A. Watson Co. and Macdonald & Kruse 1,066,716
(5) Macco Corp. 1,239,854
— United Concrete Pipe Co. 1,373,430
(6) Engineer's estimate 968,118

	(1)	(2)	(3)	(4)	(5)	(6)
1,100 cu. yd. excav., all classes, in open cut	3.00	2.00	2.00	7.23	2.90	2.00
10,600 cu. yd. excav., all classes in tunnel	42.00	45.00	46.00	49.15	60.00	46.50
200 cu. yd. excav., all classes, for tunnel enlargement	44.00	50.00	50.00	65.00	70.00	60.00
700 cu. yd. backfill	1.00	10.00	1.50	3.30	2.00	1.00
48,000 lb. furn. and installing perm. steel tunnel supports	.11	.15	.15	.36	.22	.20
150 M.B.M. furn. and erect. perm. timbering in tunnel	236.00	300.00	200.00	288.00	340.00	275.00
200 lin. ft. drilling grout holes	2.00	5.00	5.00	1.63	4.00	2.00
200 lb. furn. and placing grout pipes and connections	1.00	2.00	3.00	1.24	.85	1.00
1,200 lb. furn. and installing weep pipes	.40	1.50	1.50	1.24	.80	1.00
400 cu. yd. pressure grouting	3.00	10.00	5.00	5.00	5.00	3.00
3,600 cu. yd. concrete in tunnel lining	55.00	45.00	53.00	46.00	60.00	58.50
70 cu. yd. concrete in structures	60.00	55.00	80.00	98.00	150.00	70.00
5,500 bbl. furn. and handling cem. except in conc. pipe, mortar and bedding for pipe	5.50	6.00	5.50	6.00	4.00	5.00
8,000 lb. furn. and placing reinf. bars in structs.	.16	.20	.18	.19	.20	.20
100 lin. ft. furn. and placing rubber water stops	2.00	5.00	3.50	3.20	4.00	3.00
4,200 lin. ft. furn., laying, and testing 30-in. diam. H50P conc. pipe	11.50	15.00	17.70	15.00	28.00	11.85
1,830 lin. ft. furn., laying, and testing 30-in. diam. H75P conc. pipe	11.75	17.00	18.00	15.50	29.00	12.00
5,600 lb. furn. and installing miscel. metalwork	.55	.50	.35	.65	.60	.60
0.15 acre scarifying right-of-way	400.00	$2,000	700.00	85.00	400.00	100.00
0.15 acre seeding and fertilizing right-of-way	400.00	$2,000	200.00	75.00	400.00	120.00
0.6 ton mulching right-of-way	100.00	200.00	200.00	120.00	140.00	75.00

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SUPERVISING THE JOBS...

... Continued from page 120

J. M. Fuller is office manager. For the Corps of Engineers, **Bill Lane** is chief of operations in the Los Angeles office and **R. E. Ferguson** is resident engineer on the job.

On the $106,077 contract awarded to George E. Miller of Reno, Nev., **F. G. Riley** is superintending the work, assisted by **Cates, Bruner** and **Kingston,** operators. Contract is for construction of state highway from Garden Pass to 30 mi. south of Palisade, Nev.

Construction of the Little North Santiam River bridge about 1 mi. from Mehama on the North Santiam highway, Oregon, is under the supervision of **A. K. Lundmark,** superintendent. Other key men are **R. R. Kelley,** engineer and **L. E. Lundmark,** specialist. This is a $192,878 contract held by C. J. Eldon.

Michael Lichty is supervising grading, draining and appurtenant work on 10.1 mi. of Green River-Linwood road in Sweetwater County, Wyo., contract for which was recently awarded the Lichty Construction Co. at a figure of $141,114. General foreman for the contractor is **L. W. Martin.**

The construction of extensions to and improvement of runways at the Marine Corps Air Station at El Toro, Calif., is under the direction of **G. C. Weeshoff,** project manager and **Roy Hill,** general superintendent. This is a $6,490,000 project recently awarded to Bressi and Bevanda Constructors and A. Teichert & Son, Inc., Santa Ana, Calif. Others working on the site are **R. T. Skinner,** grade superintendent; **D. J. Bressi,** structure superintendent; **L. J. Wright,** project engineer and **E. G. Byrd,** office manager.

Under the direction of **E. L. Seifert,** general superintendent, work on the coal strip mine at Elkol, Wyo., for the Kemmerer Coal Co. is in progress. **William C. Perkins** is project engineer. Other key men on the job are: **Robert Mays,** engineer; **Lawrence A. Johnson,** engineer; **H. J. Ourada, Willis A. Moody** and **R. M. Conner,** foremen; and **Jack C. Horton** and **William Miller,** master mechanics. Morrison-Knudsen Co., Inc., is the contractor.

General construction in Shelby, Mont., is being supervised by **Thomas Mason** for H. I. Aubrey, contractor. The project cost is $138,000.

Bridge across the Green River at Green River, Wyo., being erected for the State Highway Department is under the direction of general superintendent **J. C. Hubbard. Albert Oakley** is job superintendent. This is a 30-ft. roadway, 457 ft. long, contract for which was re-

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UNIT BID PRICES... CONTINUED

Waterway Improvement...

River channel excavation, timber piling and structures

New Mexico—Middle Rio Grande Project—Bureau of Reclamation. Morrison-Knudsen Co., Inc., Los Angeles, Calif., with a bid of $897,960, was low before the Bureau of Reclamation for channelization of the Rio Grande, San Marcial to the Narrows of Elephant Butte Reservoir. Unit prices were as follows:

(1) Morrison-Knudsen Co., Inc. ....$ 897,960
(2) McGinnes Bros., Inc. 940,115
(3) Miller & Smith 1,057,275
(4) Marshall, Haas & Royce 1,091,660
(5) Cook Construction Co. 1,188,420
— Brown & Root, Inc. $1,236,605
— J. H. - N. M. Monaghan & Asso. Cos., Colorado Constructor, Inc... 1,987,055
(6) Engineer's estimate 985,507

	(1)	(2)	(3)	(4)	(5)	(6)
3,200 acre clearing	40.00	87.00	96.00	125.00	130.00	80.00
2,600,000 cu. yd. excav. for channel	.20	.16	.19	.16	.20	.17
77,500 cu. yd. excav. for cut-off trench	.20	.15	.17	.16	.20	.35
794,000 cu. yd. excav. from borrow	.20	.19	.20	.18	.20	.21
1,700 cu. yd. excav. for structs.	1.90	1.00	3.35	3.00	1.00	1.00
390 cu. yd. backfill	1.25	2.00	1.35	1.00	1.00	.80
390 cu. yd. compacting backfill	2.50	3.00	1.35	5.00	1 00	3.00
5,000 cu. yd. riprap	3.00	6.00	5.00	8.00	6.00	7.50
2,500 cu. yd. gravel bedding under riprap	3.50	4.00	5.00	8 00	3.00	5.00
186 lin. ft. furn. and laying 72-in. corru. metal pipe	33.00	30.00	32.00	50.00	40.00	30.00
8 M.B.M. furn. and erect. tr. timber in structs.	460.00	400.00	400.00	400.00	350.00	350.00
60 M.B.M. furn. and erect untr. timber in structs.	335.00	350.00	300.00	300.00	250.00	300.00
2,000 lin. ft. furn. and driving tr. timber piles	4.65	2.50	3.15	8.00	3.25	4.00
32,000 cu. yd. excav. for pilot channel	.25	.15	.20	.20	.20	.19

Water Supply...

Water mains, service connections, and sewer lines

Idaho—Bonneville County—Atomic Energy Commission. Arrington Construction Co., Idaho Falls, with a bid of $27,593 (alternate $34,810) received a contract from the Atomic Energy Commission for construction of additional water distribution and sanitary sewer lines, Idaho Falls headquarters. Unit prices were as follows:

(1) Arrington Construction Co.................$27,593 (34,810)
(2) Paul W. Larsen, Inc............................$31,266 (36,343)
(3) Intermountain Plumbing Co...............$32,381 (37,484)

	(1)	(2)	(3)
Furnish and install, including all connections to existing sewer line manhole and the Scoville Substation Control House, approx. 970 ft. of 8-in. sewer line containing 2 manholes for the lump sum of	$3,808	$3,819	$4,596
Furnish and install, including all connections to the 6-in. existing water main and the Scoville Substation Control House, approx. 350 feet of 1½-in. standard weight galvanized iron water pipe for the lump sum of	774	1,778	786
Furnish and install, including all connections to the existing 6-in. water main near the Concrete Batch Plant, approx. 905 ft. of 6-in. steel water main for the lump sum of	3,777	5,361	4,871
Furnish and install, including all connections to the existing 6-in. water main near the Concrete Batch Plant, approx. 905 ft. of 6-in. cast iron water main for the lump sum of	4,911	6,219	6,276
Furnish and install, including all connections to the existing 6-in. water main on both sides of West Ogden Ave., approx. 500 ft. of 6-in. steel water main for the lump sum of	2,561	3,165	2,380
Furnish and install, including all connections to the existing 6-in. water main on both sides of West Ogden Ave., approx. 500 ft. of 6-in. cast iron water main for the lump sum of	3,247	3,634	3,135
Furnish and install, including all connections to existing services, approx. 2,500 ft. of 8-in. steel water main for the lump sum of	11,535	13,017	12,576
Furnish and install, including all connections to existing services, approx. 2,500 ft. of 8-in. cast iron water main for the lump sum of	16,932	16,767	15,524
Furnish and install, including all piping, fittings, valves, controls and wiring, one 500 GPM Booster Pump with by-pass lines and control system for the booster and deep well pumps for the lump sum of	5,138	4,126	7,172

Irrigation...

Canal excavation, compaction, and diversion structure

Washington—Columbia Basin Project—Bureau of Reclamation. Peter Kiewit Sons' Co., Seattle, with a bid of $251,729, was low before the Bureau of Reclamation for Schedule 1 construction of earthwork and structures for Potholes East Canal. Unit prices on Schedule 1 were as follows:

(1) Peter Kiewit Sons' Co. $251,729
(2) Marshall, Haas and Royce 278,226
(3) United Concrete Pipe Corp. 289,725
(4) J. A. Terteling and Sons. Inc. $352,395
(5) Western Contracting Corp. 343,049
(6) Engineer's estimate 298,039

	(1)	(2)	(3)	(4)	(5)	(6)
23,000 cu. yd. excav., common, for canal	.15	.20	.22	.15	.15	.20
151,000 cu. yd. excav., rock, for canal	.85	1.05	1.10	1.47	1.25	1.15
2,000 cu. yd. excav., common, for core banks	.30	.25	.22	.35	.27	.25
20 M. gal. water for core banks	4.00	5.00	4.00	4.50	3 60	4.00
43,000 cu. yd. excav., common, from borrow	.30	.20	.22	.40	.26	.30
3,000 cu. yd. excav., common, for road	.50	.25	.22	.50	.22	.40
16,400 mi. cu. yd. overhaul	.40	.30	.30	.26	.36	.40
21,800 cu. yd. compacting embankments	.24	.30	.26	.41	.29	.35

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SUPERVISING THE JOBS...

. . . Continued from page 122

cently awarded to Etlin E. Peterson, Casper, Wyo.

General superintendent **Lyman L. Monson,** assisted by **Grover Bennett** and **Fred Didier,** is directing the high school and civic auditorium project under construction at Idaho Falls, Idaho, for the city. **Glen Kearney** and **Robert Taylor** are carpenter foremen. This $2,000,000 contract is being carried out by Arrington Construction Co.

On the new phosphate plant for the Monsanto Chemical Co. at Soda Springs, Idaho, **Ray Faust,** general superintendent, and **W. T. Miller,** project manager, are in charge of the work for Morrison-Knudsen Co., Inc. Also working on the project are: **Al. Guard,** job engineer; **Bill Lucas,** field engineer. **Alex Ristow** is steel foreman and **Claude Myers** general labor foreman. **John Neinzer** is office manager.

Frank Gamarra is general superintendent and **Raymond Tucker** project manager of the Wyoming state highway job of grading and surfacing 4.8 mi. on Highway 189 near Kemmerer, Wyo. This $403,971 contract is held by W. R. Schmidt Construction Co.

Sig Mahlam is general superintendent for McLaughlin Construction Co. on concrete work at the Ft. Peck project in Montana. **Glen Tirrell** is project manager on the $452,000 project.

Earthwork sub-contractor John Delphia has **Earl Barnard** as general superintendent on the Folsom Project's Mormon Island Dam in California. **W. F. Boone** is field engineer on the Corps of Engineers project.

N. A. Nelson, Jr., is directing the $278,000 project for the N. A. Nelson Construction Co., consisting of grading, surfacing, bridge removal and other work on State Highway 30 at Green River, Wyo. **Tom Close** is assistant superintendent. **Frederick Randall** is carpenter foreman and **Lloyd Nielsen** is labor foreman. Resident engineer for the State is **Oliver Baldwin.**

T. N. Creacy is superintendent for L. H. Hoffman, Portland, Ore., on this contractor's $20,000,000 contract for the construction of reinforced concrete buildings for the Kraft pulp mill in Everett, Wash.

In Henderson, Nev., where McNeil Construction Co. is building a magnesium plant for Magnesium, Inc., **Roy S. Knapp** is general superintendent and **F. J. Reiner** is project manager. **Emil Hansen** is job superintendent, **George Riddle** is rigger foreman, and **Charles Rech** is plumber foreman. **Romaine Westland** is field engineer.

Prize competition for papers on welding

EUTECTIC Welding Alloys Corp. has announced its 1951 prize competition for papers written in either of two categories, (1) welding engineering and theory, or (2) practical welding applications. Seven subjects have been selected for participants to choose from.

The competition seeks contributions to the art of welding and is open to qualified engineers, metallurgists, research personnel, instructors, welders and students. Complete specifications for papers, which must be submitted by January 30, 1952, may be obtained from Eutectic Welding Alloys Corp., 172nd St. at Northern Blvd, Flushing 58, N. Y.

Road Builders take to air for Mexico jaunt

MEMBERS and guests of the American Road Builders' Association at its Houston convention next January will have the opportunity to visit Mexico on either option of a post-convention trip itinerary planned for the Association by the United States Travel Agency, Inc. Planned as the "topper" for the Association's 50th Anniversary Meeting, the trips are of 8- and 10-day duration, with the longer jaunt including three glorious days in sunny Acapulco.

Two and a half days in Mexico City are scheduled, with free time for attendance at the bull fights; and motor trips are planned for visiting Cuernevaca, Taxco, Guadalupe, and the Pyramids of Teotihuacan. Special flights of Pan American World Airways and American Airlines will accommodate the group to and from Mexico City and Acapulco.

Priced at about $230 and $300, the trips include virtually all expenses except meals in Mexico City. Takers must possess evidence of citizenship and smallpox immunization.

Start construction for San Fernando steam plant

GROUND WAS BROKEN September 6 at the 150-acre San Fernando Valley site of a new steam plant to be built for the Los Angeles Department of Water and Power. The first two 100,000-kw. generators are expected to be in service two years from now, with two 156,000-kw. units to follow, bringing the plant up to its designed capacity of 512,000 kw., enough power for 1,000,000 people.

Design of the new plant provides complete housing only for precision equipment, the boilers to be enclosed by a steel frame shelter. The generating units will be entirely separate and without interconnection, each having its own boiler, auxiliaries, switchgear and transformer bank. These boilers will produce 850,000 lb. of steam per hr. at a pressure of 1,450 psi., to drive the turbines and 3,600-rpm. generators. Fuel oil consumption of the completed plant, operating at capacity, is estimated at 540 bbl. per hr.

UNIT BID PRICES . . . CONTINUED

250 cu. yd. excav., common, for structs.	.50	2.00	4.00	1.00	2.40	.80
2,650 cu. yd. excav., rock, for structs.	3.00	5.00	5.00	2.50	4.80	4.00
465 cu. yd. backfill	.50	.40	.65	.66	.95	.50
330 cu. yd. compacting backfill	3.00	2.75	4.00	6.50	5.00	3.00
2,300 cu. yd. riprap	6.00	7.00	4.00	1.35	8.60	4.00
600 cu. yd. gravel or crushed rock bedding for riprap	6.00	5.00	2.00	4.90	7.15	4.00
560 cu. yd. one-course road surfacing	5.00	3.00	2.00	4.20	4.30	3.50
24 lin. ft. furn. and laying 6-in. drain pipe	4.00	3.00	4.00	2.00	2.90	2.00
108 lin. ft. furn. and laying 4-in. drain pipe	3.50	2.40	3.00	1.70	2.90	1.50
200 lin. ft. drilling grout holes betw. depth 0 ft. and 15 ft.	5.00	4.00	1.50	4.70	2.15	4.00
200 cu. ft. pressure grouting	5.00	7.00	2.50	11.20	4.30	3.00
425 cu. yd. concrete in structs.	59.00	60.00	60.00	65.00	100.00	65.00
740 bbl. furn. and handling cement	5.00	6.00	6.50	7.40	5.00	5.50
66,000 lb. furn. and placing reinf. bars	.14	.13	.16	.17	.15	.15
90 sq. ft. furn. and placing ½-in. elastic filler matl. in joints	2.00	3.00	4.00	1.77	2.30	2.00
11 lin. ft. placing 9-in. rubber water stops in joints	1.00	2.00	2.50	2.20	1.60	1.50
10 M.b.m. furn. and erecting untr. timber in structs.	250.00	300.00	300.00	348.00	270.00	230.00
11 M.b.m. furn. and erecting tr. timber in structs.	300.00	350.00	350.00	356.50	300.00	280.00
Lump sum, furn. and installing cableway	$1,500	$1,500	$2,000	$1,475	$1,850	$2,000
Lump sum, furn. and installing one radial gate with hoist for headworks at canal Station 1622+11.68	$13,000	$6,500	$16,000	$16,620	$16,000	$12,500
2,650 lb. furn. and installing miscl. metalwork	.80	.55	.80	.95	.74	.60
60 lin. ft. furn. and installing elect. metal conduit ¾-in. and less in diam.	2.00	2.00	2.00	1.50	2.00	2.00
80 lin. ft. furn. and installing elect. metal conduit 1½-in. in diam.	2.50	2.00	2.50	2.95	2.50	2.50
10 lin. ft. furn. and installing elect. metal conduit 2½-in. in diam.	3.00	3.00	4.00	5.90	3.50	3.50
55 lb. furn. and installing elect. conductors and ground wires	2.00	1.50	2.50	2.95	2.15	2.00

Bridge and Grade Separation . . .

Concrete deck on timber substructure

Washington—Grays Harbor County—State. Kennard & Burnham, Seattle, with a bid of $32,771, was low before the State Department of Highways for construction on Secondary State Highway No. 9-C, Jessie Slough Bridge. Unit prices were as follows:

(1) Kennard & Burnham $32,771
(2) State Construction Co. $37,609

	(1)	(2)
2,400 cu. yd. common excavation, including haul	60.00	90.00
Lump sum, constructing and removing detour	$3,266	$5,300
2 only reflector units in place	15.00	15.00
BRIDGE		
20 cu. yd. structure excavation	15.00	10.00
173 cu. yd. concrete, Class A, in place	65.00	70.00
212 lin. ft. reinforced concrete bridge railing in place	10.00	11.00
35,000 lb. steel reinforcing bars in place	.12	.14
2,500 lin. ft. furn. timber piling (creosote treated)	1.40	1.65
36 only driving piles (creosote treated) in place	160.00	157.00
1 only furn. and driving timber test pile	910.00	800.00

Reinforced concrete slab bridge

California—San Joaquin County—State. Nomellini Construction Co., Stockton, with a bid of $178,089, was low before the State Division of Highways for construction of a reinforced concrete slab bridge across Paradise Cut overflow, about 6.7 mi. east of Tracy; approaches to be graded and paved with portland cement concrete on untreated rock base. Unit prices were as follows:

(1) Nomellini Construction Co. $178,089
(2) Erickson, Phillips and Weisberg 181,644
(3) John Delphia 187,269
(4) H. W. Ruby $191,259
(5) Dan Caputo 196,547
(6) Charles MacClosky Co. 198,744

	(1)	(2)	(3)	(4)	(5)	(6)
140 cu. yd. removing concrete	5.00	3.00	2.75	5.00	5.00	10.00
Lump sum, remov. portions of exist. conc. bridge	$10,500	$15,000	$20,000	$20,000	$15,000	$22,000
Lump sum, remov. exist. detour bridge	$4,000	$6,000	$10,000	$5,000	$6,000	$4,000
1,650 cu. yd. rdwy. excavation	1.25	1.25	1.10	1.00	1.50	1.50
210 cu. yd. ditch and channel excav.	3.25	1.50	2.50	3.00	3.50	5.00
1,250 cu. yd. struct. excav. (bridge)	4.30	3.00	3.00	4.00	6.00	4.00
700 cu. yd. struct. excav.	2.40	2.00	5.00	3.00	3.00	4.00
340 cu. yd. imp. subbase material	2.00	1.40	1.60	2.50	2.00	3.00
Lump sum, dev. wat. supply and furn. wat. equip.	$1,000	500.00	$2,800	$2,500	$1,500	$4,000
180 M. gal. applying water	3.25	2.00	1.00	2.00	3.00	5.00
25 sta. finishing roadway	17.00	20.00	20.00	20.00	20.00	40.00
1,200 ton untreated rock base	2.75	2.25	2.10	2.00	3.00	2.50
250 ton min. aggr. (P.M.S.)	6.25	5.75	5.50	4.00	7.00	6.00
13 ton paving asph. (P.M.S.)	25.00	23.50	28.00	25.00	25.00	50.00
2 ton liq. asph. SC-2 (pr. ct. and pen. tr.)	65.00	50.00	55.00	100.00	60.00	90.00
1 ton asph. emuls. (sl. ct.)	75.00	75.00	110.00	100.00	90.00	90.00
8 ton screenings (sl. ct.)	12.00	7.00	9.00	10.00	8.00	15.00
6 ton sand	6.00	7.00	8.00	10.00	10.00	15.00
83 cu. yd. P.C.C. (pavement)	27.00	30.00	25.00	30.00	25.00	30.00
100 ea. pavement tie bolt assemblies	2.00	1.00	.60	1.00	1.50	3.00
317 cu. yd. Cl. "A" P.C.C. (footing blocks)	22.00	15.00	33.00	25.00	20.00	20.00
640 cu. yd. Cl. "A" P.C.C. (structures)	55.00	65.00	61.00	57.00	65.00	70.00
7,725 lin. ft. furn. conc. piling	4.50	4.05	4.10	4.50	4.50	4.10
140 ea. driving concrete piles	260.00	266.00	225.00	275.00	250.00	216.00
124,700 lb. bar reinf. steel	.11	.12	.12	.11	.115	.11
490 lin. ft. corr. metal bridge railing	6.00	6.00	6.00	6.00	7.00	5.00
720 cu. yd. light stone riprap	16.00	14.00	7.50	14.00	20.00	20.00
310 lin. ft. new property fence	2.00	1.00	.35	1.00	1.00	1.00
Lump sum, remove. and resetting metal plate guard railing and clearance markers	300.00	380.00	450.00	500.00	400.00	750.00

Continued on page 126

Prefab steel parking places in just 15 working days

CONSTRUCTED in just 15 working days by a 5-man crew and a crane, a new prefabricated steel parking structure is now functioning in the business district of Beverly Hills, Calif. Invented by Ellis White and designed by the Multi-Deck Corp. of America, the structure measures 152 x 156 ft., and is less than 27 ft. high, but provides four parking levels that accommodate 412 automobiles in what was previously a 100-car parking lot.

Fabrication of the $427,500 building by Consolidated Western Steel Corp. includes rolled steel guides on the ramps and angled rollers that maintain automobile alignment in handling. Mechanical equipment is electrically operated. Except for foundations, the entire structure can be dismantled in eight days, enhancing its value for use on leased land that may ultimately be improved with some other type of permanent building.

STATEMENT OF THE OWNERSHIP, MANAGEMENT AND CIRCULATION REQUIRED BY THE ACT OF CONGRESS OF AUGUST 24, 1912, AS AMENDED BY THE ACTS OF MARCH 3, 1933, AND JULY 2, 1946 (Title 39, United States Code, Section 233) OF WESTERN CONSTRUCTION, PUBLISHED MONTHLY AT SAN FRANCISCO, CALIFORNIA, FOR OCTOBER 1, 1951.

1. The names and addresses of the publisher, editor, managing editor, and business manager are:

Publisher: Arthur F. King, 609 Mission St., San Francisco, Calif.

Editor: James I. Ballard, 609 Mission St., San Francisco, Calif.

Managing Editor: John J. Timmer, Jr., 609 Mission St., San Francisco, Calif.

Business Manager: L. P. Vrettos, 609 Mission St., San Francisco, Calif.

2. The owner is: (If owned by a corporation, its name and address must be stated and also immediately thereunder the names and addresses of stockholders owning or holding 1 percent or more of total amount of stock. If not owned by a corporation, the names and addresses of the individual owners must be given. If owned by a partnership or other unincorporated firm, its name and address, as well as that of each individual member, must be given.)

Arthur F. King, 609 Mission Street, San Francisco, Calif.

Louise B. King, 609 Mission Street, San Francisco, Calif.

3. The known bondholders, mortgagees, and other security holders owning or holding 1 percent or more of total amount of bonds, mortgages, or other securities are: (If there are none, so state.) None.

4. Paragraphs 2 and 3 include, in cases where the stockholder or security holder appears upon the books of the company as trustee or in any other fiduciary relation, the name of the person or corporation for whom such trustee is acting; also the statements in the two paragraphs show the affiant's full knowledge and belief as to the circumstances and conditions under which stockholders and security holders who do not appear upon the books of the company as trustees, hold stock and securities in a capacity other than that of a bona fide owner.

5. The average number of copies of each issue of this publication sold or distributed, through the mails or otherwise, to paid subscribers during the 12 months preceding the date shown above was: (This information is required from daily, weekly, semiweekly, and triweekly newspapers only.)

L. P. VRETTOS
(Signature of business manager)

Sworn to and subscribed before me this 26th day of September, 1951.

(Seal) (signed) RUTH POWELL POOL
Ruth Powell Pool—Notary Public in and for the City and County of San Francisco, State of California. My commission expires September 11th, 1954.

Suggest plan to complete abandoned dam project

A THIRTY-YEAR-OLD dam and reservoir project, which was never completed, might well aid in the solution of Southern California's water problems.

The Sutherland Dam and Reservoir, north of San Diego, Calif., on the San Diego River, was begun thirty years ago, but the project was never completed. The Chamber of Commerce of the city is currently urging that it be resumed.

If the plan were put into effect, one of the last major watershed areas in the county would be tapped. San Diego's increasing water needs would make the expenditure of the necessary $4,000,000 or $5,000,000 advisable, said Chamber officials.

Recent authorization by the Congress for the construction by the Navy of a second barrel to double Colorado River Water supply in San Diego will not be sufficient to serve the expanding population and industrial requirements.

Original foundations of the dam are still in good condition and could be used. A bond issue was suggested as a feasible method of financing the project.

Defense demands are expected to make additional water supplies necessary in the greater San Diego area. Aircraft plants and military installations are located in and around San Diego at the present time and further installations are expected within a short time. The Chamber of Commerce urges preparation now for future expansion.

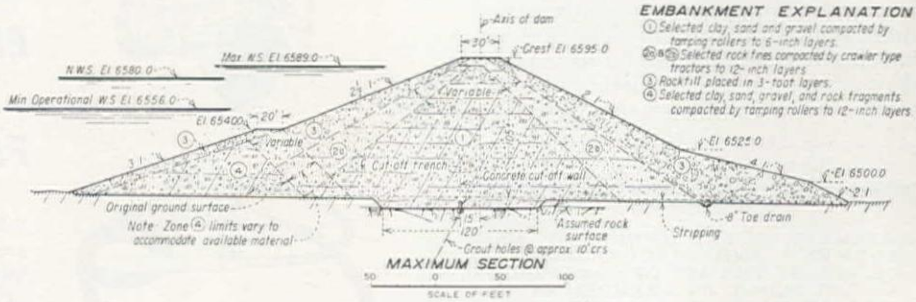
UNIT BID PRICES . . . CONTINUED

Dam . . .

Rolled earthfill embankment with concrete cutoff wall

Colorado—Colorado-Big Thompson Project—Bureau of Reclamation. Adler Construction Co., Loveland, with a bid of $825,279, was low before the Bureau of Reclamation for construction of Rattlesnake Dam. Foundation of the dam embankment will be stripped and the cut-off trench with 120-ft. maximum bottom width will be excavated to a suitable foundation. A concrete cut-off wall 5 ft. high will be constructed along center line of cut-off trench, and the foundation material will be pressure grouted. The central earth fill, Zone 1 portion of the dam embankment will be constructed of a mixture of selected clay, sand, and gravel of 5-in. maximum size from the borrowed areas and compacted to 6-in. layers with tamping rollers. Unit prices were as follows:

(1) Adler Construction Co. $825,279
(2) Colorado Constructors, Inc. 893,020
(3) The Hinman Bros. Construction Co... 912,555
(4) Winston Bros. Co. $1,054,334
(5) Engineer's estimate ....



	(1)	(2)	(3)	(4)	(5)
38,000 cu. yd. excav. for foundtn. of dam embank.	.80	1.25	1.07	2.00	.90
1,700 cu. yd. excav. for outlet works	2.65	7.00	4.00	6.50	2.00
47,000 cu. yd. excav. for spillway	1.00	1.35	1.10	2.00	1.50
800 cu. yd. excav. for cutoffs	26.50	16.40	33.00	20.00	20.00
22,000 cu. yd. excav., stripping borrow area	.26	.20	.20	.36	.30
105,000 cu. yd. excav. in borrow areas and transportation to dam embankment, Zone 1, first 105,000 cu. yd.	.37	.34	.29	.36	.40
105,000 cu. yd. excav. in borrow areas and transportation to dam embankment, Zone 1, over 105,000 cu. yd.	.30	.30	.23	.36	.35
85,000 cu. yd. earth fill in dam emb. Zone 1, first 85,000 cu. yd.	.30	.17	.22	.18	.20
85,000 cu. yd. earth fill in dam emb., Zone 1, over 85,000 cu. yd.	.18	.15	.16	.18	.18
25,000 cu. yd. earth fill in dam emb., Zone 4	.16	.25	.15	.18	.15
2,200 cu. yd. special compaction of earth fill in dam emb.	4.00	6.00	4.00	3.00	3.00
40,000 cu. yd. rock fines fill in dam emb., Zone 2a	.80	.56	.45	.70	.65
45,000 cu. yd. rock fines fill in dam emb., Zone 2b	1.50	1.50	1.73	2.00	1.90
18,000 cu. yd. placing rock in dam emb., Zone 3	.60	.75	1.00	.35	1.00
55,000 cu. yd. rock fill in dam emb., Zone 3, first 55,000 cu. yd...	1.65	1.88	1.85	2.00	1.90
55,000 cu. yd. rock fill in dam emb., Zone 3, over 55,000 cu. yd...	1.55	1.65	1.58	2.00	1.70
500 lin. ft. furn. 8-in. diam. sewer pipe and constr. emb. toe drains with uncem. joints	2.00	2.50	4.00	1.50	2.50
500 lin. ft. furn. 4-in. diam. sewer pipe and constr. drains with uncem. joints	1.80	1.90	4.00	1.50	1.80
550 lin. ft. furn. 8-in. diam. sewer pipe and constr. drains with uncem. joints	2.80	2.30	5.40	1.50	2.00
90 lin. ft. furn. and laying 4-in. diam. sewer pipe with cem. joints	1.00	2.35	1.75	1.50	1.60
3,300 lin. ft. drilling grout holes in stage betw. depths of 0 ft. and 35 ft.	2.10	3.60	3.00	2.50	2.50
1,200 lin. ft. drilling grout holes in stage betw. depths of 35 ft. and 60 ft.	2.20	4.00	3.30	2.50	2.75
500 lin. ft. drilling grout holes in stage betw. depths of 60 ft. and 110 ft.	2.40	5.55	3.60	2.50	3.00
2,000 lb. furn. and placing std. black pipe and fittings for founda. grouting	.50	.45	.48	.50	.50
3,300 cu. ft. pressure grouting	2.25	3.30	2.00	2.50	2.00
1,700 cu. ft. pressure grouting with packers	3.00	4.35	2.70	3.00	2.50
8,110 lin. ft. drilling holes for anchor bars and grouting bars in place	1.00	.75	1.06	1.00	1.50
6,265 bbl. furn. and handling cement	5.35	4.80	5.70	5.00	5.40
300,800 lb. furn. and placing reinf. bars	.15	.156	.19	.15	.15
700 cu. yd. concrete in cutoffs	22.00	20.00	33.60	35.00	25.00
160 cu. yd. concrete in dam emb. cutoff wall, except footing....	54.00	41.00	81.00	55.00	55.00
25 cu. yd. concrete in outlet works intake struct. and stilling well	50.00	100.00	121.00	90.00	85.00
34 cu. yd. concrete in outlet works gate chamber and access shaft	100.00	125.00	175.00	90.00	80.00
75 cu. yd. concrete in pipe encasement and cutoff collars......	40.00	20.00	45.00	40.00	40.00
1,580 cu. yd. concrete in spillway floor	23.00	23.70	28.00	35.00	22 00
705 cu. yd. concrete in spillway crest	19.00	17.50	33.50	42.00	25.00
370 cu. yd. concrete in spillway walls and bridge pier	42.00	57.50	67.00	70.00	55 00
8 cu. yd. concrete in spillway footbridge	110.00	170.00	163.00	90.00	75.00
60 sq. ft. furn. and placing bituminous-type joint filler............	1.50	1.60	1.35	1 50	1.50
820 lin. ft. furn. and placing metal seals, Type M1	2.00	2.85	2.00	2.00	2.00
Lump sum, furnishing and installing cement-lined cast-iron pipe and fittings; steel bend and support; valves, and miscl. accesories	$6,600	$7,000	$9,314	$7,000	$10,000
800 lin. ft. furn. and installing chain-link fence	3.50	2 70	3.35	2.50	2.50
Lump sum, furn. and installing spillway footbridge metalwork........	$4,600	$3,000	$2,360	$5,000	$3,500
Lump sum, installing ventilating system	280.00	190.00	335.00	750.00	250.00
Lump sum, furn. and installing miscl. metalwork	$2,400	$4,400	$2,010	$3,500	$1,000
90 lin. ft. furn. and installing elect. metal conduit ¾ in. and less in diameter	1.50	1.10	2 00	1.00	1.00

Continued on page 128

Bids opened to complete Isabella Dam on Kern River

AT $5,873,781.89, a joint-venture composed of Macco-Morrison-Knudsen and River Construction Corp. was low October 2 for construction of the main dam and completion of an auxiliary dam of the Isabella Project in California for the Corps of Engineers. Eight bids were submitted, ranging to $7,312,782 and representing a spread of 24½% above the low bid. Corps of Engineers' estimate, based on cost only, was $4,808,157.

Second low bid was by M. H. Hasler, D & H Construction Co. and L. E. Dixon, a joint venture, at $6,149, 912.

Isabella Dam is located 54 mi. east of Bakersfield and is in reality composed of two embankment sections. The main dam is the shorter, spanning the Kern River with a crest length of 1,725 ft. Rising 185 ft. above the streambed, it will contain 2,900,000 cu. yd. of rolled material. The auxiliary dike, 100 ft. high, is partially complete. It is 3,325 ft. long and will contain 1,800,000 cu. yd.

To be completed in 900 days, the current contract will include reinforced concrete spillway construction, excavation and embankment, installation of slide gates and tainter gates, grouting, sheet piling, and placement of about 1,060,000 lb. of reinforcing.

Roadwork helps keep contractor in good shape

ONE MONTH'S WORK on U. S. Highway 85 south of Newcastle, Wyoming, gained $195,887 for Inland Construction Co. of Omaha, paving contractor currently building 29.1 mi. of highway on a $650,000 contract let by the Wyoming State Highway Department. This single monthly estimate represents the largest ever paid in Wyoming highway work.

Performed between August 21 and September 21, the work completed placement of a plant-mix wearing surface which will receive a seal coat next spring. Specifications call for a 26-ft. wearing surface, 5-ft. shoulders, and a 24-ft. seal coat.

Changes and additions in new USBR canal specs

DATED AUGUST 1951, the new Bureau of Reclamation "Standard Specifications for Construction of Canal Systems" is an edition that improves and clarifies many points and includes added sections on newly developed methods. Changes aimed at enhancing job application of the specs have been incorporated upon suggestions received from contractors and suppliers of materials.

Of major interest are changes in requirements and in payments provisions of the sections on earthwork, including excavation, core banks, overhaul, backfill, compaction, and trimming. Modifications have been made in the section dealing with concrete, and a section covering asphaltic membrane is included.

UNIT BID PRICES . . . CONTINUED

100 lin. ft. furn. and installing elect. metal conduit 1 in. in diam.	2.00	1.40	2.70	1.50	1.20
50 lb. furn. and installing elect. conductors and grounding materials	3.00	2.80	4.00	2.00	2.00
30 lb. installing elect. apparatus	4.00	1.50	2.70	3.00	1.50
Lump sum, furn. and installing interlock switch	25.00	20.00	67.50	300.00	25.00
38,500 cu. yd. excavation for access road	.71	1.00	.80	1.15	.90
5,000 sta. cu. yd. overhaul of excav. for access road	.05	.05	.02	.05	.04
2,400 cu. yd. selected access road surfacing	1.40	1.50	.75	1.50	1.50
240 cu. yd. excav. for access road structs.	3.00	5.00	2.00	3.00	3.50
860 cu. yd. backfill for access road structs.	4.50	4.50	3.00	1.50	.70
70 cu. yd. riprap for drainage channels	4.50	7.00	5.40	6.00	4.00
25 cu. yd. gravel blanket under riprap for drainage channels	5.00	6.00	6.70	5.00	5.00
70 sq. yd. dry-rock paving for access road drainage structs.	4.50	5.00	6.70	6.00	6.00
170 lin. ft. furn. and laying 14-ga., 24-in. diam. cor. metal pipe	5.20	6.00	5.40	5.50	6.00
46 lin. ft. furn. and laying 12-ga., 36-in. diam. cor. metal pipe	10.50	11.00	10.80	12.00	12.00
52 lin. ft. furn. and laying 12-ga., 54-in. diam. cor. metal pipe	15.00	17.00	17.65	14.00	18.00
120 lin. ft. furn. and laying 10-ga., 66-in. diam. cor. metal pipe	23.00	27.00	32.50	24.00	29.00
128 lin. ft. furn. and erecting 8-ga., multiple-plate cor. metal stock pass	55.00	60.00	78.50	60.00	45.00
365 lin. ft. furn. and erecting wire-cable guard fence	3.60	2.40	3.35	9.00	3.00
59 post furn. and setting guard posts	8.00	6.00	6.00	6.00	6.00
2 cattle guard furn. and const. H-5 type cattle guards	450.00	950.00	815.00	350.00	425.00
2 cattle guard furn. and const. H-15 type cattle guards	$1,300	$2,100	$2,030	$1,000	$1,500
4.8 mi. furn. and erecting barbed-wire fence	$1,500	$1,500	$1,150	$1,500	$1,700
10 gate furn. and installing barbed-wire fence gates	15.00	15.00	20.00	120.00	20.00
3 mi. removing barbed-wire fence	300.00	400.00	400.00	500.00	500.00
Lump sum, clearing transmission lines right-of-way	.....	.....	.....	.....	.....
1 struct. constr. Type HS struct. using 50-, 55-, or 60-ft. poles	375.00	500.00	520.00	700.00	550.00
1 struct. constr. Type HS struct. using 65-, 70-, or 75-ft. poles	475.00	585.00	664.00	900.00	680.00
1 struct. constr. Type HA struct. using 55-, 60-, or 65-ft. poles	420.00	400.00	594.00	850.00	610.00
1 struct. constr. Type 3AB struct. using 55-, 60-, or 65-ft. max. pole length	485.00	500.00	683.00	900.00	710.00
1 struct. constr. Type 3AC struct. using 55-, 60-, or 65-ft. max. pole length	650.00	650.00	845.00	$1,050	800.00
1 struct. constr. Type 3AT struct. using 55-, 60-, or 65-ft. max. pole length	600.00	900.00	703.00	900.00	740.00
1 struct. constr. Type 3T struct. using 55-, 60-, or 65-ft. max. pole length	650.00	$1,500	814.00	$1,150	850.00
3 I-brace assemb. and attach. I-brace for 12-ft. pole spacing	45.00	70.00	57.00	80.00	50.00
10 guy constr. single guy	30.00	50.00	40.00	45.00	35.00
20 guy constr. double guy	45.00	55.00	65.30	60.00	40.00
1 guy constr. stub guy with 60-ft. pole	180.00	275.00	225.00	350.00	240.00
30 anchor placing plate or cone anchor	25.00	43.00	18.25	45.00	25.00
1 anchor placing grouted anchor	40.00	43.00	90.00	60.00	30.00
5 protector installing guy protectors	10.00	26.00	7.90	10.00	10.00
15 assemb. assemb. and attaching suspension-insulator assembly with 7-insulator units	30.00	45.00	33.60	50.00	34.00
6 assemb. assemb. and attaching suspension-insulator assembly with 9-insulator units	40.00	49.00	45.00	70.00	43.00
18 assemb. assemb. and attaching double tension-insulator assemb. with 9 insulator units per string and double strain yoke	85.00	130.00	95.00	140.00	95.00
0.4 mi. of line stringing three 397,500-circular mil ASCR cond.	$4,000	$4,450	$4,860	$5,000	$4,000
24 damper attaching vibration damper to ASCR conductor	11.00	43.00	15.00	20.00	11.00
4 damper attaching vibration damper to overhead gd. wire	11.00	30.00	15.00	20.00	9.00
3 wt. attaching 50-lb. hold-down weight for suspension insulators	22.00	35.00	23.00	20.00	24.00
0.5 mi. of line stringing two 3/8-in. galv.-steel overhead ground wires	$1,000	$1,600	$1,214	$2,000	$1,000
5 post placing fence ground post and grounding fences	8.00	30.00	9.76	25.00	9.00
0.3 mi. removing exist. 115-kv., 3 phase, single-circuit transmission line	$3,100	$3,000	$3,870	$5,000	$2,500

Stilling basin construction and outlet channel excavation

Arizona—Davis Dam Project—Bureau of Reclamation. Grafe-Callahan Construction Co., Dallas, Tex., with a bid of $2,731,882, was low before the Bureau of Reclamation for completion of Davis Dam Spillway Stilling Basin. Work includes completion of the spillway stilling basin concrete structure and appurtenant work; repair existing concrete; excavation of spillway outlet channel; surfacing of roadway and parking areas; and construction of sidewalk along crest of dam embankment, under Schedule 1, and excavation for improvement of the channel of the Colorado River under Schedule 2. Unit prices were as follows:

(1) Grafe-Callahan Construction Co. $2,731,882
(2) United Concrete Pipe Corp., J. A. McNeil Co., Inc., Ralph A. Bell.... 2,904,353
(3) Engineer's estimate 2,298,635

SCHEDULE NO. 1	(1)	(2)	(3)
Lump sum, credit allowed to the Government for existing pile bridge	$17,500	1.00	$65,000
Lump sum, credit allowed to the Government for existing cofferdam	$3,000	1.00	$65,000
Lump sum, unwatering foundation of spillway stilling basin	$550,000	$730,000	$585,000
Lump sum, removal of existing piling	$6,000	$8,000	$12,000
32,000 cu. yd. excav. for spillway stilling basin	6.60	6.00	6.00
500 cu. yd. excav. for lean concrete fill	34.00	22.00	20.00
2,800 cu. yd. excav. for cut-offs	15.00	17.00	12.00
66,000 cu. yd. excav. for spillway outlet channel	3.70	5.00	3.00
7,500 cu. yd. rock fill back of gravity wall	2.80	1.80	2.00
23,000 cu. yd. impervious fill	2.25	1.85	1.50
21,500 cu. yd. compacting impervious fill	2.10	2.20	1.50
550 cu. yd. area surfacing	6.30	8.00	5.00
2,000 cu. yd. gravel blanket	5.20	5.00	5.00
8,700 cu. yd. riprap	8.50	8.00	6.00
800 lin. ft. constr. 6-in. diam. sewer-pipe drains with uncem. joints	6.50	3.00	2.00
1,200 lin. ft. constr. 8-in. diam. sewer-pipe drains with uncem. joints	7.00	3.50	2.50
100 lin. ft. constr. 8-in. diam. sewer-pipe drain, cradled in conc. with uncem. joints, covered with gravel	3.10	4.00	3.50
160 lin. ft. laying 60-in. diam. corrugated-metal pipe	4.50	6.00	7.50
3,000 lin. ft. drilling holes for anchor bars and grouting bars in place	7.89	2.50	3.00
260,000 lb. placing reinf. bars and fabric	.10	.09	.09
21,000 bbl. furn. and handling portland cement	5.90	7.50	6.00
800 ton furn. and handling pozzolan	32.50	30.00	25.00
25,500 bbl. furn. and handling portland-pozzolan cement	.....	.....	5.75

UNIT BID PRICES . . . CONTINUED

2,800 cu. yd. conc. in spillway stilling basin cut-off	26.30	27.00	28.00
6,200 cu. yd. conc. in spillway stilling basin floor	28.85	27.00	28.00
18,000 cu. yd. conc. in spillway stilling basin gravity walls	30.80	27.00	25.00
90 cu. yd. conc. in drainage structs.	63.00	90.00	65.00
250 cu. yd. concrete in riprap	32.00	27.00	35.00
400 lin. ft. furn. and placing metal seals, Type Z	3.70	4.50	3.00
600 lin. ft. saw cutting outline of repair recesses	2.40	4.50	5.00
60 cu. yd. excav. of conc. in repair recesses	52.00	75.00	50.00
92 cu. yd. conc. in blockouts and repair recesses	185.00	125.00	85.00
120 sq. ft. removal of surface offsets	17.00	7.00	15.00
100 lin. ft. repair of existing metal seals, Type Z	10.00	4.50	2.50
27,600 sq. yd. preparation of sub-grade for bituminous surfacing	.05	.30	.15
30 M. gal. watering roadways and parking areas	5.30	8.00	5.00
34 ton liquid asphalt prime coat	75.00	80.00	55.00
40 cu. yd. furn. additional aggregate for road-mix surfacing	7.50	8.00	5.00
135 ton furn. liquid asphalt for bituminous surfacing	75.00	75.00	55.00
27,600 sq. yd. constructing road-mix surfacing	.28	.75	.60
30 ton liquid asphalt for seal coat	85.00	80.00	55.00
160 cu. yd. sand for seal coat	13.00	10.00	10.00
670 sq. yd. constructing concrete sidewalk	9.50	6.00	6.00
75,000 cu. yd. excav. for channel improvement, first 75,000 cu. yds.	2.35	3.10	1.60
130,000 cu. yd. excav. for channel improvement, over 75,000 cu. yds.	1.58	1.00	1.35

Highway and Street . . .

Grading and MC plant-mix surfacing

Colorado—Adams County—State. Lowdermilk Bros., Denver, with a bid of $466,536, was low before the State Highway Department for highway construction between Northend Valley Highway and North Washington St. and Federal Blvd., including grading, structures plant mixed oil. Unit prices were as follows.

(1) Lowdermilk Bros. $466,536
(2) Colorado Constructors, Inc. 468,432
(3) Northwestern Engineering Co. 476,457
(4) C. L. Hubner Co. 483,882
(5) Gardner Construction Co. 485,435
— Peter Kiewit Sons' Co. $487,614
— Schmidt Construction Co. 489,216
— Brown Construction Co. 549,875
(6) Engineer's estimate 456,976

	(1)	(2)	(3)	(4)	(5)	(6)
Lump sum, clear and grub F1002-1(8)	350.00	$1,000	500.00	$1,000	300.00	250.00
Lump sum, clear and grub SP12-382-501	$3,000	$5,000	500.00	$5,000	$3,000	$3,000
Lump sum, clear and grub SP12-382-502	675.00	500.00	$1,500	$1,000	500.00	300.00
Lump sum, rem. br. st. F1002-1(8)	50.00	100.00	200.00	25.00	125.00	25.00
Lump sum, rem. 4 str. (48-ft.) SP12-382-501	200.00	200.00	200.00	250.00	200.00	200.00
Lump sum, rem. 5 str. (24-ft.) SP12-382-501	250.00	250.00	250.00	250.00	200.00	250.00
Lump sum, rem. 15 str. F1002-1(8)	750.00	750.00	$1,000	750.00	300.00	300.00
Lump sum, rem. 8 str. SP12-382-502	400.00	400.00	500.00	400.00	200.00	150.00
Lump sum, rem. res. mail box SP12-382-501	175.00	100.00	200.00	250.00	50.00	100.00
14 ea. rem. res. conc. dit. check	60.00	35.00	50.00	15.00	30.00	10.00
Lump sum, discon. 8 conn. water line	100.00	250.00	100.00	75.00	100.00	25.00
3,830 sq. yd. rem. conc. pavement	.50	.60	.50	.30	.75	.45
Lump sum, rem. res. mail box SP12-382-502	25.00	25.00	200.00	250.00	50.00	25.00
12,400 lin. ft. rem. fence	.07	.06	.04	.05	.05	.04
275,000 cu. yd. uncl. excavation	.33	.27	.27	.25	.235	.34
3,600 cu. yd. uncl. ditch excavation	.50	1.00	1.50	.50	.75	.50
65,600 cu. yd. select borrow	.32	.47	.39	.35	.47	.52
4,000 cu. yd. uncl. exc. (stripping)	.32	.20	.20	.18	.15	.18
200 cu. yd. dry rock excav. (struct.)	2.00	2.50	6.00	2.50	2.50	4.50
2,060 cu. yd. dry com. excav. (struct.)	2.00	2.50	2.00	2.50	2.00	2.00
80 cu. yd. wet rock excav. (struct)	2.50	4.00	6.00	6.00	4.00	5.00
510 cu. yd. wet com. excav. (struct.)	3.50	3.00	6.00	5.00	3.00	3.00
3,310 cu. yd. struct. backfill CL-1	1.75	2.00	2.00	1.00	2.00	1.50
350 hr. mechanical tamping	5.00	6.00	7.00	6.00	5.00	6.00
610 hr. roller tamping roller 2U	10.00	12.00	10.00	11.00	10.00	10.00
310 hr. roller tamping roller 4U	12.00	12.00	12.00	12.00	11.00	12.00
390 hr. roller tamping F.W. roller	7.00	9.00	8.00	7.00	8.00	7.50
140 hr. roller tamping R.T. roller	6.50	7.50	8.00	7.00	8.00	7.00
3 ea. furn. tamping roller 2U	150.00	100.00	200.00	200.00	100.00	200.00
3 ea. furn. tamping roller 4U	200.00	100.00	300.00	300.00	200.00	300.00
3 ea. furn. F.W. roller	150.00	100.00	200.00	150.00	100.00	200.00
3 hr. furn. R.T. roller	150.00	100.00	200.00	100.00	100.00	75.00
9,360 M. gal. wetting	1.00	1.00	2.00	1.30	.75	1.10
2,653,000 sta. yd. overhaul	.01	.01	.01	.01	.015	.006

Continued on page 130

UNIT BID PRICES . . . CONTINUED

269,900 yd. mi. overhaul	.10	.12	.10	.20	.17	.11
26,800 ton mi. overhaul	.09	.14	.10	.12	.12	.09
21,600 ton gr. cr. rock surf—C.	.80	.90	1.00	1.30	1.28	.95
1,600 cu. yd. detour surfacing	1.00	1.75	1.00	2.00	2.00	.90
500 ton asph. (150-200 penn.)	32.50	30.00	34.00	27.00	29.00	26.00
32,700 gal. asph. rd. matl., MC	.15	.17	.18	.17	.18	.17
8,370 ton plant mixed oil pr. surf.	4.00	3.65	3.95	5.00	4.00	3.80
0.8 M. ft. bm. untr. brid. timber	350.00	300.00	500.00	300.00	300.00	300.00
0.5 M. ft. bm. misc. untr. timber	350.00	300.00	500.00	300.00	300.00	200.00
1,240 cu. yd. Class "A" conc.	52.50	59.00	47.00	55.00	64.00	50.00
19 cu. yd. Class "B" conc.	52.50	60.00	45.00	60.00	51.00	50.00
141,850 lb. reinf. str. trans. and place	.06	.04	.05	.04	.04	.045
511,100 lb. struct. str. trans. and place	.06	.035	.065	.04	.035	.05
376 lin. ft. 24-in. r. conc. culv. pipe	5.50	7.00	5.00	6.00	6.00	6.50
120 lin. ft. 8-in. cor. met. culv. pipe	2.00	2.00	2.00	2.00	2.00	1.50
98 lin. ft. 12-in. cor. met. culv. pipe	3.10	2.50	3.00	2.50	2.50	2.25
994 lin. ft. 18-in. cor. met. culv. pipe	4.00	4.00	4.00	3.50	3.00	3.00
2,060 lin. ft. 24-in. cor. met. culv. pipe	5.20	5.50	5.00	5.00	4.80	4.40
108 lin. ft. 36-in. cor. met. culv. pipe	9.50	11.00	9.00	10.00	8.00	9.00
330 lin. ft. 18-in. cor. met. siphon pipe	6.00	6.00	6.00	7.00	6.00	4.10
465 lin. ft. 24-in. cor. met. siphon pipe	7.85	8.50	8.00	8.50	7.75	5.75
5,690 lin. ft. treat. timb. piling (dr.)	2.00	2.00	1.75	1.25	1.50	2.50
20 cu. ft. riprap	30.00	10.00	10.00	10.00	10.00	10.00
1,600 lin. ft. 8-in. cor. met. p. un. drain	3.00	5.50	6.00	4.00	5.50	4.50
2,000 lin. ft. metal pl. gd. fence	3.75	3.00	4.40	4.00	3.00	3.00
19,000 lin. ft. barb wire fence (TWP)	.22	.20	.25	.24	.20	.20
11,900 lin. ft. C. W. fence (TWP)	.35	.40	.38	.30	.30	.30
15 ea. B.W. gates	15.00	10.00	15.00	30.00	15.00	15.00
3 ea. D.W. gates	50.00	50.00	50.00	50.00	50.00	50.00
1 ea. walk gates	15.00	10.00	25.00	30.00	25.00	22.00
13 ea. R.O.W. markers	10.50	10.00	10.00	10.00	10.00	10.00
4 ea. tr. gds. 18-in. siphon	20.00	25.00	60.00	30.00	20.00	30.00
6 ea. tr. gds. 24-in. siphon	25.00	55.00	60.00	40.00	25.00	55.00
14 ea. dr. pipes, conc. fl.	12.50	10.00	6.00	10.00	10.00	8.50
527 ea. timber gd. posts	5.50	5.00	6.00	5.00	5.00	5.00
975 lin. ft. 4-in. met. drain pipe	1.50	1.25	2.00	1.25	1.00	1.25
52 lin. ft. 6-in. met. drain pipe	2.00	2.00	4.00	2.00	1.50	1.60
5 ea. 4-in. C. I. val. and val. box	175.00	80.00	100.00	120.00	150.00	100.00
2 ea. 6-in. C. I. val. and val. box	250.00	100.00	150.00	150.00	175.00	150.00
2 ea. No. 13 inlet grd. and fr.	150.00	100.00	50.00	100.00	75.00	95.00
246 lin. ft. 58-in. x 36-in. C. M. Ar. C. P.	17.00	15.00	17.50	15.00	15.00	11.30
5 ea. fl. end. sec. 24-in. C.P.	57.50	50.00	75.00	60.00	50.00	60.00

Road-mix surfacing of 26.7 mi. in Nevada

Nevada—Washoe County—State. J. C. Compton, McMinnville, Oregon, with a bid of $73,703, was low before the State Department of Highways for construction of a portion of the State Highway System from Nixon to the north boundary of Pyramid Lake, a distance of 26.7 mi. Unit prices were as follows:

(1) J. C. Compton $73,703
(2) George E. Miller 73,951
(3) C. Dieterich Co. 76,658
(4) Young & Smith Construction Co. $89,122
(5) Whiting & Haymond 92,670

	(1)	(2)	(3)	(4)	(5)
Lump sum, signs	500.00	500.00	600.00	$1,000	500.00
16.58 mi. reshape roadway	150.00	250.00	400.00	500.00	500.00
210 ton liquid asphalt, Type MC-2 (seal)	35.00	35.00	34.50	40.00	36.00
1,242 ton liquid asphalt, Type SC-4 (rdmx.)	30.00	29.00	31.00	35.00	36.00
10.77 mi. roadmix (24-ft. width)	850.00	650.00	800.00	800.00	800.00
5.81 mi. roadmix (26-ft. width)	900.00	650.00	800.00	800.00	900.00
Force account, hand pick rock	....	....	....	....	....
2,580 lin. ft. beam type metal guard rail	3.00	5.00	2.75	4.00	5.00
223 ea. culvert markers and guide posts	6.00	5.00	5.00	6.00	6.00
1,930 lin. ft. paint guard rail	.50	.20	.50	1.00	.50
1,000 lin. ft. roadmix berm	1.00	.20	.50	.25	2.00
120 sq. yd. paved ditches	1.50	.50	2.00	3.00	.50

Gravel surfacing and road-mix oiling in Montana

Montana—Lincoln and Flathead Counties—State. Peter Kiewit Sons' Co., Sheridan, Wyo., with a bid of $546,300, received a contract from the Montana Highway Commission for construction of the Manicke-Kalispell highway; including 9.4 mi. of grading, gravel surfacing, road-mix oiling and small drainage structures. Unit prices were as follows:

(1) Peter Kiewit Sons' Co. $546,300
(2) Glenn Geery 579,477
(3) Roy L. Bair & Co. $589,368
(4) Sather & Sons 616,709

	(1)	(2)	(3)	(4)
558,596 cu. yd. uncl. excav. and borrow	.34	.445	.37	.44
1,814 cu. yd. culvert excav.	2.50	2.00	2.80	2.75
45,903 cu. yd. sand base	.70	.75	.98	.85
29,770 mi. yd. overhaul	.19	.15	.15	.24
2,882 ton cover coat surf., ⅝-in. gravel	4.00	3.25	3.00	3.00
49,090 ton Type "A" top coat, ¾-in. gravel	1.25	1.03	1.25	1.30
32,475 ton sel. borrow base course	.82	.77	.85	.90
45,257 ton base coat surf., grade A-2	.97	.86	1.00	1.05
211,590 gal. ap. MC-3 A.R.O.-mix	.15	.155	.16	.165
58,111 gal. ap. RS-3 A.R.O.-seal	.17	.155	.16	.165
34,949 gal. ap. MC-1 A.R.O.-prime	.17	.155	.16	.165
9.412 mi. processing	$1,200	$1,000	$1,250	800.00
756 sq. yd. processing	.50	.40	.15	.40
635 unit rolling surface coat and S.B.B.C.	7.00	7.50	7.00	8.00
560 unit rolling embankment	7.00	7.50	8.00	7.00
10,440 M. gal. watering	1.00	1.25	1.50	1.50
53.45 acre clearing	525.00	500.00	600.00	575.00
33.60 acre grubbing	475.00	300.00	600.00	400.00
282 lin. ft. 18-in. C.M.P. culverts	4.50	4.00	4.00	4.00
2,212 lin. ft. 24-in. C.M.P. culverts	6.50	5.90	5.50	6.00
166 lin. ft. 30-in. C.M.P. culverts	7.50	7.00	7.00	7.00
227 lin. ft. 36-in. C.M.P. culverts	12.00	11.20	13.00	11.00
54 lin. ft. 36-in. C.M.P. culverts—8 gauge	18.00	15.20	19.00	16.00
110 lin. ft. 48-in. C.M.P. culverts	16.00	14.90	20.00	14.50
1,470 lin. ft. 6-in. C.M.P. perforated pipe	2.00	1.45	2.50	2.00

Second Colorado River pipeline for San Diego

PASSED BY THE HOUSE on September 13 and by the Senate on October 1, an $18,000,000 authorization has been granted the Navy for construction of a second barrel for delivery of Metropolitan Water District Aqueduct water to San Diego, California. Capacity of the first pipe, constructed in 1944, has been severely taxed by renewed expansion of military facilities in the area.

In doubling deliveries of Colorado River water to San Diego, the new pipe may also settle current disputes over rights to Santa Margarita watershed supplies sought by the Marine base at Camp Pendleton. Designed to parallel the original pipe, this new barrel was postponed in 1944 due to material shortages.

States protest cuts in highway steel quotas

NOT AMONG the construction industry activities least affected by the steel shortage are Western state highway programs, which have now received their fourth quarter steel allotments and may be subject to continued curtailment of supplies in 1952. Expressing the feeling that "construction of structures in our highway system is a factor vital to national defense," Utah State Road Commission chairman D. H. Whittenburg has declared that his state is "impotent" to carry out its program of highway improvement.

Utah's steel quota for 1952 is 402 tons, including reinforcing and structural, whereas two highway overpass structures each have requirements in excess of that figure. As originally planned, the State's 1952 program calls for over 2,000 tons.

In Colorado, State Highway Engineer Mark Watrous has assailed the Government for creation of an artificial steel shortage which, he says, has given rise to a black market in steel. He disclosed that Colorado has been offered all the steel it can use for its ambitious highway program, but at prices 50% higher than at present.

In the State of Washington, alarmed at reduction of steel allotments in the fourth quarter of 1951, the State Good Roads Association has forwarded a resolution to Charles E. Wilson, director of defense mobilization. Citing Washington's strategic geographic position in the U. S., its great number of power and military defense developments, and its financial readiness to proceed with a vital highway program, the resolution in effect requests "that definite allocations of steel for highway purposes be made to the Department of Highways . . . in sufficient quantities and in sufficient time to provide for the construction of essential highways and bridges in connection with National defense."

UNIT BID PRICES . . . CONTINUED

160.97 cu. yd. Class "AD" concrete	75.00	95.00	75.00	68.00
27,266 lb. reinforcing steel	.16	.25	.16	.14
44 lin. ft. relay pipe culverts	2.50	2.00	2.00	2.00
490 cu. yd. gravel backfill	4.00	1.75	4.50	3.00
104 lin. ft. 4-in. galvanized iron pipe	4.00	5.00	3.00	3.00
3.557 M.B.M. tr. timber ditch lining	500.00	250.00	500.00	400.00
2 ea. conc. proj. markers	25.00	25.00	35.00	25.00
51 ea. conc. station markers	10.00	10.00	10.00	9.00
135 ea. conc. r/w monuments	8.00	5.00	7.00	6.00

Heavy grading for new road in Arizona

Arizona—Yavapai County—State. Arizona Sand & Rock Co., Phoenix, with a bid of $960,730, was low before the State Highway Department for construction of a highway, Cordes-Bridgeport, which begins approximately 8 to 11 mi. west of Camp Verde or 21 to 24 mi. east of Dewey; consists of heavy grading and draining work over a new alignment. Unit prices were as follows:

(1) Arizona Sand & Rock Co. $960,730
(2) Vinnell Company, Inc. 980,957
(3) Fisher Contracting Co. $988,617

	(1)	(2)	(3)
557,400 cu. yd. roadway excavation	1.44	1.46	1.44
36,500 cu. yd. overbreakage	1.08	1.095	1.08
17,000 cu. yd. slides	.72	.73	.72
4,525 cu. yd. drainage excavation	1.04	2.00	1.85
7,250 lin. ft. grader ditches	.16	.20	.15
2,700 lin. ft. crown ditches	.40	.30	.70
830 cu. yd. structural excavation	4.00	3.50	7.00
38,350 cu. yd. mi. overhaul	.40	.40	.35
2,000 M. gal. watering (CIP)	3.40	4.00	6.00
900 hr. rolling	7.00	8.00	8.50
248 cu. yd. Class A conc. (incl. cement)	63.30	70.00	75.00
24,430 lb. reinforcing steel (bars) (CIP)	.13	.125	.17
1,010 lin. ft. 24-in. corru. metal pipe (CIP except excav.)	5.70	6.00	6.50
82 lin. ft. 30-in. corru. metal pipe (CIP except excav.)	7.00	7.50	8.00
220 lin. ft. 36-in. corru. metal pipe (10 gauge) (CIP except excav.)	13.20	12.50	13.00
178 lin. ft. 36-in. corru. metal pipe (12 gauge) (CIP except excav.)	10.90	15.00	15.00
108 lin. ft. 54-in. corru. metal pipe (CIP except excav.)	18.10	21.00	23.00
Lump sum, 84-in. sectional plate pipe (various gauges) (CIP except excav.) (Sta. 4288+70)	$19,300	$21,000	$27,000
Lump sum, 84-in. sectional plate pipe (8 gauge) (CIP except excav.) (Sta. 4317+50)	$11,000	$10,000	$14,000
1 ea. cattle guard (4 unit) (CIP except excav. and conc.) (Sta. 4171+10)	$1,200	$1,100	$1,600
8 ea. r/w markers (std. C-1) (Type B or C) (CIP)	8.50	10.00	14.00
15,320 lin. ft. line fence (std. C-16) (CIP)	.27	.20	.22

Hydro plant in 13 months

. . . Continued from page 65

However, the contractor's use of equipment is very flexible to maintain a balanced rise in the embankment. End dump trucks also haul coarser material from a separate borrow pit upstream from the dam. End dumps are also used to haul the rock shell for protecting the surfaces of the embankment which will be in contact with the water. Plenty of loose material is available for riprap, and no appreciable amount of drilling and shooting has been required.

Core moisture content

No difficulties have been encountered in drying the 500,000 cu. yd. of selected material for the core. Two classes of suitable clay material are present in the area and are being used in the core section. One of these, termed Hagerman Clay, has some excess moisture. By disking the borrow pits and the fill, it can be placed at optimum moisture content. When excavated and stockpiled for later use the clay was spread in about six stockpiles and so arranged that a large surface was exposed. This permits a constant operation to be maintained by alternating the sources. Core material is placed at 20% to 24% moisture. Drying in the borrow pit usually takes about four to five hours after disking.

Core material was placed in 6-in. lifts and compacted to a weight of 93 lb. cu. ft. by sheepsfoot roller. About twelve passes with the roller gave satisfactory compaction. This compaction is about five pounds greater than natural density. Pneumatic-tired rollers were used on the random material. Water drawn from the river by a 2,000-gpm. pump was used for wetting down random material as it was placed and in the borrow pits.

KEY FIGURES in construction of the C. J. Strike Hydroelectric Development are E. A. Woodhead, left, superintendent of power plants for Idaho Power Co., and Glenn C. Johnson, right, project manager for Morrison-Knudsen Co., Inc.

Although the general character of the ground at the site was not hard on tires, the contractor maintained a special tire-handling truck to keep earth-moving equipment operating at a maximum. This truck was equipped with a hoist that could lift the large wheels from the earthmoving rigs. This unit was most effective in lessening down-time due to tire trouble.

Abutments

The south abutment consists of a similar silty clay to that found at the bottom of the river and on which the main section of the dam is built. The right, or north abutment, enters the area of pervious alluvium material some 400 ft. from the spillway. Sheet-piling, along the axis of the dam, was driven up this slope from the spillway to a depth of 19 ft. or refusal.

Seepage checked

This pervious material zone continues upstream behind the dam. To check any possible seepage a trench about 1,400 ft. long, and in some places 50 ft. deep, was excavated and filled with compacted material similar to that used in the embankment core. The zone was then blanketed upstream with a layer of impervious material for a distance of about 1,500 ft. This blanket makes contact with the impervious silt on the river channel at elev. 2355 and extends to elev. 2455 up the shore line on about a 1:6 slope. The blanket is ten feet thick at the base and 5 ft. thick at the top. It is covered with a layer of large gravel and rock to hold it in place.

Engineers

E. A. Woodhead is Superintendent of Power Plants for the Idaho Power Company with headquarters at Boise, and was in direct charge of engineering for the C. J. Strike Hydro-Electric Development. He was responsible for many of the design innovations. Donald Barclay and Carl Lewis are senior engineers connected with the project in the company's general office. Fred McCormick, assistant to the Superintendent of Power Plants, is in charge of field operations at the project site. Assisting him are R. C. Lowerie, resident engineer; Gailen Soule, Gomer Condit, M. C. Welsh, detail engineers; and Russell Stewart, chief of concrete inspection personnel.

Designers

Ebasco Services are the designing engineers. Involved are A. T. Larned, chief civil engineer, and H. L. Lowe, chief electrical engineer. Sponsoring designs are R. A. Sutherland, hydraulic; M. W. Reid, electrical; and G. R. Latham, structural.

M-K mainstays

Glenn C. Johnson is project manager for Morrison-Knudsen Company, Inc., with D. C. Thomas as assistant project manager. W. A. Abrahamson is project engineer, and L. Miller is office manager. Key men superintending construction are: James W. Rutherford, concrete; Roy J. Rasmussen, electrical; B. M. Johnson, erection; Harry A. Woodall, excavation; Roger C. Thomas, carpentry shop; Noah E. Barker and Lloyd Condit, general carpentry. Master mechanic is Frank J. Barta. Pictures of personnel in charge of the high-ball operations at C. J. Strike appear on page 113.

NEW BOOKS

Pile Foundations, First Edition—By Robert D. Chellis. Published by McGraw-Hill Book Co., Inc., 330 W. 42nd St., New York 18, N. Y. 680 pages, 6 x 9. Price $12.50.

The author, a structural designer for Stone & Webster Engineering Corp., presents the essential facts and data needed for economical and efficient design of pile foundations. The book covers the principles of soil mechanics, methods of determining pile capacities from driving resistances, and choosing piles and types of equipment. It describes and evaluates types of wood, concrete, steel piles and sheet piling, and gives methods of structural design of piles, preventing corrosion of steel piles, protecting concrete piles and load testing. Attention is given to the causes, methods of prevention, and remedies of pile-foundation failures. Developments in diesel hammers, prestressed concrete piles, sand drainage and Prepakt concrete are also discussed. The book contains tables of properties of all American and British hammers, extractors, piles and sheet piling. Standard specifications of leading technical societies and associations and of leading manufacturers of piles and piling contractors are given, and portions of leading codes affecting piling are quoted.

1575 Review Questions for Surveyors—By Russell C. Brinker. Published by Russell C. Brinker, Department of Civil Engineering, Blacksburg, Virginia. 108 pages, 8½ x 11. Price not designated.

This compilation of surveying questions is the result of many years of collecting by the writer. It is believed to be the most comprehensive set of such questions ever published. Registration license examinations from California and other states have contributed questions, although these have been rewritten. Men taking civil service or registration examinations in surveying (or the Junior or Civil Engineer examinations which usually include many surveying questions) will find help in this compilation.

Standard Practices for Low and Medium Speed Stationary Diesel Engines—Published by Diesel Engine Manufacturers Association, One North LaSalle St., Chicago 2, Ill. 200 pages, 6 x 9. Price $5.00.

This book is published with the sole aim of being of service to diesel engine users, prospective buyers and consulting engineers. It covers stationary diesel engines at speeds up to and including approximately 750 rpm., and supersedes the three previous editions of these standards (latest, 1946).

Earth Manual—Published by the Bureau of Reclamation, Department of the Interior, Denver Federal Center, Denver, Colo. Price $2.50.

This new volume is designed as a supplement to the **Reclamation Manual.** It combines pertinent material from the previously issued **Earth Materials Laboratory Test Procedures Manual,** the **Field Manual for Rolled Earth Dams,** and the **Earth Materials Investigation Manual.** In addition to collecting the valuable material issued in these previous works, **Earth Manual** offers new information on foundation investigations and control of earth materials in canals and miscellaneous earthwork.

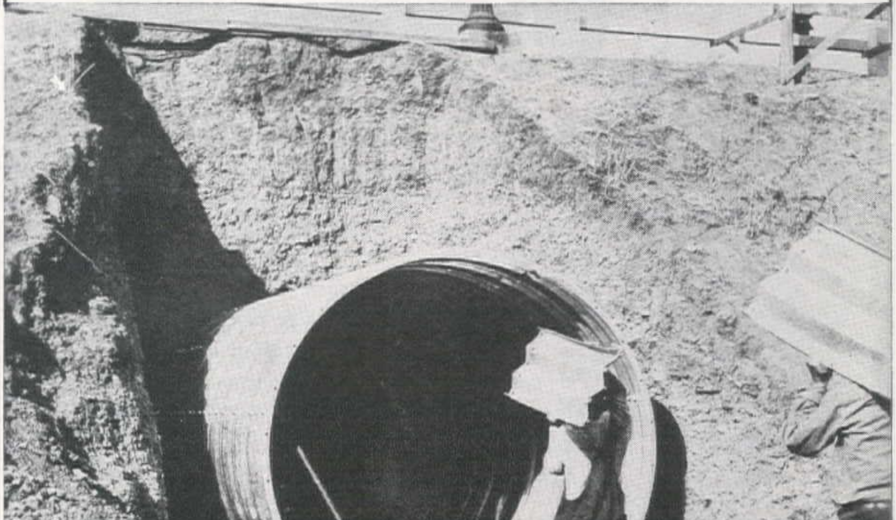
Palisades Dam completion funds sought

A SUPPLEMENTAL appropriation of $2,000,000 is sought in Congress by the Bureau of Reclamation in order to continue construction of Palisades Dam and power plant on the Snake River in Idaho. Power requirements of the AEC installation at Arco are cited in justification of the request, which would permit generation of 114,000 kw. by 1956.

Palisades Dam is the main feature of a $76,600,000 reclamation project that was dropped after preliminary work several years ago. First step under the requested appropriation would be excavation of the diversion tunnel. When completed, the earthfill dam will be 260 ft. high and impound 1,400,000 acre-feet of water. Beyond its use in power generation during the present emergency, the dam would eventually bring irrigation and flood control benefits.

Chief Joe Dam needs 120 workers

AN ADDITIONAL 120 workers are needed on the construction of Chief Joseph Dam on the Columbia River in Washington. At the present time 920 workers are engaged in completing this year's schedule before the high water and bad weather set in. The contractor's goals are the placing of first-stage concrete and the construction of a new cofferdam to the south before May.



NEW LITERATURE

1101
Cable controlled bulldozer for Cat DW10 tractor

In an informative broadside just released by **Caterpillar Tractor Co.,** the new cable controlled bulldozer for the DW10 tractor is fully described and pictured in action on construction projects. Full specifications are included along with an outline of the features offered by this multi-purpose earthmover.

1102
Field lubrication guide in 22 illustrated pages

Starting with an explanation of what Graco Convoy Lubers are, and proceeding through all phases of the lubricating equipment and accessories offered by the **Gray Company, Inc.,** this booklet is a worthwhile guide to the solution of field lubrication problems. The story is all here—told in pictures, tables, drawings and charts. Information is included on how to order specified articles. There is a complete list of Grayco service depots throughout the country. Several sections are devoted to a description of Graco "job-planned" units which are designed by the user and created by Grayco to solve particular requirements.

1103
Here's how to operate a welding or cutting outfit

Designed for students of vocational training schools—and to meet an increased need for manual training, **National Welding Equipment Co.** offers a new booklet on "Here's How to Operate a National Welding or Cutting Outfit." This fully-illustrated manual offers brief textual descriptions on how to use and assemble this equipment for the best results. It is carefully explained and illustrated adequately to be of maximum use to the novice.

1104
Concrete sewer know-how in 48-page reference guide

Tables and charts, which should be of great value to sanitary engineers, highlight this 48-page reference booklet called "Concrete Sewers." Filled with information on the design and construction of concrete sewer systems, and loaded with the latest available research data covering loads on sewer conduits, this **Portland Cement Association** booklet should answer many questions about the techniques of concrete sewer construction. "Concrete Sewers" discusses the hydraulics and construction of sewers; types and design of sewer construction and loads on sewers and sewer appurtenances. The final chapter covers maintenance and repair of sewer lines and includes information on safety precautions in sewer operations.

1105
Action-view catalog spotlights 1¼-cu. yd. tractor-shovel

This catalog not only tells the reader about the new 1¼-cu. yd. tractor-shovel made by **The Frank G. Hough Co.,** it also shows him the features that make

this Payloader a solution to many materials handling problems in the construction and public works fields. Features such as full-reversing transmission, operator visibility and safety, full hydraulic bucket control, power booster steering and the unique unit-design are clearly illustrated in the pages of this booklet. Complete specifications on the machine are included to complete the picture.

1106
Plunger pump pamphlet offers capacity tables and drawings

This new two-color, 8-page bulletin released by **The Dorr Co.,** describes the Dorrco Plunger Pump in detail. Photographs, drawings, capacity tables and text give a complete picture of the equipment. Included also are a complete set of sample specifications and preferred arrangement drawings for the pump when located at different elevations with respect to the clarifier. Features such as the adjustable stroke for quick capacity regulation, a low speed, large diameter piston which gives maximum volumetric efficiency and a common cast iron base plate for both pump and motor are explained in the booklet.

1107
Plywood properties and design data for industrial uses book

Holders of **Douglas Fir Plywood Association's** "Handbook of Uses" will be interested in receiving a copy of this new folder on properties and design data. Figures on working stresses are included in this folder, which compiles the latest information to keep the Handbook up to date. This 4-page folder should immediately follow the Basic Catalog pages in the Handbook.

1108

Timber takes its place in recreational buildings

A picture story of the versatility of timber in the construction of recreational buildings is available to architects and engineers who submit requests upon their letterhead. This bulletin, by **Timber Engineering Co.**, is jammed with photographs and descriptive captions showing the trend toward timber in many modern construction projects. Each application shown has a paragraph of explanation attached which points out the type of timber and the technique applied to the construction.

1109

Steel statistics guide

Bethlehem Pacific Coast Steel Corp. offers a 40-page booklet, loaded with tables entitled "Bethlehem Pacific Rolled Steel Products." Properties and sizes of sections rolled on individual mills of each of the company's three steel plants are listed in this valuable reference guide. Specialties manufactured by the company are also listed in the guide. Buyers of steel would do well to have a copy of this information in their libraries.

1110

Grit removal from sewage

A practical discussion of the problem of grit removal from the maximum flow to the plant is included in this 20-page booklet just released by **The Dorr Co.** The star of the booklet is the Dorr Detritor which removes over 95% of all grit larger than a definite size—usually 65 mesh—from the maximum flow to the plant. The Detritor produces a washed grit, drained of its free water, and containing not more than 3% by weight of putrescible organic matter. Detritors, the booklet explains, will operate under widely varying flows without requiring adjustments. The last eight pages of the bulletin are devoted to a discussion of grit chamber design principles. This section proves both theoretically and by grit analysis from various installations that the capacity of a grit chamber is in direct proportion to the area regardless of the relations of width, depth and velocity. The inadequacy of the "1 ft./sec.—60 sec. detention" rule-of-thumb is clearly demonstrated.

1111

Solderless connectors

In 4 pages, **Buchanan Electrical Products Corp.** offers a description of its line of Underwriters' approved "pres-SURE-connectors" for solderless splicing and terminating of electrical wires. The folder contains detailed descriptive data, installation instructions and pertinent ordering information. The text is fully illustrated with diagrams and drawings.

1112

A piece of literature with one moving part

Straub Manufacturing Co. offers a piece of literature with one moving part. The 1-page bulletin features a diagram of the Kue-Ken crushing principle—but the jaw is attached in a separate piece. By applying the suggested pencil test (through one of the holes in the jaw) one can see how the arcs pass squarely through the center line of the crushing zone, instantly gripping and crushing—without forcing the rock upward, without rubbing. The bulletin also compares the three jaw crushing principles. A coupon is included with the bulletin by which the reader can receive advice on his particular crushing problem. All in all this is a different and valuable piece of literature.

1113

Steel form advice

Advice for handling concreting jobs whether they be large or small, is contained in Bulletin No. 2035, published by the **Blaw-Knox Co.** The informative booklet is a guide to steel forms with information on how difficult assignments can be licked.

1114

Cutting crusher costs

An explanation of how this Type H Jaw Crusher starts cutting costs the day it is purchased is included in a booklet offered by **Traylor Engineering & Manufacturing Co.** Complete details and specifications about the crusher are included.

1115

Earthmoving equipment guide

Hydraulic and cable-controlled earthmoving equipment manufactured by the **Baker Manufacturing Co.** to match **Allis-Chalmers** crawler tractors is fully described in Bulletin No. 895, just released by Baker. Attachments designed to work with A-C tractors described in the bulletin include the engine-mounted hydraulic control bulldozers, gradebuilders and root rippers (for the HD-5, HD-9, HD-15 and HD-20), and three cable control units (for the HD-9, HD-15 and HD-20). Specifications are listed

Continued on page 137

CLIP AND MAIL THIS COUPON

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NEW LITERATURE

▸▸ *or for more information on*

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described in the following pages.

WESTERN CONSTRUCTION

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showing at a glance the moldboard height and width, height of lift, depth of cut, degree of tilt, weight of blade and mounting, and overall length of tractor and blade for all models.

1116

"Tricks of Scaffolding"

Although usual scaffolding jobs are described and illustrated in this new booklet just released by **Universal Manufacturing Corp.**, the emphasis is on unusual scaffolding applications. Complicated problems and their solution are shown in the new booklet, including: Racking down—from a 5-ft. panel to 40-in. width for narrow places; shortening up—7-ft. span shortens to 5 ft., 5 in.; circling—scaffolding cylindrical stacks, etc., and single bracing—less parts used in about 85% of the spans in a run. These jobs are ones that might take valuable time to solve in the field, and this booklet tries to beat the situation to the punch.

1117

"Fusion Facts"

This booklet is published quarterly by **Stoody Company** for those interested in the welding industry and hard facing alloys. Fully illustrated and containing informative articles on welding applications, this booklet would be of interest to those who are concerned with conserving and rebuilding worn out machines, etc. Typical applications of the hard facing process are shown and valuable tips are offered in each issue.

1118

Portable crusher parade

Smith Engineering Works is offering a new bulletin on "Telsmith Portable Crushers," describing in detail the portable and semi-portable units manufactured by the firm. The 12-page two-color bulletin contains full specifications, illustrations and tables to fully acquaint the reader with this line of construction equipment.

1119

Multi-purpose tractor-shovels

In 12 pages of good reading, the **Frank G. Hough Co.** offers a booklet on the versatility in the field of Hough Payloader tractor-shovels. The literature is fully illustrated with on-the-job scenes explaining how certain jobs were tackled. Specifications and special features are also pointed out in this new booklet which should be of interest to contractors, public works departments and utilities.

1120

Lining material booklet

Fiberglas, a product of **Owens-Corning Fiberglas Corp.**, and its use as an irrigation canal liner, is the subject of a new 8-page booklet, fully illustrated, just released by the firm. The booklet presents the material in the form of a well-told story. It explores the problem of seepage and leakage of vital water through the soil in various regions and then describes how the product beats this problem. There is a complete description of the characteristics of this lining material as well as information on preparation and excavation of sites, liner application, backfill, maintenance and limitations. A diagram is included on typical cross-sections.

1121

Welding alloys chart

Detailed specifications on close to 200 metal-joining alloys, including bonding temperatures, tensile strengths, recommended uses, etc., are included in a new 10-in. x 14-in. Low Temperature Welding Alloys chart by **Eutectic Welding Alloys Corp.** Major listings show proper welding alloys for use with cast iron, steel, stainless steels, copper, brass, bronze, nickel and nickel alloys, aluminum and aluminum alloys, magnesium alloys and zinc die castings as well as for hard overlaying, cutting, chamfering, piercing, gouging and joint preparation of all metals. Further subdivision of the information covers the use of the alloys with various heating methods, i.e., torch, arc, and inert gas-shielded arc welding.

1122

Water hammer, cause, effect

An 8-page study of water hammer in piping systems has been published by **The Williams Gauge Co.** Water hammer is described in non-technical terms, and then its effects upon the piping system and appurtenances are explained. Methods of controlling water hammer are considered in the illustrated booklet. The information contained in this booklet is based on a series of several hundred tests to discover more about the subject. Also included in the text is information on the effect check valves have on water hammer. This is an interesting discussion of a subject on which little information has been published.

Literature Briefs

1123

WORRIED ABOUT RUST?—If so, the **Rusticide Products Co.** tells a story in 4 pages about OSPHO, a metal primer applied directly over rusted surfaces which stops rust and primes metal for paint. Full information on prices, containers, etc., appears in the bulletin.

1124

AGGREGATE production answers are provided in Bulletin 26, **Mines Engineering & Equipment Co.** The bulletin offers the latest developments in aggregate production.

1125

CLEAN SWEEPING with the fluid-driven super-sweeper manufactured by **Lull Manufacturing Co.**, is the subject of Bulletin AD-40. The sweeper controlled completely from the driver's seat is explained.

1126

A WIRE ROPE roundup is available in a series of bulletins published by **Union Wire Rope Corp.** Information is available on scraper rope, dragline, slings, chokers, rotary line, mining machine rope, slusher and towline.

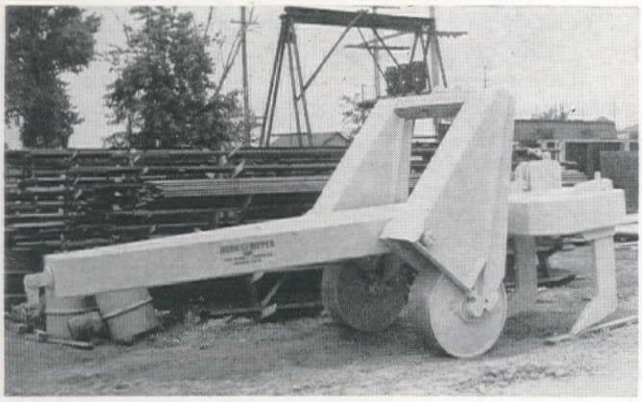
NEW EQUIPMENT

More information on any of the items in this section may be obtained by using the coupon on page 135.

1127

Economical ripper designed to hold into ground

The Hubb rite-way Ripper features economical design. The yoke wheel action is in reverse to all other makes. Design makes downward wheel arc forward and away from teeth when wheels are lowered to raise teeth. The clearance

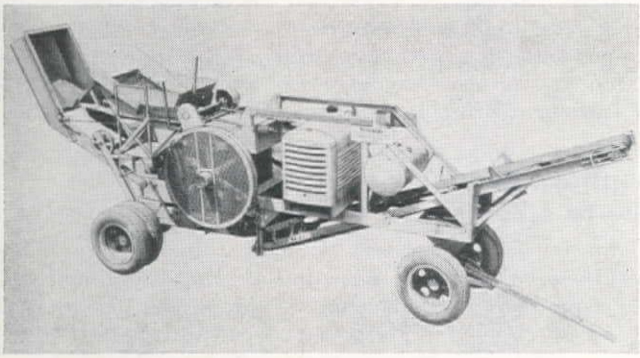


which results eliminates costly jamming of rock slabs, etc. The ripper holds into the ground more efficiently because the raised wheels fit close up to the rear. Wheels are naturally and easily raised by forward motion of ripper when desired; backing up to raise wheels is eliminated. Location of the cable anchorage at the rear of the frame, above teeth, produces a direct lift at lifting point. This means less strain to frame, cable, sheaves, and reduces amount of necessary cable power pull. Manufactured by **Hubbell Ripper Co.**

1128

Portable crushing and screening plant suited to rock or gravel operations

Built around a Dodd triple jaw crusher with a jaw opening of 11 in. by 24 in., this new crushing and screening unit is well suited to gravel and rock operations. Material is fed from a scoop which can be loaded at ground height. Sand



and fine stones pass through the grizzly, by-passing the crusher and are delivered directly to the sizing screen which is suspended under the crusher. Stone passing through the crusher is also discharged onto the sizing screen. The sizing screen is a double deck unit receiving its movement from the crusher itself. The sizing screen can be set to remove both fines and oversize or can be adjusted so that all the material is delivered to the leading conveyor. The portable plant is 25 ft. long, 92 in. high, 8 ft. wide and weighs 16,000 lb. Rated capacity is 30 tons per hour of limus 1½-in. stone. The crusher is equipped with safety springs which compress if tramp iron gets into the crusher. Manufactured by **Union Boiler & Manufacturing Co.**

1129

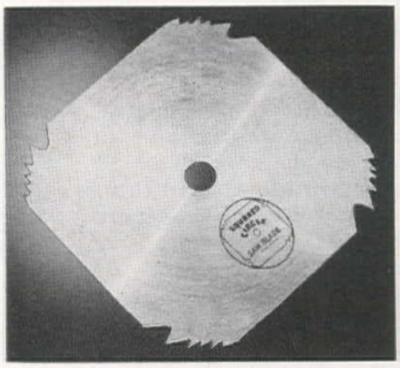
Concrete form panel designed to be reusable

This new form panel, manufactured by West Coast plywood manufacturers, combines a backbone of plywood with the smooth, tough surfaces of hardboard. **Douglas Fir Plywood Association** calls the new panel Plyron. The material is being used successfully on jobs like the New Jersey Turnpike. Plywood inner construction makes the panel a rough 'n ready friend on any construction job. It is puncture-proof, strong, rigid, dimensionally stable. In combination, the panel is split-proof and boasts of a relatively light weight. It is permanently bonded with highly moisture-resistant glue. Use of the new panel on the job has resulted in raw material savings and a high quality result.

1130

Contractors who want to cut corners can now use square saw blades

This brand new line of square saw blades operate on an entirely new cutting principle. The Squared-Circle Saw Blade will handle all types of cross-cutting and rip sawing faster than the conventional type circular saw blade. Teeth



in the new saw blade are located at each corner of the square. Absence of teeth along the sides assures very little friction during the cutting operation and therefore a cooler cutting blade and elimination of burned out blades or motors. Other features claimed for the new saw are that it requires less power to operate and has fewer teeth to sharpen and set, which results in lower upkeep. The Squared-Circle Saw Blade, a product of **Clark & Sawyer, Inc.**, is available in all standard size and shape arbors.

1131

Big capacity, no-pushbeam bulldozer developed for dirt moving contractors

Take a look at a new piece of equipment which can solve many field problems for dirt moving contractors. This new bulldozer, the 9-X, developed by **Baker Manufacturing Co.**, in cooperation with **Allis-Chalmers Manufacturing Co.'s** tractor division, can be hauled freely on the highway day or night, without special permits. Because it eliminates push beams, the 'dozer mounts 8-ft. wide blade on the 7-drawbar hp. 9-ton Allis-Chalmers HD-9 tractor. The new unit features Baker's roll-action, and the narrower blade has approximately the same total blade area and capacity as the conventional 9 ft., 6 in. model for the HD-9. In mounting, the front spring and saddle are removed and the spring pads are replaced by special brackets to which the lift mechanism is attached. This means that only vertical forces enter the truck frame, and it also means that increased clearance and improved operating characteristics make work easier in mucky or swampy operations. The unit can be used for all standard operations, offers immediate blade response and faster bite, and weighs only 3,400 lb.

1132

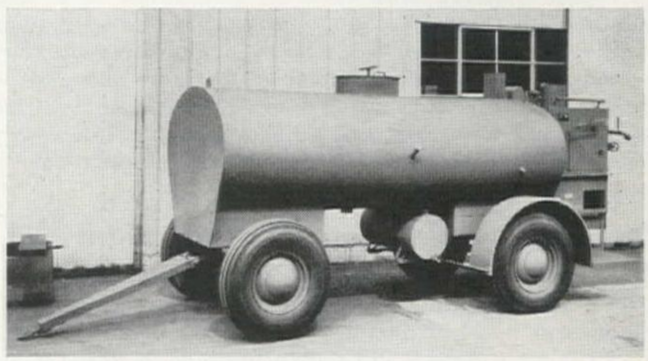
Self-lubricating mechanical wood ideal in hard-to-service equipment

Lignum-Vitae is a hard resinous wood, native to the Tropics, which offers many uses for equipment parts. It is the hardest wood known to exist in the world and can stand a working pressure of 2,000 lb. per sq. in. The specific gravity of the wood is 1.14. High resin content (about 30% of its weight) makes Lignum-Vitae ideally suited to many mechanical uses where lubrication is difficult. Can be used for rollers on cable guides, saw pin guides, roll neck bearings, acid mine water pipe line fittings, etc. Manufactured by **Lignum-Vitae Products Corp.**

1133

Improved trailer-type spray tank serves road construction and maintenance work

Designed to be highly portable, this utility unit is now constructed with a self-supporting tank. The heavy frame is eliminated and so are the dual tires—front and rear. The



capacities of this 4-wheeled frameless trailer 101 are 800 and 1,000 gal. The unit has a spray bar for small application jobs, hand spray attachment for general patch work, and a pouring pot outlet for crack filling and patch work on highways, streets, runways and parking area. The unit is manufactured by **Littleford Bros., Inc.**

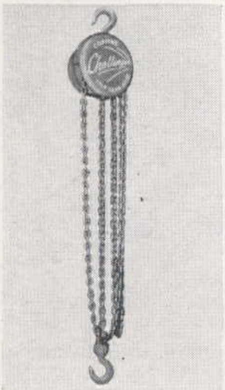
1134

Asphalt, granular soils compaction 900 to 1,200 sq. ft. per hour

This improved vibratory compactor incorporates many features for the rapid compaction of asphalt, granular soils and water-bound macadam bases. It propels itself at approximately 25 ft. per minute, and delivers up to 4,500 1¾-ton blows per minute. It will compact 900 to 1,200 sq. ft. per hour. Subbases and base courses of crushed materials are readily consolidated with this machine, using the smooth base, and water-bound macadam can be compacted to maximum density in two passes. Also can be used for the compaction of granular soils in subbases when it is necessary to secure maximum density quickly. The device handles most granular materials in 12-in. lifts, is rugged and reliable having just one moving part, the shaft of the heavy duty vibratory motor. For quick maneuverability where frequent changes of location are necessary, such as are required in pavement patching, the complete auto trailer unit, on which is mounted a 2.5-kva. (2,500 watts) Jackson Power Plant and hydraulic jack for picking up and lowering the compactor, offers great convenience. The power plant generates both single-phase and 3-phase 110-volt, 60-cycle AC and may be used to operate other power tools and lights as well as operating the compactor. Manufactured by **Jackson Vibrators, Inc.**

1135

Spur-gear hoist weighing 39½ lb. is light, strong, easy to service

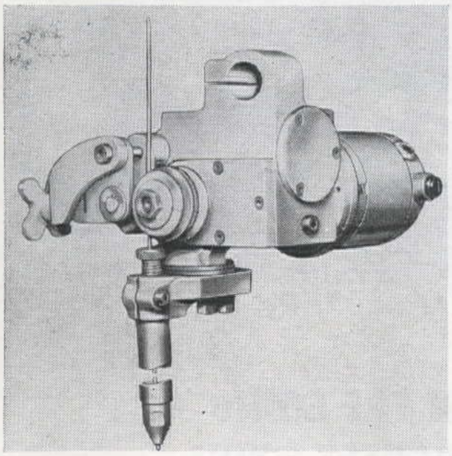


Now in production at **Coffing Hoist Co.** is the Challenger, a spur-gear hoist offering ½- and 1-ton capacities. Since the entire unit including standard length of high-strength coil chain for an 8-ft. lift, weighs only 39½ lb., it is easily moved from place to place. The use of formed steel plate in the housing, in place of cast aluminum alloy, offers strength and unusual resistance to shock-load breakage. Lamination of the back plate gives extra rigidity for supporting the hoist mechanism. This plate and all other load holding parts are of high-strength steel. Every Challenger is tested at 100% overload as it comes off the production line. Ease of servicing is assured in the design of the Challenger. It may be disassembled in a matter of minutes with simple tools; a feature which should be of great convenience to the owner. The spur-gear hoist hangs clear whether or not it is supporting a load, and is sealed and running in lubricant.

1136

Fully automatic welding head offers performance advantages

Completely automatic control of both welding head and positioner operation, is the principal feature of this new device. Also offers control of the high-frequency pilot circuit if one is used. Both head and positioner drives are



automatically stopped by rugged electro-mechanical control circuit if the arc is broken or the electrode sticks to the work piece. When high-frequency is used, it automatically cuts off the high frequency the moment the arc is established. The 944 driving motor operates on either or both the welding voltage or a separate 110-volt source. It is electrically independent of the positioner and welding transformer power supply, completely eliminating phasing problems. Feed rolls are quickly adjustable without removal from the drive shaft to accommodate any electrode size from 1/8 in. to 3/8 in. Manufactured by **Mir-O-Col Alloy Co., Inc.**

1137

Five trowels on concrete floating and finishing machine

The "Model C," announced by **Whiteman Manufacturing Co.,** has five rotating trowels instead of the conventional three, making it possible to move onto a wetter slab. It has a new type universal trowel that can be used for both floating and finishing by a simple adjustment of the pitch, eliminating the necessity of changing trowels. As on all Whiteman models, trowel pitch can be changed while the machine is in motion by turning a knob on the end of the shaft. A new stationary guard ring encircling the machine permits finishing within 1½ in. of walls, columns, etc. The new model is powered by a 6-hp., 4-cycle gas engine. A new double-groove clutch with two belts increases trowel speed 25%.

1138

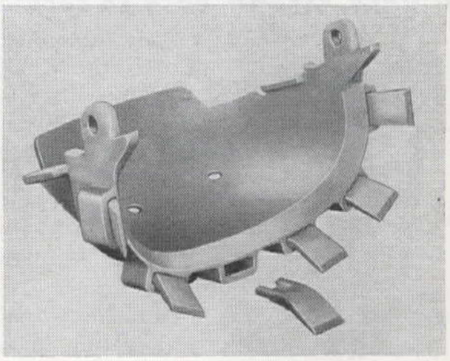
"Million-miler" diesel engine can take it and dish it out

The new "Million-Miler" diesel engine by **General Motors Corp.** offers more power and was built to haul a million miles or more. It is a new design of the 4-71 and 6-71. The new engine will power GMC 650, 740, 750, 900, 950 and 970 series trucks and tractors. Horsepower has been upped 12½% and there is positive fuel control at low speeds. Power, economy and longer-life are featured.

1139

Bucket tooth offers easy-in, easy-out operation feature

Replacement time is saved with the new easy-in, easy-out feature of this bucket tooth, manufactured by **Parsons Company,** a **Koehring Company** subsidiary. The Tap-In bucket teeth are now



standard equipment on all Trenchliners. Tap-In teeth eliminate the need for bolting or crimping edges to hold teeth in position. A precision fit taper locks the tooth firmly in place either on buckets or sidecutter bars. Sturdy tooth holders are integrally cast with the bucket lip for positive tooth support. By welding adapters to the buckets, Trenchliners of any age can be converted to use Tap-In teeth. Tap-In teeth are made of the finest grade alloy steel, heat treated and designed with added clearance for maximum wear before replacement becomes necessary. They need not be reversed.

1140

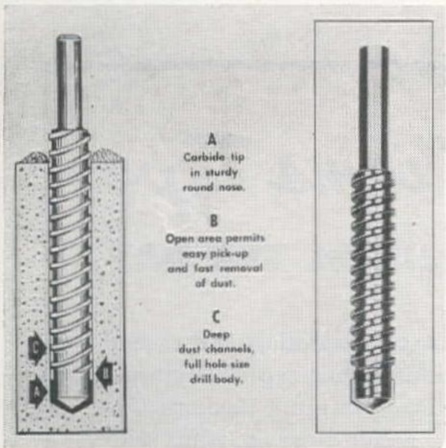
Hydraulic jack has 25-ton capacity

The lifting toe capacity of this new jack is identical to the lifting capacity on the cap. The toe rides on a bearing roller that carries the radial head against a stationary ram's flat-milled surface. The whole lifting operation is said to be smoother and easier because the broad 4½ x 4½-in. toe always remains in an even position. The Rol-Toe, Model RTJ-25, has a 7-in. lift, with minimum heights of 2½ in. when lifting on the toe and 14 in. when lifting on the cap. The Simplex Rol-Toe has two separate pumps—a high speed pump for positioning and lifting lighter loads and a high pressure pump for heavy lifting. A safety by-pass valve, set well over rated capacity, is provided to guard against overloading. **Templeton, Kenly & Co.** is the manufacturer.

1141

Carbide-tipped masonry drill cleans dust, resists strains

The "Steel Spiral" drill is machined from the solid with round nose supporting the carbide tip. The design provides ample dust clearance without necessitating gashing ahead of the carbide tip



or otherwise weakening the end that does the work. It also reduces the chance of cracked or weakened tips due to brazing strains. Double lead fast spiral dust grooves made extra deep for long life pick up the dust from immediately behind the carbide tip so that dust load can automatically distribute itself. Holes up to 12 in. deep can be drilled without stopping or removing the tool from the hole. A product of **Super Tool Co.**

1142

Portable electric saws weigh only 19 lb.

Model 42B portable electric saw is a heavy duty professional tool manufactured by **Syntron Co.** It is designed for construction, maintenance or production work. The tool offers a smooth, constant 6,000 rpm. on its 8½-in. blade and it is powered by a Universal AC and DC motor developing up to 1½ hp. Provides speed and ease up to its 2-11/16-in. capacity. Fitted with proper abrasive disc, the tool will cut metal, stone, concrete, tile, brick and many composition materials. It has dual V-belt drive, feather-balance, a safety guard, line pointer, and rip fence.

1143

Salamander designed to give real clean-burning action

This salamander offers a flame spreader inside the stack, which has horizontal louvers. Burning then occurs in a rapid spinning spiral around the flame spreader. Greater heat at the base of the stack results from this process and this leads to increased radiation. Clean-burning is the total result. No wicks, jets or valves are used on this device, and one filling burns 10 to 20 hours. Heat output is rated at 100,000 Btu. per hour on 3.4 gal. of fuel oil. **California Heater Co.** is the manufacturer.

1144

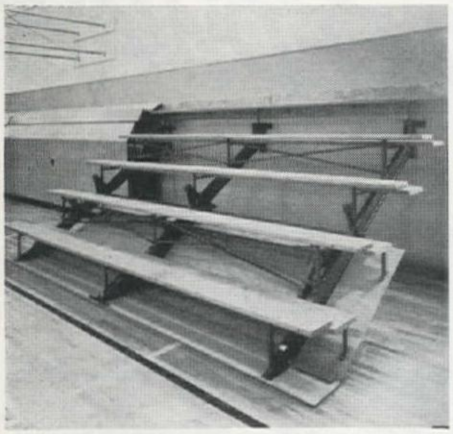
Hoe attachment design change extends excavator digging depth

This new hoe attachment for the Koehring 304 excavator extends digging depth to 19 ft., 9 in. Additional improvements offer extra resistance to side sway and extra strength to meet any operating condition for below ground level excavating. The dipper arm, officially rated as a ¾-yd. excavator, is pivoted at the end of the boom and jackknifes to dig a vertical backwall, thus reducing hand clean-up time in basement digging to a minimum. Position of the countershaft in line with boom foot mounting, eliminates dipper drift when the boom is raised. Use of double digging lines to the sturdy dipper eliminates reverse cable bends and results in important savings due to longer cable life. Adjusting links provide three variable settings to match the dipper angle to the type of material and cut being made. Manufactured by **Koehring Company.**

1145

Now you see them now you don't bleachers

When folded, these bleachers are only 2 ft., 4 in. deep, but unfolded, six 16-lineal foot bleacher sections of 5 rows each, seat about 325 persons. The bleachers



can be put into position by one man in a few minutes' time. The Rollway bleachers, manufactured by **Beatty Safway Scaffold, Inc.,** are formed of welded tubular steel units with 2 x 10-in. Structural Select Douglas Fir seat and floor boards. Weight, when bleachers are occupied, is distributed at three points: at the wall by a double bolted hangar; at the front of the stand by a lightweight plywood-covered I-beam which parallels the wall, and at the center where the down weight causes a heavy piece of spring steel to engage a lineal sleeper with the floor. In folded position the seats slant vertically to avoid catching dust, and the entire outer surface of the folded assembly is protected by ½-in. plywood panels to assure neatness.

1146

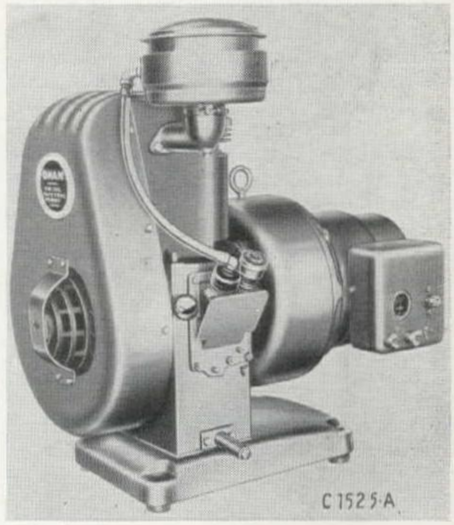
This concrete curing compound sprays on and dries rapidly

This preparation will effectively seal 200 sq. ft. of horizontal surface per gallon. Permite W-95 is economical to use and has been put to successful use by the armed forces. The preparation is applied by spraying and it does not take long to dry. By **Aluminum Industries, Inc.**

1147

3,000-watt diesel electric plant with a simplified design

Powered by an air-cooled full-diesel Onan engine, this new 3,000-watt diesel electric plant offers a simplified design which makes it possible for anyone to operate and service it. Push-switch control for electric cranking, manual compression release and an electrically heated glow-plug for cold weather starting are provided. The plant is driven by an improved four-cycle single-cylinder Onan DSP diesel engine which incorporates many new engineering features that have increased power output and operating efficiency. Exceptional oper-



ating economy has been achieved—approximately 0.155 gal. of low-cost furnace oil is consumed per kw-hr. at full rated load. Model 3DSP-1E generates 115-volt, 60-cycle, single-phase current. Other AC models available in single-phase produce 230 volts and 115/230 volts. Made by **D. W. Onan & Sons, Inc.**

AED holds first "All-Western" conference at Sun Valley

WITH A REGISTRATION of 252 the Associated Equipment Distributors of Regions 11, 12 and 14—comprising the eleven Western States—held the largest conference of this national association, aside from its annual meetings, in Sun Valley, Idaho, on October 12 and 13. The tri-regional meeting was the first of its kind to be held by AED and was organized to permit equipment distributors of the West to discuss problems common to this region. At the close of the conference opinions expressed during the final session indicated that this unique meeting was most successful and should be repeated in the future at possibly two-year intervals. Decision for the next tri-regional conference was left up to the directors of the three regions, and will probably be made at the annual AED meeting in Chicago in January.

Registration by states

Not including members of the executive committee, staff of AED and representatives of manufacturers, the registration by states was:

Arizona	4	New Mexico	13
California	58	Oregon	20
Colorado	17	Utah	40
Idaho	16	Washington	35
Montana	10	Wyoming	4
Canada	4		

Wives of members represented a relatively high proportion of those attending the conference, and non-business activities crowded the hours following the afternoon sessions, with the aid of hospitality provided by Sun Valley Lodge and the Conference Committee.

In his "Welcome to the Conference," National President R. L. Arnold of Salt Lake City stated that "The recent growth and development in the three regions assembled here is a significant reason for this conference. In addition these regions comprise the Western eleven states, which are frequently considered a sectional unit."

In his opening remarks of welcome at the first session, L. E. Jones of Butte, Mont., director of Region 12, pointed out that nine past national presidents of AED were attending the conference, indicating the importance of the gathering, as well as the contribution of the West to the national administration of AED during the 33 years of its life.

President Arnold reported on general AED affairs to the Western members. He stated that the directors were definitely opposed to any idea of moving national headquarters from its present location in Chicago, to Washington, D. C. He discussed present plans for the purchase of a building in Chicago as a permanent headquarters to reduce the high rental and crowded conditions in the present location. Also, he told the members that executive duties had become too extended for one man, and that the position of Field Secretary had been created, and was capably filled by J. R. Randle, who was attending the Sun Valley conference.

Expansion brings problems

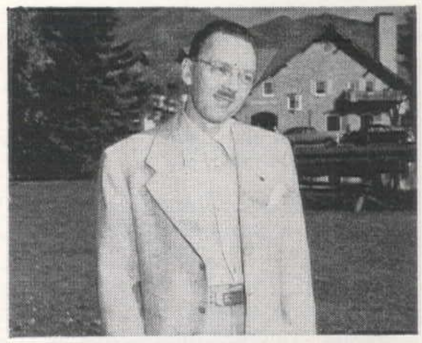
AED has now "come of age," in the opinion of President Arnold, who stated membership was becoming stable, following years of expansion. Problems, however, continue to increase, and responsibilities of the officers and committees become more complex each year.

He then proceeded to outline his ideas of the position of a trade association in a free economy. Since any trade association must promote the principles of the country, such an organization in the United States should promote free and orderly competition in business. Whereas the federal government was originated to make rules for the business game, it was now playing that game, and must be put back into the logical position of its first role.

Jack Randle, the new field secretary reported that during the eight months he had been on the newly created job, he had had to spend several in Washington, but during the short time remaining he had been traveling throughout the country visiting local groups. He indicated that he had already reactivated five groups, and was going to assist in forming a distributor group in Phoenix, Ariz., within the next few months.

E. J. Crosby, national treasurer of AED, reviewed and commented on the financial condition of the association.

The second session was presided over by Beal Shaw, director of Region 11, from Los Angeles. A presentation by Frank McBath, a past national president from Portland, on the participation of



Top: *R. L. Arnold*, International president, AED. Bottom: *Beal Shaw*, *L. E. Jones* and *Frank Skidmore*, regional directors.

Above: A general view of the convention hall looking out from the speakers' table. A total of 252 delegates registered for the Sun Valley conference.

Below: At the speakers' table for the opening session of the AED meet are, left to right: *E. J. Crosby*, treasurer; *Phil Dufford*, general chairman; *Ray Arnold*, president; *L. E. Jones*, director and *J. R. Randle*, field secretary.

distributors in manufacturers' advertising programs was followed by discussion and a resolution read by Freeman Sersanous which placed the AED members of the West on record as opposing any such participation. This resolution was carried unanimously.

C. H. Davis leads discussion

The controversial subject of the corresponding responsibilities for service of equipment between distributor and manufacturer was led by C. H. Davis of Spokane. Among other things he spoke about the increasing amount of work required on the part of the distributor's organization to get each new machine ready for delivery. The inability of the distributor to get an adequate supply of parts was a further point. He offered a resolution on this point, placing the distributors of the West on record as wanting more attention paid by manufacturers to providing ample parts service, rather than pushing complete machine sales, in the interest of keeping present equipment in operating condition. The resolution was carried without a dissenting vote. Mr. Davis did admit that the mechanics and operators of the users are not as interested in their work or their machines today as they were years ago. In his selling procedure he always insists that the machine operator be present at the time the piece of equipment is delivered.

On the subject of "What's Ahead in Washington," Harry Hush of New York and John Oechsle of Philadelphia had a tough assignment, even though they are both very familiar with AED matters in Washington. They agreed that even though they were familiar and understood today's rulings affecting the equipment distributor they would hesitate to report, because the information might be incorrect or out-of-date tomorrow.

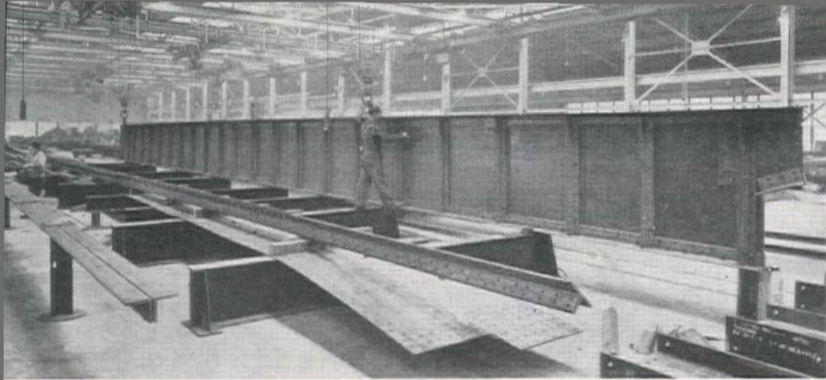
When Jack Hatten of Seattle tackled the "Let's Do Something About It" theme he admitted that the evils and problems in the equipment selling business were many but few could be met by the AED as a group. Most of them had to be handled by local distributors, because they were local or isolated problems. Many stemmed from non-AED competition. As a partial solution he urged local AED groups to bring into the organization all qualified firms. This was not intended to be a membership drive, as much as to spread the AED principles of business to firms which were now representing uncontrolled competition.

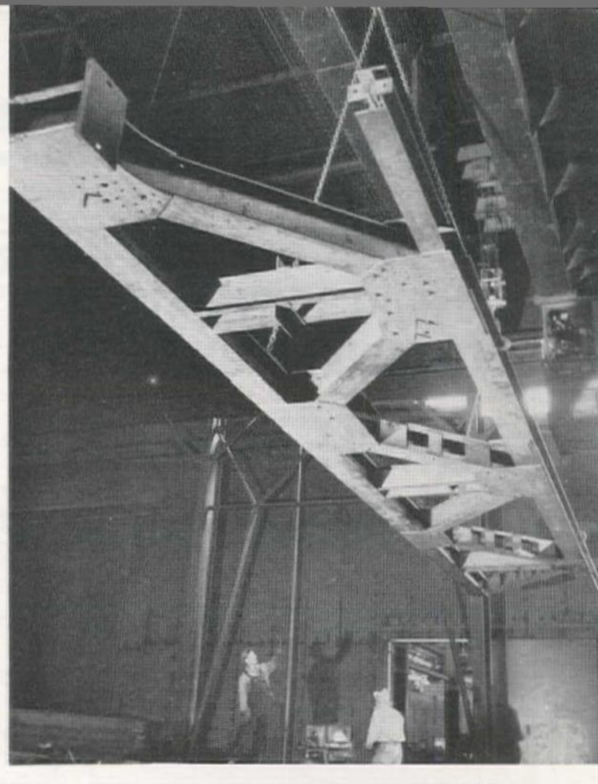
Future Western construction

At the morning session of the second day the meeting was handled by Frank Skidmore, director of Region 14, from Albuquerque. The first speaker was James I. Ballard, editorial director of *Western Construction*, San Francisco, who presented "A Long Range View of Construction in the West." Starting with the demonstration that construction generally represents about 10% of the income in any geographical area, he traced the construction volume of the West for the past 25 years and then moved into the realm of prediction by estimating the construction activity level in 1960. This was based on the expected population increase in the Western states for the next ten years, which experts place at 23% as compared to 40% for the 1940-50 decade. In the West about 75% of the construction volume is based on the increasing number of people, as compared to the 25% required to maintain the facilities of the established residents. As the acceleration of population growth declines during 1950-60 its dynamic effect on construction will fall off a corresponding amount, possibly from $1,800 per capita to $1,250 per capita, but the larger base of existing population will tend to maintain construction at current levels for the coming decade. The second part of his talk reviewed some of the current thinking among civil engineers on future technical developments that may eventually affect the type and characteristics of equipment which will be sold by AED members.

C. M. Weinberg, a recognized elder statesman among Western equipment distributors, went back through his long years of experience to counsel and bring words of wisdom and encouragement. He assured the distributors of today that their place in the national construction industry was secure. Recognition, which came hard at first, had been won. Distributors were no longer the "middlemen" handling construction machinery,

Continued on page 148





Seattle serves the Northwest —

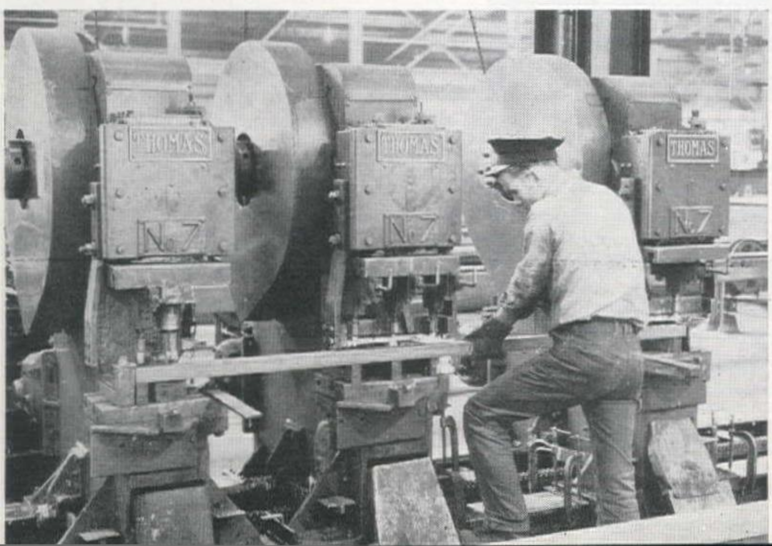
A new Bethlehem Pacific steel fabricating works

Rounding out Bethlehem's production facilities in the Pacific Northwest, this new plant has the latest equipment for tower and structural fabrication arranged for efficient operation under a four-acre roof.

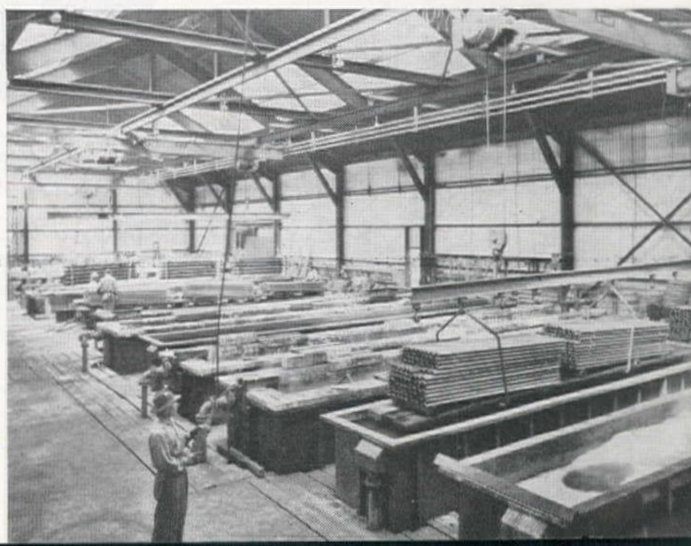
TYPICAL LARGE-SCALE operations shown here are assembly of a 15-ton bridge girder and handling a 10-ton truss fabricated for a Seattle school.

FOR A BRIDGE in Montana, a rivet team makes up an angle connection of a girder beam. Structural shop facilities include a 300-ton automatic beam rack punch and a track-mounted radial drill equipped for 160-ft. travel. At right, a column base plate is welded on a job for Weyerhaeuser Timber Co. Bethlehem's shops are fitted with mechanical flame cutting equipment and the last word in riveting and welding facilities.

IN THE TOWER SHOP, these three punches are operated simultaneously to punch five holes in a small angle. This is one step in the fabrication of transmission towers for the Bonneville Power Administration.



THESE TANKS in the galvanizing department represent all the steps in a galvanizing operation. From the right, tank contents soap wash, wash, pickle, flux, dry, and galvanize the steel as it is delivered by overhead crane.



CLASSIFIED SECTION

AED Conference

. . . Continued from page 146

but an essential service provided for manufacturers and contractors alike. He reminded his audience that municipalities and other public agencies represented often overlooked business, to supplement the sales normally made to contractors, but warned against involvements in local politics.

Mrs. Marjorie Creim of Bow Lake Equipment Co., Seattle, told about the value of the customer to any dealer and outlined means of holding him. For example, she reminded distributors about how much they would spend to gain a new customer, and then let some petty financial argument lose him. Always satisfy the demands of the customer first and then having done this take up the matter of adjustment with the manufacturer, was her plea in holding the customers that are the distributor's "Capital Asset."

In the concluding session, presided over by S. A. Stephens, Jr., director of Region 15, Montreal, Canada, James F. Truman, an insurance counsellor of Chicago, explained in detail the new AED insurance program.

At the final banquet Tracy W. Harron, past national president, from San Francisco, acted as master of ceremonies and introduced the past and present AED officers. The speaker of the evening was Charles F. Walker, president, Northwest School of Commerce, Portland.

Philip A. Dufford, Boise, was general chairman for the Sun Valley Conference. A. F. Sersanous, Portland, was program chairman. The Idaho committee on arrangements included Clyde Bunting, Peter Cohn and Harry Hurd.

NEWS of DISTRIBUTORS AND FACTORY BRANCHES

Robison-Kershaw Co., Caterpillar distributors, 245 W. South Temple, Salt Lake City, Utah, will now be known as *Wheeler-Kershaw Co.* D. A. Robison is retiring to enter the investment field and Kelsh Wheeler is joining Walter Kershaw in the new partnership. Wheeler was first associated with Caterpillar products when he was sales manager in the territory for *Landes Tractor and Equipment Co.* He later formed the J. K. Wheeler Machinery Co.

McIntosh

George McIntosh is the newly appointed sales manager for *Bay Cities Equipment Co.*, Oakland, Calif. McIntosh started selling tractors and construction equipment for *Shepherd and Crook* in Los Angeles, Calif., about 1925. He remained with that firm, which later became *Shepherd Tractor & Equipment Co.*, until 1936. McIntosh operated his own equipment rental service between 1936 and 1938 and then sold the first large order of Tournapulls west of the Rocky Mountains while working with *Peterson Tractor.* Sunnyvale, Calif. headquarters of *Wooldridge Manufacturing Co.* was McIntosh's next stop. He served as sales manager and aided in the development of the Terra-Cobra and air-controlled power unit. After working for *Soule' Equipment Co.* selling LeTourneau equipment and operating his own rental service in Oakland, McIntosh joined Bay Cities Equipment Co. a year and a half ago.

☆ ☆ ☆

Modern Machinery Co., Inc. recently opened a new store at 2963 First Ave.

South, Seattle, Wash. The new store will house complete parts and service facilities for the many well-known lines of earth-moving equipment handled by the firm and render the same service in the Seattle area that the Spokane territory receives.

☆ ☆ ☆

THOMAS A. HERBERT, long affiliated with the *Ford Motor Co.*, joins the staff of the *Western Traction Co.*, San Francisco. Herbert, at one time manager of the Ford Commercial and Fleet Division at Richmond, Calif., is a specialist in the field of trucks. He will head the *Marmon-Herrington* Ford Truck and extra heavy duty all-wheel drive truck department. Western Traction Co. is factory distributor in Northern California for the Marmon-Herrington line. Herbert will also devote some of his time to the promotion of sales of other lines handled by the firm.

☆ ☆ ☆

Fruehauf Trailer Co. is opening a used trailer department at the Los Angeles, Calif., branch to provide the motor transport system in the West with a large selection of reconditioned used truck-trailers. The new department will be located at 1444 S. Alameda, and JOHN HALWAX will be in charge.

☆ ☆ ☆

BYRON V. POWELL joins the sales staff of the *Constructors Equipment Co.*, Denver, Colo., according to D. G. GIBSON, general manager. Powell will cover the state of Wyoming and will headquarter at 1321 S. Poplar St., Casper, Wyo. He was formerly with the *Wortham Machinery Co.* of Cheyenne, Wyo.

☆ ☆ ☆

Anderson-O'Brien Co., 746 E. Washington Blvd., Los Angeles, Calif., *General Motors* distributors in Southern California for many years, announce the addition of the *Seaman* Tiller and Pulvi-Mixer to the lines already handled. The new distributor will carry the pull-type mixer, self-propelled mixer and Trav-L-Plant, plus many others. Dealer outlets are: *Lawless Brothers, Inc.*, Bakersfield; *Tulare County Tractor Co.*, Visalia, and *Lancaster Engine Co.*, Lancaster.

☆ ☆ ☆

Burke

EDWARD BURKE is now authorized sales representative for *C. A. Norgren Co.*, Denver, Colo. Burke succeeds the late STIRLING F. LAMOND, who previously acted as representative for the Norgren line of pneumatic products in Northern California.

☆ ☆ ☆

EUGENE ETZLER, 67, veteran member of the sales organization of *The White Motor Co.*, died in Los Angeles, Calif., September 17. Etzler had been White's service manager at the Seattle and Los Angeles branches in a sales-engineering capacity.

☆ ☆ ☆

Executive and plant offices of *Lincoln Electric Co.* are now located in the firm's modern plant at 22801 St. Clair Ave., Cleveland, Ohio.

☆ ☆ ☆

Republic Supply Company of California will concentrate a $750,000 stock of industrial supplies in its recently completed Northern Division headquarters at San Leandro, California. Service and deliveries from the new plant will be available to customers of the firm's Northern Division stores at Oakland, Stockton, San Jose, Fresno and the Sacramento area.

☆ ☆ ☆

HAROLD FOSTER, salesman for *Columbia Equipment Co.*, Portland, Ore., moves from Spokane and North Idaho territory to work out of the Seattle, Wash., branch. FRANK GILBERT joins the firm to cover Foster's former territory. M. W. HACKETT is also in the Spokane territory, which covers eastern Washington.

J. PETER BREHM becomes district sales representative in the San Francisco, Calif., area for the Woven Wire Fabrics Division of *John A. Roebling's Sons Co.* Brehm was a member of the Division's Los Angeles, Calif., sales force.

☆ ☆ ☆

MILTON W. BROOKS becomes sales manager of a new industrial sales division to develop new markets for component units of *The White Motor Co.* trucks and busses. Brooks has been a regional sales manager for *Cummins Engine Co., Inc.*

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