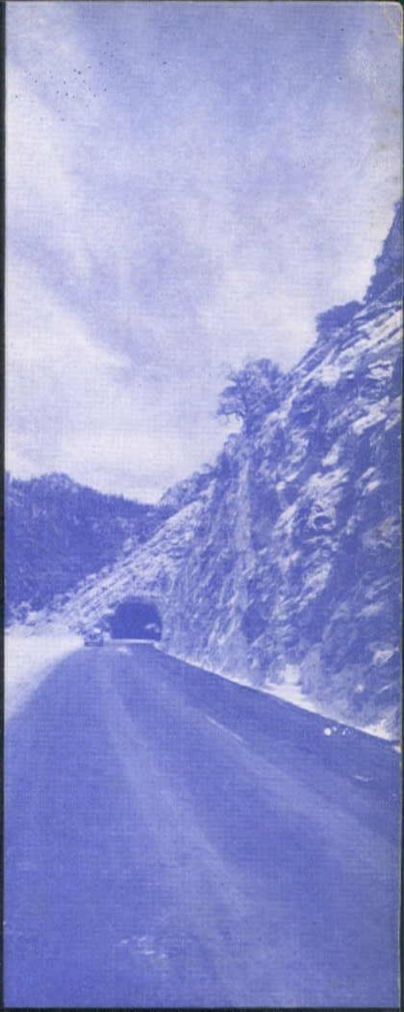
WESTERN CONSTRUCTION



ANNUAL HIGHWAY ISSUE

•

JUNE 1952

ALSO . . .

Earth cutoff under levee

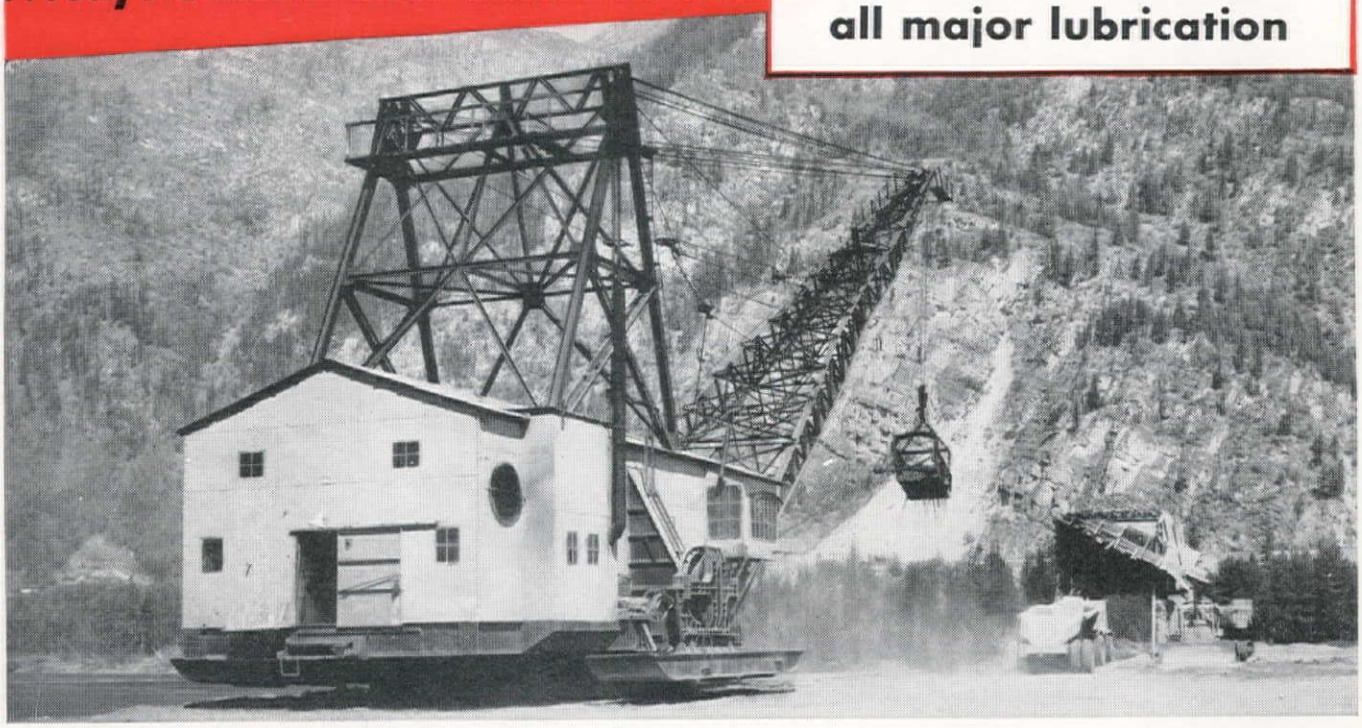
•

Pavements for jet planes

"The time and confusion saved by the TEXACO SIMPLIFIED LUBRICATION PLAN are incalculable"

...says General-Shea-Morrison Co.

Only 6 Texaco Products needed to handle all major lubrication



"Not only is it more economical to use a small number of lubricants," says the contractor for Hungry Horse Dam, Montana, "but there is little chance of error in application . . . a big factor in keeping our equipment on the job and our maintenance costs low."

PRODUCTS USED IN TEXACO SIMPLIFIED LUBRICATION PLAN

1. ENGINE LUBRICATION: Use *Texaco Ursa Oil X★★*. This fully detergent-dispersive oil keeps both heavy-duty gasoline and Diesel engines clean . . . keeps harmful deposits from forming . . . guards against wear, rust and bearing corrosion. Maintenance costs and fuel consumption are both lower.

2. CHASSIS LUBRICATION: Use *Texaco Marfak*. It's tough, longer lasting. Won't jar or squeeze out of bearings, protects against dirt, rust, wear. *More than 400 million pounds of Texaco Marfak have been sold.*

3. WHEEL BEARING LUBRICATION: Use *Texaco Marfak Heavy Duty*. It 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*. It gives long-lasting protection against dirt, water and wear. Reduces maintenance costs.

5. AIR COMPRESSOR LUBRICATION: Use recommended Texaco air compressor oils. There is one exactly suited to your particular operating conditions.

6. ROCK DRILL LUBRICATION: Use *Texaco Rock Drill Lubricant EP*. It has "extreme pressure" properties that give superior protection against wear. It guards against rust whether drills are running or idle.

Follow the Texaco Simplified Lubrication Plan for greater savings and convenience on every job. A Texaco Lubrication Engineer will gladly help you set it up to meet your particular conditions. 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.

TEXACO Lubricants and Fuels

FOR ALL CONTRACTORS' EQUIPMENT

Faithfully yours

50 TEXACO 1902 1952

for Fifty Years

TUNE IN . . . TEXACO STAR THEATER starring MILTON BERLE on television every Tuesday night. See newspaper for time and station.

24 SUCCESSFUL CONTRACTORS STAY SUCCESSFUL WITH PROVED EQUIPMENT!

THERE is no contractor in the country that has had any greater variety of excavating problems to solve than the Macco Construction Co. of San Francisco. They have had their Northwests in rock work that would take its place amongst the best shovel busting jobs that any outfit ever faced and conversely they have found that a *real* Rock Shovel means greater output in the easy digging.

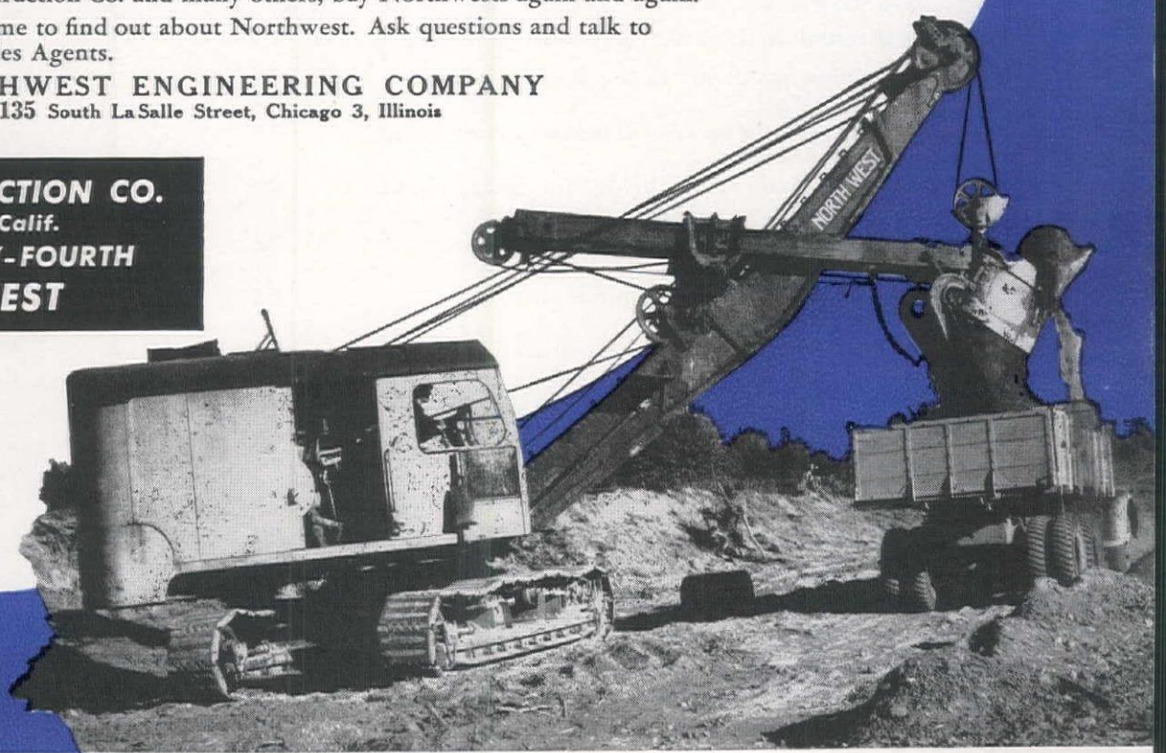
Macco Construction Co., over the years, has purchased 24 Northwests and they have used them from California to British Columbia.

Northwest brings you the Northwest Dual Independent Crowd that utilizes force most other independent crowd shovels waste, a range of Boom Hoist equipment to meet any condition, Uniform Pressure Swing Clutches, the Cushion Clutch, ease of operation without the complications and adjustments of special equipment, and a host of other advantages. These are just a few of the reasons why Macco Construction Co. and many others, buy Northwests again and again.

Now is the time to find out about Northwest. Ask questions and talk to one of our Sales Agents.

NORTHWEST ENGINEERING COMPANY
135 South La Salle Street, Chicago 3, Illinois

MACCO CONSTRUCTION CO.
San Francisco, Calif.
buy their TWENTY-FOURTH
NORTHWEST



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Successful Contractors Stay Successful with

WESTERN CONSTRUCTION

Volume 27 **JUNE 1952** Number 6

ANNUAL HIGHWAY ISSUE

ARTICLES on highway subjects

ARTICLES on other subjects

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B.F.Goodrich

tires give a four-way saving to off-the-road operators

HERE'S a way you can beat rising costs and get longer tire life in spite of rugged operating conditions. Follow the lead of off-the-road operators throughout the country who use B. F. Goodrich tires— tires specifically designed to stand the gaff of the toughest jobs.

The Concrete Pipe Company of La Grande, Oregon (below), for example, uses BFG Rock tires. These tires have a tough, thick tread that resists cuts. Husky shoulder cleats give positive traction in forward or reverse gear while the center ribs lengthen tire life.

B. F. Goodrich Tractor Grader Universal tires are the choice of the N. Fiorito Company of Seattle, Washington (right). For power wheels the Universal can't be beat. Its wedge-shaped tread of specially-compounded rubber is tops for bruise resistance and full 2-way traction.

Universal Tires—These new BFG Tractor Grader Universal tires have rolled 240 hours for the N. Fiorito Company. This operator particularly likes the non-directional Universal tread.

And these tires—like all others of 8 or more plies in the B. F. Goodrich line—are built with the exclusive *nylon shock shield*. Layers of rubber-coated nylon cords between the tread rubber and cord body stretch together under impact. These strong, elastic cords actually shield the tire body from smashing road shock. No wonder the nylon shock shield gives off-the-road operators these 4 savings:

(1) More recappable tires and more miles per recap—even under the toughest operating conditions (2) increased tire mileage (3) greater bruise resistance (4) less danger of tread separation.

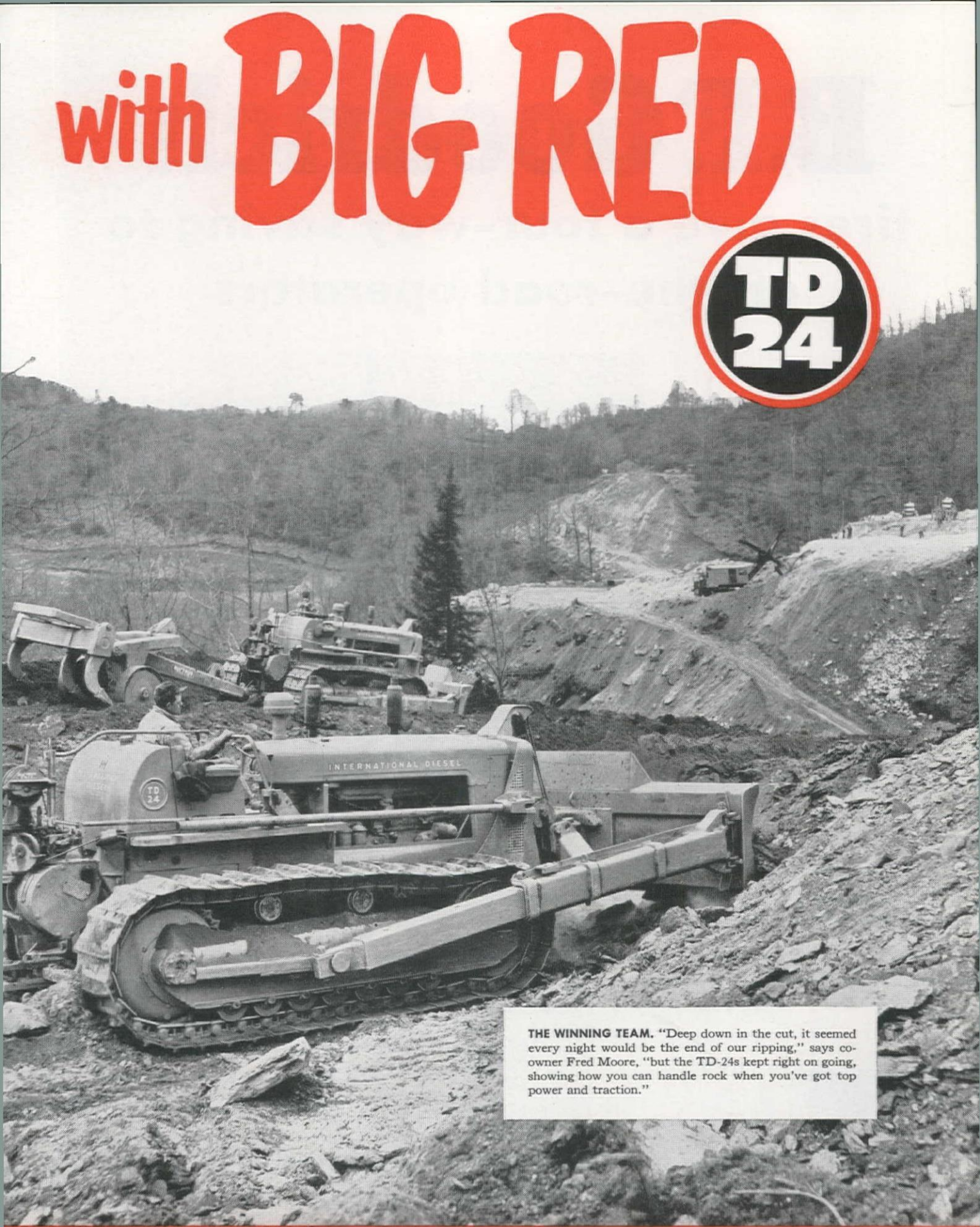
Join the list of off-the-road operators who cut operating costs and get better service from BFG tires. See your B. F. Goodrich dealer—you'll find his name under Tires in the Yellow Pages of your telephone directory—or write direct to: *The B. F. Goodrich Company, Akron, Ohio.*

Rock Tires—The Concrete Pipe Co. reports B. F. Goodrich Rock tires cut operating costs, give better service than other makes.

RESEARCH KEEPS B.F.Goodrich FIRST IN RUBBER

with BIG RED

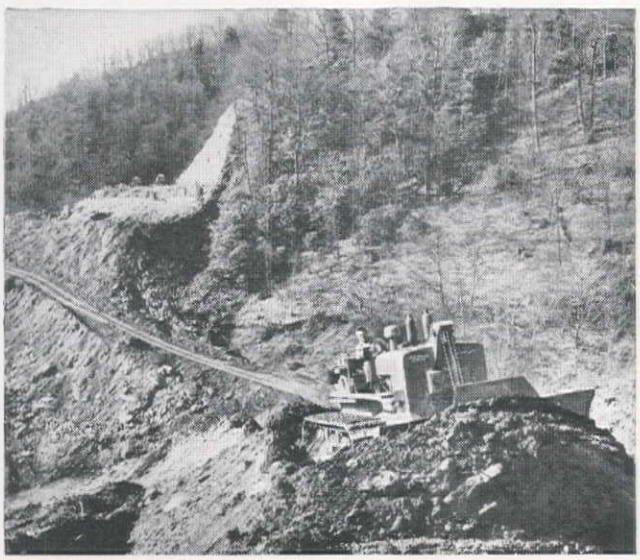
TD 24



THE WINNING TEAM. "Deep down in the cut, it seemed every night would be the end of our ripping," says co-owner Fred Moore, "but the TD-24s kept right on going, showing how you can handle rock when you've got top power and traction."

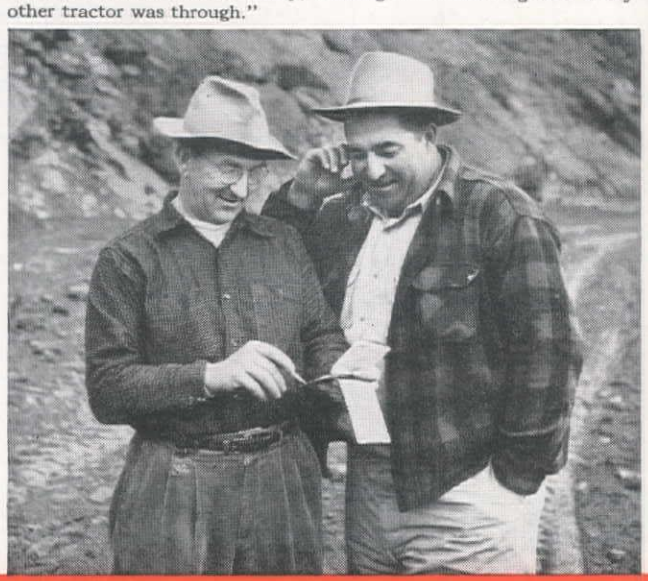
Blazin' Up the Blue Ridge

TD-24s rip up 35,000 yards of rock that otherwise would have needed blasting



PUSHOVER FOR THE CHAMP. The toughest work comes easy for the Big Red TD-24. This great International crawler digs in with 148 maximum *drawbar* horsepower—the most of any crawler on the market.

HAPPY CONTRACTORS Allan Siler and Fred Moore. As Mr. Moore says, "There are two ways to move rock: this way and by blasting. Our TD-24s saved us a lot of money, working rock loose long after every other tractor was through."



It was rough work to build a modern road from Charlotte, N. C., to the cool resorts along the Skyline Drive, atop the famous Blue Ridge Mountains.

One cut and fill followed another—and one cut alone was 110 feet deep in solid rock.

That's where Macon Construction Company dug out 93,000 cubic yards of rock, and instead of blasting it all, they were able to doze and rip out 35,000 yards with two big red International TD-24 crawlers.

"We have rock here that you couldn't touch with a dozer, till the TD-24 came along," says ripper operator Roy Cantrell. *"Now we blade where we couldn't scratch before, and the ripper tears up rock that used to need blasting."*

And dozer operator Jess Leatherwood adds, *"My TD-24 pushes more, moves faster and handles easier than any other tractor—and I've run 'em all!"*

Get complete details on TD-24 capabilities from your International Industrial Distributor . . . and you'll be a TD-24 man yourself from then on in!

INTERNATIONAL HARVESTER COMPANY
CHICAGO 1, ILLINOIS

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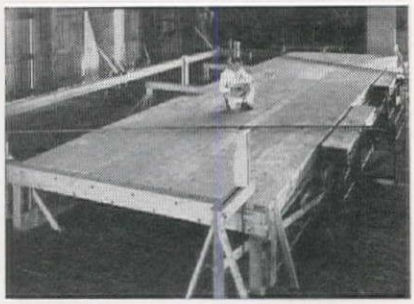
POWER THAT PAYS

PANEL DISCUSSION

Diaphragm Tests Prove Plywood Shear Strength



New specific design data which proves plywood's great resistance to shear forces set up by earthquakes and windstorms have been developed by plywood industry engineers in one of the most significant research projects of recent years.

Culminating 14 months of study, the new design data permits architects and engineers to specify plywood floor and roof construction with full confidence that the structure will withstand the great lateral stresses and shears due to high winds or seismic shocks which may be encountered in schools, warehouses, commercial and industrial structures.

As one result of this new design data, the Uniform Building Code has been amended to permit greater allowable plywood diaphragm shears. The new allowable lateral loading for plywood diaphragms are given below in condensed tabular form:

Plywood Thickness	Nail Size	Shear (lb-per-ft.-width) 2⅜" framing		
		Nail Spacing on all panel edges		
		6"	4"	3"
5/16", ⅜"	6d com.	185	280	315
⅜", ½", ⅝"	8d com.	265	400	450
½", ⅝"	10d com.	320	480	545

Tabulated shears should be reduced one-fourth for other than wind or seismic loads. Diaphragm width measured parallel with load.

In developing the material, it was assumed initially that a plywood floor or roof diaphragm would function as the load bearing web in a giant girder. Following tests with scale models, four full-size models were constructed using ½" plywood nailed across 2x10 joists. Sections were loaded with a truss system in which the loads were applied with two 30-ton hydraulic jacks.

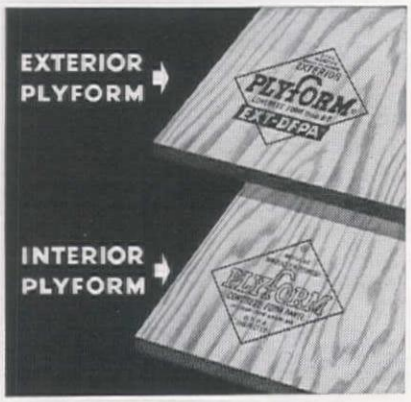
Based on 15,000 numerical observations it was found that a floor or roof sheathed with plywood acts as a horizontal girder with a fully shear resistant web. This means that stresses in individual parts and the deflection of the member as a whole can be accurately calculated.

Complete data on the tests, including simplified design information and a table of shears for various constructions are available free of charge from Douglas Fir Plywood Association, Tacoma, Wash.

PlyForm Grade Plywood Now Made In Two Types

West Coast plywood manufacturers are now using the familiar PlyForm grade-name to identify the special concrete form grades within both Interior and Exterior type.

Exterior-type PlyForm, a new grade-trademark, replaces the old Exterior Concrete Form grade-name. Identified by the new diamond-bar symbol shown below, Exterior PlyForm with 100 per cent waterproof glue is intended for use where forms will be re-used until the wood

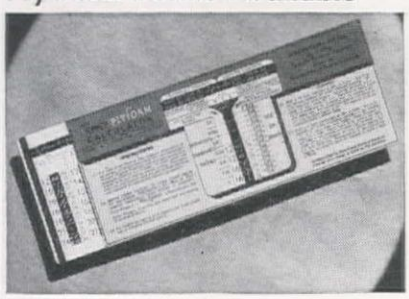


itself is worn away, in excessively humid areas, or under extreme use or storage conditions. It is edge sealed with a distinctive red sealer.

Interior PlyForm is now manufactured with newly fortified moisture-resistant glues which, although not waterproof, will withstand as many as 10 or 15 re-uses. Interior PlyForm continues to be identified by the familiar diamond grade-trademark. Edges are sealed with distinctive green sealer.

Both face and inner-ply construction of Interior and Exterior PlyForm are the same: faces are of B veneer which is smooth and solid but may contain small tight knots and neat circular repair plugs; inner ply construction (as in all Exterior fir plywood) of C veneer contributes to panel strength and rigidity. A folder which gives additional details and information on other plywood grades used for form work is available from Douglas Fir Plywood Association, Tacoma, Washington.

Slide Rule Calculator For Plywood Forms Available



A handy new slide rule calculator which gives construction data for plywood forms is available for $1.00 from Douglas Fir Plywood Association, Tacoma 2, Washington. Included with the new calculator is the leaflet "Design Assumptions for the New Keely Calculator."

YOUR CHOICE OF 3 GREAT B-TYPE SCRAPERS

B-250

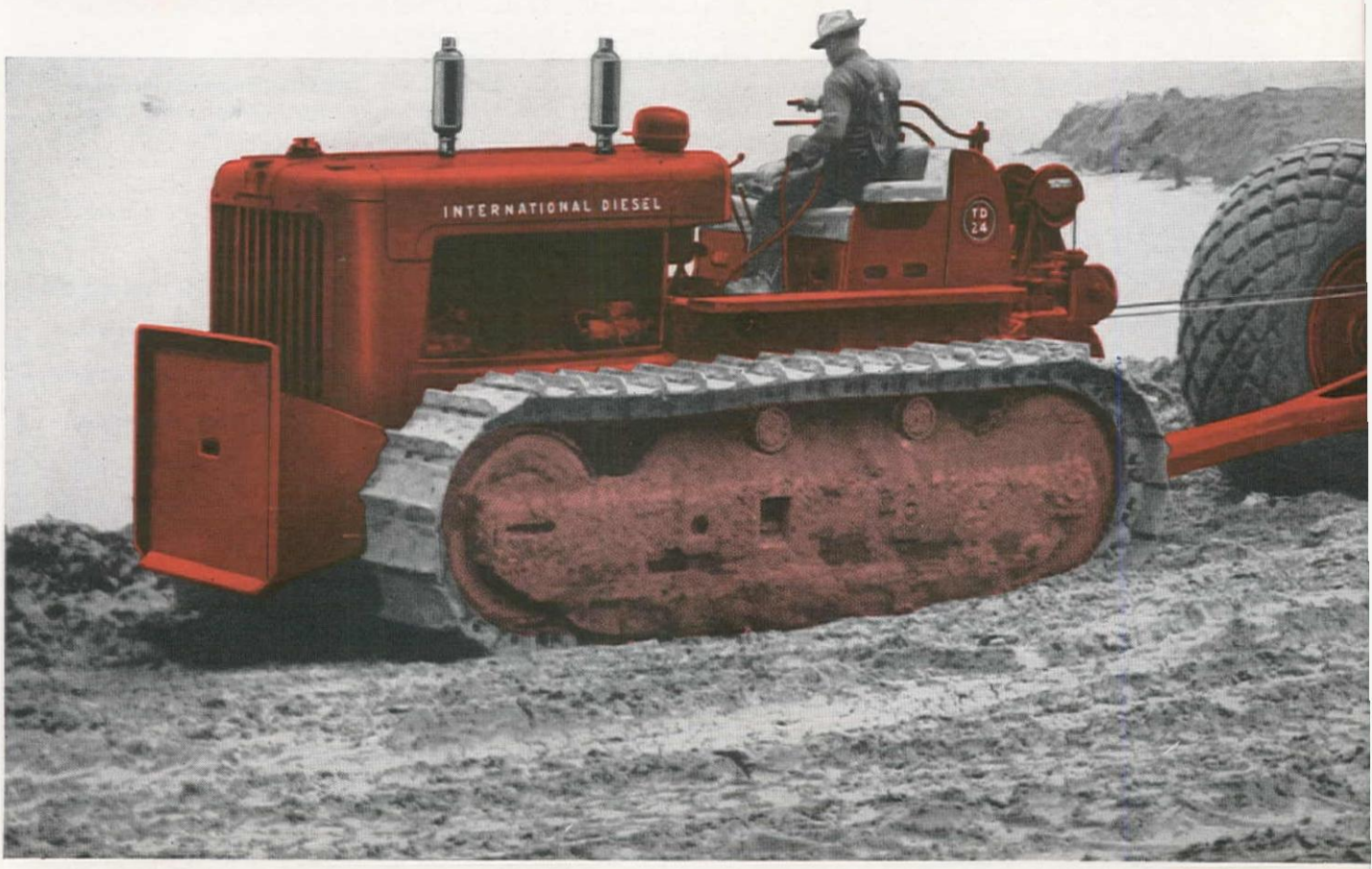
(22 yd. struck, 27½ yd. heaped). Largest scraper in current production available for use with crawler tractors. Developed along with the International TD-24 tractor to fully apply its unusual working capacity.

(10 yd. struck, 14 yd. heaped). Engineered especially to work with the International TD-18A Tractor and make a matched dirt-moving team of championship caliber.

B-170A

(16 yd. struck, 21 yd. heaped). Has greatest struck capacity of the scrapers loaded without pusher assistance. Designed as the companion to the TD-24 tractor — takes full advantage of its superior speed and power.

B-113



Each of these three Bucyrus-Erie B-Type Scraper models loads with the same "fountain" action that breaks up chunks and boils material up through to fill the bowl completely.

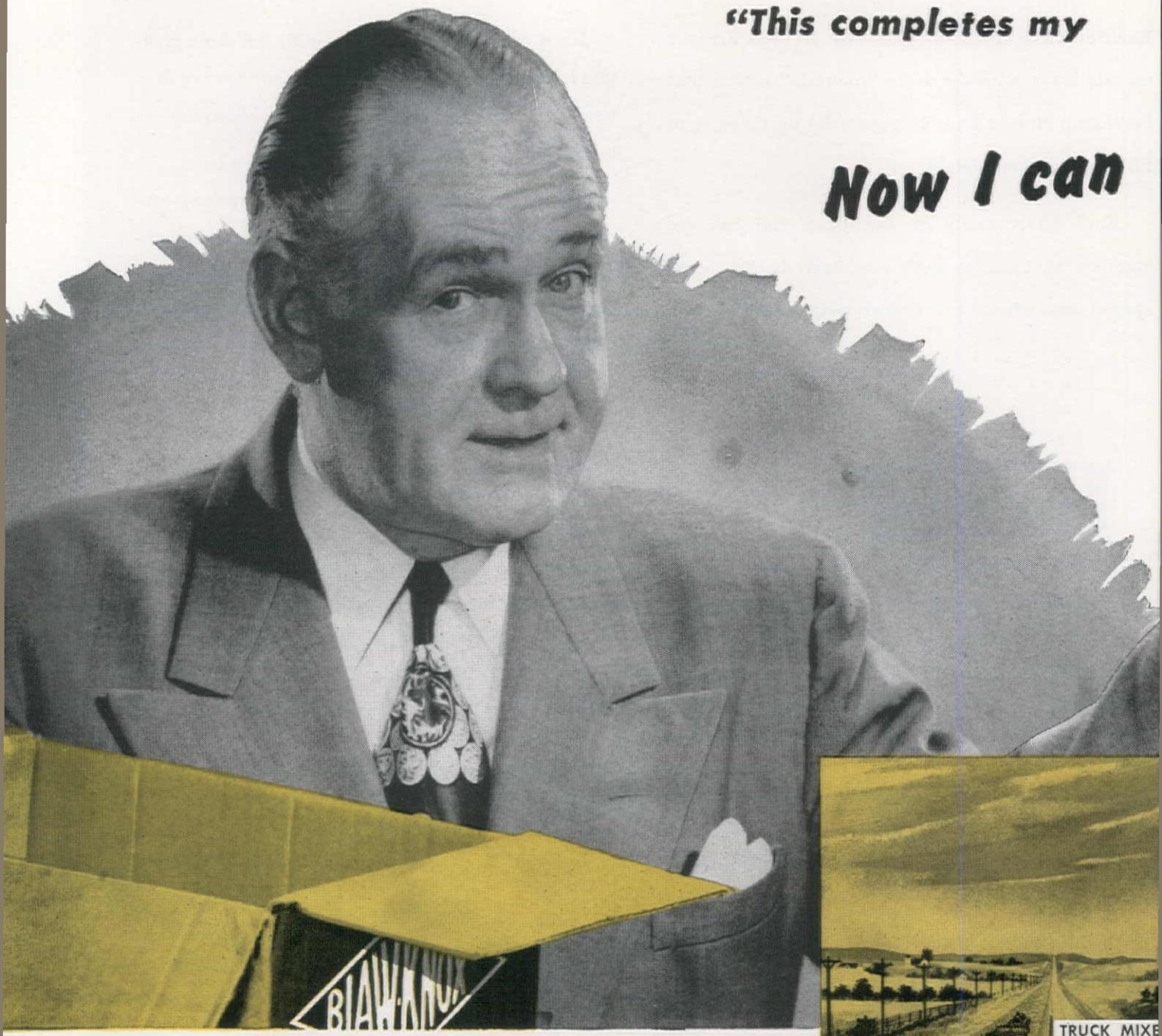
Each hauls easily on big tires, and has the stability that comes with low bowl height, wide spaced rear wheels and proper weight distribution.

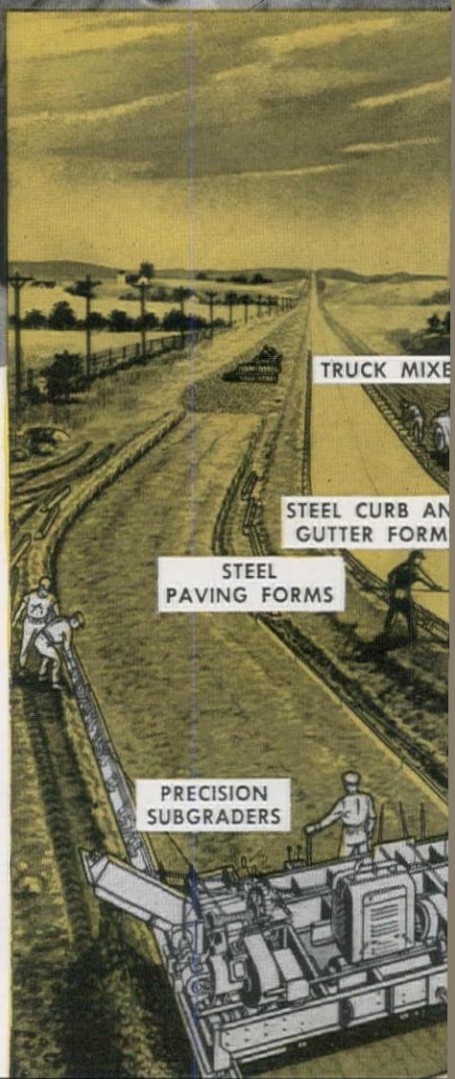
Each dumps fast and clean with the same positive *rolling* action — a type of ejection that requires less horsepower and thus permits dumping in higher tractor gear.

Each has the design refinements and strong construction throughout that mean extra ease of handling and servicing, extra yardage hauled, extra long life.

"This completes my

Now I can





BLAW-KNOX Spreader-Vibrator and Finishing Machine working on Edens Expressway near Chicago. The vibrating pan on the Spreader assured proper densification throughout the slab, even though an exceptionally stiff mix of air-entrained concrete was specified. A finish tolerance of 1/8" in 10' was required. Other Blaw-Knox equipment in this "Complete Package" included Aggregate and Cement Batching Plants, Finishing Machines and Self-Aligning Steel Road Forms. MultiFoote Pavers placed the concrete.

BLAW-KNOX 'Package'... handle any concrete paving job!"

I'VE really increased the type of jobs I can handle by completing my Blaw-Knox "package" of concrete paving equipment, and so can you, to get ready for the big construction days ahead.

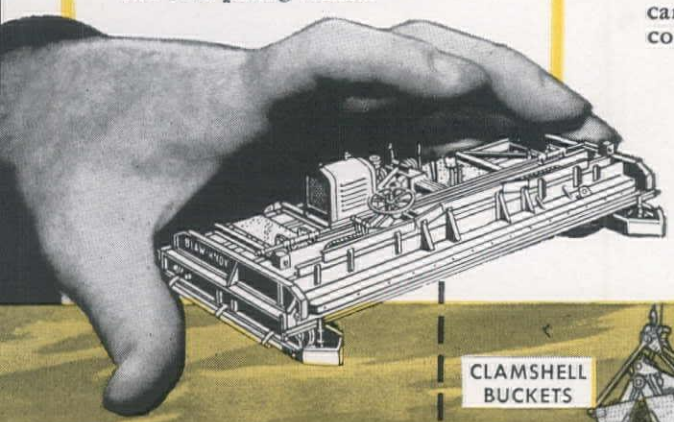
In the "Complete Package" you get *all* the equipment you need, from forms to finisher. You can use the entire set-up for the big jobs, or choose the units you need for whatever job comes up . . . roads, streets, airports, or even dams or bridges. And you can be sure of getting *all* the advantages of a "packaged" system . . . smooth, low-cost production-line operation, with each highly productive unit integrated with the others for big output at a steady, profitable pace.

You get a further profit pay-off in the *one-source* conveniences of a "Complete Package" . . . all your equipment from one responsible manufacturer vitally interested in your success, with only one financial contact, and backed by one construction-minded distributor organization working hand in glove with you to assure prompt, efficient service in parts and maintenance. One Blaw-Knox trained man can service *all* your "Complete Package" equipment! You can get the entire package on one order and in one shipment if you like, or choose the equipment you need *now*, then add the others as your needs increase.

Remember, when you have the Blaw-Knox "Complete Package", you can handle any concrete construction job faster, better and at the lower costs that assure profit.

BLAW-KNOX PAVING SPREADERS

Like the other equipment in the "Complete Package", Blaw-Knox Paving Spreaders are designed for record-smashing production and high quality performance. By using the vibratory pan attachment on the Spreader, exceptionally uniform, dense concrete free from difficult finishing problems, can be obtained. This 20-25-ft. adjustable spreader, with the automatic transverse blade, can handle the maximum output of two 34-E paving mixers.



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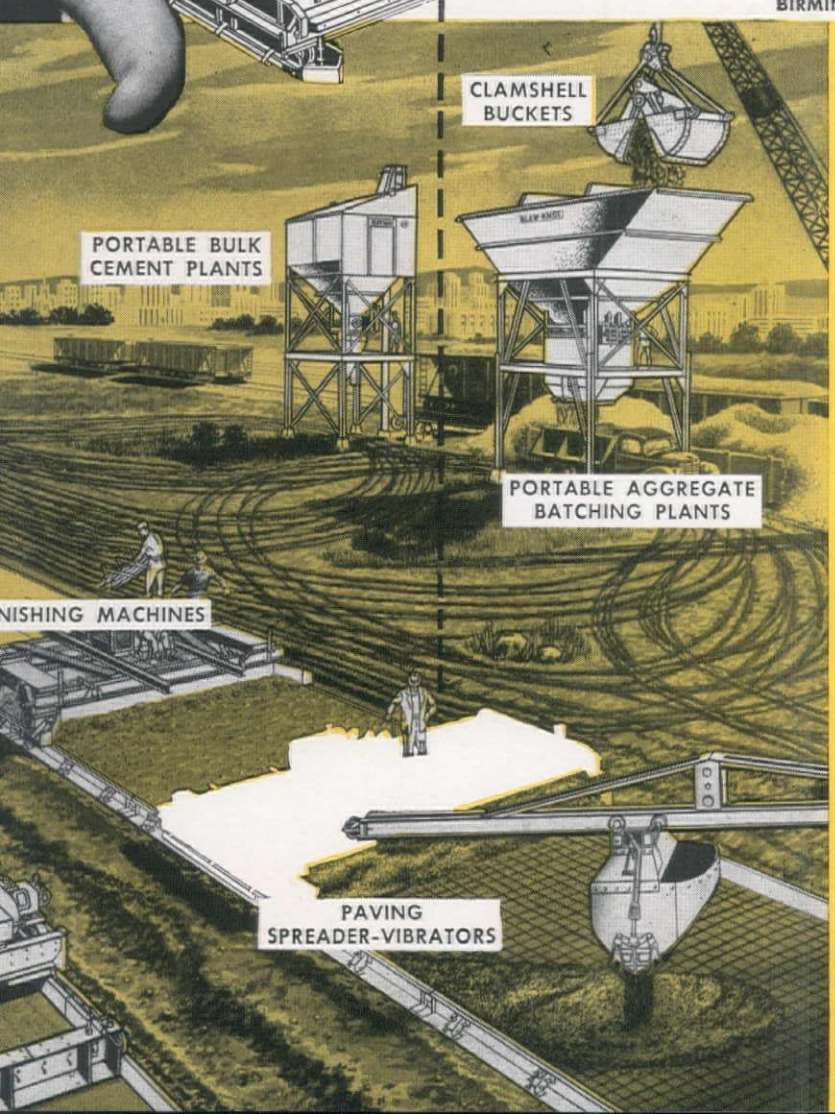

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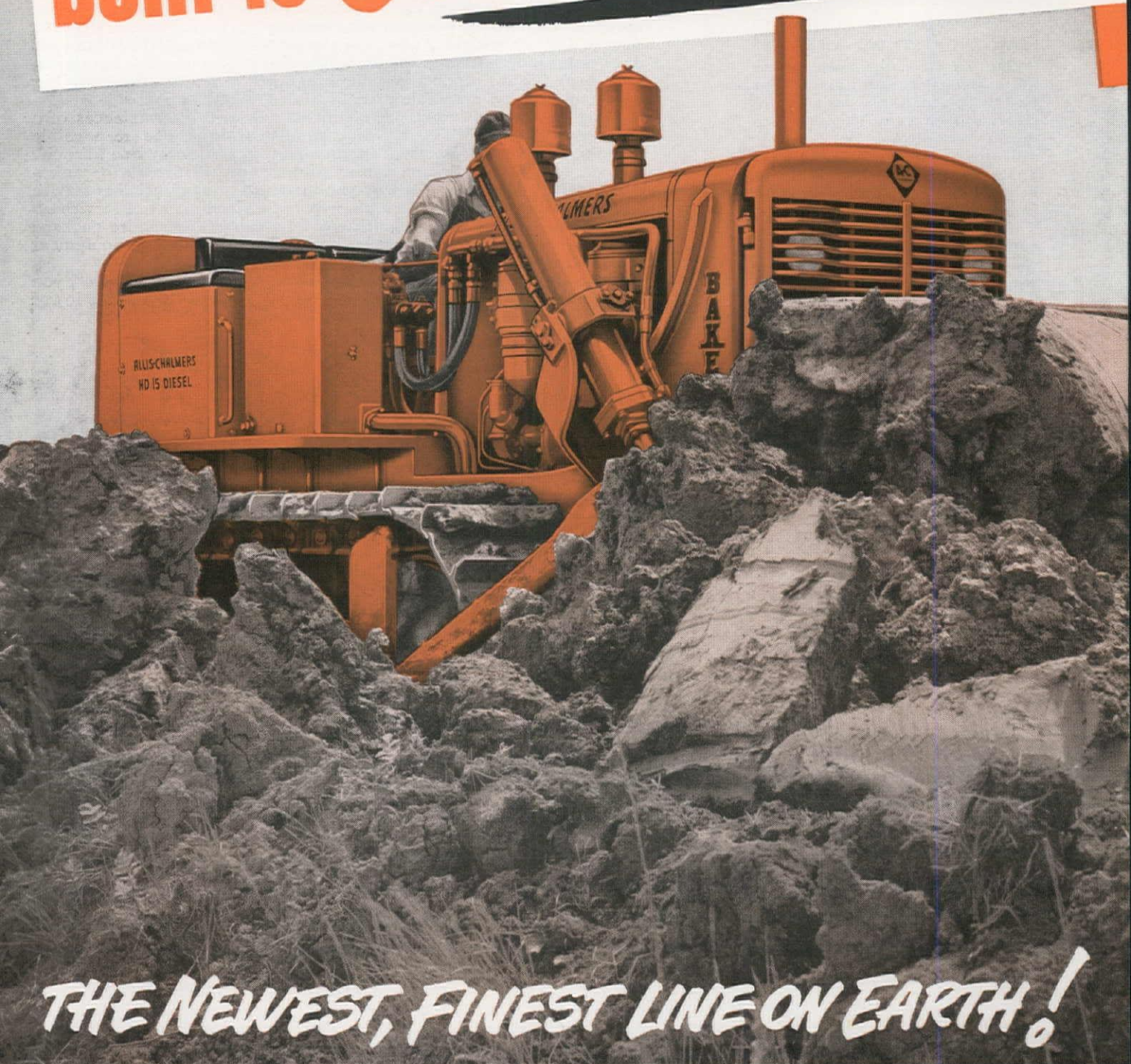
NEW ALLIS-CHALMERS HD-9, HD-15 ARE built to GET MORE DONE



THE NEWEST, FINEST LINE ON EARTH!

HD-5
40 drawbar hp.
11,250 lb.

HD-9
72 drawbar hp.
18,800 lb.

HD-15
109 drawbar hp.
27,850 lb.

HD-20
Hydraulic Torque
Converter Drive
175 net engine hp.
41,000 lb.

built to TAKE IT LONGER

Unequalled Lugability

The HD-9 and HD-15 build up greater drawbar pull faster . . . hold it longer than ever thought possible in gear transmission tractors.

For example, when tough going has pulled travel speed down 40 percent, these tractors will have increased their drawbar pull almost 20 percent over rated pull. They will lug down almost 45 percent from rated travel speed before drawbar pull even starts to fall off.

To take full advantage of this important GM 2-cycle diesel engine characteristic, the HD-9 and HD-15 have longer truck frames, lower idlers and sprockets. That means more track on the ground . . . better stability . . . sure-footed traction . . . unequalled *lugability.*

Extra Long Life

Here are a few of the many reasons why these newest, finest tractors are *built to take it.*

- **All-Steel Welded Construction**
- **More Power with Bigger Engines — Longer Engine Life**
- **More Weight, Greater Strength**
- **Extra Heavy Main Frames — No Extra Reinforcement Needed for Front-Mounted Equipment**
- **Long-Lasting, Large Diameter Clutches**
- **Double Reduction, Straddle-Mounted Final Drive Gears with Live Sprocket Shafts and Caged Bearings**
- **Positive Operating Track Release — Works in Oil**
- **All New, Specially Designed Track Assembly**
- **Positive-Seal Truck Wheels, Support Rollers and Idlers — Mounted on Tapered Roller Bearings, 1,000-Hour Lubrication!**

Your Allis-Chalmers dealer will be glad to explain all of these advantages. See him or phone him now.

SEE YOUR ALLIS-CHALMERS DEALER

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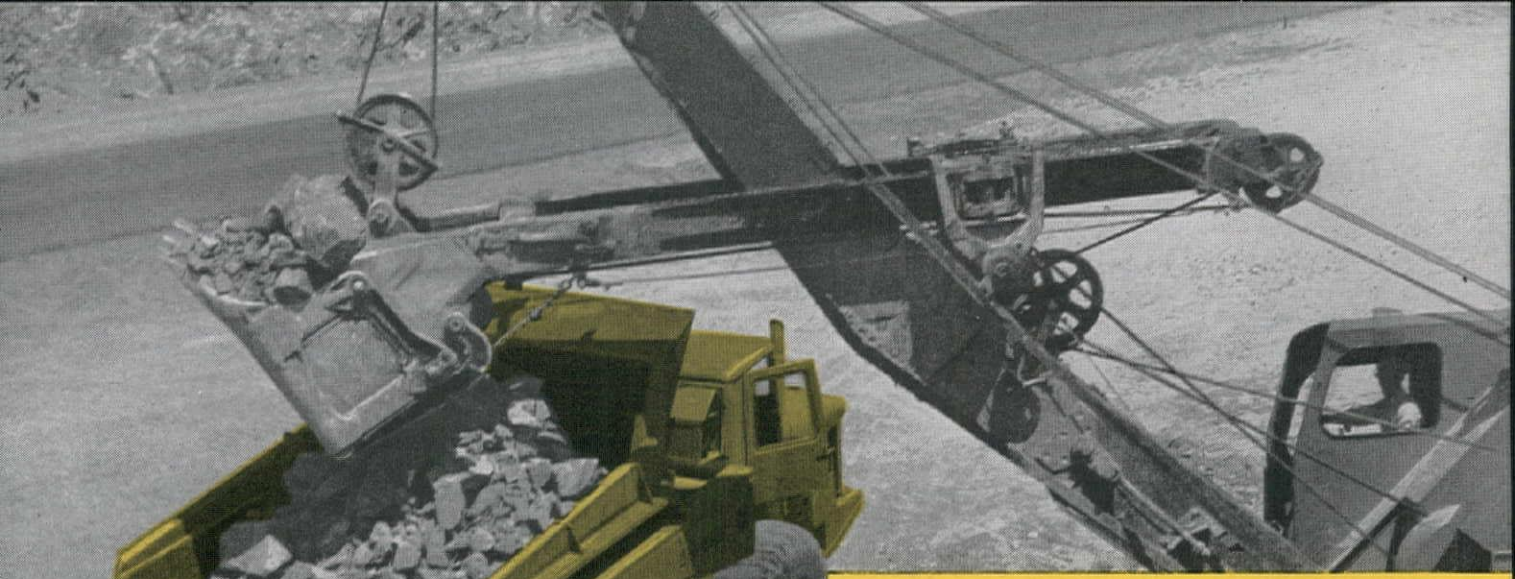
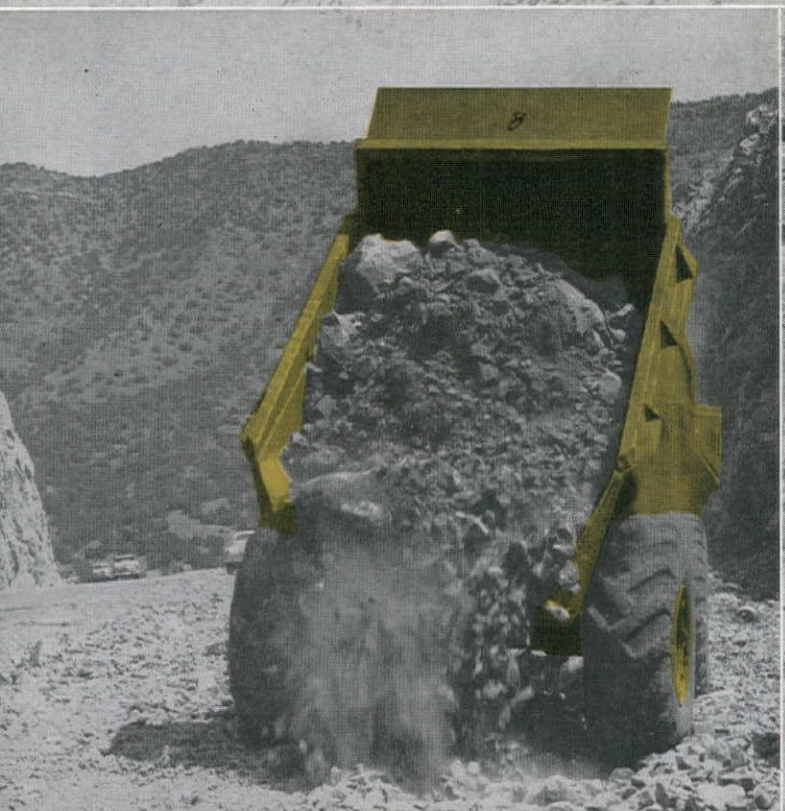
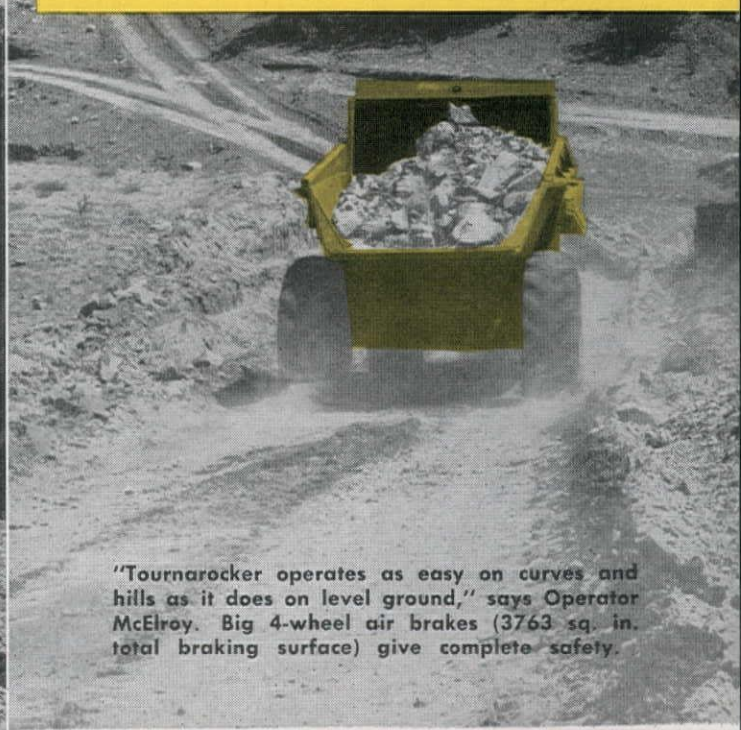


Tournarocker is loaded with 15 pay yards of granite in 3 minutes. Big square bowl, low loading height, gives shovel operator an easy-to-hit target . . . lets him load faster with shorter swings, less spillage.

135 yards of granite hourly





"Tournarocker operates as easy on curves and hills as it does on level ground," says Operator McElroy. Big 4-wheel air brakes (3763 sq. in. total braking surface) give complete safety.

Arizona — Phoenix
ARIZONA EQUIPMENT SALES, INC.

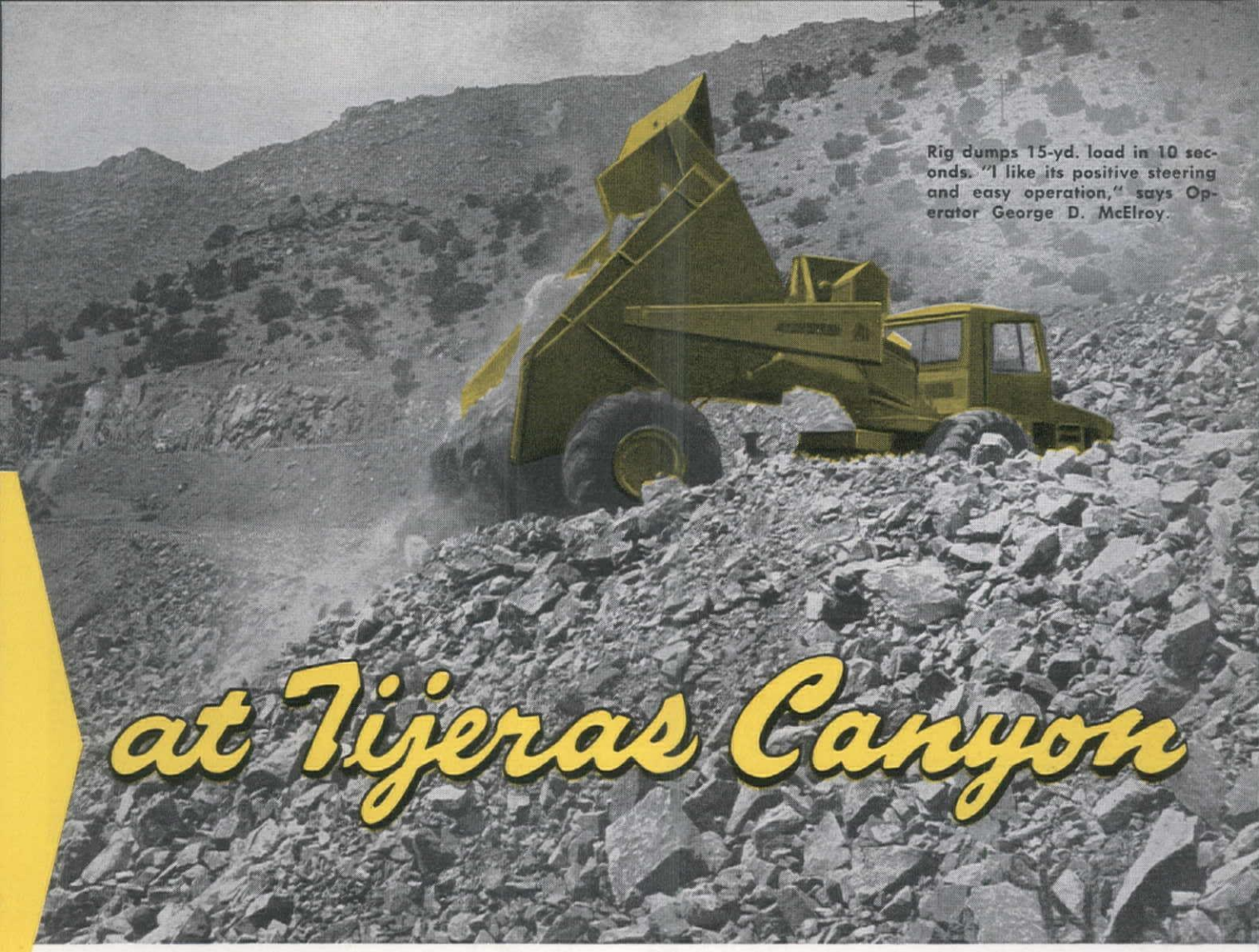
California — Los Angeles, Bakersfield
CROOK COMPANY

Idaho — Pocatello
ROCKY MT. MACHY. COMPANY

California — Oakland
BAY CITIES EQUIPMENT, INC.

Colorado — Denver
COLORADO BUILDERS' SUPPLY CO.

Montana — Helena, Billings
MONTANA POWDER & EQUIP. C



Rig dumps 15-yd. load in 10 seconds. "I like its positive steering and easy operation," says Operator George D. McElroy.

Skousen-Hise Tournarocker hauls up 10 to 15% grades

When Skousen-Hise Contracting Co., Albuquerque, New Mexico, started building a new 4-lane route for U.S. 66 through the Sandia Mountains, 6 miles east of Albuquerque, the job called for a fast, maneuverable rear-dump hauler for work in restricted quarters. After careful consideration of available machines, the company decided on a 16-ton 35 m.p.h. C Tournarocker—a rig which has a turning radius of only 13′9″. Roading the electric-control "Rocker" through traffic at Tijeras Canyon, Skousen-Hise got the following profitable production on the 1,000,000-yd. project.

2400′ cycle every 6 minutes

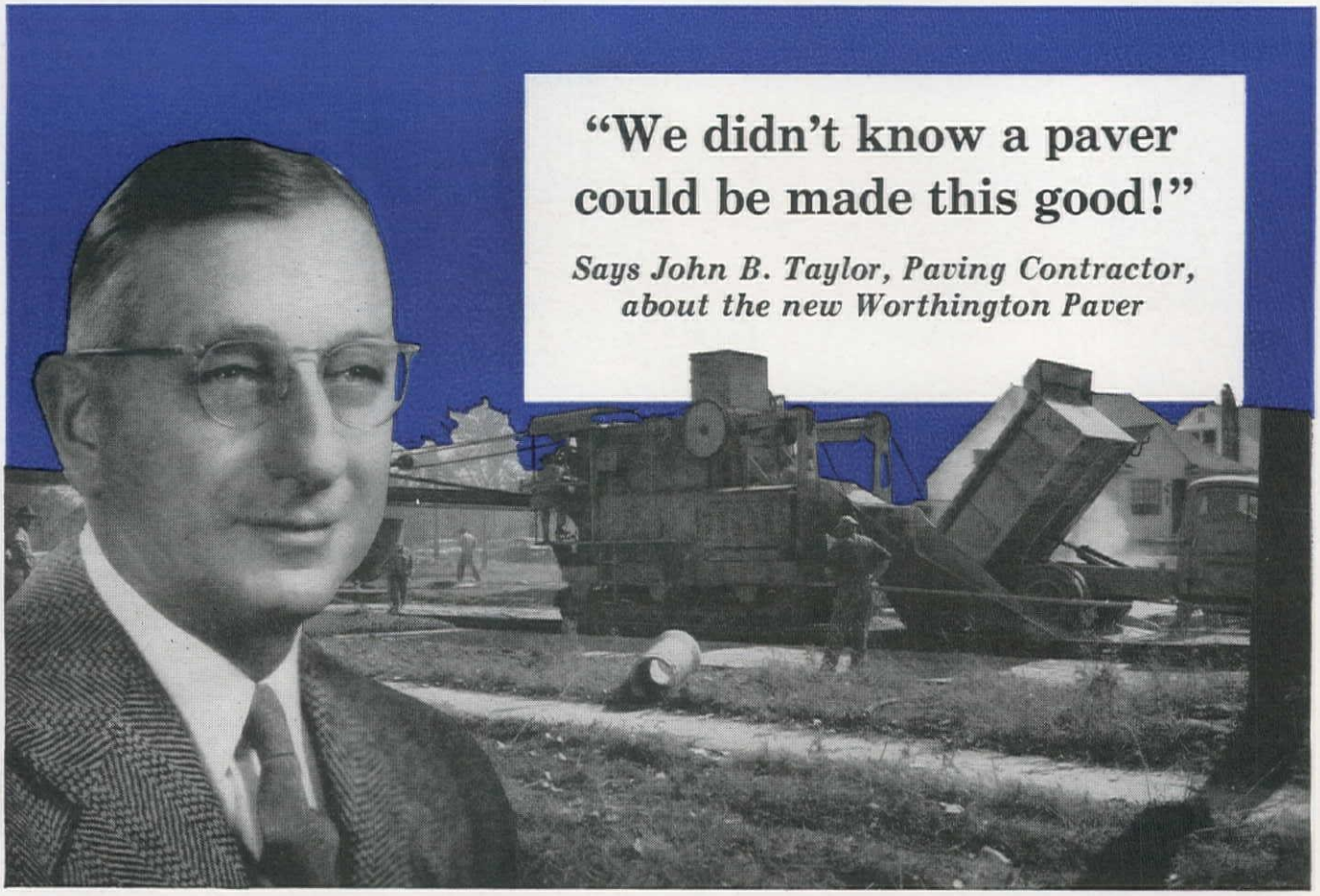
With sideboards to increase capacity, C Roadster was loaded with approximately 15 pay yards of blasted, partially decomposed granite in 9 passes of a 1¾-yd. shovel. In spite of occasional delays which boosted average load time to 3 minutes, rig completed a 2400′ cycle every 6 minutes . . . made 9 trips, delivered 135 pay yards per hour. Haul to fill included 240′ of 15% downgrade, 100′ of 10% adverse grade. Haul speed averaged 11 m.p.h.

"Can't beat Tournarocker" says Superintendent Isbell

With 2500 hours on the machine, owners are very satisfied with Tournarocker's performance. 100 days ahead of a 400-day schedule because of good weather and high production, Job Superintendent Andy Isbell says, "For maneuvering around in rocks and tight places, you can't beat the Tournarocker."

Check other job reports

Whenever you have dirt or rock to move, it will pay you to check the high output and low costs other contractors are getting with LeTourneau rear-dumps, bottom-dumps, and Carryall Scrapers. See your LeTourneau Distributor for job-proved facts and figures on work like yours.



"We didn't know a paver could be made this good!"

Says John B. Taylor, Paving Contractor, about the new Worthington Paver

"SELDOM DO WE ENDORSE ANY CONSTRUCTION EQUIPMENT" begins a letter from John B. Taylor, Taylor Brothers president, pictured here on the job, ". . . but after using the new 34E . . . we feel it our responsibility to write you."

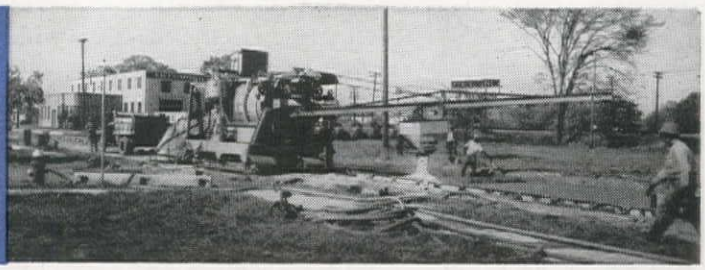
According to its president, John B. Taylor, Taylor Brothers Company, Inc., paving contractors from Birmingham, Michigan, have found that the new Worthington Model WP paver will lay more highway faster and at lower cost than any paver his company knows of.

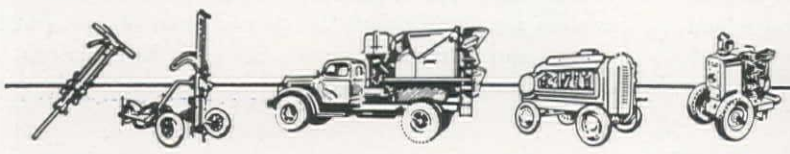
Says Mr. Taylor: "We thought we knew about your pavers' superiority after using them for 20 years, but this new 34E beats them all."

The Taylor Company has been using its Worthington Dual Drum Paver on a paving job near Dearborn.

The new Worthington paver is the practical result of forty years of experience in building pavers and other construction equipment. Learn how it can help speed *your* paving jobs by writing for Bulletin R-1700-B7 to *Worthington Corporation, formerly Worthington Pump and Machinery Corporation, Construction Equipment Division, Plainfield, New Jersey.*

NEW WORTHINGTON DUAL-DRUM PAVER at work for Taylor Brothers on a paving job near Dearborn, Michigan. Taylor's job reports indicate that the new paver, with its six-and-a-half-second skip, faster transfer and discharge automatic water control system, and hydraulically controlled bucket, is laying more highways and streets at less cost.



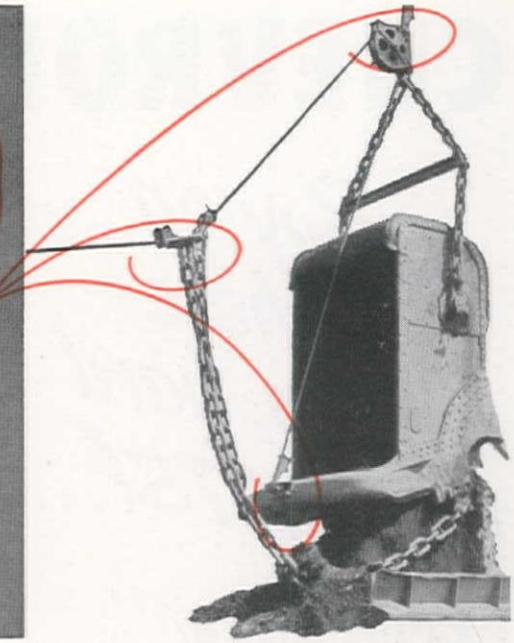


If It's A Construction Job, It's A BLUE BRUTE Job

R.2.6

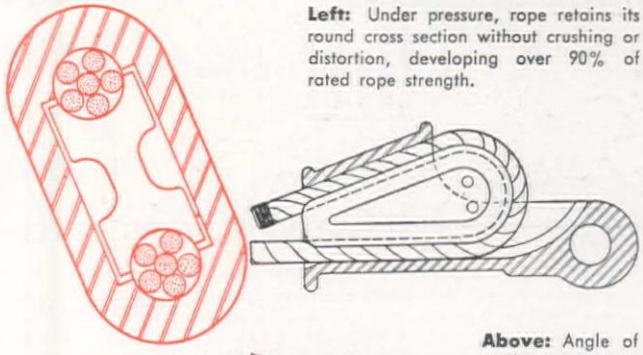
WORTHINGTON

Construction Equipment



Left: Under pressure, rope retains its round cross section without crushing or distortion, developing over 90% of rated rope strength.

Wire Rope Lasts Longer with ESCO LONG BOWL Sockets



Above: Angle of wedge prevents jamming and facilitates removal of wedge from socket.

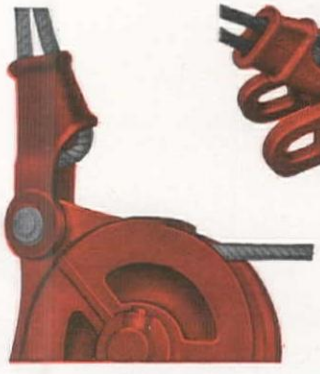
Your wire rope costs drop way down when you put *ESCO* Long Bowl sockets on your dragline buckets. For these work-tested sockets provide for the hardest pull and toughest service without crushing the rope. Made of *ESCO* Manganese Steel, they last for years, yet are unusually light in weight.

Bowl length is at least six times the rope diameter. *Every strand* of the rope maintains equal bearing pressure on both wedge and socket. Made in both closed and open types, and in all rope sizes. Also available in complete assemblies shown at the right.

For details of sizes and dimensions, see your *ESCO* representative; or mail the coupon requesting Bulletin 192, "*ESCO* Long Bowl Sockets".

Drag Rope Crowfoot

Drag Rope Hitch Yoke



Hoist Socket

ESCO

Dippers, Hoe Dippers, Dragline and Coal Loading Buckets

ELECTRIC STEEL FOUNDRY

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

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Please send me your Bulletin 192, "ESCO Long Bowl Sockets".

Name_____

Company_____

Address_____ Zone_____

City_____ State_____

CHEVROLET Advance-Design TRUCKS

Buy on these plain, hard FACTS!

CHEVROLET first in demand in value in sales

Fact No. 1

COSTS LESS TO BUY

Payload pound for payload pound, a Chevrolet truck *lists for less* than any other truck with the qualifications to handle your job. As the world's largest manufacturer of trucks, Chevrolet takes advantage of production economies to pass substantial savings on to you!

Fact No. 2

SAVES MONEY ON THE JOB

Chevrolet trucks save you money over the miles with great proved features that cut costs. Valve-in-Head economy, rugged Hypoid rear axles, extra-sturdy channel-type frames and Flexi-Mounted cabs, Ball-Gear Steering, Synchro-Mesh Transmission.

Fact No. 3

RIGHT TRUCK FOR EVERY LOAD

Your first interest in a truck is: "How well will it do the job?" That's where Chevrolet trucks have it, because they're factory-matched to the payload—tires, axles, frame, springs, engine, transmission, brakes. You get as much truck as your job calls for.

Fact No. 4

KEEPS ITS VALUE LONGER

Chevrolet trucks traditionally keep their value longer to bring higher used truck prices, year after year, at trade-in time. That means real, substantial dollar-and-cents savings when you wish to replace your present truck with a new one.

CHEVROLET ADVANCE-DESIGN TRUCK FEATURES

TWO GREAT VALVE-IN-HEAD ENGINES—Loadmaster or the Thriftmaster—to give you greater power per gallon, lower cost per load • POWER-JET CARBURETOR—for smooth, quick acceleration response • DIAPHRAGM SPRING CLUTCH—for easy-action engagement • SYNCHRO-MESH TRANSMISSION—for fast, smooth shifting • HYPOID REAR AXLE—for dependability and long life • TORQUE-ACTION BRAKES—on light-duty models • PROVED DEPENDABLE DOUBLE-ARTICULATED BRAKES—on medium-duty models • TWIN-ACTION REAR BRAKES—on heavy-duty models • DUAL-SHOE PARKING BRAKE—for greater holding ability on heavy-duty models • CAB SEAT—with double-deck springs for complete riding comfort • VENTI-PANES—for improved cab ventilation • WIDE-BASE WHEELS—for increased tire mileage • BALL-TYPE STEERING—for easier handling • UNIT-DESIGNED BODIES—for greater load protection • ADVANCE-DESIGN STYLING—for increased comfort and modern appearance.

CHEVROLET DIVISION OF GENERAL MOTORS, DETROIT 2, MICHIGAN

Proved by users from coast to coast . . .

MACWHYTE WIRE ROPE

A THOUSAND AND ONE

different ropes
Designed right—made right
PREformed and
internally lubricated

1018L

EVERY REEL of Macwhyte Wire Rope reflects a pooling of users' experience. Over the years this experience has been studied in the field by Macwhyte engineers. Your requirements dictate the design and making of Macwhyte Wire Rope for all equipment.

Recommendations for your particular needs are promptly available either from Macwhyte Distributors or Macwhyte Company.

ASK FOR CATALOG G-15

MACWHYTE COMPANY

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LOS ANGELES 21.....2035 Sacramento St., Ph: TRinity 8383
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PORTLAND 9.....1603 N.W. 14th Ave., Ph: BRoadway 1661
SEATTLE 4.....87 Holgate Street, Ph: MAin 1715

WITH 1-SECOND GRAVITY DUMP

It takes just one second to dump a full 6-yard load with Koehring heavy-duty Dumptor®. Trip the body release lever and gravity instantly tilts the scoop-shaped Dumptor body 70° . . . one second later the body is empty, and you're ready to head back for another load.

DUMPTOR gains 5 min. per hour on 1000′ haul Because you don't wait for slow-acting body hoists, you save 15 to 25 seconds every dump. This adds up to important savings in haul-time. For instance . . . on the 16 trips you'd get per hour on a 1,000′ haul, 20 seconds dumping time saved on every cycle gains 5.3 minutes more haul-time every hour. This alone adds 9% more production to your average day's yardage.

NO body hoist . . . Because there are no complicated body hoist mechanisms, Koehring Dumptors give you the same one-second dumping even in sub-zero weather. You don't lose time or spend money on expensive hoist maintenance . . . no costly replacement parts, because Koehring Dumptors have no body hoists.

NO-TURN SHUTTLE gains another 10% . . . On every haul cycle, fast-shuttling Dumptors eliminate slow turns, at the loading unit and on the dump . . . gain more productive work-time. By eliminating only 2 turns on a 1,000′ haul, time studies prove that Dumptors can save 30 seconds on every round trip. That increases hourly yardage output another 10% per unit! You get no-turn shuttle hauling with Dumptors because Koehring constant-mesh transmission provides the same 3 fast speeds forward and reverse.

One-second gravity dump . . . no body hoist maintenance . . . and no-turn shuttle haul, are all typical of Koehring Dumptor's basic principle . . . to reduce all non-productive time to the absolute minimum . . . and to increase work-time for more trips per hour, and more profits per job for you.

CK222 SP

KOEHRING HEAVY DUTY

SEE YOUR KOEHRING DISTRIBUTOR FOR COMPLETE FACTS

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

KWIK-MIX plaster-mortar MIXERS

3-P tilting plaster-mortar mixer, newest addition to the Kwik-Mix line is small, portable . . . has a capacity range of 3 to 4 cu. ft. Narrow 29" width clears standard doorways. 37" charging height provides fast, easy charging. Other features: 4 non-clogging saw-tooth blades; simple arrangement for declutching paddle-shaft; V-belt drive; 3 h.p., air-cooled engine; wide-base tires for more flotation and stability. Paddle and counter shafts on double-sealed, anti-friction bearings require no lubrication. Larger sizes: 6-P tilt and non-tilt models, big 10-P non-tilt . . . also concrete, bituminous mixers, and Moto-Bug® (power wheelbarrow).

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PACIFIC HOIST & DERRICK CO.....Seattle
COLUMBIA EQUIPMENT CO.....Boise, Portland
HARRON, RICKARD & McCONE CO. OF SO. CALIF.....Los Angeles
McKELVY MACHINERY CO.....Denver
KIMBALL EQUIPMENT CO.....Salt Lake City
NEIL B. McGINNIS CO.....Phoenix
THE HARRY CORNELIUS CO.....Albuquerque
SAN JOAQUIN TRACTOR CO.....Bakersfield
ENGINEERING SALES SERVICE, INC.....Boise
KOEHRING CO., WEST COAST SALES DIVISION.....Stockton

PARSONS TRENCHLINERS®

250 digs 3.8 in. to 9 ft. per min. . . . 30 digging feeds, 3 bucket line and conveyor belt speeds, all fully reversible, plus 3 travel speeds, give you complete flexibility of application on all types of trenching. Special side cutters and oversize teeth provide 15 different cutting widths (16" to 42" wide) with only 4 standard size buckets. Telescopic, ladder-type boom securely locks at 12" intervals for digging to 12'-6" deep. Boom shifts across full machine width, cuts to within 11" of either side. Power-shift conveyor dumps right or left. See us for full facts on this 250 Trenchliner, or on any of Parsons 4 other heavy-duty sizes.

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PACIFIC HOIST & DERRICK CO.....Seattle
COLUMBIA EQUIPMENT CO.....Boise, Portland
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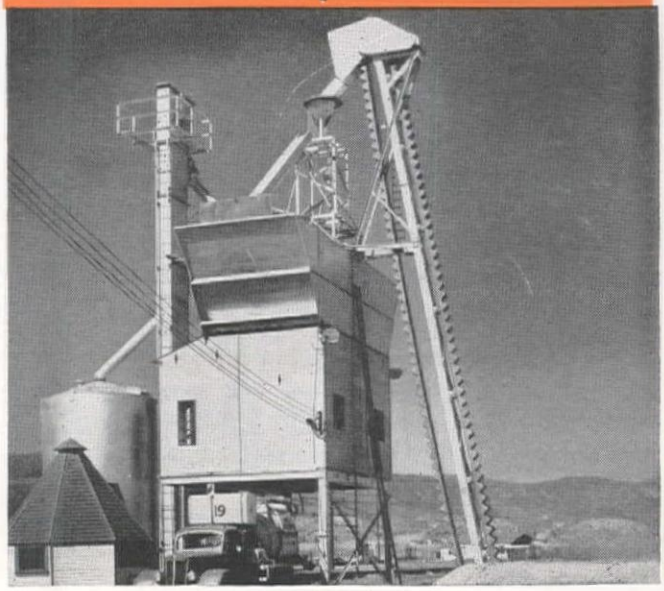
JOHNSON "Hi-Speed" BATCHERS

"Complete package" for transit-mix

. . . Specially developed for a western transit mix company this plant is typical of Johnson "complete package" engineering. Quickly erected, all-welded tandem bin has 110 cu. yd. total capacity, and consists of four 19-yd. aggregate compartments and a 250-bbl. central cement tank. 2-yd. Concentric Batcher assures accurate production at high speeds. Plant is also fully Johnson-equipped with truck-receiving hopper, screw conveyor, enclosed elevator and 520-bbl. aerated silo for cement . . . truck unloading hopper, open type inclined elevator for aggregates.



AMERICAN MACHINE COMPANY.....Spokane
BOW LAKE EQUIP. CO., INC.....Seattle
CRAMER MACHINERY CO.....Portland
WESTERN MACHINERY CO.....Salt Lake City
NEIL B. McGINNIS CO.....Phoenix
THE HARRY CORNELIUS CO.....Albuquerque
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Send your master mechanic to check on the new

GARDNER-DENVER 600

COMPARE

these Gardner-Denver values . . . no other 600-foot portable has them all

A real 600 — that's truly designed for 600-foot capacity.

Stamina — to run more hours per year for more years — to clock more hours between overhauls.

The right weight — for those long, tough jobs that demand durability.

Two-stage — gives high output for any work.

Fully water-cooled — for all-weather operation — has no complicated oil and water separation problem.

Easy starting — through use of a heavy-duty clutch.

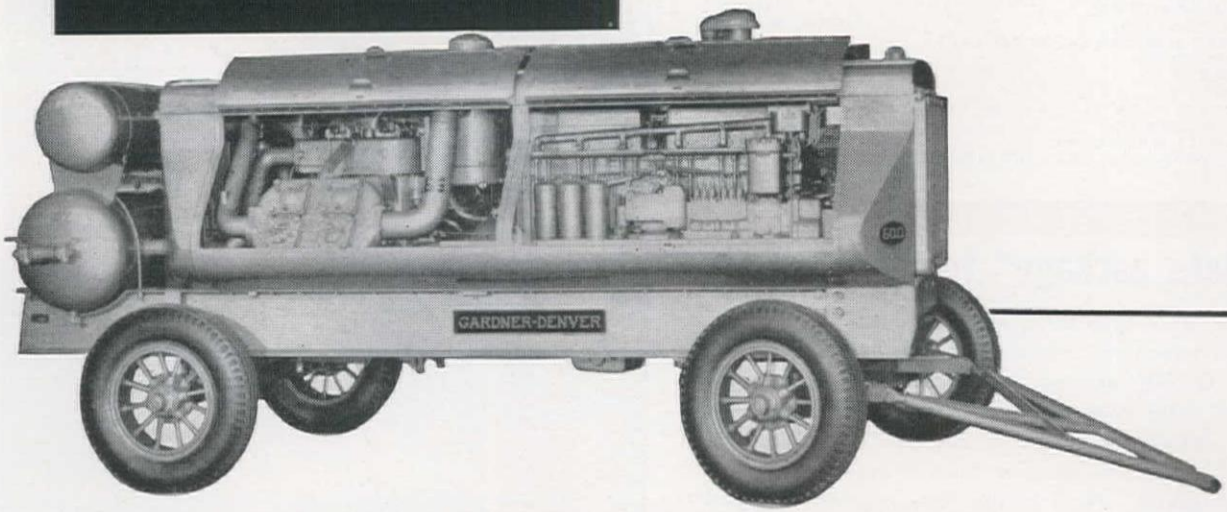
Simple controls — easy to understand — easy to use.

Moderate operating speeds — mean less wear and vibration.

Operates on sloping ground — as well as on the level.

Saves repair time — any master mechanic can make repairs in the field, with ordinary tools.

And don't forget — to compare fuel consumption, too.



Get GARDNER-DENVER and you get MORE VALUE FOR YOUR MONEY

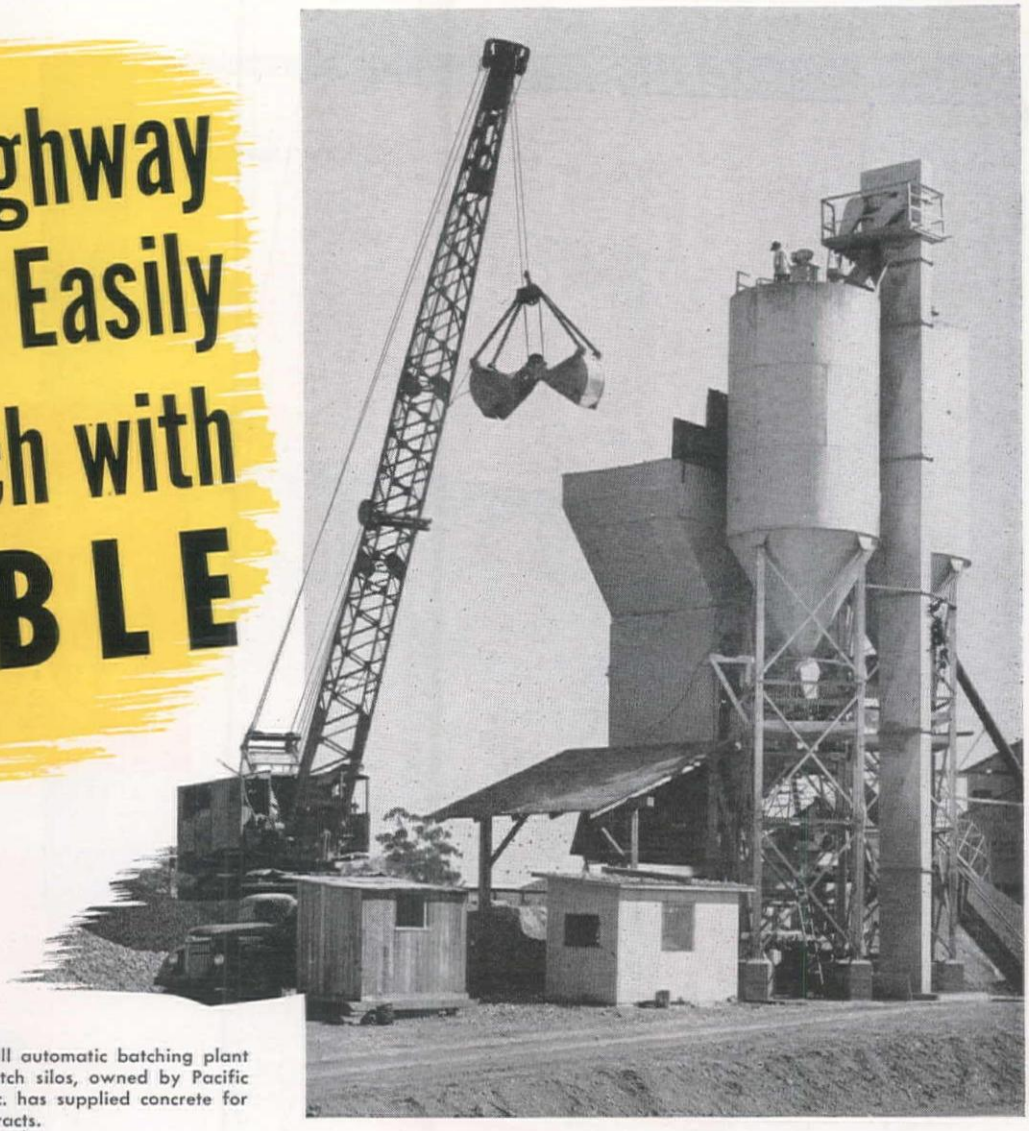
Ask for complete specifications on the Gardner-Denver 600—the big capacity portable air compressor that's built for the discriminating buyer—and backed by Gardner-Denver's 93 years of quality manufacturing experience.

SINCE 1859 **GARDNER-DENVER**

Gardner-Denver Company, Quincy, Illinois

Western Branch Offices: Butte, Montana; Denver, Colorado; Los Angeles, Calif.; Salt Lake City, Utah; San Francisco, Calif.; Seattle, Washington; Wallace, Idaho; El Paso, Texas.

Meet Highway "Specs" Easily ...Batch with NOBLE



This NOBLE CA154 full automatic batching plant with two 500-bbl. batch silos, owned by Pacific Coast Aggregates, Inc. has supplied concrete for several highway contracts.

Contractors who have recently rebuilt highways with NOBLE-batched concrete—

Guy F. Atkinson Co.	U. S. 99 & 466
N. M. Ball & Sons	U. S. 50
Fredrickson Bros.	U. S. 40
M. J. B. Construction Co.	U. S. 50
Peter Kiewit Sons' Co.	U. S. 101 & 4
Fredrickson & Watson	San Jose Freeway
C. F. Wilder-Gaasland Const. Co.	U. S. 10
Charles L. Harney Co.	U. S. 101
Fiorito Bros.	U. S. 99

54,

NOBLE clamshell-type automatic batchers, built especially for highway contractors, offer you accuracy, fast production and portability.

Right-on-the-nose accuracy is assured by NOBLE's exclusive photo relay control—neither heat nor humidity affects it. Your operator simply sets poise beam scales, batching gates automatically cut off cement and aggregate at correct weight.

Gate operation is fast, too—125 yards an hour is not unusual.

When one job is finished, you can easily dismantle your NOBLE plant and move it by truck or rail. Many NOBLE plants have batched concrete on 4 and 5 highway jobs.

Investigate the fast, accurate, portable NOBLE plant NOW. Wire, write or phone—no obligation.

DESIGNERS AND BUILDERS OF

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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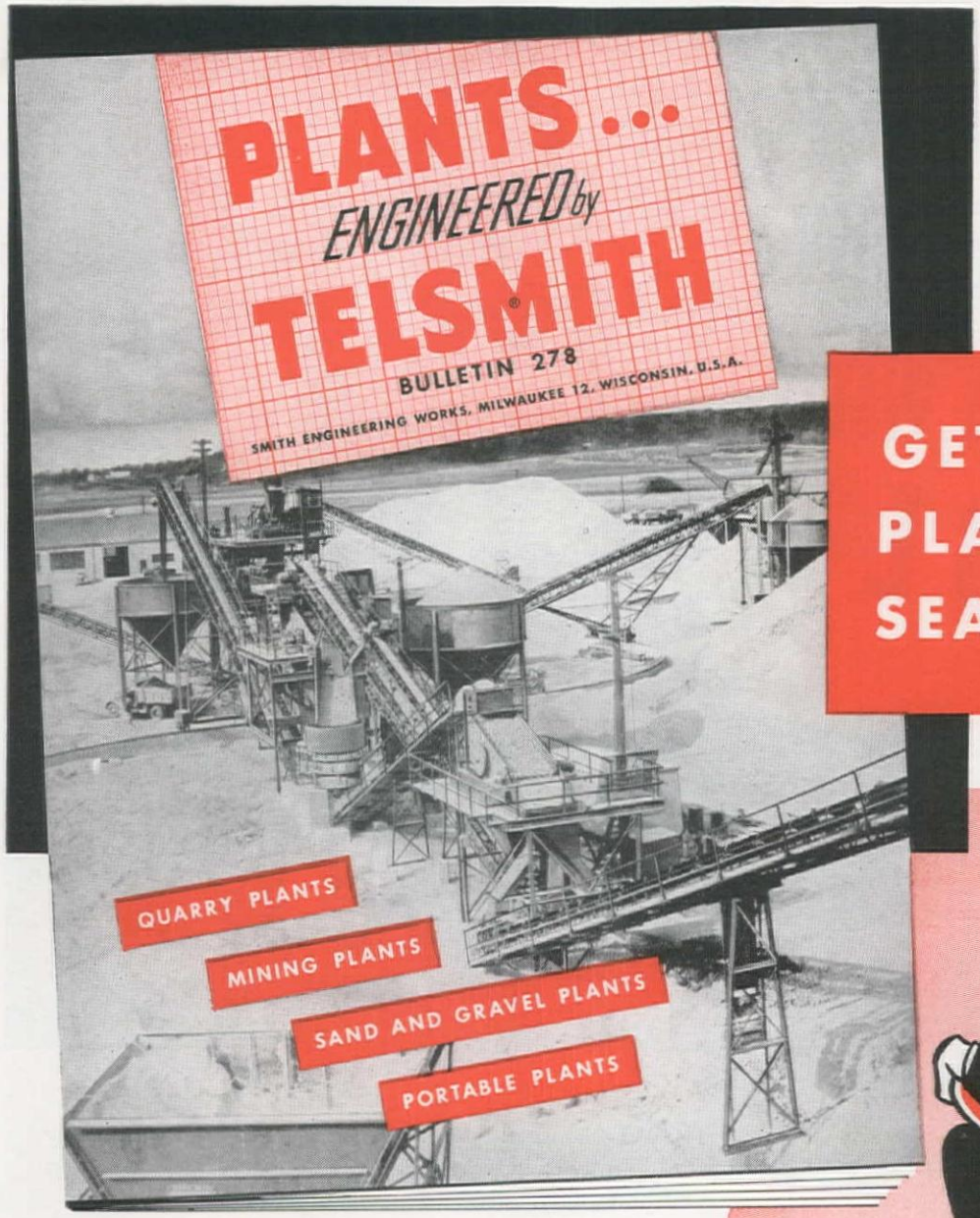
Star Machinery Co., Seattle 4, Wash.; Loggers & Contr. Machinery Co., Portland 14, Ore.; Tri-State Equipment Co., Spokane 6, Wash.; Intermountain Equipment Co., Boise, Ida.; Borchert-Ingersoll, Inc., St. Paul 4, Minn.; Sierra Machinery Co., Reno, Nev.; Western Constr. Supply Co., Chicago 12, Ill.



GET A PLANT-SIDE SEAT

Here's a plant-side seat for you—right where you can *see* photographically, some of the country's biggest, most successful plants—engineered for crushed stone, sand and gravel producers, for contractors, for mines. Of special interest is the complete, accurate data on plant capacities, types and sizes of finished products, and all the equipment—what kind, how it's laid out, and why. And you'll find out how you can get these same advantages in one complete service—a plant engineered by Telsmith. *Send for Bulletin 278.*

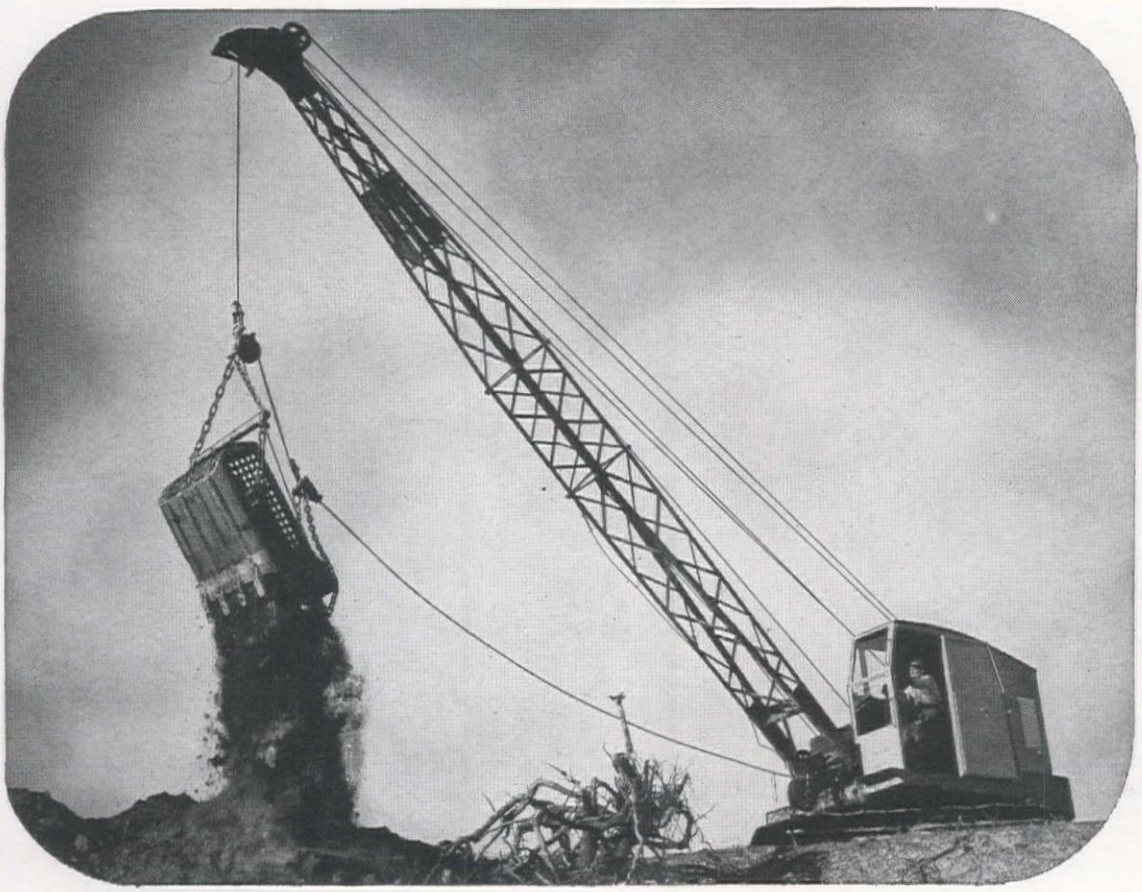
MP-9

MINES ENGINEERING & EQUIPMENT CO.

369 Pine Street • SUtter 1-7224
SAN FRANCISCO 4, CALIFORNIA

Manufactured by SMITH ENGINEERING WORKS, MILWAUKEE 12, WISCONSIN

WIRE ROPE



This is the most economical rope we've ever made for construction equipment

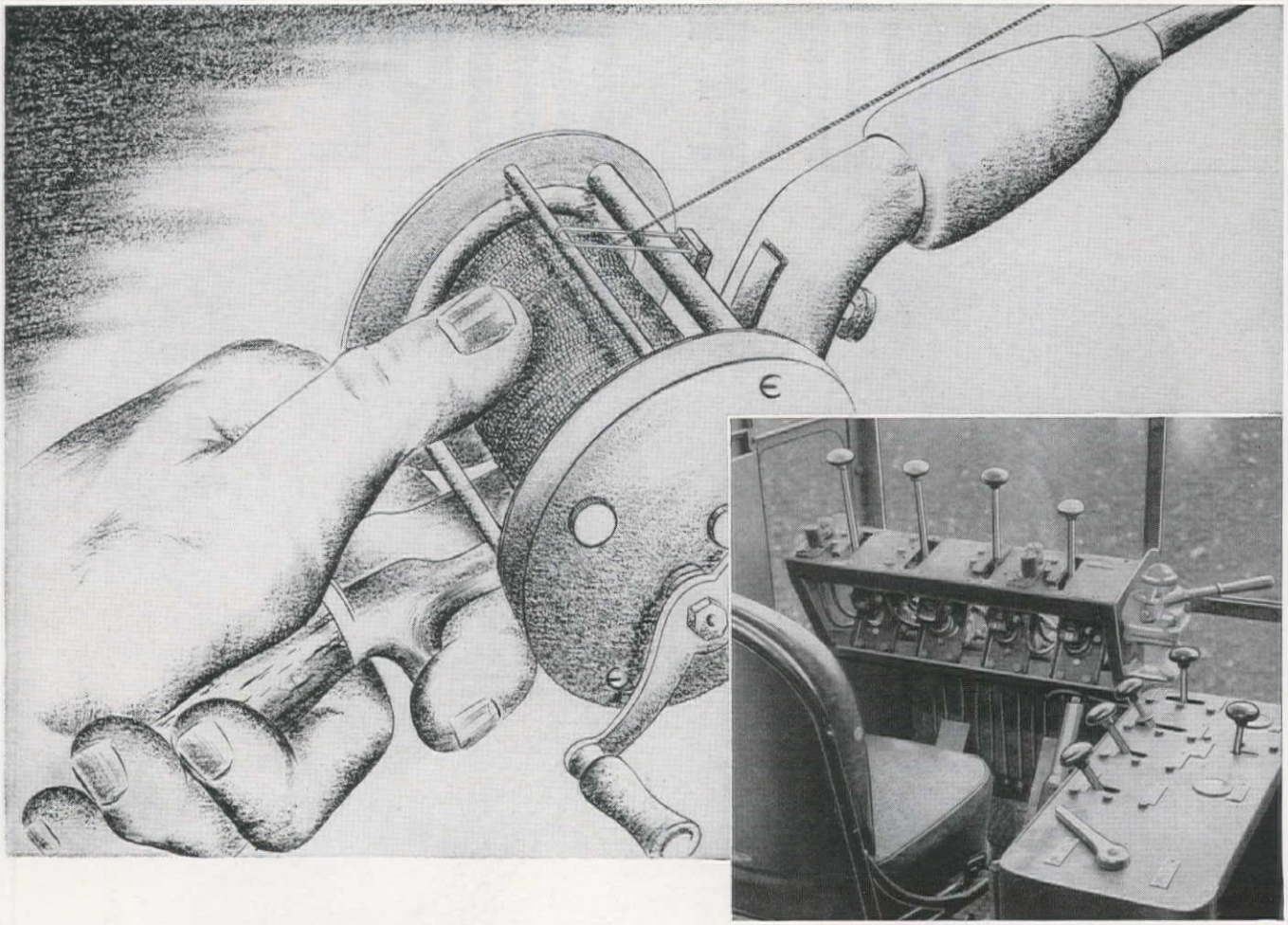
ROEBLING is the best known name in wire rope. That's partly because we were the first wire rope maker in America. But more than that, we've always led in developing better wire and better rope for every purpose.

Today's Roebling Preformed "Blue Center" Steel Wire Rope is the best choice for efficiency and long life on excavating and construction equipment. This rope has *extra* resistance to crushing and abrasion . . . stands up under rough going. It saves you time and cuts costs.

There's a Roebling wire rope of the right specification for top service on any job. Call on your Roebling Field Man for his recommendations. John A. Roebling's Sons Company, San Francisco-Los Angeles-Seattle.

ROEBLING

ATLANTA, 934 AVON AVE • BOSTON, 51 SLEEPER ST • CHICAGO, 5525 W. ROOSEVELT RD • CINCINNATI, 3253 FREDONIA AVE • CLEVELAND, 701 ST. CLAIR AVE, N. E. • DENVER, 4801 JACKSON ST • DETROIT, 915 FISHER BLDG • HOUSTON, 6216 NAVIGATION BLVD • LOS ANGELES, 5340 E. HARBOR ST • NEW YORK, 19 RECTOR ST • ODESSA, TEXAS, 1920 E. 2ND ST • PHILADELPHIA, 230 VINE ST • SAN FRANCISCO, 1740 17TH ST • SEATTLE, 900 1ST AVE S. • TULSA, 321 N CHEYENNE ST • EXPORT SALES OFFICE, TRENTON 2, N. J.



Complete Command of Operations . . .

Right under your thumb

With LIMA precision air controlled clutches and brakes you get the same smooth, easy, responsive control of the hoist and drag lines that you do when you apply the under-the-thumb tension to the line on a fisherman's reel.

There are other advantages, too. LIMA precision air control promotes long life of the machine and uniformity to the operating cycle. It also automatically compensates the adjustments of the clutches for wear of lining and to meet weather and operating conditions.

Last (but by no means least), there's no mid-afternoon slowdown because of operator fatigue. Both man and machine can work at peak level for the entire shift. **Baldwin-Lima-Hamilton Corporation, Lima Works, Lima, Ohio.**

LIMA SHOVELS are available in capacities from ¾ to 6 yards.

LIMA CRANES are available in sizes to 110 tons capacity.

LIMA DRAGLINES are available in variable capacities to suit specific needs.

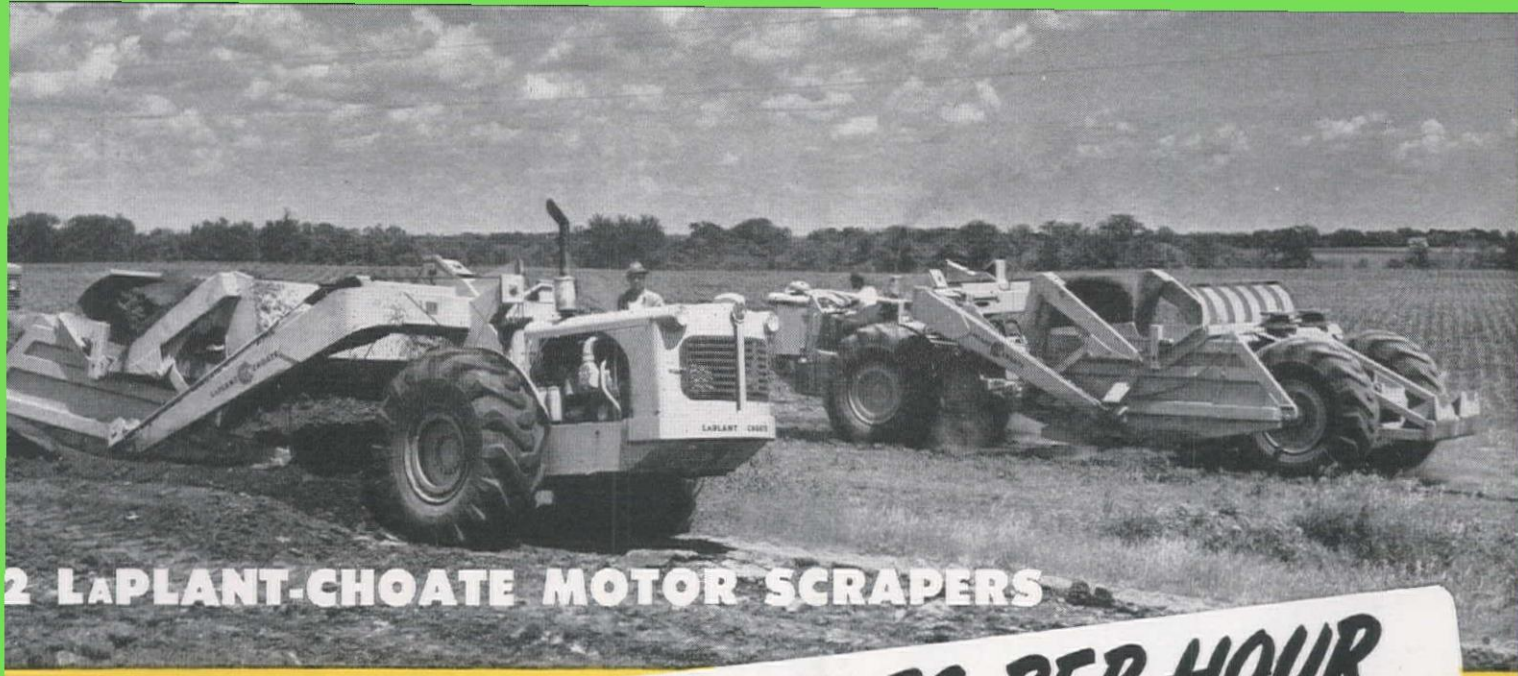
Wheel or truck mounting is available on machines of ¾ and 1½ yards capacity.

Our Seattle Office: 1932 First Ave. South, Seattle 4, Washington

Feenaughty Machinery Co., 112 S. E. Belmont St., Portland 14, Oregon; Feenaughty Machinery Co., 600 Front St., Boise, Idaho; Smith Booth Usher Co., 2001 Santa Fe Ave., Los Angeles 54, California; H. H. Neilsen Co., 216 Paxton Ave., Salt Lake City, Utah; Acme Iron Works, Culebra Ave. at Expressway N.W. San Antonio, Texas; Garfield & Co., 1232 Hearst Builidng, San Francisco 3, California; Cascade Industrial Supply, 515 Market St., Klamath Falls, Oregon; Contractors Equipment & Supply, P. O. Box 456, Albuquerque, New Mexico; Modern Machinery Co., 4412 Trent Ave., Spokane 2, Washington; Modern Machinery Co., 2963 First Ave. South, Seattle 4, Washington; Jameson Engineering Sales, Fairbanks, Alaska; Shriver Machinery Co., P. O. Box 1270, Phoenix, Arizona.

BALDWIN-LIMA-HAMILTON

SHOVELS • CRANES • DRAGLINES • PULLSHOVELS • TRUCK CRANES



2 LaPLANT-CHOATE MOTOR SCRAPERS

AVERAGE 20 MILES PER HOUR

Note the extra high apron lift of the TS300 for dumping bulky heavy materials.

MOVING RIPPED BLACK TOP

for

Weldon Zaske Construction Company
Danube, Minnesota

MOVING 18,000 yards of ripped up black top at a 20 MPH clip is typical of the speedy performance of LPC TS 300 Motor Scrapers. When County Road 22, four miles north of St. Peter, Minnesota, had to be ripped up and stockpiled for re-use, Weldon Zaske of Danube used two Motor Scrapers to speed the job. Large, heaping loads of the bulky material were picked up in 45 seconds in a distance of 60 feet, and on the one mile haul to the stockpile, the rigs *averaged 20 miles per hour!* Loads were ejected in 15 seconds.

This example of the TS 300's productive speed is just one of the reasons why so many contractors like Weldon Zaske are choosing LaPlant-Choate Motor Scrapers to set the pace on the toughest jobs.

CHECK THESE OTHER BIG-PRODUCTION FEATURES

- **BIG CAPACITY** . . . 14-cu. yds. struck and 18-cu. yds. heaped, to haul bigger payloads
- **HIGH SPEED** . . . over 22 mph, assures lower average cycle time
- **BIG POWER** . . . your choice of a 280 HP Buda or a 275 HP Cummins diesel for fast acceleration and extra power when you need it
- **EASY LOADING CHARACTERISTICS** cut more valuable seconds off your cycle time
- **EXTRA HIGH APRON LIFT** and positive forced ejection mean faster, smoother spreading

LaPLANT CHOATE

MANUFACTURING CO., INC. ® CEDAR RAPIDS, IOWA, U. S. A.

Get the facts from your nearest LPC distributor

WN-BEVIS-INDUSTRIAL EQUIP. CO.
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1022 - 77th Avenue — OAKLAND 21, CALIFORNIA

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

COLUMBIA EQUIPMENT CO.
240 S. E. 12th Ave. — RTLAND 14, OREGON
5030 1st Ave. South — SEATTLE, WASHINGTON

WESTERN CONSTRUCTION EQUIP. CO.
505 N. 24th Street — BILLINGS, MONTANA
Stephens & Mount Ave. — MISSOULA, MONTANA

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

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

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

EQUIPMENT SALES CO.
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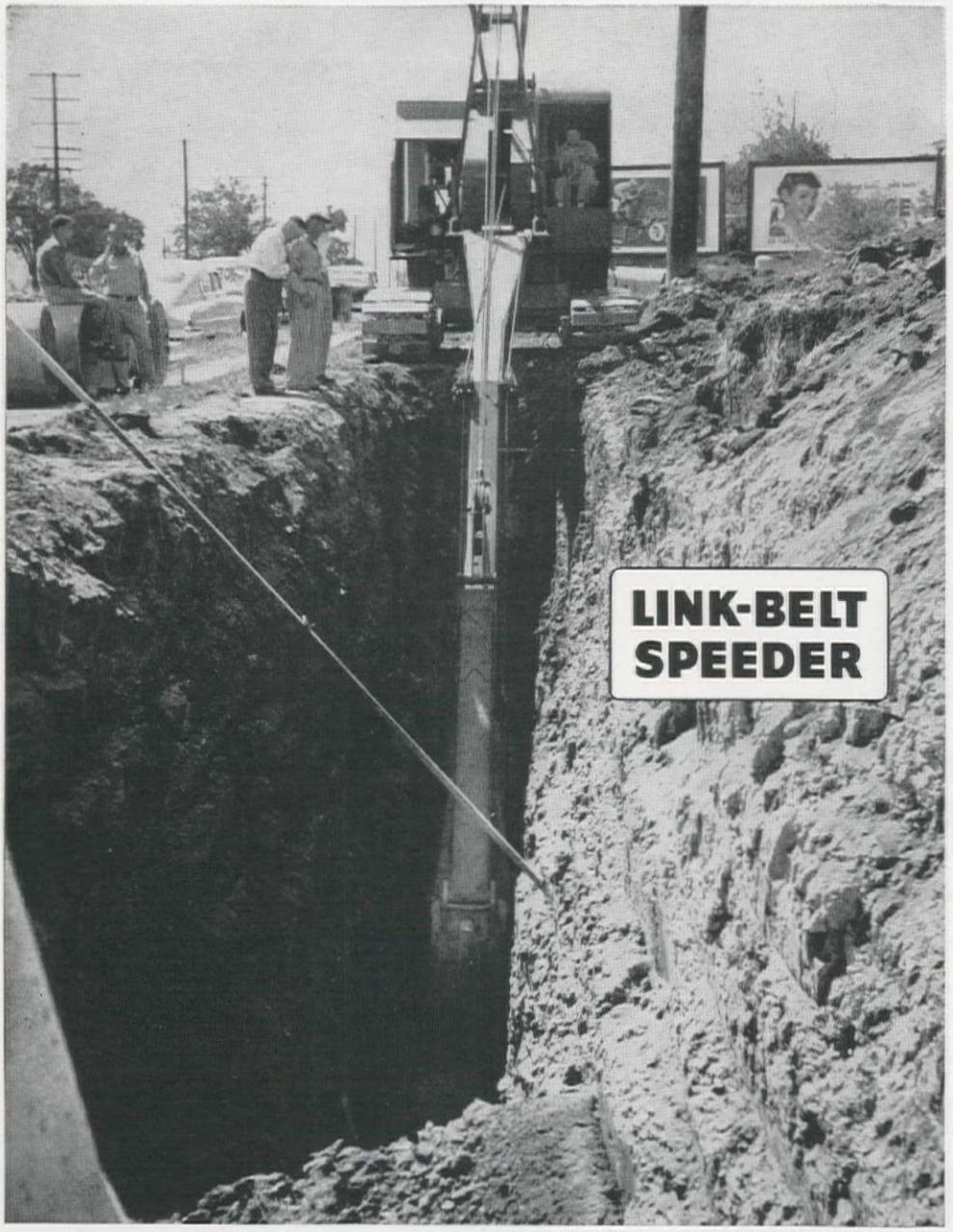
ARNOLD MACHINERY CO., INC.
433 W. Second South St. — SALT LAKE CITY 1, UTAH

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

Digs hard clay fast!

Powerful LS-85 hoists and swings simultaneously!



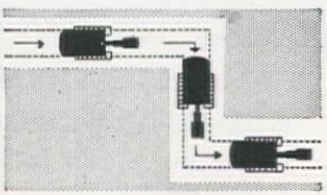
92 NET H.P. is developed at full load speed by the diesel engine of this Super ¾ yd. LS-85! The high amount of engine power is responsible for packing more digging force behind the bucket teeth. Also, that's why the LS-85 cuts so smoothly through hard clay and why it hoists and swings the load without a pause!

12,846-A

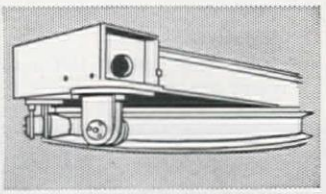
Here are LINK-BELT SPEEDER PLUS FEATURES that work for you

All-Welded Construction — Extra strength without extra weight. Resists impact and twist. Field service simple, fast.

Gooseneck Trench Hoe—improved digging and dumping plus far less undercutting of the machine on deep cuts.



Turns on a Dime. Either track can drive or be locked independently. Digging lock controlled from cab.



Hook Rollers — Cone-shaped for *true* rolling. Reduce roller and roller path loads—eliminate center pin pull.

LINK-BELT SPEEDER
CORPORATION
Builders of the most complete line of shovels, cranes and draglines
CEDAR RAPIDS, IOWA

STANDARD ENGINEER'S REPORT

DATA

LUBRICANT RPM Multi-Service Gear Lub.

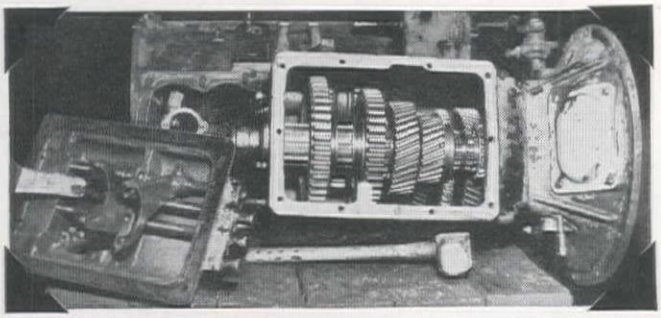
UNIT Truck-crane transmission

OPERATION General contracting—Highway, canal building, etc.

CONDITIONS Always overloaded

FIRM Parish Bros., Benicia Calif.

Overloaded gears still good after 5 years service!



THIS 5-SPEED TRANSMISSION, lubricated with RPM Multi-Service Gear Lubricant, has just completed five years of work in a crane owned by Parish Brothers, Benicia, Calif. Note excellent condition of gears. Although overloaded most of the time, they show very little wear. None were replaced, and the transmission was put back in service. "We have never lost any type of drive gear, because of lubrication, that was protected with RPM Multi-Service Gear Lubricant," says Gene Wagner, Master Mechanic.

MORE THAN 75 PIECES OF EQUIPMENT are operated by Parish Brothers. All transmissions, differentials and other gear trains are lubricated with RPM Multi-Service Gear Lubricant.

REMARKS: RPM Multi-Service Gear Lubricant gives extra protection and increases the life of many types of gears, and is especially recommended for the extreme conditions in hypoids. It comes in several grades to meet different operating conditions.

RPM

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

How RPM Multi-Service Gear Lubricant prevents wear in severe conditions

A. Contains a special compound that reacts chemically with metal to form a protective lubricating coating...resists rubbing action of hypoid gear teeth.

B. Withstands extreme temperatures and pressures...highly oxidation resistant. Keeps gears and bearings cool.

C. Inhibitors resist rusting, stop foaming in cases. Lubricates integral bearings and other parts. Will not separate.

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

Tough Jobs...

A CINCH FOR THE GRADALL

THE multi-purpose Gradall handles the *complete* job of pavement removal. To remove asphalt pavement, the Gradall exerts its powerful hydraulic "down pressure" to rip up the pavement in large pieces. Then it loads them onto trucks—all in one pass.

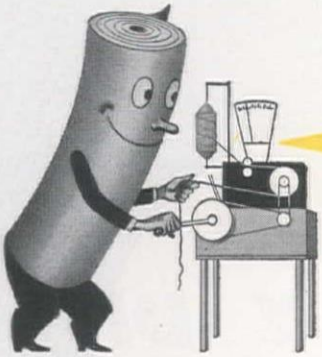
Removing grouted brick, the Gradall similarly rips and loads in one pass. And because of the smooth Gradall action, most of the brick can be salvaged.

"Tough ones" like these are typical of the wide variety of jobs on which the Gradall can cut costs and speed work to completion. Your Gradall Distributor will be glad to demonstrate how the Gradall can be applied to your particular type of construction work.

Gradall®
DIVISION OF WARNER & SWASEY Cleveland

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

GRADALL—THE MULTI-PURPOSE CONSTRUCTION MACHINE *with Controlled Down Pressure*

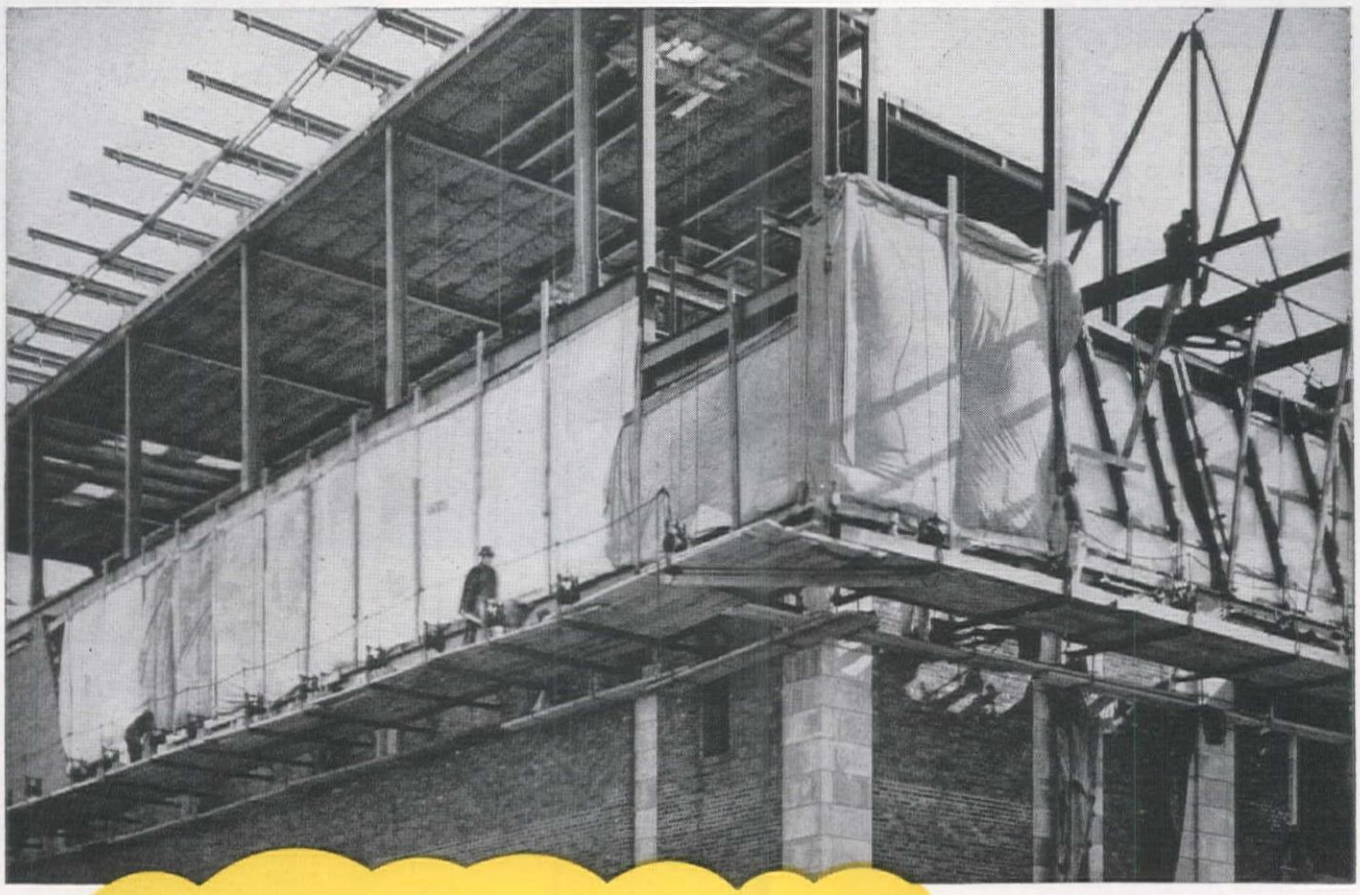


UNIFORMITY
Makes the Big Difference
In TARPAULINS

MT. VERNON — EXTRA

Gives You Greater Fabric Uniformity

Checking evenness of roving with Belger Tester. One of a series of comprehensive laboratory controls throughout production to assure uniformity in all Mt. Vernon-Woodberry products.



Mt. Vernon-Woodberry Mills

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TURNER HALSEY
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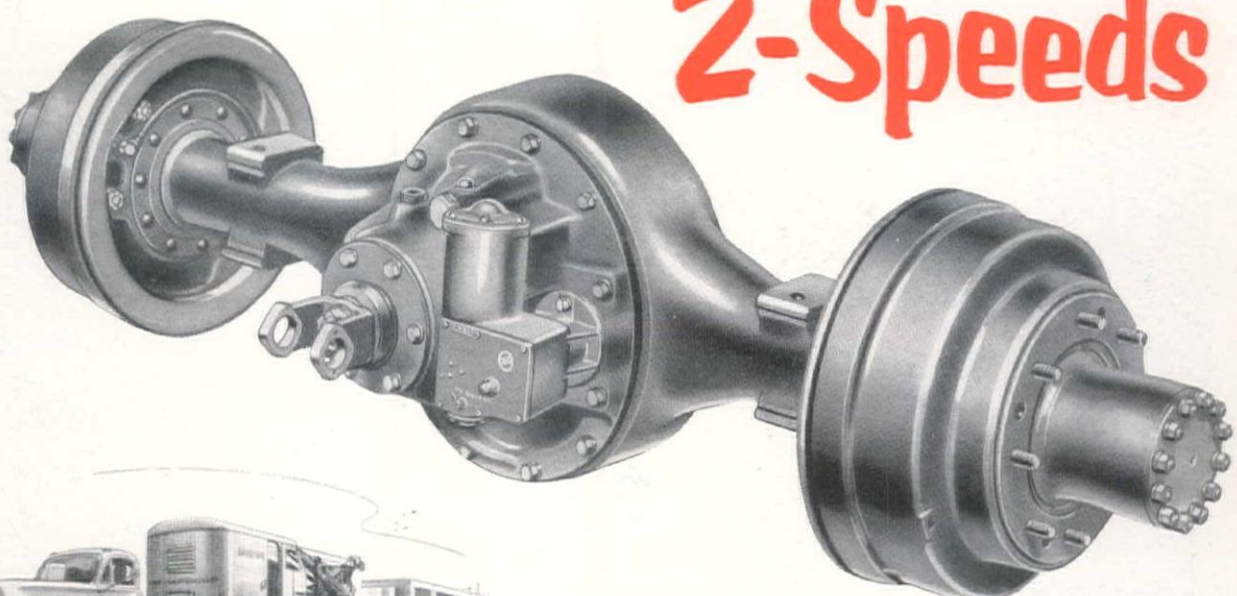
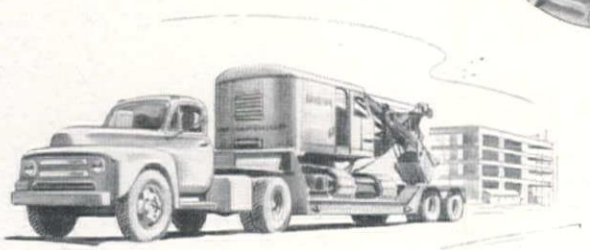
40 WORTH ST. · NEW YORK

Easy shifting helps drivers get the most out of Eaton 2-Speeds





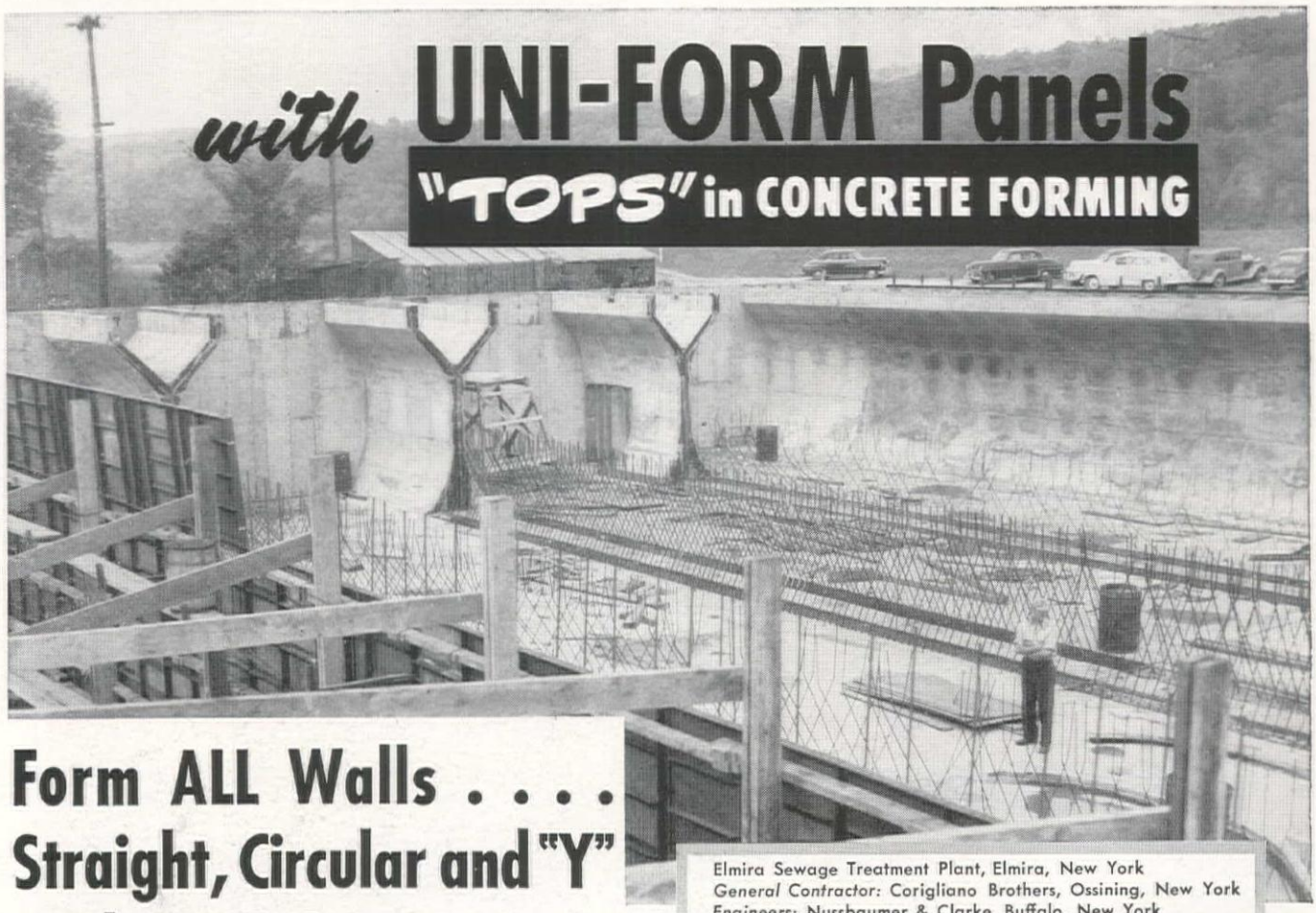
EATON 2-Speeds are easy to shift at any speed—uphill or downhill. Drivers will use all of the gear ratios provided by Eaton 2-Speeds—the right ratio for every road and load condition. Extra maneuverability, coupled with positive control at all times, means less wear and tear—not only on the driver but on the engine, the axle itself, and all power transmitting parts. Appreciable savings are realized in lower operating expense, reduced maintenance cost, and longer truck life. Your truck dealer will be glad to explain Eaton's simplified shifting, and show you how with Eaton 2-Speeds your trucks will haul more, faster, longer, at lower cost.

EATON
2-Speed Truck
AXLES

Axle Division
EATON MANUFACTURING COMPANY
CLEVELAND, OHIO

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

Fast Job Starts... LOWER COSTS



with UNI-FORM Panels

"TOPS" in CONCRETE FORMING

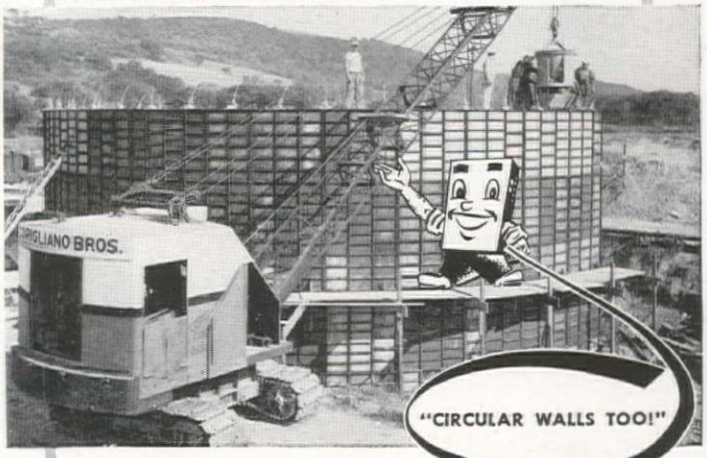
Form ALL Walls . . . . Straight, Circular and "Y" with ONE System!

- FASTER JOB STARTS . . . UNI-FORM Panels are ready to use when they reach the job.
- AUTOMATICALLY ACCURATE . . . Simple mechanical assembly
- EASIEST FORM ERECTION . . . Lock into rigid, integral unit
- MINIMUM ALIGNMENT and BRACING . . . Required on 1 SIDE ONLY

SAVE TIME . . . LABOR . . . MATERIAL

Write today for full details on Universal's "Sewage Treatment Plant Concrete Forming Package"... UNI-FORM Panels, "Y" Wall Forms, FREE Engineering and Field Service. It's designed to make money for you!

Elmira Sewage Treatment Plant, Elmira, New York
General Contractor: Corigliano Brothers, Ossining, New York
Engineers: Nussbaumer & Clarke, Buffalo, New York



Standard UNI-FORM Panels form the aeration tank. Alignment and bracing on *inside only* give clean, safe outside working area.

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FORM CLAMP CO.
Concrete Form Specialists Since 1912

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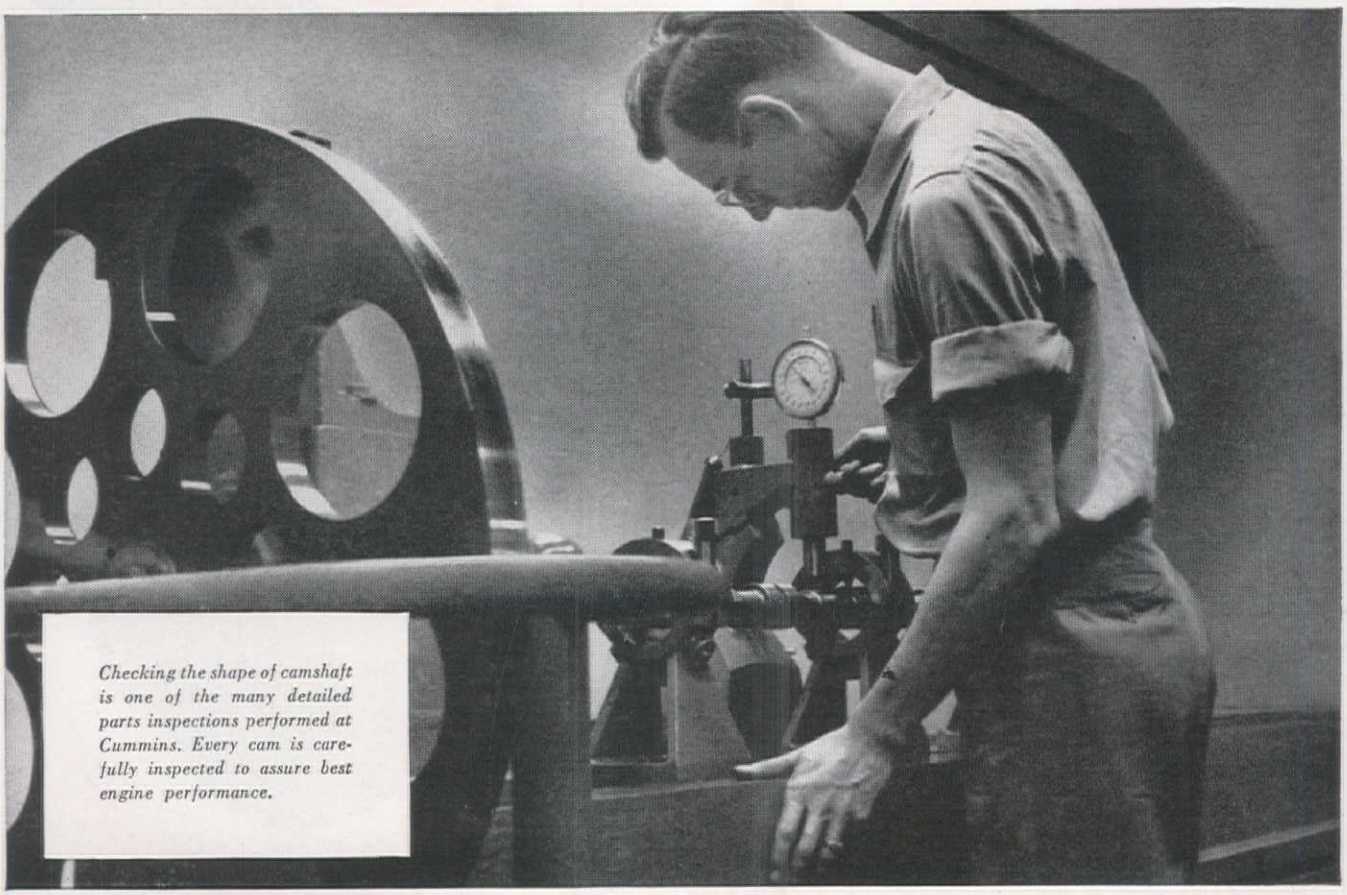
CUMMINS® DIESEL PARTS
give more service!



Checking the shape of camshaft is one of the many detailed parts inspections performed at Cummins. Every cam is carefully inspected to assure best engine performance.

...because we take *twice* the care

Every Cummins Diesel is custom-built to fit your job . . . give you years of dependable, profitable service. To make the most of Cummins performance—and keep "down time" at a minimum—it pays to use Genuine Cummins Parts for maintenance. Every Genuine Cummins Part *fits perfectly, lasts longer* . . . because it's manufactured with *twice the care.* So *always* insist on Genuine Cummins Parts – available only from Cummins dealers coast to coast. See the dealer nearest you.

Diesel power by CUMMINS

CUMMINS ENGINE COMPANY, INC., COLUMBUS, INDIANA

TRADEMARK REG. U. S. PAT. OFF.

CUMMINS Dependable DIESEL

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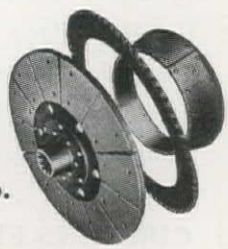
(1-11-52)

STOP *Clutch Trouble*

. . . with
VELVETOUCH
MATCHED FACING
SETS

Heavy duty hauling and earthmoving units stay on the job longer when you install Velvetouch Matched Facing Sets. Because Velvetouch clutch plate combinations give you *four* friction surfaces instead of the conventional *two!* You get extra clutch capacity . . . extra hours of service . . . extra freedom from adjustment and repair. And with Velvetouch, you can salvage worn and heat checked flywheels and pressure plates for additional savings! See your jobber, our nearest branch . . . or write The S. K. Wellman Company, 1374 East 51st Street, Cleveland 3, Ohio.



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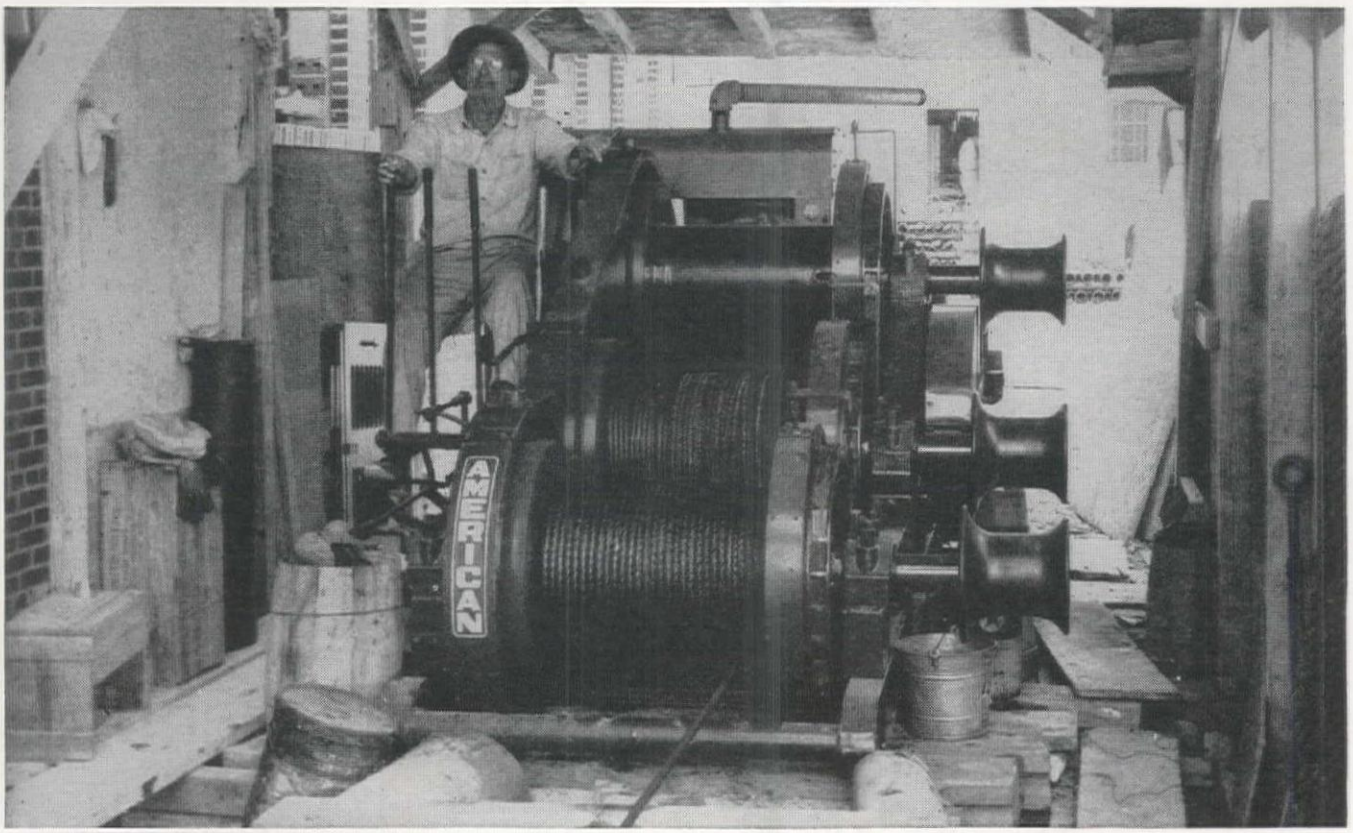
Outselling all others



THIS year, as for many years past, contractors are buying more American construction hoists than those of any other make. We make this statement not as a matter of pride for us (although it is) but as a clue to smart purchasing for you.

The picture above shows a 3-drum Model 75 American General Purpose Hoist, owned by R. P. Farnsworth & Co. Inc., New Orleans, at work on a new dormitory at Tulane University. It is one more proof of the fact that experienced, successful builders—who know their costs down to the penny—have a distinct preference for American hoists.

A full list of the "reasons why" would show dozens of design features, engineering features, assembly features quite different from those of other hoists. But the simple facts are that American hoists work better on the job, stay on the job longer, and —most important of all—*make more money for their owners.* That's why they outsell all others.

Is this the kind of equipment you want? If so, choose your next hoist from the world's broadest line, through your American distributor.

Modernize...economize...with

American Hoist
& Derrick Company
ST. PAUL 1, MINNESOTA

17 **Mail this coupon** 2102

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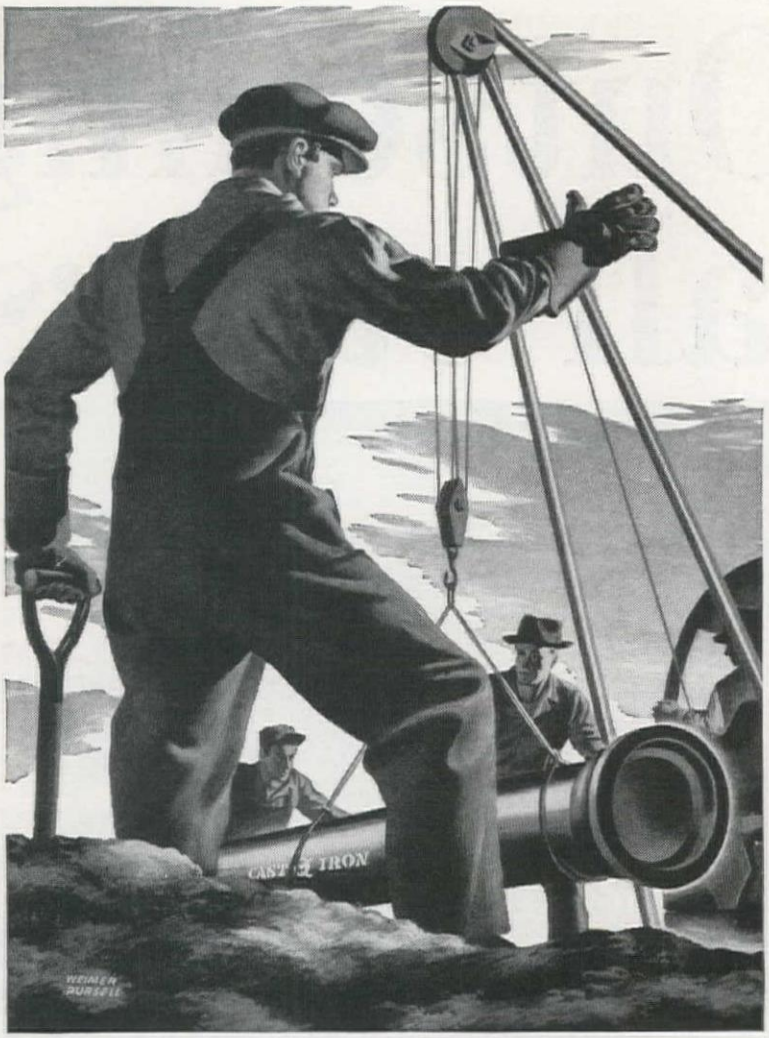


Why cast iron pipe saves millions of tax dollars

The answer is (1) cast iron pipe serves for centuries, and (2) over 95% of the pipe in service in America's water distribution systems is cast iron pipe. But let's get down to figures.

The cumulative cost of our water supply systems, from 1817 to 1951, is estimated at $6-billion, of which more than $3.5-billion is for cast iron pipe, including installation costs. The balance is for pumping stations, filter plants, storage facilities, etc.

Most of this money was raised by the issuance of bonds. Now, the useful life of cast iron pipe is at least 4 to 5 times the average term of a water revenue bond issue. Records prove that more than 35 American cities have cast iron mains in service that were installed over 100 years ago.

The answer is clear. By serving for generations after bonds issued to pay for them have been retired and forgotten, cast iron mains save many millions of tax dollars. Cast Iron Pipe Research Association, Thos. F. Wolfe, Managing Director, 122 So. Michigan Ave., Chicago 3, Ill.

One of a number of cast iron water mains which have been in service in New York City for more than a century. Over 35 other cities have century-old cast iron mains in service.

CAST IRON

®

CAST IRON PIPE

America's No. 1 Tax Saver

This 40-ton Fruehauf Machinery Trailer, equipped with 10.00 x 15, 14-ply tires, travels 25,000 miles a year on heavy-duty hauls for Pearson Truck Company.

"Our Fruehauf works 12 hours a Day, 6 Days a Week with Minimum Maintenance!"

Says **A. R. PEARSON,** *President*
Pearson Truck Co., Los Angeles, Cal.

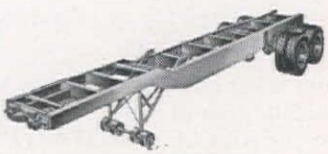
"MACHINERY AND MACHINE TOOL HAULING puts equipment through a tough workout. Our 40-ton Fruehauf Machinery Trailer is proving itself in full schedules. After more than a year of continuous operation, we can detect no signs of wear. And throughout this period, our Fruehauf has required routine maintenance only."

Fruehauf Machinery Trailers are precision-built to take heavy hauls right in stride. No matter what your hauling problem, you'll find Fruehaufs engineered with all the features needed to do *big jobs:* deep structural outside rails, rugged vertical supports, thick fir floors for easy load blocking, and unusually large level loading area, to name but a few.

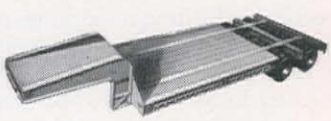
Your nearest Fruehauf representative has complete information.

THERE'S A FRUEHAUF TRAILER FOR EVERY HAULING NEED

PLATFORMS



CHASSIS



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FRUEHAUF Trailers
"ENGINEERED TRANSPORTATION"

World's Largest Builders of Truck-Trailers

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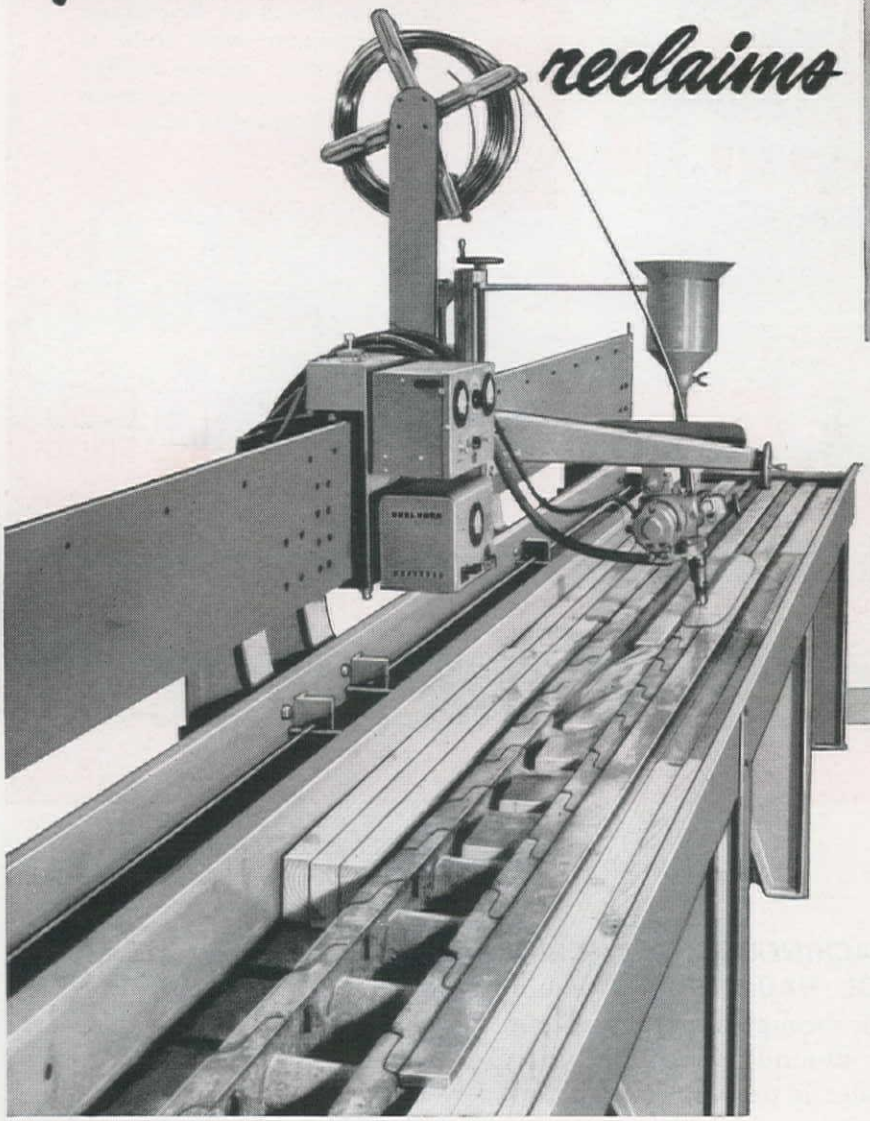
Albuquerque • El Paso • Denver

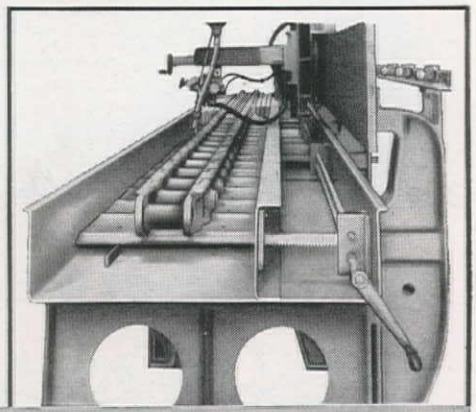
COMPLETE FACTORY SERVICE AT BRANCHES COAST TO COAST

Fast, Automatic Re-surfacing Unit

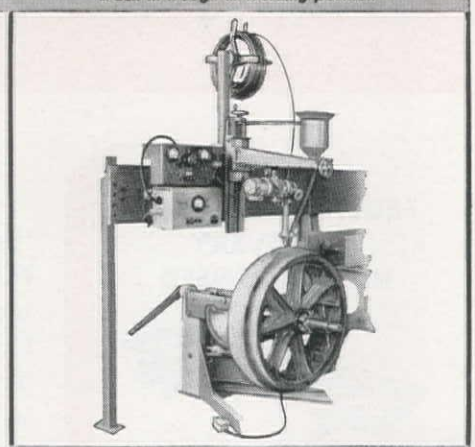
reclaims

TRACK LINKS
ROLLS
IDLERS
SHEAVES





Track in trough in welding position



Idler mounted on ROTATOR

HANDLES ALL MAKE TRACKS

Now, you can re-surface and reclaim track links, rolls, idlers, sheaves or other circular work, quickly, easily, at low cost on the BERKELEY ConSERVall. Simple and completely automatic in operation, the ConSERVall requires no skilled operator. Anyone can become expert with a few hours instruction.

Tracks can be re-surfaced and quickly returned to service at a fraction of present costs. The complete track is placed in the ConSERVall trough just as it is taken from service. Adjustments are quickly made and the re-surfacing operation begins. Weld length and space between welds are automatically controlled and indexed by cams which are quickly and easily adjusted for any type track.

The standard Model 30 ConSERVall will re-surface any track currently in use without dis-assembly or relocation of the track during the re-surfacing operation.

Rollers, idlers, sheaves and other circular work can be re-surfaced or welded by the addition of a 5 ft. Carriage Track Extension and the BERKELEY ROTATOR. ROTATOR Spindle speeds are adjustable from 0 to 7½ RPM. The Spindle is adjustable from the horizontal to a vertical position. A 12″ vertical adjustment permits re-surfacing all sizes of rolls and idlers. Cone centers assure concentric rotation of the workpiece. The ConSERVall cross slide, with its conveniently located handwheel controlled traverse, insures smooth overlap of the weld bead.

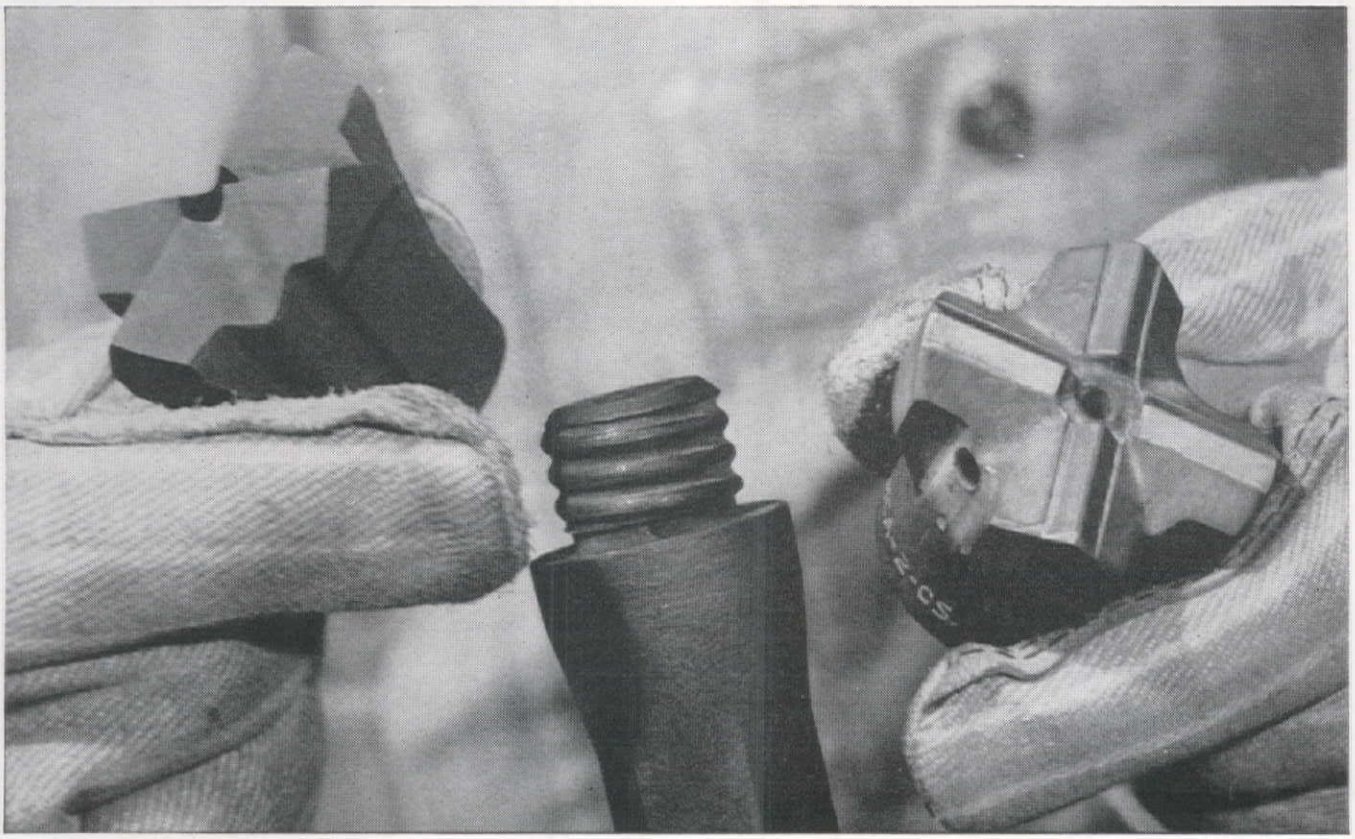
Write for illustrated Circular, complete. Specifications and prices. PROMPT DELIVERY.

PENN TOOL & MACHINE CO. **DANVILLE, ILLINOIS**

Builders of production welding machines, jigs and fixtures

AN AFFILIATE OF BERKELEY EQUIPMENT COMPANY

SWITCH TO THE BEST BIT TYPE FOR THE JOB, RIGHT ON THE JOB!



Both Timken® rock bit types fit the same drill steel!

AS the ground changes on the job, you can change to the most economical bit right *on* the job — if you're using Timken® bits. They're interchangeable. Timken carbide insert and multi-use bits both fit the same threaded drill steel.

When drilling in ordinary ground use Timken multi-use bits. With correct and controlled reconditioning, they give you the lowest cost per foot of hole when full increments of steel can be drilled.

When you hit hard, abrasive ground, quickly switch to Timken carbide insert bits for greatest economy. They're your best bet for maximum speed, constant-gauge holes, small diameter blast holes and very deep holes.

By teaming up Timken carbide insert and multi-use bits, you put the best answer to every drilling requirement right at your drillers' finger tips. Both bit types are interchangeable in each thread series. And remember that both have these three important advantages: 1) made from electric furnace Timken fine alloy steel, 2) threads are not subject to drilling impact because of the special shoulder union developed by the Timken Company, 3) quickly and easily removable.

Call upon the 20 years' experience of our Rock Bit Engineering Service for help in selecting the best bits for *your* job. Write The Timken Roller Bearing Company, Rock Bit Div., Canton 6, O. Cable address: "TIMROSCO".

Timken threaded multi-use rock bit

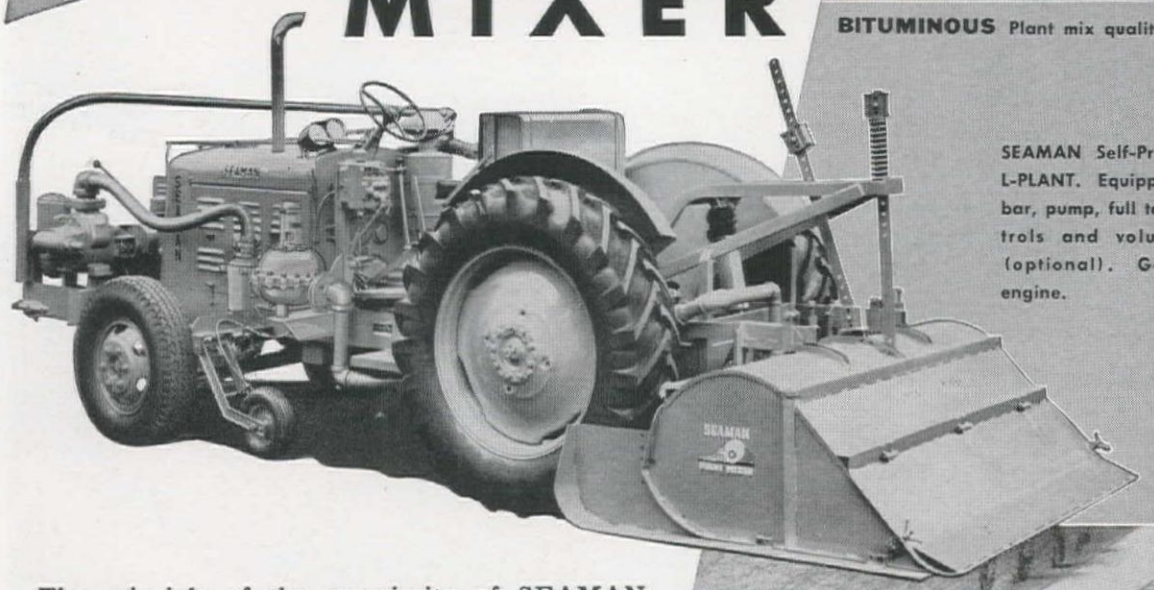
Timken threaded carbide insert rock bit

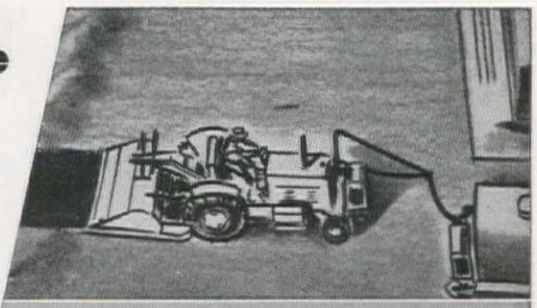
TIMKEN

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

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

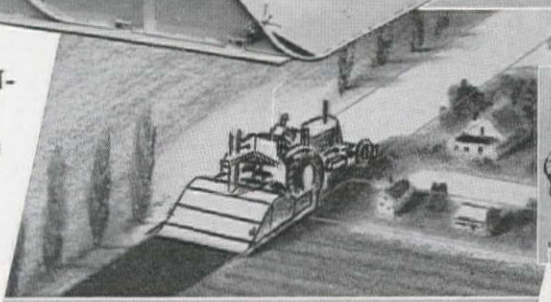
whatever move you make you're a winner with the SEAMAN MIXER



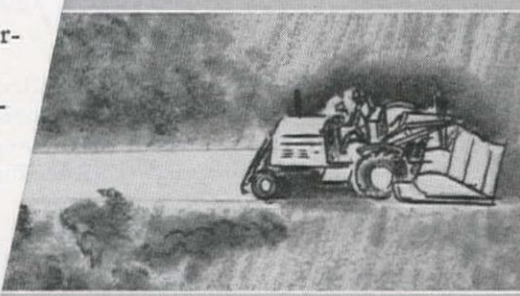


BITUMINOUS Plant mix quality at road mix cost.

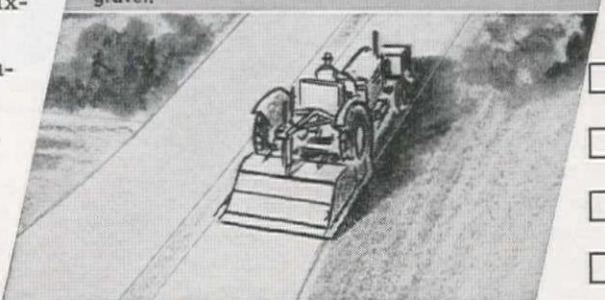
SEAMAN Self-Propelled TRAV-L-PLANT. Equipped with spray bar, pump, full tachometer controls and volumetric meter (optional). Gas or diesel engine.



MACADAM Perfect keying and interlocking of stone and distribution of fines with the SEAMAN.



GRAVEL SEAMAN-stabilization saves $150.00 to $500.00 per mile each year in maintenance and new gravel.



SOIL-CEMENT 15% stronger soil-cement bases with SEAMAN-mixing.

The principle of the superiority of SEAMAN-mixing is in the blending of all materials so uniformly that the strongest, highest load-bearing, wear and weather-resistant base is produced. Add to this the high daily output of mixed materials, the remarkably low operating cost and the small purchase investment required — and you will see why the SEAMAN is building *more miles of better roads for the tax-dollar* — than is possible with any other method of mixing. So it's your move. Make it a winner — with the SEAMAN MIXER.

FREE! Comprehensive, detailed Bulletins on

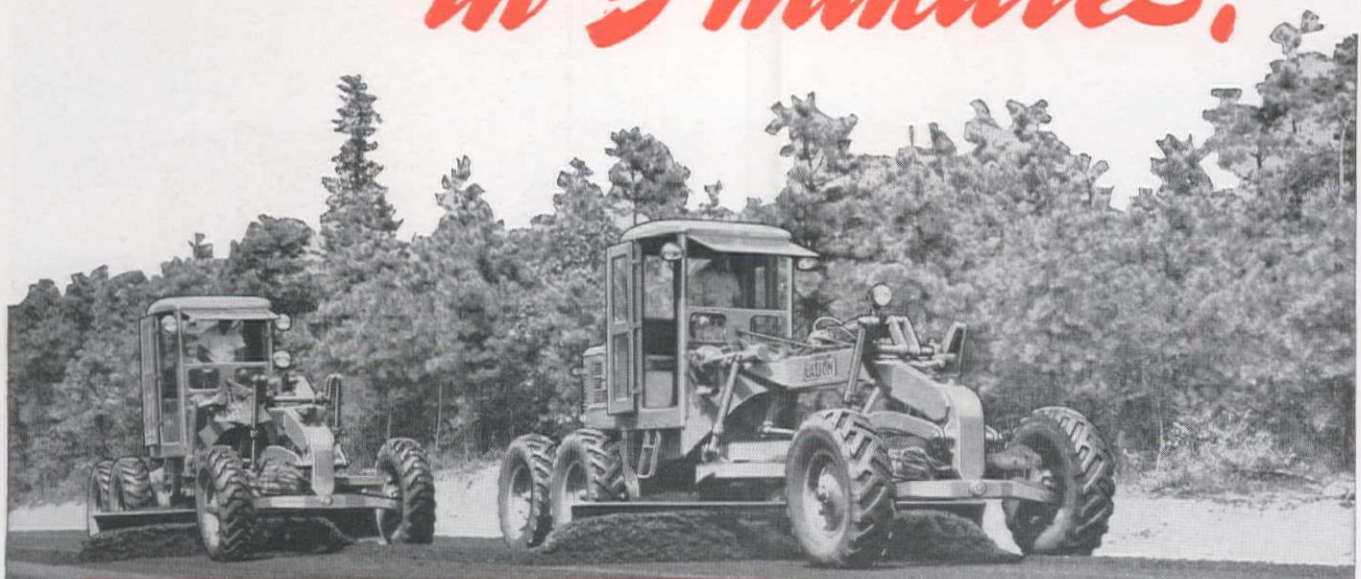
- ☐ Bituminous Construction (No. 40)
- ☐ Soil Cement Construction (No. 50)
- ☐ Macadam Base Construction (No. 60)
- ☐ Gravel Stabilization (No. 65)

Check those you want— or write giving the Bulletin numbers. Do it today.

SEAMAN MOTORS, INC.

285 N. 25TH STREET
MILWAUKEE 3, WISCONSIN

You'll be *Convinced in 3 minutes!



PROVE IT TO YOURSELF !

When you start a GALION Motor Grader thru its paces, you will *quickly* sense advantages over competitive Motor Graders. Because—

- **SIMPLIFIED HYDRAULIC CONTROLS** give you simplified operation.
- **MANUAL STEERING WITH HYDRAULIC BOOSTER** gives you ease of operation — minimum muscle work.
- **LARGE FRONT TIRES** give you extra clearance — less slippage — better flotation.
- **GEAR TYPE TANDEM DRIVE** gives you a *positive* four wheel drive.

*You'll be *convinced* that GALION Graders give you most for your money on any grading job.

Contact the nearest Galion Distributor for a demonstration—then drive it yourself to prove it to yourself.

GALION DISTRIBUTORS

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TEXAS:
El Paso.....LIVELY EQUIPMENT COMPANY

UTAH:
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WASHINGTON:
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Spokane.....MODERN MACHINERY CO., INC.
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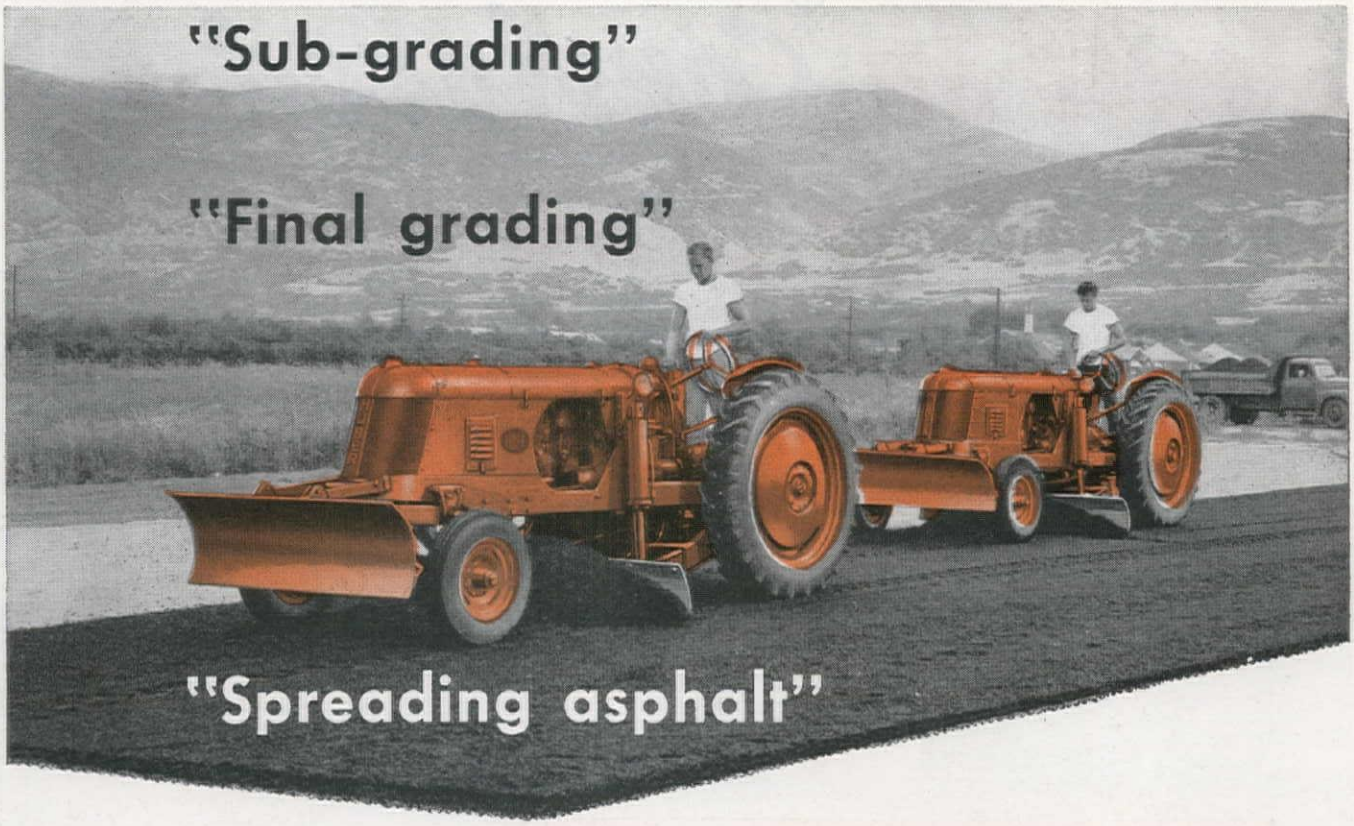
WYOMING:
Cheyenne.....CHEYENNE TRUCK EQUIP. CO.

ESTABLISHED GALION 1907

MOTOR GRADERS · ROLLERS

THE GALION IRON WORKS & MFG. CO., General and Export Offices, Galion, Ohio, U.S.A.

Cable address: GALIONIRON, Galion, Ohio



"HUBER MAINTAINERS ARE THE *Handiest Things!*"

H. Sessions & Sons of North Salt Lake, Utah, make many uses of a pair of Huber Maintainers in connection with the asphalt laying service they offer in Utah and nearby states. They've been in the business since 1945, a fact that adds significance to the comment of Mr. Sessions that "the Huber Maintainer is the handiest thing there is in a piece of machinery."

The 6,000-pound, 42½ H. P. Maintainers handle sub-grade and final grading work and spread asphalt. The two of them spread 500 tons in eight hours . . . on another job one of them spread 50 tons in 3½ hours. The Maintainers are "just the right size for laying asphalt," Mr. Sessions said.

Mr. Sessions needs only the Maintainer blade and the bulldozer attachment in his work . . . but you can have any or all of the other HYDRAULICALLY CONTROLLED attachments which enable the Maintainer to work as a lift-loader, highway mower, berm leveler, road planer, broom, snow plow or patch roller.

Huber Maintainers are handling scores of jobs for federal, state, county, municipal and township owners as well as contractors and other private users. Why not learn today, from your nearest Huber Distributor or by writing to the factory, what the Huber Maintainer can do to help you?

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
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Feenaughty Machinery Co.	Spokane 2, Washington
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The Colorado Builders' Supply Co.	Denver 9, Colorado
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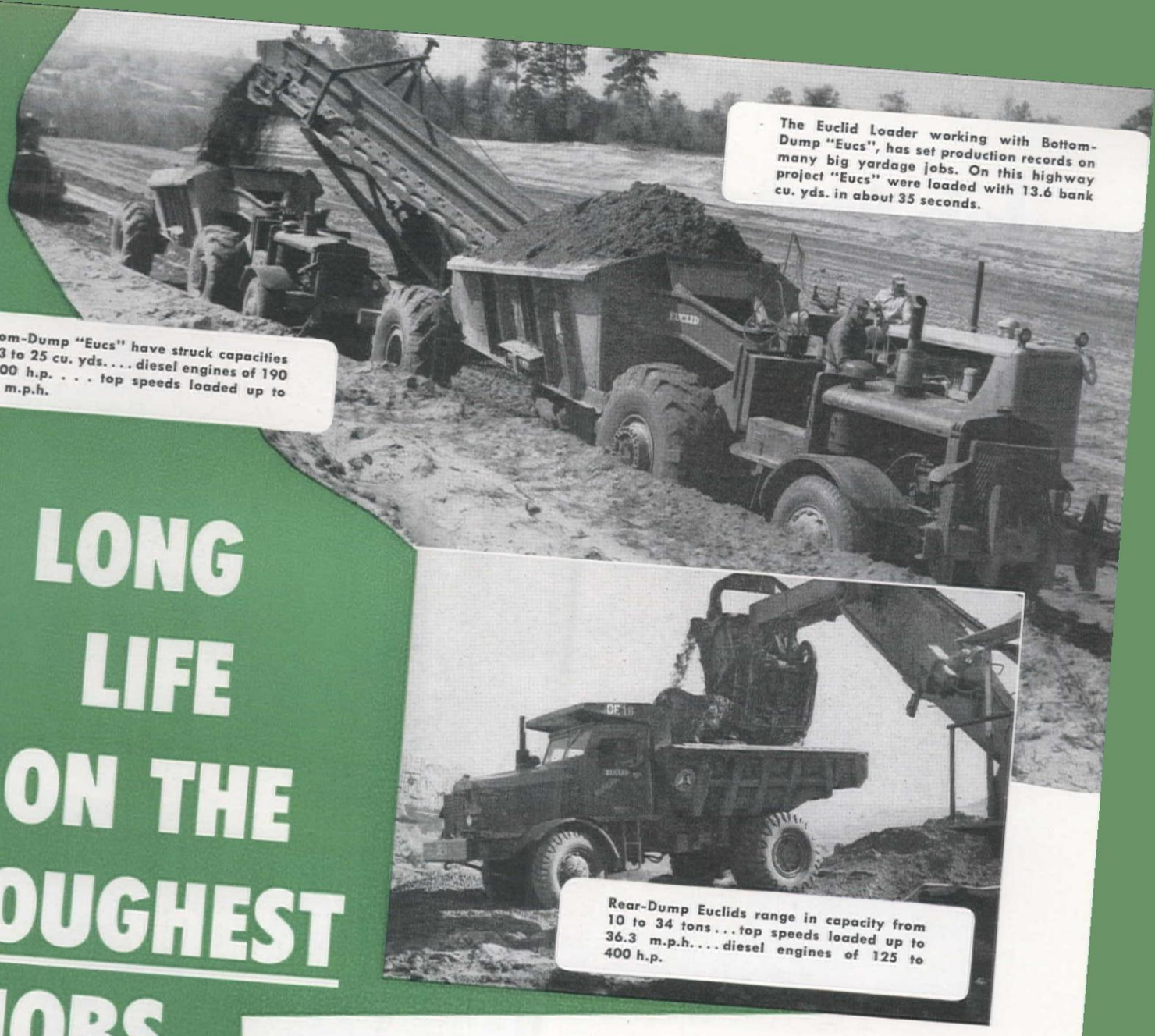
Montana Powder & Equipment Co.	Helena, Billings, Montana
The O. S. Stapley Co.	Phoenix, Arizona
Feenaughty Machinery Co.	Boise, Idaho
Flaherty Equipment Co.	Idaho Falls, Idaho
Coast Equipment Co.	San Francisco 1, Calif.



The Euclid Loader working with Bottom-Dump "Eucs", has set production records on many big yardage jobs. On this highway project "Eucs" were loaded with 13.6 bank cu. yds. in about 35 seconds.

Bottom-Dump "Eucs" have struck capacities of 13 to 25 cu. yds. . . . diesel engines of 190 to 300 h.p. . . . top speeds loaded up to 34.4 m.p.h.

LONG LIFE ON THE TOUGHEST JOBS

Rear-Dump Euclids range in capacity from 10 to 34 tons . . . top speeds loaded up to 36.3 m.p.h. . . . diesel engines of 125 to 400 h.p.

Put "Eucs" on the job and be on more jobs!

● Proof that Euclids are engineered and built for long life performance in off-the-highway service is found in the record—of the thousands built, more than 9 out of 11 "Eucs" are still in use!

Engineered and built for lasting strength, Euclids are job proved for continuous operation, less down time and lower maintenance costs on a wide range of construction, mining and quarry work.

Ask your Euclid Distributor about the Euclid features that mean more loads per hour at more profit per load—large capacity, power and traction for steep grades, and speed on the haul road.

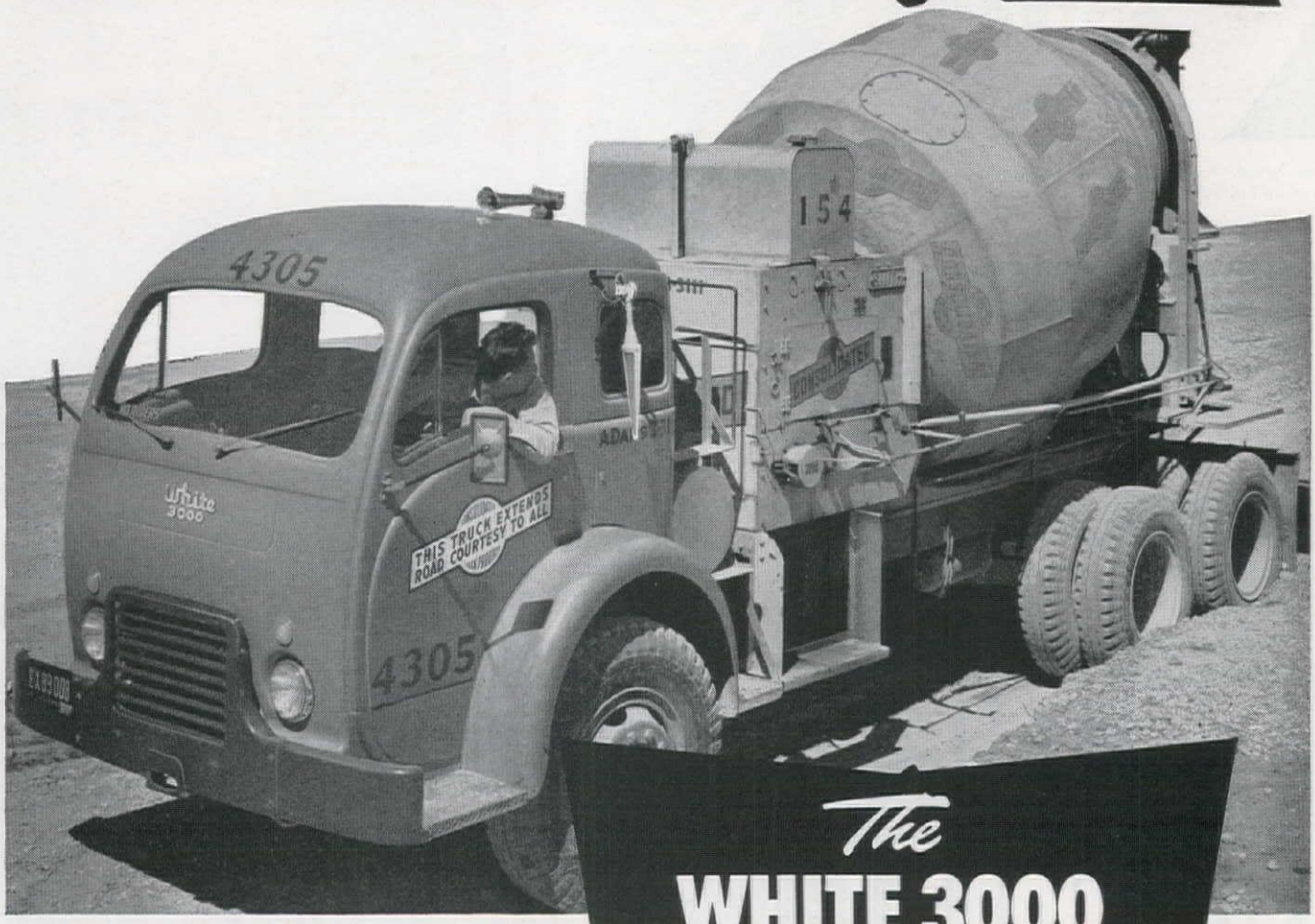
The EUCLID ROAD MACHINERY Co., Cleveland 17, Ohio

CABLE ADDRESS: YUKLID — CODE: BENTLEY

EUCLID THE PIONEER

EUCLIDS *Move the Earth*

Job-tested...Economy Proved!



The Consolidated Rock Products Company of Southern California depends on a fleet of White 3000's to meet daily construction schedules with top efficiency.

The WHITE 3000

does more work—in less time at less cost!

WHITE 3000'S PROVED COST-SAVING ADVANTAGES

1. Saves driver time and energy ...gets more work done.
2. Complete front end accessibility cuts maintenance cost. Makes service easier.
3. New safety features
4. New weight distribution permits longer bodies...more payload.
5. Saves space on the street...in the garage...better maneuverability.

Extra Capacity...load-wise and work-wise! That's why the White 3000 sets a rapid pace on construction jobs. Its new principle of weight distribution permits far greater legal capacity than is possible on conventional trucks of similar wheelbase. Its high maneuverability and ease of maintenance means extra savings of time and money. Investigate *the facts of White for yourself!* Let your local White Representative show you how you can save hours and dollars on *your* construction schedules. Call him today!

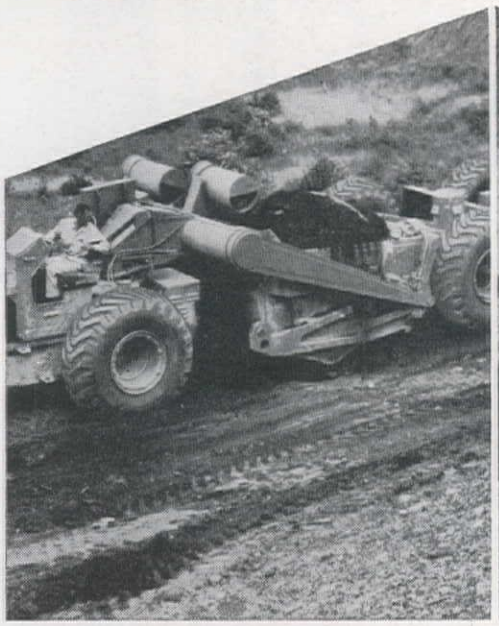
Tips its cab to service

THE WHITE MOTOR COMPANY
CLEVELAND 1, OHIO
Factory Branches, Distributors and Dealers Everywhere

FOR MORE THAN 50 YEARS THE GREATEST NAME IN TRUCKS

GENERALS

GO IN – GET THE LOAD – CARRY IT OUT and OVER THE HIGHWAY



"OFF-THE-ROAD"

"ON-THE-ROAD"

FASTER!
EASIER!
At Less COST!

General D. T. L. with deep, sharp, angled cleats and sturdy, high shoulder lugs. Designed for maximum traction on soft surfaces—forward or backward.

General H. C. T. for trucks that go off-the-road to pick-up, deliver loads. Free-rolling tread and stronger body for more miles, more safety.

Make Every Worn Tire Work Longer for More Profit!

Your GENERAL TIRE DEALER will KRAFT SYSTEM RECAP Worn Tires with the New GENERAL Truck Tire Tread of Your Choice

KRAFT SYSTEM RECAPPING
A GENERAL TIRE SERVICE

You're throwing away money when you throw away worn tires or accept an ordinary "adjustment" for them. Let your General Tire Dealer—a tire expert—restore worn tires with famous factory controlled Kraft System Recapping. You choose from the complete line of on and off-the-road new General Tire treads and he'll put that tread on your worn tire. He can do sectional repairs too. Get Kraft System Recapping—get more profit from every tire.

SPECIFY GENERAL TIRES ON YOUR NEW EQUIPMENT

B-G Redi-Fab Series Sectional Truss Belt Conveyors

IN STOCK — IMMEDIATE DELIVERY

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Barber-Greene Mixall MODEL 804

...THE NEW B-G Mixall MIXES ALL THE HOT PATCH YOU NEED, ANY TIME, ANYWHERE, ANY WEATHER

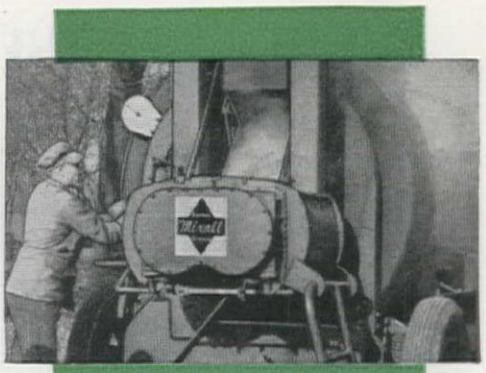
Now, the new Barber-Greene Mixall gives you the opportunity to offer high quality bituminous paving for driveways, sidewalks, service stations, industrial plants, parking lots . . . and other "black top" jobs at new low costs.

The Mixall, a completely new, compact and portable small-job maintenance and paving mixer, will produce up to 5 t.p.h. of any type hot mix . . . up to 10 t.p.h. of cold mix . . . will produce low slump Portland cement mixes. Built to be towed behind the aggregate truck for on-the-spot mixing, the Mixall is just as well suited for central plant or stock pile operation. The Mixall can work in any weather . . . even drying frozen aggregates.

Think of what you could do with the new B-G Mixall in your territory. Then see the Mixall at your first opportunity . . . or write for full information.

THE ONLY SMALL JOB MAINTENANCE MIXER WITH...

- ROTARY DRUM DRYING: The same principle used in largest B-G Continuous Dryers.
- TWIN SHAFT HEATED PUGMILL: "Kneading" action assures even coating of every aggregate particle.
- POWER SKIP HOIST: Only 14" high for easy charging.
- HIGH DISCHARGE: Can discharge directly into place, into wheelbarrows or gas buggies.



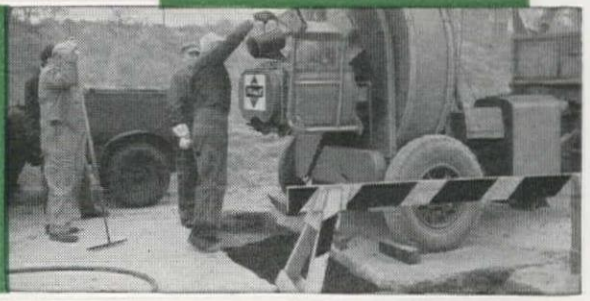
For parking lots, factory floors . . . on-the-job drying of aggregates, complete control of mix.

For playgrounds, tennis courts, roads and streets . . . scattered jobs . . . variations of mixes.

No setup time with Mixall. Operate it hitched to truck for drives, sidewalks, other small jobs.

"Stitch-in-time" maintenance prevents major break-ups; the Mixall works in any weather.

Resurfacing busy crossings, Mixall's compactness allows minimum traffic interference.



SEE YOUR Barber-Greene DISTRIBUTOR

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Wilson Equipment & Supply Co.....Cheyenne, Wyo., Casper, Wyo.
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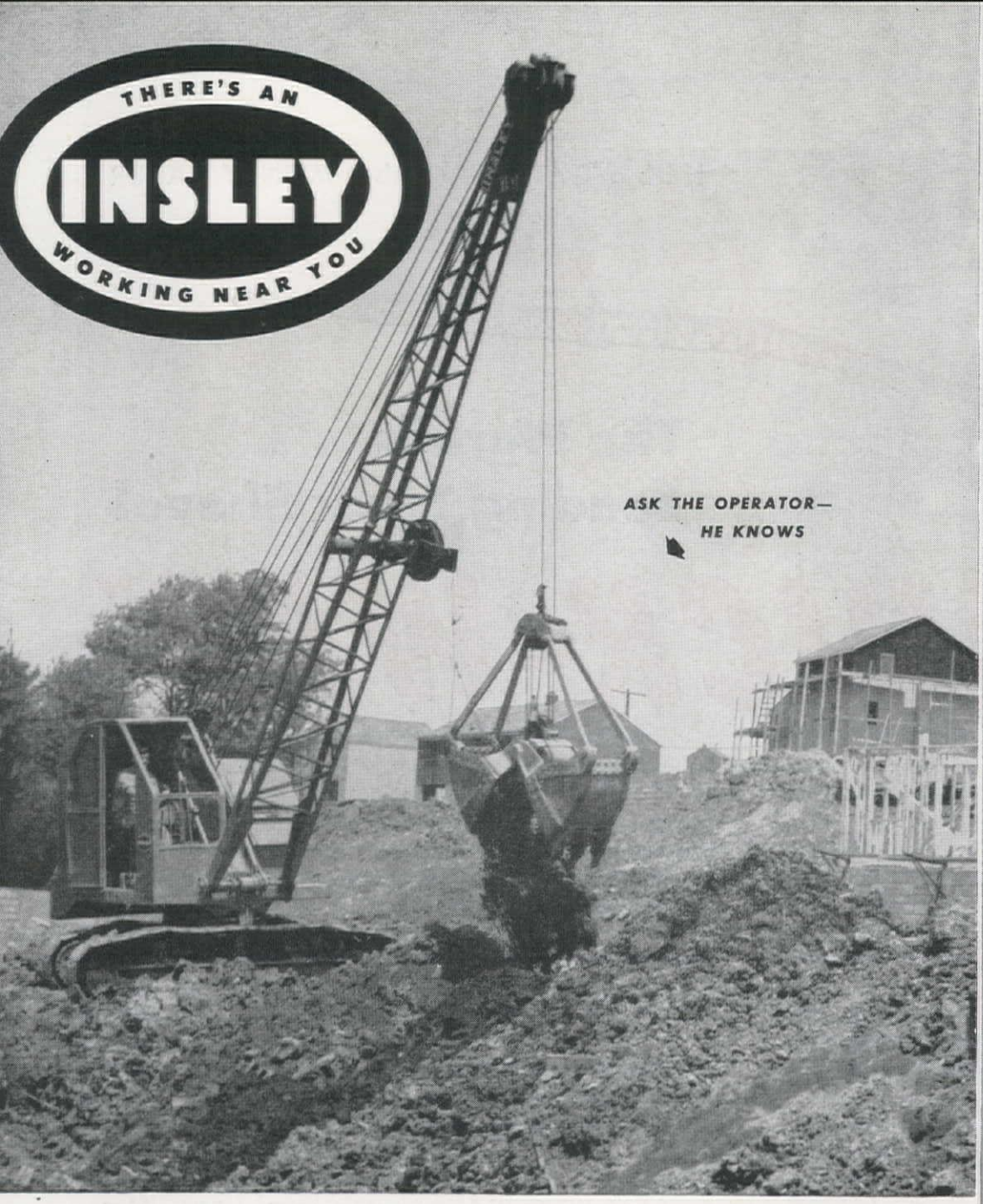
Western Construction Equipment Co. Billings, Montana, Missoula, Montana
Kimball Equipment Company.....Salt Lake City 10, Utah
State Tractor & Equipment Co.....Phoenix, Arizona
Sierra Machinery Company, Inc.,....307 Morrill St., Reno, Nevada



The INSLEY operator knows..

PROJECT RATED
INSLEY
BY THE USER—FOR THE USER

that Insley equipment can be rated-for-the-project...he knows that specification alternates make it possible to buy the exact equipment to do his job best.

INSLEY MANUFACTURING CORPORATION • INDIANAPOLIS 6, INDIANA

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CHEYENNE TRUCK EQUIP.
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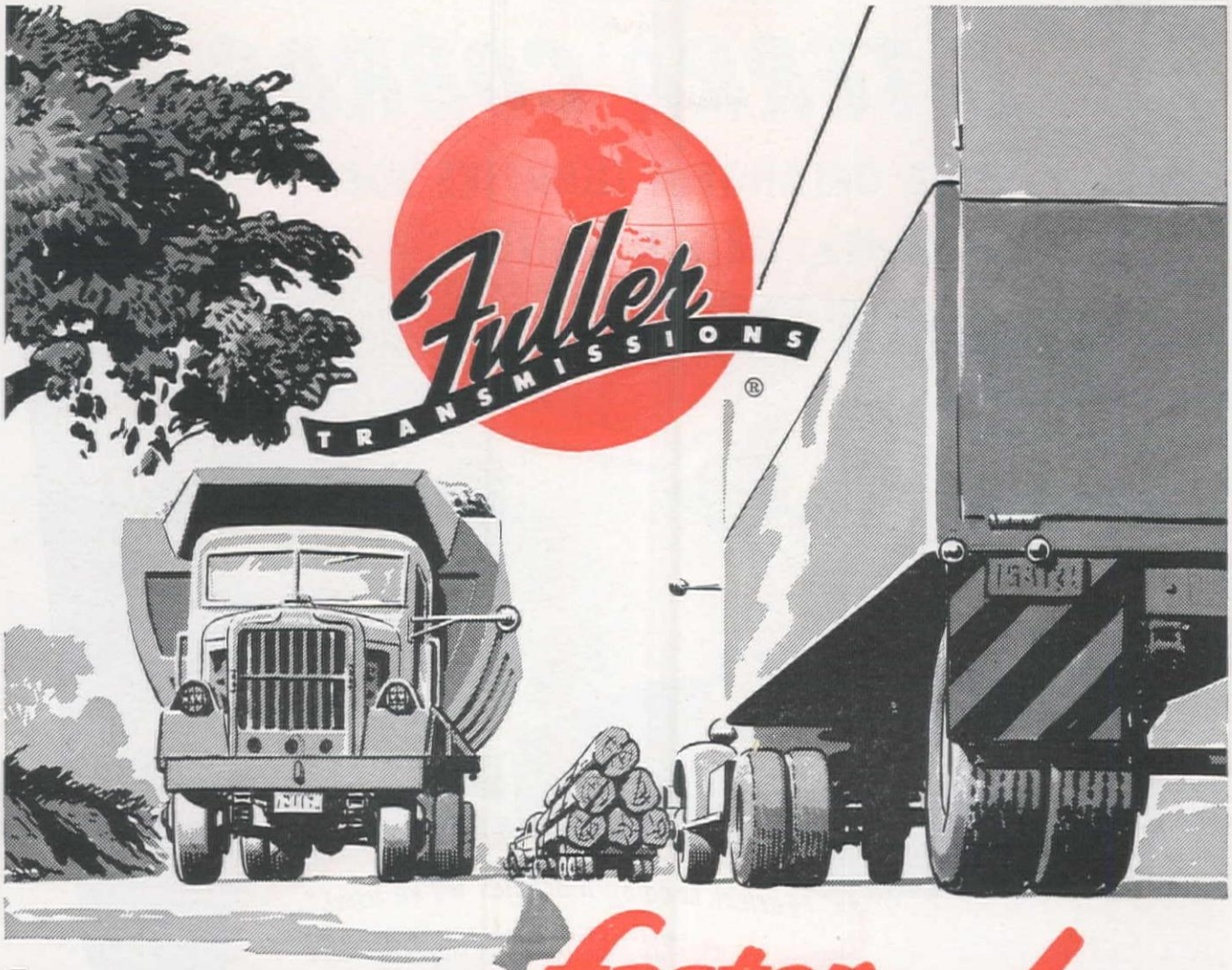


to move more, faster... use more of your engine's hp.

The formula for moving any load at higher average speeds, *for less,* is simple:

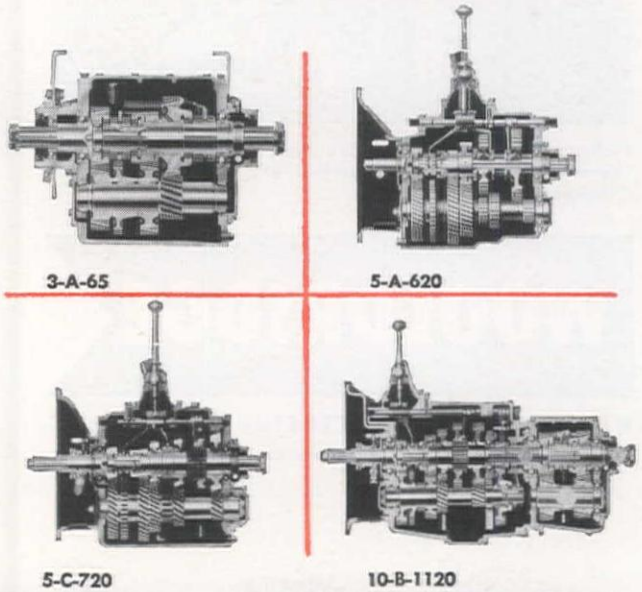
Put your horsepower to work *effectively.*

Every time you lug your engine, or even let it drop below the maximum efficiency range, you lose profits.

That's why the *right* transmission for your "road and load" is so important. That's why so many profit-wise operators specify Fuller Heavy-Duty Transmissions, Fuller Auxiliary Transmissions—and Fuller 10-Speed ROAD RANGER® Transmissions.

For the transmission is where *horsepower goes to work.* And Fuller has proved, time and again, to owner, to mechanic and to driver that Fuller Transmissions gear your rig to use more of your horsepower—to move more, faster, for less.

Illustrated are four of the wide selection of Fuller Heavy-Duty Transmissions. Ask for data on the type and hp.range in which you are interested.



FULLER MANUFACTURING COMPANY (Transmission Division), KALAMAZOO 13F, MICHIGAN

Unit Drop Forge Division, Milwaukee 1, Wis. • WESTERN DISTRICT OFFICE (SALES & SERVICE—BOTH DIVISIONS), 1060 E. 11th Street, Oakland 6, Calif.

5 TERRA COBRAS

SPEED OKLAHOMA TURNPIKE JOB for Smith, Odle & Smith

"Easiest Loading Machines we've used,"

says Eldon Smith, partner in Smith, Odle & Smith. In describing the dependable performance of the five rugged, big-capacity Terra Cobras on the Oklahoma Turnpike job, Smith also rated the machines as "the most economical on cable."

Pictured are Eldon Smith and Bob Odle, partners, and operator Thurman Owens with one of the five Terra Cobras used on the Oklahoma Turnpike job.

Smith, Odle & Smith had ample proof of Terra Cobra performance when they purchased their third Terra Cobra last November and two more early this year. Their first two Cobras were rushed in to finish moving 367,000 yards on Highway 66 last Summer, then roaded to the Oklahoma Turnpike where 850,000 yards were to be moved between September 15 and April 1. 600,000 yards of hard sandstone, shale and sand were assigned to the Cobras. By the time the full fleet of five went into action in February, each original Cobra had put in 1,500 hours. With work well ahead of schedule, typical job records showed the five big capacity 17.5 yard Cobras completing 4,000 foot cycles every 4½ minutes, averaging 750 pay yards of the tough material per hour, ten hours per day, six days per week. In spite of constant hard driving, a minimum of downtime was reported. Like Smith, Odle & Smith, you too can benefit from the recognized Terra Cobra features—faster loading and dumping—extra ruggedness—simplicity of design—easier maintenance. Let your Wooldridge Distributor help you get more production per hour plus more hours of production.

WOOLDRIDGE

WOOLDRIDGE MANUFACTURING COMPANY

Sunnyvale, California • 5345 N. Winthrop Ave., Chicago 40, Illinois


Terra Cobra


Terra Cobra Wagon


Power Control Unit


Scrapers


Rippers


Bulldozers

acceptance

Wherever you are, there's a MARION working near you —a MARION dragline, clamshell, crane, pull shovel, pile driver or walking dragline. The *worldwide acceptance* MARION machines have won over a period of 68 years is one of the best recommendations we have.

Their selection for such impressive assignments as the Boulder Dam, Panama Canal, TVA dams, and other big projects in construction, mining, quarrying and coal stripping endorses MARION as a name you can trust.

MARION has many "firsts" in the development and refinement of excavators and material handling machines. MARION offers more types and sizes of machines than any other manufacturer.

Look to MARION for resourceful, conscientious help in solving your excavating and material handling problems.

Write today for a copy of Bulletin 403-A—*it pictures and describes in condensed specifications every machine in the world's most complete line of excavating and material handling machines.*

MARION POWER SHOVEL COMPANY — MARION, OHIO

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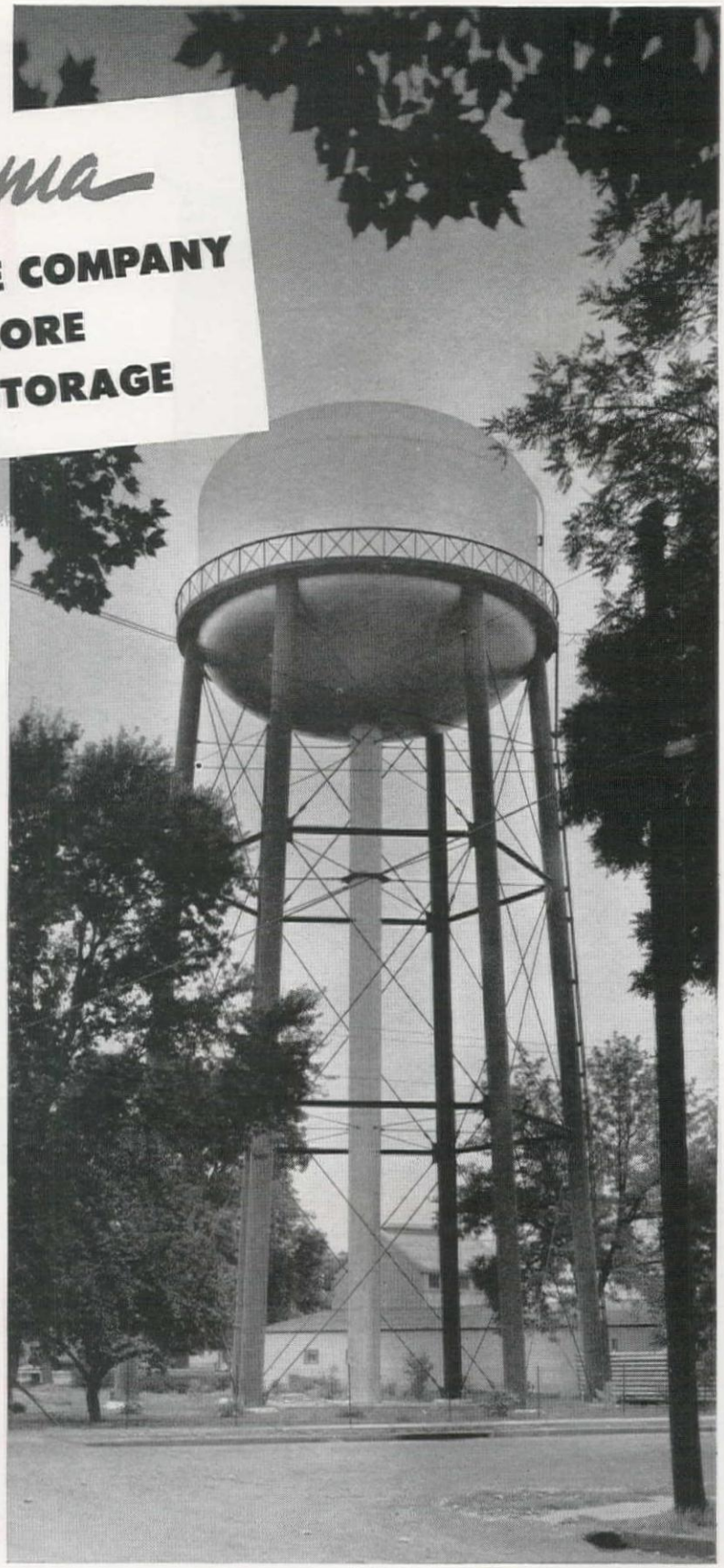
California WATER SERVICE COMPANY ADDS MORE ELEVATED STORAGE



The California Water Service Company has installed the fourth elevated water tank in its distribution system at Chico, California. It is a 300,000-gal. Horton ellipsoidal-bottom structure, designed to accomplish two important objectives. First, it increased elevated storage capacity 54 per cent. Second, it rounded out a distributed elevated storage system.

Here is a brief outline of Chico's distributed storage network and its benefits. Four elevated tanks are strategically located in sections of heavy demand. The Horton tank pictured at the right provides gravity water pressure for the western section of town. Another 300,000-gal. tank serves the northern end and two tanks of 100,000-gal. and 150,000-gal. capacities respectively, are located near the center of town. This distributed water storage helps keep water pressures in the distribution mains more uniform. In addition, each section has its own water reserve available for fire fighting or other emergencies. Reductions in pumping costs are also achieved through additional elevated storage.

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WESTERN CONSTRUCTION

June 1952 Vol. 27, No. 6

Jet aircraft vs. airfield pavements

Problems which have developed since jet aircraft began to use airfield runways received a thorough discussion at a recent conference at Port Hueneme sponsored by the Navy. Never before has the subject received such complete dissection from authorities in all branches of airport design, construction and maintenance. Information exchanged was extensive although the experts made no attempt to arrive at definite conclusions.

Development of larger aircraft has always added to the problem of designing for heavier loads, but it was not until the introduction of the jet engine that engineers were confronted with problems that could not be solved by adding strength to the runway. Suddenly, the new set of problems introduced factors of heat and blast on the surfaces of runways and other paved areas.

The jet problem is peculiarly Western, since it has its principal aspect in connection with asphaltic pavement, and most of the military airfields of the West are of the flexible design, based on the economy of first cost. This type of pavement was described as presenting a problem whenever jet planes remain stationary with engines running. After a very few minutes the exhaust from the tailpipe tends to soften the bitumen and then the force of the blast begins to blow out pieces of aggregate from the heated area. Angle of the blast and time are controlling factors. While planes are in motion during take-off the speed eliminates jet problems. Thus, damage is concentrated on three relatively small areas used for (1) warm-up, (2) final run-up prior to take-off and (3) maintenance areas where engines are tested or checked. Under present jet operations portland cement concrete pavement is not affected by this action of heat or blast, with the exception of the expansion joint filler which softens and tends to blow out onto the surface. Fuel spillage, with its softening action on asphalt, was considered not so much a technical problem as one of better "housekeeping" in the Air Force.

All of these problems, reported on another page of this issue, were discussed by engineers from the services, technical laboratories and industry.

A possible solution for the immediate problem would be to pave those areas where jets are tested, run up or maintained, with rigid type pavement, together with possibly the first short section of the runway. Otherwise, present design could continue. This change would still involve the problem of softened expansion joints, but new materials were announced which would be less vulnerable. With this modification in airfield design the problems discussed would be on the way to a solution.

Full reservoirs are hypnotizing

Unless water-supply history fails to repeat itself, the present precipitation record in the West will cause a marked relaxation in the urge for conservation. There is nothing like full reservoirs to obscure public memory on short water years. A succession of sub-normal water seasons which put restrictions on hydro-electric power, irrigation supplies and even domestic use will be forgotten with one year of normal run-off. Until the climate-cycle prognosticators improve the accuracy of their predictions, the usual engineering factor of safety should be maintained.

The West exists on an economy based on water supply. Population growth, and all its accelerating demands for commercial and industrial water, is adding yearly to the need for dependable supplies. All diversion and aqueduct schemes, even those considered as really visionary, should remain under active study. The run-off of our rivers in 1952 should not provide a murmur which will lull the West into complacency over the mounting need for water.

Breadth in highway careers

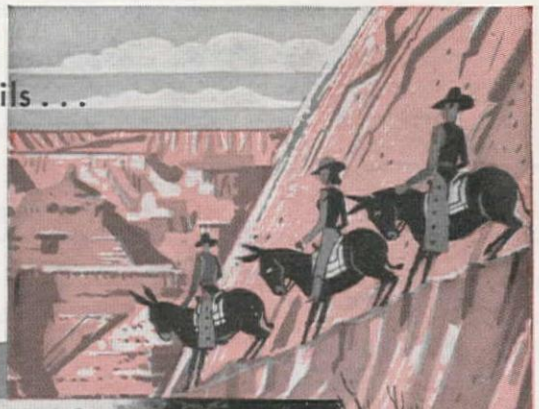
Specialization has developed within the widening framework of highway engineering, just as the same evolution has been taking place for a generation in the larger field of civil engineering. Today, highway engineers are beginning to make careers of such narrow fields as planning, or construction, or maintenance, or traffic. As highway work expands throughout the West in future years there will be a greater tendency to specialize. Young engineers get the impression that to be recognized as an expert in a narrow branch of highway work is to be assured of most rapid promotion. Again, the parallel in the parent civil engineering field should prove a reliable guide;—advance to positions of responsibility are generally based on developing a breadth of knowledge covering the entire scope of the science.

From such a broad-gauge approach this Annual Highway Issue has been designed to provide a group of articles covering the range of present highway engineering, from matters of finance to maintenance. This type of round-up embracing many phases of the subject will enable engineers of the West—especially the younger engineers—to be able to keep in touch with the broader aspects of the field while continuing to develop their specialty. Breadth of knowledge provides the broad foundation for fullest growth in technical careers.

ADMINISTRATION	X
DESIGN	X
CONSTRUCTION	X
MAINTENANCE	X
MUNICIPAL	X
BRIDGE	X

Like Mules and Canyon Trails . . .

they Go Together



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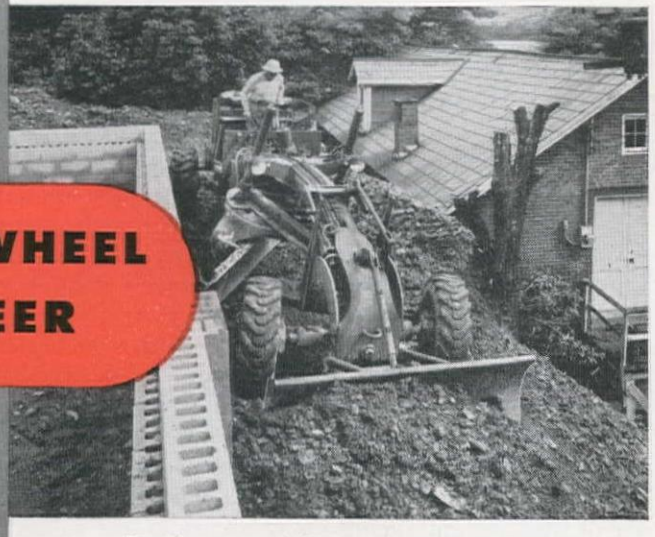

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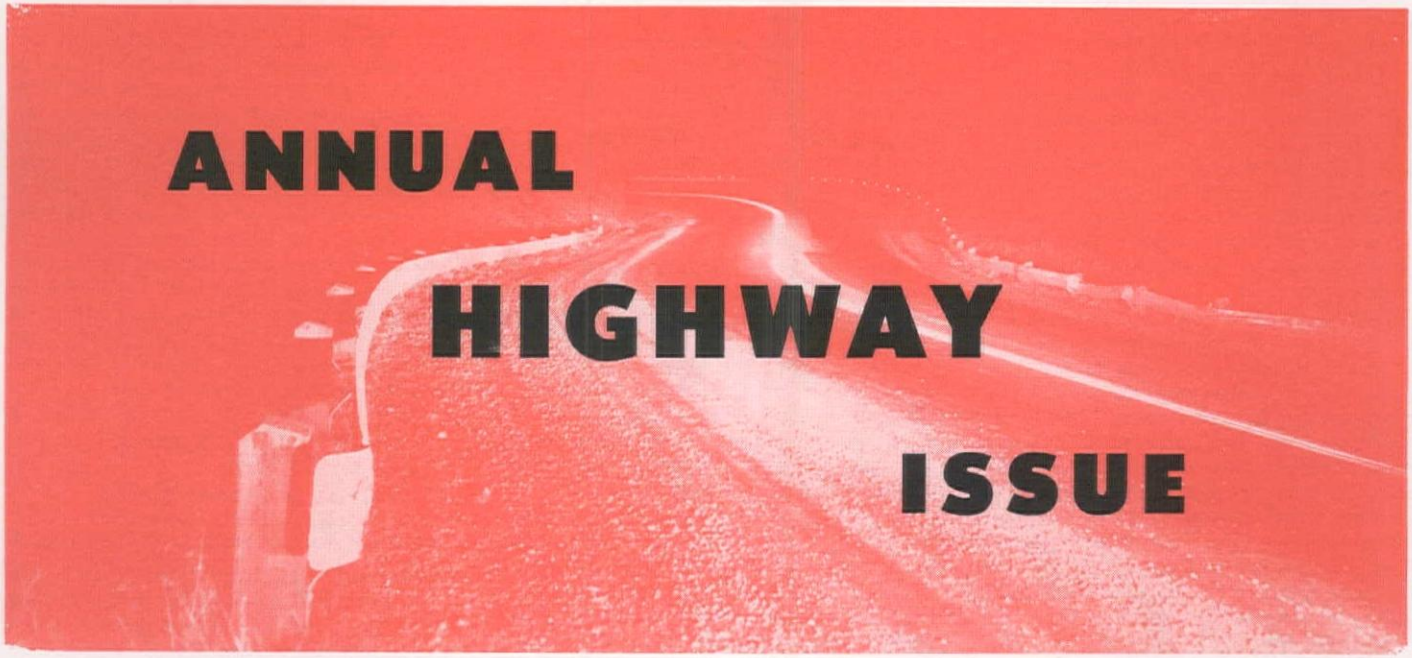


California's Index indicates the trend of—

HIGHWAY CONSTRUCTION COSTS

Need for basic information on the rise in costs during postwar inflation resulted in a study of contractors' bid figures and the establishment of an Index based on these actual prices

ADMINISTRATION	X
DESIGN	
CONSTRUCTION	
MAINTENANCE	
MUNICIPAL	X
BRIDGE	

By
RICHARD H. WILSON
Assistant State Highway Engineer
Division of Highways
State of California

A COMMODITY PRICE INDEX or cost index, as it is usually termed in connection with construction activity, is merely a convenient method of determining the annual fluctuation in costs or prices by relating them to a common base. Such comparisons are highly valuable in all lines of economic endeavor as they provide a factual means of studying, by means of "back sights," the effect of known influencing factors on the costs of commodities. This in turn provides the means for interpretation of possible effects of current factors.

Need for an index

During the first three years after World War II the nation began to realize that instead of the economic slump which had been anticipated, the country was aboard an inflationary spiral with prices on a continuing rise in all phases of the economy. During these first three postwar years the Division of Highways had been busy advancing its postwar highway construction program and, after the passage of the Collier-Burns Highway Act (1947) which materially increased revenues, with placing under contract the expanded construction program made possible by that Act.

It became apparent, however, that correction of deficiencies on the state highway system was not progressing at the rate anticipated under the increased revenue. This was the result of the continuing up-trend in prices, but the Department wanted to know just what effect inflation was having upon highway construction costs in California.

Engineers were set at work on the problem and they proceeded with a comprehensive and exhaustive study of state highway construction costs, and developed the California Highway Con-

struction Cost Index, which is now brought up to date each quarter.

At the beginning of the study in the latter part of 1948 the premise was made that the basic elements of highway construction costs to a contractor are: (1) materials, (2) wages and (3) equipment —rental or ownership. Other factors such as overhead, supervision, taxes, insurance and profit were considered as proportional to these three basic elements.

Data were developed for the years 1940 to 1948 to determine increases in costs to the contractor for the principal items going into highway construction. Labor costs on construction were likewise investigated for the same period, taking into consideration overtime and labor efficiency or productivity. The studies also included investigation of increases in equipment rental or ownership costs.

In the analysis of construction costs the intangible item of materials availability was not taken into consideration. Although the term "intangible" is applied to this item it is known to be a real factor in affecting contractors' costs. Any delays to the contractor in delivery of materials to an orderly schedule increases his cost and must be given consideration in the preparation of his bids. Nevertheless, because of the impossibility of determining this factor it was not considered in the analysis.

Contractors' actual costs

Contracting is a highly competitive business and, quite understandably, contractors are reticent in revealing details of their cost accounting. Under these conditions the state was in no position to determine with any great degree of accuracy just what materials and equipment cost a contractor and what allowances were made for the intangible factors. Data on labor costs, however, were determined quite accurately from certified pay rolls on a reasonably large number of Federal Aid highway projects.

However, it was decided that there were too many assumptions and too many omissions of pertinent factors in the data used in compiling an index by this method and as the Division of Highways was primarily interested in the fluctuations of the cost to the state for highway construction the investigators developed the California Highway Construction Cost Index based entirely upon actual contract prices for such construction. Under this factual method of approach it may not be possible to put a finger on the more obscure factors such as equipment costs, allowances for delays in delivery of materials or labor productivity, but these items are in the bid price and accounted for in the index.

Following the methods employed by the Bureau of Labor Statistics of the United States Department of Labor, which is probably the best authority on developing price indexes, the California Index was calculated fundamentally from an adaptation of the Laspeyres formula, which is expressed as:

$$I = \frac{\Sigma P_t Q_o}{\Sigma P_o Q_o} \times 100$$

P_t is the cost in the current period
P_o is the cost in the base period and
Q_o is the quantity weight in the base period.

Other authorities agree that this is the most practical formula for determining satisfactory indexes of comparative price levels, provided the time between the current period and the base is not too great. The Bureau of Labor Statistics considers about twenty years to be the maximum.

Base year and quantities

The year 1940 was selected as the base year (index number of 100) on the assumption that 1940 represented conditions before the beginning of the national defense program which started the rise in construction costs.

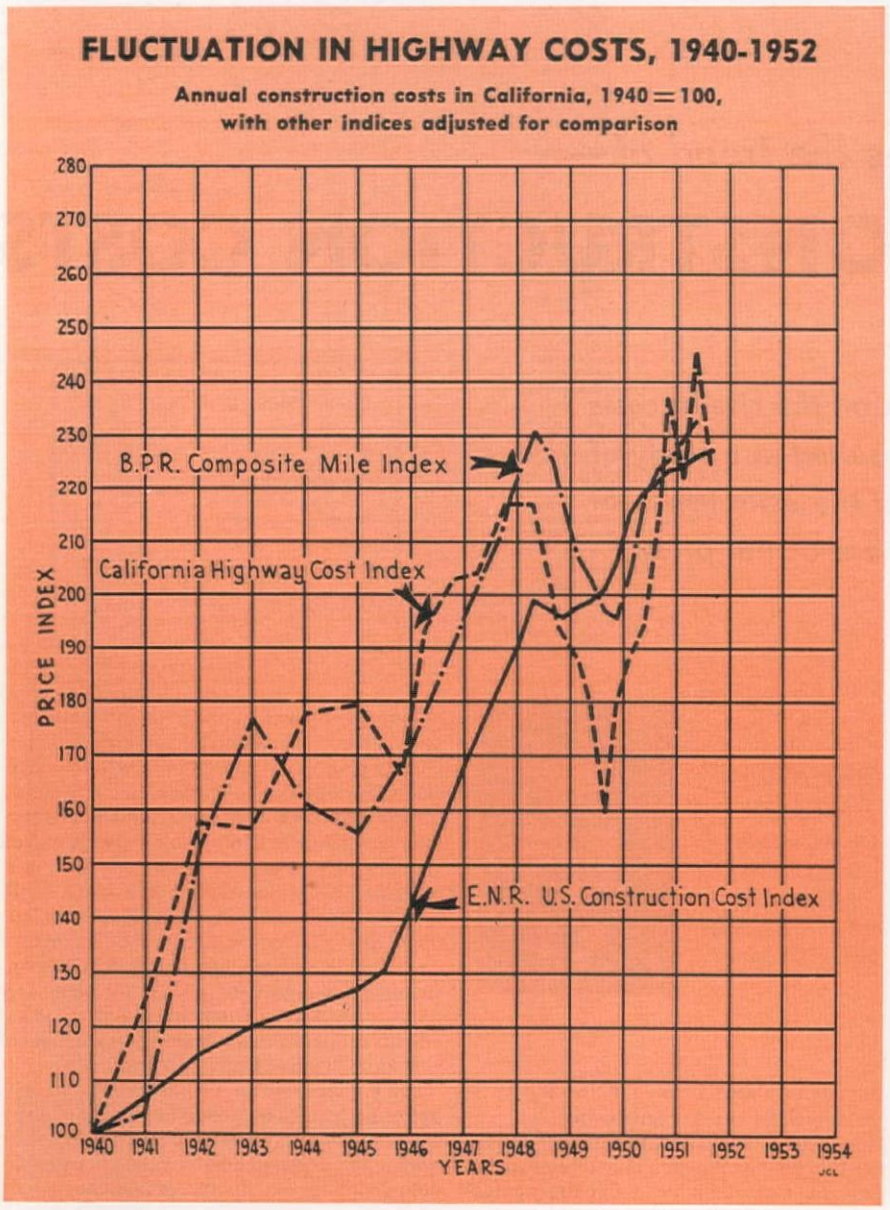
Eight major contract items were selected as representative of the majority of work on state highway contracts. To give proper weight to each item the total quantity of each for the fiscal year from July 1, 1947 to June 30, 1948 was compiled. The following is a list of the eight items and the total quantity of each for that year.

No.	*Item*	*Quantity*
1.	Roadway excavation	15,697,410 cu. yd.
2.	Crusher run base	681,611 tons
3.	Plant-mixed surfacing	1,501,178 tons
4.	Asphalt concrete	34,060 tons
5.	Portland cement concrete pavement	209,157 cu. yd.
6.	Class "A" portland cement concrete (structures)	163,760 cu. yd.
7.	Bar reinforcing steel	27,305,435 lb.
8.	Structural steel	36,413,500 lb.

The average bid prices for these items were weighted by determining the total quantity and total cost of each item in each year from 1940 to 1948 and the average weighted bid price determined.

The weighted average bid price for each of the eight items was then multiplied by the total quantity of that item for each full year from 1940 to 1945 and for each half year to June 30, 1948. In later computations of the index these have been adjusted to full years through 1949 and for each quarter for 1950, 1951 and 1952. These compilations give a comparative cost to the state of doing the same work in each period since 1940.

With 1940 taken as the base year, with an index number of 100, comparative costs, brought forward to the first quarter of 1952 are shown in the following



tabulation with percentage changes indicated for different periods.

Period	Index 1940 = 100	Change from previous period	Change from 1948
1940	100	—	—
1941	125.0	+25.0%	—
1942	157.5	+26.0%	—
1943	156.4	— 0.7%	—
1944	177.8	+13.7%	—
1945	179.5	+ 1.0%	—
1946	179.7	+ 0.1%	—
1947	203.3	+13.1%	—
1948	216.6	+ 6.5%	—
1949	190.7	—12.0%	—
1950 (1st qtr.)	160.0	—10.5%	—26.1%
1950 (2nd qtr.)	180.0	+12.5%	—16.9%
1950 (3rd qtr.)	189.2	+ 5.1%	—12.7%
1950 (4th qtr.)	194.8	+ 3.0%	—10.1%
1951 (1st qtr.)	215.4	+10.6%	— 0.6%
1951 (2nd qtr.)	238.3	+10.6%	+10.0%
1951 (3rd qtr.)	221.9	— 6.9%	+ 2.4%
1951 (4th qtr.)	245.4	+10.6%	+13.3%
1952 (1st qtr.)	224.8	— 8.4%	+ 3.7%

Transformed into a simple statement the Index indicates that work which cost $100 in 1940 cost $216.60 in 1948, $245.40 in the fourth quarter of 1951 or $224.80 in the first quarter of 1952, increases over 1940 costs of 116.6%, 145.4% and 124.8% respectively.

Comparison with other indexes

For comparative purposes the United States Bureau of Public Roads Composite Mile Index and the *Engineering News-Record* U. S. Construction Cost Index, adjusted to the 1940 = 100 base, have been plotted upon the same chart.

The Bureau of Public Roads Index is based upon actual contract prices paid in the United States as a whole for construction of a mile of composite highway. Having a factual foundation it follows the California Index within relatively close limits, the differences being accounted for by differences between local costs in California and the average of costs over the entire nation.

As the *Engineering News-Record* Index is based upon a fixed amount of materials and hours of labor and, according to the editors of the magazine is not adjusted for labor productivity, materials availability or other intangibles, it tends to be lower than the California and Bureau of Public Road indexes which are based on actual over-all costs.

What the Index shows

Highway costs as measured by the California Highway Construction Cost Index with the year 1940 taken as a base of 100, climbed during World War II and the postwar period to a peak of 216.6 in 1948. After 1948 there was a decline to 160.0 by the first quarter of 1950. From this point on, there was a very rapid rise through the second quarter of 1951. The second quarter of 1950 was 12.5% above the first quarter of 1950; the third quarter was 5.1% above the second quarter; the fourth quarter was 3.0% above the third quarter; the first quarter of 1951 was 10.6% above the fourth quarter of 1950. The Index reached 238.3 in the second quarter of 1951 which was 10.6% above the first quarter. The Index for the third quarter of 1951 decreased 6.9% from the second quarter of 1951 to 221.9, the first drop since the first quarter of 1950, which appeared to be merely a temporary leveling-off of a false peak to the general line of the continued rise as the fourth quarter of 1951 was up again to 245.4, a rise of 10.6%.

These fluctuations are now chiefly of historical interest. Through them the analyst may trace the effect of national and international factors on the general economy. The steady rise from 1940 to 1945 marked the period of war-time activity with its accompanying industrial boom which was carried over through 1948 in the "catching up" period.

Then came the rapid decline of the Index through the first quarter of 1950 as the international outlook appeared to calm a little. There was more competition for jobs, labor productivity increased and material prices were decreasing for the first time since 1940. Materials became definitely available at guaranteed prices.

Then came the Korean situation and the nation was in the throes of a national defense program with federal control of critical materials and the old uncertainties again prevailed. Scarcity of materials, whether real or synthetic, started prices rising as the Air Force, the Army and Navy launched gigantic programs of preparation and expansion. Costs soared, the California Construction Cost Index reaching 238.3 in the second quarter of 1951 and 245.4 in the fourth quarter, a rise of 53.4% in 21 months.

These ups, downs and ups, however difficult they have made the going in recent months, are nevertheless water over the dam and currently costs are down 8.4% with the Index at 224.8.

A word about the future

However, it is not thought that this drop is a firm indication of a continued downward trend. The current steel situation does not portend any drop in prices. Announcement by the Wage Stabilization Board on March 13 of its approval of the Construction Industry Stabilization Commission's policy for 1952 of a 15-cent-an-hour increase over the 10% formula adopted last August can mean nothing but further increases.

Contemplated expansion of health and welfare benefits in the construction industry with employer contributions of 7½ cents per hour indicate still additional increases in costs. The large volume of construction projects programmed by federal, state and local government coupled with planned expansion in private industry seems likely to prevent noticeable reduction in costs from acute competition.

Even though the California Construction Cost Index dropped 8.4% during the first quarter of 1952 this may stem entirely from local reactions and competition to get jobs early in the construction year. The *Engineering News-Record* Construction Cost Index, now at 227.0 continues a steady upward trend on the national scale, as does the Bureau of Public Roads Composite Mile Index which was up to 232.8 for the fourth quarter of 1951. It is our belief that the upward trend will continue for some time.

AVERAGE CONTRACT PRICES SINCE 1940

Unit prices for eight highway construction items that provide basic information for the California Index

	Roadway Excavation Per Cu. Yd.	Crusher Run Base Per Ton	Plant Mix Surfacing Per Ton	Asphalt Concrete Pavement Per Ton	PCC Pavement Per Cu. Yd.	PCC Structures Per Cu. Yd.	Bar Reinforcing Steel Per Lb.	Structural Steel Per Lb.
1940	$0.22	$1.54	$2.19	$2.97	$ 7.68	$18.33	$0.040	$0.083
1941	0.26	2.31	2.84	3.18	7.54	23.31	0.053	0.107
1942	0.35	2.81	4.02	4.16	9.62	29.48	0.073	0.103
1943	0.42	2.26	3.71	4.76	11.48	31.76	0.059	0.080
1944	0.50	2.45	4.10	4.50	10.46	31.99	0.054	0.132
1945	0.51	2.42	4.20	4.88	10.90	37.20	0.059	0.102
1st Half 1946	0.41	2.31	4.00	4.54	9.85	37.38	0.060	0.099
2nd Half 1946	0.39	2.27	4.12	5.04	12.39	49.84	0.079	0.142
1st Half 1947	0.48	2.62	4.52	6.46	12.41	47.03	0.080	0.133
2nd Half 1947	0.54	2.39	4.02	6.48	11.58	50.15	0.089	0.123
1st Half 1948	0.56	2.45	4.42	4.91	13.37	49.51	0.094	0.145
2nd Half 1948	0.52	2.64	4.80	7.00	14.01	49.08	0.103	0.131
1st Quarter 1949	0.49	2.48	4.54	5.70	11.84	48.11	0.089	0.113
2nd Quarter 1949	0.43	2.91	4.63	4.06	11.74	48.63	0.083	0.110
3rd Quarter 1949	0.41	2.40	5.05	4.60	11.53	45.35	0.080	0.093
4th Quarter 1949	0.43	2.55	3.78	3.50	12.66	44.54	0.078	0.092
1st Quarter 1950	0.34	2.22	3.65	3.74	—	40.15	0.077	0.081
2nd Quarter 1950	0.40	2.13	4.48	3.74	10.86	43.03	0.080	0.105
3rd Quarter 1950	0.41	2.32	4.25	5.50	10.91	44.34	0.093	0.131
4th Quarter 1950	0.42	2.81	4.64	4.61	12.55	43.18	0.098	0.120
1st Quarter 1951	0.45	3.07	4.06	5.22	11.71	46.38	0.103	0.206
2nd Quarter 1951	0.63	3.88	4.56	4.63	12.93	51.50	0.105	0.166
3rd Quarter 1951	0.56	2.88	4.59	3.90	12.41	46.14	0.107	0.165
4th Quarter 1951	0.66	2.91	5.66	4.89	12.71	49.38	0.105	0.169
1st Quarter 1952	0.56	3.25	4.88	4.77	14.25	47.46	0.094	0.152

NOTE: All projects in California are included except in 1946 and the first half of 1947 which include Federal Aid Projects only.

The evolution of bituminous paving in the Mountain States

BEGINNING OF AN ERA ——
In 1929 this type of road-mix highway surfacing was the first improvement over gravel roads in the Mountain States.

ADMINISTRATION	X
DESIGN	
CONSTRUCTION	X
MAINTENANCE	X
MUNICIPAL	
BRIDGE	

Two decades ago road-mix surfacing was being laid to give these areas of long distances and scant population their first all-weather roads — Today these routes are being rebuilt with plant-mix paving, with modern engineering principles applied from base course to top

IN THE EARLY '20s the highway departments in the states of Colorado, New Mexico, Utah and Wyoming were attempting to get their roads "out of the mud" by adding gravel or crushed rock material. By the end of that decade the inadequacy of this treatment, as cars began to travel faster and kick up dust, started the era of road-mix surfacing. This light type of surfacing in those states which constitute Division 9 of the Bureau of Public Roads has served a useful life far exceeding original expectations. However, in turn, road-mix surfacing has been proving inadequate for modern traffic volume and loads, which has led to the highway departments in these states reconstructing extensive mileage on those main routes with plant-mix bituminous pavement. As one era concludes and at the beginning of what may be considered a second stage of highway pavement in the Mountain States, it seems appropriate to review the history of this evolution and to record the highway development of the past 20 years.

By

A. R. ABELARD
Programming and Planning Engineer

and

W. L. EAGER
Materials Engineer

Bureau of Public Roads, Division 9
Denver, Colorado

The bulk of the highway work about 1920-25 consisted of placing gravel or rock on the road surface, although some important sections of highway in these states were constructed of portland cement concrete pavement and a few miles of bituminous surfaces, largely of experimental types. January 1926, the total miles of surfaced roads on the rural main highways in these four states were:

Surface type	*Miles*
Portland cement concrete	428
High type bituminous (bituminous conc., etc.)	66
Low type bituminous (penetrations and mixes)	33
Gravel, crushed rock or soil surfaced	3,721
Total	4,248

The number of miles considered to be main highways at that time totaled about 11,000 with less than half of them surfaced.

The tremendous advance in road construction which has been accomplished since that time is well illustrated by the

following tabulation showing the status of the rural Federal-aid primary system on January 1, 1951 in the same four states:

Surface type	*Miles*
Portland cement concrete	591
High type bituminous (bituminous conc., rock asphalt, etc.)	675
Low type bituminous (penetrations, mixes and surf. treatments)	11,736
Gravel or crushed rock	317
Unimproved or graded and drained	126
Total	13,445

Gravel surface the final answer?

For other than the most heavily traveled roads, gravel or crushed rock surfacing was considered in the early 1920's to be the final and ever lasting surface type although it was recognized that constant replacement of the surface course would be required. The most common vehicle of the day (the Model "T" Ford) seldom attained a speed of over 45 mph., and gravel surfaced roads were a wonderful improvement over the rutted earth surfaces then so common on the main highways.

The complacent satisfaction with the gravel surfaced road did not last long, however. There was a phenomenal increase in the number of motor vehicles in use. For the four states, from 1920 to 1927 the increase was from 213,117 to 473,712—about 120%. Also, the Model "T" was replaced with vehicles capable of speeds in excess of 60 mph., and the increased traffic with increased speed compounded the dust nuisance. The gravel surfaced roads in the dry climate of the West became corrugated and exceptionally rough. The rapid deterioration of these surfaces due to the high annual losses of the gravel or rock resulted in increasingly greater maintenance costs. There was an ever-growing public demand for better types of traveling surfaces which would eliminate the dust and flying-rock nuisance and hazard; which would provide a better riding surface; and, which would also reduce vehicle operating costs.

Because of the large mileage of highways involved and the limited funds available, it became apparent the problem could not be solved by construction of standard high-type pavement. The total funds available for construction in 1927 amounted only to about $10,000,000 for the four states. Even with the low construction costs existing at that time, this revenue would have built only some 300 to 400 miles of portland cement concrete pavement per year.

Funds dictate cheap treatment

Out of the earlier experimental history with fuel oil dust palliative treatments, there developed the surface treatment method and the surface mixing method. These methods were applied to existing, or new, gravel or crushed rock surfaced highways in place of the earlier treatment of natural soils with fuel oil by the penetration process. Using these methods the Western States were able to produce thousands of miles of paved surfaces within the limits of available funds.

Admittedly the pavements have not always been all that could be desired, yet they have filled that vital gap between a gravel surface and a higher type of pavement. The light mixed-in-place bituminous surfaces permitted the treatment of materials already in place and also took advantage of the drying and heating furnished by the sun, wind and warm air. The use of readily available, low cost, high production equipment, such as blade graders, disc and spring-toothed harrows, was an important factor in this method of construction.

It was found through experience that a dense grading was necessary for adequate stability since the oil itself added little to the stability of the aggregate. The fines had to be an inert mineral since clay soon caused disintegration of the bituminous surface.

"Surface mixing" popular

While much of the early construction in some of the Western States was by the "surface treatment" or "inverted penetration" methods, practically all of the early construction in Colorado, New Mexico, Utah and Wyoming was by the "surface mixing" method. By this method, enough of the existing or newly applied base course material was scarified to provide 2 to 3 in. of bituminous mat.

Oil (60-70 or 70-80% asphalt residue) was applied to the scarified material in three applications at about 0.5 gal. per sq. yd. each. After each application, the oil and gravel were partially mixed with disc or spring-toothed harrows. After all the required oil was applied, the treated material was windrowed and mixing completed with blade graders, usually of the "pull" type using light crawler tractors for power. The windrow was worked back and forth across the road as many times as necessary for mixing, then spread to required section by a blade grader. Compaction was ordinarily obtained by traffic supplemented by blading for three to ten days.

Development of materials

Prior to 1932, the liquid asphaltic materials used in mixed-in-place construction were usually asphaltic residuum fuel oil or road oil similar to the present "slow-curing" (SC) types. In 1932 a new system of classification was established with the three main types of liquid asphaltic materials designated as SC, MC, and RC. There were also several grades within each type. These specifications were revised in 1939 and have now been adopted by the American Association of State Highway Officials.

Technical considerations of road-mix

Use of light asphaltic fuel or road oils reduced the amount of artificial heating required, and permitted easier mixing with the equipment available. The proportion of asphalt was generally controlled by a formula dependent upon the grading of the aggregate or by the "stain test." Most formulas were of the type similar to that developed by McKesson and Frickstad in 1927 as follows:

McKesson & Frickstad Formula

$$P = .015a + .03b + 0.17c$$

where P = percentage asphaltic oil required
a = percentage 1"-#10 size aggregate
b = percentage #10-#200 size aggregate
c = percentage passing #200 sieve

The "stain test" permitted a direct visual measure of the relative richness of the asphaltic oil coating on the aggregate particles. Good construction men

AT THE HEIGHT of the road-mix era, this type of travel plant was used in 1938. It was able to increase the output possible by blading, aided in handling traffic, and improved the control of mixing operation.

soon learned to tell by appearance and action of the mix when it contained about the right percentage of oil. Seal coats were commonly found necessary on the mixed-in-place types using the lighter oils, since these oils lacked the resistance to the effects of moisture of heavier asphalts and since such mixtures were necessarily kept quite lean to avoid lubrication of the aggregate particles with consequent loss of stability.

As to historic mile-posts, Wyoming constructed two projects using the mixed-in-place method with a light oil in 1925. Utah started construction of this type in 1927. New Mexico and Colorado constructed their first road-mixed bituminous projects in 1928.

The majority of the mixed-in-place light bituminous construction in the first few years utilized the existing gravel or stone surfaces so naturally the construction was on roads with alignment and sight distance designed for the Model "T." Practically the only roads constructed to more modern geometric design standards were sections where the old road had not been constructed to line and grade.

Problems developed early

Many troubles developed with these light bituminous road-mixed projects. Base failures were common, partly because they had often been laid on the old existing road which had little base remaining. Since the existing material to be used as a base course was originally built to serve as a wearing course, it probably contained a higher percentage of plastic fines than desirable in a base course. In addition, over a period of time it became contaminated by intrusion of the underlying subgrade soil and by soil fines washed in from cut slopes or carried in by maintenance operations. Poor subgrade drainage often complicated the problems. As a result, tearing up, remixing and relaying became a recurring maintenance job.

In an attempt to build higher type bituminous surfaces the states experimented with other types of construction. Plant-mix projects became common in the early 1930's. Some states constructed extensive mileage of bituminous penetration surfaces; the work of R. H. Baldock, now State Highway Engineer in Oregon, and the late Dr. L. I. Hewes, Chief of the Western Headquarters of Bureau of Public Roads, was outstanding in the development of this latter type.

Soil research accelerated

The extensive failures of subgrades accelerated research in soils, culminating in standardization of soil types in the late 1930's. Many formulas were developed for determination of the base thickness required to provide structural adequacy. Use of designs based on adequate data on soils became prevalent in these four states in 1937 and 1938. The newer type projects commonly included a selected material subbase as well as a standard base course under the bituminous surface. These years marked the start of a new era in road construction for another reason too—the new bituminous surfaces were being constructed immediately after the completion of grading and draining projects. By then, the old gravel roads worthy of continued use had largely been covered with dustless surfaces.

During the years of 1926 to 1937 inclusive, these four states constructed 9,004 mi. of low type bituminous surfaced roads on their main highway system. Some of these were reconstructed during the period so that there were actually only 8,416 mi. of that construction in use on January 1, 1938. While there were still many miles of gravel or unsurfaced roads in use in 1938 they were usually on the lighter traveled roads, and further improvement was not as urgent as it had been on the gravel surfaced main highways in the early '30s.

Heavy traffic increased demands

The heavy traffic load was making obsolete many miles of the existing light bituminous surfaces. This was particularly noticeable on those surfaces placed on alignment and sight distances designed for the Model "T." As a result, an increasing percentage of the construction work since that time has had to consist of reconstruction of these old bituminous surfaces. This is illustrated by the fact that while construction activity in the twelve years of 1926 to 1937 inclusive accomplished 8,416 net miles of light bituminous surfaced roads, the construction activity in the thirteen years of 1938 to 1950 inclusive added only 3,320 mi. to the total of that type in existence—largely because it was also necessary to reconstruct 1,937 mi. of the 8,416 in use on Jan. 1, 1938.

Complacency developed

In the era ending about 1938 there was a general public opinion that when the road system was completed to a dustless surface, little further road construction would be required. There was a satisfied attitude in the Rocky Mountain area toward the light bituminous surfaces. A national trend developed toward diverting revenues derived from road users to purposes other than road construction and maintenance.

This complacent attitude began to falter in the late 1930's as accident rates soared to all-time highs, particularly on the old obsolete alignments. About the same time the adverse effect of the rapidly increasing weights of trucks on the light bituminous surfaces became clearly evident. It was an era of reappraisal of highway needs and policies.

In the prewar years of 1938 to 1941 unit construction costs were comparatively low, largely because of improvements in construction equipment. As a result, a comparatively large mileage of construction was completed during this period. This included 874 mi. of reconstruction of the 1926-37 light bituminous surfaced roads—almost 10% of the mileage that has been built.

Slow-down in wartime

Then came World War II. Excepting for road improvement work directly essential for service to military establishments, little road construction was accomplished. The road user revenues available to the highway departments decreased because of gasoline rationing and other restrictions; man power was difficult to obtain; over legal-weight loads were often permitted; maintenance suffered because of lack of equipment. The roads were considered expendable. Even with these difficulties there were 437 mi. of the 1926-1937 light bituminous construction replaced during the war period.

The post-war period

Then came the post-war period. A higher proportion of the total budgets of the highway departments had to go to maintenance to keep a worn-out plant operating. The value of the dollar was less than one-half of its prewar worth so construction costs doubled. Traffic increased by leaps and bounds, but the increased revenue did not compensate for the decrease in the value of the dollar. The postwar construction program was slow in getting started because of the shortage of equipment, engineering personnel, man power and materials. It was not until late 1947 that these difficulties could be considered as being largely overcome. Consequently the miles constructed during the postwar period did not reach the annual rate attained in the prewar period although expenditures were greater.

In the period 1946 to 1950 inclusive, an additional 625 mi. of the 1926-37 light bituminous construction was retired. This meant that on Jan. 1, 1951, there were 6,479 mi. remaining of the original 9,009 mi. that had been constructed.

Service beyond expectations

The life of these old surfaces has been far greater than could have been anticipated. Using curves of road life, the record during the prewar period indicates an average life of 14 yr. The slowdown in construction during the war period forced an extension in use of the remaining roads so that the total record on January 1951 indicates an average life of 18 yr. It must be stressed that failure of these old surfaces has not been necessarily the prime reason for retirement. While most are structurally obsolete they are also usually obsolete from the geometric viewpoint, and more often than not, the latter factor has been the deciding one as to necessity for reconstruction or relocation.

Problem now is reconstruction

Since the pressing demand for placing some kind of a dustless, all-weather surface on all of the main highways has been largely relieved by the completion of many miles of light bituminous surfaces, the overall problem has now become one of reconstruction. It is self-evident that new construction must be of a higher type, both geometrically and structurally, than the old. To accomplish a higher type of pavement the logical choice has been hot plant bituminous construction using relatively soft asphalt cements mixed with locally available aggregates similar to those previously used in the road mix type.

During the period since World War II, this change has taken place mainly

TODAY, modern plant-mix pavement is the standard on the main highways of the Mountain States with continuous plants (left) getting increased recognition and lay-down machines (right) completing the process.

Photos by Colorado State Highway Department

on the arterial highways, with the road mix type still being used largely on low traffic volume roads. An exception to these normal practices frequently occurs on high altitude projects where temperature and moisture conditions make road mixing operations expensive and the results uncertain. In these cases the engineer may specify plant mix bituminous surfaces even though the traffic volumes may not justify the higher type of pavement.

Trend to plant-mix accelerates in 1951

The trend from road mix to plant mix has been particularly noticeable in 1951. There was about a 15% decrease from 1950 to 1951 in the amount of road mix surfaces constructed in the four states, while in the same period there was an increase of 55% in the amount of plant mix surfaces laid. The cost of plant mix surfacing in 1951 was about 43% higher than the road mix surfacing on a square yard inch basis. However, it is believed that as more contractors become equipped with hot mix plants and become more familiar with their operation and advantages, the spread in cost should decrease.

In the Mountain States the length of the working season for effective road mixing is much shorter than it is for plant mixed construction. Showers or wet weather do not delay hot plant operations nearly as much as they do road mix operations. Furthermore, when the surface material is plant mixed, the contractors' operations do not inconvenience the traveling public as much and neither does the traffic interfere as much with the contractor.

Improved control methods

There has been a great improvement in design standards and control methods for these hot plant bituminous projects as compared with the original light road mix bituminous surfacings. All four states sample and test subgrade soils and prepare a design based on these tests. The California Bearing Ratio test is used as the standard method for determining depths of cover to be placed over various subgrade soils. Adjustments are made for traffic and climatic conditions. Colorado also uses the Hveem stabilometer and the cohesiometer and in general follows the present California method in evaluating subbase, base, and surface course materials. The Highway Research Board Method of soil classification is in general use. The Group Index is used to supplement information obtained from the other tests. Generally, the depths of cover placed over various subgrade soils under varying traffic and climatic conditions will be found to be quite similar under the design methods employed by each of the states.

Present road-mix methods

As previously mentioned, the mixed-in-place type is still largely used for the lighter traffic roads. Construction is invariably by contract with the contractors generally using travel plants for applying the asphaltic material and performing most of the mixing. Supplemental aeration, mixing, and laydown is by motor grader. A medium curing cutback asphalt (usually MC-3) is ordinarily used. The mat is commonly 2 in. thick by 22-24 ft. wide. Recently, there has been a trend toward the use of rapid curing cutbacks (RC-2) to gain increased stability with available poorly graded aggregates. Prime coats of MC-0, 1, or 2 grades are placed on gravel base courses before mixing operations are started. Seal coats (RC types) with stone chip cover of ½-in. maximum size are commonly placed on the completed mats.

Trends in plant-mix

Plant mixes are produced either by batch or continuous plants. There appears to be a definite trend toward the continuous type. Two or more bin sizes are used. Asphalt cements of from 85 to 300 penetration grades are used. The hot mix is placed by pavers which construct one lane at a time. The development of lay-down machines has had an effect on the choice of bituminous materials used. It is difficult to use such machines for mixes using SC and MC oils as often additional aeration is needed.

The plant mixed pavements are ordinarily 2 to 3 in. thick by 24 ft. wide. Sometimes the base is stabilized by road mixing the top 1 to 1½ in., but it is ordinarily only primed. There has been a definite trend toward elimination of seal coats from these surfaces as it is felt they are unnecessary if the pavement has been properly designed and constructed.

Some concluding figures

Of the 11,736 mi. of light bituminous surfaces in existence in 1951 in these four states on the main highway systems 6,479 mi. (about 55%) were constructed prior to 1938 and are over 13 yr. old. These 6,479 mi. remaining in use amount to about 72% of the total miles of this type constructed in the 1926 to 1937 period. The projection of the road life curve indicates that at the end of the next 10-yr. period an additional 65% or 5,770 mi. should be reconstructed. To do this, the rate of reconstruction of these surfaces must be about three times as great as the rate in the 13-yr. period of 1938 to 1950 inclusive.

The light bituminous surfaces constructed on the main highways have performed a vital and needed service. Their life has been far greater than could reasonably have been anticipated. It is to be hoped that the higher type of surfaces now being constructed can as satisfactorily serve the heavier traffic now using the roads. There is a growing feeling that even higher types of bituminous surfacing utilizing better quality and grading of aggregates will be required on the more heavily traveled main highways.

Patterns follow history

An increasingly greater part of the work now undertaken by state highway departments is on the Federal-aid secondary system. A high proportion of the roads on this system have gravel or rock surfacing or no surfacing at all. The pattern of development appears to be following the history on the main highways with the stress on minimum geometric standards and utilizing low-type bituminous surfacings. However, the knowledge gained from the experience on the main highways should result in a longer life for these newer surfaces.

100-ft. concrete girders replace steel in Oregon

By G. S. PAXSON
Bridge Engineer
Oregon State Highway Department

ADMINISTRATION . . . . .
DESIGN X
CONSTRUCTION . . . . . .
MAINTENANCE . . . . . .
MUNICIPAL . . . . . .
BRIDGE X

RESTRICTIONS on the use of structural steel in highway bridge construction, made necessary by the increased demand in defense projects, have encouraged the use of substitute materials. In very long-span structures there is, of course, no substitute for steel. In short-span work reinforced concrete has always been in a competitive position. In the intermediate range—span lengths of 100 to 120 ft.—steel girders have usually been preferred.

Several structures in this span-length range were urgently needed in Oregon, but the amount of structural steel allocated for highway purposes was so small that these projects could not be covered in the foreseeable future. Since steel reinforcement for concrete was relatively abundant, an effort was made to develop the most economical type of concrete girders for this span range.

The final design uses two main girders for a two-lane structure, arranged in a three-span continuous series, the end spans being approximately 0.8 of the center span in length, to balance positive and negative movements. The main girders are connected by transverse floor beams at 20- to 35-ft. spacing, into which are framed two intermediate longitudinal stringers. The resulting transverse deck span is thus between 7 and 8 ft., allowing the use of a 6½-in. deck.

In the drawing is shown a transverse section at mid-point of the 100-ft. span of an 80-100-80-ft. continuous series. Also shown are sections through a main girder at mid-span and at an intermediate pier. In this design the additional section needed at the intermediate piers for negative movement has been provided by widening the stem and thickening the lower flange of the girder. The same result could have been obtained more economically by deepening the girder, but at the cost of less attractive outline and less clearance at the piers.

The design stresses are based on intermediate-grade steel at 20,000 psi., and 2,300-lb. concrete with a working stress of 1,100 psi. In more than 30 years' experience building, operating and maintaining highway bridges, this department has yet to see any indication of distress in concrete structures due to traffic loads. We have no hesitance in using the design stresses listed above.

Oregon now has a total of five structures under contract with spans up to 110 ft. (see table). The first three structures—Tualatin River, Shogren Overcrossing and Hood River Overcrossing—have 30-ft. roadways and 3½-ft. sidewalks. The last two structures have 26-ft. roadways without sidewalks. Where sidewalks are provided, the areas given include both deck and sidewalks. Bid prices are somewhat misleading, as materials in superstructure and substructure were not bid separately. Bid prices also are influenced by the location of the project, availability of materials, and labor supply and rates of pay.

While our experience is limited to the few projects listed above, it seems that this type of girder span has distinct possibilities, especially during times of structural steel shortage. In fact, the costs compare quite favorably with those that would be expected with structural steel under normal supply conditions. The construction has presented no unusual or difficult problems. No special equipment or experience is required. We feel that this is one way by which construction can be kept going during periods of shortage of usual materials.

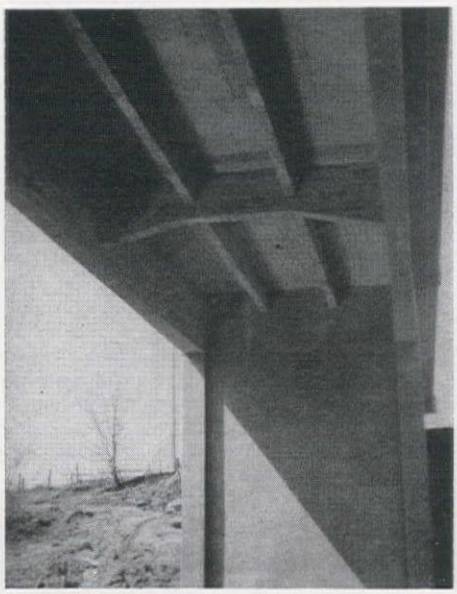
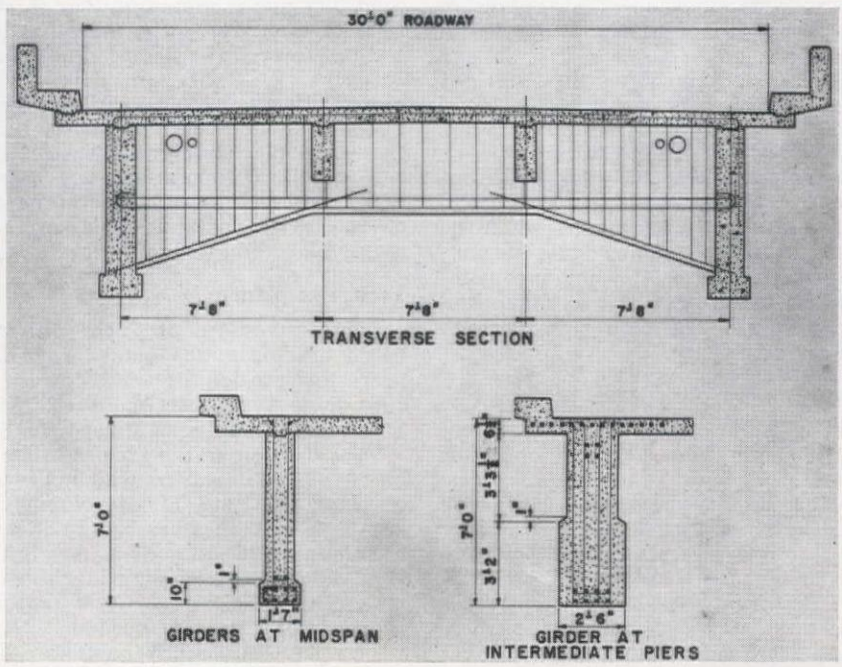


PHOTO of completed Nehalem River bridge shows framing of transverse and longitudinal members.

TABLE gives pertinent details of five bridges with spans up to 110 ft. that Oregon now has under contract.

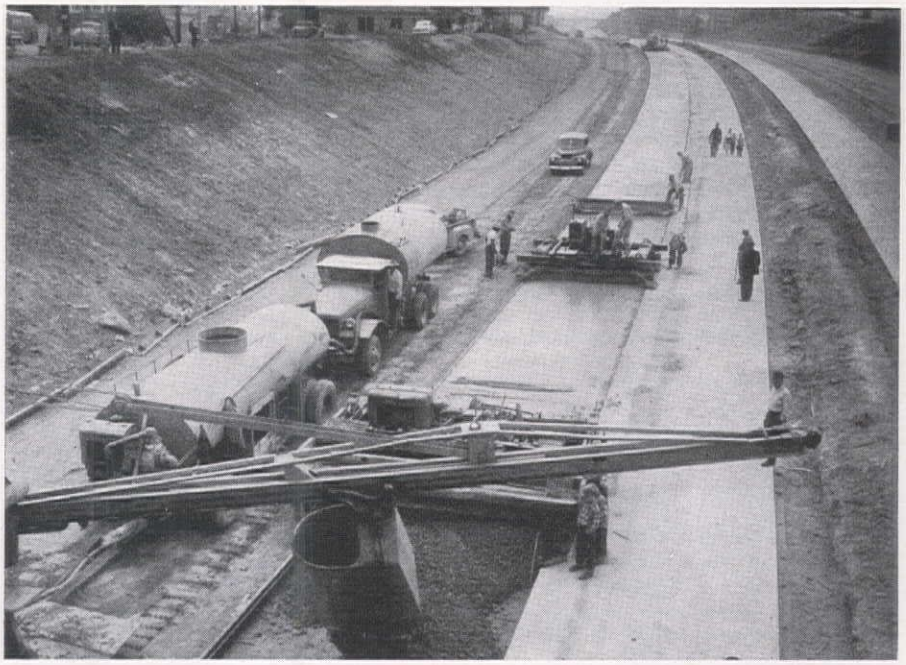
DETAILS at right show typical section of span, also girder sections at mid-span over pier.

Structure	Area, sq. ft.	Concrete, cu. yd. per sq. ft.	Steel, lb. per sq. ft.	Contract price, dollars: Concrete, per cu. yd.	Steel, per lb.	Project, per sq. ft.
Tualatin River	17,420	0.0596	17.13	$69.00	$0.09	$5.65
Shogren Overcrossing	10,656	0.0619	17.83	74.00	0.105	6.45
Hood River Overcrossing	20,178	0.0557	16.01	58.00	0.10	4.83
Nehalem River	6,760	0.0649	19.08	63.00	0.11	6.19
Trask River	6,760	0.0649	19.08	56.00	0.10	5.54



FREEWAYS—
Laboratories of paving practice

Representing the highest in both standards and cost, California freeway construction has given rise to significant developments in all concrete paving operations — State resident engineer notes problems, reviews contractors' solutions



UNDER CRITICAL observation by local interests (under boom at right of screed), freeway construction employs extensive train of equipment. Specially-built tank trailer is towed by paver, supplied by tank truck.

By
HAIG AYANIAN
Senior Highway Engineer
Division of Highways
State of California

PLACEMENT of large volumes of concrete in construction of the network of freeways that sprawls over the Los Angeles metropolitan area has been accompanied by significant improvements in design, equipment, and method. Comprising one of California's most spectacular continuing projects of recent years, the high-standard freeways (*Western Construction*, March 1952, pp. 84-85) embody problems which are perhaps common enough in paving operations, but which are considerably heightened over their open-country counterparts. With rigid specifications imposing great attention to detail upon the contractor, he must himself give equal attention to a practice of the utmost ingenuity in assembling his personnel and equipment spread and utilizing them for successful conduct of his contract. Despite their short lengths in terms of miles, these freeway contracts are multi-million dollar jobs and are bid in close competition. Their profitable completion has been marked by many of the concepts in design, equipment and method that are reviewed below.

Soil-cement subgrades

The making of subgrade in California is no longer a problem closely related to concrete paving. It has become a category of its own, due to the cement-treated subgrades that are now called for under all heavy duty concrete pavements. When this subgrade has been completed and the headers trued up to line and grade, everything is ready for the concrete to be placed.

The batching plant has grown into a rather complex machine with practically automatic operation. California standard specifications require that the batching operation be automatic after the "start" button is pressed. In addition, many batching plants have been equipped with an interlock and telltale system that will not permit discharge of the batch unless all materials are in the weigh box, and the proper amount of cement weighed, ready for discharge into the batch truck.

One recent set-up is so arranged that if the proper amount of any one material is not deposited in the weigh box, a red light indicates which material is short—important in an accumulative-weight batch. This device eliminates the chance of a batch being short on one size and long on another. It is felt by most contractors that these refinements on the batch plant are not only necessary for the required high output but that they also pay for themselves in eliminating batches that would be rejected by the inspectors. The automatic checking of cement is exceedingly important, as many rejected batches are obviously short of cement, to say nothing of those that are short by an amount not discernible to visual inspection.

Most popular for charging the hoppers of the plant is a clamshell loading from stockpiles. Some layouts utilize tunnels with belts and bucket conveyors to load the plant. Sometimes a combination is used, consisting of a clam loading to bucket conveyors. All in all, the clam is considered best and most efficient in simplicity, flexibility, and for avoiding degradation of aggregate.

Bulk cement for batching

Practically all modern batching plants utilize bulk cement. This has allowed a greater flexibility in the batch size that may be used, since California requires that no fractional sack batch be used unless the cement is weighed. The savings in the cost of cement and in the

ADMINISTRATION	
DESIGN	
CONSTRUCTION	X
MAINTENANCE	
MUNICIPAL	X
BRIDGE	

cost of labor to open and empty the sacks are appreciable. Also, the problem of storage is simplified by use of a bulk silo.

An efficient batching plant set-up can be obtained only after careful consideration of minor details. The order and methods of weighing the aggregates and cement, combined with the order and methods of discharge into the batch truck, are of importance. No little delay and trouble has been caused by the cement's landing on top of the aggregate and being subjected to blowing off while in transit. On the other hand, if all the cement is in the bottom of the truck, trouble is encountered when dumping due to the tendency for the cement to hang up. It is possible to vary the order of weighing and arrange chutes and baffles so that a happy medium is arrived at where the cement does not blow off, yet the batch does not hang up in the truck.

Moisture control

The matter of moisture in aggregate, particularly in sand, is of the utmost importance in obtaining a good job without excessive finishing costs. Nothing is more disconcerting to a paving operation than to have a uniform-slump concrete suddenly get sloppy or dry up. Such abnormal batches must be finished independently, and a smooth continuous operation has then degenerated into intermittent finishing, desirable to no one.

When trucks hauling from aggregate plants (which possibly are sending sand out as soon as it has been processed) dump wet loads directly into the batching operation, wet and sloppy batches are unavoidable. The best remedy is to take precautions against this trouble by means of a continual stockpile of sand, one that is not used until the moisture content of the numerous loads of varying wetness has blended into a more or less uniform state. At least, the change in moisture content at the mixer is then gradual enough so that adjustments can be made before the slump of the concrete has increased appreciably. In spite of lack of space for stockpiles, or possible lack of cooperation from aggregate producers, the contractor should make every effort in this regard. It will pay in hard cold cash before the paving is finished.

Mixing developments

Moving on to the actual paving operation, it is obvious that another important factor in high production of concrete is the mixer. The modern dual-drum paving mixer is a far cry from those of the past. Production that seemed impossible a few years ago is commonplace now, with jobs reaching 1,200 cu. yd. per day and over. This, of course, is due to the dual-drum feature. The 34-E pavers are rated at 1¼ cu. yd., but with allowable overloading they can and do handle 1½-cu. yd. batches. Under normal operating conditions, a completed batch is dumped about every 35 sec. To meet the specification of 50 sec. of mixing time per batch, the material is partially mixed in the first drum for 25 sec. It is then transferred to the second drum for the remaining 25 sec., while the next batch is being charged and partially mixed in the first drum. The other 10 sec. is time lost in charging the drum from the skip.

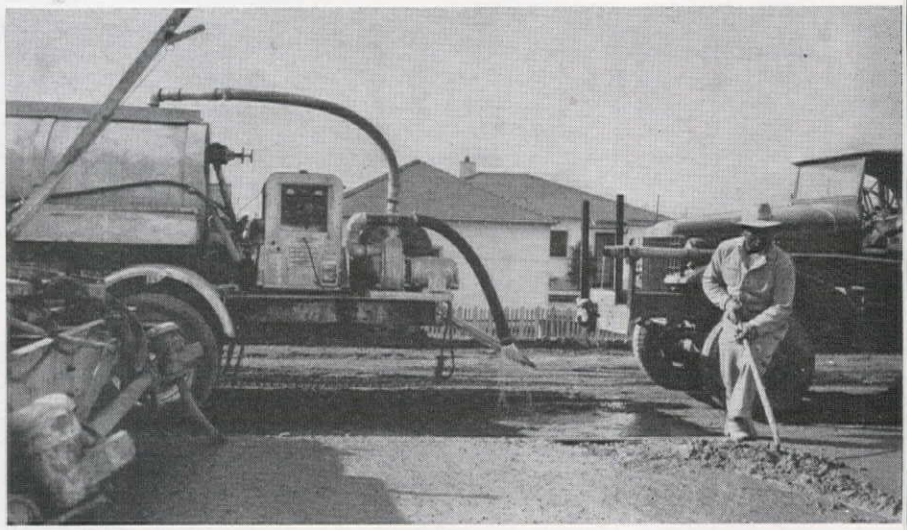
Apart from considerations of the mixer's mechanical operation alone, there are considerations imposed by the very physical nature of freeways. In particular, the many and extensive separation structures, with their low clearances for equipment, call for special attention in conduct of paving operations. In the vicinity of these structures, contractors are continually exercising their ingenuity to expedite the moves and cut down the delays. The paramount problem is that of rapidly moving equipment over a structure to the headers beyond. Various types of portable tracks have been used, as well as cranes, for handling pavers. On the other hand, when paving under a structure, the problem encountered is the lack of headroom for the raised skip of a paver. With these rigs, however, it is possible to carry three batches under the structure and discharge them. The mixer must then move out into the open and receive another three batches, two in the drums and one in the bucket. This is obviously a time consuming operation, but it is almost unavoidable.

On modern pavers the sequence is automatic insofar as charging, transfer, and discharge are concerned. Water is automatically added in the first drum. The problem has arisen on some mixers that the time of water addition is too short for the quantity of water to be added. This and other minor kinks must be adjusted before maximum production is achieved. It may be pointed out that here, as with all automatic devices, competent servicemen should be available: the regular mechanic may not be familiar with intricate timing devices. Needless to say, the cost of having a whole paving crew stand idle due to mixer troubles is not inconsequential.

The water supply to the paver has undergone changes since the days when a water line laid along the job had hose connections at intervals for the paver. Present practice is to use a tank trailer pulled by the mixer. Several versions of this set-up have been used with success and are improvements over the use of tank trucks taking turns in coupling to the mixer. A tank trailer is kept supplied by a tank truck which couples to the rear of the trailer and is pulled along only until the water is dumped to the trailer. A quick coupling connects the water line and the towing hitch.

Special water tank trailer

One contractor recently has built a special tank trailer unit which combines several features (see picture). On the rear is mounted a 5-kw. gasoline-driven generator which supplies power for a number of useful attachments. The pump to transfer water from the tank truck is powered by a 2-hp. electric motor. A 5-hp. electric motor is utilized to drive an air compressor which is used to operate any desired pneumatic tool. Numerous electrical outlets also are provided to which an electric vibrator can be plugged when needed. Finally, this rig is also equipped with 1,000 ft. of electric cord to light late finishing operations. There are numerous occasions when it is very convenient to have an electric power source handy to the paving mixer.



TANK TRAILER mounts gasoline-driven generator, thus has power supply for water-transfer pump, electric vibrators, and electrically driven compressor.

Paving equipment

The advent of modern pavement equipment has, of course, eliminated much of the hand labor previously employed to place and spread concrete after the mixer has dumped it. An approved type of spreader, for example, will replace one of the two finishing machines otherwise called for in California specifications for productions of up to 160 cu. yd. per hr. On the rear at each side the spreader usually has mounted a stinger vibrator to avoid rock pockets against the headers. Some are equipped also with a transverse vibrating screed to bring mortar to the surface. The most popular spreaders are either of the reciprocating paddle type or the

screw type and mount an auxiliary generator to furnish power for the electric vibrators.

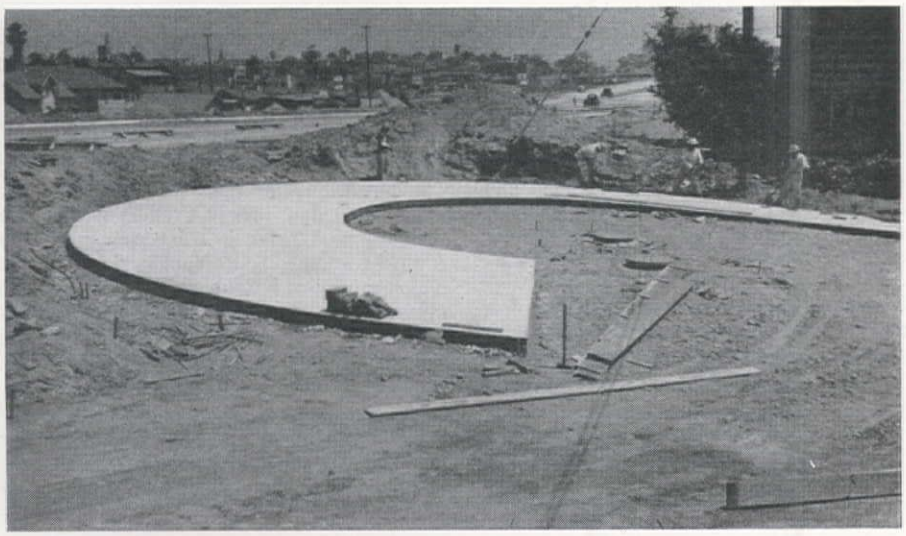
The spreader is followed by the tamping and screeding machine, sometimes referred to as a finishing machine. This machine makes two passes, a rough and then a final strike-off and tamp. On the second pass a roll of mortar should be carried by the back screed to insure the proper amount of concrete with a mortar layer on top for the subsequent finishing operations. If the operators are not coordinated, it is at times necessary to make another pass.

Operator coordination

The matter of coordination among the various operators is important if high output and quality are to be achieved. The mixer operator must deposit the concrete so that the spreader can do its job with a minimum of strain. The spreader operator must keep the back strike-off of his machine so adjusted that the proper amount of concrete is left between headers for the finishing machine. In the event too little or too much is spread, then hand labor must carry the concrete back or ahead to compensate. Often this labor can be quite an item. On the other hand, when the finishing machine attempts to spread out the excess, an undue strain is placed upon it. Maintenance costs are thereby increased and, in addition, such a large amount of concrete piled in front of the tamping bar nullifies the tamping action. The operator of the finishing machine must keep his back screed so adjusted that after his final pass a slight excess of mortar is left for the float finisher to use in the final finish. Once again, too much or too little causes added expense in time and labor.

When a paving project is being done on the interchange ramps of the more complex separations, the sharp curvatures and superelevations have a telling effect on daily output. At times, the old hand placing and finishing methods must be employed. This, in itself, brings up a secondary problem, that of a lack of finishers who know how to finish by hand to the required standards. In spite of hard work and diligence on the part of all involved, it is inevitable that the results will be inferior to those of machine finishing.

Effects of gravity show up in these same locations, even when machines can practicably be employed. Generally, the finishing machines of today are not much different from those of pre-war days; for work on ramps, one company developed a rear screed that could be skewed across the headers in order to compensate for the superelevation and keep enough concrete on the high side. On slight supers this effect can be achieved; but on urban freeway interchanges, where superelevations are pronounced, the effect is negligible. Hand shoveling from the low to the high side must be resorted to, not once but several times, as each succeeding operation causes the concrete to slump toward the low side. This appears to be a cross that the paving contractor must expect to bear on jobs of this type.



TIGHT RAMP CURVATURES and super-elevations cramp machines and call for slow, costly hand finishing—another characteristic freeway construction problem.

A partial solution to this problem is apparent in an improvement that could and should be made in the tamping bar. Present designs have tamping action imparted to the bar at its center by means of an eccentric counterbalance. The action is suitable on flat sections, but when a superelevated curve is encountered, the low side of the bar tamps while the high side merely flutters. In fact, unless all adjustments are on the money, this may occur where no super exists. One contractor has overcome the difficulty by rebuilding the machine so that tamping action is imparted to the bar at each end. Thus, a positive action is obtained regardless of superelevation, tamper springs, or other conditions, and no large rock is left near the concrete surface to interfere with finishing.

Continuing with the paving process, next is the installation of preformed strips for weakened-plane transverse joints. However, at the present time a transition to sawed joints is in progress. California standard specifications call for wooden or preformed asphalt strips to be placed in the concrete in a vertical position with the top ¼ in. below the surface. The resulting surface is smooth riding but any displacement of the strip by the float finisher causes spalling and meandering joints. Wooden strips are so unsatisfactory that most jobs do not permit their use. It was found that if the float finisher made its first pass before the joints were installed, better results were obtained. But, all in all, the preformed strip weakened plane joint has been a continual source of trouble; hence, the sawed joint. It appears to eliminate the undesirable features of preformed strips, yet it achieves the desired smoothness of the finished pavement.

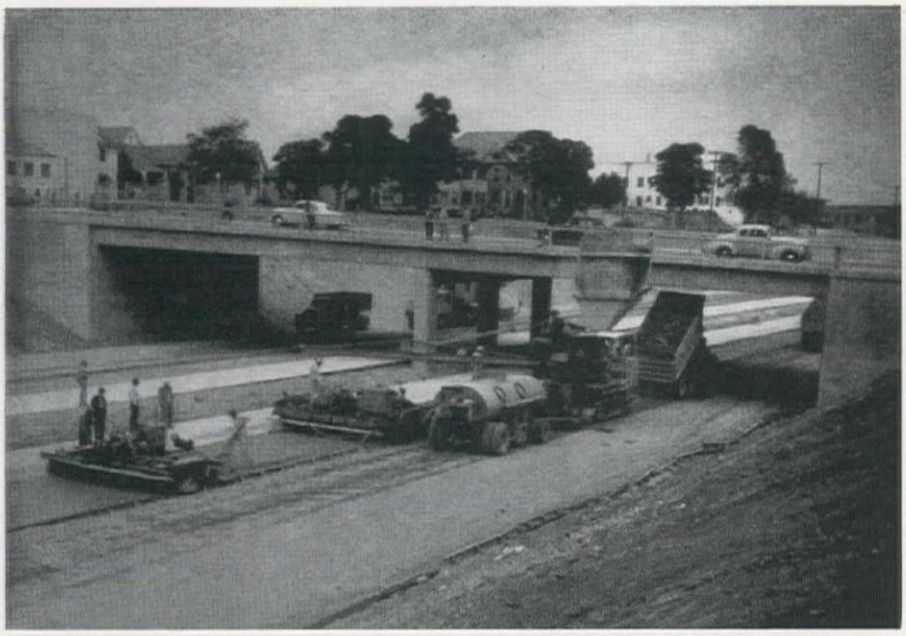
Sawing weakened plane joints

The following is an excerpt from the special provisions of a recent contract and explains procedure of sawing weakened plane joints:

> "In lieu of conflicting portions of Section 32, article (g), of the Standard Specifications, all transverse contact and weakened plane joints shall be cut in the pavement with a power driven saw. The grooves shall have a uniform depth of 2 in. and a clear width of ¼ in. maximum. Weakened plane joints at 60-ft. intervals shall be sawed approximately 8 hr. after placing the concrete, the exact time to be determined by the Engineer. The intermediate weakened plane joints at 15-ft. intervals shall be sawed within 24 hr. after placing the concrete. Any curing seal disturbed by sawing operations shall be restored by spraying affected areas with additional curing seal. Weakened plane joints shall not be filled."

The ease and comfort of freeway travel experienced by the individual motorist depends in large part upon the execution of the finishing operation. The last construction equipment to work over the concrete is the float finisher. This one machine has, as everyone knows, made possible the smooth riding pavements we know today. However, the machine alone is not sufficient. The operator of the float finisher is probably the key man in obtaining a good surface. Only by experience can he know when to perform the required operations. He must also work with the two concrete finishers who hand finish the edges and do other miscellaneous hand work.

The float finisher is essentially the same machine as originally built. It has functioned exceedingly well and is a valuable, not to say indispensable, piece of paving equipment when properly kept up and operated. It is poor policy, for instance, to attempt economy by not replacing wooden floats as they wear out. It is not too often, on a steady job, to change the floats every week. The resulting pavement surface will justify the frequent changes. On the other hand, if they are allowed to get too worn, the surface will clearly reflect it for the life of the pavement. The added expense of attempting to rectify such work will void the savings in not replacing the floats.



RESTRICTED CLEARANCE requires paver to make many passes under separation, charging drums only when in the clear.

Another point that must be watched closely is the surface plane paralleling the longitudinal joints. Any maladjustment of the edge floats or carelessness on the part of operators or finishers will result in a longitudinal joint that will produce a definite bump when a vehicle swerves across it. In addition, it breaks the pavement crossfall, thus preventing quick drainage of water off the roadway.

Recently, a contractor made an improvement on his float finisher to overcome a tendency of the machine to leave a slight ridge in the center of the lane at the vee of the floats. He placed a short float—about 4 ft. long—on a diagonal and just ahead of this vee. When properly adjusted, this float distributed excess concrete along the center of the lane and gave a more true surface from header to header.

Problems of finishing

The section of pavement immediately adjacent to bridge decks and grade-top culverts presents a problem that must be diligently attacked in order that the joint shall not result in a bump perceptible to traffic. It is obvious that these spots must be hand finished, and it is only by the use of straightedges, good finishers, and good inspection that a smooth joint can be achieved. Experience has shown that, in the case of grade-top culverts, the cheapest and best way to pour the top is with, and as part of, the pavement lane. The savings in time and money of eliminating the crossing of the deck top with equipment are considerable and, of course, the bump problem is eliminated.

The last operation in concrete finishing employs the cut float for what some call mobile straight-edging. When the pavement has set up so that walking will not mar the surface, a steel shod float about 14 ft. long is pulled across it, the float parallel to the edges. This float is so constructed that its steel cutting edge can frequently be adjusted to insure its straightness, and it is equipped with two small rubber wheels to facilitate moving. This float is then pulled across the green concrete, cutting off any bumps or projections from the surface. With successive passes overlapping by one-half the float length, double coverage is effected. If necessary, several additional passes can be made to achieve the desired uniformity of cut and resulting surface. Care in this work must be exercised particularly in the matter of its timing: tears in the surface must be repaired if the concrete is not "right" when the cutting is done. In any event the final product is, if not as pretty as an uncut pavement, a smoother riding one.

The requirements for curing concrete pavements leave a range of choice for the contractor. He may blanket with earth or sand, cover with cotton mats or impervious paper, or use a pigmented sealing compound. The period of curing has been reduced to 72 hours and the concrete surface must be kept damp until such time as the covering is placed.

COMPLETED FOUR-LEVEL grade separation, first in the world, is in heart of Los Angeles as the hub of area's freeway system.

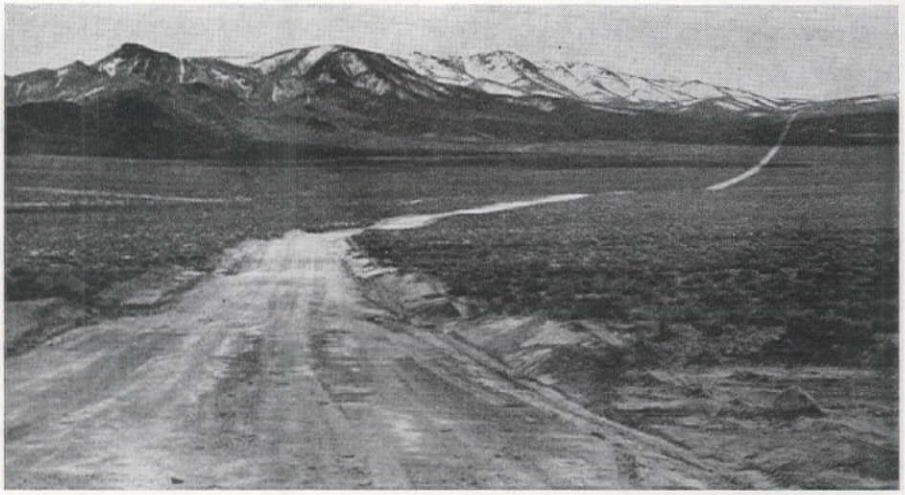
Most popular is the pigmented curing compound, applied at a rate of 1 gal. per 200 sq. ft. of pavement area. Any damage to this seal during the curing period must immediately be repaired and upon the removal of the headers, if within the curing period, the edges must be covered. The work of applying the seal is commonly subcontracted to concerns properly equipped to do so correctly. One important point is to mix the compound thoroughly prior to using, as the pigment will settle out after a time.

This 72-hr. curing period does not mean that contractor's or any other equipment can use the new pavement at the end of that time. Time of first use is governed by the modulus of rupture as determined by flexure tests on sample beams made of each day's run. California specifications require the passage of at least ten days and until the modulus of rupture is at least 600 psi. This requirement becomes important on the freeways where short runs are prevalent, as paving operations cannot be completed without waiting on curing time. It is therefore necessary for the contractor to spend time to lay out and plan his sequence of paving so that such delays will be held to a minimum.

High-volume output

It is easily seen from the foregoing that the volume of each day's run is dependent on many factors. Output on some portions of an urban freeway can be in excess of 1,000 cu. yd. per day. It well behooves estimators to scrutinize each project bid to uncover any factors detrimental to achieving the desired output and unit cost. It is inevitable on urban freeways, that the following phrase be heard repeatedly: "We sure would have had a good day if this had been a long stretch in the open."

Though built to low standards, this road provides adequate access to a mine on a desert mountain summit in Nevada — What makes it different from other routes is that most economical administration of work called for . . .



Road construction by equipment rental

ADMINISTRATION	X
DESIGN	
CONSTRUCTION	X
MAINTENANCE	
MUNICIPAL	
BRIDGE	

AN EXPEDIENT justified by defense program needs and the climatic conditions of Nevada's desert areas is typified by the State Department of Highways' recent award of a $23,750 road construction contract involving items of fully operated equipment rental alone that totaled $18,750. Commencing at a point on U. S. Highway 50 about 33 mi. east of Fallon, the work encompassed an access road extending 19 mi. southwest to the Nevada Scheelite Mine. The job was awarded to the Silver State Construction Co. of Fallon on January 21, 1952, undertaken on February 11, and completed on March 26.

The idea is born

The administrative origin of this job, and others like it, lies in Washington, D. C., in the offices of the Defense Minerals Administration, which is empowered to determine the legitimacy and feasibility of mining company applications for construction of access roads. Acting as engineering consultants to the DMA, the Bureau of Public Roads reviews proposed projects and submits estimates of probable cost to the DMA. Should the project prove acceptable, the DMA then refers it back to the Bureau of Public Roads for construction. Working in conjunction with the state involved, the Bureau then functions as in the case of any other Federal-aid job. A sole exception relates to the financing: costs of these access roads are paid entirely from special funds appropriated for the purpose by the Congress.

Since most of the roads are built to low standards of alignment and grade, Nevada has found that detailed engineering surveys and plans are unnecessary. In fact, their preparation would probably increase the cost of the work and delay its execution to such an extent that it would not be done. Therefore, only a careful field inspection of the accepted route is made, and the line flagged out. Estimates are made of the kinds and amounts of equipment needed to prosecute the work in the most economical manner.

The job is then advertised in the usual manner, the estimated number of hours for each piece of equipment being set up in the call for bids. There is usually also included an estimated amount of money to cover work to be done by force account. Typical of such work is picking rocks from subgrade and surfacing if pit run surfacing is used (as is generally the case), or purchase of other items and services that cannot be handled on a rental basis, such as explosives. On the described job, Project AM-2, the Nevada Scheelite Mine road, this force account item was estimated as $5,000.

A typical job

The first 14 mi. of Project AM-2, extending southward from U. S. Highway 50, is along the gently rolling west side of a desert valley, through a sandy decomposed granite formation requiring only very light grading. The small amount of surfacing needed was obtained from pits of decomposed granite adjacent to the work. Over the next 2½ mi. the road rises on varying grades (up to 8%) to the summit of the range bordering the valley. The upper mile of this section is in the bottom of a narrow, crooked canyon in which was encountered some rock work that required blasting.

After crossing the summit at about el. 5,600, the road descends on easy grades of about 4% through 2½ mi. of crooked, rocky canyon to the mine and mill. Despite its tortuous nature, this canyon is wide enough that the road could be constructed in the bottom with very little rock work being necessary.

No culverts were constructed on this job, the grade line being held low so that what little cross drainage there may be can run over the road with a minimum damage. Due to the extremely low average rainfall prevailing over most of Nevada, roads constructed in this manner may go for many years with no damage from runoff. On some similar construction projects, culverts have been needed; and also surfacing. Such items are included in the contract if they can easily be estimated on the usual unit cost basis.

Soon after the job was started, it was realized that it could more economically be done with the services of a tractor and ripper and a tractor and a scraper, though neither of these had been included in the original estimate. The items were therefore incorporated in the contract at agreed prices consistent with bid prices for other pieces of equipment. (See accompanying tabulation.)

Since the bid price was considerably below the amount set up for the job

. . . Concluded on page 166

Schedule of prices, Nevada Access Road Project AM-2

	Estimated Hours	Unit Bid Price	Actual Hours
Tractor, 95-hp., with dozer	250	$16.00	109
Motor grader, Caterpillar No. 12 or equivalent	800	11.00	783
Compressor, 150-cfm., with jackhammer	200	8.00	60
Power shovel, ¾-cu. yd. rated capacity	50	17.00	96
Dump truck, 3- to 6-cu. yd. capacity	200	7.00	684
Pickup truck	600	3.50	304
Tractor, 95-hp., and 12-cu. yd. scraper	—	19.70	218.5
Tractor, 95-hp., and ripper	—	16.00	50
Force account miscellaneous work	Est. $5,000	Actual	$1,898.97

There is no simple solution to—

HIGHWAY TAXATION PROBLEMS

Growth of the West is tied to highway transportation and today's pressing need is to devise a system of taxation which will finance an adequate expansion of these facilities — Various tax theories are outlined and evaluated

By JESS N. ROSENBERG
General Counsel
Western Highway Institute
San Francisco, California

WESTERN STATES have approached the problem of highway finance during postwar years from several different angles. Debt financing has been employed by a number of them to carry the burden of long deferred construction. In many instances, there has been extreme pressure for toll roads. The bulk of the revenues to do the job, however, must come from taxation, and commercial users of the highways have a natural concern regarding methods and means for providing such funds. They recognize, however, that no group of highway users can properly attempt to develop highway-user tax viewpoints divorced, in any way, from the interest of the general community, and that the motor transportation industry must therefore be prepared to cooperate with legislators, administrators, and other highway users and general taxpayers in working out satisfactory financing through taxation and otherwise.

No argument as to need

On one point there is complete unanimity—facilities need expansion, because they have been designed for a smaller number of vehicles than the total number which are today using the highways, and this situation is both national and Western. Estimates in 1947 were that there would be 46,000,000 vehicles using the nation's roads by 1970. By 1950 there were already 49,143,275 and this total was again surpassed in 1951. There is no indication as yet of any falling off in this rate of increase. In addition, the unfortunate fact that highways were considered expendable during World War II and were allowed to deteriorate through lack of proper maintenance during the war years, plus the fact that new construction was practically nil during that period, have had the regrettable and serious effect of actually decreasing the adequacy of roads at a time when need is greatest. Postwar efforts to correct this situation have been, to a great extent, nullified by the military exigencies of the Korean situation. Scarce materials, high prices, expanded needs because of a national defense program, have all contributed toward making the highway problem extremely critical.

Some of the taxation theories

Approaching the subject of highway finance, highway economists have developed various theories of allocation of motor vehicle tax responsibility over the years. These theories are directed toward assigning charges to highway users in such a manner that the amounts they pay will be related to their use and will be equitably distributed amongst classes of users. All of the various theories so far advanced may be grouped into two classes; those which attempt allocation on the basis of costs occasioned by certain types of use and those which would base allocation on the value of benefits conferred to users. Thomas H. MacDonald, Commissioner, Bureau of Public Roads, has explained some of the principal cost assignment theories[1] as follows:

"THE INCREMENT THEORY. This theory has as its foundation the undeniable fact that vehicles of different dimensions

ADMINISTRATION	X
DESIGN	
CONSTRUCTION	
MAINTENANCE	
MUNICIPAL	X
BRIDGE	

and weights differ in the extent of their requirements for highway facilities. Since existing roads and streets are, with very few exceptions, designed for a mixture of traffic of varying characteristics, the problem becomes one of determining successive requirements of cost which may be associated with an ascending scale of vehicle sizes and weights, beginning with a basic or passenger-car type, and ending with the heaviest weight group permitted on the roads. The analysis takes up in turn various elements of road cost, including pavement thickness, width, grade and alignment, structures, and maintenance; and attempts to determine the extent to which the cost requirements of each element vary with the size of vehicle. *The technical problems involved in this procedure severely tax the resources of engineering theory and experience.*

"The most difficult step in the analysis is that of determining the highway cost requirements of the basic vehicle; for there is no extensive background of experience to tell us what types of facilities would meet the demands of passenger cars and light trucks if there were no heavy trucks and busses on the roads. Another critical step is that of making proper allowance for the extent and distribution of the use of roads and streets by vehicles in the heavier weight groups. Such vehicles should be held responsible for added costs only on that mileage of roads on which their frequency of occurrence is, or is likely to be, appreciable. Failure to take this factor into account may result in an excessive assignment of tax responsibility to this vehicle group. . . .

"In spite of the complex analytical procedure it requires, the incremental method has much to commend it, both from the standpoint of engineering theory and from that of equitable assignment of tax responsibility. In any thorough-going tax study the feasibility of its use should be investigated. *Because of the technical hazards attendant upon the incremental cost analysis, it would be well for the investigator not to place complete reliance on this method alone.*[2]

"THE GROSS TON-MILE THEORY. This theory has been endorsed or adopted in a number of recent studies . . . One reason for the popularity of the gross ton-mile method may be found in its simplicity of concept and another in the fact that the data needed for the solution are much more readily obtained or approximated than is the case with a solution made according to the increment theory.

"The gross ton-mile theory assumes that, for vehicles of every type and size, motor-vehicle-tax responsibility should be measured by multiplying the weight of the vehicle (preferably average operating gross weight) by the miles traveled, and then distributing the total tax responsi-

[1] *"A Factual Discussion of Motortruck Operation, Regulation and Taxation."* Department of Commerce, Bureau of Public Roads, 1951, p. 74 *et seq.*

[2] *Author's note:* A Western Highway Institute engineer endeavored to obtain from design chiefs of several highway departments an outline of what basic design should be used as a starting point in developing the incremental theory. Because of the controversial nature of the subject all were reluctant to advance any opinion.

bility among all vehicles or all weight groups of vehicles in proportion to this product. It is asserted that the product, weight times distance, is a measure of value of use or value of service rendered to the user by the highway facility. The assertion that the product of weight of vehicle and distance traveled is a measure of value of service is apparently accepted by the advocates of the ton-mile theory, without the presentation or analysis of any data to support the statement. It may be granted that, for a given type or weight of vehicle, the distance traveled is a reasonable measure of the service received. When, however, we run the gamut from the lightest passenger car to the heaviest tractor-trailer combination, we can find no reason to say that, for these various types and sizes of vehicles, the value received from the use of highways is proportional to their weight. If a passenger car weighing 3,500 lb. travels 10 mi., and a truck weighing 35,000 lb. travels 1 mi., the gross ton-miles for the two vehicles are the same. The two operations, however, are very different and entirely different monetary considerations are involved. What seems to escape the advocates of the gross ton-mile theory is that value is something which must be measured in monetary rather than physical terms. Gross ton-miles could be accepted as a measure of value of service only if there were affirmative proof that this unit is proportional to some monetary measure of value.

"A basis in physical science is also claimed for the gross ton-mile theory. One writer on the subject *(Report of the Legislative Committee for the Study of Motor Transportation in Oregon,* p. 5) states as follows:

> " 'The direct measure of transportation is obviously the gross ton-mile or other equivalent unit defining energy absorbed by transportation (weight multiplied by distance).'

"It is evident that this writer, and numerous others who adopt the same viewpoint, have confused the ton-mile with the foot-pound. The latter is a unit of work or energy; the former is not.

"The ton-mile measures neither energy input nor the output of mechanical energy. Engine efficiency, internal friction, wind resistance, and tractive resistance are the determining factors in these relationships. Gasoline consumption itself is a measure of energy input; and, as is well known, gasoline consumption per ton-mile varies inversely with the size of vehicle. It would take at least twice as much gasoline to propel ten 3,500-lb. passenger cars 1 mi. as it would to move one 35,000-lb. truck the same distance. *Instead of imposing a tax proportional to the energy absorbed in transportation, the gross ton-mile theory attempts to compensate in part for the savings in energy consumption derived from the use of heavy vehicles—in short, to penalize efficiency in transportation.*

"The increment theory purports to distribute motor-vehicle tax responsibility in accordance with the costs occasioned by the travel of vehicles of different types and sizes. The gross ton-mile theory purports to assign costs on the basis of relative use or value of service. As stated above, the concept is highly defective in relation to value of service. As regards the relation of the gross ton-mile theory to the highway costs occasioned by vehicles of various types and sizes, the best that can be said is that higher costs are occasioned by the vehicles of heavier weight, which naturally at a given mileage will have the greater ton-mileage. *There can be no pretense that the gross ton-mile analysis produces an accurate appraisal of the costs occasioned by vehicles of different sizes and weights . . .*

"THE OPERATING-COST THEORY. . . . The proposition has been advanced that motor-vehicle operating costs, which rise steadily with size of vehicle, may be taken as a measure of the value of service provided, and therefore as a basis for assignment of road-user tax responsibility. The method of application of the operating-cost theory may be illustrated by the following example. If it were found that the cost of operation of a passenger car was 8 cents per mile and that of a certain tractor-trailer combination was 48 cents per mile, then the required tax payment, per mile, of the combination would be 6 times that of the passenger car. If the annual mileage of the combination were 3 times that of the passenger car, then their required annual tax payments would be the ratio of 18 to 1. . . . Although numerous objections can be and have been raised against this theory, there is considerable logical basis for the conclusion that the amount of money put into the operation of a motor vehicle is a measure of the value of the operation.

"The chief deficiency of the operating-cost theory, which it shares with the ton-mile theory and all other concepts based on value of service, is that it takes no account of the high costs occasioned by the use of vehicles of different types and sizes. This essential factor can only be taken into account by an incremental solution or some other solution that might be devised on the basis of cost occasioned rather than value of service."[3]

Examining the theories

From the foregoing, it is apparent that the various theories have inherent weaknesses, well recognized by the authorities. They contain both good and bad features. They all share this disadvantage—their proper application is dependent upon engineering studies and other research, most of which is not even presently projected, let alone completed. This fact has been recognized by other agencies in addition to the Bureau of Public Roads. The point has been stressed by Prof. Harmer Davis, director of the California Institute of Transportation and Traffic Engineering, in talks before the Western Interstate Committee on Highway Policy Problems, (Council of State Governments); it was confirmed by Dixwell Pierce, secretary, California State Board of Equalization, in his address to the National Tax Conference at Dallas, November 1951, "Fairer Highway User Taxes—Now;" it was recognized by the Committee on Taxation of Transportation in its report to the National Tax Association, November 1951.

These technical approaches to user tax allocation, with the inherent deficiencies we have noted, and their dependence for validity on studies to be made

[3] *Author's note:* Critics of the operating cost method have erroneously claimed that reduction of operating costs by road improvement or reconstruction unjustly lowers tax responsibility. The assignment is based on comparative costs of various vehicle classes. Only a variation amongst these classes can affect it upwards or downwards and lower operating costs do not lower tax assignment.

The "why" behind the article, and a word about the author

FUNDS for highway construction must come from taxation—either a direct use assessment, or an indirect levy based on public benefit. At present all the states of the West are actively studying this complex problem as the need for these revenues mounts. The subject is of equal interest to counties and municipalities that secure much of their road and street funds from state sources.

Because each state is usually identified with a particular plan for ultimate taxation, highway administrators may be inclined to be prejudiced in approaching any consideration of basic principles. For this reason *Western Construction* secured the cooperation of the Western Highway Institute in having its taxation authority review the subject from all its complex angles. The author was formerly chief counsel of the Washington State Tax Commission and of the Washington Public Utilities Department and has also served on the legal staff of the Atomic Energy Commission.

Western Highway Institute is a non-profit corporation organized in 1947 to serve as the regional coordination agency of the motor freight industry in the eleven Western states and Alaska with the function of providing technical advice and performing research. It maintains a professional staff which undertakes engineering and legal studies in subjects affecting motor transportation operations, taxation and related fields. Its services are available to the Western state transportation associations on a consulting basis, and staff members are currently engaged in such projects as the Western Test Road at Malad, Idaho; survey of operating costs of classes of vehicles; weighing practices and problems; vehicle license reciprocity; fuel tax differentials, and similar subjects.—*Editor.*

in the indeterminate future, when considered in the light of the pressing financial requirements for meeting present highway needs, pose the really difficult question—"What do we do now?" Obviously, the research must be pursued to completion and, just as obviously, the obligation of funding needed projects must be met immediately.

Commercial users of the highway, private and for-hire, intercity and local, long and short haul, can probably agree on one point: No state should ask its highway users to meet a highway use charge based completely on the pet assignment theory of any allocation "expert." To do so in the face of the incomplete status of the basic data upon which application of any of the theories must be founded would be extremely arbitrary, to say the least. The best that can be said for the theories of allocation at the present time is that they represent highly intangible approaches to a most complex subject.

An analogy to the process of tax or utility valuation suggests itself. The adoption, for such purposes, of any particular theory of evaluation to the exclusion of all others has been considered as capricious conduct by the courts. For instance, sole reliance by tax or rate making bodies on "reconstruction new," or original cost, or capitalization of stock and bond prices, or capitalization of net earnings, or some other single set of criteria, each of which produces its own type of distortion, has been regularly upset by judicial determination. It does not seem too unreasonable to request that the authorities follow the same approach in assessing highway user responsibility.

The judicial attitude on this subject has probably best been summarized by Mr. Justice Black in the recent case of Capitol Greyhound Lines et al vs. Brice. (339 U.S. 542, 70 Sup.Ct. 806, 94L ed 1053, 17ALR2d 407). In upholding a Maryland tax on the market value of vehicles, imposed as a condition precedent to the issuance of a title certificate, he said:

". . . Complete fairness would require that a state tax formula vary with every factor affecting appropriate compensation for road use. These factors, like those relevant in considering the constitutionality of other state taxes, are so countless that we must be content with 'rough approximation rather than precision.' Harvester Co. v. Evatt, 329 U. S. 416, 422-423. Each additional factor adds to administrative burdens of enforcement, which fall alike on taxpayers and government. We have recognized that such burdens may be sufficient to justify states in ignoring even such a key factor as mileage, although the result may be a tax which on its face appears to bear with unequal weight upon different carriers. Aero Transit Co. v. Georgia Comm'n, 295 S. U. 285, 389. Upon this type of reasoning rests our general rule that taxes like that of Maryland here are valid unless the amount is shown to be in excess of fair compensation for the privilege of using state roads.

"Our adherence to existing rules does not mean that any group of carriers is remediless if the total Maryland taxes are out of line with fair compensation due to Maryland. Under the rules we have previously described, such carriers may challenge the taxes as applied, and upon proper proof obtain a judicial declaration of their invalidity as applied. Ingels v. Morf, 300 U.S. 290. Cf. Clark v. Paul Gray, Inc., 306 U.S. 583.

"If a new rule prohibiting taxes measured by vehicle value is to be declared, we think Congress should do it. . . ."

All affected parties shrink from the very thought of congressional action in this field, but the suggestion of Justice Black gives still another reason why reasonable, fair user tax plans must be evolved.

Until there can be agreement that there is but one proper way to apportion user tax responsibility, it seems only fair that no one should be asked to pay a share unless it has been arrived at by a fair combination of the presently acceptable theories. Commissioner MacDonald has suggested this[4] in his statement to Congress to which we have already referred, and his approach seems, to the writer at least, the only avenue now open which will produce an equitable result.

He has shown that the graduation of tax responsibility indicated by an analysis on the basis of operating costs might be used as a suggested lower limit of motor-vehicle tax rates just as the findings of a ton-mile solution might give the upper limit. He further points out that even an approximate incremental solution, considered with these curves of assignment should provide an adequate basis for devising an acceptable compromise.

Before highway users can be called upon to meet the costs which we have been discussing, it is essential that highway needs be appraised and the total bill stated in terms of dollars. This appraisal should not be left exclusively to the state highway departments, whose official function is the development of the basic facts. These departments are entitled to the constructive criticism and assistance of legislative committees and interested citizens in preparing the programs which will provide essential transportation facilities and community services. No tax plan for highways can be accepted or rejected in the abstract. It must be considered in relation to the dollars needed to do the job.

This important task of putting a price tag on the highway requirements of our states belongs not only to government but to individual citizens as well. It is a community responsibility. Hal H. Hale, Executive Secretary, American Association of State Highway Officials, states:[5]

". . . It would seem that we must ultimately face the fact that with our present highway construction program and our present production rate of motor vehicles, we will very quickly come to the point where it may be necessary to limit the number of motor vehicles that can use our roads. This is certainly not a desirable state of affairs for the motor industry, or the general public.

"It is extremely unlikely that we will ever solve this highway problem, if we follow the financing trend of recent years. That is, to attempt to construct all needed improvements from revenues derived solely from the highway user tax. More and more, public opinion has turned to the philosophy that the highway user tax alone can and should support the road program. I personally believe that this will be impossible.

"Everyone benefits from the highways, whether or not they own a motor vehicle. We have long held to the philosophy that the bachelor and spinster should pay taxes to support our public school system. All married people pay a tax to support the schools, even though they may be childless.

"The same thinking that makes these financing methods sound applies to our road system. The mails are delivered over rural free delivery routes. Produce is carried to market and purchases are delivered, in one way or another, by motor vehicles moving over publicly supported roads or streets.

"There is much research to be done in the field of highway finance, and the sooner we get about it the quicker we will be relieved of some of our serious highway problems.

"A good highway system is vital to our nation. It is vital to you as an individual. If such a system is lacking, you have only yourself to blame. Highways are *your* business."

R. H. Baldock, state highway engineer of the State of Oregon, in his talk, "Who Should Pay for the Highways?" delivered to the annual meeting of the Washington Good Roads Association, Sept. 14, 1951, emphasized that a general community responsibility for roads should be considered before any assignment is made to the road user. Commissioner MacDonald has taken the same position. The principle is generally accepted, but has been somewhat neglected in application in recent years. Commercial highway users should bear this fact in mind before agreeing to assumption of additional tax burdens.

Ominously overshadowing the entire taxation picture has been the devising of certain tax structures which are designed to discourage particular types of highway use. Exorbitant tax rates on any segment of commercial users do not produce added highway revenue. They are punitive in nature and discourage the type of use affected. As the use is discontinued, tax revenue ceases. When it is borne in mind that the use of highways is in the public interest and greater use means greater benefits to all, there can be no conclusion but that use of our highways should be encouraged, especially commercial use. Discriminatory tax plans must be rejected.

The growth of this region is inextricably bound up with the expansion of highway transportation. Strategic decentralization of factories, suburban redistribution of urban populations, development of vast areas in the West not served by any transportation save that available by the public highways, all indicate the tremendous need for a broad highway program in every state. The motor transportation industry recognizes its responsibility and is prepared to cooperate with the administrators and legislators of the various states as well as other user and citizen groups in working out satisfactory taxation and financing for this vital phase of Americal life.

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[4] *"A Factual Discussion of Motortruck Operation, Regulation, and Taxation,"* supra; Appendix VI, page 100 *et seq.*

[5] "Highways Are Your Business," *The Highway Magazine,* January 1952, pp. 6, 7.

How to handle a rock plant

... A key to successful Western highway contracting

CAPACITY LOAD on the feed belt is one essential to getting capacity output from your rock plant. Of course, all other operations must be organized and equipped for this output, if maximum efficiency is to be obtained.

PRODUCTION OF GRAVEL and crushed rock is an operation of vital interest to every contractor in the West. This is particularly true in 1952. With an accelerating highway program in this region, and with competition among contractors getting keener, the bid figures and actual costs of setting up, operating and maintaining a rock plant represent an important element in the final profit on any job. On a typical divided highway project in California, for example, the production of crushed subbase and mineral aggregate material amounts to about 10% of the total job dollar. The smarter the contracting outfit the more attention will be given to the rock production phase of the job.

An example of progressive Western thinking

One of the best examples of this line of thinking, in connection with Western contracting is that of Jack Kasler of the Sacramento firm of Fredericksen & Kasler. This company has just moved in on a 9-mi. divided highway improvement on U. S. 66 on Cajon Pass, between San Bernardino and Victorville. Kasler's $2,100,000 bid was low at a time of the year when competition was particularly keen and 12 bidders were after this big project. In the belief that Kasler's viewpoint reflects the thinking of progressive Western contractors, he was asked to comment on the following questions:

An interview on this important subject with JACK KASLER

Q: What is the general nature of your work, Mr. Kasler?

A: "We're principally highway builders, but we've also done airfields, dams, bridges, and railroad jobs. We like airfield work when we can get it."

Q: What jobs have you done the past few years?

A: "The $800,000 Cuesta Grade near San Luis Obispo, the Miles Station job —about $1,400,000—near the same town, an $800,000 road job at Running Springs, and a $1,100,000 job at Pismo Beach. We did a $1,400,000 job at Beaumont on U. S. 70, and finished $800,000 jobs at Thousand Oaks and the Oxnard Airbase last year. We've got a $400,000 job at Montalvo, this one, and a $500,000 bridge on the Hollywood Freeway at present."

Q: Is the preparation of crushed rock and gravel a sufficiently important item to cause concern or special attention in your bids?

A: "You bet it is. Crushed rock items amount to a sizable part of most contracts. On this present Cajon Pass job one big rock pit was specified by the engineers in the middle of an excavation prism. It was a tough setup and there wasn't time to figure it out as closely as we would have liked. We took a chance, but I was concerned about that item until the bids were opened."

Q: What factors do you consider in the selection of rock production equipment?

A: "Several, with unit cost of production as one. The ability of a plant to be moved around quickly from place to place and operate at near-capacity production over long periods of time, and others. I don't need to tell you that a lot of our Western pits often have native

ADMINISTRATION	
DESIGN	
CONSTRUCTION	X
MAINTENANCE	X
MUNICIPAL	
BRIDGE	

AT THE SITE, plant is ready to process the rock in this sidehill cut that will provide added width for two more lanes. One set-up will be made at each end of 700-ft. length of cut without stockpiling.

gravel, maybe 70% of which will pass specifications. Naturally, we wanted a plant with some kind of bottom deck feed to pass all that acceptable material right away, without running it through the crushing mechanism. Our Pioneer 46 VE Duplex meets all these requirements."

Q: Is your plant fully portable, and how fast can you move?

A: "Our plant is as fully portable, as any big rock plant I know of. We can demobilize and move for about $1,000. And that'll let you make a lot of moves and setups. Right here at Cajon Pass the portability of our rock plant is going to let us handle that big 700-ft. pit in the roadway prism without stockpiling the material. We can set up our plant at one end, feed it by gravity with a U-dozer, and take 350 ft. off the south end, hauling that material out to finished grade. Later, when the grade is finished all around that point, we'll move the plant to the other end of the deposit and work the remainder out for mineral filler in the hot mix. We can tear down and move and be set up again in about three shifts."

Q: How about transportation over the highways? Have you solved that?

A: "I think so. Our plant is just a few tons over the legal weight limit per axle in California, and once, on a move from Monterey down the coast, we had to load it on a trailer to come within the law. But we've whipped that problem by taking out the roll crushers for a complete overhaul and hard facing prior to a move to a new job. Naturally, that's good maintenance for the plant. We haul the rolls to the new job on a separate truck, and the crushing plant can then move legally on its own rubber."

Q: Do you usually use the specified rock pits, or do you pick alternates?

A: "We use the ones specified if production costs are anywhere near comparable with other sources. Bear in mind that these highways and airfields are built to last by engineers who know their business, and that extensive tests of the general area were made by these engineers before we move in. I believe you're helping the engineers get a better job where you can use the pit sites they select."

Q: What factors do you usually consider in setting up your rock plants?

A: "The most important, in my opinion, is to set up the plant to eliminate secondary stockpiling entirely, if possible. Any time you stockpile material you've added a dime a ton to your cost. Of course, sometimes it's advantageous to stockpile in winter, when you want to keep key men and equipment busy, but even then our company tries to use that period for maintenance and heavy repairs.

"Other important considerations in the setup of a rock plant are ease of movement by hauling trucks, and the efficiency of the feed of raw material. The modern U-type dozer on a tractor like the D8, HD-20 or the TD-24 is an excellent tool to feed a rock plant and keep it running at capacity."

Q: If conditions are right, does the modern portable rock plant stand a fair chance of delivering capacity tonnage?

A: "It will often exceed capacity tonnage if conditions are right. For example, in a pit where a sizable percentage can be scalped off the bottom deck and where the oversize material is not hard, most modern plants will show top-notch performance. In a coarse pit where the rock is exceedingly hard you've got to take it easier. Our plant is driven by a Caterpillar diesel and electric motors. The development of the present day diesel engine and dustproof motors has done a lot to make rock production more efficient."

Q: What factors are important in plant operation?

A: "Well, there are a lot of important things to consider. For example, you can't expect a plant to turn out capacity tonnage hour after hour unless you make certain you've got enough trucks to keep the material hauled away. And that in turn means arranging for blades, rollers and spreader boxes to handle it on the fill or roadway.

Adjusting for pit conditions

"Another important item in the capacity operation of a rock plant is the adjustment of that plant to meet changing pit conditions. Suppose we had our jaw set rather close on a predominantly fine pit, but that the pit characteristics changed suddenly, as often happens, and the run of raw material changed to coarse, oversize stuff. If the operator didn't change the jaw crusher setting, the jaw would be working beyond its capacity while the roll crusher was loafing. In our plant we open the jaw setting, while the machine is running, to ease the jaw's work and route more material to the rolls to get a balanced optimum work condition. If the pit then started running fine, we'd choke down the jaw setting to ease the work the rolls were doing.

"The operation of any rock plant is seldom better than the over-all organization of the project as a whole, because as a rule the rock production item has to be fitted into grading schedules, installation of drainage culverts and structures, median construction and paving."

Q: How about trucks? Do you use your own?

A: "No. We have a specialty trucking concern which gives us better service at lower cost than we could do the work ourselves. The outfit is dependable and will assign what trucks we need to our job. Naturally, they're standardized pretty well the same as we are and can keep everything running in good order.

The hauling problem

"Our method is excellent here in California where we have good trucking concerns. But if our business happened to be in some other state we might decide to haul our own material. Those things are simply a matter of thinking the problem through and working with whatever conditions exist."

TOWED to the job site on its own rubber, plant had roll crushers removed during the trip for overhaul and hard-facing. This plan also brought the unit to legal California highway weight requirement.

Q: Does maintenance pay, or can it be overdone?

A: "I know of no point of diminishing returns in the preventive maintenance of our equipment. I don't believe you can overdo it, particularly now when parts are none too plentiful and steel is in short supply. We follow Pioneer's factory specifications strictly on the rock plant, Caterpillar's instructions on the diesel engines, and so on. We ran about a million tons of crushed rock through the first set of jaws on our plant without any bearing or other trouble or without replacing the jaws. I believe that was a result of good maintenance.

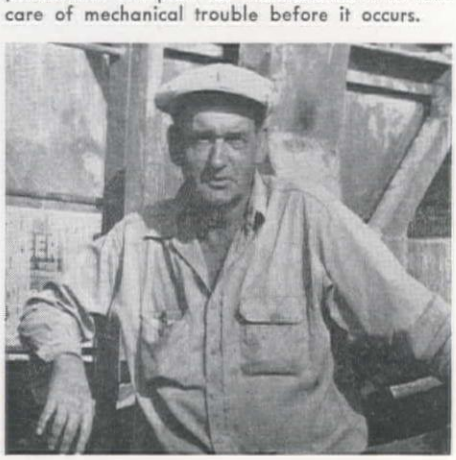
No mystery in maintenance

"It's always seemed funny to me that preventive maintenance is supposed to be some kind of an intricate science. It isn't at all. There is nothing mysterious or hard about it if there is a definite, tough and systematic policy established at the top of an organization.

"Take some of our toughest competitors: Peter Kiewit Sons' Company, Griffith Company, and Guy F. Atkinson. Or outfits like Western Contracting Corporation. One of the big things that makes them tough to compete with is the intelligent way they use and maintain their equipment. A careless contractor is probably overhauling major units of expensive diesel machinery at 2,000 hours. Outfits like the Kiewit Company get 10,000 hours before it's necessary, and then they do it at much less cost because fewer parts are required.

"Preventive maintenance isn't something to be indulged in only when the United States is at war and parts are in short supply. It's something that will give a contractor an edge on his competition at any time, if he practices it faithfully. Anybody can find out all about the subject by consulting the manufacturer's maintenance manuals, and getting extra copies so the mechanics can have theirs too."

GEORGE BELL, plant superintendent for Fredericksen & Kasler, is key man on contractor's rock production. His plan for maintenance is to take care of mechanical trouble before it occurs.



Q: You've got a modern rock plant, Mr. Kasler. Do you feel that most modern rock plants are really ahead of older models?

A: "They certainly are. And they're a long way ahead of old, outmoded stationary plants which can't be modernized because the demand isn't great enough to justify the expense. Modern rock plants regardless of make are likely to have improved features, representing experience with the machines in the field. And if you've got a good plant operator, your plant will likely have a few extras he has thought up."

Q: How important is the plant superintendent? Isn't there increasing emphasis on his importance?

A: "The plant superintendent is one of the most important key men in any organization, and he's one of the hardest to find, any more, because unfortunately a lot of our younger construction men don't see the good future there is in this kind of a job. George Bell, our plant superintendent, is exceptional. He spots trouble in the plant and has it corrected before the equipment can break down. On Sundays you'll see him welding something here or there to make sure the plant output will be sustained the following week. Parts which need replacement more frequently than others are there in George's stock bin. And that brings up something else: you've got to give your plant man what he reasonably needs in the way of parts and tools, to expect him to make any showing.

"A good plant man can do a lot toward making excellent operators out of run-of-the-mill hands. By giving these men training and encouragement, I believe he can do a lot to arouse the interest of these men; to put construction in their blood the way we've got it in ours. And some good young fellow should be picked to understudy these old timers. Like all of us, they won't last forever."

Broad perspective helps

Jack Kasler then added some words of general comment, pointing out that plant men, as well as foremen of any kind, will be more valuable if their perspective is broad. He and George Bell frequently visit jobs to see how the other contractors are handling their construction problems. Whenever he can, Kasler tries very hard to talk to all the engineers and designers, because if he knows what they want he can do them a better job.

A broad background including work as a construction engineer with the Missouri State Highway Department, and a range of highway work geographically from "both sides of the fence" he has the qualifications for counsel. In the range of contracts his firm has tackled, he is one of the West's most successful contractors.

More important than ever

At no time in the construction history of the West has the proper selection, operation and maintenance of equipment of all kinds been more important than in the current construction year. If all Western contractors will review their rock production set-ups with a view toward full efficiency, the profits on this important contract item will rise. In due time public money for highway and airport construction will buy more pavement than ever before.

"GLULAM" BRIDGE for 100-TON LOADS

Timber logging bridge with 180-ft. clear span designed for off-highway trucks having a gross weight of 100 tons — Two 180-ft. camelback trusses constructed entirely of glued laminated members and deck beams — Erection carried out with self-propelled "sky hook"

TYPICAL LOAD on the completed bridge. In addition to gross loads of 100 tons, bridge was designed to carry heavily concentrated loads induced by 70-ton track and wheel-mounted loaders used by logging company.

ADMINISTRATION	
DESIGN	X
CONSTRUCTION	
MAINTENANCE	
MUNICIPAL	
BRIDGE	X

By
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RAPID ADVANCE in utilizing the unusual properties of glued laminated timber is again demonstrated by the 180-ft. clear span logging bridge recently designed and fabricated by Timber Structures, Inc., for the Kosmos Timber Co. of Kosmos, Wash. This bridge consists of two 180-ft. camelback trusses constructed entirely of glued laminated members and glued laminated deck beams suspended at panel points 15 ft. on center, extending beyond trusses to provide outrigger bracing to truss web members. The roadway is laid with 2 x 12-in. laminated pieces on edge, spanning between deck beams.

Truss design

Although the trusses resemble the bowstring type, the top chord members are a series of straight segments 18¾ x 17⅞ in. in section. These segments were made straight to eliminate eccentricity in the top chord between panel points, thus allowing a reduction in section and simplifying manufacture and handling. Lower chords were made double, each member 9 x 14⅝ in. in section and 60 ft. in length. This necessitated the use of only two splices for the full length of the lower chord.

These chords were made in two pieces so that four timber connectors, rather than two could be used with each bolt. Such an arrangement greatly reduced the length and cost of heel joints and lower chord splices. Deck beams at each panel point consist of two beams 7 in. wide and 39 in. deep. They are hung by bolts and angles welded to the steel gussets at the lower chord and web connection. Each beam extends beyond the truss on one side only. All webs consist of two members approximately 9 x 9 in. in section.

Bracing members and nailed laminated decking represent the only material which is not glue-laminated. All connections on the trusses were made with steel gusset plates, bolts and shear plates. All timber was pressure treated with a mixture of 50% creosote and 50% petroleum oil. Bolts, split rings and shear plates were heavily galvanized, and all gussets painted with red oxide.

100-ton loading

Design work was done by R. W. Ebeling of Timber Structures' Portland office. The bridge was designed to support two fully loaded off-highway logging trucks each having a gross weight of 100 tons, and also provide for heavily concentrated loads induced by 70-ton track and wheel mounted loaders used by Kosmos Timber Co. Laminating and fabricating of all material was done at the Portland plant of Timber Structures, and was pressure treated in transit with delivery being made to the bridge site by truck.

There are, of course, many ways of erecting this type of bridge, and the selection of the method requires considerable thought. The Cowlitz River at the site was too deep and the bridge elevation too high above water to allow the economical driving of piling for falsework. For this reason, plus the fact that Dan Soderlind, superintendent, Kosmos Timber Co., had good high-line riggers available, it was decided to assemble the trusses flat on the ground and place them with a high line. One side of the crossing offered many trees for use in rigging. On the other side it was necessary to erect a 120-ft. spar and tie off all rigging to old stumps left from earlier logging.

Erection by "sky hook"

The skyline actually was four 1¼-in. cables providing support for Phil Grabinski's "Philstram," a self-propelled "sky hook" containing its own power unit for lifting. Each truss weighed 30 tons, and they were picked up at two points, at the center line by the "sky hook" and 15 ft. from one end, below the center of gravity, by a log loader. This two point suspension provided control of the truss at all times and both trusses were placed in good time with no serious trouble.

Deck beams and decking followed quickly, all placed by the "sky hook." The assembly and erection of the trusses was carried out by personnel of Kosmos Timber Co. under the supervision of Ed Moulton, superintendent for Timber Structures.

The advantages of using glued-laminated material or "Glulam" as it is more

commonly called, on a bridge of this type may be listed under four broad points: (1) design flexibility, (2) elimination of maintenance problems, (3) longer life and (4) reduced costs. Member sizes used on this job are a good example of the flexibility which Glulam provides the engineer. The 18¾ x 17⅞-in. x 17-ft. top chord members, the 9 x 14⅝-in. x 60-ft. lower chord members and the 7 x 39-in. x 30-ft. deck beams would be difficult, if not impossible, to obtain in high stress grade sawn sticks. All straight Glulam members are built up of 2-in. nominal material, widths are slightly less than standard S4S material and depths are some multiple of 1⅝ in. Structural members may be "shop grown" to any size and shape within the limits of transportation facilities. High grade material may be placed within the member where the greatest stress occurs. This quality of flexibility makes the possibilities of Glulam as a structural material almost unlimited.

Maintenance of "Glulam"

Maintenance problems caused by shrinking, checking or twisting of sawn timbers are eliminated because all members are kiln dried to approximately 12% moisture content. All members remain dimensionally stable and all connections stay tight. Creosoted sawn timbers, which give years of satisfactory service, do eventually succumb to decay and rot, usually at some point where checking or wear expose untreated portions of wood. Glulam members, being kiln dried before treatment, take a deeper penetration of preservatives, and do not check and expose untreated wood. Larger sizes eliminate many connections and splices, always a likely spot for rot or decay.

The other advantage of lower cost may seem surprising to those used to comparing Glulam to sawn members on a cost per thousand basis; however, the higher stresses allowable and larger sizes available to handle the loads of such a bridge so reduced the gross footage required that the cost with Glulam was less.

It is interesting to note that this bridge was originally designed and quoted based on using all sawn material. This was done at a time when waterproof glues were "frozen" by the Government. Before fabrication began, however, the proper glues were made available, and the bridge redesigned accordingly and a substantial reduction in cost passed on to the owner.

ERECTION of 30-ton trusses was carried out using four 1¼-in. cables as skyline attached to a self-propelled "sky hook." Another view of completed bridge is shown below.

Data on this bridge are as follows:

Clear span—180 ft.
Height of trusses at center line—25 ft.
Roadway width between wheel guards —16 ft.
Clearance between trusses—19 ft.
Vertical clearance—unlimited.
Load capacity—2 logging trucks, each with a 100-ton gross weight.

Two smaller logging bridges utilizing substantial amounts of Glulam were installed on the Olympic Peninsula approximately two years ago, and a third one, similar to the Kosmos job, is now being fabricated. However, the Kosmos project represents the first all Glulam bridge truss design erected in Washington.

Arizona county ponders ways to "catch up" $20,000,000 worth of road deficiencies

THE ROAD PROGRAM of Maricopa County, Arizona, has been described by its county engineer as $20,000,000 behind schedule. With its traffic volumes relatively heightened by urban development around Phoenix, the 4,200-mi. road system is undergoing wear and tear at a rate exceeding that of improvement by an estimated 4 mi. per yr. To remedy the situation, County Engineer Howard L. Shelp recommends doubling the counties' share in gas tax funds and adoption of two proposed laws relating to standards for subdivision roads.

Shelp has had a budget of $1,130,000 for Maricopa County roads during the past fiscal year, about $925,000 derived from gas taxes; but the total was still about $1,000,000 short of what is required to maintain and expand the system in a proper manner. Doubling the counties' tax allocation (from one cent to two) would make up most of the deficit. Shelp notes that the counties' share once was higher than at present, having been reduced one-third by legislative action in 1946 and the money directed instead to municipalities. The cities need the money, Shelp admits; so the problem seems one of increasing the tax per gallon rather than changing the method of distribution.

In the matter of subdivision streets, legislation has been proposed (and turned down at the last legislative session) which would both save and cost the county highway department money. The measures would certainly have cleared the air regarding responsibility for subdivision street maintenance, and thereby put an end to engineers' and taxpayers' headaches. Toward a saving—an indirect one—it was proposed that the county engineer be authorized to write the specifications for subdivision pavements. Such authorization would have guaranteed their adequacy, ending the current annual loss of many "improved" roads built to insufficient standards during the course of residential development. In furtherance of this idea, another proposed law would have empowered the county to maintain such subdivision roads. At present, the county is not allowed to remedy poor conditions that arise—ruts, chuckholes, and the like—and can only watch as a patch job becomes a reconstruction project through deterioration under continued traffic.

SEAL COATS—Problems & methods

Most perplexing problem of asphalt highway construction is "to seal coat or not to seal coat," and when and how—The principles are presented here, along with descriptions of the more recent developments

By RODNEY P. RYKER
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ADMINISTRATION	X
DESIGN	
CONSTRUCTION	
MAINTENANCE	X
MUNICIPAL	X
BRIDGE	

EVERY HIGHWAY ENGINEER has a pet definition for a seal coat—one of the briefer ones states: "a seal coat is a thin asphalt surface treatment applied to a pavement surface with or without a cover of mineral aggregate . . . " In addition to the problem of defining it, engineers and technicians have attempted for many years to reduce seal coating formulas and factors to an exact science.

However, as detailed and valuable as this laboratory and theoretical work is, some of these same men are among the first to admit that seal coat work has its practical side—that local conditions of supply, weather and traffic cause variables that can only be determined and evaluated on the spot. In the final analysis, the results, good or bad, are in the hands of the men who have the job to do.

Purposes of sealing

There are six generally accepted purposes for sealing pavements:

1. To seal a new or old road surface against the entrance of moisture and air.
2. To provide a non-skid texture where the existing road surface is smooth and slippery.
3. To enliven a dry or weathered surface and improve wear resistance.
4. To reinforce and build up a pavement structure.
5. To improve luminosity or night visibility.
6. To provide a demarcation for traffic guidance between shoulder sections and traffic lanes.

Of these six purposes, it is generally agreed that 1 and 2 are the two most important functions.

To these six there has been added, more or less recently, a seventh purpose:

7. To provide additional asphalt binder to the exposed surface of asphaltic concrete and other bituminous pavements to facilitate traffic sealing without affecting surface texture and non-skid values.

No seal coat will accomplish all seven purposes, but combinations of two or more are achieved on many projects when any one of the seven is chosen as the primary purpose. Their use should not be extended beyond the benefits and uses as outlined. Don't expect to cure alligator cracking caused by base failures or corrugations due to unstable mixes, by the application of a seal. Seal coats are less costly than any other type of surface treatment. They do, however, require careful planning, and competent supervision. The work is carried on at a rapid rate, errors are difficult to correct, and expensive to correct. These errors, if they do occur, bring quick and ofttimes violent, adverse public reaction. A good seal coat job can change the entire appearance and surface texture of an old pavement; and conversely, a poor job can ruin the surface of a perfectly good pavement, particularly plant mixes.

Why and when to seal

Too little attention is paid to "Why and When to Seal." The matter of when to seal falls into a similar category as the selection of the type or grade of asphaltic material to be used on a seal job—that is, the decision rests with a policy forming group. All too often pavements are sealed that do not need sealing. This is particularly true of asphaltic concrete or plant mix pavement. On the other hand, in oil mats and macadam pavements, the seal is an integral part of this type of pavement, but such is not the case with asphaltic concrete. In many instances, the sealing of these high-type pavements is an unnecessary expenditure and waste of money.

Not always necessary

As an example of the type of pavement that does not need to be sealed, a section of U. S. 99, the most heavily traveled highway in Washington, between Seattle-Tacoma, resurfaced in 1948-1949, was not sealed, and not until last summer was any part of it sealed; also the Forks-Hoh River highway on the Olympic Peninsula, constructed in 1950 and not sealed in an area with over 100 in. of rainfall per year. As a matter of fact, none of the asphaltic concrete pavements placed in Washington by the state are sealed. This is also true in the cities of Seattle, Tacoma and Spokane.

Non-skid qualities are an intrinsic part of asphaltic concrete and plant-mix pavement surfaces. The kneading action of pneumatic tires will seal the surface particles together in a short time under favorable weather conditions. And paving in unfavorable weather is not a good policy at any time. In Oregon permeability and skid tests are to be conducted prior to placing a seal on new AC pavements. If the tests prove satisfactory, sealing is to be deferred until such time as the pavements require improvement of surface texture. This policy is in line with modern practice.

Why do failures occur?

Here are some theories gathered in discussions of poor jobs with different engineers, inspectors and laymen during the past few years.

1—The seal coat aggregate contained too many fines, the rock was too dirty, the fines blotted up the asphalt and the larger particles wouldn't stick.

2—The asphalt was applied when the atmospheric temperature was too low; the cement solidified before the rock could be applied, with the result that only the finer aggregate particles clung to the surface, and all the larger stone was kicked off. When warmer temperatures occur, a slippery dangerous surface develops.

3—Asphalt cement was applied when the temperature was too high. The mat was too open and porous, and the bitumen was absorbed. Not enough cement remained on the surface to retain the rock cover.

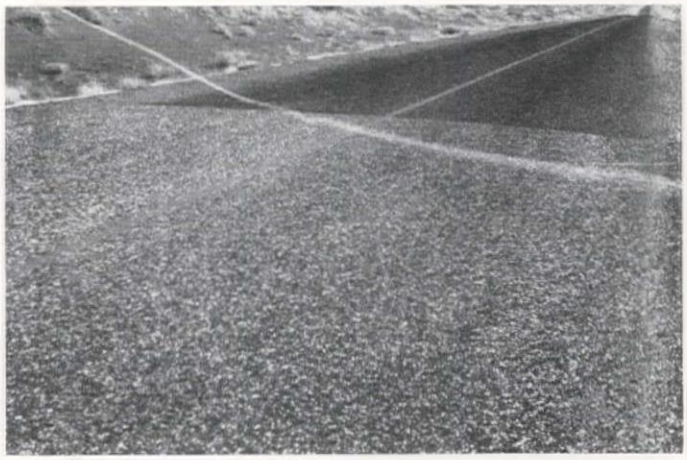
4—Not enough asphalt was applied to the surface to hold the rock. Too light an application.

5—Too much asphalt was applied and not enough cover stone, resulting in a similar condition as described in No. 2, a slippery, dangerous surface.

Two additional theories of failures advanced by the author quite recently are:

6—Certain types of asphalt, when applied to an asphaltic surface, penetrate down through the mat, soften it, and cause it to disintegrate, and

7—The cover stone did not contain



WASHINGTON—A light surface treatment applied to U. S. 10 last year. This was the second seal coat applied since the highway was built in 1933. The route carries the bulk of cross-state car and truck traffic. Detail of texture (right) shows cover of crushed gravel in foreground and crushed ledge rock in background.

enough dirt, that these fines are necessary for the asphalt to cling to in order to keep it on the surface and prevent absorption of the asphalt into the pavement.

Most of these theories are based on sound reasoning and conditions; however, the two latter reasons may not be in this category. They are mentioned merely to show some of the ideas advanced for poor results.

Cold weather problems

The worst failures observed usually involved cold weather. The best jobs are done in mid-summer when temperatures are high. Oregon specifications provide, in general, that oiling operations shall not be carried on when atmospheric temperature is less than 65 deg., and that the work shall be performed between May 1 and October 1. Washington specifications provide for a minimum ground temperature of 50 deg. These requirements did not get into the state specifications by accident. More seal coats have been ruined by cold weather, during or immediately following its application, than by any other cause.

Next to cold weather, dirty rock is probably the worst enemy of a good seal job. The State of Oregon has the solution to this problem in its specifications of ¼-in. to #10 cover stone. KEEP IT CLEAN.

Wet weather may take its toll on some projects along the coastal area, but this cause is not considered a large failure factor. Of course, engineers responsible for carrying out this work on the coast do have a difficult job in attempting to predict the weather from day to day.

To be successful, seal coats should undergo a curing period of manipulation by rubber-tired traffic in temperatures high enough to maintain the asphalt in a plastic condition. This effects an increase in the bonding area between the aggregate and the asphalt. Low temperatures tend to solidify the binder and result in destruction of the bond during initial traffic use.

The importance of quickly spreading the cover rock on the asphalt cannot be over-emphasized, regardless of the grade or type of asphalt being used. When an asphalt mat is fluid the rock covers most, penetrates deepest, and makes the best bond, all in the least time. Rock applied immediately after the oil spread has the advantage of not only these factors, but in being more free to come to rest in a position with its largest face down, and has the advantage of the creep of the oil, due to capillary action, to improve its bond.

Contractors will probably raise eyebrows at the following statement. One organization with a fine record for its effective seal coating will not permit oil spreads of more than 400 ft. Spreads of this length are allowed only after the crew has settled down to smooth operation. They start with 200-ft. spreads. This is maintained with cut-backs, SC-6 and emulsion. The organization referred to is Division VIII of the California Division of Highways, with headquarters at San Bernardino. Berndt Nelson, district construction engineer, maintained that the short spreads were economical and that he received close contractor cooperation. The daily average of production was not lowered by this procedure, the rock retention was greatly improved, and spotting practically eliminated.

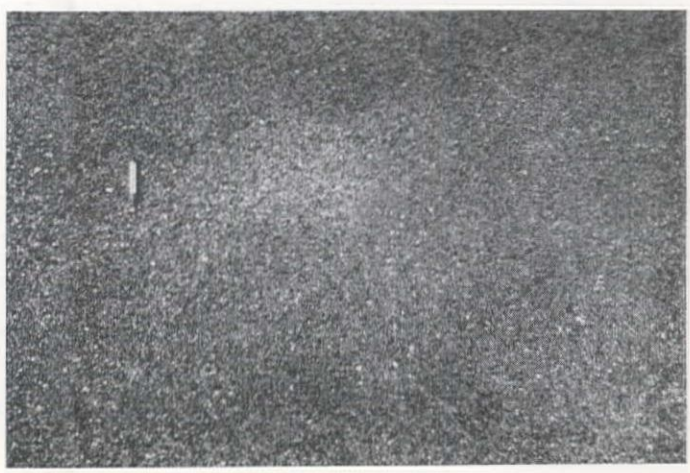
Types of asphalt and aggregate

Asphaltic binders and types of aggregate cover have become fairly well standardized. They can be listed without comment as:

Coarse sand cover—Cutbacks RC-1-2, MC-2-3, RS-1 Emulsion.

Clean ¼-in. cover—RC 2-3-4, MC 3-4, SC-6,

OREGON—Cinder aggregate was used for this seal coat on U. S. 20, Bend to Burns highway. Detail of texture (right) shows the surface of the ¼-in. to #10 mesh cinders. Skid tests showed this surface to have the highest coefficient of friction of all tests made.



RS-1, RS-2 Emulsion, 200-300 paving asphalt.

Clean ½-in. cover—RC 3-4-5, MC 3-4-5, SC-6, RS-1, RS-2 Emulsion, 150-200 and 200-300 paving asphalt.

Clean ¾-in. cover—RC 4-5, MC 4-5, SC-6, RS-1, RS-2 Emulsion, 150-200 and 200-300 paving asphalt.

Graded gravel cover—MC 2-3, SC 3-4.

Two new methods

Two methods of seal treatments warrant describing, because although not entirely new in the Northwest, they are not in general use. Each is applicable to a particular type of condition and use. The first is referred to as the "Dilute Emulsion Seal," and the second as the "Mixed Seal." Referring back to the general purposes of seal coats, the first applies to purpose No. 7 "To provide additional asphalt binder to the exposed surface of asphaltic concrete . . . without affecting surface texture . . ."

1—The "Dilute Emulsion," "Black Seal" or "Construction Seal" has only recently begun to be used widely in California, with excellent results obtained. It is a single application of mixing type of asphaltic emulsion, made from a relatively low penetration paving asphalt—an asphalt having a penetration of from 40 to 90. The emulsion is diluted with water at the rate of about 1 part water to 4 parts emulsion. Application is at the rate of from ⅛ gal. per sq. yd. to 1/20 gal., depending upon the texture of the pavement. These rates are based on the diluted material. No cover is required and under normal conditions, the break is rapid and traffic can have it within 1 or 2 hr.

Because the diluted mixing emulsion has a very low surface tension, it penetrates the surface voids rapidly, coating all of the exposed surface without bridging across the larger openings. The very light application does not provide enough asphalt to fill the voids but leaves a materially thicker film on the exposed surface. The excess is deposited in the top ¼ to ½ in. of the pavement, very effectively sealing off the remainder of the mix from air and water. Surface texture is unchanged, and the color is a little blacker than the usual fresh job of black top. It takes striping paint very well. Eventually, the color grays as on any job. That part of the seal undergoing contact with tires will in time disappear completely, but that which entered the voids, and is the only part important to this type of seal, cannot be reached by traffic and is protected to some degree from the sun. Its life and effectiveness will be long.

Some precautions

A few precautions should be observed. This method requires a mixing emulsion of relatively hard asphaltic cement base. It must be diluted with water to get the proper penetration and to avoid bridging the openings. Watering the pavement before the spread is not a substitute for dilution. A damp surface may be beneficial, but if voids are partly filled with water the surface is left too rich, and bridging occurs.

Within the limits specified, the rate of application should conform to the texture of the pavement. In extremely hot weather, it has been found advisable to very lightly dust the seal at cross walks or where traffic starts and stops at signals. The dust should not stick, and should not be applied until the emulsion is completely broken. Also, in very hot weather it is good to keep traffic off until the sun is low because the asphalt is tough and adhesive, and if pick-up does occur it will take not only the seal but may take part of the pavement with it. This is particularly true in the case of new pavements.

Properly applied, this method is characterized by excellent sealing and non-skid value, low cost, protection from raveling, no oil excess to cause pushing or bleeding, no dust nuisance, and no expense for cover and picking up the whip-off. The principal requisite for this type of seal is that the surface of the pavement to be treated must have the essential non-skid properties inherent in the pavement surface. This seal may be applied to either new asphaltic cement and plant-mix, or to old pavements in need of surface rejuvenation due to oxidation.

2—The second method is one used by the State of Washington to rehabilitate old surface treatments, road mixes or macadam penetrations, to level up the surface and improve riding qualities. The road-mix principle is used in this type of treatment called Mixed Seal or Leveling Treatment. It is generally used on secondary or lighter traffic highways. All mixing and processing is done with motor patrol blades; travel machines are not used.

Applying "Mixed Seal"

After all deep holes have been patched with previously prepared mixtures, approximately 0.3 gal. of MC-3 is applied to the surface to be treated and covered with ⅝-in. to 0 top course aggregate at the rate of 180 to 400 cu. yd. per mile of 20-ft. roadway, depending upon the depth of the depressions and irregularities to be leveled. Motor patrol blades next start mixing the aggregate back and forth across the roadway with the blade bit in contact with the oiled surface; the surface is "rubbed." Ordinarily one 6-in. bit will be worn completely down in one day's work. The friction causes the bit to smoke. In the opinion of Jack Stackhouse, bituminous engineer for the State of Washington, this is one of the most beneficial parts of this treatment, because this "rubbing" seals the cement into the surface of the existing bituminous mat in addition to removing many of the projections that cause roughness.

After the aggregate has been bladed several times, the partially mixed material is windrowed, and additional MC-3 is added where needed. The mixing is then continued by blading until a uniform mixture is obtained. The windrow is then spread over the roadway, and, depending on the amount of aggregate used, the depression only will be filled, or a complete covering of the roadway obtained. The roadway is then thoroughly rolled. If the mixture has a tendency to pick up under traffic, a light spread of ⅝-in. to 0, or ¼-in. to 0 material is made on the surface.

Where a minimum quantity of ⅝-in. to 0 aggregate is used in the mixture, the roadway surface will be "bald-headed" in places, and non-uniform in appearance. When 400 cu. yd. per mile or more aggregate is used, you have, in effect, a road-mix mat that produces a uniformly textured surface and will not require a seal coat for a number of years.

Summary

To summarize the things which must be considered in the construction of a good seal job, it is proper to restate the well-known, but often violated, good practice rules of seal coating:

1—Determine first of all if the surface needs a seal.

2—Plan the work for good warm weather.

3—Prepare your old surface with any needed patching, taking particular care to remove any loose or unstable areas, and replace with sound material. If there is any evidence of base failure, they should, of course, be repaired.

4—Have the surface clean.

5—Spread oil uniformly at the specified rate—and not far ahead of the rock.

6—Use clean, damp, dust-free rock.

7—Apply rock uniformly, and right behind the oil, at specified rate.

8—Roll adequately, but avoid over-rolling.

9—Exercise proper control over traffic until the bitumen is "set" and you are assured of good rock retention.

If all these nine steps are adhered to, there should be no cause for worry. The seal coat job will be a good one.

Presented at The Asphalt Institute Forum, Salem, Oregon, April 3, 1952.

Wyoming highway feuds with an oil well

ON CALIFORNIA'S more scenic highways, motorists have become accustomed to driving around, and even through, giant redwood trees. If a certain difficulty is not soon resolved, Wyoming motorists might have to accustom themselves to a highway divided by an oil well.

John Brorby had an oil well sitting in the center of the new Lance Creek cut-off road right-of-way. The contractor has another month's work ahead of him before he will be faced with the problem of building a road over, around, or without Brorby's oil well.

Brorby has been having trouble with drilling equipment in the one-year-old well, which is now down to a depth of 4,160 ft. Probably no trouble will result unless Brorby brings in the well, in which case he will not want to abandon the site.

After 12 years of floating on Lake Washington, what about the—

Pontoon bridge service record

Opened to traffic in July 1940, this unique concrete structure at Seattle proved an engineering success in spite of skepticism and paid for itself in nine years—Maintenance work has been at a minimum

By
HOMER M. HADLEY
Consulting Engineer
Seattle, Washington

ALMOST 12 YEARS have passed since the reinforced concrete pontoon bridge across Lake Washington at Seattle was opened to traffic, and to a success which few such projects have rivaled. Structurally the bridge has been a complete success, financially a complete success, and in respect to usefulness and service so great a success that morning and evening traffic now approaches the limits of its capacity.

Mercer Island, in Lake Washington, and the central east shore of the lake, formerly connected with Seattle only by ferries and by circuitous roads around the ends of this 20-mi. long lake, and therefore but lightly settled, were by this bridge brought into close and immediate contact with the very center of Seattle and have become populous areas covered with hundreds and thousands of new homes. Likewise this bridge and its easterly extending highway became an integral part of the principal east-west highway of the state, saving 14 mi. of distance over the former route between Seattle and Snoqualmie Pass. Its cost was moderate and its tolls were moderate. Under these conditions success was practically inevitable.

A dozen years ago, however, none of these now established facts and circumstances were definitely proven. On the contrary the basic premise of the project: that a sound and stable bridge made up of concrete barges interconnected end to end, whose decks constituted the roadway, could be floated and firmly anchored across a large body of deep water was openly doubted and scoffed at. Property owners at the Seattle end of the bridge, who quite misunderstood its character and appearance, feared it would destroy the value of their homes and fought the project bitterly. One of Seattle's principal newspapers actively supported it; another actively opposed it.

So sustained and vociferous was the opposition that finally the Washington Toll Bridge Authority was advised the PWA grant of nearly $4,000,000 would be withdrawn unless the Seattle City Council endorsed the project. This nine-member body had expressed no formal opinion concerning it up to that time and found itself divided four definitely for, four definitely against and with its ninth member of uncertain mind. After a period of suspense this ninth member finally favored the bridge and it was endorsed, by a 5 to 4 vote! It was by this scant margin that the project was saved and went forward to consummation.

Today no negative vote against the bridge could be found either in the Se-

ADMINISTRATION	
DESIGN	
CONSTRUCTION	
MAINTENANCE	X
MUNICIPAL	
BRIDGE	X

CREDIT for engineering projects must be allocated with caution, because many minds and ideas are usually active during the process of conception and design. However, in the case of the Lake Washington Pontoon Bridge, built by the Washington Toll Bridge Authority, the name of Homer Hadley is accepted by all as being identified more than any other with this unique project from the time the scheme was proposed until the twenty-five 4,558-ton concrete pontoons were cast, placed, anchored and connected to form the bridge. His comprehensive description of the project—both engineering and construction features — published in *Western Construction*, September 1939, remains the authoritative article on the subject.

After twelve years of service, the bridge and highway engineers of the West should have a report on the adequacy of this unique structure and the maintenance that has been required. *Western Construction* has asked Mr. Hadley to present a summary of its service record.—Editor.

PROVING THE STABILITY of the concrete-barge bridge, which has a flotation depth of 7½ ft., the structure is shown being buffeted by a 60-mph. wind. *Photo courtesy of Seattle P-I.*

attle City Council or outside of it. All opposition to it has vanished. Even before the construction was finished the opposition newspaper, with admirable magnanimity, declared itself wholly mistaken as to the nature, stability and appearance of the bridge and declared it would be an asset to Seattle. Such indeed it is, for apart from its great traffic usefulness the novelty of it—the fact that though built of reinforced concrete it is actually floating on the surface of the water and has no other support than the water—gives it very great interest to people, which a conventional type of bridge would have lacked entirely.

Few cities have such a dramatic approach as that presented to the motorist who rolls across the broad roadway of this bridge practically at water level, with the great snowy dome of Mt. Rainier to his left, the distant white of Mt. Baker to his right on the northern horizon, and with the steep hillside towards which he is advancing covered for miles in both directions with innumerable homes and gardens. The roadway leaves the lake, rises, divides and thrusts through the twin-tunneled hill and in but a few more minutes the motorist is in the business center of Seattle, with glimpses of Elliott Bay and Puget Sound to be seen at the cross streets.

What have the years proved?

What about the bridge, now that 12 yr. have passed? How has it stood up in service? What weaknesses, if any, have developed in it? If it were to be built over again—and a second bridge across the lake will be needed soon to carry the ever-increasing volume of traffic—what changes should be made to improve things? First of all it should be said that in all major and important respects it is a most satisfactory structure. Its anchorages have held firm and unyielding; the end-to-end interconnections of the individual units have proven completely satisfactory so that one passes from one section to another without the slightest intimation of the fact. The roadway is true and smooth and without defect. The pontoons are practically dry from shore to shore, and except for a few slight seepages from fine cracks in the special sections adjoining the ship-channel there has been no leakage through the outer shells of the pontoons. However, there has been a small and relatively insignificant amount of leakage at the sidewalk manholes which provide entrance into the cells. This leakage comes through or around the manhole covers, not through the concrete.

Concrete shows pre-eminence

Probably the most significant fact that has been demonstrated is the unique preeminence of concrete for pontoon bridge construction such as this. Similar pontoons could have been built of wood or of steel and with adequate maintenance would have served for many years. Neither, however, would have had the great stability in high winds and storm that concrete possesses, simply because they are of light weight rather than heavy weight. Here is a case where concrete's mass and heavy weight are an asset to it rather than a liability. For commercial uses in ships, concrete because of its weight is hopelessly inferior to steel; with equal dimensions and displacements, the steel ship can carry far more cargo than the concrete ship. But for use in a fixed location where moves are at long intervals of time or not at all, concrete may well prove itself superior to steel.

Here in the Lake Washington bridge, greater weight merely means greater stability. Even in the most severe storms and with spray whipping over the railings far across the roadway (see illustration) no movement can be felt in this bridge. It is as steady as a rock ledge. On its lee side the water is smooth and tranquil. On the windward side there is a curious agitation and vertical whipping motion which results from waves striking against the pontoons and being reflected backward and reversed. These reflected waves, meeting oncoming waves, toss themselves straight up into the air and are the source of supply for the wind-driven spray.

Quite numerous fine vertical cracks have developed in the sides of the pontoons, extending downward from roadway level and pinching out about water level. These are all small cracks, the largest usually occurring directly beneath the expansion joints in the solid railings. They result from the expansion and contraction of the roadway slab and the upper portions of the pontoons which are subject to all the temperature and moisture variations of sunlight and air, whereas the immersed lower portions of the pontoons are held at constant moisture content and at water temperatures which vary only a few degrees throughout the year. These cracks in the side walls, as stated, are small and are of no structural significance—nonetheless they do exist.

Cable control suitable

The level of Lake Washington waters is controlled at the locks in Salmon Bay where they outlet into Puget Sound. The extreme range is 3 to 4 ft. The design of the bridge made provision for tightening or slackening the anchor cables to adjust them to changing lake level. Actually for most of its length this has never proved necessary. The anchor cables are installed on a 1 in 3 slope and the anchors are 500 to 600 ft. out from the bridge. With such a length of cable there is considerable sag below the straight line connecting its terminal points. The result is that with the limited changes of lake level, adjustment is made by changes of cable sag and cable tension rather than by shifting the points of cable attachment within the pontoons. Only adjacent to the ship-channel opening where water depths are slight—50 to 60 ft.—is it necessary to slacken and tighten the cables to adjust to changes in lake level.

Normal maintenance is limited to these cable adjustments and to replacement of light bulbs from time to time as they require renewal. Shortly before tolls were removed certain submerged steel buoyancy tanks at the ship-channel opening and at the inshore ends of the pontoon construction were taken out, cleaned, repainted and replaced. Certain piles of the ship-channel fenders were also replaced at that time, and a complete new set of creosoted planks and pile tops were substituted for the original untreated wood construction. The above covers the maintenance that has been required.

Channel opening could be improved

The least satisfactory feature of the bridge is at the ship-channel opening. This 200-ft. opening is created by retracting longitudinally a special movable pontoon unit into a slip formed between two other special pontoons which flank the waterway or slip on either side. The lateral pontoons are connected to the sides of another special pontoon which in turn connects longitudinally with the endmost of the typical pontoons.

These lateral pontoons are themselves connected to one another at their outer ends by a submerged structural steel member which underlies the retractable pontoon. In plan there is formed an assembly resembling a tuning fork. Into the space between the legs of the tuning fork the retractable pontoon is drawn

... Concluded on page 166

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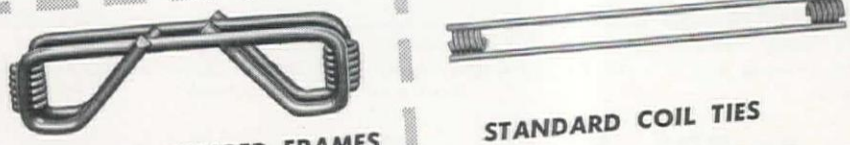
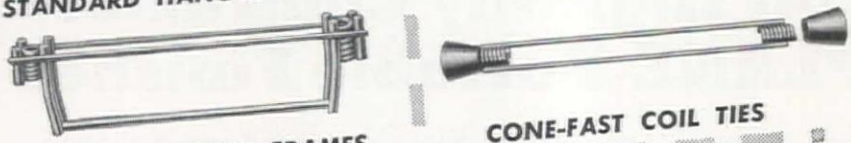


STANDARD HANGER FRAMES

STANDARD COIL TIES



SPECIAL HANGER FRAMES

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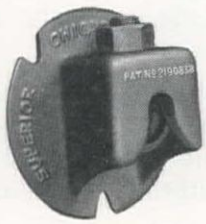
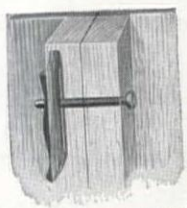
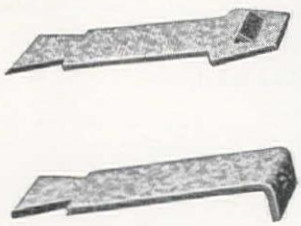
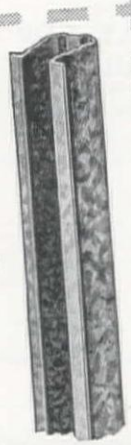


ROD CLAMPS

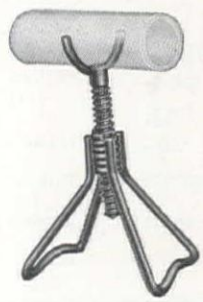


PANEL LOCK BOLTS

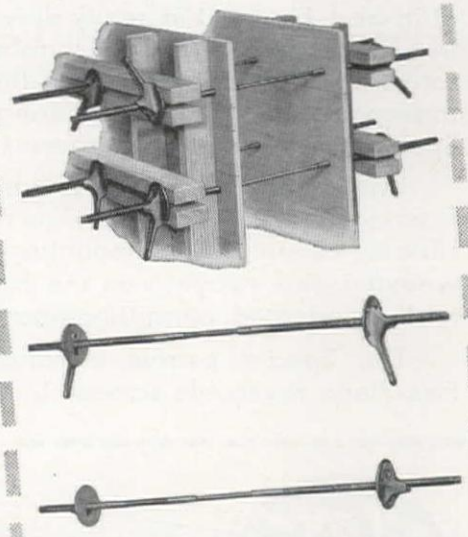




DOVETAIL ANCHORS AND SLOT



ADJUSTABLE SCREED CHAIRS



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Soil-cement streets in Truth or Consequences

Town with the new name in New Mexico lays first urban paving of this type in the state

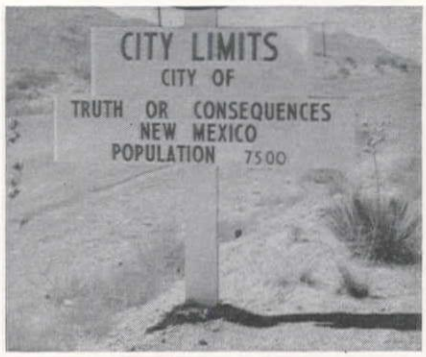
By F. H. BLACK
City Engineer
Truth or Consequences
New Mexico

ADMINISTRATION	
DESIGN	
CONSTRUCTION	X
MAINTENANCE	
MUNICIPAL	X
BRIDGE	

IN 1951, the town of Truth or Consequences, N. M., not only changed its name from Hot Springs, N. M., but it also used soil-cement on its first street improvement district. This district constituted the first urban soil-cement paving in New Mexico, and included some 13 blocks of approximately 20,000 sq. yd. Financing was by direct assessment against the property owners on a front foot basis. With the success obtained on the first district, the city council set up the second district, involving approximately the same yardage. This second district, like the first, will utilize the existing soil for a depth of 6 in. and the work is being carried out during 1952.

Soil-cement stabilization is not new to the engineering profession and its principles and methods have been described in *Western Construction* in articles published during past years.

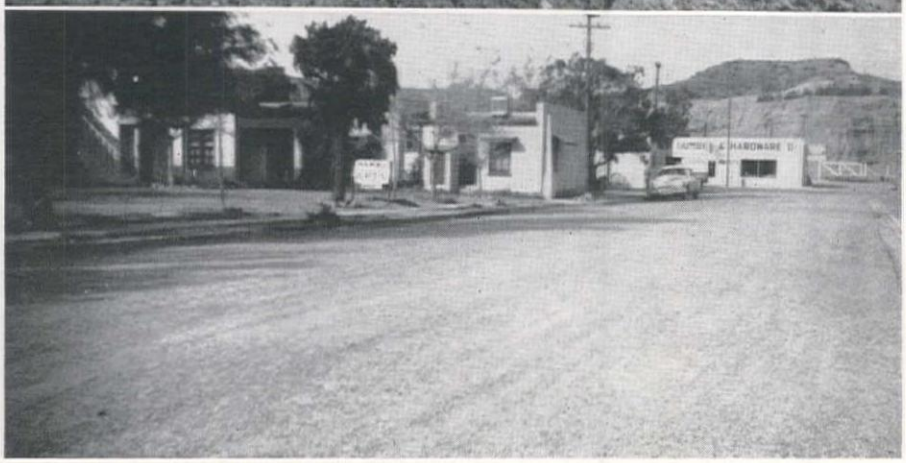
Engineering investigation of Truth or Consequences, prior to construction, showed that the streets to be paved required little excavation to meet the grade and crown desired. Adequate plans were completed showing the widths and grades required to meet drainage conditions. Soil-cement was chosen for this work because it would provide a low cost, durable paving which will require a minimum of maintenance. Adaptability of existing soil, eliminating necessity for excavation, helped lower the cost. The work was done by city forces using city equipment.



Samples of the existing soil were analyzed in a laboratory to determine the percentage of cement required to stabilize the existing soil. The stabilized material had to meet the ASTM specifications for 12 cycles of wetting and drying, and 12 cycles of freezing and thawing. An average of 8% cement was found to be adequate to meet these specifications.

TOP—Mixing 8% cement with 6-in. depth of pre-wetted soil, after the cement had been spread evenly over the street area. Water was added as required as mixing continued.

BOTTOM—Finished street represented a cost of 82 cents per sq. yd., including the bituminous wearing surface, but not curb and gutter. Processing, including water, cost 36 cents per sq. yd.



Processing procedure

With the above facts determined, curb and gutter work completed, and equipment released from other work, construction started in late July. A motor patrol was used to balance the dirt to obtain the desired grade and crown, after which soil-cement processing was undertaken in the steps listed below:

1. Scarifying and prewetting of the existing soil.
2. Spotting and spreading of portland cement and mixing with the prewetted soil.
3. Adding of water to obtain desired moisture content, and mixing further with the soil-cement.
4. Compacting the moist mixture with a sheepsfoot roller.
5. Shaping the surface to final grade and compacting the surface with pneumatic and steel rollers.
6. Placing of a protective bituminous cover to prevent surface evaporation of moisture. (This also served as a prime coat for wearing surface.)
7. Application of bituminous wearing course.

Construction details

The first operation involved scarifying the existing soil to a depth of 6 in. with a motor grader. Since the soil was largely sand and gravel some hand picking of the larger rocks was required to ease the following mixing operations. On the afternoon before the cement was to be spread enough water was added to the soil to bring the moisture content up to almost the desired percentage. This

prewetting had several advantages: (1) less water was required during mixing, giving speedier lay down; (2) lumps were softened, facilitating the mixing operations; and (3) less control of the amount of water was required the following day.

Bag cement was used and hauled to the streets on flat bed trucks. They were generally loaded the afternoon prior to construction and stored overnight so it would be readily available the following morning. The bags were spotted in rows both transversely and longitudinally at the rate of 0.36 bags per sq. yd., or 8 per cent cement by volume. The bags were then opened and dumped and then spread evenly over the loose soil with the motor patrol.

Mixing of the soil, cement and water was accomplished with a 6-ft. Seaman Pulvimixer pulled by tractor. The prewetted soil and cement were mixed first, then additional water was added in increments until an optimum moisture content was reached; and then mixed again. One 1,400-gal. gravity type water tank was used to apply the water. Compaction with a single drum sheepsfoot roller, followed immediately upon the completion of the moist mix.

As the sheepsfoot walked out of the moist mix it was removed and the street bladed to obtain the desired crown and grade. It was then rolled with a pneumatic tired roller, clipped with the motor patrol and rerolled with the pneumatic and steel rollers. As the surface moisture evaporated during sheepsfooting and finishing it was replenished by light application of water. The surface was then rolled until it was dense and tightly knit.

Upon completion of these operations on the street or streets worked any particular day the area was moistened and approximately 0.10 gal. per sq. yd. of MC-3 asphalt was applied to the surface. This cover application served two purposes: (1) a moisture retaining cover, and (2) a tack coat for the bituminous surface course which was applied later.

After all the soil-cement processing had been completed all of the streets were provided a bituminous wearing surface. This surface consisted of a double application of MC-3, using two sizes of aggregates; first minus ¾-in., followed by minus ⅜-in. chips, each being added after an application of the MC-3.

Cost and conclusion

Total cost of the work in the first district was $16,532, or $0.82 per sq. yd., exclusive of curb and gutter, but including the bituminous wearing surface, with equipment charged in at current AGC rates. The processing cost, including water, was $0.36 per sq. yd. The cement cost was $0.29 per sq. yd., and the double seal coat wearing surface, including aggregate, was $0.17 per sq. yd.

Original impetus for the development of a street program in Truth or Consequences was provided by Mayor T. B. Williams. Preliminary engineering work and recommendations were provided by Hatfield Engineering Co. of Albuquerque. The writer was responsible for engineering details and actual construction.

Here's a practical handbook on asphalt highway construction

A PRACTICAL HANDBOOK covering all phases of highway and street construction using asphaltic materials has been recently published by the Pacific Coast Division of The Asphalt Institute. Most important feature of the manual is its practical approach to all problems, from the consideration of foundation materials to seal coats and maintenance. The book is not a textbook of theory but a working manual for practical engineers and others concerned with asphaltic construction. Tables cover all phases of design, emphasizing its handbook style of treatment and its rule-of-thumb approach.

In the introduction the Institute states that "The manual shows methods of handling the engineering problems, varying upward from the most elemental compatible with satisfactory work at all, and pointing the engineer toward the methods used by the major departments insofar as he has the wish and opportunity to make use of such methods." The introduction goes on to state that the manual assumes the location of the road or street has been previously determined, surveys made and plans for earthwork and drainage completed. With these preliminaries completed, the manual takes over and provides solutions for base course requirements and the surfacing, including design and laying.

On the complex subject of soil classifications, the manual reduces the problem to simple terms and presents comparisons in the values determined by various acceptable methods. Having established this foundation value, the next section provides tabular information on selecting a base and wearing course for different classes of traffic.

From these basic values the chapters expand into more details relating to materials for the base course, their properties, testing and placing, and then concludes in the final half of the book with detailed but practical information on various types of asphaltic surfaces, their design and construction.

An outline of the principal sections in the table of contents follows:

CHAPTER 1—*General Design*
- a. Traffic Analysis and Roadway Widths
- b. Road Section Details
- c. Drainage

CHAPTER 2—*Design of Pavement Structure*
- a. Procedure
- b. Pavement Structure Design Details
- c. Selection of Base Materials
- d. Selection of Pavement Types, Final

CHAPTER 3—*Specifications*
- a. Practical Considerations
- b. Specification Writing—General and Special
- c. Construction Details

CHAPTER 4—*Construction Engineering*
- a. Engineering Policy
- b. General Plan of Operations
- c. Field Test Equipment
- d. Sampling
- e. Field Test Methods
- f. Desirable Tests to Be Made by Commercial Laboratories
- g. Inspection
- h. Composition of Asphaltic Paving Mixtures
- i. Mechanical Properties of Asphaltic Mixtures
- j. Desirable Characteristics of Pavement Mixtures
- k. Factors Governing Characteristics
- l. Control of Workability
- m. Control of Service Characteristics
- n. Design Steps for Paving Mixtures
- o. Design of Other Asphaltic Surfacings (Penetration Types)

CHAPTER 5—*Construction Methods*
- a. Production, Handling, Storage and Use of Materials
- b. Equipment
- c. Earthwork
- d. Erosion Control (During Construction)
- e. Subgrade
- f. Base Construction
- g. Penetration Surface Treatments
- h. Seal Coats and Surface Treatments
- i. Road Mix Construction
- j. Macadam
- k. Plant Mix Construction

The manual is published by the Pacific Coast Division of The Asphalt Institute, with headquarters in San Francisco. The Institute has branch offices in Los Angeles, Sacramento and Seattle.

Reno considers laws to control street openings

CHANGES and additions to Reno, Nevada, laws are under consideration which will better specify and permit enforcement of requirements for (1) making cuts in municipal pavements for utilities work and (2) maintaining sidewalks in both commercial and residential areas. Recommendations in regard to the present civic ordinance on street cutting include provision for the company concerned to pay for inspection of the work and provide maintenance of cut area for a subsequent period of two years.

The Reno subdivision ordinance may be augmented by a new provision which would require installation of sidewalks, curbs and gutters, and street pavement in subdivision areas considered by the city for annexation. Civic thought on the subject has been spurred by observations of an unsatisfactory degree of traffic safety existing in several newly incorporated subdivisions.

Closer control of sidewalk maintenance is also tentatively sought through the means of an ordinance spelling out property-owner responsibility and providing means of enforcement. The city code presently states such responsibility, but there is no ordinance empowering enforcement by the city.

DENVER, COLO.—At 9,400 ft. elevation and 10° temperature, construction of Denver's new 54" Ranch Creek line went forward with steel pipe joined by Dresser Couplings. The line carries water to the Moffat Tunnel to help provide for Denver's rapid growth.

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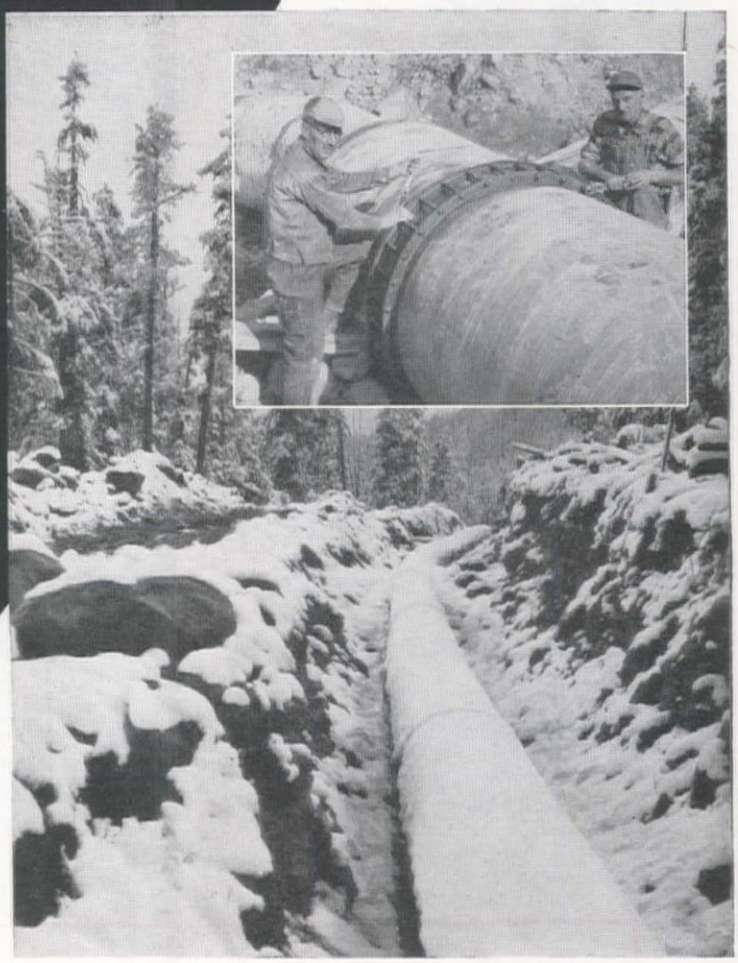

No matter if your problem is terrain . . . weather . . . labor . . . or time . . . the cheapest way to deliver water to the place where it turns into revenue is with a Dresser-Coupled steel line. It's the experienced engineer's way to get a superior line and still reduce *installation* and maintenance costs . . .

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Leakage losses are eliminated. *Controlled gasket pressure*, provided by the bolting up process in a Dresser Coupling, is your assurance of the correct *sealing* pressure all around the joint. Resilient Dresser gaskets absorb stresses from vibration, contraction and expansion, yet keep the joint "flexible-tight".

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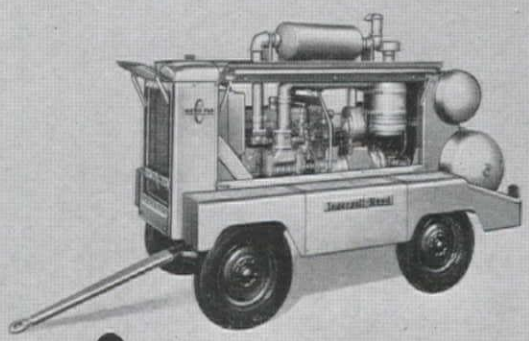

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- **Takes Full Advantage Of Modern Engine Speeds.** Compressor matched to nationally-known diesel or gasoline engines.

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Guard rails have a flare for safety

ADMINISTRATION	X
DESIGN	
CONSTRUCTION	
MAINTENANCE	X
MUNICIPAL	
BRIDGE	X

Bridge-end collisions reduced by installation of guard rails at desert wash crossings — Accident analysis techniques justify work by showing 55% reduction in frequency

By R. J. ISRAEL
Assistant Traffic Engineer
Division of Highways
State of California

INSTALLATION of flared guard railing at approach corners of substandard-width bridges on desert highways in California has been spectacularly justified by records maintained and analyzed on a before-and-after basis by the traffic department of the state Division of Highways. Treatment of 28 bridge-end locations in the period 1946-49 has been followed by a 55% reduction in the overall accident rate.

Traffic department studies are conducted constantly to evaluate effects of various highway engineering improvements. Sometimes the accident analyses indicate the form to be taken by future improvements. This article concerns a portion of U. S. Highway 60-70 in eastern Riverside County, where a great number of accidents had involved vehicles running into the ends of bridge railings, particularly where the railings were closer together than the out-to-out width of approach shoulders. Among the accident records available for study, many pertained to bridges that proved to be accident focal points because of rather special considerations, such as restricted sight distance coupled with narrow width. These "sore thumb" locations were not considered further in the study, but were left instead for individual treatment.

In any case, however, corrective measures are determined by analysis of the accident pattern. And what centered attention on the bridge-end problem in the desert was this pattern—but a collective one. Individually, these bridges were involved in an average of less than one accident per year. Collectively, there were so many of them, and they were so similar in nature, that they demanded study and treatment.

The desert portion of U. S. Highway 60-70 studies is all two-lane, generally straight, and level or only slightly rolling. Traffic is fairly uniform as to volume throughout, and the high percentage of through vehicles means that all structures carry substantially the same traffic. Speeds are high: there are no built-up areas or limited speed zones near any of the 28 bridges. Finally, all the bridges concerned are of the same design: timber trestle construction with timber curbs and railings. All of them have, within a few inches, the same roadway width—about 24½ ft.

Obtaining accident data

It had long been recognized that a relatively inexpensive method of reducing bridge-end accidents in both number and severity was intsallation of flared guard railing at the right-hand approach corner of the structure. Railings are set on a parabolic curve, with their length determined by the width of highway shoulder. For example, a 6-ft. offset between bridge curb and shoulder edge calls for a 90-ft. length of railing.

Accordingly, the Division of Highways had begun some time ago to install approach guard railings at the ends of bridges where the accident situation had proved critical. In 1948 it was made design policy to provide such railing on all new structures having widths less than the adjacent roadway and shoulders. The bridges under study had guard rails installed as follows: 11 in 1946, 8 in 1948, and 9 in 1949.

Before long it became apparent in a general way that there were fewer bridge-end accidents than before. The improvement in safety at some specific urban location might have been statistically evident, but it usually is not easy to present a clear collective picture of the effect of a single corrective device at a number of different locations. The reason is that individual locations vary widely in the physical conditions which are causative factors in their accident frequency. The accident analysts were fortunate in this case, however. Data were available on a substantial number of guard railing installations on like structures, all on a single highway route presenting homogeneous traffic conditions throughout. Because of this uniformity of physical and traffic conditions, it was feasible to combine accident data for all 28 bridges.

The period covered by the study extended from January 1, 1942, to July 1, 1951. This period included a factor which would tend to bias study results against the improvement. Specifically, the pre-guard rail period included the wartime years of gasoline rationing and a 35-mph. speed limit. It is true that traffic volumes were not materially reduced during the war on this important interstate route; but the smaller percentage of non-professional drivers and the reduction in overall speed should have combined to lower the accident rate. However, no effort was made in the study to adjust for this factor, the total period of record being used in order to increase the size of the statistical sample. All bridges were considered to have equal accident potential. The only weighting done was on the basis of actual traffic and the period of exposure; because of different construction dates, the "before" period ranged from 4 yr. to 7, and the "after" period accordingly.

Comparing safety records

During the years prior to installation of the guard rails, total traffic exposure on the group of bridges added up to 101,100,000 vehicles. The subsequent period, shorter in most cases, showed a total exposure of 50,000,000 vehicles. The actual number of reported accidents in the respective periods is shown in the following table:

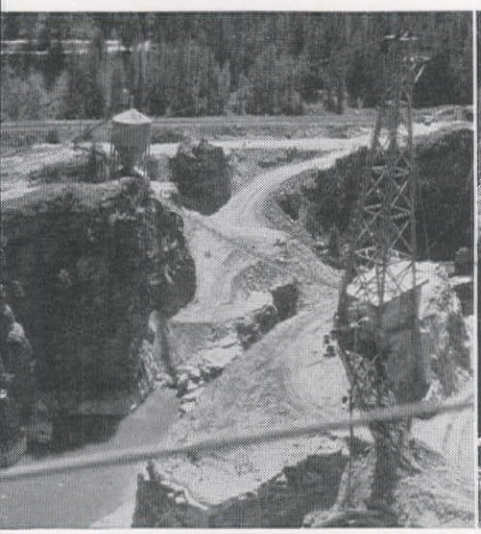
Accident type	*Period* Before	After
Fatal	7	1
Injury	31	5
Property damage	20	7

To place the comparison on a basis of equal exposure, it is necessary to divide by the number of vehicles involved in the respective periods. Thus, the overall

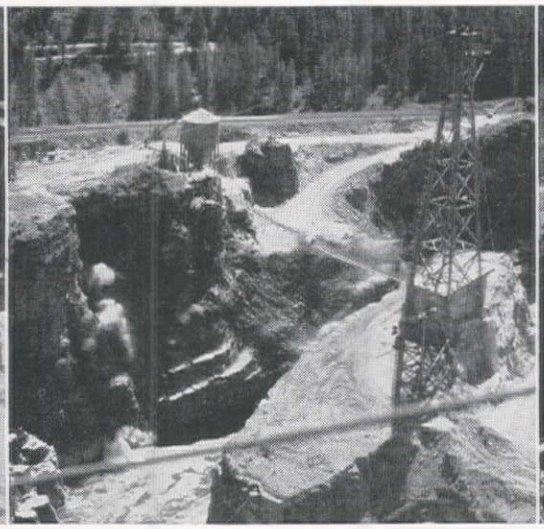
... Concluded on page 164

ENGINEERING WITH ATLAS EXPLOSIVES

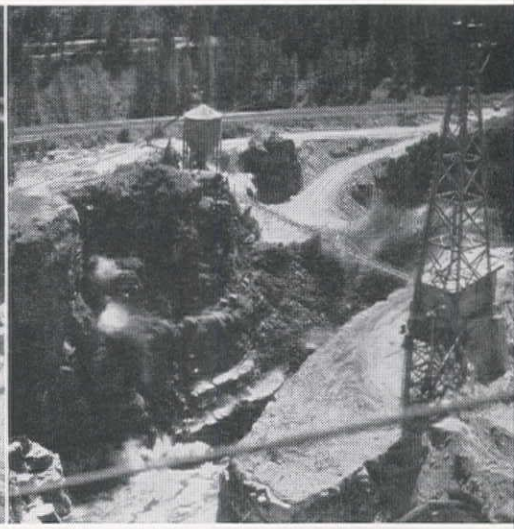
ONE ROCKMASTER® BLAST dams a river gorge



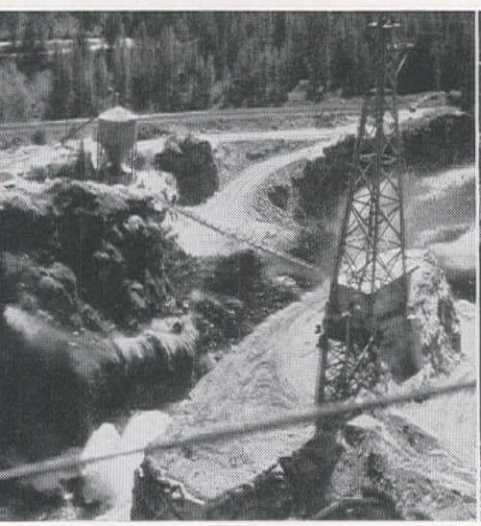
1. *The sheer walls of Cabinet Gorge in Idaho rise 350 feet above the swift Clark Fork River. Morrison-Knudsen Co., Inc. had to throw a cofferdam across waters 70 to 80 feet deep—too tough a job for truck dumping or sheet piling. So M-K used explosives.*



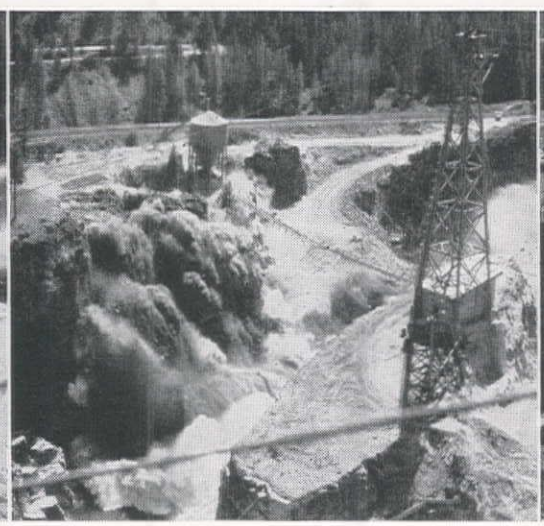
2. *The blast starts. Nearly 65,000 pounds of Atlas Flo-dyn #4 (40% free-flowing dynamite) were used.* ROCKMASTER *millisecond delay detonators Nos. 0 to 11 were used for accurate control of throw across the river.* ROCKMASTER *timing fired forward end first.*



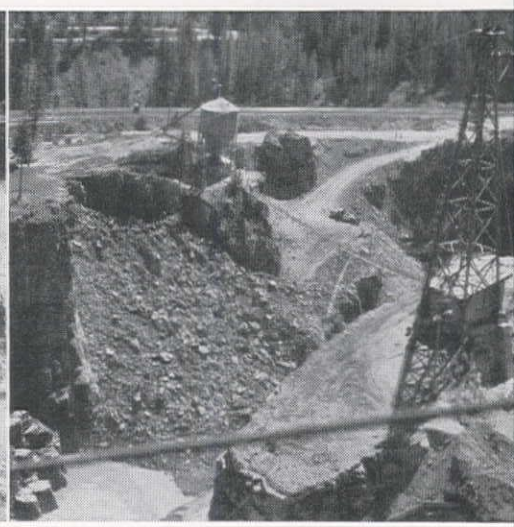
3. *The two lower benches move riverward —an example of how milli-second delay timing is used to throw rock to a designated spot. Vibration and overbreak were not factors in this blast, but note that the cement silo is undamaged and the footbridge remains up.*



4. *A second after detonation the front burst is over; bottom and top falling fast. This was a coyote-tunnel blast. But the multiple one-two punches of* ROCKMASTER *give the same control with well or wagon drill holes.*



5. *Water splashes high in displacement. Success was evident immediately after the blast when water started flowing through two tunnels prepared to divert stream. Atlas sales-technical men cooperated with Morrison-Knudsen.*



6. *Dust has settled. More than 90,000 cubic yards of rock, thrown directly across the stream as aimed, are ready for final grading and will serve as basis for further cofferdam installations.*

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Highway programs of Western States

A summary of construction planned for 1952

WASHINGTON

The Washington Department of Highways announces that 98 projects, totaling an estimated $42,391,000, will be advertised for bids during 1952. Thirty-three of these projects are included in the bond program for construction on U. S. 99 and total an estimated $18,205,000 of which $8,935,000 is for bridges and other structures. Included also in the bond program are the superstructure for a bridge across the Columbia River at Pasco, costing approximately $2,500,000, and grading on Snoqualmie Pass, costing an estimated $300,000.

Among the 63 projects to be advertised for bids and to be paid from normal motor vehicle funds are several involving an expenditure of a million or more dollars. Construction of the Battery Street subway in Seattle will cost an estimated $2,200,000, pier construction of the Duwamish River bridge in Seattle approximately $1,800,000, grading, paving and bridges from Fort Lewis to Ponder's Corner on U. S. 99 an estimated $1,100,000, and bridges and approaches over the Chehalis River connecting Aberdeen and Cosmopolis an estimated $2,900,000.

The Washington State Highway Commission definitely intends to advertise for bids on these projects in 1952 but there is a possibility that some may be postponed because of some unanticipated event beyond the control of the Commission.

A tabulation of the projects in this program estimated to cost more than $100,000 is presented on this page.

Major Projects on Washington's 1952 Highway Program

(Only jobs estimated to cost over $100,000 are listed)

Bond Issue Projects to be advertised this year

Primary State Highway No. 1

Section	*Character of Work*	*Est. Cost*
Vancouver Freeway:		
39th St. Undercrossing	R. C. bridge and appr.	$ 180,000
Broadway St. Undercrossing	Bridge	100,000
24th St. Undercrossing	R. C. bridge and appr.	160,000
14th St. Undercrossing	R. C. bridge	180,000
Interstate Br. to 5th St.	Grade, surface and pave.	380,000
18th St. Overcrossing	R. C. bridge	120,000
Salmon Cr. School to E. Fork of Lewis River	Grade, surface and pave.	2,000,000
Longview Wye Northerly	Grade, surface and pave.	300,000
Castle Rock to Toutle River	Pave	860,000
Toutle River to Foster Creek	Surface and pave	1,040,000
Jct. SSH 12-E Northerly	Grade and surface	890,000
Napavine-Chehalis Rd. North	Grade and surface	190,000
Laribee Rd.-N.P. Ry. Overcross.	Grade and surface	590,000
LaCamas Creek	R. C. bridge	210,000
Hamilton Rd. Overcrossing	R. C. bridge	160,000
Newaukum River	Twin R. C. bridges	300,000
Chehalis Western Ry. Overcrossing in Chehalis	R. C. bridge	185,000
N. P. Ry. Overcrossing south of Chehalis	Steel and R. C. bridge	530,000
Cowlitz River	Steel bridge and appr.	1,000,000
Lewis Co. Line to Maytown	Grade	2,600,000
Snohomish River	Steel and R. C. bridge and approaches	2,000,000
Union Slough	R. C. bridge	365,000
Steamboat Slough	Steel movable span bridge	900,000
Ebey Slough	Steel and R. C. bridge and approaches	1,375,000
4th St. Overcrossing in Marysville	R. C. overcrossing	100,000
4th St., Marysville to Steve Rd.	Grade	500,000
G. N. Ry. Undercrossing N. of Marysville	Steel R.R. undercrossing	300,000
Conway to Mt. Vernon	Grade	400,000

Primary State Highway No. 2

Scalehouse Easterly	Grade	300,000

Primary State Highway No. 3

Pasco to Kennewick	Steel bridge superstruc...	2,500,000

Other State Highway Projects

Hwy.	*Section*	*Character of Work*	*Est. Cost*
1	Battery St. Subway, Seattle	Vehicular subway	$2,200,000
1	Broadway Cutoff (exist'g)	Grade, surf. and pave	190,000
1	Broadway Cutoff (new)	Surface and pave	175,000
1-A	Big Lake to Canadian Line	Five bridges	210,000
2	Rainier Ave. in Seattle	Hwy.-Hwy. grade sep. and approaches	800,000
1-D	Columbia Beach Vicinity	Grade, surf. and oil	165,000
1-K	Duwamish River Bridge	Pier construction	1,800,000
1-A	Town of Sedro-Woolley	Grade, surf., pave and Ry. undercrossing	100,000
2	Monitor to Wenatchee River Bridge	Pave	120,000
10	Brewster East	Grade, surface and oil	170,000
10	East Wenatchee to Rock Island	Grade and surface	850,000
1	Fort Lewis Main Gate to Ponders	Grade, pave & bridges	1,000,000
14	Jct. PSH 14 and 21 to Pt. Orchard	Pave	137,000
9-A	Whiskey Cr., Salt Cr., and Dry Cr.	Grade, surf., and box culvert constr.	110,000
21-A	Agate Pass Br. to Winslow	Surface and pave	130,000
5	Nisqually Riv. Br. at Elbe	Steel bridge and apprs.	335,000
5	Kiona Creek to Randle	Grade, surf., and pave	550,000
8	Vancouver Easterly	Grade and pave	950,000
12	Stella to Longview Dyke	Grade, surf., and pave	200,000
12	Chinook to Megler	Riprap	215,000
13-A	Airport Road Connection	Grade, surf., and oil	215,000
3	9th St. in Walla Walla	Grade, surf., and pave	160,000
3	Dartford North	Grade, surf., & bridge	830,000
3-H	Rockford North	Grade, surf., and oil	180,000
6-A	Narcisse Creek to Tiger	Grade, surf., and oil	120,000
2	Issaquah to North Bend	Pave	350,000
15	Startup to Gold Bar	Grade, surf., and pave	150,000
1 A.N.	Skagit River at Mt. Vernon	Steel bridge and apprs.	1,200,000
1-B	Meridian St.-Bellingham and Bellingham City Limits N.	Asph. conc. resurf.	100,000
2	Wenatchee Riv. Br. to Miller St.	Grade, surf., and pave	160,000
9	Bogachiel Riv. to Hoh Riv.	Surface and oil	280,000
9-C	Pacific Beach South	Grade, surf., & bridges	270,000
13	Aberdeen to Cosmopolis	Steel and R. C. bridge and approaches	2,900,000
12-B	Naselle River	Grade, surface, oil and bridge	120,000
8	Centerville Jct.-Goldendale	Surface and pave	138,000
12	Deep River Easterly	Pave	98,000
8	Klickitat County Line N.	Grade, surf., and pave	225,000
3-A	Byron to Prosser	Grade and surface	495,000
3	Summit to Silcott	Oil	99,000
11	Paha West	Grade, surf., and pave	380,000
4-C	Hesseltine to Wilbur	Grade, surface, pave and bridges	630,000
3	Spokane East	Grade, surface, pave and bridges	500,000

COLORADO

With due regard to the need for qualification by numerous "ifs," the Colorado Department of Highways is striving for its greatest construction year in 1952, according to Chief Engineer Mark U. Watrous. Colorado operates on a calendar year basis, and will continue to do so until July 1, 1953. Its 1952 construction budget amounts to $20,561,790.00, the highest on record. This is broken down as follows:

Classification	*Projects*	*Est. Cost*
F-A Primary	34	$8,261,374
F-A Secondary	43	3,605,883
Urban Projects	5	2,626,933
State Projects	69	6,067,600

Largest projects

Largest item is $1,570,000 for the Denver Valley Highway, an urban project. Largest primary project is $874,000 for a new road between Monument and Colorado Springs. Next is $815,000 to extend the Valley Highway northward to intersection with Lafayette road. The sum of $800,000 has been provided for grading and structures on improvement of U. S. 85 between Adams City and Brighton.

Largest secondary projects are $200,000 each for grading and oiling on State Highway 96 from Pueblo west; grading, structures and oiling on State Highway 135 between Gunnison and Crested Butte, and grading, structures and surfacing on State Highway 145 between Placerville and Telluride. Largest state projects are $243,000 for a grade separation on U. S. 87 where it connects with the Denver-Boulder Turnpike; $250,000 on U. S. 40 between Muddy Pass and Walden, stabilization and oiling; and $250,000 for grading and oiling U. S. 40 from Artesia east. The sum of $2,000,800 has been appropriated for the oiling program by state forces; the maintenance appropriation is $3,085,000.

Colorado this year has awarded contracts or advertised for bids to be opened in April, on projects totaling $6,500,000. Bids were asked on at least another $1,000,000 worth of projects in May. A typical job, grading and structures on 8 miles of U. S. 85-87 between Castle Rock and Larkspur, was awarded on Jan. 11, 1952. Total cost is $556,000. This project will provide a new highway with 24-foot pavement running parallel to the existing road to form a four-lane highway. On April 30, bids were opened on a project for concrete paving on this same project. Estimated total cost of the pavement is $555,000.

Mostly plant-mix

The 29 projects under contract or advertised, cover 128 mi. and consist principally of projects combining grading, structures and oil paving. The Department is tending more to plant mix oil jobs than to road mix.

The 1952 program is unusual because of the work being done on defense access roads. Colorado is engaged in improving 162 mi. of trunk roads and 151 mi. of

Continued on page 98

CALIFORNIA

A total of $122,700,000 has been allocated in the 1952-53 state highway budget for the construction of state highways. Of this amount, $10,471,000 worth of work was under way, or had been awarded, as of last month. Another $13,213,000 worth had been advertised.

The major construction projects amount to in excess of $80,000,000. The balance is allocated for acquisition of rights-of-way ($31,326,000), operation and maintenance of the San Francisco-Oakland Bay Bridge, minor improvements and betterments, contingencies, and engineering.

The early start on 1952-53 fiscal year projects is made possible by state law, which permits the Division of Highways to award contracts on and after April 1 for construction projects included in the fiscal year budget which begins on the following July 1. As of early May, there remained in the 1951-52 budget allotment a total of $11,320,000 for construction purposes. Projects totaling that amount and financed from that source will have been placed under contract by June 30, 1952.

The accompanying table lists all construction work valued at over $500,000, in addition to some smaller projects which are nevertheless significant.

G. T. McCoy is State Highway Engineer in California.

Major projects in California highway budget for 1952-53 fiscal year

Route	*Description*	*Miles*	*Estimated Cost*
US 50	San Joaquin county line to 2 mi. E. of Redmond overhead, grade and structures	1.7	$ 586,000
US 40, 50	toll plaza to W. end of distribution structure in Oakland, surface	0.9	25,000
SR 17	Eastshore Freeway, Santa Clara County line to jct. with Route 5, grade and structures	2.8	1,240,000
SR 17	Eastshore Freeway, Fallon St. to Market St. in Oakland, grade, pave and structures	1.0	1,810,000
226	Bay Farm Island bridge in Alameda, approaches	0.6	250,000
US 99E	Oroville Wye to 20th St. in Chico, grade	16.5	835,000
US 40	through Rodeo, surface		80,000
US 50	through Placerville (portions), grade and structures	1.5	300,000
SR 180	4 mi. E. of Orange Cove Rd. to White Deer Rd., grade and surface, in Fresno County	7.0	910,000
US 101	Burns Freeway, Gannon Slough to 0.9 mi. N. of Arcata, grade, in Humboldt County	2.9	600,000
US 99	south city limits of Brawley to 1.1 mi. W. of Brawley, grade, surface and structures	2.0	440,000
US 99	Fort Tejon to Oak Glen, surface, Kern County	2.0	50,000
US 466	0.8 mi. E. of Mojave to 4.3 mi. E. of Mojave, grade and surface	3.5	150,000
US 101	Santa Ana Freeway, Vignes St. separation		400,000
166	Santa Ana Freeway, Lakewood Blvd. to Pioneer Blvd., grade, pave and structures	4.7	3,381,000
26	Ramona Freeway, Covina Hills Rd. to San Bernardino County line, structures	7.2	1,625,000
US 66 Alt.	Colorado Freeway, Patrician Way to Kensington Pl. (portions), grade, pave and structures	0.7	1,473,000
165	Harbor and Arroyo Seco freeways, Adobe St. to Washington Blvd. (portions), grade, pave and structures		5,160,000
167	Los Angeles River Freeway, 223rd St. to south jct. of Atlantic Ave., grade, pave and structures	4.6	3,305,000
SR 15	Atlantic Blvd., Anaheim-Telegraph Rd. to Garvey Ave. in Monterey Park, grade and surface	4.0	207,000
SR 14	Artesia Ave., Alameda St. to Downey Ave. (portions), grade and surface	3.8	880,000
SR 14	Artesia Ave., Downey Ave. to Palo Verde Ave., grade and surface	2.7	360,000
US 99	5.2 mi. S. of Merced to Merced, surface	5.2	320,000
US 99	Gerard Ave. to Parson St., grade and surface frontage road, Merced County	0.2	50,000
US 99	Livingston to S. of Delhi, Merced River bridge		600,000
US 101	Chualar to Spence underpass, grade and surface, Monterey County	5.3	560,000
US 101	Salinas Freeway, Market St. to N. Main St., grade, pave and structures	1.6	1,130,000
US 40	Tennessee St. to Cordelia underpass (portions) surface, Napa and Solano counties	5.5	300,000
SR 55	Finley Ave. in Newport Beach to 20th St. in Costa Mesa, grade, pave and structures	2.3	700,000
SR 14	at Santa Ana River, bridge, Orange County		500,000

Continued on page 98

COLORADO continued

feeder roads in the uranium district in Southwestern Colorado. For this work there is an appropriation of $2,338,000 in federal access funds, augmented by $130,000 in state money. One project on the trunk road, State Highway 141, between Uravan and Naturita, has been advertised for bids. This project, covering 11 mi., is for grading, stabilization, structures, surfacing and road mix oiling, and is expected to cost approximately $640,000. Two additional projects were advertised late in April, totaling approximately $500,000 more.

Access projects

Another access project, from Pueblo eastward to the Pueblo Ordnance Depot, will cost approximately $3,000,000, of which some $900,000 will be state and federal funds. The remainder will be federal access funds, amounting to about $2,100,000. This first project on this work, $1,150,000 for grading, structures and plant mix, 9 mi. was advertised for bids last month.

A similar project which has not yet jelled concerns the new atomic plant now under construction west of Denver and southeast of Boulder. The Atomic Energy Commission has not yet appropriated funds for this work, nor has the Colorado Highway Commission, but early estimates indicate its cost will be approximately $1,000,000.

MONTANA

For 1952, it is contemplated that $12,000,000 worth of construction projects will be let to contract in Montana. The estimated construction awards are broken down as follows:

Primary System	$ 7,000,000
Secondary System	4,500,000
Urban System	500,000
	$12,000,000

In addition, it is estimated that the total maintenance budget will exceed $6,000,000. Of this sum, it is contemplated that $500,000 will be let to contract for crushing and stockpiling gravel.

Projects under consideration and including those ready for designated 1952 lettings are listed as follows:

PRIMARY SYSTEM

Grading, surfacing and plant mix oil

Summit=Glacier Park Station, 8.1 mi. on U. S. 2.

Surfacing and plant mix oil

Bonita=Nimrod, 5.4 mi. on U. S. 10.
Havre=East, 10.8 mi. on U. S. 2.

Grading, surfacing and road mix oil

Malta=West, 5.0 mi. on U. S. 2.
Broadus=Southeast, 10.0 mi. on U. S. 212.
Street in Fromberg, 1.2 mi. on U. S. 310.
Ravalli=South, 3.8 mi. on U. S. 10A.
Hamilton=North, 10.0 mi. on U. S. 93.
Shawmut=West, 8.3 mi. on State Highway 6.
Polson=Elmo, 10.0 mi. on U. S. 93.

Grade and surface

Miles City=East, 9.7 mi. on U. S. 10.

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CALIFORNIA continued

Route	*Description*	*Miles*	*Estimated Cost*
US 395	Route 64 to Nuevo Rd., grade and structures, Riverside County	4.3	850,000
SR 24	Sacramento River bridge (Isleton) and Steamboat Slough bridge, redeck bascule span		75,000
98	C St. in Sacramento to N. Sacramento Freeway near Swanston Rd., grade, pave and structures	2.3	2,280,000
US 101	at San Benito River, reconstruct bridge, San Benito County		160,000
US 66	Lytle Creek to west city limits of San Bernardino, grade and surface	0.3	35,000
US 70, 99	Ramona Freeway, Los Angeles County line to Archibald Ave., structures	7.2	2,135,000
US 91, 466	Barstow to Nevada state line (portions), surface shoulders	42.3	235,000
US 101	Balboa Ave. to Las Flores (portions), surface, San Diego County	6.0	150,000
US 101	Del Mar to Encinitas, widen, San Diego County	5.3	650,000
US 101	Oceanside Freeway, 2.2 mi. S. of Carlsbad to Camp Pendleton main entrance (portions), grade, surface and structs.	4.1	2,725,000
US 40, 50	Bayshore Freeway, 16th St. to 7th St. in San Francisco, grade, pave and structures		3,640,000
US 101 Bypass	Bayshore Freeway, Augusta St. in San Francisco to Santa Clara County line (portions), grade, pave and structures		5,500,000
US 50	Corral Hollow Rd. to Alameda County line, grade and structures, San Joaquin County	5.7	550,000
US 101	in San Luis Obispo, Marsh St. to San Luis Obispo Creek, grade, surface and structures	2.3	860,000
US 101	1 mi. S. of Templeton to 4th St. in Paso Robles, grade and surface	6.5	860,000
US 101	through Paso Robles, surface	2.7	190,000
US 101	El Camino Real, 24th Ave. to 41st Ave. in San Mateo, grade and surface	1.5	110,000
US 101 Bypass	Bayshore Freeway, Colma Creek to Broadway, surface, San Mateo County	5.2	310,000
US 101	Gaviota to Gaviota Gorge, grade, surface and structures, Santa Barbara County	3.1	1,300,000
SR 152	Pacheco Pass rd., Ferguson Rd. to 5 mi. E. of Gilroy (portions), surface	2.1	95,000
SR 17	Eastshore Freeway, Route 68 to Alameda County line, grade and structures	6.1	1,960,000
US 99	Dunsmuir to Big Canyon (portions), grade and surface, Siskiyou County	4.0	1,200,000
US 40	Carquinez Bridge at Vallejo Wye, surface	0.4	80,000
US 40	N. of Vacaville to Midway, surface, Solano County	2.7	150,000
SR 33	at Newman, Crows Landing, and S. of Westly, grade and surface, Stanislaus County	1.8	175,000
US 99	1 mi. No. of Pixley to 1 mi. S. of Tipton, grade and surface, Tulare County	4.8	700,000
US 99	Tulare Airport at Tagus, pave	8.0	1,250,000
US 101	Calleguas Rd. to Central Ave., Camarillo grade separation, Ventura County		600,000
US 40, 99W	West Sacramento Freeway, Yolo County to Tower Bridge (portions), grade and pave	4.1	1,150,000

IDAHO

Federal aid primary and federal aid secondary projects on Idaho highways amounting to $12,186,482 are under contracts or scheduled for 1952 including grading, draining and surfacing of roads and building of new bridges. The total represents $8,444,100 for federal aid primary and urban projects and $3,742,382 for federal aid secondary systems. In addition the FAS program for counties will total $2,602,700.

In approving the expenditure of funds to come from federal-aid and the state funds, the Highway Board of Directors emphasized that the overall program is not based on counties individually but on the greatest needs for Idaho as a whole. Approximately 97 mi. are scheduled for improvement.

Due to delays in negotiations in the obtaining of right of way, some of the projects may not begin this year.

The funds of $8,444,100 for the federal aid primary and urban projects include $1,416,850 to complete projects under contract and $7,027,250 for new construction. Federal aid funds account for $4,917,500 and state funds total $3,526,000. On the secondary system, the funds of $3,742,382 include $3,053,800 for new construction and $688,582 to complete projects under contracts. Federal aid funds account for $2,206,812, and state funds total $1,535,570.

In assigning the various projects for 1952, the Highway Department is taking into consideration the sufficiency rating

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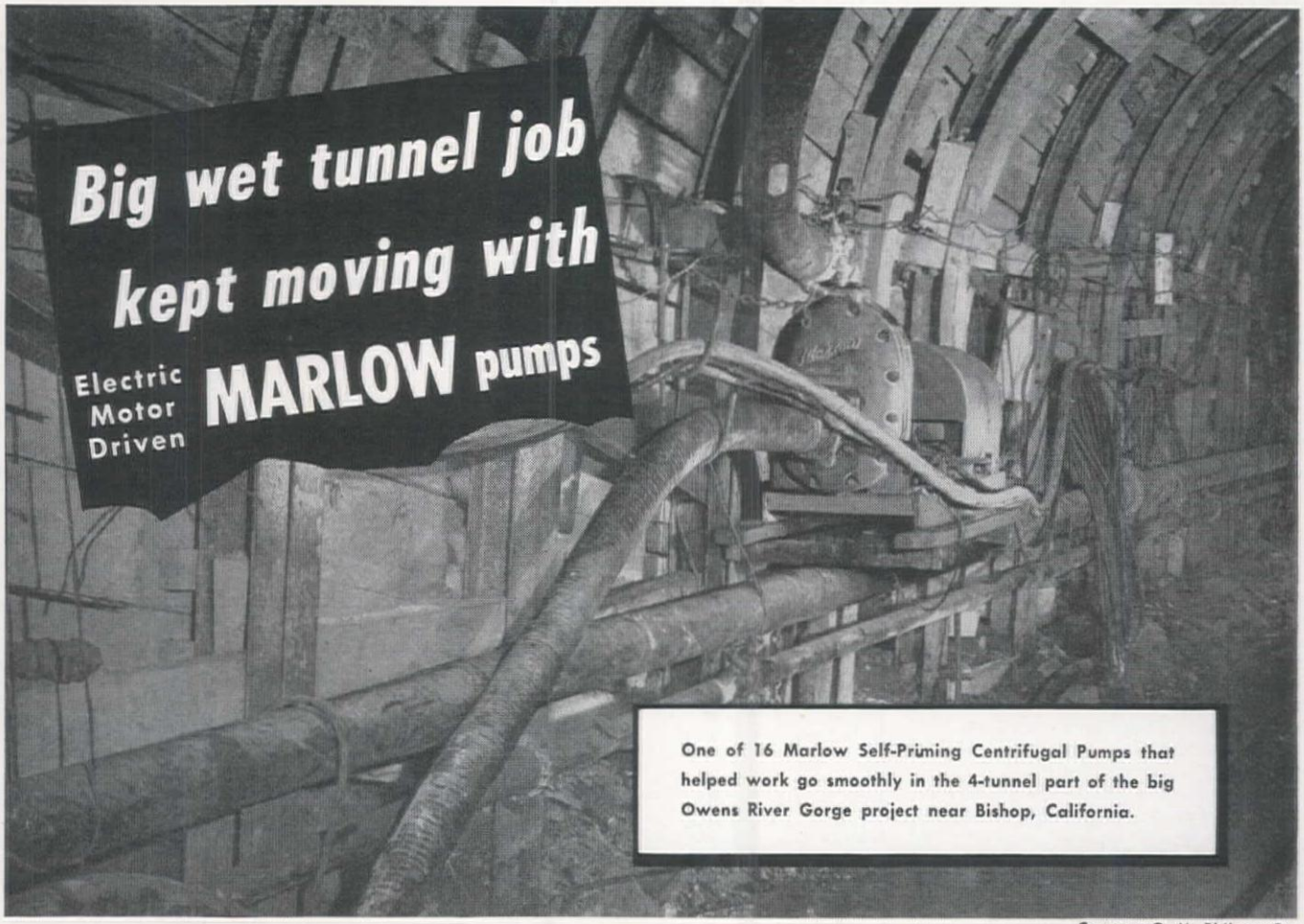

One of 16 Marlow Self-Priming Centrifugal Pumps that helped work go smoothly in the 4-tunnel part of the big Owens River Gorge project near Bishop, California.

Courtesy G. M. Philpott Co.

Marlow electric motor driven Self-Priming Centrifugal Pumps — 16 of them — were used by Owens Tunnel Contractors to help keep water out of the way during tunneling on the Owens River Gorge project. The four tunnels varied in length from 1/3 mile to 7 miles . . . long hard digging. Two of the tunnels were very wet but the Marlows took the flood of water in stride. With the water under control, pouring of the 10½ foot diameter concrete tunnel lining moved along on schedule . . . another success to which Marlow pumps contributed heavily.

Electric motor driven Marlow pumps are used more and more by contractors. Where electric power is available, they offer big advantages in automatic operation and lower operating costs. Electric motor or gasoline engine powered — Marlow Self-Priming Centrifugal Pumps have always been able to do more than any other pumps. The astounding new Marlows are *the greatest contractors' pumps ever built*. They prime faster and higher. They handle more water at lower cost. They are non-clogging, maintenance-free and last longer than any others. And the Marlow selection is largest — models in all AGC ratings, 4M through 240M, 1½" to 10" — plus many other models for special use.

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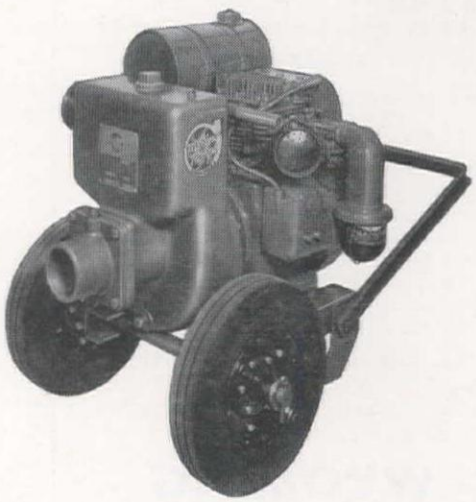

A Marlow is the only self-priming centrifugal made with a REPLACEABLE IMPELLER AND DIFFUSER. After long, hard use, they can be easily and inexpensively replaced with new ones to restore the pump to *full original efficiency*. A patented Marlow feature.

MARLOW PUMPS

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Manufacturers of the World's Largest Line of Contractors' Pumps Including the Famous Marlow Mud Hogs

MONTANA continued

Twin Bridges=West, 10.3 mi. on State Highway 41.
Sidney=Circle, 13 mi. on State Highway 23.

Structures and miscellaneous

Steel & concrete bridge & overpass over Yellowstone River on U. S. 89 in Park County.
Steel & concrete bridge over Swan River at Big Fork in Flathead county.
Steel & concrete overpass near Miles City on U. S. 10 in Custer county.
Repairs and portland concrete pavement on Glasgow underpass, 0.2 mi. on State Highway 24 in Valley county.
Treated timber bridges on Glasgow=East on U. S. 2 in Valley county.
Treated timber bridges on Sidney=South on State Highway 14 in Richland and Dawson counties.

SECONDARY SYSTEM

Grading, surfacing and road mix oil

Stanford=North, 16.6 mi. on Route 230.
St. Xavier=South, 5.4 mi. on Route 313.
Wolf Point=North, 26.2 mi. on Route 250.
Kevin=West, 6.0 mi. on Route 215.
Perma=North, 6.1 mi. on Route 382.
Bozeman=West, 3.2 mi. on Route 289.
Belgrade=South, 7.8 mi. on Route 291.
Wyola=West, 10.5 mi. on Route 418.
Nissler=Southwest, 1.4 mi. on Route 423.
Dutton=West, 18.0 mi. on Route 221.
Fort Benton=North, 4.1 mi. on Routes 230 and 223 in Chouteau county.
Lavina=South, 12.7 mi. on Route 301 in Golden Valley and Yellowstone counties.

Seal and cover

Valier=East, 14.7 mi. on Route 216.

Grade and gravel surfacing

Garland=North, 9.0 mi. on Route 332.
Malta=South, 4.7 mi. on Route 364.
Red Lodge=Luther, 7.0 mi. on Route 307.

Gravel Surfacing

Alzada=Ekalaka, 12.2 mi. on Route 323.

Structures

Steel and concrete bridge on Shelby=South on Route 417 in Pondera and Toole counties.
Treated timber bridges on Whitehall=Southwest on Route 401 in Jefferson county.
Treated timber bridges on Hilger=North on Route 236 in Fergus county.
Treated timber bridges on Fairfield=West on Route 408 in Teton county.

Troy Carmichael is State Highway Engineer of Montana, and W. J. Leary is Assistant State Highway Engineer.

WYOMING

During 1951 the Wyoming Highway Department spent approximately $9,885,000 on construction work and it appears the 1952 program will approximately equal the 1951 expenditure. As in the past, Wyoming will again match and spend all of its Federal Aid appropriations—Primary, Secondary and Urban.

Several important projects are scheduled for the coming construction season. Already contracted is the first soil cement job undertaken on Wyoming highways. This is the Gillette-East project, 10 mi. long (U. S. 14) where a cement-stabilized base will be used instead of the conventional gravel base

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IDAHO continued

system, based on information obtainable at this time, pending completion of the Idaho Sufficiency Rating Study for the overall needs of the state.

In arriving at a sufficiency rating for any given section of road, three basic elements are considered: condition, service and safety. The three are given ratings of $35, 35 and 30, respectively as compared to an ideal sufficiency rating of 100.

The tabulation of the individual major construction projects indicates the location and type of work.

E. V. Miller is state highway engineer of Idaho.

Idaho Federal Aid Program for 1952

Primary and urban—FAS State System—FAS County System

Tabulation includes only projects larger than $100,000, but totals represent the aggregate of all projects

Primary and Urban Projects

Location	*Length*	*Type*	*Bridges*	*Total*
Cole School-Fairgrounds	1.75	G-D-B.M.	—	$ 475,000
Regina-Cleft	13.6	G-D-B.M.	1-42′ 1-26′	880,300
King Hill-West*	4.96	G-D-B.S.T.	—	442,850
Raft River-Fall Creek	8.462	G-D-B.M.	—	768,000
Bannock Creek-Hawthorne Ave.	8.45	G-D-B.M.	1-81′10″	630,600
Harer-Wyoming State Line	8.41	G-D-B.M.	—	591,000
Kimball Ave. Caldwell-West	1.48	G-D-B.M.	—	240,200
High Bridge-Lemhi	5.5	G-D-B.S.T.	1-50′ 1-50′	247,500
Idaho Falls Underpass*	.88	G-D-B.M.	—	180,200
Nevada State Line-North	7.5	G-D-B.M.	1-115′	461,800
Pine Creek-Smelterville	3.17	G-D-B.M.	—	263,000
Argentine-Wallace	1.38	G-D-B.M.	1-82′ 1-90′ 1-112′2″	430,500
St. Maries Br. and O.H. and Apprs.	.45	G-D-B.S.T.	1-410′6″	574,600
Lochsa Ranger Sta. Sect.	2.5	G-D	1-107′	255,500
Utah State Line-Malad	8.5	G-D	—	494,500
New construction				$7,027,250
To complete projects under contract				1,416,850
TOTAL 1952				$8,444,100

Secondary State System

Location	*Length*	*Type*	*Bridges*	*Total*
Cleveland Bridge and Apprs.	0.60	G-D-B.S.T.	1-300′	$ 107,000
Oxford-Red Rock*	9.03	G-D-B.M.	—	260,000
Buhl-Southerly	6.18	G-D-B.M.	—	183,000
Twin Falls-Hansen	8.60	G-D-B.M.	—	299,000
Middleton—West	4.13	G-D-B.M.	—	166,400
Greer Br. and Approaches	0.42	G-D-B.M.	1-363′	238,150
Top Greer Hill-Weippe	4.52	G-D-B.M.	—	245,150
Craigmont-Mohler*	7.51	G-D-B.M.	—	511,000
Ross Point-Rathdrum	6.64	G-D-B.M.	—	268,100
Vanderdassen School-East	4.80	G-D-B.M.	1-24′	160,200
Mt. Home-Bruneau*	9.10	G-D-B.M.	—	150,000
New construction				$3,053,800
To complete projects under contract				688,582
TOTAL 1952				$3,742,382

Secondary County System

Location	*Length*	*Type*	*Bridges*	*Total*
Georgetown-Nounan*	6.9	G-D-R	1-113′ Redeck	$ 100,000
Cub River Road	4.53	G-D-R	—	115,000
Samaria Road	5.0	G-D-B.M.	—	100,000
Grandview Valley*	5.26	G-D-B.M.	—	113,000
Dufort Road	9.02	G-D-R	1-114′6″	240,000
Conner Creek Jct.-Almo	16.50	G-D-R	—	300,000
Selle Road	5.00	G-D-R	—	125,000
Parker South-Madison Co. Line	4.00	G-D-B.M.	1-160′	110,000
Highway 51 Jct.-Strike Dam	6.5	G-D-R	—	120,000
Givens Hot Springs-Walters Ferry	8.0	G-D-R	—	160,000
New construction				$2,083,000
To complete projects under contract				519,700
TOTAL 1952				$2,602,700

G = Grading
D = Draining
B.S.T. = Bit. Surf. Tr.
B.M. = Bit. Mix.
R = Rock Surface
* Contract awarded before April 20.

WYOMING continued

course. Because of the scarcity of gravel in the Gillette area, it was found that the use of soil cement would be more economical than gravel hauled in from surrounding areas. Although the bid prices showed an approximate $100,000 increase in cost for soil cement as compared to an estimated normal 3-mi. gravel haul, the price was approximately $200,000 cheaper than that bid for gravel under the actual conditions which required a haul of about 100 mi. Another 7.3 mi. connecting to the east end of this job is to be constructed this year.

Laramie to Cheyenne

A 4.6-mi. project in Telephone Canyon between Cheyenne and Laramie (U. S. 30) will be built in 1952. This job will complete a long range re-location program for the important Cheyenne-Laramie route. The old highway ascending from Laramie to Summit (highest point on U. S. 30 from coast to coast) is a slow twisting route which has been made even more troublesome in recent years by the huge increase in heavy truck traffic. The new design calls for an additional uphill lane for use by trucks and slow moving vehicles. This lane will be designed for heavier loading than the regular traffic lanes.

A 4.5 mi. grading project on U. S. 30 between Green River and Rock Springs will initiate a complete re-location of this 15-mi. stretch. The new road will be constructed to one side of the right-of-way centerline thus providing for possible future addition of two more traffic lanes. This policy will be carried out on all future projects where anticipated future traffic may require four lane or divided highways.

First in Cheyenne

Bids were opened April 18 for the first urban project in the City of Cheyenne. This will be the construction of a much needed separation over the Union Pacific Railroad tracks on Dunn Avenue in the eastern part of Cheyenne. The present overhead structure connecting south Cheyenne with the main business district is one of the heaviest travelled two lane structures in the country and the need for another connecting facility has been under consideration for some time.

One other overhead structure is scheduled for immediate contract. This will be over the Union Pacific Railroad east of Cheyenne and is necesary to complete the connection of a four lane highway already under construction with the high type construction recently completed from Pine Bluffs west to this point. Plant mix surfacing on this four lane project will be included in this contract.

Totals

Present program include 41.2 mi. of work on the Interstate System and 39.6 mi. on the Primary Federal Aid System. In addition, about $1,000,000 will be spent on state projects involving no Federal funds. Federal Aid Secondary program for the fiscal year of 1953 calls for an expenditure of $2,605,000 on 118.4 mi.

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OREGON

Construction work under contract by the Oregon State Highway Department at the beginning of the fiscal year will be about $33,000,000; total construction contracts to be let during the fiscal year is expected to run to about $30,500,000. The total amount expected to be paid out on construction projects during the fiscal year is $29,500,000, and expenditures on maintenance work during the fiscal year are expected to amount to a total of approximately $12,000,000.

The tabulation provides a listing of projects thus far programmed (authorized) for contracting during the fiscal year July 1, 1952, to June 30, 1953. Most of this work (all but about $1,000,000) is scheduled for contracting before the end of 1952. Projects below $40,000 of estimated cost are not included.

R. H. Baldock is state highway engineer of Oregon.

Oregon highway jobs to be awarded after June

(These construction projects were authorized as of April 15)

Paving is asphaltic concrete and oiling is penetration type

County	*Project and kind of work*	*Miles*	*Approximate Cost*
Baker	Pocahontas-Wingville Loop Road, resurf.	6.20	$ 150,000
Clackamas	Willamette River-Marion Co. Line, br., gr. and pav.	2.20	450,000
Clackamas	Willamette River Bridge, piers and approaches	—	875,000
Clatsop	Cannon Beach-Arcadia, paving	2.50	200,000
Coos	North Slough Bridge (Hauser-Coos Bay Section)	—	45,000
Coos	Bullards Bridge Section, bridge, grad., surf. and oil	1.03	715,000
Crook	FAS Highways 322 and 400, grad., surf. and oil	5.25	150,000
Douglas	Oakland Jct.-Deady, structure	—	215,000
Douglas	South Umpqua River-Fairgrounds, bridges, gr. and top	1.20	300,000
Douglas	Comstock Road Connections, structure, grad. and pav.	0.20	200,000
Douglas	Middle Unit, Reedsport-Dean Creek, gr., surf. and oil	2.14	304,000
Douglas	Anlauf-Elkhead Road, grading	7.36	1,100,000
Douglas	Calapooya Creek-Sutherlin Section, bridge	—	100,000
Grant	Mt. Vernon-John Day, grading and paving	6.23	311,000
Grant	Mt. Vernon-John Day Section, bridge	—	40,000
Hood River	Columbia River Bridge Approach Structure	—	46,000
Jackson	Medford-County Farm, grading and paving	5.36	605,000
Jackson	County Farm-Ashland, grading and paving	4.43	550,000
Jackson	Rock Point-Blackwell Hill, grading and paving	4.41	825,000
Lake	Lakeview Section, grading and paving	2.00	100,000
Lane	Low Pass Section, grading and paving	2.37	600,000
Lane	Springfield Section, grading and paving	2.18	335,000
Lane	Benton Co. Line-Cheshire, bridge, grading and paving	6.60	275,000
Lincoln	Fogarty Creek-Miner Creek, structures, gr. and pav.	7.10	1,600,000
Marion	Boones Rd., Pringle Cr., Battle Cr., structures	—	260,000
Marion	Center Street Bridge Approaches (Salem)	—	525,000
Multnomah	92nd Ave.-Fairview, structures	—	1,400,000
Multnomah	92nd Ave.-Fairview, grading and landscaping	7.30	800,000
Polk	West Approaches, Salem Bridge, grading and paving	1.00	145,000
Wasco	Shogren-Rowena, grading and paving	5.90	1,500,000
Washington	Boones Ferry Rd.-Willamette River, structures	—	370,000
Wheeler	Service Creek-Spray, grading and surfacing	1.90	45,000

NEVADA

Nevada's severe and prolonged winter did considerable damage to the state's road system, both on primary and secondary routes, and the extensive maintenance work necessary to rebuild or patch up these roads may have some influence on completion of the 1952 program by the end of the year. Differing, perhaps from other states which plan on a fiscal year basis, Nevada's construction program is on a calendar year basis. Due to interruptions of the recent winter damage, there has been little thought given to the 1953 program as yet. It has, however, now become quite certain that $1,830,000 of work budgeted for 1951 will be under contract this year; most of it was let during the fiscal quarter. Failure to place all of the 1951 work under contract during that year was due to loss of key engineering personnel to war industry and private industry, and inability to recruit competent replacements. Completion of the 1952 work, hampered by the same factors as well as by the weather, will depend upon availability of critical materials and upon the possibility of certain projects being declared non-essential. Major budgeted projects are tabulated below.

H. D. Mills is Nevada State Highway Engineer.

Tentative construction and maintenance budget for calendar year 1952

(In addition to those projects budgeted for 1951, but not as yet placed under contract)

Description	*Miles*	*Estimate of Cost*
U. S. 40, from 22 mi. to 40 mi. NE of Fernley, partial reconstruction, widen, plantmix surface	18.46	$500,000

Continued on page 104

JOB TAILORED CEMENTS

Portland Pozzolan

STANDARD PORTLAND

MODIFIED PORTLAND

HIGH EARLY

LOW HEAT

SULPHATE RESISTANT

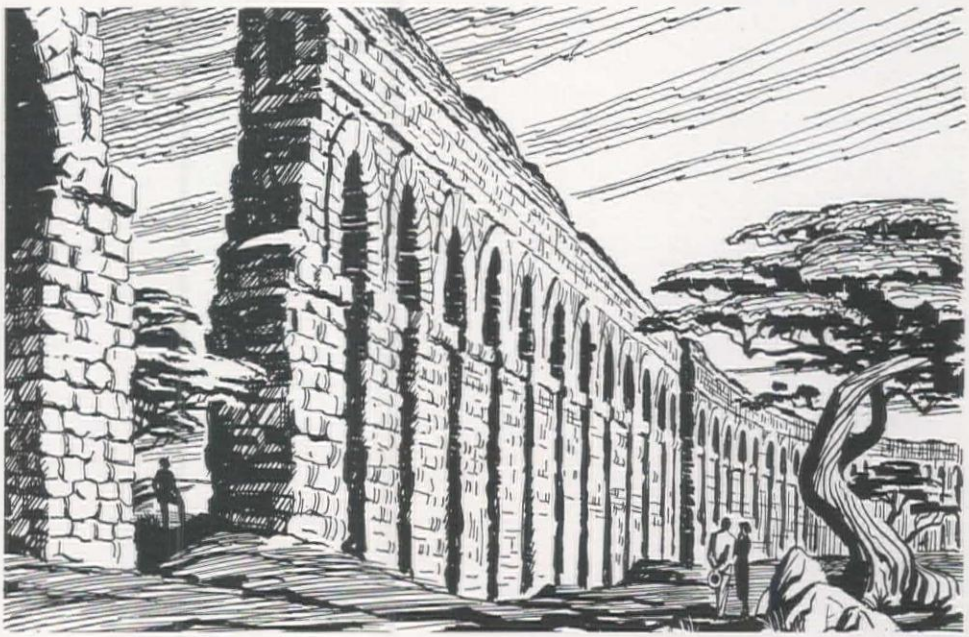
PRONTO

PORTLAND POZZOLAN

BRICK MIX

PLASTIC CEMENT

OIL WELL CEMENT



The Aqua Claudia, built between 38 and 52 A. D., is one of the many aqueducts built with pozzolan cement for the purpose of supplying water to Roman cities.

Still Standing After 2,000 Years

This old Roman aqueduct has survived twenty centuries of wars and weather. It remains a monument to the lasting qualities of pozzolan cement. The Romans found that by adding fine, reactive materials to lime they greatly improved its cementing qualities. They used volcanic ash from the town of Pozzuli—hence the name "Pozzolan." The permanence of their structures is characteristic of modern pozzolan cements.

PERMANENTE PORTLAND POZZOLAN cement is a modern counterpart of this time-tested cement of the Romans. It conforms to Federal Specification S-S-C-208a; producing a plastic, cohesive concrete that prevents the formation of rock pockets and honeycomb. It fills forms easily without segregation. It is ideal for pre-cast products and in other concrete structures where Standard Portland is used.

PERMANENTE CEMENT COMPANY

On the job - On time

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PERMANENTE, SANTA CLARA, YOSEMITE AND KAISER BRANDS OF PORTLAND CEMENT AND PERMANENTE LIME PRODUCTS

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WYOMING continued

of road. About 23 mi. is slated for grading; 65.1 mi. for grading and base course, 8.5 mi. for base course and oiling, and 21.0 mi. for oiling only. Seventeen of Wyoming's twenty-three counties are represented in this FAS program.

Farm-to-market funds

The last session of the Wyoming Legislature passed two laws providing for construction of farm-to-market roads. One provided for an additional levy of 1c per gal. of gasoline which was to be spent on country roads, the other earmarked 10% of the original 4c tax for the same purpose. Under both laws the revenue is set aside in a separate road fund in the state treasurer's office and when spent, must be matched on a 93%-7% by the counties. The county commissioners have the authority by law to direct where and how the money shall be spent. Actual road work must be contracted and supervised by the Wyoming Highway Department but maintenance of the road becomes the responsibility of the county upon completion. Construction expenditures under this program are anticipated to reach $1,500,000 during the coming year.

J. R. Bromley is superintendent of the Wyoming Highway Department.

ARIZONA

The Arizona highway program for the 1952-53 year is based on the following allocation of funds:

Anticipated state income for highway purposes	$13,000,000
Required for administration and maintenance	7,000,000
Balance for all construction	$ 6,000,000
Statewide seal coats	500,000
Balance for major construction	$ 5,500,000
*Anticipated Federal Aid	
*Primary	$ 3,500,000
*Secondary	2,500,000
*Urban	300,000
County and city matching funds	900,000
Total for major construction	$12,700,000

200 mi. of new roads

Information is not available on individual projects with respect to mileage and location, but on a basis of $60,000 per mile average cost, it would represent approximately 200 mi. of new construction.

If the steel situation approaches normal, the program will include some ten to fifteen major structures. Most of the major roadway construction would be 34 ft. and 40 ft. full-width, mixed bituminous surfaced projects. Statewide seal coat projects would represent a preservative program for approximately 250 mi. of existing pavement.

R. C. Perkins is state highway engineer of Arizona.

*Subject to Congressional appropriation.

NEVADA continued

F.A.S. 519, Portuguese Lane, grade, gravel, roadmix surface	2.0	80,000
U.S. 95, Las Vegas to Clark-Nye county line, widen, plantmix surface	52.55	660,000
F.A.S. 538, Spring Mountain to 10 mi. west, grade and gravel surface	10.00	200,000
Replace 2 bridges on S.R. 37, two bridges and approaches	1.0	80,000
U. S. 93, 10 mi. to 38 mi. N. of Wells, partial reconstruction, widen, roadmix surface	27.50	755,000
F.A.S. 578, Jiggs to South Fork Humboldt River, roadmix surface	15.04	70,000
F.A.S. 573, near Dinner Station to 7 mi. E. of Tuscarora, roadmix surface	17.65	80,000
F.A.S. 579, near Smither's Creek to E. side of Ruby Valley, grade and gravel surface	7.30	110,000
F.A.S. 592, Dyer to California state line, grade, gravel and roadmix surface	6.0	90,000
F.A.S. 602, Palisade to 6 mi. south, grade and gravel surface	6.0	170,000
F.A.S. 614, Denio to 14 mi. south, grade, gravel and roadmix surface	14.0	210,000
F.A.S. 623, 38 mi. N. of Austin to 20 mi. S. of Battle Mountain, widen and roadmix surface	28.23	225,000
U. S. 93, Pony Springs to 8 mi. south, reconstruct, roadmix surface	8.0	120,000
F.A.S. 636, Bristol Silver Mine road, additional gravel, roadmix surface	10.7	75,000
F.A.S. 639, Comet-Coalition road, roadmix surface	17.0	85,000
U. S. 93, bridge N. of Caliente, new bridge and approaches	0.2	40,000
F.A.S. 643, People's Market Road, grade, gravel, roadmix surface	1.0	25,000
F.A.S. 645 & 646, from Central north and west, grade, gravel, roadmix surf.	2.0	70,000
U. S. 95, U. S. Naval Ammunition Depot to 2 mi. W. of Kincaid, widen, plantmix surface	13.0	195,000
F.A.S. 662, Rhodes to 10 mi. southwest, grade, gravel	10.0	225,000
U. S. 95, Clark-Nye County line to Jct. A.E.C. Road, widen, plantmix surf.	5.18	65,000
U. S. 95, through Stonewall Pass, realign, reconstruct, roadmix surface	1.0	35,000
F.A.S. 538, through Pahrump Valley, grade, gravel, roadmix surface	14.0	210,000
F.A.S. 684, Winnie Lane, grade, gravel, roadmix surface	1.5	45,000
Access Road to Nevada-Massachusetts Tungsten Mine, grade, gravel, roadmix surface	7.82	145,000
F.A.S. 693 & 694, portions within Lovelock, grade, gravel, roadmix surface	1.0	75,000
U. S. 40, Reno to 1.5 mi. west, reconstruct, plantmix surface	1.5	225,000
U. S. 40, Vista to 6 mi. east, reconstruct, plantmix surface	6.0	750,000
F.A.S. 707, Boynton Lane, grade, gravel, roadmix surface	2.6	100,000
U. S. 6 & 93, East Ely to west foot Connor's Pass, reconstruct, roadmix surf.	20.0	540,000
F.A.S. 739, Jct. U. S. 6 to Cleve Creek, grade, gravel, roadmix surface	14.27	210,000
F.A.S. 739, Cleve Creek to Piermont Creek, roadmix surface	18.2	90,000
General & Specific Maintenance	3,769.57	1,864,500
Headquarters Administrative		10,000
Reserve Fund—Snow Removal—Flood Damage		100,000
Grand Total		$8,529,500

UTAH

In addition to recently increased expenditures from its maintenance funds, a result of spring flood damage in urban areas of Salt Lake City, the state of Utah has an ambitious construction program under way and outlined for the future. As of the end of April, a total of 234.6 mi. of Federal-aid construction projects, valued at $7,310,000, were in progress, the work involving both road and plant mix surfacing and structural activity on culverts and bridges. State projects under way at that time totaled 22.2 mi., and amounted to $812,000.

Lying ahead, for commencement of construction this season and next, is over $12,500,000 worth of work under various state and Federal programs. Their approximate mileages and amounts are as follows:

Classification	*Miles*	*Est. Cost*
Federal-aid Primary	28.2	$2,385,000
Federal-aid Secondary	137.2	3,352,000
Federal-aid Urban	7.2	1,500,000
Access (Federal)	180.0	1,158,000
State	105.1	3,943,000

Biggest concentration of work is scheduled for Salt Lake County, which alone accounts for 47.8 mi., and $3,163,000 of the work tabulated above.

E. G. Johnson is Chief Engineer of Utah's highway system.

Colorado has trouble in locating highway building

COLORADO State Highway Engineer Mark U. Watrous is discovering that there is more to a new state highway building than acquiring the funds. Perhaps such a structure should be built on wheels.

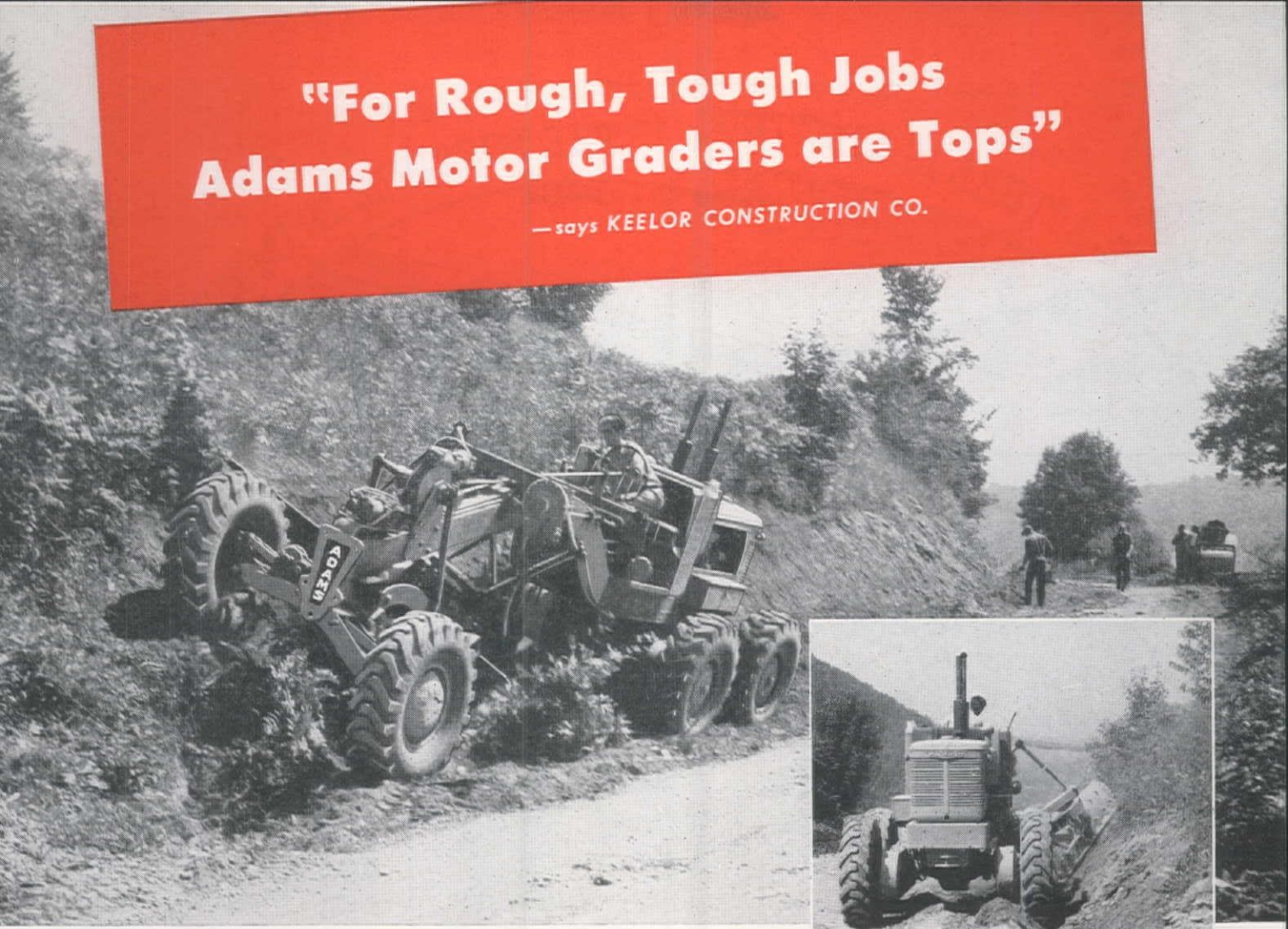
Since the department announced plans to build its new $2,500,000 building in Denver, Watrous has faced two waves of citizens' committees protesting each location selected. Last month it looked as though the building site was definitely going to be in South Denver, but the citizens of this "A" residence zone rose up in protest against the selection. They wondered why Watrous had not selected a site in one of the commercial zones selected by the Mayor's committee.

Watrous announced that since both of his proposed Denver locations seem to be in opposition to desires of the community, he is considering other cities as possible sites for the construction. Even this decision was not unchallenged. State legal minds consulted an old highway law which provided that the department be housed in a state building "in Denver."

Other groups in Colorado, meanwhile, were urging Watrous to locate the structure in their areas. He has had offers from Pueblo, Colorado Springs, and Boulder.

"For Rough, Tough Jobs Adams Motor Graders are Tops"

—says KEELOR CONSTRUCTION CO.



● On the job pictured above, a 100 hp. Adams Motor Grader is helping to grade, widen and resurface 8 miles of road in the rock area of Pennsylvania—than which there is none rougher or tougher.

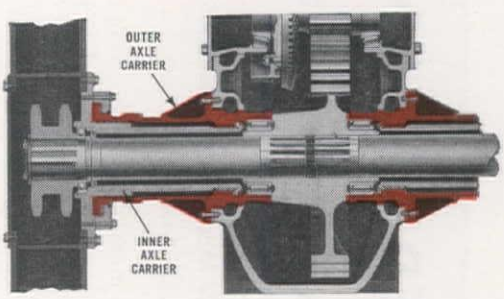
Keelor Construction Company, owner of this machine, says, "We consider Adams the best motor grader on the market, as evidenced by our recent purchase of another one of these big machines. Not only does its 100 hp. high-torque diesel engine have the lugging ability to handle roughest, toughest work, the whole machine has exceptional strength and stamina."

Performance like this is typical of all Adams Motor Graders, making them first choice of more and more contractors and highway officials. All models—from largest to smallest—offer such important advantages as *8 Overlapping Forward Speeds* • *High Arch Front Axle* • *Positive Mechanical Controls* • *Wide Range of Blade Adjustments* • and many others.

Ask your local Adams dealer to demonstrate how these great machines will step up operations and cut costs—*for you*!

J. D. ADAMS MANUFACTURING CO. • INDIANAPOLIS, INDIANA

ADAMS FULL-FLOATING REAR AXLE



In all Adams Motor Graders rear-end weight is borne entirely by heavy inner and outer axle carriers. The axle serves only to drive the machine—is not subject to the shocks and stresses that cause most axle failures in other graders.

See your local Adams dealer

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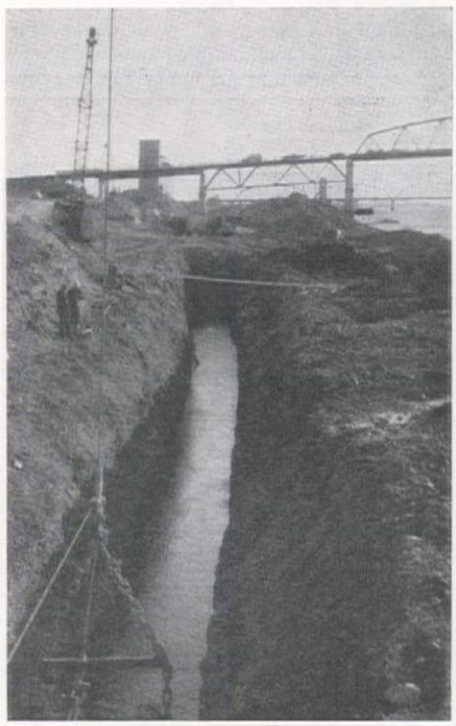
Digging a trench to keep water out

under Columbia River levees

A trench 60 ft. deep will be unwatered and stand unsupported to receive select backfill material — Impervious cutoff walls will protect river front lands against seepage as McNary reservoir raises river level upstream



AN ENGINEERING "FIRST" in the West is now being executed by Peter Kiewit Sons' Co. near Pasco, Washington, with excavation and backfilling of impervious sub-levee cutoff trenches ranging in depth to 60 ft. along about 6.3 mi. of Columbia River bank upstream from McNary Dam. The levees themselves (also being built under the same $1,467,865.50 contract) are a part of the overall system planned at Richland, Kennewick, and Pasco as a safeguard to these towns from floods on the Columbia, which will rise to new stages when McNary Dam is put into operation. Construction of the dam, near Umatilla, Oregon, will be sufficiently advanced by the spring of 1953 to permit storage in the reservoir to its normal pool elevation of 340 ft. This storage will back the Columbia River up some 62 mi., to the vicinity of Richland, Washington, and will fill the present channel approximately "bank full" near Pasco.

Below grade it's unique

While the actual levee system itself is in no way unique, its below-grade components are. Foundation material in the area consists generally of a very porous gravel, often of the "open work" type found in the Columbia River basin. If added control measures were not built in conjunction with the levees, seepage at all times (particularly during flood periods) would be enormous. The cost of construction and operation of pumping plants, over and above those already required for drainage of riparian lands behind the levees, would be prohibitive. Extensive field pumping tests and studies indicated that, for most reaches, an economical means of seepage control would be construction of impervious cutoffs down to the Ringold clay formation, lying at depths of 10 to 60 ft.

The work being done by Peter Kiewit Sons' Co. encompasses 4.3 mi. of left-bank levees near Pasco, all underlain by cutoff. Elsewhere, although no above-grade construction is necessary, the cutoff is being continued along some 2.0 mi. of relatively high riverbank to prevent seepage into a low-lying swale about a mile from the river. The contract was awarded last September and commenced the following month, with completion scheduled for March 1953.

Three ways to do it

Three options were presented the contractor for conduct of the cutoff construction. The first provided for a minimum trench width of 6 ft., with a moderately well-graded (3 in. to silt) backfill to be pushed into the trench in a semi-fluid state to prevent segregation. Such a technique would not entail unwatering the work area, and side slopes might be cut as steep as they would stand. The second option, providing for a minimum width of 3 ft., incorporated a more closely graded core material. Other provisions would be as above.

The third option, also for a 3-ft. minimum width of cutoff, provided for the use of a slurry to support the side slopes, thereby reducing excavation and backfill quantities. Backfill specifications for this option were the same as for the first, but would result in a more impervious cutoff because of the mixing with a slurry. The specified slurry would be similar to that used in oil-well drilling, and might be made of bentonite, a special clay, or similar material. Tests indicated that permeability of a cutoff so constructed (gravel and slurry) is but a fraction of 1% of the permeability of the same gravel without a slurry, and is considerably less than that of cutoffs represented in the other two options. However, it appeared that the probable additional cost of the slurry method could not be justified from the standpoint of further reduction in costs of pumping to protect the affected lands. The other options, to the extent that they lessened pumping requirements, did show a favorable cost comparison. Hence, the third option was advanced only against the possibility that the contractor could find a more economical method for its construction.

Peter Kiewit Sons' Co. chose the first option, that of a 6-ft. trench and a moderately graded backfill material. The choice was dictated by two conditions, (1) that Corps of Engineers tests had demonstrated that the gravels to be encountered would stand nearly vertical (for a sufficient time to complete the work) and (2) that a 6-ft. width gave greater scope in selection of equipment. Accordingly, the contractor is using a 5-cu. yd. Manitowoc dragline for excavating the deeper sections of cutoff trench, and a model 95 Northwest for the shallower sections.

Mixing and backfilling

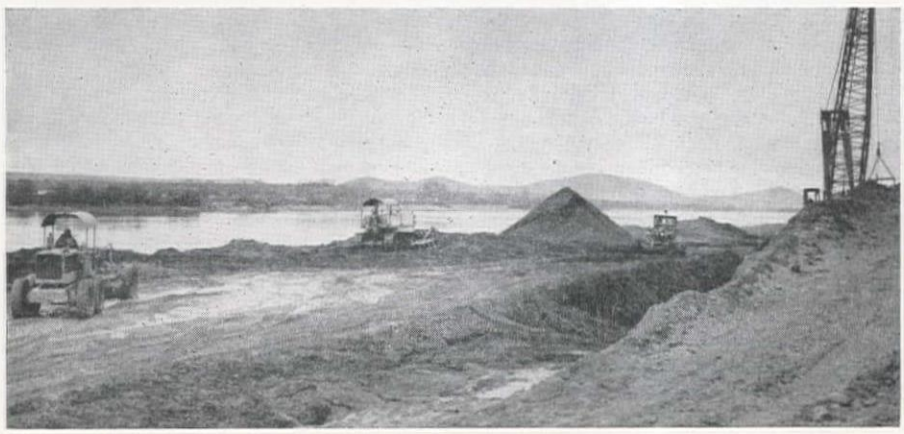
Spoil is cast well to one side and spread out for mixing with selected borrow material. Spreading is done by bulldozers, each layer topped by borrow before addition of a new spoil layer. The resulting stratified material is then thoroughly mixed by motor graders, with moisture added to effect the consistency of wet concrete. The windrowed material is then bulldozed back into the cutoff trench.

The mixing and backfilling is the key to timing of the operation. Since the open trench will not stand overly long without expensive overbreak and caving, only short lengths may be opened at a time. In fact, the dragline frequently must cease excavation until backfilling "catches up." Trying to stay only 100 ft. or so ahead of this backfilling, the dragline generally is digging very close to the toe of backfilled material in the trench as it slumps along the bottom.

To simplify excavation methods, the contractor has elected generally to keep

the trench unwatered in the short sections excavated. A 6-in. vertical dredge pump, fabricated by Pump, Pipe & Power Co. of Portland, is used, capable of pumping 1,500 gpm. against a head of 70 ft. (The trench averages about 35 ft. in depth, with 60 ft. as the maximum.) During the course of the work, volume of water pumped has remained about constant at 1,000 gpm., with occasional peaks as high as 2,500 gpm.

After placement of backfill, the completed cutoff is given at least 15 days in which to consolidate before construction begins on the levee proper. Near Pasco, a levee averaging 27 ft. in height is being built. Slopes are 2:1, and the material is mostly pit-run gravel, with a core of silt. Both bottom-dump Euclids and Caterpillar tractor-scraper combinations are being used in levee construction. As built, these levees will provide a freeboard of 5 ft. in rural areas and 8 ft. in urban areas, even under flow conditions equivalent to the 1894 flood, largest of record in this reach of the Columbia.



PROGRESS OF THE WORK

. . . is shown in three views at left, commencing (top) with excavation in the dry. Trench shown here is about 30 ft. deep. Note grading done previously to expose site. Two motor graders (center) work as a team to mix moistened backfill materials —trench spoil and selected borrow. Backfilling (bottom) follows closely behind excavation in order to minimize caving of unsupported trench.

Maintenance and use plans

These levees differ from usual Corps of Engineers flood protection works in that they will be maintained and operated by the Corps after completion as a part of the McNary Project. Most levees built by the Corps are local protection works sponsored by local interests for maintenance and operation. Special features have been used in design of the levees to provide for continued operation and expansion of ports for Kennewick and Pasco. Provision has also been made for frequent access over the levees to the reservoir for recreational and other purposes. A total of 12 automatic pumping plants are included in the combined levee system. These are primarily for removal of runoff and irrigation wastes from adjacent lands, but during periods of high reservoir level they will also handle seepage. The runoff and irrigation wastes are to be collected by an extensive system of ditches which lead generally to an interceptor ditch along the land side toe of the levee.

Decision to perform the current work was based on economic studies of the cost of purchase of the affected lands, as compared to the cost of levee construction for their protection. While the urban areas of Pasco, Kennewick, and Richland (and several adjacent rural areas) were found to warrant levee protection, it was found that purchase and abandonment of Wallula was indicated.

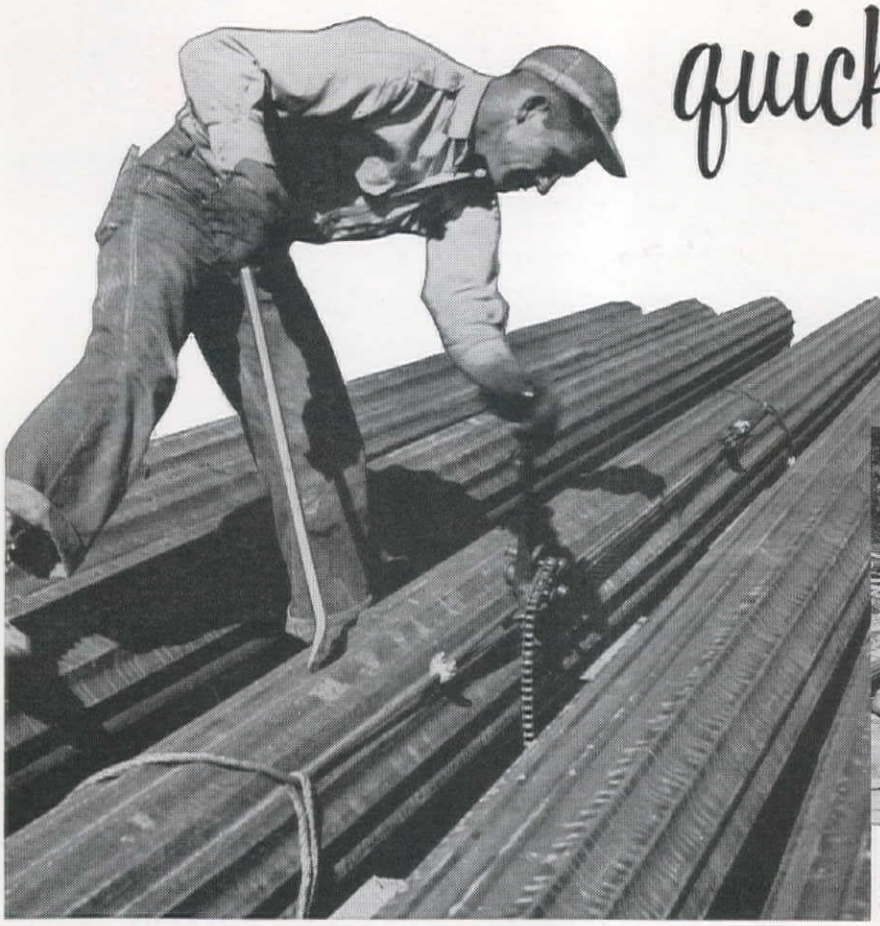
The work at Richland, 3.2 mi. in length, has been completed and is relatively minor, commensurate to the effect of McNary reservoir backwater conditions in that vicinity. The Kennewick work, on the right bank of the river, will be similar to that at Pasco, but will also entail raising several approach spans of the Pasco-Kennewick highway bridge over the Columbia. Contract for that work was awarded last spring to M. H. Hasler Construction Co. and D & H Construction Co. of Folsom, Calif., on a bid of $3,173,561.

Personnel

For the Walla Walla District, Corps of Engineers, project engineer at Pasco is George Schoch. Don Boots is superintendent and D. K. Rogers is job engineer for Peter Kiewit Sons' Co. Art Olson and Bill Cole are assistant superintendents in charge of the two shifts.

You can extend MONOTUBE PILES

quick and easy!

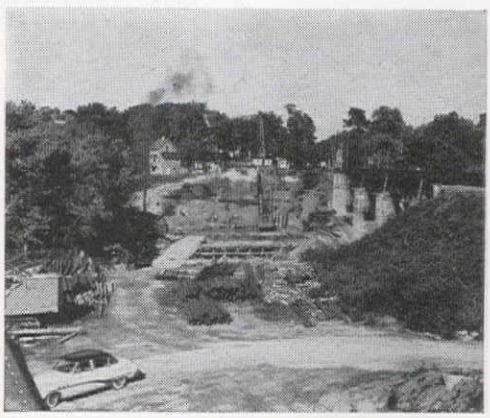


Above: Speedy nesting and welding operations on an assembly rack in the field. Tailoring piles to the required length, on the job, minimizes cut-off waste.

HERE, on a typical job, you can see the simplicity of extending Monotube piles in the field. In the photo above, a Monotube extension is being nested with a "come-along" and two cable chokers. On the same rack, as shown at right, a welder completes the job. The operation is fast . . . and sure!

There are many other Monotube advantages . . . cold-rolled strength for extra structural values . . . light weight for easier handling . . . speedier installation with light, mobile driving equipment . . . fast, easy inspection before concreting . . . simplified cut-offs with minimum waste . . . and a proven excellence in transmitting loads to penetrated soil.

Add up these important qualities and you'll see why taper-flute Monotubes are preferred by so many experience-wise engineers and contractors on foundation jobs of every description. For complete data write to The Union Metal Manufacturing Company, Canton 5, Ohio.



Overall view of foundation work for new bridge showing storage yard, pile assembly rack at left, and driving operation in background.

UNION METAL

Monotube Foundation Piles

Experts discuss the problems imposed by the—

"Jets" on airfield pavements

Symposium of military engineers and representatives of industry present the most comprehensive review to date of the effects of heat, blast and spillage at Port Hueneme meeting sponsored by the Navy and attended by 400

ATTENDANCE of more than 400 indicated the extreme interest of engineers in the problems of "Airfield Pavements for Jet Aircraft," which was the subject of a symposium sponsored by the U. S. Naval Civil Engineering Research and Evaluation Laboratory (NAVCERELAB) at Port Hueneme, Calif., on April 17 and 18. The speakers reported on all phases of the problem as it applies to existing fields, discussed the corrective measures now being used by Army, Air Force and Navy, looked into future aspects of the problem based on the planes of tomorrow, and expressed many divergent points of view on materials now commonly used for runway construction. Conclusions were rather general and not entirely in agreement, but the exchange of pertinent and valuable information represented a substantial advance in the attack on this problem which is of concern to all those engineers responsible for the design, construction and maintenance of airfields used by jet aircraft.

In general, the speakers considered the problem as ranging all the way from rather unimportant to definitely serious. Although it includes the factor of heavier wheel loads and higher tire pressures (greater pavement load intensity) the major part of all papers and discussions related to the effect of heat and blast from the jet engines. The temperature and force of the exhaust were not considered serious during the actual take-off down the paved strip, but during: (1) warm-up, (2) checking and (3) maintenance testing the time of exposure to the blast has caused problems to asphaltic pavements (flexible) and the joint material in portland cement concrete paving (rigid). These were reported, discussed and evaluated in every paper and discussion. A further problem was that of spillage of jet fuel and its softening effect on flexible pavements and joint compounds. Affected areas represent a small percentage of the airfield surfacing and if any consensus was apparent from the papers, it would be to provide a resistant type of pavement (or protective facing) on these areas where jets are fueled or warmed up. This would be the relatively easy program for the design of new fields, with the improvement of existing pavements a more difficult matter. Open graded and rough textured asphaltic surfacing was considered the most susceptible to heat and spillage damage. An expert's prediction of the jet engines of the next few years did not provide any assurance that the problem would not increase in size and intensity in the future.

Outlining the problem

Essentials of the problems were outlined by Cmdr. J. C. Luppens, Shore Establishments Divisions, Navy Bureau of Aeronautics, in a paper entitled "Effects of Jet Aircraft on Pavements." He told the group that jet planes have now been in use a sufficient length of time to permit paving requirements to be determined, and predicted that exhaust temperatures would not be much higher in future years, being fixed by basic principles of combustion. Damage to pavement by jets is limited to three distinct, but brief periods in their operation: (1) warm-up in parking area, (2) checking the engine before take-off and (3) testing engine during maintenance work, or installing of a new engine. Effect of the

CDR. J. C. LUPPENS

jet when the plane is moving is negligible. Speaking of the weight problem, Cmdr. Luppens said that jets have small size tires inflated to high pressure and are equipped with stiff shock absorbers. In landing they produce loads on runways which exceed static loads by enough to represent a separate problem of runway design, based on the unit loads at point of tire impact. Dusty runways may cause problems from dirt kicked up by one jet and drawn into the intake of the following plane during take-off. Among other specific problems he listed: (1) melting and removal of expansion joint fillers, (2) spillage of fuel and its effect on bituminous surfacing, (3) unusual build-up of heat during maintenance testing, and (4) erosion control at the end of runways.

"Air Force Requirements"

The following paper, presented by Lt. Col. Gayle L. Smith, U. S. Air Force, outlined the "Air Force Requirements" for paving for jet planes. He reminded the audience that prior to the development of jets the only engineering problem relating to runways was the gradual

LT. COL. GAYLE L. SMITH

increase in the weight of planes. This problem has never lessened (now approaching 400,000 lb. gross weight) but new factors of heat and force of blast have now been added. Giving specific figures on these new problems, Colonel Smith stated that temperatures at the tail pipe of jet engines range from 900-1,400 deg. F., dropping to 200-400 deg. about 50 ft. back. The corresponding velocity of this blast of hot gas varies from 1,800 ft. per sec. at the tail pipe to 300 ft. per sec. at a distance of 30 to 50 ft. away. This blast, and its force, can better be appreciated by the comparison of 300 ft. per sec. velocity to a wind of 204 mph. Effect of this heat and blast depends on: (1) time applied to an area, (2) height of tail pipe above pavement and (3) angle of impingement of the jet.

Reporting on the damage resulting from spillage of jet fuel, he stated that the Air Force was at first rather skeptical of this damage, but now was aware of the problem. Original fuel was prac-

tically kerosene, which did not evaporate fast and the softening action on bituminous pavement was relatively long and serious. The newer fuels evaporate faster and the damage per unit of spilled fuel is less. Planes equipped for the use of rockets in take-off introduce a further problem of a corrosive (acid) fuel that is hard on portland cement concrete surfaces and steel matting which might be used for emergency, advance fields. He emphasized the need for "good housekeeping" in the operation and maintenance of jet planes.

A comment by C. T. Rhodes of the Twelfth Naval District indicated that problems from fuel spillage were relatively minor, but injury to bituminous surfaces from blasts was serious.

Study by the Army

Beginning the afternoon session, C. R. Foster, chief, Flexible Pavement Branch, Waterways Experiment Station, Corps of Engineers, outlined the program of study being carried forward by the Army. He also listed heat, blast and spillage as the major problems. An extended time-movement study of jet planes on the ground was an important preliminary to this program of study. Starting of the jet engine, carried out on the warming-up apron, may represent an average of 3½ min. at 70% power, the check before take-off may consume about 1½ min. at 70% power or higher. During maintenance testing and checking a total of 14 min. may be involved, although this period is the least consistent of the three.

He then described a test of temperature on the runway surface under the bursts from a jet engine blast. On an asphalt surface the temperature rose to peaks of about 230 deg. F., but dropped sharply. The temperature 1 in. under the surface was never serious, by comparison. Temperatures measured on and in portland cement concrete ran 30 to 50 deg. lower. He considered 300 deg. F. as a critical surface temperature for flexible type pavement.

On the subject of spillage he considered old, asphaltic concrete more resistant to damage than new. Open graded mixes were more susceptible to spillage, and were also not as resistant to heat and blast as dense, alsphaltic concrete.

As to the problem of assisting rockets, he did not consider the effect of these as serious, since they are only used when the plane is in relatively swift motion during take-off. He did agree that their fuel is very damaging if spilled.

"Early Planning and Exploratory Tests" which led up to study being made at the NAVCERELAB was reviewed by L. A. Palmer, Head, Soil Mechanics and Paving Section, Bureau of Yards and Docks. He went into considerable detail on the effect of hot blasts on various types of aggregate. Slag was particularly resistant to the effect of heat, and many of the limestones tended to flake and crack.

He expressed the opinion that there was no problem with portland cement concrete pavements, except with the joint filler. The answer was "no joints."

In conclusion he emphasized that the damage he, and other speakers described was not to be considered unusual, or the exception, but all too common.

The program at NAVCERELAB

The test program in progress at Port Hueneme was described by J. A. Bishop, director, Soils and Pavements Division of the laboratory. The problem of jet engine effects on pavements was assigned to the laboratory in 1950 and was immediately divided into: (1) improvements to be recommended for existing air fields and (2) the designs for new pavements. Before either of these problems could receive technical help it was necessary to study the actual effect of jet engine exhausts on pavement surfaces of different types and design. All available information on the subject was first studied, but reports were conflicting. As a result the decision was made to build test sections and subject them to jet engine conditions. A test engine was set up on a portable mounting which allowed it to be tilted down a maximum of 15 deg. from the horizontal. The end of the tail pipe was maintained at 34-in. height above the slab. Test sections of

J. A. BISHOP

4-in. thickness were built using durable, gravel aggregate and Type II portland cement. Bituminous sections were laid with a dense asphaltic concrete mix.

The test provides for a 3-min. exposure to the exhaust at 50-60% power, followed by 100% power for another 3 min. The series of tests starts at the horizontal position and then the engine is tilted down in 2½-deg. increments, until the full 15 deg. is obtained. Results of this comprehensive test series will be made available by NAVCERELAB in the near future.

Jet planes of tomorrow

A look into the future of plane design was provided by Fred A. Payne, office of the chief engineer, North American Aviation, Inc. Of immediate interest, and concern to those in attendance, was his prediction of coming jet engines which might have tail pipe temperatures reaching 3,500 deg. F., and a blast velocity of 3,000 ft. per sec. This would mean a possible runway surface temperature of 1,500 deg. F., and a blast of 1,000 ft. per sec. He also indicated that the angle of the jet might reach 20 deg. from the horizontal and the tail pipe could get to within 1 ft. of the pavement surface.

Modernizing existing runways

The problem of modernizing existing airfield pavements is quite different from the development of new designs to meet the effect of jet engines.

S. A. Wallace, representing the U. S. Air Force, indicated that first cost was considered the governing factor in airfield construction. In the West this resulted in a distinct advantage for asphalt, based on present designs. Resulting problems are evident, according to Wallace, and in one extreme example about 20,000 sq. yd. of asphalt surfacing was lost at an airbase handling a fleet of 16 big bombers. He recommended that all parking aprons be paved with portland cement concrete (without joints) as well as the turn-arounds and the first 500 ft. of each runway. In his opinion, the remainder of the runways could be paved with asphalt without creating unusual problems.

F. M. Mellinger of the Corps of Engineers, U. S. Army, discussed the design of rigid pavements, confining his remarks to the problem of aggregate and its properties in the design for rigid pavements. For example, he pointed out the problem of using limestone aggregate because of the tendency to crack and flake as heat developed from jet blasts.

C. R. Foster, chief of the Flexible Pavement Branch, Corps of Engineers, minimized the problems of asphalt pavement except for areas used to maintain and warm up bombers. It was his opinion that many of the problems discussed during preceding sessions of the conference should be considered as exceptional and not representative of airfield difficulties.

Lt. F. N. Finn, Public Works Office, U. S. Navy, described in some detail the actual design and construction of overlays now being placed to add strength to existing runways at San Diego. One particular point of interest was the preference for eliminating feathered edges of leveling courses with the requirement that existing pavement must be chipped out to eliminate these thin sections of the over-lay.

Rigid v. flexible pavement

In the concluding session, the principles of portland cement concrete design were reviewed, followed by a similar description of bituminous design.

A. A. Anderson of the Portland Cement Association pointed out that heavier loads and higher tire pressures represent no problem with pavements constructed with portland cement concrete. Older pavements will operate with a reduced safety factor and new pavements could be thickened slightly to handle such increased loads. Otherwise, there

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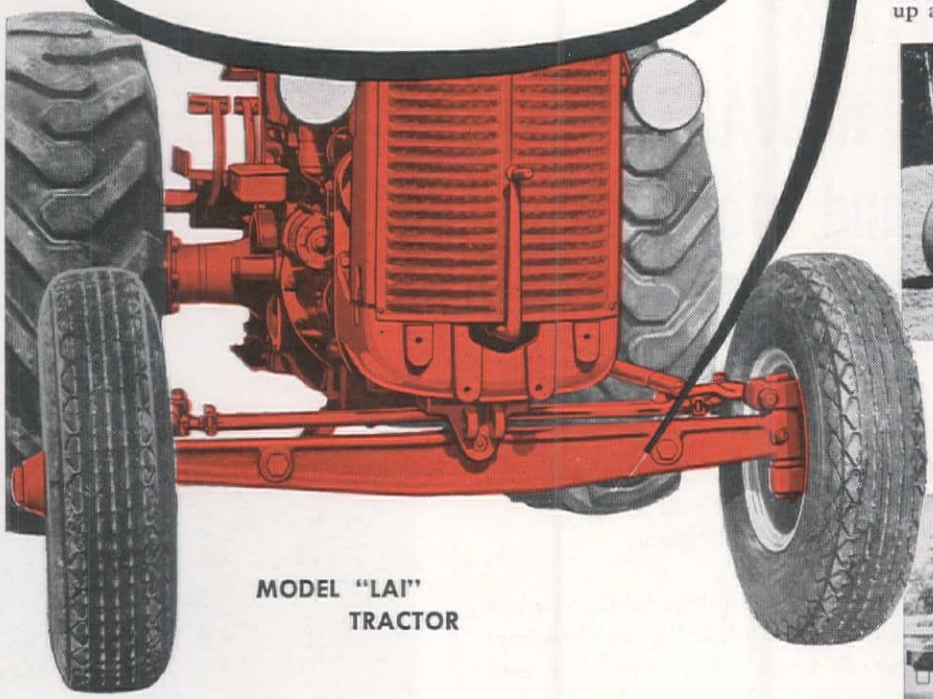
Built to Bear BIG LOADS



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Sure-footed traction of the "LAI" Tractor pulls sheepsfoot roller preparing grade for new paving of Highway 6 at a relocation in New Jersey.

Scraping up cinders and loading them into truck at Stoughton, Wisconsin. Same "LAI" Tractor and loader with hydraulic lift and dump also stock-piles materials, loads trucks during snow removal.

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CASE

"Jets" on airfields

. . . Continued from page 112

would need to be no change in present concrete design. He also indicated that fuel spillage represents no problem for runways of rigid design. Joints do represent a problem wherever fuel spillage or heat softens the joint material. However, he pointed out that new types of filler material are now available which will practically eliminate this problem if properly installed. The cost of these fillers will be higher than those used in present construction. On the problem of heat and blast from jet engines, he indicated that portland cement concrete was not affected (joint compound excepted) and did not represent any problem in airfield operation. Mr. Anderson did not discuss the engine problems of the future, stating that they were rather indefinite and would have to be met as they arise. The Portland Cement Association has no facilities for conducting tests covering the effect of jet engine operations and must rely on the data made available by the armed forces. He indicated that the Association was most anxious to cooperate in any problems relating to airfield design or construction.

J. M. Griffith, engineer of research, The Asphalt Institute, reviewed the design of flexible type pavement and indicated that the present heavier loads and higher tire pressures represent no problem in flexible design and have been solved in the construction of modern runways. In his opinion, spillage should be considered a minor problem which should be met by improved "housekeeping" rather than by a tendency to modify present pavement design. In this connection, he noted the problem did not exist in the Navy and much of the airforce problem could be charged to carelessness.

A. A. ANDERSON

The most important problem was the one resulting from the effect of heat and blast from the jet engines. He expressed the desire that the reporting on this problem could be more accurate and descriptions of the damaged areas more exact. Only in this way would it be possible to determine adequately the size of the problem and its logical solution. For example, he would like to have reports show precisely the areas damaged, their size and the actual effect of the engine exhaust on the asphaltic concrete. In the usual case of damage, he said, erosion of the pavement was extended to a depth of only ½ to ¾ of an inch and

. . . Concluded on page 164

J. M. GRIFFITH

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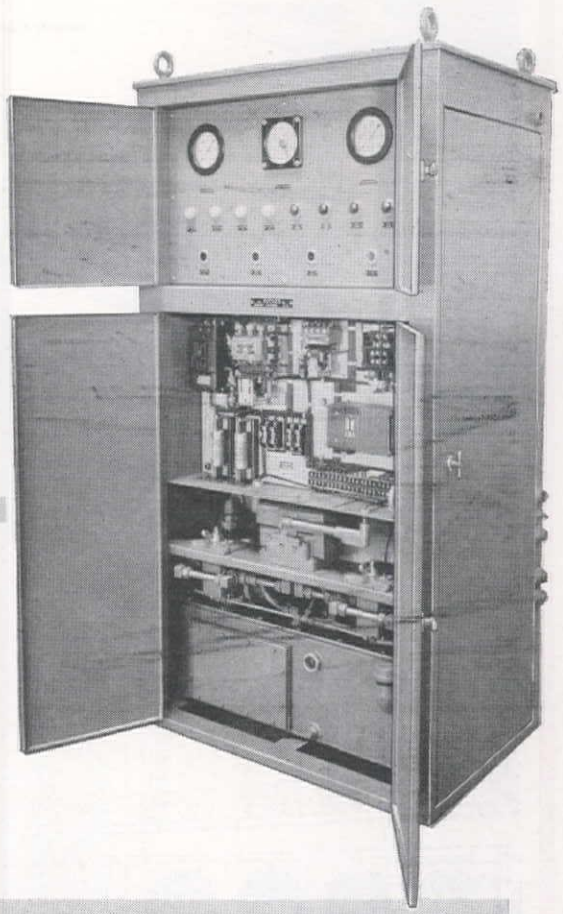

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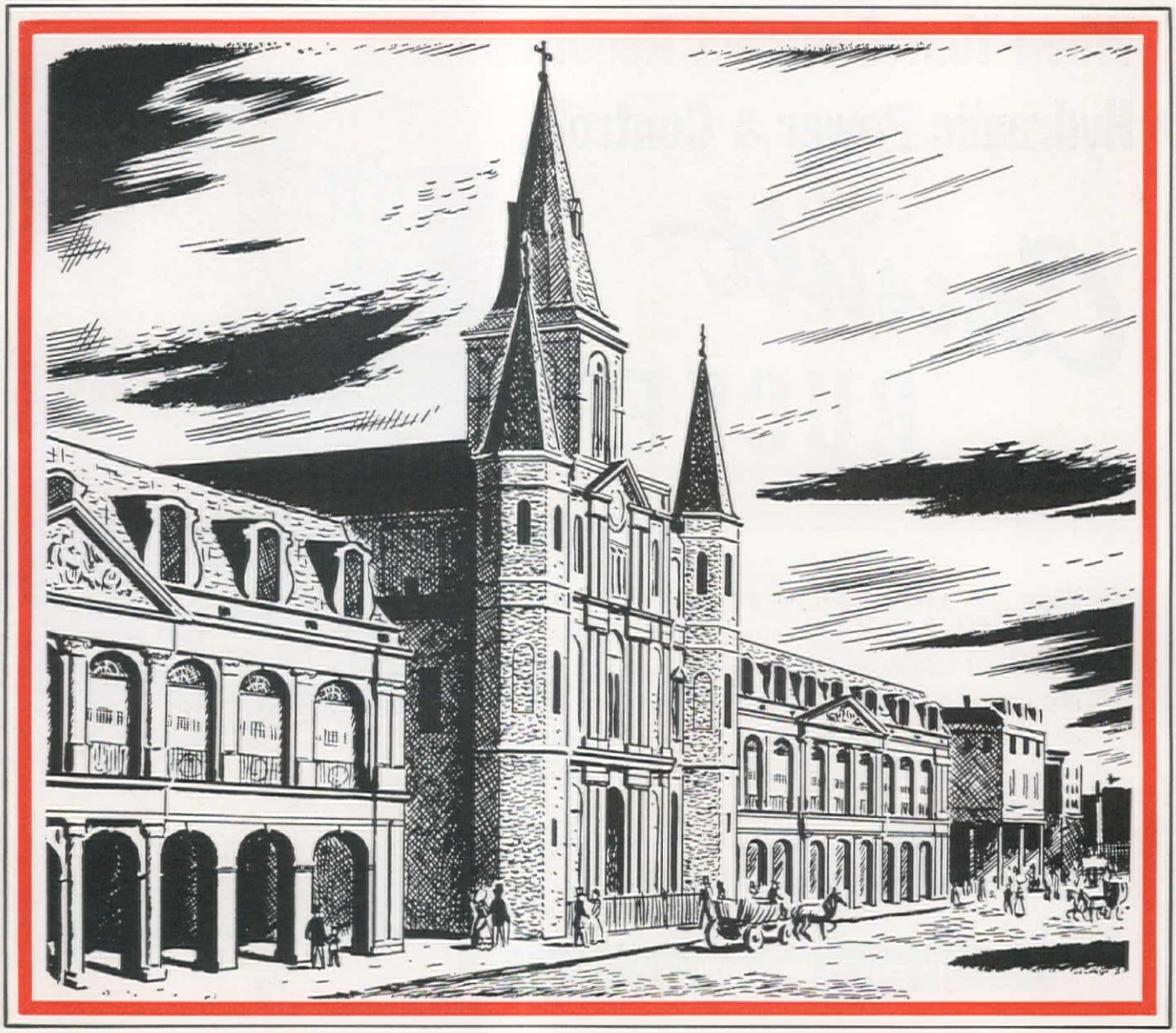

New Orleans' famed Cabildo and Cathedral of St. Louis in the Vieux Carré as seen 100 years ago

New Orleans has a cast iron gas main in service that was installed well over 100 years ago. Vehicular traffic in those times was a far cry from today's giant buses and trailer trucks. The engineering term—*traffic shock*—was then unheard of. There were no sewers, conduits and other underground services to cause soil disturbance. Yet this old cast iron main has had the shock-strength, beam-strength and effective resistance to corrosion to withstand the changes and unforeseen stresses of more than a century. New Orleans' experience is not exceptional. Cast iron water and gas mains, laid over a century ago, are still serving in the streets of more than 30 cities in the United States and Canada.

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SECOND BARREL for HETCH HETCHY

Two pipes, not for hot or cold, but to supply San Francisco's increased needs, now make up the 47-mi. long San Joaquin Valley division of the Hetch Hetchy Aqueduct—Rough ground characterized final contract at east end of job

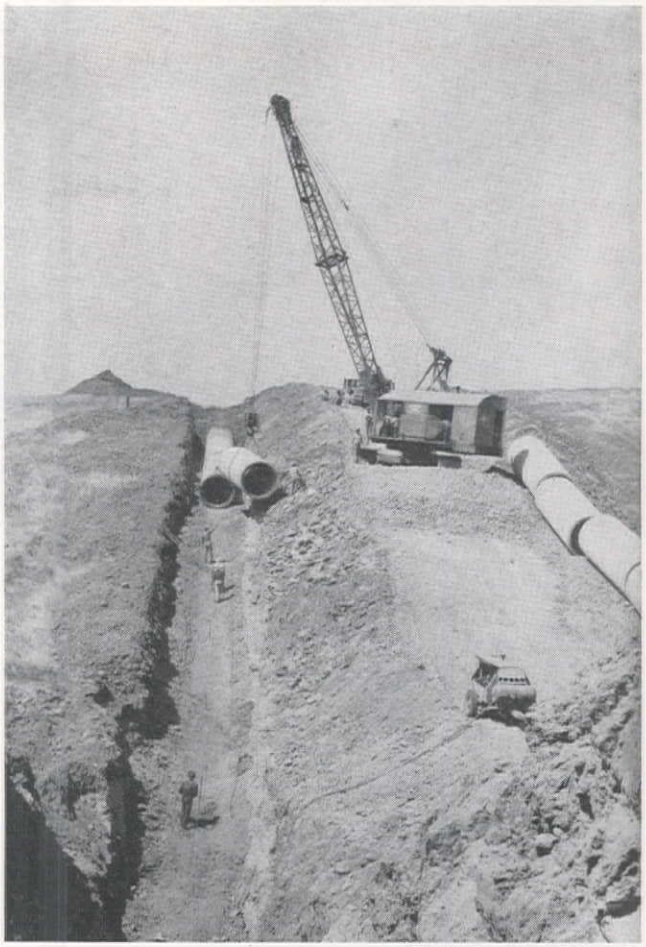


Photo by Gene Edwards

WITH COMPLETION by United Concrete Pipe Corp. of a 7.3-mi. section of 61-in. I.D. reinforced concrete pipeline east of Oakdale, Calif., the City of San Francisco is winding up a 3-yr. construction program that has seen the double-barreling of an entire division of its Hetch Hetchy aqueduct. Bringing first water to municipal San Francisco in 1934, the project has been undergoing intermittent expansion programs ever since. The described work took place in the San Joaquin Valley Division, which connects Foothill Division tunnels (Sierra Nevada) to Coast Range tunnels 47 mi. to the west across California's central valley.

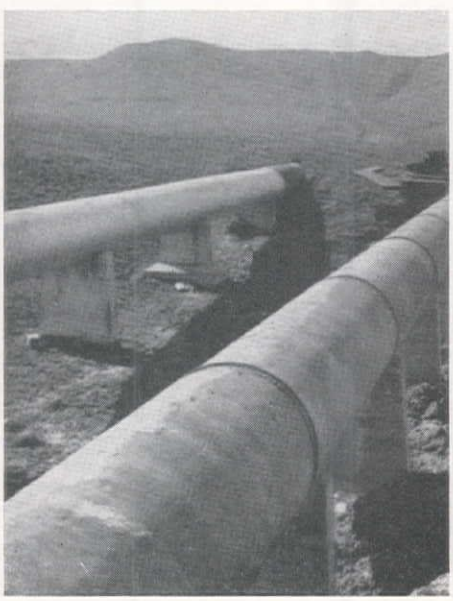
Pipelines first in expansion

The tunnels were built to near-ultimate capacity at the outset; pipeline facilities therefore have come up first for expansion. Collection facilities are also receiving attention, as current work in the Tuolumne River watershed indicates. There, the City is commencing work on a new dam and reservoir in Cherry Valley, a Tuolumne tributary lying west of the existing O'Shaughnessy Dam and Hetch Hetchy reservoir. The project was described in *Western Construction* for March 1952, pp. 86-87. Earlier work in the present San Joaquin Valley Division program was reviewed in November 1949, pp, 84-85.

Contracted by sections

The San Joaquin pipeline work was commenced in 1948. An accompanying tabulation gives particulars of the five contracts let for conduct of the work. Last links in the chain have been Sections A-1 and A-2, both lying east of Oakdale and in the transition from rugged, rocky foothill to uniform, flat farmland. The greatest difference in construction conditions, but not the most difficult, was met by P. & J. Artukovich, Inc., on Section A-2. In its 6.9-mi. length are 2 mi. of irrigated grasslands and 4.9 mi. of rolling pasture that steepens at the east to join Section A-1, lying in still more rugged ground.

THE OLD AND THE NEW cross Wildcat Canyon, Station 126 on the new line east of Oakdale. Old pipe is wrapped and painted.



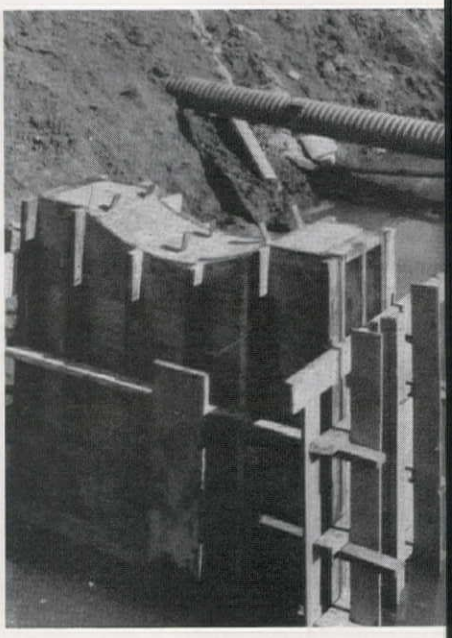
Section A-1 is all uphill or all downhill, depending on one's viewpoint, but difficult for equipment in either case. In addition, though the contours may in places be soft, the ground is not, and the upper 4 mi. of this section required the blasting of over 5,700 holes before full excavation could proceed with any hope of success by backhoe, dragline, and clamshell. The right-of-way in this reach is 200 ft. wide, as opposed to 110 ft. elsewhere along the Division. As a result, the new pipeline could be laid farther to one side of the existing line, and blasting for the new trench was less likely to damage the older pipe. Such an increased spacing, 25 ft. rather than 16 ft., was established over the "top" 2 mi. nearest Oakdale portal, terminus of the Foothill Division.

Excavation techniques

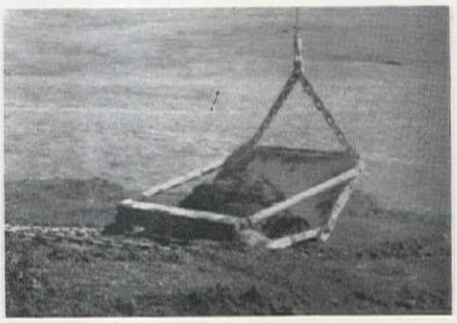
Attempts at excavation preceded the blasting, using a special heavy-duty backhoe, but United's final scheme for the rocky ground was based on shooting the trench alignment at average intervals of 6 ft. The pattern of holes at each such cross-section (two were loaded and shot for each round) included a central vertical hole sided by a pair of holes battered down and outward. These were drilled about 7 ft. deep, using wagon drills and jackhammers, and loaded with five sticks of powder apiece. The relatively light charge—for the material—and blasting mats combined to hold down the ground. Thus, it was shaken

BEEFED UP Lima (left) followed blasting to excavate trench in rugged upper reaches of United Concrete Corp. contract. (Photo by Gene Edwards.)

PIERS (below) at ravine crossings were poured of 3,000-psi. concrete, received contoured friction plate in saddle to seat pipeline.



MORMON BOARD performed rough backfilling (left and below) along most of section A-1, was followed by bulldozers and grader to restore original contour.



up and shattered in place, leaving firm, fairly natural footing for the backhoe to work from.

The backhoe used was a Lima Model 1201 fitted with a specially built boom and 3¾-cu. yd. bucket—the biggest on the coast. Total weight of this rig (see picture) was 120 tons, of which about 20 were boom and bucket alone. Rough excavation by the Lima was followed by a 3½-cu. yd. dragline and by a clamshell to achieve the desired 92-in. trench, varying in depth from 8 to 12 ft. Where necessary, a 10-man crew used tampers to fill in low spots as they proceeded otherwise to trim the trench to cradle contour to receive the joints of pipe.

In the excavation operation, as well as in pipelaying and backfilling, it was sometimes necessary to employ idle tractors and other equipment as deadmen to hold the big cranes and the backhoe in position on the steep slopes, or at least help them progress uphill.

Spoil

Spoil from excavation was in most cases cast to the south of the new trench, near or atop the existing pipeline. This simplified the problem of vehicle access, as it resulted in major obstacles being on the same side of the trench—shallow buried pipe, subject to fracture from pressure of equipment, and spoil banks from the new work. Pipe for the job was stockpiled north of the construction road, cradled between two continuous mounds of earth windrowed up for the purpose (see picture). Actual pipelaying from these cradles was by crane pick-up, using a Lima 1201.

Types of pipe

United Concrete Pipe Corp. used two types of pipe on their work, reinforced concrete pipe on entrenched tangents, and lined-and-coated steel pipe at breaks in alignment (vertical or horizontal) and ravine crossings. (The existing pipe at ravine crossings is uncoated, but it is wrapped and painted with aluminum paint.) These pipes are more fully described elsewhere on these pages, as is the lined-and-coated steel pipe laid by P. & J. Artukovich, Inc. Together, the three types represent what has been used throughout the entire 47-mi. double-barreling program. A joint detail of the concrete pipe accompanies this article. Adjacent lengths of pipe were banded at the joint by heavy paper that acted as a form for field grouting of the joint. The interior surface at the joint was plastered. Lined-and-coated pipe joints were welded and encased all around in concrete. Inside surfaces of these joints also were plastered.

Across ravines and gullies, the pipe line is supported on piers of 3,000-psi concrete, finished to a saddle contour on top to receive the pipe. A semi-circular steel plate (friction plate) is welded to reinforcing straps embedded in the concrete. This surface actually receives the pipe, without structural connection between the two. The entire joint is grouted for preservation and appearance, however, completely encasing the friction plate. Other concrete structures along the line include manholes, and anchors at bends. At horizontal bends thrust anchors consist of concrete encasement to half the depth of the pipe section. At vertical bends, concrete footing pads were poured in the trench before the pipe was laid.

Testing the line

Hydrostatic tests were applied to all portions of the line before backfilling. Water for the tests was supplied by tapping the existing pipeline, a slow procedure inasmuch as the Hetch Hetchy aqueduct has recently been needed only for a fraction of its capacity. Once filled from this source, however, a section of the new line was pumped to a pressure equal to the accumulated head from Hetch Hetchy reservoir, plus 850 ft

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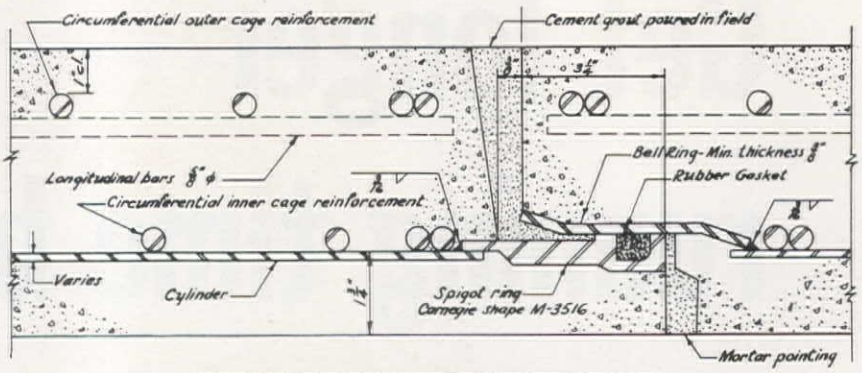
PIPE DOPE ON HETCH HETCHY

TWO GENERAL TYPES of pressure pipe have been laid by the contractors involved in construction of a second, parallel, line in the San Joaquin Valley Division of the Hetch Hetchy aqueduct. In its three contracts, totaling 19.0 mi., United Concrete Pipe Corp. has used reinforced concrete pipe of its own manufacture from the corporation's Stockton plant. The 24-ft. laying lengths each weigh about 18 tons and are of 61-in. inside diameter. Thickness of the concrete shell is 6¼ in., in which is buried a steel cylinder that varies in thickness with the operating pressure for which the pipe is designed. Much of the plate on the San Joaquin Division is ¼- and 3/16-in. Reinforcing steel ⅝ in. in diameter is wrapped around the steel cylinder; and a similar wrapping, also of ⅝-in. steel, lies 1 in. below the exterior concrete surface. Both rubber- and lead-gasket joints were permitted by the specifications; the contractor elected to manufacture the rubber-gasket type (see detail). This pipe cast in vertical position, was given both steam and water cure.

United has also used lined-and-coated steel pipe at certain points along its portions of the work (see main text). This pipe also measures 24 ft. per laying length, each of which weighs about 11 tons. The steel thickness varies from 7/16 to ½ in. The lining of each length was poured with the pipe in a vertical position at the casting yard, using a cylindrical core to establish the desired 1⅝-in. thickness of lining. Exterior coating is gunite ¾ in. thick, encasing wrap-around reinforcing of ¼-in. steel.

P. & J. Artukovich, Inc., used lined-and-coated pipe throughout its work. The 30-ft. laying lengths, each weighing between 8 and 9 tons, were fabricated in San Francisco by Consolidated Western Steel as cylinders 62 in. in diameter (I.D.) and (mostly) ½ in. thick. Shipped by rail to the Pittsburg yard of American Pipe & Construction Co., the pipe received both lining and coating there. Lining, ½ in. of cement mortar, was centrifugally applied. The exterior gunite coating was brushed on by rotary brushes while the cylinders were spun. Here also, exterior reinforcing of ¼-in. steel was buried in ¾ in. of gunite. The finished lengths were transported to the job by truck.



DETAIL OF RUBBER GASKET JOINT

Five contracts for double-barreling 47 mi. of pipeline

Section	Length, Mi.	Contractor's Bid Price	Date Started	Date Completed	Type of Pipe	Contractor
A-1	7.28	$ 1,674,018.95	December 1950	Not completed	Reinforced concrete	United Concrete Pipe Corp.
A-2	6.87	1,663,710.75	March 1951	February 1952	Lined and coated steel	P. & J. Artukovich, Inc.
B	21.09	5,296,519.00	December 1948	October 1949	Lined and coated steel	P. & J. Artukovich, Inc.
C	1.02	776,762.00	October 1949	July 1950	Reinforced concrete	United Concrete Pipe Corp.
D	10.75	2,178,261.50	December 1948	November 1949	Reinforced concrete	United Concrete Pipe Corp.
	47.01	$11,589,272.20				

This pressure was maintained for 24 hr., and leakage during that time could not exceed 25 gal. per in. of inside pipe diameter per mile. Thus, for the 61-in. I.D. pipe being laid, permissible leakage during the test period was, for each mile, 1,525 gal. (61 × 25).

Air tests were applied to joints in the lined-and-coated pipe. Three ¼-in. holes were drilled in the joints at points 120 degrees apart on the joint circumference and air at 125 psi. introduced successively into each hole, the others being plugged. All holes subsequently received plugs, welded in place.

Backfilling

Backfilling was accomplished by a variety of equipment, led by a Lima 601 equipped with a 10-ft. mormon board. The creditably restored ground surface behind the mormon board was further graded to original contour by bulldozers and, where gradients were gentle enough to permit their use, motor graders. In some especially steep reaches, bulldozers alone did the job, but a general disadvantage in their overall employment was the necessity for avoiding the existing buried line. Presence of the latter restricted the tractor operating scope.

Specified cover for the new pipeline is 2 ft. minimum, but in most cases the trench depth permitted 4 ft. of cover. Extra spoil from the current work was used to increase cover over the old line and for construction of a permanent access road graded along the right-of-way between the pipes. Excellence of the backfilling work is evident along the alignment of Section A-2, completed early this year by P. & J. Artukovich, Inc.; only the relative thinness of new grass cover attests to the recent completion date.

Final work presently scheduled on the San Joaquin Valley Division is covered by a contract let to United Concrete Pipe Corp. and planned for commencement in July of this year. The new work is centered in 300 ft. of monolithic concrete conduit extending from the Oakdale portal to a three-way manifold where the multiple pipelines are connected. This section is to be rehabilitated by insertion of a steel liner cylinder, itself mortar lined and grouted into place. The contract will run for 200 days.

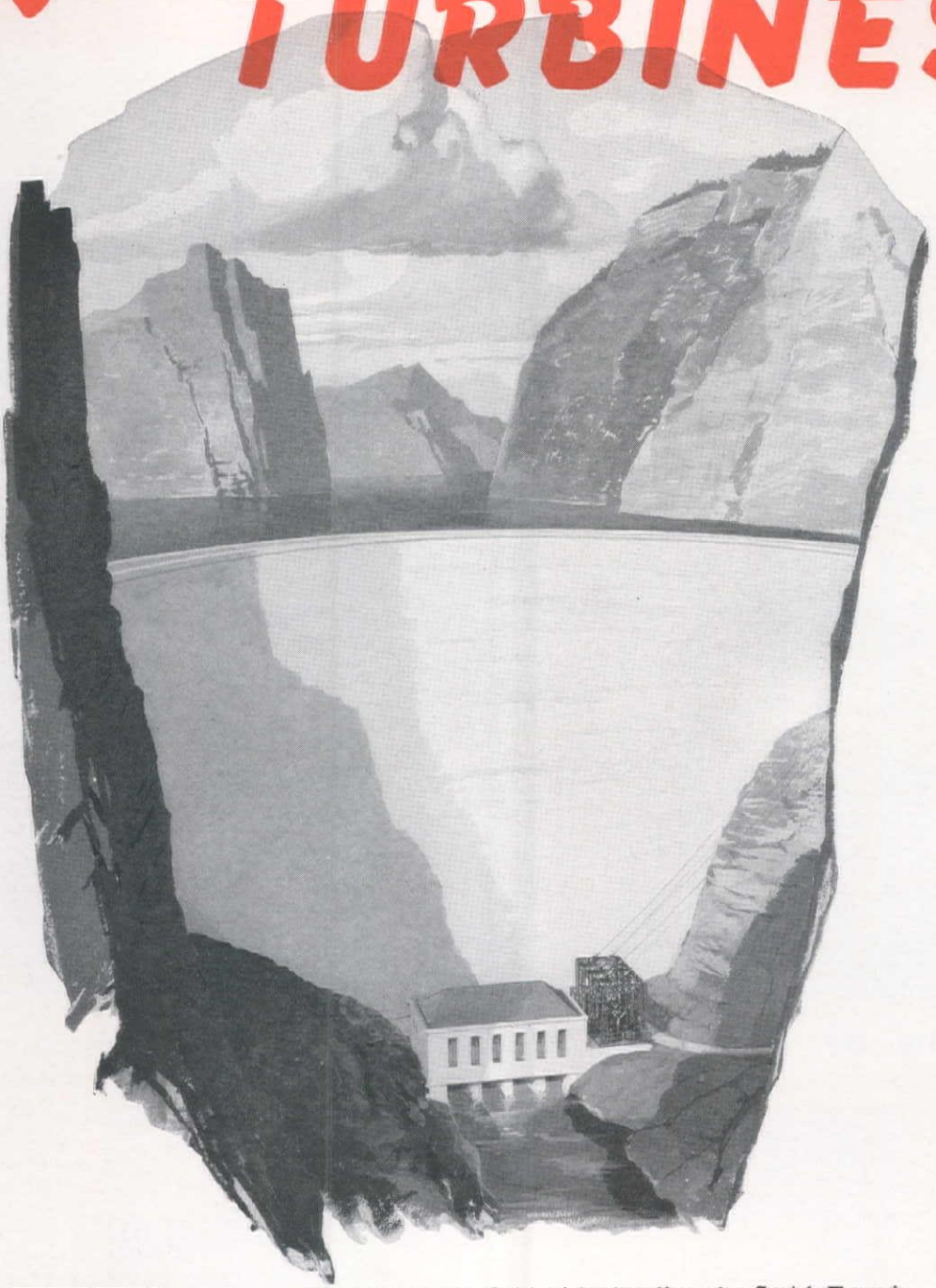
Hetch Hetchy Water Supply personnel on the current work for the City of San Francisco include Thomas Condon, resident engineer; George Jorn, office engineer; and Bill Jacobs, senior inspector. Manager of the Hetch Hetchy Water Supply is H. E. Lloyd. Job superintendent for United Concrete Pipe Corp. is Clifford Gee, job engineer is Dick McCarthy. Area superintendent is Harold Pope. Mitch Bennett superintended the recent work of P. & J. Artukovich, Inc., assisted by job engineer Paul Wasson.

Second barrel for San Diego

THE SAN DIEGO Water Authority and Admiral Joseph F. Jelley have signed the contract which provides for construction of the second tube for the San Diego Aqueduct.

Congress authorized construction of the second tube, which will parallel the one built in 1945, because the many naval installations in San Diego require more water and increasing civilian and industrial needs are involved as well. The San Diego Water Authority will pay for the $18,000,000 construction, scheduled to begin July 1, in annual instalments.

FRANCIS TURBINES



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

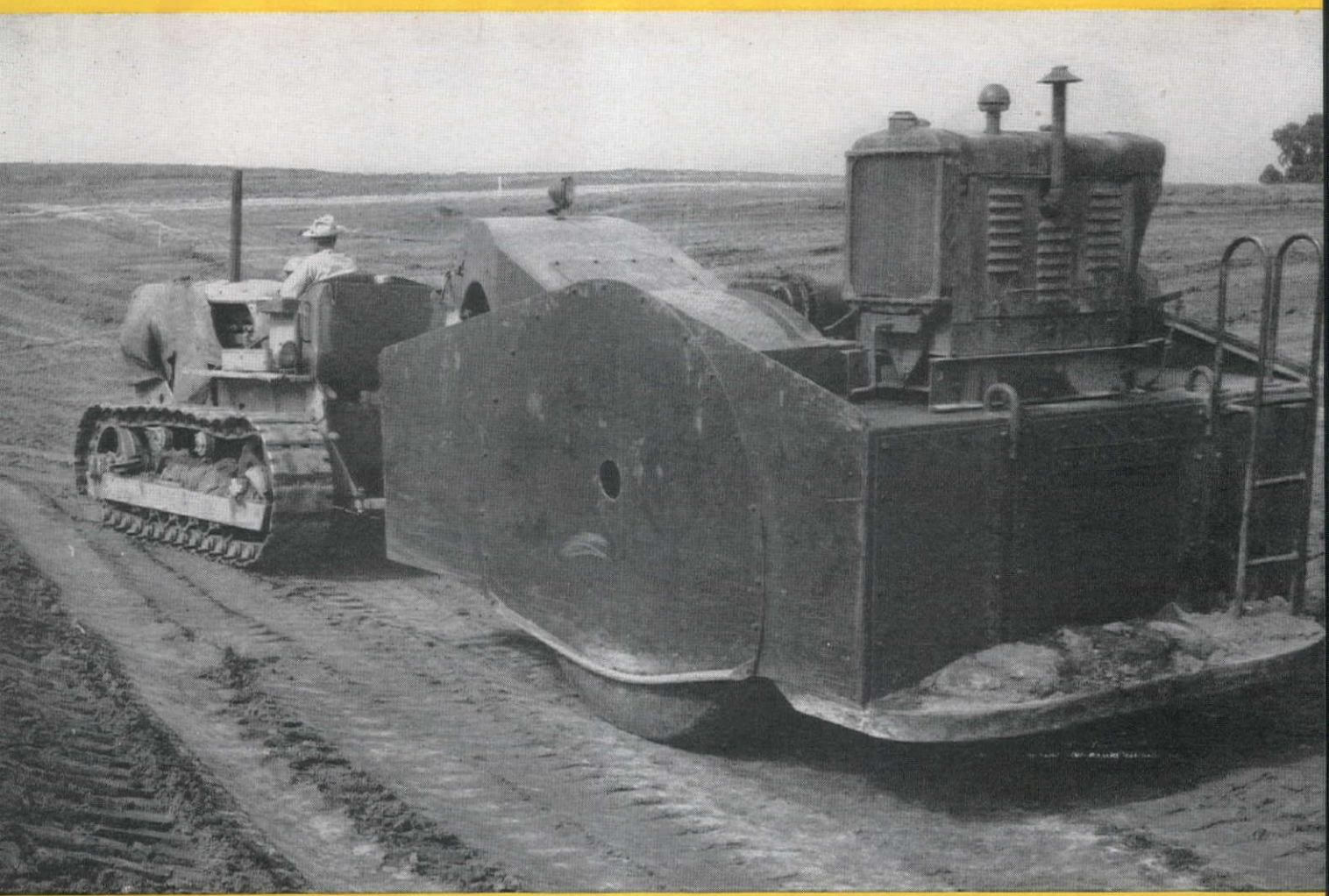
S. MORGAN SMITH CO., YORK, PENNA.

POWER by SMITH

"On one of the toughest compaction jobs we've seen –

THE Cedarapids VIBRATORY

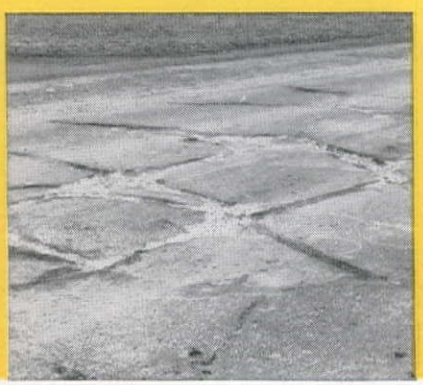
Built by IOWA



COMPACTION OF HIGHWAYS . . .

This road was NOT Compacted

It's obvious that there was little or no attempt made to obtain the proper density for the base and sub-base of this road. The less dense a material, the more room there is for water to permeate the soil. The result . . . early structural failure and a costly maintenance and repair job.



A CEDARAPIDS COMPACTOR prepared this road for paving

A good foundation means a good road with a long life expectancy. On this road, vibratory compaction to the proper density has furnished a substantial foundation to assure greater permanent structural strengths in large load bearing capacities. Road maintenance here is materially reduced.

HALL-PERRY MACHINERY CO.
Butte, Great Falls, Missoula and Billings, Montana

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COMPACTOR

OBTAINED 90% OF MODIFIED AASHO COMPACTION IN

One coverage!"

ON McGEE-TYSON AIR FORCE BASE

THE JOB — to compact 2 million yards of earth to 90% and 97% of modified AASHO for runways, aprons, taxiways and air force buildings.

TYPE OF SOIL — predominantly undesirable fat clay with small percentages of weathered chert, and high moisture conditions.

"... that's why we buy CEDARAPIDS EQUIPMENT"

says **C. M. HART,** Vice President for HARRISON CONSTRUCTION CO., Alcoa, Tenn.

"IN our book, there have been few, if any, earth construction projects that experienced the fat clay, high moisture conditions existing at this airfield site. Using only sheepsfoot rollers at first, we discovered that on fills with soils near optimum moistures, and on 4" lifts, a minimum of 6 passes were required to develop soil densities of 90% modified AASHO, and a minimum of 10 passes were required to reach densities conforming to the 97% requirements.

"But when we used the Cedarapids Model 60 Compactor on all fill areas, where moisture ran from 3 to 7% over optimum, a minimum of 3 passes for the sheepsfoot rollers *followed by one complete coverage of the Compactor* assured densities of 90% of the required compaction values. Two additional coverages were sufficient to assure 90% of modified AASHO compaction. This was on the specified 4" lift depths, although the Compactor will effectively compact 12" to 36" lifts."

IT'S THE *ONLY* VIBRATORY RUBBER-TIRED COMPACTING UNIT AVAILABLE!

There's nothing like it!

AN ENTIRELY NEW PRINCIPLE . . . WEIGHT PLUS *VIBRATION* . . . PERMITS *MORE COMPACTION THAN EVER BEFORE POSSIBLE* . . . IN FEWER PASSES . . . AT LOWER COST. THE CEDARAPIDS COMPACTOR OFTEN *EXCEEDS* SPECIFICATION DENSITIES OTHER TYPES OF ROLLERS CANNOT REACH!

HERE'S HOW THE CEDARAPIDS COMPACTOR GETS RESULTS!

The Cedarapids Compactor operates on an entirely new principle... the flotation of heavy loads without lateral soil displacement, aided by a powerful compacting vibratory thrust through the pneumatic tires. This vibratory action does more than just press the soil down ... it actually rearranges the soil particles, forcing out moisture and eliminating air voids to increase cohesion and mechanical bond. The rate of vibration, tire pressures and weight may be varied to meet specific soil conditions. On the McGhee-Tyson AFB job it was found that 75-lbs. tire pressure, 1200 cycles per minute rate of vibration, the full 30 ton weight of the unit, and 2 mph rate of travel applied an impact-compaction to the soil area under each tire approximately every 1½" of travel.

WRITE FOR THIS BULLETIN TODAY

It gives descriptive details and specifications of both the Model 60, weighing 60,000 lbs. and the Model 25, weighing 25,000 lbs., plus many typical job test reports.

headquarters for

COST REDUCING EQUIPMENT

IOWA MANUFACTURING COMPANY

Cedar Rapids, Iowa, U.S.A.

AUSTRALIAN DAM CONTRACT

Utah Construction really has it!

CONSTRUCTION of the largest earth and rock-fill dam in the southern hemisphere is getting under way near Melbourne, Australia, and the 26 Americans who have gone there to supervise work on the Big Eildon Project for Utah Construction Co. are beginning to realize that getting the work done takes a bit more doing in Australia than in the United States. For the first time in Australia's history, American high speed construction methods are being tried, to complete Big Eildon Dam in four years instead of the eight originally planned by the State Rivers and Water Supply Commission of Victoria.

The Big Eildon Project is a big job in any country. The dam requires two-stage construction and a total of about 13,000,000 cu. yd. of earth, gravel, and rock fill. More than 5,000,000 cu. yd. of rock must be removed from the spillway cut before placing 200,000 cu. yd. of concrete in the structure. A 23-ft. diameter steel-lined tunnel and shaft 1,250 ft. long begins with a 225-ft. concrete intake tower and terminates in a powerhouse equipped with two 60,000-kva., and two 8,000-kva. generators.

An extremely difficult diversion scheme involves tunneling through the concrete portion of the existing dam, which is only a few hundred feet above the new site, in order to maintain the required 1,800-cfs. discharge in the Goulburn River while the second stage of the new dam is built. Minor features of the job are the building of an earth and rock fill cofferdam on top of the existing dam and spillway; removal of the existing powerhouse and generating units; and the erection and operation of a fabricating plant for assembling the ⅝-, 1-, and 1¼-in. plate into pipe sections for the power tunnel lining.

Equipment problems

The major equipment, such as earthmovers, shovels and draglines, mixing and batching plants, was obtained from the United States; but all equipment that could be obtained in the sterling area has been purchased in Australia and Europe. Equipment and parts are hard to get anywhere these days, but when a contractor must endure from two to four months delay in water transport after the parts are located, it definitely takes the patience of Job. As an example, the 45 end- and bottom-dump trucks at Eildon have been operating for almost a year with their only repair parts coming from the project machine shop.

Australia, although of nearly the same size as the United States, has the population only of about greater New York, and even though expanding all the time, its industry falls far short of its own needs, particularly in the basic materials. For instance, only a very small quantity of steel plate comes from Australia. The major part must be imported from Japan. This latter source is good, comparatively speaking, since cement must come from England, Sweden, or Japan; reinforcing steel from Germany; and all designs for gates, valves, and permanent metal work—as well as the fabricated finished products—from Germany also. The power plant and machinery is being designed in England and the machinery itself manufactured in London for transport by ship to Australia. This comparison deals only with major features of the project, but the same applies to other materials, all of which combine both to make a nightmare for the procurement man and to make progress scheduling a highly theoretical occupation.

"The Aussies are doing well"

Considering that heavy construction work on this scale—and at a rate comparable to that on larger jobs in the States—has never before been attempted "down under," the Aussies are doing very well at learning to operate and maintain the equipment, as well as absorbing some of the American methods. Most of the heavy equipment types have been used in Australia, but not on a scale such that an appreciable number of trained men would be available. Shovel and tractor operators, diesel engine mechanics, and most other skilled trades must be trained before being allowed to operate or maintain the equipment. It is at this point that the ratio of 1,400 total employees to 26 Americans seems to be overwhelming. Gradually, however, a trained force is being built up, with noticeably increasing efficiency.

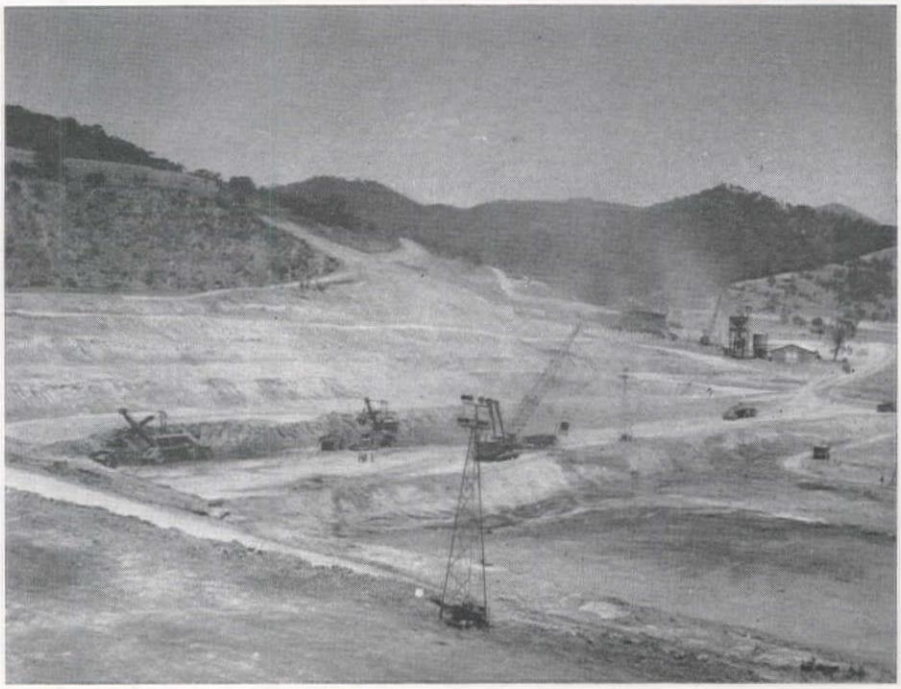
A great many of the men are New Australians, that is, immigrants from Europe and South Africa. Some of these are French, Irish, Germans, Czechs, Hungarians, Yugoslavs, Italians, and Dutch, many of whom do not speak English. This makes it extremely difficult to organize crews.

Finally, and by no means the least of the troubles, is the wide variety of work which must be done on a project of this size that contractors in the States would normally have the option, at least, to subcontract. The fabrication and installation of steel lining in the 23-ft. tunnel; the erection and painting of large gates, valves, and permanent metal work; the machinery installation; and many other supplier services (which in America can many times be more efficiently done by specialty sub-contractors) must be planned and executed by Utah's forces. As a further example, Utah is now operating hostels and mess for about 800 single workers. It is also running a saw mill. And it is completing a township that will eventually house more than 2,000 people, for whom it is now installing a water supply system and will furnish maintenance on all township utilities.

Americans in Australia to build Big Eildon Dam have been welcomed wholeheartedly; and though few of the Aussies believe the Yanks can do what they say they are going to do, they have given their support and cooperation without which the job would be impossible. The average American's appraisal of the situation in Australia is that showing the Aussies "how it is done" is going to make wiser men out of them, and that anyone who loves work can have a "whee" of a time on the Big Eildon Project.

Chief personnel for Utah Construction, Ltd., are J. D. Fogg, project manager, and W. S. Byrne, project engineer, who furnished this lively description.

FOUNDATION and abutment stripping for Big Eildon Dam are seen in this view downstream from the existing dam. As much as 60 ft. of overburden had to be removed—nearly 1,500,000 cu. yd. since October 1951.



NEWS OF WESTERN CONSTRUCTION JUNE 1952

W. L. Huber of San Francisco nominated for 1953 presidency of ASCE

WALTER L. HUBER, consulting engineer of San Francisco, has been nominated for 1953 president of the American Society of Civil Engineers. His election will be confirmed later by letter ballot of the membership. Mr. Huber will be president of the Society at the time of the national meeting in San Francisco next spring—March 4-6.

Consulting engineer

As a consultant with an office in San Francisco since 1913, he has been associated with the design and construction of important structures throughout the West, with special attention to the study of seismic-resistant design since the rebuilding of San Francisco following the fire of 1906. During the same period he has served as consultant on the investigations for, and the design of, numerous projects in the field of hydroelectric power and irrigation. Since 1941 his office has been conducted as a partnership as the firm of Huber and Knapik, Civil Engineers, San Francisco.

Distinguished career

Born in San Francisco and graduated from the University of California in 1905, his first five years of experience were divided rather equally between structural design and hydraulics, in the office of John D. Galloway. This included the period of extensive building activity following the San Francisco earthquake, and Mr. Huber has continued to maintain an intense interest in all problems involving seismic stresses. He was appointed district engineer, U. S. Forest Service in 1910 and for the next three years directed all engineering work carried out in the national forests of California and Nevada, including the review and reporting on all hydroelectric projects for which Federal permits were required.

In 1913 he established his own consulting office in San Francisco for the general practice of civil engineering and has maintained this office without interruption since that time. His practice has included structural design and construction supervision of many types of building projects for both private interests and public agencies. These buildings included many of the important additions to the several University of California campuses, public schools throughout the state, as well as commercial buildings. One of the more unusual structures was the four-story underground garage at Union Square, San Francisco.

During these years he was also employed extensively by financial institutions for investigations and reports on matters covering structural adequacy and insurance risks on existing buildings in the seismic area of the entire Pacific Coast.

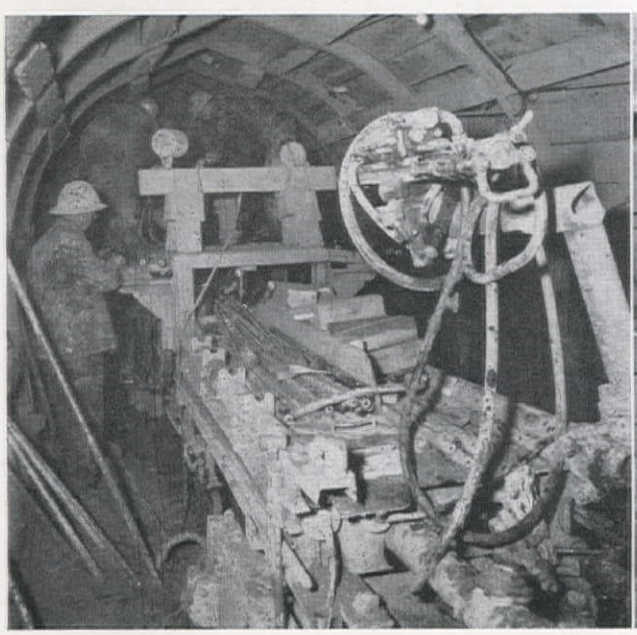
From 1930 to 1937 he served the City of San Francisco as the engineer mem-

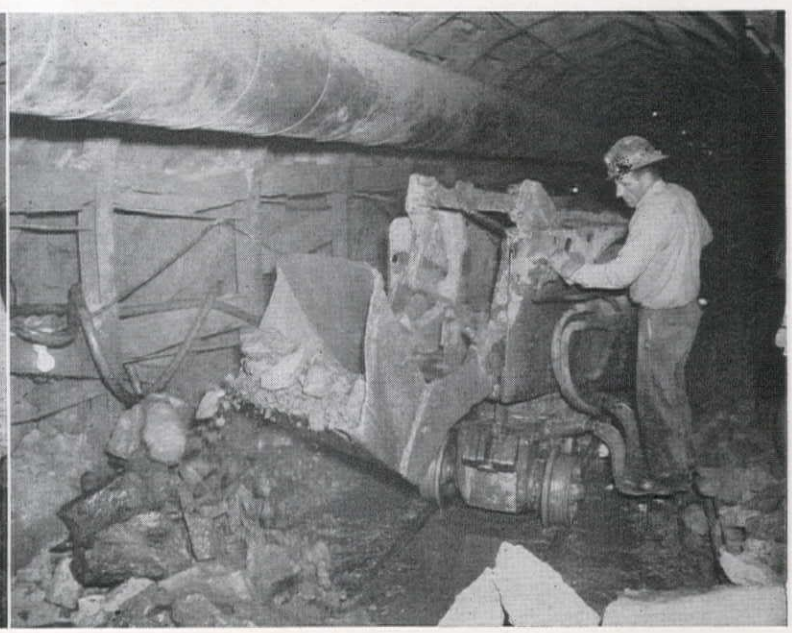
FACTS ON THE NEW HARDROCK TUNNELING RECORD SET IN COLORADO

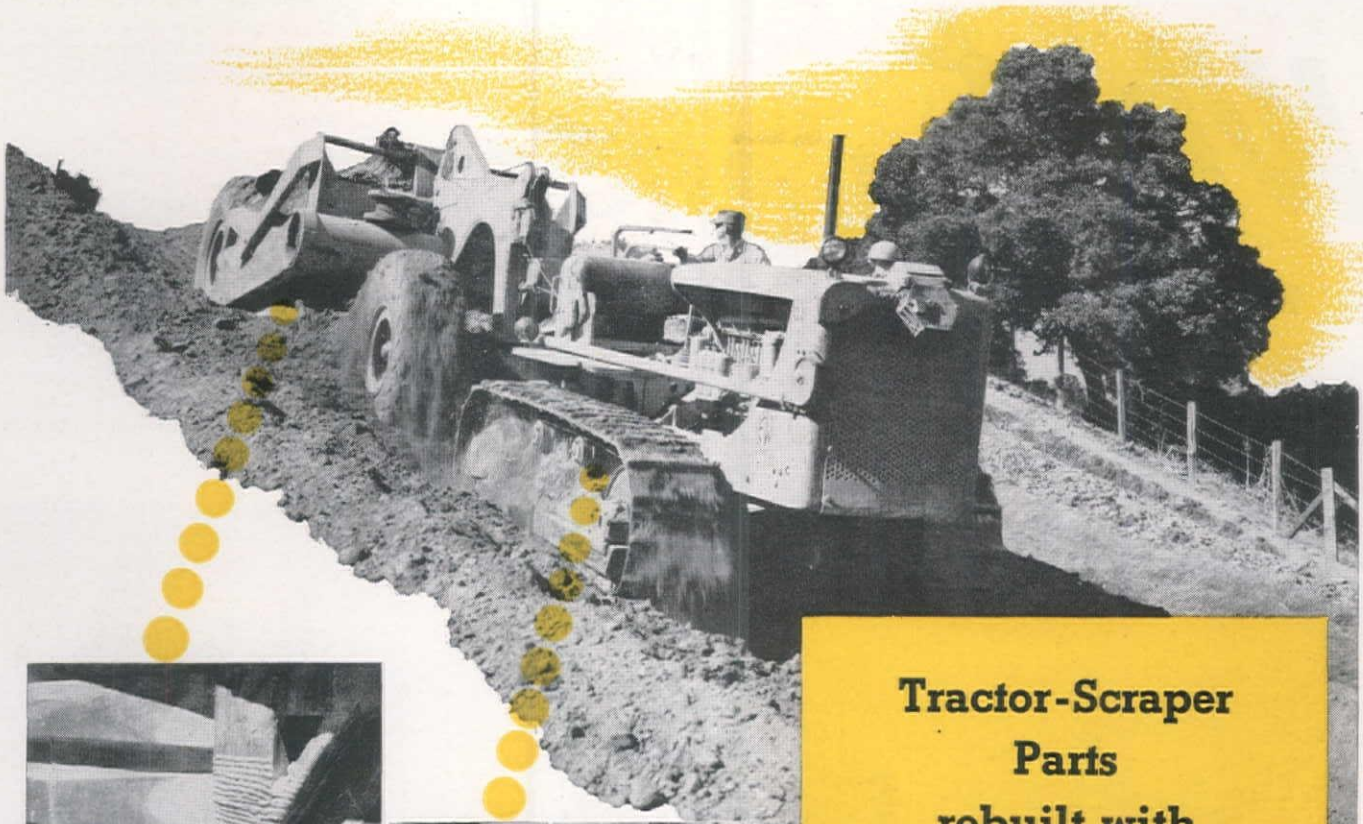
Here are a few statistics on the construction of Tunnel No. 4 of the Bureau of Reclamation's North Poudre Supply Canal job in Colorado. G. L. Tarlton Contracting Co. was the contractor with *L. A. Stiles* as superintendent.

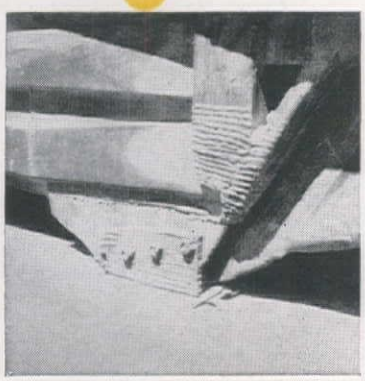
Length: **3,500 ft.**
Size: **9 ft., 4 in. rough horseshoe, 8 ft. finish, semi-elliptical.**
Rock formation: **Sundance-Sandstone, Lykins formation (where record was made). Tunnel ran through about 50% shale and 50% this formation.**
Holes drilled: **36 per round.**
Steel: **10-ft. lengths only.**
Drills: **5 used, 4 at face, 1 spare at rear of jumbo.**
Bits: **Timken Carbide.**
Cars: **90-cu. ft. Granby.**
Rounds day of record: **13.**
Advance: **111 ft.**
Date: **April 10, 1952.**
Loaders: **Model 21 Eimco.**

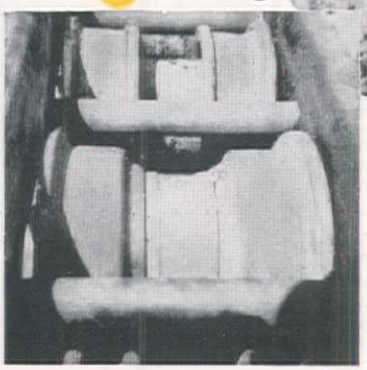
At left, below: drilling at the face. Right: mucking out with an Eimco loader. *Photos by Frank H. Spicer.*











In addition . . .
VICTORALLOY cuts rod cost and reduces welding time 25 to 50%.

HERE'S HOW:

- **VICTORALLOY** is an all-position rod . . . vertical surfaces, end bits, blades, etc., can be hardfaced in position.
- High burn-off rate, 6 lbs. per hour, speeds application.
- One pass with **VICTORALLOY'S** high, rounded bead deposits as much metal as most rods do in two passes.
- No slag interference—you eliminate chipping and cleaning.

Try **VICTORALLOY** NOW. Order a supply from your **VICTOR** dealer TODAY.

Write for literature on complete line of hardfacing alloys by VICTOR. Dealer inquiries invited.

292

Tractor-Scraper Parts rebuilt with VICTORALLOY

outwear new parts 2 to 1

VICTORALLOY is designed especially for track rollers, idlers, grousers, end bits, cutting edges, tamper feet and other parts subjected to continual abrasion and severe impact. Its high chromium content produces a hard, polished finish that reduces friction . . . and doubles working life.

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Welding and Cutting Equipment Since 1910

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ber of an advisory board which directed the affairs of the Bureau of Building Inspection, in a period when the bureau was completely reorganized.

CVA planning

For thirteen years after the opening of his office he was consulting engineer for the California Bond Certifications Commission on irrigation projects throughout the state. He served the state engineer on the planning stage of the Central Valley Project of the State Water Plan, which included early plans for Kennett (Shasta) Dam and was consultant for the U. S. War Department on flood control structures in Los Angeles, San Bernardino and Orange counties.

***Walter L. Huber*, who is the ASCE's 1953 presidential nominee**

In 1929 he was most active during initiating and drafting of the state dam control act, which has been the basis for regulating all dam design and construction in the state since that date. During the intervening years he has been called in by the state engineer, as well as by municipalities and districts, as a consultant on dam design and construction.

Mr. Huber was elected to the Board of Direction of ASCE in 1922. In 1926 he was elected vice president.

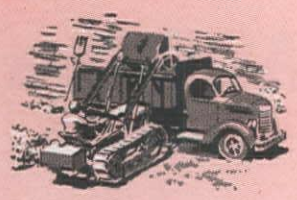
Led San Francisco Section

In 1936 he served as president of the San Francisco Section. For the next several years he served on the local legislative committee, appearing before the committees of the state legislature on matters affecting engineers.

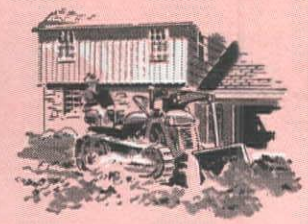
During more recent years he has been considered the unofficial advisor and counselor for the local section in matters relating to professional and Society affairs.

Helped proclaim monument

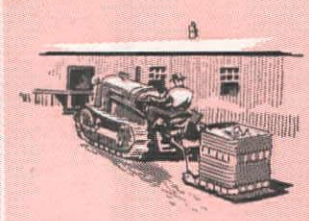
A true Westerner, with roots in California dating back to the days of '49, Walter Huber has been most active in outdoor recreation, with a particular interest in mountain areas. For 33 years he served as a director of the Sierra Club (President 1925-26) and is credited by that organization as being the person most responsible for the creation of the Devil's Postpile National Monument.



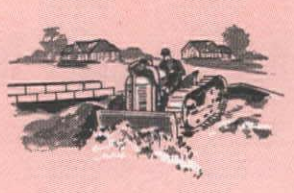
Loading out scrap material



Bulldozing



Industrial material handling



Backfilling foundations

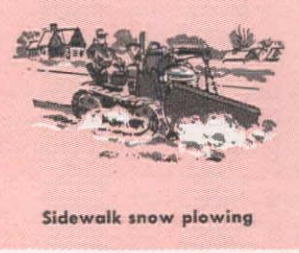
Take the Word of ...Thousands

Don't just take our word for the real, day-to-day usefulness of the Oliver "OC-3". Take the proof offered by the *thousands* of users . . . the *thousands* of uses . . . of this powerful little tractor. Just ask any owner what he thinks of his "OC-3". In the more than 12 years that the "OC-3" and its predecessor, the "HG", have been in production, they have built a reputation for user acceptance that's unequaled in their class. Proof of this is the fact that it's mighty hard to get a used "OC-3". Users just don't often sell their "OC-3" tractors.

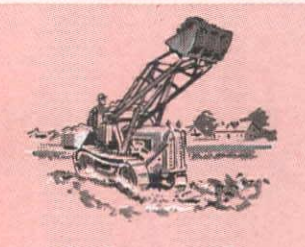
With an "OC-3" and its broad line of matched equipment . . . bulldozer, trailbuilder, front end loader, lifting fork, sidewalk snow plow, hydraulic drawbar, winch, logging kits, and many others . . . you can perform all sorts of useful tasks *every day.*

The "OC-3" has plenty of power to handle all those jobs with ease . . . a full 22 drawbar h.p. It's ruggedly built to keep maintenance and operating costs down.

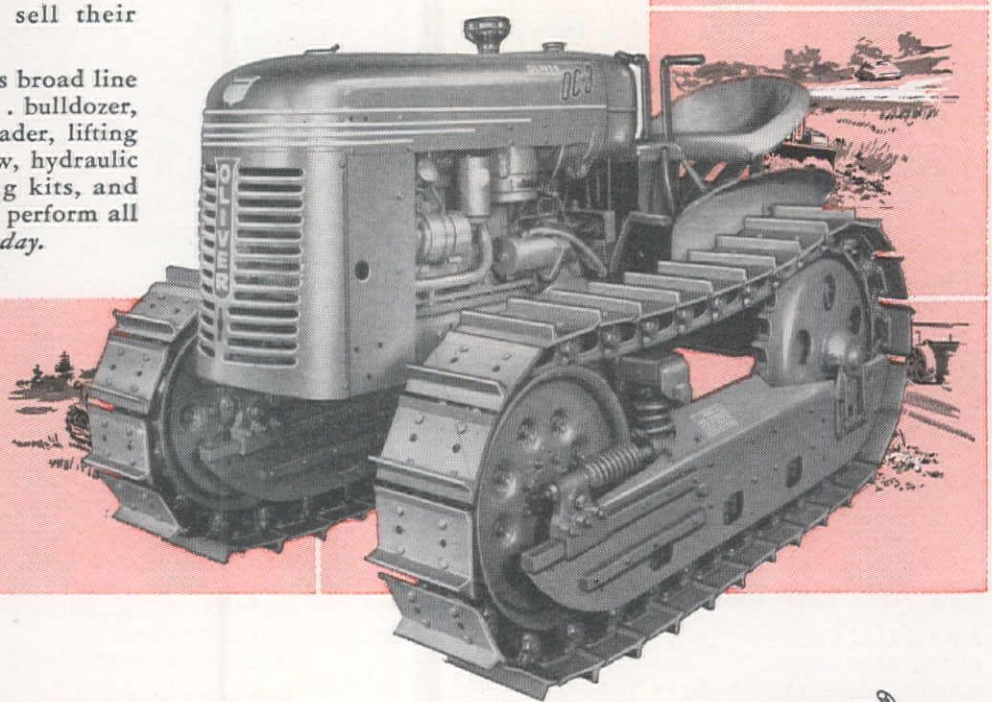
Why not have your Oliver Industrial Distributor give you all the facts on the "OC-3", the lowest priced industrial crawler tractor built. Call him or write direct to The Oliver Corporation, Industrial Division, 19300 Euclid Avenue, Cleveland 17, Ohio.

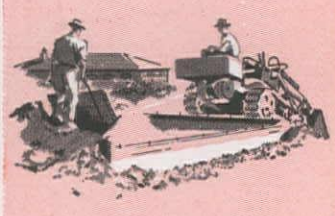


Sidewalk snow plowing



Loading out topsoil

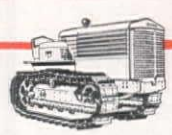




Winch operations

THE OLIVER CORPORATION

a complete line of industrial wheel and crawler tractors



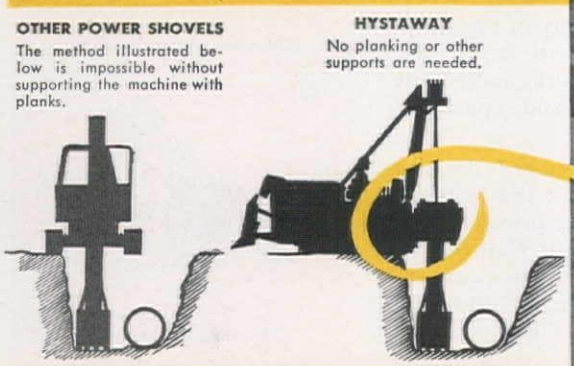
State of Arizona: Guerin Implement Co., Phoenix, 1401 S. Central St. *State of California:* Gustafson Tractor Co., Eureka; Mechanical Farm Equipment Dist., Inc., San Jose; Ashton Implement Co., Salinas; Comber & Mindach, Modesto; Cal-Butte Tractor Company, 820 Broadway, Chico; Tractor & Equipment Co.,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

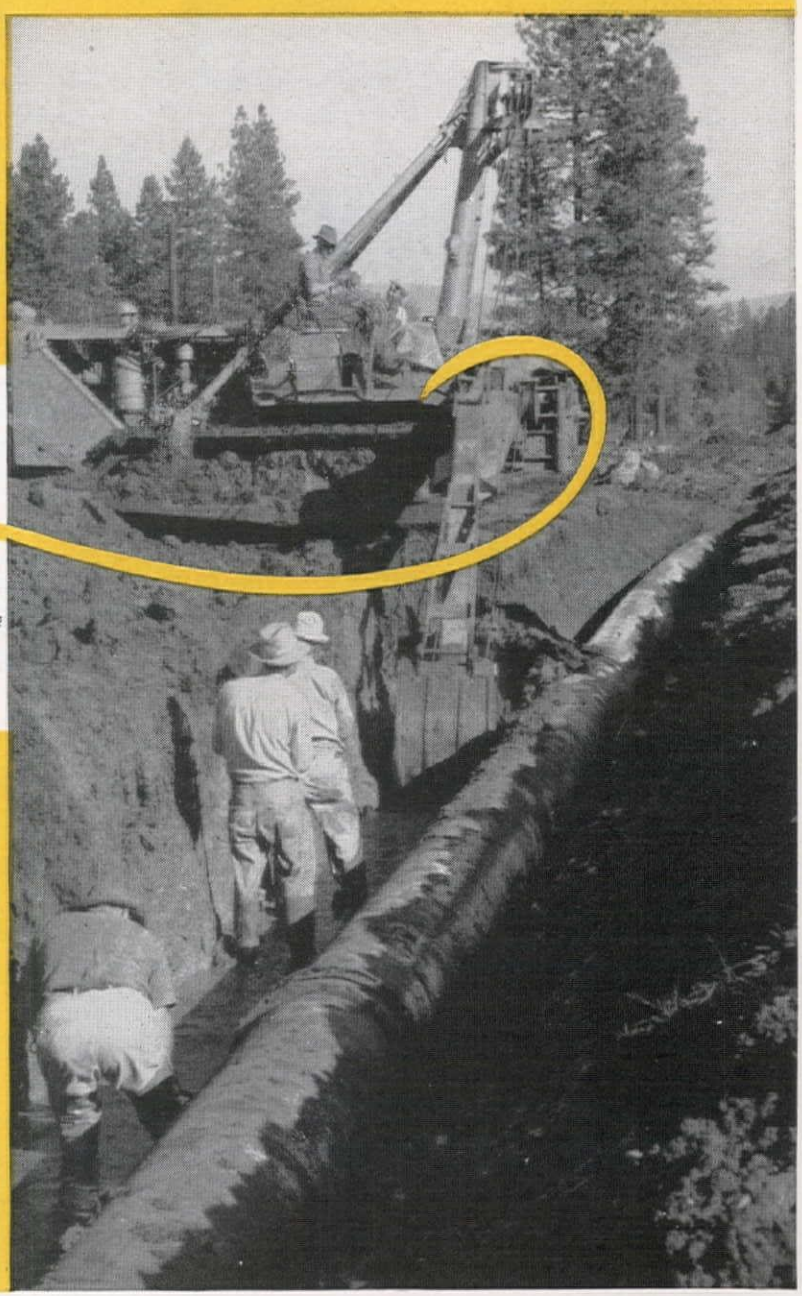
Mud and Mountains are HYSTAWAY'S Dish

EXCLUSIVE HYSTAWAY® DESIGN ADVANTAGES PAY OFF FOR PIPELINE CONTRACTOR

Not only was mud and rough mountainous terrain a problem contended with on the pipeline job shown, but in some instances trench excavation had to be accomplished by positioning the machines at right angles to the ditch.

The Hystaway is capable of full production digging in this position and it is the only excavator-crane designed to swing the boom from a point to the rear of the tracks.





In addition, because the Hystaway mounts on a Caterpillar Track-type Tractor it combines high production excavator-crane work, with full tractor mobility and maneuverability. This permits moves to be made at tractor speeds, through mud, over rocky terrain; also makes it possible to get into jobs *unassisted* and work in places inaccessible to other excavators.

The Hystaway can be equipped to operate as a Backhoe, Shovel, Dragline, Clamshell, or Crane. Controls and other operating features are similar to standards set for half-yard excavators.

HYSTER COMPANY

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WYOMING
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Turning bog into runway

on Whidbey Island

To speed the contract for a new runway at Whidbey Island Naval Air Station, Washington, Peter Kiewit Sons' Co. have used "Caterpillar" DW20 Tractors and No. 20 Scrapers on long, fast hauls.

The first problem was to remove 15 to 25 feet of bog that occupied the area, before making the fill. The contract called for moving more than 750,000 cubic yards of earth. "Cat" equipment on the job included 3 DW20 Tractors and No. 20 Scrapers, 15 D8 Tractors, a D6 Tractor, 5 No. 12 Motor Graders and 3 No. 80 Scrapers.

Material for the fill was rocky, sandy, very dry and hard to load, so that D8 push-loading was required. With pay loads of 17 cubic yards, the DW20s made the round trip of over 10,000 feet at speeds that gave each unit an average of 125 pay yards per hour. Contributing to this efficient operation was the haul road, carefully maintained and kept in first-class condition at all times.

Good equipment is valuable property in these times. It's worth taking care of. A few minutes a day spent on proper maintenance will pay off in many added hours of profitable work life. Consult your "Caterpillar" Dealer. He's there to help you with all the service facilities at his disposal.

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Phoenix, Ariz., plans 56% water supply increase

THE MUNICIPAL water supply for Phoenix, Ariz., will be increased by 56% during the next 3 yr., a $7,000,000 bond issue having been voted for the purpose on April 29. In addition to firming the city's supply at least until 1952 (according to engineers' estimates of population), the augmented system will permit lower fire insurance rates through its use of two separate sources of supply. Immediate need for commencement of the project is illustrated by the 83-mgd. estimate of peak consumption predicted for summer 1953. The existing supply system, tapping the Verde River and augmented by well water of marginal quality, has a capacity of only 73 mgd., while facilities contemplated under the new plan will raise this figure to 114 mgd.

Source of the additional water will be the Arizona Canal of the Salt River Valley Water Users Association. By special arrangement between Phoenix officials and the Association management, a fraction of the canal's capacity will be allocated for municipal use and tapped by a 30-mgd. pumping plant. Other works to be built in conjunction with this pumping plant include a pre-settling basin, a filtration plant, and a 20-mg. reservoir. Total cost of this phase of the program is an estimated $2,511,000. New transmission mains necessary to the project account for a further $2,262,000.

Another phase of the program will be rushed to completion prior to mid-1953, giving 10 mgd. of added capacity. This will include improvements to the present system, consisting primarily of a new 40-mgd. pumping plant to supply the existing pipeline from the Verde River. The new plant, however, will be built at a location further downstream, below the confluence of the Verde and Salt rivers, where low water levels cannot "dry it up" (as is the case with the present plant). A pre-settling basin will be built as a part of this construction phase also, and the present filtration plant expanded from 30- to 40-mgd. capacity.

P. G. and E. asks okay for new Calif. hydro site

PACIFIC GAS and Electric Co., San Francisco, Calif., has filed an application with the Federal Power Commission for a license for a proposed hydroelectric project on the Pit River near Redding, in Shasta County, Calif.

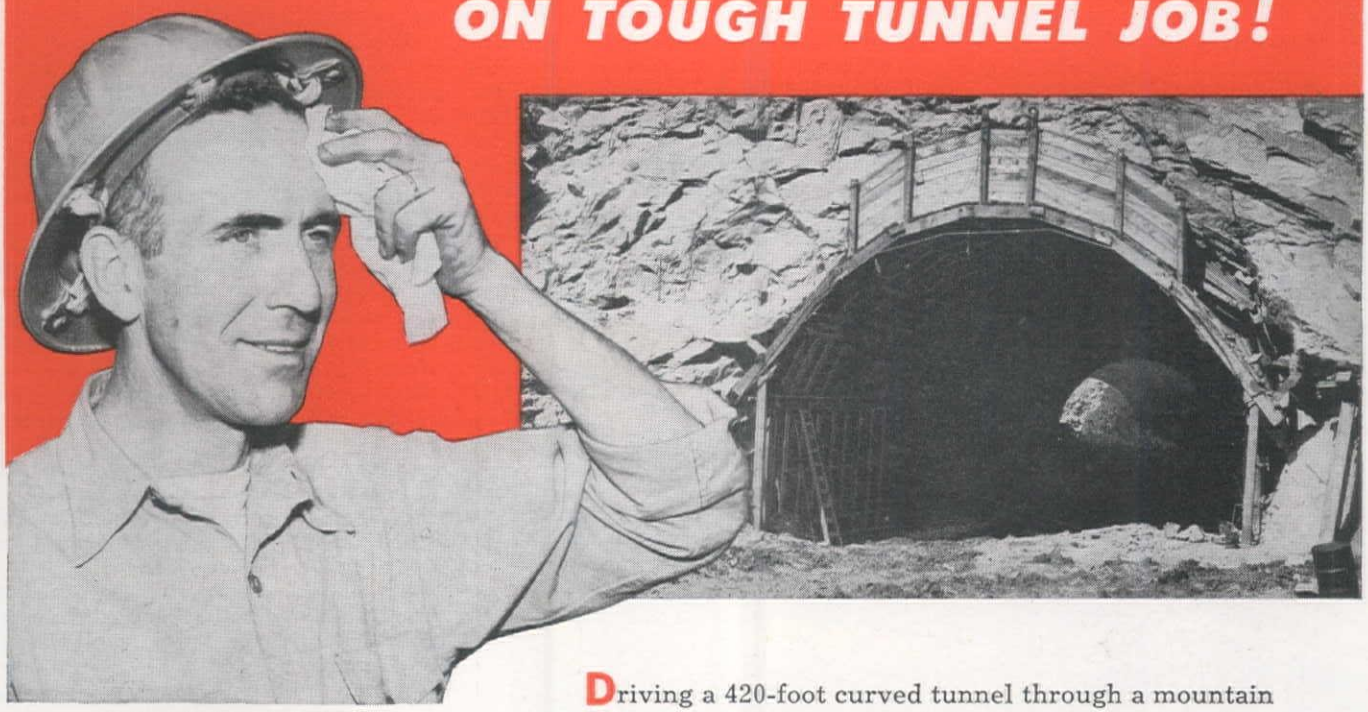
The proposed "Pit No. 6" project is a part of a planned comprehensive scheme of power development of the Pit River, the application states. The estimated total cost of the proposed Pit No. 6 project is $20,120,000.

The company plans to build a concrete gravity dam, on the Pit River, about 230 ft. high and 700 ft. in length along the crest. The reservoir formed by the dam would be about 480 acres in area and would extend upstream to the company's

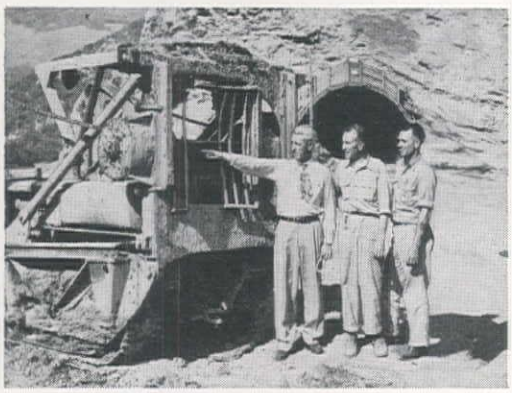
Continued on page 134

NO TIME for DOWN-TIME

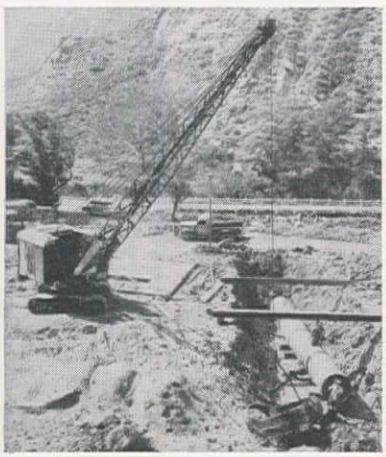
ON TOUGH TUNNEL JOB!



W. A. Ripley, Rhoades-Shofner superintendent at Gaviota Gorge.



G. P. Representatives Jack Hanafin, left, and Harry Smith, right, check lubrication of Eimco 104 RockerShovel with Ripley.



Diverting water under road and into Gaviota Creek is important phase of job.

Driving a 420-foot curved tunnel through a mountain of hard, resistant sandstone is tough business... there's no time for down-time on any piece of equipment that should be on the job.

Rhoades-Shofner Construction Co., Inc., contractors for the tunnel building project at Gaviota Gorge on U.S. Highway 101 near Santa Barbara, realize the importance of keeping machinery operating at full capacity around the clock.

Like many other Pacific Coast contractors, Rhoades-Shofner has chosen General Petroleum products and lubrication engineering to help keep its equipment on the job—day or night.

According to Superintendent W. A. Ripley, not one piece of equipment has been idle for lack of fuels or from lubrication failure since the job began last summer.

This same dependability of product and service can be yours, too. Just call the G. P. office nearest you for details on how you can enjoy longer machinery life, with less buying and stocking problems and simpler lubrication methods.

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11-13

existing Pit No. 5 powerhouse. Two penstock pipes about 160 ft. long would extend from the dam to the power plant, immediately downstream. The powerhouse would contain two 42,500-hp. units, each connected to a 36,000-kva. generator. Two 220,000-volt lines, about 3 mi. long, would extend from the switchyard at the Pit No. 6 plant to a junction with Pacific's interconnected primary transmission system.

Fire damages rail bridges in Colo. and Wash.

OFFICIALS of the Union Pacific Railroad estimate that $10,000 worth of damage was inflicted upon the railroad's 800-ft. railroad bridge at Welby, Colo.

The quick action of local volunteer firemen units prevented further damage to the $125,000 structure, and it was announced that no disruption of train traffic would be necessary.

Origin of the blaze was not immediately settled, but it was generally believed that sparks from a passing freight train might have started the spectacular blaze which was advanced by high wind.

Meanwhile, the Milwaukee Railroad's 1,000-ft. long wooden trestle over Crab Creek flats near Smyrna, Wash., was virtually half-destroyed by a blaze believed to have started from a hot brake shoe from a passing freight train. Trains of the line were rerouted over the Northern Pacific Railroad lines in Grant County.

May snow surveys alter previous forecasts slightly

THE WEST-WIDE outlook for water supply for irrigation, power generation and other uses continues to be very good and substantially as forecast by Soil Conservation Service and cooperating agencies on April first.

Slight revisions of earlier forecasts upward or downward, chiefly in response to April climatic behavior, are described as follows:

Arizona

Reservoirs on the Salt River System now store water to about 80% of capacity. The forecast of flow for April-June, inclusive, has been reduced from 500,000 to 450,000 acre-feet. About 300,000 acre-feet passed the gauging station during April. Most of the snow now is gone from the watersheds so the water remaining will come from seepage from springs and saturated soil on the watershed.

The reservoirs on the Verde River did not spill but did, however, reach 95% of capacity. The April 1 forecast of flow for April and May of 150,000 should be upped to 160,000 acre-feet.

No additional water will be added to that now stored in the San Carlos Reservoir on the Gila, or to the Lake Pleasant on the Agua Fria River.

Forecast of flow for the Colorado River at Grand Canyon for April-September is reduced from 17,200,000 to 16,000,000 acre-feet.

California

It still is anticipated that California's 1952 snow-melt run-off will be the greatest since initiation of state-wide snow surveys notwithstanding below normal April precipitation for most of the Sierra Nevada. Forecasts of the April-July run-off for various main tributaries are reduced percentagewise from the flows forecast April 1, about as follows: Sacramento above Shasta Dam, down 10; Feather down 17; Yuba down 15; American, Mokelumne and Kern, all down 10; Stanislaus and Kings, down 5; Tuolumne, Merced, Upper San Joaquin and Kaweah, no change.

Reservoirs are still being held down as far as possible to provide means of controlling later high water from snow-melt.

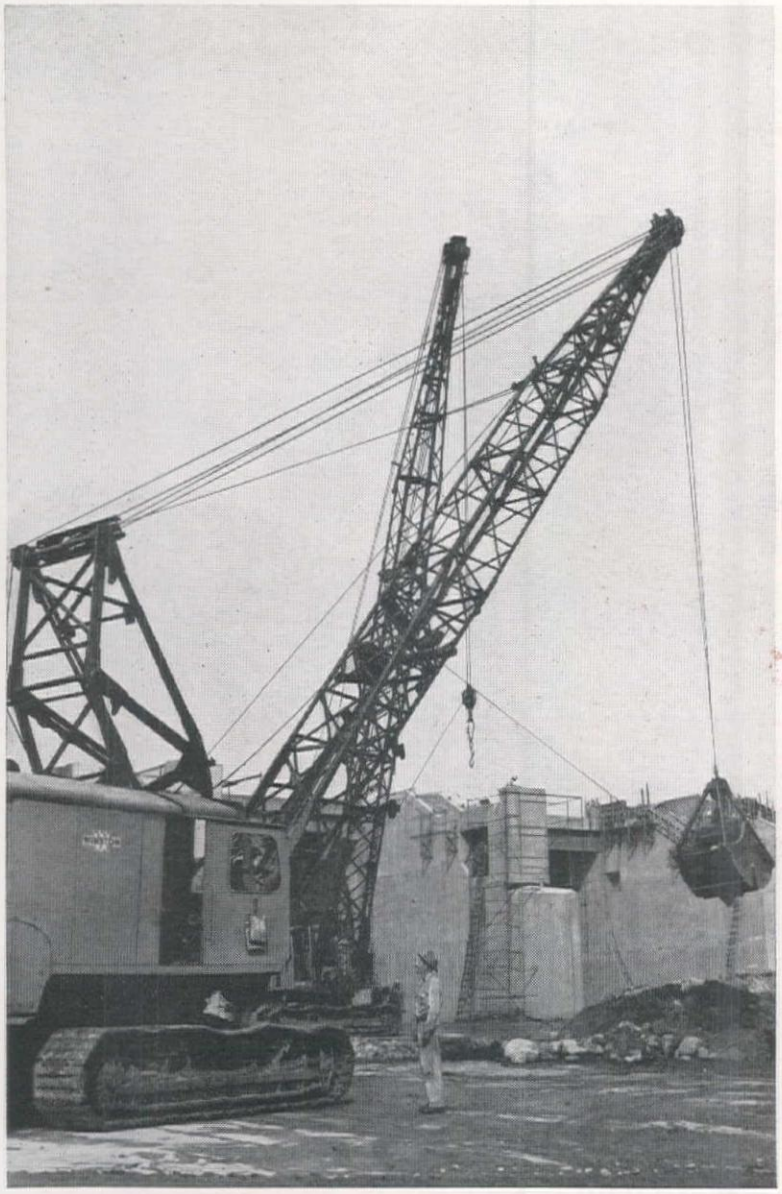
Colorado

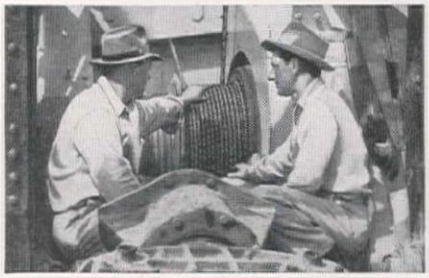
Generally very little change in forecasts.

Idaho

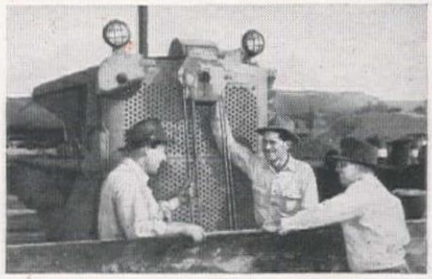
The northern half of Idaho experienced one of the driest Aprils in fifteen years, which lowered volumes of water forecast about eight per cent on the average. However, a good to excellent water supply is assured with high run-off already recorded on many of the rivers. The flood potential which has existed has been reduced because of the high flows during April and the low precipitation which occurred. The south-

Continued on page 136





Even wear-rate of a Tiger Brand line on one of the cranes at left, is pointed out to Mr. Furgeson by Master Mechanic Bob Rice, who says: "We've used Tiger Brand Wire Rope almost exclusively on this job. By giving us uniformly long life, it has cut replacement costs and reduced down-time expense on our equipment."



Free services of a Tiger Brand Representative have been available to Winston Bros. Company during construction of the $3 million left embankment and gate structure of the Whittier Narrows Dam, on California's San Gabriel River. By using the correct rope for each job, the company has secured better results.

"We've gotten long life from our Tiger Brand lines here at the Whittier Narrows Dam project," says B. H. Furgeson, above, grade foreman for Winston Bros. Company, Monrovia, Calif. "Despite strong water suction and heavy loads of wet sand, we've had to replace far fewer lines than usual!"

Winston Bros. cuts building costs with Tiger Brand Wire Rope!

For any construction 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. Contact your local distributor or write Columbia-Geneva Steel, Room 1422, Russ Building, San Francisco 6.

USS

U·S·S TIGER BRAND Wire Rope

Columbia-Geneva Steel Division, United States Steel Company, San Francisco

UNITED STATES STEEL

ern half of Idaho still had an extremely heavy snow pack as of May first. Flood potentials on the Boise, Payette, and Weiser rivers remain high. The Weiser, Big Wood, and Big Lost rivers were over flood stage during the month of April and still have a dangerously heavy snow pack at this date. The Snake River also was at flood stage for a portion of the month of April, but because of reservoir storage space, will probably be satisfactorily regulated, although high flows are in prospect as the snow-melt reaches its peak.

Montana

Snow survey measurements made on or about May 1 indicated that the high elevation snow is holding in good shape. Temperatures above average and precipitation below average in April have depleted the low elevation snow fields. Very little snow remains below 5,500-ft. elevation.

Stream flow has been high during April and will remain high as the snow-melt season continues during May and June. Seasonal stream flow forecasts have been adjusted slightly downward by virtue of the lack of precipitation during April.

The forecast for April-September, South Fork of the Flathead near Columbia Falls has been reduced from 2,630,000 to 2,135,000 acre-feet. The forecast for the Clark Fork at Herron has been reduced from 14,232,000 to 12,004,000 acre-feet.

Forecasts of flow of streams on the Missouri River side of the Continental Divide were reduced about 10% from the amounts forecast on April first.

New Mexico

Little change from that forecast on April first.

Nevada

The only forecast change for Nevada is for the Humboldt River at Palisade. April 1 forecast of 400,000 acre-feet was revised May 1 to 500,000 acre-feet, or 250% of normal. All streams in Nevada are approaching the seasonal peak with most peaks due the latter part of May. Most low snow had melted by May 1 with high snow just beginning to contribute to streamflow. Low-lying meadows along all streams are inundated and will remain so into late June or July. All reservoirs will fill to capacity and spill.

Oregon

State-wide precipitation during April averaged about 60% normal, varying from 35 to 37% normal in the Columbia River and central Oregon areas to 80 and 84% normal in the Blue and Wallowa Mountain areas. Southeastern and southcentral Oregon were about 70 and 65% normal, while southern Oregon had 43% and Willamette Valley 49% normal. Even so, several new records of streamflow for April were established. Among these several are outstanding and will be of general interest.

Inflow to Upper Klamath Lake during April has been tentatively figured at 430,000 acre-feet this year, compared to

Concluded on page 138

MILLIONS SAVED

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Whiteman

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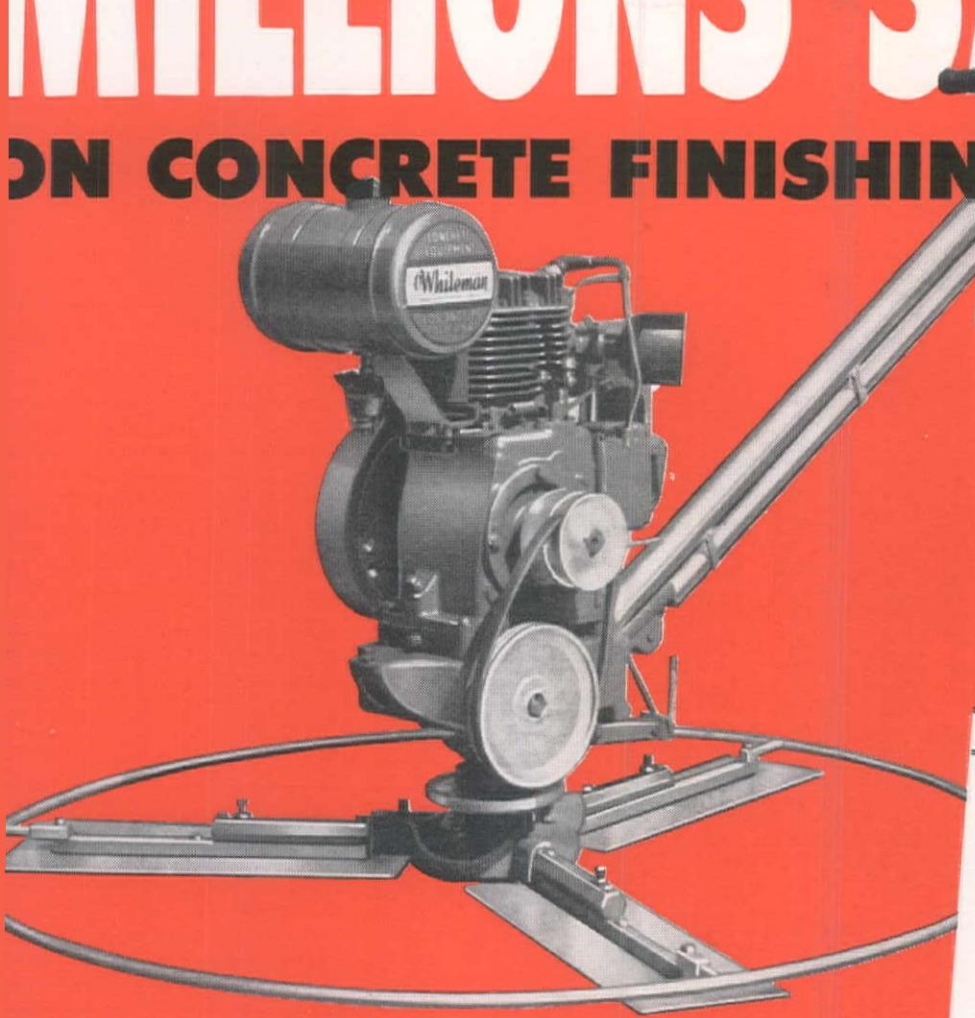

IN USE 10 YEARS! STILL GOING STRONG

ROBERT E. McKEE
GENERAL CONTRACTOR INC.

Los Angeles 39, California

Whiteman Manufacturing Company

Gentlemen:

The Whiteman Floating-Finishing Machines which we bought 10 years ago are still in use and doing a good job. We have purchased many more of these machines and find them to be highly efficient, dependable and great time and money savers on the job.

Very truly yours,

ROBERT E. MC KEE
GENERAL CONTRACTOR, INC.

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During the past 13 years, Whiteman Floating and Finishing Machines have saved millions of dollars in construction costs for contractors the world over. Constantly improved over the years, the new Model "B" is finer, more powerful than ever. Heavier 1″ spider arms maintain uniform pressure for the full width of trowels. Patented "snap-on" trowels for floating. Both sides of finish trowels are used—not just one. New Whiteman centrifugal clutch tightens belt automatically. Trowel pitch is easily adjustable when machine is in motion... another *exclusive* Whiteman feature. Gas engine or electric motor. Also available in Model "J" for smaller operations. You, too can save on concrete finishing! Send coupon for prices and literature.

Veterans Hospital, Spokane, Wash. Statler Center, Los Angeles, Calif. Hollywood Park, Inglewood, Calif.

A few Robert E. McKee projects on which Whiteman equipment has been used.

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Please send prices, literature and name of distributor for ☐ Screeding Machines. ☐ Power Buggy ☐ Floating Finishing Machines.

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MAY SNOW SURVEYS

. . . Continued from page 1

the previous April record of 346,0 acre-feet measured in 1906. The heavie flow into Klamath Lake for any sing month was measured in March of 19 at 367,000 acre-feet.

Average daily second-foot flow Rogue River above Prospect durin April was about 2,050, compared to th record of 1,691 second-feet establishe in April of 1943.

Run-off of Owyhee River into th huge Owyhee Reservoir was measure at 939,875 acre-feet during April th year, compared to 810,000 acre-fe which was the previous all-time reco measured in April of 1892.

May first revisions of Oregon's 19 water supply prospects continue to ind cate that the entire state should receiv "excellent" to "abundant" supplies th summer. Stored water in reservoirs ha now come up to 112% average and wat has been spilled from 12 out of 24 of th larger reservoirs to provide space fo later inflow.

Utah

Little revision of April first forecast The flood potentials foreseen from th early winter snow surveys are now bein realized.

Washington

The northern portion of Columbi Basin in Washington and British Co lumbia was unusually dry and warm dur ing April. As a result, the high floo potentials which existed on the main Co lumbia, Kootenai, Spokane, and lowe Snake River were reduced considerabl Heavy run-off was recorded on thes rivers during April, which means tha large volumes of water are already safel down the rivers. The total volumes fore cast were reduced by about 8% for th season. Even with this reduction, goo to excellent water supplies are forecas with above-normal high water as th melting snow produces its maximu contribution.

Wyoming

Precipitation during April was onl slightly above normal; therefore, th forecasts based on snow surveys hav not been changed. An excellent wate supply for the Jackson area and adjacen area in Idaho is assured. Jackson Lak Reservoir has been lowered in anticipa tion of the heavy run-off.

The Wind River Basin in Wyomin has felt the early spring melt wher snow depth and water content of snov has dropped abnormally. The Popo Agi River Basin was not affected too se verely, however, by virtue of the heav snow pack in that area.

The flow of the North Platte is be coming critical. The inflow to the Nort Platte reservoir system (total capacit about 2,400,000 acre-feet) was 240,00 acre-feet during April. April-July inflo is expected to be 1,200,000 acre-feet an uncontrolled spill is almost certain. Th reservoirs are only 400,000 acre-fee short of capacity.

NEW BOOKS

FOUR PLACE INFLUENCE LINE TABLES for moments, shears and reactions—Griot-Lorsch

Those of you who read the review of Prof. Kleinlogel's "Rigid Frame Formulas" will be interested in this splendid translation, and revision of Gustav Griot's book by Harold G. Lorsch, C.E., C.C.N.Y. This little book is an engineering time-saver since these four-place influence line tables reduce the work required for the analysis of continuous beams under dead and live loads, and the tables can be used in conjunction with A. Kleinlogel's book. Tabular values appearing in the book were reached analytically by two separate methods and subsequently checked by large-scale graphs. Published by Frederick Ungar Publishing Co., New York. 87 pages, 6½ x 9½. Price $3.75.

AMERICAN WOODS—Schoonover

Shelly E. Schoonover, retired regional fiscal agent for the U. S. Forest Service, covers over 150 species of American wood in this very interesting book. Of importance to designers and constructon men, Schoonover gives for each wood mentioned: the tree from which it comes and area to which it is native, a comprehensive list of the common names given the wood in use; the growth range; complete descriptions of the wood itself (including color, grain, workability, etc.) and finally a tabulation of its uses. There are photographs and an interesting series of color panels on wood grains for the readers' convenience and interest. There is a table of contents for easy reference to the woods and a list of illustrations, plus a list of selected references and an index. Published by Watling & Co., Santa Monica, Calif. 250 pages, 7 x 10½. Price $7.50.

ANALYTICAL MECHANICS FOR ENGINEERS, 4th Ed.—Seely and Ensign

Fred B. Seely and Newton E. Ensign place the emphasis in this book as in the previous editions upon "the use of general steps and procedure in analyzing problems in equilibrium and dynamics." Contains: Part I—Statics; Part II—Kinematics; Part III—Kinetics; Part IV—Special topics. There is an appendix on First moments and Centroids moments in inertia. Published by John Wiley & Sons, Inc., N. Y. 443 pages, 5½ x 8½. Price $5.50.

MECHANICS OF VIBRATIONS—Hansen and Chenea

Perhaps the best way to acquaint you with the material contained in this book by H. M. Hansen and Paul F. Chenea, University of Michigan, Department of Engineering Mechanics, is to say that it is a balanced presentation of funda-

mental theory which offers: General concepts—then systems of one degree of freedom, systems of several degrees of freedom, special topics and finally general problems on each of the book's 10 chapters. Material is presented in middle-of-the-road manner, which avoids the complexities of becoming too advanced and yet does not present its material in an elementary manner. Published by John Wiley & Sons, Inc., N. Y. 417 pages, 6 x 9½. Price $8.00.

MASONRY SIMPLIFIED, Vols. I, II—by Dalzell-Townsend

These books deal with the tools, materials and practices of masonry work (Vol. I) and construction details (Vol. II). There are tips of trade which, as the publisher points out, were previously available only by word of mouth. There is a step-by-step explanation of unit masonry with many carefully portrayed illustrations, and, perhaps one of Volume I's prime features is a complete section on blueprint reading from the practical point of view of the mason. The books read from cover to cover could easily be considered practical texts—and once completed should find a place in any construction office or library as valuable reference sources. Published by American Technical Society. 6 x 8½, 368 pages. Price $4.50 (Vol. I), $5.00 (Vol. II).

FACTORY PLANNING AND PLANT LAYOUT is a book which might be of interest to the construction industry from the view point of what modern factories require in the line of space, equipment, departmentalization, etc. William Grant Ireson presents this book as a collection of knowledge on a subject which has not been written about extensively, except in papers and articles. The round-up of plant requirements should help those interested in designing plant structures. Published by Prentice-Hall, Inc., New York. 385 pages, 6 x 8¾. Price $7.35.

HEATING, VENTILATING, AIR CONDITIONING GUIDE is the 30th edition of this annual publication of the American Society of Heating and Ventilating Engineers. With many new additions and revisions, this is a storehouse of information in the field. It is fully illustrated with diagrams, etc. Published by the American Society of Heating and Ventilating Engineers, New York. 1495 pages, 6¼ x 9¼. Price $7.50.

Books reviewed in this section are made available by J. W. Stacey, Inc., retailers of technical books (stores at San Francisco and Denver). You may obtain a copy of any book reviewed this month by sending an order to J. W. Stacey, Inc., c/o Western Construction, 609 Mission St., San Francisco 5, California. C.O.D. orders will be accepted.

READER COMMENT

Editor, *Western Construction:*

Reference is made to the letter t
Editor, *Western Construction*, May 195
from W. W. Moore concerning th
article entitled "Building Settlemer
Tests on Two Foundation Types."

It is unfortunate indeed that M
Moore finds it necessary to read implica
tions into the above article which ap
peared in *Western Construction*, Marc
1952. This article was written for th
purpose of describing methods and cost
involved in the settlement observatio
and foundation investigation program
The objective in mind was to promot
the keeping of settlement records, t
emphasize their value, and to illustrat
that such programs can be carried ou
economically, as well as effectively. Th
controversy over bearing capacity an
settlement estimates was mentione
merely as background material and n
attempt was made to compare criticall
the recommendations made by M
Moore's firm with the observed action o
the buildings.

The above mentioned letter notes sev
eral items concerning the paper whic
should be clarified further. Mr. Moor
correctly points out that the pictures o

CALENDAR OF MEETINGS

June 16-18—**Western Safety Conference,** Municipal Auditorium, Long Beach, Calif.

June 16-21 — **American Society of Civil Engineers,** Denver Convention, Cosmopolitan Hotel, Denver, Colo.

June 23-27—**ASTM, 50th Anniversary meeting,** Statler Hotel, New York, N. Y.

June 23 to July 5—**4th Institute of Northwest Resources,** Oregon State College Campus, Corvallis, Ore.

June 23-27 — **American Society for Testing Materials,** Annual Meeting, New York City, New York.

June 26-28—**Symposium on Earthquake and Blast Effects on Structures,** University of California campus, Los Angeles, Calif.

July 21-25—**Conference on Clays and Clay Technology,** Berkeley campus, University of California.

July 28-Aug. 1—**USBR Conference of 1952,** Cody, Wyo.

August 24-27—**58th Annual Congress of the American Public Works Association,** Los Angeles, California.

September 3-13—**American Society of Civil Engineers,** Centennial Celebration, Conrad Hilton Hotel, Chicago, Ill.

e two buildings were interchanged and correctly labeled in the article. This as regrettable, but resulted from an ror in publication.

I wish to assure Mr. Moore that the ttlements reported in the article repre- nt total settlement for both buildings. preloading surcharge was applied in a ction of the Food Technology Build- g after the footings were poured and ttlement readings begun. In this con- ction, a buried bench mark was ob- rved and no measurable settlement due the surcharge fill was apparent.

A comparison of the structural con- lerations in each building is, of course, portant. However, it is believed that e column loads in the Food Technol- y and Animal Industries buildings are t so different nor the soil profiles so ssimilar as to preclude drawing inter- ting comparisons of the action of the o foundation types.

It is important to note in this respect at all other buildings on the campus e founded on spread footings with de- gn loads considerably in excess of ose recommended by Mr. Moore's m. There are no buildings constructed piles. Yet, a careful examination of buildings revealed no excessive struc- ral damage which could be attributed rectly to differential settlement or ear failure of the soil. It was only be- use of the adverse recommendations the firm of Dames & Moore that the cessity for a settlement observation ogram was noted by college author- es. The purpose, as pointed out in the ticle, was to provide a basis for future sign in view of the difference of inion concerning these two buildings. rtainly these settlement records will invaluable in this respect.

Mr. Moore's statement that this article "likely to do harm to the engineering ofession and to hamper general and oper use of soil mechanics" is un- endly, to say the least, and it is difficult r the authors to determine what may ve prompted such a statement. It is e authors' contention that this article scribes methods that **will** promote the roper use of soil mechanics" in its use- l relation to structural engineering, as posed to a **detached** science based en- ely on laboratory soil tests.

PHILIP P. BROWN
Formerly of Civil Engineering Department,
Oregon State College

pril 30, 1952.

lyde Kennedy, prominent Vestern engineer, succumbs

LYDE C. KENNEDY, 71, dean of nsulting sanitary engineers in the est, died April 25, following a short ness. Mr. Kennedy was the founder d senior partner of the engineering fice of Clyde C. Kennedy in San Fran- sco. He established the office 35 years o. The office is being carried on by his o sons, Richard and Robert who have en partners for several years.

Many of the major water and sewage eatment projects in the West were de-

signed under Mr. Kennedy's direction. Some of these larger plants include San Francisco's recently completed North Point and Southeast Sewage Treatment Plants and the older Golden Gate Park Plant. His sewerage projects have also included Tacoma, Washington; Phoenix, Arizona; and Sacramento, Pittsburg, San Leandro and Stockton in California. Water supply projects have included Phoenix as well as Eureka, Calistoga and Novato in California. During the war numerous projects were carried out, the largest of which was the Naval Supply Depot at Clearfield, Utah.

C. C. Kennedy was born in Indiana in 1881. He received an A.B. degree from Earlham College, Indiana, and an M.S. degree from the University of California. During World War I he served as a captain in the Sanitary Corps. He was a life member of the American Society of Civil Engineers, a member of American Water Works Association, American Association for the Advancement of Science, and California Sewage Works Association; a founding member of the Federation of Sewage Works Associations, and a fellow in the American Public Health Association. As a Quaker he was long a trustee of Whittier College.

In 1926, when *Western Construction* (then *Western Construction News*) was founded, Mr. Kennedy served on the editorial staff in an advisory capacity. During several years he was actively associated with establishing the editorial pattern of this publication.

Engineers' approval asked for Oregon bridge plan

OFFICIALS of Wasco County, Oregon, have requested permission from the Portland District, Corps of Engineers to construct a bridge across the Columbia River at Three Mile Rapids.

The proposed site is downstream from Covington Point, where bridge construction was started but had to be abandoned on the Corps' orders.

Plans call for a fixed structure at right angles to existing channel and the lower entrance to the planned The Dalles dam navigation locks. Clearance would be 566 ft. horizontal at normal water level in the main channel, and 86.2 ft. vertical. Over the proposed locks at normal water level, clearance would be 250 ft. horizontal and 102.2 ft. vertical.

USBR bid calls issued for several Western jobs

BUREAU of Reclamation bid calls during the past month included the distribution at Madera for the Central Valley Project in California. This job includes 1,210,000 cu. yd. of excavation for laterals.

Calls were issued for prospect diversion dam and canal construction on the Eden Project, near Farson, Wyoming, on Little Sandy Creek. Work involves a 40 ft. long, 4 ft. high rock weir, and 12 ft. of earth dike. A .5 mi. reach of 15 cfs. capacity prospect canal and canal headworks structure are also included.

Calls were anticipated for construction of the distribution system near Moses Lake, Washington, for the Columbia Basin Project. Work involves construction of 3 mi. of distribution system of 2 to 5 cfs. capacity for part-time farm units on East Low Canal, consisting of 1 mi. of precast concrete pipe line with appropriate turnout structures to 5 part-time farm units, and about 1.5 mi. of cfs. pipe and unlined wasteway for interception and conveyance of ground water.

New Mex. highway dept. to build new facilities

THE NEW MEXICO State Highway Department plans to build a district shop and office facilities in Albuquerque on a 10-acre tract on South Broadway near Miles Rd.

An error on page 68

IN THE ARTICLE discussing the design of 100- to 120-ft. long concrete girders for bridges in Oregon, it is incorrectly stated that the design stress is based on 2,300-lb. concrete. According to the original manuscript prepared by G. S. Paxson, Bridge Engineer, Oregon State Highway Department, the stress is based on 3,300-lb. concrete.

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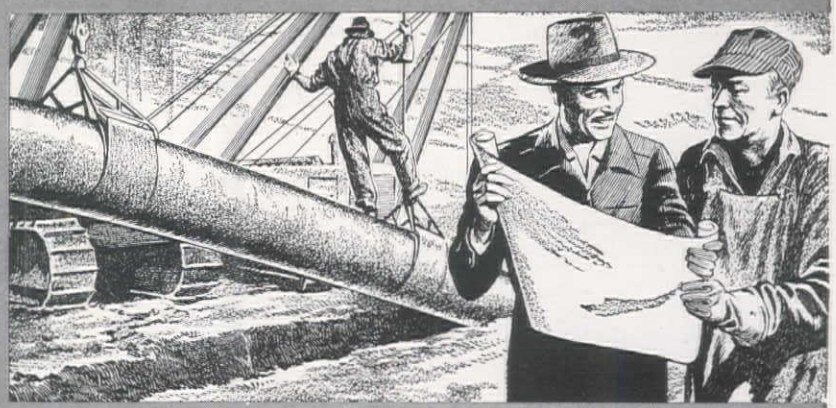

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ENGINEERS ON THE MOVE

E. R. (Ray) Huber has been appointed regional engineer of Region 3 of the U. S. Forest Service, succeeding **Howard Waha,** who retires after many years of service. Region 3 includes the national forests of Arizona and New Mexico. Huber will headquarter in Albuquerque.

* * *

Leigh Morgan is the newly appointed acting city engineer of Havre, Mont. He will hold the appointment until **John Haugen** returns from a tour of duty with the U. S. Army in Germany. Morgan has been assistant city engineer since 1951.

* * *

Harry Larsen is now an engineer with Ben C. Gerwick, Inc., San Francisco. He will be engaged in engineering construction work.

* * *

Frank A. Kittredge, chief engineer of the National Park Service, retired May 31. Kittredge served with the Bureau of Public Roads before and after World War I. The Going-to-the-Sun highway in Glacier National Park was a product of Kittredge's design, and he was a principal in creating a workable program for national park roads, including those in Yellowstone.

* * *

Raymond F. Grefe steps into a new position as chief of engineering for the Pacific Northwest Region of U. S. Forest Service. Grefe succeeds **James Frankland,** who retires.

* * *

Lloyd Inman is the new assistant manager of Longview, Wash., Municipal Water Department.

* * *

Samuel C. Jacka has a new assignment in Berkeley, Calif., as director of public works. Jacka has been the acting director since the departure of **Richard Gallagher** to become public works director in San Diego, Calif.

* * *

The post of Assistant Chief Engineer, Riverside County Flood and Water Conservation District, Calif., goes to **Fred S. Haines.** Haines worked on the Colorado River Aqueduct from 1926 to 1939.

* * *

Harry E. Jordan, secretary of the American Water Works Association, is going to Paris for the June 9-13 meeting of the International Water Supply Association.

* * *

Gilbert H. Dunstan has a new position as professor of sanitary engineering, Department of Civil Engineering, and sanitary engineer, Division of Industrial Research, Washington State College. Dunstan comes to the West from the University of Alabama's sanitary engineering department.

* * *

Col. E. G. Itschner is now in Portland, Ore., to assume his new duties as North Pacific Division engineer, Corps of Engineers. Itschner replaces **General O. E. Walsh,** who goes to the Mediterranean Division in North Africa as division engineer. Itschner served in the Pacific Northwest on a previous occasion as Seattle district engineer from August 1949 to September 1950. Following a tour of duty in Korea, during which he was wounded, Itschner became engineer of the Fifth Army Corps in Chicago.

Itschner

Douglas

Col. Henry G. Douglas is assigned to head the newly established San Francisco, Calif., field office of the engineer inspector general, 130 Sutter Street. Douglas will work directly under the Chief of Engineers, Washington, D. C., in his new position—inspections and investigations in the North and South Pacific divisions of the Corps, including all civil and military construction being accomplished in the states of Montana, Idaho, Washington, Oregon, California, Nevada, Utah and Arizona, plus Alaska and Hawaii.

* * *

Bob Kyle takes over new duties as city manager of Coos Bay, Ore. Kyle was the former city engineer of North Bend and at one time, assistant city engineer in Corvallis.

* * *

After 27 years of service, **Anthony J. George** retires as superintendent of sewer construction for Salem, Ore.

* * *

Eugene I. Pease retires from his position with the Seattle District Corps of Engineers after 41 years of continuous service. Pease was the only professional engineer employed in the Seattle District at the inception of the Columbia River "308 Report" work. In his capacity as chief of the engineering division, Pease was responsible for the Seattle District's work on "308." He also served as full time engineering consultant to the District Engineer in the international integration of long-range programs for development of the potential power resources of the Columbia River and its tributaries in Canada and the U. S.

* * *

Glen Sherwood, formerly with the California State Highway Department at Eureka, is now assistant city engineer in Pullman, Wash.

* * *

Ira K. Young, Pueblo, Colo., is the chairman of the newly created Colorado State Highway Commission. He was chairman of the old highway advisory board.

* * *

For an idea that saved the government nearly a quarter of a million dollars, **H. C. Brunyer,** inspector for the Bureau of Reclamation at Coulee Dam, received a $100 award. Brunyer suggested the use of a steel frame for seat construction to "set" the floating caisson for the repair of the spillway bucket at Grand Coulee Dam. The device he suggested made possible rapid and watertight seating of the floating caisson used to repair the spillway bucket. Its use shortened the programmed time for the entire maintenance job from five to three years.

* * *

William E. Wheeler, civil engineer for the Bureau of Reclamation at Hungry Horse Dam, transfers to the State Department for assignment to Iran under the Point Four program. He will be construction engineer in charge of construction of irrigation system facilities.

* * *

William Killmore now serves in Billings, Mont., as chief of the Bureau of Reclamation's Region 6 construction branch, Division of Design and Construction.

* * *

Retirement of **William R. F. Wallace** as assistant Arizona district engineer, U. S. Bureau of Public Roads, is announced. Wallace's retirement prompted commendations from the State Highway Department and other prominent Arizona groups for his 32 years of service to the field of highway construction.

* * *

Holmes & Narver, Inc., engineers-constructors, announce that **J. Frank Geary,** mining engineer, has joined the firm as head of its mining division. Geary will locate at the firm's home offices, 828 So. Figueroa St., Los Angeles, Calif. **Howard W. Hall** joins the firm as vice president.

* * *

Wyoming State Highway Department personnel changes include: promotion of **Kirby H. Olds** from road designer to assistant road design engineer; **Warren A. Gallup** from project engineer at Lusk to planning engineer at Cheyenne, and **M. A. VerBrugge** from materials engineer to assistant chief material engineer. **George A. Brown, Jr.,** becomes a project

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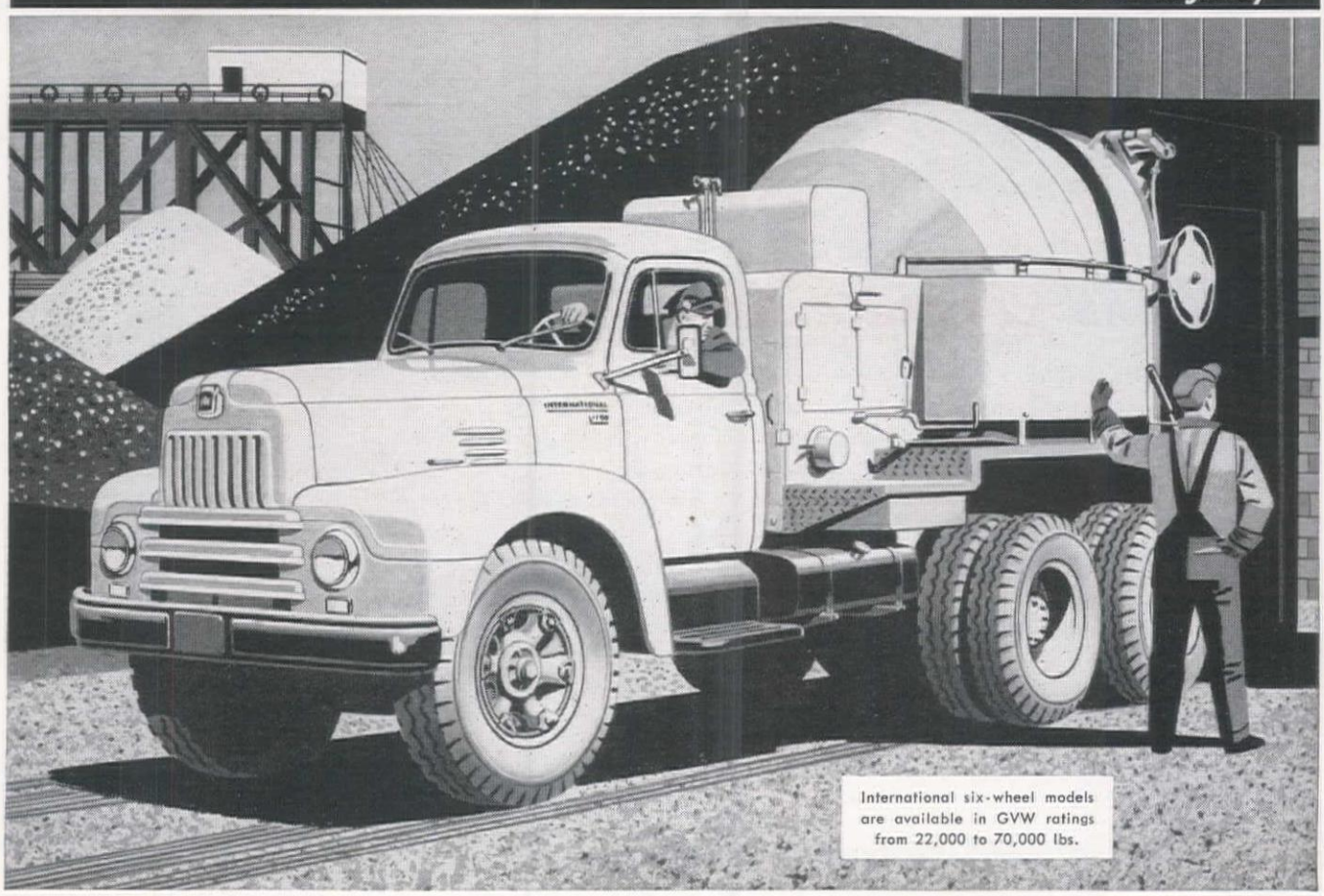


International six-wheel models are available in GVW ratings from 22,000 to 70,000 lbs.

engineer, and **G. T. Bath** moves from planning engineer to secondary engineer.

* * *

Franklin Thomas, prominent Southern California figure who serves as a director of the Metropolitan Water District, chairman of the Colorado River Board of Calif., and Dean of Students at California Institute of Technology, is Southern California's "man of the year" by the vote of more than 1,000 members of the area's construction industry.

* * *

Richard T. Montgomery is expected to receive an appointment as chief engineer for Glacier National Park. Montgomery succeeds **Ira S. Stinson,** who moves to park service's general offices at Omaha, Neb.

* * *

Paul J. Cannell, recently an associate of Knappen-Tippetts-Abbett-McCarthy Engineers, San Francisco, is now executive director for the Missouri Basin Survey Commission.

* * *

D. L. Cheney is again the elected president of the Alaska Chapter of Associated General Contractors. Cheney is vice president of S. Birch and Sons. Other reelected officers of the chapter are: **A. M. Strandberg,** vice president; **John J. Grove,** secretary-treasurer. The directors for 1952 are: **M. P. Munter, D. W. Clayton, C. William Hufeisen, G. E. Lefler,** and the three reelected officers. **Larry Moore** is chapter manager and **Vic Guns** is assistant manager.

***D. L. Cheney,* re-elected president of the Alaska AGC. (See item.)**

DEATHS

Allen R. Pease, 66, structural engineer, died in Los Angeles, Calif.

* * *

Brig. Gen. James A. O'Connor, 66, builder of Alaska's military road died March 23 of a heart attack in Los Angeles, Calif. O'Connor was head of the Northwest Service Command from 1942 to 1944.

* * *

Andrew Carruthers, 57, civil engineer, died April 12 in his Brigham City, Utah, home. Carruthers was city surveyor in Brigham City and a resident engineer for the State Road Commission.

* * *

Frank Reagan, 80, superintendent of construction, died April 11 in Portland, Ore. Reagan supervised construction of several of Portland's prominent buildings.

* * *

Eugene Schaub, 69, Cache County, Utah, surveyor, died March 19 in Logan, Utah. Schaub had been county surveyor for 40 years. One of his first projects had been laying out the main Logan Boulevard.

* * *

E. T. Thurston, 79, civil engineer, died in Oakland, Calif. Thurston was for many years superintendent of buildings in the City of Oakland.

* * *

Charles B. Wegman, contractor, died April 16 in Portland, Oregon. Wegman's firm constructed the Vanport housing and industrial developments during World War II.

* * *

Darwin H. Strong, 80, construction engineer, died April 1 in Los Angeles, Calif. Strong was an engineer for Los Angeles Gas & Electric Corp. before his retirement.

* * *

C. Laurence Warwick, executive secretary of American Society for Testing Materials, died April 23 in Philadelphia, Pa. Warwick made many contributions to the field of standardization and research in materials.

Harold W. Yost, Yost & Gardner, Phoenix engineers, received the Arthur Sidney Bedell Award "for outstanding personal service in the sewage works field as related particularly to the problems and activities of the Arizona Sewage and Water Works Association."

* * *

David A. Stoner, Bureau of Reclamation regional chief of irrigation operations at Sacramento, Calif., leaves for India to assist in an Indian government famine relief program for increased food production with irrigation water obtained from 2,000 new wells.

* * *

Harold N. Corbin is city manager of Boulder City, Nev. Corbin's appointment marks another step in the gradual direction of self-government for the Bureau of Reclamation-built community near Hoover Dam. Eventually, the city will be a municipality, which will incorporate under the laws of Nevada.

* * *

Charles Foulke is the acting city engineer of Redlands, Calif., on a part-time basis. Foulke, who was once city engineer in San Bernardino, is on a temporary appointment to replace the late **Edgar T. Hamm** until a permanent appointment is made.

* * *

R. A. Smith, vice president of the Southern California Chapter of the Associated General Contractors of America, now occupies a seat on the California State Apprenticeship Council. Governor Earl Warren named Smith to succeed **C. A. Myers** of Los Angeles.

* * *

Neil Burke is the new city engiener of Englewood, Colo. In his new position as head of the department of public works, Burke's first assignment will be to establish grades on the city's streets. Burke comes to this new post from an Oklahoma consulting engineer's firm.

* * *

J. A. Merchant has been appointed registrar of the Association of Professional Engineers of British Columbia. Merchant replaces **R. E. Wilkins,** who has been appointed supervisor of civil engineering for British Columbia Electric.

* * *

E. A. Moritz, director of the Bureau of Reclamation's Region 3, received the Department of Interior's highest honor —distinguished service award—"for an eminent career of 31 years in government service." The award was presented by Commissioner Michael Straus during the dedication of Arizona's two new 82,500-kw. generators in Hoover Dam power plant.

* * *

Ralph W. Butterfield is appointed assistant director of the contracts and supply division of the U. S. Atomic Energy Commission. Butterfield has had a long career in government.

SUPERVISING THE JOBS

Columbia River Constructors, Inc., have **P. J. Soukup** as project manager, **George Piedmont** as general superintendent and **G. M. Shupe** as project engineer on the construction of the Chief Joseph Dam powerhouse in Washington. This is a $39,749,997 project.

* * *

W. O. Lane is supervising the job for McKinnon-Decker Co. on 7.7 mi. of grading, gravel surfacing, road-mix oil, highway between Ethridge and Shelby, Toole County, Mont. **Arnold Powell** is grade foreman on the $351,862 project, and **Red Olson** is surfacing foreman.

* * *

Stearns Eason is superintendent on construction of 1.0 mi. of the Yellowstone Park Highway in Bonneville County, Idaho. **Keith Phillips** is carpenter foreman and **Wilford Taylor** is equipment foreman for Arrington Construction Co. on the $145,309 project.

* * *

Nilson-Smith Construction Co. has **A. L. (Dutch) Willems** as superintendent on the $228.513 project for 18.3 mi. gravel surfacing, road mix oil and drainage structures on the Hogan-Simms Section of the Rogers Pass-Simms Rd. highway, Lewis and Clark and Cascade counties, Washington.

* * *

Jack Harrington is job superintendent for K. F. Jacobsen & Co., Inc., on the $636,216 construction of 4.7 mi. of paving from Castle Rock to Toutle River in Cowlitz County, Washington.

* * *

C. C. Bettancourt is superintendent for Joseph Bettancourt on the $1,471,258 construction of a junior high school building in Vallejo, Calif. **Bill Bassett** is project engineer.

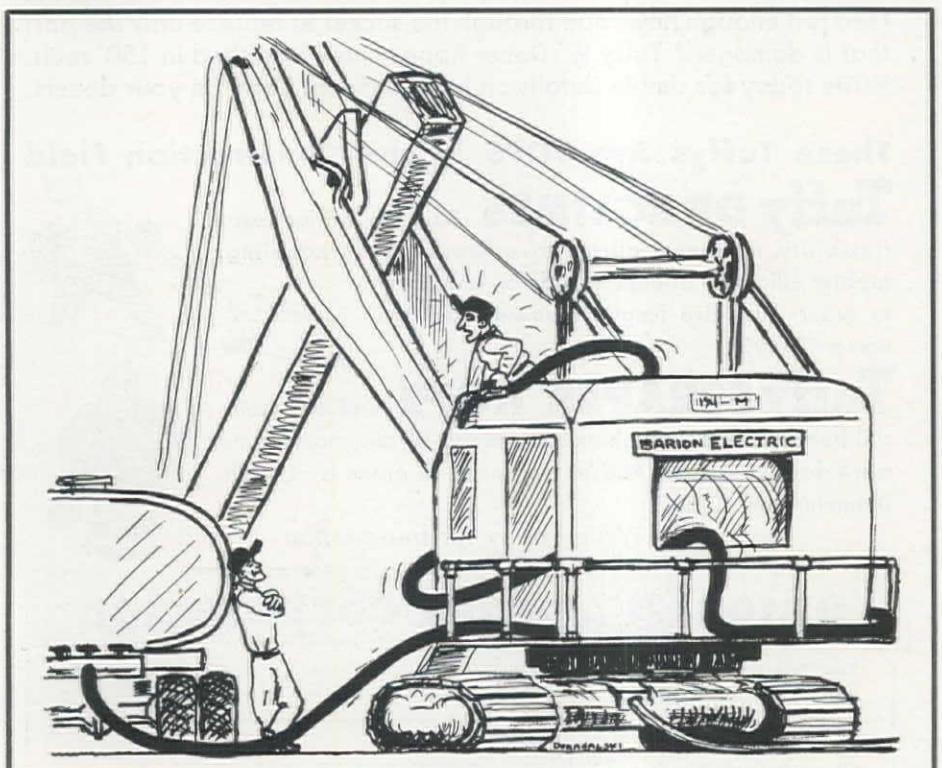
* * *

Pozzo Construction Co. has **Henry VonderKuhlen** as job superintendent on the $1,545,208 construction of a 5-story, reinforced concrete addition to St. Joseph Hospital, Burbank, Calif. **Louis Pozzo** is project manager.

* * *

Combustion Engineering-Superheater, Inc., has **C. B. Roberts** as district superintendent and **M. V. Veney** as erection superintendent on fabrication and erection of a power boiler in Antioch, California, for the Contra Costa steam plant of the Pacific Gas and Electric Co. **E. P. Petit** is assistant erection superin-

Down-time . . . . . By Domagalski



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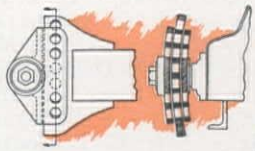

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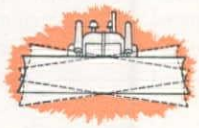

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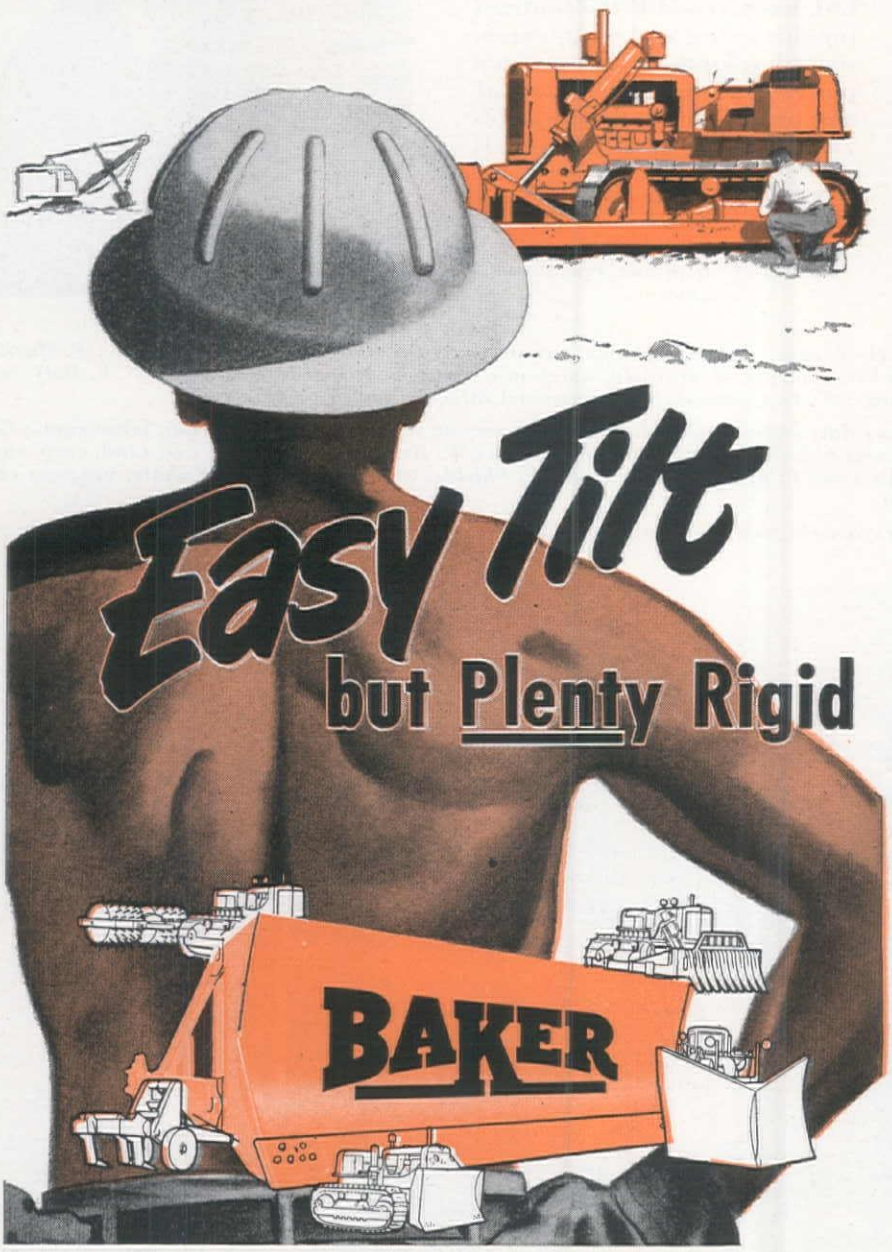

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•

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Casper, Wyoming

tendent on the $6,000,000 project. W. T. Baltezor is general foreman, L. J. Sims is welder foreman, and S. J. Beaver is millwright foreman. Boilermaker foremen are: F. E. Erwin, S. J. DeRosa, A. B. Mayberry, A. W. Egan, T. R. Turley and L. E. Boggess.

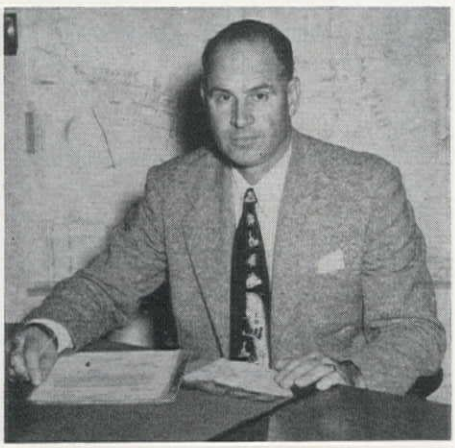
* * *

Cement work on the Gaviota tunnel, recently holed-through, is under the supervision of W. A. Ripley. A. A. Nemitz is carpenter and concrete superintendent, Vern Paul is carpenter foreman and Lloyd Oelschlaegel is tunnel foreman. Leo Doody is powder foreman and Slim Higgins is master mechanic. E. L. Arndt is engineer. Rhoades-Shofner Construction Co. holds the contract.

* * *

Construction of Lookout Point Dam by the Morrison-Kiewit-Macco joint venture is being supervised by H. I. Maxwell. John Erickson is carpenter superintendent, H. D. Adkins and Allen Baskins, concrete superintendents, J. Logan, excavation and fill superintendent and Leonard Kinyon, master mechanic. R. Knapp is quarry superintendent, Everett Woodhead is electrical superintendent and Gordon Marquiss is high line superintendent. S. T. Brown is aggregate superintendent, J. H. Poynter, batch plant superintendent, and Thomas H. Morris is labor coordinator. T. W. Starr is plumbing superintendent. Foremen are: D. E. Flake, general; Alfred Higgins, B. B. Schaffer, H. L. Fosnot, L. L. Bean and L. O. Sparks, carpenter; E. J. Williams, truck; J. Murphy, lubrication; H. O. Dellen, batch plant; H. E. Long, mechanic; J. S. Niemann, screening plant; J. P. Bellegante, shift; J. E. Skene, shift; O. L. Godfrey, ice plant; R. J. Broom, tunnel; M. A. Graham, concrete; G. S. Creacy, shift; R. G. Bostwick, high line; J. E. Hen-

M-K's "Can-do" crew on B. C. hydro project



These men are now at work on Morrison-Knudsen Co., Ltd.'s mammoth hydroelectric project in British Columbia. Aluminum Company of Canada, Ltd. has given M-K the contract for this entire end of an extensive development to provide power for the production of aluminum (see article, pp. 74-76 of the April 1952 issue).

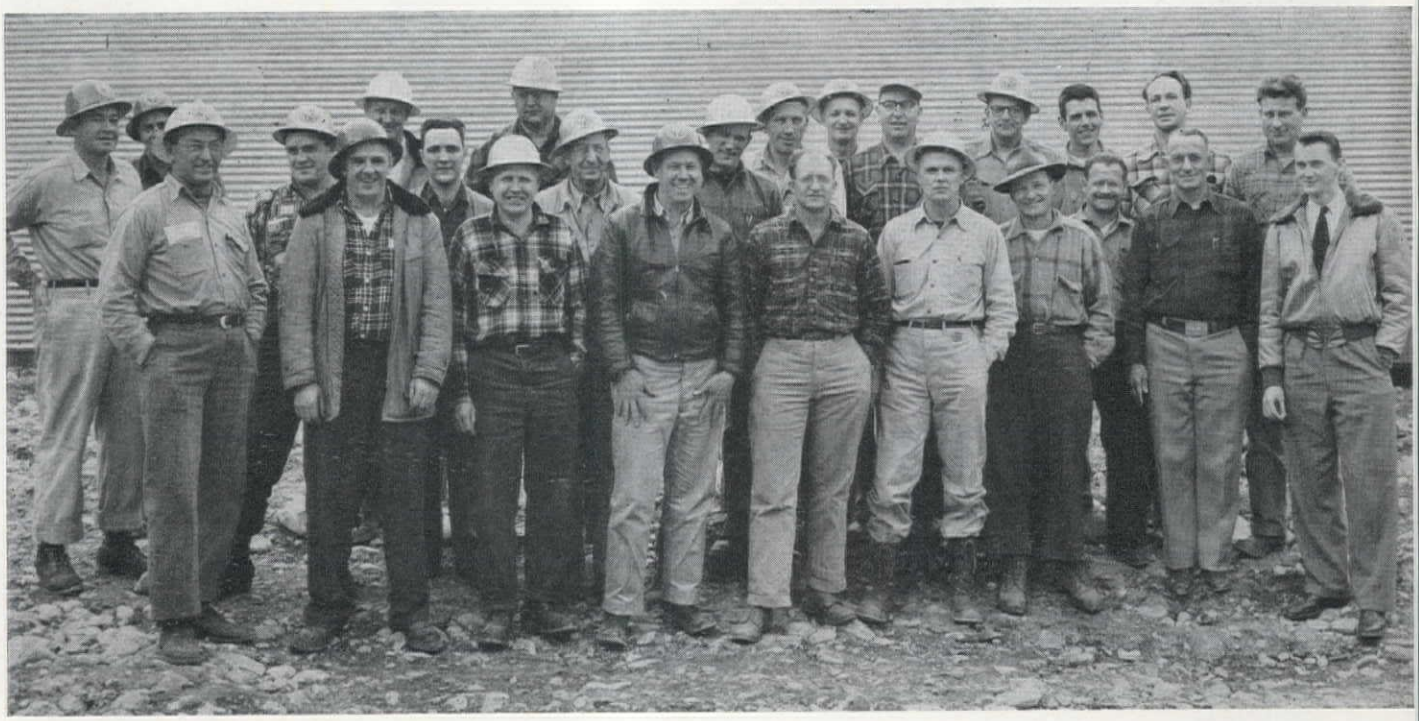
LEFT: *A. O. Strandberg*, project manager.

RIGHT: *G. H. White*, operations engineer.

FRONT ROW—left to right: *Nels Seagrin*, elect. supt.; *Mike Hackman*, tunnel eng.; *Russ Madsen*, asst. proj. mgr.; *F. Buckley*, plumbing supt.; *G. T. Harrison*, transmission line supt.; *H. B. Hatfield*, warehouse supt.; *W. Richards*, road supt.; *N. V. Daly*, labor relations mgr.; *E. H. Steelman*, coding cost eng.; *W. O. Cameron*, asst. personnel director.

BACK ROW—left to right: *M. McKenzie*, heavy duty equip. supt.; *A. Smithies*, concrete supt.; *L. Christopherson*, labor supt.; *G. S. Binger*, transport supt.; *H. Smart*, personnel mgr.; *A. S. Hunter*, batch plant supt.; *W. Hawkins*, mech. supt.; *D. Lind*, carp. supt.; *H. Fisher*, rigger supt.; *W. Whidden*, safety director; *C. Browne*, camp supt.; *F. Shields*, transport supt.; *B. Kuhnle*, progress eng.; *R. Reed*, eng. chief; *F. Mead*, reinf. steel supt.

NOT SHOWN—*Ray Davis*, tunnel supt.; *Mark Knight*, asst. area supt.; *Jim Libby*, construction eng.; *V. A. Roberts*, east side area mgr.; *Al Parkin*, general super., east side.



sley, pipefitter; **H. Mott,** cement finisher; **R. R. Chenoweth,** night walker. **L. E. Steelman** is project manager and **D. M. Drugan** is office manager on the $18,696,000 project. **D. W. Lutes** is project engineer and **J. S. Whitworth,** field engineer.

* * *

General construction for the Crown-Zellerbach Corp. in San Leandro, Calif., is under the supervision of **Cloyd L. St. Clair.** Swinerton & Walberg Co. holds the $1,500,000 contract. **Vern L. Claar** and **Bob Johnson** are carpenter foremen. **Samuel E. Franc, Jr.,** is engineer.

* * *

Douglas Nye is superintendent for Panelcrete of Calif. on construction of a building for Moore Industrial Co., San Jose, Calif. **Gus Lian** is job superintendent on the $500,000 project. Giulio E. Cardarelli has the subcontract on concrete work with **Arnie Heidel** as carpenter foreman.

* * *

The $4,500,000 construction of runways and parking areas at Moffett Field, near Mountain View, Calif., is under the supervision of **R. D. Alexander. Charles La Ha** is general foreman, and **Jack Keller** is master mechanic. **Wayne Alexander** and **Bill Mosley** are excavation foremen. **Gill Southworth** is general concrete foreman and **Hugh Blanchard** is labor foreman. **Vern Swanson** is office manager, **Bill Chance,** business manager and **Ed Haines,** job engineer. Commercial Materials Co. is handling the quarry operations. **Joe Canto** is job superintendent, **Joe Burnside,** master mechanic, and **E. J. Hunt** is office manager.

* * *

Construction of a shop and laboratory building at San Jose, Calif., to cost $600,000, is under the supervision of **Joe O. Olson. A. Pomeroy** and **J. Pellegrino** are carpenter foremen. **C. Staabi** is labor foreman. **C. H. Rossi** is job engineer. Barrett & Hilp holds the contract.

* * *

Air-terminal building construction at Mills Field, San Francisco, Calif., is under the supervision of **F. D. Scott** with **H. K. Nourse** as job superintendent. **Larry Stevens** is carpenter foreman, **Mike Collins** is labor foreman, and Clinton Construction holds the $7,000,000 contract.

* * *

Box culvert construction for the City of San Mateo, Calif., is under the supervision of **C. Cole,** with **Bob Schrott** as carpenter superintendent. **Jack Armstrong** is office manager for McGuire & Hester, holder of the $300,000 contract.

* * *

Construction of a one-story, reinforced concrete office building in Menlo Park, Calif., for the American Insurance Co., is under the supervision of **Jack Myers. Jack Morgan** is carpenter foreman and **Bob Funk** is office manager for The Austin Company.

* * *

Construction of Wilbur Junior High School in Palo Alto, Calif., is under the supervision of **C. L. Mills. George**

Moore and **Fred Samuels** are his assistants. **Floyd Bradford** is general foreman for Howard J. White, Inc., holder of the $1,125,000 contract. **Chuck Rhamy** is general construction foreman. The job consists of eight, one-story frame and structural steel buildings.

* * *

Construction of 19.6 mi. of U. P. railroad and N. P. railroad, Walla Walla and Benton counties, Washington, is being supervised by **M. F. Moulton** for J. A. Terteling & Son, contractor. **John Moyer** is engineer, and **Duke Brown** is office manager.

* * *

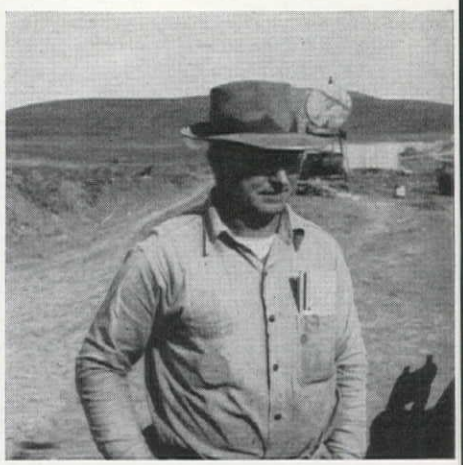
Manson Construction & Engineering Co. has **Gus Lorenz** as superintendent on construction of Oso Bridge and its approaches on Snohomish County Rd. in Washington. **Ole Ronmark** is carpenter foreman.

* * *

Richard Keiser is general superintendent for Ralph Larsen & Son on construction of the ranch-type city hall in Palo Alto, Calif. **A. M. Mitchell** is general foreman. L. C. Smith, grading and excavating subcontractor, has **Dick Dawson** as job superintendent.

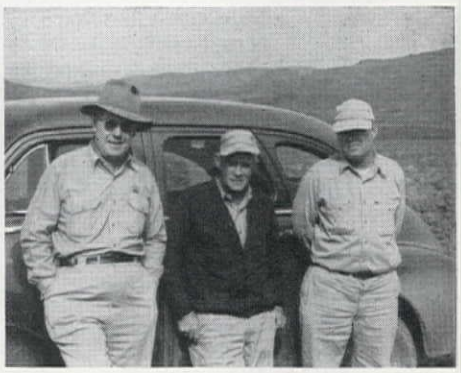
* * *

W. G. Bell is general superintendent for Piombo Construction Co. on construction of the $1,600,000 San Mateo Freeway and Cloverleaf. **W. H. Griggs** is carpenter foreman, **Jim Hawkins** is equipment foreman and **Bud Kerr** is office manager.



ABOVE—Superintendent for United Concrete Pipe Corp.'s $1,674,000 contract on the Hetch Hetchy aqueduct east of Oakdale, Calif., is *Clifford Gee*. The work will be completed this summer, but United stays on with a new contract for rehabilitation work at the Oakdale portal of Foothill Division tunnels on the aqueduct.

BELOW—Wind-up work on the second San Joaquin Valley Division pipeline of the Hetch Hetchy aqueduct is under resident engineer *Tom Condon* (left), with *Bill Jacobs* as senior inspector and *Glenn Smith* as inspector on excavation operations.



A. A. Tuttle is superintendent for C. B. Tuttle, Long Beach, Calif., contractor, on construction of the San Luis Freeway at San Luis Obispo, Calif. **C. O. Bodenhamer** is carpenter foreman. The subcontractor on highway work, Valley Paving & Construction Co., has **Carl Van Derlinden** as superintendent, **John Silver** as grade foreman, **Noel Carmack** as mechanic and **John Oscar Thompson** as powder foreman.

* * *

Haas Construction Co. has **A. G. Johnson** as superintendent and **L. E. Olson** as assistant superintendent on construction of the Pacific Grove sewage treatment plant, Pacific Grove, Calif.

* * *

Paul Stevens is general superintendent for A. W. Stevens Contracting Co. on construction of an overcrossing in Wenatchee, Wash. **J. McKay** is carpenter foreman, **A. Morgan** is reinforcing steel foreman and **C. Lee** is labor foreman.

* * *

Disposal plant construction for the City of Menlo Park, Calif., is under the supervision of **E. F. Walker. C. W. Wig-**

gins is carpenter foreman for Peter Sorensen, contractor. **W. E. Johansen** is cement finishing foreman. West Coast Steel Co. is subcontractor on the reinforcing steel. **R. D. Derringer** is steel foreman.

* * *

Rolf J. Jensen is general superintendent for Barrett & Hilp on construction of O'Connor Hospital, San Jose, Calif., for the Sisters of Charity of St. Vincent's de Paul. **Harold Richardson, Jim Kennedy, Fred Pettijohn** and **John Nelson** are carpenter foremen. **Fred Jans** is concrete foreman, **Cliff Adsit,** labor foreman with **Charles Stanfield.**

* * *

Jack A. Nelson is general superintendent for Nielsen & Nielsen on construction of the $1,000,000 music building at San Jose State College, San Jose, Calif. **L. B. Cooper** is carpenter foreman with **Ted Grund.** Richards Steel Co. has the subcontract. **Norman Johnson** is steel foreman.

* * *

Hospital addition construction in San Jose, Calif., is under **Frank Porter's** supervision, with **Dan Westfall** as his assistant. **Tony Ravetto** is steel foreman on the $1,125,000 project for Elmer J. Freethy, contractor. **Grant Kaufman** is project manager.

* * *

Phil A. Bethel is general superintendent for Rothschild, Raffin & Weirick on construction of the $630,000 Lakeside Elementary School District, San Francisco. Eaton & Smith, excavating and grading subcontractor, has **Bob Trask** as job superintendent.

* * *

A. F. Carlson is general superintendent for Williams & Burrows, Inc., and Carl M. Swensen Co. on construction of Peninsula Hospital, Burlingame, Calif. **A. H. Wilson** is assistant superintendent on the $4,000,000 project. **Stanley Sabotka, A. W. Benning** and **Dwight Fowler** are carpenter foremen. **O. T. Anderson** is concrete foreman, **Thomas Cole,** labor foreman, and **J. D. Ames,** cement finishing foreman. **John J. Legry** is office manager.

* * *

Al Schuff is superintendent on construction of Park Central Medical Building in Phoenix, Ariz. **George Hickman** is general foreman, **Bob Hale** is labor foreman, and **Carroll Oldham** is timekeeper. The project, being built by owners Burgbacher, Burgbacher and Behrstock, will cost $2,500,000.

* * *

Wesley O. Orrestad is general superintendent for H. Halvorson, Inc., on construction of Deaconen Hospital in Wenatchee, Wash., and school construction at Entiat. **Cecil Clemments** is foreman on the hospital project and **John Lamb** is foreman on the school construction.

* * *

In Las Cruces, Calif., where Granite Construction Co. is completing a 3½-mi. highway job, **Mark Sholar** is general superintendent and **J. L. Farrell** is structural superintendent.

CONTRACTS

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

★★

Alaska

$3,525,549—**S. Birch & Sons Construction Co., C. F. Lytle** and **Green Construction Co.,** 208 Central Bldg., Seattle, Wash.—Award for construction of outside utilities at Elmendorf Air Force Base; by Corps of Engineers.

$624,825—**M. R. Smith,** P. O. Box 1953, Anchorage—Award for construction of a utility distribution system in Anchorage; by The Alaska Railroad.

Arizona

$766,370—**Marshall, Haas & Royce,** P. O. Box 95, Belmont, Calif.—Low bid for earthwork, concrete canal lining, structures, Mohawk Canal and Radium Hot Springs flood protection system, Wellton-Mohawk Division, Gila Project; by Bureau of Reclamation.

$299,808—**Lyle Price,** P. O. Box 548, Flagstaff—Low bid for construction of a 26-ft. wide roadway, 5.9 mi. long, bet. Clifton and Alpine in Apache National Forest, Greenlee County; by BPR.

California

$5,000,000—**Arnold Construction Co.,** 962½ S. Atlantic Blvd., Los Angeles—Construction of 500 stucco and frame dwellings, Fairmont Park, San Diego; by Arnold Construction Co.

$234,479—**Guy F. Atkinson Co.,** P. O. Box 259, Long Beach—Low bid for 0.3 mi. of grading and paving with plant mix surfacing and construction of reinforced concrete box girder bridge on Colorado Freeway, Pasadena, Los Angeles County; by St. Div. of Hwys.

$1,433,130—**Guy F. Atkinson,** 10 W. Orange Ave., So. San Francisco—Award for construction of Lexington Dam, near Los Gatos; by Santa Clara Valley Water Conservation Dist.

$297,523—**Barber & Breedon,** 7309 El Cajon Blvd., La Mesa—Low bid for construction of sanitary sewer lines in Madison, Roosevelt and other streets, Carlsbad; by Carlsbad Sanitary District.

$1,133,900—**James I. Barnes Co.,** 262 S. Lake St., Los Angeles—Low bid for construction of a reinforced concrete, 3-story library, Los Angeles; by Board of Law Library Trustees.

$193,754—**Basich Bros. Construction Co., R. L. and N. L. Basich**—Low bid for 11.1 mi. plant mix surfacing to be placed over existing roadbed and seal coat applied, and applying seal coat to about 55 mi. of the existing surface between Indio and Black Butte, Riverside County; by St. Div. of Hwys.

$247,647—**Bebek & Brkich,** 9638 E. Rush St., El Monte—Low bid for construction of a storm sewer separation project bet. Jackson and Santa Clara Sts., and 8th and 21st Sts., San Jose; by City of San Jose.

$261,197—**Bosko & Bradarich,** 8512 Fishman Rd., Pico—Award for sanitary sewers in Sewer District 13-B, Los Angeles; by City of Los Angeles.

$360,264—**Cox Bros. Construction Co.,** P. O. Drawer C, Stanton—Low bid for about 28 mi. of grading and surfacing with plant mix surfacing on untreated rock base bet. Route 60 and 0.2 mi. north of Garfield Ave. in Orange County; by St. Div. of Hwys.

$3,252,200—**Dinwiddie Construction Co.,** Crocker Bldg., San Francisco—Award for construction of 4 storehouses, Naval Air Station, Alameda; by Twelfth Naval District.

$148,868—**G. W. Ellis Construction Co.,** 8240 Lankershim Blvd., North Hollywood—Low bid for 15 mi. of widening, placing imported subbase material, and untreated rock base and plant mix surfacing to be placed over new base and existing surfacing, bet. the south city limits of Bishop and Texaco Corners, Inyo County; by St. Div. of Hwys.

$179,899—**Gallagher & Burk, Inc.,** 344 High St., Oakland—Low bid for surfacing E. 14th St., between 13th Ave. and Derby St., Oakland; by City of Oakland.

$914,182—**John C. Gist,** 1020 46th St., Sacramento—Low bid for construction of two underpasses under the tracks of the Southern Pacific Co. at B St. and Elvas Wye in and near Sacramento, Sacramento County; by St. Div. of Hwys.

$2,617,653—**M. H. Golden Construction Co.,** 3845 Noel St., San Diego—Low bid for construction of eight warehouse buildings at Oceanside; by Eleventh Naval District.

$288,336—**Charles L. Harney, Inc.,** 575 Berry St., San Francisco—Low bid for 0.7 mi. divided highway portions to be graded and surfaced with plant mix surfacing on cement treated base; existing pavement to be widened on other portions and surfaced with plant mix surfacing on cement treated base and on existing pavement; street connections and transitions to be graded and surfaced with plant mix surfacing on existing pavement and on various types of bases; miscellaneous structures and lighting for 6-lane divided highway bet. Castro St. and San Lorenzo Creek, Alameda County; by St. Div. of Hwys.

$1,305,700—**Harry Heirshberg,** 6052 Venice Blvd., Los Angeles—Low bid for construction of the single-story, frame and stucco Centennial High School, Compton; by Compton Union High School District.

$140,378—**C. V. Kenworthy,** Rt. 2, Box 654, Stockton—Low bid for grading about 1.9 mi. on Ukiah-Boonville Rd., bet. 2.9 mi. and 4.8 mi. west of State Highway Route 1, Mendocino County; by St. Div. of Hwys.

$100,000—**Vido Kovacevich Co.,** 5300 Imperial Highway, South Gate—Low bid for 4.1 mi. of plant mix surfacing to be placed over existing pavement on a portion of the project and a portion to be widened with imported subbase material untreated rock base and plant mix surfacing over the new base and existing pavement, bet. Anaheim-Telegraph Rd. and Garvey Ave., Los Angeles County; by St. Div. of Hwys.

$2,366,000—**M & K Corporation, Fredrickson & Watson Construction Co.,** 405 Montgomery St., San Francisco—Award for construction of barracks and mess hall facilities, Moffett Field; by Twelfth Naval District.

$1,607,820—**Robert E. McKee,** 4700 San Fernando Rd., West Los Angeles—Award for general construction, building units at Patton State Hospital; by St. Div. of Arch.

$214,368—**McKinnon Construction Co.,** Rt. 1, Box 187, Sandy—Low bid for earthwork and structures, Lost River Channel improvements, West Canal enlargement, Langell Valley, Modoc Unit, Tule Lake Division, Klamath Project; by USBR.

$209,800—**Merrick Iron Works,** 18th and Campbell, Oakland—Low bid for construction of an upper-deck painting scaffold (traveler) and track, San Francisco-Oakland Bay Bridge; by St. Div. of Hwys.

$180,494—**Midland Constructors, Inc.,** 3332 E. Florence St., Huntington Park—Award for clearing and constructing Madras-Redmond 230-kv. transmission line, 26.1 mi. in length, Jefferson and Deschutes counties; by Bonneville Power Administration.

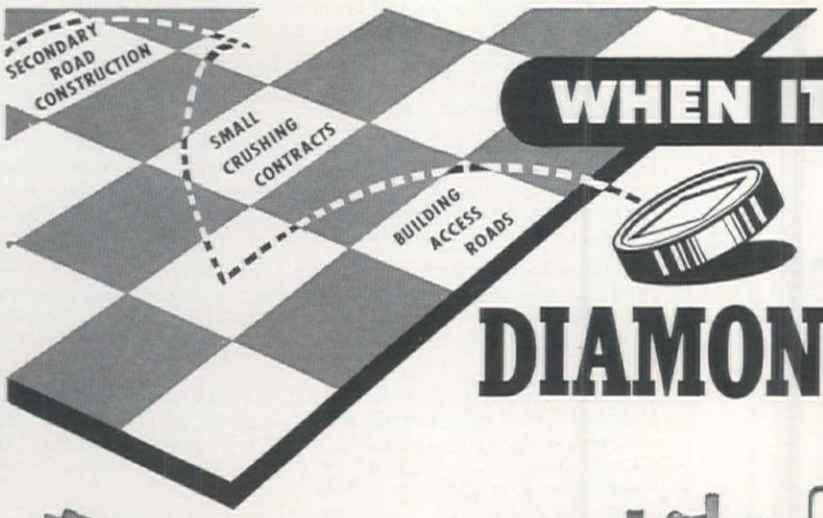
$390,609—**C. K. Moseman,** 727 Barron Ave., Redwood City—Low bid for a slab and girder bridge of reinforced concrete and structural steel, across Merced River, about 1.2 mi. north of Livingston; by St. Div. of Hwys.

$313,814—**Oberg Bros. Construction Co.,** Box 640, Inglewood—Low bid for construction of a reinforced concrete bridge to be constructed and about 0.1 mi. of city streets to be reconstructed on Harbor Freeway at Olympia Blvd., Los Angeles, Los Angeles County; by St. Div. of Hwys.

$159,456—**Oilfields Trucking Co.** and **Phoenix Construction Co., Inc.,** Box 751, Bakersfield—Low bid for about 3.5 mi. of roadway to be graded, imported subbase and base materials to be placed and surfaced with plant mix surfacing bet. 0.8 mi. and 4.3 mi. east of Mojave, Kern County; by St. Div. of Hwys.

$132,877—**B. Pecel & Sons,** 11751 Rose St., Los Angeles—Low bid for installing sanitary sewers in Sewer District 12, Los Angeles; by City of Los Angeles.

$719,323—**J. H. Pomeroy Co.,** 333 Montgomery St., San Francisco—Award for extension of portal crane tracks and miscel-



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laneous work, Mare Island Naval Shipyard; by Twelfth Naval District.

$1,388,800—**Albert Reingart,** 3825 E. 7th St., Long Beach—Award for construction of Paramount High School; by Compton Union High School District.

$694,774—**Richter Bros.,** P. O. Box 1511, Oroville—Low bid for 14.9 mi. of grading and portions surfaced with plant mix surfacing on untreated rock base and highway lighting system to be installed, bet. 3.8 mi. north of Oroville Wye and 20th St. in Chico, Butte County; by St. Div. of Hwys.

$104,967—**Richter Bros.,** P. O. Box 1511, Oroville—Low bid for about 2.8 mi. of grading, imported borrow placed and penetration treatment and seal coat applied, bet. 5 mi. east of Browns Valley and 0.9 mi. east and bet. 7 mi. east of Stanfield Hill and Frenchtown Rd., Yuba County; by St. Div. of Hwys.

$183,152—**Arthur B. Siri, Inc.,** 1356 Cleveland Ave., Santa Rosa—Low bid for 1.7 mi. of grading and surfacing with imported base material (cement treated) and a seal coat applied thereto, bet. 0.4 mi. south of Lower Lake and 0.3 mi. north of Cache Creek, Lake County; by St. Div. of Hwys.

$1,048,738—**A. Teichert & Son, Inc.,** 1846 37th St., Sacramento—Low bid for 43 mi. of grading and surfacing with plant mix surfacing on cement treated base, Siskiyou County; by St. Div. of Hwys.

$163,718—**A. Teichert & Son, Inc.,** 1846 37th St., Sacramento—Low bid for 2.4 mi. of grading and surfacing with plant mix surfacing on untreated rock base on Pacific Ave. bet. 5 Mile House and Calaveras River, San Joaquin County; by St. Div. of Hwys.

$207,126—**Thomas Construction Co.,** 4929 Hedges Ave., Fresno—Low bid for construction of two reinforced concrete bridges, and streets to be graded and surfaced with plant-mix surfacing on imported base material, in San Luis Obispo, Grand Ave. and Buena Vista Ave.; by St. Div. of Hwys.

$8,898,200—**Ford J. Twaits, Morrison-Knudsen Co., Inc.,** and **Macco Corporation,** joint venturers, 449 S. Beaudry St., Los Angeles—Award based on tilt-up method of construction for work on Marine Corps Artillery Training Center, Twenty-nine Palms; by Bureau of Yards and Docks.

$1,003,903—**B. J. Ukropina, T. P. Polich** and **Steve Kral,** 2115 Adair St., San Marino—Low bid for constructing the superstructure for a bridge across American River, near Elvas, about 1 mi. northeast of Sacramento, Sacramento County; by St. Div. of Hwys.

$232,208—**Ventura Pipe Line Construction Co.,** 899 N. Olive St., Ventura—Low bid for schedules 1-3 (modified prestressed concrete pipe and prestressed concrete cylinder pipe) of the Carpenteria Section, South Coast Conduit, Cachuma Project; by USBR.

$257,125—**R. A. Wattson Co.,** 5528 Vineland Ave., Los Angeles—Award for aqueduct supply line 7 mi. in length, Oceanside; by City of Oceanside.

$1,155,929—**Webb & White,** 7220½ Melrose Ave., Los Angeles—Low bid for the construction of two railroad underpasses and about 0.7 mi. of grading and surfacing with portland cement concrete pavement on cement treated subgrade over imported base material and imported subbase material or imported pervious material, for a 6-lane divided highway on the Los Angeles River Freeway, bet. 0.2 mi. south of Dominguez St. and Del Amo Blvd., Los Angeles County; by St. Div. of Hwys.

$4,691,115—**Wynn-Grinnan,** 2311 Salerno Drive, Dallas, Tex.—Low bid for construction, management and finance of a 562-unit housing facility at Marine barracks, Camp Joseph H. Pendleton, Oceanside, Calif.; by Dept. of the Navy.

Colorado

$265,437—**Broderick & Gibbons, Inc.,** 600 E. Santa Fe Trail, Pueblo—Low bid for construction of a 22-ft. base and bituminous surfaced roadway along 15.5 mi. of the Greenhorn Highway in San Isabel National Forest, Pueblo and Custer counties; by BPR.

$1,097,324—**Eagle Erection Co.,** Box 146, Shoshone, Wyo.—Low bid for completion of Pole Hill power plant and switchyard and Flatiron power and pumping plant and switchyard, Estes Park, Foothills power aqueduct, Colorado-Big Thompson Project; by USBR.

Idaho

$1,152,953—**Carl M. Halvorson,** 218 Builders Exchange Bldg., Portland—Award for construction of a roadway and a crushed

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. . . says **K. F. HOFFMAN,** *owner, Tri-State Excavating Company, Dubuque, Iowa*

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rock surface on 4.8 mi. of the Boise-Stanley Highway (Lucky Peak Dam Relocation), Boise County; by St. Dept. of Hwys.

$104,121—**Marion J. Hess,** Malad—Award for construction of a roadway and a crushed gravel surface on 4.5 mi. of the Cub River Rd. in Franklin County; by St. Dept. of Hwys.

$29,180,346—**J. A. Jones Construction Co.,** and **C. H. Tompkins Co.,** 907 S. 16th St., Washington, D. C.—Award for construction of Palisades Dam, Irwin; by USBR.

$225,066—**Stone & Thaut,** Spokane, Wash.—Award for construction of a roadway and a roadmix bituminous surface on 6.7 mi. of the Spirit Lake Highway between Ross Point and Rathdrum in Kootenai County; by St. Dept. of Hwys.

$115,936—**Thurston Storey,** Lewiston—Award for construction of a 112.5-ft. concrete bridge over the Palouse River and the roadway and a crushed rock surface on 0.5 mi. of the Grangeville-Harvard Highway, bet. Harvard and Deary in Latah County; by St. Div. of Hwys.

Montana

$132,484—**Stanley H. Arkwright, Inc.,** 1200 6th Ave. No., Billings—Award for crushing and stockpiling 147,500 cu. yd., ⅝-in. crushed gravel surfacing in Big Horn, Carbon, Musselshell, Stillwater, Sweet Grass, Treasure and Yellowstone counties; by St. Hwy. Comm.

$121,855—**S. Birch & Sons Construction Co.,** 314 Ford Bldg., Great Falls—Award for 3.8 mi. grading, gravel surfacing, road mix oiling and construction of small drainage structures on the Malta South Highway in Phillips County; by St. Hwy. Comm.

$145,528—**S. Birch & Sons Construction Co.,** 314 Ford Bldg., Great Falls—Award for 10.8 mi. of plant mix bituminous surfacing and seal-coat oiling on the Chinook West and Gilford-Havre East Highway, Blaine and Hill counties; by St. Hwy. Comm.

$136,235—**Hansen and Parr Construction Co.,** 1103 No. Calispell, Spokane, Wash.—Award for construction of three bridges on the new 47-mi. Forest Service road, west side of Hungry Horse Reservoir; by USBR.

$128,080—**Heald & Christler,** Cody—Award for 8.1 mi. of grading, gravel surfacing and construction of small drainage structures bet. Garland and Miles City in Custer County; by St. Hwy. Comm.

$253,614—**Hilde Construction Co., Inc.,** 3810 7th Ave. No., Great Falls—Award for 9.4 mi. grading, gravel surfacing, road mix oiling and construction of small drainage structures bet. Stanford and Geraldine in Fergus and Judith Basin counties; by St. Hwy. Comm.

$224,877—**Kiely Construction Co.** and **Union Construction Co.,** Box 466, Missoula—Award for 5.3 mi. of gravel surfacing, plant mix oiling and construction of a guard rail on the Turah-Bearmouth Highway (Bonita-Nimrod Section), Missoula and Granite counties; by St. Hwy. Comm.

$123,542—**Naranche & Konda,** Butte—Award for crushing and stockpiling 100,000 cu. yd. ⅝-in. crushed gravel surfacing; by St. Hwy. Comm.

$339,738—**A. T. Nolan Co.,** Minneapolis, Minn.—Award for 10.0 mi. of grading, gravel surfacing, road mix oiling and construction of small drainage structures bet. Broadus and the Wyoming Line in Powder River County; by St. Hwy. Comm.

$224,735—**Riggon-Nelson Construction Co.,** Harlem—Award for 5 mi. grading, gravel surfacing, road mix oiling and construction of small drainage structures on Dodson-Malta and Malta-Saco Highway, Phillips County; by St. Hwy. Comm.

$184,363—**Thomas Staunton,** 806 1st National Bank Bldg., Great Falls—Award for 7.1 mi. grading, gravel surfacing, road mix oiling and small drainage structures; widening existing timber bridge bet. Stanford and Geraldine, Judith Basin County; by St. Hwy. Comm.

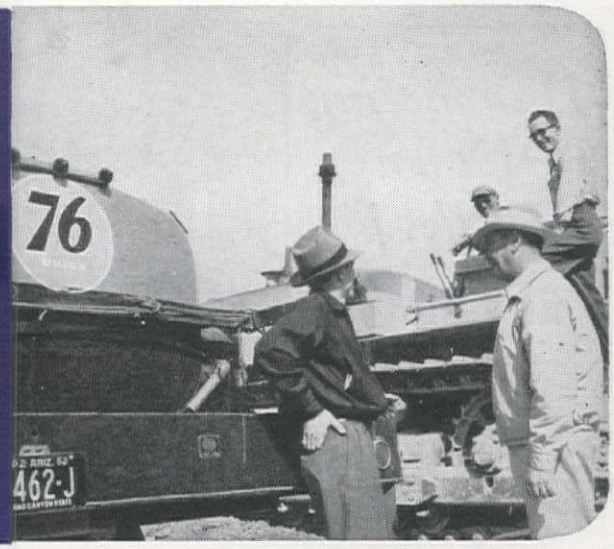
Nevada

$2,855,699—**MacDonald, Young & Nelson, Inc.,** and **Morrison-Knudsen Co., Inc.,** 351 California St., San Francisco—Award for construction of magazines, Naval Ammunition Depot, Hawthorne; by Twelfth Naval District.

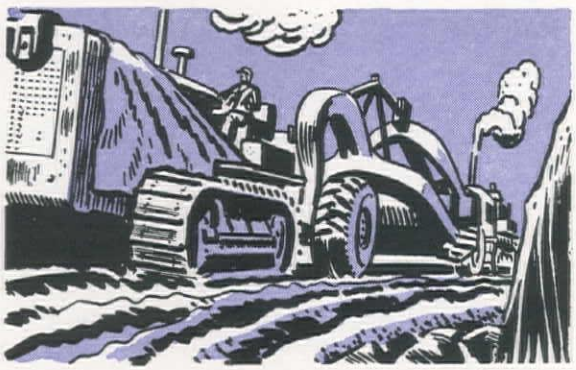
$137,695—**Silver State Construction Co.,** Fallon—Award for construction of a highway from a junction with U. S. 40 near Mills City to the Nevada-Massachusetts-Tungsten Mine, a distance of 7.8 mi. in Pershing County; by St. Dept. of Hwys.

"Over-all maintenance costs are held to a minimum with T5X"

says Arizona Contractor



W. J. HENSON, contractor in Prescott, Ariz., uses Union Oil products in 117 pieces of construction equipment. Mr. Henson writes: "We have been particularly pleased with Union's success in recent years in reducing the number of petroleum products required to serve many needs. We are convinced our over-all maintenance costs are held to a minimum by the use of all-purpose T5X motor oil . . ."



Construction men throughout the U.S. find that T5X motor oil protects *every* type of internal combustion engine in all industrial operations. This outstanding versatility is possible because T5X is a combination of fortifying additives and 100% pure paraffin-base stocks found in no other motor oil.

T5X meets and exceeds the rigid Army specifications for a heavy-duty oil. This amazing *purple* oil minimizes ring sticking, sludge, lacquer and gum formation. T5X also reduces oxidation, retards carbon formation, and keeps precision-fitted moving parts covered with a protective film at all times.

Developed by the manufacturers of UNOBA—the industry's original multi-purpose grease

OFFICES

Los Angeles, Union Oil Building — Chicago, 1612 Bankers Building — New York, 4904 RCA Building
New Orleans, 917 National Bank of Commerce Building — Cincinnati, 2111 Carew Tower Bldg.

UNION OIL COMPANY OF CALIFORNIA 76

New Mexico

$157,855—**Allison and Haney,** P. O. Box 1507, Albuquerque—Low bid for 7.9 mi. of the Porter-East road in Quay County; by St. Hwy. Dept.

$518,338—**Brown Contracting Co.,** P. O. Box 1479, Albuquerque—Award for 16.9 mi. of construction on the Corona-Carrizozo road in Lincoln County; by St. Hwy. Dept.

$126,246—**Floyd Haake,** 1111 Lovato Lane, Santa Fe—Award for 6.8 mi. of work on the Mosquero-Bueyeros Rd., Harding County; by St. Hwy. Dept.

$198,302—**Lowdermilk Bros.,** Los Alamos—Low bid for construction of the Los Alamos, Atomic Energy Commission access road consisting of 30 ft. of grading and 22 ft. of bituminous surfacing for a distance of 1.5 mi. in Los Alamos County; by BPR.

$474,747—**Lowdermilk Bros.,** P. O. Box 501, Los Alamos—Low bid for 9.9 mi. construction Deming to Las Cruces road in Dona Ana County; by St. Hwy. Dept.

$609,017—**Lowdermilk Bros.,** P. O. Box 501, Los Alamos—Award for 6.8 mi. of work on the Questa-Arroyo Mondo road in Taos County; by St. Hwy. Dept.

$163,932—**G. I. Martin,** 520 So. Tulane, Albuquerque—Award for 90.2 mi. of construction from Obar to Tucumcari and Hagland to Tucumcari in Quay County; by St. Hwy. Dept.

$119,761—**F. D. Shufflebarger,** 200 E. Central Ave., Albuquerque—Award for 1.8 mi. of work on the Tucumcari-Conchas Dam road in San Miguel County; by St. Hwy. Dept.

$139,606—**Skousen Construction Co.,** 201 Springer Bldg., Albuquerque—Award for 11.3 mi. of construction on the Silver City-Lordsburg road, Hildalgo County; by St. Hwy. Dept.

Oregon

$135,576—**Babler and Rogers,** 4617 S.W. Milwaukie Ave., Portland—Award for 2.9 mi. of grading and 3.3 mi. of paving on the Ontario-Evans Corner Section of the Ontario-Lincoln School County Rd., south and west from Ontario; by St. Hwy. Comm.

$175,000—**Empire Construction Co.,** 4506 S.E. 39th St., Portland—Low bid for 4,970 lin. ft. sewage system, Oregon City; by City of Oregon City.

$121,162—**General Construction Co.,** P. O. Box 3860, Portland—Award for construction of a reinforced concrete and steel viaduct, 368 ft. in length over Hood River on Columbia River Highway near the city of Hood River; by St. Hwy. Comm.

$375,501—**E. C. Hall Co.,** 12012 S.W. Barbour Blvd., Portland—Award for 2.6 mi. of grading and paving the Tigard-Newberg Section of the Pacific Highway West; by State Hwy. Comm.

$1,669,626—**Ross B. Hammond Co.,** Box 3901, Portland—Low bid for construction of a 5-story, reinforced concrete hospital addition; by Emanuel Hospital.

$175,328—**Lebanon Electric Co.,** 66 E. Sherman St., Lebanon, Ore.—Award for construction of a 20-mi., 115-kv. transmission line, Eugene; by Lane County Electric Cooperative.

$697,645—**C. R. O'Neil,** Mitchell—Award for 4.3 mi. of grading and paving on the Hauser-Coos Bay Section of the Oregon Coast Highway, south of Hauser; by St. Hwy. Comm.

$124,746—**Snook Bros.,** Corvallis—Award for 0.3 mi. of highway roadbed and surfacing and 340-ft. reinforced concrete viaduct on the Nehalem River Bridge on the Nehalem Secondary Highway; by St. Hwy. Comm.

$100,678—**United Contracting Co.,** 9898 N.E. Hancock Dr., Portland—Award for 0.2 mi. of grading, 1.0 mi. of paving on The Dalles Section of the Columbia River Highway in The Dalles, Wasco County; by St. Hwy. Comm.

$207,386—**Warren Northwest, Inc.,** P. O. Box 5072, Portland—Award for 6.2 mi. of grading and paving on the Woodburn-Mt. Angel Section of the Hillsboro-Silverton Secondary Highway; by St. Hwy. Comm.

$102,085—**Warren-Northwest, Inc.,** P. O. Box 5072, Portland—Low bid for work, grading, gravel surfacings, drainage, etc., on 26 street improvement projects in Albany; by City of Albany.

$429,005—**O. C. Yocom,** McMinneville—Award for 17.5 mi. of grading and 20.9 mi. of oil mat surfacing the Lena-Nye Section of the Heppner Highway about 16 mi. east of Heppner and 23 mi. south and west of Pendleton; by St. Hwy. Comm.

Utah

$406,220—**Gibbons & Reed Co.,** 259 W. 3rd So., Salt Lake City—Low bid for 6 mi. bituminous concrete road at various locations in Salt Lake City, Salt Lake County; by St. Rd. Comm.

$334,611—**Hilton & Carr Construction Co.,** 922 12th St., Ogden—Low bid for construction of the concrete and steel Echo Canyon Overhead structure and approaches in Summit County; by St. Rd. Comm.

$796,039—**Strong Co.,** Springville—Low bid for a graded and drained roadway between Lagoon-Layton, a length of 5.7 mi., Davis County; by St. Road Comm.

$109,498—**Thorn Construction Co., Inc.,** Springville—Low bid for constructing 1.7 mi. of a bituminous surfaced road on Springville main street and Springville South; by St. Rd. Comm.

Washington

$104,213—**Associated Sand & Gravel Co.,** 2508 Colby Ave., Everett—Award for 2.4 mi. of work from Richmond Heights to Everett and Town of Edmonds, King and Snohomish counties; by St. Dept. of Hwys.

$1,192,822—**Guy F. Atkinson Co.,** 341 Skinner Bldg., Seattle—Award for 0.2 mi. of work on the Ebey Slough Bridge, Snohomish County; by St. Dept. of Hwys.

$143,989—**S. Birch & Sons Construction Co.,** P. O. Box 1926, Great Falls, Mont.—Award for 10.9 mi. of work on Primary State Highway No. 3, Pullman vicinity, Whitman County; by St. Dept. of Hwys.

$158,563—**Diesel Oil Sales Co.,** 2155 Northlake Ave., Seattle—Award for 4.9 mi. of work on the K M Mountain Easterly, Primary State Highway No. 12, Wahkakum County; by St. Hwy. Dept.

$105,113—**Diesel Oil Sales Co.,** 2155 Northlake Ave., Seattle—Award for 32.6 mi. of work, Nugent's Bridge to Deming, etc., Primary State Highway Nos. 1 and 5, Whatcom and King counties; by St. Hwy. Dept.

$176,766—**Henry Hagman,** Cashmere—Award for work, Spokane River Bridge-Barker Road, Spokane County; by St. Dept. of Hwys.

$158,285—**Harbert Bros.,** Estacada—Low bid for 2.5 mi. of grading, and miscellaneous work along the Lewis River Highway in the Clifford Pinchot National Forest, Cowlitz County; by BPR.

$3,000,000—**Lewis Construction Co.,** 308 Lowman Bldg., Seattle—Award for construction of frame buildings to contain 4 and 6 units each, Bremerton; by View Crest Garden Apartments, Inc., 308 Lowman Bldg.

$562,216—**Phil McInnis & Henry George & Sons,** 417 Hutton Bldg., Spokane—Low bid for earthwork and structures, Potholes East Canal, Pasco Wasteway Station, Columbia Basin Project; by USBR.

$214,690—**Rumsey & Co.,** 3821 Airport Way, Seattle—Award for construction of the Newaukun River Bridge, Lewis County; by St. Dept. of Hwys.

$1,020,383—**Thorburn & Logozo,** 4608 36th Ave., S.W., Seattle—Award for construction of 36 houses and another building at Diablo Dam, Seattle; by City of Seattle.

$3,073,376—**U. S. Steel Co. (American Bridge Division),** 525 William Penn Place, Pittsburgh, Pa.—Award for superstructure of Columbia River Bridge at Pasco, Benton and Franklin counties; by St. Hwy. Dept.

$306,472—**Western Asphalt Co.,** 309 W. 39th St., Seattle—Award for 12.8 mi. of work from Issaquah to No. Bend, etc., King County; by St. Dept. of Hwys.

Wyoming

$242,352—**J. H. - N. M. Monaghan & Co. Assoc.,** Rt. 1, Derby, Colo.—Award for base course surfacing plant mix course and miscellaneous work on 10.9 mi. of the Midwest-Casper Rd. in Natrona County; by St. Hwy. Dept.

$202,596—**Northwestern Engineering Co.,** P. O. Box 567, Denver—Award for construction of an overhead crossing over the Union Pacific Railroad tracks, approaches and miscellaneous work on 0.2 mi. near the intersection of 9th St. and Dunn Ave., in Cheyenne, Laramie County; by St. Hwy. Dept.

GUARD RAILS

. . . Continued from page 94

accident rate per million vehicles in the pre-guard rail period was 0.574, as compared to a rate of 0.260 after the installations. This is a reduction of 55% in the rate for all types of accidents at bridge ends. For the fatal and injury accidents combined, the reduction was even more striking: from 0.376 per million vehicles before to 0.120 after, a reduction of 68%. It is noteworthy that, while casualty accidents during the "before" period out-numbered non-injury accidents almost two to one, the picture was reversed during the "after" period.

Guard rail tapered across the width of the shoulder at the bridge approach achieves this remarkable improvement in safety in two ways. Obviously, it is a distinct aid to visibility, particularly at night. And it also serves as a general warning to the driver unfamiliar with the route that a situation requiring caution and added alertness lies ahead.

In its function, the railing acts to deflect into its proper lane a vehicle that is traveling too close to the shoulder. Even though the vehicle may actually strike the guard rail, damage will often be negligible. In the extreme case, a sideswipe crash into a flexible guard rail is considerably less likely to be lethal than a head-on crash into a solid bridge end.

The total cost of guard rail installations at the 28 bridges studied was $13,092.20, an average of $468 per bridge. These cost figures include, of course, a relatively high transportation expense and excessive travel time because of the isolated locations of the work.

"JETS" ON AIRFIELDS

. . . Continued from page 114

represented a very small percentage of the total paved area. Further, he indicated that these eroded areas could be patched without difficulty and that the body of the pavement was not affected.

Admitting that there has been some damage from the effect of jet engines, he discussed the problem of "What to do?" Dense, smooth texture asphaltic pavement is most resistant to jet effects as it reflects heat and blast more readily. The asphaltic concrete should be designed for maximum impermeability (5% or less voids) to resist the effect of fuel spillage. The rolling of the pavement with rubber-tired rollers following the usual steel rollers helps to secure this maximum compaction. For the older, open textured surfacing which is more readily damaged by spillage, an overlay of asphaltic concrete, designed and rolled to maximum density, will help.

As to the problems which may develop in the future based on the evolution of jet plane design, he indicated these were still in the realm of speculation and that plane designers should be asked to consider problems of airfield pavements in these new designs.

He stated The Asphalt Institute wished to be of maximum service in connection with the use of this material in airfield design and operation.

UNIT BID PRICES

Selected bid abstracts for Western projects

Dam

Palisades Dam: 14,000,000 cu. yd. of fill; concrete spillway and outlet works; 1,900-ft. concrete-lined tunnel

Idaho—Palisades Project—USBR. J. A. Jones Construction Co., and C. H. Tompkins Co., Seattle., received a contract from the Bureau of Reclamation on the low bid of $29,180,346 for construction of Palisades Dam, power plant and relocation of roads. Principal features are: Schedule I, construction of an earth-fill dam approximately 260 ft. high and 2,000 ft. long. Construction of a spillway consisting of an unlined open-cut inlet channel, a concrete inlet structure with two 20-ft. by 50-ft. radial gates, a 28-ft. inside diameter concrete-lined tunnel, a concrete-lined outlet channel and an unlined channel section. Construction of an outlet work consisting of a concrete intakes structure, excavation and concrete lining of an inclined entrance shaft and 26-ft. inside diameter concrete lining for the existing outlet tunnel, steel tunnel liner, concrete and brick control house and concrete stilling basin. Construction of a power system consisting of a power intake structure, excavation and concrete lining of an inclined entrance shaft, 26-ft. inside diameter concrete lining for the existing power tunnel, 26-ft. inside diameter conduit section, steel tunnel liner, steel penstock manifold, and concrete anchor block; and the construction of a reinforced concrete and brick power-plant building approximately 100 ft. by 246 ft. including installation of embedded parts for four 39,500 hp. turbines. Relocation of Idaho State Highway No. 29, consisting of earthwork and structures for approximately 3 mi. of highway. Schedule II (relocation of forest service road, consisting of earthwork, structures and surfacing for approximately 18 mi. of roadway. Unit prices were as follows:

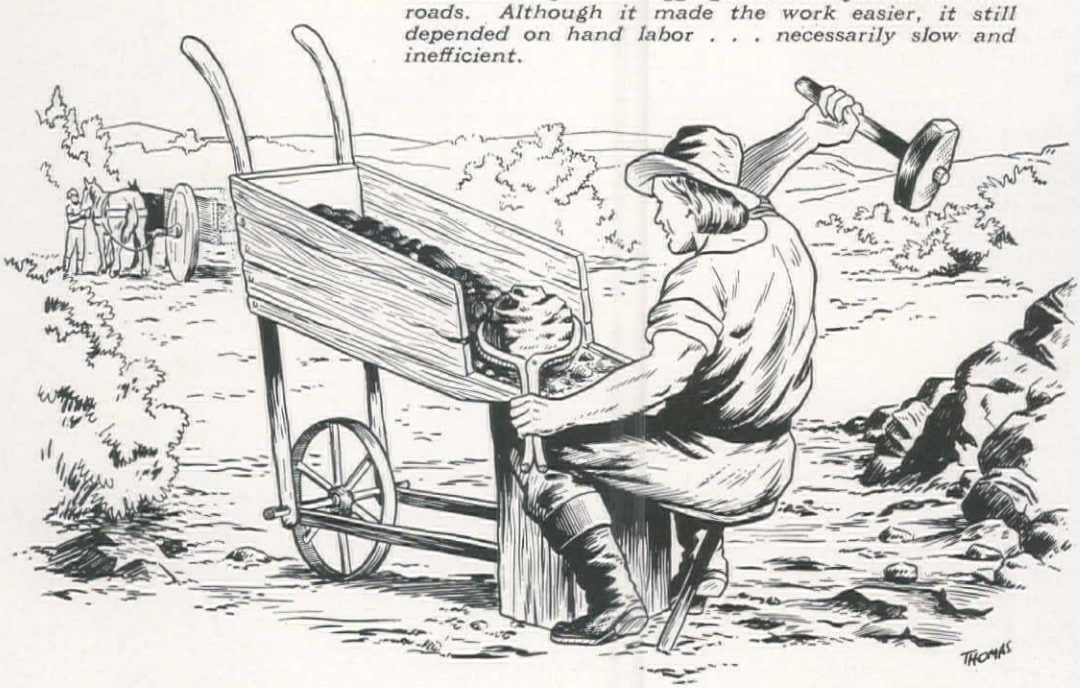
(1)	J. A. Jones Co., C. H. Tompkins Co.	$29,180,346
(2)	Winston Bros. Co., Foley Bros, Inc., Donovan Construction Co., C. F. Lytle Co., Johnson-Drake & Piper, Inc., Al Johnson Construction Co.	30,430,203
(3)	Morrison-Knudsen Co., Peter Kiewit Sons' Co., J. A. Terteling & Sons, Inc., Ralph E. Mills Co., Inc., General Construction Co., Macco Corp.	30,899,280
(4)	Utah Construction Co.	33,433,967
—	Guy F. Atkinson Co., Charles L. Harney, Inc., A. Teichert & Son, Inc., Bressi & Bevanda Constructors, W. E. Kier Construction Co.	34,193,704
—	S. A. Healy Co. (Sched. I only)	35,756,241
—	Pickett & Nelson (Sched. II only)	444,135
—	Kiely Construction Co. (Sched. II only)	481,962
—	Burggraf Construction Co. (Sched. II only)	495,445
(5)	Engineer's estimate	25,519,394

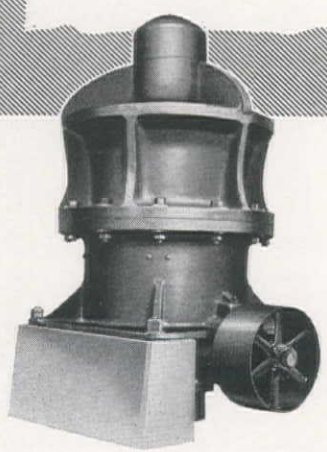
		(1)	(2)	(3)	(4)	(5)
Lump sum,	diversion and care of river during constr. and unwatering foundations	1,050,000	1,108,000	534,600	1,449,000	750,000
190	acres clearing borrow area K	450.00	675.00	190.00	300.00	300.00
572,000	cu. yd. excav., common, in open-cut, at dam site, first 572,000 cu. yd.	.89	1.15	.77	.81	.50
572,000	cu. yd. excav., common, in open-cut, at dam site, over 572,000 cu. yd.	.53	.50	.68	.60	.45
585,000	cu. yd. excav., common, in open-cut, at date site, separation, and transportation to dam embankment, first 585,000 cu. yd.	1.08	1.55	1.02	1.27	.75
585,000	cu. yd. excav., common, in open-cut at dam site, separation and transptn. to dam embankment, over 585,000 cu. yd.	.67	.67	.79	.84	.70
210,000	cu. yd. excav., rock, in open-cut, at dam site, first 210,000 cu. yd.	4.15	4.40	4.73	6.50	3.50
210,000	cu. yd. excav., rock, in open-cut, at dam site, over 210,000 cu. yd.	3.50	2.75	4.22	3.20	3.00
760	cu. yd. excav., all classes, in cut-off	20.00	35.00	34.80	30.00	16.00
120,000	cu. yd. excav., of exist. rock-fill stock pile	.95	.90	.51	.87	.50
52,000	cu. yd. excav., all classes, in spillway tunnel	17.00	18.40	15.63	25.00	15.00
18,600	cu. yd. excav., all classes, in inclined shafts	22.00	22.00	20.31	33.00	18.00
1,739,000	lbs. furn. and placing perm. structural-steel tunnel supports, steel tunnel-liner plates, and steel lagging	.14	.20	.191	.15	.17
5,000	lin. ft. furn. and installing tunnel reef support belts	5.00	1.00	3.39	6.00	3.00
690,000	cu. yd. excav., stripping borrow areas	.35	.32	.36	.36	.30
1,700,000	cu. yd. excav., common, in borrow area K and transptn. to dam embankmt., first 1,770,000 cu. yd.	.74	.60	.47	.53	.45
1,770,000	cu. yd. excav., common, to borrow area K and transptn. to dam embankt., over 1,770,000 cu. yd.	.45	.32	.42	.39	.40
663,000	cu. yd. excav., common, in borrow area L, separation and transptn. to dam embank., first 643,000 cu. yd.	.82	1.60	.91	.92	.55
643,000	cu. yd. excav., common. in borrow area L, separation, and transptn. to dam embank., over 643,000 cu. yd.	.49	.65	.70	.68	.50
1,500,000	cu. yd. excav., common, in borrow area M, separation, and transptn. to dam embank., first 1,500,000 cu. yd.	.86	1.15	.81	.76	.60
1,500,000	cu. yd. excav., common, in borrow area M, separation, and transptn. to dam embank., over 1,500,000 cu. yd.	.47	.45	.60	.55	.55
1,839,000	cu. yd. excav., common, in borrow area M, and transptn. to dam embank., first 1,839,000 cu. yd.	.57	.90	.43	.55	.43
1,839,000	cu. yd. excav., common, in borrow area M, and transptn., to dam embank., over 1,839,000 cu. yd.	.29	.37	.39	.41	.38
1,000,000	cu. yd. excav., common, in borrow area N and transptn. to dam embank., first 1,000,000 cu. yd.	.71	.70	.60	.70	.53
1,000,000	cu. yd. excav., common, in borrow area N and transptn. to dam embank., over 1,000,000 cu. yd.	.43	.37	.50	.51	.48
50,000	cu. yd. placing topsoil	.40	.50	.94	.75	.60

(Continued on next page)

Sitting down on the job!

Almost a century ago, this rig was suggested by Macadam to produce aggregate on the job for his new roads. Although it made the work easier, it still depended on hand labor . . . necessarily slow and inefficient.





The Traylor TY Reduction Crusher, with its compact design and job-proved efficiency, is a perfect example of advanced crushing machinery. Bulletin 6112 gives specifications and description.

The construction industry has progressed through many interesting stages before reaching its present level of efficiency. As the production of aggregate on the job became more widespread, Traylor took the lead in developing and producing more efficient machinery scientifically designed to produce more uniform, cubical aggregate. That is how, over the past 50 years, Traylor has become one of the main suppliers of rock crushing equipment. It takes experience to build top-notch crushing equipment. Traylor has experience . . . half a century of it.

OUR GOLDEN ANNIVERSARY YEAR
1902 — 1952

TRAYLOR ENGINEERING & MANUFACTURING CO.
478 MILL ST., ALLENTOWN, PA.

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WEST COAST BRANCHES
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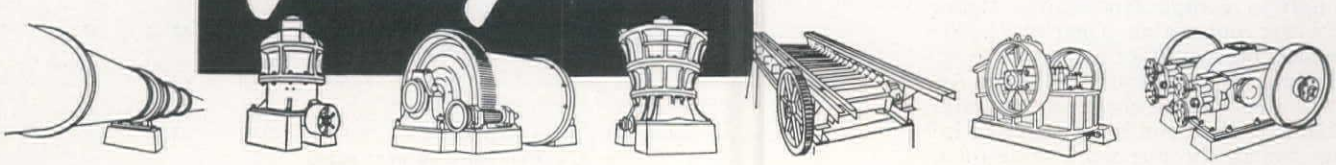
607 Sharon Bldg., 55 New Montgomery St., San Francisco 5, Calif.

a **Traylor** *leads to greater profits*



EQUIPMENT RENTAL

. . . Continued from page 73

($28,000), more surfacing was done than had originally been intended, thus gaining a better final product than planned. A large underrun will be noted in the items of compressor hours and force account, due to the fact that much less rock was encountered than had been anticipated. Also, a large overrun in shovel and truck hours is evident, due to placement of the increased quantity of pit run surfacing.

Final amount of the contract was $25,324.42 which, together with the cost of one state employee acting as superintendent and timekeeper, totals considerably less than the job allocation. Completed jobs of this type, constructed by the state Department of Highways, are turned over to the counties or to the mining companies for maintenance.

PONTOON BRIDGE

. . . Continued from page 86

back when passageway for ships is required, and from this space it is advanced to reestablish continuity of the roadway. This construction necessitates offsetting the roadway, two lanes on each side of the slip. While with its easy curves this offsetting entails no serious inconvenience to practically all traffic, the fact remains that the only fatal accidents that have occurred on the bridge have resulted from drivers failing to offset and crashing into the central concrete. On what is otherwise a magnificent straight highway across the lake such incongruities as this are to be avoided. Also it has been demonstrated in the case of log tows that the bridge must remain open for a far longer time than would be required with a bascule or a vertical lift span.

Reference has been made to the remarkable financial success of this bridge. The original revenue bonds issued in 1938 were 30-year bonds and bore 4% interest. From the outset the bridge earned money and as time passed the earnings became increasingly great. In 1940 it was refinanced with average 3⅛%, 20-year bonds; in 1944 it was refinanced with 16-year 1½% bonds; in 1945 it was refinanced with 10-year 1¼% bonds. Toward the last the bridge was clearing more than $1,000,000 per year. The final retirement of bonds took place July 2, 1949, almost exactly nine years to the hour from July 2, 1940, the day and time on which it was first opened to traffic. The right kind of a toll bridge in the right place is a goodly means of making money.

To Lacey V. Murrow, the then director of the Washington State Highway Department, full credit is due for recognizing the possibilities and potentialities of this project and for carrying it through to completion against strong and bitter opposition. Charles E. Andrew, the present chief consulting engineer of the Washington Toll Bridge Authority was in direct charge of all design and construction and is deserving of full credit for all the fine work done on it.

UNIT BID PRICES . . . CONTINUED

		(1)	(2)	(3)	(4)	(5)
49,000	cu. yd. backfill	.76	.55	3.38	.70	.60
1,000	cu. yd. filling existing test pits and exploration shafts, tunnel, and trenches	20.00	6.00	16.65	5.00	7.00
8,675,000	cu. yd. earth fill in dam embankmt., zones 1 and 2	.16	.20	.18	.19	.14
2,500	cu. yd. special compaction of earthfill in dam embankment	3.00	3.00	2.55	5.00	3.00
3,569,000	cu. yd. sand, gravel, and cobble fill in dam embankment, area 3	.09	.11	.17	.15	.10
4,450	cu. yd. special compaction of zone 3 matl.	2.00	3.00	2.56	3.00	2.00
873,000	cu. yd. backfill in dam embankment, zone 4	.11	.11	.094	.10	.25
258,000	cu. yd. cobble and boulder blanket	.50	.35	.15	.39	1.15
50,000	cu. yd. sand, gravel, and cobble blanket	.70	.22	.77	.80	1.00
268,000	cu. yd. placing riprap	.70	.25	.80	1.00	1.15
500	lin. ft. furn. 8-in. diam. sewer pipe and constr. embankmt. tee drains with uncemented jts.	3.00	2.00	1.66	3.00	2.50
3,000	lin. ft. furn. 12-in. diam. sewer pipe and constr. embankmt. tee drains with uncemented jts.	3.75	2.40	2.63	4.30	3.50
800	lin. ft. furn. 18-in. diam. sewer pipe and constr. embankmt. tee drains with uncemented jts.	5.50	3.80	4.88	9.20	6.00
200	lin. ft. furn. 36-in. diam. reinf. conc. pipe and constr. inspection wells	14.50	11.00	48.12	24.70	25.00
10	sets furn. and placing inspection wall conc. bases and covers	100.00	45.00	167.97	70.60	30.00
2,780	lin. ft. furn. 4-in. diam. sewer pipe and constr. drains with uncemented jts.	6.65	1.20	4.31	1.10	1.80
6,430	lin. ft. furn. 6-in. diam. sewer pipe and constr. drains with uncemented jts.	7.00	1.30	3.29	1.70	2.10
1,430	lin. ft. furn. 8-in. diam. sewer pipe and constr. drains with uncemented jts.	7.30	2.00	36.27	3.00	2.50
310	lin. ft. furn. and laying 4-in. diam. sewer pipe with cemented jts.	6.30	1.30	2.01	1.70	1.70
315	lin. ft. furn. and laying 6-in. diam. sewer pipe with cemented jts.	6.40	2.00	1.79	2.40	1.80
450	lin. ft. furn. and laying 8-in. diam. sewer pipe with cemented jts.	6.60	2.50	2.26	3.50	2.10
85	lin. ft. furn. and laying 12-in. diam. sewer pipe with cemented jts.	7.20	3.00	4.08	5.40	3.00
50	lin. ft. furn. and laying 15-in. diam. sewer pipe with cemented jts.	7.80	5.00	5.29	8.70	4.00
330	lin. ft. furn. and laying 24-in. diam. 14-gage corrugated pipe	8.00	6.00	7.17	8.70	7.00
200	lin. ft. furn. and laying 4-in. diam. clay drain tile with open jts. embedded in gravel	2.00	3.00	2.47	1.50	1.80
3,000	lin. ft. drilling drainage holes	10.00	6.20	3.96	5.85	4.00
59,000	lin. ft. drilling grout holes in stage between depths of 0 ft. and 35 ft.	2.30	2.75	2.34	2.58	2.25
1,750	lin. ft. drilling grout holes in stage between depths of 35 ft. and 60 ft.	2.40	2.80	2.40	2.58	2.50
2,900	lin. ft. drilling grout holes in stage between depths of 60 ft. and 110 ft.	2.50	2.75	2.60	2.58	2.75
1,000	lin. ft. drilling grout holes in stage between depths of 110 ft. and 160 ft.	2.60	2.75	2.73	2.58	3.00
30,000	lb. furn. and placing std. black pipe and fitgs. for conc. cooling systems and foundtn. grouting	.70	.50	.39	1.06	.60
12,500	lb. furn. and installing std. zinc-coated pipe and fittings, and special grout outlets	.75	.72	.65	1.20	.90
2,220	ea. hook-up to grout holes	7.00	4.80	12.90	4.60	15.00
32,400	sacks pressure grouting	2.60	1.90	3.50	2.06	2.00
42,000	sacks pressure grouting with packers	2.75	2.15	3.95	2.28	2.50
800	sacks pressure grouting joints and cooling system	10.00	4.00	3.31	3.75	3.00
68,000	lin. ft. drilling holes for anchor bars and grouting bars in place	1.80	1.10	1.24	2.85	1.50
13,000,000	lb. furn. reinforcement bars	.095	.085	.104	.072	.06
13,200,000	lb. placing reinf. bars	.045	.035	.051	.043	.05
400	welds welding reinforcement bars	2.00	9.00	19.80	2.10	2.00
8,100	cu. yd. conc. in intake structs. below elev. 5630	55.50	37.50	45.28	70.00	45.00
390	cu. yd. conc. in intake structs. above elev. 5630	80.00	60.00	119.65	114.00	85.00
2,140	cu. yd. conc. in beams, slabs, and girders of intake structs.	170.00	76.00	133.41	200.00	75.00
185	cu. yd. conc. in blockouts in intake structs.	250.00	95.00	206.58	145.00	90.00
2,400	cu. yd. conc. in lining of inclined shafts of outlet and power tunnels	60.00	47.00	75.58	84.00	45.00
25,950	cu. yd. conc. in lining of outlet and power tunnels	23.00	30.00	33.50	32.00	25.00
3,500	cu. yd. conc. in conduits	42.00	35.00	35.38	32.00	35.00
2,100	cu. yd. conc. in diversion channel lining	39.00	42.00	50.95	47.00	35.00
6,400	cu. yd. second-stage conc. in diversion adits	20.50	35.00	23.73	18.00	35.00
23,550	cu. yd. conc. in penstock and outlet pipe encasement and outlet-works control house substructure	20.50	30.00	22.64	28.00	25.00
720	cu. yd. conc. in outlet-works control house	100.00	80.00	137.64	150.00	75.00
7,260	cu. yd. conc. in stilling basin floor	24.00	25.00	26.32	24.00	22.00
2,830	cu. yd. conc. in stilling basin counterforted walls	48.00	40.00	50.23	42.00	55.00
3,075	cu. yd. conc. in stilling basin wall slabs	59.00	60.00	72.93	48.00	35.00
750	cu. yd. concrete in cut-offs	20.50	26.00	37.67	32.00	25.00
500	cu. yd. conc. in dam embank. cutoff walls, except footings	100.00	85.00	113.37	70.00	45.00
1,128	cu. yd. conc. in spillway inlet struct. below counterforted walls	24.00	23.00	28.37	25.00	35.00
1,240	cu. yd. conc. in spillway-inlet-struct. floors	24.00	23.00	25.35	21.00	32.00
4,015	cu. yd. conc. in spillway-inlet-struct. lining	44.00	30.00	35.13	40.00	35.00
380	cu. yd. conc. in spillway-inlet-struct. walls	120.00	90.00	129.79	135.00	60.00
1,175	cu. yd. conc. in spillway-inlet-struct. highway bridge, operating bridge, compressor house and counter pier above elev. 5570.0	62.00	50.00	57.47	97.00	70.00
19,800	cu. yd. conc. in lining of spillway inclined shaft and tunnel	30.00	30.00	40.20	41.00	30.00
1,250	cu. yd. conc. in spillway-outlet-channel lining	54.00	38.00	65.56	61.00	40.00
1,820	cu. yd. conc. in spillway-outlet-channel gravity walls	25.00	28.50	40.75	37.00	25.00
2,250	cu. yd. backfill conc. for power-plant struct.	20.00	23.00	22.12	17.00	20.00

(Continued on next page)

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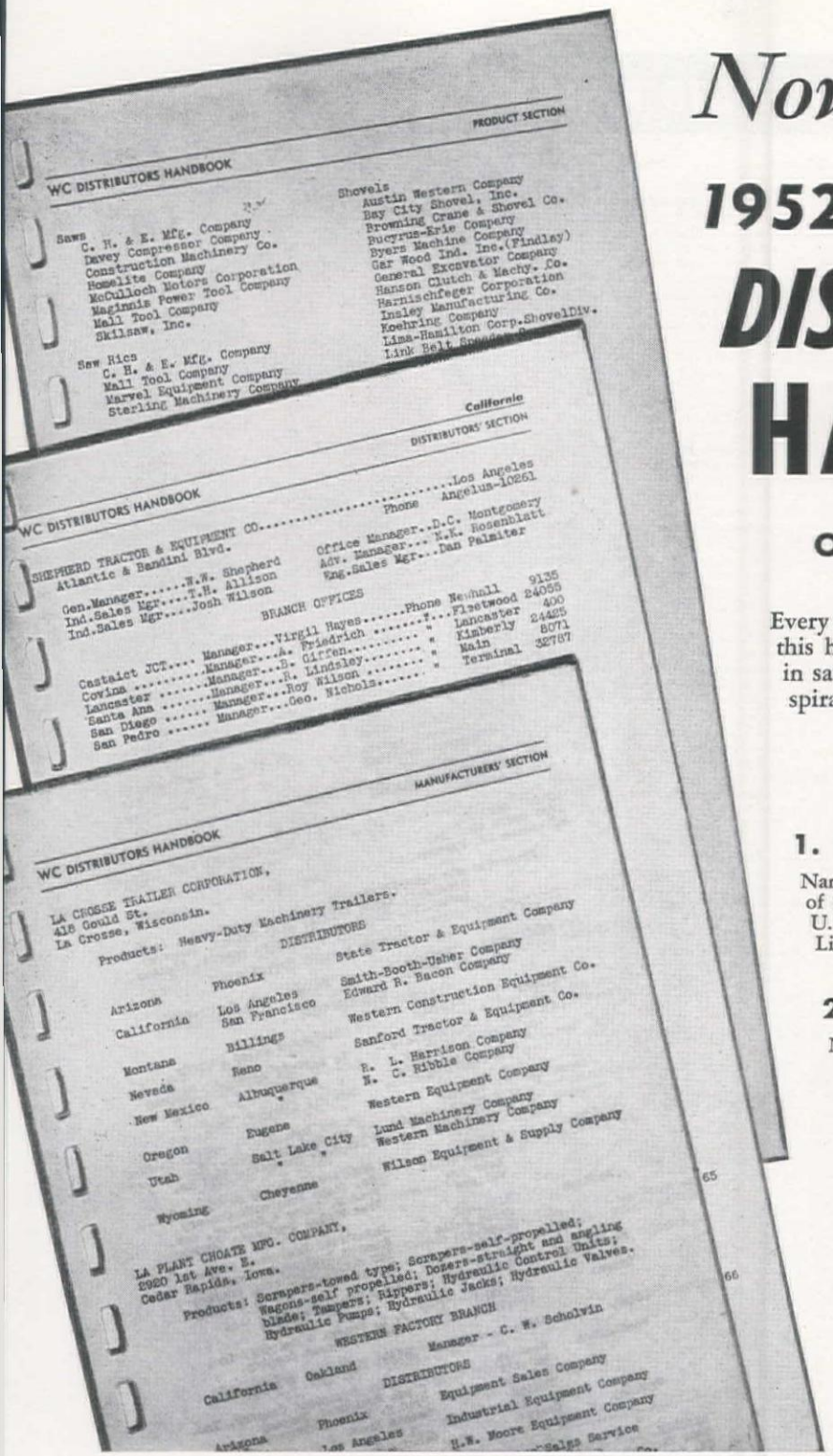
UNIT BID PRICES . . . CONTINUED

		(1)	(2)	(3)	(4)	(5)
7,450	cu. yd. first-stage conc. in power-plant substruct.	33.00	33.00	35.25	58.00	30.00
7,600	cu. yd. first-stage conc. in power-plant intermediate struct.	59.00	36.00	68.94	90.00	40.00
260	cu. yd. first-stage conc. in power-plant superstructure	130.00	90.00	147.42	200.00	90.00
6,350	cu. yd. second-stage conc. in power-plant struct.	24.00	23.00	26.08	40.00	30.00
40	cu. yd. conc. in blockouts in power-plant struct.	220.00	100.00	90.54	145.00	100.00
620	lin. ft. conc. in sills for power-plant struct.	4.00	4.00	9.15	8.00	2.50
160	cu. yd. conc. in cable duct	150.00	95.00	212.49	180.00	40.00
1,150	cu. yd. conc. in training walls	55.00	56.00	54.33	69.00	50.00
220	cu. yd. conc. in dumped riprap	17.00	15.00	21.30	14.00	35.00
6,400	cu. yd. cooling concrete	1.40	2.20	1.29	2.00	.80
220	lin. ft. constructing type "A" control jts.	2.80	4.00	4.30	7.30	3.00
30	lin. ft. constructing type "B" control jts.	2.80	2.00	4.20	7.30	2.50
9,000	sq. ft. furn. and placing 1-in. corkboard joint filler	1.40	1.40	2.33	1.20	1.75
60	sq. ft. furn. and placing ½-in. corkboard joint filler	.70	2.00	1.87	1.20	1.30
110	sq. ft. furn. and placing ¾-in. bitum. jt. filler	1.40	2.00	1.29	1.80	1.50
5,270	lin. ft. placing rubber water stops	2.40	1.20	1.94	1.80	1.50
4,200	lin. ft. furn. and placing metal water stops	4.00	2.30	1.42	1.70	2.00
700	lin. ft. furn. and placing metal seals	4.00	3.40	2.39	5.00	2.50
350	lin. ft. constr. asph. seals	11.00	6.00	9.69	10.00	10.00
50	lin. ft. installing rubber jt. strips with metal straps	2.80	2.70	1.16	2.00	1.70
900	lin. ft. installing rubber jt. strips without metal straps	1.40	1.05	.84	4.20	1.40
13	recess finishing recesses for lighting panel bds. miscl. power bds., and other elect. equip.	15.00	18.00	6.76	22.00	15.00
17,000	sq. ft. furn. and installing precast-cement roof slabs	.90	1.20	.88	2.30	1.25
22,600	sq. ft. furn. and placing roof insulation	.55	.50	.59	.60	.60
24,800	sq. ft. furn. and placing coal-tar-saturated-felt roofing	.55	.36	.45	.60	.35
4,400	sq. ft. furn. and placing membrane waterproofing	.75	.85	.52	.70	.70
650	sq. yd. furn. and applying 2 coat asph.-emuls. dampproofing	1.90	1.80	.26	2.30	1.50
300	sq. ft. furn. and install. steel swinging doors	12.50	10.00	8.08	13.70	14.00
560	sq. ft. furn. and install. steel windows with ventilators	5.50	5.20	4.91	5.50	6.00
2,300	sq. ft. furn. and installing steel windows without ventilators	5.50	4.60	4.85	4.75	5.00
160	sq. ft. furn. and installing fixed stormproof louvers	5.50	7.30	4.39	18.30	7.00
40	sq. ft. installing fixed stormproof louvers and adjustable louvers	2.00	3.00	2.14	3.60	5.00
32,500	sq. ft. constr. brick walls for power-pl. struct.	3.80	5.00	4.27	4.50	2.10
2,400	sq. ft. constr. brick walls for outlet-works control house	2.80	5.00	2.07	2.12	.90
6,400	sq. ft. construct. 12 and ½-in. falls for outlet-works control house	3.80	5.00	4.27	4.50	2.10
1,314,000	lb. erecting struct.-steel building framing for power-plant superstructure	.06	.05	.051	.07	.08
740	sq. ft. erect. insulated metal side-wall panels	1.40	2.90	.44	.50	2.00
13,500	lb. installing embedded metal frames	.28	.20	.143	.48	.25
77,000	lb. installing slot covers, hatch covers, manhole covers, and gratings	.20	.11	.128	.18	.15
2,400	sq. ft. furn. and installing corkboard insulation on hatch covers	1.40	.60	.12	1.80	.75
110,000	lb. installing anchor bolts	.31	.28	.262	.37	.25
3,300	lb. installing pipe hand-railing	.30	.20	.299	.48	.30
34,000	lb. installing oil storage tanks	.06	.05	.131	.06	.08
2,000	lin. ft. furn. and erect. chain-link fence	4.00	3.75	5.17	2.38	4.00
72,500	lb. installing track rails and hoist trolley beams	.09	.22	.095	.23	.08
Lump sum,	finishing and install. access hatchway to roof	200.00	630.00	146.00	460.00	250.00
4,300	lb. installing slotted metal inserts	.30	.80	1.444	.57	.30
610,000	lb. installing trashrack metalwork	.07	.07	.046	.04	.07
40,000	lb. installing trach rake assembly	.11	.11	.079	.17	.12
6,500	lb. installing ladders	.28	.23	.336	.37	.25
53,000	lb. installing draft-tube pier noses	.08	.18	.05	.09	.10
26,000	lb. installing miscl. metalwork	.35	.30	.123	.53	.25
Lump sum,	furn. and installing outlet and power tunnel liners	750,000	830,000	1,049,006	621,000	670,000
3,000,000	lb. installing penstock outlet pipe manifolds	.15	.13	.216	.19	.10
380,000	lb. installing radial gates	.125	.07	.099	.11	.07
84,000	lb. installing radial gate hoists	.08	.08	.114	.14	.08
400,000	lb. installing frame, seats and guides for fixed-wheel and bulkhead gates, trash rake, and stop logs	.15	.17	.129	.14	.09
668,500	lb. installing fixed-wheel and bulk-head gates	.06	.10	.094	.08	.08
150,000	lb. installing fixed-wheel gate hoists	.09	.13	.101	.14	.09
4,000	lb. installing control equip. and piping for fixed-wheel gate hoists	.55	.34	.527	.73	.30
1,320,000	lb. installing ring-follower and outlet gates	.09	.06	.05	.07	.07
1,200,000	lb. installing butterfly valves	.08	.10	.058	.08	.06
230,000	lb. installing hollow-jet valves	.09	.12	.058	.09	.08
290,000	lb. installing cranes and hoists	.09	.12	.083	.06	.05
Lump sum,	installing embedded parts of four 39,500 hp. hydraulic turbines	110,000	85,000	246,268	178,000	90,000
13,500	lb. installing metal pipe fittings and valves smaller than 6 in. in diam.	.36	.30	.32	.90	.35
40,000	lb. installing metal pipe fittings and valves 6 in. and larger in diam.	.30	.24	.29	.37	.30
33,000	lb. furn. and installing cast-iron soil pipe, fittings, and floor drains	.40	.47	.543	.90	.40
47,000	lb. furn. and installing cast-iron bell-and-spigot and flanged pipe, fittings, and valves	.60	.42	.543	.84	.35
6,600	lb. furn. and installing steel pipe and welding fittings	.40	.60	.543	.87	.60
8,000	lb. furn. and installing steel pipe and screwed flanges, screwed fittings and roof drains	.40	.50	.512	.77	.55
66,000	lb. installing embedded air-vent pipes	.15	.16	.261	.23	.15
9,500	lb. installing ice prevention air system	.35	.40	.349	.73	.30

(Continued on next page)



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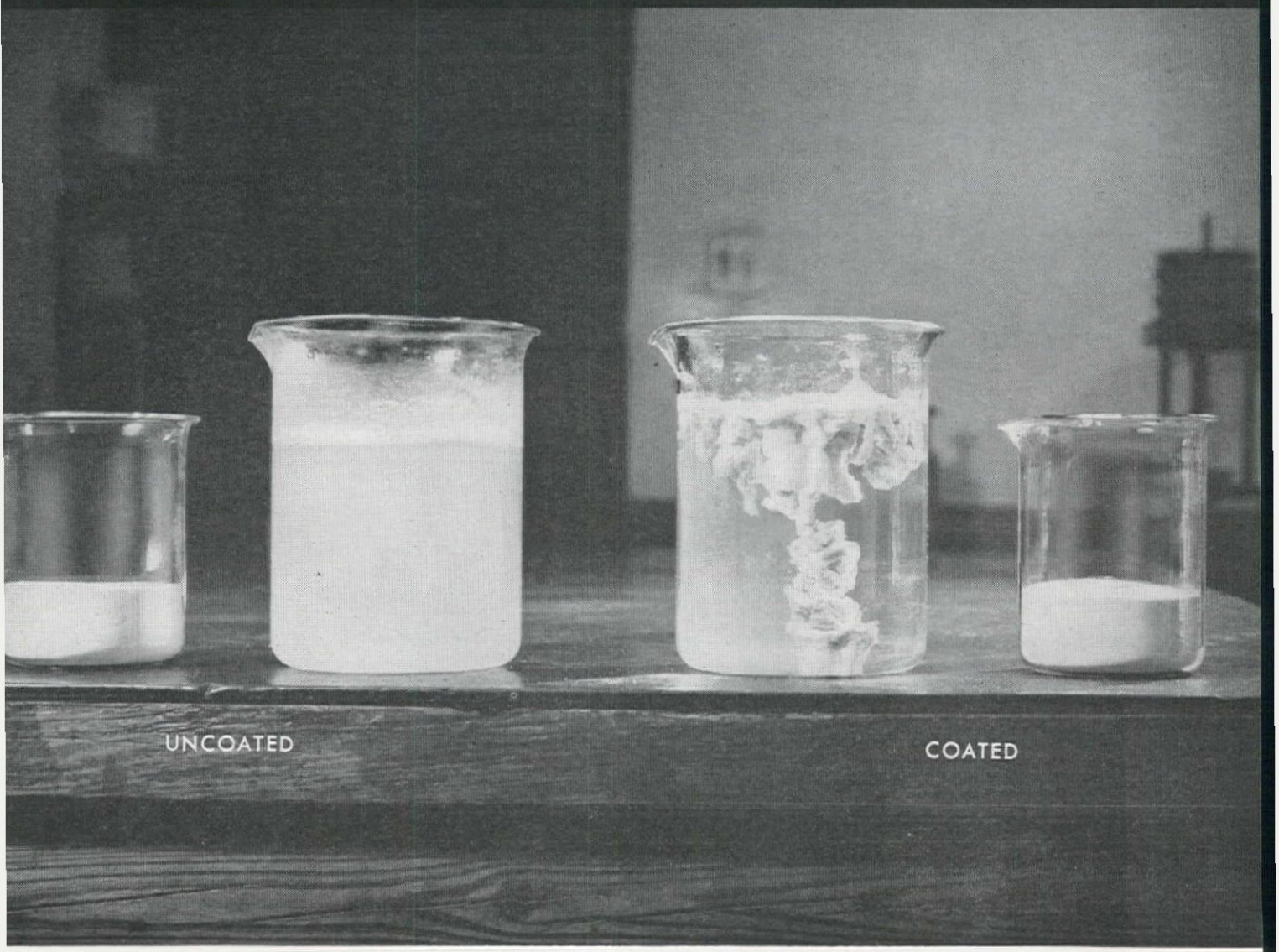
UNIT BID PRICES . . . CONTINUED

		(1)	(2)	(3)	(4)	(5)
600	lin. ft. furn. and install. embedded electrical metal conduit ½-in. in diam	1.40	1.00	1.38	1.00	.70
8,200	lin. ft. furn. and install. embedded electrical metal conduit ¾-in. in diam.	1.50	1.10	1.45	1.00	.85
5,500	lin. ft. furn. and install. embedded electrical metal conduit 1-in. in diam.	1.60	1.35	1.90	1.09	1.10
5,200	lin. ft. furn. and install. embedded metal conduit 1 and ½ in. in diam.	1.70	2.10	2.84	1.80	1.65
2,700	lin. ft. furn. and install. embedded electrical metal conduit 2 in. in diam.	3.00	2.50	3.57	2.10	2 20
1,500	lin. ft. furn. and install. embedded electrical metal conduit 2 and ½ in. in diam.	3.50	3.50	5.05	3.00	2.75
500	lin. ft. furn. and install. embedded electrical metal conduit 3 in. in diam.	4.10	4.40	6.05	3.90	3.25
250	lin. ft. furn. and install. embedded electrical metal conduit 3 and ½ in. in diam.	5.30	5.20	7.75	5.40	3.80
50	lin. ft. furn. and install. embedded electrical metal conduit 4 in. in diam.	6.50	6.00	8.60	6.80	4.50
435	lin. ft. furn. and install. embedded electrical nonmetallic conduit 3 in. in diam.	2.40	2.20	3.49	1.20	2.00
365	lin. ft. furn. and install. embedded electrical nonmetallic conduit 4 in. in diam.	3.00	2.80	3.97	1.60	3.00
13,000	lb. furn. and install. ground cables and ground rods and making ground conn. in the power plant and tailrace	1.70	1.80	2.64	2.25	1.30
350	lb. furn. and install. ground cable adjacent to switchyard cable duct	2.40	1.80	2 55	1.80	1.50
530	lb. furn. and install. ground cables and ground rods and making ground conn. in control house, compressor house, and hoist houses	1.80	1.80	2.64	2.40	1.50
3,500	lb. installing power contact conductors for 150-ton traveling crane	.30	1.80	.70	1.60	1.20
475	lb. installing crane-trolley conductor system in outlet-works control house	1.00	1.80	1.11	1.40	.80
10	outlet furn. and install. 460-volt power receptacle outlets complete with enclosures and matching plugs	100.00	50.00	81.38	160.00	60.00
16	fixture furn. and install. embedded lighting fixtures in concrete	100.00	50.00	46.53	97.00	50.00
16	fixtures furn. and install. embedded lighting fixtures in brick	100.00	50.00	46.53	97.00	50.00
6,000	cu. yd. gravel surfacing	3.50	.50	2.83	2.20	3.00
300	post furn. and setting conc. guard posts	15.00	13.00	7.76	15.00	15.00
1,400	lin. ft. drilling 1 and ½ in. min. diam. holes for piezometer apparatus	11.00	2.00	6.46	3.00	2.00
96,000	lin. ft. installing piezometer tubing in dam embankment	.25	.05	.23	.06	.10
1,500	cu. yd. trenches for test apparatus	4.00	5.50	4.65	15.00	6.00
1,750	lb. installing settlement apparatus in dam	4.00	1.20	.32	1.00	.70
Lump sum,	installing test apparatus in terminal well for dam	4,000	850.00	2,584	750.00	1,000
32	point installing surface settlment pts. on dam	15.00	11.00	38.80	20.00	10.00
	Relocation of Idaho State Highway No. 29 (U. S. No. 26)					
75	acre clearing right-of-way	400.00	40.00	490.00	800.00	300.00
1,500,000	cu. yd. excav., common, for roadway	.40	.45	.59	.58	.30
195,000	cu. yd. excav., rock, for roadway	1.55	1.80	1.24	2.85	1.25
635,000	cu. yd. matls. for highway embank., zone 2	.50	.45	.55	.82	.70
74,000	M. gal. watering	1.75	1.40	2.00	2.75	3.00
18,000	roller hr. rolling embankment	7.50	11.50	14.00	10.00	8.00
850,000	mi. cu. yd. overhaul	.25	.165	.15	.20	.25
6,900	lin. ft. furrow ditch	.40	.40	2.12	.46	.35
4,300	cu. yd. excav., all classes, for structs.	3.00	4.40	3.59	7.30	2.00
4,000	cu. yd. compacted backfill	2.50	3.70	5.38	5.20	3.50
600	cu. yd. crushed-rock or gravel blanket under dumped riprap	4.50	2.20	3.89	6.40	4.00
100,000	cu. yd. dumped riprap	2.25	1.90	1.86	2.78	3.00
100	cu. yd. hand-placed riprap	20.00	7.50	8.24	12.80	10.00
65	cu. yd. retaining walls	100.00	52.00	105.00	90.00	60.00
186	lin. ft. furn. and laying 18-in. diam. class A, culvert pipe	4.50	4.00	6.37	6.50	5.00
664	lin. ft. furn. and laying 24-in. diam. class B, culvert pipe	6.50	5.00	9.11	9.00	7.50
96	lin. ft. furn. and laying 24-in. diam., 16-gage, corrugated-metal pipe	5.50	4.50	6.67	8.00	6.50
772	lin. ft. furn. and laying 24-in. diam., 14-gage, corrugated-metal pipe	6.50	5.00	7.64	9.00	7.50
400	lin. ft. furn. and laying 24-in. diam., 10-gage, corrugated-metal pipe	10.00	8.30	11.19	14.00	10.85
268	lin. ft. furn. and laying 36-in. diam., 8-gage, corrugated-metal pipe	17.00	15.00	18.58	24.00	17.50
928	lin. ft. furn. and laying 48-in. diam., 12-gage, corrugated-metal pipe	17.50	15.00	18.82	28.00	18.00
386	lin. ft. furn. and laying 48-in. diam., 8-gage, corrugated-metal pipe	23.00	20.00	23.67	36.00	25.50
580	lin. ft. furn. and erect. 84-in. diam., 1-gage, multiple plate corrugated-metal pipe	75.00	77.00	91.60	107.00	80.00
4	protectors furn. and placing corrugated-metal embankment protectors	30.00	50.00	41.62	81.00	30.00
200	lin. ft. furn. and laying 8-in. diam., 16-gage, corrugated-metal embankment pipe	2.50	2.10	3.09	4.00	2.30
2	sq. yd. grouted cobble gutter	20.00	30.00	18.50	27.00	10.00
10,000	lin. ft. guardrail	2.80	3.80	5.02	4.20	2.75
90	post guide posts	11.00	10.00	10.69	11.00	6.00
55	marker right-of-way markers	11.00	14.00	27.51	11.00	12.00
22,600	ton ¾-in. max. crushed-rock surfacing	2.90	3.00	3.07	1.80	2.00
90	ton liquid asphalt MC-2	75.00	60.00	39 96	48.00	40.00
75	ton liquid asphalt MC-4	75.00	60 00	39.97	48.00	40.00
2,350	ton cover coat material	5.00	7.60	3.52	5.00	10.00
	SCHEDULE NO. 2					
	Relocation of Forest Service Road					
120	acre clearing right-of-way	500.00	365.00	581.62	450.00	400.00
276,000	cu. yd. excav., common, for roadway	.45	.50	.52	.38	.40
51,000	cu. yd. excav., rock, for roadway	2.00	1.80	1.94	1.60	1.35

(Continued on next page)

PROGRESS IN EXPLOSIVES . . .



WHICH BEAKER HAD THE BANG?

The small beaker (left) contains ammonium nitrate. This is an important explosives ingredient, but it absorbs moisture readily. Notice in the large beaker (left)—how it dissolves immediately in water.

The small beaker (right) contains *Hercules* ammonium nitrate *treated with a special resin*. In the large beaker (right) note how the resin-treated ammonium nitrate repels water without affecting explosives' properties.

Here is a simple example of Hercules' pioneering that gives you better blasting efficiency under adverse storage and climatic conditions both in manufacture and in field use.

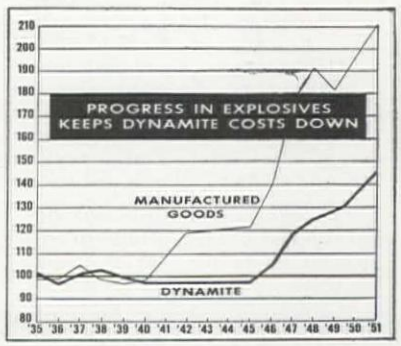


Chart shows relative stability of dynamite prices since 1935, as compared with prices of other manufactured goods. 1935-39 values=100.

HERCULES POWDER COMPANY

INCORPORATED

Explosives Department, 973 Market St., Wilmington 99, Del.

XR52-4

UNIT BID PRICES . . . CONTINUED

	(1)	(2)	(3)	(4)	(5)
50,000 mi. cu. yd. overhaul of excav. for roadway	.30	.22	.36	.15	.30
3,800 cu. yd. excav., all classes, for structs.	3.00	4.40	2.58	4.00	2.50
1,300 cu. yd. compacted backfill	2.50	3.70	3.88	2.85	3.50
170 sq. yd. dry-rock paving	13.00	7.00	18.09	7.00	10.00
3,066 lin. ft. furn. and laying 15-in. diam. pipe	4.00	3.00	5.30	3.00	4.00
692 lin. ft. furn. and laying 18-in. diam. pipe	4.50	3.50	6.27	4.00	5.00
756 lin. ft. furn. and laying 24-in. diam. pipe	6.50	5.00	7.82	5.00	7.50
484 lin. ft. furn. and laying 36-in. diam. pipe	11.50	11.00	18.01	9.25	13.50
36 lin. ft. furn. and laying 60-in. diam. pipe with conc. head-walls	50.00	32.00	27.90	31.00	28.50
10,000 lin. ft. furn. and constr. right-of-way fence	.45	.30	.91	.68	.25
15,500 cu. yd. gravel surfacing	3.00	1.40	2.26	1.15	2.50

Streets and Highways

Plant-mix surfacing on untreated rock base

California—Solano County—State. A. Teichert & Son, Inc., Sacramento, submitted the low bid of $122,748 to the State Division of Highways for 2.5 mi. of borders, shoulders and base construction of untreated rock base, and the central portion of the roadbed to be surfaced with plant-mixed surfacing between 2.5 mi. north of Vacaville and Midway. Unit prices were as follows:

(1) A. Teichert & Son, Inc. $122,748
(2) Fredrickson Bros. 125,216
(3) Harms Bros. 130,209
(4) Parish Bros. $155,040
(5) J. Henry Harris 160,120

	(1)	(2)	(3)	(4)	(5)
40 cu. yd. removing concrete	15.00	9.00	25.00	13.40	18.00
2.0 mi. excavating border trenches	$1,000	550.00	750.00	600.00	$3,853
90 cu. yd. structure excavation	5.00	4.00	5.00	5.00	6.00
7,000 cu. yd. imported borrow	1.50	1.20	1.40	2.92	1.56
Lump sum, dev. water supply and furn. watering equip.	$1,000	$1,000	$1,000	300.00	$6,555
1,500 M. gal. applying water	2.00	2.00	1.75	3.00	2.60
24,500 ton untreated rock base	2.30	2.25	2.40	2.72	2.69
6,700 ton mineral aggr. (P.M.S.)	4.50	5.25	5.40	6.10	6.60
300 ton paving asphalt (P.M.S.)	25.00	25.00	24.00	26.60	26.00
80 ton liquid asphalt, SC-2 (pr. ct.)	27.00	32.00	28.00	30.00	34.50
135 ton sand (pr. ct.)	4.00	6.80	5.00	8.00	5.00
24 ton asphaltic emulsion (sl. ct.)	35.00	39.00	45.00	40.00	44.40
240 ton screenings (sl. ct.)	7.00	10.50	8.00	7.00	6.00
43 cu. yd. Class "A" P.C.C. (structures)	90.00	90.00	80.00	85.00	85.00
9 cu. yd. Class "A" P.C.C. (curbs)	70.00	65.00	60.00	50.00	60.00
30 ea. guide posts	7.00	7.00	7.50	8.00	8.00
96 lin. ft. 12-in. C.M.P. (16 ga.)	4.00	4.25	3.00	3.12	3.00
8 lin. ft. 18-in. C.M.P. (16 ga.)	6.00	6.25	4.10	6.00	5.00
6,300 lb. bar reinforcing steel	.12	.17	.18	.20	.17
8 ea. horiz. reflector units	10.00	8.50	10.00	6.50	10.00

Grading and asphaltic concrete paving

Washington—Cowlitz County—State. K. F. Jacobsen & Co., Inc., Portland, Ore., submitted the low bid of $636,216 to the State Department of Highways for 4.7 mi. paving from Castle Rock to Toutle River on Primary State Highway No. 1. Unit prices were as follows:

(1) K. F. Jacobsen & Co., Inc. $636,216
(2) Fiorito Bros. 645,598
(3) Peter Kiewit Sons' Co. 711,608
(4) N. Fiorito Co. $729,542
(5) Northwest Construction Co. 819,349

	(1)	(2)	(3)	(4)	(5)
5.5 acres clearing	300.00	200.00	200.00	300.00	600.00
4.1 acres grubbing	250.00	200.00	100.00	300.00	600.00
49,830 cu. yd. common excav., including haul of 600 ft.	.40	.50	.60	.60	.60
2,330 cu. yd. solid rock excav., including haul of 600 ft.	1.50	2.50	3.00	1.00	1.75
2,080 cu. yd. common trench excav., including haul of 600 ft.	2.00	1.00	.60	2.50	2.50
18,050 cu. yd. stas. overhaul	.02	.05	.02	.02	.02
434.0 M. cu. yd. stas. overhaul	5.00	6.00	10.00	6.00	6.00
1,990 cu. yd. structure excavation	3.00	1.50	3.30	3.00	3.00
118 days smooth wheeled power roller	52.00	50.00	55.00	50.00	60.00
20 days tamping roller	65.00	50.00	60.00	55.00	65.00
117 days pneumatic tired roller	56.00	50.00	50.00	55.00	60.00
30 days mechanical tamper	48.00	50.00	35.00	50.00	50.00
4,830 lin. ft. slope treatment Class A	.20	.20	.20	.15	.25
336.3 stas. (100-ft.) finishing roadway	14.00	12.00	20 00	15.00	12.00
4,580 M. gals. water	2.50	2.50	2.00	2.00	3.00
130 cu. yd. gravel backfill for foundations	3.50	4.50	1.50	5.00	5.00
770 cu. yd. gravel backfill for drains	3.50	4.50	5.00	5.50	10.00
135,490 ton selected roadway borrow	.62	.62	.65	.85	.95
15,240 cu. yd. cr. stone suf. top crse. in pl. from stkple.	.70	.80	.50	.70	1.00
4,050 cu. yd. cr. stone surf. base crse. in place from stkple.	.70	.80	.55	.70	1.00
2,274 ton Type I-1 asph. conc. pvt. Cl. C wear. crse	8.75	9.00	9.20	9.40	9.50
4,143 ton Type I-1 asph. conc. pvt. Cl. L lev. crse.	8.45	9.00	9.20	9.40	9.50
45 ton asph. cement MC-3 prime coat	43.00	45.00	50.00	45.00	50.00
104,024 sq. yd. cement conc. pvt. 14 da 5 sack mix 9-in. sect.	3.43	3.51	3.95	3.75	4.20
1,008 only dowel bars with rubber caps	.35	.40	.35	.50	.40
36,072 lin. ft. dummy joints	.03	.02	.10	.08	.15
7,272 lin. ft. 1-in. sawed joints	.45	.35	.40	.55	.60
15,408 lin. ft. 2-in. sawed joints	.55	.40	.50	.65	.70
10 only temp. bridge across pavement, takedown type	150.00	100 00	100.00	150.00	150.00
144 lin. ft. pavement headers	1.25	2.00	1.00	3.00	3.00
3,060 lin. ft. asphaltic concrete gutter	.50	.50	.75	.60	.65
116 lin. ft. asphaltic concrete traffic bars	1 25	2.00	1.10	2.25	2.00
2 only asphaltic concrete traffic buttons	7.00	2.00	5.00	4.00	3.50
29.4 cu. yd. concrete Class A	75.00	70.00	75.00	80.00	80.00
4.9 cu. yd. concrete Class C	75 00	50.00	75.00	100.00	85.00
6,490 lb. steel reinforcing bars	.115	.14	.11	.25	.15
1 only steel spring box cover	300.00	25.00	50.00	50.00	50.00
2,235 lin. ft. plain conc. or V.C. drain pipe 10-in. diam.	1.20	1.15	1.25	1.15	1.45
255 lin. ft. std. reinf. conc. culv. pipe 12-in. diam.	2.00	2.35	2.50	2.00	2.25

(Continued on next page)

A BUSY CORNER

is no problem with a Schramm 105

Pneumapower

because it is . . .

- COMPACT AND LIGHT WEIGHT
- EASY TO HANDLE
- HAS LOW UPKEEP
- GOOD FOR 24-HOUR SERVICE

THE JOB: Operating a sandblast at midnight cleaning limestone exterior of the Pennsylvania Bank Building, 15th and Chestnut Streets, Philadelphia, Pa.

CONTRACTOR: Leo J. Dawson, specializing in waterproofing and sandblasting, an enthusiastic user of Schramm Air Compressors.

Write for Bulletin SPB-51

SCHRAMM INC.

The Compressor People

WEST CHESTER • PENNSYLVANIA

SAN FRANCISCO—1315 Howard St.
Phone: UNderhill 3-6655

LOS ANGELES—1021 E. Eighth St.
Phone: TUcker 2431

SCHRAMM AIR COMPRESSORS

UNIT BID PRICES . . . CONTINUED

		(1)	(2)	(3)	(4)	(5)
249	lin. ft. std. reinf. conc. culv. pipe 18-in. diam.	3.20	4.50	3.70	4.00	4.00
50	lin. ft. bit. ctd. corr. met. culv. pipe No. 16 ga. Type No. 2, 12-in. diam.	3.25	5.00	4.00	3.50	3.00
18	lin. ft. relaying conc. culvert pipe 12-in. diam.	2.00	1.00	1.50	2.00	2.00
93	lin. ft. relaying conc. culvert pipe 18-in. diam.	2.00	2.00	1.50	4.00	3.00
665	lin. ft. plain conc. or V.C. sewer pipe 8-in. diam.	.90	1.00	1.00	1.05	1.35
193	only concrete culvert pipe collars	2.50	1.25	3.50	4.00	15.00
400	lin. ft. galvanized iron water pipe ¾-in. diam.	1.20	.75	.80	1.00	.85
268	lin. ft. galvanized iron water pipe 4-in. diam.	6.00	3.50	3.00	4.00	3.50
80	lin. ft. relaying cast iron water pipe 4-in. diam.	1.25	2.00	1.50	3.00	3.00
14	only catch basins	120.00	100.00	75.00	150.00	150.00
450	lin. ft. std. beam guard rail	3.25	3.00	3.20	3.50	3.50
1,991	lin. ft. temporary beam guard rail	2.75	2.25	3.20	2.75	3.00
500	lin. ft. resetting temp. beam guard rail	1.25	1.00	1.00	2.00	2.00
240	only reinf. conc. spot posts	11.50	12.00	12.00	12.00	10.00
17	only timber spot posts	9.00	12.00	10.00	8.00	10.00
28	only monument cases and covers	30.00	45.00	40.00	35.00	45.00
5,280	cu. yd. top soil in place, including haul	1.25	1.50	1.40	2.50	3.00
500	lin. ft. removing temporary beam guard rail	.50	.60	.70	.75	.80
1,355	lin. ft. removing wood guard rail	.40	.25	.70	.50	.60
Lump sum, removing portions of exist. box culvert		350.00	100.00	$2,500	500.00	250.00
1,510	sq. yd. removing cement concrete pavement	1.20	.75	.90	1.00	1.00
480	sq. yd. removing asphaltic concrete pavement	.50	.50	.50	.50	.70

Grading, drainage and asphaltic concrete paving in Oregon

Oregon—Douglas County—State. E. L. Gates & Co., Inc., Salem, submitted the low bid of $731,139 to the State Highway Commission for grading and paving the Winchester Bay-Clear Lake Unit, between Winchester Bay and Forest boundary of the Oregon Coast Highway. Unit prices were as follows:

(1)	E. L. Gates & Co., Inc.	$731,139	
(2)	Kuckenberg Construction Co.	786,292	
(3)	Fred H. Alate Co. Oregon Ltd. and E. C. Hall Co.	837,590	
(4)	Roy L. Houck & Son	$ 849,836	
(5)	Berke Bros.	1,024,545	
(6)	McNutt Bros.	1,066,994	
—	C. J. Montag & Sons	1,179,060	

		(1)	(2)	(3)	(4)	(5)	(6)
Lump sum, clearing and grubbing		$42,500	$87,500	$48,000	$60,000	$150,000	$154,000
1,400	cu. yd. struct. excav., unclassified	3.50	3.50	4.00	3.50	3.50	5.00
220	cu. yd. trench excav., unclassified	3.00	2.50	2.00	3.50	3.50	3.00
710,000	cu. yd. genl. excav., location "A", uncl.	.43	.32	.57	.50	.56	.59
266,000	cu. yd. genl. excav., location "B", uncl.	.30	.57	.30	.50	.56	.59
2,000,000	yd. sta. short overhaul	.015	.02	.015	.015	.02	.015
21,000	cu. yd. sta. long overhaul	.60	1 00	.50	.50	.60	.60
3.45	mi. finishing roadbed and slopes	500.00	500.00	$1,000	500.00	$1,000	500.00
15,000	lin. ft. rounding cutbanks	.15	.20	.20	.15	.15	.20
1,000	lin. ft. 8-in. perf. metal dr. pipe, coated	2.50	2.25	2.50	2.50	3.00	2.50
100	cu. yd. ⅜-in. - 0 backfill in drains	6.00	10.00	6.00	3.00	10.00	6.00
50	lin. ft. 12-in. conc. pipe	1.85	2.00	2.00	1.85	2.50	2.00
840	lin. ft. 18-in. conc. pipe	3.85	3.75	3.50	3.75	4.00	4.00
150	lin. ft. 24-in. conc. pipe	5.25	4.75	4.50	5.25	6.00	5.25
1,000	lin. ft. 18-in. extra str. conc. pipe	4.25	3.75	4.25	4.30	5.00	4.75
1,300	lin. ft. 24-in. extra str. conc. pipe	6.25	5.00	6.00	6.00	6.50	6.35
140	lin. ft. salvaging culvert pipe	2.00	3.00	3.00	2.00	5.00	2.00
340	cu. yd. Class "A" concrete	75.00	75.00	70.00	70.00	75.00	90.00
64,000	lb. metal reinforcement	.12	.14	.13	.10	.125	.12
60	only concrete sight posts	11.00	12.00	10.00	11.00	11.00	11.00
1,500	lin. ft. metal guard rail	3.00	3.50	4.00	3.50	3.50	4.00
21,000	cu. yd. 2½-in. - 0 material in base	3.00	3.15	3.25	3.26	3.50	3.70
8,700	cu. yd. ¾-in. - 0 matl. in base and shldrs.	3.75	3.15	3.25	3.26	3.60	3.70
640	M. gal. sprinkling	3.00	2.00	3.00	2.50	2.50	2.50
3.45	mi. preparation of base	200.00	200.00	200.00	200.00	200.00	300.00
540	cu. yd. ¾-in. - 0 matl. in binder course	4.00	4.00	4.00	5.30	4.00	5.00
86	ton furn. and placing RC-3 asph. in binder course	50.00	50.00	50.00	42.70	50.00	52.00
11,600	ton Class "B" asph. conc.	7.25	7.25	7.25	7.50	7.25	8.00
50	ton RS-1 emuls. asph. in seal coat	55.00	55.00	55.00	42.70	55.00	52.00
300	cu. yd. aggregate in seal coat	5.50	5.50	5.50	5.30	5.50	5.00

Road-mix surfacing, 7½ mi. in Idaho

Idaho—Lewis County—State. Carbon Bros., Spokane, Wash., submitted the low bid of $505,186 to the State Department of Highways for construction of a roadway and a roadmix bituminous surface on 7.5 mi. of the Nez Perce Highway between Craigmont and Mohler. Unit prices were as follows:

(1)	Carbon Bros.	$505,186	
(2)	F. R. Hewett	519,564	
(3)	Roy L. Bair	544,911	
(4)	McNutt Bros.	$548,218	
(5)	Peter Kiewit Sons' Co.	593,029	
(6)	Engineer's estimate	485,768	

		(1)	(2)	(3)	(4)	(5)	(6)
1,360	lin. ft. 18-in. pipe culverts	3.90	3.65	4.40	3.75	7.00	4.00
870	lin. ft. 24-in. pipe culverts	6.00	5.50	5.00	5.85	8.00	5 25
175	lin. ft. 36-in. pipe culverts	11.00	10.00	14.00	11.45	12.50	9.50
114	lin. ft. 48-in. pipe culverts	17.00	13.00	18.00	17.00	20.00	13.00
90	lin. ft. 60-in. pipe culverts	26.00	20.00	29.00	26.00	30.00	20.00
110	lin. ft. 72-in. pipe culverts	33.00	26.00	33.00	32.00	36.00	26.00
18,400	lin. ft. wire fence, Type I	.15	.20	.50	.25	.21	.16
2,080	lin. ft. wire fence, Type II	.20	.25	.60	.30	.27	.18
2,900	lin. ft. wire fence, Type IV	.25	.30	.70	.40	.35	.25
2	ea. project markers	25.00	25.00	25.00	30.00	25 00	25.00
196	ea. right-of-way markers	6.00	10.00	7.50	7.00	15.00	6.00
2	ea. const. 30-ft. wire gate	30.00	35.00	125.00	20.00	20.00	7.00
3,575	cu. yd. salvage and pl. old surf.	.75	.30	1.00	1.50	.65	.40
Lump sum, prepare stockpile site		300.00	200.00	300.00	500.00	500.00	300 00
4	ea. removal of culvert	300.00	200.00	350.00	200.00	100.00	40.00
230,000	cu. yd. uncl. excav.	.71	.66	.50	.72	.79	.55
880	cu. yd. excav. for struct.	2.00	3.00	2.50	3.00	3.50	4.00
30,600	yd. mi. haul	.25	.20	.12	.25	.25	.30
5,750	M. gal. watering embankments	.10	.50	1.90	3.00	1.00	2.00
2,775	M. gal. water base and surf. course	1.25	2.50	1.90	3.00	1.50	2 00
136	day rolling power roller	40.00	50.00	50.00	45.00	45.00	40.00
287	day rolling tamping roller	4.00	32.00	50.00	90.00	45.00	40.00
880	cu. yd. mechanical tamping	2.00	1.00	5.00	1.00	1.50	2.50
49	sta. oblit. of old rd., Cl. I	10.00	10.00	20 00	20.00	12.00	15.00
89	sta. oblit. of old rd. Cl. II	30.00	20.00	20.00	40.00	20.00	30.00

(Continued on next page)

44,800 ton cr. rk. base, ¾-in. max.	1.85	2.00	2.30	1.67	2.25	1.75
47,500 ton cr. rk. surf., ¾-in. max.	1.95	2.10	2.35	1.70	2.35	1.95
12,442 ton cr. rk. in wind., ¾-in. max.	1.95	2.10	2.50	2.25	2.30	1.85
15,000 ton cr. rk. in stkpl., ¾-in. max.	1.35	1.35	1.50	1.10	1.75	1.60
825 bbl. RC-1 rd. mat., prime	7.50	7.50	7.50	8.75	7.25	7.40
1,170 ton blot. matl., Cl. A	2.85	3.20	2.11	2.65	1.50	2.35
7.506 mi. mix. fin. roll, Cl. B	950.00	950.00	800.00	$1,200	850.00	800.00
3,090 bbl. MC-3 asph. rd. matl., rdmix.	7.50	7.50	7.50	8.60	7.00	7.40
228 ton mix-pl. bit. surf. appr. rs.	5.35	4.00	4.75	9.00	1.60	3.50
805 bbl. MC-5 asph. rd. matl. seal	7.50	7.50	8.00	8.75	7.25	7.40
1,650 ton cov. coat matl., Cl. 2	3.65	4.15	3.25	3.80	4.00	3.85
134 cu. yd. conc., Cl. A	75.00	70.00	110.00	70.00	57.00	70.00
15,000 lb. metal reinforcement	.15	.14	.20	.15	.18	.12
710 lin. ft. 12-in. pipe culverts	2.50	2.75	3.10	2.70	3.50	2.75

Grading, compacting, and asphaltic concrete paving

California—Los Angeles County—State. R. A. Erwin, Colton, submitted the low bid of $30,350 to the State Division of Highways for paving with asphalt concrete in Pomona, between Hamilton Blvd. and west city limits, about .7 mi. on existing roadway. Unit prices were as follows:

(1)	R. A. Erwin	$30,350	
(2)	Matich Brothers	32,284	
(3)	W. E. Hall Construction Co.	33,263	
(4)	Vido Kovacevich	33,945	
(5)	Griffith Company	34,705	
(6)	J. E. Haddock, Ltd.	$34,888	
—	George Herz & Co.	34,979	
—	Warren Southwest, Inc.	35,453	
—	Ralph J. Laird	35,525	
—	E. L. Yeager Co.	40,321	

	(1)	(2)	(3)	(4)	(5)	(6)
1,000 cu. yd. removing concrete	3.00	4.50	3.50	5.00	4.40	4.00
700 cu. yd. roadway excav.	1.00	1.50	.70	1.00	1.70	1.80
6,000 sq. yd. compacting original ground	.10	.04	.08	.10	.05	.075
2,700 ton untreated rock base	1.80	1.70	2.05	1.85	1.80	1.03
Lump sum, dev. wat. sup. and furn. wat. equip.	$2,000	400.00	150.00	100.00	550 00	$1,000
160 M. gal. applying water	1.00	2.40	4.00	2.50	2.00	2.00
6 ton liq. asph., SC-2 (pr. ct.)	30.00	45.00	35.00	30.00	30 00	42.00
4,400 ton asph. concr.	4.00	4.50	4.77	4.80	4.95	4.80
15 ton asphaltic emul. (paint binder and sl. ct.)	60.00	40.00	70.00	40.00	55.00	65.00
10 ea. adjust. manholes to grade	35.00	45.00	22.00	25.00	30.00	30.00

Plant-mix surfacing and seal coating

California—Riverside County—State. Basich Bros. Construction Co., R. L. and N. L. Basich, submitted the low bid of $193,754 to the State Division of Highways for 11.1 mi. of plant-mix surfacing to be placed over existing roadbed and seal coat applied; and about 55 mi. of seal coating over existing surface between Indio and Black Butte. Unit prices were as follows:

(1)	Basich Construction Co.	$193,754	
(2)	G. W. Ellis Construction Co.	203,428	
(3)	Peter Kiewit Sons' Co.	$231,782	

	(1)	(2)	(3)
19,520 ton mineral aggregate (P.M.S.)	4.20	3.90	4.35
980 ton paving asphalt (P.M.S.)	23 50	22.00	27.00
932 ton asphalt emuls. (pt. bdr. and sl. ct.)	37.50	40.00	40.00
9,780 ton screenings (sl. ct.)	5.50	7.00	8.50

Water Supply

Water tank reservoirs, piping, and pumping plant at Salt Lake City

Utah—Salt Lake County—City. Paulsen Construction Co. submitted the low bid on Schedule I (concrete), construction of water tank reservoirs for the Salt Lake City High Level Water Supply System. Keyes Tank Co. was low bidder for steel construction of the tanks with a bid of $106,369. Walker Welding & Construction Co. presented the low bid of $23,644 for piping work on Schedule II. In Schedule II, construction of the pumping plant, Bruno Corp. was low bidder at $24,970. Unit prices were as follows:

SCHEDULE I

Steel		Concrete	
(1)	Keyes Tank Co.	$106,369	(6) Paulsen Construction Co.	$105,889
(2)	Bruno Corp.	111,943	(7) Dorland Const. Co.	112,535
(3)	Wright Eng. Co.	112,680	(8) Olson Const. Co.	128,682
(4)	Paulsen Const. Co.	115,258	(9) Bruno Corp.	131,161
(5)	Chicago Bridge & Iron Co.	116,871	— Tolboe & Harlin Const. Co.	132,020
—	Olson Const. Co.	126,438	— Young & Smith Const. Co.	150,400

	(1)	(4 & 6)	(2 & 9)	(7)	(3)	(5)
11,000 cu. yd. excav. for water tank reservoirs, incl. clearing and grub., disposing of unwanted matls., cleaning up site, etc., for steel cyl. tanks	.60	1.09	1.25	.....	.90	.97
12,000 cu. yd. ditto above, for prestressed reinf. conc. tanks	.....	1.09	1.25	.80	.....	.....

(Continued on next page)

UNIT BID PRICES . . . CONTINUED

	(1)	(4 & 6)	(2 & 9)	(7)	(3)	(5)
900 cu. yd. furn., placing, compacting and testing spec. gravel backfill under reserv. structs.	3.00	2.06	3.00	2.40	2.90	3.13
200 cu. yd. (concrete) furn., placing, leveling and testing of sand cushion (not oiled)) under prestressed reinf. conc. tank type, reservoirs	.....	2.70	3.00	.....	.....	.....
200 cu. yd. (steel) furn. all matls., mixing, placing, level and testing, oil sand cushion under steel tank type reservoirs	9.40	3.25	6.10	.....	8.00	8.62
Lump sum (steel) furn. all matls. and constr. complete in all details (two) 1,000,000-gal. capacity steel cyl. tank type water reservoirs with ellipsoidal roofs, incl. painting and appurtenances	$85,499	$93,770	$85,868	.....	$89,950	$92,360
Lump sum (concrete) furn. all matls. and constr. complete in all details (two) 1,000,000 gal. capacity prestressed reinf. conc. tank type water reservoirs with R.C. roofs, incl. appurt.	.....	$80,091	$93,206	$89,110	.....	.....
9,000 cu. yd. furn., placing and compacting embank. fill around prestressed reinf. conc. reservoirs for service roadway	.....	.37	1.25	.40	.....	.....
1,800 sq. yd. furn. required matl., grading, graveling and finishing complete the service roadway at the near reservoir site	2.00	.58	1.65	1.25	1.40	1.51
200 sq. yd. furn. and place rock rip-rap at reservoirs	4.20	3.75	2.00	2.00	2.00	2.16
Lump sum, furn. all matls. and erect chain link fence complete around reservoir site area	$5,250	$5,200	$5,036	$5,413	$5,700	$6,150

SCHEDULE II

(1) Walker Welding & Construction Co.	$23,644	— Corenson Bros. & D. W. Brimhall	$32,607
(2) Lambson Bros.	24,918	— Wright Engineering & Construction Co.	35,633
(3) Enoch Smith Sons Co.	26,136	— Griffith, Gornall & Carman, Inc.	44,438
(4) Ross Construction Co.	27,653	— Byran Ewell	46,382
(5) Olson Construction Co.	27,935	— Young & Smith Construction Co.	66,683
(6) Contracting Corporation	28,110		

	(1)	(2)	(3)	(4)	(5)	(6)
6,700 cu. yd. excav. of trenches for pipe lines, incl. backfilling of trenches, etc.	1.00	1.60	1.40	2.00	1.48	1.50
400 cu. yd. excav. for structs., incl. backfilling, etc.	1.25	2.00	2.00	3.00	2.15	2.10
Laying of various diameter pipe and fittings, furn. by the City as follows:						
7,300 lin. ft. (a) laying 16-in. diam. cast iron mech. joint pipe and fittings	1.10	.75	.90	.65	1.00	1.00
2,510 lin. ft. (b) laying 12-in. diam. cast iron mech. joint pipe and fittings	.95	.70	.80	.50	.87	.90
138 lin. ft. (c) laying 12-in. diam. cast iron bell and spigot pipe and fittings	1.45	.70	.90	.50	.90	1.00
2,750 lin. ft. (d) laying 8-in. diam. cast iron mech. joint pipe and fittings	.45	.60	.70	.40	.84	.85
36 lin. ft. (e) laying 8-in. diam. cast iron bell and spigot pipe and fittings	1.00	.60	.70	.40	.89	.85
40 lin. ft. (f) laying 12-in. sched. 40—steel pipe	1.00	.70	2.00	5.00	1.41	1.50
280 lin. ft. (g) laying 8-in. diam. conc. bell and spigot pipe and fittings	1.50	.60	1.80	1.00	.82	.85
Setting of various sizes and type of valves, etc., furn. by the City as follows:						
8 ea. (a) setting 12-in. hub end gate valves	18.00	25.00	30.00	50.00	16.00	15.00
1 ea. (b) setting 12-in. flanged gate valves	14.00	20.00	30.00	50.00	16.00	15.00
2 ea. (c) setting 8-in. hub end gate valves	14.00	20.00	20.00	40.00	13.00	12.00
1 ea. (d) setting orifice flanges, plates, etc.	10.00	20.00	10.00	80.00	3.62	3.50
4 ea. (e) setting air release valve and assemb. compl.	15.00	18.00	25.00	20.00	20.00	15.00
15. Furn. of all matl. for and constr. various sizes and types of conc. boxes for housing valves and other devices, complete with cast iron frames and covers. Boxes as follows:						
4 ea. (a) constr. conc. valve box compl. 4-ft. - 0-in. diam.	225.00	125.00	150.00	200.00	153.00	160.00
4 ea. (b) constr. conc. valve box. compl. 5-ft. - 0-in. diam.	250.00	150.00	200.00	250.00	170.00	170.00
4 ea. (c) furn. and install precast reinf. circular conc. valve box, 4-ft. - 0-in. diam. complete. Alternate for Item 15 (a)	175.00	125.00	150.00	200.00	153.00	160.00
4 ea. (d) furn. and install precast reinf. circ. conc. valve box, 5-ft. - 0-in. diam. compl. Alternate for Item 15(b)	200.00	150.00	200.00	250.00	165.00	170.00
50 cu. yd. furn. all matls. and place conc. thrust anchors, conc. covering over pipe, etc.	25.00	20.00	20.00	30.00	36.00	35.00
Lump sum, furn. all matls. and placing 60 ft. of 48-in. corr. iron pipe drain complete; clearing, grubbing and disposal of same; placing embank. fill, rip-rap, etc.	990.40	$1,700	$1,800	$1,200	$1,520	$1,500
10 ea. setting or placing cast iron valve boxes, furn. by the city	10.00	5.00	10.00	20.00	6.75	6.50

SCHEDULE III

(1) Bruno Corp.	$24,970	(5) Interstate Electric Co.	$27,809
(2) B. R. Dootton	25,704	(6) Dorland Construction Co.	27,819
(3) Wright Engineering & Construction Co.	26,310	— Paulsen Construction Co.	28,615
(4) Enoch Smith Sons Co.	26,530	— Olson Construction Co.	30,480
		— Young & Smith Construction Co.	35,600

	(1)	(2)	(3)	(4)	(5)	(6)
100 cu. yd. structural excav. at pumping plant site, clearing and grubbing, grading, cleaning up site, etc.	2.25	1.50	2.00	20.00	10.50	7.90
10 cu. yd. furn. matls. and constructing conc. motor and pump bases compl., incl. setting of anchor bolts	25.00	80.00	40.00	60.00	111.00	81.00
Lump sum, setting all pipe, fitting, pumps, motors, regulators, valves, devices, etc., furn. by the city. Located within, under and adjacent to pump house, compl. in all details, incl. furn. and applying protective pipe covering	$1,665	$2,450	$1,650	$2,000	$2,854	$2,654
Lump sum, furn. matls. and constr. pump house, compl. in all details	$9,100	$9,654	$9,500	$9,500	$11,903	$10,803
Lump sum, furn. all matls. and install. elect. equip. controls, lighting system, etc., compl. in all details	$13,320	$12,200	$14,100	$13,730	$10,441	$12,311
Lump sum, furn. all matls. and installing chain link fence complete as required	410.00	450.00	480.00	460.00	500.00	451.00

Bridge and Grade Separation

Reinforced concrete box girder bridge

California—Mendocino County—State. Transocean Engineering Corp., San Lorenzo, submitted the low bid of $117,771 to the State Division of Highways for construction of a reinforced concrete box girder bridge to be constructed, and approaches about 0.21 mi. in length to be surfaced with road-mix surfacing and seal coats applied, across Indian Creek, about 5 mi. northwest of Boonville. Unit prices were as follows:

(1)	Transocean Engineering Corp.	$117,771	
(2)	Tumblin Co.	127,629	
(3)	R. G. Clifford & C. O. Bodenhamer	142,858	
(4)	E. A. Forde Co.	156,104	
(5)	O'Connor Bros.	$158,377	
(6)	Bos Construction Co.	158,384	
—	D. M. Snadling	158,411	
—	Eaton & Smith	169,768	

	(1)	(2)	(3)	(4)	(5)	(6)
Lump sum, detour bridge	$7,400	$10,000	$9,000	$6,342	$15,000	$13,000
Lump sum, remov. exist. bridge	$5,272	$8,500	$6,000	$4,934	$5,000	$12,500
Lump sum, clearing and grubbing	250.00	$2,800	$3,000	$3,528	$1,000	$3,500
9,200 cu. yd. roadway excav.	.40	.95	1.10	1.20	1.10	1.00
562 cu. yd. structure excav.	2.00	2.50	5.00	6.00	5.00	5.00
340 cu. yd. ditch and channel excav.	1.25	.75	3.00	1.00	2.50	1.00
9,000 sta. yd. overhaul	.02	.01	.02	.015	.02	.01
560 cu. yd. imported borrow	1.50	2.50	2.20	3.12	1.50	2.75
360 cu. yd. I.B.M.	2.25	3.50	2.50	4.38	2.25	4.00
Lump sum, dev. wat. sup. and furn. wat. equip.	$1,200	$2,500	$2,000	$3,200	$1,000	$2,600
350 M. gal. applying water	1.50	3.00	1.50	3.77	2.50	3.25
13 sta. finishing roadway	30.00	5.00	20.00	10.00	20.00	5.25
7 ton liq. asph., SC-2 (pr. ct. and penetr. tr.)	60.00	50.00	70.00	63.00	100.00	55.00
4 ton asphaltic emul. (pt. bdr. and sl. ct.)	75.00	60.00	80.00	75.00	65.00	65.00
28 cu. yd. screenings (sl. ct.)	4.00	10.00	14.00	15 00	10.00	11.00
290 cu. yd. min. aggr. (R.M.S.)	4.50	5.00	8.00	6.30	4.90	5.50
23 ton liq. asph., SC-3 or SC-4 (R.M.S.)	40.00	33.00	35.00	45.00	35.00	35.00
4,000 sq. yd. mix. and compact. R.M.S.	.20	.15	.25	.195	.30	.16
145 lin. ft. placing R.M.S. dikes	.50	.65	.60	1.00	1.00	.70
760 cu. yd. Class "A" P.C.C.	72.70	62.00	71.50	89.10	90.00	88.00
490 lin. ft. concrete railing	4.00	5.00	6.50	9.00	7.50	8.50
50 lin. ft. rubber waterstops	3.00	4.00	2.00	5.00	3.00	2.50
2,012 lin. ft. furn. conc. piling	4.30	3.50	3.50	4.10	4.50	3.50
94 ea. driving conc. piles	60.00	90.00	150.00	105.60	105.00	100.00
7 ea. r/w monuments	5.00	7.50	7.00	10.00	8.00	8.00
2 ea. instal. culvert markers	2.00	5.00	4.00	8.00	7.00	6.00
12 ea. instal. guide posts	2.00	6.00	4.00	7.50	6.00	7.00
0.3 mi. new property fences	400.00	$1,000	$1,000	$1,200	$3,168	$1,050
41 lin. ft. 18-in. C.M.P. (16 ga.)	5.00	4.00	4.00	7.00	5.00	4.50
17 lin. ft. 8-in. C.M.P. down drain (16 ga.)	2.00	3.00	3.00	6.00	3.25	3.50
1 ea. spillway assembly	30.00	25.00	25.00	40.00	60.00	30.00
160,000 lb. bar reinf. steel	.11	.11	.12	.115	.12	.105
4,100 lb. misc. steel	.40	.45	.35	.75	.60	.30
100 lin. ft. metal plate guard railng	4.00	4.00	3.50	5.00	6.00	6.00

NEW LITERATURE

601

36-page well drilling guide explains new method

This is a story well told of a new water well drilling method presented in interesting manner with a minimum of words. Full-page pictures placed opposite a paragraph of explanation tell the new approach to well digging in an easy-to-read and see manner. This is the story of the complete project from start to finish using a Mobile Drill mounted upon a Willys-Overland. **Mobile Drilling, Inc.**, has issued the material.

602

Elevated steel tanks of large capacity

This 24-page booklet discusses the advantages of using large elevated steel tanks to provide gravity pressure in municipal water works systems. It contains detailed information on the design and construction of Horton radial-cone elevated tanks, which are built in capacities from 500,000 to 3,000,000 gal., and the Horton spheroidal elevated tanks built in sizes from 1,000,000 to 3,000,000 gal. Included in the booklet are twelve photographs of actual installations, a table of sizes, and a page of drawings showing construction details. **Chicago Bridge & Iron Co.** is offering the booklet.

603

Curious about the Penta method of wood preservation?

If you are interested in the pentachlorophenol method of protecting wood against decay and insect attack, this 40-page booklet just released by **Monsanto Chemical Co.** is aimed directly at you. The booklet takes a question and answer approach to give information on everything from "What is Penta?" to "How do Penta solutions preserve wood?" All the information is right here for contractors, builders and lumber dealers who work with wood.

604

A booklet on traffic concrete —extremely hard surface

Dynapakt concrete floors are the subject of this 20-page booklet which delves into the materials used and especially developed methods of installation. This information explains that the durable topping is long lasting because its extremely dense structure is uniform throughout the entire depth. There is an interesting step-by-step comparison of Dynapakt low-water ration methods, as opposed to wet mixes. **Flash-Stone Co., Inc.**, is releasing the booklet.

605

32-page "Cat" attachment guide is available

"Attachments increase profits" is the title of this new catalog from **Caterpillar Tractor Co.** It shows many possibilities for adapting Caterpillar diesel tractors to specific jobs. The fully-indexed catalog explains uses and construction of each tractor attachment. Thirty action pictures supplement the catalog views. Specification drawings and dimensions are provided where needed. Such practical, low-cost items as cab heaters, rain traps and air prescreeners are included, plus information on the steel cabs available with four models of tractors.

606

800 building materials

Contained in this reference list for asphalt, asbestos and magnesia products are some 800 building materials derived from these substances. The manual gives army, navy, federal, ASTM and other specifications, plus their corresponding product. The book indicates whether the

products meet, can meet, or do not meet required specifications. All of this information is cross-indexed to provide efficient reference for anyone with a specification finding problem. The **Philip Carey Mfg. Co.** is offering the new manual.

607

A bucket brochure with complete specifications

Details, diagrams and photographs in this 28-page booklet present a full history of the **Owen Bucket Co.** line. The firm's half-century in bucket manufacturing has produced a line of buckets with a great many features which insure good performance. The booklet takes a close look at the design, individual parts and construction features. Ratings, dimensions and weights are included in several tables which are correlated with attachment and dimension drawings appearing in the booklet. Also included is a section on special buckets and grapples.

608

Wheel-type ditcher guides

Gar Wood Industries, Inc., offers two fully illustrated catalogs concerning the Buckeye Model 314 and Model 303 wheel type ditchers manufactured by the firm. Construction and operational features of the Model 314 pipeline and utility ditcher are contained in the first booklet, and the second deals with Model 303, a versatile, medium utility ditcher.

609

Concrete floor, roof slabs

The 1952 catalog of Flexicore concrete floor and roof slabs is now available from **The Flexicore Co., Inc.** Included in the 8-page catalog are: diagrams showing how Flexicore slabs are used with all types of construction; a simplified load chart; an explanation of how prestressing Flexicore slabs permits heavier loads on longer clear spans, and new ways to install heating systems including hot water radiant and warm air split system that combines circulating air with a radiant floor.

610

Bulletin on bin-level control

Bulletin 11-0 covers the complete line of "Tellevel" automatic, bin-level control switches produced by **Stephens-Adamson Mfg. Co.** The heavy duty and explosion-proof units are introduced in this bulletin for the first time. Complete diagrams of controls in various applications are contained.

611

Folder on air line cleaner

If you are interested in a well-composed, 8-page bulletin on a mechanical cleaner that removes 92% of oil, moisture and dirt from compressed gas and air lines, then you'll want a copy of **Logan Engineering Co.'s** informative catalog on the Aridifier. The material contains diagrams, application examples and 10 graphs on how to select the proper size aridifier for the specific job.

612

Auxiliary electric power info

"Auxiliary Electric Power for Public Utilities" is a new folder describing the types and sizes of Onan electric plants suitable for every public utility need. A spread of utilities applications is shown, including Onan units being used for standby purposes protecting FM radio transmitters, microwave central transmitters and relay stations. Specifications are given for plants from the 400- to 5,000-watt size in both AC and DC models. **D. W. Onan & Sons, Inc.**

613

Link-Belt Speeder equipment

Included in this catalog, No. 2373, are photographs and brief descriptions and applications of sixteen models of **Link-Belt Speeder Corp.** equipment. Material is included on equipment ranging from ½- to 3-yd. capacities; 10 to 60-ton lifting capacities, and descriptions of crawler-mounted, wheel-mounted and truck-mounted equipment. For the convenience of the reader there is a listing of specific literature from the firm which can augment the thumbnail descriptions contained about each of the items in the catalog.

614

Surfacing suggestions

This is a collection of material on **The Concrete Surfacing Machinery Co.'s** line of equipment with special emphasis on the Berg highway surfacing machine with power take-off. This machine is shown grinding uneven expansion joints and other surface irregularities from concrete and asphalt highways. Other Berg products appear on an insert page. All items are illustrated and explained.

615

Vermiculite specifications

For the first time, concise data on the new vermiculite—sand concrete—as a fill over structural floors, as a floor slab over supports on relatively close spacing,

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and as a slab laid on the ground—is presented in this 12-page booklet. Also included in the booklet are specifications for vermiculite concrete floors on ground (with and without radiant heating units) that are topped with sand and concrete. **The Vermiculite Institute** is making the material available.

616

Street lighting engineering guide

There are 84 pages of guidance in the design of street lighting systems presented in this "Street Lighting Engineering Guide" now available from the **Westinghouse Electric Corp.** Starting with such fundamental considerations as the purposes of street lighting and the quantity of light required, the booklet carefully builds up the more involved discussions on design procedures, roadway illumination computations, and electrical distribution systems. Sample problems and their step-by-step solutions are given.

617

Applicator bar tractor repairs

Manganal Special Shape Applicator Bars for the repair of tractors are the subject of the Manganal Marketer (Volume 2, No. 11) available on request from the **Stulz-Sickles Co.** Included in this publication is a table listing the lineal feet requirements for International, Caterpillar, Cletrac and Allis-Chalmers tractors. The repairman can estimate how much of the grouser has been worn away and pick the size bar which will bring the grouser up to the original size from actual-size diagrams listed in the Marketer. Complete details for welding on the bars are supplied along with explicit directions and illustrations.

618

Ditcher data

The BriScoe ditcher which slopes, as it cleans, as it digs, is fully explained and illustrated in a folder released by **E. V. Briscoe and Son.** This informative little folder briefly states and shows design features and capabilities of this ditcher line which claims a size for every need. The folder explains that the ditcher moves over 500 cu. yd. of earth an hour at a cost as low as 2¢ a yard. Two illustrated bulletins and one fully explainative folder are available on this equipment.

Literature briefs . . .

619

WOOD YOU?—**Simpson Logging Co.** is offering free samples and informative illustrated literature on Simpson Allwood Hardboard. You can get this information by filling out the coupon in this section.

620

WATCH CHAIN WONDERS—**Henry Wild Surveying Instrument Supply Co.** is telling the story of optical squares in Booklet WE4. Pentagonal prisms and optical squares you can wear on your watch chain are discussed.

621

DRILL TEAM—Drills and breakers manufactured by **Warsop Power Tools, Inc.,** are fully described in folders and specifications now offered by the firm.

622

"CAT" SCRAPER CLOSE-UP — All the information on the economical earthmoving features of Caterpillar No. 10 and No. 15 scrapers is contained in the **Caterpillar Tractor Co.'s** new folder.

623

"SCOTCH" TAPES PIPES—The protection of buried pipes from corrosion with "Scotch" plastic tapes No. 21 and No. 22 is the subject of a new 8-page illustrated booklet available from **Minnesota Mining and Manufacturing Co.**

624

MOTO-BUG BANTER—Here are 25 action photographs that demonstrate MOTO-BUG operation in construction, etc., plus a close-up view of the machine's design features. **Kwik-Mix** is releasing the bulletin.

625

HOISTS AND BODIES—Information is available from **Perfection Steel Body Co.** on its line of hydraulic hoists for use with its bodies.

626

WESTERN PINE NEWS—"Western Pine Moulding Patterns" is the new release of the **Western Pine Association,** illustrating each of the new patterns in full size details. The Association has standardized 114 casing and base moulding patterns under the nomenclature of the WP series.

627

WIRE ROPE CARE—This is for you if you are interested in "Use and Care of Leschen wire rope." **A. Leschen & Sons Rope Co.** is offering the booklet, filled with money-saving advice for users.

628

PUMP CATALOG—A catalog featuring contractors pump by **Marlow Pumps** is ready for you. Illustrations and special features appear in the catalog.

629

GROUTER AND PLACER—A complete catalog on the Weber System Type S grouter and placer is now available from **C. L. Ballard.**

630

TRANSMISSION TALK—Condensed specifications on the entire line of heavy-duty transmissions and auxiliaries, produced by **Fuller Manufacturing Co.,** are now available in an 8-page bulletin just released by the firm.

631

TRACTOR LATCH-ON — Free literature is available from **J. I. Case Co.** on the new eagle hitch for the Vai Industrial Tractor.

632

BIG SCRAPER — **Caterpillar Tractor Co.** is offering an illustrated broadside featuring its No. 90 large capacity scraper.

633

FLOORS WITHOUT FLAWS—**A. C. Horn Co., Inc.,** is offering this practical 12-page guide for economical and efficient care of floors. The conditioning, repairing and maintenance methods for a wide variety of floor materials is included in the booklet.

634

CUT ENGINE WEAR!—**Standard Oil Co. of Calif.** is offering a free booklet called "Now you can cut engine wear rate as much as 85%." The booklet tells all about RPM Delo Oils.

635

MAINS WITHOUT MAINTENANCE — Specifications and reference material for those interested in water main pipes are available in this little booklet, released by **Keasbey & Mattison Co.**

636

ROOFING PROBLEMS? — "Solving Roof Problems" is a 32-page brochure released by **The Tremco Manufacturing Co.** which tells you how to diagnose the problem and then treat it correctly.

637

CRANEMOBILE CATALOG—All the details on several sizes of CraneMobiles appear in this new catalog, released by **Bay City Shovels, Inc.**

638

COUPLING DATA — **Dresser Manufacturing Division, Dresser Industries,** is offering three folders, "Report of Dresser Coupled Lines," "Bridge River" and "Style 38" for your engineering data file.

639

SPRAY BAR BUSINESS — Here are the details about the way in which simplified piping speeds operations with this Standard Steel Pressure Distributor, manufactured by **Standard Steel Works.**

640

RESISTANT RUBBER — Saran rubber, a corrosion-resistant material used for tank linings, is discussed in a new booklet offered by **Saran Lined Pipe Co.,** distributors of the material for The Dow Chemical Co.

Maps of Alaska available from Geological Survey

THE BIG FACE of Alaska is now down in map form, thanks to the efforts of the Geological Survey.

Extensive aerial techniques were used to map the huge territory over a period of several years. Officials believe that the maps will be of service to public and private interests in Alaska, and that development will proceed more rapidly with such information available.

The maps will be distributed at various outlets throughout Alaska with the main headquarters in Juneau as the focal point. Those interested in obtaining maps by mail should write to: U. S. Geological Survey, Map Distribution Section, P. O. Box 2659, Juneau, Alaska.

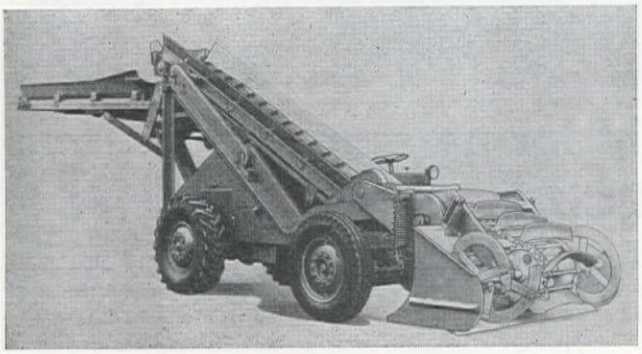
NEW EQUIPMENT

More information on any of the items in this section may be obtained by using coupon on page 179.

641

Take a look at this stockpile-windrow loader

Athey Products Corp. is announcing its new Force-Feed HiLoader after four years of research and testing. It features the full-floating feeder, which is suspended from two coil springs and a pivot, allowing paddle blades to "float" over



the contours of the windrow. The new auger gather-feeder speeds up loading from stockpiles and wide windrows. The spiral blades extend to the moldboards of the gather to keep a steady flow of materials feeding inward to the paddle blades. The 30-in. conveyor belt of the new loader is cleated to handle snow, sand and other light materials as well as heavier earth, etc. A swiveling discharge conveyor is another feature of the HiLoader. The conveyor can be directed 45 deg. right or left of center and is controlled hydraulically from the operator's seat. The operator's platform is on the left side for unobstructed visibility in all directions. A Ford, 95-hp., 6-cylinder engine powers the unit which can travel at speeds up to 19 mph.

642

New principle applied in this all-purpose water repellent

Thompson's Water Seal works on an entirely new principle. It expands in the pores of the material treated—wood, concrete, brick, or other masonry—effectively sealing them against moisture penetration. On an actual job in Pittsburg, Calif., the forms on the footings of the Pittsburg Heights School across from Camp Stoneman stood through weeks of heavy rains and were under water three times before concrete was poured. They did not have to be reset, and they stripped clean and quickly, showing no noticeable deterioration of the plywood which had been treated with this seal. The forms were used several more times without retreating them. **By-Chemical Products Co.**, the manufacturer, plans state-wide distribution of the seal immediately for use by contractors and others.

643

New line of skid-shovels produced for use on International tractors

Available in 1¼-, 2- and 3-yd. sizes, this new skid-shovel for International tractors has break-out action which gives the bucket a crowding action at every bite, assuring a heaped

load from any cut. The bucket is rolled back as much as 28 in. before the load is lifted, and that extra yardage does not slip off the heap. Loads are transported with shoes skidding on the ground providing clear vision and perfect balance over the roughest terrain. All hydraulics are fully enclosed and protected. **The Drott Manufacturing Corp.** is the manufacturer.

644

Versatility keynotes hardboard in tempered and standard grades

Sustained quality and strength are claimed for this All-wood hardboard, the product of years of reseach into the chemical properties of ordinary waste slabwood. Dimensional stability for all structural and decorative purposes is

claimed for the new material, now available in a variety of sizes and thicknesses. The construction field could use the hardboard for concrete forms, flooring—both sub and top, etc. The material can be sawed, routed, nailed, drilled or planed without shredding, chipping or splitting. **Oregon Lumber Co.** is the manufacturer.

645

Three methods of drilling from the same rig

Rotary, auger and percussion drilling on the same rig is the prime feature of **Mobile Drilling, Inc.'s** new drill rig. A hydraulic feed of approximately 8,000 lb. pressure is offered by the B-36 drill, whose hydraulic feed cylinder is located

directly over the rotary turn table. The carriage of the drill is of tubular construction as is the drill mast, which nests in the tube members of the drill carriage. The B-36 maximum depth for auger drilling without water is approximately 150 ft.; depth for rotary drilling with water is in excess of 300 ft. Light in weight, the B-36 can be mounted on a Willy's jeep or any truck with a power take-off.

646

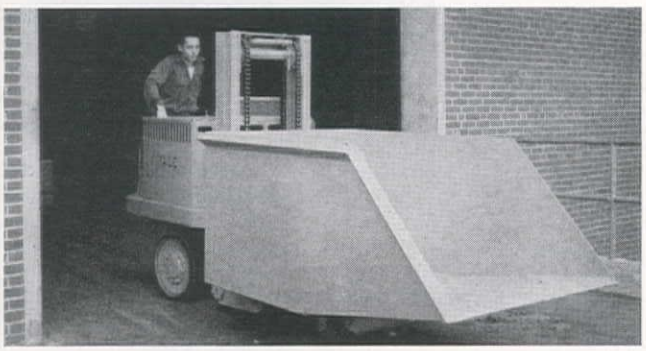
Compound developed to set anchor bolts, repair concrete floors in minutes

Por-Rok Quick Setting Cement is a new compound which is designed for fastening machinery, hand rails, etc., to concrete by means of anchor bolts in 15 to 30 minutes. The preparation is applied cold, eliminating any of the hazards of heating. The compound is suited to repairing chuck holes and breaks in concrete without disrupting any activities or normal operations. Por-Rok is a powder which has only to be mixed with water and then applied. It is a self-bonding, self-leveling, oil-resistant product of **The Hallemite Manufacturing Co.**

647

80-cu. ft. hopper mounted on electric truck

Designed for handling bulky loads of loose material such as sand, gravel, aggregate, etc., is the new 4,000-lb. capacity high-lift platform truck with an extra-large 80-cu. ft. end-



dump hopper. The versatile hopper can be tilted downward to scoop up loads, or loaded from overhead. A specially shortened platform has been placed on the standard 4,000-lb. electric high-lift truck to accommodate the hopper. The platform elevating mechanism is used to dump the hopper. Manufactured by **The Yale & Towne Manufacturing Co.**

648

Truck mixer announced equipped with truck engine drive

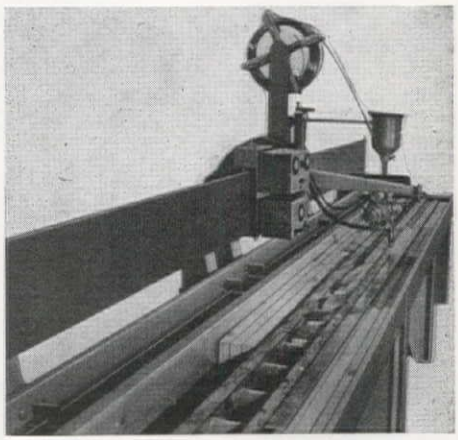
Because the engine of the mixer is eliminated in this new design, the deadweight of the mixer is reduced by about 1,300 lb. This means bigger pay loads can be carried without

exceeding highway weight limits. As the weight is reduced so is the length, by approximately 19 in., which helps to solve the weight distribution problem. A considerable amount of weight is shifted from the rear axle to the front axle, enabling operators to meet stringent rear-axle load restrictions. The elimination of one engine lessens fuel consumption. **The T. L. Smith Co.** offers the new design in 4½, 5½ and 6½ yd. sizes.

649

Welder and re-surfacing unit reclaims track links, etc.

This unit, called ConSERVall by **Penn Tool & Machine Co.**, the manufacturer, automatically welds or re-surfaces any part or workpiece requiring a hori-

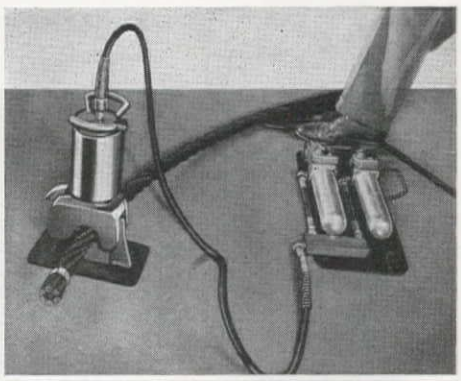


zontal pass. With the addition of a power driven, variable rotations speed rotator, the ConSERVall will re-surface any circular work, such as rolls, idlers, sheaves, etc. Welding length and space between welds are automatically controlled and indexed by cams which are quickly and easily adjusted to handle any type track. The resurfacing is done by the submerged arc method. No flash is visible at any time. Standard model is 30 ft. long, made up of three 10-ft. sections, each section a complete work table. A 5 ft. long carriage track extension permits moving the welding head over the rotator when circular work is to be handled.

650

Latch-type design added to wire rope cutter line

Simplicity of operation is the keynote for the new series 15 Guillotine cutting equipment. A click of the latch opens the



anvil; material to be cut is laid in position, and main body of tool is raised back to vertical position which automatically locks tool in cutting position. Cutting time as little as 7 seconds can be obtained, depending upon pump assembly used. Up to 50 tons thrust is exerted, which makes clean cut through up to 1¾-in. wire rope. The heavy duty shear-type blades are easily removable for sharpening when it is needed. The series is available with a variety of electric and

air-hydraulic pump assemblies, including foot lever and remote control operations. Manufactured by **Manco Mfg. Co.**

651

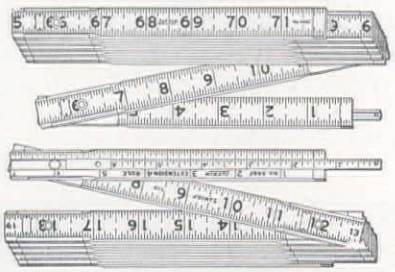
Vinyl-coated gloves protect against chemicals, oils, acids

Hyflex gloves, plastic-coated protective gloves, have been placed on the market by **Houghton Laboratories, Inc.** Made by a new centrifugal process, these are canvas gloves which are coated with a tough, abrasion-resistant vinyl plastisol. The new application process makes possible exceptional adhesion to the canvas and freedom from pinholes. These gloves stand a wide temperature range from freezing temperatures to as high as 200 deg. F. Minimum order is one dozen, which costs $8.00.

652

Here's a new multi-purpose extension rule

When this model X46F is used, it is the only rule needed for easy and accurate inside, outside, regular, and flat reading measurements. Numbering be-

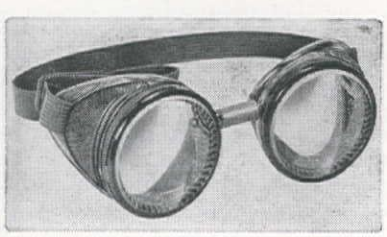


gins at the extension end of the rule, both sides, for flat reading or for regular measurements. This means that in flat measuring the measurement lies close to the work even when the rule is partly open. The brass extension slide allows inside measurements up to 78 in. A stop prevents the brass slide from coming out. The rule is marked in consecutive inches to 16ths. Folded length is 8 in. This is a product of **The Lufkin Rule Co.**

653

Cup-type goggles designed for comfort and safety

These goggles are scientifically designed to conform to the wearer's face. They are available in chipper, welder, dust and splash goggles. There are more



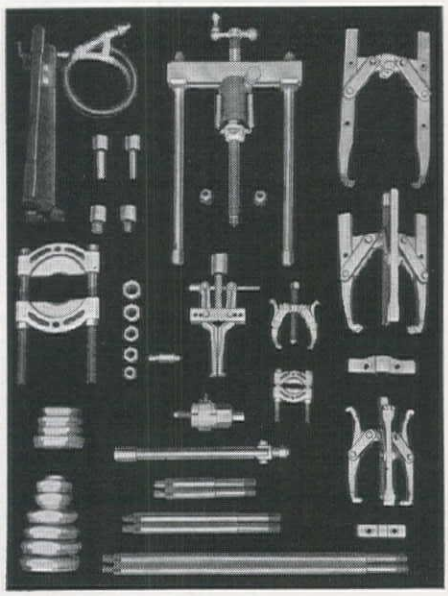
than 300 perforations in the side-shield to allow for air circulation, and added ventilation slots in the lens ring provide circulation across inner lens surface to reduce fogging. All the goggles have ball-chain nose bridge, with a lever-type lock for easy adjustment. Lenses are easily changed, and the goggles have a

long stretch head band attached which is easily adjusted. **Fendell Company** is the manufacturer.

654

OTC kit converts International sets to hydraulic power

This set with the **Owatonna Tool Co.**'s 17½-ton Power-Twin hydraulic ram contains the minimum assortment of



pullers, adaptors and attachments essential to service International Farm Tractors. Takes the hard work out of pulling and installing operations involving gears, bearings, sleeves, pulleys, shafts, sprockets, bearing outer races, bushings, etc. The power-twin with center hole construction, eliminates torque, broken tools and parts and does the job 75% faster than screw-operated pullers.

655

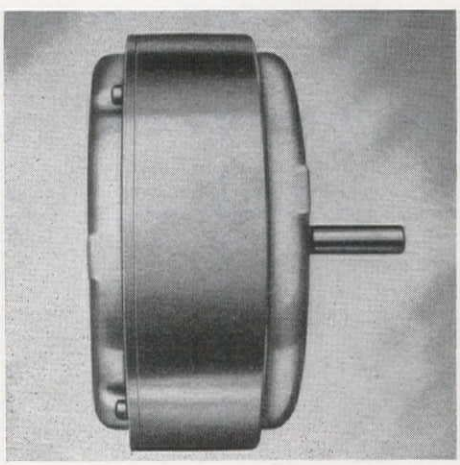
New series of 73-hp. power units announced

This new series of 199 power units joins the stationary power unit line of **The Oliver Corp.** The engines are available for gasoline and diesel fuels and engineering development is now being completed for LP gas. The 6-cylinder engine features overhead valves, replaceable cylinder liner, etc. The engine has a 4-in. bore and a 4-in. stroke, with a displacement of 302 cu. in. Maximum continuous duty rpm. is 1,800, with intermittent duty at 2,000 rpm., and a governed speed range from 1,200 to 2,000 rpm., with close governor regulation. Interchangeability of parts and mounting dimensions between diesel and carbureted models are prominent features in this line.

656

"Wafer" motor ideal where flat design is needed

Here is a different motor well suited to applications requiring a totally enclosed, air cooled unit with a flat design. It is available in ratings from 1/20th



through 5 hp., and in speeds from 450 to 3,600 rpm.—single or polyphase. On ventilating and air moving installations where the motor itself is to be mounted within the piping or vent, the unit is valuable. The unique frame design permits mounting (1) by means of "ears," (2) drilled and tapped holes in endbells, or (3) by any other special requirement of the user. It can be mounted in any position with the shaft up or down. **Reuland Electric Co.** is the manufacturer of this "Wafer" motor which is available in a wide number of frame sizes.

657

New type of concrete mixer in 2- and 3-cu. yd. sizes

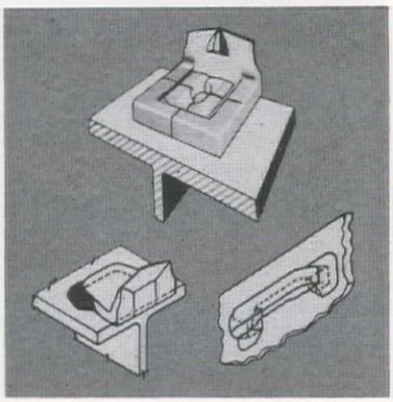
The Econ-O-Mixer mixes in a stationary drum by means of a patented paddle that wipes the drum clean, automatically, at the end of each mix. Less than ten minutes are required for a com-

plete mix, either in transit or on the job. This unit is designed primarily for small businesses. The mixer weighs only 3,000 lb., and is easily installed on any two-ton chassis. It stands 7 ft., 6 in. high; length of drum, 6 ft.; diameter, 4 ft. in the 2-cu. yd. model; and in the 3-cu. yd. model, overall height is 8 ft., 6 in.; drum, 6 ft. long, 5 ft. in diameter. Eight-foot swivel chute swings at right angles to either side. **McCoy Econ-O-Mixer Corp.** is the manufacturer.

658

Adjustable clip aids welded-steel construction

This new clip, known as K3A, facilitates the erection of welded-steel, multiple-story building construction. Col-



umn variations from a true straight condition, caused by tolerances which are permitted in mill-rolled columns, make this a handy feature for erectors of structural steel secured by welding. The new adjustable clip provides easy adjustment in structural steel assembly for the first time. **J. H. Williams & Co.** is the manufacturer.

659

Magnesium cement makes durable flooring

Magna-Crete is the name given this combination of magnesium chloride and magnesium oxide with certain fillers and fine aggregates. It is a cement that sets within a few hours and forms a hard, dense durable mass with excellent characteristics as a flooring material. The preparation is marketed in dry form to be mixed on the job to a mortar consistency, then spread, leveled and finished by troweling. Magna-Crete offers good bonding qualities, resistance to oils and greases, granite hard surface, high structural strength and low maintenance cost. **Flash-Stone Co., Inc.,** is the manufacturer.

660

Spring gives easy truck riding and control

The Load-Booster, for heavy highway hauling, now has a new feature called Torq-Leaf spring suspension, which can take motors without torque limitation, providing the gross load at the ground does not exceed 17,000 lb. per bogie axle. It consists of 9 plates, 3½ in. wide by ½ in. thick. A new flat plate spring clamp with multiple wedge block adjustment and tight, double-wrapped spring eyes, enables these heavy duty walking-beam springs to give unusual soft-riding qualities . . . and help a truck hug the road on turns, without "dancing off the road." **Detroit Automotive Products Corp.** is the manufacturer.

661

Plasticized synthetic rubber protection for airfields

Air strips which take a beating from the spillage of jet fuels, etc., can now be protected by this plasticized synthetic rubber and tar blend developed by **Naugatuck Chemical Division of U. S. Rubber Co.** "Surfa-Aero-Sealz" is the name given the new coating.

662

Lightweight electrode holder is convenient tool

Featuring a lightweight, high copper alloy for maximum conductivity and plenty of room for the operator's hand,

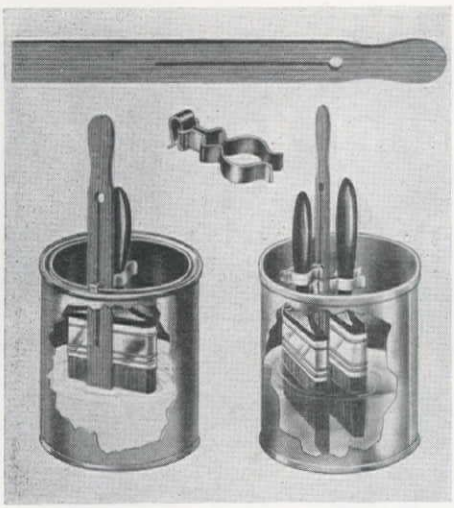
the new Twecotong electrode holder is now available from **Tweco Products Co.** The body and tip ends of the holder are insulated with Tweco's patented "Super-

Mel" insulators. Tip end insulators are interchangeable. The holder will handle from 7/32-in. through 1/16-in. electrodes. The welding cable may be soldered or clamped mechanically to the body of the holder. Only 9¼ in. long, the new holder is helpful in hard-to-get-at jobs.

663

Support for paint brushes and a stirrer as well

This handy gadget is a combination paint brush support, clamp and stirrer which should act as a third hand for painters. The brush support is a slotted stirring stick 14 in. long, equipped with a sliding clamp (see illustration). The clamp has a spring action and will grip a brush handle of any size. The rear clip is designed to attach the brush support to the edge of the paint can, pail, overalls, etc. The clamp can be moved up or down on the stick to accommodate any size brush, paint can or pail. The unit retails for $.25 with extra clamps priced at $.10 each. **Progressive Enterprises** is the manufacturer of the unit.



664

Line of surveying instruments for use by contractors

Four instruments make up the new "N" line for the use of contractors and builders. The moderately priced set includes: a convertible transit-level, heavy duty 12-in. Dumpy level, service transit-level (farm level) and a hand level. The design of the line is simplified to combine rugged construction, ease of use in the field at moderate cost, with the degree of precision required by builders' and contractors' applications. The new instruments are constructed of brass and bronze. **C. L. Berger & Sons, Inc.,** is the manufacturer.

665

Lubricant developed with great heat resistance, synthetic base

Sotol retains its lubricative power and will not melt and run away even at a temperature of 1,000 deg. F. or more, and it is, conversely, capable of remaining effective at zero temperatures. It resists washing away by water and forestalls corrosion of surfaces to which it is applied. The qualities of the new lubricant which make it so highly resistant to the elements are attributed to the use of a new synthetic base, principally of earth. This is a product of **Southwestern Petroleum Co.**

666

An improved line of bolt cutters is introduced

Interstate Drop Forge Co., which acquired the tool line of the **Helwig Mfg. Co.,** is bringing the line out again with heat-treated, drop-forged handles,

plates and jaws. The results achieved by using drop forgings, in place of castings, include a greater strength and rigidity and a considerable reduction in overall weight. Full-forging means that side