WESTERN CONSTRUCTION NEWS

CIVIL ENGINEERING AND CONSTRUCTION IN THE FAR WEST

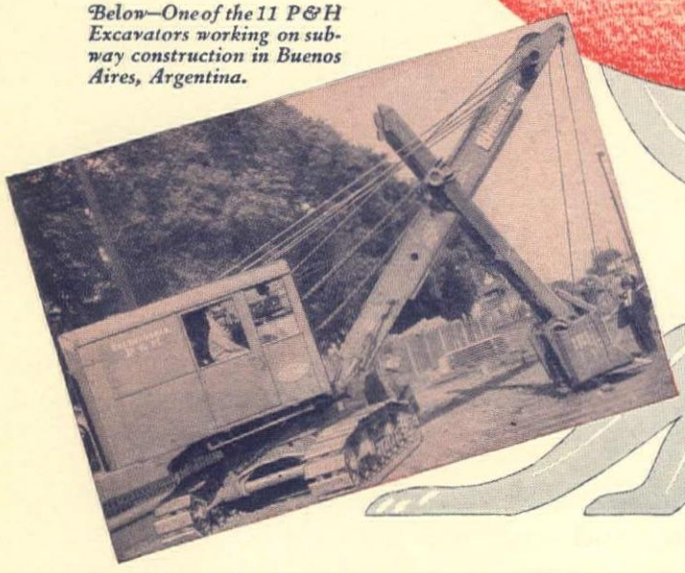
PUBLISHED SEMI-MONTHLY
VOLUME V NUMBER 7

SAN FRANCISCO, APRIL 10, 1930

25 CENTS A COPY
$3.00 PER YEAR

POWER SHOVELS IN SOLID ROCK CUT ALONG THE SHORE OF LAKE KEECHELUS, STATE ROAD No. 2, BETWEEN NORTH BEND AND CLE ELUM, DEPARTMENT OF HIGHWAYS, WASHINGTON; EDWIN J. DUNNIGAN, INC., CONTRACTOR

All over the world



Below—One of the 11 P&H Excavators working on subway construction in Buenos Aires, Argentina.

BUILDING roads in Russia, Colombia, Guatemala, South Africa, Cuba and Canada; digging sewers in Australia; on irrigation, drainage and sanitation projects in Honduras, Peru and Mexico; handling oil tanks in Curacao; building railroads in England, Japan and India; loading sugar cane in Hawaii, Porto Rico and the Philippines; mining nitrates in Chile; building subways in the Argentina, tunnels in Spain and dikes in Holland; all over the world you will find P&H Excavators and Cranes.

More than 3000 P&H Gasoline, Electric and Diesel Excavators are now in service. They are made in sizes from ½ to 3½ cubic yards. All are convertible into shovel, dragline and crane. For full particulars write the

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ROBERT M. TAYLOR, *Pacific Coast Manager*

Service Stations, Complete Repair Part Stocks and Excavators at San Francisco, Los Angeles and Seattle, Wash.

P&H

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Diesel
CRANES
DRAGLINES

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DEVOTED TO CIVIL ENGINEERING AND CONSTRUCTION IN THE FAR WEST

VOLUME V APRIL 10, 1930 NUMBER 7

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SUBSCRIPTION RATES

THE annual subscription rate is $3 in the United States and foreign countries where extra postage is not required. To Canada $4 and to foreign countries where extra postage is necessary the annual rate is $5. Single copies 25 cents.

Published semi-monthly by
WESTERN CONSTRUCTION NEWS, INC.

Main Office:
114 SANSOME STREET
SAN FRANCISCO, CALIF.

Eastern Representatives:
F. R. JONES, 1013 Garrick Bdg.
Chicago, Ill.
ROBT. P. SMITH, Guarantee Title Bdg.
Cleveland, Ohio
H. B. KNOX, JR., 101 Park Ave.
New York, N. Y.

Branch Office:
422 WESTERN PACIFIC BDG.
LOS ANGELES, CALIF.

S. H. WADE, *President and General Manager*
S. J. SANDERS, *Vice-President* PHILIP SCHUYLER, *Managing Editor*
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Full loads *with* "Caterpillar" Tractors

Plenty of power—the sure traction that conquers sand and mud—positive steering—*thus are full loads assured to the earth mover**. Wide "Caterpillar" tracks bridge soft spots and wet—they worry about the weather not at all! So are jobs completed in record time—so is the owner of "Caterpillar" equipment able to handle a greater number of jobs at greater profits!

Prices—f. o. b. Peoria, Illinois

TEN	$1100	TWENTY	$1900
FIFTEEN	$1450	THIRTY	$2375
SIXTY	$4175		

Caterpillar Tractor Co.

PEORIA, ILL., *and* SAN LEANDRO, CALIF., U.S.A.
Track-type Tractors / Combines / Road Machinery
(There is a "Caterpillar" Dealer Near You)

CATERPILLAR
REG. U.S. PAT. OFF.
TRACTOR

*The picture shows a "Caterpillar" being used to enlarge the airport at Long Beach, California.

Fifteen-ton, gasoline operated crane equipped with Industrial Brownhoist Clamshell. Industrial Brownhoist Gas Cranes range in capacity from 6 to 40 tons; those up to 15 tons capacity may be furnished with railroad or crawler trucks.

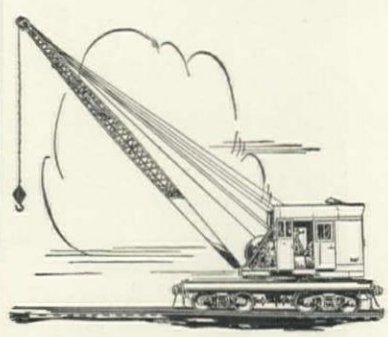
When You Buy Your Next Crane

You'll want the most up-to-date machine on the market, one which will be adaptable to all of your handling needs and one which will show a maximum saving. These are some of the advantages you get in buying an Industrial Brownhoist crane.

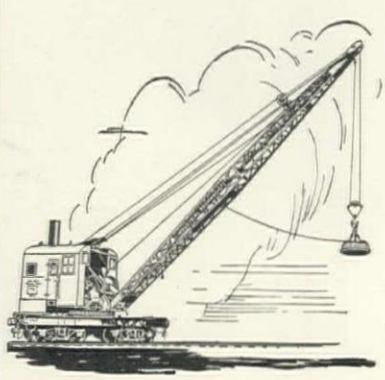
Industrial Brownhoist, the country's pioneer locomotive crane builder, has specialized for over fifty years in the design and manufacture of these machines. Capacities range from 6 to 200 tons, by far the most complete line ever built, and cranes are furnished with steam, gas, electric or Diesel engine power.

Tried and proved worthy through the years, on all kinds of handling work, these cranes have justified the confidence that the country's leading companies have placed in them. As a result, far more Industrial Brownhoist cranes are in service than any other make.

If you are undecided as to the correct type of handling equipment for your work, our nearby factory trained representative can give you a lot of helpful facts on the subject.



Diesel powered 25-ton capacity Industrial Brownhoist crane on hook work.



Eight-wheel steam crane equipped with electric generator set and lifting magnet.

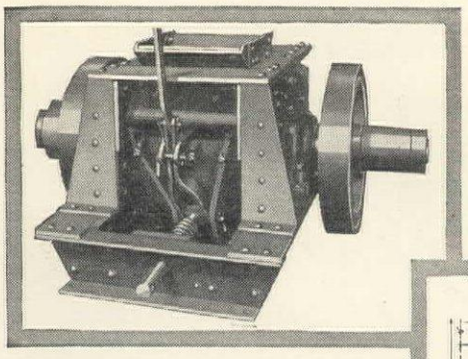
Industrial Brownhoist Corporation, General Offices, Cleveland, Ohio

District Offices: New York, Philadelphia, Pittsburgh, Detroit, Chicago, New Orleans, San Francisco, Cleveland.

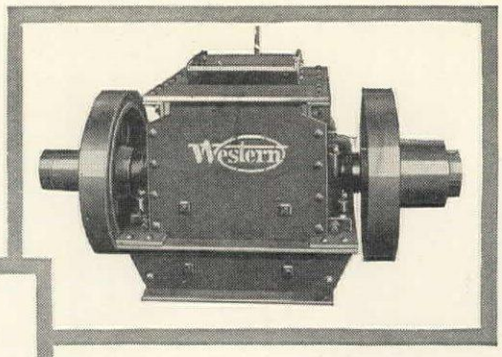
Plants: Brownhoist Division, Cleveland; Industrial Division, Bay City, Michigan; Elyria Foundry Division, Elyria, Ohio.

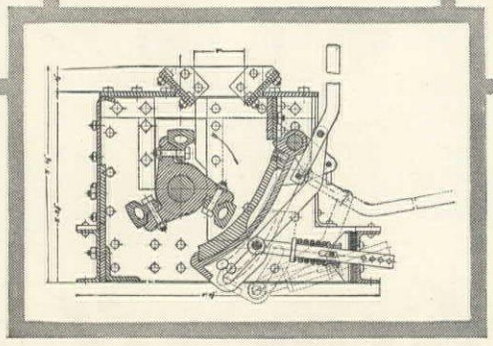
INDUSTRIAL BROWNHOIST

When writing to INDUSTRIAL BROWNHOIST CORPORATION, *please mention Western Construction News*



THE LEVER WHEN LOWERED ALLOWS THE DIE TO SWING DOWN, RELEASING MATERIAL IN CRUSHER





SECTIONAL DRAWING INDICATING POSITION OF THE DIE AND HAMMERS AND THE HEAVY CONSTRUCTION

THE WESTERN ROTARY CRUSHER IS A COMPACT UNIT—VITAL PARTS ARE OF HIGHEST QUALITY ALLOY STEEL. FRAME IS OF HEAVY PLATES AND SHAPES SECURELY JOINED

A new crushing principle saves power and increases production

The NEW WESTERN ROTARY CRUSHER

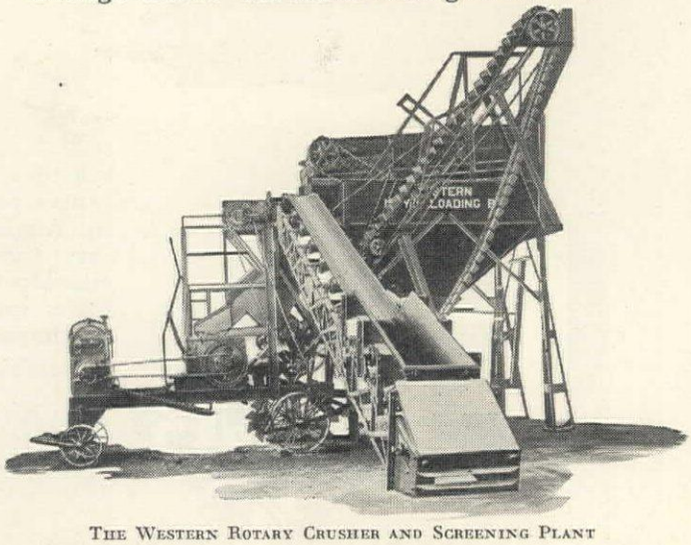
STRIKE a stone that is suspended in the air and it will readily break into cubiform pieces following the lines of stratification. The use of this entirely new principle in the Western Rotary Crusher results in a cheaper machine of greater capacity which produces a much better grade of crushed stone than old style crushers.

The structural steel frame contains a rotor 20 inches in diameter to which are rigidly fastened three steel hammers 20 inches long and which barely clear a fixed die. As the rotor revolves at 1000 r.p.m., these hammers strike 50 blows per second against rock as it falls through. The design includes a device to prevent injury in case hard stone or iron gets into the crusher. Self-aligning roller bearings are sealed in dust-proof housings and require oiling but twice a week.

The economy of the new Western Rotary Crusher is found in its increased production and lower power requirements. It produces 15 to 25 cubic yards of one-inch gravel per hour and requires but 60% of the power needed by crushers of greater size and less capacity! Weighing only 6000 lbs., it is portable.

Crushing and Screening Plants

The Austin-Western line includes a number of rock and gravel crushing and screening plants in types and sizes to meet every condition of service and locality. The most economical plant set up, using the Western Rotary Crusher, is shown below. This plant consists of a 24-ft. belt conveyor; a grizzly screen; a rotary crusher mounted on a truck; a 35-hp. engine; a revolving screen; a standard 15-yard steel bin and the necessary spouting. Write us for bulletins covering these machines in detail. The Austin-Western Road Machinery Co., 435 Brannan St., San Francisco, Calif. Chicago Office: 400 North Michigan Avenue.



THE WESTERN ROTARY CRUSHER AND SCREENING PLANT

Austin-Western
ROAD MACHINERY

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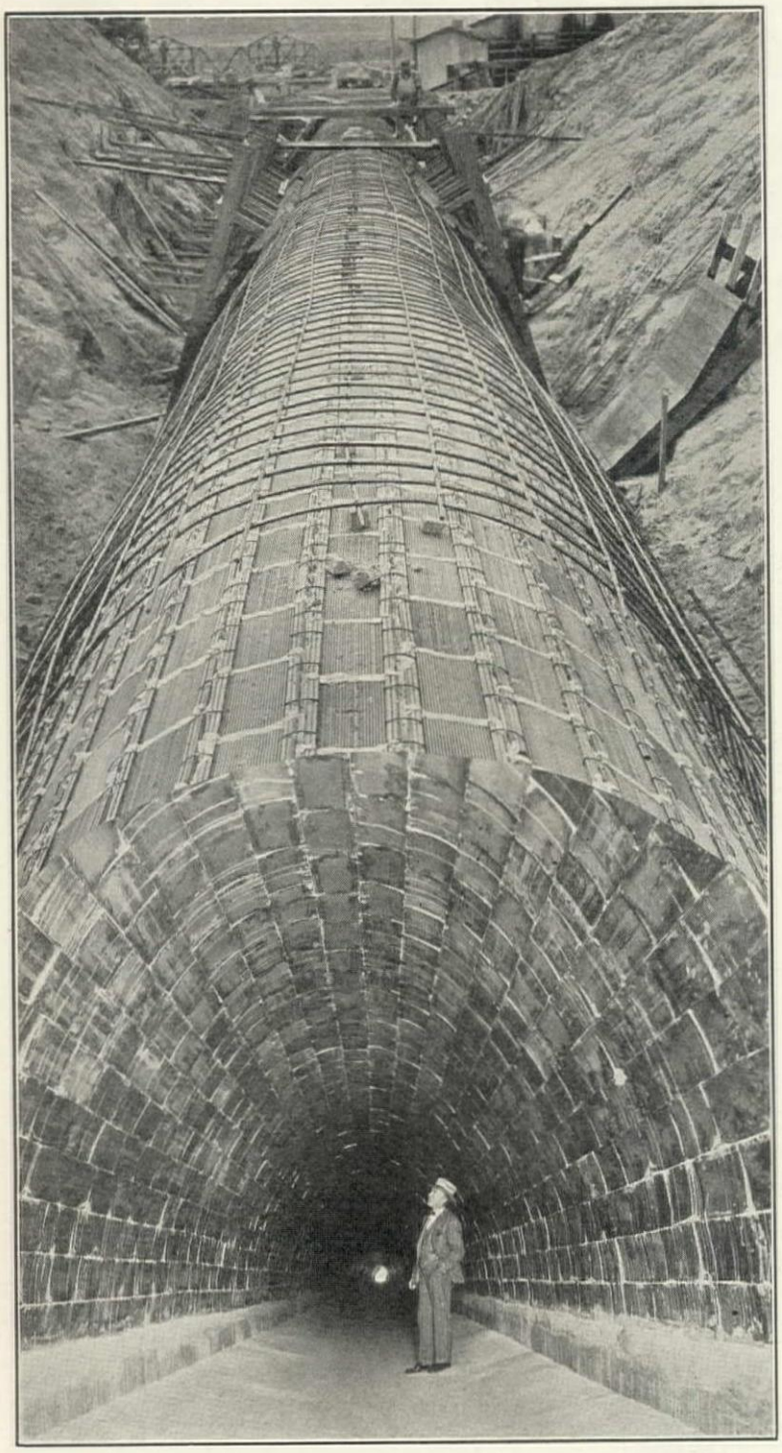


VITRIFIED CLAY—the Only Everlasting Material for Sanitary Sewers

Section of Main Outfall Sewer for Los Angeles Metropolitan Sewer District, as designed by A. K. Warren, Chief Engineer, Los Angeles Metropolitan Sewer District.

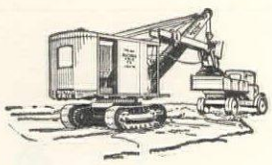
The entire length of arch in this twelve miles of Outfall Sewer is completely lined with Vitrified Salt Glazed Clay Segment Sewer Blocks in order to protect the concrete superstructure from the ever present acids and sewer gases. This line ranges in size from 5′3″ to 10′6″.

Pacific Clay Products

PACIFIC

Suite 650
Chamber of Commerce Bldg.

1151 South Broadway
Los Angeles



A 1/2-YARD SHOVEL – CRANE – DRAGLINE –

Built to Earn Extra Profits

Look into the 1020 — it will give you greater respect for 1/2-yard machines. As rugged and reliable for its work as a big quarry shovel. Users prove it — and there are *more* small Bucyrus-Erie Shovels in use than any other make! The 1020 reflects the experience of building 10,000 machines. Check these features: Ball-bearings . . . special steels . . . unit steel construction . . . over-size shafts, bearings and clutches . . . gears incased and running in oil. ***Write for bulletin on the 1020***

Power shovels, clamshells, cranes, draglines, dragshovels, ½ to 16-yard capacity — electric, steam, gasoline, Diesel, gas + air, Diesel + air.

Dipper, hydraulic and placer mining dredges.

BUCYRUS-ERIE COMPANY

Plants: South Milwaukee, Wis., Erie, Pa., Evansville, Ind. General Offices: South Milwaukee, Wis.

West Coast Branch Office: 989 Folsom Street, San Francisco.

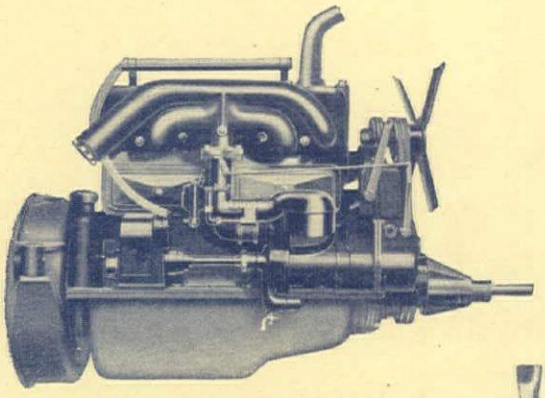
Clyde Equipment Company, Portland, Ore., Seattle, Wash. Concrete Machinery & Supply Company, Los Angeles, Cal.

A-29-4-10-30-WCN

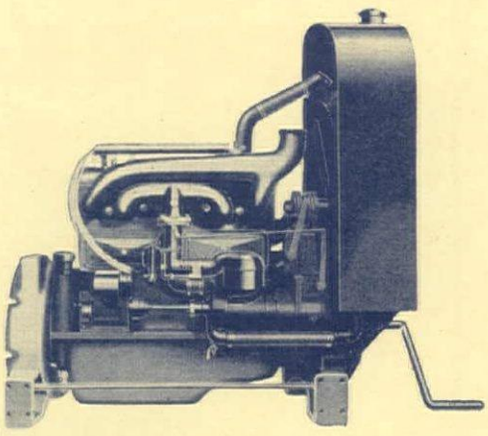
BUCYRUS ERIE

[SEE SIX JENISON MACHINERY COMPANY PAGES FOLLOWING]

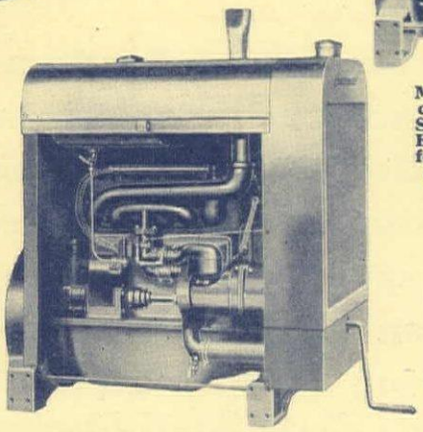
PRACTICAL POWER



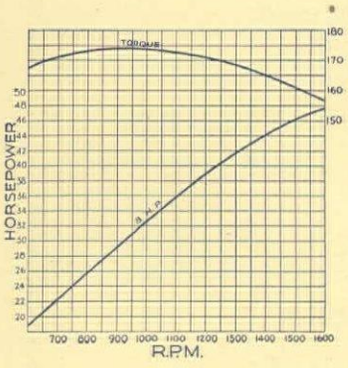
Model S12—4-cylinder Red Seal Industrial Engine with Automotive type housing



Model S12—4-cylinder Red Seal Industrial Engine with foot-type housing and radiator



Model P39A Red Seal Industrial Power Unit with Model S12 Industrial Engine



A ROAD construction gang pushing through the Everglades . . . a tractor humming in a great bare field in Iowa . . . aggressive manufacturers of industrial equipment in Michigan—all require steady, practical power. It must be strictly economical power too, that smoothly meets the special requirements of these hurrying men who have no time to alter and slowly adjust temperamental engines.

A Heavy Duty Continental Engine is the logical choice in agriculture or industry. It fully satisfies the most exacting manufacturer, jobber, and final user, by furnishing them with a reliable power plant that has been fitted and assembled to meet one particular need and steadily reduce the cost of operation.

CONTINENTAL MOTORS CORPORATION
INDUSTRIAL EQUIPMENT DIVISION
Office and Factory: Muskegon, Michigan
The Largest Exclusive Gasoline Motor Manufacturer in the World

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Colyear Motor Sales

Continental Engines

★ LOCAL STOCKS JENISON MACHINERY COMPANY AND SERVICE ★

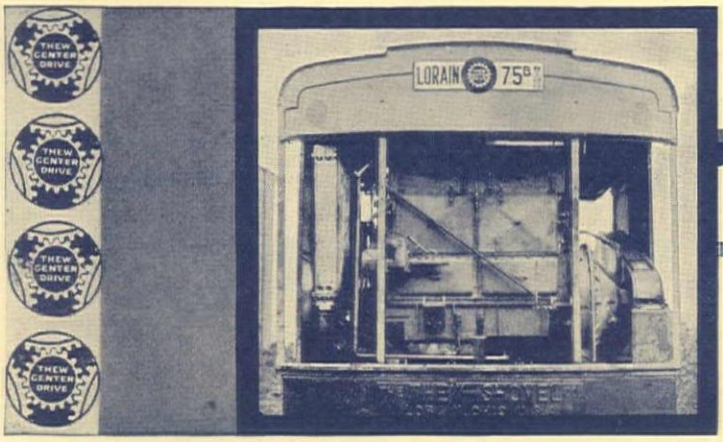
When writing to CONTINENTAL MOTORS CORPORATION, *please mention Western Construction News*

THE LORAIN 75 DIESEL POWERED

40,000 cu. yds. in 30 days
at a fuel cost of $75.00.

HERE is a shovel, crane, clamshell, dragline, that has all the advantages of the Diesel—low fuel cost, and high torque power at drag-down low speeds—plus all the features of the Center Drive. This means power that can be concentrated on one motion or spread over three operations as required.

THE THEW SHOVEL COMPANY
Lorain, Ohio



THEW

Lorain 75 equipped with Atlas Imperial Diesel Engine

Distributed by:
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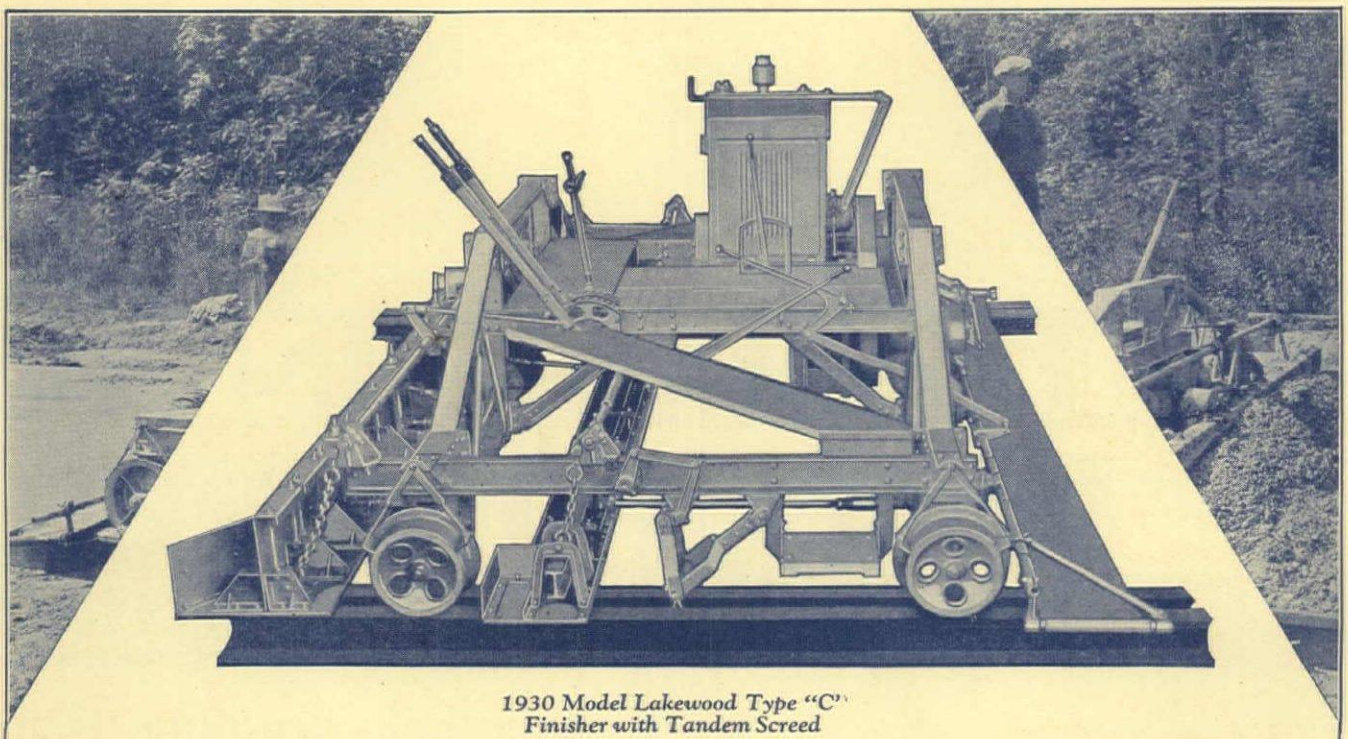
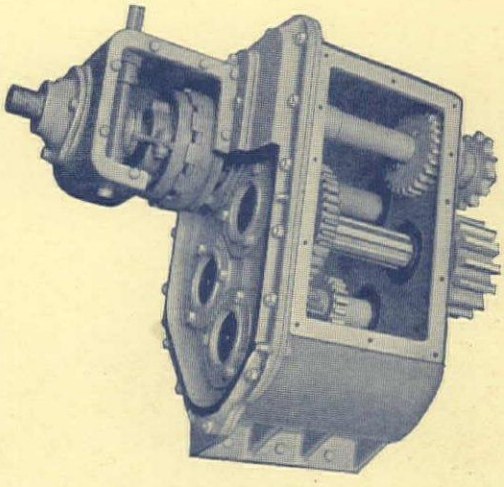
When writing to The Thew Shovel Co., *please mention Western Construction News*



1930 Model Lakewood Type "C" Finisher with Tandem Screed

4 *years without a replacement*

That's the Record of the main transmission of the Lakewood Type "C" Finisher



Automotive transmission means alloy steel, heat treated gears and shafts running in oil mounted on Timken bearings.

WITH hundreds of machines in operation all over the world - no replacement gears or shafts have ever been furnished for this gear box which transmits power to all operating parts of the machine. That record stands as silent testimonial of the value of the automotive type transmission obtainable only in the Lakewood Type "C" Finisher.

Write for Bulletin 47

EXPORT OFFICES: 30 Church St., New York City · · CABLE ADDRESS: Brosites

LAKEWOOD

The Lakewood Engineering Co. CLEVELAND · O.

California Representatives: **JENISON MACHINERY CO., 58 Fremont Street, San Francisco; SMITH BOOTH USHER CO., 1910 Santa Fe Avenue, Los Angeles**

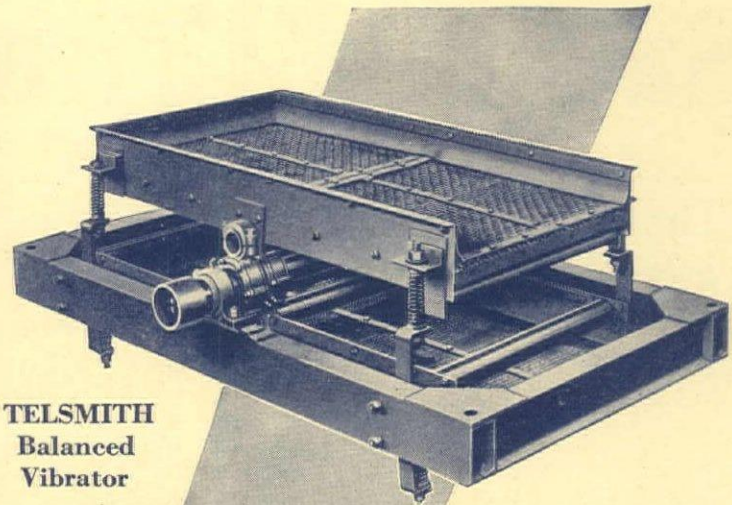
★ LOCAL STOCKS JENISON AND SERVICE ★

When writing to THE LAKEWOOD ENGINEERING CO., *please mention Western Construction News*

100 Hours
Continuously
under 100% overload

How many screens could stand this test without shaking themselves to pieces? Telsmith stood it and was still running smoothly . . . . bearings cool and bolts tight . . . . at the finish.

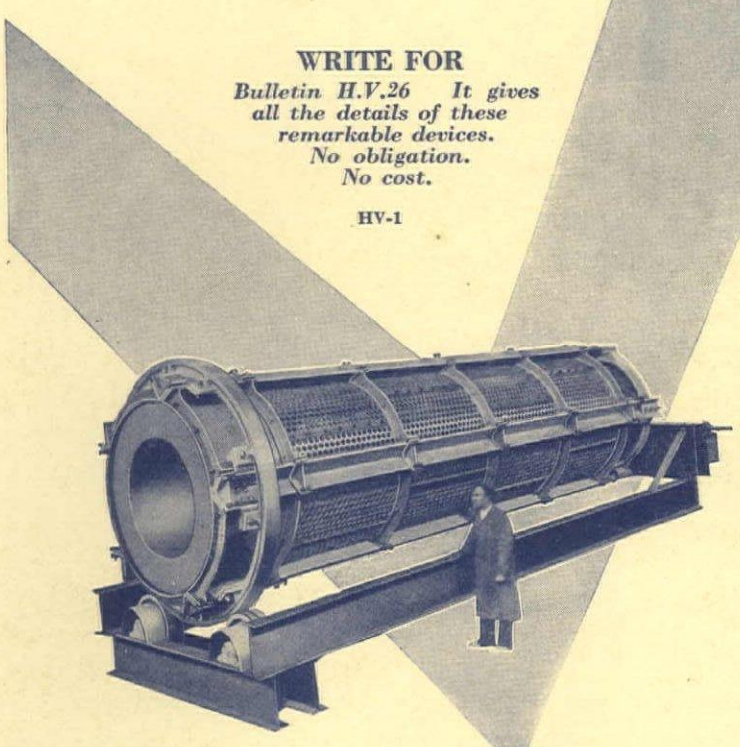
For the screens vibrate . . . . not the frame . . . . in the new Telsmith Balanced Vibrator. It hits 1400 R.P.M. . . . . there's not a dead or lazy spot on either screen. So smoothly balanced is the opposite movement of the two decks . . . . and so slight is the vibration transmitted to the frame that a thimble will stay stationary on the steel skids. Opposed eccentrics do the work . . . . one screen tray goes up while the other goes down, and vice versa. Using less than 2 hp., Telsmith develops an unusually large capacity. It's built substantially, too, for long service.



TELSMITH
Balanced
Vibrator

WRITE FOR
Bulletin H.V.26 It gives all the details of these remarkable devices. No obligation. No cost.

HV-1



The *New* TELSMITH HERCULES SCREEN

All steel . . . with TIMKEN Tapered Roller BEARINGS *throughout* . . . you can turn a 60-in screen by hand. Every vital part is protected against dirt, sand, water and friction.

Reenforcing segments bind screen plates and longitudinal angles . . . segments and perforated plates are drilled to template and bolted together, forming an *absolutely rigid* cylinder. Screen sections and segments are easily renewable . . . . . *without drilling.* The supporting frame is made of Bethlehem I-beams . . . a strong, non-deflecting structure.

SMITH ENGINEERING WORKS
1826 Holton Street, Milwaukee, Wis.
JENISON MACHINERY CO.
58 Fremont St., San Francisco
GARLINGHOUSE BROTHERS
2044 Santa Fe Ave., Los Angeles

TELSMITH

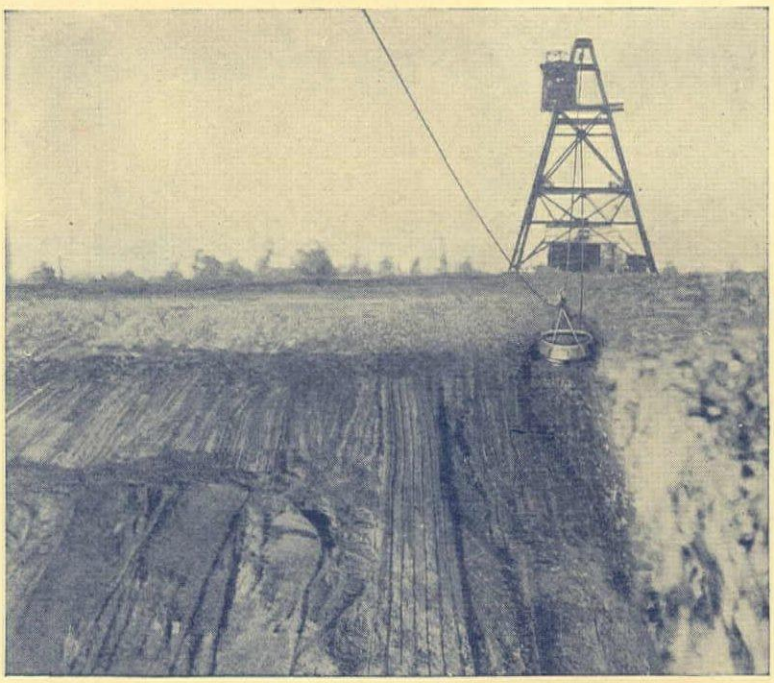
★ LOCAL STOCKS JENISON MACHINERY COMPANY AND SERVICE ★

When writing to Smith Engineering Works, *please mention Western Construction News*

Sauerman Tower Slackline

The Economical Excavator for Handling Large Yardages Over Long Hauls

Solves the Earth-Moving Problems Encountered in Constructing Canals, Dams, Reservoirs, Etc.



ALL previous records for low costs in moving earth distances of 600 to 1000 feet have been shattered during the last few years by the powerful, long-range, mobile Sauerman tower slackline excavators.

There has been a gradual increase in the size of these machines to meet the continual demand of contractors for excavators with longer operating radii and larger hourly handling capacities. As a result of this development, Sauerman tower excavators now are designed with towers as high as 125 feet, and operating spans as long as 1000 feet.

In digging wide canals or reservoirs, and in constructing levees, a Sauerman tower excavator has a distinct advantage over other types of excavating machinery. It is able to reach entirely across the projected excavation and move the excavated material into place in one operation in volumes of as much as 400 cu. yd. per hour.

Every engineer and contractor who specializes in large scale earth-handling work, should keep this Sauerman excavator in mind, as it offers wonderful possibilities of reducing costs on his future projects.

SAUERMAN BROS., Inc., CHICAGO, ILLINOIS

Pacific Coast Distributors:

Jenison Machinery Co.
58 Fremont St., San Francisco

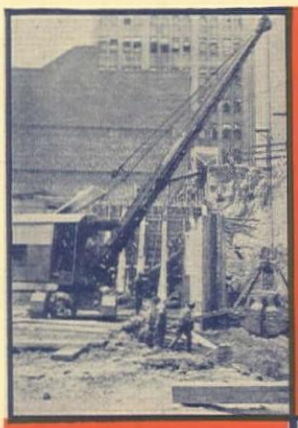
Smith Booth Usher Co.
228 Central Ave., Los Angeles

Clyde Equipment Co.
Portland, Ore., Seattle, Wn.

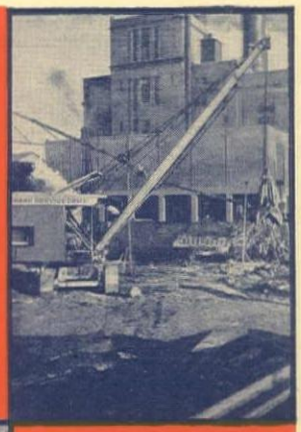
SAUERMAN

★ LOCAL STOCKS JENISON MACHINERY COMPANY AND SERVICE ★

When writing to SAUERMAN BROS., *please mention Western Construction News*



COMPARE YOUR COSTS WITH THOSE OF THE ½ YARD UNIVERSAL 35



THERE are jobs that can be handled cheaper with big machines than with the ½ yd. Universal 35. There are a lot of jobs that look like big machine jobs that a Universal 35 can actually handle at lower costs. But why guess about it when you can get the facts and figures?

Write us that you want to talk costs, no obligation, we'll show you the records, then you can buy knowing whether or not you're getting the most profit from the job.

THE UNIVERSAL CRANE CO., Lorain, Ohio

One investment gives you a machine you can operate with shovel, crane, clamshell, dragline, or skimmer scoop boom.

The Universal 35 is mounted on the famous 2-Speed Center Drive Crawler for easy maneuvering.

THE GREATEST VALUE IN A ½ YARD MACHINE

UNIVERSAL-35

Truck Crane and Universal "35" Representatives: The Universal Crane Co., Los Angeles Calif.; The Universal Crane Co., San Francisco, Calif.; The Feenaughty Machinery Co., Portland, Seattle, Spokane.

Universal "35" Representatives only: The Smith Booth Usher Co., Los Angeles, Calif.; The Jenison Machinery Co., San Francisco, Calif.

★ LOCAL STOCKS JENISON AND SERVICE ★

When writing to THE UNIVERSAL CRANE COMPANY, *please mention Western Construction News*

Get this straight

"it digs without plowing"

about shallow grading

The milling action of the picks-and-paddles of the Haiss Excavator is a powerful effort. It feeds material to the buckets *fast*—and contractors have been moving big yardage at low costs:

46,340 yards of hard clay-ey street topping in Saskatoon @ 8.3c* a yard
15,000 yards of top soil at Olympia at 7c* a yard
700 yards of street grading in a 9-hour day in Cincinnati
440 yards of 12" x 8' wide strip grading in 9 hours at Benton Harbor
500 yards a day of airport grading spoil into dump wagons at Glenview

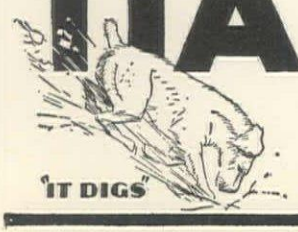
*Depreciation 2c. per yard.

There's nothing like it for shallow grading—and 'twill handle cuts up to 4 ft. deep. Write for Bulletin 629—address George Haiss Manufacturing Co., Inc., Canal Place & E. 144th St., New York, or the Representative nearest you.

Western Representatives:

A. L. Young Machinery Co.	*San Francisco*
Brown-Bevis Company	*Los Angeles*
Clyde Equipment Co.	*Seattle*
Clyde Equipment Co.	*Portland*
Steel Products Corporation	*El Paso*
Burnite Machinery Co.	*Denver*
Stannard Arnold Machinery Co.	*Salt Lake City*
Hall, Perry Machinery Co.	*Butte*

HAISS EXCAVATOR



665

A BRUTE for CRUSHING—

DIAMOND Double Unit Crushing and Screening Plant

A jaw crusher for the primary--- A roll crusher for reduction---both in one compact portable unit that will crush TWICE the amount of oversize and deliver from 400 to 600 yards of sized material per day.

It is equipped with The Diamond Timken roller bearing crusher for power economy.

Write for our 1930 Catalog describing our complete line of Sand and Gravel handling machinery.

Kratz & McClelland, Inc.
522 Bryant Street
SAN FRANCISCO, CALIF.

Concrete Machinery & Supply Co.
777 E. Merrill Avenue
LOS ANGELES, CALIF.

Feenaughty Machinery Co.
324 Belmont Street
PORTLAND, OREGON

Diamond Iron Works, Inc.

MINNEAPOLIS, MINN. U.S.A.

When writing to DIAMOND IRON WORKS, INC., *please mention Western Construction News*

Doing a double job . . . . 20 miles long . . . . . .

TWENTY miles of up-hill and down-dale digging was only a part of the service rendered by the two Link-Belt type K-55 trench shovels on this Albany, N.Y., water main. Each was equipped with a 2½ yd. bucket.

The pipe used was 48 inch heavy, cast iron—probably the world's longest pipe job using this heavy type of cast pipe.

Section by section the Link-Belt Trench Hoes dug the trench then swung the 7-ton pipe into place. Twenty-seven sections per day of trench (7 feet wide at bottom), and pipe laid, was not unusual, in spite of 15 to 20% grades and often wet digging.

This was another job handled by Pepper Bros., the popular contractors of Syracuse and Albany, New York, now using five Link-Belts. Out of long experience, Mr. Vic Pepper wrote: "Link-Belts may be more expensive than some of the others, but by far they are the cheapest to operate."

The Link-Belt through-and-through quality in Shovel-Crane-Dragline units will lower *your* yardage and handling costs. Gasoline, Diesel, or electric power.

Shovels—Cranes—Draglines of ¾ to 2 yd. capacity, heavy duty units

LINK-BELT COMPANY

Builders of Locomotive Cranes for 30 years. Portable Loaders—Crawler Cranes—Shovels—Draglines

San Francisco
GARFIELD & CO.
Hearst Bldg.

Portland
LOGGERS & CONTRACTORS MCHY. CO.
345 E. Madison St.

A. H. COX & CO., Inc.
1757 First Ave., S.
Seattle

HARRY C. COLLINS
2411 East 26th St.
Los Angeles

Phoenix
MINE & SMELTER EQUIP. CO.
Lock Box 788

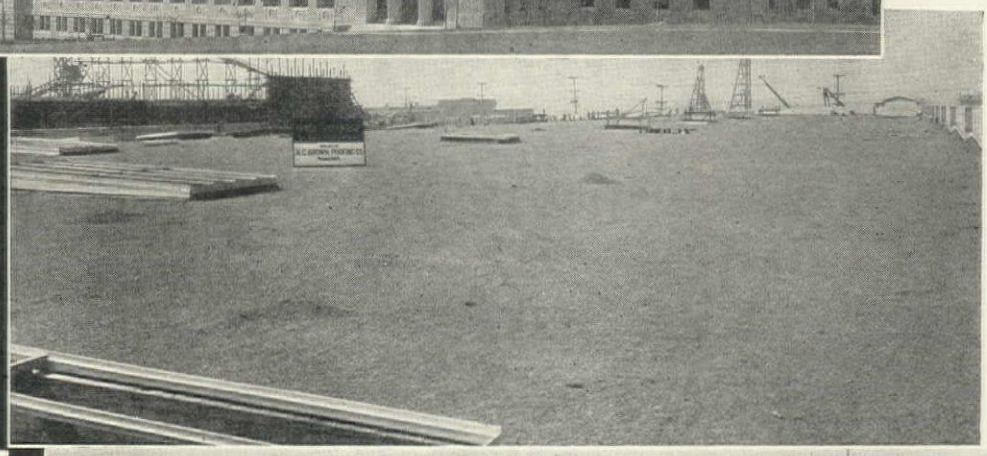
3913

LINK-BELT

SHOVELS + CRANES + DRAGLINES

When writing to LINK-BELT COMPANY, *please mention Western Construction News*

A Pabco 10-Year Built-Up Roof . . . 685 squares . . . protects the new Life Science Building of the University of California at Berkeley.



Libby, McNeill & Libby enjoy the protection of a Pabco 20-Year Built-Up Roof on Warehouse B, Oakland. The 2400 squares used 12 carloads of Pabco Products

425 squares of Pabco 15-Year Built-Up Roofing were used on Pier 42, San Francisco, by the California State Board of Harbor Commissioners.

PABCO MULTIPLE PROTECTION

THE CROWNING FEATURE OF YOUR BUILDING

should be a roof that will give trouble-free, lasting protection to the structure itself and to its valuable contents.

PABCO 10, 15 and 20 Year Guaranteed Roofs are protecting thousands of structures from attacks of the elements. The materials in these built-up roofs are thoroughly saturated and waterproofed at the factory, by controlled machine methods, with two coats of blended bitumen.

Hence a Pabco Roof installation always is waterproof in spite of variable climatic and labor conditions.

Our corps of engineering experts will gladly give you, without obligation, advice and suggestions on your roofing, or any other waterproofing problem involving structural, industrial and engineering protection.

PABCO 10, 15 and 20-YEAR ROOFS

THE PARAFFINE COMPANIES, INC.

LOS ANGELES · OAKLAND · SAN FRANCISCO · PORTLAND · SEATTLE · KANSAS CITY
SOMERVILLE, N. J. · NEW YORK CITY · LONDON, ENGLAND · SYDNEY, AUSTRALIA

Manufacturers of

Pabco Multi-Service Paints, Varnishes, Lacquers and Enamels, Pabco Waterproofing Paints and Compounds, Mastipave, Pabco 10, 15 and 20 Year Roofs, Malthoid Membrane Dampcourse, Pabcobond and Other Products

WATER TRANS-PORTATION

OUR pioneer railroads tested their mettle when they undertook the gigantic task of pushing their lines forward over almost boundless miles on our western plains.

Great American cities of the Middle West were made possible by them since transportation of people and of goods to them was a necessary antecedent of their founding.

But today the continued well-being of those same cities is even more dependent upon success in the transportation of water to them without interruption and without reduction in volume.

Water transportation is our business. The illustration, recently made, is on our sixth water-transportation line for one representative Middle West city, Denver.

Like all other Lock Joint Pressure Pipe lines, this will transport water, the life giver, without interruption, because troublesome repairs and maintenance will be rarely needed, and without diminution, because it cannot tuberculate and thereby lose any of its initial high carrying capacity.

LOCK JOINT PIPE COMPANY
Established 1905
AMPERE, N. J.

Pressure, Sewer, Subaqueous, Culvert

LOCK JOINT
Reinforced Concrete
PRESSURE PIPE

When writing to Lock Joint Pipe Co., *please mention Western Construction News*

Each of the two Blaw-Knox Central Mixing Plants which Wiley-Maxon Construction Company are using on the Columbia-Wrightsville Bridge consist of the following equipment--

A 500 barrel Cement Bin, equipped with a screw conveyor arrangement to transfer the cement to the Batchers on the 100-ton Blaw-Knox Batcher-plant. This Batcherplant is equipped with a Volume Batcher and a Blaw-Knox Inundator. A Ransome Mixer is the mixing unit on each plant.

Two thoroughly reliable Blaw-Knox Central Mixing Plants—one at each end of the job—feature the concreting operations on Wiley-Maxon Construction Company's tremendous bridge project over the Susquehanna River.

Contractors have learned to rely upon the ability and experience of Blaw-Knox to furnish efficient plants for central mixing. Blaw-Knox Central Mixing Plant installations have made it possible to produce specification concrete on thousands of jobs, large and small.

Permit Blaw-Knox to make recommendations for your Central Mixing Plants. You will be placed under no obligation if you avail yourself to this engineering service.

BLAW-KNOX COMPANY

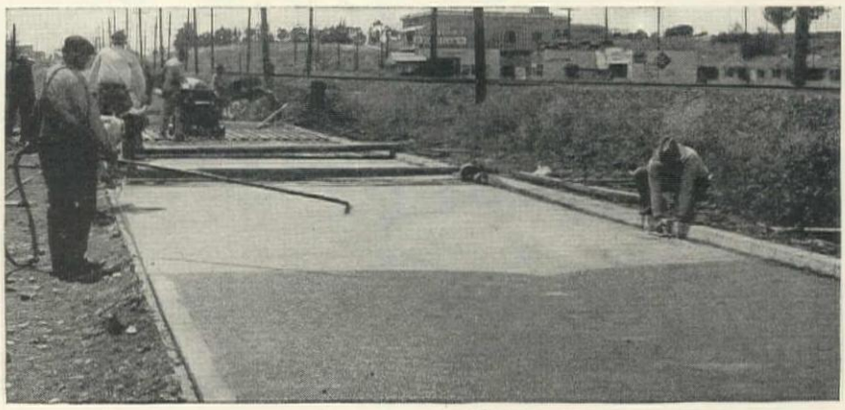
2089 Farmers Bank Bldg., Pittsburgh, Pa.

Garlinghouse Bros., 16th Street and Santa Fe Avenue, Los Angeles, Calif.; Harron, Rickard & McCone, 1600 Bryant Street, at 15th, San Francisco, Calif.; J. L. Latture, 312 E. Madison Street, Portland, Ore.; Pacific Hoist & Derrick Co., 818 First Avenue, S., Seattle, Wash.; L. A. Snow Co., 1032 Sixth Avenue, S., Seattle, Wash.

BLAW-KNOX

TRADE MARK REG. U.S. PAT. OFFICE BLAW-KNOX

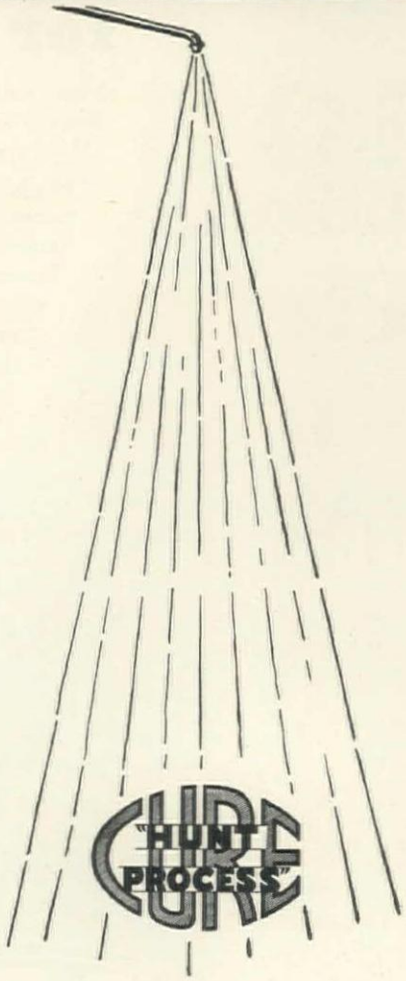
With This Better Method-



You Can Spray It then *Forget* It!

ONLY one simple operation is needed when you cure concrete with the "Hunt Process"—the modern method of internal cure. There is no need to go back over the job again and again to fill the dikes or to wet down the earth cover. The entire curing process—so far as you are concerned—is completed when the mixing water has been sealed into the concrete by the airproof and waterproof film of "Hunt Process." As the cure progresses, this film hardens and adheres closely, practically becoming a part of the concrete without penetrating into it.

Curing need no longer be a matter of controversy between the engineer and the contractor. Literally, you can spray the concrete and then forget it. With the mixing water sealed in, the process of hardening goes forward under ideal conditions. "Hunt Process" jobs are completed when the last square yard of concrete has been sprayed.



The "Hunt Process" is good for any form of concrete work including dams, pipes, bridge abutments, retaining walls and similar structures. A helpful booklet telling you in detail how you may benefit from this better method of curing is ready to put in the mail. The coupon will bring it.

McEVERLAST, INC.
[TM REG]

111 West Seventh Street, Los Angeles, California

35 East Wacker Drive, CHICAGO, ILL. | 1754 Graybar Bldg., NEW YORK, N. Y. | 1314 Magnolia Bldg., DALLAS, TEXAS

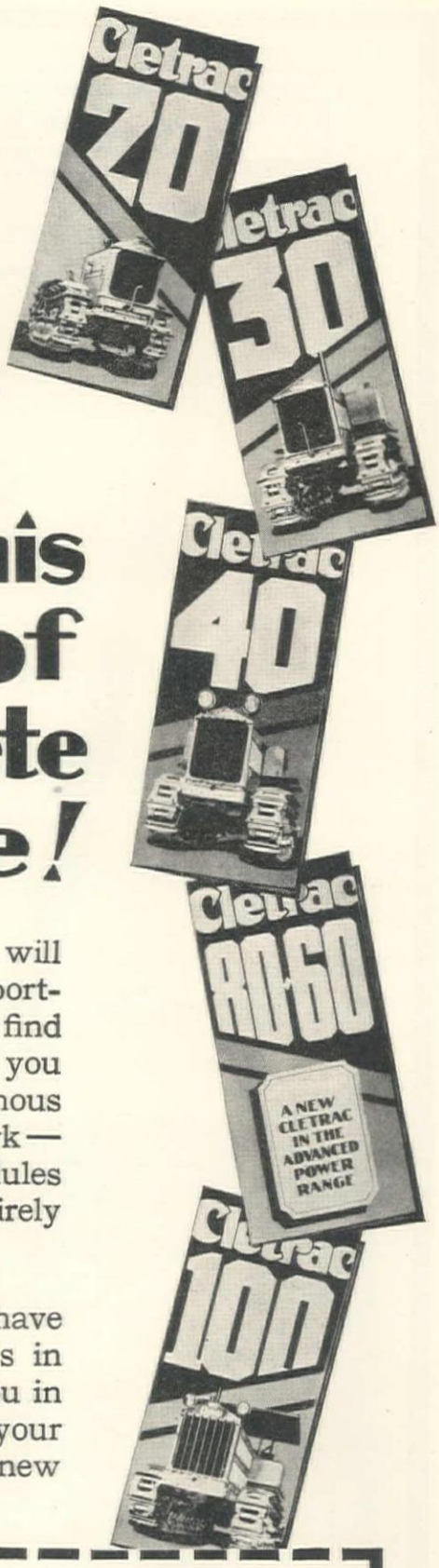
OFFICES IN PRINCIPAL CITIES

I want further information on this better method of curing.

Name.....

Address.....

City.....State.....



Get this Outline of Cletrac's Complete Power Service!

THE coupon below — or a postal card — will bring you FREE, this colorful new Cletrac portfolio. In a clever pocket on the inside you will find five strikingly illustrated catalog folders to tell you in picture and story the big things these five famous Cletrac models are doing in your field of work — how they are cutting costs — speeding up schedules — doing more kinds of work — setting up entirely new standards of efficiency and economy!

Amazing records for capacity and endurance have been made by every one of the rugged models in this famous line of tractors. What they offer you in the way of service or in helping you to solve your problems of power, is clearly shown in this new Cletrac portfolio. There is no obligation. Merely mail a postal or the coupon below.

The Cleveland Tractor Co.
19332 Euclid Avenue Cleveland, Ohio

THE CLEVELAND TRACTOR CO.,
19332 Euclid Avenue, Cleveland, Ohio.

Send me the new Cletrac portfolio outlining Cletrac's power service.

Name_____

Address_____

When writing to THE CLEVELAND TRACTOR COMPANY, *please mention Western Construction News*

Bit-u-muls

"HEAVY TRAFFIC" *Pavement* *at* "LIGHT TRAFFIC" *Costs*

A revolutionary development in paving

After years of extensive research . . . its quality proved, by widespread use throughout the world . . . Bitumuls now offers the demonstrated answer to the public's demand for more roads.

Combining the meritorious features of the two well-known hot asphaltic types . . . Bitumuls construction results in durable, non-skid, water-proof, rock pavements . . . *with no heating costs whatever.*

Voids are reduced to a minimum. And, because the use of excess asphalt is eliminated, there is no shoving and surface bleeding.

Easy to Lay

Only simple equipment required to construct. Application may be with the popular types of gravity or pressure distributors, or with ordinary pouring pots.

Applied at any atmospheric temperature, except freezing weather . . . and in damp, or even mildly rainy weather . . . Bitumuls non-skid paving adds many months to your construction season.

To get more miles from your paving dollars . . . on secondary roads, primary roads, city streets, subdivisions, widening, resurfacing, maintenance, and airports . . . investigate Bitumuls low-cost construction.

Be sure that your specifications measure up to Bitumuls. It is unadulterated . . . 99½% pure.

Mail the coupon for manual, with detailed facts, technical data, and specifications.

Make This Practical Test

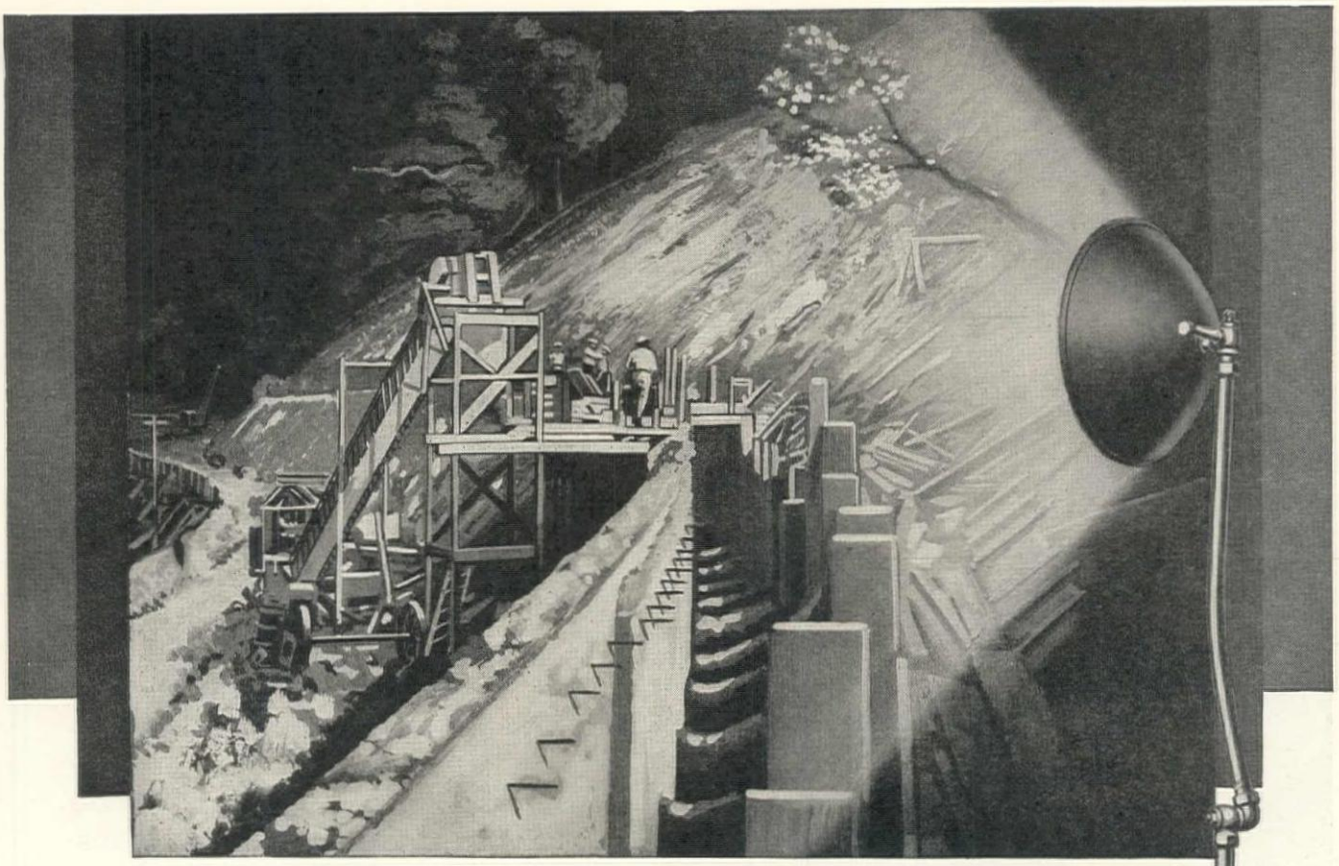
Order a sufficient number of barrels of Bitumuls to make a thorough test. Have your regular paving crews apply it . . . in small areas . . . with ordinary gravity or pressure distributors, or with pouring pots. See for yourself the amazing possibilities of Bitumuls in your pavement construction and maintenance . . . its low cost . . . its durability . . . its non-skid surface.

AMERICAN BITUMULS COMPANY—Branches throughout the world

In the East write to: 4200 O'Donnell St., Baltimore. In the West write to: 503 Market Street, San Francisco.

Please mail me your free manual . . . without obligation

Name_____ **Address**_____



. . . . Carry Through With Carbic Light . . .

WHEN late starts, unfavorable weather, lack of materials, or any other cause of delay forces you to rush the job along—a night shift with Carbic Flood Lights will see you through.

Carbic Flood Lights enable your night shift to work rapidly and safely. Their powerful, clear white rays are perfectly diffused. There is no glare and no dark shadow. Carbic Light penetrates fog, smoke or dust. It is good light to work by.

Carbic Flood Lights are low in first cost and economical to operate. They are simple, rugged and dependable—and meet every night-illuminating requirement.

Your night shift can hustle with Carbic Light.

Carbic is distributed by the Union Carbide Sales Company through its national chain of warehouses and is sold by jobbers everywhere.

CARBIC
PROCESSED CARBIDE FOR CARBIC LIGHTS & GENERATORS

OXWELD ACETYLENE COMPANY

Unit of Union Carbide and Carbon Corporation

NEW YORK

Sales offices in principal cities

In Canada: Dominion Oxygen Co., Ltd., Toronto

Technical Publicity Department, Room 1201, 205 East 42nd Street, New York, N. Y.

Without obligation, I would like to have additional information on Carbic Lights.

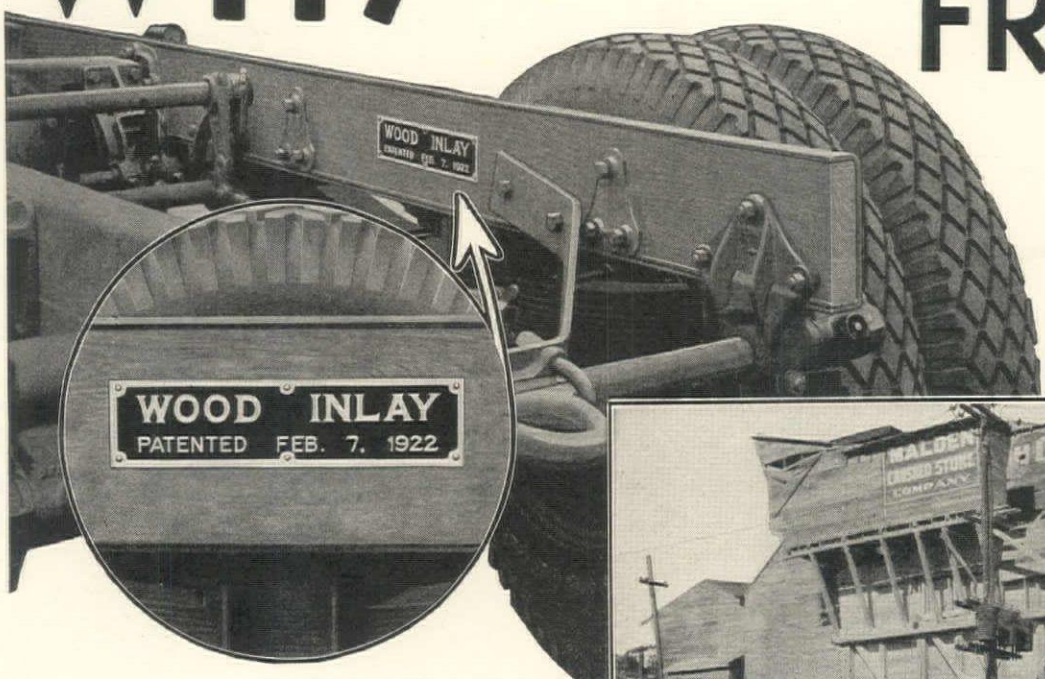
Name _____

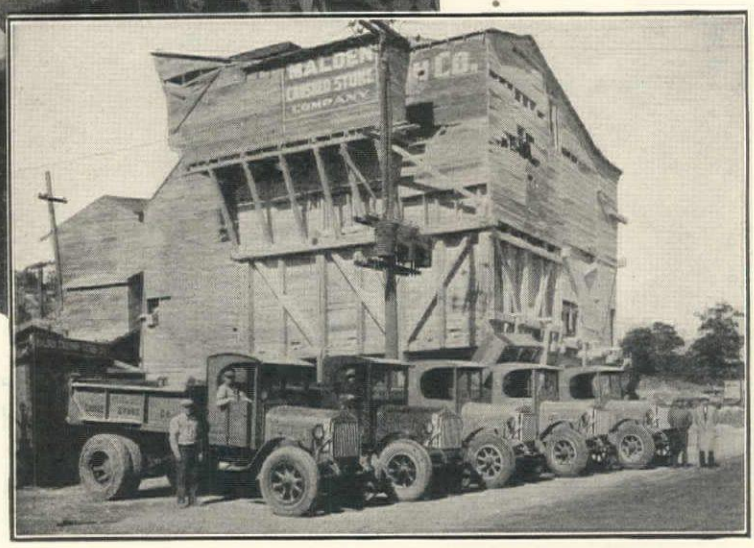
Street Address _____

City _____ *State* _____

W.C.N. 4-10-30

WHY a wood-lined FRAME ?





Sterling DC-26, 7 to 8½ tons, a husky, chain drive six

When a truck frame is all-steel, what is to protect the motor and fine working parts from destructive road shock and vibration? Springs and rubber tires are some help . . . but no real protection.

Strike a hard blow with a steel-headed hammer. Your hand isn't jarred . . . the wooden handle absorbs the shock. That's why the Sterling steel frame is *wood-lined* . . . for added rigidity, super-strength and extra flexibility that insure real protection . . . an additional safeguard *exclusively Sterling*.

Seasoned, solid oak planks are machine pressed into the steel channels. Snug-fitting bolts, through oak and steel, are kept *tight* by lock-nuts . . . no rivets to work loose. Repairs are fewer, replacements easier. The shock-absorbing wood lining gives quieter operation, a smoother running engine . . . halts crystallation of metal . . . lengthens the truck's life. Steering gear, foot pedals, and motor supports are mounted on the wood-inlay . . . making a Sterling easier to drive, with much less fatigue.

For pamphlet, "Why a Wood-Lined Frame?" write to Driver Dan in care of Sterling Motor Truck Company, Milwaukee, Wisconsin.

Driver Dan Says:

It takes more than good looks to increase payload. It's the hidden qualities in a truck that cut hauling costs.

STERLING MOTOR TRUCK CO. OF CALIFORNIA
1190-98 Howard St., San Francisco

Oakland Sacramento Fresno Stockton San Jose

Sterling TRUCKS

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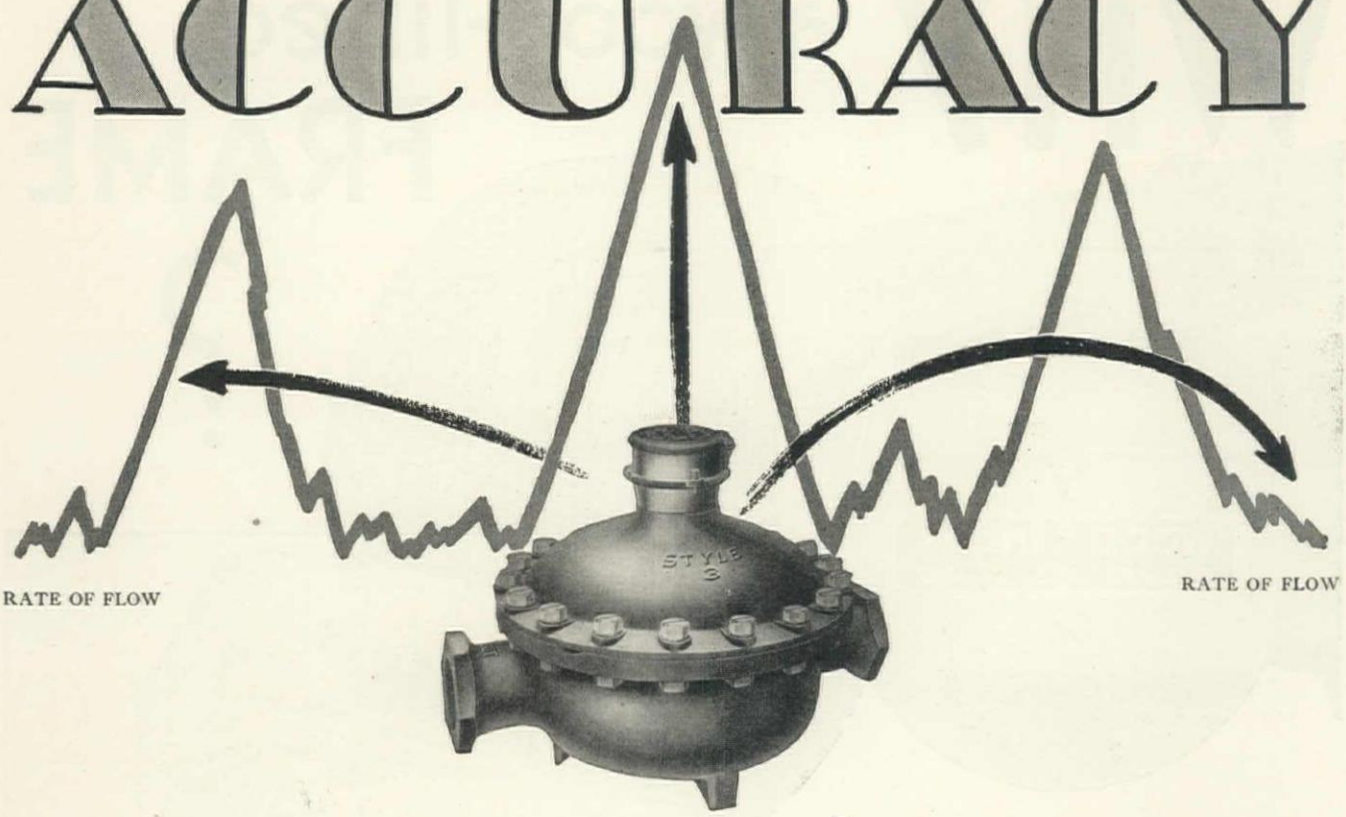
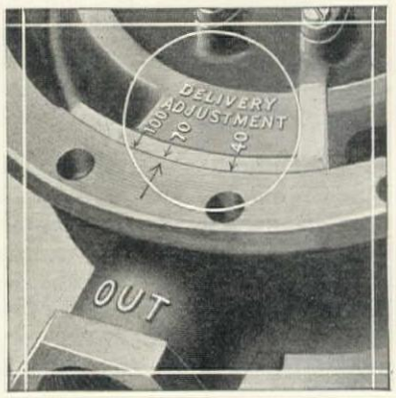
ACCURACY



TRIDENT Style 3 DISC METER

Trident Style 3 Disc Meters mean accurate registration *(more revenue)* where the rate of flow varies considerably. They will give the same degree of sustained accuracy at both extremes of volume as well as all intermediate points. One of the complete line of Neptune-built "Cash Registers of the Water Works Field."

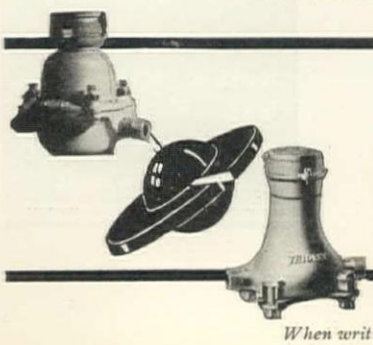


Special "Delivery Adjustment" on Trident Style 3 meter (range 40 to 100 pounds) insures accurate operation at varying pressures.

NEPTUNE METER COMPANY
THOMSON METER CORPORATION
50 East 42nd Street New York City
Neptune Meter Co., Ltd., Toronto, Ontario

Pacific Coast Branches:
LOS ANGELES: 701 East Third Street SAN FRANCISCO: 320 Market Street
PORTLAND: 525 Johnson Street

PIONEERS IN METER PROGRESS—YESTERDAY, *TODAY*, TOMORROW



THE POSITIVE MOVEMENT

of the TRIDENT METER Disc (as also in the LAMBERT Meter) insures the all-range accuracy of Trident Style 3 Meters. Above meters have also Trident Oil-enclosed Gear Train and Heat-proof renewable rubber bushings in Register and Gear Train.

When writing to NEPTUNE METER COMPANY, LTD., *please mention Western Construction News*

PHILIP SCHUYLER
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M. Am. W. W. Assn.
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CHESTER A. SMITH
M. Am. Soc. C. E.
ASSOCIATE EDITOR

VOLUME V | APRIL 10, 1930 | NUMBER 7

The payment of large bonuses to contractors for speedy and efficient construction—on the increase—is 'good business' when properly safeguarded. The completion of the Pardee dam nearly two years ahead of schedule saved the East Bay Cities from a serious water famine. The bonus paid the contractors, The Atkinson Construction Co., was a sound investment.

Bonuses For Speed and Efficiency in Construction

At the present rate of progress, the contractors on the Suisun bay bridge for the Southern Pacific Co.—Siems, Helmers & Schaeffner, Inc., and the U. S. Steel Products Co.—will earn large bonuses, which will be more than compensated by the saving in cost of operation of the present train-ferry service.

To secure speed in construction as a rule requires an efficient and experienced organization. Worthwhile bonuses, therefore, encourage bids from experienced and responsible constructors, who have learned to value pride in their work as well as the dollar of profit.

Much has been written on the whys and wherefores of prosperity, but the masterpiece of all was recently penned by Ernest Elmo Calkins, and published under the caption 'Now Is the Time to Advertise' in the March issue of 'Review of Reviews'. This article is already being reprinted—in fact, it should be given the widest publicity. Prosperity is summed up by Calkins in the simple formula 'keep the dollar turning over'—incidentally an axiom of Henry Ford—and the greater the acceleration of the cycle, the greater the prosperity, and vice versa.

Advertising An Aid To Prosperity

Calkins believes that our recent years of prosperity are the direct product of advertising, and cites enough instances to prove it. Furthermore, he states:

"Few business men, even those who employ it, rate advertising highly enough. When a manufacturer has implicit confidence and lives up to it, the results are sometimes startling. This year, advertising is more needed, not because people have less to spend, but because they hesitate to spend it. It will be a fine test of advertising. It is far more logical to advertise when sales are hard than when they are easy. Yet many otherwise logical manufacturers curtail advertising at the first sign of a business cloud."

We are sure that our advertisers—many new ones and some using increased space—will profit by their confidence in the power of advertising to increase the momentum of the revolving cycle of prosperity.

Occasionally a city engineer has the opportunity to hold his position long enough to carry out his dreams for city betterment. We have in mind at present, Olaf Laurgaard, city engineer of Portland, Oregon, who is largely responsible for awakening a lethargic municipality, a city which had gotten into the slump of contentment.

The City Engineer's Pride in His City

It has been a long, persistent battle with but little remuneration other than the pride in achievement of a worthy goal. There will be others to lay claim to some of the accomplishments underway and they should be accorded due credit, but Laurgaard deserves full recognition as the father of the new Portland which is building.

There is no reason why more city engineers cannot follow in his foosteps. There should be as much glory in city betterment as in the construction of a monumental dam or bridge.

One of the problems which confronts the program committee of every engineering or contracting organization is to keep 'within bounds' in number and length of subjects to be discussed at conventions. It is difficult to cover a wide range of subjects and territory in discussions limited to two or even four sessions of two hours each. Many of the papers presented could be materially curtailed in length, if the authors would prepare them well in advance of the meeting and then 'prune' them. Or, if the paper must necessarily be lengthy, they might well read only a synopsis before the convention.

Concise Papers at Conventions

Curtailed papers, or abstracts prepared by the author, would also help the editor of the journal of each association in solving the problem of publishing all the papers presented at the many conventions, the number and frequency of which are increasing. As a sample of abstracting, we recently published a synopsis of A.W.W.A. 1929 California section papers and summarized the 1929 C.S.W.A. papers. Only by the expedient of 'high-lighting' these papers could we make room for and give our readers the useful facts and experiences presented by the several authors.

Saku Hydroelectric Project, Japan

Design and Construction of a $10,000,000 Development on the Tone River—Largest Plant in Japan—Dams and Surge Tank Designed 'Earthquake Proof'—Details of Fishway and Electric Fish Screens

By S. SHIMODAO

Civil Engineer, Kanto Hydroelectric Power Co., Tokio, Japan

The Saku hydroelectric development is on the Tone river at the end of the Kanto plains and is the largest plant in Japan proper. It is about 80 miles from Tokio, the greatest power market of the country. The development was completed in the spring of 1929 under the direction of K. Tsuruta, chief engineer of the Kanto Hydroelectric Power Co., for which company I had charge of the civil engineering.

The project includes a diversion dam with a special fishway; a sand basin 600 ft. long by 180 ft. wide; a horseshoe-shaped water tunnel 18.5 by 18.5 ft., and 7.5 miles long, discharging into a regulating reservoir of 30,000,000 cu.ft. capacity; a pressure conduit, 15 ft. diam. and 4358 ft. long, leading the water therefrom to an elevated differential surge tank 262 ft. high and of 965,000 gal. capacity; and three 10-ft. diam. penstocks, each feeding a 36,000-b.hp. turbine at an effective head of 378 ft. All important structures were designed 'earthquake proof'.

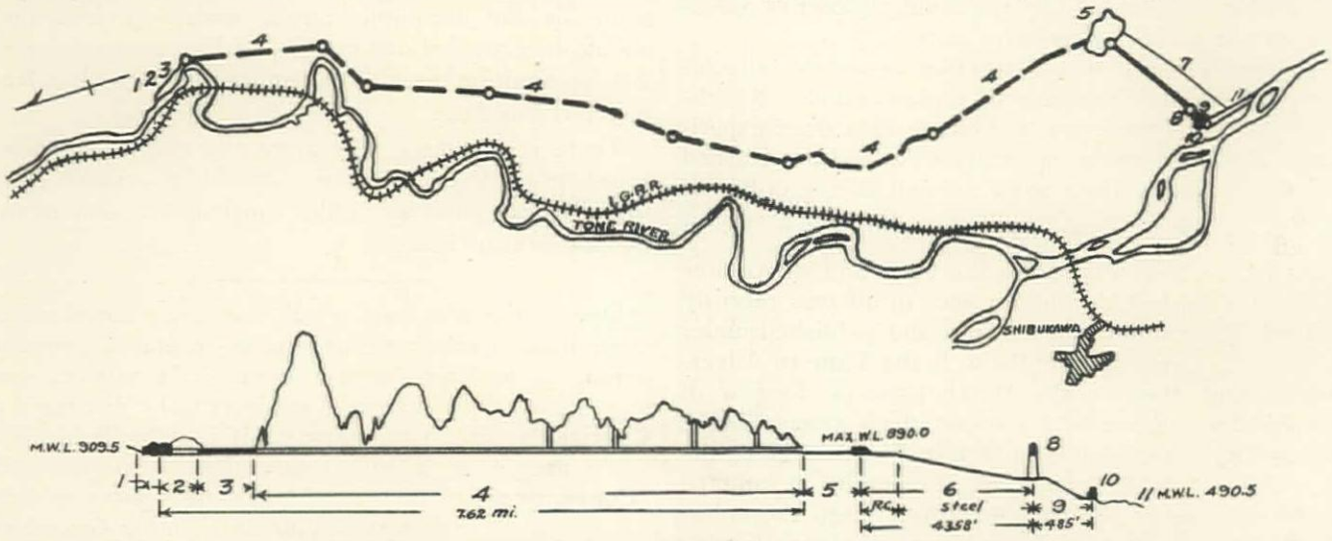


FIG. 1. SKETCH PLAN AND PROFILE OF 108,000-HP. SAKU HYDROELECTRIC PROJECT ON TONE RIVER, 80 MILES FROM TOKIO, JAPAN, SHOWING: 1—INTAKE, 2 AND 4—TUNNELS, 3—SAND BASIN, 5—REGULATING RESERVOIR, 6—PRESSURE CONDUIT, 7—SPILLWAY, 8—SURGE TANK, 9—PENSTOCK, 10—POWERHOUSE, 11—TAILRACE

Fig. 1 is a vicinity map and profile of the development. Detailed notes on the design and construction of the plant follow.

Dam and Rolling Gates—The government required us to design the dam to handle 150,000 c.f.s. out of a drainage area of 655 sq.mi., or about 230 c.f.s. per sq.mi. This quantity of water flows over the dam at a depth of 29 ft. Due to the proximity of the watershed, the steepness of slope, and the geological formation—granite and andesite—the runoff is sudden and large. The floods come usually in the spring, when the warm rain from the Pacific ocean melts the snow accumulated during the winter months, and in autumn, when the typhoon visits from the tropics, holding a great quantity of moisture. The minimum flow during the winter months when the snow forms in the mountains, drops to 1.68 c.f.s. per sq.mi. The average runoff is 4.72 c.f.s. per sq.mi. or about 1600 m.m. of rainfall. The mean elevation of the watershed is 3635 ft. above sea level and the distance from the ocean is 100 miles.

An overflow dam 40 ft. high, mounted by three roller gates 15 ft. high by 58 ft. long in the clear; two Stoney gates 15 ft. high by 21 ft. wide; and three Stoney-type sluice gates 12.5 ft. wide by 32 ft. high, compose the dam structure. The main purpose of this combination is to discharge quickly a large quantity of flood water. Because a government railway and a perfectural highway run low along one bank, and a village and another powerhouse exist less than a mile upstream, it was not permissible to extend the backwater further than the powerhouse nor to raise the water level above the highway.

Although the rolling gate cost about 2½ times as much as a Stoney gate for the same purpose, its selection was forced from the flood water conditions. The two 15 by 21-ft. Stoney gates were built to regulate the water at normal flow and to direct the stream on the side of the fish ladder.

The main cylinder of the rolling gate is 11 ft. diam.,

built with ⅜-in. plate steel riveted to 7 by 3-in. channels spaced circumferentially at 20 deg. apart. Each of the channels is braced to a diametrically placed triangular stiffener, also built of 7 by 3-in. channels and spaced 4.5 ft. apart by means of 3½ by 3½ by 0.425-in. angles. A shield plate is attached to the cylinder to increase the height 4 ft., making the total 15 ft. The total weight of the rolling gate is 62.2 tons, or about 1 ton per lin.ft. of gate, the total length being 61 ft. 8 in. and the clear span 58 ft.

Most of the rolling gates built so far are hoisted on geared racks by a sprocket chain on one end and are counterbalanced at the other end. On another job, we had a sad experience during a flood when some of the drifting logs got caught in the geared racks, disabled the operation of the gate, and finally caused it to break by piling up logs and raising the water. In the design of the present gate, we eliminated the geared racks and in their place laid 100-lb. rails, on which the gate rolls. The gate is lifted at both ends by wire ropes and sheaves, eliminating torsion and insuring easy adjustment of balance. Two sprocket chains are wound around the end of the gate on both sides of the lifting sheave, an end of one chain being anchored at the top and one end of the other at the bottom, thus preventing dislocation. The water-tight seal at the two ends of the gate is of simple arrangement: a planed cast-iron block is anchored into the concrete pier, and to the seal plate of the gate is bolted a square timber which slides tightly against the block. For water tightness at the bottom, the timber piece bolted to the shield plate rests on an I-beam embedded in the crest of the gate. So far this arrangement is entirely satisfactory. An emergency outfit for power in case of storm when the transmission line might be cut off, is built of a 100-hp. gasoline engine (dismantled from a locomotive) which is connected to a generator. The power required for lifting the rolling gate is 20 hp.

Fishway—With the increasing number of hydroelectric plants being constructed, and with accumulated knowledge from past experiences, greater attention is being paid to the problem of the fishway than heretofore. The building of a fishway is only an added burden on the part of power companies, yielding no return. In such a densely populated country as Japan, depriving any occupation from the local people at once brings up a serious social problem. Until a few years ago, when plants were built at the most favorable sites, streams were diverted into the waterways usually by low dams. Consequently, the problem of fishways was not so seriously considered as at present.

The most favorable sites, that is: the middle section of river plants, are rapidly being exhausted, and power plant sites are moving to the lower and upper sections. Better methods of water utilization are being pursued by building storage and regulating dams across the river. These two facts change the problem of the fishway, and the Bureau of Fishery has begun to issue many instructions concerning the construction of fishways and conservation of fishing as a natural resource.

Of the fishways built until recently, practically all are of the Cail ladder type. Those having a slope of 6:1 are most abundant, 8:1 and 10:1 following in order of number; in width, 4 ft. is most abundant, followed by 6, 3, and 5 ft. The cost of 97 fishways in-

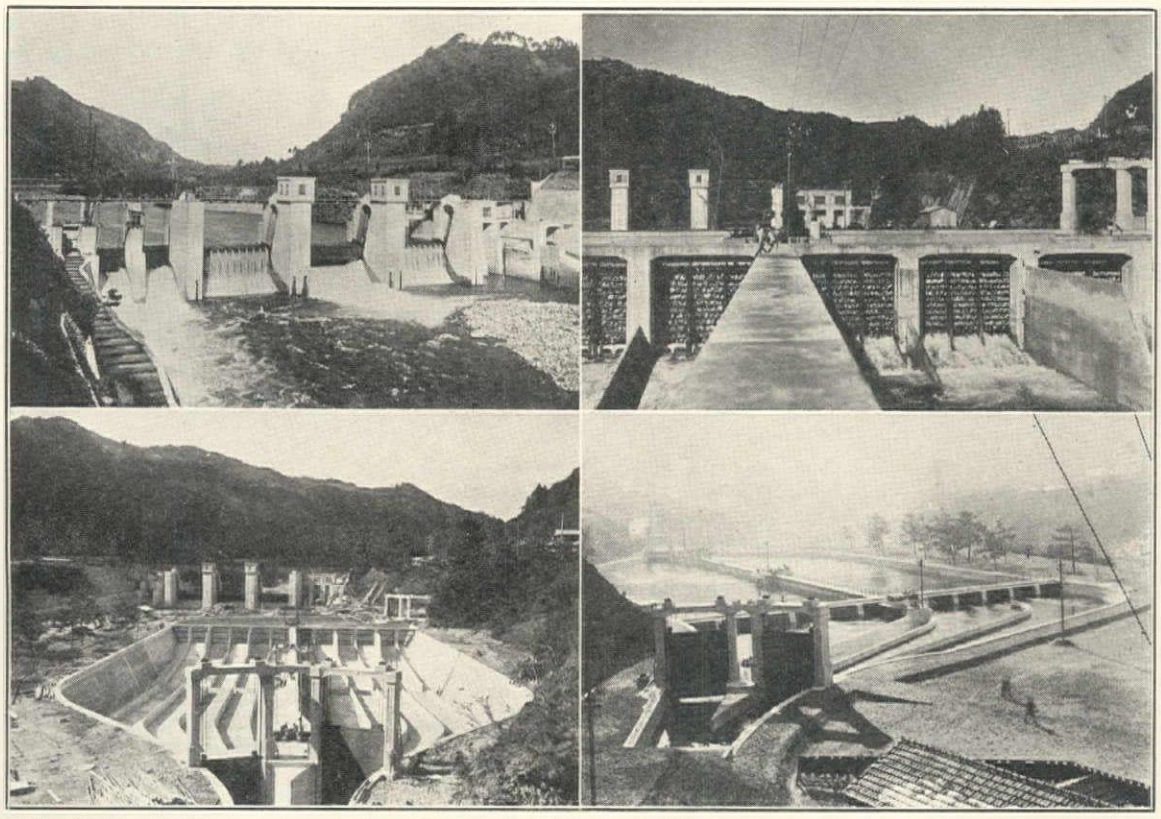


FIG. 2 (UPPER LEFT) GENERAL VIEW OF DIVERSION DAM FROM UPPER END OF SAND BASIN, WITH FISH LADDER ON LEFT. (UPPER RIGHT) COBBLESTONE RACK FOR DESTROYING VELOCITY OF WATER ENTERING SAND BASIN. (LOWER LEFT) INTERIOR OF SAND BASIN SHOWING TROUGHS, CROSSWISE GUTTER, AND OUTLET GATES. (LOWER RIGHT) GENERAL VIEW OF SAND BASIN AND S-CURVED FOREBAY FROM END OF TUNNEL

vestigated amounts to $300,000, representing about 0.2% of the total cost of the developments.

In the last two years, three large hydroelectric plants have been built in the lower section of the Tone river. They are: the storage-type plant of the Shogawa Hydroelectric Co., with a 260-ft. dam; the regulating dam of the Toshin Electric Co., raising the water 80 ft. above the natural stream level; and the Kanto Hydroelectric Power Co. diversion dam plant described in this article. With the advent of these power plants, marked changes in design were ordered by the Bureau of Fishery. The Toshin development required a fish ladder 1350 ft. long and 18 ft. wide, with an average slope of 15:1; and the Shogawa dam resorted to the elevator system similar to the Baker

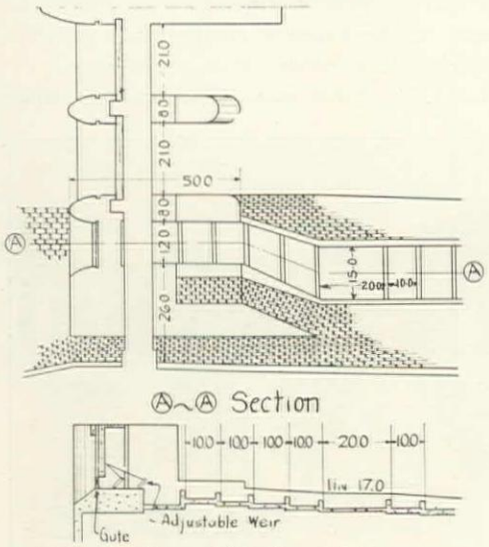


Fig. 3. Plan and Section of Fishway

river (Oregon) development, but had to build an approachway in the way of a natural river 36 ft. wide and 6527 ft. long, allowing water to flow at a depth of 1.5 ft.

The Kanto fishway is also of the ladder type, having a total length of 552 ft. and a rise of 32.20 ft., giving an average slope of 17:1 and a width of 15 ft. The 15-ft. wide fishway is partitioned by crosswise walls about 4 ft. high every 10 ft. and, after 5 such walls, a rest pool is built 20 ft. long. Every wall rises 8½ in. above the previous one, and the quantity of water is regulated to flow at that depth over the crest of the walls by means of a gate. On one side of the partition walls, 6-in. square holes are provided 20 in. above the floor for eels; and on the opposite side of these, notches are built on the crest of the partition walls 4 in. deep by 2 ft. wide, allowing 12½-in. depth of water to flow at these sections for Japanese trout. The remaining portion of the crest is provided for the most important fish, ayu, or plecoglassus altivelis. The notches and the square holes alternate sides at every rest pool. The reason for providing them all on one side during the 5 steps of walls is that the spaces between them having become larger than heretofore, a continuous current is thought to be more easily found by the fish. At the top, the gate provided can shut off debris during turbulent waters. Two movable weirs, built with boards hinged at the bottom, are provided behind the gate to care for the change in water level above the dam. The design of fishway is a special problem for each locality and type of fish. In our case, we observed fish ascending the ladder in good numbers last summer, the first season operated.

Besides the fish ladder, the company was ordered to build electric fish screens at the foot of the fish ladder, in front of the intake, and at the mouth of the tailrace canal. Of the three, two have been built—one at the intake and one at the tailrace. That at the intake having been placed in front of the ladder as ordered was instantly clogged with debris during the flood, and 6 men could not keep it clean, so it was decided to place it behind the screen. The same difficulty in construction exists for the one at the foot of the fish ladder, because the debris brought down by a single flood will instantly carry it away and, also, it has to take care of the log rafts that come down during dry seasons. The one actually built was at the tailrace and contains five rows of electric wires, spaced from the upstream end as follows: the space between the first and second row is 8 ft.; between the second and third row, 12 ft.; between the third and fourth row,

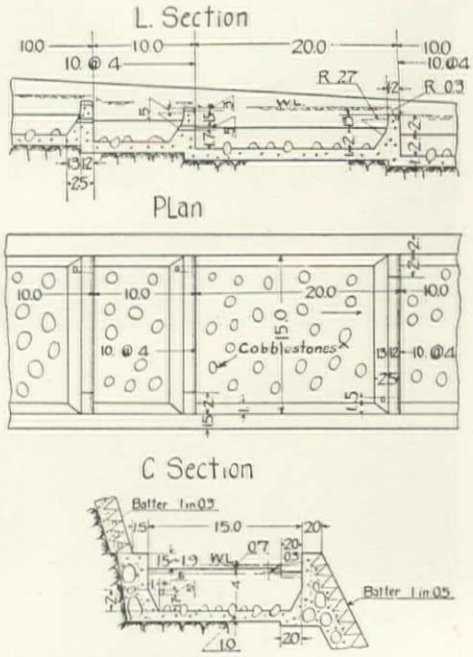


Fig. 4. Details of Fishway

12 ft.; and between the fourth and fifth row, 30 ft. Each row is composed as follows: between the floor and the water surface, No. 6 copper wire is stretched horizontally 3 ft. apart. For a distance of 10 ft. from both banks, No. 6 copper wires are spaced 1 ft. apart parallel to the bank of the tailrace canal forming meshes with the horizontal wires. The two sets of wires are bound together with No. 20 copper wire and then soldered. The ends of the horizontal wires are attached to insulators, so as not to ground. The variable spacing of the rows is to get up different degrees of electric field to care for the several kinds of fish and not to shock them too strongly. The spacing of vertical wires is to set up a denser field at banks where the fish is most likely to travel. Twenty to fifty volts are charged to the screens. The best voltage is yet to be decided, and the 50-volt experimental charge floated some fish about 8 in. long. A too strong current

weakens the fish and makes them unable to climb the ladder.

Intake—The intake structure is built in a Japanese fan or funnel shape, having a frontage of 102 ft. with six inlets 12.5 ft. wide by 9 ft. high, and tapers to three gates 10 ft. wide by 11.5 ft. high at the bell-mouth of the first tunnel. The sill of the inlet is 10 ft. above the floor of the sluiceway and its crest is at normal water level. A curtain wall extends along the entire frontage on top of the inlets. This combination makes the inlets avoid the great quantity of floating debris and boulders and gravel during high water by being partly submerged. The floor of the intake tapers down to a debris trap in front of the gates at a grade of 20%, thus sluicing out all large materials before entering the tunnel. Two guide walls dividing the flow into three streams lead the water to the three gates, thus preventing eddy formation.

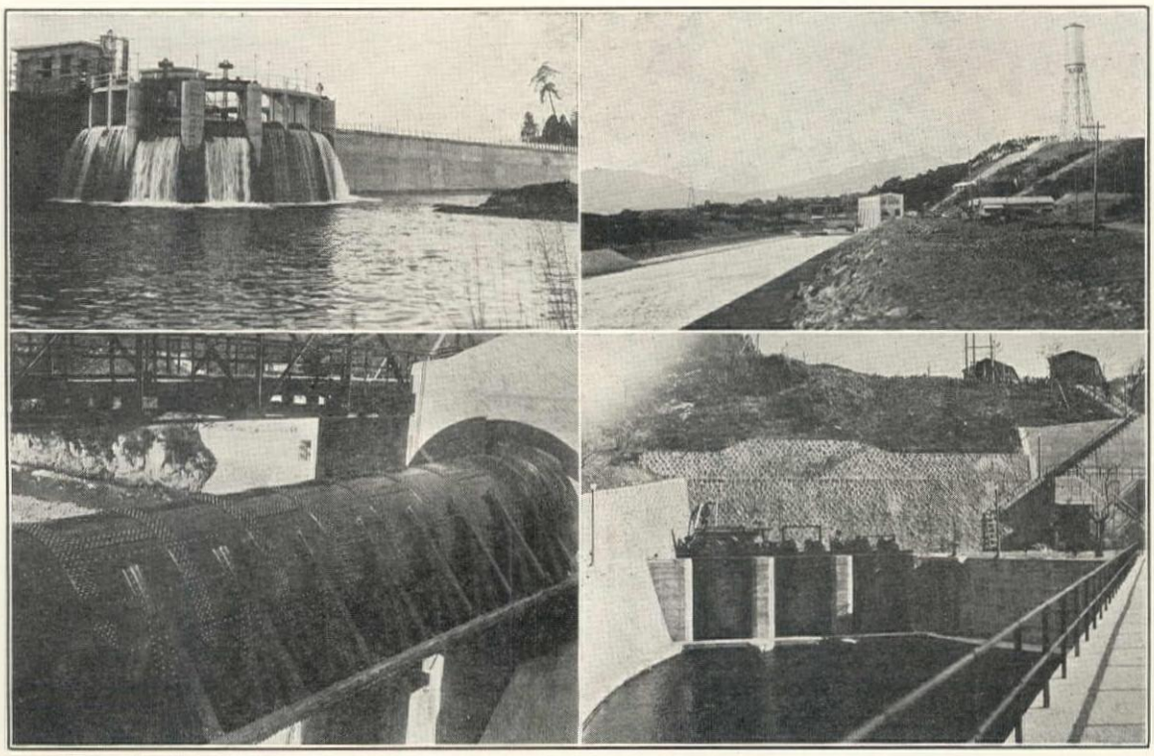


FIG. 5. (UPPER LEFT) INTAKE TOWER FOR PRESSURE CONDUIT FROM REGULATING RESERVOIR. (UPPER RIGHT) TAILRACE, POWERHOUSE, SWITCHING STATION, PENSTOCK LINE, AND DIFFERENTIAL SURGE TANK. (LOWER LEFT) HOISTED VIEW OF ROLLER GATE ON DIVERSION DAM AT INTAKE SHOWING WATER SHIELD. (LOWER (RIGHT) INSIDE OF INLET STRUCTURE SHOWING GATES AT TUNNEL ENTRANCE

Sand Basin—The design of the sand basin is given much consideration in this country because of flood water conditions. In earlier developments and where means of sand elimination were inadequate, there have been instances of waterways being clogged with sand. In our case, we were favored with a natural location that enabled us to build a sand basin of adequate size a few hundred feet from the intake. It has a boat shape, 600 ft. in length, 180 ft. in width, and a maximum depth of 20 ft., and is proportioned to give an average velocity of 0.5 ft. per sec. Owing to the topography, the sand basin and the intake are connected by a curved tunnel which sets up a centrifugal motion of the water. The forebay of the sand basin is also curved in plan, forming an S curve with the connecting tunnel. An ideal diverger could not be built—such as walls widening at angles of 5 to 12 deg. This fact gave rise to the problem of how to lead the water uniformly into the sand basin proper. After various experiments, two parallel racks were built across the sand basin 3 ft. apart, with gas pipes, and were loosely filled with cobblestones. This arrangement kills the approaching velocity and leads the flow gently into the sand basin. The entire basin is divided into two compartments by a central wall and provided with gates on each side of the wall both at the inlet and exit, so that the water can be bypassed through one compartment and at the same time allow the other compartment to be washed. The part of the central dividing wall at the forebay is built boat shape, with overflowing crest, and discharges the excess water into a waste tunnel. In front of the cobblestone rack is a trap conduit, 4 by 6 ft., slit open on top, so that all large material is caught here and carried away by a 7 by 7-ft. tunnel built under the central dividing wall. Screens are provided in front of the cobblestone rack, so as to prevent excessive clogging. The floor of the sand basin slopes down on a 3⅓% grade to a crosswise gutter, which is connected to the sluice tunnel by a gate. Each half compartment is divided into six troughs by guide walls 4 ft. high, which gives good scouring action when washing.

The general principles underlying the design were: to catch the larger material as quickly as possible; to lead the water uniformly into the basin; to have uniform deposition by making the depth greater as the water flows toward the middle so that the coarser material would reach the floor first; then reversing the order and making the floor shallower as it approaches the exit, so that the finer suspended material would strike the floor; and finally in washing, to give

a scouring action by means of troughs making use of the slope of the floor.

When the basin is dewatered, coarse sand is found deposited in the forebay; in the first half of the basin proper, fine sand which is quickly washed away when emptying; and in the last half, silt mixed with small pieces of saturated twigs, which is very sticky and needs considerable washing. The depth of sedimentation is quite uniform. During the high water season and when the basin was operating at ⅓ capacity, the depth of sedimentation was about 15 in. a month and at normal flow about 4½ in.

Tunnels—Except for three short cut and cover sec-

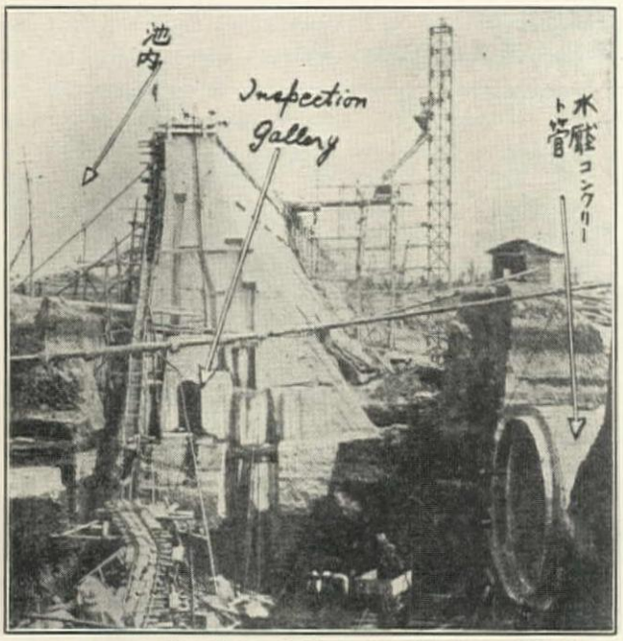


Fig. 6. Construction View of 86-ft. Gravity Dam at Outlet of Regulating Reservoir, Showing Inspection Gallery, Concreting Tower, and Upper End of Reinforced Concrete Pressure Conduit

tions aggregating 768 ft., the entire waterway from the sand basin to the regulating reservoir is made up of tunnels. The tunnels have a cross-section horseshoe in shape, 18.5 ft. wide by 18.5 ft. high, a slope of 1:2000, and a maximum discharge capacity of 1750 c.f.s.

Due to the relatively cheap cost of labor and the high cost of materials, construction methods followed here must be based on a good balance between the two factors. The bottom pioneer heading is driven first, followed by breast, crown, arch, and side enlargements. This is a most flexible method where labor is not yet skilled in the operation of modern equipment. By pushing the bottom heading driving to the utmost, the other operation can be carried on at will. This method gives large exposed surfaces in blasting and enables the powder men to take good advantage of the rock seams. In rocks of medium hardness, by this method about 3 lb. of dynamite is required per cu.yd. for driving the bottom heading. For a size of this tunnel in rock, the average consumption of dynamite per cu.yd. of excavation is about 1½ lb. Where the tunnel is timbered, this method enables the use of smaller timber, as the enlargements are made in small volumes. For timber, raw Japanese pine logs 6 in. to 1 ft. round are used, as this pine is the most elastic and durable timber found in the country. Where the ground is soft, the crown heading is excavated first, and as soon as the upper semicircle is excavated, it is lined with concrete, leaving the side for support. The side excavation is done in small strips of 6 to 12 ft., and concreted. After the concrete has set, the remaining strips are excavated and concreted. One or two 150-hp. air compressors were installed at all adits and shafts, except for the short tunnels where hand drilling was employed. As there was no hard rock drilling, Ingersoll-Rand IR-12 and DCR-23 drills were employed. Electric and gasoline locomotives were used to haul out the muck in the longer tunnels. Two-ton elevators were installed at the vertical shafts.

The first mile of the tunnels penetrated an andesite formation and no difficulty was experienced. The rest of the tunnels penetrated uncompacted boulders and gravel, volcanic cinders and tufa formations. In the gravel formation, quicksand pockets connected with subterranean streams. Some of these were drained by auxiliary tunnels with success. In one instance, the pocket broke loose, emitting a large volume of water,

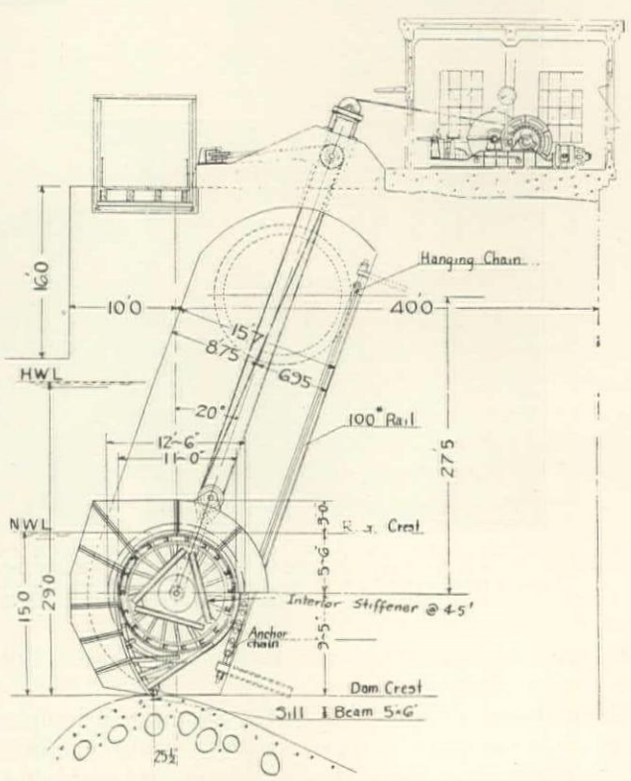


Fig. 7. Section of Roller Gate 58 ft. Long by 15 ft. Diam. on Diversion Dam at Intake

washed away the timbering, and killed a number of men. In this case, the saturated area was so large that drainage tunnels driven could not make it penetrable, so that the tunnel was diverted until suitable ground was found. In the tufa formation, we struck several large blowholes, some having a volume as large as 4000 cu.yd., filled with water and silt. These, once drained out, caused no difficulty, although the sudden gushout of water from them did quite a damage. Some of the cinder formations carried considerable water, but as they were usually in thin strata, they were all penetrated. Eighty per cent of the tunnels were tim-

bered; grouting was done at all places where it was deemed necessary.

Regulating Reservoir—A regulating reservoir of 30,000,000 cu.ft. capacity and 33 acres in surface area was built out of rice patches. Its basin consists of tufa overlaid by various materials erupted from the once active volcanos in the neighborhood. An earth dam was considered at first, but abandoned on account of the ununiform nature of existing soils. Then a gravity dam proved to be the choice, comparing it with an Ambursen dam on account of the deepness of foundation and the cost of the formwork. The crest length of the dam is 1566 ft.; the height and base width of the maximum section, 86 and 70 ft., respectively; and its top width, 6 ft. It is built with 1:3:6 concrete, filled with cobblestones in the interior, and the wet surface is of 1:2:4 concrete for a thickness of 4 ft. Contraction joints are provided every 60 ft. Small vertical drainage wells at the joints connect with a horizontal gallery. A grouted cutoff is provided.

After the big earthquake of 1923, all important structures in this country are required to be 'earthquake-proof'. In our case, the dam was designed for horizontal accelerations of 2000 mm. per sec.^{2} and 1000 mm. per sec.^{2} for reservoir full and reservoir empty, respectively. Designing a dam for earthquake induces few changes in shape from what it has been heretofore. The fundamental triangular section as developed by Levy, the French authority, is modified for various conditions imposed; such as seismic force, uplift, silt pressure, limiting principal stress, and allowable vertical pressure on foundation or on the masonry of the dam. The rectangular top width is made as small as possible to reduce the overturning moment induced in an earthquake. The water face is required to have a batter, as the resultant will be forced outside of the middle third in a right triangular dam when a seismic force acts; but this batter is taken advantage of in case of reservoir full in that the weight of water imposed on the batter and the center of gravity moved to the water surface reduce the overturning moment. A few other points to be considered in designing a dam for earthquake are: the unit weight of masonry is reduced by the vertical component of the seismic force acting; the height of water wave increases in proportion to the height of the dam and seismic intensity; the distance between crosswise joints (such as expansion joints) should not be less than 2 times the resultant seismic factor multiplied by the height of the center of gravity of the section considered above the foundation bed, as the traversing seismic wave causes relative displacements of the dam's base and may cause its separation from the bed. The resultant seismic factor, k, is expressed as follows:

$$k = \frac{\alpha h}{g - \alpha v}$$

where αh = horizontal component of maximum seismic acceleration,

αv = vertical component of same, and

g = acceleration of gravity = 9800 mm. per sec.^{2}

(The reader is referred to the paper by N. Mononobe, submitted to Section 4 of the World Engineering Congress held at Tokio this year.)

The tunnel outlet is connected to a tower intake of the pipe line leading to the powerhouse by a reinforced concrete pressure pipe. The purpose of the tower intake is to utilize the water at full reservoir level at light loads, allowing excess water to spill from its crest into the reservoir. During dry periods it takes 20 hours to refill the reservoir after the plant has discharged the peak load, the reservoir being drawn down about 15 ft. In this way, we save water as well as head.

The intake tower is 50 ft. diam., built of reinforced concrete. It has four gates, 8 by 9 ft., which are opened at peak loads to draw the water from the reservoir.

Pressure Conduit—The pressure conduit leading from the regulating reservoir to the differential surge

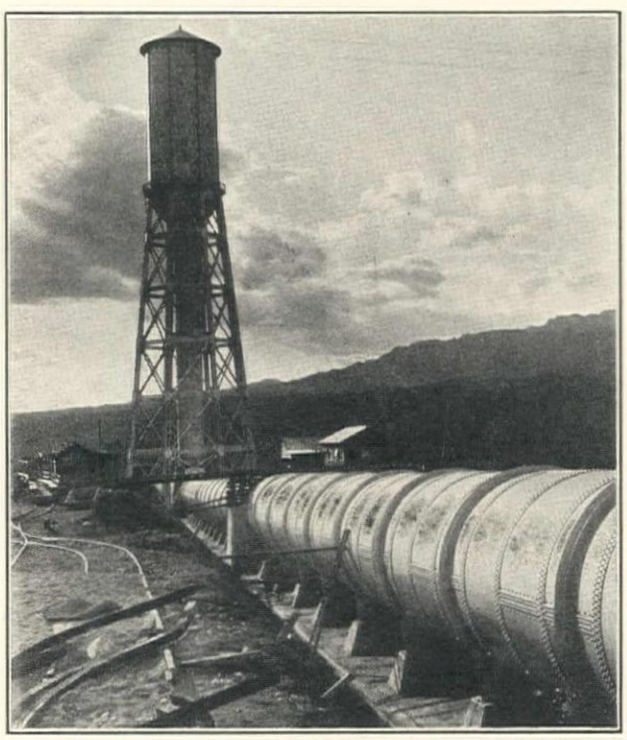


Fig. 8. Steel Pressure Pipe 13-in. Diam. on Steel Saddles, with Anchor Block in Center Foreground, and 41-ft. Diam. Differential Surge Tank in Background, Height to Roof 262 ft.

tank is 15 ft. diam. The first 1000 ft. of its length, where the hydrostatic head is about 60 ft., is built of reinforced concrete pipe. In constructing the pipe, a base slab 6 in. thick was poured first to the spring line, conforming to the outer diameter of the pipe. To this slab were anchored tie bolts for the centering, and supporting bolts for the working platform and for tying the reinforcing so as not to vibrate the steel when pouring. A certain length of complete circle was placed each day, eliminating longitudinal construction joints. All concreting was done in winter months to reduce the shrinkage due to temperature change as much as possible, and was backfilled with earth as soon as practicable. Expansion joints were provided every 240 ft. Temperature steel was inserted to the amount of 0.4% of the cross-sectional area of the concrete.

The steel pipe is from $\frac{9}{16}$ to $\frac{13}{16}$ in. thick. For a pipe of this size, the stress caused by a partly filled condi-

tion is greater than that caused by full hydrostatic pressure. To stiffen the pipe against the force mentioned, the pipe is made to rest on a steel saddle built in the shape of a girder, its upper flange conforming to the curve of the pipe. The girder rests on the back of a 12-in. channel which is embedded in a concrete support, the distance between the supports being 22.5 ft. Two 66 by 46 by ½-in. stiffening angles are provided on each side of the steel girder saddle. Provision is made to lubricate the supporting flange of the girder to facilitate sliding during expansion and contraction. Calculation shows that a pipe of this size supported on concrete saddles causes excessive stress in the circumferential rivets when expanding or contracting, on account of the great weight of the pipe

Fig. 9. Finished Section of Horseshoe-Shaped Tunnel 18.5 by 18.5 ft., Maximum Discharge 1750 c.f.s., Between Sand Basin and Regulating Reservoir. Check Valve Emits Ground Water

and the higher friction coefficient. Before placing the line in operation, the thinner sections of the pipe were put in the partly filled condition by building bulkheads and filling with water. No defects were observed, the elongation of the horizontal diameter at midspan with about 13 ft. of water at the bulkhead was 22/16 in. and the vertical diameter shortened about 1 in. at the top only. The deformations increased as the depth of water. Anchor blocks were placed 450 ft. apart. Due to the flat slope, it was possible to put the expansion joints midway between the anchor blocks, relieving them of large thrusts. The slip joint type of expansion joint as used at the Drum plant (California) of the Pacific Gas & Electric Co. was used, and proves to be satisfactory. Air valves were provided every 450 ft. They were connected to the pipe by an intermediate gate valve so that they can be cleaned at intervals. For all rivets over 1⅛ in. diam., 70 and 125-ton Hanna bull riveters were used.

Differential Surge Tank—Due to the topography and size of plant, a high and large surge tank was required. This structure was also designed 'earthquake-proof'. It is advantageous to reduce the mass of such a tall and topheavy structure in designing for earthquake. Accordingly, the differential surge tank was adopted as its cross-sectional area is about one-half that of a simple surge tank for the same purpose. The advantage of the differential surge tank can be readily seen when we compare the overturning moment induced by an earthquake with that by wind pressure. In our case, the tank was designed for a horizontal seismic acceleration of 1500 mm per sec.^{2} The total overturning moment for the above in kip ft. is 211,760; whereas the same for that caused by wind pressures of 40 lb. per sq.ft. on the tank body and 60 lb. per sq.ft. on the projected area of the supporting frame is 61,000; the ratio being 3.5:1. About 1000 tons of steel was required, while the same structure designed for the above wind pressures requires but 750 tons. The shell of the tank was designed to resist the horizontal shearing stress induced by the earthquake, the horizontal shearing stress being caused by the horizontal component of the seismic force acting on the water and on the metal. The elastic theory was used, since from symmetry the tangent at one end does not rotate and each half ring can be considered as an arch fixed at one end. The neutral point method was used, dividing the arch into small elements; and by arithmetical integration of the forces, the bending moments induced were calculated. The result was that an 8 by 3½ by ¾-in. angle was required to stiffen each shell plate 7 ft. high. The balcony girder was designed by the same principle taking care of the thrusts induced by the supporting posts. On the outside of the tank body, two 8 by 8 by ¾-in. angles were riveted to it vertically at each post as an additional safeguard against earthquake.

The foundation consists of a reinforced concrete annular slab: 100 and 60 ft. in external and internal diameters, respectively; 6 ft. thick; and mounted by 8 pedestals for the posts.

The general dimensions of the surge tank are as follows: The diameter is 41 ft.; the height of the cylindrical part, 84 ft.; the depth of the hemispherical bottom, 17.25 ft., its bottom being in the form of a diaphragm 20 ft. diam., acting as an expansion plate for the 15-ft. diam. pipe connecting the pressure conduit and the tank, and at the same time transmitting the weight of water above it directly to the foundation; the diameter of the internal riser, 12 ft.; the height of the posts, 178 ft.; the diameter of the post circle at foundation 76.625 ft., giving the posts a batter of 1/10; and the total height of tank above its pedestals, 262 ft.

Designing a structure for extreme conditions such as an earthquake, allows the use of higher unit stresses than ordinary. In this country, 25 to 50% higher unit stresses are adopted, according to the importance of the structure; in our case, 25% higher stresses were used. All column stresses are required to be transmitted by rivet shear and not by the butt end of the columns.

The tank is proportioned to care for 3090 c.f.s. rejection for full load shut down, this being about 10% in excess of the full load discharge; and for increase of flow from 1300 c.f.s. to 2700 c.f.s.

The performance was checked for 36,000 hp. shut

down recently and the results correspond closely with calculations. The difference in surge height for the first quarter cycle was only 0.2 ft., that is: between actual and calculated.

Penstock Manifold—The penstock manifold divides the flow of the 15-ft. conduit into three 10-ft. penstocks immediately below the surge tank. It has a shape like that at the Davis Bridge plant, the only difference being that instead of the large tie bolts, fish-shaped partition plates act as tension members for tying the flat surfaces together.

Powerhouse—The powerhouse is built in one floor system, the generator floor being omitted. It is built in a steel skeleton frame enveloped with reinforced concrete. After the foundation and the steel framework were completed, the building construction was carried on simultaneously with the erection of the machinery. The steel frame was designed to be strong enough to carry the runway cranes and the enveloping reinforced concrete made the whole structure strong enough to resist earthquakes.

Tailrace Canal—In order to gain about 8 ft. of head, a large tailrace canal was excavated. It has a length

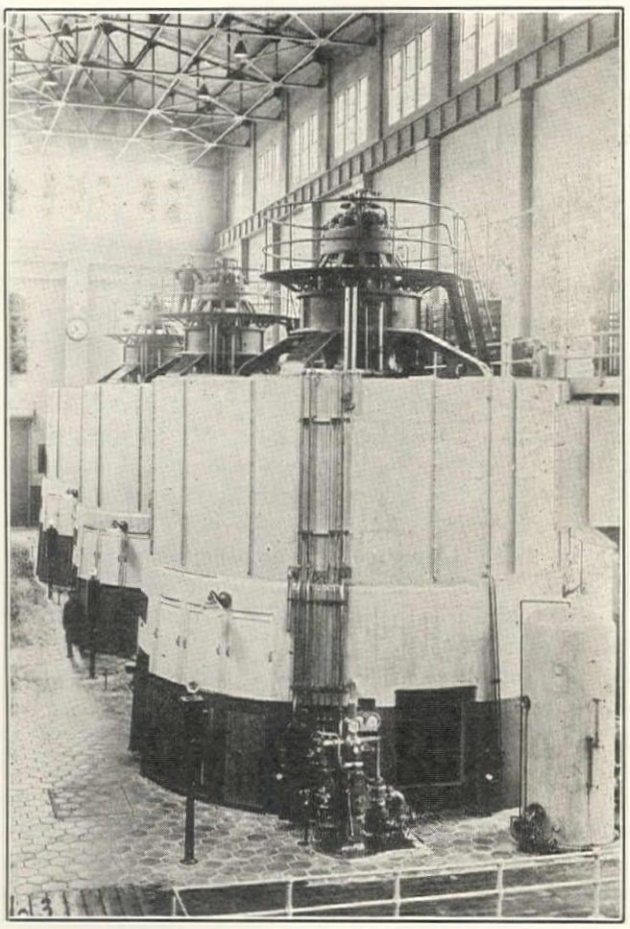


Fig. 10. Interior of Powerhouse. Three 28,000-kv-a. Allis-Chalmers Generators on Supporting Barrels

of 2150 ft., a bottom width of 83 ft., and a side slope of 2:1. The side slopes were faced with precast concrete slabs. A Bucyrus 1½-yd. dragline excavator was used for the job, the excavation supplying 120,000 cu.yd. of concrete aggregates for the lower section of the development.

Spillway Conduit—A spillway conduit built in cut-and-cover section connects the regulating reservoir with the tailrace canal. Near the discharge, where it ends in a steep slope, it is built with 9-ft. diam. steel pipe. The steel pipe discharges upward at the floor of the canal through an 18-ft. diam. pipe section where the depth of the water is 16.5 ft., measuring to the center of the 9-ft. pipe. This depth of water converts the high velocity head in the pipe into pressure head in a large measure, and little turbulence is observed.

Construction Items—The amount of work involved was as follows:

Total volume of excavation	1,265,160 cu.yd.
Total volume of concrete	330,776 cu.yd.
Total amount of cement used	410,000 bbl.
Total weight of steel used	8,915 tons
Total amount of power used	10,576,000 kw-hr. @ 1.75¢

The company furnished all necessary cement. The average unit prices by contracts were as follows:

Tunnel excavation	$ 4.00 per cu.yd.
Tunnel lining with concrete	6.25 per cu.yd.
Earth excavation	0.50 per cu.yd.
Rock excavation	1.00 per cu.yd.
Mass concrete	2.80 per cu.yd.
Reinforced concrete	3.50 per cu.yd.
Reinforcing steelwork, labor and material	50.00 per ton
Structural steelwork, fabrication, erection, and material	125.00 per ton

The total cost of the development, exclusive of the transmission system, was $10,000,000.

Editor's Note—Although Japan is outside the territory covered by **Western Construction News**, we are publishing this article because it contains construction features of particular interest to engineers and contractors in the far west, particularly as regards the fish ladder over the diversion dam and provision in all structures for resistance against earthquakes. The project described by Shimodao serves as an index of contemporary hydroelectric construction in the Orient.

TOPOGRAPHIC MAPS FROM AERIAL PHOTOGRAPHS BY THE HUGERSHOFF PATENT

During the last maneuvers of the German army, all maps were taken from the artillery and a base line with elevations was run, this base line being of such extent that it would appear in three consecutive aerial pictures. The army air service then took the photographs, made contour maps covering a depth of 15 miles, and delivered these maps to the field forces in less than 36 hours. Firing data were placed on the maps and the artillery made over 85% direct hits on its objectives. Later, the Imperial Geographic Survey checked the maps with precise ground controls and found a horizontal error of 1 in 5000 with meter-interval contours, and a vertical error of only 18 cm. In a survey of Washington, D. C., similar precision was obtained.

The method for making topographic maps direct from aerial photographs with a minimum of ground control is patented by Hugershoff. The contour maps are made in one operation by stereoscopic instruments and methods. Exclusive rights to the use of this process are held by the Aerotopograph Corp. of America, Washington, D. C., of which C. H. Birdseye, formerly chief topographer of the U. S. Geological Survey, is an officer. Marshall Wright is field engineer for the corporation and the western correspondents are: Brown & Brown, Portland; Mel Kennedy, Los Angeles; and George S. Young, Oakland.

Control of Cracking in Concrete Dams

By LEWIS H. TUTHILL

Concrete Technologist, Valley Springs, California

The property of continual volume change of concrete, as evidenced by cracking, is demanding more careful consideration than has previously been given to it, as engineering progress has now reached a point when greater dimensions of concrete dams (and other structures) are being planned each year.

With increased size of structures goes the necessity for greater durability, permanence, and safety. The design must insure that the structure as a whole, and each of its integral parts, will function as planned, as constructed, and in whatever condition it is certain to exist from that time on. This means that the volume change of concrete during and after construction must be thoroughly analyzed in its effect of cracking and separating masses ordinarily assumed to be monolithic.

It is not my purpose to dictate rules for design; but rather to give a simple summary of the causes and manifestations of this property of the material as a basis upon which action in design may be taken, and to suggest ways and means during construction for minimizing the amount and effect of cracking.

Cracking on Faces of Contraction Joints—Although crack planes on radial lines from outside surfaces are caused by the same things that make for cracks on the faces of the contraction joints, they introduce no indeterminate or doubtful conditions, and may be eliminated by proper spacing of contraction joints. For this reason, hereafter the discussion pertains only to the cracking of questionable effect appearing on the faces of the contraction joints and in other places where the plane of the cracking is in a similar or other undesirable direction.

Causes of Volume Change—Volume change in concrete is principally caused by two things: (1) temperature variation and, (2) alternate wetting and drying. If the entire volume of the mass were similarly affected throughout, and if all parts and the whole were unrestrained, there would be no cracking. The following simple calculation shows that high stresses may be introduced when the material is not free to adjust itself to the new conditions. A temperature variation of only 20° F. with the coefficient of expansion of 0.000006 gives a 0.012% change in dimension. With a modulus of elasticity of 2,500,000, this means a tension of 300 lb. per sq.in. if the ends are fixed, regardless of length which is beyond the limit of the concrete. In a dam, the dimensions become fixed by contact with the foundation and by the unchanged condition of material in the interior of the mass. Why should a transverse crack in the 200-ft. base of a dam, exposed for weeks as a bypass section, cause surprise and chagrin when the non-appearance of the crack would be far more astonishing under the circumstances, as that would mean horizontal movement on the foundation?

All this is generally understood, but what apparently is often overlooked is that shrinkage due to drying out of concrete is usually greater than that due to normal temperature ranges. A summary of research on this shows 0.16% shrinkage from original set volume upon drying,[1 and 2] whereas a temperature change of 100° F. will produce only $100 \times 0.000006 = 0.06\%$ change in dimension. This explains the persistent presence of vertical cracks normal to the radii in the angles of the offset keys on the exposed contraction joints during construction of most dam sections over 40 ft. thick, regardless of the time of year or the temperature of the concrete when placed, or of the difference (or lack of it) in temperature between the inside and outside of the block.

This cracking under all temperature conditions is an indication that the possibility of refrigerating the aggregate, so that the concrete would always be placed at 50° F., in order to reduce ultimate temperature of setting, and consequently the difference in temperature between the inside and the outside of the block, would have a limited effect on minimizing cracking. Also, considering the cost of such an operation compared with the results, this would be an impractical procedure. It does show that control of cracking is dependent upon prevention of drying, and this means constant wetting and minimum exposure to drying and cooling by keeping the structure as nearly horizontal as possible during construction. The suggestion is submitted that such cracks appearing in the downstream part of the section would be made to appear in more structurally desirable directions if the offset keys were made parallel to the face of the dam —instead of vertical—and ended in the center of the section rather than coming out at the faces. This innovation is being carried out on the flood control dam on the Calaveras river for the city of Stockton, California.

Controlling Depth and Direction of Cracks—Some encouragement may be derived from the probability that such cracking penetrates only a small fraction of the thickness of the block. The reason for this is that the conditions which were responsible for the presence of the cracks on the surface (lower temperature and drying) are not present a short distance inside the mass. But the possibility exists that, as time goes on and the center of the block approaches the outside condition, the cracks which have started may gradually penetrate farther with each alternating condition of stress, moisture, and temperature. Thus it becomes

[1] 'Volumetric Changes in Mortars and Concrete' by R. E. Davis and G. E. Troxell, University of California, 1929 meeting, A.C.I.

[2] 'Variations in Standards of Portland Cement', P. H. Bates, A.C.I. Journal, November, 1929.

desirable in assuring the functioning of the structure as designed, that such cracks should be controlled in direction in some such manner as suggested above. Also, these cracks should be minimized in width and number as much as is practicable during construction, by the influence of the following factors under experienced authoritative technical control of concrete manufacture for uniformity of product.

Effect of Uniformity of Concrete—The importance of uniformity of quality of concrete cannot be too strongly emphasized in this connection. Uniformity of strength, consistence, cement and water content, and grading and distribution of aggregate will contribute largely to reducing and distributing shrinkage cracking, regardless of more fundamental factors which may be applied. Such uniformity has many other structural and economic advantages and may be maintained within comparatively narrow limits by proper attention to all the steps in the procedure of concrete construction.

Effect of Other Factors—Recently reported research on this subject shows that the amount of volume change varies directly with the amount of cement, the amount of water, and the fineness of grading and size of aggregate[1]. This is a fortunate combination of circumstances, for aggregates properly graded to the maximum size possible in massive work require less cement and water per cubic yard of concrete for adequate strength, impermeability, density, and workability, than smaller materials making a considerably lower fineness modulus.

Such mixtures of lower cement content and a wider range of aggregate sizes require more careful control in assembling, handling, and placing, if the essential uniformity is to be maintained. These requirements are entirely practical, however, as has been demonstrated to a certain degree on several projects with, incidentally, considerable economy.

Chemical Constitution of Cement—Probably the most important basic influence upon volume change is the chemical constitution of the cement. Variations in length of test beams under similar conditions (except brand of cement) have been shown to be from 0.11 to 0.22%.[2 and 3] A variation in temperature rise in the first 24 hours of setting of 118° to 208° F. was found in a group of 32 cements[2]. The average volume change in three brands of high-early-strength cement was reported 25% greater than for three normal portlands[4]. High-early-strength is usually of no particular advantage in dams, as they are seldom loaded in less than three months. It has been found that the cements showing the lowest volume change were those comparatively high in iron and low in alumina[5].

These brief conclusions from extensive investigations would seem sufficiently pointed to indicate the advisability, where hundreds of thousands—perhaps millions—of barrels of cement are to be used, of some comparative study before arrangements are made to purchase the material. In most cases, some selection of brand is possible, especially at similar prices. In that event, such studies should determine: (1) the brand showing minimum volume change; (2) the probability of it continuing thus throughout the period of delivery; (3) the possibility of improving it—or one of the other economically available brands—in this respect for at least the amount of work in question; and (4) the advisability of specifying essential physical and chemical tolerances to this end.

Powdered Pumicite—In recent months, some studies have been made to determine the influence upon volume change of substituting a naturally powdered pumicite for a portion of the cement[6]. The results show a reduction of setting temperature rise in proportion to the amount of silica substituted (20 to 30%). Also, for these amounts a 10% reduction in modulus of elasticity was noted. This increase in elasticity will permit proportionately greater freedom from cracking, because stresses caused by a given condition will be thus reduced.

Cracking in the Lines of Minimum Transverse Stress—It is practically impossible to place contraction joint planes other than the usual radial joints without having certain stresses cross them at some time or another under the various conditions of loading. If the natural cracking is directed in the lines of minimum transverse stress, as is usually quite feasible, the rough surfaces of the crack plane will transfer such occasional light stresses as may occur, where a smoothly constructed plane would not.

It is believed that, if cracking is thus controlled in direction, and minimized in amount by proper attention to detail in concrete manufacture, this questionable element in large concrete dams will be brought within adequately determinable safe and economic limits.

[6]Roy W. Carlson, Los Angeles County Flood Control District.

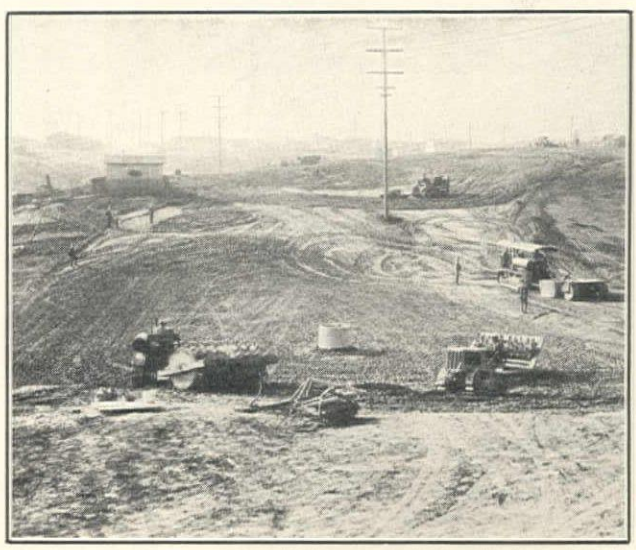
[3]"Researches in Concrete' by W. F. Hatt, Bulletin No. 24, Purdue University.

[4]W. F. Hatt's discussion of 'Volumetric Changes in Mortars and Concrete'.

[5]"Volume Changes of Portland Cement as Affected by Chemical Composition and Aging' by A. H. White, University of Michigan, 1929 meeting, A.S.T.M.

LOS ANGELES OPENS E. THIRD ST.

The accompanying illustration shows earth-moving equipment opening East 3rd st. in the city of Los Angeles, J. J. Jessup, city engineer.



Caterpillar Tractors Pulling McMillan Scraper, Fresno, Scarifier, and Sheeps-Foot Tampers

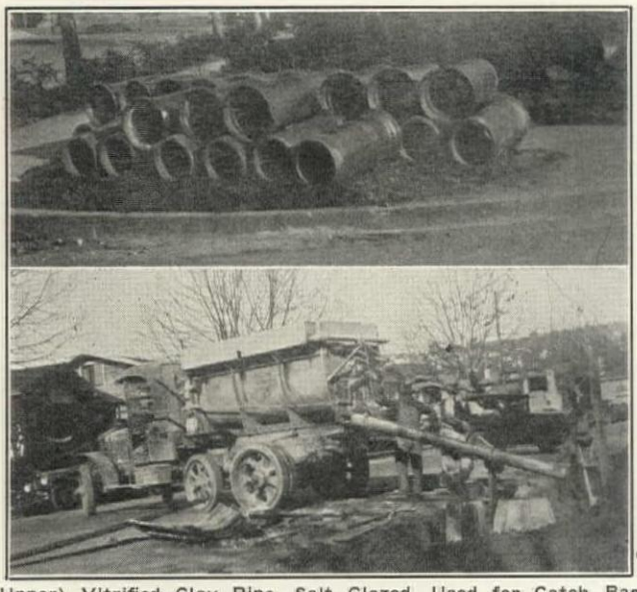
North Berkeley Storm Drain System, Berkeley, California

J. C. Hickey, of Alhambra, California, will complete his contract about June 20 for unit No. 4 of the Berkeley storm drain system. Construction began January 10 and has been somewhat handicapped by weather conditions and by rock encountered in trench excavation. However, the work is well organized and properly equipped and good progress is now being made. On February 21, the pipe footage was one-third com-

Fordson-Killefer Loader Clearing Street of Excess Material

pleted and the project, from the standpoint of contract price, was one-half completed.

Quantities—The contract involves 38,875 cu.yd. of unclassified excavation; 21,930 lin.ft. of 75 to 15-in. reinforced concrete pipe; 2410 lin.ft. of 12 to 4-in. vit-



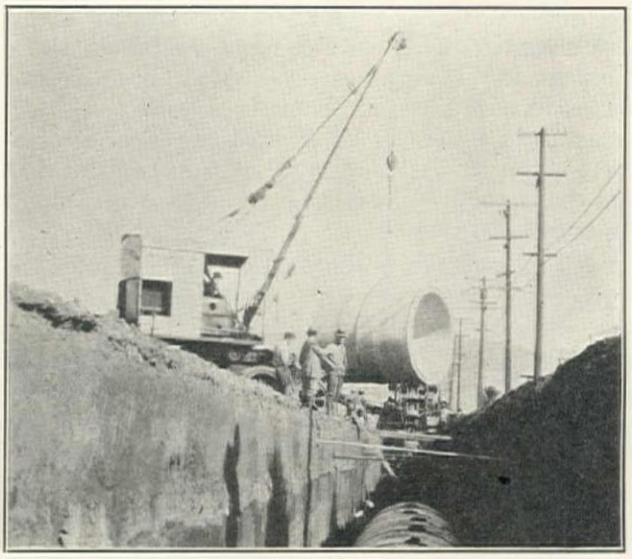
(Upper) Vitrified Clay Pipe, Salt Glazed, Used for Catch Basin Connections. (Lower) Constructing Manhole with Truck-mixed Concrete

rified clay pipe; 69 standard and 2 water-seal manholes; 67 catchbasins, assorted types; 13 curb inlets, assorted types; 12 sanitary intercepts; 50 cu.yd. of 'A' and 40 cu.yd. of 'B' concrete; 20 cwt. reinforcing steel; 30 cu.yd. foundation rock; 1000 sq.ft. asphalt and 3000 sq.ft. oil-macadam paving.

The contract price was $221,666, of which the city will pay $13,000 in cash and the balance under the 1911 Improvement Act. Unit bids were published in the November 10th, 1929, issue, p. 40.

Trenching—Trench excavation is being done with an Austin model 42-15 trencher, working to an average depth of 11 ft. and a maximum width of 112 in., the minimum width of trench being 40 in. This machine averages 600 cu.yd. in ordinary material. Lateral stubs and catchbasin connections are being excavated with a Barber-Greene ditcher. For removing pavement, Ingersoll-Rand air tools are used; these are powered by a Rix 120 compressor.

Backfilling is done with an Austin model BF-4 machine. Excess material is removed with a Killifer



Laying Hume Concrete Pipe with Universal Crane Mounted on Fageol Truck

loader attached to a Fordson rubber-tired tractor. This unit loads into three 1½-yd. dump trucks—two Dodges and one Ford—and has a capacity of 300 cu.yd. per 8-hour day.

Pipe Laying—Pipe 30-in. and larger is laid with a Universal crane mounted on a 6-ton Fageol truck. This 6-ton unit has satisfactorily handled the 75-in. pipe in 8-ft. sections weighing 7½ tons. Pipe 27 in. and smaller is laid by hand, using a tripod and hand winch on the heavier sections.

All vitrified pipe is being supplied by Gladding, McBean & Co. and is being laid with cement joints. Pipe 24 in. and smaller is being furnished by the California Concrete Products Co. and that 27 in. and larger by the American Concrete Pipe Co.

Concreting—On manholes, catchbasins, etc., Hickey is using truck-mixed concrete supplied by the Pacific Coast Aggregates Co. The average concrete requirement is 6 cu.yd. on manholes and 3 cu.yd. on catchbasins; a total of 2000 cu.yd. being used. The truck

Backfilling Trench on Marin Avenue, North Berkeley, with Austin BF-4 Backfiller. Austin 42-15 Trencher in Distance

mixers are mounted on Pierce-Arrow 8-ton trucks. A fleet of three trucks is used to haul 2½-yd. loads of class 'A' concrete, the average haul being 4 miles.

Personnel—Harry Goodridge is city engineer and Sam Hart is storm drain engineer for the city of Berkeley. J. M. Housley is personally superintending the contract for J. C. Hickey (also on the job in person) with headquarters at Albany, California. A crew of 40 men is employed on the work.

Editor's Note—Unit bid summaries on other projects in the Berkeley storm drain system were published during 1929 as follows: March 10th issue, p. 48; April 25th issue, p. 50; and September 10th issue, p. 48. An article by S. A. Hart on construction of Unit No. 5 was published in the February 10th, 1930, issue, p. 75

South Side Vitrified Pipe Sewer, Missoula, Montana

By R. B. HARTENBOWER

Engineer, Morrison-Knudsen Co., Missoula, Montana

Morrison-Knudsen Co. is constructing a complete sanitary sewer system in what is known as Special Improvement District No. 75, for the city of Missoula, Montana. The system will care for that portion of the city lying south of the Missoula river.

System Desecribed—For construction, the system is divided into five parts, namely: (1). A 30-in. main trunk sewer which receives sanitary sewage from the entire area (this sewer traverses and extends northerly along Russell st. and discharges into the Missoula river); (2). subsidiary main No. 1; (3). subsidiary main No. 2; (4). Walnut st. subsidiary main; and (5). all the lateral sewers embraced within the entire area of district No. 75. The five divisions are included in one general contract.

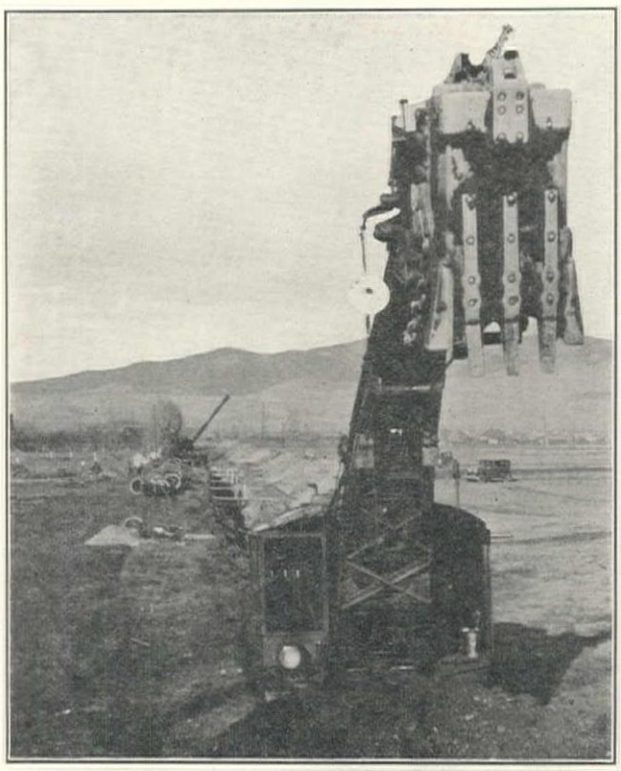
Scope of Work—Excavation and refill totals 135,078 cu.yd., divided into: 1280 cu.yd. of solid rock, 1998 cu.yd. of intermediate, 131,500 cu.yd. of gravel and earth, and 300 cu.yd. of embankment. There is 86,500 lin.ft. or 16.38 miles of double strength vitrified pipe sewer in place, including 3493 lin.ft. of 30-in., 3302 lin.ft. of 21-in., 6740 lin.ft. of 18-in., 4847 lin.ft. of 15-in., 1430 lin.ft. of 12-in., 43,200 lin.ft. of 10-in., and 14,415 lin.ft. of 8-in.

Wye branches total 3192 (all 2½ by 6-in.), of which 5 are 30-in., 5 are 21-in., 16 are 18-in., 23 are 15-in., 4 are 12-in., 2482 are 10-in., and 657 are 8-in. There are 194 standard manholes complete, of which 155 are concrete, 4-ft. diam., and 39 are brick, 5-ft. diam., and 46 standard flush tanks complete, each 4½ ft. diam.

Contract—Bids were received September 24, 1929, from Morrison-Knudsen Co., Boise, Idaho ($464,420); J. F. Shea, Portland, Oregon, and Clifton, Applegate & Toole, Spokane, Washington ($469,419); and J. C. Maguire, Butte, Montana ($481,505); the engineers estimate being $470,260. (A complete list of unit bids was published in the October 25th, 1929, issue, p. 64.)

The contract was awarded to Morrison-Knudsen Co., who began work November 1, 1929, and shut down for cold weather on January 7, 1930, resuming construction on February 1. The project will be continued as weather permits, the contract time expiring October 1, 1930.

Progress—By January 27, the contractor had completed the 30-in. main trunk line; the manhole construction was 50% complete; all (720 lin.ft.) 21-in.



P&H No. 700 Trench Hoe on 30-in. Main Sewer Near Third St., Missoula, Montana. Insley Excavator Laying 30-in. Vitrified Clay Pipe in Background. December 30, 1929

pipe and 2900 lin.ft. of 18-in. pipe had been laid on subsidiary main No. 3; and 2300 lin.ft. of 8-in. laterals had been laid. The job was 16% complete as of that date.

Equipment—For excavating the larger trunk lines, one P&H No. 700 power shovel with trench hoe at-

tachment is used and on the smaller trunk lines and laterals a class 'C' Insley excavator with trench hoe attachment is used. As a utility machine, the contractor has a Byers 'Bearcat' shovel with clamshell and skimmer attachment. With the clamshell attachment, the 'Bearcat' excavates where the sewer crosses water mains and other obstacles; it is also used to lay heavy pipe on the trunk lines. The skimmer attachment will be used to clean up excess material after backfilling. For excavating laterals, one Parsons trencher, model 40, is used, and in connection with the trencher, a 70-ft. portable Northern conveyor carries excavated materials back over the trench for backfill.

Caterpillar '30' with La Plante-Choate Bulldozer Backfilling 14-ft. Trench on Trunk No. 3, Russell St., Missoula

Laying 21-in. Vitrified Clay Pipe on Trunk No. 3 Between Fourth and Fifth St., Missoula, November 28, 1929

One Caterpillar '30' and a LaPlante-Choate bulldozer with hydraulic lift are used to backfill the trunk lines and other trench sections where the conveyor is operated.

C. W. Swearingen, civil and consulting engineer of Missoula, is the sewer engineer and E. S. Hathaway is the city engineer of Missoula. For Morrison-Knudsen Co., M. H. Knudsen is president; H. W. Morrison, vice-president and general manager, and C. W. Joslyn, secretary-treasurer. I am in charge of construction of the South Side sanitary sewer system for Morrison-Knudsen Co.

FUNDAMENTAL FACTS FOR THE CONSTRUCTION INDUSTRY*

The first Government census of the construction industry is a part of the 1930 decennial census. For many years contractors have realized the necessity for obtaining more complete and accurate statistics to promote efficiency in the conduct of their industry. It is expected that essential facts will be available for this purpose as a result of the census.

Construction statistics have previously been gathered by private agencies to serve particular purposes, but a comprehensive census is not feasible for them to undertake. Statistics on building permits, in cities where such permits are required, have been gathered for years but they do not give a complete picture of the situation. Public and quasi-public or community buildings often do not require permits. Also, a great amount of building construction has been done outside the corporate limits of cities, where no permits are required. Engineering-construction such as railroads, sewers, waterworks, and the like, is not covered by permits. The statistics gathered by other private agencies on the value of contracts awarded have not completely covered the United States, nor have they covered much of the smaller construction.

The present census will make available information concerning the approximate number and kind of general contractors, subcontractors, and operative builders in the United States, and the total value of work performed by them during 1929. General contractors will classify themselves as building, highway, grading, waterworks, dredging, railroad, and other branches. Similarly, subcontractors will indicate the trade in which they are engaged.

Questions regarding the number of skilled and unskilled workmen on the payrolls, and the total annual payroll, will have a direct bearing on the matter of employment in this second ranking industry. It will also indicate the seasonal character of various kinds of construction. The trend toward rental rather than ownership of construction equipment will also be disclosed, as well as various items of expense such as rent, liability insurance, bond premiums, and all other overhead. This cost of industry will be of value to each individual concern engaged in any particular type of construction.

Although only contractors whose gross business during 1929 exceeded $25,000 are required by Act of Congress to fill out the report blanks, about 150,000 contractors or contracting firms will be canvassed by mail and possibly later by special field agents. Information furnished will be held in strict confidence.

*Extracts from an article by Alanson D. Morehouse, chief of the construction section, division of distribution, U. S. Bureau of the Census.

Lake Keechelus Vicinity Project, State Road No. 2, Washington

By F. W. Gloor

Resident Engineer, Washington Department of Highways, Hyak, Washington

On July 30, 1929, the Washington Department of Highways let a contract to Edwin J. Dunnigan, Inc., Seattle and St. Paul, for the final section of the new highway across Snoqualmie pass between North Bend and Cle Elum, Kittitas county. The completion date is June 1, 1930, contract time ending September 1.

This project includes 5.2 miles of clearing, grading, and gravel surfacing along the shore of Lake Keechelus, and is quite difficult to construct. At this point the new highway closely follows the narrow, dangerous, and obsolete road that has been the only passable route of travel across the mountains. This old road must be kept open to traffic while the new highway is under construction. In spite of heavy traffic and numerous other difficulties, the contractor has set a good record for speed and efficiency in highway construction, with a minimum of delay to passing motorists.

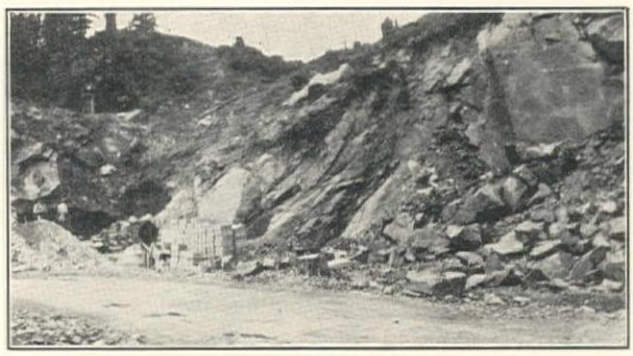
The approximate amount of the contract is $304,000.

Clearing—Soon after the contract was let, large crews were rushed to the job. A modern construction camp was erected, and clearing and grubbing operations commenced. Within a short time, 70 laborers, 4 teams, and 1 Caterpillar '30' were busy cutting the brush and clearing the right-of-way for power shovels. The unusually dry season created an extreme fire hazard, and the work was carried on under difficult conditions. As the piles of brush and logs could not be burned during the dry summer months, it was necessary to place the slashings and debris out of the way of grading operations and yet where they could be safely burned when weather permitted.

Excavating Trench for Highway Along Shore Line of Lake Keechelus; 1¼-yd. Northwest Shovel in Foreground

Grading—Drilling was carried on in two shifts of 10 hours each. Eight Sullivan compressors, two Sullivan model 'C' pneumatic tool sharpeners, two Sullivan model GF2 oil furnaces, and twenty Gardner-Denver jackhammers were used on the job for drilling and coyote holes in the rock cuts. One well drill was used in a large solid rock and cemented gravel cut. This well drill was an assembled unit constructed and operated by Jenson & Co.

The first shovel began operation August 12, 1929, working two shifts. As the job progressed, additional shovels were added until there was a total of six in use. These included two Northwest 1¼-yd., two Erie 1¼-yd. gas+air, one Bucyrus 1-yd. diesel-powered, and one Orton ½-yd. shovel. At the peak of grading operations, fourteen 4-yd. dump trucks and two 7-yd. Linn tractor trucks were used in moving material from the shovels. The dump trucks on grading included six Whites, two Pierce-Arrows, two Internationals, three Kenworthys, and one Republic.



Loading Coyote Hole with Dupont

As the work progressed, it was necessary to shoot and remove the rock bluffs along the lake shore, and at the same time to maintain a passable thoroughfare during the daytime. This work was facilitated by closing the highway to all travel between the hours of 10 p.m. and 6 a.m.; thus it was permissable to block the road during the closed period.

As soon as the drilling on each large cut was completed, the holes were loaded with dynamite. Then, just before the closing hour, two shovels were moved up, one on each side of the cut, and held in readiness barely out of range of the blast. Shortly after the highway was closed, the shot was fired and the shovels immediately started clearing a temporary roadway through the loosened material. Dupont 40%, 60%, and special stumping dynamite was used throughout the work. Some Dupont black powder was also used. This clearing was usually accomplished in a few hours. The shovels were then returned to the ends of the cut to complete its removal.

Smaller shots—bulldozing and stumping—could not be delayed in this manner and it was frequently necessary to hold up traffic for short intervals. Despite the constant stream of traffic and frequent blasting, no injuries were suffered by passing motorists. The occa-

sional necessity for blocking the road to permit the loading and dumping of trucks where the roadway was especially narrow was another cause of traffic delay. As construction was carried on at various points, there were often several delays in the course of a trip through the project.

The width of roadway between shoulders is 28 ft. on cut and fill, plus standard widening on the inside of curves.

Finishing and Surfacing—Finishing crews followed closely behind the shovels, half of the roadway being finished while one-way traffic was maintained on the other half. All finishing was done quickly and efficiently by teams and hand labor.

Crushed gravel surfacing was placed on the grade as soon as it was completed. The crushed gravel was included in contracts for adjoining surfacing improvements and was supplied by three crushing plants—two large semi-permanent units and a small portable unit. The type and capacity of the three crushers is given in Table I.

TABLE I

Feature	Crusher No. 1	Crusher No. 2	Portable Crusher
Power	100-hp. diesel	85-hp. steam	60-hp. gas
Primary crusher	36-in Cedar Rapids universal	8-in. McCulley gyratory	12-in. Bulldog
Secondary crusher	36-in. Symonds cone	24-in. Symonds disc	
Capacity (cu.yd. per hour)	40	30	15

Most of the surfacing was hauled by five Mack and two Kenworthy dump trucks.

The finished gravel surface is 20 ft. wide and 11 in. deep. When eventually paved with concrete, the surface will also be 20 ft. wide. The largest gravel in the sub-base is 3 in. diam. An average of 4000 cu.yd. of gravel is used per mile.

Structures—The concrete work included 7 large reinforced box culverts containing a total of 470 cu.yd. of concrete and 71,000 lb. of reinforcing steel. This work was sublet to J. R. King & Co., of Seattle, who also subcontracted 1.0 mile of grading. Construction of the culverts was commenced August 23, 1929, and completed October 14, using a 3-sack Rex mixer. Although it was necessary to secure the aggregates at a considerable distance from the project, the culverts were completed without inconvenience or delay to the grading operations.

Progress—When construction was at the peak, over 260 men were employed. The contractor rushed the work to take advantage of good weather during the fall season. When the job was shut down by heavy snow on December 12, there was 4.2 miles of grading completed. Within the 4-month period, 177,000 cu.yd. of solid rock excavation and 84,000 cu.yd. of class 'A' excavation was moved. On March 25, the contract was 85% complete.

Personnel—The contract for the Lake Keechelus Project was let by Samuel J. Humes, director of highways, E. C. Simpson being the district engineer with headquarters at Yakima. I am the resident engineer on this project.

Jud Maguire is superintendent for Edwin J. Dunnigan, Inc. Charles Pitts was the culvert foreman and Clyde Reeves the grading foreman for J. R. King & Co.

Editor's Note—A progress article on the Lake Keechelus Vicinity Project was published in the November 25th, 1929, issue, p. 630.

Highway Construction in Colorado River Canyon

Heavy Grading on F.A.P. 297-C Between DeBeque and Palisade, Mesa County, Colorado

By JOHN J. VANDERMOER

Division Engineer, Colorado State Highway Department, Grand Junction

Hinman Bros. Construction Co., Denver, Colorado, is making good progress on 10 miles of grading and graveling on F.A.P. 297-C (State Road No. 4) through the Colorado river canyon to connect DeBeque and the present road at Palisade on the west end of Plateau canyon. In the 1930 state highway budget a 4-mile contract is proposed (F.A.P. 297-D) which would give an outlet down the Colorado river and open the new road to travel. The project, when completed, will replace the 23-mile Plateau canyon road, a crooked and dangerous route through the 'bad lands' to the east of the Colorado river canyon. Besides being 8 miles shorter than the old road, it will provide a water grade.

There also is left a 1-mile project to be built whenever a new bridge is constructed at DeBeque. This can be deferred for some time, as the old bridge is still available.

Location—F.A.P. 297-C extends for 4.5 miles across the DeBeque flats and then enters the Colorado river canyon, where it continues downstream for 5.5 miles. The main line of the Denver & Rio Grande Western is on the west side of the canyon, while the new highway is on the east side. There will be no vehicular outlet down the river until F.A.P. 297-C and 297-D are completed.

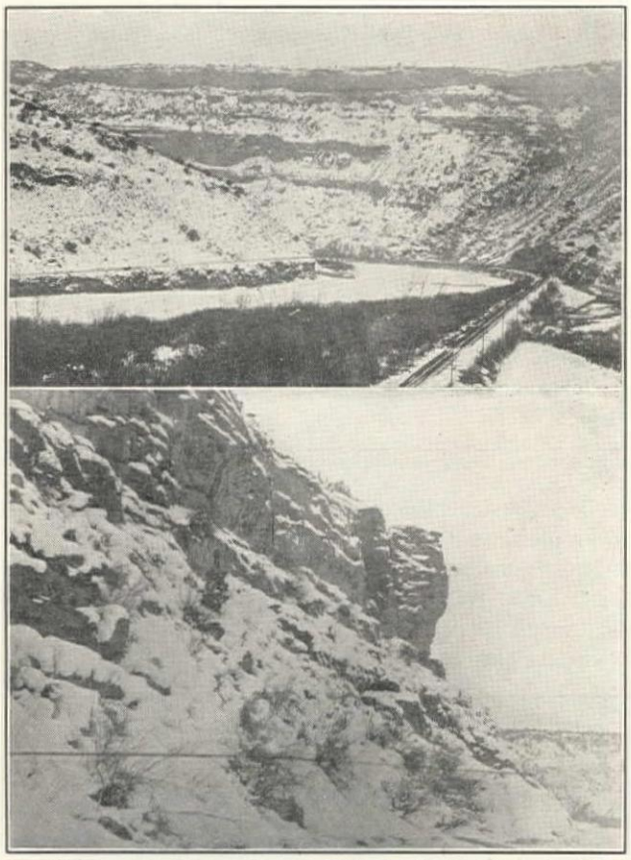
DeBeque is 40 miles east of Grand Junction, Colorado. It is on the main east and west highway through the center of the state, connecting Denver and Grand Junction, and is the center of oil shale development for this section of Colorado.

Design—The first 4.5 miles of roadway is ordinary earthwork and the last 5.5 miles is heavy rock. The embankment section will have a 26-ft. roadbed and the excavation section through the canyon will be 24 ft. wide, with a road ditch 12 in. deep. The embankment section slopes will be 1½ : 1 and those in the canyon section will be fitted to the material encountered—at this time the probable slopes are ¼ : 1 to ½ : 1.

The entire project will be surfaced to a width of 20 ft. and will have a 2-in. parabolic crown. The 4-in. base course will require 26 cu.yd. of crushed Colorado river gravel per 100 ft. and the 2-in. top course will be placed at the rate of 19 cu.yd. per 100 ft. The surfacing material will be graded to the following circular openings:

Diam. of Circular Screen (in.)	% Retained
1	0
½	25
⅛	70

The bridges are all pile driven and consist of creosoted douglas fir, including piling. They range from



(Upper) Colorado River Canyon Between DeBeque and Palisade, Colorado; Denver & Rio Grande Western Railroad Along West Side, New Highway Location Shown by Line Along East Side. (Lower) Typical Heavy Rock Excavation for Highway Along Left Bank of Colorado River Canyon

23 to 138 ft. total span and use a bent spacing of 23 ft. in nearly all cases. These bridges are designed for reinforced concrete floors 6½ in. thick and 20 ft. wide. The larger culverts are of reinforced concrete and the smaller ones are of corrugated metal pipe, with concrete headwalls.

Contract—The contract was awarded in June, 1929, for $312,453. Nine bids were received, the highest being $384,030, the average $347,405, and the engineers' estimate $338,627. The unit prices ranged from $0.22 to $0.83 per cu.yd. on borrow, $0.70 to $1.05 per cu.yd. on unclassified material, and $0.87 to $2.00 per cu.yd. on surfacing.* An allowance of 10% is made for engineering and contingencies, bringing the total estimate (based on the contract) to $343,699.

Progress—The contract calls for the project to be completed within 250 working days and it appears that this requirement will be met. The contractor has practically completed the first 4.5 miles across the DeBeque flats, including grading, bridges, culverts, and surfacing, and has rough-graded 4.5 of the 5.5 miles in the canyon section. Work will be continued throughout the winter. On February 6 the elapsed time was 139 working days and the project was 50% complete.

The maximum labor payroll to date has been 130 men per day.

Equipment—The list and cost of the contractor's equipment, including screening plant, follows:

One 1½-yd. Lorain-75 gas shovel (new)	$15,000
One 1¼-yd. Koehring gas shovel (new)	15,000
Two Ingersoll-Rand type 20 air compressors, with six jackhamers and sharpeners	10,000
Three 2½-ton White trucks	12,000
Two 2½-ton G.M.C. trucks	7,756
Five 2-ton G.M.C. trucks	13,125
Two Caterpillar '30' tractors	5,000
Two Twin City stationary engines for crushing plant	5,000
Two Universal crushers for crushing plant	6,000
One crushing plant complete, over and above engines and crushers (contractor's design)	5,000
Total	$93,881

Most of this equipment was new when construction was commenced. This has been reflected in good progress, with few delays.

Construction Methods—Sand and gravel for concrete and surfacing is taken from a pit adjacent to the Colorado river at the DeBeque end of the project.

Ordinary construction methods were used on the upper 4.5 miles, where the work consisted mostly of

(Upper) Highway Construction in Colorado River Canyon, Looking Upstream from Sta. 400. (Lower) Gravel Crushing Plant Near DeBeque for Surfacing Highway

side borrow. On the lower 5.5-mile section through the Colorado river canyon, all work was carried on from the upper end, as the only available bridge across the river was at DeBeque.

The steady high water of the 1929 construction season made it dangerous to attempt any other crossing than the bridge at DeBeque. This bridge is designed

*The unit bid summary was published in the June 25th, 1929, issue, p. 48.

for light loads only, so the two new shovels were ordered shipped knocked down and were assembled by the contractor after being carted across the bridge. They were then taken direct to the beginning of the canyon section.

As the entire 5.5 miles of canyon section was inaccessible except by foot, it was decided to construct a pioneer road, within the excavation lines wherever possible. The first shovel was used to rough out this road and the second shovel completed the excavation to line and grade. This method of construction has facilitated the work, as it allowed the transportation of men, equipment, supplies, and material as the pioneer road progressed.

Each shovel is accompanied by an air compressor which is operated continuously to produce muck for that shovel. Most of the shovel work is casting and there is considerable waste, with a minimum of overhaul required to date. The native rock is a soft sandstone that drills, springs, and shoots to good advantage. Some of the roadbed must be drilled and shot down from the cliffs above into the riverbed. This material can be placed without the use of a shovel, but the drilling and shooting is rather expensive. The explosives in use are black powder and 40% DuPont dynamite.

A feature of the contract is its magnitude, this being one of the heaviest projects constructed by the state. Another feature is the bid price of $0.73 per cu.yd. of unclassified excavation through the canyon section. However, the State Highway Department feels that the project is being economically built and it is hoped that the contractor will earn a legitimate profit.

Personnel—L. D. Blauvelt is state highway engineer of Colorado. Although the project is within my district, R. E. Cowden, locating engineer, is in direct charge for the state, reporting direct to J. E. Maloney, assistant highway engineer at Denver. Wallace Hinman represents Hinman Bros. Construction Co. and maintains a local office at DeBeque.

Ariel Hydroelectric Project, Lewis River, Washington

By O. L. LeFever

General Superintendent, Northwestern Electric Co., Portland, Oregon

The Ariel hydroelectric project is located on the north fork of the Lewis river 12 miles northeast of Woodland, in Clark and Cowlitz counties, Washington. It has an ultimate capacity of 160,000 kw. in four units and will be leased and operated by the Northwestern Electric Co., of Portland. The plant is owned by the Inland Power & Light Co., of Portland, and is being constructed by the Phoenix Utility Co., of New York City. The Electric Bond & Share Co., New York, is doing the engineering on the project. Construction began November 1, 1929, and will be completed August 1, 1931; the estimated total cost of the development is $8,500,000.

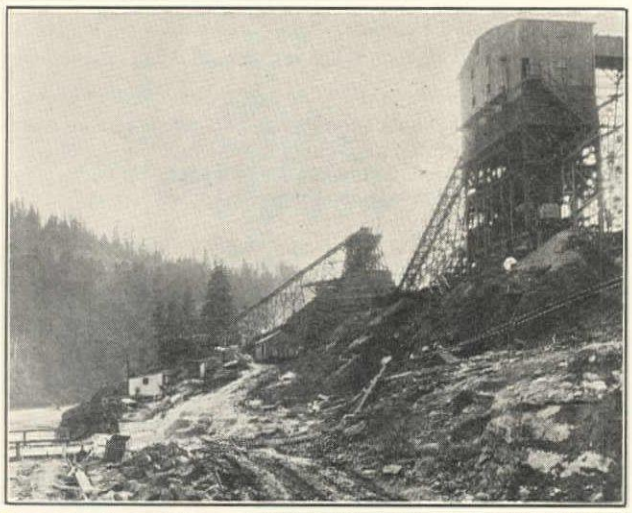
Dam—The dam will be of single arch construction, 200 ft. high, with a gravity section at each end, the crest length being 1295 ft. The spillway on the north, or Cowlitz county, side will have four tainter gates.

ARIEL HYDROELECTRIC PROJECT, LEWIS RIVER, WASHINGTON; SHOWING BUCYRUS-ERIE 1¼-YD. DIESEL ELECTRIC POWER SHOVEL, LINN TRACTOR TRUCKS, SAUERMAN 2-YD. DRAGLINES, CLYDE DERRICKS EQUIPPED WITH ELECTRIC HOISTS AND WILLIAMS BUCKETS, AND WHIRLEY DERRICKS

Power-House and Equipment—Just below the arch of the dam will be the power-house with space for two 45,000-kw. generating units, operating under a maximum head of 180 ft. For the present, only one unit will probably be installed. An option has been taken

on a second unit to be installed, provided load conditions make it necessary. The upstream face of the dam and the two units will be connected by 15-ft. straight penstocks. Just ahead of the units there will be either butterfly or Johnson valves, the type being undetermined at this date (March 13).

Direct-connected exciters will be used, with a pilot



Concrete Aggregates and Mixing Plant Equipped with Telsmith Crushers and Smith 2-yd. Mixers

exciter on top to provide for high-speed excitation; there will also be motor-driven spare exciters. The governor will be motor-driven and will receive its energy from slip rings on the pilot exciter. A water wheel will drive the house generator.

Progress—A 1467-ft. diversion tunnel is being driven from both ends, 150 lin.ft. of work remaining on March 13. The bore is 27-ft. diam. and the finished tunnel will be horseshoe-shaped, with a section giving the

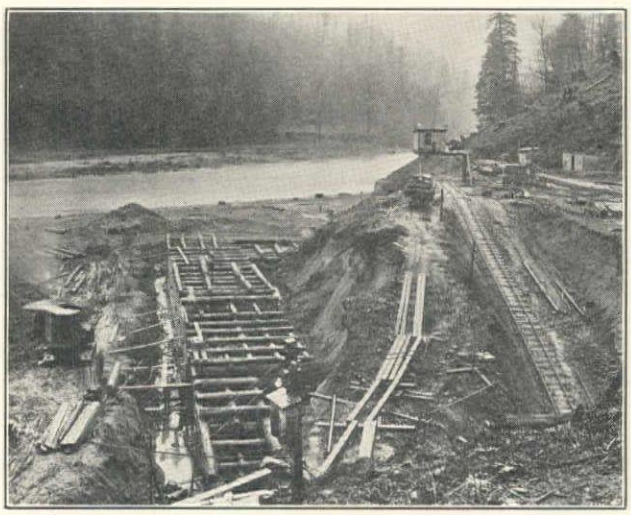
Excavating for Sump at Intake End of Tunnel, with Bucyrus-Erie Air Shovel

equivalent of a 25-ft. diam. circle. Driving is done by the top heading and bench method, the best weekly progress being 150 ft. and the daily 29 ft.

Excavation on the dam abutments is nearing completion.

Equipment—Major equipment on the work includes: three 2-yd. T. L. Smith mixers; four Linn tractor trucks; two ⅝-yd. Bucyrus air muckers on tunneling; two 1¼-yd. Bucyrus diesel shovels; a Telsmith plant for handling concrete aggregates; two Sauerman 2-yd. slackline outfits for removing sand and gravel from the river; four Clyde derricks and electric hoists, equipped with 2-yd. Williams clamshell buckets, for excavating the dam foundation below the river level; three Whirley derricks, equipped with 2-yd. Williams bottom drop buckets, for handling concrete on the dam; six 7-ton Whitcomb gas locomotives; one 30-ton Ohio locomotive crane for handling material from the cars to trucks and storage at Woodland; four 1050-c.f.m. Ingersoll-Rand air compressors; one Joshua Hendy giant for excavating side wings of the dam; twenty drift drills; and twenty Jackhamers.

Personnel—H. F. Lincoln is the construction manager for the Phoenix Utility Co. L. T. Merwin, vice-



Cofferdam at Upriver Entrance to Tunnel; Bucyrus Diesel Crane at Left, Whitcomb Locomotive in Background

president and general manager of the Northwestern Electric Co., is that company's executive on the work and Lyman Griswold, consulting engineer, Portland, is the engineering contact man on construction. I am contact man on all machinery, electrical equipment, and general details.

CALIFORNIA SEWAGE WORKS ASSOCIATION

The 1930 Spring Conference of the California Sewage Works Association will be held at Sacramento April 21 to 22 (see March 10th issue, p. 129, for the tentative program). John W. Alvord, of Alvord, Burdick & Howson, consulting engineers, Chicago, will replace Harrison P. Eddy of Boston as guest speaker at the evening meeting of April 22. His subject will be 'Biological Engineering'.

AMERICAN SOCIETY OF CIVIL ENGINEERS

The national spring meeting of the American Society of Civil Engineers will be held at Sacramento, California, April 23 to 26, headquarters being at the Hotel Senator. The meeting will be attended by many eastern engineers; it affords an excellent opportunity for personal contact with men of prominence in the profession and deserves the attendance of all engineers in the far west.

American Water Works Association

Pacific Northwest Section Will Meet in Portland, Oregon, April 24 to 26

Water works men in Oregon and Washington have an excellent program in store at the third annual meeting to be held at Portland, April 24 to 26. The officers of the section and the program committee have 'covered the field' and in the following tentative program the technical papers are outlined in some detail.

Thursday, April 24

8 to 9:30 a.m. Registration at convention headquarters, Portland hotel.

9:30 a.m. to 12 noon. Round table discussion at headquarters.

2 to 4:30 p.m. Round table discussion at headquarters, or golf tournament on Eastmoreland links.

Friday, April 25

9:30 a.m. Address of welcome by George L. Baker, mayor of Portland. Response by Ben S. Morrow, chairman of the Section.

TECHNICAL PAPERS (FORENOON SESSION)

(1) 'Design and Construction of Intake Screens for Gravity Pipe-Line Intakes', by J. W. Cunningham, of Baar & Cunningham, consulting engineers, Portland.

(a) Proper arrangement of headgates, waste-ways, racks, and screens.

(b) Advantages which may accrue from short-time sedimentation at the intake or along the line.

(c) A new form of automatic self-cleaning leaf screen.

(d) Fine screening of water through large areas at low velocity, which may in some instances replace filtration.

(e) Lantern slides will probably be used with this paper.

(2) 'Municipal Water Utility Accounting', by G. B. Schunke, utility accountant, Water Department, city of Seattle, Washington.

(a) Historical. (Outline of early forms of municipal corporate entities leading to present-day organizations.)

(b) Regulation of Utility Accounting Methods. (Analysis of present classifications regulating municipal water utility accounting. Reasons for same. Advantages and defects.)

(c) Financial Structure of Municipal Water Utilities. (Capital set up. Budgetary operation of plant. Provisions of reserves.)

(d) Commercial Cost Accounting. (Discussion of methods best adapted to assist management in efficient operation of plant.)

(e) Public Relations. (Consumer accounting methods Handling of delinquent accounts. Adjustments.)

TECHNICAL PAPERS (AFTERNOON SESSION)

(3) 'Water Works Management', by R. H. Corey, division engineer, Pacific Coast Division, Public Works Engineering Corp., Salem, Oregon.

(a) Personal qualities required.
(b) Intermediary between superiors and public.
(c) Adoption of general policy for all.
(d) Relations with employees.
(e) Public relations.
(f) Relations with regulatory bodies.
(g) Pure water the first duty.
(h) Ample financial return.
(i) Accounting.
(j) Operation efficiency, supply, leakage, meters, etc.
(k) Maintenance.
(l) Complaints.
(m) Extensions.
(n) Future development of source and system.

(4) 'Metering, Maintenance, and Testing in a Small Town', by A. H. Labsap, superintendent of water department, Washington Gas & Electric Co., Longview, Washington.

(a) Location of mains in alleys makes protection of meters a serious problem.
(b) Advantages and disadvantages of meters in alleys.
(c) Procedure in applying for service, and record kept by company.
(d) Meter is tested, stamped, and sealed.
(e) Method used in keeping meter registers from clouding.
(f) Trouble encountered in protecting meters.
(g) Synopsis of Department of Public Works rules for testing meters.
(h) Result of tests.
(i) Cost of test and maintenance.
(j) Parts of meters that required renewal most often.
(k) Effect of testing on water unaccounted for.

(5) 'Relationship of the State College of Washington to Water Works Engineering Practice', by M. K. Snyder, professor of sanitary engineering, State College of Washington, Pullman.

(a) Courses in sanitary engineering offered at the State College.

(b) Assistance which the college offers to engineers and municipalities in making examinations and analysis of water supplies.

(c) Two or three typical cases in sanitary examination that have been made.

(6) 'Outline of Method of Rating Water Works Systems for Insurance Purposes', by C. F. Wagner, engineer, Oregon Insurance Rating Bureau, Portland.

(a) Method of applying grading schedule in general use by National Board of Fire Underwriters in grading water systems for insurance rating purposes.

(b) Various features of water systems which present different weights in the insurance scale.

(c) Relative value of items that go to make up a complete water system.

(7) 'In What Respect can the Oregon State College be of Assistance to Oregon Municipalities in the Solution of their Water Supply and Distribution System Problems?' by C. A. Mockmore, associate professor of civil engineering, Oregon State College, Corvallis.

(a) General Information. (Through correspondence and conferences.)

(b) Special Tests. (Of meters, pipes, etc.)

(c) Research Problems. (Seminar subjects for engineering students and by engineering experiment station on hydraulic and sanitary problems.)

EVENING DINNER AND ENTERTAINMENT

7 p.m. At this session, Jack J. Hinman, Jr., national president of A.W.W.A., will address the members and guests. (Portland hotel.)

Saturday, April 26

9:30 a.m. Motor busses will leave headquarters for a trip over the Portland water system, including a visit to the headworks and a luncheon at the Bull Run dam.

PERSONAL MENTION

C. C. Kennedy, San Francisco, has been retained as consulting engineer on the revamping of the filtration plant of the Sacramento, California, municipal water supply.

Henry Z. Osborne and Walter E. Jessup, consulting engineers, Los Angeles, have moved their offices to the Bradbury bdg., Third st. and Broadway. The firm's practice is in municipal, sanitary, and hydraulic engineering.

J. A. Hall, secretary of the Fresno Irrigation District, has been elected president of the Fresno, California, Engineers' Club, succeeding F. E. Twining. A. Segel will serve as vice-president and R. D. Likely as secretary-treasurer.

Andrew M. Jensen, consulting engineer, San Francisco, will handle the engineering on the proposed transcontinental line of the Continental Air Express, working on a part-time basis. This line will follow the Hamilton-Epley hotel chain across the southern route from Los Angeles to New York.

Jack J. Hinman, Jr., associate professor of sanitation, University of Iowa, and national president of the American Water Works Association, will attend the fourth annual meeting of the Pacific Northwest Section, A.W.W.A., at Portland, Oregon, April 24 to 26. Hinman will speak before the Section on the evening of April 25.

J. F. Coleman, of J. F. Coleman Engineering Co., New Orleans, Louisiana, and national president of the American Society of Civil Engineers, will visit the San Francisco Section of the Society in company with J. M. Howe, national vice-president, and George T. Seabury, national secretary, following the annual spring meeting at Sacramento, California, on April 23 to 25.

Emil F. Cykler, since 1922 vice-president of the Pan-Pacific Piling & Construction Co. and the Western Dredging Co., both of Los Angeles, is now entering consulting work on harbor, reclamation, dredging, and wharf engineering. His offices will be in the Bank of Italy bdg., Seventh and Olive st., Los Angeles. Prior to 1922, Cykler spent 6 years on dredging and wharf work in Honolulu, during this period being chief engineer of the Hawaiian Contracting Co. and the Hawaiian Dredging Co. Cykler is a member of the American Society of Civil Engineers.

OBITUARY

William C. Elsemore, 56, engineer and contractor of Eureka, California, died January 13, following a long illness. Elsemore was a classmate of President Hoover at Stanford University. For some years until 1922 he was senior partner in the contracting firm of Elsemore & Jacobs. Since that year he had been in the contracting business for himself. Prior to his contracting experience, Elsemore served five terms as city engineer of Eureka. He is survived by his widow.

ASSOCIATIONS

San Diego Section, American Society of Civil Engineers—A monthly dinner meeting was held at the Athletic Club on February 27, at which the section adopted a committee report generally endorsing the major traffic street plan of the City Planning Commission, and suggesting the advisability of some minor changes. Leopold J. Mensch, M. Am. Soc. C.E., Chicago, addressed the section on 'Recent Tendencies in Reinforced Concrete Design'.

American Society of Agricultural Engineers, Pacific Coast Section—The Spring Meeting of this Section will be held at Oregon State College, Corvallis, Oregon, on Friday and Saturday, May 2 and 3. M. R. Lewis, vice-chairman, is in charge of arrangements. The principal topics to be discussed are: agricultural machinery, lumbering, electric power, tillage, and reclamation. W. L. Paul (John-Deere Plow Co.) is chairman, and Walter W. Weir (University of California) is Secretary.

Oakland Engineers Luncheon Club—At a regular meeting on March 21, held at the Athens Athletic Club, W. E. Emmett, district engineer of the American Institute of Steel Construction, San Francisco, gave an illustrated talk on the Marble canyon highway bridge over the Colorado river. For the two April meetings (first and third Fridays) the subjects are: 'Putting a Mountain Through a Sieve, or the Manufacture of Cement', by J. E. Jellick (Calaveras Cement Co.); and 'Natural Gas—What it Means to the Bay Region', by E. M. Seel.

Pacific Northwest Branch, A.G.C.—New officers elected at the tenth annual meeting of this branch in Portland, February 14 and 15, include: O. J. Amberg, Spokane, president (re-elected); James Murdock, Seattle (reelected), W. T. Jacobsen, Portland, and George D. Lyon, Spokane, vice-presidents; J. H. Collins, Spokane, treasurer; Dan Hannah, Spokane, executive secretary. Excepting Hannah, these men are also directors. Additional directors chosen are: J. C. Compton, W. H. Feigenson, G. W. Gauntlett, Natt McDougall, and C. T. Parker, Portland; G. J. Kieburtz, J. W. Lawlor, and J. G. McFee, Seattle; F. R. Hewett, W. G. Meyers, and S. G. Morin, Spokane. The program and an illustration of the convention group appeared in the March 10th issue, p. 147. The registered attendance at the meeting was 193.

Rocky Mountain Section, A.W.W.A.—At the fourth annual meeting in Denver, February 13 and 14, the following officers were elected: chairman—L. C. Osborn, city engineer, Loveland, Colorado; vice-chairman—G. C. Culberson, manager of water works, Raton, New Mexico; secretary-treasurer—Dana E. Kepner, district manager, Pacific States Cast Iron Pipe Co., Denver, Colorado; directors for three-year term—Frank E. Keenan, water superintendent, Gunnison, Colorado, and Chester Truman, superintendent of Northfield Water Co., Colorado Springs, Colorado; national director to represent the section on the A.W.W.A. board of direction—D. P. Porter, superintendent, North Side Water Works, Pueblo, Colorado. Over one hundred water works men attended the annual meeting, the program of which was published in the February 25th issue, p. 116.

SAN FRANCISCO SECTION, AM. SOC. C.E., DEFENDS FRANK E. BONNER

The San Francisco Section of the American Society of Civil Engineers came strongly to the defense of Frank E. Bonner, executive secretary of the Federal Power Commission, now 'under fire' before a congressional committee in Washington, by endorsing unanimously resolutions of confidence submitted by the directors of the Section at a special evening meeting on March 18.

The resolution, which was sent immediately to President Hoover; Patrick J. Hurley, secretary of war; Ray Lyman Wilbur, secretary of the interior; and Arthur M. Hyde, secretary of agriculture, reads as follows:

'As the executive officers of the San Francisco Section of the American Society of Civil Engineers and in accordance with instructions and authorization of the Board of Directors of the Section, we are addressing you to express the confidence of the membership of the Section in Frank E. Bonner, executive secretary of the Federal Power Commission.

'Bonner served many years as district engineer of the U. S. Forest Service with headquarters in San Francisco, and during this entire period proved an able, efficient, and entirely fair official. In view of an unfortunate controversy which has recently arisen before a congressional committee wherein Bonner has, we believe, been unfairly attacked, the officers of the San Francisco Section of the American Society of Civil Engineers feel that they would be remiss in their duty if they did not at this time extend this expression of confidence in Bonner as an engineer and as a conscientious public official.'

Following the business session, R. R. Martel, professor of civil engineering at the California Institute of Technology, gave an illustrated lecture on 'Earthquake-Resistant Building Construction in Japan—Theory and Practice'.

New Equipment and Trade Notes

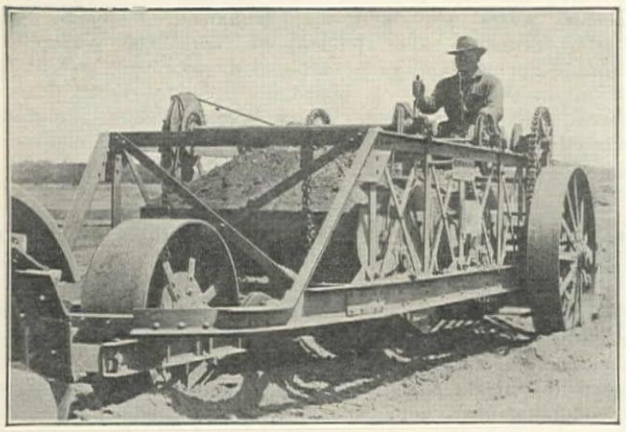
THE ARCO CO. BUILDS WEST COAST PLANT AT LOS ANGELES

The Arco Co., Cleveland, Ohio, has selected Los Angeles as the location for a new paint plant to serve the western, Latin American, and Oriental trade. This plant will consist of three brick buildings—a paint manufacturing, lacquer, and varnish unit—with metal trim and concrete floor construction, having a total floor space of 16,500 sq.ft. Operation is scheduled to begin before July 1, 1930.

The Los Angeles factory will be known as The Arco Co., Ltd., of California, with Howard Wise in charge. The general sales manager will be Howard Raeney and E. B. Hagar, now manager of the San Francisco branch, will be district manager with headquarters in Los Angeles.

BALL WAGON GRADER COMBINES DIRT MOVING REQUIREMENTS

The Ball wagon grader combines five dirt moving requirements in one piece of equipment—it digs, loads, transports, dumps, and spreads. Its manufacturer, the Blaw-Knox Co., of Pittsburgh, Pennsylvania, claims that 8, 10, 12, and 14c dirt moving costs are not unusual, and can cite numerous jobs



Ball Wagon Grader of the Blaw-Knox Co. A Dirt-Mover which Digs, Loads, Transports, Dumps, and Spreads

where these costs have been obtained on street construction, roads, dams, airports, subdivisions, cuts, fills, and leveling.

One man handles the unit (two digging buckets, each of 40 cu.ft. capacity) and is able to control the cutting depth and load the buckets to heaping capacity without scarifying when working in hard, gravelly clay; hard adobe; gumbo; oil and gravel roads; silt; sod; etc. A 7-ft. spreader blade at the rear of the Ball wagon grader carries 9 to 14 cu.ft. in addition to that in the buckets, and is of value where spreading must be limited to thin layers for rolling. Designed with an extremely short turning radius, the grader and its tractor can be turned in a 16-ft. roadway. When two of the wagon graders are used in train, the short turning radius is increased to 20 ft.

KRATZ & McCLELLAND, INC., ACQUIRE ADDITIONAL EQUIPMENT LINES

Kratz & McClelland, Inc., 522 Bryant st., San Francisco, announce that they have recently been appointed Northern California dealers for the following lines of construction equipment: Diamond Iron Works (rock crushing and gravel plants); G. W. Williams Co. (clamshell and dragline buckets); Heltzel Steel Form & Iron Co. (steel road forms, bins, and batchers); Ames Iron Works (motor road rollers); Union Iron Works (pile hammers and foundation equipment); N. P. Nelson Iron Works (conveying equipment and loaders); Milwaukee Locomotive Co. (gasoline locomotives); Bartlett & Snow (concrete truck bodies); and Greiman Ditcher Co. (ditchers and trench supporters).

These lines, in addition to the Ransome Concrete Machinery Co. (concrete mixers, paving mixers, towers, and chutes); the Novo Engine Co. (gasoline engines, hoists, pumps, and lighting outfits); and the Chausse Oil Burner Co. (asphalt plants, kettles, and surface heaters) give Kratz & McClelland a very complete stock of well known construction equipment.

ARMCO CULVERT MANUFACTURERS ASSOCIATION

Members of the Armco Culvert Mfrs. Association, headquarters at Middletown, Ohio, manufacture corrugated iron products under the following listings: Airport drainage; bridge floors; catchbasins; culverts; paved invert culverts; drainage gates; perforated drains; siphons; storm sewers; stream enclosures; part circle street culverts; undercrossings; and well casings.

Western members of the Association include:
The Burnham Mfg. Co., Woods Cross, Utah.
California Corrugated Culvert Co., West Berkeley, California.
The R. Hardesty Mfg. Co., Denver, Colorado.
Pure Iron Culvert & Mfg. Co., Portland, Oregon.
Spokane Culvert & Tank Co., Spokane, Washington.
Western Metal Mfg. Co., Dallas, El Paso, and Houston, Tex.

STEPHENS-ADAMSON MFG. CO. OPENS SEATTLE OFFICE

The Stephens-Adamson Mfg. Co. has opened a branch sales and engineering office at 521 Skinner bdg., Seattle, Washington, for the purpose of giving the Pacific northwest a complete service on its material handling products, including elevating, conveying, screening, and hoisting machinery. This office will be in charge of Charles J. Horn, who has been assistant chief engineer at the company's main plant for a number of years. Horn's general experience and technical background make it possible for him to assist customers and prospective customers in the planning of new material handling projects, and in revising present installations.

OWEN BUCKET CO. ANNOUNCEMENT

H. W. Botten, treasurer and general manager, and E. L. Kelzer, central division manager of the Owen Bucket Co., of Cleveland, Ohio, recently visited the Pacific coast states to investigate business conditions. At this time the appointment was announced of J. R. Arnold as district manager of Northern California and Nevada, to succeed the late R. R. Slick. Arnold was formerly Fresno district manager of the Coast Road Machinery Co. The Northern California office and warehouse of the Owen Bucket Co. will remain at 2857 Hannah st., Oakland, where a large stock of buckets will be carried.

HELTZEL STEEL FORM & IRON CO. ANNOUNCEMENT

The Heltzel Steel Form & Iron Co., Warren, Ohio, a fabricator of steel plates and of steel forms for all types of concrete construction, announces the appointment of B. M. Clark as manager of sales, succeeding W. J. Savage, resigned. Clark has been assistant manager of sales for several years and is therefore familiar with the equipment problems of concrete contractors.

Free Outflow—No Backflow

TODAY thousands of Calco Automatic Drainage Gates in service all over the country testify to the effectiveness of this truly automatic method of drainage control. Where flood, tide water or other abnormal conditions would cause backflow in drains and storm or sanitary sewers, this trusty regulator of flow is rendering an efficient trouble-free protection from damage and inconvenience.

The very simplicity of their sturdy cast iron construction is the secret of the success of Calco Automatic Drainage Gates. Double hinged, with flexible bearings, this gate is sensitive in operation and offers scarcely any obstruction to outflow. An accurately machined seat with sufficient play to allow a grinding motion insures a continually watertight barrier that *stops* backflow.

These gates can be secured in sizes from 8 to 84 inches. Attached to any desired length of Armco Corrugated Iron Pipe, they are quickly and economically installed even in the most unfavorable soil conditions.

Our engineers are always ready to show you how Calco Automatic Drainage Gates can help solve your drainage problems.

ARMCO Ingot Iron

ADDRESS

Armco Culvert Manufacturers Association

Middletown, Ohio

OR THESE MEMBERS

The Burnham Mfg. Co.
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The R. Hardesty Mfg. Co.
DENVER, COLO.—MISSOULA, MONT.

Spokane Culvert & Tank Co.
SPOKANE, WASH.

Western Metal Manufacturing Co.
EL PASO, TEXAS

CALCO AUTOMATIC DRAINAGE GATES *with* ARMCO CORRUGATED IRON PIPE

UNIT BID SUMMARY

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

IRRIGATION AND RECLAMATION

NEWELL, SOUTH DAKOTA—GOVT.—DRAINS AND STRUCTURES

Kremer & Hog, Minneapolis, Minn., $173,057 (Schedules 1, 2, and 3 combined), submitted low bid to Bureau of Reclamation, Newell, South Dakota, for constructing 67 miles of open drains and drainage structures on Belle Fourche Project, S. D. Bids from:

	SCH. 1	SCH. 2	SCH. 3	SCH. 1, 2, and 3 comb.
(A) Kremer & Hog, Minneapolis, Minn.	$49,912	$59,221	$63,923	$173,057
(B) W. H. Puckett Co., Boise, Idaho	no bid	63,560	no bid	
(C) A. Guthrie & Co., St. Paul, Minn.	55,617	66,520	71,295	193,432
(D) Metropolitan Const. Co., Omaha, Nebr.	no bid	69,322	no bid	
(E) John Phillips Co., San Francisco	87,158	99,869	111,927	298,954

SCHEDULE No. 1

		(A)	(C)	(E)
405,000	cu.yd. excavation of drains	.11	.12	.20
660	cu.yd. excavation for structures	1.00	1.25	1.00
3,300	cu.yd. backfill about structures	.30	.35	.35
500	cu.yd. puddled backfill about struc.	.50	.75	.50
54	cu.yd. concrete in structures	27.00	30.00	25.00
600	ft. drive piling for structures	.60	.50	.75
18	M. ft. b.m. erecting timber bridges	25.00	40.00	30.00
4	M. ft. b.m. erect timber (fl. and drain inl.)	50.00	60.00	45.00
1,000	ft. 15-in. corr. pipe, laying	.20	.45	.40
1,200	ft. 24-in. corr. pipe, laying	.35	.55	.50
180	ft. No. 42 metal flume, erecting	.40	.80	.75
50	ft. No. 48 metal flume, erecting	.50	1.00	1.00
5	M. ft. b.m. preserv. treat. of lumb.	18.00	18.00	15.00

SCHEDULE No. 3

		(A)	(C)	(E)
520,000	cu.yd. excavation of drains	.11	.12	.20
850	cu.yd. excavation for structures	1.00	1.25	1.00
5,500	cu.yd. backfill about structures	.30	.35	.35
800	cu.yd. puddled backfill about struc.	.50	.75	.50
55	cu.yd. concrete in structures	27.00	30.00	25.00
500	ft. drive piling for structures	.60	.50	.75
15	M. ft. b.m. erect timber in bridges	25.00	40.00	30.00
5	M. ft. b.m. erect timber (fl. and drain inl.)	50.00	60.00	45.00
500	ft. 12-in. corr. pipe, laying	.16	.40	.30
1,600	ft. 15-in. corr. pipe, laying	.20	.45	.40
1,650	ft. 24-in. corr. pipe, laying	.35	.55	.50
420	ft. 30-in. corr. pipe, laying	.40	.60	.75
2	miles move an excavating machine	20.00	50.00	25.00

SCHEDULE No. 2

		(A)	(B)	(C)	(D)	(E)
460,000	cu.yd. excavation of drains	.11	.12	.12	.13	.195
850	cu.yd. excavation for structures	1.00	1.00	1.25	.90	1.00
5,200	cu.yd. backfill about structures	.30	.35	.35	.20	.35
700	cu.yd. puddled backfill about structures	.50	.50	.75	.55	.50
61	cu.yd. concrete in structures	27.00	25.00	30.00	30.00	25.00
1,650	ft. drive piling for structures	.60	.50	.50	.60	.75
70	M. ft. b.m. erecting timber (bridges)	25.00	20.00	40.00	45.00	30.00
3	M. ft. b.m. erect timber (fl. and drain inl.)	50.00	30.00	60.00	45.00	45.00
480	ft. 12-in. corr. pipe, laying	.16	.25	.40	.20	.30
1,500	ft. 15-in. corr. pipe, laying	.20	.25	.45	.25	.40
90	ft. 18-in. corr. pipe, laying	.25	.40	.50	.25	.50
1,080	ft. 24-in. corr. pipe, laying	.35	.40	.55	.25	.50
400	ft. 30-in. corr. pipe, laying	.40	.40	.60	.30	.75
160	ft. 36-in. corr. pipe, laying	.45	.45	.70	.35	1.00
10	M. ft. b.m. presev. treat. of timber	18.00	15.00	18.00	15.00	15.00
2	miles move an excavating machine	20.00	20.00	50.00	10.00	25.00

SEWER CONSTRUCTION

SPARKS, NEVADA—TREATMENT PLANT AND VITRIFIED AND CONCRETE SEWERS—CITY

Contract awarded to H. A. Teget, 224 Harvard Place, Ontario, Calif., $69,933 for vitrified outfall sewer and treatment plant for the City of Sparks, Nevada. Bids received from:

(1) H. A. Teget, Ontario $69,933
(2) Fredrickson & Watson, Oakland 74,050
(3) Southern Construction Co. 74,485
(4) A. G. Raisch, San Francisco $74,905
(5) Heafey-Moore Co., Oakland 82,327
(6) H. Gould, Sacramento 82,992

		(1)	(2)	(3)	(4)	(5)	(6)
1,391	ft. 21-in. vitr. pipe sewer	3.50	3.35	3.00	3.40	2.90	2.95
150	ft. 10-in. vitr. pipe sewer	2.00	1.15	1.45	1.50	1.25	1.30
3,271	ft. 21-in. conc. pipe sewer	4.25	3.70	3.70	3.90	3.25	3.25
1,275	ft. 12-in. conc. pipe sewer	2.25	2.15	2.25	2.25	1.80	1.85
7	standard manholes	$100	$95	$125	$50	$68	$70
6	special manholes	$65	$110	$80	$50	$77	$75
960	cu.ft. conc. in pipe supports	.55	1.50	.75	.50	.75	.77
1	inverted siphon crossing	$80	$110	$150	$100	$125	$130
18	6-in. tee branch on 21-in. pipe	2.00	2.25	1.50	4.00	4.00	5.00
1	treatment plant complete	$44,800	$51,000	$50,000	$53,000	$62,520	$63,000
	Extra concrete per cu.yd.	18.00	25.00	30.00	40.00	27.00	30.00
	Extra reinforcing steel, per lb.	.045	.06	.06	.10	.06	.06
2,300	yd. grading of aeration maze	.60	.35	1.25	.01	.35	.35

C. C. Kennedy, Call Bldg., San Francisco, is the Consulting Engineer.

STREET AND ROAD WORK

PORTLAND, ORE.—STATE—GRADING AND SURFACING

Contract awarded to W. H. Hauser, 3129 E. Seventh St., Oakland, who bid $55,135 to Oregon State Highway Commission, Portland, for grading .93 mile of the Multnomah County Line-Oswego Section of the Pacific Highway, CLACKAMAS COUNTY. Bids on:

(1) Clearing and grubbing
(2) 63,000 cu.yd. excavation
(3) 96,000 sta.yd. overhaul
(4) 19,000 yd.mi. truck haul
(5) 85 cu.yd. rubble masonry
(6) 30 ft. 12-in. concrete pipe
(7) 130 ft. 12-in. corr. metal pipe
(8) 80 ft. 18-in. corr. metal pipe
(9) 500 cu.yd. base course surfacing

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	TOTALS
W. H. Hauser, Oakland	$3500	.65	.02	.20	15.00	1.50	1.50	2.50	3.50	$55,135
Geo. Abraham, Portland	3500	.80	.03	.18	14.75	1.15	1.00	3.00	3.00	$64,475
J. A. Lyons, Portland	1500	.90	.02	.18	14.00	1.50	1.25	2.35	3.00	67,817
Kern & Kibbe, Portland	1750	.89	.03	.20	8.00	1.50	1.00	2.00	2.75	68,240
John Slotte & Co., Astoria	5750	.86	.02	.18	10.00	2.00	2.00	3.00	3.60	69,960
A. C. Greenwood, Portland	4750	.88	.03	.25	12.00	1.50	1.50	2.50	3.00	72,080
J. Rebman, Portland	800	.98	.03	.13	15.50	1.20	1.25	2.00	3.00	72,141
Clifton, Applegate & Toole	1250	.97	.03	.25	15.00	2.00	1.50	2.00	3.50	74,805
Joplin & Eldon, Portland	2500	1.05	.03	.22	12.00	1.00	1.00	1.70	3.50	80,151
C. R. Johnson, Portland	3000	1.18	.03	.18	12.00	1.25	1.00	1.50	3.00	87,622
J. J. Dann, Portland	1500	1.25	.05	.30	15.00	1.50	1.00	2.50	3.25	95,250
La Pointe Construction Co., Portland	1200	1.32	.03	.20	16.00	1.40	1.30	2.10	2.80	95,484

Contract awarded to A C. Greenwood, 500 N. Front St., Portland, who bid $186,185 for 3.17 miles grading of the Tahkenitch-Gardiner Summit Section of the Roosevelt Coast Highway, DOUGLAS COUNTY. Bids received on the following items:

(1) Clearing and grubbing.
(2) 310,000 cu.yd. excavation, single class
(3) 236,000 sta.yd. overhaul
(4) 11,000 yd.mi. truck haul
(5) 2,900 ft. 18-in. concrete pipe
(6) 250 ft. 24-in. concrete pipe
(7) 300 ft. 36-in. concrete pipe, heavy
(8) 300 ft. 6-in. porous drain tile

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	TOTALS
A. C. Greenwood, Portland	$54,000	.37	.02	.30	2.50	3.50	7.00	.50	$186,185
Liesche & Tofte, Marshfield	34,800	.45	.025	.25	3.65	4.70	9.25	.40	196,402
Bauers & Bauers, Dayton, Wash.	37,408	.48	.02	.25	2.90	4.00	9.50	.75	204,928
Joplin & Eldon, Portland	48,000	.47	.025	.24	.50	.50	8.00	.38	211,839
Guy F. Atkinson Co., Portland	40,000	.49	.02	.30	3.25	6.00	9.00	1.00	212,675
Newport Construction Co., Portland	36,000	.59	.03	.30	3.00	4.00	9.00	.50	240,660
F. J. Kernan, Reedsport	50,000	.595	.025	.205	3.90	4.50	8.00	.40	256,520
Clifton, Applegate & Toole	36,750	.67	.03	.25	3.00	4.00	8.00	1.00	265,640
Morrison-Knudson Co.	50,000	.69	.02	.50	4.00	4.60	9.00	.32	288,496

To Harmon & Tittle, Eugene, Ore., who bid $94,860 for 4.43 miles grading on Scottsburg-Burchard Creek Section of Umpqua Highway, DOUGLAS COUNTY. Bids on:

(1) Clearing and grubbing
(2) 89.000 cu.yd. common excavation
(3) 53,000 cu.yd. solid rock excavation
(4) 176,000 sta.yd. overhaul
(5) 22,000 yd.mi. truck haul
(6) 1,500 ft. 18-in. concrete pipe
(7) 180 ft. 36-in. concrete pipe, heavy
(8) 1,500 ft. 6-in. porous drain tile
(9) 3,000 cu.yd. temporary gravel surfacing

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	TOTALS
Harmon & Tittle, Eugene	$2000	.42	.74	.02	.17	2.50	7.50	.40	.90	$ 94,860
Joplin & Eldon, Portland	4250	.34	.80	.03	.25	2.25	8.00	.40	1.80	99,405
Washburn & Hall, Portland	3500	.40	.80	.02	.20	2.50	8.00	.40	1.25	99,685
Leische & Tofte, Marshfield	3575	.35	.83	.03	.20	2.90	8.10	.39	1.60	100,568
J. J. Dann, Portland	4500	.32	.87	.02	.25	2.90	9.00	.50	2.00	101,790
Bauers & Bauers, Dayton, Wash.	7500	.38	.85	.02	.22	2.20	6.75	.33	2.10	106,770
Guy F. Atkinson Co., Portland	5500	.40	.90	.02	.25	3.00	9.00	1.00	2.00	112,640
Earl L. McNutt, Eugene	6000	.40	1.00	.02	.30	2.25	6.50	.50	1.00	113,875
Clifton, Applegate & Toole	5000	.45	.89	.03	.25	2.25	7.00	.50	2.00	115,715
A. C. Greenwood, Portland	5000	.40	1.00	.03	.30	2.50	7.50	.50	1.50	117,120
Newport Construction Co., Portland	4500	.40	1.05	.03	.28	2.80	8.00	.30	1.40	118,247
F. J. Kernan, Reedsport	4852	.36	1.10	.04	.22	3.50	8.00	.40	1.77	120,912
Morrison-Knudson Co., Boise	4000	.46	1.25	.03	.42	3.00	9.00	.32	1.80	138,670

PORTLAND, ORE.—STATE—OILING—SHERMAN, WASCO, AND HOOD RIVER COUNTIES

Cascade Petroleum Co., Portland, $84,581, low to State Highway Commission for The Dalles Oiling Project, Sherman, The Dalles-California, and Columbia River Highways. Bids from:

(1) Cascade Petroleum Co., Portland $84,581
(2) J. C. Compton, McMinnville 127,362
(3) J. F. Forbes, Olympia, Wash. 129,723
(4) United Contracting Co., Portland $132,402
(5) F. J. Kernan, Reedsport 171,072

	(1)	(2)	(3)	(4)	(5)
Bituminous Macadam Surface, Type B-5, Section No. 1 (Sherman Highway)—					
15.7 miles prepare subbase	45.00	65.00	50.00	90.00	427.93
11,000 cu.yd. placing aggregate	.45	1.60	1.40	1.34	2.21
12,500 yd.mi hauling aggregate	.15	.25	.25	.35	.30
700 tons asphalt in place	27.20	29.00	28.00	32.50	4.10
Oil Macadam Surface Treatment, Type 0-30, (The Dalles-California Highway, Section No. 2)—					
14.8 miles prepare base	45.00	75.00	200.00	175.00	475.00
1,800 cu.yd. placing aggregate	1.10	2.00	2.50	2.10	1.90
2,200 yd.mi. hauling aggregate	.20	.30	.40	.35	.30
165 tons No. 3 oil in place	34.50	30.00	30.00	32.60	40.00
Non-Skid Wearing Surface, Type N-1 (Columbia Highway, Section No. 3)—					
5,250 cu.yd. placing aggregate	.60	1.80	1.50	1.68	.30
9,200 yd.mil. hauling aggregate	.15	.30	.30	.35	.30
275 tons asphalt in place	28.90	30.00	35.00	36.60	35.50
Non-Skid Wearing Surface, Type N-2 (Columbia Highway, Section 3)—					
12,900 cu.yd. placing aggregate	.60	1.65	1.50	1.30	1.95
22,000 yd.mi. hauling aggregate	.15	.30	.30	.35	.30
640 tons asphalt in place	31.50	30.00	35.00	34.70	35.80

CARSON CITY, NEV.—STATE—CLARK COUNTY—GRADING AND SURFACING

Contract awarded to Martin Bros. Trucking Co., 1389 Gladys St., Long Beach, who bid $85,613 to State Department of Highways, Carson City, Nevada, for grading and surfacing 20 miles in CLARK COUNTY, from Crystal to West Slope of Mormon Mesa. Bids from:

(1) Martin Bros. Trucking Co. ..... $ 85,613
(2) A. D. Drumm, Jr., Fallon 97,969
(3) Isbell Const. Co., Carson City 103,963
(4) Dodge Bros., Inc., Fallon $107,241
(5) Utah Const. Co., Ogden, Utah 113,093
(6) Engineer's estimate 108,989

	(1)	(2)	(3)	(4)	(5)	(6)
91,000 cu.yd. excavation	.34	.36	.35	.45	.47	.45
101,282 sta.yd. overhaul	.03	.03	.04	.05	.05	.05
12.07 mi. prepare subgrade and shoulders	100.00	100.00	100.00	100.00	100.00	100.00
8.15 mi. widen gravel surface	100.00	100.00	100.00	100.00	150.00	100.00
42,000 cu.yd. cr. rock or gravel	.78	1.00	1.10	.95	1.00	1.00
300 cu.yd. cr. rock or gravel (st.)	.72	1.00	1.10	.95	1.00	1.00
Furnish water equipment	250.00	$2000	$1000	$1500	$800	$1000
646 M gal. apply water	3.00	1.00	3.50	2.00	5.00	2.00
147 cu.yd. A concrete	26.00	33.00	35.00	35.00	35.00	35.00
182 cu.yd. B concrete	24.00	33.00	35.00	35.00	35.00	35.00
146 ft. 15-in. corr. pipe, install	1.00	.50	.50	.50	.60	.75
488 ft. 18-in. corr. pipe, install	1.00	.50	.50	.50	.70	.75
468 ft. 24-in. corr. pipe, install	1.25	.50	.75	.50	.80	.75
130 ft. 30-in. corr. pipe, install	1.50	.50	1.00	1.00	1.00	.75
362 ft. 36-in. corr. pipe, install	2.00	.50	1.00	1.00	1.40	.75
294 ft. 15-in. corr. pipe, remove	1.50	.50	.50	.50	.50	.75
112 ft. 18-in. corr. pipe, remove	1.75	.50	.50	.50	.60	.75
1,344 lin.ft. standard timber guard rail	.70	1.00	1.00	1.00	1.00	1.00
1,704 lin.ft. remove timber guard rail	.10	.10	.10	.10	.05	.15
50 lin.ft. remove and reset 24-in. corr. pipe, (including re-setting four headwalls)	5.00	2.00	2.50	1.50	2.50	1.75
34 demolish headwalls	5.00	5.00	5.00	5.00	2.00	5.00
127 corrugated metal pipe culvert extensions	12.50	10.00	10.00	10.00	10.00	10.00
146 removing and reset monuments	3.50	2.00	2.00	3.00	3.00	1.50

PORTLAND, ORE.—STATE—GRADING—MALHEUR COUNTY

Contract awarded to J. A. Terteling & Sons, Moscow, Idaho, who bid $145,792 to Oregon State Highway Commission, Portland, for grading 13.31 miles of Tunnel-Harper Section of Central Oregon Highway, MALHEUR COUNTY. Bids received from:

(1) J. A. Terteling & Sons, Moscow $145,792
(2) E. L. Gates, Kemela 146,280
(3) W. H. Puckett Co., Boise 150,202
(4) J. W. Feak Construction Co., Tacoma 153,739
(5) Ryberg, McHugh & Cowley, Boise $158,750
(6) Earl L. McNutt, Eugene 160,720
(7) A. C. Greenwood, Portland 163,915
(8) Bauers & Bauers, Dayton, Wn. 164,717
(9) Johnson & Rosten, Portland 173,070

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Clearing and grubbing	$1,500	$700	$1,250	$800	$1,500	$2,000	$1,500	$750	$2,000
71,000 cu.yd. common excav.	.30	.25	.24	.21	.25	.42	.28	.24	.35
69,000 cu.yd. inter. excavation	.30	.40	.31	.42	.36	.50	.40	.40	.40
85,000 cu.yd. solid rock excavation	.80	.75	.84	.82	.87	.65	.90	.95	.90
93,000 sta.yd. overhaul	.05	.02	.04	.02	.04	.02	.02	.02	.03
5,000 yd.mi. truck haul	.26	.20	.20	.18	.20	.30	.30	.22	.22
10,000 cu.yd. earth cushion	.24	.40	.20	.35	.30	.40	.30	.30	.30
10,000 yd.mi. earth cushion haul	.18	.20	.20	.17	.20	.25	.30	.22	.22
46 cu.yd. A concrete	26.00	32.00	31.00	28.00	30.00	30.00	30.00	30.00	27.50
100 cu.yd. B concrete	23.50	28.00	28.00	28.00	27.00	30.00	30.00	25.00	25.00
40 cu.yd. rubble masonry	5.00	15.00	14.00	12.00	10.00	15.00	12.00	10.00	12.00
3,100 cu.yd. riprap	1.00	1.50	2.00	2.25	3.00	2.00	1.25	2.50	2.50
360 sq.yd. rock slopes, hand pl.	1.00	2.00	1.00	2.50	1.40	1.00	1.50	4.50	2.00
114 M ft. b.m. lumber and timber	62.00	60.00	70.00	65.00	55.00	70.00	65.00	65.00	65.00
600 ft. 12-in. conc. culv. pipe	1.15	1.10	1.05	1.25	1.10	1.00	1.25	1.00	1.25
1,400 ft. 18-in. conc. culv. pipe	2.05	2.20	2.00	2.40	2.10	2.00	2.50	1.90	2.65
400 ft. 24-in. conc. culv. pipe	2.75	3.00	2.95	3.25	2.70	2.75	3.25	2.60	3.70
560 ft. 36-in. conc. culv. pipe	5.60	6.00	5.25	6.60	5.90	5.50	7.00	5.20	7.50
600 ft. 18-in. conc. siphon pipe	2.25	2.30	2.66	2.50	2.30	2.25	3.00	2.00	3.15
180 ft. 24-in.conc. siphon pipe	2.90	3.10	3.50	3.50	2.90	3.00	4.00	2.75	3.75

PHOENIX, ARIZ.—STATE—SURFACING AND OIL PROCESSING

Yglesias Brothers, 560 Spreckels Theatre Bdg., San Diego, California, who bid $78,349, low bid to Arizona State Highway Commission, Phoenix, for surfacing and oil processing of State Highway Contract, F. A. Projects 84-A and 76 Reo, the work to begin at end of pavement about one mile northwest of Marinette and extend about 14.5 miles toward Whittman, and the other to begin at end of 84-A and extend about 7 miles to Hot Springs Junction. Bids received from:

(1) Yglesias Bros., San Diego $78,349
(2) Schmidt & Hitchcock, Phoenix 81,162
(3) Skeels & Graham, Roseville $81,468
(4) Packard & Tanner, Phoenix 87,778

F. A. PROJECT 84-A

	(1)	(2)	(3)	(4)
151,030 sq.yd. preparation of subgrade	.015	.013	.01	.015
21,906 cu.yd. additional material	.75	.91	1.00	1.05
59,060 cu.yd.mi. haul add. material	.17	.17	.16	.20
339,818 gal. oil applied to road	.07	.075	.07	.07
14.302 mile mix, lay, and finish road	$500	$435	$525	$500

F. A. PROJECT 76-REO

73,664 sq.yd. preparation of subgrade	.02	.02	.01	.03
1,260 cu.yd. subgrade stabilizer	2.00	.96	1.50	2.00
4,410 cu.yd.mi. haul subgr. stabilizer	.20	.17	.16	.20
147,328 gal. oil applied to road	.07	.075	.07	.07
6.975 mile mix, lay, and finish road	$500	$435	$525	$550

SACRAMENTO, CALIF.—STATE—CONCRETE PAVING—GLENN COUNTY

Basich Bros. Const. Co., 3788 S. Vermont St., Los Angeles, who bid $146,319, low bid to California Division of Highways, Sacramento, for 5.2 miles of concrete paving from Logandale to Willows, GLENN COUNTY. Bids received on the following items:

(1) 2,000 cu.yd. roadway excavation
(2) 58,800 sta.yd. subgrade for pavement
(3) 43,000 cu.yd. pit-run gravel (subbase and shoulders)
(4) 11,240 cu.yd. A concrete (pavement)
(5) 277,000 lb. reinforcing steel (pavement)
(6) 100 lin.ft. laminated timber guard rail
(7) 269 stations finishing roadway

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	TOTALS
Basich Bros., 3788 S. Vermont St., Los Angeles	.30	.09	.57	9.00	.05	1.00	3.00	$146,319
C. W. Wood, Stockton	.25	.05	.59	10.00	.05	1.00	2.00	155,698
Fredrickson & Watson Const.	.23	.08	.64	10.30	.045	1.00	4.75	162,298
Hanrahan Co., San Francisco	.30	.09	.69	9.97	.05	1.00	5.00	162,919
T. M. Morgan Paving Co., Los Angeles	.50	.08	.80	9.50	.05	1.00	8.00	162,986
Mathews Const. Co., Sacramento	.50	.09	.82	9.55	.045	1.50	6.00	163,123
N. M. Ball, Porterville	.40	.09	.70	9.95	.05	1.00	10.00	164,670
M. J. Bevanda, Stockton	.25	.15	.77	10.00	.047	1.00	2.00	168,487
Average Bid	.34	.09	.70	9.80	.048	1.06	5.10	161,000

TUNNEL CONSTRUCTION

LOS ANGELES, CALIF.—CITY—TUNNELS—FIGUEROA ST. EXTENSION

H. W. Rohl Co., Roosevelt Bdg., Los Angeles, who bid $652,788, low bid to the Board of Public Works, City Hall, Los Angeles, for three tunnels on the Figueroa St. Extension, through Elysian Park, a total length of 996 ft., to be 46½ ft. wide and 28 ft. high. Bids received from:

(1) H. W. Rohl Co., Los Angeles $652,788
(2) Macco Construction Co. 653,123
(3) J. G. Donovan & Son 672,921
(4) J. F. Shea Co. 684,682
(5) Torson Construction Co. $699,344
(6) R. E. Cooney 705,988
(7) Thos. Haverty Co. 735,162
(8) Martter & Bock 746,747

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
851 ft. cross sec. Tun. No. 1	$365	$371	$392	$361	$365	$410	$375	$445
100 ft. cross sec. Tun. No. 2	$550	$414	$592	$539	$534	$604	$474	$600
45 ft. cross sec. Tun. No. 3	$600	$452	$685	$583	$596	$590	$499	$625
1,521 sq.yd. white gla. tile sur.	6.50	7.00	6.60	6.00	7.00	7.20	6.50	6.60
7,349 sq.yd. plas. tun. arches	1.25	.75	.63	.60	.75	1.20	1.23	.72
Light. fix., metal stand., etc.	$5,800	$7,000	$8,000	$6,000	$12,000	$7,200	$6,280	$6,600
Portal walls and appr. walls	$65,000	$60,500	$61,000	$57,000	$56,786	$50,000	$100,000	$63,500
Storm drain and sanit. sewers	$30,000	$26,000	$27,500	$26,500	$33,000	$27,000	$30,000	$40,000
Trans. vault and fiber conduit	$1,250	$1,200	$750	$1,000	$1,000	$2,000	$1,075	$1,100
Ped. subway, Sta. 0-74.89	$6,500	$7,000	$10,500	$8,000	$5,698	$8,400	$12,000	$7,500
Ped. subway, Sta. 12-80	$3,000	$3,600	$4,500	$4,700	$3,695	$5,500	$5,000	$4,500
184,531 sq.ft. 8-in. conc. pave.	.18	.20	.19	.22	.20	.20	.25	.21
122 ft. light curb	.30	.50	.45	.60	.45	.40	.50	.45
2,613 ft. 21-in. special curb	.60	.75	.75	.88	.60	.65	.90	.60
221 ft. steel curb armor	1.20	1.40	1.00	2.00	1.50	1.25	1.00	1.50
70,603 cu.yd. excav. outs. tun.	.80	1.00	.60	1.35	1.48	1.00	1.00	.83
22,344 sq.ft. sidewalk	.12	.18	.13	.16	.18	.13	.15	.15
2,456 ft. wire fence	1.30	1.75	1.50	1.50	1.50	1.30	1.45	1.50
Remove portions of bridge	$1,000	$500	$330	$500	$500	$500	$1,000	$100
All steel reinf. in place	$2,800	$3,000	$3,140	$3,000	$3,000	$3,300	$3,075	$2,840
439 cu.yd. 'F' concrete	17.00	20.00	27.50	20.00	15.00	17.00	35.00	20.00
382 cu.yd. 'C' concrete	17.00	24.00	25.50	13.00	14.00	20.00	32.00	20.00
Concrete hand rail	$7,500	$6,000	$4,675	$7,500	$6,750	$7,500	$7,000	$7,500
Concrete lighting stand.	$4,500	$3,600	$3,000	$6,000	$3,600	$5,000	$3,845	$5,000

WATER SUPPLY SYSTEMS

SAN DIEGO, CALIF.—CITY—ENLARGING MORENA DAM

Contract awarded to Gist & Bell, 186 East El Dorado St., Arcadia, who bid $61,489 to City of San Diego for Morena Dam spillway enlargement. Bids received from:

(1) Gist & Bell, Arcadia $61,489
(2) Monarch & Breen, Inc., San Diego 66,515
(3) Miracle Const. Co., San Diego $71,202
(4) Butterfield Const. Co., San Diego 76,228

	(1)	(2)	(3)	(4)
8,000 cu.yd. embankment, Class 1	1.15	.90	1.30	1.90
1,000 cu.yd. embankment, Class 2	1.30	1.50	1.80	2.25
800 cu.yd. excav. for rubble masonry, Cl. 1	1.00	1.25	1.30	2.00
1,000 cu.yd. spillway excav., Cl. 1	1.30	1.25	1.40	1.60
1,400 cu.yd. spillway excav., Cl. 2	1.50	2.00	1.90	2.40
2,000 cu.yd. spillway excav. below cr., Cl. 1	2.50	2.40	2.50	2.75
4,000 cu.yd. spillway excav. below cr., Cl. 2	2.50	2.40	2.50	3.15
400 cu.yd. concrete	14.00	25.00	29.00	22.50
600 cu.yd. rubble masonry	8.50	9.00	7.45	7.50
800 bbl. cement	3.50	4.50	3.40	2.80
55,000 lb. reinf. steel	.03	.05	.035	.025
20,000 lb. struc. steel	.05	.10	.0825	.07
60 1-in. wall anchors	2.00	2.50	3.15	2.50
1,500 ft. 2-in. holes in masonry	1.50	.40	.32	.75
300 ft. 1-in. holes in masonry	1.00	.30	.25	.60
100 ft. expansion joints	.50	.20	.375	.25
800 ft. 2-in. pipe railing	1.50	2.00	2.32	1.75
22 automatic flash gates	$480	$500	$575	$525
44 stop plank groove cover plates	12.00	12.00	14.00	13.00
1 outlet tower cupola ladder	50.00	50.00	41.50	40.00
1 22-in. manhole	50.00	50.00	38.00	35.00
1 20x28-in. manhole	50.00	80.00	76.25	75.00
1 6-in. diam. dome cover plate	$100	60.00	62.75	70.00
5 valve stem stuffing glands	75.00	75.00	80.00	75.00

CONSTRUCTION NEWS SUMMARY

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

TABULATION OF AWARDS

Awards for the month of March, 1929, for Engineering Construction projects in the Far Western States total $36,534,000, as follows:

Paving	$ 5,760,000
Grading, highways	4,013,000
Bridges	3,720,000
Sewer construction	2,750,000
Water supply systems	4,341,000
Irrigation	3,050,000
Power development	8,750,000
Railroad construction	1,675,000
River and harbor work	1,050,000
Lighting systems	1,425,000
	$36,534,000

LARGE WESTERN PROJECTS

(See Construction News, this issue, for details.)

WORK CONTEMPLATED

Paving streets in District 78 for City of Miles City, Mont.; $438,000.

Seawall on Railroad Ave. for City of Seattle, Wash.; $900,000.

Wells, reservoirs, pumping plants, and pipe lines, etc., for City of Whittier, Calif.; $300,000.

BIDS BEING RECEIVED

Dredging Ellis Slough in City of Richmond, Calif.; bids to April 16.

BIDS RECEIVED

Tunnels on Figueroa St. extension through Elysian Park for City of Los Angeles; H. W. Rohl, Los Angeles, $652,788, low.

CONTRACTS AWARDED

Pier at Naval Operating Base, Pearl Harbor, T. H., for Bureau of Yards and Docks, to Hawaiian Dredging Co., Honolulu, $396,038.

Tunnels for Bureau of Reclamation, Nyssa, Ore.: SCHEDULE No. 5—To T. E. Connolly, San Francisco, $982,116; SCHEDULES 6 and 7—To J. F. Shea Co., Portland, $1,025,208; and SCHEDULE 8—To S. S. Magoffin & Co., North Vancouver, B. C., $530,684.

Hotel at Point Loma, San Diego, Calif., for Leon Reich, Los Angeles, to Hart Bros. Construction Co., Los Angeles, $1,500,000.

STREET and ROAD WORK

WORK CONTEMPLATED

SAFFORD, ARIZ.—Plans by City for paving 17 blocks in the business and residential districts of the City of Safford. Martin Layton is the City Clerk of Safford. Weiland Engineering Co., P. O. Box 693, Pueblo, Colo., are the Consulting Engineers. 3-20

LOS ANGELES, CALIF.—Plans by County Surveyor, protests Apr. 21 for improving Kenburn Ave. about 0.73 mile, work involving 6160 cu.yd. excavation, 102,655 sq.ft. 4-in. Bitumuls paving, curbs, gutters, and 155 ft. 55-in. corr. pipe, $31,000. 3-26

SALINAS, CALIF.—Plans by City Engr., H. F. Cozzens, protests Apr. 7 for improving Front St. involving 47,226 sq.ft. 5-in. concrete paving, corr. culverts, $13,200. 3-27

SAN DIEGO, CALIF.—Plans by H. W. Jorgensen, City Engr., for improving Benson St. involving 23,445 sq.ft. 6-in. concrete paving, 570 ft. 6-in. and 413 ft. 8-in. 'C' cast-iron pipe, 2 hydrants. Bids after Apr. 14. 3-22

SANTA CRUZ, CALIF.—Plans by City Engr., protests Apr. 14 for improving Windsor St., S. Branciforte Ave. and Pine St., concrete paving, vitr. sewers, etc. 3-27

MILES CITY, MONT.—Plans being made by City Engineer, J. W. Hall, bids soon for, (1) Paving streets in Dist. 77, $16,900; (2) Paving streets in Dist. 78, $438,000; (3) Paving streets in Dist. 80, $128,000; and paving streets in Dist. 79, $82,000.

BIDS BEING RECEIVED

JUNEAU, ALASKA—Bids to 9 a.m., Apr. 25, by Bureau of Public Roads for: (1) Improving Tongass Highway, Ketchikan Wards Cove Section 1, widening, located adjacent to the Tongass National Forest, about 3.62 miles, involving: Clearing and grubbing; 3000 cu.yd. common excavation; 19,500 cu.yd. solid rock excavation; 8500 cu.yd. borrow; 10,600 cu.yd. crushed rock top; 14 M ft. BM untreated timber; 45 cu.yd. B concrete; 1666 lin.ft. corrugated pipe; 60 ft. timber truss (alternate); 60 ft. steel bridge (alternate). (2) Glacier Highway, Mendenhall Glacier Section, located adjacent to and within the Tongass National Forest, involving: Clearing and grubbing; 69 stations excavation; 1200 cu.yd. gravel; 68 M ft. BM untreated timber trestle; 2 M ft. BM treated timber trestle; 20 cu.yd. C concrete; corrug. pipe. (3) Wrangell Highway, Cemetery-Shoemaker Bay St., 2 miles, involving 11,800 cu.yd. roadway excavation; 3900 cu.yd. gravel surfacing; 13 M ft. BM lumber; corr. pipe, etc. 3-24

PHOENIX, ARIZ.—Bids to 2 p.m., Apr. 18, by Arizona State Highway Comm. for (1) 42½ miles oil processing Yuma-Phoenix Highway west of Yuma-Maricopa County Highway, involving: 450,000 sq.yd. preparation of subgrade; 35,000 cu.yd. mineral aggregated (surf.); 140,000 cu.yd. mi. haul mineral aggregated (surf.); 900,000 gal. oil; 42.5 mi. mix, lay, and finish; (2) 10 miles of Phoenix-Yuma Highway from Piedra west, involving: 105,000 sq.yd. subgrade preparation; 15,000 cu.yd. mineral aggregated (surf.); 23,000 cu.yd. mi. haul mineral aggre. (surf.); 212,000 gal. oil; 10.0 mi. mix, lay, and finish. 3-28

BAKERSFIELD, CALIF.—Bids to 11 a.m., Apr. 14, by County for tennis court at West Side Park, Bakersfield. 3-28

BURBANK, CALIF.—Geo. R. Curtis Paving Co., Los Angeles, $35,357, low bid to City for improving Riverside Drive, asphalt paving and water system. 4-4

CRESCENT CITY, CALIF.—Bids to 11 a.m., Apr. 16, by Public Works Officer, Navy Yard, Mare Island, California, for repairs to the road to the U. S. Naval Radio Compass Station, Point St. George, Crescent City. 3-24

LONG BEACH, CALIF.—Bids to 2 p.m., April 18, by City Clerk, Long Beach, for improvement of Industrial Ave. east of Cherry St., and other streets, involving 1311 lin.ft. curb, 6634 sq.ft. sidewalk, and water mains. 4-4

LOS ANGELES, CALIF.—Bids to 10 a.m., Apr. 23, by Board of Public Works, Los Angeles, for improvement of Oakden Drive and Jewett Drive Impr. Dist., involving: 57,870 cu.yd. cut; 14,745 cu.yd. fill; 170,216 sq.ft. concrete paving, 6 in.; storm drain; sanitary sewer; water system. 3-27

LOS ANGELES, CALIF.—Bids to 2 p.m., April 21, by County for improvement of Carmenita Road, from Section Line Road to Anaheim-Telegraph Road, involving 17,903 cu.yd. excavation, 304,788 sq.ft. 2-in. asphalt-concrete surface, 281,672 sq.ft. 3-in. asphalt-concrete base, and 185,528 sq.ft. 4-in. disintegrated rock shoulder with rock and oil surface; $89,900. 4-2

OAKLAND, CALIF.—Bids to 10:30 a.m., Apr. 15, by County Clerk for grading ¾ miles of Skyline Blvd., alternative bids as follows: PROPOSAL A, 40,000 cu.yd. grading; 720 ft. 12-in. corrugated pipe; 70 ft. 15-in. corrugated pipe; 10,000 sta.yd. overhaul. PROPOSAL B, 52,000 cu.yd. grading; 720 ft. 12-in. corrugated pipe; 400 ft. 15-in. corrugated pipe; 15,000 sta.yd. overhaul. PROPOSAL C, 85,000 cu.yd. grading; 1000 ft. 12-in. corrugated pipe; 400 ft. 15-in. corrugated pipe; 100 ft. 18-in. corrugated pipe; 70,000 sta. yd. overhaul. 3-26

OAKLAND, CALIF.—Bids to 10:30 a.m., April 22, by County Clerk for improving 2 miles of E. 14th St., from San Leandro to Hayward, involving 16,500 cu.yd. excavation, 15,000 cu.yd. borrow, 363,000 sq.ft. 6-in. concrete base with 2-in. asphalt surface, OR 276,000 sq.ft. 6-in. concrete base with 2-in. asphalt surface, OR 198,000 sq.ft. 6-in. concrete base with 2-in. asphalt surface, vitrified sewers, corrugated culverts, and 160,000 lb. reinforcing steel, etc. 4-3

OAKLAND, CALIF.—Bids to 10:30 a.m., April 22, by County Clerk for 2 miles Hayward-Redwood Canyon, near Pinehurst Road, to cost $50,000, involving: PROPOSITION A—92,000 cu.yd. grading, 1700 lin.ft. 12-in. and 600 lin.ft. 18-in. corrugated culverts, 30,000 sta.yd. overhaul. PROPOSITION B (Alternative)—120,000 cu.yd. grading, 2100 lin.ft. 12-in. and 820 lin.ft. 18-in. corrugated culverts, 40,000 sta.yd. overhaul. 4-4

REDWOOD CITY, CALIF.—Bids to 10 a.m., April 14, by County Clerk for improving streets in Menalto Park, involving 36,000 cu.yd. grading, 430,000 sq.ft. 4-in. rock macadam base with 3-in. asphalt surface, vitrified and concrete sewers; 1921 Act. 3-29

SACRAMENTO, CALIF.—Bids to 2 p.m., April 30, by California Division of Highways for: (1) COLUSA COUNTY—12.7 miles grading from Bear Creek to 5 miles west of Williams, involving 48 acres clearing and grubbing, 240,000 cu.yd. roadway excavation, 1440 cu.yd. concrete (structures), 124,000 lb. reinforcing steel, corrugated culverts, etc.; (2) COLUSA COUNTY—8.3 miles grading from Williams to Maxwell, involving 120,000 cu.yd. roadway excavation, 570 cu.yd. 'A' concrete (structures), 63,000 lb. reinforcing steel, corrugated culverts; and (3) SAN DIEGO COUNTY—0.9 mile from San Onofre to San Clemente, involving 26,000 cu.yd. roadway excavation, 2075 cu.yd. concrete paving, 55,000 lb. reinforcing steel. 4-2

SACRAMENTO, CALIF.—Bids to 10 a.m., Apr. 14, by County Clerk for grading Manzanita Ave. 3-22

SAN JOSE, CALIF.—Bids to 11 a.m., April 21, by County for asphalt surfacing: (1) 8000 lin.ft. of Senter Road from Tully to Singleton Road. (2) 1.3 miles of San Jose and Alviso Roads. (3) 1900 lin.ft. of Sunnyvale Ave. from Maude to Lawrence Ave. 4-1

SAN LUIS OBISPO, CALIF.—Bids to 2 p.m., Apr. 15, Division of Highways, District Engineer, Bank of Italy Bdg., San Luis Obispo, for about 6.5 miles of heavy fuel oil to be furnished and applied to the shoulders, in SANTA BARBARA COUNTY, between Elwood Overhead Crossing and Coleta, and between Carpinteria and Rincon Cutoff. 3-20

SAN LUIS OBISPO, CALIF.—Bids to 2 p.m., April 25, by Department of Public Works, Division of Highways, at the office of the District Engineer, L. H. Gibson, District V. Bank of Italy Bdg., San Luis Obispo, for about 15.1 miles in SANTA BARBARA COUNTY, between Buckhorn Creek and second crossing of the Cuyama River, of heavy fuel oil to be furnished and applied as dust layer. 3-31

SANTA ROSA, CALIF.—Bids to 12 m., April 21, by County for: (1) First District, El Verano to State Highway, and Petaluma to Sonoma Highway, involving 1050 tons crushed rock (County furnishes), and 1150 tons screenings (County furnishes 700 tons), 320 tons heavy and 420 bbl. light road oil. (2) Second District, Alton Road (2 miles), involving 300 tons crushed rock, 200 tons screenings, 40 tons heavy and 80 bbl. light oil. (3) Second and Fifth Districts, Graton-Occidental Road (5 miles), Molino Road (1 mile), involving 900 tons crushed rock (County furnishes), 600 tons screenings (County furnishes), 120 tons heavy and 240 bbl. light oil. (4) Fifth District, Bodega Highway (3 miles), involving 450 tons crushed rock (County furnishes), 300 tons screenings (County furnishes), 60 tons heavy and 120 bbl. light oil. (5) Valley Forge Highway (1 mile), involving 400 tons crushed rock, 125 tons screenings, and 38 tons heavy oil. 4-2

STOCKTON, CALIF.—Bids to 11 a.m., Apr. 14, by County Clerk for grading and surfacing J. R. Pearson Road, $9750. 3-25

WILLOW GLEN, CALIF.—Bids to 7:30 p.m., April 21, by City for 80,000 sq.ft. 3-in. asphalt base with 2-in. Durite surface on Willow Glen Way.

BOISE, IDA.—Bids to 2 p.m., April 15, by State for: (1) 5 miles of Grace-Preston Highway, BANNOCK COUNTY, involving 6400 cu.yd. gravel surfacing; (2) Furnishing 7000 cu.yd. crushed rock in stockpiles for Buhl-Castleford Road, TWIN FALLS COUNTY; and (3) 3 miles Grace-Preston Highway from Cleveland to Preston, involving 31,000 cu.yd. roadway excavation, 1000 cu.yd. gravel surfacing.

OLYMPIA, WASH.—Bids to Apr. 15, by Washington State Highway Commission, Olympia, for CLALLAM AND JEFFERSON COUNTIES—Constructing 37 miles of bituminous treated road surface by the plant mix method, from end of pavement west of Agnew to junction with Port Ludlow road, about 6 miles west of Port Townsend, involving: 395,000 sq.yd. surfacing. OLYMPIC HIGHWAY—Oil treating as a dust palliative about 139 miles from end of pavement north of Hoquiam to Lake Quinault, end of pavement north of Shelton to junction with State Road No. 14, Liliwaup to Jackson's Cove, Quilcene River to Discovery Bay, and Port Angeles to Forks, in Grays Harbor, Jefferson, Mason, and Clallam Counties, and 57 miles of State Road No. 14, junction of Olympic Highway to Gig Harbor and junction Gig Harbor branch to Harper, in Mason, Kitsap, and Pierce Counties, involving: 12,320 barrels of oil. 3-22

OLYMPIA, WASH.—Bids to April 29 by State Highway Commission, Olympia, Wash., for the following improvements: SKAGIT and WHATCOM COUNTIES—Paving 2 miles with cement-concrete, waterfront paving gats of Pacific Highway. WHITMAN COUNTY—Grading and draining 1.2 miles, in Thornton vicinity, of Inland Empire Highway. KLICKITAT COUNTY—Clearing, grading, and draining 4.9 miles, Unit No. 1, Goldendale to Summit, North Bank Highway. YAKIMA and KLICKITAT COUNTIES—Surfacing 12.2 miles with crushed stone, Sink Stream north and Sink Stream 1 to Summit, of North Bank Highway. CLALLAM COUNTY—Resurfacing 14.2 miles with crushed stone, East Beach to Fairholm, of Olympic Highway. PACIFIC COUNTY—Clearing, grading, and draining, and surfacing 0.6 mile with crushed stone, Nasel River bridge approaches of Ocean Beach Highway. WAHKIAKUM and COWLITZ COUNTIES—Surfacing with crushed stone 13.9 miles, Cathlamet to Stella, of Ocean Beach Highway. 4-4

OLYMPIA, WASH.—Bids to Apr. 15, by State Highway Commission, Olympia, Washington, for: PIERCE COUNTY—Paving 4.1 miles of Pacific Highway with cement, from Fort Lewis to Nisqually. SNOHOMISH COUNTY—Clearing, grading, draining, and surfacing 2.8 miles of Everett to Pacific Highway Road, surfacing with crushed stone, from Beverly Park to Everett. 3-21

BIDS RECEIVED

PHOENIX, ARIZ.—Yglesias Bros., Spreckels Theatre Bdg., San Diego, $79,349, low bid to State for oil processing from Marinette toward Whitman, and to Hot Springs Junction. (See Unit Bid Summary.) 3-24

EUREKA, CALIF.—Engelhart Paving & Construction Co., Eureka, $8731, low bid to State Division of Highways, District Engineer, Eureka, for ½ mile grading and surfacing at Arcata Crossing, HUMBOLDT COUNTY. 4-2

LOS ANGELES, CALIF.—Low bids as follows by California Division of Highways, District Engineer, Associated Realty Bdg., Los Angeles: LOS ANGELES COUNTY—15 miles fuel oil to be applied to shoulders between Galivan and Irvine in Orange County, and between Leffingwell Ranch and north county line in Los Angeles County; G. M. Duntley, 772 S. San Pedro, Los Angeles, $2724. SAN DIEGO COUNTY—18 miles fuel-oiling of shoulders from Oceanside and north boundary; G. M. Duntley, 772 S. San Pedro, Los Angeles, $3467. VENTURA COUNTY—24 miles fuel-oiling of shoulders from Camarillo to Ventura, and from Ventura to 3 miles north of Seacliff; California Road Oil Service Co., 704 Richfield Bdg., Los Angles, $3998. 4-4

LOS ANGELES, CALIF.—J. L. McClain, 3452 W. Slauson Ave., Los Angeles, $241,736, low bid to City for improving Laurel Canyon Road from Pacoima Ave. to Lookout Mountain Road, grading, concrete paving, sewers, and water system. 4-4

MENLO PARK, CALIF.—Peninsula Paving Co., Standard Oil Bdg., San Francisco, $64,518, low bid to City for improving College Ave. and Cambridge Ave., grading, paving with 4-in. waterbound rock macadam base with 3-in. asphalt surface, concrete sewers, etc. 4-4

VENTURA, CALIF.—Fleming Construction Co., Pomona, $79,139, low bid to County for concrete paving, 4½ miles from Simi to Moorpark, on Los Angeles Ave. 4-3

DENVER, COLO.—J. F. Roberts & Sons, Denver, Colo., $238,207, low bid to State for 10 miles concrete paving south of Colorado Springs, Highway No. 1, EL PASO COUNTY.

PORTLAND, ORE.—Cascade Petroleum Corp., Portland, Ore., $84,531, low bid to State for The Dalles Oiling Project. (See Unit Bid Summary.) 3-31

CONTRACTS AWARDED

BURLINGAME, CALIF.—To W. A. Dontanville, Salinas, $4984 for grading site of Hoover School for Burlingame Elementary School District. 3-25

INGLEWOOD, CALIF.—To Geo. H. Oswald, 366 E. 58th St., Los Angeles, $71,393 to City for improvement of Market St., between Kelso St. and Arbor Vitae St., by grading, concrete paving, sidewalk, King Ferronite lighting posts, etc. 3-20

KING CITY, CALIF.—To A. J. Raisch, 46 Kearny St., San Francisco, $91,351 for concrete paving of streets for City. 3-28

MARTINEZ, CALIF.—To L. W. Hesse, 1007 18th St., Merced, $2950 for grading for Martinez Junior High School. 3-31

MONTEREY, CALIF.—To Clark & Henery Construction Co., Chancery Bdg., San Francisco, $25,014 for asphalt paving of Camino Bienvenida, etc., in Mesa Tract for City. 4-3

PACIFIC GROVE, CALIF.—Awards as follows by City for asphalt paving streets: (1) To Clark & Henery Const. Co., Chancery Bdg., San Francisco, $17,047 for improving Gibson Ave., and (2) To Clark & Henery Const. Co., $16,910 for improving Fountain Ave. 3-25

SACRAMENTO, CALIF.—To Basich Bros. Construction Co., 3788 S. Vermont St., Los Angeles, who bid $146,319 to California Division of Highways, Sacramento, for 5.2 miles of concrete paving from Logandale to Willows, GLENN COUNTY. (See Unit Bid Summary.) 3-31

SACRAMENTO, CALIF.—To H. W. Rohl Co., Roosevelt Bdg., Los Angeles, at $100,372 to California Division of Highways, Sacramento, for 1.9 miles grading in SAN BERNARDINO COUNTY, between The Pass and two miles down Waterman Canyon. (See Unit Bid Summary, March 25th issue.) 3-26

SALINAS, CALIF.—Awards as follows by County: (1) To J. L. Conner, Box 86, Monterey, $65,021 for concrete paving of Salinas-Monterey Road from Salinas to Hilltown; and (2) To J. L. Conner, Monterey, $1987 for improving by grading and surfacing of San Miguel Canyon Road. 3-28

SAN DIEGO, CALIF.—To V. R. Dennis Const. Co., Box 183, Stat. A, San Diego, $17,579 for paving Palmero St., asphalt paving, concrete sewers, cast iron mains for City. 3-26

SAN FRANCISCO, CALIF.—To Basalt Rock Co., Napa, who bid $2.016, total bid of $5842, for light fuel-oiling of 23 miles from Middletown to Old Williams Road in LAKE COUNTY, involving 2898 bbl. fuel oil. Work for California Division of Highways, District Office, San Francisco. 3-31

SAN RAFAEL, CALIF.—To P. S. Harless, P.O. Box 594, San Rafael, $37,961 for improving A St., Second St., etc., vitrified sewers, asphalt paving, corrugated pipe, etc. 4-4

SANTA ROSA, CALIF.—Awards as follows by County for oiling: (1) Contract awarded to Highway Builders, Ltd. (E. A. Forde), 640 Redhill Ave., San Anselmo, who bid $19,668 for roads in Fourth District (18½ miles). (2) Contract awarded to Geo. French, Jr., Box 675, Stockton, who bid $6974 for roads in Second District (6½ miles). 3-31

VALLEJO, CALIF.—To John W. Huggard, 17 Brooklyn Ave., San Jose, who bid $1857 for paving Lozier Alley with concrete, between Sonoma and Sutter Sts., Vallejo. for City. 3-26

VENTURA, CALIF.—To Will F. Peck Co., 1120 N. Las Palmas, Los Angeles, $57,759 to Ventura County, for improvement of Grimes Canyon Road between Fillmore and Moorpark, 3.2 miles, by excavation, concrete paving, corr. iron pipe, etc. 3-20

WHITTIER, CALIF.—To Griffith Co., L. A. Railway Bdg., L. A., $15,184 for improving Walnut St., concrete paving, sewer and water system for City. 3-25

BOISE, IDAHO—Awards as follows by State: (1) To Robinson Const. Co., Twin Falls, Ida., $11,136 for gravel surfacing 9.5 miles from Montpelier to Paris, BEAR LAKE COUNTY; and (2) To Triangle Const. Co., Spokane, Wash., $10,500 for crushing gravel for North and South Highway, WASHINGTON COUNTY.

CARSON CITY, NEV.—To Martin Bros. Trucking Co., 1389 Gladys St., Long Beach, who bid $85,613 to State Department of Highways, for grading and surfacing 20 miles in CLARK COUNTY, from Crystal to West Slope of Mormon Mesa. (See Unit Bid Summary.) 3-28

PORTLAND, ORE.—Awards as follows by State: CLACKAMAS COUNTY—To. W. H. Hauser, 3129 E. Seventh St., Oakland, who bid $55,135 for grading 0.93 mile of the Multnomah County Line-Oswego Section of the Pacific Highway. Work involving approximately 62,500 cu.yd. excavation. CLATSOP COUNTY—To Arthur Gentemann, who bid $17,325 for furnishing broken stone for maintenance and betterment purposes for Canyon Beach Junction-Nehalem Summit Section of the Oregon Coast Highway. Work involving 12,000 cu.yd. broken stone. DOUGLAS COUNTY—To A. C. Greenwood, 500 N. Front St., Portland, who bid $186,185 for grading 5.17 miles of the Tahkenitch-Gardiner Summit Section of Roosevelt Coast Highway. Work involving approximately 310,000 cu.yd. excavation. DOUGLAS COUNTY—To Harmon & Tittle, who bid $94,860 for grading 4.45 miles of Scottsburg-Burchard Creek Section of Umpqua Highway. Work involving approximately 141,500 cu.yd. excavation. GRANT COUNTY—To Hart Construction Co., Union, Ore., who bid $70,245 for surfacing 24.5 miles of Mountain Rest-Little Beech Creek Section of Pendleton-John Day Highway, Long Creek-Hamilton Section of Market Road No. 1, and Mt. Vernon-Biggs Ranch Section of Market Road No. 2. Work involving approximately 40,000 cu.yd. broken stone and 8000 cu.yd. bank-run talus. LANE COUNTY—To J. W. & J. R. Hillstrom, Marshfield, Ore., who bid $72,380 for resurfacing 21 miles of Nimrod-Belknap Springs Section of Mackenzie Highway. and furnishing materials for maintenance purposes, involving 40,000 cu.yd. broken and crushed gravel. MALHEUR COUNTY—To J. A. Terteling & Sons, Moscow, Ida., who bid $145,792 for grading 13.31 miles of Tunnel-Harper Section of Central Oregon Highway. Work involving 235,000 cu.yd. excavation. (See Unit Bid Summary.) 3-29

SALT LAKE CITY, UTAH—Awards as follows byState Road Comm. (1) to Utah Const. Co., Ogden, Utah, $116,810 for 8 miles grading and surfacing from Morgan to Henefer Flat, MORGAN AND SUMMIT COUNTIES; and (2) To Wheelwright Const. Co., Ogden, Utah, $24,369 for 13 miles surfacing from Ash Creek Bridge to Toquerville, WASHINGTON COUNTY.

OLYMPIA, WASH.—To J. L. Smith Construction Co., 212½ Madison St., Seattle, who bid $121,089 to State Highway Department, for paving with cement concrete 6.4 miles between Ludlow and Port Townsend, in JEFFERSON COUNTY, on Olympia highway, Washington. 3-28

OLYMPIA, WASH.—Awards as follows by State: (1) To A. L. Aukamp, Yakima, $56,870 for 4.3 miles surfacing with stone from Lowden to Tocuet, WALLA WALLA COUNTY; and (2) To Triangle Const. Co., Spokane, Wash., $67,743 for 8.5 miles surfacing with stone from Diamond Lake south, PEND OREILLE COUNTY.

OLYMPIA, WASH.—Awards as follows by Washington State Highway Commission: KLICKITAT COUNTY—To Campbell Construction Co., Renton, who bid $78,569 for 3 miles grading and draining of North Bank Highway, Unit 2, from Maryhill west, involving 186,470 cu.yd. excavation and 1450 lin.ft. pipe culverts, etc. DOUGLAS COUNTY—To George A. Banderet, Bryn Mawr, Wash., who bid $50,997 for 3.5 miles clearing, grading, and draining Chelan-Okanogan Highway, from Orondo north, involving $85,330 cu.yd. excavation, 108 ft. tunnel, 86 cu.yd. concrete, and 550 lin.ft. pipe culverts, etc. DOUGLAS COUNTY—To Hargrave Construction Co., Spokane, who bid $63,944 for 40 miles bituminous-treated road surface, by penetration method, of Sunset Highway from Waterville to Douglas-Grant County Line, involving 231,000 sq.yd. surfacing. 4-4

OLYMPIA, WASH.—Awards as follows by State Highway Commission, Olympia, Washington: KING COUNTY—To S. A. Moceri, Thompson Bdg., Seattle, who bid $169,300 for 8.1 miles paving of Pacific Highway, from Kent-Des Moines road to Seattle. CHELAN COUNTY—To Standard Asphalt Paving Co., 522 No. Cedar St., Spokane, who bid $46,197 for construction of about 36 miles of bituminous treated road surface by the road mix method on State Road No. 10, Chelan-Okanogan Highway, from Chelan to Chelan-Okanogan county line, and Pateros to Malott in OKANOGAN COUNTY, involving about: 385,000 sq.yd. road surfacing. BENTON COUNTY—To Standard Asphalt Paving Co., 522 No. Cedar St., Spokane, who bid $59,815 for constructing about 26.9 miles of bituminous treated road surface by the plant mix method on State Road No. 3, Inland Empire Highway, from end of pavement 6 miles west of Kennewick to Prosser, involving approximately: 286,000 sq.yd. surfacing. 3-21

SEATTLE, WASH.—Awards as follows by County: (1) To Goetz & Brennan, Seattle, $143,208 for concrete paving Fifth Ave. northeast from 85th St. to University cutoff; Meridian Ave. from 85th St. to Haller Lake Circle; Haller Lake Circle and 10th Ave. northeast and University Cutoff; (2) To Eastside Const. Co., Seattle, $15,731 for grading 2 miles of Lincoln Ave. extension; (3) To C. L. Creelman $13,000 for concrete paving ½ mile of Kirland-Redmond; (4) To Anderson & Liljebeck, Seattle, $25,000 for 1 mile concrete paving Enumclaw-Black Diamond Road; (5) To C. L. Creelman, Seattle, $25,361 for 1 mile concrete paving Auburn-Black Diamond Road; (6) To Erickson Paving Co., Seattle, $15,288 for concrete paving Kent-Meredith Road.

WENATCHEE, WASH.—To Standard Asphalt Paving Co., Spokane, Wash., $18,832 for oiling surfacing 8 miles from Chelan to Manson for County.

BRIDGES and CULVERTS

WORK CONTEMPLATED

VALLEJO, CALIF.—Plans being made by T. D. Kilkenny, City Engineer, for Sacramento St. Bridge to be built over Northern Electric Railroad cut north of town; $13,000. 4-1

BIDS BEING RECEIVED

SACRAMENTO, CALIF.—Bids to 2 p.m., Apr. 23, by California Division of Highways for (1) SAN BERNARDINO COUNTY—Steel Bridge over Mojave River, 3 miles north of Victorville, involving 5900 cu.yd. roadway excavation, 2100 cu.yd. concrete, 260,000 lb. reinf. steel, 750,000 lb. structural steel, 19,200 lb. cast-iron and 69,000 lb. structural steel (railings); and (2) MODOC COUNTY—2 timber bridges, involving 3000 ft. creosoted douglas fir, 60 M ft. BM douglas fir, 87 cu.yd. concrete, etc. 3-26

SACRAMENTO, CALIF.—Bids to 2 p.m., April 30, by California Division of Highways, Sacramento, for a timber bridge over Alder Creek, 29 miles north of San Simeon, MONTEREY COUNTY, involving 600 cu.yd. structure excavation, 140 cu.yd. 'B' concrete, 127 MBM redwood (dense select all-heart structural), 48 MBM redwood timber (select all-heart structural), 68 tons broken stone, and 6 tons asphalt road oil. 4-2

STOCKTON, CALIF.—Bids to 11 a.m., April 21, by County for bridge on Van Allen Road over Little John Creek. 3-28

BIDS RECEIVED

LOS ANGELES, CALIF.—Fisher, Ross, MacDonald & Kahn, Inc., Box 628, Azusa, $1,246,636, low bid to Board of Public Works for 2400 ft. reinforced concrete viaduct over Los Angeles River on Fourth St. 4-2

CONTRACTS AWARDED

NAPA, CALIF.—To John H. May, Napa, $4667 for widening Jefferson St. bridge for City. 3-25

SACRAMENTO, CALIF.—To Rocca & Caletti, P. O. Box 243, San Rafael, who bid $16,170 to California Division of Highways, Sacramento, for construction of a timber, steel, and concrete overhead crossing over the tracks of the Northwestern Pacific Co. Railroad at Forbes Station, MARIN COUNTY. 3-27

SALINAS, CALIF.—To M. B. McGowan, Call Bdg., San Francisco, who bid $26,674 to Monterey County for construction of three reinforced concrete bridges—one at Castroville, and two on the Salinas-Watsonville Road between Castroville and Salinas in Supervisor District No. 1. 3-28

SAN RAFAEL, CALIF.—To M. B. McGowan, 74 New Montgomery St., San Francisco, $1619 for timber bridge for City. 3-21

PORTLAND, ORE.—To Clackamas Construction Co., 473 Ainsworth Ave., Portland, $49,690 for reinforced concrete bridge over Klamath River on Green Springs Highway at Keno, KLAMATH COUNTY, for State. 3-29

SEWER CONSTRUCTION

WORK CONTEMPLATED

FAIRFIELD, CALIF.—Plans by Engr., George Wiles, Fairfield, Solano County, and protests will be heard Apr. 14 by Solano County for sewer district covering 300 acres of land to the north and south of Vallejo and along the Benicia Road. Work will involve: One pumping plant, consisting of two 4-in. pumps and motors; 3000 lin.ft. 12-in. cast-iron pipe force main; 72,000 ft. vitrified pipe system from 6-in. to 36-in. diameter. 1925 Act, $160,000. 3-25

SAN MATEO, CALIF.—Plans by E. P. Wilsey, City Engineer, for sewer system in southern portions of City, involving 3130 ft. 21-in., 2800 ft. 18-in., 2610 ft. 15-in., 1360 ft. 12-in., 2200 ft. 10-in., 13,470 ft. 8-in., and 12,600 ft. 6-in. vitrified sewers; 5700 ft. 6-in. and 3530 ft. 4-in. vitrified laterals; 122 manholes, 2 sumps, 1 pumping unit (complete), and 1 pumping unit (remove from present location). Protests April 21; 1911-15 Acts. 4-4

KLAMATH FALLS, ORE.—Plans by City Engineer, C. C. Kelley, protests April 21, with reference to the construction of sewers in North Klamath Falls, portions of Buena Vista, Lakeview, and Fairview Additions No. 2, etc., known as 14th Sewer Unit. Estimated cost as follows: $92,059 for vitrified pipe and $92,059 for concrete pipe. 4-1

PORTLAND, ORE.—Plans by City Engineer, O. Laurgaard, for West Lander St. trunk sewer, to cost $305,000.

BIDS BEING RECEIVED

MODESTO, CALIF.—Bids to 7:30 p.m., April 21, by City Clerk for furnishing: (1) One sewage clarifier and mechanical skimmer to serve surface area of not less than 2950 sq.ft., solution depth at edges of 7 ft., capacity required 20,650 cu.ft., bottom slope not less than 1 to 12. (2) One sludge digestor 30 ft. diam., 18 ft. deep; and gas selection dome. (3) One sewage sludge pump, 80 g.p.m.; pressure 20 lb. per square inch. 4-1

BIDS RECEIVED

GALT, CALIF.—Harry Gould, 1022 27th St., Sacramento, $36,014, low bid to Galt Sanitary District for vitrified sewers and sewage disposal plant. 4-2

CONTRACTS AWARDED

CARLSBAD, CALIF.—To H. A. Teget, 224 Harvard Place, Ontario, who bid $10,908 to Carlsbad Sanitary District, Carlsbad, San Diego County, for constructing vitrified sewers in Ocean St., Laguna Drive, Mountain View Drive, etc. 3-25

FRESNO, CALIF.—To Fresno Builders Supply Co., Fresno, who bid $1018 for constructing vitrified pipe sewer on Roading Heights. Work for City of Fresno. 4-4

LOS ANGELES, CALIF.—To M. Simunovich, 3305 W. 66th St., Los Angeles, who bid $54,458 for constructing vitrified sewers in Motor Ave., between Forrester Drive and Manning Ave., for City. 4-2

LOS ANGELES, CALIF.—To Bebek & Brkich, 5011 E. Slauson Ave., Maywood, who bid $89,700 for vitrified sewers in Eastmont Ave., Flint St., etc., for Los Angeles County, about 9.16 miles, involves: 8-in., 10-in., and 12-in. vitrified sewer. 3-20

OCEANSIDE, CALIF.—To J. C. Duncan, American Bank Bdg., L. A., $12,898 for improving the Strand, involving 6-in. cast-iron pipe, pumping plants, etc., for City. 3-22

SPARKS, NEV.—To H. A. Teget, 224 Harvard Place, Ontario, $69,933 for vitr. outfall and treatment plant for City. (See Unit Bid Summary.) 3-25

WATER SUPPLY SYSTEMS

WORK CONTEMPLATED

MONTECITO, CALIF.—Bonds voted by Montecito County Water Dist. $200,000 for purchase of water rights and constructing Reser. No. 3 to cost $25,000; C. A. Wyant, 29 San Ysidro Road, Santa Barbara is Engr. 3-27

SAN BRUNO, CALIF.—Bids rejected for improvement of Sneath Lane, involving 27 ft. 8-in. and 3380 ft. 6-in. cast-iron pipe and 3 6-in. gate valves, rejected, low bid from E. W. Redman, Patterson Bdg., Fresno, $3664. Work will be readvertised. 3-28

WHITTIER, CALIF.—Bond election Apr. 14, by City to vote $310,000 for: Wells, including motors, pumping plants, and buildings, etc., $45,000; 36-in. pipe-line from the wells to settling basin, $21,600; settling basins, $23,800; 30-in. pipe-line from the settling basin to the reservoir, including meter, $57,790; 10,000-gallon reservoir, $75,095; 10-in. pipe-line from the reservoir to Rideout Heights to Rideout Heights Reservoir, $2130; Rideout Heights Reservoir, $8500; 24-in. pipe-line connecting the 10,000,000 gallon reservoir and the Greenleaf Reservoir, $22,500; 16-in. pipe-line from the Greenleaf Reservoir to the Painter Reservoir, $4500; two booster plants, including pumps and motors, etc., to connect the reservoir, $5000; booster plant, including pump and motors to connect the Greenleaf and Painter Reservoirs, $3000; booster pumping plant, including pumps and motors in College Hills, $3000; Corliss engine and signals, $10,000; repairs to the Greenleaf Reservoir, $5000; 4-in. water mains, $8500; 6-in. water mains, $4500; 8-in. water mains, $6500. M. R. Bowen is the City Engineer. 3-25

KENT, WASH.—Plans by Miller Engineering Co., Burke Bdg., Seattle, and bids will be called for soon by the City of Kent, Wash., for water system improvements, as follows: Improvements to the headworks near Lake Sawyer, and installation of 10 miles of pipe-line from headworks to reservoirs within the town of Kent, involving about 24,000 ft. 18-in., 16,000 ft. 16-in., and 12,000 ft. 14-in. pipe. Bonds voted, $125,000, by City. 3-25

OLYMPIA, WASH.—Plans by City Engr., Chas. H. Williams, City Hall, Olympia, and Cons. Engr., W. A. Kunigk, City Hall, Tacoma, for water system improvements as follows for City of Olympia: One 4,000,000 gallon reservoir; one 500,000 gallon elevated tank and booster pumps; one 250,000 gallon elevated tank and booster pumps; several miles of 6-in. to 16-in. cast-iron mains. Cost $250,000. Bond election soon. 3-25

BIDS BEING RECEIVED

LOS ANGELES, CALIF.—Bids to 2 p.m., Apr. 14, by County for water system improvements in the County Water Works District 10 (Springdale Addition), as follows: Specif. No. 162, iron body water valves, involving: 18 4-in., 10 6-in., 6 8-in., 18 4-in. gate valves, flanged. Specif. No. 163, brass service cocks, etc., involving: 285 ¾-in. brass curb cocks, 125 1-in. copper goose necks, 35 ¾-in. copper goose necks, James Jones Brass Co. or equal. Specif. No. 160, cast-iron pipe, involving: 1896 ft. 8-in., 4980 ft. 6-in., 7860 ft. 4-in. Specif. No. 161, wrought steel pipe, involving: 80 ft. 4-in., 4700 ft. 1¼-in., 320 ft. ¾-in. 3-27

LOS ANGELES, CALIF.—Bids to 2 p.m., April 21, by County for reinforced concrete reservoir at Big Pines to cost $5400. 4-3

SAN BRUNO, CALIF.—Bids to 8 p.m., Apr. 23, by City Clerk, for water extension in Belle-Air Park, involving: 2889 lin.ft. 6-in. cast-iron pipe, 3038 lin.ft. 4-in. cast-iron pipe, 11 hydrants. This is a cash job. 3-28

SOUTHGATE, CALIF.—Bids to 8 p.m., April 15, by City for: (1) Furnishing and installing a deep-well turbine pump, electric motor, etc., in 12-in. well at Ardmore Ave. and Otis St. (2) Furnishing and installing a deep-well turbine pump, electric motor, etc., in 12-in. well on Kauffman Ave. 4-4

BIDS RECEIVED

WOODSIDE, CALIF.—Thermotite Const. Co., 580 Stockton Ave., San Jose, $16,653 low bid to University of California, Berkeley, for 1,000,000 gallon reinf. concrete reservoir for Bear Gulch Water Co. near Woodside. 3-28

CONTRACTS AWARDED

EUREKA, CALIF.—To Fairbanks-Morse Co., Spear and Harrison Sts., San Francisco, who bid $969 to John Griffith, Superintendent of Public Works, 524 D St., Eureka., for furnishing one deep-well turbine pump, 350 g.p.m. capacity against a head of 85 ft., with a motor to be 440-volt 3-phase 60-cycle, A. C., and at a speed not to exceed 1800 r.p.m. 4-3

LA VERNE, CALIF.—To Fairbanks-Morse Co., Los Angeles, at $1770 for installing new pump and constructing addition to Booster Pump Station for City. 3-20

SAN DIEGO, CALIF.—To Gist & Bell, 185 East El Dorado St., Arcadia, who bid $61,489 to City of San Diego for Morena Dam spillway enlargement. (See Unit Bid Summary.) 3-26

SOUTHGATE, CALIF.—To Chicago Bridge & Iron Works, Rialto Bdg., San Francisco, who bid $12,850 to City of Southgate for furnishing and erecting a steel tower and tank, with a capacity of 150,000 gal. 4-3

WATSONVILLE, CALIF.—To Grant L. Miner, Bank of Palo Alto Bdg., Palo Alto, who bid $100,481 for the construction of water system improvements for City, consisting of constructing filter plant and reservoir. Award of contract was based on the elimination of the grading and concrete lining of reservoir (to be done by the City), and elimination of electric generator, Pelton Water Wheel, and redwood covering of filter and sedimentation basin. 3-26

CHEHALIS, WASH.—To American Cast Iron Pipe Co., $5423 for cast-iron pipe for City. 3-27

EVERETT, WASH.—To Robt. E. Moore, 910 31st. Ave., Seattle, who bid $340 per acre, total bid of $71,400, for completion of the clearing of Lake Chaplain, involving 210 acres of clearing in connection with the Sultan River Water Project for the City of Everett, Wash. 3-29

TACOMA, WASH.—To Birchfield Boiler Co., Tacoma, who bid $8396 for furnishing steel pipe to Board of Contracts and Awards, Tacoma. 3-24

IRRIGATION and RECLAMATION

BIDS RECEIVED

NEWELL, S. D.—Kremer & Hog, Minneapolis, Minn., $173,057 low for 67 miles open drains and structures on Belle Fourche Project, for Bureau of Reclamation. (See Unit Bid Summary.) 3-24

CONTRACTS AWARDED

DOS PALOS, CALIF.—Awards as follows by Dos Palos Drainage District for pumps and motors for seven wells for the District: (1) To Byron Jackson Pump Mfg. Co., Berkeley, as follows: $1011 for Well No. 2, $1054 for Well No. 6, $1011 for Well No. 7; (2) To Fairbanks, Morse & Co., San Francisco, as follows: $831 for Well No. 4, $831 for Well No. 5; (3) To Pelton Water Wheel Co., San Francisco, as follows: $849 for Well No. 3; and (4) To Sterling Pump Works, Stockton, as follows: $975 for Well No. 8.

TRACY, CALIF.—To Pereira & Reed, Tracy, $4117 for canal excavation, timber and concrete structures for Banta-Carbona Irrigation District. 3-21

NYSSA, ORE.—Awards as follows by Bureau of Reclamation, care Owyhee Irrigation District, Nyssa, Oregon, for the construction of concrete lined tunnels on the Owyhee Project, in Oregon and Idaho:

SCHEDULE No. 5—Contract awarded to T. E. Connolly, 461 Market St., San Francisco, who bid $982,116 for upper portion of Tunnel No. 1 (16 ft. 7 in. diameter). SCHEDULES No. 6 and 7 COMBINE—Contract awarded to J. F. Shea Co., Henry Bdg., Portland, Oregon, at $1,025,208 for work under Schedule No. 6, consisting of lower portion of Tunnel No. 1 (16 ft. 7 in. diameter), and work under Schedule No. 7, consisting of work on upper portion of Tunnel No. 5 (9 ft. 3 in. diameter). SCHEDULE No. 8—Contract awarded to S. S. Magoffin & Co., North Vancouver, B. C., who bid $530,684 for lower portion of Tunnel No. 5 (9 ft. 3 in. diameter). (See Unit Bid Summary, Mar. 25th issue.) 3-28

SURETY BOND AND CASUALTY INSURANCE DIRECTORY

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RAILROAD CONSTRUCTION

CONTRACTS AWARDED

CANBY, ORE.—To W. H. Hauser, 3129 E. Seventh St., Oakland, for the construction of embankment for line change from New Era, Oregon, to Canby, Clackamas County, Oregon, work for the Southern Pacific Company, San Francisco. Work involves 55,000 cu.yd. earthwork. 3-21

TUNNEL CONSTRUCTION

BIDS BEING RECEIVED

SACRAMENTO, CALIF.—Bids to 11 a.m., April 14, by U. S. Engineer's Office, California Fruit Bdg., Sacramento, for the construction of the inspection tunnels at the site of the proposed Kennett Dam, and also the necessary timbering of same near the town of Kennett, Shasta County, California. Work involves: (1) Construction and timbering of Tunnel No. 1, 400 ft. long (if awarded alone). (2) Construction and timbering of Tunnel No. 2, 400 ft. long (if awarded alone). (3) Construction and timbering of Tunnel No. 3, 400 ft. long (if awarded alone). (4) Construction and timbering of Tunnels No. 1 and 2, each 400 ft. long (if awarded together). (5) Construction and timbering of Tunnels No. 1 and 3, each 400 ft. long (if awarded together). (6) Construction and timbering of Tunnels No. 2 and 3, each 400 ft. long (if awarded together). (7) Construction and timbering of all three tunnels, No. 1, 2, and 3, each 400 ft. long (if awarded together). 4-4

BIDS RECEIVED

LOS ANGELES, CALIF.—H. W. Rohl Co., Roosevelt Bdg., Los Angeles, $652,788, low bid to City for three tunnels on Figueroa St. Extension through Elysian Park. (See Unit Bid Summary.) 3-21

RIVER AND HARBOR WORK

WORK CONTEMPLATED

SEATTLE, WASH.—Plans by City Engr., W. D. Barkhuff, City-County Bdg., Seattle, Wash., for improvement of Railroad Ave. from Madison St. to Bay St. by the construction of a seawall and filling, etc. Work involves: 20,000 cu.yd. precast reinforced concrete; 2550 cu.yd. reinforced concrete in place; 2556 tons reinforcing steel in precast concrete; 398 tons reinforcing steel in reinforced concrete; 948 tons steel tie rods, nuts; 330,000 cu.yd. earthwork fill; $900,000. The seawall is to be 6040 ft. long, varying from 25 ft. to 50 ft. in height. 3-24

BIDS BEING RECEIVED

FORT MASON, CALIF.—Bids to April 21, at the office of the Quartermaster Supply Officer, Fort Mason, Calif., for construction and completion of the hull, superstructure, fittings, and appurtenances of one all-welded steel hoist boat to be known as the H-1. It is required that bids be submitted for the construction, installation of all units, and completion of the hull superstructure, fittings, and appurtenances, except furnishing the propelling plant with its auxiliaries, the electrical plant and the turntable crane, and all other items to be furnished by the Government, as set forth in the specifications. 3-31

RICHMOND, CALIF.—Bids to 12 m., April 16 (by invitation only) by Engineer E. A. Hoffman, City Hall, Richmond, Contra Costa County, for improvement of Ellis Slough in the Richmond Inner Harbor. Work involves the following approximate quantities: 539,779 cu.yd. dredging in mud, 977,330 cu.yd. dredging in clay, 9675 lin.ft. dry levee, 4315 lin.ft. wet levee, and 1080 ft. core levee. This is a private project. The owners are: Santa Fe Land Co., Richmond; San Francisco Bridge Co., San Francisco; Duncanson & Harrelson, San Francisco; Richmond Navigation & Improvement Co., Richmond; Richmond Investment Co., Richmond; Enterprise Foundry Co., San Francisco; and A. Banzoff. 3-29

PEARL HARBOR, T.H.—Bids to 11 a.m., Apr. 23, by District Public Works Office, Pearl Harbor, T.H., for dredging at Naval Ammunition Depot, Pearl Harbor. 3-26

CONTRACTS AWARDED

STOCKTON, CALIF.—Awards as follows by County: (1) To Bundesen and Lauritzen, Pittsburg, $3399 for ferryboat at Middle River; and (2) To M. A. Jenkins, 36th and Y Sts., Sacramento, for timber ferry landings and approach trestle on Bacon Island at Middle River. 4-1

PEARL HARBOR, T. H.—To Hawaiian Dredging Co., Honolulu, who bid $396,038 to Bureau of Yards and Docks, Navy Department, Washington, D. C., for reinf. concrete pier, quay, and bulkhead, including piping and electrical work at the Naval Operating Base (Naval Station and Submarine Base), Pearl Harbor, T. H. 3-22

MACHINERY and SUPPLIES

BIDS BEING RECEIVED

FORT MASON, CALIF.—Bids to April 21 at office of the Quartermaster Supply Officer, Fort Mason, for furnishing the following: (1) One lightweight, high-speed, direct acting, 2 or 4-cycle, solid or air injection marine diesel engine, its accessories and fittings, of 6 or 8 cylinders, not less than 225 shaft hp. at normal propelling revolutions, and shall deliver required horsepower on standard commercial grade gasoline for air corps retriever known as H-1. (2) One diesel engine generator set, to be of the D.C. 115-volt 4-pole, compound-wound type, with capacity of 15 kw. Engine to be of the vertical 2 or 3-cylinder, 4-cycle, water-cooled type. Also electrical fixtures, switchboard, wiring system, running lights, shore leads, electrical supplies on board, wiring plans, diesel electric auxiliaries, and sanitary and fire pump. Oil transfer pump and fresh-water pump for H-1. (3) One turntable crane, including turntable, fittings, and spares, for H-1. 3-31

SACRAMENTO, CALIF.—Bids to 11 a.m., Apr. 15, by U.S. Engineer Office, California Fruit Bdg., Sacramento, for one gasoline operated combination clamshell and dragline excavator crane. Spec. No. 1811, Order No. 30-320 obtainable from the above. 3-27

SAN FRANCISCO, CALIF.—Bids to 3 p.m., April 15, by U. S. Engineer's Office, 401 Custom House, San Francisco, for furnishing two 14-in. hydraulic gate valves for the U. S. Dredge 'San Pablo'. 4-3

CONTRACTS AWARDED

LYNWOOD, CALIF.—To Rensselaer Valve Co., L. A., $465 for furnishing 11 hydrants to City. 3-21

OAKLAND, CALIF.—Awards as follows by East Bay Municipal Utility District: (1) To Allis-Chalmers Mfg. Co., $5925 for 9 transformers; (2) To Spears-Wells Machinery Co., Oakland, $1185 for electric stable arc welder; and (3) To The Rix Company, S. F., $3500 for one air compressor. 3-27

PASADENA, CALIF.—Awards as follows by City: To C. G. Claussen Co., who bid $40,742 for 7680 ft. 24-in. 'C' cast-iron water pipe. To U. S. Cast Iron Pipe & Foundry Co., who bid $12,000 for 20,000 ft. 6-in. 'B' cast-iron water pipe. To U. S. Cast Iron Pipe & Foundry Co., who bid $15,700 for 10,000 ft. 12-in. 'B' cast-iron water pipe. To Reliable Iron Foundry, who bid $2805 for 33 tons of Class 'D' fittings. 4-3

BUILDING CONSTRUCTION

WORK CONTEMPLATED

PASADENA, CALIF.—Plans by City Bdg. Dept., City Hall, Pasadena, for completion concrete of the Rose Bowl, Pasadena. Cost of completion and increasing the Bowl's seating capacity to 100,000, is $200,000. 3-22

POINT LOMA, CALIF.—Plans by Wm. H. Kraemer, Architect, 3923 W. Sixth St., L. A., for 9-story reinf. conc. and steel frame hotel at Point Loma, San Diego, for Leon Reich, 434 N. Coronado St., Los Angeles. Contract awarded to Hart Bros. Const. Co., 3921 W. 6th St.. L. A. Cost, $1,500,000. 3-25

BIDS BEING RECEIVED

BURLINGAME, CALIF.—Bids to 7:30 p.m., Apr. 14, by Burlingame Elementary School Dist. for 2-story 'C' reinf. concrete and stucco Herbert Hoover School. $65,000. W. H. Weeks, S. F., is Architect. 3-22

EUREKA, CALIF.—Bids to 2 p.m., Apr. 15, by County for (1) American Legion Memorial Bdg. at Arcata to cost $30,000; and (2) American Legion Memorial Building at Fortuna to cost $30,000. 3-25

MARTINEZ, CALIF.—Bids to 7 p.m., April 24, by Alhambra Union High School District for a two-story reinforced concrete and stucco school, the Martinez Junior High School. $240,000. W. H. Weeks, Hunter-Dulin Bdg., S. F., is Architect. 3-22

SAN CARLOS, CALIF.—Bids to 8 p.m., Apr. 15, by San Carlos Elementary School Dist. for reinf. concrete school building on Elm St. $50,000. E. L. Norberg, Burlingame and S. F., is Architect. 3-24

SAN JOSE, CALIF.—Bids to 11 a.m., April 21, by County for concrete library building at County Almshouse; $10,000. 4-3

CONTRACTS AWARDED

AUBURN, CALIF.—To Salih Bros., Quinby Bdg., Los Angeles, for reinforced concrete theatre at Auburn for Auburn Amusement Co., to cost $60,000. R. Falkenrath, Los Angeles, is Architect. 3-29

CHICO, CALIF.—Awards as follows by State Architect, Sacramento, for construction of the assembly building at Chico State Teachers' College, Chico, Butte County. The building is to be a 2-story steel and concrete frame structure, with balcony, brick and concrete walls, concrete floors, and tile and composition roofing. GENERAL CONSTRUCTION awarded to Campbell Construction Co., 800 R St., Sacramento, who bid $133,616. PLUMBING, HEATING, and VENTILATING awarded to Frederick W. Snook Co., 596 Clay St., San Francisco, who bid $18,523. ELECTRICAL WORK awarded to Alta Electric Co., 938 Howard St., San Francisco, who bid $13,994. 4-3

OAKLAND, CALIF.—To S. S. Herrick, 18th and Campbell Sts., Oakland, $19,772 to the Oakland Port Commission for structural steel frame for the Ninth Ave. Pier Shed, involving: 250 tons structural steel. 3-25

OPPORTUNITY PAGE

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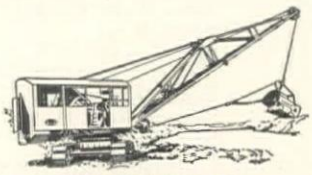

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Pacific Pipe Co.
Pacific States Cast Iron Pipe Co.
U. S. Cast Iron Pipe & Fdy. Co.
Weissbaum & Co., G.

Pipe—Flanged
National Cast Iron Pipe Co.

Pipe Line Machinery
Bacon Co., Edward R.
Harnischfeger Sales Corp.
Harron, Rickard & McCone Co.
Jenison Machinery Co.
W-K-M Company, Inc.

Pipe, Lock-Bar
Western Pipe & Steel Co.

Pipe, Preservative
Columbia Wood & Metal Preservative Co.

Pipe, Pressure Line
Lacy Manufacturing Co.
Lock Joint Pipe Co.
Western Pipe & Steel Company

Pipe, Riveted Steel
Lacy Mfg. Co.
Montague Pipe & Steel Co.
Pittsburgh-Des Moines Steel Co.
Western Pipe & Steel Co.

Pipe, Sewer
Gladding, McBean & Co.
Pacific Clay Products

Pipe, Standard
Claussen & Co., C. G.
Pacific Pipe Co.
Weissbaum & Co., G.

Pipe, Vitrified
Gladding, McBean & Co.
Kartschoke Clay Products Co.
Pacific Clay Products

Pipe, Welded Steel
California Corrugated Culvert Co.
Lacy Manufacturing Co.
Montague Pipe & Steel Co.
Steel Tank & Pipe Co.
Union Tank & Pipe Co.
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Plows, Road
Bacon Co., Edward R.
Galion Iron Works & Mfg. Co.
Hackley Equipment Co., P. B.
Jenison Machinery Co.
Spears-Wells Machy. Co.

Pneumatic Tools
Gardner-Denver Co.
Ingersoll-Rand Co.
Leitch & Co.
Schramm, Inc.

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Oxweld Acetylene Co.

Powder
Giant Powder Co., Cons., The
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Power Units
Continental Motors Corp.
Harron, Rickard & McCone Co.
Hercules Motors Corp.
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Preservative—Wood, Metal, etc.
Columbia Wood & Metal Preservative Co.
Paraffine Companies, Inc., The

Pumps, Centrifugal
Byron Jackson Pump Mfg. Co.
Industrial & Municipal Supply Co.
Ingersoll-Rand Co.
Jaeger Machine Works, The
Pelton Water Wheel Co., The
Rix Company, Inc., The
Woodin & Little

Pumps, Deep Well
Byron Jackson Pump Mfg. Co.
Industrial & Municipal Supply Co.
Jenison Machinery Co.
Pelton Water Wheel Co., The
Pomona Pump Co.
Woodin & Little

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OPPORTUNITY PAGE

CONTINUED

OFFICIAL BIDS

NOTICE TO CONTRACTORS

Grading, Paving and Bridge

Sealed proposals will be received at the office of the State Highway Engineer, Public Works Building, Sacramento, California, until 2 o'clock p.m. on April 30, 1930, at which time they will be publicly opened and read, for construction in accordance with the specifications therefor, to which special reference is made, of portions of State Highway, as follows:

Colusa County, between Williams and Maxwell (III-Col-7-B, C), about eight and three-tenths (8.3) miles in length, to be graded.

Colusa County, between Bear Creek and five miles west of Williams (III-Col-15-D, E), about twelve and seven-tenths (12.7) miles in length, to be graded.

Monterey County, a timber bridge across Alder Creek about 29 miles north of San Simeon (V-Mon-56-A), consisting of sixteen 19-foot spans on frame bents with concrete pedestals.

San Diego County, between San Onofre and San Clemente (VII-S.D-2-D), about nine-tenths (0.9) mile in length, to be graded and paved with Portland cement concrete.

Proposal forms will be issued to only those Contractors who have furnished verified statement of experience and financial condition in accordance with the provisions of Chapter 644, Statutes 1929, and whose statements so furnished are satisfactory to the Department of Public Works. Bids will not be accepted from a Contractor to whom a proposal form has not been issued by the Department of Public Works.

Plans may be seen, and forms of proposal, bonds, contract and specifications may be obtained at the said office, and they may be seen at the offices of the District Engineers at Los Angeles and San Francisco, and at the office of the District Engineer of the district in which the work is situated. The District Engineers' offices are located at Eureka, Redding, Sacramento, San Francisco, San Luis Obispo, Fresno, Los Angeles, San Bernardino and Bishop.

A representative from the district office will be available to accompany prospective bidders for an inspection of the work herein contemplated, and Contractors are urged to investigate the location, character and quantity of work to be done, with a representative of the Division of Highways. It is requested that arrangements for joint field inspection be made as far in advance as possible. Detailed information concerning the proposed work may be obtained from the district office.

No bid will be received unless it is made on a blank form furnished by the State Highway Engineer. The special attention of prospective bidders is called to the "Proposal Requirements and Conditions" annexed to the blank form of proposal, for full directions as to bidding, etc.

The Department of Public Works reserves the right to reject any or all bids or to accept the bid deemed for the best interests of the State.

DEPARTMENT OF PUBLIC WORKS,
DIVISION OF HIGHWAYS.
C. H. PURCELL, State Highway Engineer.

Dated April 2, 1930.

NOTICE TO CONTRACTORS

Bridges

Sealed proposals will be received at the office of the State Highway Engineer, Public Works Building, Sacramento, California, until 2 o'clock p.m. on April 23, 1930, at which time they will be publicly opened and read, for construction in accordance with the specifications therefor, to which special reference is made, of portions of State Highway, as follows:

Modoc County (II-Mod-28-C), two timber bridges, one across North Fork of Pit River about 3½ miles northeast of Alturas consisting of seven 19-foot spans with concrete deck on pile bents and the other across Shields Creek channel change about 4 miles northeast of Alturas consisting of three 19-foot spans with concrete deck on pile bents.

San Bernardino County, a bridge across Mojave River 3 miles north of Victorville (VIII-SBd-31-D), consisting of one 270-foot through steel truss span, five 51-foot concrete girder spans and one 48-foot concrete girder span on concrete piers and bents.

Proposal forms will be issued to only those Contractors who have furnished verified statement of experience and financial condition in accordance with the provisions of Chapter 644, Statutes 1929, and whose statements so furnished are satisfactory to the Department of Public Works. Bids will not be accepted from a Contractor to whom a proposal form has not been issued by the Department of Public Works.

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The Department of Public Works reserves the right to reject any or all bids or to accept the bid deemed for the best interests of the State.

DEPARTMENT OF PUBLIC WORKS,
DIVISION OF HIGHWAYS.
C. H. PURCELL, State Highway Engineer.

Dated March 26, 1930.

POSITION WANTED

POSITION WANTED—Young man desires position with construction company doing street or highway work. Four years' experience on street, sewer, etc., as surveyor and inspector. Three years highway. At present employed on highway survey. Experienced in handling men and had some bookkeeping. Would like to make connection where there is chance for advancement and permanent employment. Would like to start as timekeeper, cost clerk, foreman, or in similar capacity. Single, sober, and will accept any location offering desired opportunity. Field, office, or both. Box 350, W. C. News.

HELP WANTED

As listed by the Engineering Societies' Employment Service, 57 Post Street, San Francisco. Applicants will please apply direct to them.

RESEARCH ENGINEER, experienced structural man for application of new building material. Must be resourceful, persevering, and of good personality. Must be able to meet customers and prospects and bring his job to a satisfactory conclusion with such help as he can obtain from salesmen in the field and engineering and research facilities at home. Must be college graduate, well grounded in the theory of mechanics and structural design. Should also have a varied experience with structural design. Experience with field and shop erection would help. Half time traveling anywhere in the United States. Apply by letter. Headquarters, East. W-570.

COLLEGE INSTRUCTOR in Civil Engineering and Mathematics, preferably not over 30, and married. Should have at least 1 year of successful teaching. Salary $3000-3250 for 9 mos. Apply by letter with references and photo. Location, Northwest. R-3068-S.

VALUATION ENGINEER, experienced, for analyzing book record and building up unit costs for inventory. Temporary, about 3 mos. Salary open. Location, So. California. R-3061-S.

DESIGNING DRAFTSMAN, civil engineer with structural steel experience. Apply by letter. Salary $300 a month. Location, South America. Headquarters, New York City. K-273-W-617-S.

FIELD ENGINEERS AND TOPOGRAPHICAL DRAFTSMEN, for employment in Cuba, Central and South America. Must be single and not over 35 years of age. Starting salaries, $125-175 per mo. plus living quarters. Apply by letter; if for drafting send samples of work. Headquarters, East. R-2931-S.

FELLOWSHIPS, for teaching and research in the fields of civil engineering, including highway and structural engineering, electrical engineering, and mechanical engineering, including heating and ventilation. Research fellow devotes most of his service time to assigned laboratory investigations: this work is not applicable toward graduate credit or thesis. The teaching fellow assists in the instruction of students in laboratory or design courses. Stipend of each fellowship is $750 for the academic year of nine months, from the middle of September to the middle of June. This includes exemption from tuition fees. Apply only by letter. Location, Middlewest. K-266-W-569-C-S.

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Pumps, Dredging and Sand
Jenison Machinery Co.

Pumps, Hydraulic
Jenison Machinery Co.

Pumps, Power
Gardner-Denver Co.
Jaeger Machine Works, The

Pumps, Road
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Jaeger Machine Works, The
Jenison Machinery Co.
Novo Engine Co.
Woodin & Little

Pumps, Sewage
Dorr Co., The
Fairbanks, Morse & Co.
Industrial & Municipal Supply Co.

Pumps, Sewage Ejector
Industrial & Municipal Supply Co.

Pumps, Sludge
Dorr Co., The

Pumps, Water Works
Fairbanks, Morse & Co.
Industrial & Municipal Supply Co.
Jenison Machinery Co.
Pelton Water Wheel Co., The
Pomona Pump Co.

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Bacon Co., Edward R.
Claussen & Co., C. G.
United Commercial Co.

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Pacific Coast Steel Co.
Soulé Steel Co.

Reinforcing Wire Fabric
Soulé Steel Co.

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Chicago Bridge & Iron Works
Western Pipe & Steel Company

Riveting Machines
Ingersoll-Rand Co.
Rix Company, Inc., The

Road Finishers
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Blaw-Knox Co.
Jenison Machinery Co.
Lakewood Engr. Co.

Road Forms
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Harron, Rickard & McCone Co.
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Lakewood Engr. Co.

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Austin-Western Road Machy. Co.
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Spears-Wells Machinery Co.
West Coast Tractor Co.
Young Machinery Co.,A. L.

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Seaside Oil Co.
Shell Oil Co.
Standard Oil Co.
Union Oil Co.

Road Oil, Emulsified
American Bitumuls Co.

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Jenison Machinery Co.
Spears-Wells Machinery Co.

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Rules, Steel, Wood and Aluminum
Lufkin Rule Co., The

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Young Machinery Co., A. L.

Scarifiers
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Le Tourneau Mfg. Co.
Spears-Wells Machinery Co.
West Coast Tractor Co.

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Screens, Vibrating
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Link-Belt Meese & Gottfried Co.
Smith Engineering Co.

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Speeder Machinery Corp., The
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Thew Shovel Co., The
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Peerless Mchy. & Mfg. Co.
Rix Company, Inc., The
Western Pipe & Steel Co.

Tanks, Corrugated
California Corrugated Culvert Co.
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Tanks, Elevated Steel
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Lacy Manufacturing Co.
Montague Pipe & Steel Co.
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United Tractor & Equipment Corp.
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Leschen & Sons Rope Co., A.

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Transportation, Water
American-Hawaiian Steamship Co.

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Garfield & Co.
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Thew Shovel Co., The

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Jenison Machinery Co.
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Valves
California Corrugated Culvert Co.
Claussen & Co., C. G.
Industrial & Municipal Supply Co.
Pacific Pipe Co.
Water Works Supply Co.

Valves, Gate
California Corrugated Culvert Co.
Claussen & Co., C. G.
Pelton Water Wheel Co., The
Water Works Supply Co.

Valves, Hose Gate
Greenberg's Sons, M.

Valves, Hydraulic
California Corrugated Culvert Co.
Pelton Water Wheel Co.
Water Works Supply Co.

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Jenison Machinery Co.
Smith Engineering Co.

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Water Works Supply Co.

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Water Supply Installations
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Wallace & Tiernan
Water Works Supply Co.

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Water Wheels
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