WESTERN CONSTRUCTION NEWS

ENGINEERING CONSTRUCTION IN THE FAR WEST

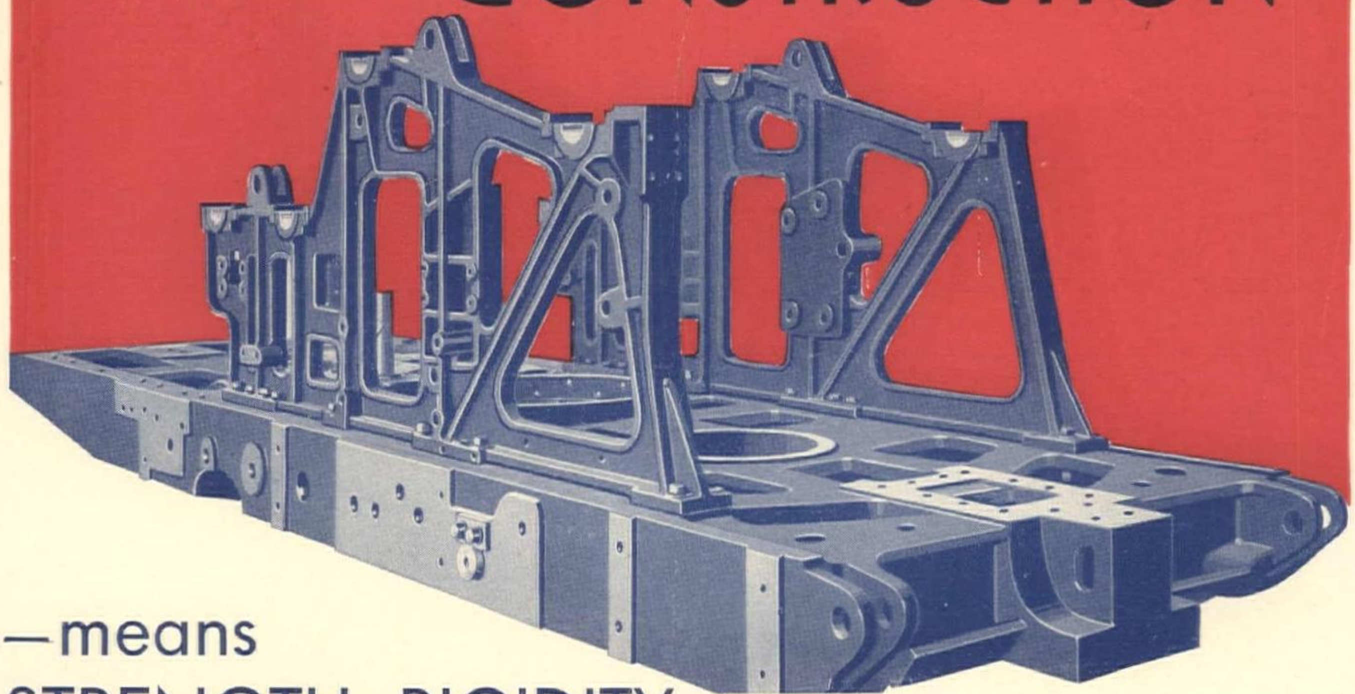
PUBLISHED SEMI-MONTHLY
VOLUME V NUMBER 23

SAN FRANCISCO, DECEMBER 10, 1930

25 CENTS A COPY
$3.00 PER YEAR

GRADING ALONG WOLF CREEK ON 3.78-MILE SECTION OF STATE HIGHWAY FROM TWIN BRIDGES TO SOUTH FORK, MINERAL COUNTY, COLORADO

Unit Cast Steel Construction



—means STRENGTH, RIGIDITY and PERMANENCE of ALIGNMENT

The greatest single factor of support for P & H power is unit cast steel construction. All the main frames of P & H Excavators, including the revolving frame, car body, side stands and side frames of the crawlers, are heavy single-piece steel castings. The engine is mounted directly upon the revolving frame, instead of on structural sills attached to the frame. Shafts and gears are kept in perfect alignment at all times. There is less wear, and maintenance costs are reduced to the minimum.

Shafts are of chrome-manganese steel, extra large and heavy, and those for heavy duty are forged and heat-treated. Gears are extra wide faced, hobbed from steel blanks. All of this sturdy construction explains why P & H Excavators are able to stand up year after year under the tremendous power of their large motors.

HARNISCHFEGER SALES CORPORATION
Established 1884
4490 W. National Ave., Milwaukee, Wis.
32 Beale St., San Francisco   2025 Santa Fe Ave., Los Angeles
ROBERT M. TAYLOR, Pacific Coast Manager
Service Stations, Complete Repair Part Stocks and Excavators at San Francisco, Los Angeles and Seattle

P&H
EXCAVATORS
½ to 3½ cu. yds.

(A-561)

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WESTERN CONSTRUCTION NEWS

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DEVOTED TO ENGINEERING CONSTRUCTION IN THE FAR WEST

VOLUME V — DECEMBER 10, 1930 — NUMBER 23

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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.

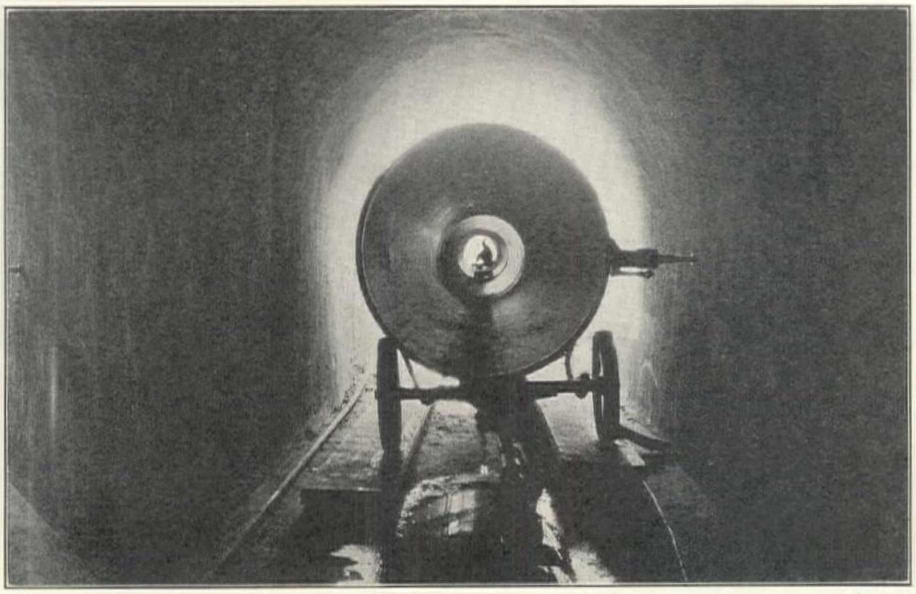
Main Office:
114 Sansome Street
San Francisco, Calif.

Eastern Representatives:
F. R. Jones, 201 N. Wells Street
Chicago, Ill.
H. B. Knox, Jr., 101 Park Ave.
New York, N. Y.

Branch Office:
455 Western Pacific Bdg.
Los Angeles, Calif.

S. H. Wade, *President and General Manager*
S. J. Sanders, *Vice-President* Philip Schuyler, *Managing Editor*
Entered as second-class matter at the postoffice at San Francisco, California, under the act of March 3, 1879


Industrial Brownhoist products include a complete line of crawler cranes and shovels, locomotive cranes, erection cranes, pile drivers, buckets, and belt and chain conveyors.
INDUSTRIAL BROWNHOIST



San Diego Pipe Line = Method of Handling Pipe in Tunnels

Excerpt from a letter from H. N. Savage, Hydraulic Engineer, City of San Diego:

The sixteen-mile reach of 40"-35" steel plate electric-welded pipe . . . contract work has been executed to the satisfaction and with the approval of all of the City's Inspectors, Resident Engineer, and in my personal knowledge, based on frequent inspection, has been carried on and out in a prominently efficient and satisfactory manner.

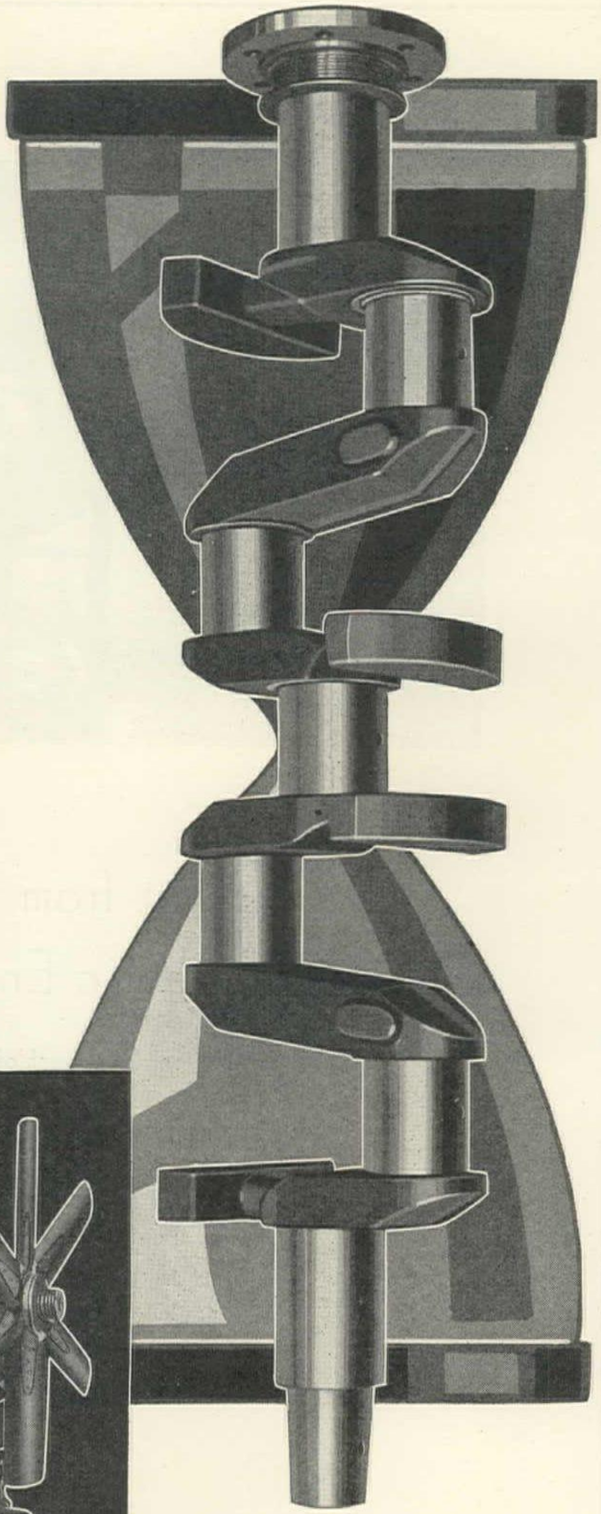
Based upon the visits paid by many engineers from near and far-away places, the work has attracted unusual attention and I have heard only favorable comments from visiting engineers on the type and quality of work. . . The character and reliability of the welders was very outstanding, as demonstrated by the practical absence of leaks or even sweats.

Western Pipe & Steel Co. of California

San Francisco — Taft — Los Angeles
Fresno — Phoenix

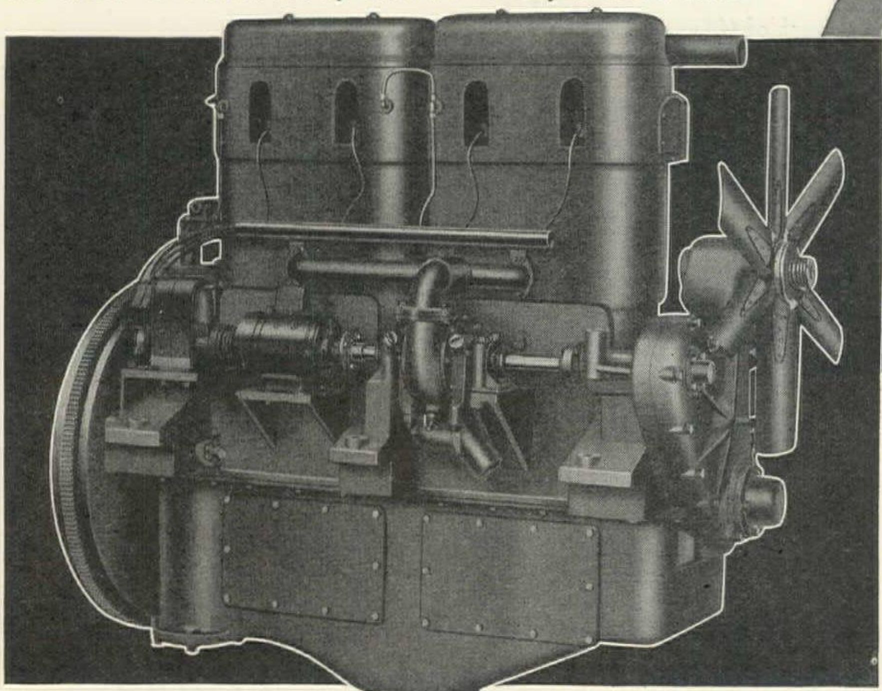
The LE ROI Crankshaft

is *guaranteed* for the life of the engine*!*



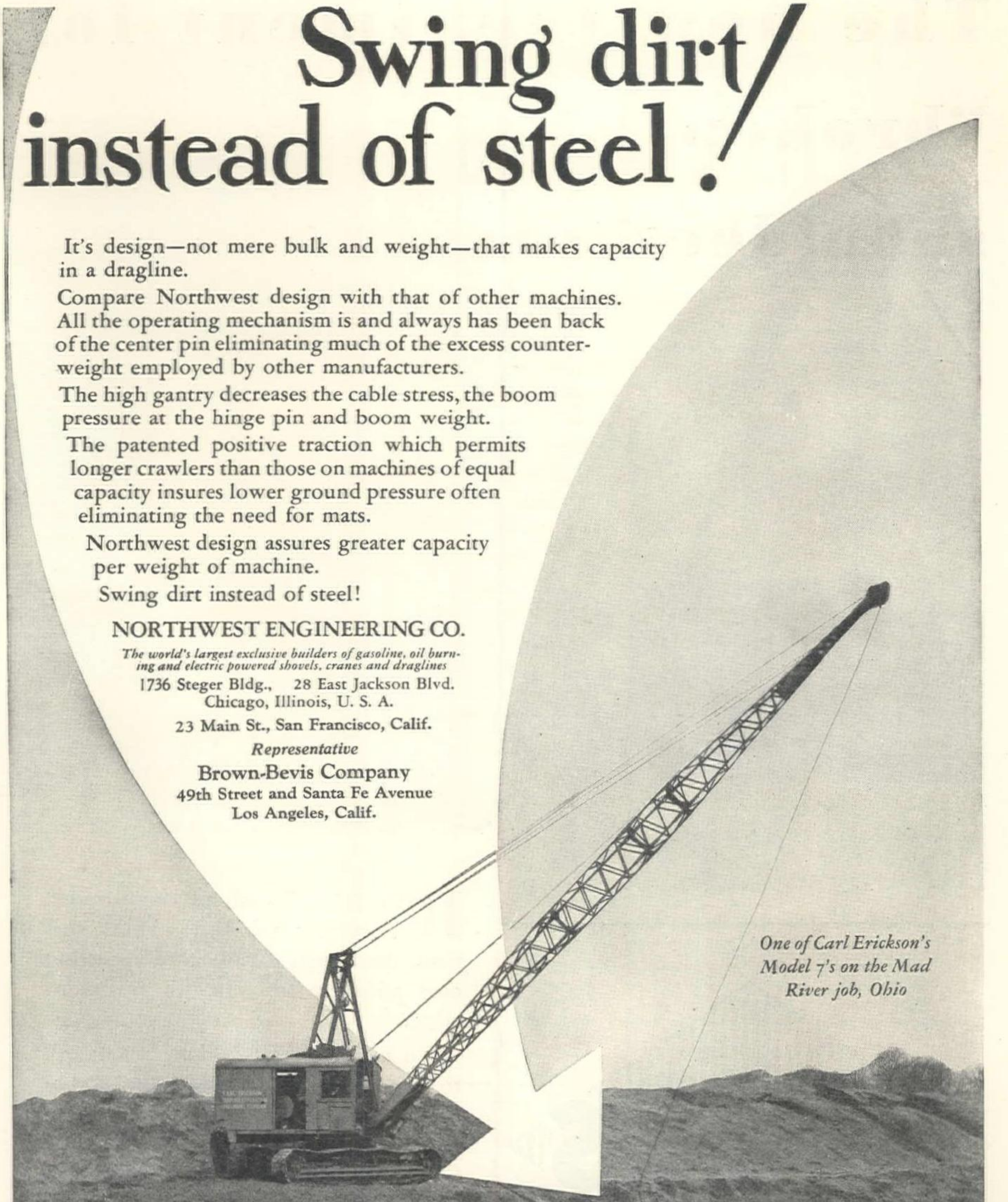
This massive backbone of the engine delivers its constant flow of power steadily, smoothly, masterfully . . . The finest steel that science can produce gives it a tremendous strength and stamina equal to the heaviest overloads. Its perfection of balance eliminates destructive vibration . . . There are times when the lifetime guarantee on the Le Roi crankshaft proves priceless . . . Le Roi Engines keep men and machinery moving . . . keep earnings constant . . . keep profits safe . . . Le Roi service is the utmost . . . it stands for Dependable Power.

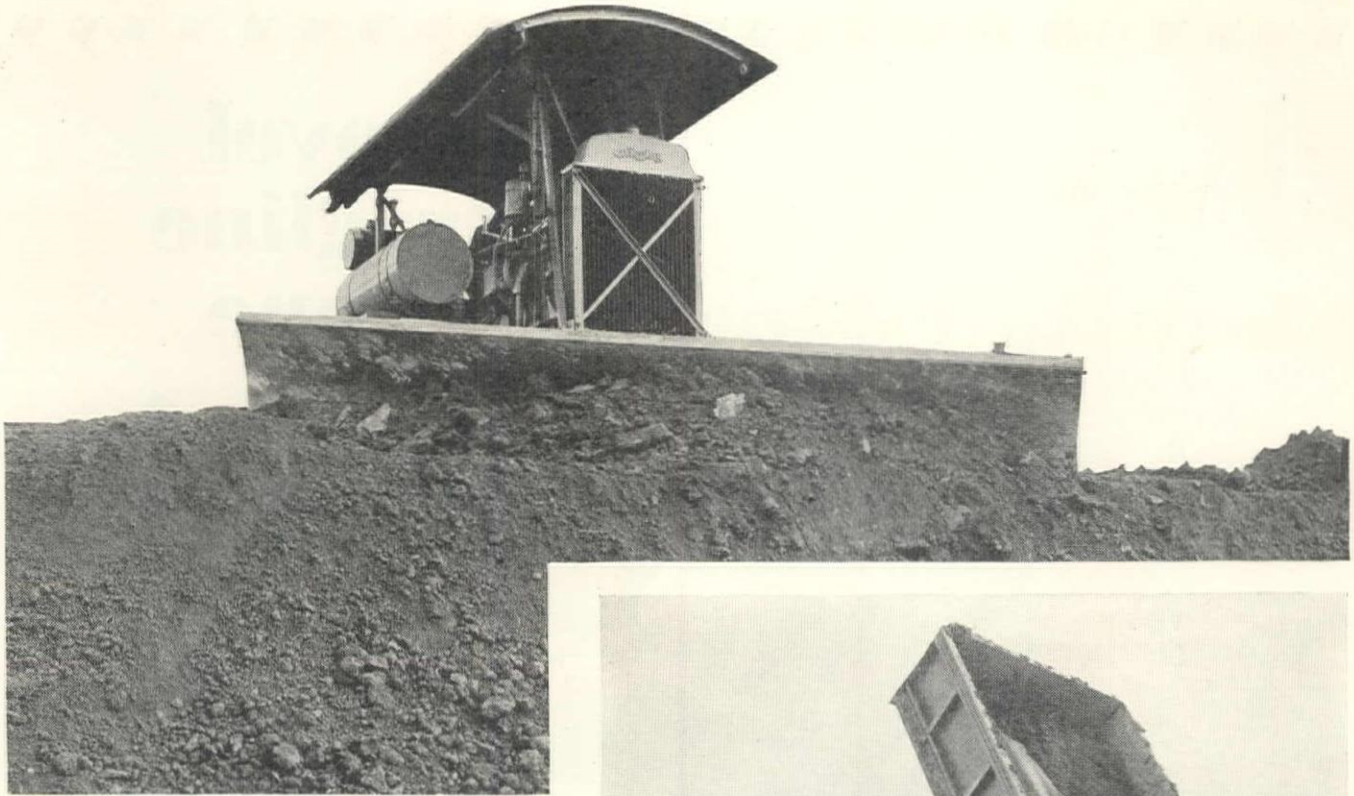
LE ROI COMPANY, *Milwaukee, Wisconsin*



FOR DEPENDABLE POWER

LE ROI ENGINES


Swing dirt instead of steel!
It's design—not mere bulk and weight—that makes capacity in a dragline.
Compare Northwest design with that of other machines. All the operating mechanism is and always has been back of the center pin eliminating much of the excess counterweight employed by other manufacturers.
The high gantry decreases the cable stress, the boom pressure at the hinge pin and boom weight.
The patented positive traction which permits longer crawlers than those on machines of equal capacity insures lower ground pressure often eliminating the need for mats.
Northwest design assures greater capacity per weight of machine.
Swing dirt instead of steel!
NORTHWEST ENGINEERING CO.
The world's largest exclusive builders of gasoline, oil burning and electric powered shovels, cranes and draglines
1736 Steger Bldg., 28 East Jackson Blvd. Chicago, Illinois, U. S. A.
23 Main St., San Francisco, Calif.
Representative
Brown-Bevis Company
49th Street and Santa Fe Avenue
Los Angeles, Calif.
One of Carl Erickson's Model 7's on the Mad River job, Ohio
NORTHWEST
1¾ 1¼ 1YD 1½ 2YD ½ ¾
WCN 12-10-Gray



Push *or* Pull

"CATERPILLAR" Tractors pull the big wagons away from the shovel—or, fitted with a bulldozer, push the earth over the edge of the fill. The pictures show two of the eight Sixty tractors used by Reed & Lapsley in building the huge C. & O. railroad yards at Russell, Kentucky.

Plentiful power and wide tracks that go most anywhere pull down the costs of earth moving—and push up the profits!

Caterpillar Tractor Co.

PEORIA, ILL. *and* SAN LEANDRO, CALIF., U. S. A.

Track-type Tractors , Combines , Road Machinery

(There's a "Caterpillar" Dealer Near You)

Prices—f. o. b Peoria, Illinois

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

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

When writing to CATERPILLAR TRACTOR CO., *please mention Western Construction News*

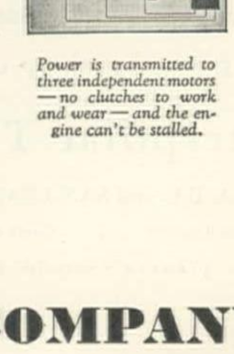
Shovel Dragline Crane

A COMPLETE range of shovel, dragline and crane equipment is ready to go with the Marion 1¼ yd. Gas-Electric — the new-type excavator that operates without clutches.

A SIZE FOR EVERY NEED

- Type 450 1¼ yd. Steam, Electric, Gas-electric, Diesel-electric.
- Type 32-1½ yd. Steam.
- Type 460 1½ yd. Electric, Gas-Electric.
- Type 480-2 yd. Steam, Electric.
- Type 490-2¾ yd. Electric.
- Type 4120-3 yd. Electric.
- Type 5120-3 yd. Electric.
- Type 4160-4 yd. Electric.
- Type 125-4 yd. Steam, Electric.
- Type 5320 8 yd. Steam, Electric.
- Type 5480-12 yd. Electric.

Hundreds of these speedy, rugged machine are already in the field, outdigging and out-wearing clutch-type shovels in an amazing manner. In fact 50% of Gas-Electric owners operate *two or more* of this remarkable excavator. It is the only Gas-Electric in the field — Marion's exclusive contribution to the excavating industries. Type 450 will do *your* work. Write us about your own situation and the kind of equipment you need. Get the facts first hand without obligating yourself in any way.



Power is transmitted to three independent motors — no clutches to work and wear — and the engine can't be stalled.

Come to Shovel MARION *Headquarters*

EVERYWHERE RELIABLE — SINCE 1884

THE MARION STEAM SHOVEL COMPANY

DISTRICT OFFICES — NEW YORK — CHICAGO — PHILADELPHIA — BIRMINGHAM
KANSAS CITY — SEATTLE — SAN FRANCISCO

MARION, OHIO, U. S. A.

in 10½ hours with this Gas+Air

Figure it out for yourself—302 x 7 equals 2114 yards of dirt this contractor moved in 10½ hours. No wonder he says he's *making money* with his Gas+Air shovel!

Hundreds of other contractors everywhere are cashing in on the proven Gas+Air principle of design and you can do the same. Let us give you full details about Gas+Air convertible shovels.

Representatives throughout the U. S. A. Offices or distributors in all principal countries. *Branch Offices:* Boston, New York, Philadelphia, Atlanta, Birmingham, Pittsburgh, Buffalo, Detroit, Chicago, St. Louis, Dallas, San Francisco.

BUCYRUS-ERIE COMPANY, *General Offices:* South Milwaukee, Wisconsin. *Plants:* South Milwaukee, Wis.; Erie, Pa.; Evansville, Ind. *West Coast Branch Office:* 989 Folsom St., San Francisco. Clyde Equipment Company, Portland, Ore., Seattle, Wash. Concrete Machinery & Supply Company, Los Angeles, Calif.

BUCYRUS ERIE

STILL A FEW LEFT—"How about this Gas + Air?" is making shovel men do some real thinking! Send for your copy.

A-204—12-10-30—WCN

BUCYRUS-ERIE CO.,
South Milwaukee, Wis.

Please send me the booklet "How About This Gas+Air?"

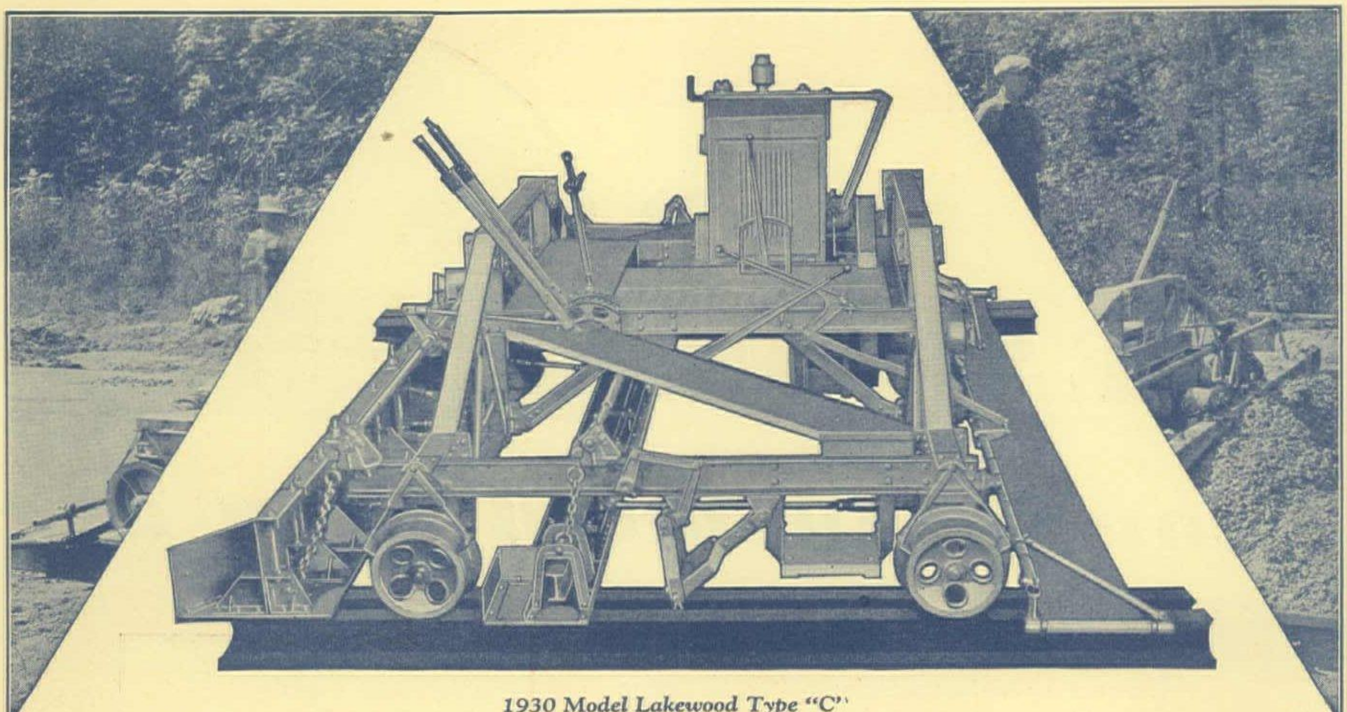
Name .... *Position* ....

Company .... *Address* ....

City .... *State* ....

When writing to BUCYRUS-ERIE COMPANY, *please mention Western Construction News*

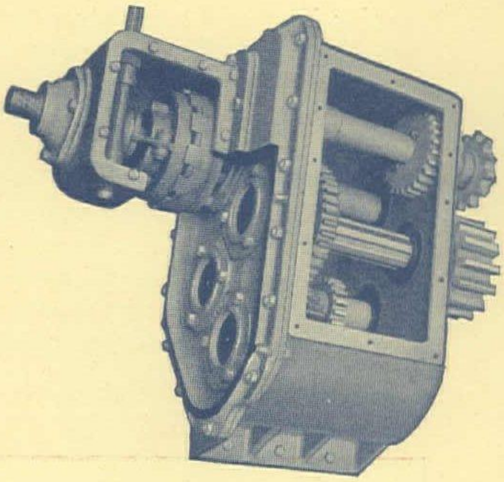
[SEE FIVE JENISON PAGES FOLLOWING]



*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

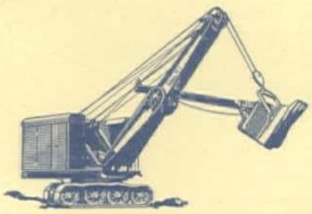
LAKEWOOD

The Lakewood Engineering Co. CLEVELAND · O.

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

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

THE tremendous power which propels a Lorain Center Drive Shovel with all its tons of steel at 1½ miles an hour, can be concentrated directly to the crowd motion when the machine is digging.



THEW CENTER DRIVE

THE THEW SHOVEL COMPANY · LORAIN, OHIO

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SMITH BOOTH USHER, Los Angeles, Calif.; JENISON MACHINERY COMPANY, San Francisco, Calif.; FEENAUGHTY MACHINERY CO., Portland, Seattle, Spokane; AMBLER & RITER, Salt Lake City, Utah; H. W. MOORE EQUIPMENT CO., Denver, Colorado

THEW LORAIN

45 - 55 - 75

When writing to THE THEW SHOVEL CO., *please mention Western Construction News*

Differential Surge Tanks Regulate Power Plants

The general efficiency of a water power development is increased by close regulation of hydraulic turbines. The Johnson differential surge tank provides such regulation scientifically, without the use of pressure limiting devices such as synchronous by-passes or other water-wasting arrangements. Each installation is complete in itself, without effecting regulation by other units operated in parallel.

965,000-gal. Differential Surge Tank Regulating the Kanto Hydro-Electric Power Company's 55,000 Kilowatt Saku Plant in Japan

Ask for a Copy of this Booklet

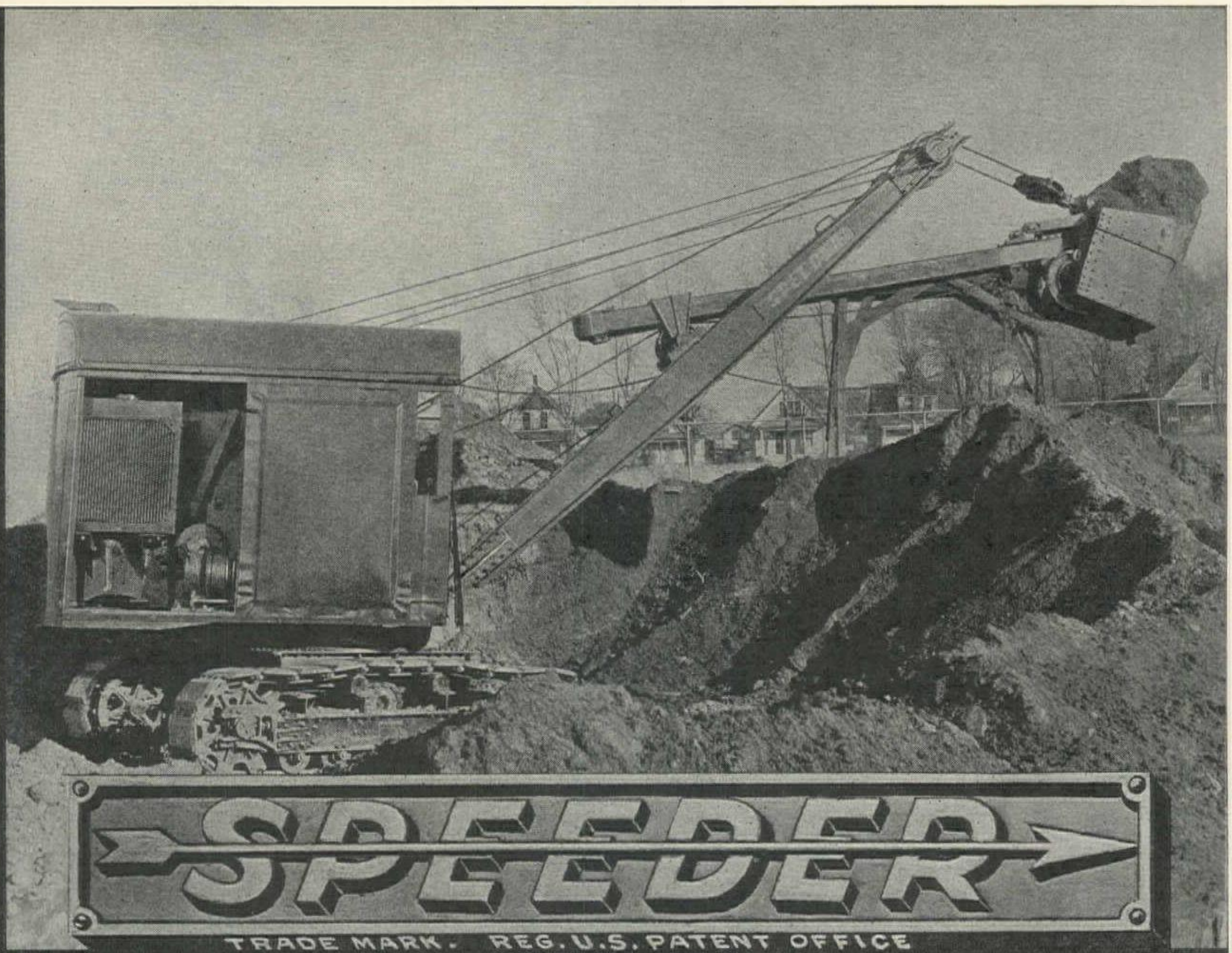
THE Johnson differential surge tank differentiates the accelerating head from the static head by means of a restriction between the tank proper and the conduit. The exact style and size of the restriction must be determined specially for each plant. Ask our nearest office for a copy of the booklet illustrated at the left.

CHICAGO BRIDGE & IRON WORKS

San Francisco: 1013 Rialto Building
Seattle: 4301 Smith Tower

B-180

HORTON TANKS



. . ANNOUNCES A NEW LIGHT CONVERTIBLE SHOVEL

OF the same simple type of construction as the world famous Speeder Model B3, the machine that revolutionized the one-half yard field. All the important model B3 features—such as 2 speeds thruout, on drums, travel, swing, the Speeder patented crowd, light weight, and in addition several other features such as all gears, including travel gears, cut from solid blanks and running in oil-tight cases and the main drums equipped with Timken Bearings. Fully enclosed cab, electric lights and starter, are standard equipment.

3/8 YARD

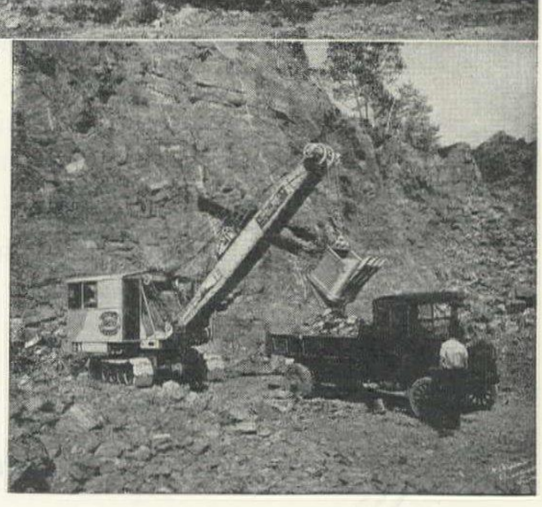
FULL REVOLVING
FULLY CONVERTIBLE
HIGH SPEED TRAVEL *and* OPERATION *thruout*

SPEEDER
MACHINERY CORPORATION

Pioneer manufacturers of full revolving, fully convertible, one-half yard gasoline shovels

1201 Sixth Street S.W. Cedar Rapids, Iowa, U. S. A.

55% of Link-Belts Sold in 1930 Are Repeat Orders



IT IS a significant fact that so large a proportion of orders for Link-Belt Shovels—Cranes—Draglines is repeat business. And also probably just as significant is the fact that amongst those users are listed some of the most prominent and largest concerns in the country—Ford, Anaconda, U. S. Steel, Ceneral Electric, Standard Oil, Swift & Co., and other industrial leaders. This is the best proof we can offer of the good-all-the-way-through quality of the Link-Belt Shovel—Crane—Dragline.

LINK-BELT COMPANY

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

Los Angeles: Harry C. Collins, 2411 East 26th St.
Phoenix: Mine & Smelter Equipment Co., 7th Ave. and Santa Fe Tracks
San Francisco, Calif.: Garfield & Co., Hearst Bldg.
Seattle: A. H. Cox & Co., Inc., 1757 First Ave. South
Portland: Loggers & Contractors Machinery Co., 345 E. Madison St.

4153

LINK-BELT

SHOVELS—CRANES—DRAGLINES—¾ to 2½ Yd.

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

SUPER-STRENGTH in every unit . . . *super-engineering* in every detail of Sterling construction. All-bolted, steel frame is wood-lined for added rigidity, super-strength and extra flexibility . . . a protection against frame-weaving and destructive vibration . . . exclusively Sterling. *Red Head* Ricardo Removable Head engine . . . more power, smoother power, with less fuel at all speeds . . . more years of low up-keep service. Over-sized and extra-sturdy units throughout. That's the *why* of the stronger, sturdier, speedier Sterling . . . for every hauling requirement, 1 to 12 tons capacities.

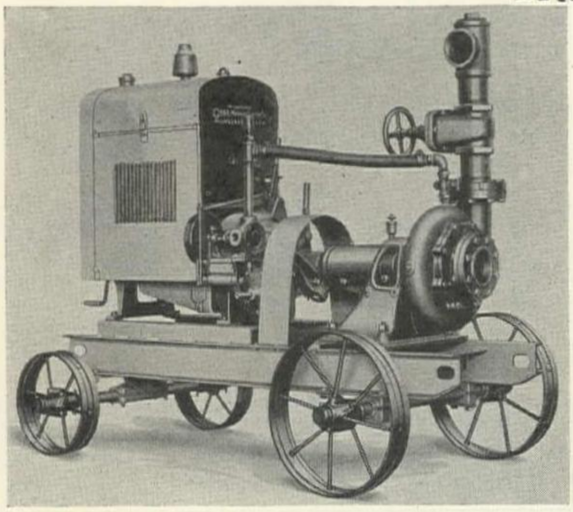
STERLING MOTOR TRUCK CO. OF CALIFORNIA
8th and Howard Sts., San Francisco
Oakland Sacramento Fresno
Stockton San Jose

Sterling Chain-drive Sixes
for extra heavy hauling

222

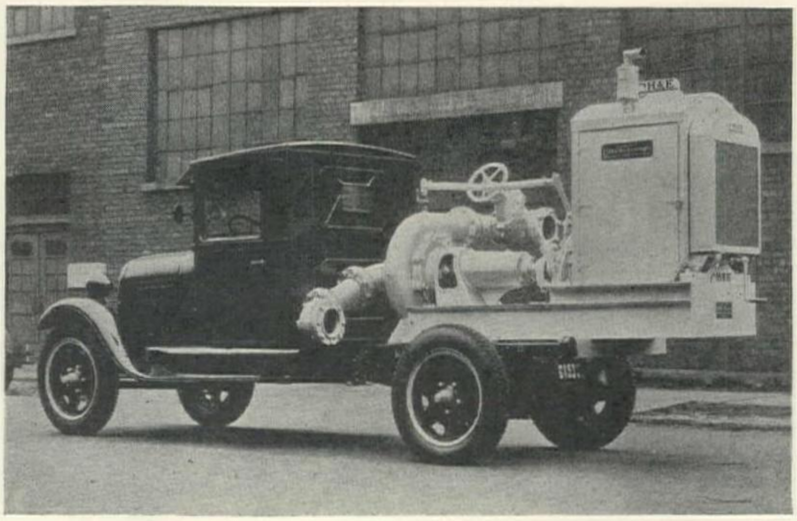
Continuous operation

without clogging!



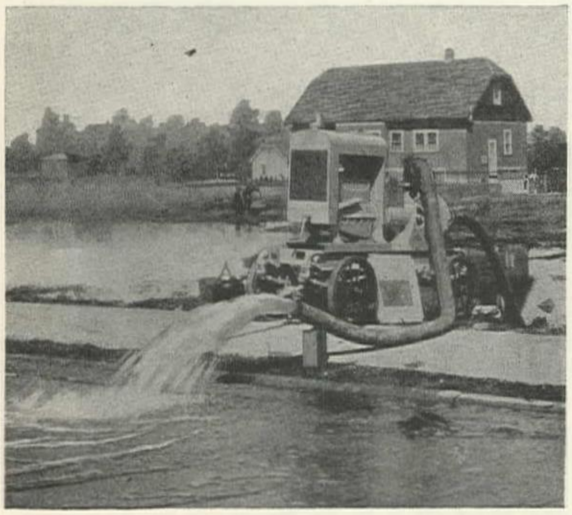
(Above) F-M Wood Trash Pump unit mounted on a truck built of channel iron with steel wheels. This style mounting is also available on a spring suspension rubber tired truck.

PORTABLE Fairbanks-Morse Wood Trash Pumps prove their mettle on jobs where fluids containing fibrous or stringy foreign matter and large solids must be handled. *These* pumps operate continuously without clogging! And they eliminate the need for screening.



(At right) A 6-in. Fairbanks-Morse Wood Trash Pump driven by a 30-hp. 4-cylinder gasoline engine and mounted on a Ford truck.

(Below) Portable F-M Wood Trash Pumps are easy to handle and give dependable service on all kinds of jobs.



You can see how F-M Wood Trash Pumps speed up work on tough jobs. Shutdowns to take the pump apart are avoided. Time is saved because it is unnecessary to raise the end of the suction hose during operation as neither screen nor foot valve is used. A single bar keeps out bricks, tin cans, and other refuse that might lodge crosswise. These pumps will pass any solid that will pass around the 90° suction elbow and enter the impeller.

Portable F-M Wood Trash Pump units are made in sizes 4 to 8 inches. Gasoline engine or electric motor power is optional. Several types of mounting are offered. Your request will bring complete information promptly.

FAIRBANKS, MORSE & CO., Chicago

Pacific Coast Service:

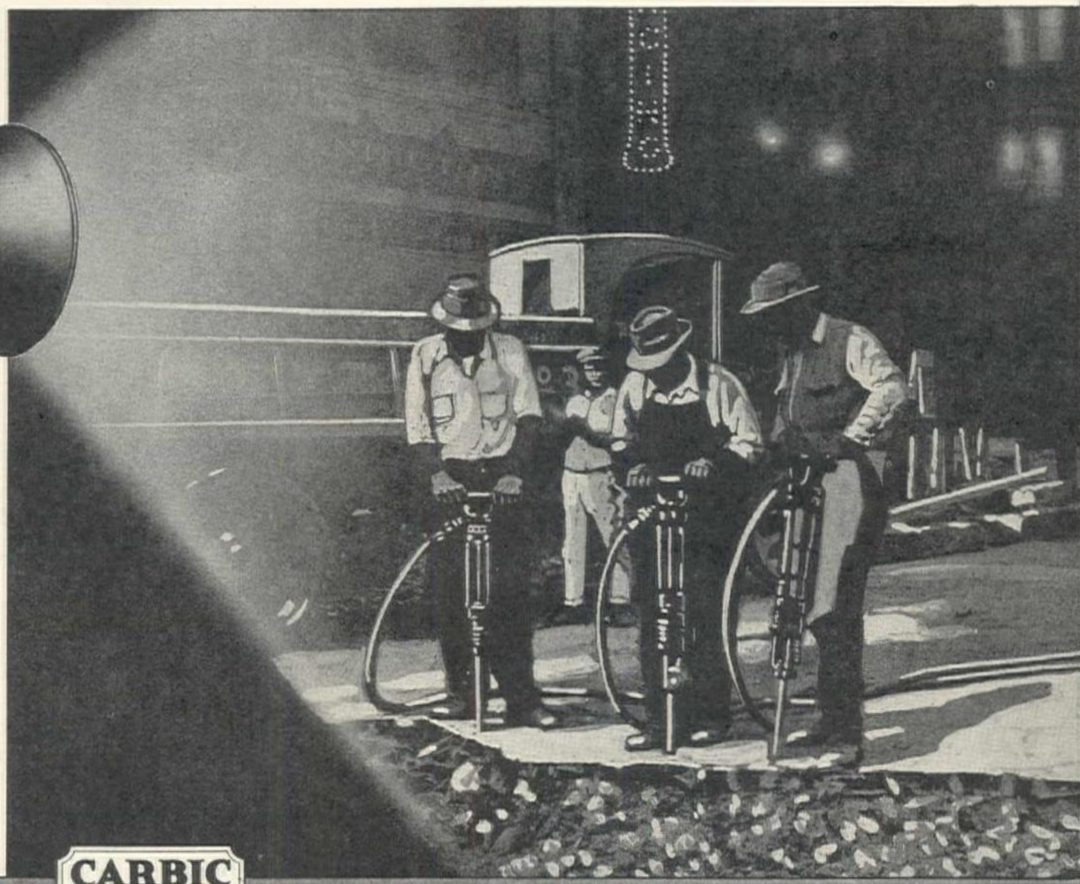
Los Angeles, Calif. .... 423 East Third Street
San Francisco, Calif. .... Spear and Harrison Streets
Portland, Ore. .... East First and Taylor Streets
Seattle, Wash. .... 550 First Avenue, S.
Spokane, Wash. .... 1113 West Railroad Avenue
Salt Lake City, Utah .... 14 S. West Temple
Tacoma, Wash. .... 432 Perkins Building

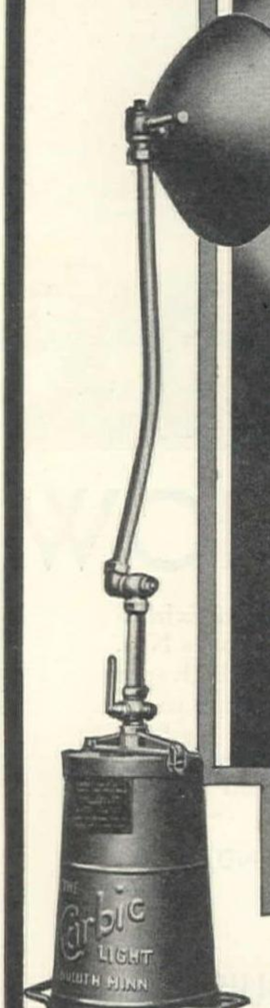
FAIRBANKS-MORSE PUMPS

POWER, PUMPING AND WEIGHING EQUIPMENT

When writing to FAIRBANKS, MORSE & CO., *please mention Western Construction News*

Hustle through with CARBIC LIGHTS





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

Carbic Flood Lights provide strong, clear, penetrating, diffused illumination and enable work to continue full force with safety after dark.

The initial cost of Carbic Flood Lights is low, and operating expense is negligible.

Contractors in every branch of industry are hustling through to greater profits with Carbic Lights.

Technical Publicity Dept. **12th floor**
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*...............
WCN 12 10-30

OXWELD ACETYLENE COMPANY

Unit of Union Carbide UCC *and Carbon Corporation*

NEW YORK

Sales Offices in Principal Cities

When writing to Oxweld Acetylene Company, *please mention Western Construction News*

CLETRAC

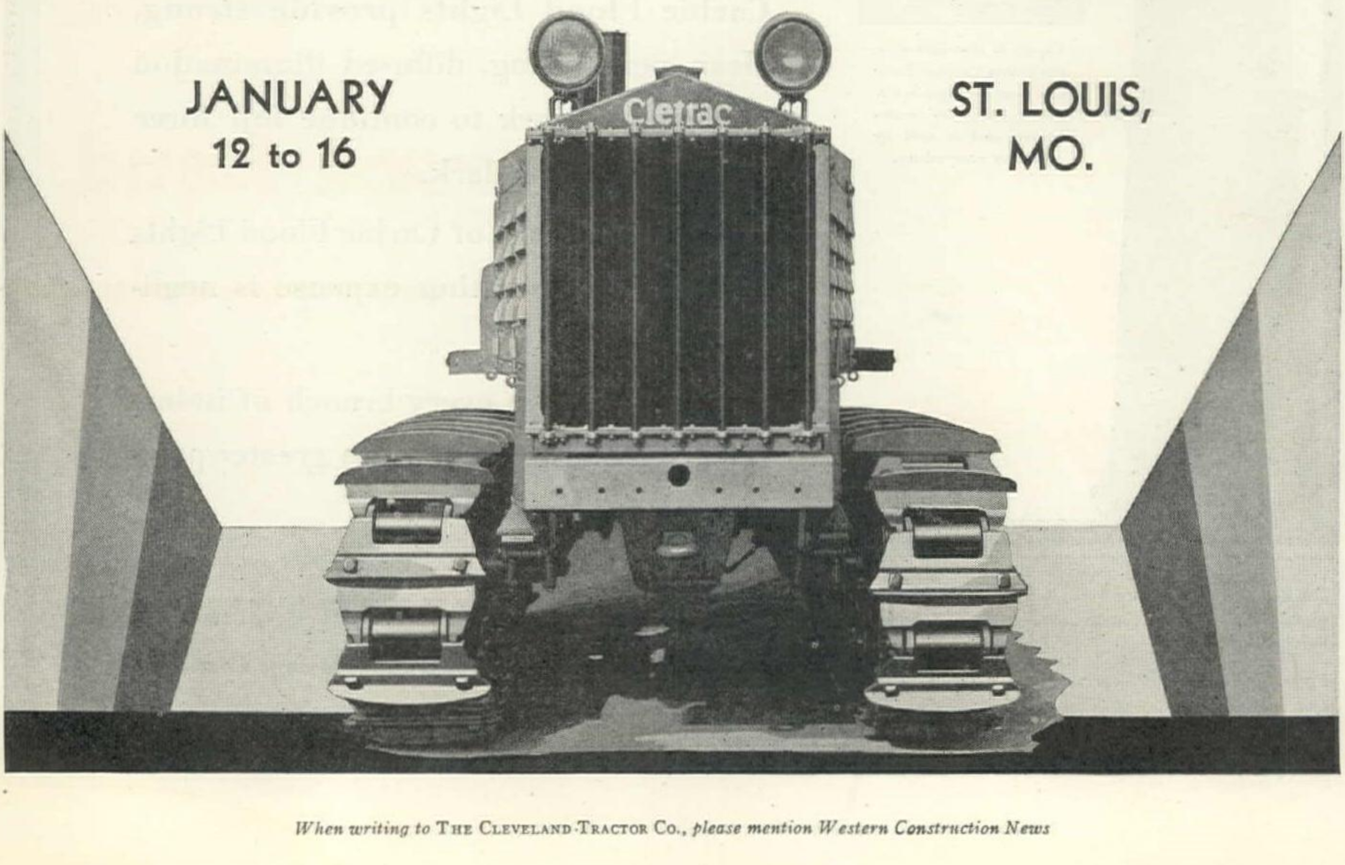
AT THE 1931 ROAD SHOW

A bigger, better and more elaborate show than ever before! A gigantic convention of a gigantic industry! Surely you'll attend this greatest of the year's industrial events.

Cletrac extends to you this cordial invitation to visit its booth and hotel headquarters when attending the Show in St. Louis.

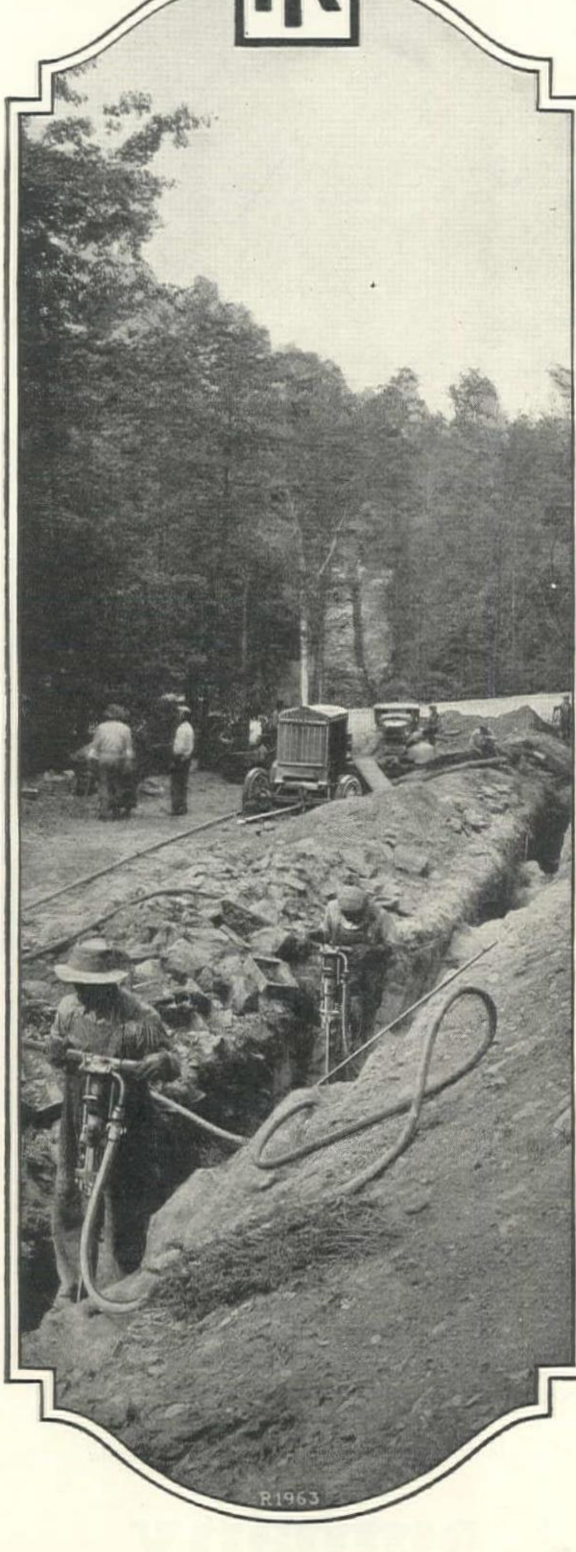
The Cletrac Line will be shown in Exhibition Building "A" in adjoining spaces Nos. 24 and 44. This will be one of the high spot exhibits of the Show. You will want to see it — and get first hand the really big facts about Cletrac's complete line of tractors for the road builder, contractor and general industrial user of tractor power.

THE CLEVELAND TRACTOR COMPANY, 19332 EUCLID AVE., CLEVELAND, OHIO



Portable Air Compressors

will simplify your trench work



Your job may be a pipe line trench over a hilly fairway . . . or a long gas line through the busy city streets . . . or a water main along the edge of town. Whatever it is, an I-R Portable Compressor outfit will save you time and expense if rock and stiff clay are encountered.

Ingersoll-Rand Company manufactures an excellent line of equipment for trench and pipe line work. There are portable compressors and "Jackhamer" drills; paving breakers and pneumatic diggers; drill sharpeners and oil furnaces; backfill tampers, hoists, and numerous other types of pneumatic tools. The largest of the portable compressors will operate, simultaneously, 3 "Jackhamer" drills, a No. 34 sharpener, and a 6F oil furnace.

I-R machines will pay for themselves within a few weeks of steady operation. Let us show you how they save money over laborious hand methods.

INGERSOLL-RAND COMPANY of CAL.

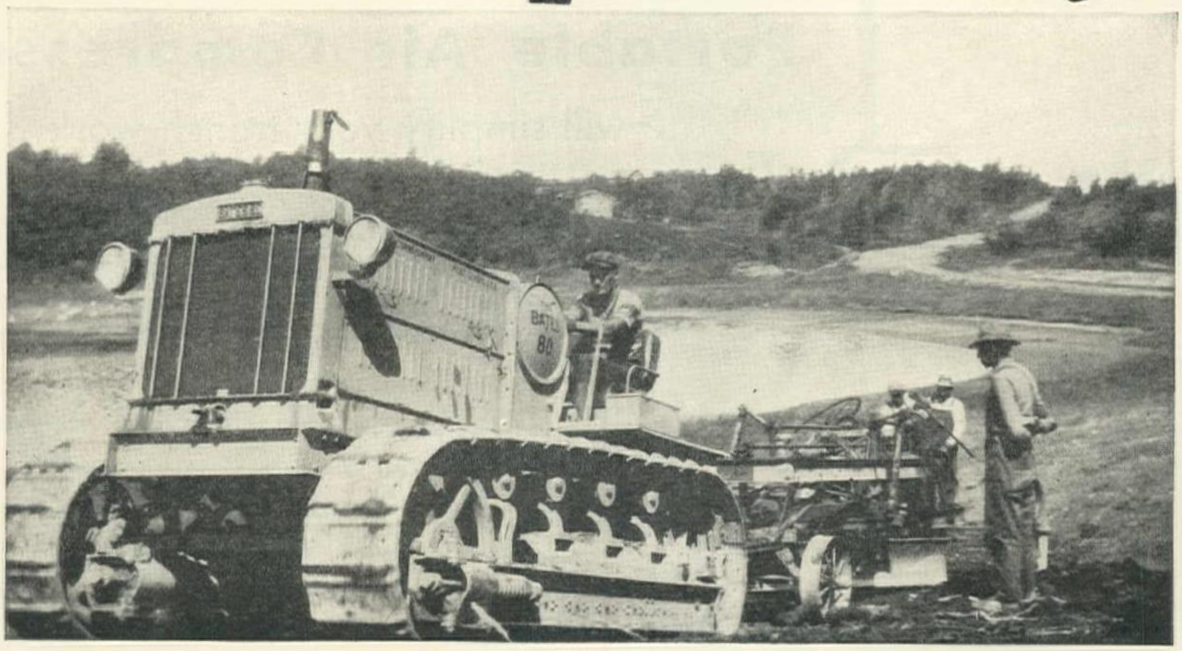
Los Angeles, Cal. — Seattle, Wash.
San Francisco, Cal. — New York City, N. Y.

Ingersoll-Rand

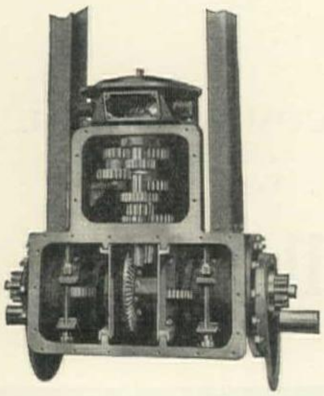
232-PC

Left: This long pipe line trench, most of it through rocky ground, was put down rapidly with the aid of I-R Portable Compressors and "Jackhamer" Drills.

Built-in Dependability!



with Large Size Extra Strong Transmission Gears



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M. Am. Soc. C. E.
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MANAGING EDITOR

A. GILBERT DARWIN
Jun. Am. Soc. C. E.
ASSISTANT EDITOR

WESTERN CONSTRUCTION NEWS

CLYDE C. KENNEDY
M. Am. Soc. C. E.
ASSOCIATE EDITOR

CHESTER A. SMITH
M. Am. Soc. C. E.
ASSOCIATE EDITOR

VOLUME V | DECEMBER 10, 1930 | NUMBER 23

Adequate Compensation for Consulting Engineers

It seems to us about time that the antiquated Federal legislation limiting the compensation of consulting engineers to $25 per diem should be revised to conform to present-day standards. Consulting engineers of the preferred class receive today in non-governmental employment at least $100 per day; and yet, these same engineers are serving on such important commissions as the Hoover dam, Mississippi river flood control, and many other vast projects at $25 per day and expenses. Why should 'Uncle Sam', the richest government in the world, stigmatize one of the greatest of the professions with the earmarks of inferiority?

It may be, and of course is a real honor, with the attachment of great prestige, to serve on one of these commissions, and very likely Uncle Sam is generous in paying for the number of days of service. But, the fact remains that it is ridiculous, to say the least, to rate men of such ability at $25 per diem on projects costing hundreds of millions of dollars.

The same thing applies to legislation in several states, such as California, where the compensation of consulting engineers is likewise limited to $25.

Mokelumne and Hetch Hetchy

While crews of men are driving feverishly from many headings to complete the 28-mile Coast Range tunnel of the Hetch Hetchy water supply project for San Francisco by 1933—scheduled date—contractors are rushing construction on a 12-mile temporary pipe-line to connect the Spring Valley water system of San Francisco with the recently completed Mokelumne river project of the East Bay Municipal Utility District, and thus save San Francisco from the greatest threatened water shortage in its history.

Needless to say, it is most fortunate indeed for the East Bay Cities that they did not tie up with the Hetch Hetchy supply, for if the Mokelumne project had not been completed a year or two ahead of schedule, there would have been a real water famine on both sides of San Francisco bay.

The 12-mile interconnecting pipe-line, under construction, is merely a temporary installation, as we understand it, to be used until the Hetch Hetchy project is completed. It would appear to us that this pipe-line should be maintained as a permanent link between these important water supplies.

The Hetch Hetchy aqueduct from the Sierra Nevada is 156 miles long, of which 85 miles is in tunnel; and the Mokelumne river aqueduct is 94 miles long, including 9 miles of tunnels. For several years, each of these aqueducts will have single pipe-lines, and the chance of a serious break in either, from earthquake or other unforeseen causes, will be always present; also, the local storage reservoirs might not at that time be adequate to supply the demand.

We hope that the water works and city officials of these two districts will see fit to maintain this connection and thus give the San Francisco bay region a double source of water supply.

Properties of Mass Concrete

What do we know about the properties of concrete in large masses? The American Concrete Institute has decided we know but little—so little, that it has appointed a special committee (No. 108) for intensive research. This committee is already actively functioning, and proposes to solve the problem, or at least know a lot more than we now know, before it is time to pour concrete in the most massive of all structures—the Hoover dam.

As we have frequently commented, the art of concrete manufacture and placement has been advanced rapidly during the past few years, but the improvement has been almost solely in proportioning of ingredients, selection of aggregates, and methods of placing. But little attention has been paid to the characteristics of the cement used, except as to higher tensile strength and quicker setting properties.

During the past few years, engineers have endeavored to measure the effect of heat of chemical reaction upon the strength of mass concrete in various structures such as dams, foundations, and bridge piers. A summary of these observations is recorded in the article in this issue by Ivan E. Houk on 'Temperature Variations in Concrete Dams'.

In the opinion of some members of this committee —of which Raymond E. Davis, professor of civil engineering in charge of the materials testing laboratory, University of California, is chairman, and some of the most prominent engineers in the United States are members—the 'age old' standard specification for cement, at least for mass concrete, must be revised.

Provided sufficient funds can be promptly secured, and the cement industry will collaborate to the fullest, we can hope for many valuable data from this intensive research, in the laboratory and in the field, which can be profitably used in the construction of the Hoover dam and other mass concrete structures.

Tiger Creek Conduit

For the Mokelumne River Hydroelectric Project, California, of the Pacific Gas & Electric Company—19-Mile Concrete Flume Built with Special Apparatus

The Tiger creek conduit is one of the several particularly interesting features of the Mokelumne river \$40,000,000 hydroelectric project under construction by the Pacific Gas & Electric Co., which serves all of Northern California.

The Mokelumne river project, which was described

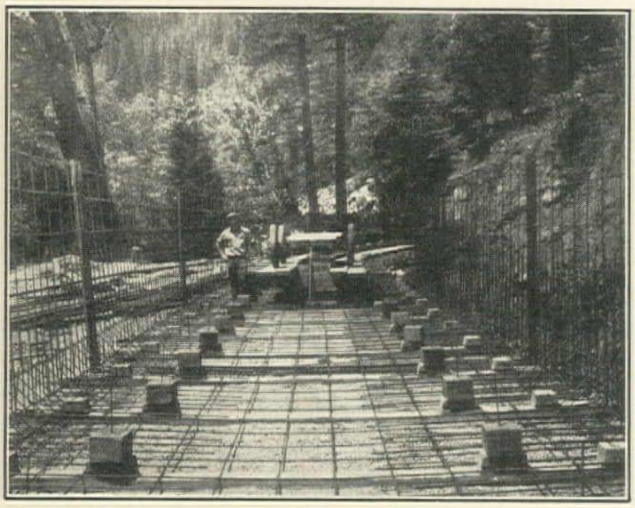
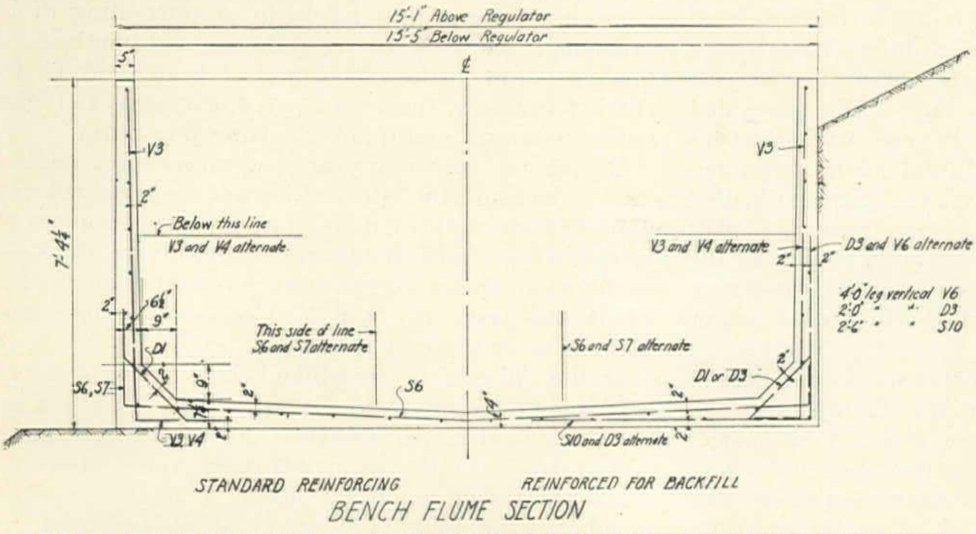


Fig. 1. Tiger Creek Bench Flume, Showing Concrete Floor Ties and Reinforcing Steel in Place

in detail in the May 25th, 1930, issue, includes the following main features: Salt Springs reservoir of 130,000 ac-ft. capacity, formed by a rock-fill dam 328 ft. high, crest length 1300 ft., containing 3,000,000 cu.yd., at base elevation of 3620 ft.; (75% completed); Salt Springs powerhouse of 11,000 kv-a. capacity, (under construction); Bear river supplemental development (to be constructed later); the Tiger creek conduit, 21½ miles long, and consisting of a concrete flume 14 ft. wide and 7 ft. deep, of 550 c.f.s. capacity, 18¾ miles long, interspersed with 7 tunnels; the Tiger creek regulating reservoir, penstock, and powerhouse of 60,000 kv-a. capacity (under construction); a diversion dam, in Mokelumne river below Tiger creek powerhouse; 4-mile concrete flume, penstock, and powerhouse of 15,000 kv-a. capacity at West Point (to be constructed); diversion dam and 13-mile concrete flume to serve the Electra powerhouse (to be rebuilt); and transmission lines from Salt Springs powerhouse to Tiger creek, West Point, and Electra, and a 94-mile, 220,000-volt, line from Electra to Newark on San Francisco bay (under construction).

In line with its policy of constructing various works so that maintenance and replacement will be reduced to a minimum, the Pacific Gas & Electric Co. gave considerable thought to the Tiger creek conduit, which is built along the steep slope (right bank) of the Mokelumne river, a wild and isolated mountainous country. A reinforced concrete flume built on a solid-cut bench 18 ft. wide, was selected as the type offering the least interruption of service and most stable, and was found to be more economical than any other type of construction, such as a timber flume. There are 7 tunnels (10 ft. 9 in. high by 10 ft. wide, horseshoe shaped) aggregating 2½ miles, and two siphons. At one place, a heavy covered conduit section, 1700 ft. long, was used as a substitute for a tunnel.



Reinf. Steel for One 20-ft. Std. Section

36–V3–½″φ x 8′–0″
34–V4–½″φ x 5′–0″
70–D1–⅜″φ x 4′–0″
18–S6–½″φ x 16′–8″
34–S7–½″φ x 6′–5″
26 ½″φ x 19′–9″—spacers

Reinf. Steel for One 20-ft. Section with Backfill on One Side

36–V3 –½″φ x 8′–0″—walls—inside
34–V4 –½″φ x 5′–0″—walls—inside
53–D1 –⅜″φ x 4′–0″—corners—diagonal
17–D3 –⅜″φ x 8′–6″—corners—diagonal
18–V6 –½″φ x 7′–6″—walls—outside
18–S6 –½″φ x 16′–8″—floor—top
34–S7 –½″φ x 6′–5″—floor—top
17–S10–½″φ x 8′–6″—floor—bottom
26 ½″φ x 19′–9″—spacers

FIG. 2. CROSS-SECTION OF TIGER CREEK BENCH FLUME, SHOWING TWO TYPES OF SIDE-WALL REINFORCEMENT

Excavation of 12 miles of the bench for the flume, including 3 short tunnels, was contracted by Bechtel & Palmer, of San Francisco; the remaining 6 miles being graded by the P. G. & E. construction department (See page 258, May 25th issue). The excavation was kept close to grade and compacted with 10-ton rollers and a Fordson sheepsfoot tractor.

Design of Flume—The walls of the flume are 5 in. thick at the top, tapering to 6½ in. thick at the bottom with a beveled inside brace; the bottom is 7¼ in. thick at the sides tapering to 4 in. at the center. The reinforcement consists of ½-in. round bars, arranged as shown on the cross-section of the flume (see Fig. 2).

Experiments made on a 2000-ft. concrete flume of about the same dimensions, indicated the necessity for using about two-thirds of one per cent longitudinal reinforcing in order to eliminate large shrinkage cracks. For the Tiger creek flume it was found more economical to install expansion joints, using copper water stops at 20-ft. centers and only enough longitudinal reinforcing to act as ties for the transverse bars. The resultant saving is about $1.50 per foot of flume.

The inside wall of the concrete flume is designed (by additional reinforcement) to withstand the pressure of slide material from the outside when the flume is empty, as well as the pressure of water from the inside, when the flume is full. The outside wall is designed for water pressure only.

Drainage is secured by 8-in. concrete pipes laid across the bench, with a maximum spacing of 300 ft. in earth sections and 500 ft. in rock sections.

This concrete flume is being built with four complete outfits.

Immediately following excavation, grading, and compacting of the bench, water supply pipe-lines are laid, and then the concrete ties poured.

The forms for these ties are made of 2 by 4-in. lumber, laid on the side and nailed together to form a box; each box being used again many times as a unit. The ties are cast with 4 rectangular vertical projections (see Fig. 1) with a groove around the sides for bonding the ties to the bottom of the flume, the tops being at floor level. The two outside projections carry the inside steel forms for the walls, and the two inside projections support the wooden construction track and rail. The outside steel forms rest on the extreme end of the concrete ties. Jaeger 4 and 7-ft. gas-driven mixers are used for pouring the concrete ties.

The overhead roadway and deer crossings, and trestles and viaducts, are constructed by separate crews ahead of the flume construction proper.

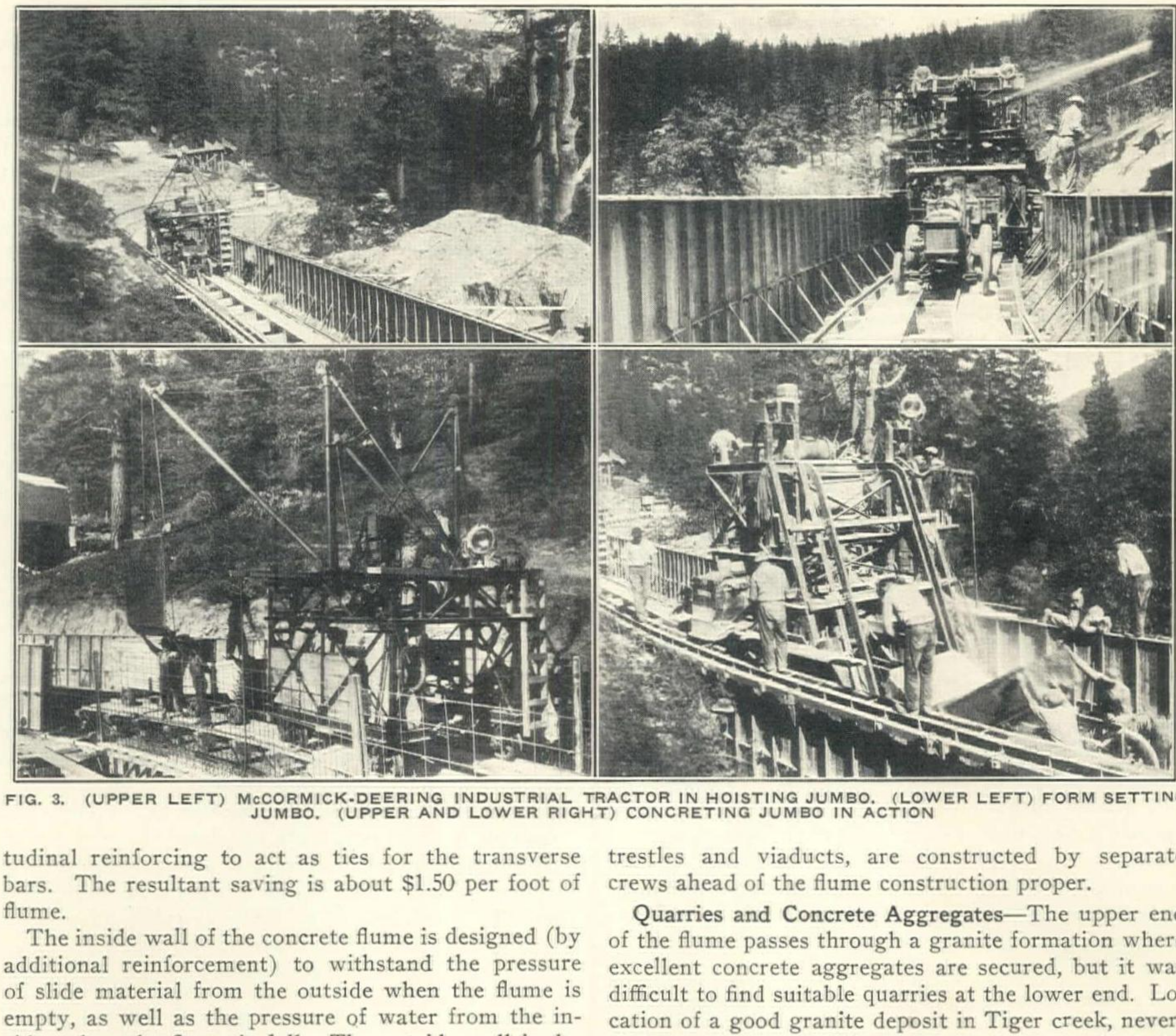


FIG. 3. (UPPER LEFT) McCORMICK-DEERING INDUSTRIAL TRACTOR IN HOISTING JUMBO. (LOWER LEFT) FORM SETTING JUMBO. (UPPER AND LOWER RIGHT) CONCRETING JUMBO IN ACTION

Quarries and Concrete Aggregates—The upper end of the flume passes through a granite formation where excellent concrete aggregates are secured, but it was difficult to find suitable quarries at the lower end. Location of a good granite deposit in Tiger creek, nevertheless, met the deficiency at the lower end of the project.

Four aggregate bunkers with batchers were erected at convenient intervals, over the flume, to supply this 21½-mile conduit; each of steel and wood construction and demountable. Each bunker has a capacity of 55 cu.yd. in two compartments, equipped with Johnson weigh bins. Aggregates are hauled to these bunkers in Mack 3½-ton compound drive trucks, with 4-yd. steel dump bodies actuated by hydraulic hoists. Cement is purchased from several companies in Bates valve bags and hauled by truck from Martell, the railroad terminus, that from the Calaveras Cement Co. plant being hauled direct in trucks 60 miles. The cement is unloaded onto a platform on the bunkers and chuted into the delivery trailer-trucks on top of the aggregates.

Distributing Aggregates—Aggregates and cement are hauled from the bunkers to the traveling concrete mixer jumbos in trains of 7 specially designed trailer trucks drawn by McCormick-Deering 10-20 industrial tractors equipped with pneumatic tires—speed, 10 miles per hour. The trailers each carry 26 cu.ft. of aggregates and 3 sacks of cement. They are designed to track closely in both directions, because the board track does not permit of much width on curves. The axles are of special nickel steel and are equipped with fifth wheels, and model AA Ford wheels and tires with specially designed hubs and Timken bearings. The bodies are mounted on Hyatt roller bearings, and roll forward, overbalance, and dump. A single lever operates the body and hinged end door. These trailers weigh 1275 lb. each, and were made by the Mutual Engineering Co., of South San Francisco.

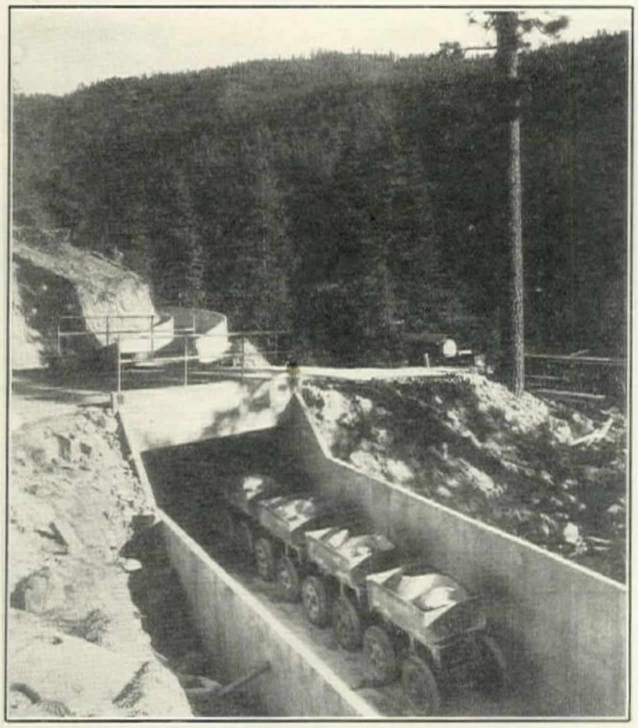


Fig. 4. Concrete Slab Road Bridge Across Flume, with Train of Concrete Aggregate Trailers and McCormick-Deering Industrial Tractor Passing Underneath

Tractor Hoisting Jumbo—For switching the tractors from one end of the trains to the other, a special, self-propelling jumbo is used. The frame is similar to that of the concrete mixing plant jumbo, described hereafter, but lighter. It is equipped with a Milwaukee 3-ton, floor operated, self-contained electric hoist, with an 18-ft. lift and speed of 32 ft. p. m., and automatic limit-height switch. The tractor is turned end for end while hoisted. This jumbo, as well as the other jumbos, was designed by the construction department of the P. G. & E. Co. and the Mutual Engineering Co., and built by the latter.

The steel panel forms were made by the Steel Tank & Pipe Co., of Berkeley. They are 5 ft. wide by 7 ft. high and weigh 500 lb., except a few sets 2 and 3 ft. long for use on the curves. Each of the four concreting units is supplied with enough forms for 650 lin.ft. of flume.

Form Setting Jumbos—For erecting the steel forms a special jumbo was designed, with a fabricated steel frame similar to the tractor-hoisting jumbo, and equipped with derricks instead of the tractor hoist. Each derrick is operated by a double-drum hoist driven by a 3-hp. motor; capacity 1000 lb. to top of the 20-ft. boom. This jumbo carries three 1-kv-a. transformers, 2400 to 240/120 volts, for power and light, connected to the main power supply cable by a flexible 3-conductor, No. 10 special shielded 2500-volt cable. A cable reel is not necessary, as on the concreting jumbos.

Form-Stripping Jumbos—These are similar in type and construction to the form-setting jumbos, except that they are not self-propelling. These were built at the P. G. & E. shops at Salt Springs dam.

Form-Moving Trailers—For moving the forms, each of the concreting units has a string of 6 steel trailer cars, which are pulled when loaded by the McCormick-Deering industrial tractors. These cars have 18 by 4-in. solid rubber-tired wheels, with the same gauge, axles, hubs, wheel attachments, fifth wheels, and couplings as the trailers for hauling aggregates. They have a steel skeleton body 6½ ft. long, 3 ft. wide, with end stake pockets.

Concreting Jumbos—The design of these traveling concrete mixing and placing plants required considerable ingenuity. There are four of these jumbos, each 14½ ft. high above rails, 13 ft. long, and 10 ft. wide. They are fitted with 2 double-flanged wheels having fixed supporting housings and 2 similar wheels pivoted; the gauge being 8 ft. 4 in. They are self-propelling at a speed of 30 ft. per min., and are driven by 5-hp. elevator-type motors through reduction gears and a system of shafts, sprockets, and chains, connected to the two wheels with fixed supports. The loading hopper travels on inclined channel-iron rails at the rear end, and is hoisted by a 7½-hp. elevator motor through suitable reduction gears. High and low-point limit switches are provided.

The concrete mixer, of special design, is of the revolving paddle type, equipped with maganese steel paddle tips and shell. The shafts carrying the paddles are of special steel and revolve at 40 r.p.m.

Concrete is discharged through a double gate, sliding both ways from the center, into a hopper directly beneath the mixer, and thence through chutes to 2 belt conveyors, extending through the sides of the tower to hoppers above the side walls of the flume. The belt conveyors are reversible and are operated by 3-hp. motors. The discharge of concrete is regulated by the sliding gate and by a hinged deflector, like a butterfly valve, in the inside of the mixer hopper.

Power is supplied through a flexible, 3-conductor, No. 10, solid copper, special shielded cable to three

10-kv-a. 2200/220-volt transformers. The cable is wound on a motor-driven reel, designed for a maximum cable tension of 80 lb. at 55°F.; the reel standing still for 10 min. after this tension is reached before reaching the limit of temperature rise. All motors on the jumbo are 220-volt, and push-button operated by one man.

Power is transmitted at 2500 volts from transformers at suitable points along the flume, through 3-conductor, No. 10, solid copper cable, insulated with 30% Para rubber.

Procedure—The real value of this mechanical layout is that it permits pouring of the concrete flume monolithically.

The train of trailer-trucks hauling the aggregates travels through the completed flume on the concrete bottom, except for the section represented by the previous two-day pour, the section under construction, and the form-setting section, where the train travels on a planked track.

The tractor is cut loose on reaching the rear end of the connecting jumbo, is run through to the tractor hoisting jumbo and raised; while each successive trailer, after being cut loose and its load dumped into the concrete hopper, is shoved through the concrete jumbo and the hoisting jumbo, and reconnected into a train. The tractor is then turned round, lowered, and pulls the train away.

The first concrete is poured into the side forms of the flume, up to midway of the height, the jumbo moving back and forth along a 60-ft. section. The concrete is tamped as poured, fills the beveled space at the foot of the forms, and spreads about a foot out into the bottom. The belt conveyor is then reversed and the concrete discharged into a hopper feeding a short section of pipe swivel-connected to the under side, and is distributed over the bottom; and then is screeded to grade and trowel finished. The belt conveyors then are again reversed and the walls completed. In this way, not only is a monolithic job secured, but fresh concrete is poured on concrete which has not as yet set. Recently light electric hammers* have been employed to vibrate the forms while the concrete is poured.

Curing—Careful consideration was given to various methods of curing, including asphalt sprays, but water curing was selected as satisfactory and less expensive. Burlap is hung over both sides of the walls to a point 3 ft. from the bottom, and kept wet for two weeks; water being supplied through wooden troughs mounted on the top of the walls, the ends being connected with pieces of rubber hose on the curves. Perforated ¾-in. pipes were also tried but found less satisfactory.

Progress—Concrete pouring commenced late in June of this year. It naturally required several weeks to smooth out the kinks in this new equipment. An average of 150 lin.ft. of completed flume per unit per shift was made for the first three months; since which time the average is 200 lin.ft.; or more than one mile of flume per week for the four units. About 12 miles of flume has been completed to date.

*Syntron.

Concrete Mix and Control—The mix is designed for concrete having a strength of 2500 lb. per sq.in. at 28 days. Sand and rock are all produced at local plants, the maximum size of rock being ¾ in. The mix varies somewhat, depending on the grading of material and the variation in the water-cement ratio.

Trestles, Bridges, and Siphons—There are about 95 elevated structural sections of the flume, having a total length of 9000 lin.ft. The elevated flumes have the same general cross-section as the bench flume, the floor being increased in thickness and girders being

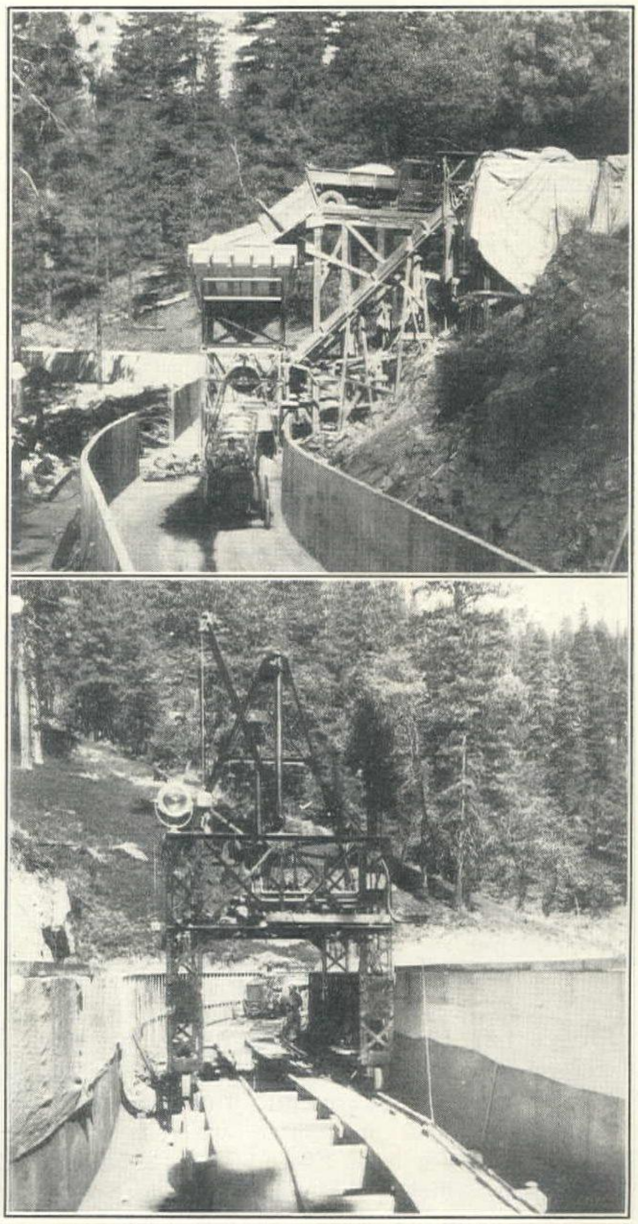


Fig. 5. (Upper) One of Four Concrete Aggregate Bunkers Equipped with Johnson Weigh Batcher. Mack Truck Dumping Aggregates to Bunker. (Lower) Form Stripping Jumbo

added under the side walls to carry the loads to the columns. Designs were prepared for spans varying between 16 ft. and 32 ft. on 2-ft. intervals, enabling the choice in the field of the span best suited for the foundation condition at each site.

Two of the elevated flumes are supported on arches. One of these arches is across Bear river, where the span is 158 ft. and the crown of the arch is 100 ft. above streambed. The second arch is at Alder gulch, where the span is 134 ft. and the height of crown 65 ft. above the bottom of the gulch. These two structures were designed by Harold B. Hammill, consulting engineer of San Francisco. There are two steel siphons, one 490 ft. long crossing the west branch of Panther creek, and one 840 ft. long across Deer creek. Panther creek siphon varies from 93 in. to 90 in. diam. for its entire length.

Concrete slab bridges are used wherever the road and flume cross. Suitable deer escapes and timber deer crossings are provided at intervals.

The elevated flumes—all concrete—are now under construction, some being completed. The general plan is to pour the substructure—including the floor—in advance and complete the side walls with the mechanical equipment aforedescribed.

Intercepting Local Run-off—Provision is made by feeder conduits to intercept the run-off from drainage basins crossed by the conduit. Cole creek and Bear river are the most productive watersheds; and the feeder capacities will be 250 and 550 c.f.s. respectively. Minor basins which will also be picked up are: Beaver creek, East Panther creek, West Panther creek, and Tiger creek.

Tiger Creek Regulating Reservoir—For a distance of nearly 18 miles, the Tiger creek conduit has a capacity of 550 c.f.s. In order to permit the operation of Tiger creek powerhouse on an 85% load factor, it is necessary to provide a small amount of storage near the lower end of the conduit, the plant using 625 c.f.s. over the peak hours. A regulating reservoir with an effective capacity of 160 ac-ft. is being constructed in Tiger creek. The dam is of the buttressed type, 100 ft. high and 470 ft. long on crest. Excavation of foundations is 90% complete and 20% of the concrete has been poured.

Tiger Creek Penstock and Powerhouse—Between Tiger creek regulating reservoir and the powerhouse, the conduit, 2½ miles long, has a capacity of 625 c.f.s. At the lower end, a small forebay of 40 ac-ft. capacity is being constructed to permit an instantaneous increase in the load on the plant.

The penstocks, previously described in the May 25th issue, are now under construction and will be completed by July, 1931; about one-half of the pipe being in place. Foundations for the powerhouse have been poured and the steel frame erected.

Construction of the afterbay dam has started.

Personnel—The entire Mokelumne river project is being designed and constructed by P.G.& E. forces. The engineering features are under the supervision of A. H. Markwart, vice-president in charge of engineering; I. C. Steele, chief of the division of civil engineering; Walter Dreyer, office engineer; G. C. Green, field engineer; with J. D. Galloway, as consultant on design of Salt Springs dam; J. P. Jollyman, chief of the division of electrical engineering; and E. A. Crellin, chief assistant.

Construction of the project is under the supervision of O. W. Peterson, engineer of general construction; Hector Keesling, chief assistant; P. I. Kurtz, field superintendent of Salt Springs dam and works westerly to Bear river; G. M. Wehrle, field superintendent from Bear river to and including the corporation yard at Martell, the railroad terminus; J. E. Cooney, assistant superintendent in charge of concrete flume construction; R. D. Reeve, resident engineer. E. H. Steele is engineer of transmission line construction.

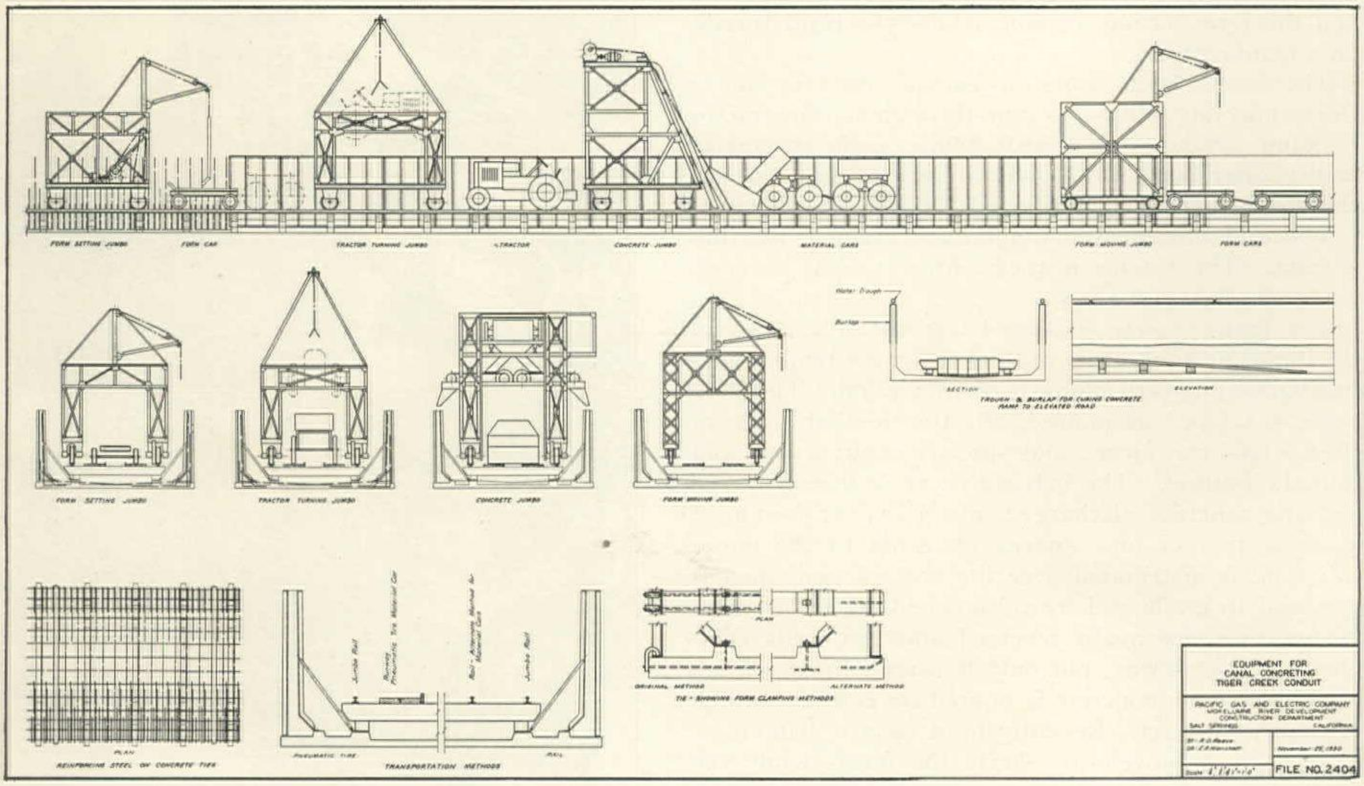


FIG. 6

West Central Avenue Bridge, Albuquerque, New Mexico

By M. B. REYNOLDS
Project Engineer, State Highway Department, Santa Fe, New Mexico

The West Central Avenue bridge provides a crossing of the Rio Grande two miles north of the present Barelas bridge and is on w. Central ave. extended. It gives the city of Albuquerque, New Mexico, a second and more direct outlet toward Gallup by way of the Laguna cutoff and will relieve Barelas bridge of some traffic by serving the numerous farms and communities on the west side of the river, many of which use Albuquerque as a marketing center. This bridge is the important link of a road tying into the Laguna cutoff close to the airport of the Western Air Express, and provides a more direct route from the airport to the city.

Design — This bridge is unique because of the unusual use of materials in its design. It consists of fifty-four 25-ft. spans of steel and concrete superstructure, resting on creosoted pile and timber bents and abutments. It is the second bridge of this type to be built in the vicinity, Barelas bridge, two miles below, being the same type but is 200 ft. longer and of somewhat heavier construction. Both bridges have a 20-ft. roadway with 6 ft. sidewalk on the upstream side and concrete handrail; and are designed for a loading of two 15-ton trucks.

This type of bridge was selected to give a pleasing appearance to the superstructure, as it is within the city, a creosoted pile substructure being used for two reasons; 1. limited funds; and 2. the river bottom is expected to be lowered by work of the Middle Rio Grande Conservancy District.* At some future time, after this lowering is completed, the piles can, if necessary or desired, be cut off below low water and a narrow concrete pier founded on the piles for foundation.

The substructure of the West Central Avenue bridge consists of 53 creosoted pile and timber bents and two creosoted pile and timber abutments. There are six 60-ft. piles in each bent and eight 60-ft. piles in each abutment. Caps are of 12 by 14-in. timber, 30 ft. long. The bents are braced in the usual manner with 3 by 10-in. sway braces and are further braced by 3 by 10-in. girts placed at the low water elevation, which for this river is the sand line. The abutments or bulkheads are lagged with 3 by 8-in. lagging, and 8 by 12-in. buck braces 4 ft. long are provided at each pile. All creosoted timber is dense Southern yellow pine, creosoted 12 lb. to the cubic foot.

The superstructure consists of five lines of steel I-beam stringers, supporting a concrete roadway slab and concrete handrail. One 16-in. by 35-lb. Carnegie beam carries one-half of the sidewalk slab, the other half being supported by and forming part of the upstream roadway curb, which in turn is carried by the upstream roadway stringer. In order to bring the sidewalk stringer to the correct height, it is elevated above the cap by two blocks at each bent, one 8 by 14 by 24-in. and the other 12 by 14 by 24-in.

WEST CENTRAL AVENUE BRIDGE OVER RIO GRANDE AT ALBUQUERQUE, NEW MEXICO

The concrete roadway slab is 8¼ in. thick, of which ¾ in. is monolithic wearing surface. The sidewalk slab is 5½ in. thick, including a ½-in. wearing surface, Transverse expansion joints are provided over each bent, and a longitudinal expansion joint runs the length of the bridge over the center roadway stringer. Premoulded bituminous joint filler was used for all expansion joints. A copper plate, with a V-trough pressed into it, was placed at each transverse joint, 2 in. below the surface of the concrete. This trough will drain surface water to one side, not allowing it to drip down upon the bed plates.

One of the features of this bridge is the use of concrete tie beams at the ends of each span. On the Barelas bridge, which is of the same general type, 6-in. steel I-beams were riveted to the webs of the stringers. The concrete beams are 21¾ in. deep, including the

*See article on Conservancy District, November 25th issue, p. 566.—Editor.

8¼-in. slab, and 15 in. wide; they are reinforced with four ⅞-in. round bars in the bottom and ½-in. square stirrups. Bearing is obtained on the bottom flange of the stringer by dropping the beam down to it on a 45-deg. batter. On account of the transverse expansion joint which is made at each bent, these beams must carry a portion of the live load as well as tie the stringers together. The tie beams are poured monolithically with the slab.

Provision for future lighting of the bridge was made by placing conduit in the handrail posts and providing inserts under the slab on both sides, to which longitudinal conduit can be hung. Anchor bolts to fit a standard Newell were placed in the posts so that there will be a light every 75 ft. along the bridge.

Pile Driving—The piling were driven by means of an overhanging driving rig. A 60-ft. steel derrick carrying a Vulcan-Warrington No. 3 steam hammer was provided, steam being furnished by a 16-hp. boiler. The general procedure was to drive a bent of piling, cut the piles to correct elevation, and then cap the bent. After capping, 2 by 6-in. ribbons were nailed on and well smeared with skid grease, after which the driver was moved ahead.

Pile driving began on the east or Albuquerque side

P&H 20-ton Dragline Making Fill on which to Leave West Central Avenue Bridge

with the driving of piling for abutment 1 and the fourteen 45-ft. piling which were placed directly in front of the abutment for bank protection. There were no particular difficulties encountered in driving. The piling were practically all driven to full penetration, which means about a 12-in. cutoff due to trimming the butt to fit the steel driving hood. Each pile after cutoff was given a coating of hot creosote oil, and then hot tar, after which it was covered with a piece of 26-gauge galvanized sheet iron.

Water for the boiler was obtained from a pump near the east abutment, and carried through a 2-in. pipe-line laid along the bents. Coal was carried out to the driver in sacks until the laying of steel caught up with the driver. It was then loaded onto a car running on the two downstream stringers, and pushed out to the end of steel, then transferred to the driving rig by hand.

There was considerable water in the river during the driving period, but it caused no trouble as the current was slow except in some channels where it was swift and deep. In these few channels it was difficult to set the piles accurately and in one or two cases the channels were changed by going upstream and placing a line of heavy stock fencing across the channel, thus slowing down the current and causing a bar to deposit.

Several methods of getting the piling out to the driver were used. The piling were stacked on the east bank, and as long as the driver was close enough it was easy to tie the pile line on and snake the piling out. To provide a snatch line, a cable was laid across the river and anchored to a deadman on the west bank. A snatch block was attached to this cable so that the pile line could pull against it in snaking the piling out over the riverbed. The drum would not accommodate enough line to snake the piling all the way out, so they were pulled about 300 ft. with a team until the quicksand got bad; then a Fordson tractor with hoist attachment was used. The tractor was mounted on heavy timbers laid across the steel on span 23. Piling for the last 10 bents were hauled around to the west side of the river by way of Barelas bridge.

Placing of sway braces and girts was delayed somewhat by high water, as it was desired to get the girts on at as low an elevation as possible. Drilling of bolt holes through the sways and piling was done by air drills run from an air line laid along the bridge on the bents. Holes were drilled $\frac{1}{16}$-in. smaller than the bolt diameter. Where there were spaces between the caps and the sway braces or between sways and piling, these spaces were filled with creosoted shim stock and the sways brought up tight.

Steel—The roadway of this bridge is carried by five 21-in. Carnegie I-beam stringers. One stringer on the center-line is a 70-lb. beam, two are 58-lb., and two are 55-lb. The sidewalk stringer is a 16-in., 35-lb. Carnegie beam.

As there was no shop work to be done on the steel, the contractor elected to ship the beams in and put the red lead shop coat on them himself. This was done with a Binks spray gun outfit.

The plans called for one anchor-bolt hole to be punched in the flange at one end of each stringer, and provided that this be done in the field. Also, in order to pass the ⅞-in. round reinforcing bars for the concrete tie beams through the web of the stringers, it was necessary to make four holes through the web in each end of every stringer. These holes were burned in the webs by means of an acetylene torch. They were not neat in appearance, but the concrete completely covered them.

The steel was hauled to the job and unloaded close to abutment No. 1 within easy reach of a stiff-leg derrick. The holes were punched in the flanges, the web holes were burned in, and the red lead coat of paint applied before placing of stringers was commenced.

The steel stringers were hoisted by the stiff-leg derrick onto a car running on the two downstream stringers. This car was pushed out by hand until the steel could be picked up by another and smaller stiff-leg derrick and placed on the span ahead. Placing of the steel followed within four spans of the pile driving. The stringers were clipped to the bed plates, which were anchored to the caps by two ¾-in. lag screws. One end of each stringer was fixed by having a lag screw pass through the flange; the other end was left free to slide under the clip on the bed plate. A templet was used for drilling starting holes in the cap for the lag screws, and by placing the templet with regard to a transit line the stringers were lined across the bridge.

The steel was painted two field coats by means of a spray gun except on windy days when the hand method was resorted to. White lead in oil, with lamp black to give a battleship gray color, was used for the field coats.

Concrete—As soon as the pile driving and laying of steel had progressed far enough to insure that the form carpenters would not be held up, forming of the concrete roadway and sidewalk slabs was begun. The form work started when the driver was at bent No. 21, and by the time the forms were ready to receive concrete the driver had reached bent No. 35. Enough forms were provided to pour 18 half-spans of roadway and 27 spans of sidewalk. The upstream half of the roadway and the sidewalk were poured first, because it was necessary to leave the two downstream stringers open for dollying the coal out to the driver, and stringers out to the steel gang.

Concrete was made at the Springer Transfer Co. central mixing plant and hauled to the job in trucks. For the first 27 spans, a hopper and incline was built on the ground near abutment No. 1 and the trucks dumped into the hopper. From the hopper, the concrete was dumped into buggies which were pulled up another incline onto the bridge by means of a Fordson hoister and pushed by hand out to the slab being poured. Dumping the trucks into the hopper gave a remixing effect, and a man was kept on the hopper to spade the concrete so that any segregation occurring in the 2.9-mile haul would cause no trouble.

For pouring the last 27 upstream half-spans of roadway and the sidewalk slabs, the hopper was moved out to span 27 and the concrete trucks backed out to it and dumped. From the hopper, the concrete was buggied out to the slab being poured as before.

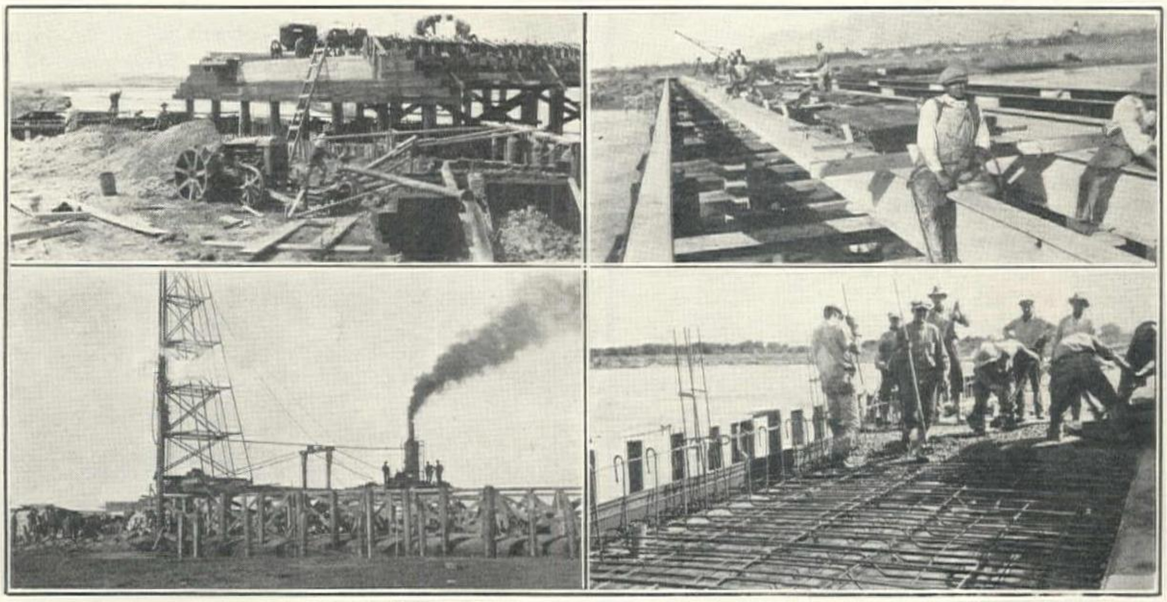
After finishing pile driving and placing the last span of steel, a form crew started forming the downstream roadway slab. The fact that there was a longitudinal joint down the centerline of roadway, made it possible to pour one-half the roadway at a time.

As the design provided a concrete tie-beam monolithic with the slab at the ends of each span and also a copper expansion plate in each joint, it was necessary to pour alternate spans one day and then pour the intermediate spans two days later. The intervening day was used for changing header boards, placing reinforcing steel, and getting ready for the next pour. As soon as possible after pouring, the concrete was covered with burlap and wet down. The following day it was covered with a layer of sand, which was kept wet by sprinkling two or three times a day.

The roadway and sidewalk slabs are of class 'A' concrete, being a nominal 1:2:4 mix. The mix actually used was 1:2.2:3.2, as this was found to give better workability and required close to 6.3 sacks of cement per cubic yard, meeting the specification. Test cylinders were made for every 100 cu.yd. of concrete poured, all test results being over 3000 lb. per sq.in. at 28 days.

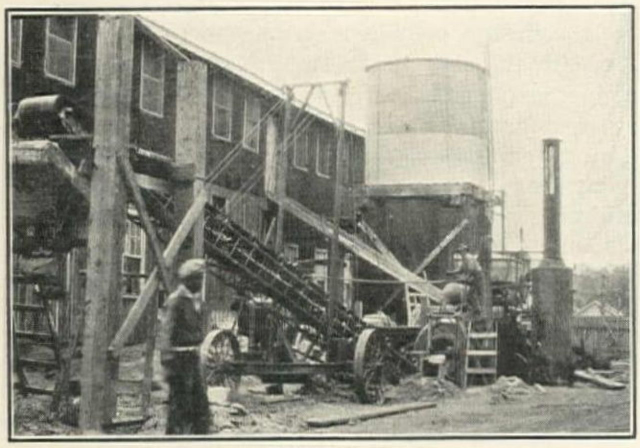
The handrail for this bridge is of class D concrete, using 7.3 sacks per cubic yard. The rails were precast and stored, then hauled to the job as needed. There are 4 posts per span on each side of the bridge. The posts were poured in place, a one-sack mixer for this purpose being set up on the bridge.

Utilities—The sidewalk slab was half poured when the Telephone Co. decided to lay a conduit box under this slab for the purpose of carrying a transcontinental line across the river on this bridge. In order to carry the conduit box and the additional load imposed, it was necessary to increase the amount of steel in the sidewalk slab. From bent No. 27 to abutment No. 2 this



(UPPER LEFT) COFFERDAM AND EXCAVATION FOR WEST BANK PROTECTION. (UPPER RIGHT) PUTTING IN FLOOR FORMS. (LOWER LEFT) DRIVING 45-FT. PILES FOR EAST BANK PROTECTION WITH VULCAN No. 3 STEAM HAMMER. (LOWER RIGHT) PLACING CONCRETE ON DOWNSTREAM FLOOR SLAB OF SPAN 31 was done, and inserts were put in the slab so that hanger bolts could be easily attached.

For carrying the conduit under the slab that was already poured, open-web steel joists were provided which would span two bents. These joists, to give a tight fit under the slab, were blocked up from the cap by means of creosoted timber blocks. Two manholes were provided, and a housing for loading coils was built under each manhole by boarding up the two upstream piling directly under the sidewalk slab.



Concrete Plant for West Central Avenue Bridge

This work was done for the Telephone Co. by the bridge contractor, but the plans were first approved by the State bridge department.

Progress and Personnel—The bridge and approaches were completed in 156½ working days, well ahead of the 180 working days allowed.

The contract was originally let to Armstrong & Armstrong, of Roswell, New Mexico, but was sublet to the Levy Construction Co., of Denver. J. H. Miner, New Mexico representative for the Levy Construction Co., was directly in charge for the contractor and Chas. O'Leary was the contractor's superintendent. The bridge was designed by E. B. Van de Greyn, bridge engineer, New Mexico State Highway Department; I was project engineer on the job.

W. C. Davidson is state highway engineer and R. W. Bennett is office engineer for the Department. The contract for this bridge was in district 3, of which Frank Kimball is district engineer.

A. G. C. TWELFTH NATIONAL CONVENTION

Preparations are being made in San Francisco for one of the most elaborate and interesting national conventions of the Associated General Contractors of America when the Northern California Chapter plays host to 1200 or 1500 visitors January 25 to 30, 1931. A special train carrying delegates from the east will leave Chicago at 10:30 a.m. January 20 over the Santa Fe, picking up the southerners at Kansas City and at Newton, Kansas, and the south-central delegates at Colorado Springs, arriving in Los Angeles, January 24, San Francisco, January 25. The St. Francis and Palace hotels have been named convention headquarters, with the sessions being held in the former and the banquet on Thursday night, January 29, at the latter hostelry.

The sessions will be opened by A. E. Horst, of Philadelphia, and Rock Island, president. A. P. Greensfelder, president of the Fruin-Colnon Contracting Co. of St. Louis, has been nominated for president of the A.G.C. for 1931, and is being voted into office this month, with W. A. Starrett, president of the Starrett Corp. of New York City, as vice-president at large. C. E. Bressler, of Wells & Bressler, Santa Ana, California, has been nominated as the vice-president of the national organization from Zone 7.

The annual Christmas entertainment of the Northern California Chapter will this year be held in conjunction with the National Convention.

TWIN BRIDGES TO SOUTH FORK HIGHWAY, MINERAL COUNTY, COLORADO

The H. C. Lallier Construction Co., Denver, will complete a contract about June, 1931, for grading, drainage, surfacing, and one concrete bridge in Mineral county, Colorado, between Twin Bridges and South Fork, contract price $114,590. The contract is designated as F.A.P. 298-C and is 3.78 miles long.

To November 12, the following progress had been made: Grading—80%, drainage—90%, surfacing—50%, and miscellaneous items—70% completed. It is expected that the rough grading will be completed before the winter shutdown, but it is doubtful if fine grading and surfacing can be finished this season, as storms and severe cold are liable to close the work until about April 15.

Placing Shots in Box Canyon on F.A.P. 298-C, Colorado

There is considerable heavy rock excavation on this contract, including a box canyon section along Wolf creek. Rock is being loaded with a Koehring power shovel; typical grading operations on this project are shown on the front cover illustration.

W. J. Walsh is resident engineer on F.A.P. 298-C for the Colorado Highway Department.

Olympic Extension for Northern Pacific

Plans are being prepared by the engineering department of the Northern Pacific Railway Co. for 60 miles of railroad from Moclips, Washington, to the north bank of Hoh river near Spruce, estimated cost $5,900,000. Bernard Blum is chief engineer at St. Paul and A. F. Stotler is assistant chief engineer at Seattle.

Temperature Variations in Concrete Dams

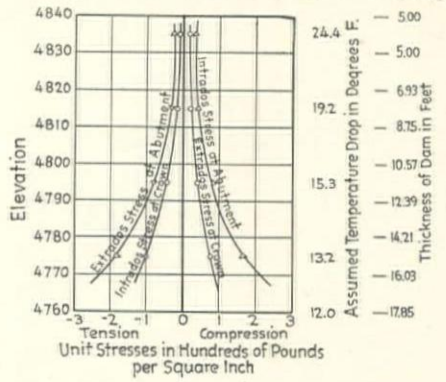
Effects on Stress—Measurements at Bureau of Reclamation Dams—Summaries of Observational Data—Curves for Arch Dam Design

By IVAN E. HOUK*
Senior Engineer, U. S. Bureau of Reclamation, Denver, Colorado

Concrete temperature variations must be carefully considered in designing arch, or arched gravity dams, if reliable estimates of load distribution and maximum stress are to be made. Measurements show that seasonal concrete temperature changes alone may cause appreciable radial deflections, and important secondary stresses, at times when the structures are subjected to full water-load. If need for early operation of the reservoir requires grouting of the construction joints or pouring of closing plugs before the setting heat has been entirely dissipated, the additional temperature drop to be expected from this source must also be considered in the stress analyses and in the development of an adequate design.

The actual movements of the dam resulting from temperature changes are not in themselves consequential, whether in an upstream direction due to an increasing temperature, or in a downstream direction due to a decreasing temperature. However, their effect on the distribution of water load between arch and cantilever elements, and on the magnitude of the arch stresses, is important, especially in the case of the downstream movements where the cantilever loads and resulting maximum cantilever stresses are usually increased, and where the temperature stresses in the arches are added to the water load stresses. The tension stresses produced at the arch extrados at the abutments, and at the arch intrados at the crown, by the drop in concrete temperature which occurs during the winter and spring months, are especially undesirable because they may cause vertical cracking and corresponding increases in compressive stress at the opposite sides of the arches. Dissipation of the setting heat remaining in the concrete at the time of grouting the construction joints or pouring the closing plugs, may produce similar effects.

Setting Heat—The generation and dissipation of setting heat is more important in the case of unusually large and thick dams than in the case of dams of ordinary size. Other things being equal, the rise in concrete temperature due to generation of setting heat increases as the thickness of the dam increases. This is because of the less favorable opportunity for the heat to be conducted to the faces of the thicker dams and there radiated into space. However, in the case of seasonal variations in concrete temperature resulting from changes in outside air and water temperatures, the reverse is true. It is just as hard for outside heat to get into the interior of the dam as it is for the interior heat to get out. Other things being equal, seasonal variations in concrete temperature decrease as the thickness of the dam increases, so that the effect of such variations on the design of the dam becomes less important as the size of the dam increases. In the design of the 727-ft. Hoover dam, which, according to present tentative plans, will have a thickness of 650 ft. at the base, the effects of seasonal concrete temperature changes were found to be negligible in the lower arches where the thicknesses are greater than about 200 ft. For instance, the analysis of an arch 243 ft. thick, showed that a drop in average concrete temperature of one degree Fahrenheit would cause a radial deflection of 0.000012 ft., a maximum tension of 12.3 lb. per sq.in., and a maximum compression of 2.0 lb. per sq.in., quantities which are negligible in comparison with the effects of either water load or setting heat.



Temperature Stresses in Gerber Dam
caused by Maximum Drop in Temperature below Mean Annual Value
Calculated by Cain Formulas.
Fig. 1

As the generation of setting heat and the accompanying maximum rise in concrete temperature are directly due to the setting of the concrete, both are intensified by increasing the yield, or cement content, of the concrete, other things being equal. However, the relation between maximum rise in concrete temperature due to setting heat and the cement content of the concrete, probably is not a straight line relation owing to differences in rates of curing of the different mixes. Seasonal ranges in concrete temperatures caused by seasonal ranges in outside air and water temperatures are not appreciably affected by ordinary variations in cement content or concrete mix. This is due to the fact that the diffusivity constant is not appreciably affected by such variations. Experiments at the University of Illinois, made with concrete mixes varying from 1 part of cement and 2 parts of aggregate to 1 part of cement and 9 parts of aggregate, showed no definite variation in density, conductivity,

*Member, American Society of Civil Engineers.

specific heat, or diffusivity constants; the diffusivity constant being defined as the 'thermal conductivity divided by the product of specific heat and density'.[1]

Effect on Stress—Fig. 1 shows the extrados and intrados temperature stresses calculated for the crown and abutment sections of the Gerber dam, an 80-ft. arch dam built on the Klamath Project, Oregon, a few years ago.[2]

The assumed temperature drops, in degrees Fahrenheit, and the thicknesses of the arch rings, in feet, are shown at the right of the diagrams. It will be

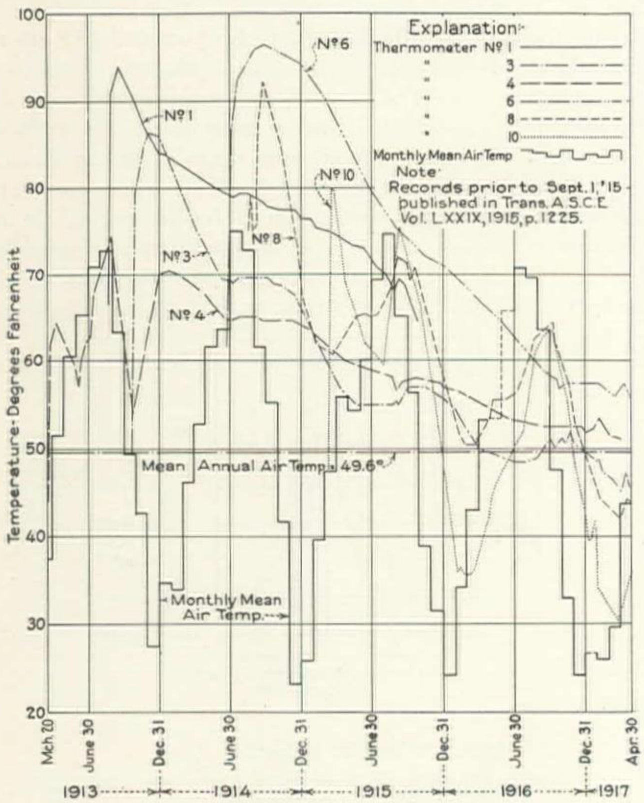


FIG. 2,-TEMPERATURE OBSERVATIONS-ARROWROCK DAM

noticed that temperature drops of 12.5 to 13 deg. near the base of the dam, where the thickness varied between 15 and 17 ft., caused temperature stresses of 100 to 200 lb. per sq.in., the stress being tension at the extrados at the abutment and at the intrados at the crown, and compression at the intrados at the abutment and at the extrados at the crown. The t/r ratio was about 0.10 at the lower elevations, and the corresponding central angle about 75 deg.

Recent trial load stress analyses for a somewhat higher and thicker dam having about the same curvature, showed reductions in maximum stress of as much as 25% in cantilever compression at the downstream edge of the base, 16% in maximum arch compression, and 50% in maximum arch tension, due solely to reductions of 8 to 14 deg. in estimated temperature drop. This shows the importance of carefully studying the magnitude of temperature changes to be expected in concrete dams of ordinary size, so that accurate estimates can be made for purpose of design.

[1]'The Thermal Conductivity and Diffusivity of Concrete', by A. P. Carman and R. A. Nelson, Bulletin No. 122, Engineering Experiment Station, University of Illinois, Urbana, Illinois, 1921, p. 28.

[2]'Gerber Dam, Klamath Project, Oregon—Details of Design and Construction', by A. L. Darr, **Western Construction News**, March 10, 1926, p. 29.

Concrete Temperature Measurements—During the last quarter of a century, concrete temperature measurements have been made at a number of dams, reinforced concrete arch bridges, concrete bridge piers, retaining walls, foundations for buildings, and other important concrete structures. The investigations made by Thaddeus Merriman at the Boonton dam in New Jersey, during the period 1903-1906, constituted the first real attempt to measure and analyze temperature changes in the interior of a large dam.[3] The studies made by C. S. Nichols and C. B. McCullough at the Squaw Creek bridge at Ames, Iowa, and at the Walnut Street bridge, in Des Moines, Iowa, during the period 1909-1912, also deserve special mention.[4]

Other structures at which concrete temperature measurements were made during the earlier years of investigation, include the Brooklyn Avenue bridge at Los Angeles; the Walnut Lane bridge at Philadelphia; the Kensico dam in New York; the Arrowrock dam in Idaho; the Gatun Lock walls at Panama; the Hollingsworth & Whitney Co. canal walls at Madison, Maine; the Compton Hill reservoir retaining wall at St. Louis; the Rock Creek and Lake Spaulding dams in California; and the Waldeck dam in Germany. Concrete structures at which temperature measurements have more recently been made include the Cleveland, Cincinnati, Chicago & St. Louis Railway Co. bridge at Sidney, Ohio; the Tirso dam in Italy; the Wilson dam in Alabama; the Gerber, Emigrant Creek, and Bull Run dams in Oregon; the Stevenson Creek and Shaver Lake dams in California; the Gibson dam in Montana; the Coolidge dam in Arizona; the La Jogne dam in Switzerland; the Sennar dam in Egypt; and the Cedar Avenue bridge in Minneapolis.

A large number of the more recent concrete temperature measurements, particularly those made at dams in the western United States, have been carried on by, or in cooperation with, the Engineering Foundation Arch Dam Committee. The concrete temperature measurements made by this Committee at the Stevenson Creek Test Dam in California were briefly described in Volume I of the Arch Dam Report.[5] It is presumed that the other concrete temperature measurements made by this Committee will be published in future reports. Some of the concrete temperature measurements at important dams, such as those made at the La Jogne dam[6] in Switzerland and the Waldeck dam[7] in Germany, have been published in great detail. Others have not been published at all, or have only been briefly mentioned in engineering publications. The elaborate measurements made by the New York Board of Water Supply at the Kensico dam in New York, during the years 1913 to 1915, have never been adequately described in technical literature.

Some of the thermometer installations at the aforementioned structures were made for the specific pur-

[3]Discussion of Charles S. Gowen's article on 'The Effect of Temperature Changes on Masonry', by Thaddeus Merriman; Trans. Am. Soc. C. E., Vol. LXI, December, 1908, p. 413 to 429.

[4]'The Determination of Internal Temperature Range in Concrete Arch Bridges', by C. S. Nichols and C. B. McCullough, Bulletin No. 30, Engineering Experiment Station, Ames, Iowa, January, 1913.

[5]'Engineering Foundation Arch Dam Investigation', Vol. I; Proc. Am. Soc. C. E., May, 1928, Part III.

[6]'Variations and Distribution of Temperature in the Montsalvens Dam', by Paul Joye and Alphonse Christen, Bulletin Technique De La Suisse Romande, Annee, 1922.

[7]'Temperature Movements in the Waldeck Dam', by Thurnau, Deutsche Wasserwirtschaft, 1924, p. 117 to 125.

pose of determining effects of setting heat on concrete temperatures. Consequently, in several such instances the temperature observations were discontinued as soon as the setting heat was dissipated and before sufficient data were obtained to determine the seasonal changes in concrete temperatures resulting from variations in outside air or water temperatures. In other instances, readings were continued for several years, so that the data secured furnish valuable information regarding both seasonal concrete temperature changes and effects of setting heat.

Measurements at Reclamation Dams—Measurements of concrete temperature variations have been made by the Bureau of Reclamation at Arrowrock dam on the Boise Project, Idaho; at Gerber dam on the Klamath Project, Oregon; and at Gibson dam on the Sun River Project, Montana. The measurements made at Arrowrock dam from the time the thermometers were installed in 1913, 1914, and 1915, until September 1, 1915, have already been adequately described.[8] A condensed record of all measurements made prior to April 30, 1917, is shown on Fig. 2. The observations were discontinued on that date, due to the fact that half of the thermometers were out of order and the measuring instrument giving trouble. A study of the records obtained after September 1, 1915, shows that seasonal variations in interior concrete temperatures, resulting from seasonal variations in outside air and water temperatures, are more important, and extend to greater depths from the faces of the dam, than was found in conclusions 6 and 7 of the original study.[9] The later measurements show that seasonal variations in concrete temperature may amount to more than 20 deg. F. at a depth of 10 ft. and to as much as 7 deg. at a depth of 20 ft.; also that they do not decrease to negligible values until a depth of more than 30 ft. is reached. The contracted time scale used in Fig. 2 helps to emphasize the effects of setting heat and to show the rates of dissipation of heat at the different thermometers. Thermometer No. 1, which went out of commission in the fall of 1915, was, prior to that date, falling at a rate which would indicate a complete dissipation of setting heat in a total time of 4.4 years. Thermometer No. 1 was located near the center of the cross-section in the lower part of the dam, at a perpendicular distance of 76 ft. from the downstream face and approximately 93 ft. horizontally from the upstream face. Additional data on the location of the thermometers and the results of the concrete temperature measurements at Arrowrock dam, also similar data for the concrete temperature investigations at the Gerber and Gibson dams, are included in the summaries in Tables I and II.

Seventeen electrical resistance thermometers were installed in Gerber dam during the course of its construction.[10] These were located at three elevations at the crown section, the individual thermometers being placed at various distances from the upstream and downstream faces at each elevation. Unfortunately, readings were not begun as soon as the thermometers were covered with concrete. Consequently, no information was secured regarding the rise and fall of the interior concrete temperatures due to generation and dissipation of setting heat. When observations were begun on January 1, 1925, it was found that approximately half of the thermometers were out of order. However, periodic readings at the remaining thermometers, with some interruptions due to moisture troubles with the measuring instrument, have been continued since that time, so that the data now available furnish some information regarding seasonal changes in concrete temperature. Fig. 3 shows a typical season's record of concrete temperatures at Gerber

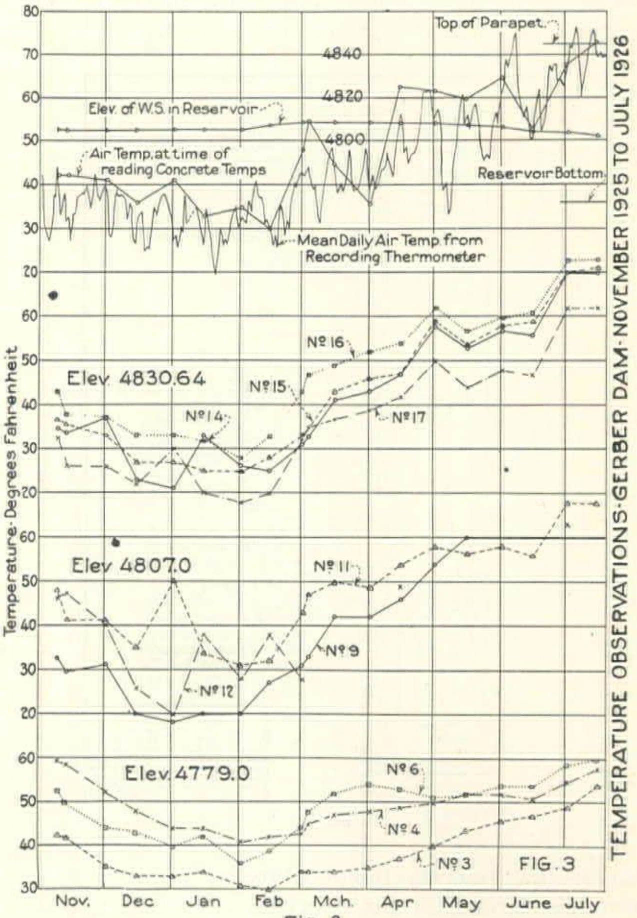


Fig. 3

dam; also elevations of reservoir water surface, reservoir bottom, top of parapet, and mean daily air temperatures determined by a recording thermometer.

Thirty-one electrical resistance thermometers were installed in Gibson dam during August and October, 1928. These thermometers were placed at various distances transversely across the dam in the section back of the outlet valve house; 18 at an elevation 30 ft. above the base of the dam where the thickness is 54.5 ft., and the remaining 13 thermometers 95 ft. higher where the thickness is 25.3 ft. A more substantial type of resistance thermometer was used in the Gibson dam installations; and probably greater care was also used in placing the instruments. At the present time, after two years of observations, all 31 of the thermometers are still registering; and all records appear to be satisfactory except those secured at Thermometer No.

[8] 'Temperature Changes in Mass Concrete', by Charles H. Paul and A. B. Mayhew, Trans. Am. Soc. C. E. Vol. LXXIX, 1915, p. 1225.
[9] Loc. cited, p. 1267.
[10] Gerber Dam, Klamath Project, Oregon—Details of Design and Construction, by A. L. Darr; Western Construction News, March 10, 1926, p. 29.

21, where the readings seem to be consistently low to the extent of a few degrees. The Gibson concrete thermometers were designed and manufactured by Henry H. Plumb, electrical engineer in the Denver office of the Bureau of Reclamation. Fig. 4 shows the details of their construction and the specifications for the resistance coils.

Readings at the Gibson dam thermometers were taken just before the instruments were covered with concrete, about three times a day during the week after placing, and periodically at somewhat greater intervals from that time to date. Consequently, accurate data were obtained regarding the rise and fall of concrete temperature due to generation and dissipation of setting heat; and reliable data undoubtedly will be available sometime in the future regarding seasonal

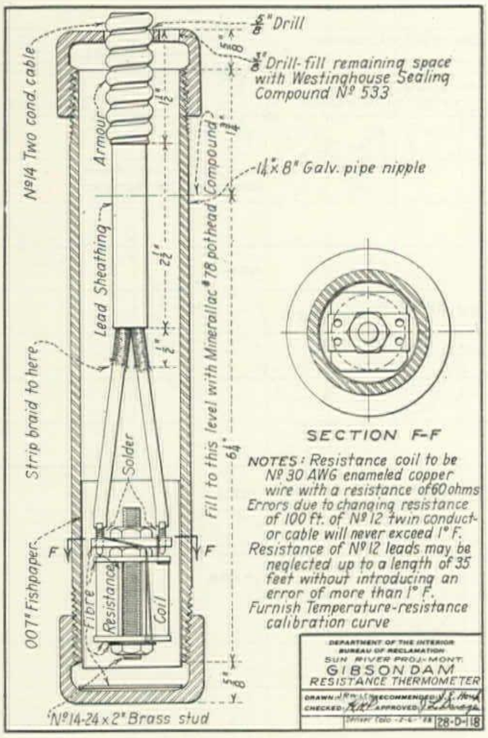


Fig. 4

changes in concrete temperature at different depths from the surface of the concrete. Table I gives the location of each thermometer with respect to the nearest face of the dam, the maximum rise in concrete temperature due to setting heat, and the time required for the concrete temperature to reach its maximum value. Fig. 5 and 6 show the variations in concrete temperature through the dam, at the two elevations where the thermometers are located, for selected dates of observation. The changes in shape of the curve near the face of the dam illustrate the varying lag in temperature at different depths from the surface of the concrete. Planimeter measurements of the curves for the first month after installation, show that the maximum rise in average concrete temperature for the entire thickness of the dam, caused by setting heat, amounted to 30.1 deg. F. at the upper elevation, where the thickness is 25.2 ft., and to 39.1 degrees at the lower elevation, where the thickness is 54.5 ft. The average cement content for the entire dam was 1.00 bbl. per cu.yd.

TABLE I
Maximum Rise in Concrete Temperature Caused by Setting Heat, Gibson Dam, Sun River Project, Montana*

					Conc. temp. in °F			
Therm. (No.)	Concrete thick. (ft.)	Location of therm., or nearest face	Dist. to nearest face (ft.)	Date of placing	Time of placing	Maximum	Rise in temp.	Time to reach max. (days)
1	54.5	Upstream	0.5	Aug. 14, 1928	54.8	86.2	31.4	5
2	54.5	Upstream	1.0	Aug. 14, 1928	54.1	88.4	34.3	5
3	54.5	Upstream	2.0	Aug. 14, 1928	54.6	91.9	37.3	5
4	54.5	Upstream	3.0	Aug. 14, 1928	55.4	94.9	39.5	5
5	54.5	Upstream	5.0	Aug. 14, 1928	55.6	101.2	45.6	10
6	54.5	Upstream	8.0	Aug. 14, 1928	56.3	105.2	48.9	13
7	54.5	Upstream	12.0	Aug. 14, 1928	56.5	106.5	50.0	13
8	54.5	Upstream	16.0	Aug. 14, 1928	56.1	105.6	49.5	13
9	54.5	Upstream	22.0	Aug. 14, 1928	56.7	102.8	46.1	25
10	54.5	Downstream	22.0	Aug. 14, 1928	55.8	102.0	46.2	28
11	54.5	Downstream	16.0	Aug. 14, 1928	56.7	99.7	43.0	26
12	54.5	Downstream	12.0	Aug. 14, 1928	57.5	98.9	41.4	22
13	54.5	Downstream	8.0	Aug. 14, 1928	58.6	96.0	37.4	14
14	54.5	Downstream	5.0	Aug. 14, 1928	59.4	92.2	32.8	11
15	54.5	Downstream	3.0	Aug. 14, 1928	59.4	87.7	28.3	8
16	54.5	Downstream	2.0	Aug. 14, 1928	58.6	83.9	25.3	4
17	54.5	Downstream	1.0	Aug. 14, 1928	57.3	78.7	21.4	4
18	54.5	Downstream	0.5	Aug. 14, 1928	56.4	78.1	21.7	3
19	25.2	Upstream	0.5	Oct. 30, 1928	37.2	52.6	15.4	6
20	25.2	Upstream	1.0	Oct. 30, 1928	38.8	60.2	21.4	6
21	25.2	Upstream	2.0	Oct. 30, 1928	37.8	54.1	16.3	6
22	25.2	Upstream	3.0	Oct. 30, 1928	37.6	64.1	26.5	6
23	25.2	Upstream	5.0	Oct. 30, 1928	38.6	68.0	29.4	6
24	25.2	Upstream	8.0	Oct. 30, 1928	38.5	73.2	34.7	6
25	25.2	Center	12.5	Oct. 30, 1928	39.2	75.4	36.2	6
26	25.2	Downstream	8.0	Oct. 30, 1928	39.5	75.2	35.7	6
27	25.2	Downstream	5.0	Oct. 30, 1928	39.4	71.5	32.1	6
28	25.2	Downstream	3.0	Oct. 30, 1928	38.6	66.2	27.6	6
29	25.2	Downstream	2.0	Oct. 30, 1928	37.6	60.6	23.0	6
30	25.2	Downstream	1.0	Oct. 30, 1928	38.7	55.8	17.1	6
31	25.2	Downstream	0.5	Oct. 30, 1928	38.5	52.6	14.1	6

*Cement content 1.00 bbl. per cu.yd.

Summaries of Observational Data—Table II summarizes all the information I have thus far been able to secure relating to maximum variations of internal concrete temperature as caused by seasonal variations in outside air and water temperatures. Miscellaneous pertinent data regarding location of thermometers, thickness of concrete, periods of time covered by the observations, places of publication, condition of reservoir, and so forth, are included in Table II, as well as the maximum range in concrete temperature. The maximum range in concrete temperature given is the difference between the maximum observed concrete temperature and the minimum observed concrete temperature, regardless of whether or not they occur in the same year, the maximum concrete temperature being determined after the setting heat has been entirely dissipated. Distances from the thermometers to the nearest surface of the concrete are the shortest distances, whether horizontal, inclined, or vertical. The data are arranged in the approximate order of increasing concrete thickness, the comparatively thin reinforced concrete retaining walls and arch bridges being included first, then the thinner concrete arch dams, and finally the heavier gravity dams. Items are numbered consecutively throughout the table to facilitate future references, but the original thermometer numbers are given in the column following the name of the structure, location, and reference.

Fig. 7 shows the maximum variations in concrete temperature plotted as ordinates against the corresponding distances of the thermometers from the nearest concrete face as abscissas, the same method of plotting that was used by Thaddeus Merriman in studying the Boonton dam temperature measurements.[11] In fact, Merriman's curve, $R = \frac{45}{\sqrt[3]{D}}$, where R is the temperature range in degrees Fahrenheit and D the depth from the surface of the concrete in feet, is shown by the dotted line on the diagram. Merriman's curve is somewhat below the average of the plotted points for depths less than 10 ft., and somewhat above the average for depths greater than 16 ft.

The points plotted in Fig. 7 are somewhat scattered, as would naturally be expected. Undoubtedly, a part of the erratic nature of the data is due to the effects of variations in reservoir water surface elevation. In some cases, the reservoir surface was below the elevation of the thermometers when the maximum range

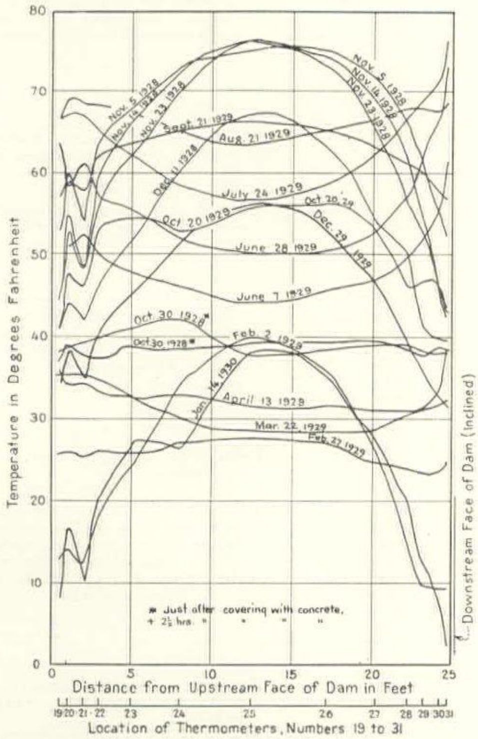


FIG. 5, CONCRETE TEMPERATURES AT ELEVATION 4675 MIDWAY BETWEEN CONTRACTION JOINTS 17 AND 18

in concrete temperature was observed; in other cases, it was above the thermometers throughout the entire period of observation. Of course, in the case of the concrete arch bridges there was no water present to affect the temperatures. Notes regarding the relative elevations of reservoir water surface and concrete thermometers during the periods of measurement were included in the 'Miscellaneous Remarks' column of Table II whenever possible.

Two curves are shown on Fig. 7, besides Merriman's curve. Curve A is drawn so as to lie above all but the very highest points. Curve B is drawn somewhat lower than Curve A, but is still well above the average of all actual measurements, and probably somewhat above the average of all points not affected by reservoir water temperatures. Curve A can be used if one wishes to be ultra-conservative. Curve B is probably satisfactory for most engineering work requiring data on variations in concrete temperature at different depths from the surface of the concrete, caused by variations in outside temperatures.

Temperature Curves for Arch Dam Design—In order to properly design arch dams, the engineer needs to know the maximum range in concrete temperature for the entire thickness of the dam, rather than the maximum range at different depths from the surface of the concrete. Consequently, curves are needed

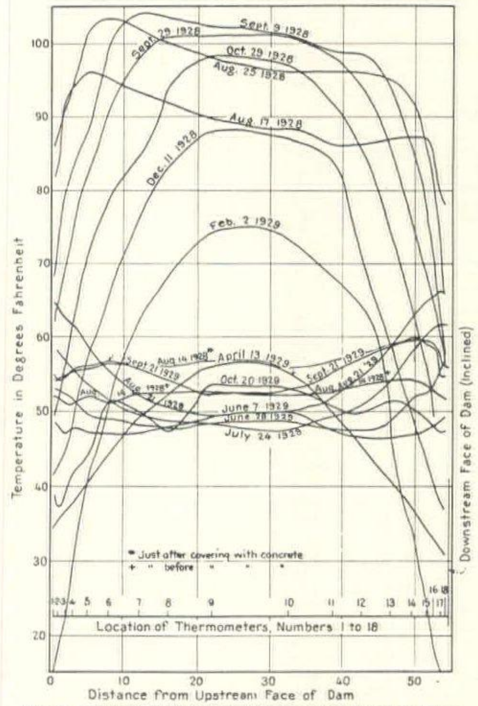


FIG. 6, CONCRETE TEMPERATURES AT ELEVATION 4580 MIDWAY BETWEEN CONTRACTION JOINTS 17 AND 18

which will show the maximum temperature range for dams of different thickness, where the maximum range is the average for the entire thickness instead of at a given point. Such curves can easily be determined from the data shown on Fig. 7. Any ordinate in Fig. 7 may be considered as the center of a dam having a thickness equal to twice the distance represented by the corresponding abscissa. For such a consideration, Curve A, or Curve B, between the Y-axis and the selected ordinate, represents the maximum range in concrete temperature at different points between one face of the dam and the center line, the Y-axis being one face of the dam. Similar curves would exist on the other side of the center-line. Consequently, the area beneath Curve A, or Curve B, at the left of any ordinate, divided by the abscissa for that ordinate, gives the average maximum range in concrete temperature based on Curve A, or Curve B, for a dam having a thickness equal to twice the distance represented by the given abscissa. Such areas can be measured with a planimeter and average maximum temperature ranges calculated for a number of thicknesses of dam. Fig. 8 shows curves determined in this way, the pair of full line curves being based on Curve A, and the pair of dotted line curves, on Curve B. The lower curve in each pair gives temperature ranges one-half as great as the upper; in other words, the ranges to be expected in case one side of the dam were insulated so as to prevent any escape of heat through that surface.

For the purpose of designing arch dams, the engi-

[11] Loc. cited, p. 419.

neer needs to know the maximum temperature stresses which may occur in the dam when the reservoir water surface is at its highest elevation, rather than the maximum temperature stresses which may occur when the reservoir is empty. Consequently, for design purposes, the temperature range at the upstream face of the dam is determined by the range in reservoir water temperature rather than by the range in air temperature. Variations in reservoir water temperature follow the variations in air temperature very closely at the surface of the reservoir, but decrease in magnitude very rapidly as the depth below the surface increases. Measurements of water temperature at different depths in Cheeseman reservoir near Denver, Colorado,[12] show

TABLE II

Maximum Variations of Internal Concrete Temperature Due to Seasonal Variations in Outside Temperature

Item (No.)	Structure, Location, and Reference	Orig. Therm. (No.)	Approx. Dates	Conc.* Thick. (ft.)	Air T. Range (°F.)	Conc. T. Range (°F.)	Dist.† to Nearest Face (ft.)	Location of Thermometer	Miscellaneous Remarks
1	Ret. wall, St. Louis, Mo.	1	1917	1.50	122‡	111.0	0.25	East side	Well 10 ft. high, surrounding basins at
2	Ann. Rep. Water Comr.	2	and	1.50		106.5	0.75	At center	Compton Hill reservoir, both sides ex-
3	1918, p. 49.	3	1918	1.50		117.5	0.25	West side	posed to sun.
4	Squaw Creek conc. arch	A-2	1909	0.75	121§	86.4	0.38	At center ring	Numbers A-2 at crown, at north side of
5	bridge, Ames, I. See	B-1	and		136**	74.1	2.75	S. end pier	bridge; numbers B-2 at crown, at south
6	Bull. 30, Eng. Exp.	B-2	1910	0.75		85.0	0.38	At center ring	side of bridge.
7	Sta., Iowa State Col.,	B-1	1911		142§	77.5	2.75	S. end pier	
8	Ames, Iowa; by C. S.	A-1	and		157**	84.7	2.75	N. end pier	
9	Nichols and C. B. Mc-	B-2	1912	0.75		81.9	0.38	At center ring	
10	Cullough, pp. 39 and 50.	A-2		0.75		72.5	0.38	At center ring	
11	Walnut Street conc. arch	2	1912	4.00	128§	69	0.50	Near intrados	Thermometers in arch ring at east end of
12	bridge, Des Moines, I.	3		4.00	148**	63	2.00	At center	bridge. Numbers 4, 6, and 8 under
13	See Bull. 30, Eng. Exp.	4		4.00		67	2.00	At center	south sidewalk; others under north side-
14	Sta., I. State Coll.,	5		4.00		67	0.50	Near extrados	walk.
15	Ames, Iowa; by C. S.	6		1.58		87	0.79	At center	
16	Nichols and C. B. Mc-	7		1.58		91	0.79	At center	
17	Cullough, p. 67.	8		1.33		93	0.67	At center	
18		9		1.33		97	0.67	At center	
19	Brooklyn Ave. filled span-	1	1909		70§	36	1.0–	At crown	Max. and min. therms. embedded in re-
20	drel, concrete arch bridge, Los Angeles, Calif.	2	–1911		90**	28	1.0	At haunch	movable conc. plug placed in arch ring, about 1 ft. from s. edge. (Data courtesy John C. Shaw.)
21	Walnut Lane open spandrel arch rib bridge, Phil., Pa. See Trans. Am. Soc. C. E., Vol. LXV, p. 457.	1	1908	9.50	85§ 105**	42.8	4.75	Center of rib at haunch	Electric resistance thermometer installed some time after completion of arch ribs.
22	C. C. C. & St. L. RR.	1	1923	13.75	104§	45	1.00	Near haunch	Numbers 1, 3, and 6 were in center of
23	bridge at Sidney, O.	2	and	13.75	124**	35	6.88	Near haunch	ring, 1 ft. in from edge of arch. Others
24	Unpublished data fur-	3	1924	5.50		54	1.00	At crown	were at center of ring but were from
25	nished by J. B. Hunly,	4		5.50		48	2.75	At crown	8 to 15 ft. horizontally from edges of
26	Engr. of Bridges and	5		5.50		48	2.75	At crown	arch. Thermometers were lowered in
27	Structures, Cincinnati,	6		13.75		45	1.00	Near haunch	pipes set in the concrete.
28	O. See Eng. News-Rec. Oct. 11, 1923, also Ry. Rev., Oct. 6, 1923.	7		13.75		36	6.88	Near haunch	
29	Tirso Dam, Italy; see Hydraulic Engineering, Dec., 1928.		1924			48	1.64	In buttress	Rein. conc. multiple arch with masonry buttresses.
30	Gerber reinforced con-	3	1925	14.39	115	41	4.00	Upstream side	Downstream side is south side. Ther-
31	crete arch dam, Klam-	4	to	14.39	135**	36	6.39	Upstream side	mometers 3, 4, and 6 were about 25 ft.
32	ath Irrigation Project,	6	1929	14.39		40	2.00	Downstream side	below reservoir water surface; 9, 11,
33	Oregon. See accom-	9	incl.	9.30		47	2.00	Upstream side	and 12 were at about the same level as
34	panying text.	11		9.30		61	2.00	Downstream side	the water; and 14, 15, 16 and 17 were
35		12		9.30		43	0.50	Downstream side	25 ft. above the water.
36		14		5.00		65.5	1.00	Upstream side	
37		15		5.00		62.5	2.50	At center	
38		16		5.00		59.5	1.00	Downstream side	
39		17		5.00		71	0.33	Downstream side	
40	Emigrant Creek conc.	1	1925	5.51	85§	47.5	0.5	Downstream side	Res. w. s. below thermometers at time
41	arch dam, Talent Irri-	2	to	5.51	105**	38	2.2	Downstream side	maximum temperature range was de-
42	gation District, Talent,	3	1927	5.51		37.2	1.7	Upstream side	termined.
43	Ore. Unpublished data	1	incl.	10.25		34.8	1.0	Downstream side	Res. w. s. 25 ft. above therm. at time of
44	furnished by the dis-	2		10.25		28.5	2.6	Downstream side	min. temp.; Res. empty at time of max.
45	trict.	3		10.25		30.8	4.0	Downstream side	temp.; for all therms. except No. 1.
46		4		10.25		32	4.6	Upstream side	Range at No. 1 not affected by Res.
47		5		10.25		33.5	3.1	Upstream side	water. Res. w. s. 25-70 ft. above therm.
48		1		15.89		38.2	0.5	Downstream side	at time of min. temp.; Res. empty at
49		2		15.89		25.5	2.5	Downstream side	time of max. readings of upstream
50		3		15.89		20.5	4.5	Downstream side	therm.
51		4		15.89		19.5	6.5	Downstream side	Air temp. range meas. at Ashland.
52		5		15.89		21.5	7.4	Upstream side	
53		7		15.89		23.2	3.4	Upstream side	
54	Boonton masonry gravity	5	1904	46	135‡	30	2.0	Upstream side	Masonry 50% concrete and 50% large
55	dam, near Boonton,	6	and	46	116††	19	11.3	Upstream side	stones.
56	New Jersey. See Mer-	8	1905	45		20	11.0	Downstream side	
57	riman's discussion,	9		44		37	2.5	Downstream side	
58	Trans. Am. Soc. C. E., Vol. LXI, 1908, p. 420.	10		37		22	16.0	At center	
59	Arrowrock gravity con-	1	1914	186	118§	0	76.0	At center	Range for No. 5 determined before water
60	crete dam, Boise Irri-	3	to	150	138**	7	20.0	Downstream side	rose to level of thermometer. Ther-
61	gation Project, Idaho.	4	1917	154		0	58.5	Upstream side	mometers 9 and 10 under water during
62	See article by Chas. H.	5		145		37	3.5	Upstream side	summer months. No. 4 and 6 under
63	Paul and A. B. May-	6		103		0	31.0	Upstream side	water 100 ft. or more.
64	hew, Trans. Am. Soc.	7		73		55	2.0	Downstream side	Sand-cement concrete; mix 1:2½:5:2¾.
65	C. E., Vol. LXXIX,	8		73		22.5	10.0	Downstream side	
66	1915, p. 1225; also this	9		73		47	1.0	Upstream side	
67	article.	10		21		33	10.0	Upstream side	
68	Waldeck curved masonry	T_1R	1915	50.2	77‡‡	14.4	5.9	Upstream side	Dam built of quarried stone, laid in lime
69	dam, Germany. See	T_2R	to	50.2	77‡‡	9.0	15.7	Upstream side	mortar; max. ht. 151 ft. Ten therm.
70	'Temperature Move-	T_3R	1918	50.2	77‡‡	13.0	22.9	Near center	located in two rows symmetrical about
71	ments in the Waldeck	T_4R		50.2	77‡‡	12.6	12.5	Downstream side	center of dam. Rows placed at one-
72	Dam' by Thurnau,	T_5R		50.2	77‡‡	36.0	4.0	Downstream side	half ht. of dam, 378 ft. from crown
73	Deutsch Wasserwirth-	T_1L		50.2	77‡‡	15.7	5.9	Upstream side	section, and 190 ft. from abutments.
74	schaft, Apr., 1914, p.	T_2L		50.2	77‡‡	9.4	15.7	Upstream side	R signifies right side of dam; L signi-
75	117 to 125.	T_3L		50.2	77‡‡	......	22.9	Near center	fies left side. Upstream therm. show
76		T_4L		50.2	77‡‡	12.6	12.5	Downstream side	effect of water in reservoir.
77		T_5L		50.2	77‡‡	34.7	4.0	Downstream side	

*Horizontal, in case of dams; normal to center line, in case of arch rings. †Shortest distance, whether horizontal, inclined, or vertical. ‡At face of concrete. §At U. S. W. B. Station. **At face of concrete: estimated by adding 20° to difference between max. and min. air temperatures. ††Min. temp. to max. temp. in shade. ‡‡Difference between maximum and minimum daily mean air temperatures.

that seasonal variations of water temperature in large storage reservoirs in the Rocky Mountain region are of minor importance below a depth of 100 ft. Similar measurements at large reservoirs in other parts of the country show substantially the same condition. Consequently, the upstream face of the dam below a depth of 100 ft. may be considered as fully protected from outside temperature changes during the time the dam is being subjected to the full water load. Since different dams may have different thicknesses at equal depths below their crests, the consideration of concrete temperature changes resulting from seasonal variations in reservoir water temperatures may mean a different concrete temperature range curve for each dam, for thicknesses occurring between the top of the dam and a depth of 100 ft.

Fig. 9 shows curves of maximum range in concrete temperature used by the Bureau of Reclamation in designing the Deadwood, Gibson, and Owyhee dams; in making preliminary designs for the Hoover dam; and in making analytical studies for the Gerber and Thief Valley dams. The Deadwood dam is an arch dam 160 ft. high, now under construction on the Boise project, Idaho. It has a maximum cross-section varying in thickness from 9 ft. at the top to 62 ft. at the bottom. The Gibson dam, recently completed on the Sun River project, Montana, is an arch dam 200 ft. high, having

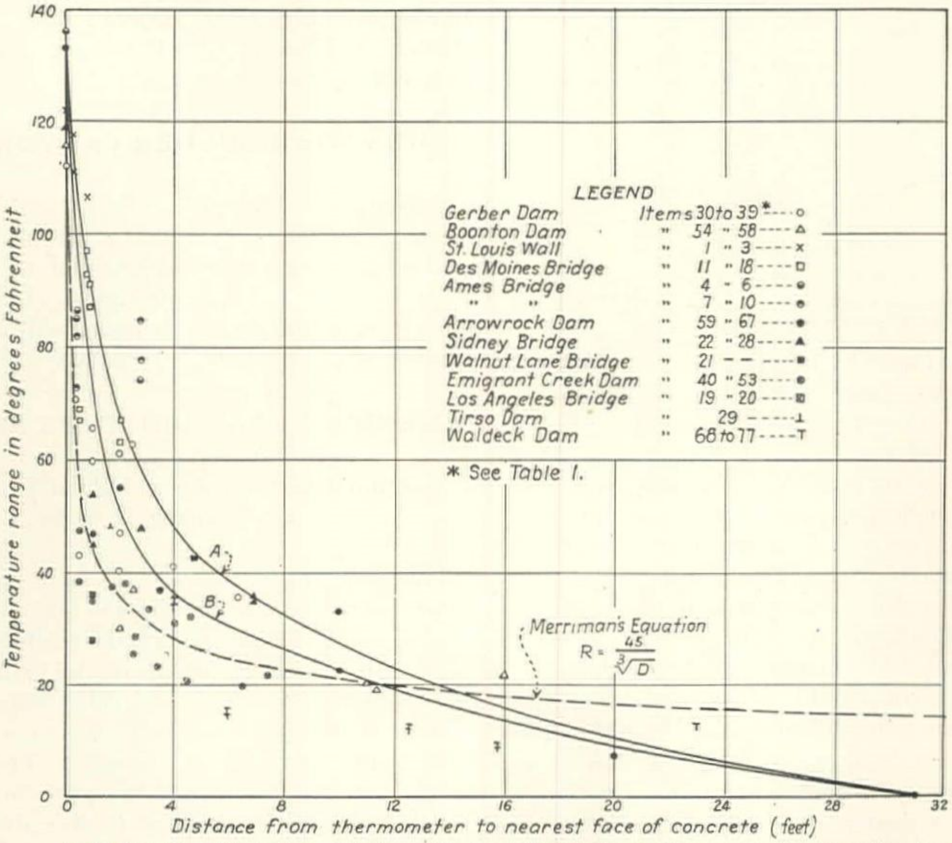


Fig. 7, Maximum Variations of Internal Concrete Temperatures Observed in Existing Structures

a thickness at the crown section varying from 15 ft. at the top to 90 ft. at the base.[13] The Owyhee dam, now under construction on the Owyhee project, Oregon, is a heavy, curved gravity dam, 405 ft. high, having a thickness at the crown section varying from 30 ft. at the top to 244 ft. at the base.[14] Tentative plans for the 727-ft. Hoover dam provide a thickness at the crown section varying from 45 ft. at the top to 650 ft.

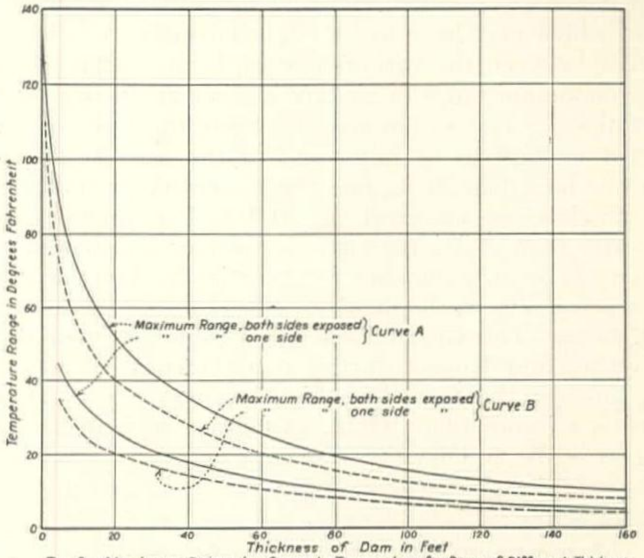


Fig. 8.—Maximum Range in Concrete Temperature for Dams of Different Thickness

at the base.[15] The Gerber dam is a comparatively low, thin arch dam having a thickness at the crown section varying from 5 ft. at the top to 18 ft. at the base.[16] The tentative design for the Thief Valley dam, which will be only about 50 ft. high and which has not thus far been built, provides thicknesses varying from 5 ft. at the top to 10 ft. at the base.

Each curve in Fig. 9 was corrected for effects of

[12] 'Temperatures in Denver Reservoirs', by Ivan E. Houk, Public Works, November, 1927, p. 405-409.
[13] See Western Construction News, August 25, 1926, p. 42; also August 10, 1927, p. 38.
[14] 'Owyhee Dam—Details of Design of 405-ft. Concrete Arch-Gravity Dam for Owyhee Irrigation Project', by J. L. Savage; Western Construction News, May 10, 1928, p. 284 to 291.
[15] 'Boulder Dam, Colorado River, Preliminary Statement', by R. F. Walter; Western Construction News, January 10, 1929, p. 7 to 15.
[16] Loc. cited.

variations in reservoir water temperature at the upstream face of the dam, which accounts, primarily, for the difference between the curves for the smaller thicknesses. Another factor which was considered, and which may have had a slight effect on the differences between the various curves, is the variation in the maximum range in air temperature at the different locations. The differences between the curves are great enough to be important in the case of thicknesses less than 20 ft., and are noticeable in the case of thicknesses as great as 50 ft. For thicknesses greater than 70 ft., the curves coincide; which means that where such thicknesses occur in the dams represented on Fig. 9, the depths are approximately 100 ft. or more. The Gibson dam curve is lower than the Owyhee and Hoover curves at a thickness of 40 ft., because of the fact that this thickness occurs at a depth of more than 100 ft. at Gibson, at a depth of about 60 ft. at Owyhee, and does not occur at all at Hoover, the thickness at the top of the Hoover dam being 45 ft.

The most important differences between the concrete temperature range curves shown on Fig. 9 are the differences between the curves for thin arch dams

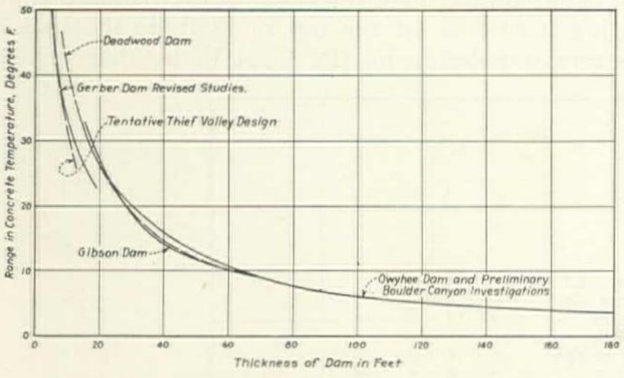


Fig. 9.—Curves of Maximum Range in Concrete Temperature Used in Designing Various Reclamation Dams (Setting heat to be dissipated before grouting joints.)

such as the Gerber and Thief Valley dams, and those for the comparatively heavy arch dams, such as the Deadwood, Gibson, Owyhee, and Hoover dams. For the latter group, I believe that an average curve could be used for all four structures. The calculation of special curves for such dams is undoubtedly justified, in view of the importance of the structures. However, in view of the erratic nature of the observational data shown in Table II and on Fig. 7, it is doubtful if any one of the Deadwood, Gibson, Owyhee, or Hoover curves is more applicable to the structure for which it was calculated than would be an average curve drawn so as to balance the difference between the four.

Fig. 10 shows an average concrete temperature range curve determined in such a manner. This curve can be used in the design of heavy arch or curved gravity dams having cross-sections similar to, and not thinner than, the cross-section of the Deadwood dam. Since the stresses caused by a drop in temperature are the ones which will be combined with the full load stresses in the design studies, only half the temperature range shown by the curve will be used in the stress calculations. The use of this curve assumes that the setting heat will be completely dissipated before the construction joints are grouted. It also assumes that the grouting will be done when the average concrete temperatures are not higher than the mean annual concrete temperature corresponding to the mean annual air and reservoir water temperatures at the particular location under consideration.

Acknowledgments—Bureau of Reclamation dams are designed under the direction of J. L. Savage, chief

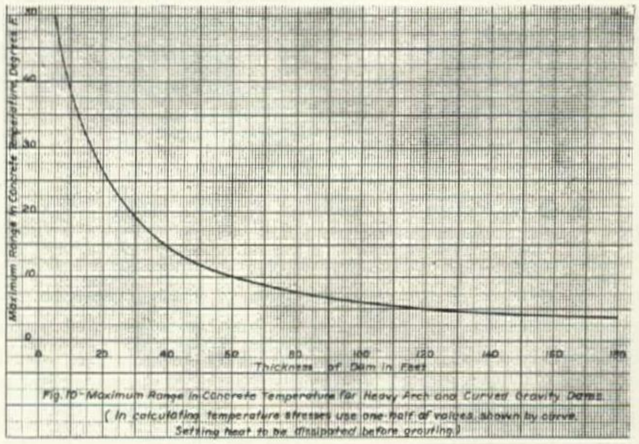


Fig. 10

designing engineer. All engineering and construction of the Bureau is under the direction of R. F. Walter, chief engineer, with headquarters at Denver, Colorado, and all activities of the Bureau are under the general charge of Elwood Mead, commissioner, with headquarters at Washington, D. C.

BIDS FOR BOULDER CANYON PROJECT

Bids for the 10¼-mile railroad and 7-mile highway between Boulder City and Hoover dam will be opened in the Las Vegas office of the Bureau of Reclamation on January 12 and 7, respectively. Bids on the 727-ft. Hoover dam and related features will be opened in the Denver office, probably in the latter part of February.

AMERICAN ROAD BUILDERS ASSOCIATION

28th Annual Convention and Road Show at St. Louis, January 12 to 16

The 28th annual convention and road show of the American Road Builders' Association will be held at St. Louis, Missouri, January 12 to 16, 1931. The keynote of this convention will be the benefit of increased road construction to nation-wide unemployment. The various sessions will include ones on equipment, location, traffic, and highway finance. The road show, as usual, will fill all available space in the St. Louis Arena, and will be more attractive than ever because of the diversity and number of exhibits (about 300).

The annual road shows are attended by more than 25,000 people, most of whom are directly interested in highway and street construction and maintenance. Practically every manufacturer of pertinent equipment has an interest in an instructive exhibit, and the technical sessions are very constructive.

The coming convention at St. Louis promises to be a record-breaker, with many westerners present.

Venice Canals Converted into Paved Streets

Los Angeles Beach Suburb Drains Waterways Through Concrete Pipe System to Sump and Lifts Storm Water to Ocean Outfall—Canals Filled From Adjacent Land and Paved With Asphaltic Concrete

By O. H. BARNHILL, *Pasadena, California*

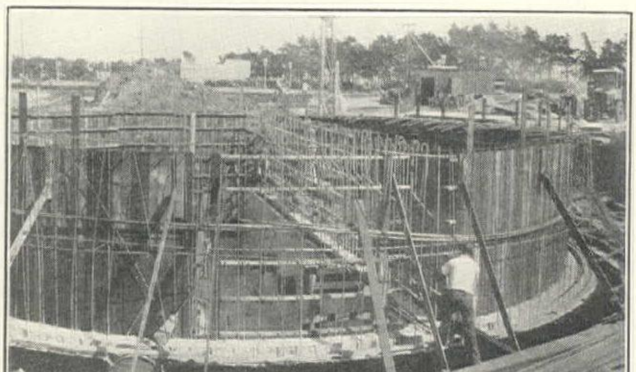
The recent draining of 1.6 miles of canals in Venice, beach suburb of Los Angeles, and substituting therefor 2½ miles of paved streets involved the solution of some unique engineering problems.

The change from drainage canals to broad level streets has materially enhanced the beauty of this largely residential district, besides facilitating the movement of traffic.

Historical—The waterways were constructed in 1903-04 to drain swampy tidelands, serving also to transport pleasure-craft. Development of the automobile and greatly increased traffic across the canal zone from city to ocean rendered imperative the change from water to land transportation.

For 11 years the people of Venice, which was formerly a separate city, tried in vain to agree upon a program of canal-filling and street-widening. In order to get action on these much-needed projects, the beach municipality finally annexed itself to Los Angeles. The contract for the job mentioned was let soon thereafter, but for two years construction was delayed by legal complications. The appellate court held that waterways could not lawfully be converted into roadways. The supreme court, however, reversed this decision.

The canals of Venice formerly were divided by Venice boulevard into two systems. The south district,



Placing Outside Forms and Reinforcing Steel for Sump Tank at Venice, First Lift Completed

which still remains, consists of a series of waterways extending at right angles from Grand canal, which parallels the beach and empties into the ocean two miles south of the business district. In the north area, which has been drained, several canals converged to the upper end of the main waterway, into which they emptied through five concrete pipes underneath the street named.

Draining Canals—The canals were drained by pumping their contents through one of the pipes, the others being blocked up. A box was built around the mouth of the open drain to bring the top above high tide. A Fairbanks-Morse centrifugal pump delivering 1000 g.p.m. emptied the drains.

The elevation of the canal area is practically the same as that of the ocean at high tide, therefore gravity drainage of storm water could not be considered. The district was so fully occupied with residences that filling-in was impracticable.

The plan adopted consists of underground pipes emptying into a sunken tank, from which water is

Constructing Semi-Elliptical Concrete Storm Water Drain for Outfall Between Surge Tank and Ocean

pumped high enough to flow through a 1700-ft. conduit to the ocean.

The drains include 2938 ft. of 12 to 21-in. cement pipe and 6222 ft. of 24 to 48-in. reinforced concrete pipe made by the United Concrete Pipe Co., of Los Angeles. The pipe was laid upon old canal beds, supported by rock mattresses 4 to 12 in. thick. In a few places, concrete cradling was used.

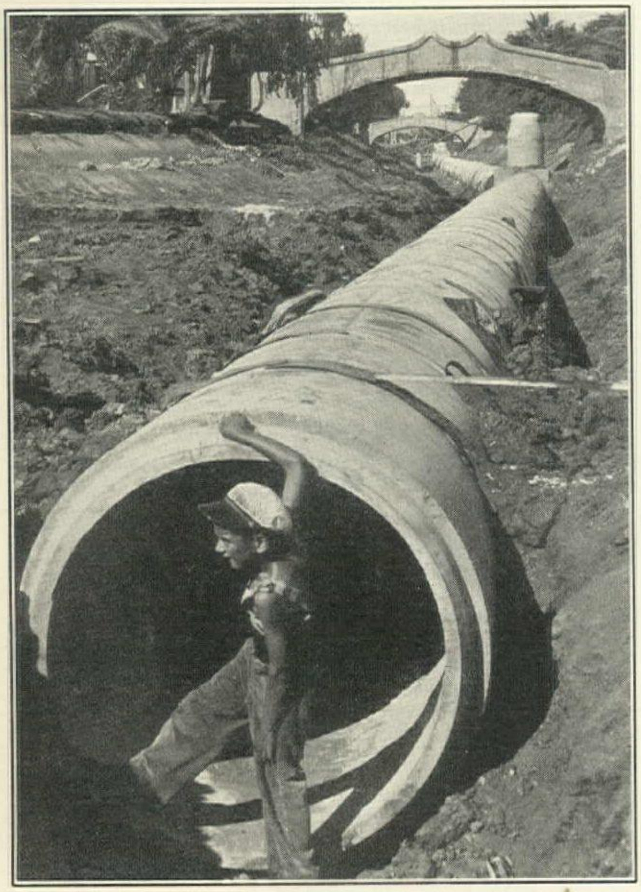
A Northwest dragline was employed in excavation. This machine worked from the canal bank wherever a footing could be obtained, but most of the time operated from the bottom of drained waterways, where 10 in. of mud covered gravelly clay subsoil.

Part of the pipe was laid with the dragline, using a U-bar instead of a bucket. The rest was rolled down the canal bank by hand, controlled by a chain run through the pipe joint. The pipe was then settled into position with the aid of a Bent chain block attached to a portable steel derrick straddling the pipeline.

Pipe joints were closed by wrapping around each a strip of tar paper and holding it in place with two hoops of small wire and backfilling up to the spring line of the pipe, while cement was poured through an opening torn in the top of the paper band.

To maintain the static head on the pumps, grades on all drains were kept flat. When the pipes are flowing full the maximum velocity of the water will be only 3½ to 4 ft. per second.

Outfall—The outfall from the pumping plant is a semi-elliptical reinforced concrete drain 5 to 5½ ft. wide. A special section was designed for crossing under the Abbott Kinney Co. tunnel, a 5 by 6-ft. concrete box carrying steam pipes to various buildings and two 10-in. hot water pipes supplying a large indoor swimming pool. Due to the limited head from

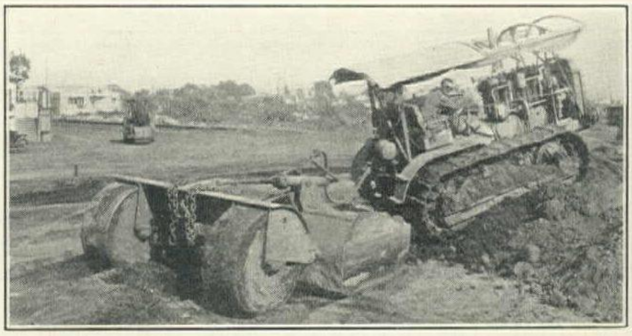


Reinforced Concrete Storm Drain Laid Along Empty Canal

the surge chamber of the storm-water pumping plant to ocean high tide, it was necessary to make the drain an integral part of the steam tunnel. The outer surface of this section of the drain is rectangular, its top forming the invert of the tunnel, while the inner surface retains its semi-elliptical shape.

The outer 100 ft. of the storm drain is exposed to surf action, the arch crown being the same elevation as maximum high tide. In order to increase the stability of this section of the outfall, it is supported by three rows of 12-in. creosoted redwood piles 15 ft. long, spaced 5 ft. from centers and embedded 6 in. below the bottom slab of the drain. Greater thickness of this section of the arch—1.9 ft.—was obtained by making the outer surface circular, while the inside remained semi-elliptical. Sides and bottom were also made thicker. The effect of wave action is minimized by cutting off the end of the drain at an angle of 45 degrees.

G. L. Powell, the subcontractor who built the storm water disposal system, holds basic patents on a new method of trench construction, which was employed



Caterpillar '60' and Ateco Hydraulic Scraper Grading Street Above Former Drainage Canal

in erecting the outfall drain. The side walls were laid horizontally from the surface downward as workers removed earth, in such a way as to form individual units or tanks. The first of these structures was removed as soon as concrete for the drain was placed, filling-in finished, and the second tank completed. This method saves lumber and increases the safety factor.

Sump Tank—The sump tank is a cylindrical reinforced concrete structure 50 ft. diameter and 20 ft. deep, the top being level with the surface of the ground. Ground water conditions are such that during periods of excessive rainfall the full hydrostatic head may be exerted upon the tank nearly to the top of the ground. It was estimated that 750 cu.yd. of concrete would be necessary to keep the structure from floating. In order to make up this weight, the bottom slab was made 5 ft. thick.

The outside wall is 24 to 30 in. thick. A cutoff wall 2 ft. thick divides the wet well from the machinery chamber 4 ft. from the center of the tank, the water reservoir being the larger of the two compartments.

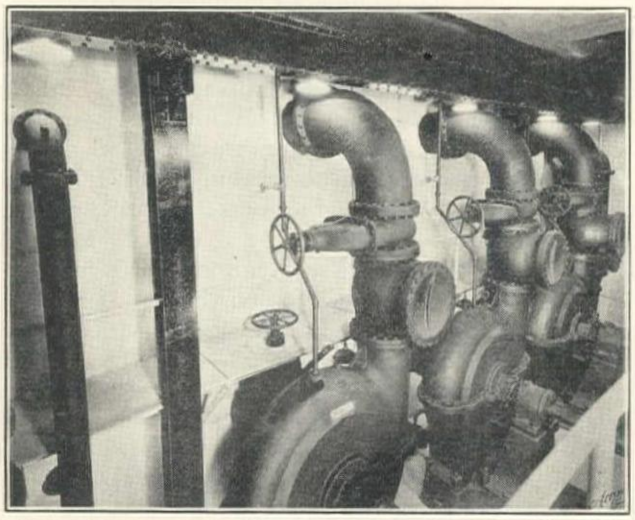
The size of the machinery well was reduced to the minimum, in order to give the water compartment sufficient cross-sectional area to prevent the float apparatus from operating at such short intervals that there would be danger of burning out parts of the control system or overheating the motors.

The suction pipes extend horizontally from the pumps through the partition into the wet well at an elevation permitting automatic priming as the water rises. The vertical discharge pipes empty into a surge chamber 10 ft. wide and 5 ft. deep, extending diametrically through the structure at the elevation of the outfall drain.

The pumping plant is a booster station operating against a low head. The smaller units are thrown into operation when the water in the wet well reaches a depth of 6½ ft. As the water level rises, the various pumping combinations are placed in operation until the full capacity of the plant has been reached when the water is 10 ft. deep, the surface coinciding with the crowns of the incoming drains.

The pumps are Fairbanks-Morse Wood trash horizontal centrifugal open-runner type, developed in New Orleans especially for handling flood water containing much debris. There are three 20-in. 14,000-g.p.m. pumps, one 14-in. 6000-g.p.m., and one 8-in. 2000-g.p.m. A 4-in. sump pump, manually controlled, draws either from the wet well or machinery compartment. A cleanout manifold leading to the sump in the machinery well is connected to the lower part of each of the larger units.

The pumps are driven by 440-volt, 50-cycle electric motors operating on three-phase current. As the five larger pumps operate at relatively low speeds, silent chain drives are used. The sump pump is directly connected to the motor by a flexible coupling. All motors are continuous-duty, horizontal-shaft, double squirrel-cage, induction type. The American High Speed Chain Co. furnished the individual silent chain drives. These drives are enclosed in oil-tight casings.



Battery of Automatically Controlled Fairbanks-Morse Wood Trash Centrifugal Pumps in Sump Tank

Except the sump unit, all pumps are automatically controlled by means of a float apparatus especially designed for this installation by Fairbanks-Morse engineers. A single master float controlling all pumps is mounted on a rod which swings in a vertical plane and is connected by gears and cams so as to give eleven different combinations of the five units, as follows: 2000, 6000, 8000, 14,000, 16,000, 20,000, 22,000, 30,000, 36,000, 44,000 and 50,000-g.p.m.

A special emergency float acts independently of the main control, putting the pumps in operation in case the principal system fails to function. The emergency float also rings an alarm bell when it kicks in.

Filling Canals—The drained canals were filled by Raymond Lewis, who moved 97,000 cu.yd. of material with three Erie 1-yd. shovels—two gas and one steam—and several 6-ton, 6-wheel Moreland trucks. Thirty of these trucks were employed during the peak period of construction. About two-thirds of the dirt was obtained from widening and regrading Ocean Park boulevard, the remainder coming from lot levelling and building excavation.

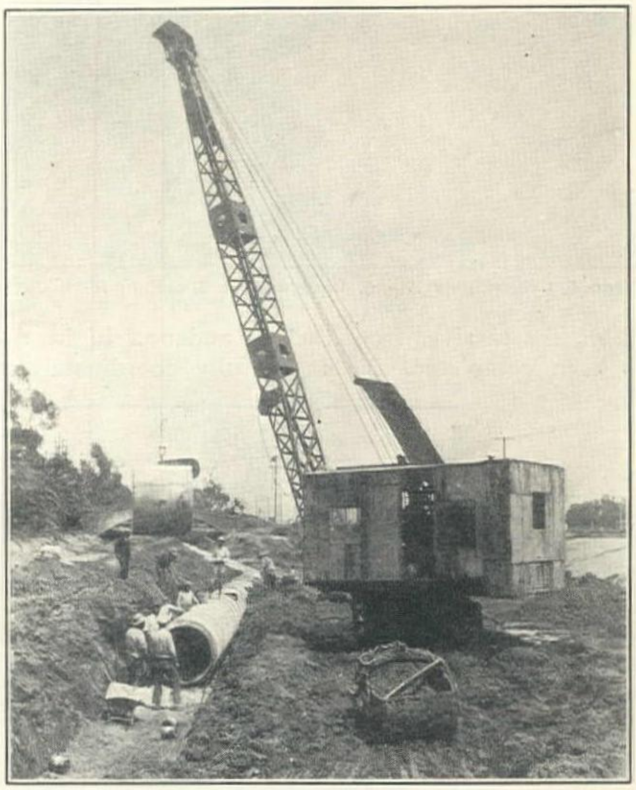
Preceding excavation of Ocean Park boulevard for regrading, the 6-in. concrete pavement was broken with a 3000-lb. cast-iron ball rig on an Erie shovel from which the bucket and dipper sticks had been removed. This breaker, with an 8-ft. drop, cracked 15,000 to 20,000 sq.ft. of pavement per day and has been used to demolish over 2,000,000 sq.ft. of material.

The canals were 40 ft. wide and 6 ft. deep and carried 4 ft. of water. It was considered impracticable to fill the ditches with thin layers of material as the bottom was too soft to support a loaded vehicle. Trucks were backed up to the canal bank at convenient places and dumped, building up a fill over which machines were driven to complete the work.

A 4-ft. layer of earth was first put in, then puddled and jetted by flooding the surface and carrying water to lower portions of the fill through pipes driven into it, after which the future road was brought to grade.

The canal filling job proved a difficult one, because of the difficulty of access to the ditches and unstable character of the bottoms. Trees, houses, and sidewalks along the canal banks obstructed truck traffic, while seepage water in the drained ditches seriously interfered with building up a solid grade.

Asphaltic concrete was selected for paving the filled-in streets, there being 637,336 sq.ft. of 7-in., the contract price being $158,059. The contractor, R. A. Wattson, of Los Angeles, laid 750 tons of asphaltic concrete per day, mixing being done in a plant built by the Union Tank & Pipe Co., of Los Angeles.

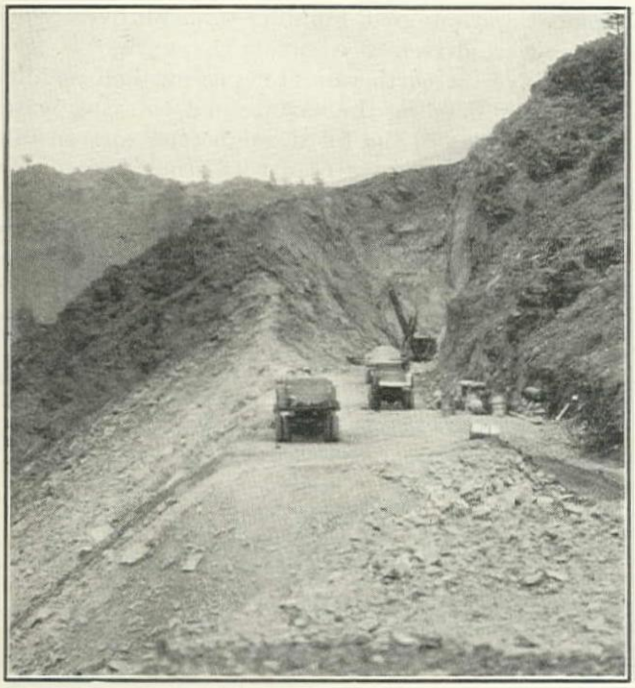


Northwest Dragline with U-Bar Laying Reinforced Concrete Storm Drain

The additional main items in the contract were: unplastered cement curb—21,784 ft., $12,416; one-course cement sidewalk—96,375 sq.ft., $14,456; gutter—29,638 ft., $6652; grading, $115,450; storm water disposal plant, $138,721; storm drains, $127,200; water system, $31,750; water services, $9620.

Pacific Highway, California

Wren & Greenough, Portland, Oregon, have completed over half of their contract for grading 7 miles of highway between Yreka and Klamath river, through the Shasta river canyon, Siskiyou county, California. Two miles of detour road on the opposite side of Shasta river from the old and new highways has been completed. To more fully coordinate the work, grading on the two miles of new highway between Yreka and Shasta river was discontinued early in July, and will be resumed when the crushing plant for surfacing is put in operation. During July and August, two of the shovels were shut down pending a settlement with one of the sub-contractors. Finishing has been started on a two-mile section, and the concrete work is over 80% complete. No work has been done on north of Klamath river.

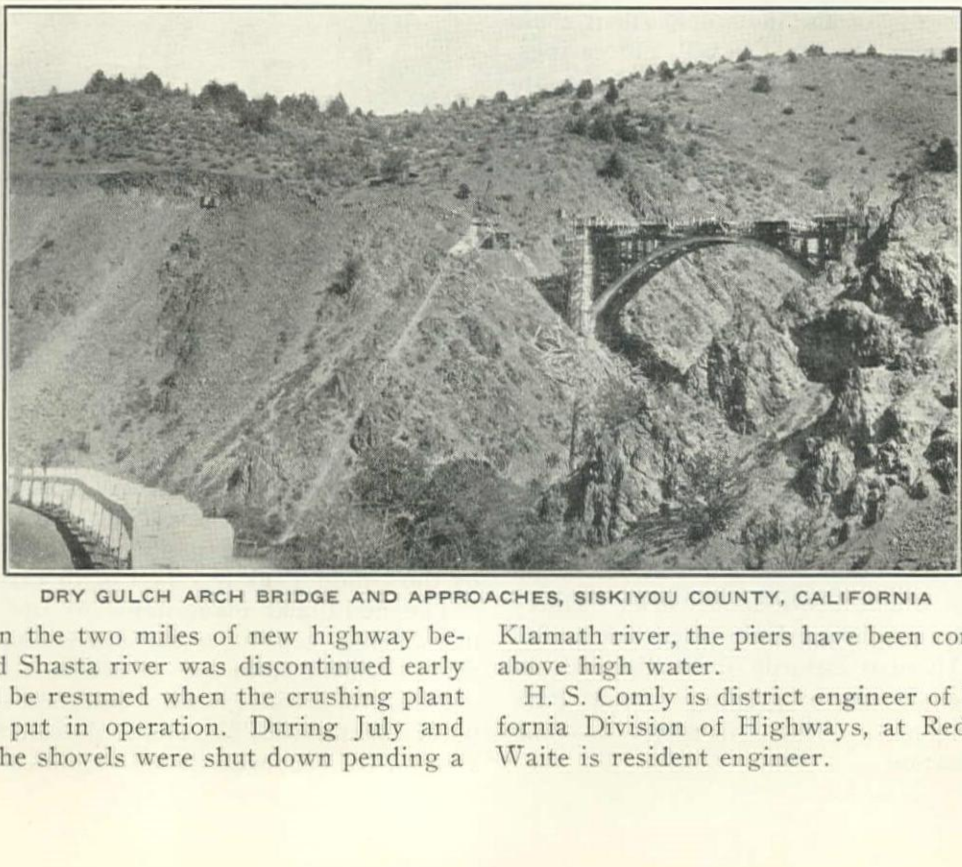


Wren & Greenough's 1½-yd. Bucyrus-Erie Diesel in 75-ft. Cut

At present (November 15) there are five power shovels on the project, as follows: one 1½-yd. Marion '32' steamer, two 1½-yd. Bucyrus-Erie diesels, one 1¼-yd. Thew-Lorain gas, and one 1-yd. Bucyrus-Erie steamer. Additional equipment includes two Gardner-Denver 540-c.f.m. electric compressors; one Sullivan 2-stage, 540-c.f.m. electric compressor; three portable compressors, Schramm and Sullivan; two Sullivan tool sharpeners; one Sullivan oil furnace; ten 5-yd. trucks; two Koehring 'Dumptor' tractors.

The contract price for the grading is $571,626 and includes the following main items: Roadway excavation—649,500 cu.yd. at $0.70; overhaul—1,223,700 sta.yd. at $0.01; structure excavation—6850 cu.yd. at $1.50; crusher-run base—8890 cu.yd. at $1.50; untreated crushed gravel or stone surfacing—9560 cu.yd. at $1.50; screenings in stock piles—2390 cu.yd. at $1.50; and class 'A' concrete—940 cu.yd. at $25.

There are five large bridges on this section which are not included in the grading contract. Of these, one is a concrete girder bridge at the first crossing of Shasta river, and has been completed for some time. A concrete arch bridge at Dry gulch has just been finished. At the second crossing of Shasta river, a bridge 250 ft. above the water, the placing of steel has just begun. The concrete double-arch bridge at the third crossing of Shasta river has the arch ribs poured. On the fifth bridge, a concrete girder structure across Klamath river, the piers have been constructed to well above high water.



DRY GULCH ARCH BRIDGE AND APPROACHES, SISKIYOU COUNTY, CALIFORNIA

H. S. Comly is district engineer of District II, California Division of Highways, at Redding, and C. F. Waite is resident engineer.

Boulder Canyon Project Statistics

The U. S. Bureau of Reclamation recently released a series of questions and answers on the Boulder Canyon project, reprinted from the February, March, May, June, August, and November, 1930, issues of the 'New Reclamation Era'. Figures used in the 'primer' were taken from preliminary plans, studies, and estimates, and may be materially changed when final plans are approved and surveys made of the irrigable area within this project. An abstract of the 'Boulder Canyon Project Primer' follows, together with some information from other sources.

SCOPE AND COST OF PROJECT

1. **Project includes**—Dam and power plant in Black canyon, Colorado river, and All-American canal.

2. **Purpose of project**—Flood control and river regulation, irrigation, silt control, power development, domestic water supply.

3. **Appropriations authorized**—Total $165,000,000 under project act of December 21, 1928. Dam and reservoir, $71,600,000; power development, $38,200,000; All-American canal, $38,500,000; interest during construction, $17,700,000. (See item 95.)

HOOVER DAM IN BLACK CANYON

4. **Type of dam considered**—Arch-gravity.

5. **Height of dam**—727 ft. above foundation rock, raising water surface 582 ft.

6. **Length of dam**—950 ft. along crest.

7. **Top and base widths of dam**—45 and 650 ft.

8. **Volume of concrete**—3,600,000 cu.yd. in dam and 800,000 cu.yd. in power plant and appurtenant works.

9. **Volume of concrete placed by Bureau in various project dams and structures to June 30, 1930**—4,392,000 cu.yd.

10. **Excavation for dam**—1,600,000 cu.yd. open cut.

11. **Cement required for Hoover dam**—5,500,000 bbl.

12. **Cement used by Bureau in 26 years of construction**—4,926,000 bbl.

13. **Steel required for Hoover dam**—5,500,000 lb. reinforcing; 1,900,000 lb. pipe and fittings; 32,500,000 lb. metal conduit (penstocks); 10,600,000 lb. structural (powerhouse, etc.); 20,000,000 lb. gates and hoists.

14. **Geologic conditions of damsite**—Foundation and abutments, andesite breccia, hard and durable. 190,000 lin.ft. of grout and drainage holes and 228,000 cu.ft. of grout.

15. **Construction period for dam**—7 years (1938 earliest completion).

16. **Men required on construction**—Not over 1000 at any time.

17. **Capacity**—30,500,000 ac-ft. when full.

18. **Area**—145,000 acres (227 sq.mi.).

19. **Length**—115 miles between Black and Bridge canyons; also extends 35 miles up Virgin river.

20. **Width**—From several hundred feet in canyons to 8 miles.

21. **Elevation of high-water line behind reservoir**—1229 ft. above sea level.

22. **Lands retained for reservoir purposes**—Those below elevation 1250 ft.

23. **Uses of reservoir capacity**—9,500,000 ac-ft. for flood regulation; 5,000,000 to 8,000,000 ac-ft. for silt pocket; 12,000,000 to 15,000,000 ac-ft. for active or regulation storage.

24. **Annual silt deposit in reservoir**—80,000 to 250,000 ac-ft., present conditions. Will decrease with upstream development.

25. **Total silt deposits at end 50-year period**—Not over 3,000,000 ac-ft.

26. **Length reservoir shore line**—550 miles.

27. **Annual evaporation**—600,000 ac-ft.

28. **Land**—Withdrawn from entry for construction purposes.

OUTLET WORKS

29. **River diversion**—By earth and rock-fill cofferdam and through four 50-ft. diam. concrete-lined tunnels, two on each side of river. 1,900,000 cu.yd. tunnel and shaft excavation and 1,200,000 cu.yd. material in cofferdam.

It has been proposed that the Government assume responsibility for design and capacity of diversion tunnels after the tunnels and cofferdams have been completed in accordance with approved designs. This means that the contractor will be responsible for any flood damage during construction of the diversion works and the Government responsible for damage and reconstruction costs resulting from destructive floods thereafter.

30. **Total length diversion tunnels**—16,300 ft. through rock.

31. **Use of tunnels following river diversion**—Two as penstock tunnels and two for spillway outlets.

32. **Outlet works**—Two diversion tunnels and two power penstock tunnels main supply for forty 72-in. needle-valve outlets in canyon walls. Valves receive water through 28-ft. diam. power intake valves.

33. **Sluiceways through dam**—Eight metal-lined conduits 6¾-ft. diam. to carry low flow of river while plugging diversion tunnels. Two 6 by 6-ft. slide gates for each sluiceway.

34. **Type of spillways**—Two 'glory holes' discharging through 50-ft. diam. vertical shafts to outside diversion tunnels.

35. **Spillway capacity**—200,000 c.f.s. without overtopping dam.

POWER PLANT

36. **Installed capacity**—1,000,000 to 1,200,000 hp.

37. **Continuous firm power output**—663,000 hp., with 83% plant efficiency and 10% maximum shortage.

38. **Electrical energy available on completion of dam**—4,330,000,000 kw-hr. yearly.

40. **Amortization through sale of power**—Pay all expenses of operation and maintenance works by Government and cost of constructing dam and power plant, with interest, in 50-year period.

41. **Use of revenues in excess amortization requirements**—62½% for flood control ($25,000,000) repayment, and 18¾% each to Arizona and Nevada.

42. **Power plant location**—U-shaped structure, just below dam, one-half each side of river.

43. **Water supply to turbines**—Four pressure tunnels, two each side of river, provided with shut-off gates and trash racks.

44. **Machinery installation for 1,000,000 hp.**—Twelve 85,000-hp. hydraulic turbines, twelve 11 by 10-ft. balanced valves, twelve 75,000-kv-a. generators with exciters, thirty-six 25,000-kv-a. 220,000-volt transformers, four 250-ton cranes, switchboard, control apparatus, machine shop, etc.

45. **Operating heads**—Maximum 582 ft., minimum 422 ft., average 520 ft.

46. **Sale price for primary or firm power**—$0.00163 per kw-hr. at transmission voltage.

47. **Secondary or dump power available yearly**—1,550,000,000 kw-hr. on completion of dam, then yearly decrease of 8,600,000 kw-hr.

48. **Sale price for secondary or dump power**—$0.0005 per kw-hr. at transmission voltage.

49. **Rate adjustment**—Provided for at end of 15-year period from execution of lease, and every 10 years thereafter.

50. **Revenue from sale of power**—First year of operation derive $7,057,900 from sale of 433,000,000 kw-hr. primary, and $775,000 from sale of 1,550,000,000 kw-hr. secondary power.

51. **Average annual income from sale of firm energy**—$6,550,000 over 50-year repayment period.

52. **Operation and maintenance of power plant**—By City of Los Angeles and Southern California Edison Co. under supervision of Department of the Interior.

53. **Power allocation**—18% to Arizona, 18% to Nevada, 36% to Metropolitan Water District of Southern California, 6% to

smaller municipalities, 13% to City of Los Angeles, and 9% to Southern California Edison Co.

54. **Payment for plant machinery**—Government will install machinery and equipment costing $17,700,000 and contractors will pay off in ten equal installments an amount sufficient to amortize total cost.

55. **Transmission cost**—Paid for by contractors who purchase power.

WATER ALLOCATION

56. **Basis of Colorado river compact**—Mean annual runoff 16,000,000 ac-ft.

57. **Allocation to upper basin states**—7,500,000 ac-ft.

58. **Allocation to lower basin states**—7,500,000 ac-ft., with right to later increase beneficial consumptive use by 1,000,000 ac-ft.

59. **California's share**—Aggregate annual consumptive use of not to exceed 4,400,000 ac-ft.

60. **Nevada's share**—300,000 ac-ft. provided for exclusive beneficial use (under provisions of Boulder Canyon project act).

61. **Arizona's share**—2,800,000 ac-ft. under project act, plus one-half surplus unapportioned, and exclusive beneficial consumptive use of Gila river and its tributaries within the state.

62. **Tri-state agreement**—Although provided for under project act, states have not yet agreed on above allocation.

RIVER FLOW

63. **Greatest measured discharge of Colorado river**—200,000 c.f.s. at Yuma.

64. **Estimated short-period maximum flow**—300,000 c.f.s. in 1884.

65. **Smallest measured discharge**—1200 c.f.s. at Yuma.

66. **Discharge at Hoover damsite**—22,000 ac-ft. average.

67. **Runoff at damsite**—15,700,000 ac-ft. annual average.

68. **Maximum flood discharge after completion of project**—For floods since 1900 would be 48,000 c.f.s. at dam and 35,000 c.f.s. in delta region. An 1884 flood reduces to 75,000 c.f.s.

IRRIGABLE AREAS

69. **Irrigable land in United States below Boulder canyon reservoir**—2,000,000 acres by preliminary estimate (subject to survey).

70. **Gross area in Arizona**—900,000 acres.

71. **Gross area in California**—1,000,000 acres.

72. **Gross area in Nevada**—15,000 acres.

73. **Possible Arizona projects**—Parker-Gila valley (600,000 acres); Parker (116,000 acres); Mohave valley (33,000 acres); Cibola valley (16,000 acres); Yuma (112,000 acres); etc.

74. **Possible California projects**—Imperial valley (800,000 acres); Coachella valley (72,000 acres); Palo Verde valley (79,000 acres); etc.

75. **Irrigable area in Nevada**—Cottonwood island (3000 acres) and additional acreage by pumping.

76. **Classification of irrigable lands**—public, 44%; private, 40%; state, 1%; railroad, 2%; Indian, 8%; entered, 5%.

TOWNSITE

77. **Location**—6 miles due west of damsite at summit and near terminus of Los Angeles & Salt Lake branch.

78. **Name**—Boulder City.

79. **Water supply**—Pump 6 miles from Colorado river, lift 2050 ft., settling basins and filtration system similar to Yuma; or, tap underground flow in Las Vegas valley about 20 miles distant and lift 650 ft.

80. **Other improvements**—Sewerage system, street surfacing, sidewalks, curbs, highway, and railroad to damsite.

81. **Building program**—Office building and living quarters for Government employees.

82. **Housing for contractors**—A portion of townsite set aside for camps, the housing to meet Government building restrictions.

83. **Ownership of land in townsite**—By Government. Vacant public land under first form withdrawal.

84. **Town lots for business purposes**—Government may give 20-year lease, retaining ownership and supervisory control, occupancy subject good behavior, objective a model town.

85. **Population**—3000 to 4000 during construction period.

86. **Permancy of Boulder City**—Probably permanent, due scenic attractions at hand or close by.

87. **Immediate work at townsite**—Those projects listed in items 79 and 80.

88. **Appropriations for work program**—$525,000 for town and highway is provided in first year's operations.

89. **Type of buildings**—Those suited to climate, conditions being somewhat similar to Yuma and Salt River projects. Experienced town planner engaged.

90. **Temperature range**—20° to 120°F.

91. **Distance, Boulder City to Las Vegas**—25 miles.

92. **Elevation of townsite**—About 2500 ft.

ALL-AMERICAN CANAL

93. **Purpose**—Carry water from Colorado river to Imperial and Coachella valleys in southeastern California.

94. **Location**—Entirely within the United States.

95. **Coachella branch canal**—Estimated cost $11,000,000. This item not authorized in $165,000,000 appropriation under project act.

96. **Reimbursable expenditures for canals**—Cost of canals and appurtenant structures returnable to Government under repayment contract with irrigation districts.

97. **Payment for water**—No charge to districts in two valleys (Imperial and Coachella) for use, storage, or delivery of irrigation water or water for potable purposes.

98. **Alternate intake locations**—At Laguna dam 10 miles northeast of Yuma; or from new diversion dam 5 miles north of Laguna, gaining added head to increase area irrigable by gravity and saving excavation through the sand hills west of Yuma.

99. **Initial diversion**—15,000 c.f.s., including water supply for Yuma project.

100. **Maximum canal section**—200 ft. wide at water surface, 134 ft. wide at bottom, 22 ft. deep.

101. **Length All-American canal**—75 miles.

102. **Length Coachella branch**—115 miles.

103. **Sand hills crossed by All-American canal**—10 miles through ridge of shifting sand, deepest cut 100 to 120 ft.

104. **Canal protection against drifting sand**—Grow vegetation in zone each side; cover dune sand with coarser excavated material; spray sand with crude oil; maintain 30-ft. berm each side canal at level mesa floor.

105. **Concrete lining required**—4 miles of All-American and 33 miles of Coachella branch canals.

106. **Structures on All-American canal**—10 siphons or culverts under numerous washes, including siphons under Alamo and New rivers.

107. **Structures on Coachella branch**—79 siphons or culverts.

108. **Total Excavation**—60,000,000 to 65,000,000 cu.yd. of which 4% is rock.

109. **Power possibilities**—At Pilot knob 7 miles west of Yuma, and at four canal drops, total 60,000 kw.

110. **Additional water supply for San Diego**—Considering feasibility of carrying water from some point on west side Imperial valley through All-American canal and Imperial Irrigation District system to San Diego.

111. **Water supply asked by San Diego**—155 c.f.s., with necessary energy to lift this water over 4000 ft. and deliver to coastal plain in San Diego county.

IMPERIAL AND COACHELLA VALLEYS

112. **Irrigable area Imperial Irrigation District**—515,000 acres, of which not over 450,000 acres now irrigated.

113. **Growing season Imperial valley**—365 days.

114. **Elevation Imperial valley**—250 ft. below sea level at Salton Sea to 0 ft., with adjoining mesas or high lands at elevations of 50 to 150 ft. above sea level.

115. **Rainfall in Imperial valley**—3 in. per year.

116. **Irrigable area in Coachella valley**—72,000 acres probable under canal system; 12,000 acres now under cultivation; gross acreage of valley 187,000.

117. **Ownership of Coachella valley lands**—Public, 20%; private, 70%; state, railroad, and Indian, 10%.

PERSONNEL

118. **Commissioner of Reclamation**—Elwood Mead, Washington, D. C.

119. **Chief engineer, Bureau of Reclamation**—R. F. Walter, Denver.

120. **General superintendent of construction, Bureau of Reclamation**—S. O. Harper, Denver.

121. **Chief designing engineer, Bureau of Reclamation**—J. L. Savage, Denver.

122. **Construction engineer, Boulder Canyon project**—Walker R. Young, Las Vegas.

123. **Assistant construction engineer, Boulder Canyon project**—Ralph Lowry, Las Vegas.

124. **Office engineer, Boulder Canyon project**—John C. Page, Las Vegas.

125. **Hoover dam consulting board**—A. J. Wiley, Boise; D. C. Henny, Portland; L. C. Hill, Los Angeles; W. F. Durand, Leland Stanford University.

126. **Hoover dam consultant specialists on concrete problems**—F. R. McMillan, Portland Cement Association, Chicago; W. K. Hatt, Purdue University; Raymond E. Davis, University of California; H. J. Gilkey, University of Colorado.

127. **City planner for Boulder City**—S. R. DeBoer, Denver.

128. **Consulting engineer, sanitary features of Boulder City**—Burton Lowther, Denver.

129. **Consulting architect on Boulder City**—Gordon B. Kaufmann.

PERSONAL MENTION

Tracy R. Bouseman has been appointed city engineer of South Gate, California, succeeding **Edward M. Lynch.** Bouseman is also city engineer of Bell, California.

Charles D. Vail, commissioner, Department of Improvements and Parks, city and county of Denver, Colorado, has been appointed state highway engineer of Colorado, succeeding the late **L. D. Blauvelt.**

John C. Page, formerly superintendent of the Grand Valley project, Bureau of Reclamation, at Grand Junction, Colorado, has been transferred to Las Vegas, Nevada, as office engineer on the Boulder Canyon project.

T. L. E. Haug, designing engineer for the East Bay Municipal Utility District, Oakland, until 1929, has joined the Verde River Irrigation & Power District, Phoenix, Arizona, as designing engineer. **J. G. Bailhache** is chief engineer and general manager of the district.

F. F. Smith, construction engineer for the Bureau of Reclamation on the recently completed Echo dam, Salt Lake Basin project, Utah, has left for Mexico City to make a report for the J. G. White Engineering Corp. on the Naza river irrigation project near Torreon, Mexico.

C. E. Stricklen has been appointed state engineer of Oregon, succeeding **Rhea Luper,** resigned. Stricklen has been in the state engineer's office since 1912 and is an engineering graduate from Oregon State College; he also attended the Willamette University law school and the University of Idaho.

Henry E. Blood, chairman of the Utah State Highway Commission, was elected president of the American Association of State Highway Officials at the annual convention in Pittsburgh, Pennsylvania, on November 19. **S. C. Durkee,** state highway engineer of Nevada, was elected a vice-president of the association.

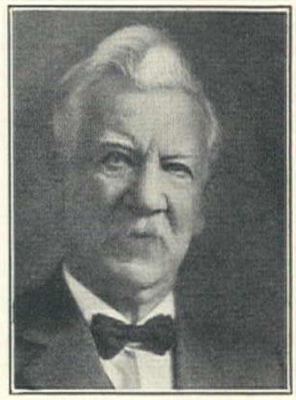
The Pacific Coast Foundation Co., Inc., 58 Sutter st., San Francisco, has been formed to design and/or construct bridges, tunnels, foundations, subaqueous works, and hydraulic developments. **J. Y. Leveque** is a director and the executive vice-president; **D. E. Root** is a director and the vice-president in charge of construction; and **Francis Betts Smith** is consulting engineer. **Sherman W. Gibbs,** an associate of Smith, will also serve in a consulting capacity.

Burton Lowther, Denver, Colorado, has been appointed consulting hydraulic and sanitary engineer to make an investigation and report covering the sanitary features of Boulder City, the town to be built by the Bureau of Reclamation near Hoover damsite. Lowther's report will include recommendations as to source of water supply, water sedimentation and purification (if required), type of equipment and general location of water works system, location and design of sewerage system and sewage treatment plant.

Charles P. Berkey, professor of geology, Columbia University, New York City; **Louis C. Hill,** consulting engineer, Los Angeles; and **J. B. Lippincott,** consulting engineer, Los Angeles, will review the engineering features of work under the $38,800,000 Los Angeles water bond issue, the units of which were described in the May 25th issue, p. 259.

Willis T. Batcheller, Inc., consulting engineers, Seattle, and the affiliated Portland Canal Power Co., have moved from the Dexter Horton bdg. to larger quarters in the Exchange bdg. The $3,000,000 hydroelectric project at Hyder, Alaska (see September 10th issue, p. 428), and a $300,000 irrigation project near Chelan, Washington, are among the major activities of the firm.

W. F. Luning has again been elected county surveyor of Tehama county, California. Luning holds the record for the longest term as county surveyor in the state of California—and possibly the United States—having served 36 years as county surveyor and 10 years as deputy. Eight years of his service as deputy were under his son, C. A. Luning, who W. F. Luning has named as his deputy for the ensuing four years.



W. F. LUNING

W. F. Luning was born in Red Bluff, California, July 3, 1857, and was appointed deputy surveyor in 1884 under the late H. B. Shackelford. In 1881, F. J. Nugent and Luning laid out the town of Corning and made the first survey for the Southern Pacific extension from Willows to Tehama. During 1884, W. S. Green and Luning surveyed the first 40 miles of the Central Irrigation Canal. Luning early in life established a reputation for integrity and dependability, and the record votes which he has received at each election attest the faith the people have in his ability, in spite of the fact that he has been practically stone deaf for 12 years.

OBITUARY

J. J. Cooke, 75, president of the J. J. Cooke Contracting Co. of Denver, Colorado, died early in October.

Henry Harnischfeger, president of the Harnischfeger Corp., Milwaukee, manufacturers of P&H construction equipment, died November 15.

T. G. Gerdine, 58, in charge of topographic and geodetic surveys for the Pacific division, U. S. Geological Survey, at San Francisco, died recently.

Charles F. W. Herrmann, pioneer engineer of Santa Clara county, California, died on November 11, at his home in Saratoga, at the age of 84 years. Herrmann came to California in 1869 with his brother, A. T. Herrmann, and founded the firm of Herrmann Bros., civil engineers and surveyors, one of their early jobs being the first detail map of Santa Clara county. During this period he spent a few years in the employ of the Southern Pacific Co. at Sacramento. He was also county engineer of Santa Clara county for three years, constructing the Mount Hamilton road to Lick Observatory.

Herrmann is survived by his widow and two nephews, Fred C. Herrmann, consulting engineer of San Francisco, and Frank Herrmann, civil engineer, of San Jose.

ASSOCIATIONS

AMERICAN SOCIETY OF CIVIL ENGINEERS

Los Angeles Section—A regular dinner meeting of the Section was held October 8, preceded by a 'junior forum' (for junior members and student chapter members). R. J. Villagrana, of the Standard Oil Co., gave an illustrated lecture before the junior forum on 'Oil Drilling Methods and Equipment'. Following the dinner, R. S. Gardner, of Merritt-Chapman & Scott Corp., described with the aid of moving pictures several of the marine salvage operations conducted by his company.

The first fall meeting of the Section was held September 10. P. L. Johnson, of the Bell Telephone laboratories, presented an illustrated lecture on sound and sound reproduction.

Sacramento Section—The following programs have been given at recent weekly meetings of this Section:

July 15—'General Conditions in China' (address) by R. D. Goodrich, employed with U. S. Army Engineers on water resources investigations in California. Goodrich is professor of civil engineering at the University of Wyoming and spent 9 years in China on flood control.

July 22—'Power Within' (motion picture showing construction and operation of a modern automobile motor, loaned by U. S. Bureau of Mines).

July 29—'Profession Consciousness in Engineers' (paper) by Charles S. Pope, construction engineer, California Division of Highways.

August 5—'Methods of Mining and Treatment of Ore at Bingham Plant of Utah Copper Co.' (paper) by Drury Butler, county surveyor, Sacramento.

August 12—'Improvements to State Highways in the Vicinity of Sacramento' (paper) by George McCoy, administrative assistant to state highway engineer. Section requested Society to take action toward having the name of the dam to be constructed on Colorado river changed from 'Boulder' to 'Hoover'.

August 19—'Importation of Natural Gas from Southern to Northern California' (paper) by R. A. Fuller, manager of gas department, P.G.& E.Co. Motion pictures of pipe-line construction shown.

September 2—'Emulsified Asphalt' (paper) by T. H. Dennis, maintenance engineer, California Division of Highways. Illustrated by motion pictures of the recently-completed model highway at Yreka.

September 16—'Proposed San Francisco Trans-Bay Bridge' (address) by Charles E. Andrew, bridge engineer, California Division of Highways.

September 23—'Fifty Years in the Telephone Industry' (talk) by D. E. Marsh, Pacific Telephone & Telegraph Co. Two reels of motion pictures showing development of switchboards and long distance transmission.

September 30—'General Don Mariano Guadalupe Vallejo' (address) by Otto von Geldern, consulting engineer, San Francisco. This meeting was seventh annual ladies' day luncheon at Elks' club, attendance 106.

October 7—Discussion of State Employees Retirement Act to be voted on at election on November 4.

San Francisco Section—The 'first annual convention' of the San Francisco section was held at the Union League Golf & Country club near San Bruno on September 20, the total attendance being 137. This convention was the customary social event on the annual calendar to which ladies were invited. The program included tennis and golf tournaments for men, bridge tournament for ladies in the afternoon, mixed bridge in the evening, a banquet, a short convention program (burlesque), and dancing.

The registration included 61 members of the Section and 7 members of the California Student Chapter, 61 ladies, and 8 men guests. The golf tournament drew 20 players and the tennis tournament 8; afternoon and evening bridge was participated in by 16 and 24 players, respectively; 120 attended the banquet. Golf prizes were won by C. R. Rankin (first) and J. R. Fox and L. H. Niskian (tied for second); Jack Moskowitz won the first prize at tennis and S. S. Gorman the second; the prize for afternoon bridge was won by Mrs. E. T. Thurston.

The convention program which followed the banquet was called to order by Ralph G. Wadsworth, chairman of the entertainment committee. The Hon. Mayor James Roll-Off (Hyde Forbes) made an address of welcome to the city and the Hon. Ole Olson, congressman-at-large, (J. I. Ballard) an address of welcome to the United States. President Henry Dewell gave the response to the two addresses and presented the tournament prizes. I. Wuzza Nenjinier, licensed engineer with dues paid to 1931, (Oswald Speir) offered 'Some Reminiscences of San Francisco Engineering', and Dr. Internal Work (E. M. Knapik) presented a lengthy paper before the dam division, his audience rapidly dwindling from 120 to 0. Dancing followed.

Through the courtesy of the Pacific Gas & Electric Co., an excursion to the Salt Springs dam and powerhouses was held October 18 and 19, attendance 40. Geo. D. Whittle, D. J. Fee, and C. J. Nobmann composed the excursion committee for this event.

Western Washington Section—At the first regular monthly meeting this fall, held at the Engineers' club, Seattle, September 30, Joseph Jacobs (of Jacobs & Ober, consulting engineers, Seattle) reported on the summer meeting of the Society which occurred in Cleveland July 9 to 11. J. L. Stannard, chief engineer of the Department of Public Utilities, city of Tacoma, told of the plans for the 1931 summer meeting of the Society, to be held at Tacoma.

GEORGE WASHINGTON BICENTENNIAL CELEBRATION—1932

The George Washington Bicentennial Commission is making good progress, enlisting the support of every state in the Union for the proposed 'greatest celebration in history'—the 200th anniversary of the birth of George Washington, engineer and 'Father of Our Country.' Beginning on February 22, 1932, and ending on Thanksgiving day, there will be monthly programs throughout the nation, but principally in Washington, D. C.

CALIFORNIA ASSOCIATED CONCRETE PIPE MANUFACTURERS

The fourth annual coast-wide meeting of this association was held at the Ambassador hotel, Oakland, September 26 and 27. Business sessions were held on the morning and afternoon of the first day and morning of the second, irrigation problems being discussed. M. V. Loving, secretary of the American Concrete Pipe Association, Chicago, spoke regarding the concrete pipe industry throughout the United States and Canada.

New officers elected for a term of one year include: president—Fred Spiekerman, Lodi; vice-president—H. W. Chutter, Fresno; secretary-treasurer—A. A. Clark, Visalia; directors—Gilbert Williamson, Yuba City; B. J. Ukropina, Los Angeles; B. R. Pollard, Fresno; O. H. Price, Healdsburg; J. J. Duggan, Porterville; Henry Schoelton, Sunnyvale; and A. B. Smith, Oakland.

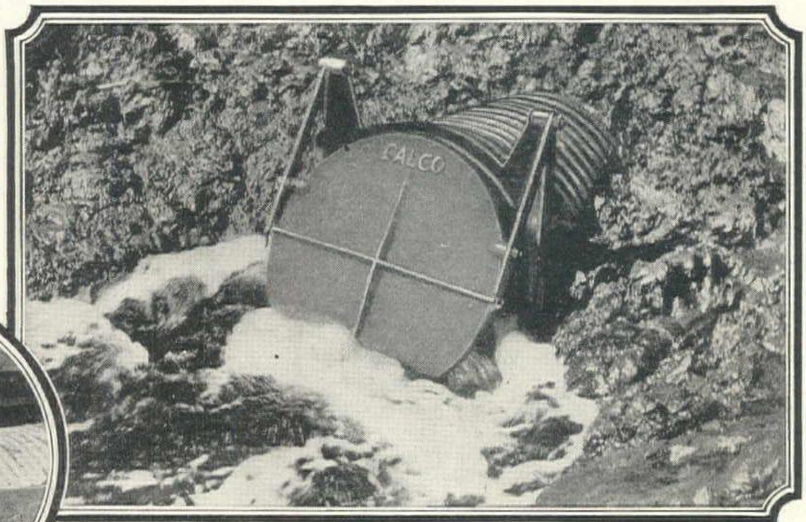
A. S. T. M. COMMITTEE ON CEMENT

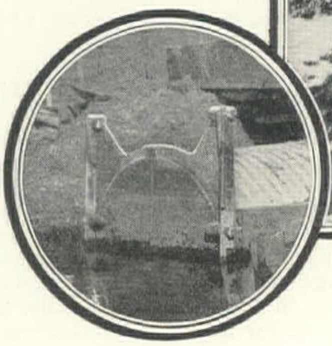
Committee C-1 (on cement) of the American Society for Testing Materials held a reorganization meeting at Washington, D. C., September 5 and 6 and prepared a preliminary program for the next two years. During the past year the committee secured adoption by the Society of a tentative specification for high early strength portland cement and an upward revision of standards for portland cement. Now the committee proposes a more detailed study of these two most widely used hydraulic cements and also of masonry or plastic cements. The investigation of each type of cement and the preparation of a standard therefor will be placed under separate subcommittees.

Although the total membership of Committee C-1 is limited to 75, suggestions will be welcomed from all those interested in the testing and use of cement. The committee will continue under the chairmanship of P. H. Bates of the U. S. Bureau of Standards, with F. H. Jackson of the U. S. Bureau of Public Roads as secretary.

RISING WATERS

Hold No Concern When





CALCO Automatic Drainage Gates Protect Your Drains

HUNDREDS of cities protect their citizens from damaging backflow in drains by taking advantage of the dependable, automatic outlet control of Calco Automatic Drainage Gates.

Attached to any desired length of Armco Corrugated Iron Pipe, Calco Gates are easily installed. Enduring and reliable in service because of their sturdy and simple construction, they are admirably suited to guard the outlet of any drainage system subject to a reversal of flow.

Armco Culvert Manufacturers Association

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OR THESE MEMBERS

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New Equipment and Trade Notes

RECENT SULLIVAN BULLETINS

The Sullivan Machinery Co., Chicago, Illinois, has released a number of important new bulletins, including the following:

'Sullivan Electric Lighting Plants' are adapted for illumination of night work where regular sources of electric light are not available.

'Core Drilling by Contract' is a service rendered by the Sullivan drilling department (established 1884) in engineers' test borings and mineral prospecting.

'Type 10 Diamond Core Drill' is a small, light, portable hydraulic-feed core drill useful for test borings, as well as mining and similar core drilling.

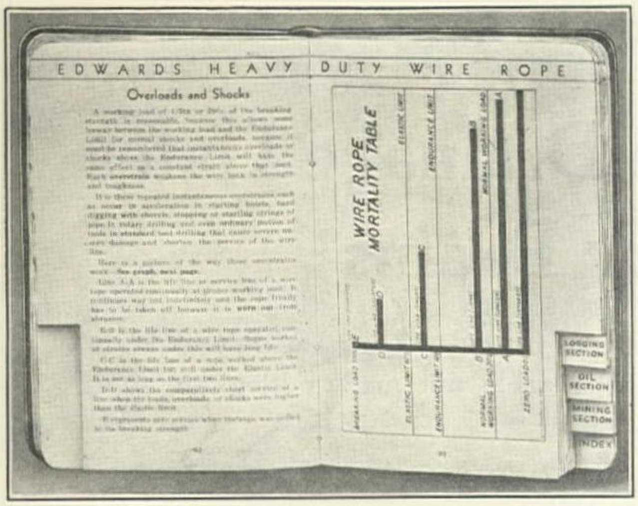
'Type 50 Diamond Core Drill', capacity 3000 ft., is designed primarily for oilfield shallow production and structure drilling, but also has advantages for test boring and mineral prospecting.

'Sullivan GV Pipe-Line Painter'. This device has recently been perfected for spray painting long lengths of pipe-line.

EDWARDS HANDBOOK ON WIRE ROPE

The right rope in the right place, says 'Old Man Performance'.

The E. H. Edwards Co., San Francisco, manufacturer of wire rope, has just completed a pocket-size wire rope handbook of 192 pages, prepared from the practical angle of everyday questions. What should be expected of wire rope? How



do lines act under certain conditions, and why? What can be done about it? How many lines should be strung, and when should they be taken off? What is the life of wire rope, and how may it be prolonged? These are a few of the everyday problems that are treated from the viewpoint of the wire rope user.

In addition to standard information on construction, size, breaking strength, list price, and other matters, this handy reference book contains many valuable data on the use of wire rope in the field. The information has been conveniently divided and indexed (see illustration) into sections, such as Logging, Oil Field, Mining, etc.

McCORMICK-DEERING MODEL 30 INDUSTRIAL TRACTOR

The model 30 McCormick-Deering industrial tractor is a large unit embodying the many construction and performance features of the smaller model 20. The model 30 is powered by a four-cylinder, valve-in-head engine, and develops over 40 hp. on the belt at a governed speed of 1050 r.p.m. The belt pulley has a speed of 593 r.p.m.; forward speeds for this tractor are 2.5, 4.0, and 6.7 m.p.h. A power take-off shaft is available on special order.

Features of the model 30 tractor include: removable cylinders; crankshaft ball bearings; one-piece main frame; complete unit assemblies; factory-sealed governor; high-tension magneto; circulating splash-type lubrication with built-in oil filter; carburetion on kerosene or gasoline; heavy-duty, internal, self-energizing brakes.

This tractor is described and illustrated in 'Powertrax' for November, an International Harvester Co. trade journal.

LINK-BELT ENGINEER ON SEWAGE DISPOSAL EQUIPMENT

The Link-Belt Co., Chicago, has appointed Frank W. Lovett as engineer in charge of sewage disposal equipment in the western territory, headquarters Chicago. Lovett has been with Link-Belt 13 years, including 8 years on the design of machinery for sewage treatment plants.

SHERWIN-WILLIAMS METAL PROTECTIVE PAINTS

The Sherwin-Williams Co., Cleveland, has released a 28-page illustrated booklet containing information on metal protective paints. Subjects covered in this booklet include: general outline on types of paints, composite paints, boiled linseed oil, combination carbon paints, charcoal carbon paints, graphite carbon paints, red lead paints, problems of the petroleum industry, special acid-fume-resisting paint, superheated surfaces, underground piping, oil and gasoline resisting coating, preparation of metal surfaces for painting, specifications for painting.

BUCYRUS-ERIE EQUIPMENT DATA

Recent illustrated catalogues of the Bucyrus-Erie Co., South Milwaukee, Wisconsin, include the following:

Bulletin B-521—The 52-B diesel shovel-dragline-clamshell-crane—2¼ yd.—Atlas Imperial diesel engine equipped—16 pages.

Bulletin D-1203—The 120-B electric-steam 4-yd. revolving shovel for quarry and mine use—24 pages.

Bulletin FBE-10201—The 1020 convertible clamshell-lifting crane shovel-dragline-drag shovel—½-yd. gasoline, diesel, or electric power—20 pages.

Bulletin FBE-10301—The 1030 convertible clamshell-lifting crane shovel-dragline-drag shovel—¾-yd.—20 pages.

Bulletin D-1006—The 100-B electric-steam, 3-yd. revolving shovel—24 pages.

'What About this Gas+Air'—A 16-page booklet discussing the mechanical principles involved in operation of the gas+air, a three-engine machine giving independent power for crowd and swing.

OXWELD PORTABLE WELD TESTER

The Oxweld Acetylene Co., New York City, has developed in cooperation with the Union Carbide & Carbon Co. research laboratories a portable tensile testing machine designed to facilitate the testing of welds in the field or shop. The testing machine weighs 165 lb. and consists of a tubular compression member with a set of grips in the head, and a hydraulic cylinder-block in the base. The cylinder block contains a communicating pump and cylinder and the cylinder pressure operates a piston carrying a second set of grips. Using a set of conical blocks in place of the grips, the standard ½-in. diam. round specimens may be tested. The load is measured directly in pounds per square inch by a calibrated pressure gauge actuated by cylinder pressure.

The Patents Holding Corp., Frederick, Maryland, has granted a license to the Caterpillar Tractor Co. of Minneapolis to manufacture power-propelled road graders and maintainers under patents controlled by the former company.

UNIT BID SUMMARY

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

BRIDGES AND CULVERTS

SACRAMENTO, CALIF.—STATE—MARIN COUNTY—TIMBER, CONCRETE AND STEEL

Healy-Tibbitts Const. Co., 64 Pine St., S. F., $329,667 low bid to California Division of Highways, Public Works Bdg., Sacramento, for steel, timber and concrete bridge over tracks of Northwestern Pacific Railroad at Manzanita, MARIN COUNTY. Bids from 16 low:

(1) Healy-Tibbitts Const. Co., S. F. $329,667
(2) H. W. Rohl, Los Angeles 333,335
(3) Fredrickson & Watson & Fredrickson Bros. 340,972
(4) MacDonald & Kahn, S. F. 341,436
(5) Pacific Bridge Co., Portland 343,961
(6) Merritt-Chapman & Scott 346,710
(7) Lord & Bishop, Sacramento 347,499
(8) Rocca & Caletti, San Rafael 352,131
(9) Butte Const. Co., S. F. $353,786
(10) Siems-Helmers, San Anselmo 367,335
(11) Skeels & Graham 372,228
(12) S. F. Bridge Co., S. F. 374,156
(13) A. W. Kitchen, S. F. 385,659
(14) Mercer-Fraser Co., Eureka 389,384
(15) M. B. McGowan, San Francisco 395,228
(16) Schuler & McDonald, Oakland 403,600

Bids received on the following items for the construction of this project:

(A) 700 cu.yd. struct. excav.
(B) Furnish and drive test piles
(C) 2,500 ft. untr. fir piles, 44′
(D) 6,200 ft. untr. fir piles, 45′
(E) 2,600 ft. cr. fir pile, 44′
(F) 2,520 ft. cr. fir pile, 45-64′
(G) 17,900 ft. cr. fir pile, 65-84′
(H) 28,600 ft. cr. fir pile, 85′ up
(I) 3,100 ft. Red. pile, 84′
(J) 29,750 ft. Red. piles, 85′ up
(K) 1,138 drive piles
(L) 1,900 ft. reinf. conc. piles
(M) 50 tons gravel backfill
(N) 66 yd. 'A' conc. (tremie)
(O) 580 yd. 'A' conc. (bridge)
(P) 455 yd. 'B' conc. (bridge)
(Q) 72,000 lb. rein. steel
(R) 315,000 lb. struct. steel
(S) 5,200 lb. cast steel
(T) 1,600 M. redwood (dense sel.)
(U) 520 M. redwood (select)
(V) 10½ M. douglas fir timber
(W) 1,300 tons asphalt concrete
(X) 280 sq.yd. asph. plank
(Y) 1 operating mach. unit
(Z) 1 lot of miscellaneous work

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)
(A)	2.00	5.00	8.50	3.00	6.50	1.80	5 00	3.50	5.10	1.20	4.00	5.00	.65	10.00	9.00	5.00
(B)	$1000	$4000	$650	$110	$500	$775	$1000	$2000	68.00	$300	$1000	$540	$160	$1000	$1182	$1500
(C)	.25	.25	.23	.193	.20	.21	.25	.22	.24	.25	.27	.29	.225	.18	.25	.20
(D)	.25	.25	.26	.21	.21	.22	.30	.28	.27	.27	.31	.29	.25	.20	.27	.22
(E)	.70	.70	.68	.705	.70	.71	.90	.71	.775	.77	.86	.82	.74	.65	.75	.75
(F)	.70	.80	.75	.785	.80	.78	1.00	.78	.86	.85	.95	.84	.80	.72	.90	.80
(G)	.75	.90	.78	.83	.83	.82	1.05	.83	.92	.90	1.00	.93	.845	.76	.90	.90
(H)	.80	1.00	.90	.95	.96	.94	1.10	.97	1.09	1.07	1.15	.98	1.00	.88	1.00	1.00
(I)	.60	.90	.68	.64	.70	.65	.70	.76	.62	.71	.73	.71	.70	.77	.75	.90
(J)	.70	.90	.85	.852	.85	.84	.90	.81	.95	.93	.96	.88	.90	.87	1.00	1.10
(K)	12.00	15.00	16.00	15.00	10 00	13.00	12.00	19.00	12.00	13.50	12.50	10.00	13.60	26.00	20.00	20.00
(L)	3.00	3.00	3.00	2.50	5.00	2.10	3.50	2.80	3.15	4.00	5.00	3.75	2.85	4.00	4.00	3.00
(M)	3.00	3.00	2.50	3.25	3.00	1.90	3.00	3.50	3.36	3.00	3.25	4.75	2.75	3.00	7.00	2.50
(N)	20.00	54.00	22.50	38.00	20.00	13.50	23.00	16.00	19.10	10.00	18.00	33.50	21.50	25.00	20.00	15.00
(O)	25.00	15.00	17.00	16.30	18.00	25.00	23.00	18.00	16.30	21.00	22.00	20.60	19.75	30.00	25.00	25.00
(P)	22.00	15.00	17.00	13.00	16.50	21.00	20.00	18.00	12.10	29.50	18.00	20.00	21.75	20.00	20.00	18.00
(Q)	.05	.04	.04	.045	.045	.04	.045	.045	.042	.0475	.04	.06	.047	.04	.05	.04
(R)	.065	.05	.07	.07	.07	.066	.065	.07	.07	.065	.065	.075	.067	.07	.065	.07
(S)	.15	.10	.12	.135	.20	.115	.15	.15	.146	.12	.15	.15	.135	.11	.12	.15
(T)	80.00	82.00	82.00	84.25	82.50	85.00	80.00	85.85	88.27	87.50	90.50	90.00	$102	95.00	95.00	$100
(U)	85.00	80.00	81.00	83.50	80.00	89.00	80.00	84.00	84.66	95.00	88.50	$102	$107	96.00	$105	90.00
(V)	75.00	$100	75.00	52.00	70.00	94.00	50.00	60.00	95.40	83.00	55.50	$157	71.00	98.00	70.00	50.00
(W)	6.00	4.00	5.75	7.35	9.00	5.50	6.00	6.20	5.80	6.50	6.25	6.40	6.40	5.00	6.00	8.00
(X)	3.00	3.00	3.50	5.00	3.00	3.10	4 00	5.10	4.10	5.70	5.00	5.00	5.20	4.50	3.50	3.00
(Y)	$9000	$4000	$9500	$8000	$8000	$8530	$7500	$8000	$8239	$8210	$8000	$9154	$7623	$7000	$7000	$11,000
(Z)	$1700	$500	$700	$700	$2000	$2500	$1000	$500	$820	$750	$500	$2000	$346	$450	$1000	$5000

OAKLAND, CALIF.—CONCRETE—CRANDALL SLOUGH—COUNTY

W. W. Hayes, Call Building, San Francisco, $50,744, low bid to County for two bridges over Crandall Slough, 3 miles south of Alvarado on Alvarado-Centerville Road. Bids on:

(1) 500 cu.yd. excavation, below elev. 15
(2) 2,500 cu.yd. excavation, above elev. 15
(3) 1,800 cu.yd. grading roadway
(4) 14,000 sq.ft. 8-in. waterbound macad. paving
(5) 1,570 cu.yd. concrete in bridge
(6) 267,000 lb. reinforcing steel
(7) 200 ft. corrugated pipe
(8) Removal of bridges

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	TOTALS
W. W. Hayes, San Francisco	4.00	1.00	.55	.12	18.422	.0395	2.10	$3685	$50,744
N. Lena, Alameda	.25	1.70	1.35	.08	16.50	.0425	2.00	6537	52,114
C. A. Bruce & Sons, Pleasanton	.25	2.00	1.45	.07	19.00	.04	2.25	6000	55,675
C. Emil Force, Piedmont	2.75	1.60	1.75	.15	19.60	.04	1.00	4500	56,777
M. B. McGowan, San Francisco	6.00	2.20	1.00	.115	20.00	.047	1.80	2345	58,670

George A. Posey is County Surveyor of Alameda County.

SACRAMENTO, CALIF.—STATE—BUTTE COUNTY—STEEL

J. H. Pomeroy & Co., Railway Exchange Bdg., Portland, and 251 Kearny St., San Francisco, who bid $138,848, low bid to California Division of Highways for steel bridge with concrete deck over the tracks of the Western Pacific RR and over north fork of the Feather River at Pulga, BUTTE COUNTY, composed of one 349.95-ft. steel arch span, one 82.14-ft. plate girder span, one 79.06-ft. plate girder span, two 62.51 ft. plate girder spans and one 44.02-ft. plate girder span. Bids on:

(1) 590 cu.yd. Class 'A' concrete
(2) 92,000 lb. reinforcing steel
(3) 1,540,000 lb. structural steel
(4) 35,000 lb. cast steel
(5) 59,000 lb. structural steel (railings)
(6) 34,000 lb. cast iron (railings)
(7) 1,000 lb. bronze expansion plates
(8) 1 lot of miscellaneous work

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	TOTALS
J. H. Pomeroy & Co.	19.00	.046	.0702	.0892	.123	.1035	.65	$750	$138,848
Rocca & Caletti	20.00	.05	.077	.12	.10	.07	.45	$850	148,760
Gutleben Bros., Oakland	25.00	.06	.0815	.10	.10	.06	.60	$395	158,215
M. B. McGowan, S. F.	28.00	.05	.08	.15	.12	.09	.50	$1340	161,550
C. J. Nystedt	32.00	.055	.085	.12	.13	.095	.45	15.00	171,890
Minneapolis-Moline Power Implement Co., L. A.	28.00	.056	.084	.14	.165	.145	.55	$1750	172,897

H-671

SAN DIEGO, CALIF.—CITY—FIRST STREET BRIDGE—STEEL

Contract awarded to Hazard Contracting Co., 2528 Kettner Boulevard, San Diego, who bid $123,809 for constructing steel bridge to be known as the First Street Bridge, work for the City of San Diego, San Diego County. Bids from:

(1) Hazard Contracting Co. $123,809
(2) Gutleben Bros., Oakland.... 129,544
(3) Daley Corporation, San Diego.... 130,980
(4) Jarboe Construction Co. 131,557
(5) Lynch-Cannon Engrg. Co. 132,492
(6) V. R. Dennis Const. Co., San Diego....$134,168
(7) Frank Doran, San Diego.... 143,419
(8) Holland Const. Co., L. A..... 145,627
(9) Gist & Bell, Arcadia 146,001
(10) Engineer's estimate 139,671

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
884 cu.yd. excavation	.50	.20	.25	.35	1.00	.30	1.50	.60	.55	.45
1,429 cu.yd. found. excavation	1.00	1.50	1.00	1.62	2.00	1.00	2.00	1.35	1.00	1.25
11,281 cu.yd. embankment	.80	.45	.80	.60	1.00	.50	1.00	.60	1.00	.90
28,950 sq.ft. subgrade	.01	.01	.01	.015	.01	.01	.02	.015	.01	.01
27,916 sq.ft. asph. pave.	.20	.11	.109	.14	.20	.15	.16	.20	.15	.13
1,985 sq.ft. conc. pavement	.22	.17	.193	.29	.30	.20	.20	.275	.30	.20
3,823 sq.ft. sidewalk	.17	.15	.163	.19	.20	.16	.20	.20	.15	.19
1,132 lin.ft. curb	.60	.48	.47	.70	.60	.55	.60	1.00	.50	.45
9 water services	20.00	15.00	15.70	23.20	25.00	15.00	25.00	25.50	2.00	18.00
1 6-in. curb inlet	100.00	25.00	35.00	75.00	50.00	50.00	$150	82.50	50.00	60.00
1 20-in. curb inlet	$175	$125	$133	104.50	$175	$150	$250	$135	$100	$110
56 ft. 12-in. corr. iron culv.	3.00	1.80	1.95	2.10	2.00	2.00	3.00	2.40	1.50	2.00
128 ft. 18-in. corr. iron culv.	4.00	3.60	2.35	2.90	2.80	4.00	4.00	3.00	2.50	2.80
62 ft. 24-in. heavy culvert	5.00	3.00	2.95	4.05	3.70	4.00	4.00	3.75	3.00	3.70
277 cu.yd. conc. 'C' (wall)	30.00	18.00	17.50	16.00	25.00	21.00	26.00	21.00	23.00	27.50
10 cu.yd. conc. 'D' (wall)	20.00	14.60	8.50	7.60	20.00	17.00	21.00	17.00	25.00	17.50
198 cu.yd. conc 'B' (piers)	30.00	17.00	14.00	12.40	24.00	21.00	25.00	21.00	20.00	22.50
410 cu.yd. conc. 'C' (piers)	25.00	19.00	16.70	15.05	25.00	21.00	26.00	22.00	25.00	27.50
15 cu.yd. conc. 'D' (piers)	30.00	14.60	8.50	7.60	20.00	17.00	21.00	21.00	25.00	17.50
571 cu.yd. conc. 'C' (deck)	25.00	23.00	27.10	24.20	20.00	19.00	26.00	31.00	27.00	32.50
1,047 ft. metal rail	5.00	7.25	6.40	6.25	3.50	6.50	8.00	7.40	7.50	3.50
Railing (complete)	$ 200	$ 220	$ 312	$327	$137	$300	$300	2.60	$300	$137
7 ornamental lights, comp.	1200	1800	1667½	$1856	$1000	$1500	$2000	$2250	$2000	$1659
Structural steel (comp.)	57,700	77,000	75,653	$78,764	$69,700	$81,000	$70,300	$79,500	$79,000	$72,884

PORTLAND, ORE.—GOVT—CONCRETE—SIUSLAW NATIONAL FOREST

Award of contract recommended to Kuckenberg-Wittman Co., Inc., Board of Trade Bdg., Portland, Ore., who bid $60,823 to the U. S. Bureau of Public Roads, Portland, for 5 reinf. concrete bridges and 1 box culvert on Salmon River Highway, Siuslaw National Forest, LINCOLN COUNTY. Bids on:

(1) 1,070 cu.yd. roadway excav., Schedule A
(2) 1,230 cu.yd. roadway excav., Schedule B
(3) 1,265 cu.yd. structure excavation
(4) 430 cu.yd. Class 'A' concrete
(5) 1,080 cu.yd. Class 'D' concrete
(6) 225,200 lb. reinf. steel
(7) 1,930 lb. bronze bearing plates
(8) 15 cu.yd. cement rubble masonry
(9) 250 cu.yd. handlaid riprap
(10) 200 cu.yd. handlaid rock embankment

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	TOTALS
Kuckenberg-Wittman Co., Portland	.85	.35	4.00	24.00	28.00	.04	.50	15.00	5.00	3.00	$60,823
J. J. Badraun, Portland, Ore.	.50	.50	4.00	27.00	28.00	.045	.40	10.00	3.00	3.00	62,098
F. L. Odom, Salem, Ore.	.50	.40	4.00	23.50	29.00	.04	.35	15.00	5.00	4.00	63,435
Dolan Const. Co., Tillamook, Ore.	.60	.60	4.00	27.00	28.00	.04	.50	15.00	5.00	4.00	65,103
Gilpin Const. Co., Portland, Ore.	.75	.75	4.00	30.00	30.00	.045	.50	15.00	5.00	3.00	69,674
W. T. Butler Co., Seattle, Wash.	.50	.75	5.50	32.00	34.00	.045	.70	25.00	4.00	5.00	78,187

STREET AND ROAD WORK

SACRAMENTO, CALIF.—STATE—GRADING AND ASPHALT PAVING—IMPERIAL COUNTY

V. R. Dennis Const. Co., P. O. Box 183, Station A, San Diego, $227,453, low to California Division of Highways, Sacramento, for 6 miles grading and paving between Araz and Yuma, IMPERIAL COUNTY. Bids from:

(1) V. R. Dennis Const. Co. $227,453
(2) Steele Finley, Santa Ana 240,238
(3) Basich Bros. Const. Co. 249,914
(4) R. E. Hazard Contracting Co. 249,965
(5) H. W. Rohl, Los Angeles 273,257
(6) Southwest Paving Co. $288,644
(7) Griffith Company 292,818
(8) Hanrahan Company, San Francisco.... 294,950
(9) Hall-Johnson Co. 310,950

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
211,900 cu.yd. roadway excavation	.15	.17	.28	.17	.20	.25	.22	.22	.28
480,000 mi.yd. haul	.08	.07	.085	.095	.13	.13	.14	.12	.14
1,692 cu.yd. struct. excavation	1.25	.75	.60	.75	1.00	1.00	.80	.75	.95
72,000 sq.yd. subgrade	.11	.09	.065	.06	.10	.20	.09	.09	.09
29,100 tons asph. concrete	4.20	4.65	4.15	4.88	4.50	4.50	4.85	5.38	5.00
260 cu.yd. 'A' concrete (struct.)	20.00	22.00	15.00	16.00	25.00	15.00	25.00	25.00	25.00
10,900 lb. reinf. steel	.06	.05	.045	.04	.05	.065	.05	.05	.05
100 ft. 18-in. corr. pipe	.50	.35	.20	.50	.50	.50	.50	.50	.75
118 ft. 24-in. corr. pipe	.50	.50	.25	.50	.50	.70	.80	.50	.75
168 ft. 30-in. corr. pipe	.75	.75	.25	.50	1.00	.80	.80	1.00	1.00
414 ft. 36-in. corr. pipe	1.25	.75	.30	.50	1.00	1.25	1.00	1.50	1.00
80 ft. clean and relay pipe	1.00	.75	.30	.40	1.00	.50	1.00	.75	3.00
516 ft. 4-in. tile underdr.	.15	.25	.50	.20	.50	.50	.25	.50	.50
37 yd. gravel blanket	2.25	3.50	1.00	2.50	1.00	4.00	3.50	1.50	2.50
83 ft. timber guard rail	2.00	1.25	1.50	1.25	1.00	1.25	1.50	1.00	1.25
103 M redwood (dense select)	93.00	$100	85.00	70.00	$100	92.00	$105	85.00	$105
28 M redwood (select)	82.00	$100	85.00	70.00	$100	92.00	$105	85.00	$105
1,800 ft. fur. tr. piles	.85	.95	.80	.70	1.00	.90	.80	.75	.90
90 each drive piles	15.00	10.00	15.00	5.00	10.00	11.00	15.00	10.00	16.00
22 yd. remove concr.	2.00	5.00	2.00	3.50	5.00	3.50	2.50	5.00	2.50
7 mi. new prop. fence	$300	$450	$375	$435	$400	$500	$500	$400	$400
315 sta. finish roadw.	3.00	4.00	5.00	4.00	5.00	6.00	5.00	5.00	8.00
52 monuments	3.00	2.00	2.00	3.00	3.00	3.00	3.00	3.00	3.00

SACRAMENTO, CALIF.—STATE—GRADING AND BITUMINIZED MACADAM—SANTA CLARA COUNTY

Contoules Const. Co., PO Box 194, Yosemite, and 46 Collins St., S. F., $212,284, low bid to California Division of Highways for 10.7 mi. grading and paving with bituminous macadam from San Felipe to Bells Station, SANTA CLARA COUNTY. Twenty lowest bids as follows:

(1) Contoules Const. Co. $212,284
(2) E. C. Coats, Sacramento 214,750
(3) H. W. Rohl, Los Angeles 217,851
(4) Healy-Tibbitts Co., S. F. 223,738
(5) Fredrickson & Watson, Oakland 224,904
(6) Hemstreet & Bell, Marysville 226,154
(7) F. W. Nighbert, Bakersfield 328,642
(8) A. Teichert & Sons 228,784
(9) M. J. Bevanda, Stockton 229,333
(10) Irving L. Ryder, San Jose 233,275
(11) Larsen Brothers, Galt $233,283
(12) C. W. Wood, Stockton 240,531
(13) McCray Company, L. A. 241,255
(14) Granite Const. Co. 244,889
(15) Peninsula Paving Co. 248,659
(16) J. F. Knapp, Oakland 253,994
(17) W. H. Hauser, Oakland 256,623
(18) V. R. Dennis Const. Co., San Diego 266,235
(19) Skeels & Graham, Roseville 279,551
(20) Isbell Const. Co., Fresno 299,365

Bids on the following items:

(A) 191,000 yd. roadway excav.
(B) 950,000 sta.yd. overhaul
(C) 4,000 cu.yd. imported borrow
(D) 2,805 cu.yd. struct. excav.
(E) 456 cu.yd. 'A' conc. (Struct.)
(F) 43,000 lb. reinf. steel
(G) 35,300 cu.yd. cr. run gr. base
(H) 20,000 tons broken stone (Bit. macadam surf.)
(I) 950 tons emulsified asphalt
(J) 1,240 bbl. light fuel oil
(K) 230 ft. 8-in. corr. pipe
(L) 132 ft. 12-in. corr. pipe
(M) 764 ft. 15-in. corr. pipe
(N) 1,952 ft. 18-in. corr. pipe
(O) 44 ft. 24-in. corr. pipe
(P) 120 ft. 30-in. corr. pipe
(Q) 83 ft. clean and relay pipe
(R) 1,000 ft. 8-in. perf. metal pipe underdrain
(S) 59 move and reset headwalls
(T) 172 culvert markers
(U) 566 timber guide posts
(V) 50 cu.yd. remove concrete
(W) 30 remove trees, size 1
(X) 20 remove trees, size 2
(Y) 3.7 mi. new property fence
(Z) 17 mi. move and reset fence
(AA) 119 monuments
(BB) 551 sta. finish roadway

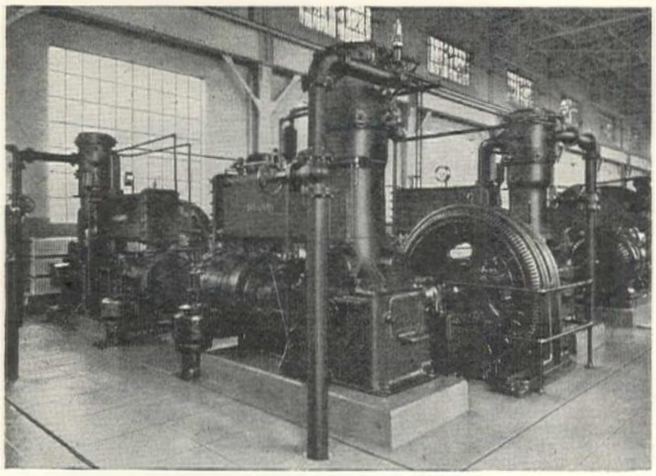
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)	(20)
(A)	.30	.35	.35	.325	.30	.35	.45	.34	.37	.39	.33	.38	.36	.32	.35	.38	.45	.35	.60	.42
(B)	.005	.005	.005	.005	.005	.01	.02	.01	.008	.005	.01	.01	.005	.01	.005	.005	.01	.01	.0075	.01
(C)	.40	.50	.35	.55	.40	.50	.65	.80	1.00	.39	.50	.50	.70	.50	.50	.50	.60	.85	.60	.65
(D)	.75	1.00	1.00	.75	1.00	1.00	1.00	.80	1.00	1.00	1.00	1.00	1.00	.90	1.20	1.00	1.50	1.50	1.00	1.00
(E)	22.00	25.00	20.00	16.00	20.00	25.00	27.50	20.00	21.00	22.50	22.00	20.00	20.00	21.50	25.00	20.00	22.00	25.00	25.00	26.00
(F)	.05	.045	.06	.04	.045	.05	.06	.04	.05	.05	.05	.05	.05	.045	.06	.045	.05	.05	.0475	.055
(G)	.93	1.00	1.00	1.60	1.55	.90	2.37	1.13	1.25	1.435	1.00	1.00	1.50	1.22	1.00	1.75	1.00	1.35	1.10	1.87
(H)	3.10	2.45	2.75	2.45	2.70	2.90	3.75	2.75	2.50	2.09	3.20	3.30	2.80	3.50	3.65	2.75	3.25	3.72	2.75	4.00
(I)	20.00	24.00	23.00	22.20	24.00	24.00	25.00	25.65	22.00	24.95	25.00	24.00	24.00	25.70	27.00	25.00	22.00	24.25	25.00	26.00
(J)	2.50	2.00	2.00	1.85	2.00	2.10	2.15	2.00	2.00	1.95	2.25	2.00	2.20	2.00	3.20	2.50	2.00	2.10	2.50	2.50
(K)	.30	.50	.30	.25	.50	.50	.50	.40	.40	.50	.30	.50	.40	.30	.45	.30	.30	.60	.50	.50
(L)	.30	.50	.40	.35	.50	.50	.60	.40	.40	.60	.30	.50	.50	.30	.50	.40	.40	.60	.50	.50
(M)	.35	.50	.50	.45	.50	.50	.70	.40	.50	.75	.35	.50	.60	.35	.50	.50	.50	.70	.60	.50
(N)	.50	.60	.50	.55	.50	.50	.70	.50	.50	.80	.45	.50	.75	.40	.50	.60	.50	.75	.75	.50
(O)	.60	.70	.50	.70	.50	.50	.70	.75	.60	1.00	.60	.50	1.00	.50	.60	.70	.60	1.00	1.00	.75
(P)	.70	1.00	.70	.90	.50	1.00	.70	1.00	.60	1.25	.90	1.00	1.25	.60	.60	.80	1.00	1.25	1.50	1.00
(Q)	.60	1.00	1.00	.75	.50	1.00	1.50	.75	1.00	3.00	.70	.50	1.00	.35	.75	1.00	1.00	1.00	1.00	1.00
(R)	2.00	1.30	1.20	1.20	1.20	1.40	1.70	1.25	1.50	2.00	2.00	1.50	1.50	1.13	1.40	1.25	2.00	1.65	1.75	1.50
(S)	10.00	10.00	10.00	10.00	10.00	10.00	17.00	10.00	10.00	20.00	10.00	8.00	10.00	7.00	20.00	10.00	10.00	17.00	10.00	15.00
(T)	2.00	2.00	2.00	2.10	2.00	2.00	2.80	2.50	1.60	2.00	2.50	1.50	2.25	3.00	3.50	2.50	1.00	2.80	2.50	2.50
(U)	2.10	2.15	2.00	2.25	2.20	2.50	3.40	3.00	2.50	3.00	3.00	2.00	2.75	3.50	4.00	3.00	1.00	2.50	2.75	2.75
(V)	4.00	2.00	5.00	5.00	3.50	2.00	3.00	6.00	7.00	3.00	20.00	3.00	4.00	2.50	5.00	3.00	10.00	2.50	3.00	5.00
(W)	7.00	10.00	10.00	4.00	5.00	10.00	20.00	15.00	10.00	20.00	10.00	5.00	5.00	5.00	10.00	5.00	5.00	20.00	10.00	10.00
(X)	7.00	20.00	30.00	6.00	5.00	15.00	25.00	25.00	15.00	40.00	20.00	10.00	10.00	5.00	20.00	15.00	10.00	30.00	20.00	15.00
(Y)	$600	$500	$500	$500	$400	$500	$550	$500	$600	$400	$500	$600	$500	$550	$700	$450	$500	$300	$500	$500
(Z)	$250	$250	$300	$250	$200	$300	$250	$200	$200	$300	$300	$300	$300	$330	$350	$350	$300	$250	$350	$250
(AA)	3.00	3.00	3.00	2.00	2.50	3.00	3.00	3.00	2.00	3.00	3.00	3.00	2.50	2.50	3.50	3.00	3.00	3.50	3.00	3.00
(BB)	8.00	5.00	5.00	5.00	5.00	5.00	5.00	7.00	5.00	4.00	5.00	5.00	4.00	8.00	5.00	5.00	10.00	12.50	5.00	5.00

DENVER, COLORADO—STATE—KIT CARSON COUNTY—OIL PROCESSING

H. C. Lallier Const. & Engr. Co., Denver, Colorado, $111,218 low bid to State Highway Commission for 18.6 miles oil processing from Stratton to Burlington, KIT CARSON COUNTY. Bids from five lowest bidders as follows: (1) On Road Mix and (2) On Plant Mix:

	(1)	(2)
(A) H. C. Lallier Const. & Engr.	$111,217	no bid
(B) C. V. Hallenbeck, Rifle, Colo.	119,387	no bid
(C) Hinman Bros. Co., Denver	127,635	no bid
(D) Hamilton & Gleason, Denver	no bid	$119,578
(E) Mt. States Const. Co., Pueblo	no bid	141,275

	(1)	(2)	(3)	(4)	(5)
Remove structures	500.00	100.00	50.00	50.00	50.00
10,500 lin.ft. remove fence	.01	.01	.01	.01	.01
48,200 cu.yd. common excavation	.16	.20	.24	.30	.18
157,000 sta.yd. overhaul	.02	.02	.02	.02	.02
4,300 yd.mi.haul	.20	.20	.20	.25	.08
3,900 tons replacing gravel	.60	.71	.90	.75	.93
35 cu.yd. Class 'A' concrete	20.00	20.00	21.00	25.00	21.00
20 cu.yd. Class 'B' concrete	20.00	20.00	21.00	25.00	21.00
2,700 lb. reinforcing steel	.05	.06	.07	.06	.06
974 ft. 15-in. corr. pipe culv.	1.50	1.25	1.54	1.80	1.35
252 ft. 18-in. corr. pipe culv.	1.70	1.50	1.65	2.00	1.55
84 ft. 24-in. corr. pipe culvert	2.50	2.50	2.60	3.00	2.40
68 ft. 30-in. corr. pipe culv.	3.00	3.00	3.30	3.50	3.00
108 ft. relay corr. pipe	.60	.50	.70	1.00	.35
21,000 ft. barbed wire fencing	.05	.05	.055	.06	.055
6 gates for fence	5.00	3.00	4.00	5.00	5.00
1,000 ft. picket snow fencing	.50	.40	.80	.25	.40
4 project markers	40.00	15.00	25.00	25.00	20.00
36 right-of-way markers	4.00	5.00	4.00	5.00	4.00
63,000 tons gravel or crushed rock surfacing (Road Mix)	.60	.71	.85		
438,000 gal. asphalt oil (road mix)	.084	.07	.075		
218,000 sq.yd. oiling (Road Mix)	.075	.10	.071		
ALTERNATIVE ITEMS					
63,000 tons gravel or crushed rock surfacing (Plant Mix)				.75	.97
438,000 gal. asphalt oil (Plant Mix)				.055	.074
218,000 sq.yd. oiling (Plant Mix)				.09	.12



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PACIFIC COAST STEEL CORPORATION
Subsidiary of Bethlehem Steel Corporation
General Offices: Matson Building, San Francisco

Seattle: 28th Avenue S. W. and W. Andover Street
Portland: American Bank Building *Honolulu:* Schuman Building
Los Angeles: Pacific Finance Building

Export Distributor: Bethlehem Steel Export Corporation, 25 Broadway, New York City

PACIFIC COAST STEEL CORPORATION

PHOENIX, ARIZ.—GOVT.—GRADING—COCONINO COUNTY

C. G. Willis & Sons, 2119 E. 25th St., Los Angeles, who bid $149,068, low bid to U. S. Bureau of Public Roads, Phoenix, Ariz., for 2.818 miles grading Oak Creek Nat. Forest, COCONINO COUNTY, Arizona. Bids from:

(1)	C. G. Willis & Son, L. A.	$149,068
(2)	Morrison-Knudsen Co., Boise, Idaho	161,151
(3)	J. A. Donovan & Sons, L. A.	176,270
(4)	Geo. W. Orr, El Paso, Tex.	179,548
(5)	Gist & Bell, Arcadia	187,698
(6)	Merritt-Chapman & Scott	193,630
(7)	H. J. Hagen, Globe, Ariz.	206,114
(8)	Henry Galbraith, Jerome, Ariz.	$205,362
(9)	B. B. Boyd, San Diego	233,964
(10)	Miracle Const. Co. and R. A. Wattson	247,209
(11)	E. J. Maloney, Gallup, New Mexico	262,869
(12)	Pearson & Dickerson, Riverside	280,431
(13)	Engineer's estimate	222,110

Bids received on the following items for the construction of this project:

(A) 22 acres clearing
(B) 149,000 cu.yd. roadway excavation
(C) 1,850 cu.yd. structure excavation
(D) 1,500 cu.yd. borrow excavation
(E) 143,600 sta.yd. overhaul
(F) 2.818 miles finish earth gr. road
(G) 198 cu.yd. 'A' concrete
(H) 156 cu.yd. 'D' concrete
(I) 47,620 lb. reinforcing steel
(J) 920 cu.yd. cement rubble masonry
(K) 1,114 lin.ft. 18-in. corr. pipe
(L) 198 lin.ft. 24-in. corr. pipe
(M) 640 lin.ft. 36-in. corr. pipe
(N) 147,000 lb. structural steel
(O) 50 cu.yd. hand laid raprap
(P) 940 cu.yd. hand laid rock embank.
(Q) 6,000 lin.ft. wood guard rail
(R) 1 each cattle guard
(S) 7,940 lin.ft. protection ditch
(T) 80 right of way monuments
(U) 96 ft. 30-in. perf. corr. metal pipe
(V) Lump sum hardware for bridge

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)
(A)	$100	$200	$150	$75	$200	$150	$250	$100	$200	$250	$350	$300	$125
(B)	.575	.63	.70	.80	.78	.88	.95	1.00	1.12	.98	1.25	1.33	1.00
(C)	1.50	2.20	2.50	2.50	2.50	1.50	1.50	1.50	1.50	1.00	3.00	3.00	2.00
(D)	.50	.60	.40	.65	.50	.55	.95	.50	.70	1.50	1.00	.70	.50
(E)	.01	.01	.02	.02	.02	.02	.02	.03	.04	.04	.03	.03	.04
(F)	$350	$300	$500	$300	$300	$500	$200	$100	$200	$500	$300	$500	$250
(G)	30.00	35.00	37.00	25.37	28.00	26.00	28.00	25.00	24.00	40.00	28.00	30.00	30.00
(H)	34.00	36.00	42.00	41.00	40.00	26.00	30.00	22.00	30.00	40.00	31.00	50.00	32.00
(I)	.065	.06	.065	.055	.06	.05	.045	.07	.055	.07	.055	.05	.06
(J)	7.00	15.00	16.00	10.00	16.00	12.00	13.00	10.00	16.00	16.00	12.00	20.00	17.00
(K)	2.25	2.25	2.20	1.60	2.00	2.25	2.00	2.50	2.14	2.50	2.75	2.50	2.00
(L)	2.75	3.00	3.20	2.50	2.50	3.20	3.00	3.50	2.84	3.50	3.25	3.00	2.75
(M)	5.25	5.00	6.00	4.87	5.00	5.50	6.00	4.50	5.16	6.00	6.00	5.00	5.00
(N)	.085	.07	.07	.0764	.07	.065	.065	.07	.065	.075	.07	.08	.075
(O)	4.00	3.50	3.75	2.00	3.00	4.00	6.00	1.00	4.00	3.00	3.00	2.00	4.00
(P)	4.00	1.50	2.25	1.25	2.00	3.00	1.00	.50	2.00	2.00	1.50	1.00	3.50
(Q)	1.45	.70	1.00	1.00	1.10	1.00	1.25	1.00	.95	1.75	1.00	1.00	1.20
(R)	$325	$200	$450	$600	$400	$150	$300	$300	$445	$400	$525	$600	$500
(S)	.20	.30	.07	.06	.30	.22	.10	.10	.10	1.00	.75	.10	.10
(T)	3.25	10.00	3.00	3.50	3.00	10.00	3.00	3.00	4.00	2.00	5.00	5.00	3.50
(U)	5.50	4.00	5.50	6.00	5.00	4.25	6.00	5.00	4.42	10.00	2.50	10.00	4.75
(V)	$125	$150	$100	$60	$100	$150	$75	$100	$48	$700	$75	$500	$75

BELMONT, CALIF.—CITY—ROCK MACADAM AND ASPHALT PAVING, SEWERS, ETC.

Contract awarded to Union Paving Co., Call Bdg., San Francisco, who bid $196,305 as follows (only bid submitted to City) for the improvement of various streets:

35,000	cu.yd. excavation	.58
700,000	sq.ft. rock macadam base and oil and screenings surface	1.25
180,000	sq.ft. rock macadam base with 2½-in. asphalt surface	.16
4,000	lin.ft. 2-ft. concrete gutter	.90
4,000	lin.ft. concrete curb and gutter	1.00
49	catchbasins	78.00
10	manholes	100.00
50	ft. 8-in. concrete storm sewers	1.10
900	ft. 10-in. concrete storm sewers	1.25
1,200	ft. 12-in. conc. storm sewers	1.50
100	ft. 18-in. concrete storm sewers	2.00
8,000	ft. 4-in. vitrified sewers	1.00
25	cu.yd. reinforced concrete	30.00
50,000	ft. redwood headers	.15

Work under 1911 Improvement Act. Geo. A. Kneese, Redwood City, is Engineer.

SALT LAKE CITY, UTAH—STATE—SURFACING—TOOELE COUNTY

Dodge Bros., Inc., Fallon, Nev., who bid $183,400, low bid to Utah State Road Commission for resurfacing with gravel 41.4 miles from Wendover to Knolls, TOOELE COUNTY. Bids received on:

(1) 95,000 cu.yd. gravel surfacing
(2) 35,000 cu.yd. borrow

	(1)	(2)	TOTALS
Dodge Bros., Inc.	1.82	.30	$183,400
Nevada Rock & Sand Co.	1.85	.25	184,500
Olof Nelson, Logan, Utah	1.88	.25	187,350
Wheelwright Const. Co.	1.90	.20	187,500
W. W. Clyde and J. W. Whiting	1.97	.28	196,950
Ora Bundy, Ogden, Utah	2.03	.28	202,650
Wm. Hoops, Twin Falls, Ida.	2.00	.50	207,500
Utah Const. Co., Ogden, Utah	2.20	.30	$219,500
B. D. Palfreyman, Provo, Utah	2.23	.25	220,600
J. W. Sumsion, Springville, Utah	2.22	.28	220,700
Gibbons & Read	2.20	.35	221,250
Reynolds-Ely Const. Co.	2.40	.40	242,000
Ryberg Bros.	2.70	.27	265,950
Engineer's estimate	2.40	.35	240,250

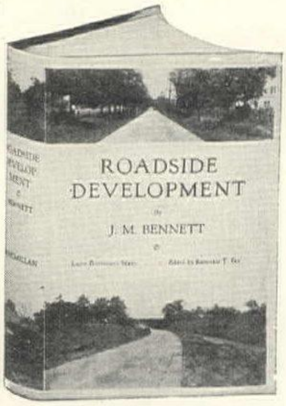
BAKERSFIELD, CALIF.—COUNTY—GRADING—McKITTRICK-BELRIDGE ROAD

Contract awarded to W. K. McMillan, 2088 Howard St., San Francisco, who bid $41,485 for the grading of portions of the McKittrick-Belridge Road for Kern County. Bids received from five lowest bidders as follows on:

(1) 1,700 cu.yd. drainage culvert excavation
(2) 2,500 cu.yd. ditch excavation
(3) 50,500 cu.yd. roadway excavation
(4) 645 cu.yd. concrete (structures)
(5) 72,000 lb. reinforcing steel

	(1)	(2)	(3)	(4)	(5)	TOTALS
W. K. McMillan, San Francisco	1.00	.80	.22	28.50	.06	$41,485
Steele Finley, Santa Ana	.75	.30	.30	22.00	.045	42,152
Kern Contracting Co., Bakersfield	.50	.50	.35	24.00	.05	43,910
V. R. Dennis Const. Co., San Diego	.75	.40	.24	20.00	.05	44,061
J. F. Knapp, Oakland	1.00	1.00	.25	25.00	.06	44,732

J. R. Thornton is the County Surveyor of Kern County.


ROADSIDE
DEVELOPMENT
J. M. BENNETT

SAN FRANCISCO, CALIF.—CITY—GRADING—SECTION A OF ALEMANY BOULEVARD

Contract awarded to H. V. Tucker, 300 Vermont St., San Francisco, who bid $38,731 to Board of Public Works for grading Section A of Alemany Boulevard from Mission St. to Bayshore Boulevard. Bids on:

(1) 120,000 cu.yd. excavation
(2) 2 brick manholes
(3) 100 ft. 12-in. vitrified sewer
(4) 170 ft. 18-in. vitrified sewer
(5) 70 cu.yd. 'B' concrete
(6) 7,000 lb. reinforcing steel
(7) 600 ft. 18-in. corr. culvert
(8) 1 redwood intake for 18-in. culvert

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	TOTALS
H. V. Tucker, San Francisco	.2879	75.00	1.25	1.90	28.00	.05	2.00	75.00	$38,731
Meyer Rosenberg, S. F.	.32	100.00	2.00	1.50	30.00	.05	2.00	25.00	42,730
Sibley Grading & Teaming Co.	.335	75.00	1.55	1.55	20.00	.05	1.75	100.00	43,668
Healy-Tibbitts Const. Co.	.365	80.00	1.60	1.85	25.00	.045	1.90	25.00	47,664
Granfield, Farrar & Carlin, S. F.	.39	100.00	1.50	1.75	25.00	.04	2.25	150.00	50,977
MacDonald & Kahn, S. F.	.40	100.00	2.50	3.00	22.00	.06	3.50	50.00	53,070
L. J. Cohn, San Francisco	.42	100.00	1.50	2.50	24.00	.04	2.50	100.00	54,735
C. B. Eaton, San Francisco	.50	100.00	2.00	3.00	30.00	.05	2.50	75.00	64,935

OAKLAND, CALIF.—CITY—HOPKINS STREET—CONCRETE

Heafey-Moore Co., 344 High St., Oakland, who bid $83,516, submitted the low bid to the City of Oakland, Alameda County, for the improvement of Hopkins St. from Coolidge Ave. to High St. Bids received from:

(1) Heafey-Moore Co., Oakland (low bidder) $83,516
(2) W. A. Dontanville, Salinas 90,226
(3) Fredrickson & Watson Const. Co., Oakland 97,263
(4) Central California Roads Co., Oakland 90,057
(5) N. M. Ball, Berkeley 90,901
(6) Oakland Paving Co., Oakland $107,514
(7) Hanrahan Co., San Francisco 92,564
(8) Union Paving Co., San Francisco 92,965
(9) J. H. Fitzmaurice, Oakland 99,571
(10) J. H. Quimby, San Francisco 87,841

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
344,626 sq.ft. grading	.02	.02	.0425	.045	.035	.06	.0225	.04	.045	.035
852 ft. curb with guard	.75	.90	.80	.55	.50	.85	1.00	.75	.90	.65
10,350 ft. concrete curb	.50	.45	.53	.30	.40	.60	.50	.65	.60	.45
270,020 sq.ft. 7-in. concrete paving	.216	.23	.23	.21	.22	.24	.24	.215	.2375	.21
923 sq.ft. concrete driveway	.25	.28	.26	.21	.30	.20	.18	.25	.25	.20
60,816 sq.ft. sidewalk	.15	.15	.165	.15	.17	.16	.15	.15	.15	.15
188 ft. 10-in. vitr. conduit with concrete cover	1.25	1.48	2.00	1.98	2.00	2.00	1.75	1.28	2.50	2.00
14 ft. 10-in. vitr. conduit	1.25	1.48	1.30	1.32	1.70	1.50	1.25	1.28	1.50	1.50
101 ft. 12-in. vitr. conduit	1.23	1.95	1.40	1.76	1.80	1.50	1.60	1.70	1.75	2.00
46 ft. 15-in. vitr. conduit	1.45	2.20	1.75	2.40	2.00	1.50	2.00	1.90	2.50	3.00
28 ft. box culvert	2.40	3.50	5.00	3.25	3.20	3.00	4.00	2.00	2.50	2.00
2 concrete handholes	15.00	28.00	10.00	17.00	25.00	15.00	20.00	25.00	15.00	20.00
2 concrete inlets	20.00	65.00	35.00	50.00	20.00	40.00	50.00	25.00	45.00	50.00
1 manhole	60.00	86.00	65.00	71.00	70.00	70.00	80.00	75.00	50.00	80.00
1 st. water inlet, Type A	30.00	86.00	50.00	60.00	38.00	60.00	60.00	75.00	45.00	60.00
12 st. water inlets, 34 in.	35.00	70.00	65.00	58.00	40.00	60.00	50.00	60.00	50.00	50.00
176 ft. 8-in. vitr. sewer	1.00	1.70	1.00	1.05	1.20	1.50	1.25	1.30	1.50	1.50
2,347 ft. 5-in. vitr. sewer	.69	1.65	.80	1.20	1.00	1.25	.80	1.00	.60	1.00
9 manhole tops	23.00	30.00	20.00	17.00	20.00	30.00	10.00	25.00	25.00	25.00
2 lampholes	15.00	30.00	30.00	22.00	30.00	20.00	20.00	25.00	15.00	15.00
1 lamphole removed	7.00	25.00	30.00	20.00	10.00	10.00	5.00	10.00	5.00	10.00
4 Y branches	.50	1.15	1.50	1.50	1.00	1.00	1.00	.60	1.00	2.00

SAN FRANCISCO, CALIF.—GOLDEN GATE HEIGHTS—CITY—MACADAM

California Const. Co., Standard Oil Bdg., San Francisco, $45,081, low for streets in Golden Gate Heights on Lawton St., Funston St., 12th, 11th Ave., etc. Bids on:

(1) 163,000 sq.ft. 6-in. waterbound macadam base with 2-in. asphalt surface.
(2) 150,000 sq.ft. 6-in. waterbound macadam base with 2-in. Emulsified asphalt surface.
(3) 19,000 lin.ft. armored concrete curb.
(4) 38 brick catchbasins.
(5) 1 catchbasin reset.
(6) 900 ft. 10-in. vitr. culvert.
(7) 5,000 ft. 6-in. vitr. side sewers.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	TOTALS
California Const. Co., San Francisco	.097	.07	.60	90.00	50.00	1.00	.60	$45,081
Fay Improvement Co., San Francisco	.105	.108	.70	83.00	25.00	1.27	.80	54,937
J. F. Dowling, San Francisco	.11	.10	.65	100.00	25.00	1.00	.50	52,505
C. B. Eaton, San Francisco	.13	.125	.70	75.00	50.00	1.25	.75	61,015

TUNNEL CONSTRUCTION

SAN FRANCISCO, CALIF.—ELEVATOR SHAFT—GOVT—NEW MEXICO

Award of contract recommended to Chas. H. Dunning, Heard Bdg., Phoenix, Ariz., who bid $61,491 to the U. S. National Park Service, Underwood Bdg., San Francisco, for sinking a 750-ft. elevator shaft at Carlsbad Caverns National Park, New Mexico. Bids on the following items:

(1) 3,500 cu.yd. excavation.
(2) 1,000 sta.yd. overhaul.
(3) 18 tons setting I-beam track supports.
(4) 15,000 sq.yd.in. gunite in place, reinf.
(5) 5,000 sq.yd.in. gunite in place, plain.
(6) 21 cu.yd. 'A' pre-mixed concrete.
(7) 19 cu.yd. 'B' pre-mixed concrete.
(8) 5 cu.yd. 'C' pre-mixed concrete.
(9) 8 tons erect steel falsework in shaft.
(10) 15 tons erect steel pent house frame.
(11) 750 ft. place pipe and conduit, shaft.
(12) 50 tons hauling materials.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	TOTALS
Chas. H. Dunning	9.25	.15	80.00	1.10	1.00	23.00	38.00	38.00	$110	60.00	.50	4.20	$61,491
Mittry Bros. Const. Co., Los Angeles	16.00	.25	$140	1.10	1.00	30.00	30.00	30.00	95.00	90.00	.50	12.50	84,205
Robt. E. McKee	18.00	.10	$200	.75	.65	50.00	50.00	45.00	$200	50.00	2.00	6.00	87,575
Fraser-Davis Co.	21.30	.10	$350	.60	.55	36.00	30.00	30.00	75.00	70.00	1.00	no bid	96,376

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 November, 1930, for Engineering Construction projects in the Far Western States, totaling $19,730,000, as follows:

Paving	$ 3,200,000
Grading, highways	6,200,000
Bridges	3,250,000
Sewer construction	620,000
Water supply systems	1,650,000
Irrigation and reclamation	250,000
Power development	1,500,000
River and harbor work	550,000
Railroad construction	2,000,000
Lighting systems	510,000
	$19,730,000

LARGE WESTERN PROJECTS

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

WORK CONTEMPLATED

Railroad from Moclips, Wash., to Hoh River, Wash., for Northern Pacific Ry., St. Paul, Minn. $5,900,000.

Concrete paving near Covina and Baldwin Park for Los Angeles County. $400,000.

Dam known as El Vado Dam for Middle Rio Grande Conservancy District, Albuquerque, New Mexico. $1,600,000.

BIDS BEING RECEIVED

Asphalt paving 11 miles from Paso Robles to north boundary, SAN LUIS OBISPO COUNTY, for California Division of Highways, bids to December 17.

Highway from Boulder City to Hoover Damsite, Nevada, for Bureau of Reclamation, Las Vegas, Nev., bids to January 7.

Grading and oil surfacing 29 miles in San Bernardino County for California Division of Highways, bids to Dec. 24.

Reservoir, 35,000,000 gallons capacity, for City of Glendale, bids to Dec. 30.

Railroad, 10 miles, from Summit to Hoover Dam, Boulder Canyon Project, for Bureau of Reclamation, Las Vegas, Nev., bids to January 12.

Grading 11 miles in Grant County from Vantage to Burke for State of Washington, 590,000 cu.yd. excavation, bids to Dec. 30.

BIDS RECEIVED

Concrete and cast-iron pipe-lines, detritor, tunnels, reservoir, etc., for City of Phoenix, Ariz., Schmidt & Hitchcock, Phoenix, Ariz., $2,056.000 low.

James Lick Junior High School at San Francisco, Anderson & Ringrose, S. F., $484,000 low.

CONTRACTS AWARDED

Bridge over NW. Pacific RR. at Manzanita, Marin County, for California Division of Highways, to Healy-Tibbitts Const. Co., S. F., $329,667.

Pier 23 for Board of State Harbor Comm., at San Francisco, to Healy-Tibbitts Const. Co., S. F., $347,597.

STREET and ROAD WORK

WORK CONTEMPLATED

CULVER CITY, CALIF.—Plans by City Engineer, protests Dec. 8, for improving Sepulveda Blvd., involving 1,620,000 sq.ft. grading, 471,500 sq.ft. 6-in. asphalt base with 2-in. Warrenite Bit. surface, 427,000 sq.ft. 6-in. concrete base with 2-in. Warrenite Bit. surface, 5-in. disintegrated granite sub-base, sewers, corr. culverts, etc. 12-1

LOS ANGELES, CALIF.—Plans by County Surveyor, protests Dec. 22, for improving Bonita Ave., Main Ave., etc., near Covina and Baldwin Park, 6 miles, involving 96,000 cu.yd. excavation, 1,480,000 sq.ft. concrete paving, 410,000 sq.ft. 1½-in. oil macadam paving, corr. pipe, etc., $400,000. 11-29

OAKLAND, CALIF.—Plans by City Engr., protests Dec. 11 by City, for improving E. 10th St., Russet St., 45th Ave., etc., involving 154,790 sq.ft. 7-9-in. concrete paving, vitr. pipe, corr. iron and conc. culverts, etc. 11-22

PALO ALTO, CALIF.—Plans by City Engineer, J. F. Byxbee, Jr., protests Dec. 8, for (1) Improving High St., involving 70,000 sq.ft. asphaltic paving, concrete sewers, 8 electroliers, grading, etc.; and (2) Improving Palo Alto Ave., Hale St., Pope St., etc., involving 404,483 sq.ft. grading, 354,935 sq.ft. 6-in. concrete paving, cast iron mains, valves, hydrants, sewers, etc. 11-29

ROSS, CALIF.—Plans made, protests Dec. 11 by City, for improving Chestnut Ave., Bridge Road, etc., paving with Bitumuls, vitr. culvert, etc. 11-22

SAN DIEGO, CALIF.—Plans by H. W. Jorgensen, City Engineer, protests soon, for improving Ash and Gragory Sts., involving 34,600 sq.ft. 6-in. asphalt paving, 550 ft. 6-in. and 315 ft. 4-in. cast iron mains, hydrants, etc. 12-2

SALT LAKE CITY, UTAH—Plans by H. C. Jessen, City Engineer, for paving streets in Dist. 33, to cost $87,000. Bids after Dec. 11.

BIDS BEING RECEIVED

PHOENIX, ARIZ.—Bids to 2 p.m., Dec. 8, by State Highway Comm. for: (1) 4 miles grading Benson-Vail Highway near Benson, and bridges, involving 32,000 cu.yd. roadway excavation, 25,500 cu.yd. borrow, 1600 cu.yd. concrete, 130,000 lb. reinf. steel; (2) Concrete paving 1.7 miles near Florence on Florence-Tucson Highway, involving 26,300 sq.yd. concrete paving, etc.

PHOENIX, ARIZ.—Bids to 2 p.m., Dec. 22, by Arizona State Highway Comm. for: (1) Safford-State Line Highway from Duncan east to State Line, involving 60,000 cu.yd. excavation, 850 cu.yd. concrete structures, 11,000 cu.yd. subgrade stabilizer, corr. pipe, etc.; (2) Globe-Safford Highway, involving 31,500 cu.yd. roadway excavation, 1100 cu.yd. concrete, 88,000 lb. reinforcing steel, corr. pipe; and (3) Phoenix-Yuma Highway, involving 2000 cu.yd. excavation, concrete structures, etc. 12-4

PHOENIX, ARIZ.—Bids to 2 p.m., Dec. 15, by Arizona State Highway Comm., Phoenix, Ariz., for 25 miles Topock-Oatman Highway from Topock to Oatman, work involving 174,000 sq.yd. prepare surfacing, 348,000 gallons oil applied to surface, 16.5 miles mixing, laying, and finishing. 11-28

TUCSON, ARIZ.—Bids to Dec. 15, by County Board of Supervisors, Court House, Tucson, Ariz., for the oil treating of 43 miles of County Roads. Work to be done under bond issue. 12-2

SACRAMENTO, CALIF.—Bids to 2 p.m., Dec. 17, by California Division of Highways for: (1) SANTA BARBARA COUNTY—2.8 miles from Gaviota to north of Las Cruces, involving 107,000 cu.yd. of roadway excavation, 6860 cu.yd. 'A' concrete paving, 1930 cu.yd. 'A' concrete structures, 318,700 lb. reinf. steel, etc.; and (2) SAN LUIS OBISPO COUNTY—10.9 miles grading and asphalt paving from Paso Robles to north boundary, involving 160,000 cu.yd. roadway excavation, 47,900 tons asphalt paving, 660 cu.yd. concrete structures, 64,000 lb. reinf. steel, 2800 bbl. fuel oil, etc. 11-19

SACRAMENTO, CALIF.—Bids to 2 p.m., Dec. 30, by California Division of Highways for 3 miles from Harts Station east in KERN COUNTY, involving 28,500 cu.yd. imported borrow, 1700 tons broken stone, 35 tons Emulsified asphalt, etc. 12-3

SACRAMENTO, CALIF.—Bids to 2 p.m., Dec. 23, by California Division of Highways, Sacramento, for: (1) NEVADA COUNTY—7.4 miles from west of Washington Road to ½ mile east of Summit, work involving 58 acres clearing and grubbing, 219,000 cu.yd. roadway excavation, 1850 cu.yd. structure excavation, concrete structures, etc. 11-29

SALINAS, CALIF.—Bids to 7:30 p.m., Dec. 15, by City Clerk for improving Pajaro St. from Sausal St. to Lake St., involving 29,240 sq.ft. 6-in. concrete paving. $7827. 11-20

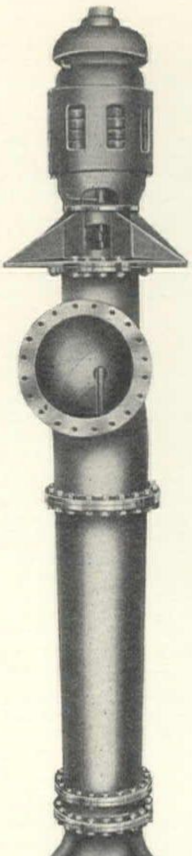
SAN DIEGO, CALIF.—Bids to Dec. 22, by City, for improving Madison and Fortieth, involving 127,700 sq.ft. 6-in. asphalt paving, 1841 ft. 6-in. and 322 ft. 4-in. cast iron pipe, 4 hydrants, etc. 12-2

VENTURA, CALIF.—Bids to 11 a.m., Dec. 16, by County for: (1) 2 miles of Elisoe Road in Wheeler Canyon, involving 4500 tons asphalt surfacing; and (2) 4 miles of oil macadam on Ventura Ave., involving 150,000 sq.ft. 5-in. oil macadam. 11-21

BOISE, IDAHO—Bids to 2 p.m., Dec. 16, by State, for 2.8 miles from Lewiston to Washington State Line, NEZ PERCE COUNTY, involving 70,000 cu.yd. excavation, 7100 cu.yd. rock surfacing, reinf. concrete cribbing, etc. 12-2

BOISE, IDA.—Bids to 2 p.m., Dec. 9, by State for 5.7 miles from Spencer south, CLARK COUNTY, involving 42,000 cu.yd. excavation, 12,800 cu.yd. gravel surface, etc. 11-24

LAS VEGAS, NEV.—Bids up to 10 a.m., January 7, by Bureau of Reclamation, Las Vegas, Nevada, for 7 miles of highway from near Boulder City to Hoover Damsite. Work is located 25 to 30 miles southeast of Las Vegas, Nev., on main line of L. A. & Salt Lake RR. Work involves 418,720 cu.yd. open cut excavation, 6000 cu.yd. tunnel excavation, 249,000 sta.yd. overhaul, 2000 cu.yd. backfill, 160 cu.yd. concrete, 5000 cu.yd. concrete crib wall, 5600 sq.yd. dry rock paving, place 8000 lb. reinf. steel, erect 30 M ft. b.m. permanent tunnel timber, erect 45 M ft. b.m. timber (bridge), lay 4510 ft. 18 to 72-in. corr. pipe, 39,000 cu.yd. gravel surfacing, 147,000 sq.yd. oil treated surfacing, 27,000 lin.ft. guard rail. Work to be completed in 140 calendar days. Specification 517 from Bureau of Reclamation, Las Vegas, Nevada; Denver, Colorado; or Washington, D. C. 11-28



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PORTLAND, ORE.—Bids to 10:30 a.m., Dec. 11, by State, for: COOS COUNTY—13.6 miles Lakeside-North Bend Section of the Roosevelt Coast Highway, involving 32,200 cu.yd. broken stone or crushed gravel, 40,000 cu.yd. excavation. DESCHUTES COUNTY—11.7 miles of the Hampton-Lake County line section of the Central Oregon Highway, work 11,000 cu.yd. pit run gravel. GRANT COUNTY—3.4 miles of the Rock Creek-Valades Ranch Section of John Day Highway, involving 75,000 cu.yd. excavation. JOSEPHINE COUNTY—19 miles of the Redwood Junction-Caves Section of the Oregon Caves Highway, involving 54,000 cu.yd. broken stone or crushed gravel, 31,000 cu.yd. excavation. LANE COUNTY—10 miles of the Berry Creek-Florence Section of the Roosevelt Coast Highway, work involving 45,500 cu.yd. broken stone. LINN COUNTY—3 miles of the Bryant Hill-Trout Creek Section of the Santiam Highway, involving 135,000 cu.yd. excavation. MALHEUR COUNTY—11.48 miles of the Lancaster-Vale Section of the John Day Highway, work involving 94,000 cu.yd. excavation, 50,000 cu.yd. crushed gravel. 11-29

SALT LAKE CITY, UTAH—Bids to 2 p.m., Dec. 15, by Utah Road Commission for 16 miles highway and 3 bridges in GRAND COUNTY from Cisco to Colorado, involving 115,000 cu.yd. roadway excavation, 35,500 cu.yd. gravel surfacing, 74 tons structural steel, etc. 12-6

OLYMPIA, WASH.—Bids to 10 a.m., Dec. 30, by State Highway Comm. for: (1) WHATCOM COUNTY—2.5 miles from Bellingham to Austin Pass, and from Warnick to Glacier, involving 87,000 cu.yd. roadway excavation, 7270 cu.yd. stone surfacing; (2) SPOKANE COUNTY—3.2 miles from Dennison to Deer Park, involving 63,350 cu.yd. roadway excavation, 13,300 cu.yd. stone surfacing; (3) 11.7 miles GRANT COUNTY from Vantage to Burke, involving 590,880 cu.yd. roadway excavation, 40,410 cu.yd. loose riprap, 1120 cu.yd. cement rubble masonry; (4) LEWIS COUNTY—7.1 miles concrete paving from Meskill to Beam Road; and (5) WHATCOM COUNTY—2.1 miles Lake Samish Road, involving 67,190 cu.yd. roadway excavation, 6390 cu.yd. crushed stone surfacing.

BIDS RECEIVED

PHOENIX, ARIZ.—N. G. Hill & Co., 1344 E. McKinley St., Phoenix, Ariz., $31,132 low for road mix oiling 5.8 miles from Phoenix East, for State. 11-28

PHOENIX, ARIZ.—Chas. G. Willis & Sons, 2119 E. 25th St., Los Angeles, $149,068 low to Bureau of Public Roads for 2.8 miles grading Oak Creek National Forest, COCONINO COUNTY, Ariz. (See Unit Bid Summary.) 12-4

LOS ANGELES, CALIF.—P. K. Akmadzich, 3029 Gilroy St., Los Angeles, $207,400, low bid to City for improving Broadway and 120th St. Dist., grading, concrete paving, storm drains, sanitary sewers and water system. 11-29

OAKLAND, CALIF.—Low bids as follows by City: (1) Heafey-Moore Co., 344 High St., Oakland, $83,516 low for improving Hopkins St. from Coolidge Ave. to High St., grading, concrete paving, vitr. pipe conduits, etc.; and (2) Ed Bowman, 9017 B St., Oakland, low for macadam paving, reinf. conc. conduits on 92nd Ave. from G St. to Russet St. 12-4

SACRAMENTO, CALIF.—Low bids as follows by California Division of Highways: (1) SANTA CLARA COUNTY—Contoules Const. Co., P.O. Box 194, Yosemite, and 46 Collins St., S. F., $212,284 low for 10.7 miles grading and bit. macadam paving from San Felipe to Bells Station; and (2) V. R. Dennis Const. Co., P.O. Box 183, Station A, San Diego, $227,453 for 6 miles grading and asphalt paving from Araz to Yuma, IMPERIAL COUNTY. (See Unit Bid Summary.) 11-26

SAN FRANCISCO, CALIF.—California Const. Co., Standard Oil Bdg., S. F., $45,081 low for macadam paving Funston St., Lawton St., 12th Ave., etc., in Golden Gate Heights for City. 12-3

SALT LAKE CITY, UTAH—Dodge Bros., Inc., Fallon, Nev., $183,400 low bid to Utah State Road Commission for resurfacing with gravel 41.4 miles from Wendover to Knolls, TOOELE COUNTY. (See Unit Bid Summary.) 11-28

CHEYENNE, WYO.—Low bids as follows by State (1) V. C. Hallenbeck, $130,400 low for gravel surfacing Project 872; (2) Richard Spatz, $19,826 low for 13 miles surfacing Cheyenne-Pine Bluffs Road; (3) Summit Const. Co., $23,520 low for 7 miles surfacing Moorcroft-Carlile Road; (4) Taggart Const. Co., $21,656 low for 3 miles surfacing Worland-Tensleep Road; (5) T. J. Tobin Const. Co., $56,595 low for surfacing 10 miles Midwest-Kaycee Road; (6) T. J. Tobin Const. Co., $56,142 low for 10 miles surfacing Midwest-Kaycee Road; and (7) T. J. Tobin Const. Co., $20,944 low for 2.4 miles surfacing Casper-Midwest Road.

CONTRACTS AWARDED

PHOENIX, ARIZ.—To O. F. Fisher, Security Bldg., Phoenix, Ariz., $24,380, to the U. S. Bureau of Public Roads, for 11.32 miles subgrade reinforcement on Sections G and H of Clifton-Springerville National Forest Highway, APACHE COUNTY, Arizona. 11-28

TUCSON, ARIZ.—To White & Miller, Tucson, Ariz., $11,500 for paving Sixth St. for City.

BAKERSFIELD, CALIF.—To W. K. McMillan, 2088 Howard St., S. F., $41,485 for grading McKittrick-Belridge Road for County. (See Unit Bid Summary.) 11-19

BELMONT, CALIF.—To Union Paving Co., Call Bdg., S. F., $196,305 for improving streets for City, grading, rock macadam and asphalt paving, concrete and vitr. sewers. (See Unit Bid Summary.) 11-20

FRESNO, CALIF.—To Valley Paving & Const. Co., Visalia, $33,820 for 2500 ft. 3-in. Permanite asph. surface and 5000 ft. curbs and gutters on Mt. Whitney Ave. in town of Riverdale, work for Fresno County. 11-28

GLENDALE, CALIF.—To John Papac, 726 N. Hill St., L. A., $183,683 to City for improvement of San Fernando Road. Work involves 8-in. conc. paving, sidewalks, driveway, Class B curb, armored curb, water system complete, lighting system complete, sewer house connec., culvert complete, and storm drains complete. (See Unit Bid Summary, Nov. 25th issue.) 11-24

MILL VALLEY, CALIF.—To McDonald & Maggiora, 236 2nd St., Sausalito, $7384 for concrete paving Blithedale Road for City. 12-4

PACIFIC GROVE, CALIF.—To Granite Const. Co., Watsonville, $14,659 for improving 3rd, 4th, 10th Sts., etc., paving with Dur-Emulse, corr. pipe, sewers, etc. 11-24

SACRAMENTO, CALIF.—Awards as follows by California Division of Highways: (1) MARIN COUNTY—To Granfield, Farrar & Carlin, 65 Hoff Ave., San Francisco, $189,633 for 3 miles grading and bituminized macadam surfacing from Alto to Waldo; and (2) SANTA BARBARA COUNTY—To Macco Const. Co., Clearwater, $22,518 for 0.3 mile grading and concrete paving at Nokoqui Creek. (See Unit Bid Summary, Nov. 25th issue.) 11-28

SAN DIEGO, CALIF.—To Griffith Co., 2104 Main St., San Diego, who bid $42,438 for improvement of Eads Ave. for City, grading, paving with concrete, cast-iron water mains, fire hydrants, reinf. concrete culverts, reinf. conc. box culvert, etc. 11-26

SAN FRANCISCO, CALIF.—To E. J. Treacy, Call Bdg., S. F., $2648 for improving crossing of Kansas St. and 22nd St., paving with concrete and asphalt, for City. 11-24

SAN FRANCISCO, CALIF.—To H. V. Tucker, 300 Vermont Street, San Francisco, who bid $38,731 to the Board of Public Works, City Hall, San Francisco, for the grading of Section A of the Alemany Boulevard from Mission Street to Bayshore Boulevard. 11-21

SAN FRANCISCO, CALIF.—Award recommended to Triangle Rock & Gravel Co., San Bernardino, $32,714 for 10.8 miles grading and placing selected material on Laguna Highway in Cleveland National Forest, SAN DIEGO COUNTY, for Bureau of Public Roads. 11-25

SAN JOSE, CALIF.—Awards as follows by City: (1) To Peninsula Paving Co., Standard Oil Bdg., S. F., $3763 for improving Vermont St., paving with 4-in. asphalt; and (2) To San Jose Paving Co., San Carlos and Dupont Sts., San Jose, $2242 for 4-in. asphalt paving Morlan Ave. 11-25

SANTA CRUZ, CALIF.—To Granite Const. Co., Watsonville, $8333 for macadam paving Palm St. near Watsonville for County. 11-26

SANTA MARIA, CALIF.—To Santa Maria Construction Co., Santa Maria, who bid $28,575 to the City for improving Cypress St. between Broadway and Suey Ave., and portions of other streets. Work involves asph. concrete and oil macadam. 11-20

SEBASTOPOL, CALIF.—To Albert Helwig, 4 Marys Lane, Sebastopol, for 13,000 sq.ft. 5-in. concrete paving Burnett St. for City. 12-2

STOCKTON, CALIF.—To Geo. French, Jr., P.O. Box 685, Stockton, $14,967 for 3.36 miles of Manteca Road Division Ave. from Ave. B to Durham Ferry Road for County, grading and surfacing. 11-18

DENVER, COLO.—Awards as follows by State: (1) To H. C. Lallier Const. & Engr. Co., Denver, Colo., $111,218 for road mix oiling surfacing 18 miles from Stratton to Burlington, KIT CARSON COUNTY; (2) To Mt. States Const. Co., Pueblo, Colo., $57,600 for grading approaches and overhead crossing from Florence to Portland, FREMONT COUNTY; (3) To J. H. Miller & Co., Denver Colo., $77,000 for 6.5 miles grading and surfacing from Fraser to Grancy; and (4) To Utah Const. Co., Ogden, Utah, $159,140 for 9.8 miles grading and surfacing from Avon to Wolcott, EAGLE COUNTY.

DENVER, COLO.—To A. R. Mackey, Ft. Morgan, Colo., $75,150 for 5 miles grading of Black Mesa National Highway, GUNNISON COUNTY, for Bureau of Public Roads.

SANTA FE, N. M.—To T. J. Tobin Const. Co., Albuquerque, New Mexico, $201,160 for 8 miles grading and surfacing and bridges from Algodones to Santa Fe, SANDOVAL and SANTA FE COUNTIES, for State.

OLYMPIA, WASH.—Awards as follows by State: (1) To C. L. Creelman, Seattle, $51,550 for 7.6 miles grading in YAKIMA COUNTY from Grandview to Sunnyside; (2) To Morrison-Knudsen Co., Spokane, Wash., $32,560 for grading 3 miles from Wishram Hill to Museum, KLICKITAT COUNTY; and (3) To J. S. Pederson, Enumclaw, Wash., $32,200 for grading 3 miles from County Line to Oakville, GRAYS HARBOR COUNTY.

OLYMPIA, WASH.—Awards as follows by State: (1) To Union Const. Co., Portland, Ore., $61,900 for grading 4 miles from Wallalla east, WALLA WALLA COUNTY; (2) To F. A. Moceri, Inc., Seattle, Wash., $143,285 for concrete paving 9.3 miles near Sequium, CLALLAM COUNTY; (3) To Graham Bros. & Medley, Chehalis, Wash., $66,895 for 5.3 miles grading from Goldendale northeast, KLICKITAT COUNTY.

SEATTLE, WASH.—To Moceri Bros., Seattle, $4230 for constructing concrete sidewalks on Brandon St. for City.

BRIDGES and CULVERTS

WORK CONTEMPLATED

SANTA BARBARA, CALIF.—Plans by County Surveyor, Owen H. O'Neill, for bridge over San Rogue Creek, to be 450 ft. long. $50,000. 11-25

SANTA ROSA, CALIF.—Plans completed by Engr., J. B. Piatt, Daugherty-Shea Bdg., Santa Rosa, and bids open Nov. 23 by Joint Highway District No. 16, Santa Rosa, for 900-ft. bridge over Russian River, 1½ mi. above Jenner, involving: steel bridge involving two 145-ft. steel deck truss spans and nine 60-ft. steel girder spans with conc. deck and steel H-beam piling and two reinf. conc. abutments, one 40 and one 30 ft. (lump sum bid), 58,000 cu.yd. roadway excavation, 27,000 sta.yd. overhaul, 6000 ft. prop. fence, 10 gates, 116 ft. 12-in., 70 ft. 24-in., and 180 ft. 30-in. cor. pi., 17 cu.yd. 'A' concrete (culverts). H. B. Hammill, 381 Bush St., San Francisco, is consulting engineer. 12-3

BIDS BEING RECEIVED

OAKLAND, CALIF.—Bids to 10:30 a.m., Dec. 16, by County, for cleaning and painting Bay Farm Island Bridge. $2000. 11-29

BIDS RECEIVED

SACRAMENTO, CALIF.—J. H. Pomeroy & Co., Railway Exchange Bdg., Portland, Ore., and 251 Kearny St., S. F., $138,848 low bid to State Division of Highways for steel bridge over tracks of Western Pacific RR. and over north fork of Feather River at Pulga, BUTTE COUNTY. (See Unit Bid Summary.) 12-3

SAN FRANCISCO, CALIF.—Healy-Tibbitts Con. Co., 64 Pine St., San Francisco, $7315 low bid to Board of Public Works for reinf. concrete pipe trestle at Alemany Blvd. 12-3

PORTLAND, ORE.—Kuckenberg-Wittman Co., Board of Trade Bdg., Portland, Oregon, $60,823 low bid to U. S. Bureau of Public Roads for 5 reinforced concrete bridges and 1 box culvert on Salmon River Highway, Siuslaw National Forest, LINCOLN COUNTY, Oregon. (See Unit Bid Summary.) 11-28

CONTRACTS AWARDED

BAKERSFIELD, CALIF.—Awards as follows by County: (1) To Currie & Dulgar, Land Co. Bdg., Bakersfield, $8951 for 3-compartment concrete culvert on Bakersfield-Taft Highway; (2) To F. A. Greenough, 130 Lincoln St., Bakersfield, $2317 for timber bridge on Shafter-Lerdo Highway; and (3) To Currie & Dulgar, Land Company Bdg., Bakersfield, $1764 for reinf. concrete culverts on Kern River Park Highway. 11-19

BERKELEY, CALIF.—To Lee J. Immel, 1031 Evelyn Ave., Berkeley, $628 for corr. culvert on Euclid Ave. for City. 11-18

REDWOOD CITY, CALIF.—To W. O. Tyson, 42 Jefferson St., Redwood City, $688 for retaining wall on Redwood Creek for City. 11-18

SACRAMENTO, CALIF.—To R. B. McKenzie, Red Bluff, who bid $32,370 to the California Division of Highways for substructure for bridge over Feather River at Pulga, BUTTE COUNTY. 11-28

SACRAMENTO, CALIF.—To Healy-Tibbitts Construction Co., 64 Pine Street, San Francisco, who bid $329,667 to the California Division of Highways, Public Works Building, Sacramento, for construction of a steel, timber, and concrete bridge over the tracks of the Northwestern Pacific Railroad at Manzanita, MARIN COUNTY. (See Unit Bid Summary.) 12-4

SAN DIEGO, CALIF.—To Hazard Contracting Co., 2528 Kettner Blvd., San Diego, $123,800 for steel bridge on First St. for City. (See Unit Bid Summary.) 12-2

SANTA BARBARA, CALIF.—To Roy L. Richardson & Son, 2611 Orella St., Santa Barbara, $5980, for reinf. conc. bridge, located on Patterson Ave., over San Jose Creek, SANTA BARBARA COUNTY. 12-2

SAUSALITO, CALIF.—To V. Maggiora, 236 2nd St., Sausalito, $950 for retaining wall at Central School for School Dist. 11-25

STOCKTON, CALIF.—To John Hackman, Box 206, Stockton, $1830 for timber and concrete bridge on Waverly Road over Duck Creek for County. 11-25

LAMAR, COLO.—To Pueblo Bridge & Const. Co., Pueblo, Colo., $36,000 for reconstructing bridge for County over Arkansas River near Lamar.

OLYMPIA, WASH.—To General Construction Co., Seattle, $61,430 for steel and concrete bridge over Snoqualmie River, KING COUNTY, for State.

SEWER CONSTRUCTION

WORK CONTEMPLATED

GONZALES, CALIF.—Bond election during January by Gonzales Sanitary Dist., to vote $35,000 for sewer improvements, involving 35,000 ft. 12-in. to 6-in. sewers and sewage treatment plant, $55,000, balance under 1911-15 Acts. Burns-McDonnell-Smith Engr. Co., Western Pacific Bldg., Los Angeles, are Engineers. 12-1

OGDEN, UTAH—Plans by City Engineer for storm sewer on Twenty-fourth St., $45,000.

BIDS BEING RECEIVED

REDWOOD CITY, CALIF.—Bids to 10 a.m., Dec. 15, by County, for sewer system at Colma, involving 78,000 ft. 6-in. to 12-in. vitr. pipe, 2247 ft. 8-in. and 14-in. cast iron pipe, pumping plant, 325 manholes, etc. 12-1

WESTMORELAND, CALIF.—Bids to 7:30 p.m., December 11th, by Westmoreland Sanitary District, Westmoreland, Imperial County, for constructing 20,000 lin.ft. 8-in. to 12-in. vitrified pipe sewer. Work under 1911 Improvement Act. Plans and specifications from Currie Engrg. Co., Anderson Bdg., San Bernardino. 11-24

CONTRACTS AWARDED

BERKELEY, CALIF.—To J. M. Heafy, 1707 Cedar St., Berkeley, $400 for vitr. sewer on Indian Rock Path for City. 12-2

MONTEREY, CALIF.—To John Pestana, 1232 35th Ave., Oakland, who bid $10,668 to City of Monterey, Monterey County, for vitrified pipe sewer on Fillmore St., Grace St., Terry St., Parcel St., Lyndon Ave., Alice Street. 12-3

OAKLAND, CALIF.—To Ed Bowman, 9017 B St., Oakland, $9705, to City for reinf. conc. conduits, corr. iron and conc. culverts on E. 10th St., Russet St., 50th Ave., etc. 11-24

PALO ALTO, CALIF.—To P. & H. Const. Co., 5th and Keyes Sts., San Jose, $2916 for storm sewer on Lytton Ave. for City. 11-18

SACRAMENTO, CALIF.—To J. R. Reeves, Twelfth and American River, Sacramento, $16,995 to City, for drainage system at the Municipal Airport, using pure iron pipe. 11-29

SALINAS, CALIF.—To R. H. Downer, 700 E. 24th St., Oakland, $4986 for concrete and vitrified sewer on Hoover St. and Cattlemens Lane for City. 12-3

SAN FRANCISCO, CALIF.—To E. J. Treacy, Call Bdg., S. F., $2303 for vitr. sewer on Brussels St. from Ward to Mansell for City. 11-24

GREAT FALLS, MONT.—To McGuire & Blakeslee, Great Falls, Mont., $36,875 for constructing Third St. sewer for City.

WEST LINN, ORE.—To Goldfredsen & Tease, Portland, Ore., $21,160 for sewer in Holly Garden District for City.

WATER SUPPLY SYSTEMS

WORK CONTEMPLATED

MILLBRAE, CALIF.—Bond election December 14 by the Millbrae Public Utility District, Millbrae, San Mateo County, to vote $14,000 in bonds for the construction of water system improvements. Work consists of cast-iron pipe system, valves, hydrants, and one 30,000-gallon steel tank. Geo. A. Kneese, Court House, Redwood City, is Engr. 11-22

SAN FRANCISCO, CALIF.—Plans by City Engr. Office for furnishing and installing an electrically driven centrifugal pump, 5700 g.p.m. against 10-ft. head, at the San Francisco Mills Field Municipal Airport. 11-25

EL PASO, TEX.—Plans by City Engr. for constructing 40,000,000-gallon reservoir on Brown St. $300,000. Bids will be called shortly.

OLYMPIA, WASH.—Plans by City Water Supt. for 2,500,000-gallon reservoir and 250,000-gallon elevated storage tank on East Side Hill. 11-21

BIDS BEING RECEIVED

BEVERLY HILLS, CALIF.—Bids to 8 p.m., Dec. 16, by City for: (1) Pipe-line for Water Treatment Plant No. 2, involving 900 ft. 16-in., 2360 ft. 14-in., and 1125 ft. 6-in. pipe-line; and (2) Furnishing 5050 ft. 14-in. Class 'A', 'B', or 100 or 150 cast-iron pipe. 11-21

GLENDALE, CALIF.—Bids to 10 a.m., December 30, by City Clerk, G. E. Chapman, for 35,000,000-gallon reservoir. Work involves 26,000 cu.yd. reinforced concrete, 238,322 sq.ft. of roof area, 160,000 cu.yd. excavation, 10,000 cu.yd. tamped embankment, 22,000 cu.yd. earth covering to be placed on top of concrete roof. 11-28

MONROVIA, CALIF.—Bids to 7:30 p.m., Dec. 15, by City for booster pump to be installed at Ivey Ave. pumping plant. 11-24

SACRAMENTO, CALIF.—Bids to 8:15 p.m., Dec. 11, by City, for 31 water meters. 12-2

SAN DIEGO, CALIF.—Bids to Dec. 15 by City Clerk for water mains in blocks 71, 78, 98, 106, and 127, City Heights. Work involves 3288 ft. 6-in. 'B' cast-iron pipe, 4 fire hydrants. 11-26

SAN FRANCISCO, CALIF.—Bids up to 2:30 p.m., December 17, by Board of Public Works, City Hall, San Francisco, for furnishing and installing electrically driven centrifugal pump, 5700-g.p.m., 10-ft. head, at San Francisco Mills Field Municipal Airport. 12-4

BOULDER CITY, NEV.—Bids to 2 p.m., December 12, by the U. S. Bureau of Reclamation, Wilda Building, Denver, Colorado, for the fabrication and erection of 2 arc-welded or riveted plate steel tanks for water supply, Boulder City, Nevada, Boulder Canyon project. One tank will be 100 ft. in diameter and 34 ft. high, with No. 10 gauge sheet steel roof, of 2,000,000 gallons capacity, to be erected in Boulder City. The other tank will be 40 ft. in diameter and 25 ft. high, without roof, of 235,000 gallons capacity, to be erected at the site of the filter plant about 4 miles east of Boulder City. The tanks will be erected on oiled sand foundations constructed in advance by the government. 11-22

PORTLAND, ORE.—Bids to 2 p.m., Dec. 8, by Frank Coffinberry, City Purchasing Agent, City Hall, Portland, for furnishing 6-in. to 24-in. gate valves. 11-24

BIDS RECEIVED

PHOENIX, ARIZ.—Schmidt & Hitchcock, 11th and Jackson Streets, Phoenix, Arizona, and American Concrete Pipe Co., Los Angeles, who bid $2,056,000 on Schedule 'A' (complete project, Units 1 to 5 inclusive), submitted low bid to City (on basis of centr. cast reinf. concrete pipe for main supply line) for constructing water system improvements for the City of Phoenix, Arizona. Work involves main supply line and tunnels, 20,000,000-gallon concrete-lined reservoir, supply line from reservoir to City, cast-iron distribution lines, valves, hydrants, and detritor. C. C. Kennedy, Call Building, San Francisco, is the Consulting Engineer. 12-4

MADERA, CALIF.—Industrial & Municipal Supply Company, 7 Front Street, San Francisco, who bid $1812, submitted the low bid to the City of Madera, Madera County, for furnishing and installing a pump at the sewage disposal plant. Pump is to be 600 g.p.m. to 900 g.p.m., direct-connected to electric motor. Other bids received as follows:

Fairbanks Morse Company	$1847
C. V. Martin	1950
DeLaval Steam Turbine Co.	2031
Water Works Supply Co.	2049

12-4

MONTEREY, CALIF.—Low bids as follows by Quartermaster, Presidio of Monterey: (1) To Geo. C. DeGolyer, Federal Telegraph Bdg., Oakland, $1750 for laying cast-iron water mains extensions; and (2) Geo. C. DeGolyer, Federal Telegraph Bdg., Oakland, $3075 for drainage system. 11-26

SAN DIEGO, CALIF.—F. A. Rhodes, 2160 Hickory St., San Diego, Calif., $3285, low bid to the Public Works Office, for installing a second water connection at the Naval Operating Base (Hospital), San Diego. 12-1

CONTRACTS AWARDED

BEVERLY HILLS, CALIF.—To Nead Const. Co., 809 Avalon Blvd., Wilmington, $24,918 to City for reinf. conc. sediment basin, mixing tanks, and clarifier structure at Water Treatment Plant No. 2. 11-21

SANTA BARBARA, CALIF.—To C. G. Claussen & Company, San Francisco, who bid $747 for furnishing 900 lin.ft. 6-in. Class 'C' cast-iron pipe to the City. 11-22

SEATTLE, WASH.—To Congiusta Const. Co., Seattle, $7035 for water mains on Brandon St. for City.

MACHINERY and SUPPLIES

BIDS BEING RECEIVED

PHOENIX, ARIZ.—Bids to 2 p.m., Dec. 10, by U. S. Indian Field Service, 4100 Rhoads Circle, Phoenix, Ariz., for one concrete mixer, equal to 7S Lakewood. 11-22

WHITERIVER, ARIZ.—Bids to 5 p.m., Dec. 10, by U. S. Indian Service, Whiteriver, Arizona, for furnishing a sectional cast-iron steam boiler, with output of 2800 sq.ft. of radiation and a grate area of about 8½ sq.ft. 12-3

MERCED, CALIF.—Bids to 11 a.m., Dec. 13, by R. Vanden Heuvel, president, Merced Cemetery District, Merced, for galv. pipe. W. E. Bedesen, Merced, is Engineer. 12-2

SAN DIEGO, CALIF.—Bids to 11 a.m., December 13, by A. V. Goeddel, Superintendent of the Purchasing Department, City of San Diego, San Diego County, for furnishing the following: 35,000 ft. ¾-in. Malleable Copper tubing, 60-ft. lengths; 2000 ft. 1-in. Malleable Copper tubing, assorted lengths. Specification No. 118-A obtainable from above. 12-3

CHEMAWA, ORE.—Bids to 2 p.m., December 11, by Salem Indian School, Chamawa, Oregon, for furnishing following galv. iron pipe and fittings: 80 ft. 2-in., 100 ft. 1¼-in., 150 ft. ¾-in., 150 ft. ½-in. 12-3

BIDS RECEIVED

CAVITE, P. I.—Worthington Machinery Corporation, who bid $49,440, low bid to the Bureau of Yards and Docks, Navy Department, Washington, D. C., for furnishing and installing motor-driven and steam-driven air compressors on foundations to be provided by the Government, at the Naval Station, Cavite, P. I. 11-20

CONTRACTS AWARDED

COALINGA, CALIF.—To Hickey Pipe & Supply Co., Coalinga, who bid $36 per 100 ft. for furnishing 5000 ft. 3-in. lap-welded pipe to City. Other bids:

Richmond Sanitary Co. (at mill)	$33.12
Santa Fe Pipe & Supply Co., L. A.	34.75
Pacific Pipe Co., San Francisco	35.66
C. G. Claussen & Co., Inc.	35.66
Federal Pipe Supply Co.	35.66
Bunting Iron Works	39.06
Oil Well Supply Co.	44.26

12-3

OAKLAND, CALIF.—To San Leandro Rock Co., San Leandro, who bid 90¢ per cu.yd. to the Board of Port Comm. for furnishing and delivering to the Oakland Municipal Airport 5000 cu.yd. of quarry waste from second-grade rock. 11-25

PASADENA, CALIF.—To Consolidated Steel Corp., 1200 N. Main St., Los Angeles, who bid $11,980 to City for furnishing and erecting one 39,500-bbl. steel fuel oil tank. 11-26

RIVER and HARBOR WORK

BIDS BEING RECEIVED

OAKLAND, CALIF.—Bids to 3 p.m., December 26, by the U. S. Engineer's Office, Custom House, San Francisco, for dredging in Oakland Harbor. Work involves 691,074 cu.yd. dredging. 11-26

BIDS RECEIVED

SACRAMENTO, CALIF.—Healy-Tibbitts Construction Company, 64 Pine Street, San Francisco, who bid $2.58 per ton, low bid to the U. S. Engineer's Office, California Fruit Bdg., Sacramento, for furnishing, delivering, and placing 1000 tons of riprap stone along the Sacramento River in the vicinity of Ryde, Calif. 11-21

SACRAMENTO, CALIF.—Hutchinson Company, 1450 Harrison Street, Oakland, who bid $2.57 per ton, submitted the low bid to the U. S. Engineer's Office, California Fruit Building, Sacramento, for furnishing and placing riprap stone along the Sacramento River in the vicinity of Isleton and Walnut Grove. Other bids as follows:

Blake Bros., San Francisco	$2.60 ton
Healy-Tibbitts Const. Co., S. F.	2.65 ton

12-3

CONTRACTS AWARDED

SAN FRANCISCO, CALIF.—Contract awarded to Healy-Tibbitts Construction Co., 64 Pine St., San Francisco, $347,597 to Board of State Harbor Comm. for substructure for Pier 23, reinf. conc. jacketed piles and reinf. conc. deck. Other bids as follows:

Merritt-Chapman & Scott, San Pedro	$352,000
McDonald & Kahn, S. F.	353,000
M. B. McGowan, San Francisco	357,000
A. W. Kitchen, San Francisco	365,945
Schuler & McDonald, Oakland	388,773
Clinton Const. Co., S. F.	410,800

12-4

IRRIGATION and RECLAMATION

WORK CONTEMPLATED

EL NIDO, CALIF.—Bonds voted by the El Nido Irrigation District, El Nido, Merced County, $135,000, for irrigation works. Work involves the installation of: (1) Twelve miles of main canal, involving 150,000 cu.yd. canal excavation, 65,000 sq.ft. 2-in. concrete lining; (2) Fifteen miles of lateral canals, involving 120,000 cu.yd. canal excavation; and (3) Construction of 24-in. to 48-in. siphons with headwalls, bridges, drops, stop-gates and sidegates, etc. Plans by Consulting Engineer, A. Blakesley, care of Merced Irrigation District, Merced. 11-18

ALBUQUERQUE, N. M.—Plans by Engineer, J. L. Burkholder, Middle Rio Grande Conservancy District, Court House, Albuquerque, New Mexico, for the El Vado Dam on the Rio Chama, 175 miles north of Albuquerque, N. M. Dam will have a top length of 1400 ft., will be 600 ft. long at the base, and the crest will be 175 ft. above the present stream bed. The main body of the dam will consist of an embankment of gravel and rock fill and the upstream face will be covered with reinforced concrete 8-in. thick at the top and 12-in. at the bottom. The downstream face will be covered with a heavy layer of rock fill. Work involves: 2,000,000 lb. of reinforcing steel, 170,000 sacks of cement, 1,000,000 lb. of metal work, 350,000 cu.yd. of gravel fill, 100,000 cu.yd. excavation; $1,600,000, and project will be let probably by contract during the spring of 1931. 11-29

BIDS BEING RECEIVED

DENVER, COLO.—Bids to 2 p.m., December 18, by the Bureau of Reclamation, Wilda Building, Denver, Colorado, for one motor driven gate hoist with motor and two gate assemblies complete. 11-28

CHELAN, WASH.—Bids to 8 p.m., Dec. 19, by Howard Flat Irrigation Dist. 1, Chelan, Wash., for irrigation system to include concrete pump house, two 700-hp. cent. pumps and motors, and furnishing and laying 5200 lin.ft. 30-in. steel pipe, ¼ in. thick; 22,530 lin.ft. 30-in. steel pipe, $\frac{3}{16}$ in. thick; 1322 lin.ft. 24-in. steel pipe, $\frac{3}{16}$ in. thick; 1325 lin.ft. 20-in. steel pipe, $\frac{3}{16}$ in. thick; 9519 lin.ft. 16-in. steel pipe, $\frac{3}{16}$ in. thick; 15,768 lin.ft. 12-in., 8 gauge (B.W.G.) pipe; 6154 lin.ft. 8-in., 8 gauge (B.W.G.) pipe; 2083 lin.ft. 6-in., 8 gauge (B.W.G.) pipe; 30 lin.ft. 4-in., 8 gauge (B.W.G.) pipe, complete with valves, fittings, hydrant, air valves, blowoff valves. W. T. Batcheller, Inc., Exchange Bldg., Seattle, is Engineer. 11-28

BIDS RECEIVED

PALMDALE, CALIF.—Los Angeles Mfg. Co., 2500 E. Twenty-third St., Los Angeles, $4400, low bid to Little Rock Creek Irrigation District for 12-in. Toncan welded pipe line and valves. 12-1

SACRAMENTO, CALIF.—E. T. Fisher, Stockton Hotel Annex, Stockton, who bid $3201, submitted the low bid to U. S. Engineer's Office, for levee along the Feather River near Lee Station of the Southern Pacific Railroad, 8 miles northeast from Knights Landing. 11-28

SACRAMENTO, CALIF.—R. P. Easley, 705 E Street, Antioch, who bid .0975¢ per cu.yd., low bid to the U. S. Engineer's Office, California Fruit Bdg., Sacramento, for raising and enlarging the existing levee near Alicia Station of Sacramento Northern Railway, along the Feather River, two miles southerly and downstream from the town of Marysville. Work involves 36,500 cu.yd. earthwork. 11-18

SACRAMENTO, CALIF.—Olympian Dredging Co., 249 1st St., S. F., who bid 174¢ per yd., only bid to U. S. Engineer's Office, Sacramento, for raising levee on west side of Yolo By-pass from near pump house, Reclamation Dist. 2068, 6 miles south, for distance of 1 mile to north levee of Liberty Island Reclamation Dist. Work involves 157,000 cu.yd. earthwork. 11-18

CONTRACTS AWARDED

DENVER, COLO.—Awards as follows by Bureau of Reclamation, Denver, for Pumping Station No. 1, Minidoka Project, Idaho: PUMPING UNIT—Awarded to Pelton Water Wheel Co., S. F., $13,836; and ELECTRICAL EQUIPMENT—To General Electric Co., $6293. 11-20

LIGHTING SYSTEMS

CONTRACTS AWARDED

RED BLUFF, CALIF.—To Butte Electric & Manufacturing Co., 956 Folsom Street, San Francisco, who bid $3873 to the City of Red Bluff, Tehama County, for lighting system on Walnut Street by construction and installation of an ornamental electrolier lighting system with 20 single-light electroliers and all necessary conduits and appurtenances including electrolier standards of the Union Metal Manufacturing Company. 12-3

VISALIA, CALIF.—To Butte Electric & Mfg. Co., 956 Folsom Street, San Francisco, who bid $19,999 to the City of Visalia, Tulare County, for lighting system on North and South Court, North and South Locust, North and South Church and North and South Garden Streets. Bids received from:

(1) Butte Elect. & Mfg. Co. $19,999
(2) R. A. Wattson, Los Angeles 20,601

	(1)	(2)
4,450 ft. 1¼-in. conduit	.50	.36
460 ft. 2-in. conduit	.70	.47
310 ft. 2½-in. conduit	.90	.60
14,300 ft. No. 8 cable	.09	.15
51 electroliers, 2-light, Union Metal Co. design No. 2281	311.50	312.00

12-3

POWER DEVELOPMENT

BIDS BEING RECEIVED

MARE ISLAND, CALIF.—Bids to 11 a.m., Dec. 24, by Bureau of Yards and Docks, Navy Department, Washington, D. C., for furnishing a 2000-kw. turbo-alternator erected on structural steel supports to be provided by the Government, changes to the existing switchboard panel and electrical apparatus, and the services of a supervising erector, at the Navy Yard, Mare Island, Calif. Specif. No. 6362 from Commandant, Navy Yard, Mare Island, Calif. 11-24

BIDS RECEIVED

SEATTLE, WASH.—Ward Construction Co., 1218 North Alder St., Tacoma, Wash., $279,847, low bid to the City for sub-structure for the Diablo Power House. 11-24

CONTRACTS AWARDED

PASADENA, CALIF.—To C. C. Moore Co., S. F. and Los Angeles, $141,140 for steam boilers, etc., for Municipal Light Plant for the City of Pasadena, Los Angeles County. 12-4

RAILROAD CONSTRUCTION

WORK CONTEMPLATED

MOCLIPS, WASH.—Plans by Engineering Department of the Northern Pacific Railway Company, St. Paul, Minnesota, for the construction of 60 miles of railroad from Moclips, Washington, to the north bank of the Hoh River near Spruce. $5,900,000. 11-25

BIDS BEING RECEIVED

LAS VEGAS, NEV.—Bids to 10 a.m., Jan. 12, by the Bureau of Reclamation, Las Vegas, Nevada, for the construction of a railway, approximately 10¼ miles long, from the Summit (near Boulder City townsite) to Hoover Dam, Boulder Canyon Project, Arizona-California-Nevada. Work is located about 25 to 30 miles southeast of Las Vegas, Nevada, which city is on the main line of the Los Angeles & Salt Lake (U. P.) Railroad. Work involves: 473,700 cu.yd. all kinds of open-cut excavation; 26,000 cu.yd. tunnel excavation; 574,000 sta.cu.yd. overhaul; 221,500 cu.yd. long-haul borrow; 384,000 cu.yd.mi. hauling long-haul borrow; 5500 cu.yd. backfill; 200 cu.yd. concrete; 4500 sq.yd. dry-rock paving; 2500 cu.yd. concrete crib wall; 15,000 lb. reinforcement bars, place; 180 M ft. B.M. permanent timbering in tunnel, erect; 2680 lin.ft. 24-in. to 60-in. diam. corr. metal pipe, laying; 25 M ft. B.M. timber in bridges or trestles, erect; 2000 lin.ft. piles, driving; 10.23 miles laying track; 20,400 cu.yd. ballast, placing. The above work is to be done under Specification No. 518, from Bureau of Reclamation, Las Vegas, Nev., Denver, Colo., and Washington, D. C. 12-1

CONTRACTS AWARDED

OAKLAND, CALIF.—To Worden & Forsythe, 264 Sybil Ave., Oakland, who bid $4285 to Oakland Port Commission, for laying track material on the 348-ft. extension to the outer Harbor Terminal. 12-2

TUNNEL CONSTRUCTION

CONTRACTS AWARDED

SAN FRANCISCO, CALIF.—Award recommended to Chas. H. Dunning, Heard Bdg., Phoenix, Ariz., $61,491 for sinking 750-ft. elevator shaft at Carlsbad Caverns National Park, New Mexico, for U. S. National Park Service. (See Unit Bid Summary.) 11-26

BUILDING CONSTRUCTION

WORK CONTEMPLATED

BERKELEY, CALIF.—Plans being prepared by Architect, George B. McDougall, State Architect, Public Works Building, Sacramento, and call for bids will be issued about December 9, bids to be opened at a later date, for a reinforced concrete and stucco school building addition at the Deaf School of California, located on Warring and Parker Streets, Berkeley. The estimated cost of the above work is $100,000. 12-2

BIDS BEING RECEIVED

SAN JOSE, CALIF.—Bids to 11 a.m., Dec. 15, by County, for 2-story reinf. concrete service building at County Hospital. 12-1

STOCKTON, CALIF.—Bids to 2 p.m., Dec. 16, by State Division of Architecture, Sacramento, for 2-story reinf. conc. hospital and industrial building at Stockton State Hospital. $110,000. 11-20

HAWTHORNE, NEV.—Bids to 11 a.m., Dec. 26, by the Bureau of Yards and Docks, Navy Department, Washington, D. C., for construction of buildings and dugouts, including concrete, steel, and iron work; railroad tracks, conveyor and cableway systems; cranes and hoists; boiler plant and equipment, and heating, plumbing, ventilating, electric light and power, telephone and alarm systems at the Naval Ammunition Depot, Hawthorne, Nevada. $285,000. 11-25

BIDS RECEIVED

IONE, CALIF.—Low bids as follows by State Architect's Office, Public Works Bdg., Sacramento, for 2-story residence at Preston School of Industry near Ione, Amador County: GENERAL—Bilt-Rite Construction Co., 1203 Walnut St., Berkeley, $13,855 low; PLUMBING AND HEATING—Scott Co., 243 Minna St., S. F., $5327 low; and ELECTRICAL WORK—Luppen & Hawley, 3126 J St., Sacramento, low. 12-2

SAN FRANCISCO, CALIF.—Low bids as follows by City for the construction of a 3-story Class 'B' concrete, stucco, and terra cotta James Lick Junior High School, to be located at Noe and 25th, Castro and Clipper Streets, San Francisco: GENERAL CONTRACT—Anderson & Ringrose, 320 Market Street, San Francisco, $484,000 low; STRUCTURAL STEEL—Minneapolis Steel & Mchy. Co., Sharon Bdg., S. F., $9920 low; MECHANICAL WORK—H. Lawson, 465 Tehama St., S. F., $37,000 low; ELECTRICAL WORK—Alta Electric Co., 938 Howard St., S. F., $31,190 low; and PLUMBING—Turner Co., 329 Tehama St., S. F., $28,600 low. 12-3

SCHOFIELD BARRACKS, T. H. — Henry Freitas, Honolulu, T. H., $464,000, low bid to the Department Quartermaster, Construction Division, Fort Shaffer, T. H., for 49 sets of non-commissioned officers' quarters and one bachelor non-commissioned officers' building, etc., at Wheeler Field, Schofield Barracks, T. H. 12-1

CONTRACTS AWARDED

FAIRFIELD, CALIF.—Awards as follows by County for reinf. conc. and stucco library at Fairfield. GENERAL—To Frank Cress, 828 Excelsior, Oakland, $24,417; PLASTERING—To P. H. Donnelly, 3957 Oakmore Road, Oakland, $5444; PLUMBING AND HEATING—To Scott Plumbing & Electric Co., 1900 M St., Sacramento, $5436; PAINTING—To Wilcoxsen & Wilson, 1724 34th St., Sacramento, $1697; and ELECTRICAL—To Fairfield Battery & Electric Co., Fairfield, $1347. 11-24

LIVERMORE, CALIF.—To N. H. Sjoberg & Sons, Call Bdg., S. F., $50,886 for reinf. concrete and stucco club and lodge building at Livermore for Alameda County. 11-18

RICHMOND, CALIF.—To P. M. Sanford, Richmond, $26,890 for terra cotta and brick addition to Woodrow Wilson School. 12-1

SAN JOSE, CALIF.—Awards as follows by the State Architect's Office, Public Works Building, Sacramento, for the construction of a 2-story reinforced concrete and brick veneer gymnasium (first unit), to be located at the San Jose State Teachers College at San Jose, Santa Clara County: GENERAL—To J. J. Grodem, 1028 San Antonio Ave., Alameda, $97,995; PLUMBING AND HEATING—To W. F. Serpa, 497 No. 13th St., San Jose, $15,250; and ELECTRICAL WORK—To Gaubert Bros. Electric Co., 286 W. Santa Clara, San Jose, $6355. 12-3

SAN FRANCISCO, CALIF.—To Spivock & Spivock, Hobart Building, San Francisco, for the construction of a 1-story 30 by 100 stucco and frame tennis club building, 8 tennis courts and 2 practice courts, lighting system, wire post fencing, and macadam work, to be located at Pine Lake Park, Sloat Boulevard and Mirasol, San Francisco. $33,000. 11-20

SANTA ROSA, CALIF.—To L. Halverson, 128 Dutton St., Santa Rosa, $37,839 for brick junior college building for Santa Rosa Junior College. 11-18

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THE BUYERS' GUIDE

Refer to advertisements for addresses of companies listed. Advertisers index on page 70

(Continued on page 66)

OPPORTUNITY PAGE

CONTINUED

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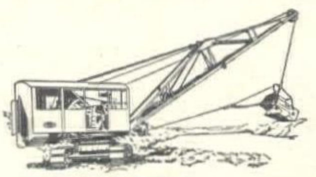

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SITUATIONS WANTED

POSITION WANTED as Gas Shovel Engineer or Master Mechanic in construction work. Eight years' experience Master Mechanic, four years' Gas Shovel Engineer. References can be furnished. Jack Milton, General Delivery, Sonora, Calif.

POSITION WANTED by Draftsman on pipeline work and maps. Four years' experience. References can be furnished. Write H. L. Page, 32 Plaza Drive, Berkeley.

ENGINEER DESIGNER, 38, with a wide range of first-class experience, including 10 years' foreign service, covering Mine Development and Operation, Recovery and Treatment Plants, various production plants and the Steel Industry. Desire a permanent connection either as Engineer Plant Superintendent or in the Sales Field where ability, foresight and business acumen are recognized and rewarded with equitable remuneration. Employed at present. Box 505, Western Construction News.

POSITION WANTED by ditcher operator. Six years' experience on wheel and ladder-type machines. Can repair and maintain machines. Will go anywhere. Box 575, W.C.N.

SITUATION WANTED—A labor foreman, experienced, sewer construction, concrete, street, curb and gutter, walks, pipe lines, general work. Box 350AA, Route 2, Redwood City, Calif.

HELP WANTED

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

CIVIL ENGINEER, technical graduate, 30-45 years old, thoroughly experienced on design of steel and concrete girders, trusses, foundations, etc. Salary $300-350 month depending upon experience. Preference will be given to a resident of San Francisco. R-3423-S.

CIVIL ENGINEER, graduate, with experience in the design and construction of sewers and water works, to purchase an interest in an engineering business. Some experience in electrical engineering desirable. Apply only by letter. Location, Kansas City. W-499-C-S.

ENGINEER, who has designed heat exchangers, including calculations. Oil refinery experience is essential. An engineer who has been with the Braun Corp. would have the experience. Salary, $6000 a year, perhaps more. Location, vicinity of New York City. K-325-W-1919-S.

OFFICIAL BIDS

NOTICE TO CONTRACTORS

Sealed proposals will be received at the office of the East Bay Municipal Utility District, 512 Sixteenth Street, Oakland, California, until 5:30 p.m., Thursday, December 18, 1930, and will at that hour be opened, for constructing and furnishing, f.o.b. Twenty-second and Adeline Streets, Oakland, California, one pumping unit and equipment for El Cerrito Booster Plant.

Plans and Specifications for this work may be obtained by application to the office of the District at 512 Sixteenth Street, Oakland, California.

JOHN H. KIMBALL, Secretary.

Oakland, California, December 3, 1930.

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THE BUYERS' GUIDE—*Continued from Page 64*

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Industrial & Municipal Supply Co.
U. S. Cast Iron Pipe & Fdy. Co.
Water Works Supply Co.

Explosives
Giant Powder Co., Cons., The
Hercules Powder Co.

Equipment—Rental
Atkinson Construction Co.
Contractors Mchy. Exchange
Tieslau Bros.

Filters, Water
California Filter Co., Inc.

Fire Hydrants
Industrial & Municipal Supply Co.
Rensselaer Valve Co.
Water Works Supply Co.

Floating Roofs
Chicago Bridge & Iron Works

Flood Lights
Oxweld Acetylene Co.
Taylor & George

Flooring, Industrial
Paraffine Companies, Inc., The

Floors, Mastic
Wailes Dove-Hermiston Corp.

Flumes, Concrete
Portland Cement Association

Flumes, Metal
California Corrugated Culvert Co.
Montague Pipe & Steel Co.

Fluxes
Victor Welding Equipment Co.

Forms, Steel
Blaw-Knox Co.
Jenison Machinery Co.
Lakewood Engr. Co.

Form Ties
J. M. Willard Co.

Freight, Water
American-Hawaiian Steamship Co.

Gas Holders
Chicago Bridge & Iron Works
Western Pipe & Steel Co.

Gates, Cast-Iron
California Corrugated Culvert Co.

Gates, Radial
California Corrugated Culvert Co.

Gates, Sheet Metal
California Corrugated Culvert Co.

Governors, Steam Engine
Gardner-Denver Co.
Young Machy. Co., A. L.

Governors, Turbine
Pelton Water Wheel Co., The

Grader Blades
Solano Iron Works

Gravel Plant Equipment
Austin-Western Road Mchy. Co., The
Bacon Co., Edward R.
Bodinson Mfg. Co.
Bucyrus-Erie Co.
Diamond Iron Works, Inc.
Guest Crushing Machines, Inc.
Harnischfeger Sales Corp.
Jenison Machinery Co.
Link-Belt Co.
Smith Engineering Works
Young Mach. Co., A. L.

Hammers, Steam Pile
Bacon Co., Edward R.
Harron, Rickard & McCone Co.
Kratz & McClelland, Inc.
Union Iron Works, Inc.

Hoists, Hand and Power
Bacon Co., Edward R.
Gardner-Denver Co.
Harnischfeger Sales Corp.
Harron, Rickard & McCone Co.

Hoists, Hand, Power (Cont.)
Ingersoll-Rand Co.
Jaeger Machine Works, The
Jenison Machinery Co.
Link-Belt Co.
Novo Engine Co.
Sullivan Machinery Co.
West Coast Tractor Co.
Worden Co., W. H.
Young Machy. Co., A. L.

Hoppers, Steel
Bacon Co., Edward R.
Blaw-Knox Co.
Haiss Mfg. Co., Geo.
Jenison Machinery Co.
Lakewood Engr. Co.
Link-Belt Co.

Hose, Steam, Air and Water
Gardner-Denver Co.
Ingersoll-Rand Co.
Leitch & Co.
Rix Company, Inc., The

Hydro-Tite
Industrial & Municipal Supply Co.

Insurance, Casualty
Aetna Casualty & Surety Co.
Associated Indemnity Corp.
Commerce Casualty Co.
Consolidated Indemnity & Insurance Co.
Detroit Fidelity & Surety Co.
Fidelity & Casualty Co. of N. Y., The
Fidelity & Deposit Co. of Maryland
Glens Falls Indemnity Co.
Great American Indemnity Co.
Indemnity Insurance Co. of North America
Maryland Casualty Co.
Massachusetts Bonding & Insurance Co.
New Amsterdam Casualty Co.
Rolph, James Jr., Landis & Ellis

Iron, Plates and Sheets
American Rolling Mill Co., The

Jacks, Lifting
Jenison Machinery Co.

Kettles, Tar and Asphalt
Bacon Co., Edward R.
Montague Pipe & Steel Co.
Spears-Wells Machy. Co.
Young Machy. Co., A. L.

Leadite
Water Works Supply Co.

Loaders, Power, Truck and Wagon
Haiss Mfg. Co., Geo.
Industrial Brownhoist Corp.
Jaeger Machine Works, The
Jenison Machinery Co.
Link-Belt Co.
Spears-Wells Machy. Co.
Young Machy. Co., A. L.

Locomotives, Electric, Gas and Steam
Jenison Machinery Co.

Lumber
McCormick Lumber Co.

Metal Lath
Truscon Steel Company

Meters, Venturi
Water Works Supply Co.

Meters, Water
Industrial & Municipal Supply Co.
Neptune Meter Co.

Mixers, Chemical
Dorr Co., The

Mixers, Concrete
Bacon Co., Edward R.
Foote Company, Inc.
Garfield & Co.
Harron, Rickard & McCone Co.
Jaeger Machine Works, The
Jenison Machinery Co.
Lakewood Engr. Co.
National Equipment Corp.
Ransome Concrete Machinery Co.
Young Machy. Co., A. L.

Mixers, Plaster
Bacon Co., Edw. R.
Jaeger Machine Works, The
Jenison Machinery Co.
Young Machy. Co., A. L.

Motors, Gasoline
Continental Motors Corp.
Hercules Motors Corp.
Jenison Machinery Co.
Le Roi Co.

Oxy-Acetylene Apparatus
Oxweld Acetylene Co.

Oxygen in Cylinders
The Linde Air Products Co.

Paints, Acid Resisting
Columbia Wood and Metal Preservative Co.
Inertol Company, Inc.
Paraffine Companies, Inc., The
Wailes Dove-Hermiston Corp.

Paints, Metal Protective
Columbia Wood and Metal Preservative Co.
Inertol Company, Inc.
McEverlast, Inc.
Paraffine Companies, Inc., The
Wailes Dove-Hermiston Corp.

Paints, Technical
American Bitumuls Co.
Columbia Wood and Metal Preservative Co.
Inertol Company, Inc.
Paraffine Companies, Inc., The
Wailes Dove-Hermiston Corp.

Paints, Waterproofing
Columbia Wood and Metal Preservative Co.
Inertol Company, Inc.
McEverlast, Inc.
Paraffine Companies, Inc., The
Wailes Dove-Hermiston Corp.

Pavers, Concrete
Bacon Co., Edw. R.
Foote Company, Inc.
Harron, Rickard & McCone Co.
Kratz & McClelland, Inc.
National Equipment Corp.
Ransome Concrete Machinery Co.

Paving Breakers
Gardner-Denver Co.
Ingersoll-Rand Co.
Leitch & Co.
Rix Company, Inc., The
Schramm, Inc.
Sullivan Machinery Co.

Paving, Contractor
Warren Bros. Roads Co.

Paving Plants
Bacon Co., Edward R.
Jaeger Machine Works, The
Jenison Machinery Co.
Standard Boiler & Steel Works

Paving Tools
Bacon Co., Edward R.
Harron, Rickard & McCone Co.

Penstocks
Chicago Bridge & Iron Works
Lacy Manufacturing Co.
Pittsburgh-Des Moines Steel Co.
Water Works Supply Co.
Western Pipe & Steel Co.

Pile Drivers
Bacon Co., Edward R.
Bucyrus-Erie Co.
Harnischfeger Sales Corp.
Harron, Rickard & McCone Co.
Industrial Brownhoist Corp.
Ingersoll-Rand Co.
Jenison Machinery Co.
Kratz & McClelland, Inc.
Northwest Engineering Co.
Orton Crane & Shovel Co.
Thew Shovel Co., The
Union Iron Works, Inc.

Piles, Concrete
Raymond Concrete Pile Co.
MacArthur Concrete Pile Corp.

Piling
Pacific Coast Steel Corp.

Piling, Redwood
Union Lumber Co.

Pipe, Bell and Spigot
National Cast Iron Pipe Co.

Pipe, Cast-Iron
American Cast Iron Pipe Co.
Claussen & Co., C. G.
Industrial & Municipal Supply Co.
National Cast Iron Pipe Co.
Pacific States Cast Iron Pipe Co.
U. S. Cast Iron Pipe & Fdy. Co.
Water Works Supply Co.

Pipe, Cement Lined
American Cast Iron Pipe Co.
National Cast Iron Pipe Co.
U. S. Cast Iron Pipe & Fdy. Co.

Pipe, Centrifugal
National Cast Iron Pipe Co.

Pipe Clamps and Hangers
Kortick Mfg. Co.

Pipe Coatings
American Concrete Pipe Co.
Inertol Company, Inc.
McEverlast, Inc.
Paraffine Companies, Inc., The
Wailes Dove-Hermiston Corp.

Pipe, Concrete
American Concrete Pipe Co.
Lock Joint Pipe Co.
Portland Cement Association

Pipe, Culvert
California Corrugated Culvert Co.
Gladding, McBean & Co.
Pacific Clay Products
Western Pipe & Steel Company

Pipe Fittings
American Cast Iron Pipe Co.
Claussen & Co., C. G.
Industrial & Municipal Supply Co.
National Cast Iron Pipe Co.
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.
Jenison Machinery Co.

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 Co.

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.

Pipe, Vitrified
Gladding Bros. Mfg. Co.
Gladding, McBean & 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.
Western Pipe & Steel Co.

Plows, Road
Austin-Western Road Mchy. Co., The
Bacon Co., Edward R.
Jenison Machinery Co.
Spears-Wells Machy. Co.

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

Poles, Redwood
Union Lumber Co.

Powder
Giant Powder Co., Cons., The
Hercules Powder Co.

Power Units
Bacon Co., Edw. R.
Continental Motors Corp.
Hercules Motors Corp.
International Harvester Co.
Jenison Machinery Co.
Novo Engine Co.

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
Washington Iron Works
Woodin & Little

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OPPORTUNITY PAGE

CONTINUED

OFFICIAL BIDS

NOTICE TO CONTRACTORS

Pipe System, Pumps, Etc.

Notice is hereby given that sealed proposals will be received by Howard Flat Irrigation District, Chelan, Washington, up to eight (8:00) o'clock p.m. Friday, December 19th, 1930, and then publicly opened, for the construction of a complete irrigation system for said District.

The work involved will include the construction of a concrete pump house with pumping equipment including two 700-horsepower centrifugal pumps, furnishing and laying 5,200 lineal feet of 30-inch pipe ¼ inch thick, 22,530 lineal feet of 30-inch pipe $\frac{3}{16}$ inch thick, 1,322 lineal feet of 24-inch pipe $\frac{3}{16}$ inch thick, 1,325 lineal feet of 20-inch pipe $\frac{3}{16}$ inch thick, 9,519 lineal feet of 16-inch pipe $\frac{3}{16}$ inch thick, 15,768 lineal feet of 12-inch 8 gauge B.W.G. pipe, 6,154 lineal feet of 8-inch 8 gauge B.W.G. pipe, 2,083 lineal feet of 6-inch 8 gauge B.W.G. pipe, 30 lineal feet of 4-inch 8 gauge B.W.G. pipe, complete with valves, fittings, hydrant, air valves, blow-off valves and appurtenances.

No proposal will be considered except as same is made in strict conformity with the advertisement therefor and upon the forms of proposals furnished by the Engineers. Proposals will be received only from reliable Contractors who can furnish satisfactory evidence that they are experienced in this class of work and are financially responsible.

Payment for the work will be made with the general bonds of the District which have been authorized and adjudicated as required by law.

The District reserves the right to reject any and all bids.

The plans and specifications for such work are now on file and open to public inspection in the office of Willis T. Batcheller, Inc., Consulting Engineers, 1903 Exchange Building, Seattle, Washington, and may be obtained by prospective bidders upon deposit of Ten Dollars ($10.00). Five Dollars ($5.00) of said deposit will be refunded upon return of plans and specifications by December 26th.

CHARLES R. SARGENT,
Secretary, Howard Flat Irrigation District.

F. W. EASLEY,
O. M. BROWNFIELD,
R. N. SMITH,
Board of Directors.

NOTICE TO CONTRACTORS

Pig Lead

Sealed proposals will be received at the office of the East Bay Municipal Utility District, 512 Sixteenth Street, Oakland, California, until 8:00 p.m., December 10, 1930, and will at that hour be opened, for furnishing approximately 50 tons of Pig Lead.

Specifications may be obtained upon application to the office of the District, Room 33.

Oakland, California, November 28, 1930.

JOHN H. KIMBALL, Secretary.

UNITED STATES DEPARTMENT OF AGRICULTURE

BUREAU OF PUBLIC ROADS

Grading

San Francisco, Calif., December 4, 1930

Sealed bids, in single copy only subject to the conditions contained herein, will be received until 2:00 o'clock p.m. on the 30th day of December, 1930, and then publicly opened, for furnishing all labor and materials and performing all work for grading Section 'F' of Route 23, Quincy-Beckwith National Forest Highway, in Plumas National Forest, Plumas County, Calif. The length of the project to be graded is 7.99 miles and the principal items of work are approximately as follows:

Clearing, 29 acres.
Unclassified excavation, 73,180 cu.yd.
Structural excavation, 660 cu.yd.
Overhaul, 97,800 sta.yd.
Finishing, 7.942 miles.
Treated timber in place, 85 M b.m.
Treated timber piling in place, 1600 lin.ft.
Concrete in place, 100 cu.yd.
Reinforcing steel in place, 1250 lb.
Corr. metal pipe in place, 2322 lin.ft.
Bituminous wearing surface in place, 655 sq.yd.
Right of way monuments in place, 102 each.

Proposals will be received from capable and responsible contractors who must submit with their request for Standard Government Form of Bid an attested statement on forms to be supplied by the District Engineer of their financial resources and construction experience. Standard Government Form of Bid will be supplied only to contractors showing sufficient experience and financial resources to properly construct the work contemplated.

Where copies of plans and specifications are requested, a deposit of $10 will be required to insure their return. If these are not returned within 15 days after opening of bids the deposit will be forfeited to the Government. Checks should be certified and made payable to the Federal Reserve Bank of San Francisco.

Guarantee will be required with each bid as follows: In the amount of five (5) per cent of the bid.

Performance bond will be required as follows: In the amount of one hundred (100) per cent of the total contract price. Performance shall begin within ten (10) calendar days after date of receipt of notice to proceed and shall be completed within two hundred fifty (250) calendar days from that date, exclusive of any time that may intervene between the effective date of orders of the Government to suspend operations on account of weather conditions and the effective date of orders to resume work and subject to such extensions as may be provided for under the Special Provisions.

Liquidated damages for delay will be the amount stated in the Special Provisions for each calendar day of delay until the work is completed and accepted.

Partial payments will be made as the work progresses for work and material delivered if such work and material meet the approval of the contracting officer.

Article on patents will be made a part of the contract.

Bids must be submitted upon the Standard Government Form of Bid and the successful bidder will be required to execute the Standard Government Form of Contract for Construction.

The right is reserved, as the interest of the Government may require, to reject any and all bids, to waive any informality in bids received, and to accept or reject any items of any bid, unless such bid is qualified by specific limitation. Award of contract will not be made until the Cooperative Agreement covering the proposed work has been executed by the Secretary of Agriculture.

Envelopes containing bids must be sealed, marked, and addressed as follows:

Bid for Road Construction. To be opened 2:00 o'clock p.m., December 30, 1930.
Project 23-F, Quincy Beckwith. 807 Sheldon Bldg., 461 Market Street, San Francisco, Calif.

C. H. SWEETSER, District Engineer

UNITED STATES DEPARTMENT OF THE INTERIOR

BUREAU OF RECLAMATION

Highway—Boulder Canyon Project

Washington, D. C., November 20, 1930

Sealed bids (Specifications No. 517) will be received at the office of the Bureau of Reclamation, Las Vegas, Nevada, until 10 o'clock a.m., January 7, 1931, and then publicly opened, for furnishing labor and materials and performing all work for the construction of a highway approximately seven miles long from the vicinity of Boulder City to Hoover dam site, Boulder Canyon project, Arizona-California-Nevada. The work is located about 25 to 30 miles southeast of Las Vegas, Nevada, which town is on the main line of the Los Angeles and Salt Lake (U. P.) Railroad. The principal items and the estimated quantities involved are as follows: 418,720 cubic yards of all classes of open cut excavation; 6000 cubic yards of tunnel excavation; 249,000 station cubic yards of overhaul; 2000 cubic yards of back fill; 160 cubic yards of concrete; 5000 cubic yards of concrete crib wall; 5600 square yards of dry rock paving; placing 8000 pounds of reinforcement bars; erecting 30 M ft. b.m. of permanent tunnel timbering; erecting 45 M ft. b.m. of timber in bridge; laying 4510 linear feet of 18-in. to 72-in. corrugated metal pipe; furnishing and placing 39,000 cubic yards of gravel surfacing; oil treating 147,000 square yards of surfacing; constructing 27,000 linear feet of guard rail. This invitation for bids does not cover the purchase of materials which are to be furnished by the Government. Materials to be furnished by the contractor and those furnished by the Government are described in the specifications which will be a part of the contract. For particulars, address the Bureau of Reclamation, Las Vegas, Nevada; Denver, Colorado; or Washington, D. C.

ELWOOD MEAD, Commissioner.

UNITED STATES DEPARTMENT OF THE INTERIOR

BUREAU OF RECLAMATION

Railroad—Boulder Canyon Project

Washington, D. C., November 24, 1930

Sealed bids (Specifications No. 518) will be received at the office of the Bureau of Reclamation, Las Vegas, Nevada, until 10 o'clock a.m., January 12, 1931, and then publicly opened, for furnishing labor and materials and performing all work for the construction of a railway, approximately ten and one-quarter miles in length, from the Summit (near Boulder City townsite) to Hoover Dam, Boulder Canyon project, Arizona-California-Nevada. The work is located about 25 to 30 miles southeast of Las Vegas, Nevada, which city is on the main line of the Los Angeles and Salt Lake (U. P.) Railroad. The principal items and the estimated quantities involved are as follows: 473,700 cubic yards of all kinds of open-cut excavation; 26,000 cubic yards of tunnel excavation; 574,000 station cubic yards of overhaul; 221,500 cubic yards of long-haul borrow; 384,000 cubic-yard-miles of hauling long-haul borrow; 5500 cubic yards of back fill; 200 cubic yards of concrete; 4500 square yards of dry-rock paving; 2500 cubic yards of concrete crib wall; placing 15,000 pounds of reinforcement bars; erecting 180 M ft. b.m. of permanent timbering in tunnels; laying 2680 linear feet of 24-inch to 60-inch diam. corrugated metal pipe; erecting 25 M ft. b.m. of timber in bridges or trestles; driving 2000 linear feet of piles; laying 10.23 miles of track; and placing 20,400 cubic yards of ballast. This invitation for bids does not cover the purchase of materials which are to be furnished by the Government. Materials to be furnished by the contractor and those furnished by the Government are described in the specifications which will be a part of the contract. For particulars, address the Bureau of Reclamation, Las Vegas, Nevada; Denver, Colorado; or Washington, D. C.

ELWOOD MEAD, Commissioner.

THE BUYERS' GUIDE—*Continued from Page 66*

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

Pumps, Dredging and Sand
Jenison Machinery Co.

Pumps, Hydraulic
Jenison Machinery Co.

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

Pumps, Road
Bacon Co., Edward R.
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.
Washington Iron Works

Rails
Claussen & Co., C. G.

Reinforcing Bars
Pacific Coast Steel Corp.
Soulé Steel Co.

Reinforcing Wire Fabric
Soulé Steel Co.

Reservoirs, Steel
Chicago Bridge & Iron Works
Western Pipe & Steel Co.

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

Road Finishers
Bacon Co., Edward R.
Blaw-Knox Co.
Jenison Machinery Co.
Lakewood Engr. Co.

Road Forms
Bacon Co., Edward R.
Blaw-Knox Co.
Heltzel Steel Form & Iron Co.
Jenison Machinery Co.
Lakewood Engr. Co.

Road Graders and Scrapers
American Tractor Equipment Co.
Austin Western Road Machy. Co., The
Bacon Co., Edward R.
Caterpillar Tractor Co.
Jenison Machinery Co.
Jumbo Scraper Co.
Robinson Tractor Co.
Shaw Excavator & Tools Co.
Spears-Wells Machinery Co.
Taylor & George
West Coast Tractor Co.
Worden Co., W. H.
Young Machinery Co., A. L.

Road Oil
Gilmore Oil Co.
Seaside Oil Co.
Shell Oil Co.
Standard Oil Co.
Union Oil Co.

Road Oil, Emulsified
American Bitumuls Co.
Shell Co.

Road Rollers
American Tractor Equipment Co.
Austin Western Road Machy. Co., The
Bacon Co., Edward R.
Huber Manufacturing Co.
Jenison Machinery Co.
Spears-Wells Machinery Co.
Taylor & George

Roofing
Paraffine Companies, Inc., The

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

Saws, Portable
Ingersoll-Rand Co.
Jenison Machinery Co.
Young Machinery Co., A. L.

Scarifiers
American Tractor Equipment Co.
Austin-Western Road Mchy. Co., The
Bacon Co., Edward R.
Jenison Machinery Co.
Le Tourneau Mfg. Co.
Robinson Tractor Co.
Spears-Wells Machinery Co.
West Coast Tractor Co.
Worden Co., W. H.

Scrapers, Dragline, Fresno, Wheeled
American Tractor Equipment Co.
Austin-Western Road Mchy. Co., The
Bacon Co., Edward R.
Jenison Machinery Co.
Jumbo Scraper Co.
Sauerman Bros., Inc.
Shaw Excavator & Tools Co.
Solano Iron Works
West Coast Tractor Co.

Screens, Sand and Gravel
Bacon Co., Edward R.
Bodinson Manufacturing Co.
Diamond Iron Works, Inc.
Haiss Mfg. Co., Geo.
Jenison Machinery Co.
Link-Belt Co.
Smith Engineering Co.
Young Machinery Co., A. L.

Screens, Sewage
Dorr Co., The
Link-Belt Co.

Screens, Vibrating
Link-Belt Co.
Smith Engineering Works

Second-Hand Equipment
Atkinson Construction Co.
Contractors Mchy. Exchange
Excavating Equipment Dealers, Inc.
Hackley Equipment Co., P. B.
Tieslau Bros.

Sewage Disposal Apparatus
Dorr Co., The
Industrial & Municipal Supply Co.
Link-Belt Co.
Wallace & Tiernan
Water Works Supply Co.

Sewer Joint Compound
Ric-Wil Co., The

Sharpeners, Rock Drill Steel
Gardner-Denver Co.
Ingersoll-Rand Co.

Sheet Piling
Pacific Coast Steel Corp.

Shovels—Diesel Engines
Atlas Imperial Diesel Engine Co.

Shovels, Electric, Gasoline, Steam
American Hoist & Derrick Co.
Bacon Co., Edward R.
Bucyrus-Erie Co.
Excavating Equipment Dealers, Inc.
Harnischfeger Sales Corp.
Harron, Rickard & McCone Co.
Industrial Brownhoist Corp.
Jenison Machinery Co.
Link-Belt Co.
Marion Steam Shovel Co.
National Equipment Corp.
Northwest Engineering Co.
Ohio Power Shovel Co.
Orton Crane & Shovel Co.
Spears-Wells Machinery Co.
Speeder Machinery Corp., The
St. Louis Power Shovel Co.
Thew Shovel Co., The
Young Machy. Co., A. L.

Shovels, Hand
Jenison Machinery Co.
Worden Co., W. H.

Sluice Gates
California Corrugated Culvert Co.
Water Works Supply Co.

Spreaders, Gravel, Rock and Asphalt
Bacon Co., Edward R.
Jenison Machinery Co.

Standpipes
Chicago Bridge & Iron Works
Montague Pipe & Steel Co.
Pittsburgh-Des Moines Steel Co.
Western Pipe & Steel Co.

Steel, Drill
Gardner-Denver Co.
Ingersoll-Rand Co.
Leitch & Co.
Rix Company, Inc., The

Steel Plate Construction
Chicago Bridge & Iron Works
Lacy Manufacturing Co.
Montague Pipe & Steel Co.
Pittsburgh-Des Moines Steel Co.
Western Pipe & Steel Co.

Steel, Structural
Pacific Coast Steel Corp.
Western Iron Works
Western Pipe & Steel Co.

Street Sweepers, Sprinklers, Flushers
Austin Western Road Machy. Co., The
Jenison Machinery Co.

Steel Joists
Truscon Steel Co.

Steel Piling
Pacific Coast Steel Corp.

Steel Windows
Truscon Steel Co.

Subgraders
Bacon Co., Edward R.
Blaw-Knox Co.
Lakewood Engineering Co.

Swimming Pool Equipment
California Filter Co., Inc.

Tamping Rollers
American Tractor Equipment Co.

Tanks, Air Compressor
Ingersoll-Rand Co.
Lacy Manufacturing Co.
Rix Company, Inc., The
Western Pipe & Steel Co.

Tanks, Corrugated
California Corrugated Culvert Co.
Western Pipe & Steel Co.

Tanks, Elevated Steel
Chicago Bridge & Iron Works
Lacy Manufacturing Co.
Montague Pipe & Steel Co.
Pittsburgh-Des Moines Steel Co.
Western Pipe & Steel Co.

Tanks, Oil Storage
Chicago Bridge & Iron Works
Lacy Manufacturing Co.
Steel Tank & Pipe Co.
Western Pipe & Steel Co.

Tapes, Measuring, Steel and Fabric
Lufkin Rule Co., The

Testing Laboratories
Hunt Co., R. W.

Tie Plates
Pacific Coast Steel Corp.

Ties, Redwood
Union Lumber Co.

Timbers, Redwood
Union Lumber Co.

Torches, Welding and Cutting
Oxweld Acetylene Co.
Victor Welding Equipment Co.

Towers, Transmission
Pacific Coast Steel Corp.
Water Works Supply Co.

Tractors
Bacon Co., Edward R.
Caterpillar Tractor Co.
Cleveland Tractor Co.
International Harvester Co.
Linn Mfg. Corp., Division of La France-Republic Corp.
National Brake & Electric Co.
Robinson Tractor Co.
West Coast Tractor Co.
Worden Co., W. H.

Tractor Parts
Taylor & George

Trailers—Heavy Duty
Williams Co., G. H.

Tramways
American Steel & Wire Co.
Bacon Co., Edward R.
Leschen & Sons Rope Co., A.

Transmission Machinery, Power
Bodinson Mfg. Co.
Link-Belt Co.

Transportation, Water
American-Hawaiian Steamship Co.

Trench Excavators
Austin Mchy. Corp.
Bacon Co., Edw. R.
Cleveland Trencher Co., The
Harnischfeger Sales Corp.
Jenison Machinery Co.
Link-Belt Co.
Thew Shovel Co., The

Truck Cranes
Harnischfeger Sales Corp.
Jenison Machinery Co.
Universal Crane Co., The

Trucks
International Harvester Co.
La France Republic Corp.
Linn Mfg. Corp., Division of La France-Republic Corp.
Sterling Motor Truck Co.

Tunnel Shovels
Bucyrus-Erie Co.
Harnischfeger Sales Corp.
Jenison Machinery Co.
Marion Steam Shovel Co.
St. Louis Power Shovel Co.

Turbines, Hydraulic
Pelton Water Wheel Co., The
Water Works Supply Co.

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