WESTERN CONSTRUCTION NEWS

CIVIL ENGINEERING AND CONSTRUCTION IN THE FAR WEST

PUBLISHED SEMI-MONTHLY
VOLUME V NUMBER 5

SAN FRANCISCO, MARCH 10, 1930

25 CENTS A COPY
$3.00 PER YEAR

COLUMBIA RIVER-LONGVIEW INTERSTATE TOLL BRIDGE BETWEEN WASHINGTON AND OREGON THREE WEEKS BEFORE COMPLETION OF SUSPENDED SPAN; BETHLEHEM STEEL CO., GENERAL CONTRACTOR; STRAUSS ENGINEERING CO., ENGINEERS

CLOGGED MAINS-LITTLE WATER

THIS OR

Clogged water mains naturally mean a reduced supply of water in case of fire.. Some cities and towns try to shut their eyes to this fact, but it's a fact just the same . . . . .

If your mains are clogged your Fire Department will be handicapped . . . Keeping them clean by the

National Method

means less work for your Fire Department —and a better record for your Health Department too, because dirty clogged mains harbor all sorts of filth.

Our catalog will not cost you anything —and it may open your eyes to some facts that will enable you to start things moving in your city . . .

National Water Main Cleaning Company
HUDSON TERMINAL BUILDING NEW YORK CITY

THIS

CLEAN MAINS-PLENTY OF WATER

Water Works Supply Co.

501 Howard Street
SAN FRANCISCO

2326 East Eighth Street
LOS ANGELES

SEATTLE: Water Works & Power Equipment Co., White Building

Where you find a RIX you find ACTION. RIX gets things done. At the right, an action photo of one of several RIX Portables which are cutting costs and speeding up service for P. G. & E. Notice the special mounting.

SPECIAL

WHEN you've got to do a job in a *special* rush, when you get a *special* bonus for cutting contract time, when you've got to bid *especially* close, when you run up against *special* problems, then is when you appreciate a RIX "SIX" most. Its pioneer dependability. Its 26% higher efficiency. Its fighting spirit. Its capacity to stand the gaff and keep going until the job is done. RIX is the *only* Compressor equipped with a *Super-Charger*. Special mountings for special purposes. And RIX *"Express Service"* with every RIX Rig. Write for Bulletin 8-S.

COMPRESSED AIR MACHINERY · RIX · SAN FRANCISCO · LOS ANGELES

IF you need AIR you need RIX

RIX "6"

PORTABLE AIR COMPRESSORS

The *Pioneer* RIX line includes vertical and horizontal compressors in all sizes for all purposes, compressor service and supplies, and pneumatic tools. Rix Co. are also agents for COCHISE Drills, and exclusive distributors for THOR Pneumatic Tools in Los Angeles and Seattle territories.

RIX COMPANY, Inc.

400 4th St., San Francisco

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WESTERN CONSTRUCTION NEWS

DEVOTED TO CIVIL ENGINEERING AND CONSTRUCTION IN THE FAR WEST

VOLUME V MARCH 10, 1930 NUMBER 5

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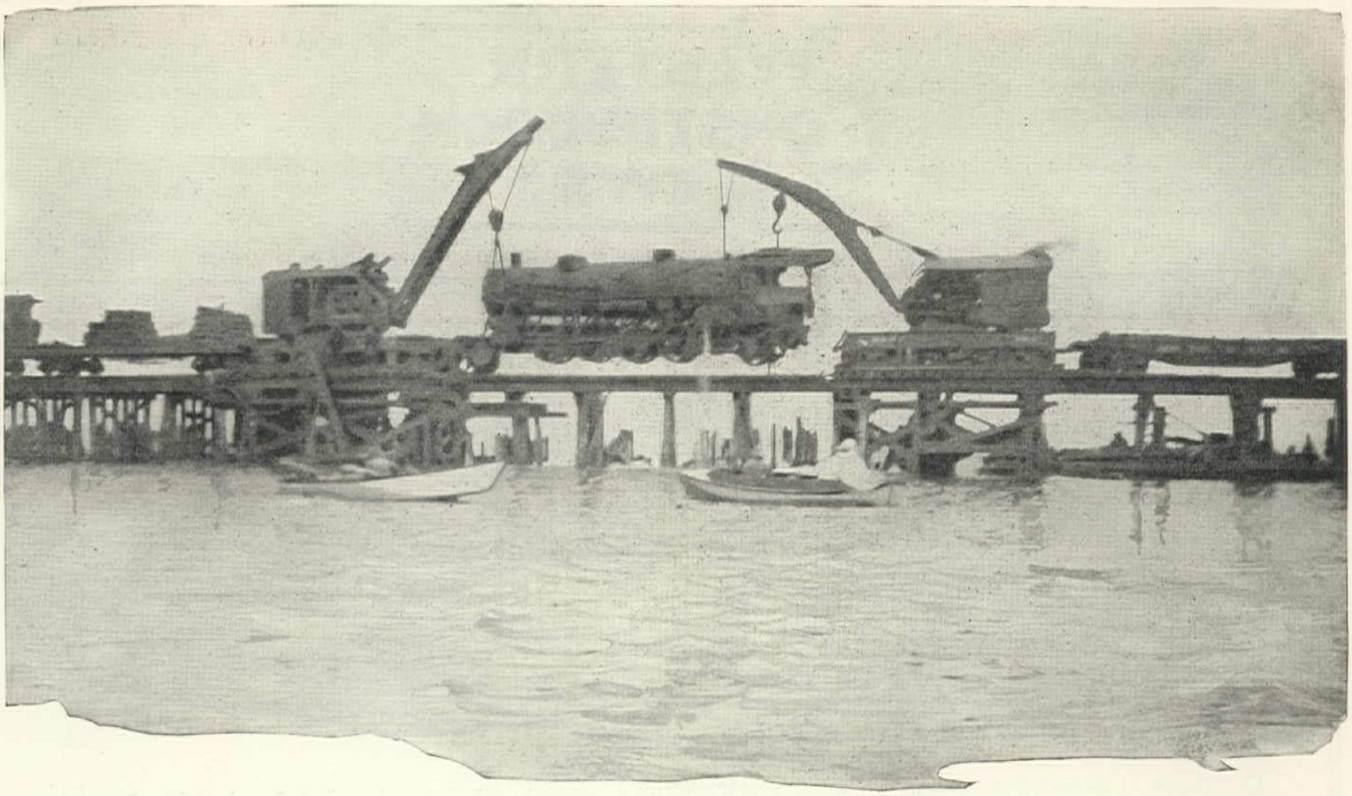

A $35,000 Job Done For $1,900

Raising a one-hundred and fifty-ton locomotive from thirty feet of water is an unusual job but an easy one for Industrial Brownhoist cranes. When bids were taken on this work thirty-five thousand dollars was the lowest price submitted, but the above cranes, with the help of a diver, did it for nineteen hundred dollars and the lift only took seven minutes.

On the unusual jobs which are constantly coming up, as well as the ordinary run of handling work with bucket, hook and magnet, Industrial Brownhoists often effect savings of time and money comparable to the above.

Because they do produce an unusually high return on the money invested, Industrial Brownhoist cranes and shovels are in use throughout the world, handling the loads of modern industry. The type and size to do your work will be gladly described to you by our nearby representative.

INDUSTRIAL IB BROWNHOIST

Locomotive Cranes 6 to 200 Tons Capacity

Crawler Shovels Cranes

Clamshells

Industrial Brownhoist Corporation, General Offices, Cleveland, Ohio

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

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is FLOOD TIME

High Waters of the Mississippi River in Louisiana

Continuous Chlorination

Will Safeguard Your Water Supply

Every Spring "old man river" starts his annual rampage—dealing death and destruction to the unprepared. With the first thaws of Spring comes his warning! . . . Will you be ready?

Will you be ready to overcome the gross pollution that the flood will bring to your water supply?

Will you be ready with W. & T. apparatus and Liquid Chlorine to destroy the microbes of disease and eliminate the danger of water-borne epidemics?

W. & T. are ready now! . . . Why wait for the flood.

"The Only Safe Water is a Sterilized Water"

WALLACE & TIERNAN

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Manufacturers of Chlorine Control Apparatus

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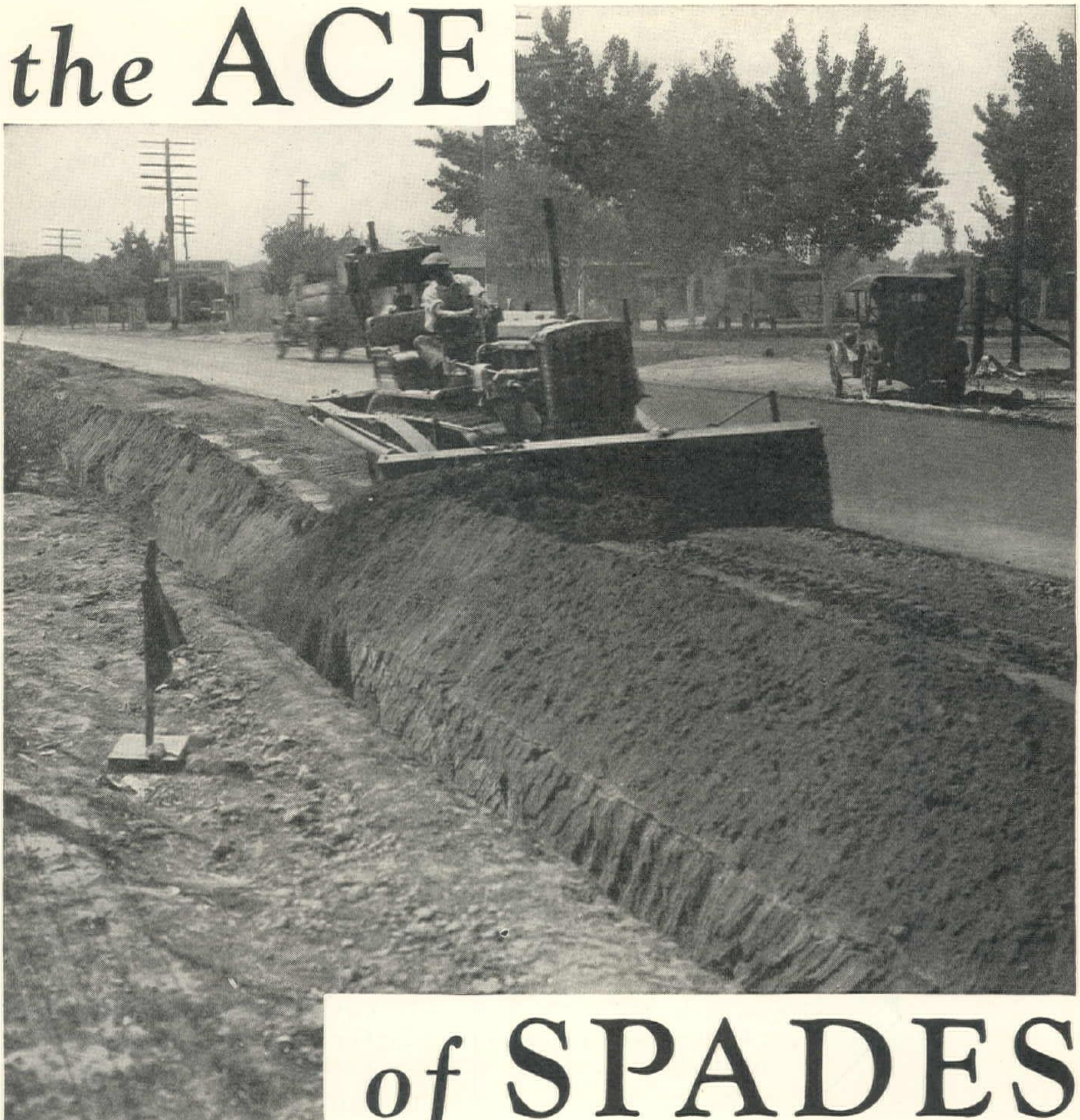
BALTIMORE, BOSTON, BUFFALO, CHARLESTON, CHARLOTTE, CHATTANOOGA, CHICAGO, CLEVELAND, DALLAS, DENVER, DETROIT, INDIANAPOLIS, JACKSONVILLE, KANSAS CITY, KNOXVILLE, LEXINGTON, LINCOLN, LOS ANGELES, MINNEAPOLIS, NEW YORK, OGDEN, OKLAHOMA CITY, PHILADELPHIA, PITTSBURGH, ROANOKE, SAN FRANCISCO, SEATTLE, SPOKANE, ST. LOUIS, SYRACUSE. WALLACE & TIERNAN, LTD., TORONTO, WINNIPEG, CANADA. WALLACE & TIERNAN, LTD., LONDON, ENGLAND

H-6

the ACE



of SPADES

THE "Caterpillar" Tractor likes a back-filling job—it proves its traction by the way it rides the soft soil; the power by the volume of earth that pours off the blade; its speed by the number of men with shovels it replaces. Back-filling after gas or water mains or cable have been laid is an ideal job for the "Caterpillar" to prove its ability to do things *better, quicker, cheaper.*

Prices—f. o. b. Peoria, Illinois

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

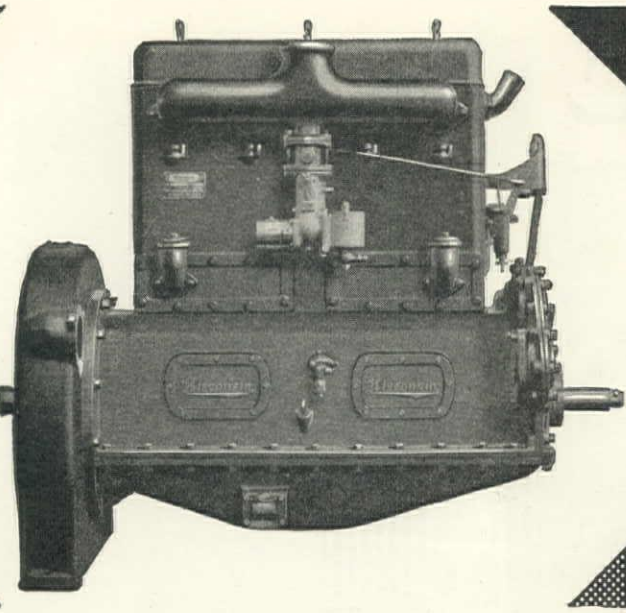
Caterpillar Tractor Co.

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

Track-type Tractors Combines Road Machinery

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

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



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Naturally
we are biased
in favor of Wiscon-
sin Engines. We believe
they are the finest engines in
the world. But that is enthusiasm
which you may not share.

So we would rather have prospective users adopt Wisconsin Engines on a basis of "self-determination" . . . We invite responsible builders of industrial machinery, trucks and tractors to put a Wisconsin Engine on their own test blocks . . . check the performance rigidly . . . let the engine do its own selling. For what we say doesn't matter . . . but the engine's performance *does.*

Do you want an engine to test? Acquaint us with your power problem, and the test can be arranged easily.

Built in a full range of Sixes and Fours, from 20 to 150 h.p., for industrial machinery, trucks and tractors.

Wisconsin Motor Co.
Milwaukee
Wisconsin

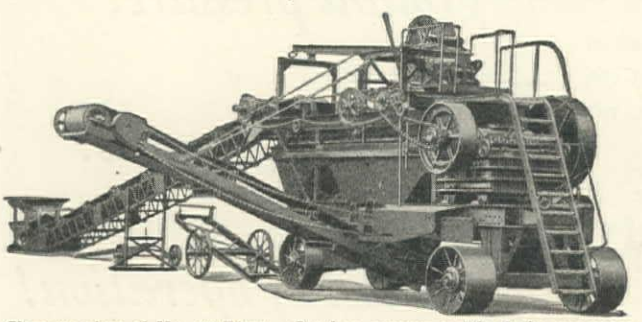
WISCONSIN ENGINES

MORE *per* CUBIC INCH POWER

PIONEER GRAVEL EQUIPMENT

"Setups" to Fit Your Job

We have been making Screening, Crushing and Loading plants for fifteen years, perfecting every little detail and sparing no expense to give you the particular "setup" to do your job. If you need our big capacity one-unit plants, we will tell you so and show you why. If a simpler and less expensive one will do, we'll recommend that. But whatever screening, crushing or loading problem you have, there's a "Pioneer" setup to fit it.



Close-up view of No. 12 Plant. Crushes, screens and loads in one operation, one handling of pit-run gravel. Powered by 60 H. P. gasoline engine or by steam or electric motor. Capacity 350 to 500 cubic yards in 10 hours. Equipped with sand ejector.

Write for new 80-page catalog with 28 blue print setups of Pioneer Gravel Equipment.

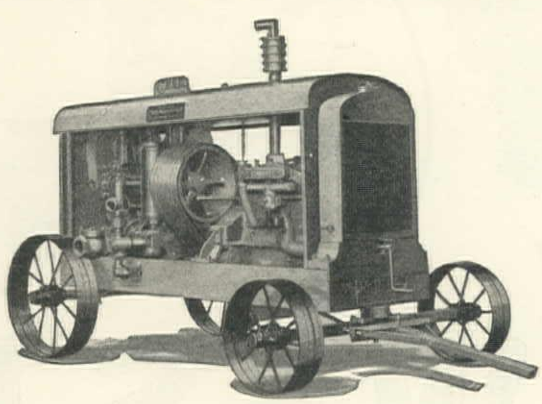
We manufacture a complete line of 11 different sizes of Crushing and Screening Plants, also Loading Plants, Drag Lines, Storage Bins, Conveyors, Shakers, Revolving Screens, etc.

PIONEER GRAVEL
EQUIPMENT MFG. CO.
MINNEAPOLIS :: MINNESOTA

HARRON, RICKARD & McCONE CO.
1600 Bryant Street, SAN FRANCISCO (SINCE 1875) 2205 Santa Fe Avenue, LOS ANGELES

C. H. & E.

NEW No. 11 TRIPLEX PUMP

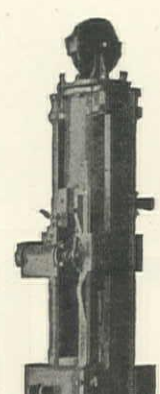


WHY THE C. H. & E. NEW 1929 TRIPLEX PUMP IS BETTER

Forged Steel Crank Shaft. Texrope Drive. Crank Shaft Roller Bearings. Steel Gears. Special Metal Valves. Welded Steel Truck Frame. Silent and Smooth-Running. No Vibration or Clashing of Gears.

Capacity 80 Gallons Per Minute—500 Pounds Pressure.

WARRINGTON VULCAN PILE HAMMERS



are designed in accordance with the best engineering principles to drive the most piling in the shortest time with the least damage to the piling and the least wear on the machine.

Catalogue furnished on request

Harron, Rickard & McCone Co.

Since 1875

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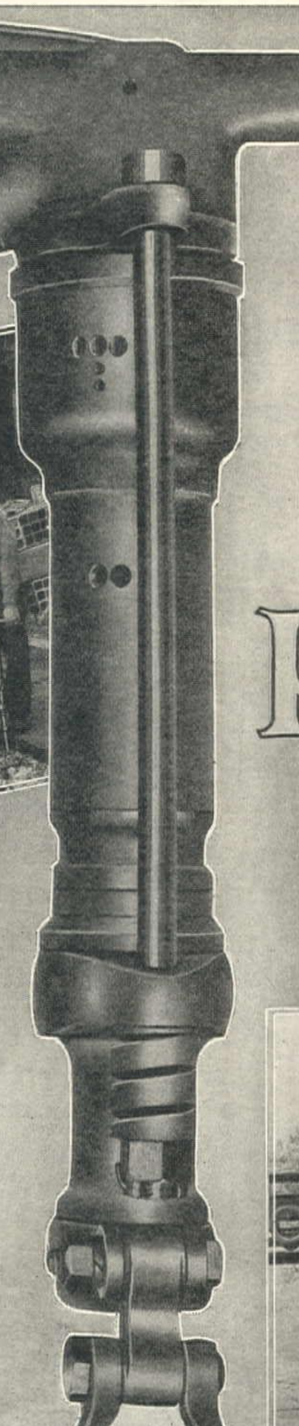
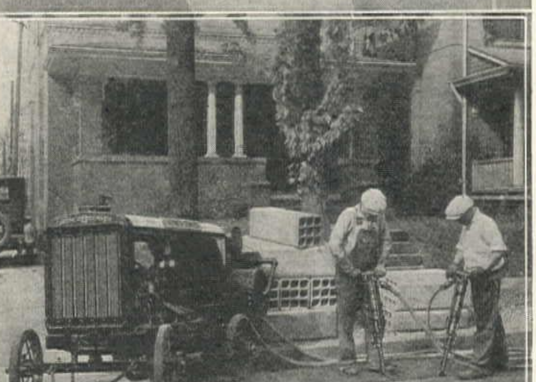


A New GD POWER TOOL

MODEL 415 is a new Lightweight Power Tool weighing 47½ lbs. which is particularly adaptable for loosening paving and Belgian blocks, for breaking paving and concrete in street railway repair work and demolition work where it is necessary for the operator to hold the machine in a horizontal position, which would be impossible with the heavier machines. Also, it is especially efficient as a heavy power spade in caisson work where the formation is hard and lighter spades are not suitable.



WRITE FOR BULLETIN

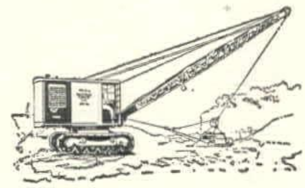
GARDNER-DENVER COMPANY
ROCK DRILL DIVISION
DENVER, COLORADO
Sales Offices Throughout the World

GARDNER-DENVER

When writing to GARDNER-DENVER COMPANY, *please mention Western Construction News*

CONSIDER THESE FACTS

BEFORE YOU BUY A 1/2 YARD SHOVEL



DO YOU KNOW that you can buy a 1/2-yard gasoline, Diesel or electric shovel, crane or dragline from the world's largest builders of excavating machinery? Built, in every way — materials, workmanship, design — to the same high standards as the big, powerful, rugged quarry and coal stripping shovels. - - - Born of actual field experience with over 10,000 machines operating in all classes of excavation in all parts of the world.

Write for bulletin

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

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

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

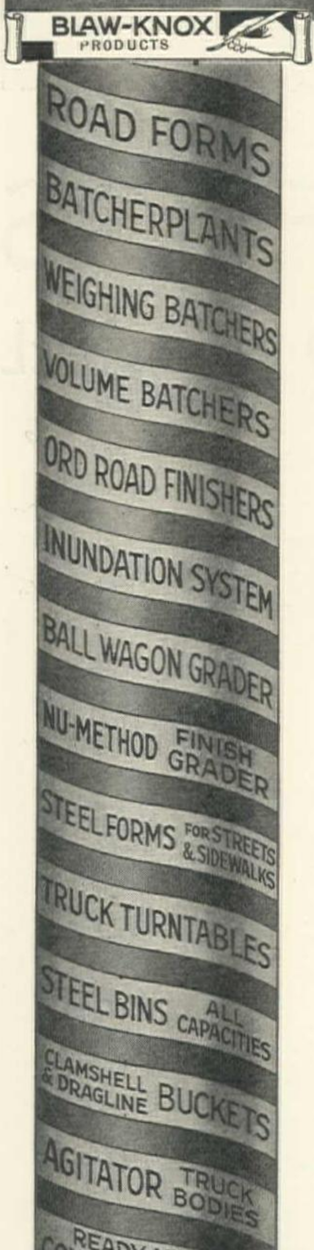
A-28-3-10-30-WCN

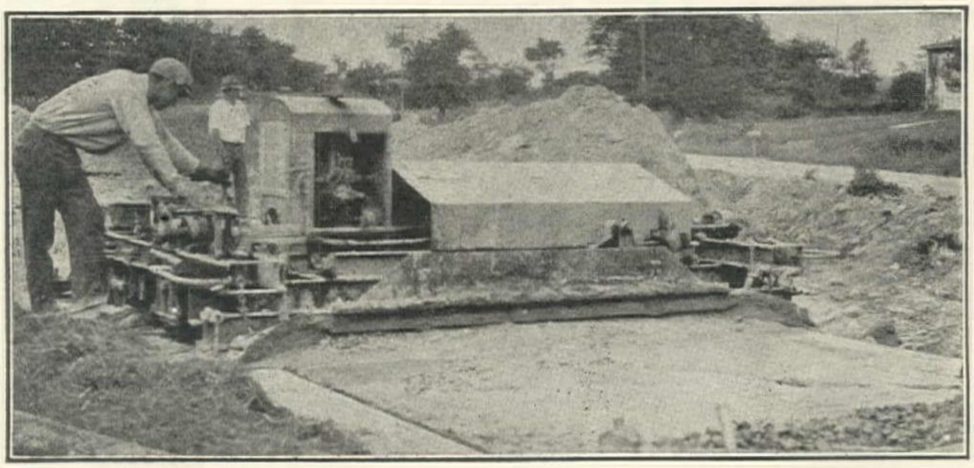
BUCYRUS ERIE

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

Dipper, hydraulic and placer mining dredges.

ORD - the original Double Screed finisher





The popularity of the ORD ROAD FINISHER is ever increasing as hundreds of contractors attest to its low maintenance cost. No ORD has ever worn out.

The DOUBLE SCREED ACTION ***spreads*** and ***kneads*** the concrete into place---producing a ribbon-smooth job.

Bulletin No. 6 will tell you all about the ORD ROAD FINISHER. Write for your copy to—

BLAW-KNOX COMPANY
2089 **Farmers Bank Building, Pittsburgh, Pa.**

New York	Philadelphia	Cleveland
Chicago	Birmingham	Detroit
Boston	Buffalo	Baltimore

Smith Booth Usher Co., 1910 Santa Fe Ave., Los Angeles
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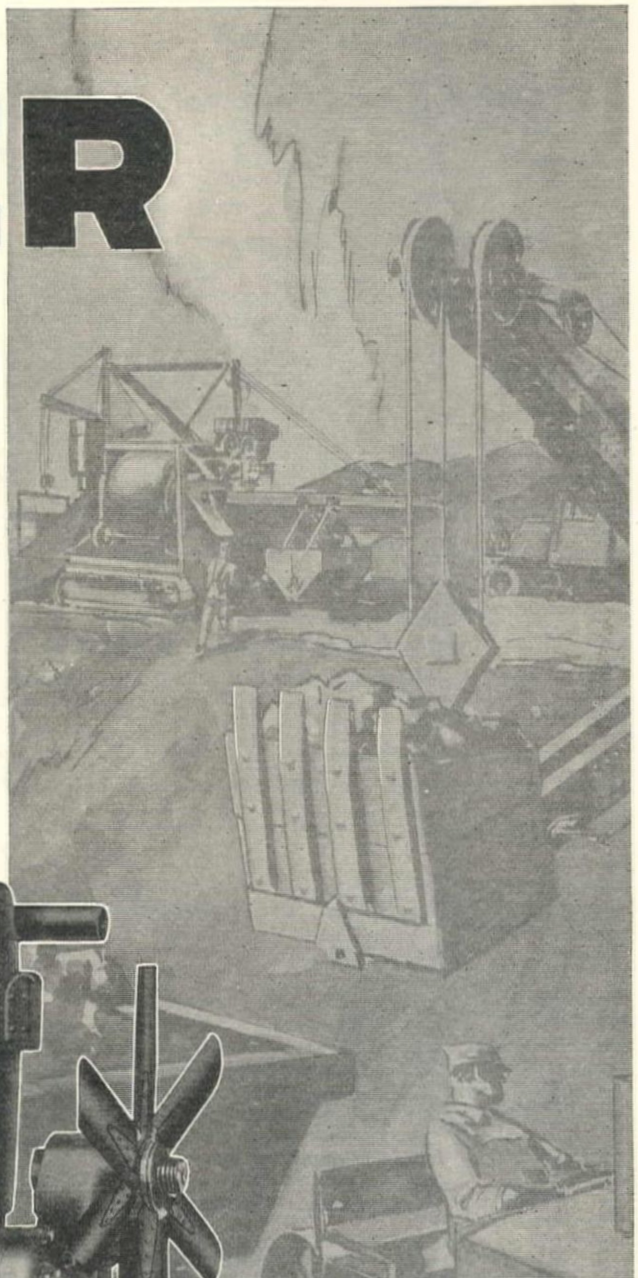
Garlinghouse Bros., 16th St. and Santa Fe Ave., Los Angeles

20

BLAW-KNOX

SMOOTHER POWER

THAT'S WHAT YOU WANT

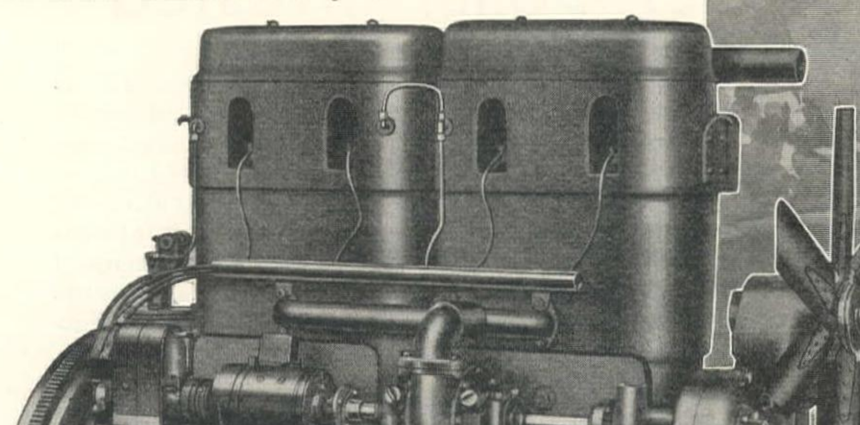


SMOOTHER POWER . . . vibrationless power bespeaks LeRoi Engine quality . . . quality in design and materials. So completely has this quality been apparent to its world-wide users, that they are now using LeRoi gasoline engines in the "toughest" of heavy duty service of manifold variety.

And LeRoi's performance bears out its staunch build . . . in road-building . . . in logging . . . in dirt-moving and hundreds of other applications. Its efficiency is told in its low operating costs . . . its ability to provide "full-measure" power under capacity load . . . and its long years of faultless service.

Those using the LeRoi Engine know of its flexibility, of its smooth acceleration and of its low upkeep costs. You can look to the LeRoi for Dependable Power . . . always!

LE ROI COMPANY, Milwaukee, Wisconsin

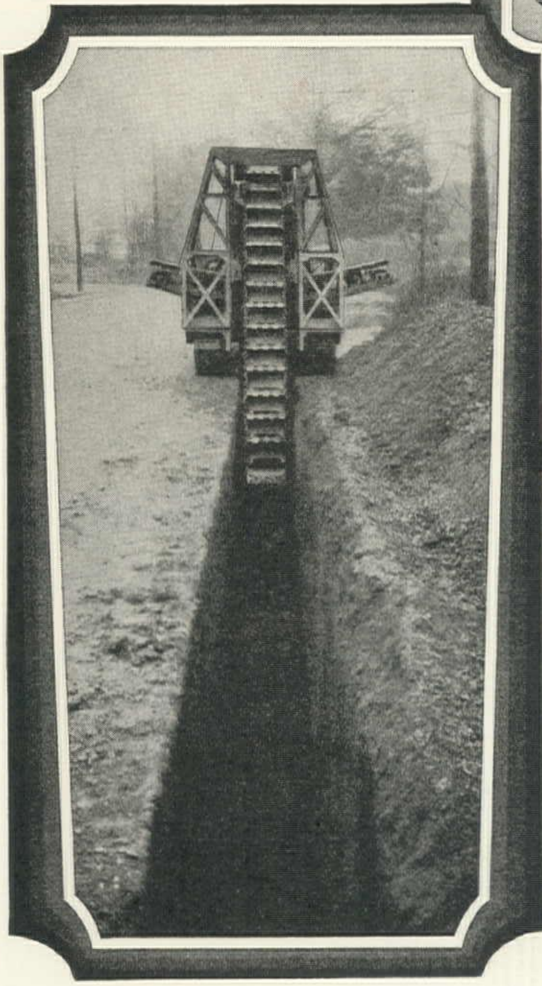


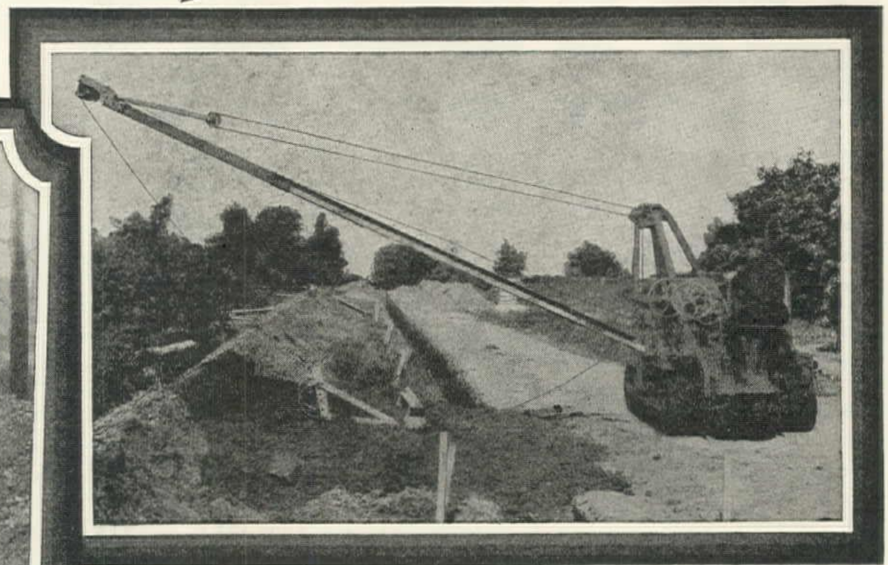
LE ROI ENGINES

FOR DEPENDABLE POWER

When writing to LE ROI CO., *please mention Western Construction News*

Consider Maintenance





Greater Earning Capacity per Dollar Invested

IN buying Buckeye equipment, you are investing in its earning power—its consistent daily all-around service and usefulness. Sensational performance has never been featured as a Buckeye sales incentive. *Every* Buckeye is sold on its characteristic ability to serve efficiently, month after month and year after year, with minimum mechanical depreciation. That's why hundreds of fifteen and twenty year old Buckeyes continue "on the job" season after season—delivering maximum production at minimum operating cost.

Buckeye Model 140 Service Trencher is small in size but big in working ability. It meets ideally the particular requirements of service line excavation. This Buckeye works efficiently in restricted areas as well as in open spaces. It operates rapidly and profitably on innumerable small main trenches. Power steering and full-length Alligator (crawler) wheels give remarkable ease of control. *Turns completely in its own length.* Two bucket line speeds and eight cutting speeds. Even at maximum digging depth, it never undercuts traction units. Safety device protects against overload. Power shifted conveyor permits instant change of delivery—without stopping the excavator. Ask for descriptive bulletin.

Buckeye Model F Service Backfiller will speed up the job and lower your costs. This handy little Buckeye supersedes and antiquates improvised backfilling methods. With overall dimensions of 69″ in width (without boom), 7′ 6″ high and weighing but 4 tons, it is easily maneuvered along restricted right-of-ways or transported from one job to another. Its adjustable-length boom has a swinging range of 160°, and is conveniently raised or lowered. "Back-action" scraper feature enables it to work from the spoil-bank side of the ditch. Equally efficient in both city and cross-country operations, it is ideal equipment for refilling small and medium-size trenches. Write for specification and performance data.

THE BUCKEYE TRACTION DITCHER CO., FINDLAY, OHIO

for over thirty years

Buckeye

Representatives:

A. L. YOUNG MACHINERY CO.
SAN FRANCISCO

The BROWN-BEVIS CO.
LOS ANGELES

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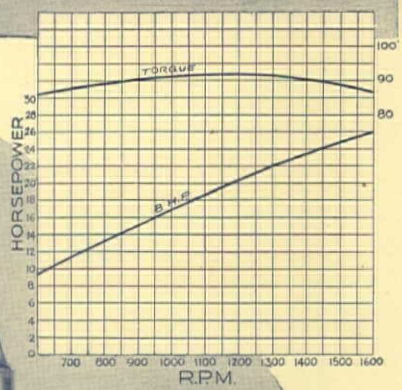
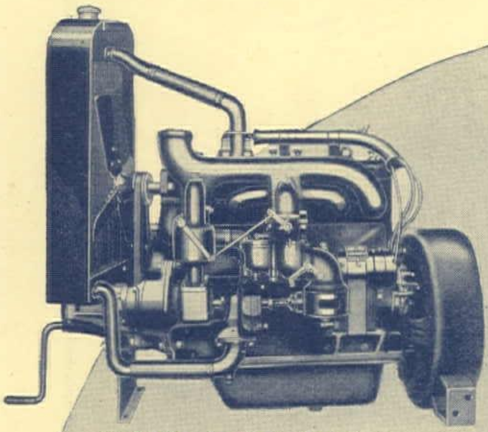
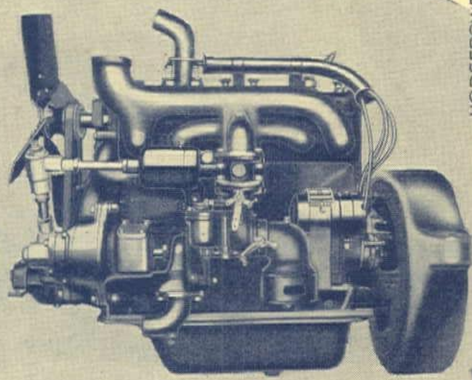
[SEE SEVEN JENISON PAGES FOLLOWING]

ENGINE SATISFACTION

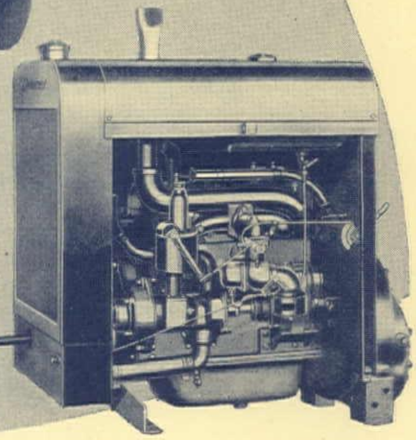




Model H9—4-cylinder Red Seal Industrial Engine with foot-type housing and radiator



Model H9—4-cylinder Red Seal Industrial Engine with Automotive type housing



Model P20A Red Seal Industrial Power Unit with Model H9 Industrial Engine

FOR SUCCESSFUL PERFORMANCE A.G.C.-A.

CONTINENTAL MOTORS Powerful as the Nation AMERICA'S STANDARD

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Colyear Motor Sales
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Colyear Motor Sales

THERE is a Continental model built for every branch of industry and transportation. Also a variety of engines specially adapted to the grueling requirements of individuals within these industries.

For example, the series above shows that Continental engines are constantly being designed to meet specific needs. Here is a separate engine for the manufacturer, jobber or user, who demands a stripped, useful accessory; one more completely assembled with foot-type mounting and a rugged, self-contained power unit. All Heavy Duty Continental Industrial engines can be furnished in these three types with an abundance of steady, economical power for daily service.

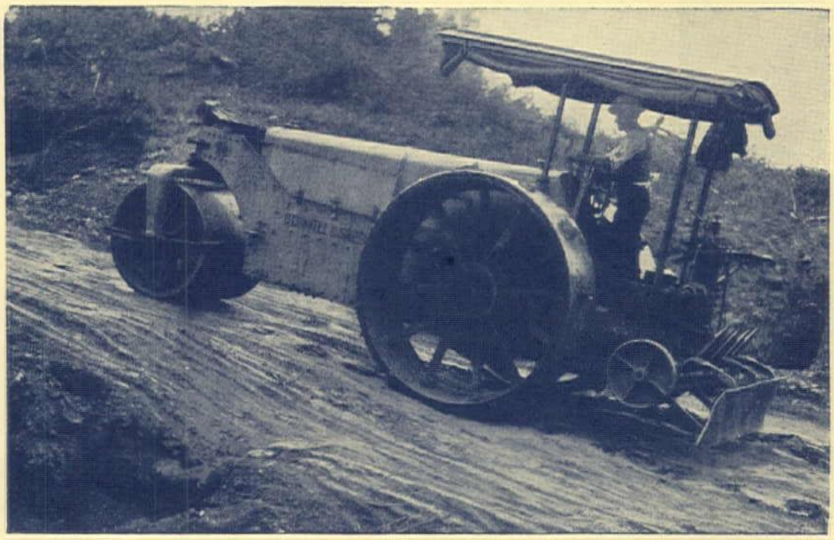
CONTINENTAL MOTORS CORPORATION
INDUSTRIAL EQUIPMENT DIVISION
Office and Factory: Muskegon, Michigan
The Largest Exclusive Gasoline Motor Manufacturer in the World

Continental Engines

★ LOCAL STOCKS JENISON AND SERVICE ★

No Job too Tough for a Galion ----

The Galion Master rolling Amiesite on a street construction job. Note close-to-the-curb rolling. No hand tamping needed here.



The Galion Master rolling a steep grade into a fill. Galion Rollers have ample power to go where they are needed.

GALION Master Road Rollers have ample power to go where they are needed. The 55 H.P., heavy-duty, slow-speed Climax Trustworthy Motor used in the Galion Master was designed for heavy industrial service. The easy, positive control of the Galion Master Roller makes close-to-the-curb rolling possible.

Galion Masters have unlimited adaptability. They are used as a bull-dozer as well as a roller in making a fill; they have been tried out in every type of roller service.

The Galion Master Rollers are made in 10 or 12-ton sizes as desired, and supplied with or without the powerful and efficient pneumatic scarifier attachment.

Complete information about this and other types of Galion Road Machinery will be sent on request. Write now.

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Smith Booth Usher Company
LOS ANGELES

Feenaughty Machinery Co.
PORTLAND, BOISE, SPOKANE, SEATTLE

Brown, Fraser & Co., Ltd.
VANCOUVER, B. C.

C. H. Jones Co.
SALT LAKE CITY

Hall-Perry Machinery Co.
BUTTE, MONT.

F. Ronstadt Co.
TUCSON, ARIZ.

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FOR SUCCESSFUL PERFORMANCE · A.G.C.·A·

The Galion Iron Works & Mfg. Co.

Galion ----- Ohio

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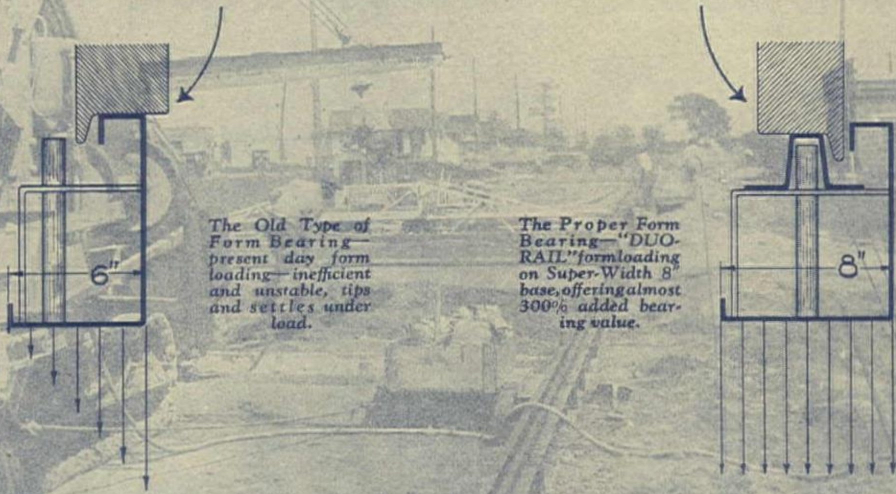
Puts the Load Where It Belongs

Not There . . . *but* . . . There



The First Fundamental Advance in Road Forms in Ten Years

THE Auxiliary rail puts the load where it belongs—over the center of the 8″ base—to give uniform loading conditions. The weight of the finisher helps to hold the form steady instead of causing it to tip. Only 100 to 125 feet of auxiliary rail is needed on each side of the finisher, the sections being carried forward as the work progresses.

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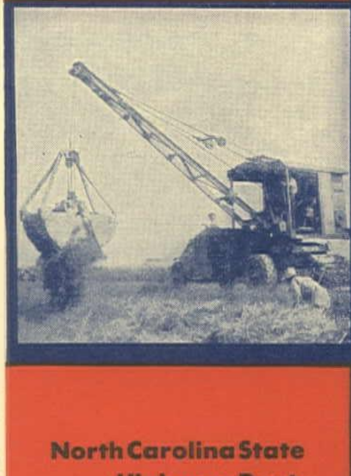

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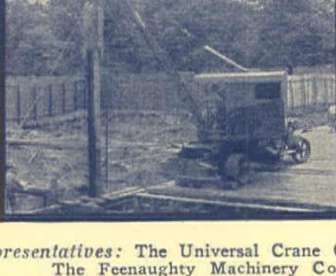

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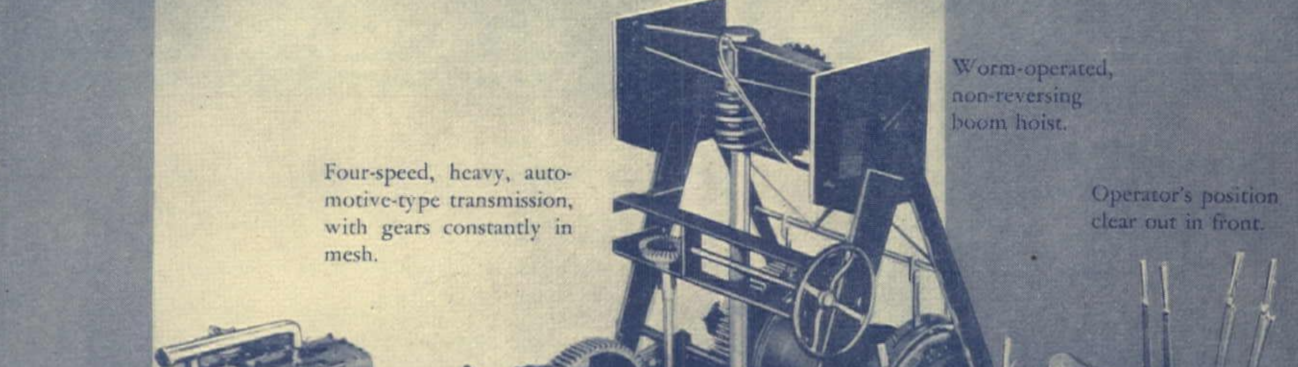

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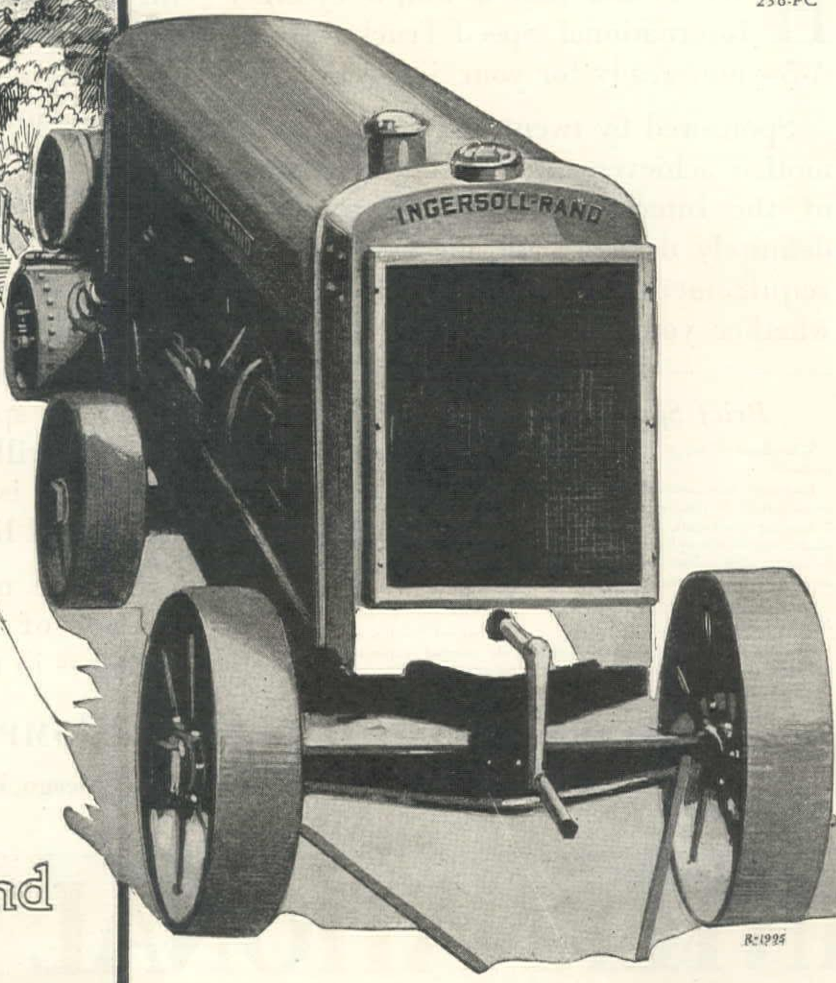
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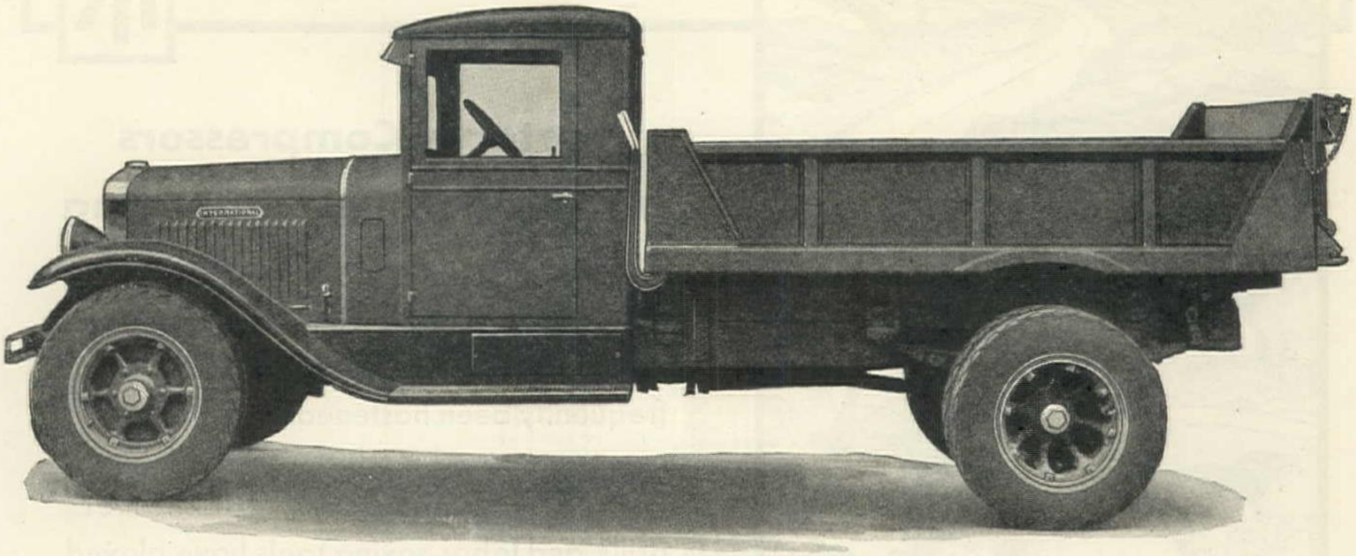

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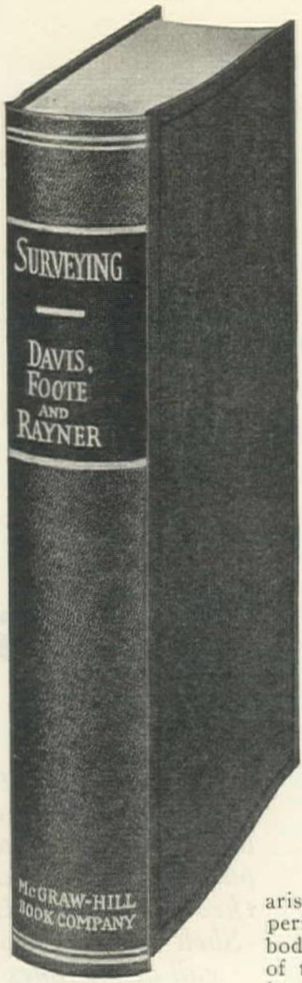

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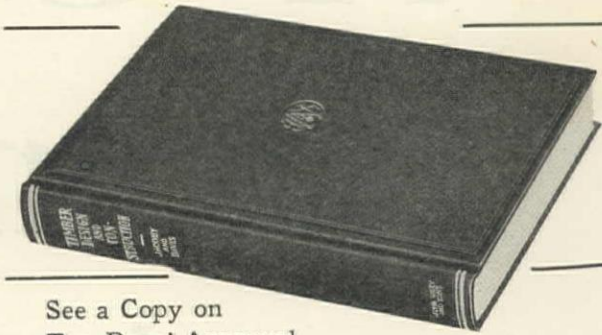

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Timber Design
AND
Construction

By HENRY S. JACOBY
Professor Emeritus of Bridge Engineering, Corneyy University

and ROLAND P. DAVIS
Professor of Structural and Hydraulic Engineering, Cornell University

Structural engineers everywhere know Jacoby's "Structural Details." The second edition, under the more appropriate title "Timber Design and Construction," has just been published, partly rewritten and brought thoroughly up-to-date by the junior author, Roland P. Davis.

The book treats thoroughly the design of timber structures by the application of the principles of mechanics and strength of materials. The authors have made every attempt to present this material in a clear and convenient form. Particular stress is laid on the details in the examples on the design of joints, beams and trusses. In several of the articles the order of design is given in full. Included are a great number of selected references to the engineering periodicals and transactions that contain illustrative material. The book contains also ten folding plates, and twenty-seven full page illustrations. Diagrams and tables are used liberally and the illustrative figures are clear and well labelled.

CONTENTS

Fastenings Used in Framing
Joints Used in Framing
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Index

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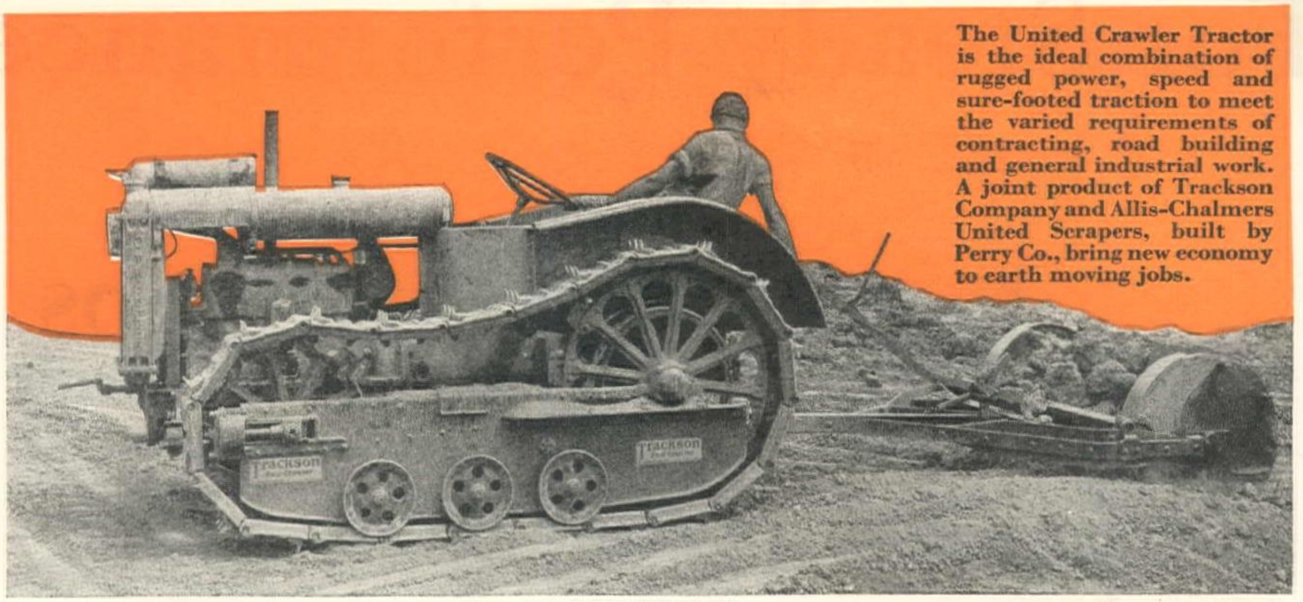

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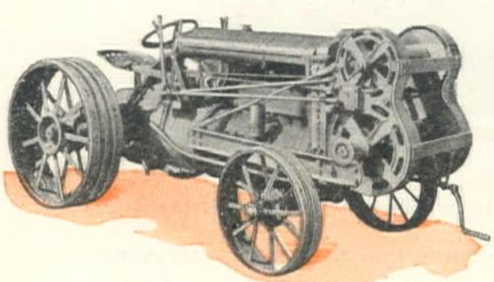

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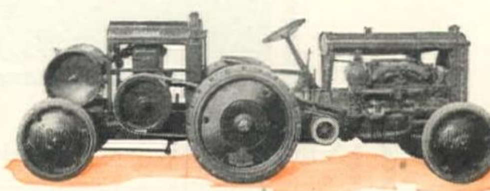

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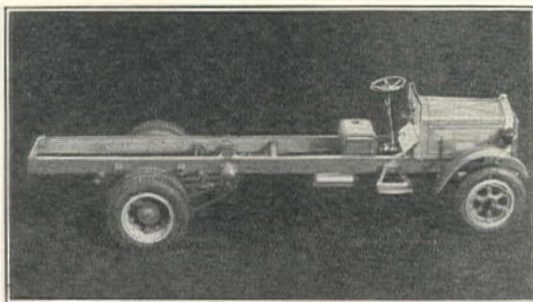

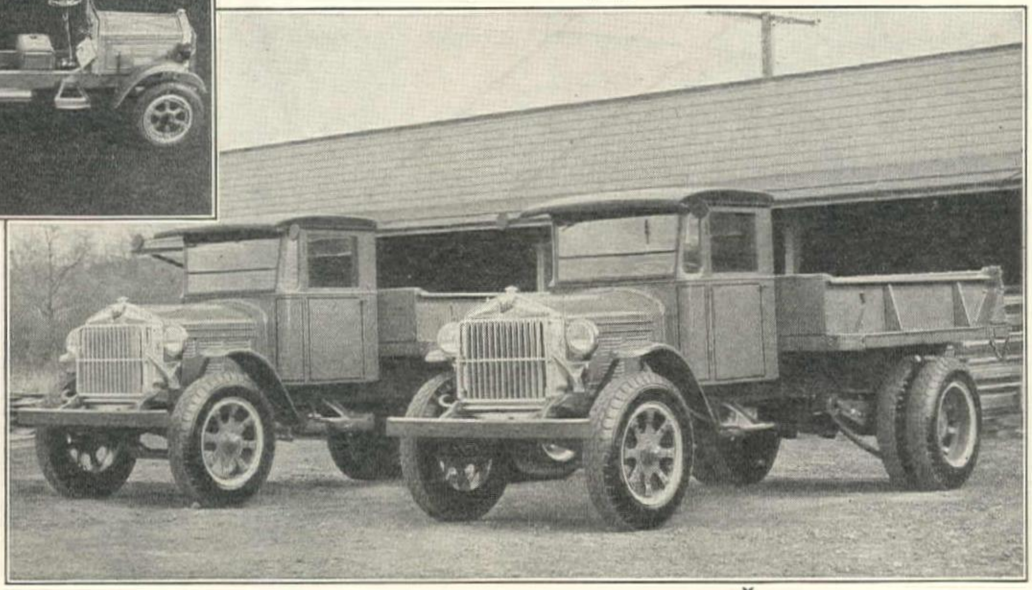

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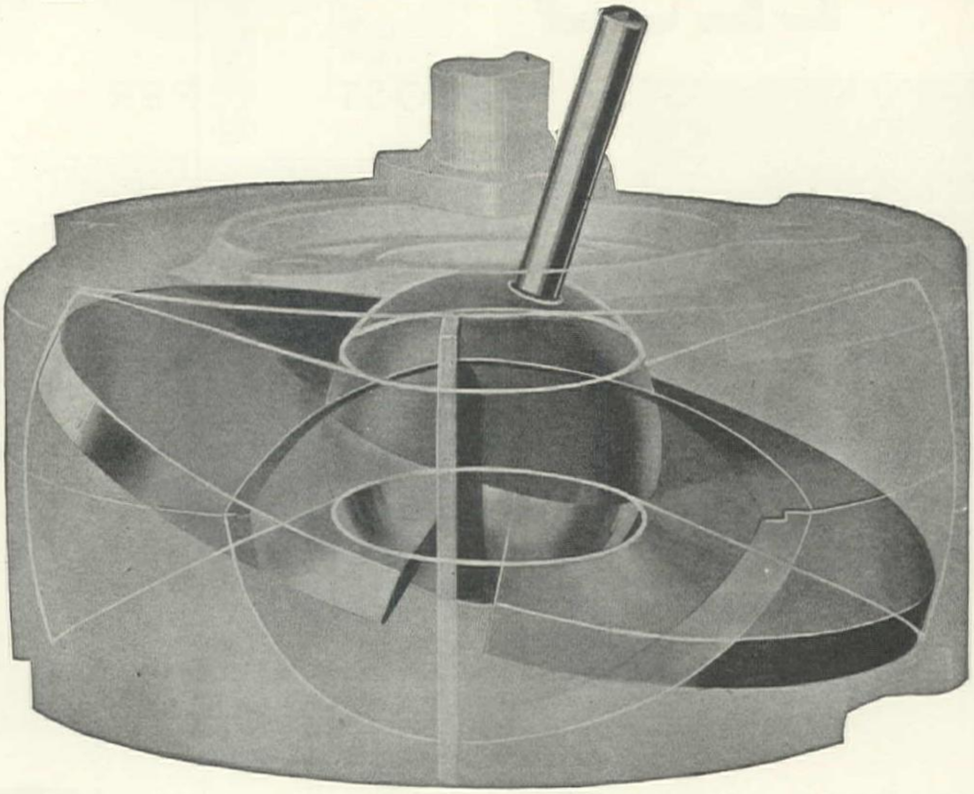

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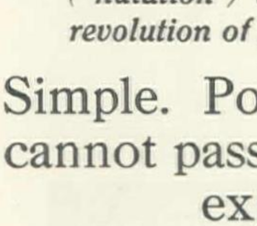

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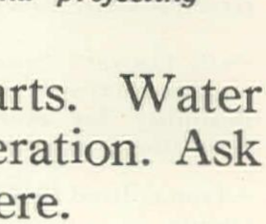

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VOLUME V | MARCH 10, 1930 | NUMBER 5

Shrinkage Cracks in Concrete

Although we know far more about the causes of expansion and contraction cracks in concrete than we did a few years ago, we have not yet solved the problem of their prevention or their control to predesigned lines.

This is particularly true of mass concrete in dams, especially in odd shaped structures such as the Coolidge dam. That some shrinkage cracks have developed in the huge massive domes of this dam (described elsewhere in this issue), is to be expected. This monolithic concrete structure, 250 ft. high, 560 ft. long on crest, is tied to the bedrock at both end abutments as well as foundation to prevent leakage. As this mass of 191,000 cu.yd. of concrete gradually cooled there was inevitable shrinkage. Cement grouting of these shrinkage cracks may prove sufficient to restore the monolithic strength and prevent leakage.

The question, nevertheless, arises in structures of this kind whether the steel in the lighter sections, such as the domes, is sufficient to resist shearing.

Incidentally, the design of a multiple dome dam, like the Coolidge, is a difficult mathematical problem. A. Floris discusses in this issue the structural design of domes with especial reference to the irregular domes of the Coolidge dam.

Drainage plus Irrigation

We had to over-irrigate and spoil a lot of land before we learned that proper drainage and aeration of soil are as important as adequate moisture. Until but recently we depended upon open ditches, supplemented with covered tile drains, to reclaim bogged areas, with occasional similar provisions on some irrigation projects.

In some irrigated areas in the far west in sandy soil, such treatment was neither feasible nor satisfactory, and pumping from wells was resorted to with better-than-anticipated results. And, as water is so precious, it was but natural that this drainage water should be conserved and re-used for supplemental irrigation.

We have previously recorded the results obtained in drainage plus irrigation by pumping from wells in the San Joaquin Valley, California, and in the Imperial Irrigation District, California, and in this issue will be found 'Deep Wells and Pumps for Drainage and Supplemental Irrigation', as developed in Idaho.

In more ways than one, successful farming must hereafter depend to an increasing degree on agricultural and civil engineers.

Riveting

Until we develop 'noiseless riveting', or more specifically welding, to the point of accepted dependability, we must continue to give close attention to the fine points of riveting. Securing the ideal in field riveting in conjunction with speed and economy is difficult—as so much depends on the human element. Many a well designed steel structure has been materially weakened, sometimes disastrously, by poor riveting.

Norman B. Green in this issue discusses the problem in its relation to 'Connection Angles Subject to Bending'—stressing the necessity for proper bolting and tightening before riveting.

Squaring the Circle

'Squaring the Circle' has been a synonym for ages for doing the impossible. Many a professor in college has worried the lowly freshman with this problem—maybe you were one of those who suffered. Now comes an engineer, R. M. Frandsen, who claims he has solved the 'impossible' after 28 years of effort. We have a number of mathematical geniuses among our subscribers, as well as many college students, to whom we submit the problem of squaring the circle (elsewhere in this issue) for verification and discussion.

Speeding up Steel Erection

Practically every big steel construction job—bridges and buildings—has been hanging up a record for speed and efficiency. One of the latest claimants to the banner is the Longview highway toll bridge over the Columbia river. On this huge structure, in spite of unusually severe winter weather, the steel fabricators and erectors completed the 12,500 tons of steel superstructure in the short period of eight months, the 1200-ft. cantilever span being closed February 13. This erection is at the rate of 50 tons per calendar day, and will enable the bridge to be dedicated and opened to traffic on March 29.

Rapid construction, when efficiently and economically performed, releases capital, reduces carrying charges, and in most cases increases convenience, comfort, and pleasure. Therefore, adequate bonuses for early completion are worthwhile—they are prizes for efficiency.

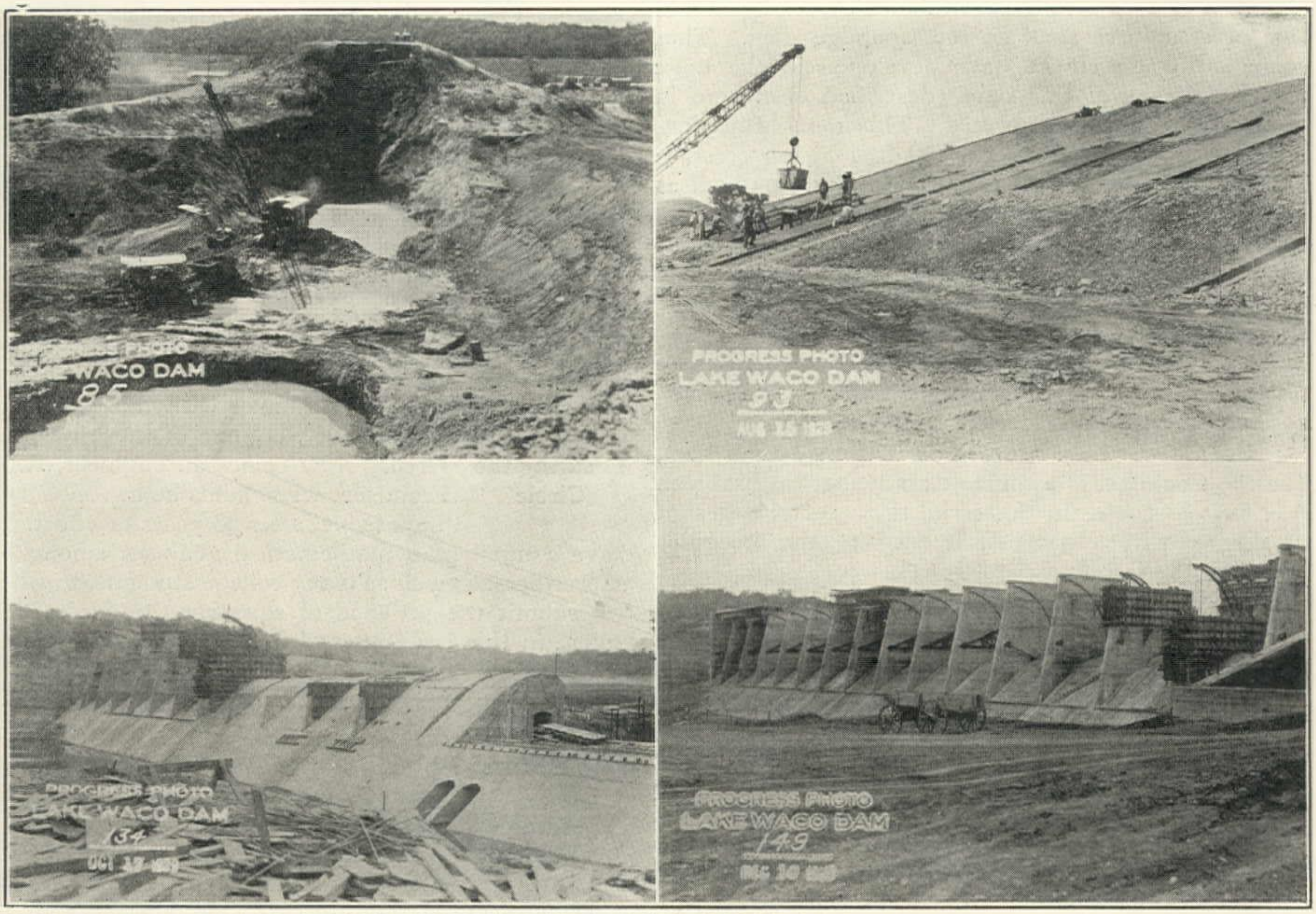
Lake Waco Water Supply Project for Waco, Texas

Earth-Fill Dam—Cast-Iron Pipe Aqueduct—Filtration Plant Additions—Elevated Tank

By O. H. FLOYD* and J. L. LOCKRIDGE*

Floyd & Lockridge, Consulting Engineers, Dallas, Texas

The city of Waco, Texas, population 65,000, began construction of the Lake Waco water supply project in the fall of 1928. This project includes a rolled earth-fill dam across the Bosque river, creating a storage reservoir 5 miles northeast of Waco; 5½ miles of pressure pipe aqueduct; a 5,000,000-g.p.d. addition to the filtration plant. There is also a 250,000-gal. elevated steel tank in the western part of the city, which is not included in the water bond issue, and is being separately built. The Lake Waco project replaces a pumping and filtration plant built in 1914 on the banks of the Brazos river (supplemented by wells), the water of which at times has excess salinity.



(UPPER LEFT) LORAIN '75' DIGGING CUTOFF TRENCH ALONG CENTER LINE OF DAM. (UPPER RIGHT) NORTHWEST DRAGLINE WITH 60-FT. BOOM PLACING CONCRETE SLOPE PAVING ON LAKE WACO DAM. (LOWER LEFT) CONSTRUCTING SPILLWAY WEIR AND TAINTER GATES. (LOWER RIGHT) SPILLWAY WEIR WITH MOST OF THE PIERS COMPLETED AND TAINTER GATES ERECTED

The W. E. Callahan Construction Co., of Dallas, Texas, is building the project under our plans and supervision. Two general contracts are required—one for the dam and one for the pipe-line and filter plant additions.

Had it not been for the fact that the region suffered from one of the hardest winters experienced in many years, the new project would have been finished about the middle of February. The final completion date is now estimated at April 15, and it appears that, despite the addition of a few items not originally considered, the cost will be $150,000 under the original estimate of $1,350,000.

Storage—The earth-fill dam on the Bosque river is 65 ft. high above streambed and 5700 ft. long on the crest, 443 ft. wide at the base and 25 ft. at the top, containing 560,000 cu.yd. of rolled and puddled material. It creates a reservoir with a surface area of 2700 acres and storage of 39,000 ac-ft., which is equivalent to about 13,000,000,000 gal. This storage, supplemented by the low water flow of the river, will supply over the

*Member, American Society of Civil Engineers.

driest periods about 19,000,000,000 gal. per year, or nearly 60,000,000 g.p.d. It is not likely that Waco will ever need this much water, but in the course of 75 to 100 years silting up will somewhat reduce the capacity of the reservoir.

Dam—Under the center of the dam is a cutoff trench, 10 to 40 ft. deep and 10 to 16 ft. base width, requiring 75,000 cu.yd. of excavation. The trench was dug through gravel to shale and backfilled with clay, using a Lorain-75 dragline. Borrow pit material was excavated with two Lorain-75s—one gas shovel and one dragline. Excavated material was loaded into 7-yd. caterpillar-type Euclid wagons, two wagons making a train. The trains were hauled by Caterpillar '60' tractors and the material dumped in windrows on the dam, that from the cutoff trench being used on the downstream toe. This windrowed material was spread with road graders, sprinkled, and rolled, excepting the core section which was crowded into a pool of water and then settled.

The upstream slopes of the dam are 2½:1, 3:1, and 4:1, and the downstream slopes 2:1, 3:1, and 4:1. The upstream slope has a 6-in. reinforced concrete face on a 6-in. blanket of gravel, and the facing terminates in a 4-ft. wave breaker wall on the upstream shoulder of the dam. The gravel blanket contains 7500 cu.yd. of material and there is 9000 cu.yd. of concrete in the face. Concrete sloping was placed with a Northwest dragline, using a 60-ft. boom, for as far as this equipment would reach. The upper part of the slope was placed by dumping concrete from 5-yd. Wichita trucks into a hopper and then running it to chutes, a central mixing plant equipped with a 1½-yd. Smith mixer supplying the concrete. After the paving was hard enough, it was covered with earth or sand and kept moistened until properly cured. The downstream slope is being sodded with Bermuda grass and this protective work will be completed by March 15.

All excavation for the dam, the embankment, the gravel blanket, and the concrete facing had been completed by February 14. The excavation and earth-fill was subcontracted by Peterson, Shirley & Gunther, of Omaha, Nebraska.

Spillway Structure—The spillway has a capacity of 170,000 c.f.s., secured by 16 tainter gates on the crest, each 25 ft. wide by 15 ft. high. The concrete weir is ogee shaped and is 445 ft. long and 20 to 30 ft. high. The spillway required 65,000 cu.yd. of excavation and 30,000 cu.yd. of concrete. A highway bridge spans the spillway, for which all but one span and the downstream guard rail had been placed by February 14.

The tainter gates will be operated by two 30-ton travelling electric hoists. All of the gates are in and it is expected that the hoists will be in operation about the middle of March, at which time storage can commence. The flow of the river as of February 14 would half fill the lake in 60 days, but this is likely to be supplemented by small floods which would fill it in a few weeks after the gates have been closed.

The Virginia Bridge & Iron Co., of Roanoke, Virginia, subcontracted the tainter gates; and Philips & Davies, of Kenton, Ohio, are furnishing the traveling hoists for the tainter gates and also the caterpillar-type gates for the outlet conduits.

Aqueduct Control Works—Leading to the conduit under the spillway are inlet and outlet channels. These are open ditches 18 to 20 ft. deep and 14 ft. wide on the bottom, side slopes 1½:1, for which 80,000 cu.yd. of excavation was required.

The service outlet is a 5 by 6-ft. concrete conduit under the south end of the spillway wall, terminating in a surge tank. Two reinforced concrete sluice conduits, each 6 ft. by 8 ft. 9 in. (arched) and 103 ft. long, are contained in the spillway section. These are controlled by Broome sluice gates, operated by electric hoists; both gates have been installed.

The river channel was closed and water diverted through the outlet structure on July 29, 1929.

Cast-Iron Pipe Aqueduct—On the upper end of the 5½-mile aqueduct—along the flatter gradient—42-in. cast-iron pipe is being laid. On the lower end of the line, 37½-in. cast-iron pipe is used. This 37½-in. pipe is manufactured by taking the outside mold for a class 'C' standard 36-in. pipe and then using a core, so as to give the necessary shell thickness to withstand high tensile stresses—the maximum head on the line being 80 ft.

It was originally planned to use 40-in. (meter size) pipe. After the contract was let, it developed that meter pipe could not be easily obtained in time to meet

Northwest Power Shovel Laying Cast-Iron Pipe for Lake Waco Aqueduct

the completion date. Accordingly, a substitution was made and the relative lengths of the two sizes of cast-iron pipe adjusted so as to give the same total loss of head as would have occurred with the meter size pipe. The pipe is being furnished by the U. S. Pipe and Foundry Co. and valves for the aqueduct are supplied by the Rensselaer Valve Co.

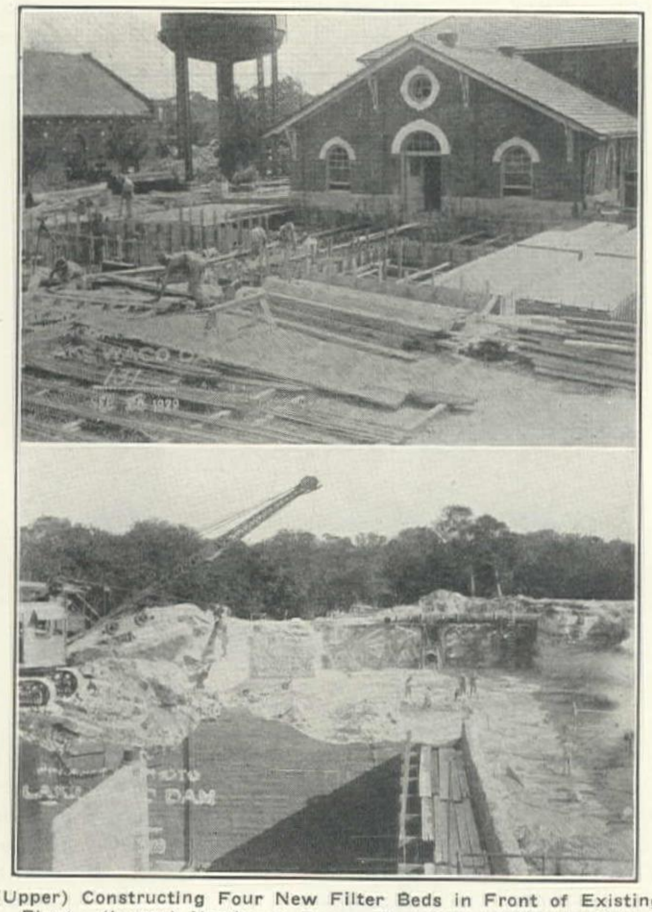
Excavation for and laying of pipe are handled by two Northwest power shovels, one equipped as a dragline and the other as a hoe. Where the trench is not too deep, all excavation is done with the hoe and the dragline is used as a crane for pipe laying. During good weather, excellent progress has been made on the pipe-line. On the record day, over 1500 ft. of pipe was laid, and on two or three days 1400 ft. was laid. Except for 1500 ft. of line in a deep rock cut 1½ miles below the dam, all pipe had been laid by February 14.

A good grade of braided hemp and Leadite is used to joint the pipe-line. Two sections, each 1½ miles long, have been tested. These show a leakage of less than one-third the allowable 150 g.p.d. per inch diam. per mile.

Filtration Plant Additions—The old filtration plant has a capacity of 5,000,000 g.p.d., which the additions will double. The new filter beds, of which there are four, are already being used, and the old ones are being remodeled. Chlorine is added to the water supply after it has passed the filters.

The sedimentation basin required 13,400 cu.yd. of excavation, mostly in soft, white limestone; and the filter plant additions contain 1750 cu.yd. of concrete. Excavation was made with the two Northwest power shovels. One end of the old filter house was removed and the building extended to take in the new filters.

Equipment for the filter plant is being furnished and installed under subcontract by E. W. Bacharach & Co., of Kansas City, Missouri. Valves for the plant are being furnished by the Rensselaer Valve Co., of Troy,



(Upper) Constructing Four New Filter Beds in Front of Existing Plant. (Lower) Northwest Power Shovel Excavating in Soft Limestone for Filter Plant Sedimentation Basin

New York. The Harrison Construction Co., of Waco, is doing the concrete work under subcontract.

Distribution—At the present time the per capita consumption is about 80 g.p.d. We expect this consumption to increase with the new supply, as a number of industries have private wells which are not entirely satisfactory. Also, in the summer when much of the Brazos river water is used, the present supply is not good for shrubbery and flowers.

The principal filtered water storage is in a 5,000,000-gal. reservoir in the western part of the city. This gives a head at the pumping plant of 220 ft., a fair average for most of the business district. The residence section grades from this down to 10 ft. head on some of the higher hills. This low pressure will be corrected by an elevated tank described hereafter.

The distribution system contains standard cast-iron pipe and, until recently, lead joints were used. However, Leadite is now being used on some of the newer lines. The maximum size of pipe is 24 in. and a duplicate line connects the pumping plant and distributing reservoir, part of this line being 16 in. and included in the new improvement.

Elevated Steel Tank—A 250,000-gal. elevated steel tank is being erected on a hill in the western part of the city to give adequate pressure for a large residence section which is now under a head of less than 50 ft. A supply system in this district will be blocked off by valves and the water pumped from the main reservoir into the elevated tank. This tank will give a minimum head on the highest ground of 110 ft. A contract for the tank was let to the Chicago Bridge & Iron Works who began erection February 15; it will be completed by April 15.

This particular improvement, when completed, will cost $40,000, and will be paid for from water revenues rather than from the bond issue for the Lake Waco water supply project.

Personnel—The entire water department is handled by an elective water board of five persons, of which Cecil C. Shear is chairman. W. H. Deaton has for a number of years been superintendent of water. He was able to supply us with an excellent set of records which was valuable in the early studies. T. C. Shuler is resident engineer for Floyd & Lockridge and S. E. McCullough is superintendent for the W. E. Callahan Construction Co.

Editor's Note—Previous information on the Lake Waco project has been published in **Western Construction News** as follows: unit bid summary on the earth-fill dam and structures—December 10th, 1928, issue, p. 32; unit bid summary on the cast-iron pipe aqueduct and filtration plant addition (p. 46) and a progress article by Floyd & Lockridge (p. 294)—June 10th, 1929, issue.

C.S.W.A. 1929 Journal

The 1929 Journal of the California Sewage Works Association, underwritten and published by **Western Construction News, Inc.**, has been completed and mailed to the 226 members and many other people.

Railroad Extension on Olympic Peninsula

It is expected that the Olympic extension of the Northern Pacific-Union Pacific railroad from Moclips, Washington, north, will be contracted during the spring of this year. The extension would cost $6,400,000.

Longview-Rainier Interstate Toll Bridge Completed

Suspended Span on Main Cantilever Closed February 13—Dedicated on March 29—Opens Short Route Across Columbia River Between Washington and Oregon

The 1200-ft. main cantilever span for the Columbia river-Longview bridge connecting Longview, Washington, and Rainier, Oregon, was closed on February 13, eight months after superstructure erection began.* The roadway surface is now being placed and the bridge dedication is scheduled for March 29 at 2 p. m.

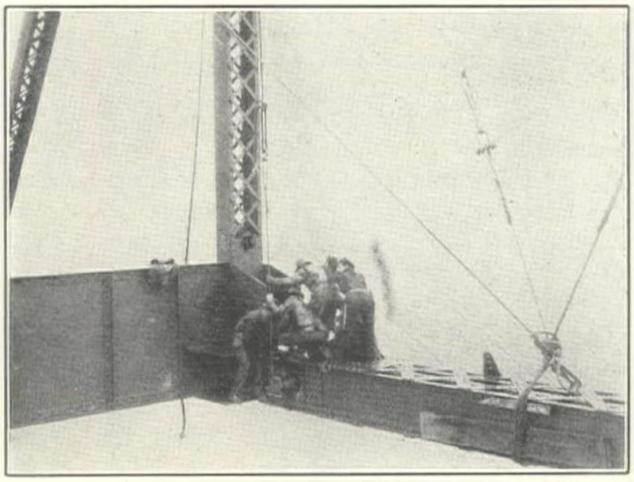
An elaborate program will be sponsored by Longview and President Hoover has agreed to assist in the dedication by pressing the key which will symbolize the official opening of the bridge. The governors of four Pacific coast states and the premier of British Columbia will attend the ceremonies.

Need of Bridge—The bridge is the only structure across the Columbia river within 100 miles of its mouth and is half way between Portland and Astoria. It forms an important connecting link in the Pacific highway extending from Vancouver, B. C., to Tia Juana, Mexico. This highway will eventually be extended north into Yukon Territory via Fairbanks and to Circle City in the Arctic Circle; the southern extension ending at Mexico City.

To reach Tacoma, Seattle, and Vancouver, residents of Northwestern Oregon have until this date been obliged to ferry across the Columbia or to use a 106-mile detour. The bridge brings the ocean beaches of Oregon 100 miles closer to western Washington, including Puget sound, and the west-side Columbia river highway between Rainier and Portland is made accessible to motorists.

The completion of a 12-mile section of highway between Rainier and Vernonia, Oregon, will shorten the direct route via the bridge between the Pacific Northwest and California.

Physical Features—The bridge is 8192 ft. long, including wooden approaches, and has a maximum height from top of steel to mean low water of 330 ft., with a clearance of 196.5 ft. for the cantilever span. The Washington approach is 2618 ft. long and the Oregon approach 1754 ft. long. Besides the 1200-ft. cantilever span—which includes a 440-ft. suspended span—there are two 760-ft. anchor arms and steel deck spans joining the main bridge to the timber approaches.



Connecting a 28-ft. Chord to Close 1200-ft. Cantilever Span of Columbia River-Longview Bridge on February 13

CLOSING SUSPENDED SPAN ON COLUMBIA RIVER-LONGVIEW BRIDGE

Substructure—Pier construction was begun during October, 1928, and included four major piers—two for the deep waterway and two at the shore ends of the

*A description of the bridge, with a list of equipment, and construction methods and progress on piers, was published in the August 10th, 1929, issue, p. 402.

anchor arms; five smaller piers on the Oregon side; and four pedestal piers carrying a steel tower on the Washington approach.

The main channel piers, No. 2 and 3, have bases 84 ft. square, supporting four concrete pedestals which are topped by a shaft and bent structure. A concrete slab resting on the bent structure carries a 165-ft. steel tower. The top of both piers is at elev. +30 ft.; the base of pier 2 resting at elev. –75 ft. and that of pier 3 at elev. –60 ft.

There was 124,000 cu.yd. of excavation; 25,000 cu.yd. of concrete; 350 tons of reinforcing and 163 tons of structural steel; 1000 M f.b.m. of timber cribbing; 10,000 cu.yd. of riprap; and 436 piling in the substructure. About 20,000 cu.yd. of concrete was tremied, the remainder being placed in the dry after cribs had been unwatered.

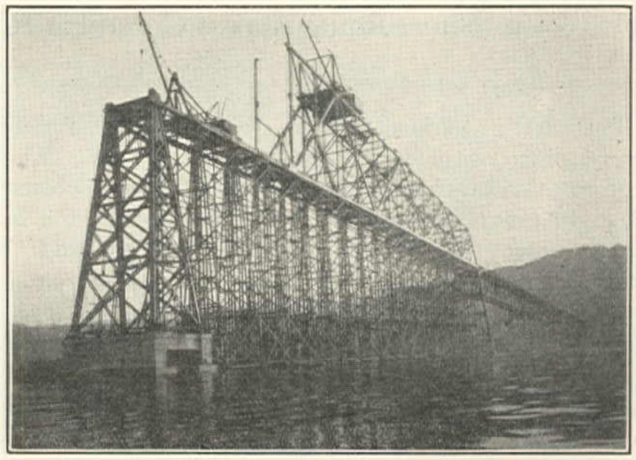
Steel Superstructure—The superstructure contains 12,500 tons of steel. The smaller steel spans were erected on falsework with a traveler operating on the floor level. The two main towers (on piers 2 and 3) were erected by the traveler on the bridge floor, while the two 760 ft. anchor arms were erected on wooden falsework, using a 1-boom traveler on the floor and a 2-boom traveler on the top chord.

The Final Chord, a 28-ft. Deck Span on the Columbia River-Longview Bridge. Erection of 12,500 Tons Superstructure Steel Completed in 8 Months. Enoch Gerrick, Steel Foreman, in Foreground, and J. H. Pomeroy of J. H. Pomeroy & Co., Erectors, in Background

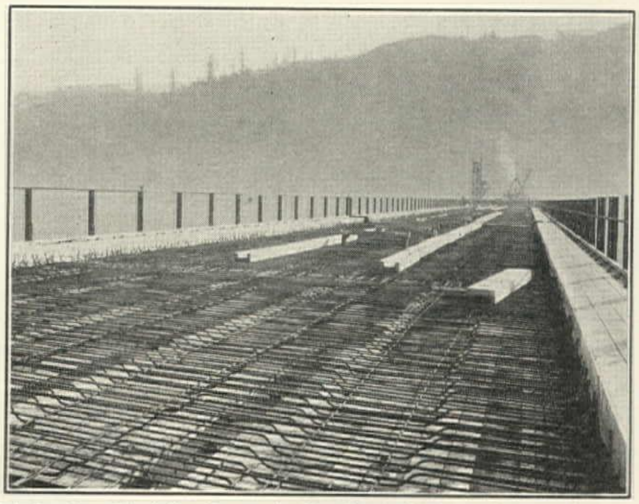
For the main span, the two 380-ft. cantilever arms were erected by the traveler operating on the top chords, steel being hoisted from the river at the piers and sent out to the top derrick over the material track on the bridge floor. A 440-ft. suspended span was cantilevered out from both arms and closed in the center by eight 500-ton hydraulic jacks. Slotted holes in the chords and diagonals at the center and in the chords at each end allowed adjustment by jacking to the final position.

Decking—As a light weight deck was desired, tests of many materials were made and a volcanic cinder from the Bends (Oregon) was selected for coarse aggregate. The roadway deck is a reinforced concrete slab, 1:1:2 mix, 6¾ in. thick and 27 ft. wide, and there are two 3-ft. sidewalks.

Financing, Engineering, and Construction—The structure is privately owned by the Columbia River-Longview Bridge Co., of which W. D. Comer, Seattle, is president; Wesley Vandercook, Longview, secretary; and Joseph Strauss, Chicago, chief engineer. It was financed through the sale of bonds by J. & W. Seligman, New York City, and Bradford, Kimball & Co., San Francisco, and is to cost $5,800,000.


Constructing Anchor Arm on Oregon Side, Columbia River-Longview Bridge, October 22, 1929

Design and supervision of construction is handled by the Strauss Engineering Corp., with J. B. Strauss, president and chief engineer; C. E. Paine, vice-president in direct charge of field work; J. S. Watson, resident engineer; and John Zoss, assistant resident engineer. D. N. Wetherell was the resident engineer until illness removed him from the work.


Reinforcing Steel for Concrete Roadway Slab on Oregon Approach to Columbia River-Longview Bridge

The general contractor is the Bethlehem Steel Co., whose engineer is G. F. Beckerley of the San Francisco office. The subcontractors include:

Substructure—Pacific Bridge Co., Portland.

Pile driving—Hart Construction Co., Longview.

Timber approaches and concrete floor deck—Lindstrom & Feigensen, Portland.

Roadway grading—Henry Niblett, Longview.

Steel fabrication—Wallace Bridge & Structural Steel Co., Seattle.

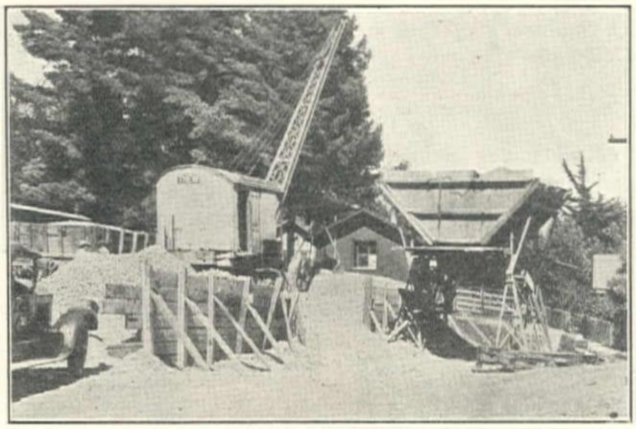
Steel erection—J. H. Pomeroy & Co., Seattle.

Fenders—F. S. Booth & Co.

Bond Issue Roads, Marin County, California

Across the Golden Gate from San Francisco, and forming the north headland of that passage, lies Marin county. So great are the endowments of nature, it is familiarly known as 'Marvelous Marin'. It is the gateway county of the famed Redwood Empire which extends far to the north; but within its own boundaries, Marin county offers a diverse scenic background of mountain, forest, field, and stream, with the ever interesting ocean shore.

With a lack of adequate highways, the beauty spots of Marin county were inaccessible and therefore lost to visiting motorists. Even communication within the county was made over the obstacle of bad roads.



Thew Type 'O' Gasoline Crane with 40-ft. Boom and 1-yd. Owen Bucket Unloading Rock for Whites Hill-Point Reyes Highway. Bunker Equipped with Johnson Weighing Batcher

Now, however, work is progressing to eliminate that obstacle.

Improvements Made—Were the county to delay construction until funds accrued from the regular sources of income, it would be many years before the amazing benefits of good roads would be apparent. Rather than delay progress for such a period, the county board of supervisors submitted a bond issue to the voters, thus to have the roads and let the benefits help pay for them. It has been known for a long time that increased travel brings increased revenue and prosperity, and Marin county is more than confident that it is making a good investment.

In 1925, bonds were voted for $1,225,000 to improve needed sections of the county highway system. The most important projects selected by the supervisors were 6½ miles on the Novato-Hicks valley road and 14 miles on the Whites Hill-Point Reyes highway. Both of these roads are paved with portland cement concrete, making more than 20 miles of this type built by bond issue to date. About 8 miles of other types of surfacing has been laid on additional projects.

The Novato-Hicks valley road, completed in 1927, serves a farming community largely given to the production of fruit, dairy, and poultry products.

The Whites Hill-Point Reyes highway* taps a section which is extremely popular as a vacation and resort district, with picturesque cabins spotted along the creeks. With the new road affording ideal motor communication, it is expected that this district will be further enhanced and greatly improved. The concrete pavement winding over the gently rolling country affords a scenic boulevard of great enchantment.

In the construction of this highway, some changes were made from the former alignment of the road, with other changes in gradient; 22,000 cu.yd. of excavation being required.

Marin county specifications for concrete pavement are up-to-date, and include the most modern application of design and construction. Material requirements are similar to those for California state highway pavement, with 6-sack mixes and a water limit of 55 lb. per sack of cement. The usual consistence is measured by the slump test, 1½ in. being allowed.

The pavement is of 8-6-8 portland cement concrete, 18 ft. wide. Joints were placed transversely at intervals of 33⅓ ft., and consist of 1-in. redwood boards cut to meet the shaped subgrade. The height of the joint is ½ in. less than the thickness of the pavement. With this design, the pavement is finished over the joint and later cut and edged along the redwood strip. Joints of this type have been in use more than two years and are serving satisfactorily.

Multifoote 27-E Paver on J. V. Galbraith Contract, Whites Hill-Point Reyes Highway

Proportioned batches of aggregate were hauled to the grade in White and Fageol trucks and a Freeman turntable was utilized on the narrow subgrade. Cement

*See progress article, September 25th, 1929, issue, p. 496.

was hauled, stocked on the grade, and dumped from bags into the skip of a Multifoote 27-E mixer. Two finishing machines followed the mixer, and these demonstrated their adaptability to work on pavement with many curves. Angle irons nailed on the top of the headers facilitated finisher operation.

Following the machine finishing, two longitudinal floats were used. One of these was operated as a planer and the other as a finish float. Considerable attention was paid to finishing, so as to produce a smooth riding road. Within exacting specifications, a maximum of 1/8-in. variation was allowed under a 10-ft. straightedge. Following the finishing of joints and edging along the headers, the pavement was covered with burlap for initial protection. The final curing was accomplished by ponding and earth cover, the pavement being kept wet for 14 days.

The finished pavement is regarded as one of the smoothest riding highways in northern California. J. V. Galbraith, of Petaluma, was the contractor, and E. J. Smith was his superintendent. Design, construction, and inspection were under Rodney Messner, county engineer of Marin county. The Whites Hill-Point Reyes highway was opened to general traffic on November 1, 1929.

Forest Highway Program in Washington and Northern Idaho

Allocation of $467,500 Forest Highway Funds for the Fiscal Year 1931

By W. H. LYNCH
District Engineer, District 1, U. S. Bureau of Public Roads, Portland, Oregon

Editor's Note—In the January 10th, 1930, issue, pp. 3 and 4, W. H. Lynch outlined his 1930 construction and maintenance program for the states of Oregon, Washington, and Montana. This work includes forest highway and national park projects, and federal aid participation with the several states. At that date, the forest highway program for Washington and northern Idaho had not been settled and it was announced that this information would be published in a later issue.

For the fiscal year 1931, the allocation of forest highway funds for seven projects in these areas is as follows:

Washington

Mt. Baker Highway—For the past two years the Bureau has been widening and straightening this road between Shuksan and Austin pass. The increasing demands of traffic make further improvements necessary, and $50,000 will be used to continue the work.

Baker River Route—The grading of 2 miles of this project is now under contract. For the further extension toward Baker lake and such advance clearing as is necessary to provide for future construction, $55,000 has been programmed.

Tonasket-San Poil Highway—The grading and surfacing of this section of the forest highway, from a connection with the State's work on the west to the west end of the old Republic-Wauconda project on the east, was completed last fall. To grade easterly toward Republic as far as the funds will permit, and also to extend the clearing of the right-of-way to provide for another season's construction, $80,000 has been allotted.

Randle-Yakima Route—During the past season, the grading and surfacing of this route was completed to a point 7 miles easterly from Lewis. The allotment of $92,000 has been recommended for the easterly extension of the grading and for the construction of the Clear Fork creek bridge.

Wind River Route—About 5 miles on this project has been surfaced with bank-run material, and $20,500 has been allotted to widen and resurface certain embankments and to grade and surface as much of the balance of the project as possible.

Maintenance—To carry out the obligation to maintain these highways for a period of two years following construction, $15,000 has been provided for the five Washington projects.

Northern Idaho

North & South Highway—An allotment of $80,000 has been recommended to continue the work between Emida and Harvard. It is proposed to continue the grading for 3.9 miles, to surface 6.6 miles, and to finish the clearing to Harvard.

Clarks Fork Highway—The portion of this route in Idaho has been improved as a surfaced road from Pack river to the town of Clarks Fork. From Clarks Fork easterly for 2.3 miles the improvement is under contract for grading. The $65,000 recommended will be used to continue the grading easterly to the Idaho-Montana line, a distance of 5.75 miles.

Maintenance—To carry out the obligation to maintain these highways for a period of two years following construction, $10,000 has been provided for the two northern Idaho projects.

Ariel Hydroelectric Project on Lewis River

The Northwestern Electric Co. has begun work on a 100,000-hp. hydroelectric development at Ariel on the Lewis river 13 miles above Woodland, Washington. A diversion tunnel 25 ft. diam. and 1600 ft. long, is now being driven and the construction camp is nearly completed.

The dam will be 240 ft. above river level and the maximum depth to bedrock 200 ft. The reservoir will be 12 miles long and the completed project will cost $10,000,000.

Deep Wells and Pumps For Drainage and Supplemental Irrigation Water In Idaho*

By E. H. Neal
Irrigationist, Idaho Agricultural Experiment Station, Moscow

In Idaho, as elsewhere in the irrigated region, the continual application of water has made necessary the construction of extensive drainage works to protect irrigated lands upon which from $100 to $300 per acre has been placed in water delivery systems, preparation for irrigation, and in improvements. In general, this drainage has been attempted by the use of deep open or by closed tile drains. As time passed since the early drains were constructed, it has become increasingly apparent that the results have not been as far reaching as was expected, and that while the rise of ground water in certain sections was checked, the continual application of water to higher areas still overtaxes the natural underground drainage supplemented by the artificial drainage, and more areas are becoming waterlogged each year.

Utilizing Excess Underground Water—If the excess accumulation of water underneath valuable farm lands can be removed at some place and utilized for irrigation, rather than wasted away from the land, true conservation of this most valuable resource—water—can be accomplished. Pumping the excess water to the surface with deep well pumps of large capacity then serves the double purpose of relieving the land of its excess ground-water and providing water for irrigation.

Driving Head and Westinghouse Motor for Pomona Deep Well Turbine Pump, 850-ft. Lift

Furthermore, the available supply of irrigation water is definitely limited and must be used more efficiently and must serve larger areas if agriculture by irrigation is to be extended. Drainage by artificial channels and natural underground means often results in a return flow on the lower reaches of streams. This may be more than sufficient for the adjacent lands that can be served, while shortage may exist upon the upper reaches of the same stream. Also, the considerable quantities of water discharged by drains and return flow in the non-irrigation season, as well as the water stored in the soil below the level of the drains, is not utilized for irrigation.

Operation of Deep Wells—The feasibility of pumping from underground for the dual purpose of effecting drainage and at the same time making the pumped water available for irrigation use, has been well demonstrated by experience in various irrigated areas in California and Arizona, where substantial quantities of water are taken from underground each year. In these localities, where pumping wells have been in operation for years, it has been found that wells from 12 to 18 in. diameter, cased with light steel, perforated at the water-bearing strata, and sunk to such a depth as to connect with the permanent ground-water level, have a capacity that makes operation economically feasible and are best suited to the pumping equipment available. Where the wells are not sunk considerably below the upper ground-water level to a connection with the permanent waterbearing strata, experience has demonstrated that a constant and sufficient source of water supply may be lacking.

In addition to the drainage effect and recovery of irrigation water, drainage by pumping has the additional advantage of flexibility. Plants can be placed at critical spots in wet areas, can be added to whenever necessary, and a whole system need not be installed at once. The unsightly open drain with its ugly spoil bank, cutting through farms and occupying valuable lands, is unnecessary.

An Idaho Study—In the Boise valley in southwestern Idaho, a pioneer installation of deep well pumps has been studied by the Department of Agricultural Engineering, University of Idaho, in cooperation with the Idaho Committee on the Relation of Electricity to Agriculture. In this study, particular attention has been paid to the cost and effectiveness of drainage. The group of four wells studied was the first sunk in this section and, as a result, considerable extra expense was incurred during the exploratory work necessary. This extra expense will be unnecessary as other plants are added. Furthermore, with the experimental nature of these installations, the method

*Paper presented at the 1929 meeting of the Land Reclamation Section, American Society of Agricultural Engineers, Kansas City, Missouri, December 30-31, 1929.

of development used for one well has not proven satisfactory, and as a result the yield is low.

Two of the wells are of the gravel wall type, 18 in. diam. and, respectively, 133 and 100 ft. deep. Two others are of the California stovepipe type, one 12 in. diam. and 146 ft. deep and the other 18 in. diam. and 132 ft. deep. The 12-in. well was drilled to its full diameter without first putting down test holes. As first constructed, the depth was 203 ft., with the following log: soil—0 to 5 ft.; clay—5 to 96 ft.; fine sand—96 to 146 ft.; and clay—146 to 203 ft. The casing later collapsed at the 132-ft. level, but was swedged out and 12-in. casing was placed to 142 ft. An attempt was made to gravel wall the well at the same time. The yield from this well has never been satisfactory. The failure of the well to produce water economically illustrates the necessity for careful test-hole exploration before drilling the well.

This study indicates that the first cost of the plants is from $4000 to $6000, or about $5.00 per ac-ft. produced. The cost of operation of properly designed installations runs from $0.60 to $0.90 per ac-ft. This is with a drawdown of 35 to 45 ft. and a yield of 3 to 6 c.f.s., or 1300 to 2700 g.p.m. Not all of the present plants have attained this yield; they have been experimental in character because of the absence of information upon development methods that should be employed. Data upon motor and pump depreciation and repairs are not available, but in any case these costs will not be more than a few cents an acre foot. A pump similar in construction and an electric motor used for water supply on the University of Idaho campus has run from 12 to 20 hours each day since the spring of 1921 with but one repair—a copper gasket in the thrust bearing being replaced in the spring of 1929.

In this state, exemption from taxes is allowed upon those portions of the plants and transmission lines of power companies that are used in the production and transmission of power for irrigation pumping. With this tax exemption discount and the low rate offered for irrigation pumping, the average cost per kilowatt-hour used has been 9 mills. To get this lower rate, the pumps must be operated continuously from May 15 to October 1.

The experience gained by the irrigation district with these wells has demonstrated that on account of extreme variations in underlying formations, the details of well construction—diameters and proper depths—must be carefully studied for each individual well. Properly designed pumps, experience, and good judgment, must always be depended upon to insure successful installations.

As regards the effectiveness of the drainage, the data collected have not been in sufficient detail to justify conclusions or specific recommendations. A series of observation wells was placed on lines at right angles through each of the pumping plants. Upon attempting to work with the data obtained, it became evident that ground-water levels were not observed often enough and that the observation wells are too few in number for a study to be made of the extent of the drainage affected. However, an examination of the surface indicates that from 700 to 1000 acres around each of the pumps has been effectively drained.

The first cost of a pump drainage system is substantially below the cost of the open drainage system often used in this state. The largest difference comes in the cost of power to operate the pumps. To offset this cost, there is the value for irrigation of the water pumped. The water developed by open drains can not usually be recovered at a place where it can be applied to the lands from which it is contributed.

Drainage by Pumping or Open Channels—The lack of success resulting from drainage by channels and the difficulty of effectively measuring the results of pump drainage, is undoubtedly due to the presence of ground-water under pressure. Coarse sands and gravel underlie much of the irrigated land. Irrigation upon the higher lands, and resulting deep percolation, introduces water to the coarse strata. The soil above these strata offers a frictional resistance to the upward movement, depending upon the depth and character of that soil. This serves to partly confine the water and place it under hydrostatic pressure. Because of the lack of uniformity in depth and character of soil, the wet areas follow no definite rule in occurrence. Under such conditions, pumping from wells lowers the water table much more than is possible with open drains, even when artesian wells are drilled along the open drain.

In addition to swamp lands unaffected by the present system of open drains, there is a real need for an additional water supply to supplement the present water rights in late summer and in seasons of drought. As the farmers diversify their crops, more water is needed in late summer. As grazing and erosion upon the watershed serve to deplete the late summer supply of streams, the need for additional water becomes more evident. In fact, the farmers of the Boise valley are now advocating construction of a new storage reservoir to provide additional water for late summer and for seasons of drought. However, the building of an additional storage reservoir will not effectively meet this need for additional water. The present reservoirs have not always filled and a new reservoir could not be filled during five years out of each thirty. If several consecutive seasons of low runoff should occur, it is doubtful if much water would be available from such a reservoir for use in the second season of low runoff.

In the areas served by the Boise river, it is estimated that from 150,000 to 200,000 ac-ft. of water can be obtained each year by pumping from wells, with the possibility of pumping additional water in seasons of scarcity. This is water that now flows in the gravity drains, and water that returns directly to the river as return flow. Only a part of this water is again diverted and used during the irrigation season, and all of it flows unhindered to the ocean during the non-irrigation season. With a carefully planned installation of electrically operated deep well pumps on the lower lands, this water could all be reclaimed and used on adjacent lands, freeing the gravity water for use on other lands higher up the river. The ground itself could then serve as a reservoir, and would conserve the water until it is withdrawn during the irrigation season.

Comparing the cost of such a development with that for storage water, the average cost of pumping, $0.75 per ac-ft. is 6% interest on $12.50 or 4% interest on $18.75. The capitalized cost of pumping water is then from $17.50 to $23.75 per ac-ft. It is doubtful if additional storage can be obtained at this price, as the cost of storage water in the Arrowrock reservoir, built on the Boise river in 1915, was $17.50 per ac-ft. Reservoir water at the same price per ac-ft. is not comparable with water pumped from the land, for there would be an annual fee charged against the storage water for reservoir operation and maintenance and for the supervision of the conveying channels. This fee would be from $0.10 to $0.25. In addition, the loss by seepage through the conveying channels would be 5 to 15%. These charges would be in addition to those for distribution and seepage on the project itself. If it was possible to obtain electrical energy at a lower rate from some of the nearby government power plants, the cost of pumping would be further reduced.

Chemical analysis of water pumped from deep wells shows that it contains a lower concentration of alkali salts than does nearby surface drainage water, and is not harmful when used for irrigation purposes.

Legal Status—In Idaho, under the doctrine of appropriation, the legal status of water developed by pumping is not fully settled. As a means of protecting the right to the use of such water, an application for a water right upon each well has been made to the Department of Reclamation of the state.

An Illustrative Contract—An illustration of the confidence in pumping from deep wells as a means of obtaining drainage and supplemental irrigation water, is shown by a contract recently executed between a drainage district and a canal company in the Boise valley. By this contract, the drainage district guarantees to supply 7000 ac-ft. of water each year to the canal company, to be paid for at the rate of $1.00 per ac-ft. This drainage district is starting on a pump drainage development under which 20 wells will eventually be installed.

The problem of drainage and of full utilization of our limited water supply is of major importance throughout Idaho and the irrigated west.

Editor's Note—Previous articles on drainage and pumping from wells have been published in **Western Construction News**, as follows: 'Drainage by Pumping from Wells' by Walter W. Weir, April 10th, 1926, issue, p. 33; 'The Drainage of Irrigated Areas' by Hyde Forbes, November 25th, 1926, issue, p. 33; 'Drainage in the Imperial Irrigation District, California' by Thos. N. Hildreth, September 25th, 1927, issue, p. 46.

California Sewage Works Association

Program for 1930 Spring Conference

A board meeting of the C.S.W.A. was held in Los Angeles on January 8, attended by F. A. Batty, Los Angeles, president; W. A. Allen, Pasadena, second vice-president; Alexander Bell, Burlingame, director; C. G. Gillespie, Berkeley, director; A. K. Warren, Los Angeles, director; A. W. Wyman, Pasadena, director; W. T. Knowlton, Los Angeles, board of control member; and E. A. Reinke, Berkeley, secretary.

The board of directors first selected San Luis Obispo as the best place to hold the spring conference in April. Soon thereafter, the American Society of Civil Engineers announced April 23 to 26 as the date of the national spring meeting at Sacramento. As many of the members of the C.S.W.A. will also wish to attend this meeting, it was suggested that the spring conference be held in conjunction with the sanitary section of the society. But, as the C.S.W.A. is primarily for sewage works operators and practical discussions, the directors finally decided to hold the spring conference at Sacramento, April 21 to 22, immediately preceding the society convention.

The program for the spring conference follows:

(1) Meet in Chico at 8 a.m., April 21, visiting the Chico sewage treatment plant from 8:30 to 10:00. This plant features mechanically cleaned bar screens, clarifier with skimming, and separate sludge digestion with heating and gas collection. H. H. Hume, city manager, and Martin C. Polk, city engineer, will answer questions at the plant.

(2) Drive to Davis, arriving at 1 p.m. for lunch as guests of the Farm School.

(3) In the afternoon visit the Davis farm, research laboratory, and sewage treatment plant. John Jacobson, superintendent of construction, will explain the operation of the pumping plants, Imhoff tank, sprinkling filter, and final settling tanks, and will assist in demonstrating the use of tools for Imhoff tanks and simple laboratory tests indicating the efficiency of the treatment plant.

(4) Informal dinner at Hotel Sacramento, Sacramento, with open round table discussion.

(5) Morning of April 22, drive to Lodi for school at activated sludge plant, followed by luncheon at Hotel Lodi. J. F. Blakely, city clerk, is making arrangements for the visit and operators' school. L. F. Barzellotti, city engineer, and Fred W. Post, sewage plant manager, will also welcome the caravan.

(6) On the return trip to Sacramento, C. W. Deterding, city engineer of Sacramento, will show the construction of a new sewer system in that city.

(7) The feature of the evening dinner meeting on April 22 will be a talk by a nationally known authority on sewage works and their operation, Harrison P. Eddy, of Metcalf & Eddy, consulting engineers, Boston, on 'Management, an Essential of Success in Sewage Treatment'.

A medal or plaque, designed by A. K. Warren and donated by Wallace & Tiernan, will be awarded at the annual meeting to that plant which has been most efficiently operated and maintained. In addition, the operator will receive a cash prize of $25.

Squaring the Circle

By R. M. FRANDSEN
Structural Engineer, San Francisco

The old saying: 'As impossible as squaring the circle', has been handed down to us from the dawn of civilization. When the ancient Egyptians had to retreat to the highlands during the yearly overflow of the Nile, all landmarks designating property and boundary lines became obliterated, and when the waters receded, it was up to the surveyors to remeasure the land and proportion it so that every land owner or renter was allotted the same area each year for planting purposes. Forced by necessity, the art of geometry therefore early became a well developed science. Probably the astronomers instructed the surveyors in their schools of 'mystery'. But already the mystics were at a loss how to lay out a square of the same area as a circle—they could do it only by approximation.

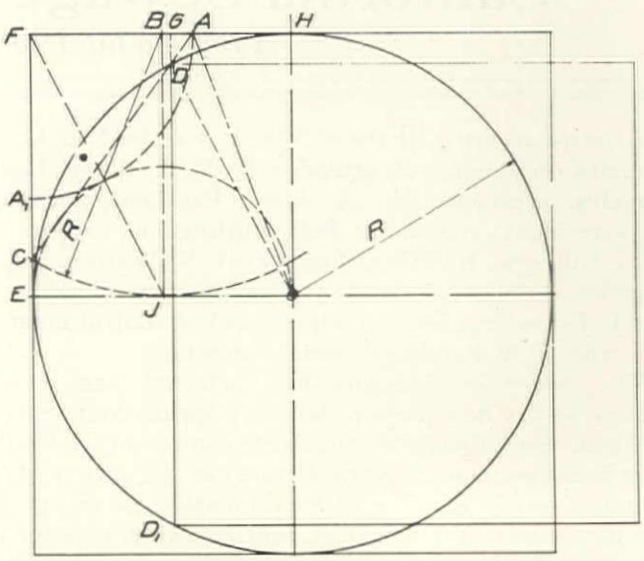
The ancient Greeks, who obtained their first science from the Egyptians, knew and were using the well known function for Pi—which every mechanic now is using—22/7; this approximation is somewhat too little. During the Middle Ages a new value was sometimes used: 355/113; this is nearer, but a little too much. After the invention of zero, 0, and the introduction of decimal fractions, it became more common to use 3.14159 or simply 3.1416. In structural engineering it is not uncommon to use 3.14159265; but for astronomical calculations often 30 or more decimals are used.

Up to the present date nobody has been able to draw a square of the same area as a given circle, with the means of a compass and a straight-edge only. In many textbooks it has been claimed to be impossible—just as impossible as for a man to fly. And, as we know, this did not deter many a 'fool' from trying to do it. Just as aviation has had its 'fools' from Icarus on down, so has there been many a 'nut' who tried in vain to square the circle.

How highly the ancients valued the finding of new mathematical truths and theorems is best illustrated by the famous legend told of Pythagoras, who lived more than 500 years B.C. While he was taking a bath, his mind was working on the proportions of right-angled triangles. Suddenly the truth struck him: the proportions were always such that the sum of the squares of the two shorter sides was equal to the square of the longest side. So he jumped out of his bath and ran, stark naked, out on the street and yelled: "Eureka, Eureka" (I have found it, I have found it). When Ptolemy had found that theory which still bears his name, he exclaimed: "Let us go to the Capitol and bring the Gods a sacrifice". And he sacrificed six steers on the altar of Zeus. Archimedes, another Greek mathematician, who took an important part in the defense of Syracuse against the Romans, was working on the problems of the circle while the final battle was on. He was sitting in his studio and contemplating a number of circles he had drawn on the floor, when a Roman soldier entered, looking for him. And Archimedes was so absorbed in his thoughts that he only said to the interrupter: "Don't step on my circles". But the soldier cut him down.

It is my belief that I have almost done the 'impossible' and have devised a geometric means for squaring the circle. None of the reasons advanced to prove that it could not be done would satisfy me, and the idea of solving the puzzle kept haunting and spurring me on. In the last 28 years it seemed that I had found a solution 7 times, but every time the calculations showed that it was not exact. Now, after these years, I also say 'Eureka'. It can be easily done by any mechanic who will follow these instructions:

Problem—To draw a square of the same area as a given circle.



Frandsen's Geometrical Solution for Squaring the Circle with Compass and Straight-edge

1. Draw the circle with a vertical and horizontal diameter.

2. Draw a square of four tangents around the circle, two verticals and two horizontals.

3. Draw a semicircle of radius ½R, tangent to the inside of the given circle, on the left-hand half of the horizontal diameter.

4. Connect the center of the semicircle with the upper left-hand corner of the square.

5. Draw a quarter circle around the upper left-hand corner, tangent to the semicircle, until it intersects the upper tangent in point A.

6. Locate point B on the upper tangent opposite the center of the semicircle.

7. With B as center and R as radius, draw an arc to intersect the vertical tangent in the point C.

8. Connect points A and C with a straight line. The line AC cuts the given circle in two points, the point nearest to A being marked D.

9. Project point D vertically on the lower part of the circle at D_1. The distance from D to D_1 is the side of a square of the same area as the given circle.

Proof—

$R = OE = OH = 1;\ EJ = JO = BF = 0.5$

$AF = A_1F = \sqrt{1.25} - 0.5 = 0.618033988874944$

$FJ = \sqrt{1.25} = 1.118033988874944$

$(FA)^2 = AH = 1.5 - \sqrt{1.25} = 0.38196601125055$

$AB = AF - 0.5 = 0.118033988874944$

$CF = \sqrt{0.75} = 0.866025403784$

$CE = 1 - \sqrt{0.75} = 0.133974597215$

$(CA)^2 = (CF)^2 + (AF)^2 = 0.75 + AH = 1.13196601125055$

$(CA)^2 = 2.25 - \sqrt{1.25}$

$CA = 1.0639389155$

$(AO)^2 = (AH)^2 + (HO)^2 = 4.5 - 3\sqrt{1.25} = 3AH$

$$AO = \frac{\sqrt{1.5 - \sqrt{1.25}}}{\sqrt{3}} = 1.07046626931$$

$< FAC = 54^\circ\ 29'\ 11.957''$ $< AOH = 20^\circ\ 54'\ 10.854''$

$< FCA = 35^\circ\ 30'\ 48.042''$ $< OAH = 69^\circ\ 05'\ 49.145''$

$< DAO = 56^\circ\ 24'\ 58.90''$ $\sin ODA = \dfrac{AO \times \sin DAO}{OD}$

$< ADO = 116^\circ\ 54'\ 05.33''$

$< AOD = 6^\circ\ 40'\ 55.77''$

$$DA = \frac{OD \times \sin AOD}{\sin DAO} = 0.13967598\ldots$$

$$GD = \frac{DA \times CF}{AC} = \log.\ 0557356 = 0.11369348$$

$$2\ GD = 0.22738696$$

$DD_1 = 1.77261304\ldots$

$\sqrt{\pi} = 1.77245385\ldots$

$Error = 0.00015919\ldots = 33''$ about

Q.E.D.

ROAD CONSTRUCTION IN CAIRO, EGYPT

By ZAKI OSMAN EL-SELEMI
Civil Engineer, Road Department, City of Cairo

Egypt has a population of 15,000,000, of which 1,250,000 is in Cairo, the main city and seat of government. Cairo has three types of street paving—macadam, sheet asphalt, and stone block—totalling 1,500,000 sq.m. There are about 1,000,000 automobiles in the city.

The main street of Cairo is 135 ft. wide and extends for 10 km. from Abbasia to the new city of Heliopolis. From building line to symmetrical center-line, the cross section of this street is: a footpath 16-ft. wide and lined with palm trees; 30 ft. of concrete and sheet asphalt pavement; 15.5 ft. of tree-lined parking; and a railroad right-of-way in the center, which is 13 ft. wide and carries one track.

For 1929 the state highway program was estimated at £50,000 Egyptian ($250,000). This included 350 km. to Assaun; enlargement between Cairo and Alexandria; and new construction between Cairo and Fayum. The state is planning a 2½-year road program to cost £100,000.

Low-Cost Road Construction—With the increase in traffic on Egyptian highways, the more important district roads have from time to time been surfaced with a 6-in. layer of limestone macadam. To strengthen these roads, 4 in. of basalt macadam is added, topped with a thin coating of Suez bitumen, volatile flux, and solar oil. The Suez bitumen is brought from Suez on the Red sea. Three grades of topping are in use—F-60, F-70, and C, with respective contents of 60, 70, and 100% bitumen soluble in 82°C. The F grades are used for first and second coats and the C grade for surfacing roads which had previously been treated with bitumen, or were worn so thin as to require patching. As the C grade is unfluxed and more viscous than the F, it has to be treated to a higher temperature and then pressure-sprayed on the road. The F grades can be applied with a brush.

Composition of Asphalt Layers—In Cairo the typical composition for road surfaces is asphalt, with three layers for heavy traffic, two for moderate traffic, and one for light traffic. Under the asphalt is a dressed and compacted macadam, forming a good foundation. The three asphalt layers are known as concrete asphalt (black base in the United States), binder, and surface sheet. Each layer is applied 1¼-in. thick, then rolled with an 8-ton roller and finally compacted with a 5-ton roller.

The asphalt is secured from Trinidad lake and is fluxed with about 10% of Suez bitumen to produce a penetration of 12 to 18. The proportions of ingredients in the three layers vary slightly; a typical analysis is given in Table I.

TABLE I

Material	Percentage of Material in— Concrete Asphalt	Binder	Sheet Asphalt
Asphaltic cement	13	8	18
Filler (limestone dust)	3	0	10
Graded sand	44	11	72
¾-in. stone (basalt)	40	81	0

The graded sand is proportioned for light and heavy traffic as in Table II.

TABLE II

Screen	Type of Traffic— Light %	Heavy %
10-40 mesh	33	22
40-80 mesh	44	44
80-200 mesh	22	33
Pan	1	1

Remarks—Asphalt mixtures are manufactured in two plants having mixers of 700-lb. capacity each. The plants are run by 50-hp. semi-diesel engines and the mixing system is similar to that of most plants in the San Francisco region. The paving cost per sq.m. does not differ greatly from that per sq.yd. in California.

Editor's Note—Zaki Osman El-Selemi is studying low-cost roads in the United States and will report to his government on recommended surface types, proper road building and maintenance equipment, and the latest construction methods. A short account of his studies was published as a personal note in the January 10th issue, p. 25.

Do Multiple Dome Type Dams Develop Dome Action?

By A. FLORIS
Civil Engineer, Los Angeles, California

Various types of dams have been proposed recently with the purpose of improving on those in current use. Most of these types, however, possess an ephemeral significance, since the improvements they introduce are not of a lasting value.

The present article deals primarily with the Coolidge dam, a multiple dome type, which has attracted worldwide attention for its boldness and novelty. In fact, it represents one of the highest buttressed dams ever built and for this reason alone deserves a careful analysis of its merits or possible defects.

What is a Dome—In order to form a correct idea of the statical properties of dome-like dams, it is necessary to know exactly what a dome really is. This seems, at first sight, to be superfluous but, nevertheless, it is essential for a proper understanding of the statical behavior of these structures under stress.

The first requirement of a dome is to have an axis of symmetry and to be quite thin in comparison with its other dimensions of span and rise. This is a 'conditio sine qua non' of a dome, in the absence of which no action bearing its name can be expected to take place in the structure. The two conditions of the body, mentioned above, produce a certain stress distribution which is characteristic of these structures, being at the same time favorable to their static equilibrium. No other structure possesses such exceedingly advantageous properties, combined with a great strength and resistance. Structures not complying with the above requirements are simply not domes at all.

Membrane Stresses—Stresses in a dome, with the exception of its boundaries, can be assumed without much error to act axially—that is to say, they are distributed uniformly over the section, thus giving to the structure a relatively great strength. This renders the dome exceptionally fit to support considerable loads over relatively large spans. The stress condition, just described, is similar to that of a membrane subjected to a uniform inner pressure, with the difference that in the latter the stresses are purely tension, while in the former these are mainly compression, with bending stresses of a higher order of magnitude and therefore negligible. These axial stresses in a shell of rotation are commonly called membrane stresses.

In order to restrict the problem, domes of rotation only will be considered in the present article, as these are of main importance for the purpose in view. In a dome or, more correctly, in a shell of rotation the stresses are acting along its meridians and parallel circles. In an axially symmetrical loading, the meridian stresses are always compression, while the ring stresses may be compression, or both tension and compression depending on the rise of the dome. They are all principal stresses. In spherical shells under their own weight, the ring stresses are compression up to a rise of about 52 deg., measured between the axis of rotation and the abutment of the shell. If the span is greater than that defined by the above angle, then below this limit appear tensile stresses extending to the abutment of the dome. This point of change from compression to tension, that is, the point of zero

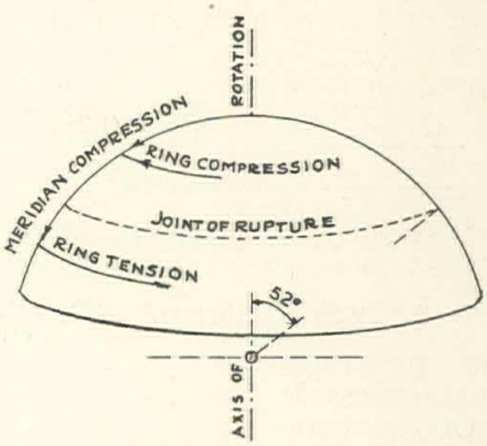


FIG. 1

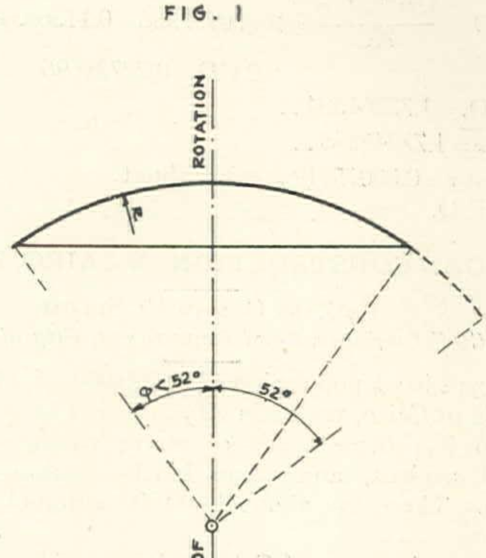


FIG. 2

stresses of the ring, is the well-known joint of rupture which constitutes an important criterion of the economic feasibility of the structure. (See Fig. 1 and 4.) The upper part of the dome above this joint tends to push the structure outward, while the lower part below the joint tries to pull the dome inward, thus contributing considerably to its stability. This balancing effect of the ring stresses is due to the double curvature of the spherical shell, since conical domes have not such properties. In these last structures, the ring stresses are everywhere compression. While in this way the ring stresses in a shell of rotation with double curvature keep the structure in balance, the loads acting upon it are transmitted to the abutment by the aid of the meridian stresses. Consequently, the stresses produced in the ring are balancing stresses, while those developed in the meridian are supporting stresses.

Joint of Rupture—Every spherical dome therefore must have a joint of rupture before the structure can be considered practically feasible. Very flat domes not possessing a joint of rupture are not only economically inferior, but under certain circumstances are even dangerous. The thrust developed at the abutment of these domes is excessive in such cases. (See Fig. 2.) Dischinger[1] conceived the clever idea to make domes without a joint of rupture, to obtain such a joint. This can be accomplished by changing the curvature of the meridian curve in such a way that a joint of rupture will appear in the dome.

It is a well-known fact that hemispherical domes do not produce a thrust at their abutment, because the angle between the axis of rotation and the abutment is 90 deg. or, in other words, the tangent to the meridian curve at this point is vertical. (See Fig. 4.) In a hemispherical shell under vertical loads, a joint of rupture is always present. Consequently, any meridian curve of a shell possessing a vertical tangent at the abutment will have also a joint of rupture, thus satisfying the conditions previously stated. (See Fig. 3.)

Bending Stresses—Elastic-theoretical investigations have shown, and experiments also confirmed, this fact beyond doubt that, in addition to the membrane stresses, there are developed at the boundaries of the shell and especially at its abutment bending stresses normal to its mid-surface. These stresses oscillate from positive to negative values until they disappear quickly not far from these boundaries. The stress condition thus defined disturbs somewhat the equilibrium of the shell, as given by the membrane theory, but being restricted to a comparatively small portion of the dome is not of outstanding importance. Nevertheless, by changing the curvature of the meridian curve, as stated previously, and by reducing the stiffness of the tie-ring at the abutment, Dischinger was enabled to neutralize the harmful influence of these bending stresses.

Under an unsymmetrical loading of the shells of rotation with double curvature, the theory of the membrane stresses can hold true only in the case of an antisymmetrical loading. This means that to a pressure on one-half of the dome corresponds an equally great suction on the diametrically opposite half of the dome. Under this loading condition, the structure can be considered as a dome, since the stresses developed therein are mainly membrane stresses and therefore uniformly distributed over its section. However, the meridian and ring stresses are not principal stresses, as there are produced additional shearing stresses rotating in pairs in the planes of these normal stresses.

Reissner[2] and Dischinger[1] have shown that the stress condition of the shell varies with the loading, the distribution of which must follow, under the above mentioned restrictions, a cosine law, or better, it must be expressible in a Fourier series in order to make the solution of the problem possible. According to the chosen law of pressure variation, the shell will have

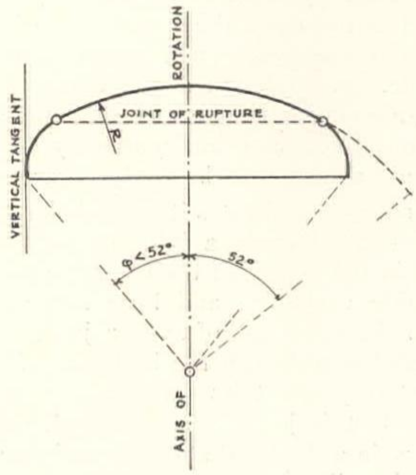


FIG. 3

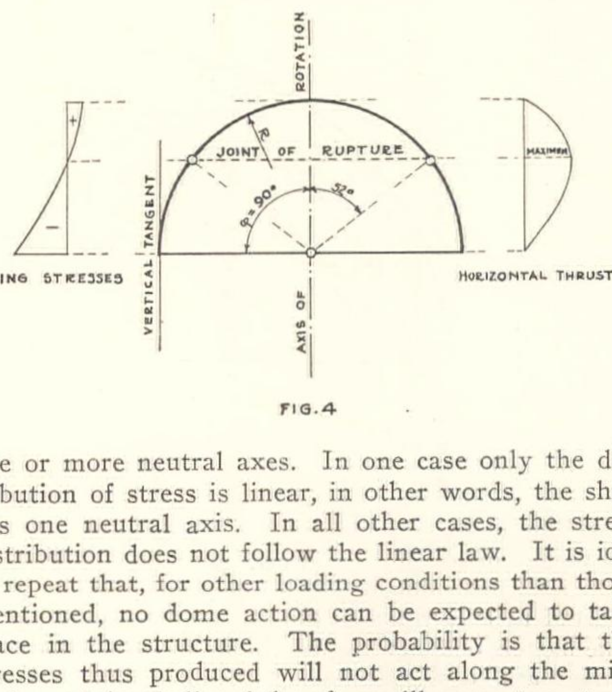


FIG. 4

one or more neutral axes. In one case only the distribution of stress is linear, in other words, the shell has one neutral axis. In all other cases, the stress distribution does not follow the linear law. It is idle to repeat that, for other loading conditions than those mentioned, no dome action can be expected to take place in the structure. The probability is that the stresses thus produced will not act along the mid-surface of the shell and therefore will generate a stress condition which cannot be treated analytically.

After these preliminary remarks on the true meaning and definition of the dome as a statical element, it is comparatively simple, in what follows, to investigate the statical properties of the Coolidge dam, which is the only existing structure of the multiple dome type.

Statical Properties of Coolidge Dam—One of the main objections against the classification of the Coolidge dam as a dome type, and which cannot be contradicted, is the fact of its enormous thickness

[1] 'Schalen-und Rippenkuppeln' by Franz Dischinger in Handbuch fuer Eisenbetonbau, Vol. 6, Part 2, 4th Ed., Berlin, 1928, p. 181.

[2] 'Spannungen in Kugelschalen (Kuppeln)' by A. Reissner in Mueller-Breslau Festschrift, Leipzig, 1912.

[1] 'Schalen-und Rippenkuppeln', p. 196.

Shells of such sectional dimensions cannot be considered as membranes. The stresses produced therein are certainly not uniformly distributed over the section. Consequently, bending stresses will ensue and the assumption of the dome barrels as shells will be fallacious and misleading.

Another objection which questions the very meaning of this dam as a dome is the absence of an axial symmetry. A portion of the dome is only available, while the remaining portion is replaced by the buttresses. This being the case, the possibility of assuming the existence of the membrane stresses in such a structure is remote. It is shown above that shells possessing axial symmetry of shape and loading, or axial symmetry of shape and antisymmetry of loading, are domes and as such can be analyzed accordingly.

Under these conditions it is doubtful whether in the case of vertical loads a joint of rupture can be developed in the domes of the Coolidge dam. However, the double curvature and high rise of these domes point to the existence of such a joint for the sake of their stability although the influence of the buttresses will certainly affect its formation to a considerable degree. If this joint is not formed, then the domes are either in a doubtful statical condition or the stress distribution differs from that of the membrane theory to such an extent that a dome action cannot be expected to take place in the structure. Consequently, the barrels of this dam are of a hybrid nature between dome and arch, possessing the good properties of neither.

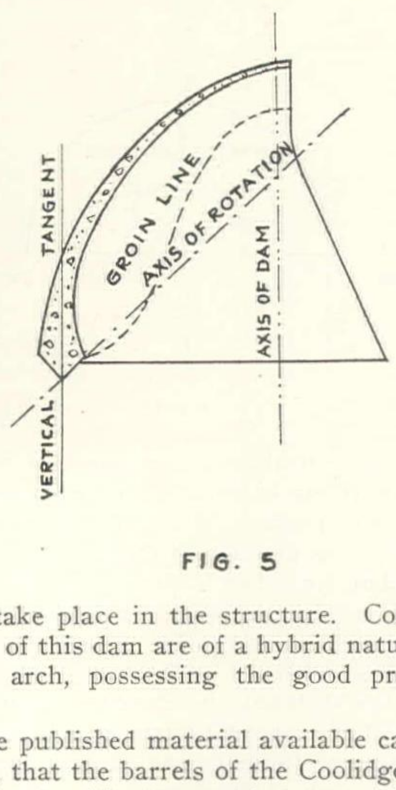


FIG. 5

From the published material available can be taken as granted, that the barrels of the Coolidge dam have been analyzed without regard to a possible dome action. It was thought probable that this omission will give to the structure an additional strength. In the light of the theory of domes already discussed briefly, this is problematical, since the stresses obtained by the arch theory will be inaccurate and their distribution erroneous. Structures which cannot be analyzed with a reasonable degree of accuracy should be avoided. This is especially true in cases where the design of a structure can be replaced easily without an economic loss or disadvantage by other types having no such defects.

Domes should be necessarily very thin, a requirement which cannot be met successfully in hydraulic structures under a great waterhead. The high and unrestricted pressure of water in high dams renders the use of exceptionally thin sections inadvisable. On the other hand, domes of considerable thickness are of a doubtful value as structural elements. Here may be argued that domes of great spans have been in use since the Romans and later through the Middle Ages and the Renaissance up to the present time. However, these structures, because of their great thickness, hardly can be classified as domes in the light of recent research. Their stress distribution is uncertain and they are by no means shells. Pure membrane stresses cannot be developed in these structures.

Supposing that the occurrence of the membrane stresses in the domes of the Coolidge dam is possible, then the change of the curved surface of the dome into the straight form of the buttresses will obviously affect the distribution of these stresses generating bending moments. At the groin line, this can be mitigated to some extent by the counteraction of the adjoining barrels. However, this is only approximately true for the middle dome. The two adjacent domes are statically much inferior in this respect.

Also, the overhanging upper part of the domes between two buttresses, or between buttress and canyon wall, can be in equilibrium by the aid of bending stresses only, because the domes there are lacking of axial symmetry. Consequently, membrane stresses cannot be developed in this part of the dam.

If a dome action could occur in this dam, the vertical tangent to the meridian curve at the abutment of the dome would undoubtedly eliminate the thrust in the barrels. This will neutralize the cantilever action of the dome and, consequently the undesired bending moments produced by the counteraction of the rock foundation. (See Fig. 5.) In the Coolidge dam the change of the shape of the dome meridian at the abutments into a curve having a vertical tangent will probably minimize not only the cantilever moment but also will cause perhaps a better stress distribution in the domes. These favorable conditions, however, are speculative to some extent and cannot be relied upon.

In domes, the main loads are due to weight of structure, as snow and wind are of secondary importance. In a dam of the multiple dome type the opposite is the case, as water pressure is a serious item compared with the weight of the dam. This pressure is unsymmetrical and a portion of the dome being only available, the antisymmetry of loading is not existing in this case. Therefore, the solution of the problem of stress determination in the Coolidge dam appears to be hopeless.

The trajectories of the principal stresses offer a good picture of the stresses developed in a body, so that if their path can be traced even approximately, they are of great assistance in cases of doubt. For this reason, a rough sketch of the trajectories is useful and desirable. This will be attempted in the following:

The most probable case that the stresses in the barrels will be membrane stresses occurs when the dam is empty. The trajectories of the first principal normal stresses will diverge toward the rock foundation following approximately the upstream and downstream faces of the dam. The trajectories of the second principal normal stresses will intersect the first mentioned and also the downstream face at right angles, as both kinds of these trajectories are orthogonal. The intersection of the upstream face of the buttress by these trajectories will depend on the stress condition of the dome. If the stresses in the dome are membrane stresses, then the trajectories of the meridian stresses will be the extension of those of the first principal normal stresses, while the trajectories of the ring stresses will be also the extension of those of the second principal normal stresses. This is the simplest possible, and at the same time idealized, stress condition which, in the case under consideration, is a rough approximation, or merely a guess. Any other distribution of the principal stresses will be more complicated and therefore most difficult to follow.

If the water pressure comes into action, the stress distribution in the dam will be materially modified. Here is the point where the main difficulties start. The trajectories of the principal normal stresses in the buttresses, in points at least some distance in from the upstream face, can be determined approximately. This is explained in detail in some treatises on dams. However, to fix the trajectories of the principal normal stresses in the barrels of the Coolidge dam is not an easy task.

As the antisymmetry of loading is not possible in the domes of this dam under water pressure, the theory of domes as developed recently is of no avail in this case. It cannot be assumed from considerations of analogy, even roughly, that neutral axes will be formed in the dome. This being the case, the tracing of the trajectories is not feasible.

The consideration that the water pressure on two adjacent surface elements of the dome will be principal stresses in its interior, furnishes an unfavorable result. Assuming that the direction of these stresses remains unchanged, then they will intersect each other in the neighborhood of the groin line, thus generating tension in this part of the structure. This assumption, however, neglects the influence of the meridian stresses, which can be appreciable.

With regard to the distribution of the trajectories of the principal normal stresses in the buttresses of the Coolidge dam, it was tacitly assumed that no inclined contraction joints were provided. Since this is not the case, the trajectories of the separated parts of the buttresses, owing to the presence of these joints, will have an individual and independent distribution in each part, which will materially deviate from those already outlined. It is believed, however, that the difference between the two cases will not profoundly alter, at least in principle, the distribution of the trajectories of the principal normal stresses in the domes.

Conclusions—The above results are simplified assumptions of possible stress variations and consequently cannot claim to be exact. They show, however, that the investigation of the stress condition in the Coolidge dam is seemingly beyond the power of modern analysis.

Finally, it will be perhaps not superfluous to mention that the study of domes, with particular reference to their possible application to dams, has led me to the negative conclusions stated. They are in no way meant to reflect upon the ability of the eminent engineers who have developed the multiple dome type as it is represented by the Coolidge dam. They are merely thoughts pursuing no other than scientific aims.

COOLIDGE DAM

Dedication on March 4—Data on Shrinkage Cracks

The dedication of the Coolidge dam, on the Gila river, Arizona, for the San Carlos Irrigation project, was held on March 4, former President Calvin Coolidge (and Mrs. Coolidge) performing the ceremony, together with J. C. Phillips, governor of Arizona. Officials of the Department of the Interior, Bureau of Indian Affairs, Bureau of Reclamation, the consulting engineers, and the contractors were present. Unfortunately, C. R. Olberg, formerly assistant chief engineer, U. S. Indian Irrigation Service, who conceived this type of dam and was its principal designer, is with the U.S.S.R. in Tiflis, Caucasia, and could not be present.

The ceremonies were broadcast by the Union Oil Co. over KTAR.

The Coolidge dam is on one of the main highways of Arizona, 141 miles from Phoenix by one route, and 120 by the other. The highway from Globe to the dam, 35 miles long, was lined with flags for the occasion.

The dedication ceremonies were preceded by a 'dam luncheon' on the parapet of the dam, sponsored by Atkinson, Kier Bros., Spicer Co., the contractors—similar to the dedication luncheon given by the Atkinson Construction Co. on the Pardee dam.

The Coolidge dam is architecturally a masterpiece. Its beauty, enhanced by a setting among the colorful Arizona mountains—together with the participation of many of the Pima and Apache Indians—marked this ceremony as one of the most unique and impressive ever held.

The invocation was given by the Reverend Dirk Lay, the 'White Chief' of the Pima Indians, and missionary at the Sacaton Indian Reservation. Hugh Patton, a full-blooded Pima Indian, made an impressive speech. After the ceremonies, the braves of the Pima and Apache tribes smoked a 'pipe of peace', the pipe used being an ancient one recently unearthed near Casa Grande. Calvin Coolidge smoked the pipe with them and was inducted into each tribe as a chieftain. These tribes then dedicated the Coolidge dam with their own ceremony.

Among the other speakers were: Peter D. Overfield, of Casa Grande; Edgar B. Merritt, representing the Department of the Interior and Commissioner of Indian Affairs; and E. W. Clapp, of the Southern Pacific Co.

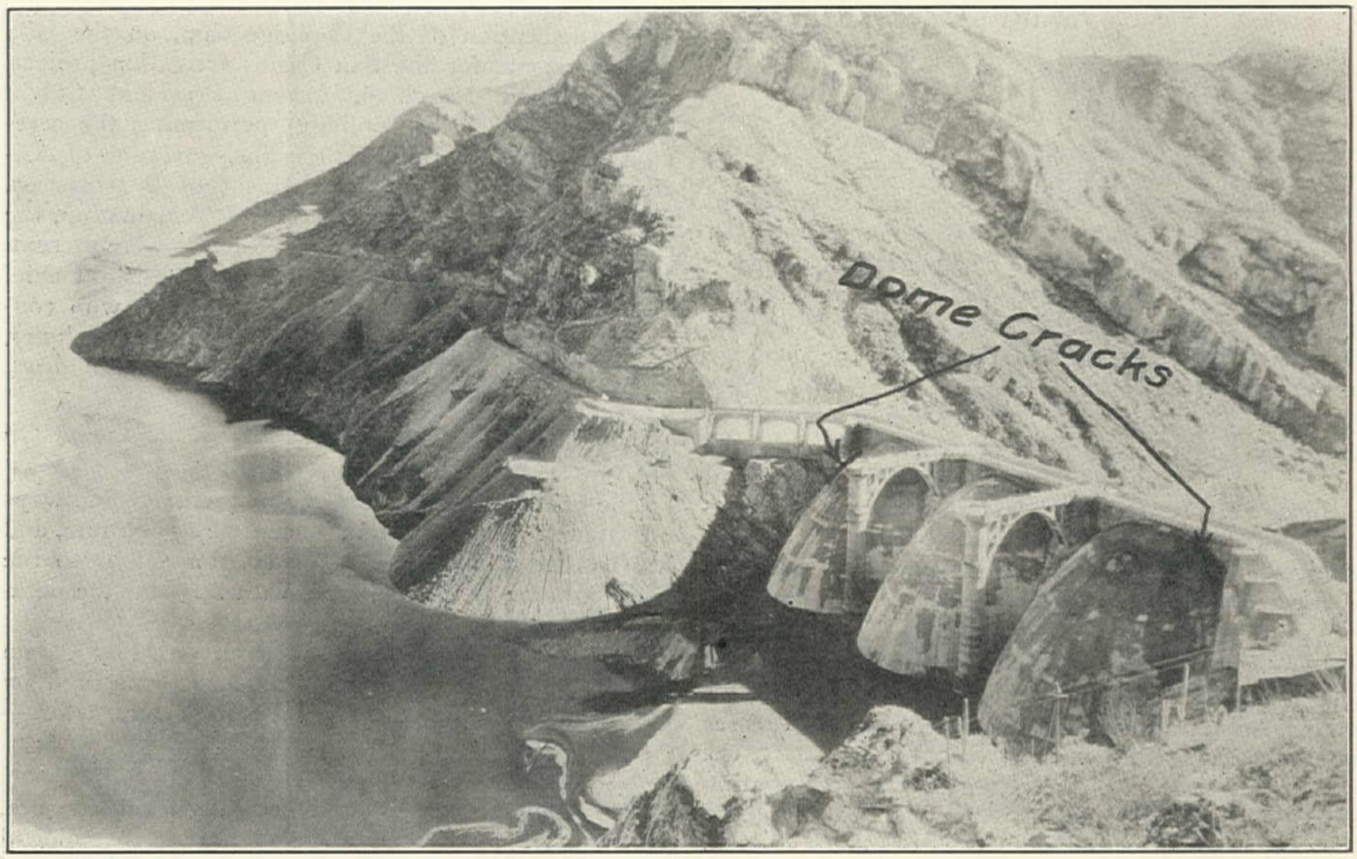
The Coolidge multiple-dome dam was designed by C. R. Olberg, with the assistance of H. C. Neuffer; C. W. Southworth being construction engineer. The consulting engineers on design and construction were Louis C. Hill, Fred A. Noetzli, A. J. Wiley, General L. C. Langfitt; and the architects, Wright & Gentry, of Los Angeles.

The dam is 250 ft. high above streambed and 560 ft. long on crest; with two spillways around the ends, each 150 ft. wide. A detailed description of this dam, by C. R. Olberg, was published in the December 25th, 1926, issue; the construction plant, etc., in the September 25th, 1928, issue; and construction progress articles in other issues, followed by an article on 'The Symmetry of Design and Economics in Construction' by J. G. Tripp, construction superintendent, in the November 10th, 1929, issue.

As might be expected, shrinkage cracks have developed—one in each of the abutment domes near the top. Early in February the Secretary of the Interior appointed, at the recommendation of the Commissioner of Indian Affairs, a board of consulting engineers to investigate and report on the most suitable type of spillway gates, and on shrinkage cracks and such other features of the dam as may call for comment and recommendations. This board, comprising Louis C. Hill, A. J. Wiley, and Fred A. Noetzli, inspected the dam on February 11 and 12, and submitted a report on its findings to the Commissioner of Indian Affairs on February 15, the part relating to the cracks being in substance as follows:

During the cold weather of December and January two cracks developed in the domes above the present water surface where the domes join bedrock at the base of the small side buttresses. At both those points there is an abrupt change in the slope of the rock surface.

The crack in the east dome (left-hand side) extends from elev. 2485 to elev. 2515 ft. (the parapet crest is at elev. 2535 ft. and river bed is 2313 ft.). It has a maximum width of 0.06 in. The crack in the west dome (right-hand side) starts at the spring line of the dome at elev. 2440 ft. and extends upward to elev. 2500 ft. It has a maximum width of 0.10 in. No cracks could be detected in the center dome or in the side domes adjacent to the middle buttresses.



COOLIDGE DAM, GILA RIVER, ARIZONA, SHOWING APPROXIMATE LOCATION OF CRACKS IN EAST AND WEST DOMES

The level of the reservoir formed by the Coolidge dam has been rising very slowly since the dam was completed in November, 1928, the maximum level attained so far being 120 ft. above streambed, or 100 ft. below the crest. Both cracks in the dam are above the present reservoir level; therefore, it appears that they are not due to load conditions, but rather have resulted from the unavoidable shrinkage of the concrete. Filling of the cracks with cement grout to make up for the deficiency of material caused by this shrinkage may therefore be expected to restore the dam to its original condition as designed.

The Coolidge reservoir will impound nearly 1,200,000 ac-ft., forming a lake 25 miles long and 2 miles (average) wide; and will irrigate 100,000 acres. The maximum flood discharge of Gila river is 92,000 c.f.s.

Connection Angles Subjected to Bending

By NORMAN B. GREEN*
Structural Engineer, San Francisco, California

Editor's Note—Norman B. Green received his A.B. degree in civil engineering from Stanford University, class of 1921, and his M.S. degree in mechanics from the University of Illinois in 1923. He was research assistant at the University of Illinois from 1921 to 1923. Green was with the U. S. Bureau of Public Roads from October, 1923, to January, 1924; the Pacific Gas & Electric Co. from January, 1924, to August, 1925; in the office of Christopher Henry Snyder, consulting structural engineer, San Francisco, from August, 1925, to July, 1926; in the office of Reed & Corlett, architects, Oakland, from July to November, 1926. He has been in private practice since November, 1926. Green is an associate member of Sigma Xi, national honorary scientific fraternity.

In the usual windbracing connection of beams to columns in a steel building frame, the outstanding legs of the angles against the columns are placed in bending, the rivets through the leg being subjected to direct tension. In the design of the angle leg for bending, it is necessary to make an assumption as to the nature of this flexure. This will be made clear by reference to Fig 1, showing that the angle may bend as a single cantilever as at (a) or in a reversed curve as at (b). In the first case, the rivet through the outstanding leg offers no restraint, and in the second case it produces a restraint and a consequent fixing moment.

With no reliable information on the subject, it has been customary in design to assume either that the rivet offers no restraint at all to bending of the angle, or that it offers complete restraint. Under the first assumption, the bending moment at the root of the angle will be twice as great as under the second assumption, and the restrained angle will be correspondingly stronger. On account of the wide variation in results as determined by the design assumption, some authorities arbitrarily assume the angle thickness (see, for example, 'Steel Construction' by H. J. Burt).

Rivet Tests by Young—A peculiar fact bearing directly on this subject was discovered during the recent tests relative to 'Tensile Working Stress for Rivets', carried out at the University of Toronto by C. R. Young. In brief, it has been demonstrated experimentally that a rivet under initial tension, due to contraction in cooling, will not elongate when a tension is applied in the direction of its axis, until the applied tensile stress exceeds the initial stress resulting from cooling. Since the initial stress is usually in the neighborhood of the elastic limit, this means that under working stresses the rivet acts as a rigid body.

Application to the Problem—To make clear the application of this fact to the problem, consider Fig. 1 (c) and (d). In Fig 1 (c), a pair of angles is subjected to a direct pull 2W and held in place against a flat surface by the action of two rivet tensions P. If it is assumed that the rivets elongate as indicated in the sketch, then there will also be a concentration of bearing pressure R at the end of the angle, so that the action of P and R together produces a fixing moment. Fig. 1 (d) is intended to show the elastic line of the angle in its bent condition, with the various forces acting, the elongation of the rivet being represented by δ. It is now obvious that, if the rivet is rigid in axial tension and $\delta = 0$, the elastic line remains horizontal at P and the angle leg is fixed at each end. Under this condition, there is an inflection point halfway between the load P and the end at W, so that the angle is twice as strong as it would be if it acted as a cantilever beam.

Suppose now that the connection rivet or bolt elongates when load is applied, such as would be the case if it had no initial tension. This would presuppose either a loose rivet or a bolt that had not been properly tightened.

Referring again to Fig. 1 (c) and taking axes X and Y as shown, from static equilibrium

$$P = R + W \qquad (1).$$

Also, if K equals a constant determined by the elastic properties of the rivet or bolt, then

$$P = K\delta \qquad (2).$$

An equation can be written for that part of the elastic curve to the right of the load P and another for the portion to the left of P:

$$EI\frac{dy}{dx} = \tfrac{1}{2}Rx^2 + C_1 \qquad (3).$$

$$EI\frac{dy}{dx} = \tfrac{1}{2}Rx^2 - \tfrac{1}{2}Px^2 + Plx + C_2 \qquad (4).$$

The constant C_1 is determined from the requirement that when $x = l$, $y = P/K$, which gives $C_1 = \frac{EIP}{Kl} - 1/6\,Rl^2$.

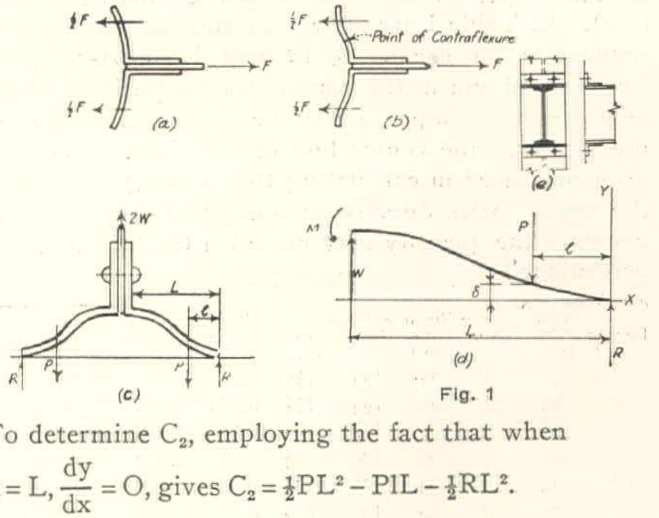


Fig. 1

To determine C_2, employing the fact that when $x = L$, $\frac{dy}{dx} = 0$, gives $C_2 = \tfrac{1}{2}PL^2 - PlL - \tfrac{1}{2}RL^2$.

Substituting these values of C_1 and C_2 in Eq. (3) and (4),

$$EI\frac{dy}{dx} = \tfrac{1}{2}Rx^2 + \frac{EIP}{Kl} - 1/6\,Rl^2 \qquad (5).$$

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$$EI\frac{dy}{dx} = \tfrac{1}{2}Rx^2 - \tfrac{1}{2}Px^2 + Plx + \tfrac{1}{2}PL^2 - PlL - \tfrac{1}{2}RL^2 \quad (6).$$

If now the expressions (5) and (6) are equated for the value $x = l$, after simplification and rearranging

$$(\tfrac{1}{2}L^2 - 1/6l^2)R + (Ll - \tfrac{1}{2}L^2 - \tfrac{1}{2}l^2)\,P = -\frac{EIP}{Kl} \quad (7).$$

Now, substituting the value of P from (1) into (7) there is obtained the relation

$$R = W\left(\frac{\frac{L^2}{2} + \frac{l^2}{2} - lL - \frac{EI}{Kl}}{Ll - \frac{2}{3}l^2 + \frac{EI}{KL}}\right) \quad (8).$$

The quantity δ as defined by Eq. (2) is the elongation of the rivet shaft between the insides of the heads. Young has investigated theoretically the additional extension arising from deformation of the heads themselves and found it to be negligible. If, then, l_1 equals the length of the rivet measured between the insides of the heads, A the area of the cross-section of the rivet shaft, and E the modulus of elasticity:

$$S = \frac{Pl_1}{EA}, \text{ whence } K = \frac{EA}{l_1},$$

and the same relation applies to a bolt.

It should be noted that I is the moment of inertia of that width of angle leg that is held by one rivet. For example, with an angle 10 in. long, held by two rivets, the value of I would be for a width of leg of 5 in., or for a long connection with rivets spaced 3 in. apart, the effective width for each rivet would be 3 in.

By the use of equations (8) and (1), R and P can be determined for any set of conditions; and by equating to zero the bending moment produced by these reactions, the inflection point can then be located. In this computation, it is necessary to assume a position for the resultant bearing pressure R. This will certainly lie close to the edge of the angle and its distance from the edge is arbitrarily taken as ⅛ in.

Connection Angles for Windbracing—The commonest case of a windbracing connection employing angles in bending is that of a beam connected by top and bottom angles to a column flange, as shown in Fig. 1 (e). In Table I are shown various designs for this connection for use on 8, 10, and 12-in. H-columns. The last column in the table gives the position of the inflection point in per cent of distance from the face of the angle to the center line of the rivet. Since the lever arm used in calculating the bending moment in the angle varies directly as this percentage, for convenience the quantity may be called the 'moment arm percentage'.

Table I

Angle		Rivets or Bolts				Reactions in terms of w		Dist. inflec. pt. to face of angle	
Length (in.)	Thickness (in.)	No.	Diam. (in.)	Gauge	Grip (in.)	R	P	(in.)	% of (L-l)
	½	2	¾	1¾	1⅛	0.360	1.360	0.845	67.5
8	⅝	2	¾	1¾	1¼	0.220	1.220	0.877	78.0
	¾	2	⅞	1¾	1⅜	0.117	1.117	0.870	87.0
	½	2	¾	1¾	1¼	0.330	1.330	0.880	70.5
10	⅝	2	¾	1¾	1⅜	0.178	1.178	0.925	82.0
	⅝	2	⅞	1¾	1⅜	0.220	1.220	0.877	78.0
	¾	2	1	2	1½	0.204	1.204	0.970	77.5
	½	2	¾	1¾	1¼	0.315	1.315	0.895	71.5
12	⅝	4	¾	1¾	1⅜	0.258	1.258	0.840	74.5
	¾	4	¾	1¾	1½	0.099	1.099	0.890	89.0

An examination of the last column of Table I indicates that for the assumed condition of no initial tension in the rivet or bolt the angle leg is not even approximately fixed, as the moment arm percentage would in that case be 50. As previously shown, if the initial tension in the rivet is greater than the working tensile stress, the rivet is rigid in its action for working loads and the angle leg is fixed. This would mean an initial stress in excess of 15,000 lb. per sq.in., which is Young's recommendation of a unit stress of 10,000 lb. per sq.in. with an increase of 50% for connections taking wind load only. For an initial stress somewhat less than the working stress, the percentage lies somewhere between 50 and the values given in the table. As the bending stress at the fillet of the angle varies directly as the moment arm percentage, the value of having a high initial tension in the shaft of the rivet or bolt is apparent. The results of this analysis taken with the experiments of Young, demonstrate that a high initial tension is more than simply uninjurious—it is a great advantage both as regards the strength and the rigidity of connections of this type.

Bolts vs. Rivets—It has been the practice among many structural engineers to use bolts through the column flange rather than rivets for important connections of that type. This is done for two reasons: because it has been believed that a rivet with a high initial tension could not safely carry any additional load; and because it is frequently necessary to use large rivets or bolts to develop sufficient tensile resistance, and it is usually neither convenient or practical to use large rivets or even two sizes of rivets on the same job. In view of recent experimental results, the first objection to the use of rivets no longer carries any weight. However, bolts will still continue to be used in certain cases, for the second reason mentioned. It will therefore be of advantage to discuss this question of initial tension as it applies to rivets and bolts.

By virtue of contraction of the rivet shaft as it cools after driving, a rivet ordinarily will develop a high initial tensile stress. Tests carried out by Baumann and Bach in Germany in 1912, show that for power driven rivets with a grip of 1½ in. and with plates that have been planed perfectly flat, the initial stress is about equal to the elastic limit of the rivet steel. In practice, there are certain factors which will effect this contraction stress. Recent specifications of the American Institute of Steel Construction mention two of these, namely: paint on contact surfaces, and overdriving of rivets.

It is my belief that a still more important factor is the straightness of the plates. It is evident that a plate with a bend in it—and particularly a thin plate—may deflect inward under the grip of the cooling rivet, so that the contraction of the rivet shaft will develop little stress. Every erection man has noticed that rivets driven at one point of a connection may be found to be loose after rivets have been driven at neighboring points; and this effect can be attributed directly to lack of straightness in the plates. A practical way to aid the development of a high initial tensile stress in all rivets is to bolt up the joint thoroughly before any rivets are driven, and tighten these bolts nearly to the breaking point, so as to bring the plates together. Preferably, every rivet hole should be bolted, and certainly every other hole, removing the bolts one at a time as the rivets are driven.

Where bolts are employed in the connection, it is apparent that unless these are taken up tight there will be no initial tension. Furthermore, on account of lack of straightness of plates, it may be necessary to take up each individual bolt several times before all the bolts in a connection are tight. Tests described by D. S. Kimball in the 'American Machinist' for December 17, 1914, indicate that it is possible to produce a tensile stress of from 16,000 lb. per sq.in. on the gross section for a 1¼-in. bolt, to 23,000 lb. for a ⅞-in. bolt, by using a proper wrench length. These stresses are described as those to be expected in making a steam tight joint, but the results were rather discordant. If the results were discordant under laboratory conditions, they would be far more so on a steel frame in the field where quick erection is generally to the advantage of the contractor and where the men are often working in awkward positions and on a bolt not always completely accessible.

Conclusions—In view of the uncertainty in regard to the initial tensile stress in the rivet or bolt shaft, it is not possible to calculate a definite value for the moment arm percentage in a given case. At the same time, certain qualitative conclusions can be drawn from the preceding analysis and from the percentages given in Table I. In the first place, an application of Young's results to the problem shows that if the rivet or bolt has a high shaft stress, the angle is perfectly restrained. Secondly, the importance of a high initial tensile stress in the rivet or bolt shaft is made apparent, since the bending stress at the angle fillet may be nearly doubled because of a low shaft stress. (That is, the moment arm percentage may vary between 50 and 89.)

It appears, then, that the strength and rigidity of an angle connection is tied up closely with the longitudinal stress condition of the connecting rivets or bolts. It has been pointed out that certain factors make this stress quite variable in practice; a fact that is given general recognition by the failure to figure frictional resistance in riveted connections. It seems, therefore, unreasonable and inconsistent to assume a full restraint for the angle. In any case, an assumption of engineering design should never presuppose the most favorable conditions, but rather the average or even the least favorable. An examination of Table I would seem to show that a moment arm percentage of 70 would strike a fair average between favorable conditions for developing restraint in the angle and unfavorable conditions. It is realized, of course, that this value is more or less arbitrary.

Bolts have the advantage over rivets, as the pull on the wrench handle gives a direct measure of the tension in the bolt shaft. In a carefully bolted joint, there might be justified the use of a moment arm percentage of 50, providing there is no possibility of the nut loosening.

OWYHEE PROJECT EXTENSIONS CALLED FOR BIDS

Bureau of Reclamation to Contract 9.85 or 7.70 Miles of Tunnels and 2.8 Miles of Roads in Eastern Oregon

Bids will be received by the Bureau of Reclamation at the office of the Owyhee Irrigation District, Nyssa, Oregon, until 10 a.m., March 11, for the construction of concrete-lined tunnels and roads for the distribution system of the Owyhee project in Oregon and Idaho. The work is located on the Oregon Short Line railroad near Nyssa and involves: tunnel No. 1—18,722 lin.ft. of 14-ft. diam.; tunnel No. 2—33,307 lin.ft. of 9 ft. 4 in. diam.; or tunnel No. 1—18,722 lin.ft. of 16 ft. 7 in. diam.; and tunnel No. 5—21,920 lin.ft. of 9 ft. 3 in. diam.; road to inlets of tunnels No. 1 and 2—5378 lin.ft. of 14-ft.; tunnel canyon road—4800 lin.ft. of 16 ft.; road to top of Owyhee dam—4700 lin.ft. of 14-ft.; and a 16-ft. timber highway bridge connecting this road and the top of dam.

The principal items and maximum estimated quantities follow:

Tunnel excavation—280,000 cu.yd., all classes.
Excavation other than tunnels—114,000 cu.yd., all classes.
Overhaul—23,000 sta.yd.
Tunnel lining—74,000 cu.yd. of (approx.) 1:2:4¼ concrete.
Pressure grouting—1600 cu.ft.
Corrugated metal culvert pipe—Lay 600 lin.ft. of 12 and 18-in.
Closed drains for tunnels and outlets—Construct 53,000 lin.ft.
Timbering in tunnels—Furnish and erect 330 M f.b.m.
Structural steel in tunnels—Furnish and erect 209,000 lb.

The invitation for bids does not cover the purchase of materials which are to be furnished by the Government, including cement, admixture for concrete, pipe and pipe fittings for drains, metal pipe and fittings for grout-hole connections, corrugated metal culvert pipe and coupling bands, lumber and hardware for the highway bridge.

The contract time on this work is 1275 days.

SALT SPRINGS DAM

The Pacific Gas & Electric Co. is making good progress on the construction of the Salt Springs rock-fill dam on the north fork of the Mokelumne river, in the Sierra Nevada, California. The dam will be 330 ft. high, 1300 ft. long on crest, will contain 3,000,000 cu.yd. and will impound 130,000 ac-ft. (See April 10th, 1929, issue, p. 183.)

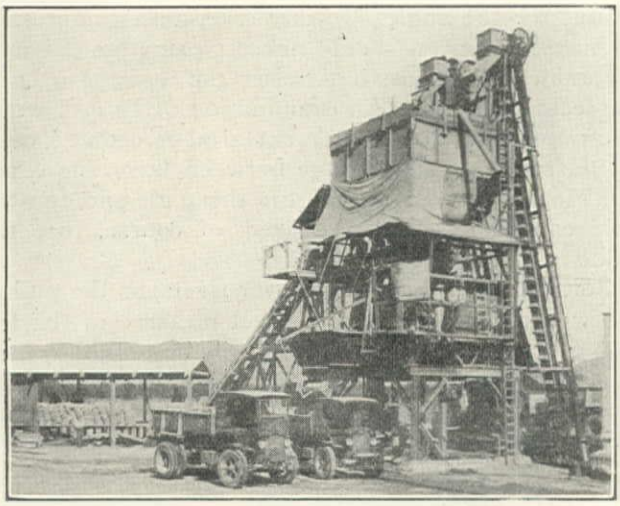
As this dam is at elev. 3900 ft., progress was slowed up during the winter months, but from now on an average of 125,000 cu.yd. per month of rock fill will be placed. The rock fill is up to a point 225 ft. above streambed, with 1,725,000 cu.yd. in place. The derrick-placed facing on the upstream slope (15 ft. thick) is half way up; four cranes being used on this work: three Marion ¾-yd. electric powered, and one Bucyrus air powered.

The dam is being built by the construction department of the P.G. & E. Co., under supervision of O. W. Peterson, construction superintendent, and P. I. Kurtz, resident superintendent.

Bechtel & Palmer, contractors on the 12-mile main conduit below the dam, are operating 3 power shovels—Northwest, Osgood, and P&H.

Ventura Boulevard, Los Angeles

The Will F. Peck Co., Hollywood, has completed two contracts for improving Ventura blvd. in the city of Los Angeles. The work included grading, portland cement concrete paving, sewers, water and gas mains, conduits, and storm drains, for 6½ miles between Lankershim and Sepulveda blvd.; the two jobs being combined as one operation. The new width of Ventura blvd. from curb to curb is 70 ft., consisting of 10-8-10-in. concrete, and the paving totalled nearly 2,000,000 sq.ft.



Central Mixing Plant for Paving Ventura Blvd.

Contract Quantities and Unit Prices—The contract for improvements between Pacoima ave. and Sepulveda blvd. (M.I.D. 61) was let May 27, 1929, for $439,373. Major items in the contract were:

Roadway grading—76,400 cu.yd. (lump sum)—$22,000
Grading in Los Angeles river channel—107,000 cu.yd. excavation and 90,228 cu.yd. embankment (lump sum)—$29,000
Portland cement concrete paving—1,263,634 sq.ft. at $0.1875.

For improvements between Lankershim blvd. and Pacoima ave. (M.I.D. 62), contract price $230,827, the principal quantities and unit prices were:

Grading (lump sum)—$12,300
Portland cement concrete paving—651,900 sq.ft. of 10-8-10-in. at $0.1875

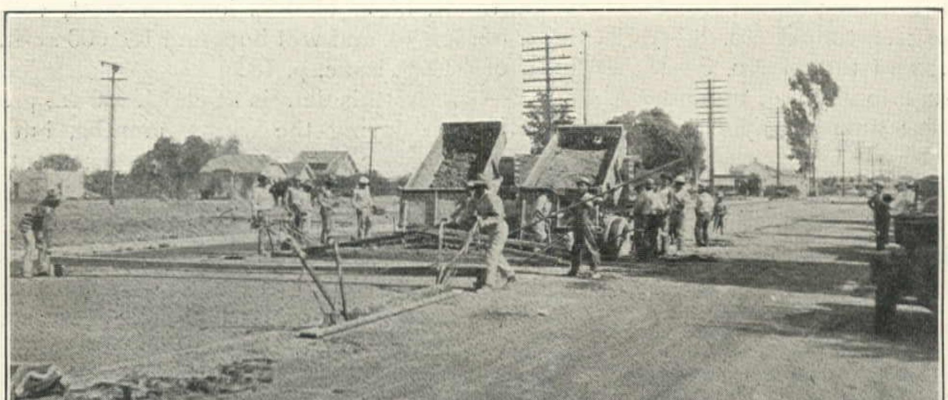
Concreting Plant—A central mixing plant, equipped with a T. L. Smith mixer, was erected at the center of the job, west of Whitsett ave. Cement was hauled from a Los Angeles plant 15 miles distant, using Mack trucks and trailers, with an average load of 420 sacks. A fleet of 14 Autocar trucks, of late design, with the body especially arranged for this class of work, was used to haul concrete. In these trucks the rear end of the body is 6 in. wider than the front end and the corners are rounded instead of square, thereby eliminating any tendency of the concrete to cling to the body.

Construction Problems—The most important feature of the work was the amount and variety of utilities which had to be installed before paving could commence. There were several miles of water and gas mains and sanitary sewer lines in the contract. The sanitary sewer was laid as a double line, one on each side of the street. Seven complete storm drains were required to handle the different waterways which intersect the boulevard. Most of these drains were of pre-cast pipe and only one required the construction of wooden forms.

As part of the contract it was specified that a 20-ft. paved roadway be kept open for traffic at all times. No detour was permitted on the job. The asphalt paving was used to bring the old roadway up to the new grade. A 10-in. section of concrete was laid west of Pacoima to Whitsett ave. but the main section of concrete was 8 in. thick, with 10-in. shoulders.

Also, one-half mile of the Los Angeles river channel was shifted about one-fourth mile to the north and a new roadway was built over the natural riverbed. This channel change required 107,000 cu.yd. of earth excavation and embankment.

Personnel—J. J. Jessup is city engineer and D. M. True is office engineer for the city of Los Angeles. The Will F. Peck Co. is made up of Chas. P. Cooke, E. H. Bashaw, and Finley B. Smith. William Percy was the contractor's superintendent of construction, and L. C. Farley was resident engineer for the city.



SPECIAL-BODY AUTOCAR TRUCKS DEPOSITING CONCRETE ON VENTURA BLVD.

Recent Development in Sewage Disposal in the East*

By R. F. GOUDEY†

Resident Engineer, Bureau of Water Works and Supply, City of Los Angeles, and formerly Resident Engineer, State Department of Public Health, at Los Angeles

Part I

The following statements are based on observations made at sewage treatment plants of Chicago, Aurora, Milwaukee, Cleveland, Boston, Brockton, New York, Plainfield, Baltimore, Salem, Ohio, and Indianapolis, as inspected by me during August and September. 1929.

Bar Screens

All of the new plants are being equipped with self-cleaning, one-inch bar screens, of which there are now four new types. The simplest of these is the Evers, Sauvage Co. screen at Calumet. It is a small, compact, and satisfactory screen, and operates continuously.

The second is a type developed by a man named Johnson, of the Chicago Sanitary District, for the North Side plant, and is made by the Link-Belt Co. Owing to the steepness of bars and the clumsiness of the raking device, most of the material is lost before reaching the top. Further changes should be made upon it before it is used extensively.

The third type of screen is the Dorr type, perfecting the design originated by the city of Los Angeles at Hyperion, such as installed at Aurora, Illinois. A number of the operators and engineers who were interviewed, disliked the curved bars of this screen, which occasionally get out of alignment, causing trouble. This has led to a new type of Dorr bar screen, first installed at Salem, Ohio. The unique features are the carrying of the water on the same carriage which operates the rake, and the use of straight bars. It operates automatically only when the loss of head exceeds four inches. It appears to be an excellent screen.

In addition to the general installation of mechanically cleaned bar screens, there has been a move to make them operate intermittently and automatically. At Aurora, Illinois, and Salem, Ohio, the screens operate when the loss of head through the bar screen reaches 4 in. A contact is made which operates the bar screen until the loss of head is reduced to normal. The saving in the wear on the machine alone justifies automatic operation. In addition, greater removals are secured, because, with fuller loads on the rakes, fewer solids are lost.

At the North Side plant, Chicago, the screens are operated automatically, but according to a predetermined and fixed cycle of operation.

Incineration of screenings is now being practiced at Salem, Ohio, in a little apartment-house incinerator set adjacent to the screen and in the same house with the screen. This incinerator is manufactured by the Buffalo Cooperative Stove Co. The main feature is that the burner operated by gas from the digestion tank has ports on the underneath side and serves as a grate for the screenings which are thrown directly on top of the burners.

Pressing of screenings at Milwaukee by the Berrigan Press to 6% moisture has proven troublesome in cleaning. A centrifuge is now being installed.

Grit Chambers

Owing to the fact that practically all of the grit chambers, as used in the east, are settling out organic matter, which causes odors in the material removed from the grit chambers, there has been a movement to design mechanically operated grit chambers for new installations, and to install mechanical washing devices for old installations. Aurora, Illinois, has a new type of Dorr detriter. This is merely a shallow tank with 18-in. water depth, giving a detention of 40 sec., and has on the bottom a revolving system of rakes, forcing the grit to a hopper in one side of the tank. Here it is picked up by the tractor belt, which gradually works the grit up a narrow slot to a point of discharge above the water level. The gradual rubbing of the sand in this channel washes it free of organic matter, and this organic wash water has a separate channel back to the detriter tank. The success of this type of detriter is very marked.

At Salem, Ohio, the grit chamber has been designed in conjunction with a grease removal plant, prior to preliminary clarification. Air is made to keep the organic matter in suspension. The installation is successful.

Promising experiments with a Dorr type of grit washer are now being conducted in the open grit chambers at Milwaukee.

Many of the eastern plants have housed over their grit chambers.

Fine Screens and Screenings

The use of fine screens in sewage treatment is on the decline. None of the new plants visited or that I heard talked of, used, or expect to use, fine screens in any part of the process.

A rather unique use of fine screens is in connection with sedimentation at Indianapolis. The sewage flows through a channel and battery of fine screens, and approximately two-thirds of the sewage water is screened. The solids remain in the one-third sewage flow not screened, and this concentrated flow is then allowed to settle. This unquestionably is a step in the right direction, as it gives a more concentrated flow to settle, and more efficient methods of settling can be devised for it. At the present time, the efficiency of the settling tanks at Indianapolis has not been worked out to where they get an overall removal greater than 36%. This may be due to faulty removal of deposited material.

Baltimore passes the settled effluent through a 20-mesh screen to remove floating solids and grease prior to dosing or sprinkling filters.

Milwaukee has demonstrated the success in digestion of screenings. The entire output of screenings from their plant is pumped to heated digestion tanks with gas collection. Heat is generated entirely from

*Reprinted from Vol. II. No. 1, California Sewage Works Association 1929 Journal.

†Associate Member, American Society of Civil Engineers.

gas collected. A production of 120 cu. ft. of gas per million gallons of sewage flow is being obtained with a temperature of 130°. Good digestion is obtained in less than 30 days, and lower temperatures down to 80° D. are being used. The digested screenings are odorless and dewater readily. The plan is to return the digested sludge to the incoming sewage. What effect this will have on the treatment plant has not yet been determined.

The Tark screens at Milwaukee have been giving excellent results; the brushes not giving any particular trouble from wearing, as was anticipated by many engineers.

Preliminary Sedimentation

Imhoff Tanks—The outstanding feature of sedimentation is that no new two-story tanks are being built. At Plainfield, New Jersey, the Imhoff tanks are being reconstructed to give plain sedimentation. The flowing-through chambers are removed and steep sides are given to the hopper bottoms. The modified two-story tanks give far better removals, 60% and better, and effect a very material saving in labor. Instead of having a man spend his full time removing scum from the flowing-through chamber and breaking up scum in the gas vents, the scum formation with the plain sedimentation tank is practically negligible.

Baltimore has given up the use of two-story tanks and has a large number lying idle.

At Calumet, scum was being removed from the two-story tanks for the first time in seven years. It consisted mostly of mash and oil. Grease analyzed 70% mineral oil. The Kane type of gas collector on the scum chamber of the tanks at Calumet has given good results. The gas production during the year averages 0.4 cu. ft. per capita.

The use of colloiders in the two-story tanks at Calumet does not justify continuance. Mohlman states that at Decatur, where the sewage is much stronger, it may be beneficial. The colloider is merely alternating aeration and settling in the flowing-through chamber. In the aerating section, lath baffles have been installed to increase surface area. This type of treatment is supposed to permit sprinkling filter rates up to 5 m.g.d. It produces fair results, but the cost is greater, at least for weak sewages, than other types of treatment.

Mechanical Clarification—All of the large clarification plants built in the east during the past three years have been of the Dorr type. Most of them are in connection with separate sludge digestion plants, which are described later. The clarification units installed at Chicago have not been entirely satisfactory. Contributing causes are the use of short-circuiting types of inlets and grit passed by the grit chambers. The rakes have been made longer, and half of the old ones have been removed. All of the sedimentation tanks visited could benefit by Pasadena's experience in type of inlets.

Practically all of the plain sedimentation tanks are now being equipped with scum removal equipment. A rather new development has been made at Aurora, where the scum is pumped to a steel tank, where it is allowed to settle and separate. The water under the scum is drawn off and only the concentrated scum is pumped to the digestion tank.

The plain sedimentation tank at Salem, Ohio, acts as a grease removal plant. The inlet channel has been enlarged to make it a combined aeration and grit chamber. The grease precipitated by the air is allowed to collect on the surface of the sedimentation tank, and is removed by hand periodically, at a port near the flow line.

The Link Belt equipment for the clarifiers at Indianapolis is giving a fair clarification, but one can readily see that it needs improvement, for the concentrated material it is called upon to clarify. There is no doubt in my mind that the concentration of the sewage prior to sedimentation is one of the coming features in future clarification.

At Aurora, Illinois, the preliminary sedimentation tank has been covered. This greatly improves the appearance of the plant, controls odors, prevents wind disturbance, and in general gives a very good impression.

Progress In Sludge Digestion

Three years ago, on a trip east, I found only three small separate sludge digestion plants with mechanical removal of sludge, and none were equipped with gas collection and heating. There are now 59 separate sludge digestion tanks, with 66 digesters. Of the latter, 41 have gas collection and heating. This enormous increase shows clearly the present trend of sewage clarification and sludge digestion, and, in my mind, is an object lesson to engineers who still persist in designing works of an antiquated type.

The following list covers some of the larger plants employing gas collection and heating:

City	Population
Antigo, Wisconsin	12,000
Fond du Lac, Wisconsin	30,000
Aurora, Illinois	55,000
De Kalb, Illinois	25,000
Springfield, Illinois	60,000
Grand Rapids, Michigan	300,000
Toledo, Ohio (pending)	600,000
San Antonio, Texas	300,000
Fort Worth, Texas	225,000
Waco, Texas	75,000
Springfield, Missouri	55,000
Salem, Ohio	15,000
Peoria, Illinois (not yet built)	....

So far, Dorr equipment has been installed on all large projects, including those above mentioned. Although their type of clarification equipment costs more than the Link-Belt type and others, I am told the saving in more economical concrete construction, which the Dorr plant allows, has been giving, by actual contracts, a lower total first cost.

For eastern conditions, sludge must be stored at times for six months, and even though the sludge is heated an allowance of 1.5 cu. ft. per capita is made. In unheated tanks, an allowance of 3.0 cu. ft. per capita is now considered standard.

A good test of the advantage of sludge heating was experienced at Sioux Falls, South Dakota. The plant was put into operation without sludge heating in the winter of 1927-8. The sludge was acid, and caused trouble on drying. In the following winter the tanks were restarted, but the sludge was heated. No trouble was experienced with an acid sludge, and no lime was added.

It is important to drain the scum under the gas dome daily, until good digestion is established.

(To be continued)

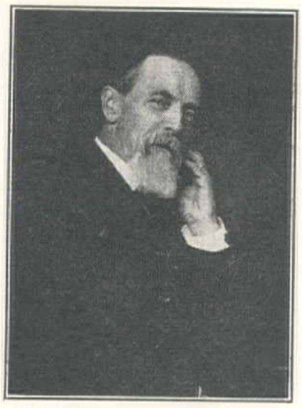
Reminiscences of the Pioneer Engineers of California*

By OTTO VON GELDERN†
Consulting Engineer, San Francisco

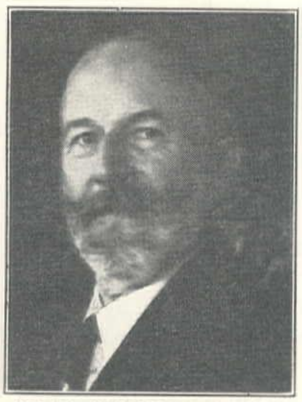
Part VI

Prof. Hilgard, though not an engineer, was so closely connected with the agricultural development of our state that its history of reclamation and irrigation cannot be written without mentioning this illustrious name.

His university assistant, the late W. K. Winterhalter, who died but recently, in 1929, should not be forgotten in this connection. Winterhalter was probably the best trained agricultural engineer in California. He became nationally and internationally known; particularly as an expert in the cultivation of sugar beets. He was trained in the great agricultural colleges of Germany and came to California in the earlier days, when a young man. On several occasions he went to Europe in the interests of our beet sugar industries and rendered exceedingly valuable services for them. He could be sent to any part of the world, because he spoke so many languages that he could never be lost anywhere. His death was a great loss to our state. He cannot readily be replaced.



EUGENE WALDEMAR HILGARD



W. K. WINTERHALTER‡

Professionally he combined knowledge and erudition with an experience extending over a long period of practical activity, and it is just this which made him so valuable in the agricultural development of California.

James Dix Schuyler was a famous California engineer of the post pioneer period, noted for his activity in the construction of dams. His name became internationally known. He was a prolific writer on engineering subjects, particularly on that relating to dam construction. In 1911 he published the first edition of one of his well-known books entitled: 'Reservoirs for Irrigation, Water-Power and Domestic Water-Supply', containing an account of various types of dams, and the methods and plans of their construction. During his lifetime Schuyler constructed many dams; the one most frequently mentioned in connection with his name, the one which made him famous, is that located twelve miles southeast of San Diego, in the Sweetwater river, known as the Sweetwater dam, a curved masonry structure raised from a slender profile, having a height of twenty feet, to a height of sixty feet, and later on to one of ninety-odd feet with a base width of forty-six feet. It was built in the years 1887 and 1888. As a matter of historic interest it may be stated that Schuyler was at one time the assistant state engineer; this was about 1877. Schuyler was a large man, physically, that is, he was stout, but in spite of that he was very active and agile. Large physically he was also large mentally; he had been gifted by nature with a keen, penetrating mind, and he knew how to use this great gift to the best advantage for the benefit of his fellowman. He died in 1912 at the age of sixty-three.

JAMES DIX SCHUYLER†

While agricultural and highway engineering have been the last and most important phases of our profession, the first engineering activity in California was that of hydraulic mining; the second that of railway building. The illustrious pathfinders who solved the difficulties of crossing the Sierra Nevada are deserving of our highest admiration. There is one who died re-

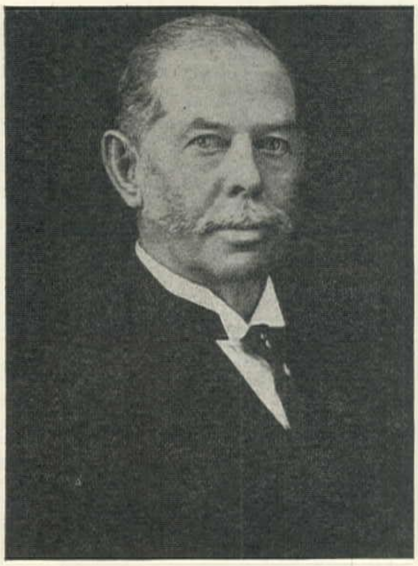
*Part I was published in the September 25th; Part II in the October 25th; Part III in the November 10th; Part IV in the December 10th, 1929, and Part V in the February 10th, 1930, issue.

†Member, American Society of Civil Engineers.

‡Member, American Society of Agricultural Engineers.

cently at a ripe old age, who accomplished what had never been accomplished in just that way before, and that is the late chief engineer of the Southern Pacific Co., William Hood.

I have always considered him one of the foremost of California engineers. In a way he was inimitable, particularly in the line which made him famous. He had a very extensive scientific knowledge and a wide-awake interest in the new developments of technical science. He was an omniverous reader who devoured technical and scientific literature. He died in 1926, when he was somewhat over eighty, but he never did get really old, for he retained his bodily vigor and force of character to the last day of his life. I saw



WILLIAM HOOD†

him about ten days before his death when I had a long conversation with him. He was going downtown to get shaved; he walked erect and with a stride that we seldom see now-a-days in men who are sixty. When he did die he did it suddenly; there was no agony about it; he went away like a man who had performed a long and serious task, had finished it to his satisfaction, and was ready to leave the field of his earthly activity without making any ado about it.

And that was typical of all the sturdy pioneer engineers of California. They attended to their affairs with all the energy they possessed, and adhered to this principle until they had reached the end of their career. They deserve our respect, for we shall not see their like again.

Since this address was written another railway engineer has passed away, one who was typically Californian, the late John D. Isaacs.

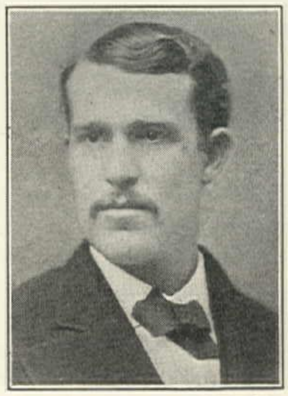
Another one of the early railway engineers should be mentioned here, the late Howard Schuyler, an elder brother of James Dix Schuyler. In his youth and early manhood he served as a private soldier, and later as an officer, during and after the war of the rebellion, having enlisted when a mere lad in the second Kansas regiment in May, 1861.

Some years after the war, he entered the service of the Kansas Pacific Railway, during which time he had to work his way up from the bottom of the ladder; and he had the energy, the capacity, and the endurance to perform this feat.

As early as 1867, he was in charge of one of the parties assigned to make the location of the thirty-fifth parallel transcontinental railway route, which he carried through to the Pacific coast. This was a dangerous undertaking, full of hardships, severe tests of physical endurance, courage, and bravery.

During the construction of the main line of the Kansas Pacific, from Fort Wallace to Denver, a work which followed the location survey just mentioned, and which he completed in 1870, he met with a serious accident. The wheel of a locomotive passed over one of his feet, crushing all the bones of the toes. It is remarkable that he recovered the full use of this foot.

In 1871, he became one of the organizers of the Denver & Rio Grande Railway, filling the position of chief engineer and general manager until May, 1873, when he resigned to accept the position of chief engineer of the North Pacific Coast Railroad in California (now the Northwestern Pacific), which he constructed from Sausalito to the Russian river. He next built the San Diego breakwater under contract for the War Department, and then made the railroad



HOWARD SCHUYLER †§

location surveys for the Sonora, and the Sinaloa and Durango routes in Mexico. In 1875 he married a daughter of Samuel Brannan, a 49-er, and one of the empire builders of California.

From 1880 to 1883, Schuyler was chief engineer on the construction of the Mexican Central Railway. This terminated his professional career, all too soon. He died in Switzerland, December 3, 1883, within eight days of his thirty-ninth birthday.

Howard Schuyler was a self-made man in every sense of the word, one who by his own perseverance, intelligence, and energy raised himself to the height of his profession against all obstacles, reaching it at an age when the career of most men is at its beginning only. (To be continued)

§Father of Philip Schuyler, editor of **Western Construction News.**
†Member, American Society of Civil Engineers.

San Francisco Buys Spring Valley Water Co.

The city and county of San Francisco purchased the water system of the Spring Valley Water Co. on February 26 for $40,021,540. This will form the distributing system for the Hetch-Hetchy water supply project now nearing completion.

BOOK REVIEWS

STRESSES STATICALLY DETERMINED

By JOHN CLAYTON TRACY, C.E.

John Wiley & Sons, Inc.—426 pages—7¾ x 10½—Boards—$6.00

This text is intended to give a thorough working knowledge of the theory of stresses in statically-determined structures. Features of the arrangement are: an exceptionally comprehensive and thorough presentation of the fundamentals of statics; the classification of all problems in statics and the corresponding problems in stresses into eight cases, with a standard solution for each case; a general method of attack that enables the analyzing of a problem and the forces involved, and a determination of the case under which it falls; the solution of problems which illustrate the practical application of principles and methods; the inclusion of practical comments, notes, and suggestions; the exclusion of all matter on design that will not be helpful in studying stresses. Part I is devoted to statics, part II to stresses due to dead load, and part III to stresses due to live load.

CONSTRUCTION OF ROADS AND PAVEMENTS

By THOMAS RADFORD AGG, C.E.

McGraw-Hill Book Co., Inc.—511 pages—6 x 9—Boards—$4.00

In the new, fourth edition, of this helpful text and reference book (originally offered in 1916) are included the most important developments in the economics, methods, and materials of efficient highway engineering.

The author opens with a brief sketch of the development of highway systems and their management, as a background to the study of efficient construction and maintenance. He then gives authoritative, thorough discussion of all the essentials—surveying and planning; drainage and control of erosion; design, construction, and maintenance of the various types of roads and pavements; economic comparison of types; choice, testing, and use of materials. A glossary of words and terms employed in highway engineering is also included.

To the third edition published in 1924 have been added three entirely new chapters—economics of highway grades, design of municipal pavements, and road slabs of concrete.

BRIDGES: A STUDY IN THEIR ART, SCIENCE, AND EVOLUTION

By CHARLES S. WHITNEY, M.C.E.

William Edwin Rudge—363 pages—9 x 12—Boards—$20.00

This volume represents a notable contribution to a subject that daily claims more attention from the engineering profession—engineering architecture. In his foreword the author states the three-fold purpose of his work to be: "First, to give a method for the application of fundamental architectural principles to the design and criticism of bridges"; second, "to present the historical background of the modern bridge"; and third, "to present a selection of artistic bridges of all types".

The book is divided into two parts, and each part into several sections.

Part One is composed of 210 pages of discussion and photographs. Obviously, this part is designed to accomplish the author's first two objectives. Section One presents in an interesting manner the fundamental principles of architecture as applied to bridges. The bridge accomplishments of the Romans are considered in some detail in Section Two. Sections Three and Four, The Dark Ages and the Renaissance, continue the fascinating story of the bridge; numerous historical structures are shown and discussed from the standpoints of methods of construction and architectural treatment. Section Five, The Eighteenth Century, is quite properly devoted to French bridges of this period. Jean Rudolphe Perronet receives well merited recognition. Modern Bridges is the caption of Section Six. Photographs of a number of arch and suspension bridges are shown, but no mention is made, or illustration given, of other types of steel bridges recently erected in this country.

Part Two, embracing 143 pages, contains five sections. The first section is entitled Influence of Material in Bridge Forms, and discusses briefly, and in a popular way, this topic. The remaining sections, Bridges of Wood, Bridges of Stone, Bridges of Concrete, and Bridges of Steel are composed entirely of photographs illustrating these subjects. The illustrations of wooden bridges are taken largely from European and Asiatic practice. It would seem that this material has been of enough importance in bridge building in the United States to warrant the inclusion of an example or two for historical reasons, if no other. A hundred illustrations, or more, of stone and concrete bridges gathered from many countries show the state of the bridge builder's art so far as these materials are concerned. Steel bridges are represented by some sixty-four illustrations, many of which are from American practice. An outstanding feature of the book is the abundance of fine illustrations, 402 being used. 'Bridges' was published November 4, 1929, and the edition is limited to 2000.

IVAN C. CRAWFORD,
Dean, College of Engineering, University of Idaho.

TIMBER DESIGN AND CONSTRUCTION

By HENRY S. JACOBY and ROLAND P. DAVIS

John Wiley & Sons, Inc.—328 pages—6 x 9—Boards—$4.50

Under the title of 'Structural Details', Jacoby first published this volume in 1909. It was revised and brought up to date by Davis, the title changed to conform more closely to the contents, and the second edition, partly rewritten, published in 1930.

Chapter I contains a digest of experiments and research on fastenings used in framing—bolts, nuts, washers, spikes, nails, screws, dowels, pins, keys, and metal straps and plates. Joints used in framing—tabled and plain fish-plate, tenon-bar and shear-pin splices, lap and scarf, bearing, dovetail, mortise-and-tenon, step, angle blocks, and metal shoes—are described in chapter II, designs being worked out for the principal types. Chapter III covers wooden beams and columns, including examples of combination, deepened, and trussed beams, and columns; with explanations on the use of beams, columns, beam hangars and anchorages, post caps, and angle braces. In chapter IV, wooden roof trusses, the bay of a building is designed and detailed, including rafters, purlins, and truss. Practical examples—slow-burning mill construction, trestle construction, truss bridges, arch centering, miscellaneous structures, and an article on dry rot—are contained in chapter V. In chapter VI the subjects are: commercial grading, tests of clear timber, and allowable unit designing stresses (A.R.E.A. and U.S.F.S. tests).

Much attention to detailing is given, as it is essential that all connections and details have the same degree of security as the framed members. Too often in practice the same attention is not given to details of timber structures as would be given to those of steel structures. Realizing that a single volume cannot treat fully the broad subject of timber design and construction, the authors give numerous selected references to engineering periodicals and transactions.

REINFORCED CONCRETE CONSTRUCTION
Volume I—Fundamental Principles

By GEORGE A. HOOL, S.B.

McGraw-Hill Book Co., Inc.—380 pages—6 x 9—Boards—$3.50

This volume forms the first part of a regular course on reinforced concrete construction offered by the extension division of the University of Wisconsin and written primarily for those who desire to take up the subject by correspondence. Its practical value for self-instruction is evident by the heavy demand for the three volumes of the series, one valuable feature is the use of a standard notation throughout.

The chapter headings are: concrete; steel; concrete and steel in combination; rectangular beams; slabs, cross-beams, and girders; shear and moment considerations in continuous beams; simple rectangular flat slab floors; columns; single column footings; bending and direct stress; slab, beam, and column tables; slab, beam, and column diagrams.

PERSONAL MENTION

Amer C. Stolp became manager of the Marysville Water Co., recently bought by the California Water Service Corp., on February 6.

Donald K. Lippincott, member A.I.E.E. and I.R.E., registered patent attorney, has opened an office at 57 Post street, San Francisco.

G. A. Elliott, formerly general manager and chief engineer of the Spring Valley Water Co., San Francisco, has opened an office for general practice and consultation in engineering in the Merchants Exchange bdg., San Francisco.

F. E. Weymouth, chief engineer for the Metropolitan Water District of Southern California, is making a complete inspection of the Hetch Hetchy project and the Spring Valley water system of the city of San Francisco.

A. D. McDougall, vice-president of A. Guthrie & Co., general contractors, Portland, Oregon, and father of Natt McDougall, was honored on his 63 years in the contracting business and his recent 82nd birthday by being made a life honorary member of the Pacific Northwest Branch, A.G.C., by declamation, at the banquet during the tenth annual convention of the branch in Portland on February 15.

Nelson A. Eckart, assistant city engineer of San Francisco, has been named general manager of the entire city water department, following the purchase on February 26 of the Spring Valley Water Co. Eckart, who has been in charge of the Hetch Hetchy project under M. M. O'Shaughnessy, city engineer, will receive a yearly salary of $15,000—the same as that which O'Shaughnessy has been receiving as city engineer.

W. D. Barkhuff, city engineer of Seattle, has reorganized his department on the division plan, with three assistant city engineers of equal status. On this basis, O. A. Piper has charge of the management of the department; D. W. McMorris has charge of legal work and bridges, approves all contract documents, and gives general consulting advice; and T. H. Carver has charge of construction on the municipal water supply and hydroelectric developments. Assistant engineers in this reorganization (the district plan having been abandoned) are: C. L. Wartelle on plans and specifications and street lighting; L. R. Andrews on paving and concrete construction; I. W. Embury on sewers and grading; J. H. Quense on water supply; and H. F. Faulkner on inspection and the testing of materials.

OBITUARY

Edward A. Rix, 75, founder and president of The Rix Co., Inc., of San Francisco died at Oakland, California, on January 8. His company, founded 53 years ago, is a large manufacturer of compressed air machinery, is the agent for Cochise drills, and a distributor for Thor pneumatic tools.

Rix was born in San Francisco and was educated at the University of California, graduating with a B.A. degree in the class of '77. He was a member of the American Society of Mechanical Engineers and the American Society of Civil Engineers.

There are five survivors in the immediate family. A son, Austin, succeeds to the presidency of The Rix Co., Inc.

ASSOCIATIONS

A. W. W. A. MEMBERSHIP CAMPAIGN

Five hundred new members before the St. Louis convention is the ambitious goal set by Arthur E. Gorman, chairman of the 1930 membership committee, American Water Works Association.

The campaign in its first stage was launched the first of February with an appeal to the entire membership of A. W. W. A. for assistance in furnishing a list of 'live' prospects. The returns indicate a wide interest in the campaign by the membership, as 257 cards had been returned by February 24, recommending 2009 prospects.

The drive is being organized in co-operation with the section offices and committees in the unorganized states; it will be carried out by personal solicitation and by direct mail. The direct mail campaign to prospects will consist of five mailings beginning the third week of March and concluding two weeks before the St. Louis convention. Through section committees it is planned to personally solicit every prospect on the list, the direct mail campaign being depended on to create interest in the association and assist in the membership drive.

Among the various section and state committees, everyone interested in the association is being called on to make this campaign a success.

THE BOUCHER CO. ANNOUNCES SERVICE TO CONTRACTORS

The Boucher Co., Ltd., recently dedicated its new suite of offices in the California State Life bdg., Sacramento, and at the opening a large number of its contractor friends were entertained. The offices of the company have been arranged for

(Upper) New Main Office of the Boucher Co., Ltd., at Sacramento, California. (Lower) One of the Special Offices for the Convenience of Contractors

the special convenience of contractors, one office being furnished with all the necessary equipment contractors would use when figuring their bids.

By being located in Sacramento, the company is able to render a special service to contractors on state work, as it can handle a lot of the necessary details in connection with their bids and contracts. The Boucher Co. extends an invitation to contractors to make use of the many conveniences and services which it offers.

'Construction Week' at Portland, Oregon

'Construction Week' is a fair title for the week of February 10 to 15 at Portland, Oregon, as four important meetings were held during that period.

OREGON BUILDING CONGRESS

On February 10, the Oregon Building Congress held its annual banquet in the ballroom of the Multnomah hotel. Certificates were presented to a number of newly accredited building trades guildsmen. A revival of interest in the guild of handicrafts has been lately promoted by all sections of the building industry; the idea underlying the guild being that superfine and intelligent craftsmen should be distinguished in an appropriate manner, as an appreciation of their peculiar talents.

HIGHWAY OFFICIALS MEET

In the same week, a meeting of highway officials of Oregon, Washington, Montana, and Idaho was held at the Multnomah hotel for the purpose of developing more uniform specifications along certain lines of highway construction.

OREGON ECONOMIC CONFERENCE

On February 11, Governor Norblad assembled the economic leaders of the state of Oregon in an Oregon Economic Conference, modeled on that recently held by President Hoover, and designed to concentrate similar attention to forwarding construction and other means of tiding over the transition period of an economic change in fundamental conditions. Public officials, representatives of the various utilities, railways, banks, investment houses, contractors, supply men, labor leaders, and chambers of commerce, attended this meeting en masse. A permanent Oregon Economic Committee is designed as a result of the meeting.

TENTH ANNUAL CONVENTION, PACIFIC NORTHWEST BRANCH, A.G.C., PORTLAND, OREGON, FEBRUARY 14 AND 15, 1930

PACIFIC NORTHWEST BRANCH, A.G.C. CONVENTION

The Pacific Northwest Branch, Associated General Contractors of America, consisting of the Portland, Seattle, and Spokane Chapters, convened at the Multnomah hotel in its tenth annual meeting on February 14 and 15. The A.G.C. convention had particular interest in a number of papers and their prearranged, orderly discussion, including:

Morning Session, February 14

Otto J. Amberg, president, Pacific Northwest Branch, A.G.C., presiding.

(1). Address of Welcome by Geo. L. Baker, mayor of Portland, and response by O. J. Amberg, president, Pacific Northwest Branch, A.G.C.

(2). 'National A.G.C. Convention at New Orleans', by Wm. H. Feigenson, national director, A.G.C., Portland.

(3). 'Vocational Licensing Acts of California', by James F. Collins, director, State Department of Professional and Vocational Standards, Sacramento.

(4). 'Legislative Needs of the Construction Industry in the Pacific Northwest', by Thos. W. Holman, of Roberts, Skeel & Holman, Seattle, attorneys for the Pacific Northwest Branch. Discussion.

Afternoon Session, February 14

James Murdock, president, Seattle Chapter, A. G. C., presiding.

(5). 'Material Credit Remedies Open to the Construction Industry', by Geo. W. Herron, secretary, Building Material Dealers Credit Association, Portland. Discussion.

(6). 'Improvements Needed in Oregon Compensation Insurance Act', by W. H. Fitzgerald, commissioner, Oregon State Industrial Accident Commission, Salem. Discussion.

(7). 'Contractors' Liability Insurance Hazards', by A. O. Steuberg, Metropolitan Casualty Insurance Co., Seattle. Discussion.

(8). 'Technical Education for Construction Practices', by H. S. Rogers, dean, School of Engineering, Oregon State College, Corvallis. Discussion.

Morning Session, February 15

G. D. Lyon, president, Spokane Chapter, A.G.C., presiding.

(9). 'Two Years of Prequalification of Contractors', by W. H. Lynch, district engineer, U. S. Bureau of Public Roads, Portland. Discussion.

(10). 'Oregon Highway Program for 1930-31', by Roy A. Klein, state highway engineer, Salem.

(11). 'Washington Highway Program for 1930-31', by Samuel J. Humes, director of highways, Olympia.

(12). 'Idaho Highway Program for 1930-31', by J. D. Wood, commissioner of public works, Boise.

(13). 'The Current Study of the Columbia River by the War Department', by G. R. Lukesh, colonel, Engineer Corps, U.S.A., division engineer, Portland.

Afternoon Session, February 15

W. T. Jacobsen, president, Portland Chapter, A.G.C., presiding.

(14). 'Precision in Building and Other Construction Contracts', by J. C. Stevens, consulting engineer, Portland.

(15). 'Recent Methods in Surfacing, Curing, and Finishing Concrete Pavements and Floors', by W. G. Perrow, Portland Cement Association. (Illustrated.)

(16). 'Buildings, Bridges, and Structures Using Controlled Mix of Manufactured Concrete', by Horace Warren, of Swigert, Hart & Yett, Portland. (Illustrated.)

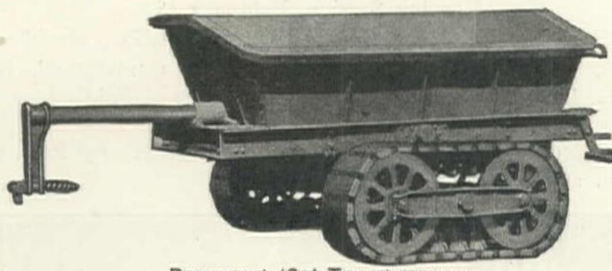
(17). 'Longview Bridge—Foundation to the Last Rivet', by E. C. Gaumnitz, of J. H. Pomeroy & Co., steel erectors, Longview, Washington. (Illustrated.)

New Equipment and Trade Notes

DAVENPORT 'CAT-TREAD' DUMP WAGONS

The Davenport Locomotive & Mfg. Corp., Davenport, Iowa, manufacturer of industrial locomotives for the past 30 years, recently announced production of a new line of crawler-type dump wagons to be marketed under the name of 'Davenport Cat-Tread Wagons'. These wagons are said to be especially adaptable for all types of earth-moving where loading is done with power shovels or elevating graders. Their large capacity, combined with the ability to operate successfully regardless of weather or surface conditions, enable them to move much greater yardage than is possible with teams, and to continue working when conditions would prohibit the use of teams and ordinary round wheel dump wagons. These wagons are designed for use with tractors of the crawler type. The large supporting area of the Cat-treads, combined with the use of Timken bearings in the wheels, make it possible to haul full loads with minimum tractive effort under adverse conditions.

Davenport cat-tread wagons at the present time are made in two sizes—5 and 7-yd., with respective weights of 8400 and



Davenport 'Cat-Tread' Wagon

10,500 lb. The capacities are based on level measure and are increased 1 to 2 yd. by an auxiliary side board which may be readily fitted to the low side of the dump body. Cat-tread wagons are now made only with bottom dump. A simple, efficient, and easily operated dumping and wind-up device is set at the rear. The dump doors drop vertically, permitting free discharge of the load and non-interference with the dumped material. Later, the manufacturer plans to add further models, including a three-way dump body for jobs where it is necessary to dump over the edge of a fill.

The main frame is a 9-in. ship channel, which provides maximum rigidity of the dump body. The axle hanger is an alloy steel casting riveted to the frame channel. To prevent bulging, a tie rod extends across the frame and is secured to the axle hangers. It is claimed that the design of the axle hangers and the materials used insure long life in service and prevent failures due to torque set up when turning, or to twisting.

Among the special construction features are: the cat-tread assembly is rugged in all details and is rated at 15 tons capacity; the tread assembly is of special analysis steel, specified because of its tough, wear resisting quality; the one-piece wheels which carry the treads are assembled in a rugged H-frame which keeps the wheels in constant alignment and prevents broken or twisted axles when operating over uneven ground.

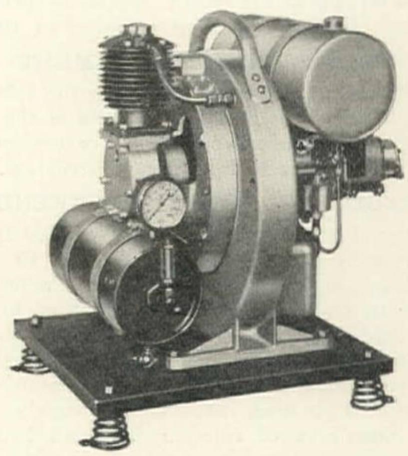
GLADDING, McBEAN & CO. APPOINTS FACKT

George B. Fackt, graduate ceramic engineer and authority on terra cotta, has been appointed assistant general manager of Gladding, McBean & Co., with offices at the Los Angeles headquarters of the company. Fackt was formerly vice-president and general manager of the Northwestern Terra Cotta Co., Chicago.

HOMELITE PORTABLE AIR COMPRESSOR AND POWER UNIT

The Homelite Corp., Port Chester, New York, has begun production on two new machines—a portable air compressor and a portable power unit.

The portable air compressor (for pressure up to 200 lb.) has a capacity of 6 c.f.m. It includes a built-in 1½-hp. Homelite air-cooled gasoline engine and weighs 85 lb. complete, the price f.o.b. Port Chester being $210. It is furnished with a



Homelite Portable Air Compressor

Bosch waterproof magneto, has a gravity feed and float type carburetor, contains only 6 moving parts, and has ball bearings throughout. This compressor is said to be ideal for operating pneumatic hammers for drilling in brick, concrete, etc.; spray painting; inflating automobile tires; and other uses.

The portable power unit is furnished as a 1½-hp. gasoline engine to take the place of a like size electric motor. It weighs 85 lb. complete with driving pulley to fit both shafts—1800 and 450 r.p.m.—and costs $175 f.o.b. Port Chester. This unit can be used to operate drills, grinding and polishing wheels, circular saws, pumps, and compressors.

O. R. PETERSON-ERSTED CO. TO HANDLE THE FORDSON TRACTOR

O. R. Peterson-Ersted Co., Ltd., 3320 Twentieth st., San Francisco, has been appointed a distributor of Fordson agricultural tractors. The company will have supervision of the territory including northern California, Nevada, and the Hawaiian Islands, and will be responsible for the appointment of dealers. The announcement is in line with a new plan of distribution, whereby the sale of Fordson tractors, formerly handled by Ford automobile dealers, is placed with dealers in farm machinery. Ford dealers, however, will continue to service the Fordson tractor.

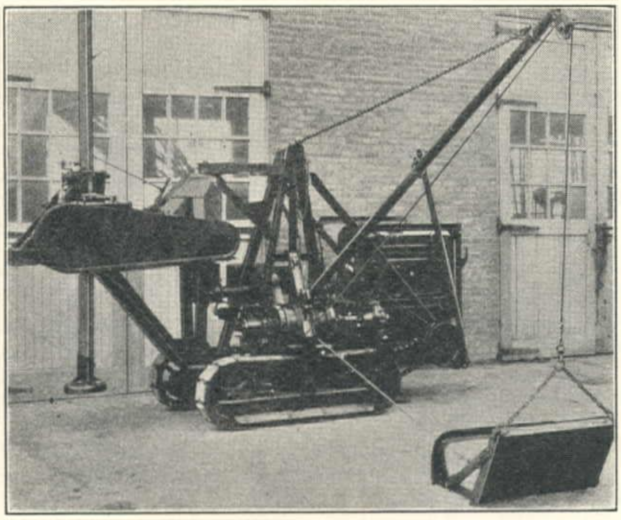
The personnel of the O. R. Peterson-Ersted Co., Ltd., includes O. R. Peterson, who has been associated with the distribution of Fordson tractors, equipment, and accessories since 1919; A. J. Ersted, who has had 20 years' experience in manufacturing machinery of various kinds, and who pioneered the front-end 'Hyster' hoist for the Fordson tractor; and H. J. Cooke, Los Angeles branch manager of the O. R. Peterson Co. from 1923 to 1926, and manager of the equipment division of B. Hayman Co., Inc., Los Angeles, from 1926 to 1929.

The tractor which soon will be ready for distribution in this section contains a number of important improvements over former models, the horsepower has been increased 27.5% and at 2¾ m. p.h. plowing speed the tractor will now develop 30 hp. Easy starting is assured by a new high-tension magneto, with impulse starter. Another feature is the addition of a pump to the cooling system, keeping the engine at the right temperature for maximum efficiency. An enlarged air washer holds 17 quarts of water, the crankcase breathing into this washer to keep fumes from reaching the driver. Other improvements include a new lubricating system with a large filter screen to separate grit and carbon from oil as it circulates in the crankcase; a stronger and longer-wearing crankshaft; a redesigned transmission; and heavier rear-wheel fenders and platforms.

CLEVELAND TAMPER-BACKFILLER

The Cleveland (Ohio) Trencher Co., for many years a manufacturer of trench-digging equipment, has announced a new, compact, and powerful machine which combines the related operations of tamping and backfilling. This machine is of special interest because by its use the necessity of tamping and backfilling with hand-labor is eliminated.

The Cleveland Tamper-Backfiller is but 58 in. extreme width, permitting it to be used in narrow and confined areas. It is mounted on full crawler tracks for ease of handling and to enable it to travel over rough ground and across excava-



Cleveland Tamper-Backfiller

tions. The backfiller, of conventional type, operates with a telescopic boom ranging in length from 14 ft. 2 in. to 20 ft. 2 in. The entire unit is self-contained and is powered by a 4-cylinder Hercules model OX gasoline engine. Backfilling and tamping speeds of 3½, 7, and 11½ ft. per min. are available, and the unit has a road speed of 5 m.p.h.

The tamping mechanism, which will work either at the center or side of the machine, consists of a 150-lb. steel tamping head that can be dropped 45 times per minute from a height of 26 in. Gear shift speed changes provide instant means of determining the number of blows struck per given distance, according to the requirements of the soil.

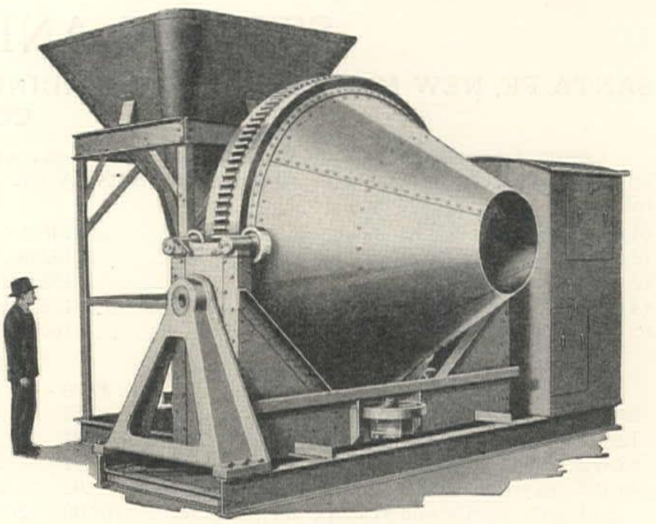
With this mechanical tamping, materials such as wet clay—exceedingly difficult to tamp by hand—are easily handled. This eliminates the hauling away of wet clay and the expense of backfilling with some other material, such as sand or gravel. Moreover, the Cleveland tamper will replace the earth so tightly that less remains to be hauled away. The usual method of tamping with the machine is to straddle the trench and tamp in the center but, where obstacles prevent this, the mechanism may be easily and quickly swung, so that the machine runs parallel with the trench and tamps at full efficiency at the side.

GENERAL PAINT CORPORATION

Through its Hill, Hubbell & Co. division, the General Paint Corp. has installed in a number of eastern plants the equipment for mechanical wrapping and coating of pipe.

SMITH 84-S TILTING MIXER

The T. L. Smith Co., Milwaukee, Wisconsin, builder of Smith mixers and pavers and now one of the independent divisions of the National Equipment Corp., featured at the Road Show the 1930 model 27-E paver and the 84-S Smith 3-yd. tilting mixer with Weigh-mix equipment. The 1930 paver follows the familiar Smith design with the fewest pos-



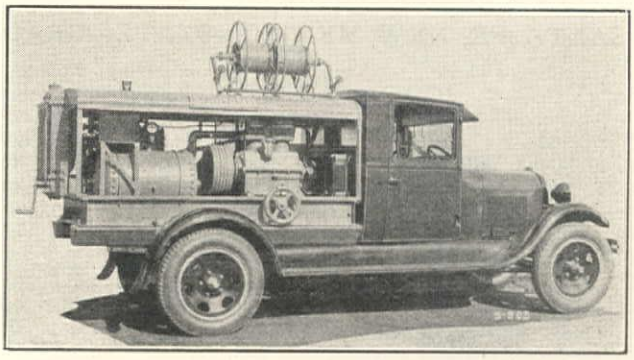
Smith 84-S Tilting Mixer with Weigh-Mix Equipment

sible parts, heavy low frame, ball and roller bearings, automatic operation, and extremely accurate water measuring. According to the manufacturers, the water measuring tank is constructed to give accurate measuring regardless of its tilt.

The new 84-S Smith tilting mixer with Weigh-mix equipment is particularly designed for central mixing plant use. It is capable of giving a full charge to a 3-yd. truck. A saving of 8 to 10 ft. in the height of the mixing plant is possible through the use of the Weigh-mix, a proportioning device to weigh the sand, stone, cement, and water. The design of the mixer includes such modern features as ball and roller bearings with complete redesign of the power tilt unit.

SCHRAMM ENGINE-DRIVEN WELDER COMPRESSOR COMBINATION

Schramm, Inc., West Chester, Pa., has produced a new engine-driven welder compressor combination for steel and tank erection contractors and also for pipe-line work, consisting of a 300-amp. welder and a 120 or 60 c.f.m. Schramm compressor mounted on a Ford truck chassis. The combina-



Schramm Engine-Driven Welder Compressor Combination

tion is built in various other sizes and mountings such as steel-wheeled truck, skidded for semi-portable and stationary installation, spring-mounted trailer, etc.

The advantage of this combination is that the preparation of the surface to be welded often requires other mechanical means—holes must be drilled or surfaces must be cleaned with the aid of drills, chipping hammers, riveters, wire brushes, emery wheels, or sand blasts.

UNIT BID SUMMARY

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

STREET AND ROAD WORK

SANTA FE, NEW MEXICO—STATE—GRADING, SURFACING AND STEEL BRIDGES—SANTA FE COUNTY

Contract awarded to Veater & Davis, El Paso, Tex., who bid $148,926 for 5.7 miles grading and surfacing and two concrete and steel bridges from Santa Fe to Canoncito, SANTA FE COUNTY, for State Highway Commission. Nine lowest bids as follows:

(1) Veater & Davis, El Paso, Tex. $148,926
(2) Lee Moor Contracting Co., El Paso, Tex. 152,602
(3) Everly & Allison, Las Vegas, Nev. 152,912
(4) Geo. W. Orr, El Paso, Tex. 155,505
(5) McClure & Sprague, Tucumcari, N. M. 160,064
(6) Platt-Rogers, Inc., Pueblo, Colo. $166,429
(7) Rawls & Wright, El Paso 168,783
(8) E. H. Honnen, Colorado Springs, Colo. 169,179
(9) H. C. Lallier, Denver, Colo. 177,429
(10) Engineers estimate 177,429

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
53 acres clearing and grubbing	30.00	30.00	30.00	50.00	15.00	50.00	15.00	60.00	50.00	80.00
82,252 cu.yd. excavation, unclassified	.55	.50	.53	.55	.60	.65	.625	.67	.65	.80
12,544 cu.yd. common excavation	.21	.30	.30	.25	.35	.30	.40	.28	.25	.20
63,472 cu.yd. common borrow	.21	.28	.24	.22	.26	.27	.28	.26	.25	.20
46,185 sta.yd. overhaul	.03	.03	.03	.03	.03	.03	.03	.03	.03	.03
5.74 mile scarify and reshape surf. courses	100.00	50.00	50.00	50.00	50.00	75.00	50.00	50.00	100.00	75.00
2,060 cu.yd. binder	.85	.80	.30	.65	.30	.30	.75	.60	.50	.85
10,425 cu.yd. cr. selected mater. in base courses	1.60	1.37	1.75	1.65	1.65	1.60	1.50	1.80	2.00	1.60
1,192 cu.yd. 'A' conc. box culverts and syphons	21.00	22.00	20.00	21.50	21.00	22.00	23.00	19.00	25.00	21.00
23 cu.yd. 'B' conc. metal culv. pipe headwalls	23.00	18.00	20.00	20.00	21.00	22.00	22.00	20.00	25.00	21.00
127,338 lb. reinf. steel conc. culv. and syphons	.055	.055	.055	.055	.055	.0475	.055	.055	.05	.06
671 lb. reinf. steel metal pipe culv. headwalls and spillways	.055	.055	.055	0.55	.055	.0475	.055	.055	.05	.06
180 lin.ft. 24-in. corr. galv. metal culv. pipe,	3.00	3.38	3.25	3.00	3.75	3.00	3.10	3.00	4.00	2.80
158 lin.ft. 30-in. corr. galv. metal culv. pipe	4.00	4.34	4.00	3.90	4.00	4.00	3.85	3.80	5.00	3.40
66 lin.ft. 36-in. corr. galv. metal culv. pipe	6.00	6.97	6.00	6.50	6.00	6.00	6.00	6.10	6.00	5.30
89 sq.yd. riprap	1.50	1.50	1.00	1.00	2.00	2.00	1.50	1.50	4.00	1.00
1 each cattle guard	650.00	675.00	700.00	750.00	650.00	700.00	550.00	600.00	800.00	350.00
200 lin.ft. woven wire guard fence	1.00	1.00	1.00	1.00	1.00	1.00	1.50	1.00	1.00	1.25
3 each reinf. conc. monuments and markers	15.00	15.00	30.00	15.00	20.00	25.00	15.00	20.00	20.00	15.00
48,135 lin.ft. galvanized barbed wire fence	.045	.05	.06	.0525	.06	.06	.05	.05	.06	.05
12 each gates	19.00	18.00	16.00	20.00	18.00	15.00	20.00	12.00	20.00	18.00
1,625 cu.yd. excavation for structures	1.00	2.00	1.75	3.00	1.75	1.50	2.50	2.10	2.00	2.00
554 cu.yd. 'A' concrete substructure	19.00	19.00	20.00	18.00	20.00	22.00	23.00	22.00	25.00	24.00
164 cu.yd. 'A' concrete superstructure	20.00	22.00	20.00	21.00	20.00	22.00	23.00	24.00	25.00	24.00
111,586 lb. reinforcing steel	.05	.055	.055	.05	.055	.0475	.055	.055	.05	.06
132,679 lb. structural steel	.045	.05	.05	.05	.05	.05	.05	.055	.05	.0525
58 cu.yd. cement rubble masonry	12.00	12.00	12.00	12.00	12.00	15.00	12.50	10.00	20.00	10.00
1,270 cu.yd. borrow for fill inside U abutments	.35	.60	.30	.40	.30	.50	.50	.30	.50	.20
19 cu.yd. cr. selected material base course	1.60	1.37	1.75	1.65	1.65	1.50	1.50	1.80	2.00	1.60

SANTA FE, NEW MEXICO—STATE—GRADING AND SURFACING—ROOSEVELT COUNTY

Contract awarded to Armstrong & Armstrong, Rowell, New Mexico, $95,819 for 15 miles grading and surfacing from Portales to Roswell, ROOSEVELT COUNTY, for State Highway Comm. Bids from:

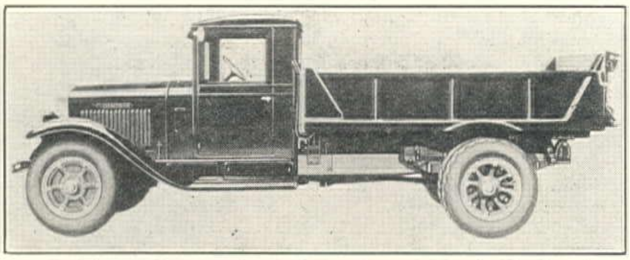
(1) Armstrong & Armstrong, Rowell, New Mexico $ 95,819
(2) Lee Moor Contracting Co., El Paso 97,479
(3) Everly & Allison, Las Vegas, New Mexico 98,540
(4) T. J. Tobin, Albuquerque, New Mexico 102,540
(5) Dudley & Amesbury, El Paso, Texas 103,261
(6) Frank Donahue, Artesia, New Mexico $108,811
(7) W. S. Pigg & Son, Denver 112,059
(8) Ed. Lemke & Co., Albuquerque, New Mexico 119,622
(9) Engineer's estimate 116,504

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
15,659 cu.yd. excavation, unclassified	.16	.18	.17	.18	.16	.20	.18	.20	.18
157,936 cu.yd. common borrow	.16	.18	.17	.18	.16	.19	.17	.18	.18
15.151 mi. scarifying and reshaping surface course	40.00	60.00	50.00	40.00	50.00	50.00	50.00	50.00	75.00
21,879 cu.yd. surface plating course	.30	.20	.25	.18	.30	.20	.29	.50	.50
35,949 cu.yd. crushed selected material, surface course	1.42	1.40	1.45	1.58	1.60	1.67	1.80	1.75	1.75
107 cu.yd. Cl. 'A' concrete box culverts and siphons	24.00	26.75	26.00	22.00	24.00	26.50	26.00	25.00	24.00
34 cu.yd. Cl. 'B' conc. metal culv. pipe headwalls	25.00	25.75	26.00	25.00	24.00	26.50	27.00	25.00	24.00
12,100 lb. reinf. steel, conc. culverts and siphons	.06	.06	.07	.055	.06	.07	.06	.07	.08
1,095 lb. reinf. steel, metal pipe culv. hdwlls. and spy	.06	.06	.07	.055	.06	.07	.06	.07	.08
518 lin.ft. corr. galv. metal culvert pipe, 24-in. diam	3.50	3.25	3.20	3.15	3.50	3.25	3.25	4.47	2.75
94 lin.ft. corr. galv. metal culvert pipe, 30-in. diam	4.25	4.00	3.92	4.00	4.20	4.00	4.00	5.15	4.00
2 each reinf. conc. monuments and markers	20.00	15.00	30.00	15.00	15.00	20.00	15.00	20.00	15.00
69,223 lin.ft. galvanized barbed wire fence	.0425	.05	.05	.05	.05	.045	.05	.08	.05
18 each gates	16.00	20.00	20.00	14.00	18.00	20.00	15.00	20.00	20.00
8,961 lin.ft. reconstructed fence	.015	.02	.02	.03	.05	.03	.03	.03	.02

INTERNATIONAL MODEL A-5, 3-TON SPEED TRUCK

The new International speed truck, model A-5, is designed to meet a wide range of hauling requirements. It is built in four wheelbases—156-in. for dump and semi-trailer service; 170, 190, and 210-in. for general hauling. The three longer wheelbases provide for maximum body lengths (back of cab) as follows: 13, 15, and 17½ ft., respectively. On the 156-in. wheelbase chassis may be mounted 2½-yd. dump bodies, 9 or 9.5 ft. long.

Outstanding among its features are the 6-cylinder engine with its 7-bearing crankshaft, 7-bearing camshaft, and removable cylinders; the single-plate clutch with built-in. vibration damper; an exclusive transmission with five speeds forward and one reverse; spiral bevel gear drive axle; mechanical four-



Model A-5 International 3-Ton Speed Truck Equipped with Dump Body

wheel brakes; heavy pressed steel-channel tapered frames.

Force-feed lubrication is employed. The gear-type oil pump, driven from the camshaft, supplies oil under pressure to all main, connecting rod, camshaft, and rocker arm bearings. All lubricant passes through the oil filter, which is of the latest type. This lubrication system contains no pipes, the drilled camshaft acting as the oil distribution manifold. The centrifugal water pump, attached directly to the cylinder head, delivers water from the radiator to the water jacket at the rate of one gallon per horsepower through the entire range of engine speed. Battery ignition is regular but, when required, high-tension magneto ignition can be supplied at additional cost. The 11-in. single-plate clutch has a built-in vibration damper which dissipates all torque reaction from the power plant and eliminates the transmission of noise from engine to rear axle.

Transmission reductions are as follows: first, 7.35:1; second, 5:1; third, 3.13:1; fourth, 1.75:1; fifth, direct, or 1:1; and reverse, 9.04:1. This feature permits high speed for cross country hauling, while the four low-speed reductions provide enormously increased pulling ability for hill climbing and negotiating sand, mud, or soft roads. Axle reductions of 7.16:1 and 6.43:1 are provided.

Service brakes are of the mechanical, internal expanding, self-energizing, 2-shoe type, operating on all 4 wheels. The exceptionally large brake drums are made of high-carbon steel machined to close limits and secured to the wheels by large heat-treated steel bolts. Inspection holes in the drums permit easy, accurate adjustment. Auxiliary rear springs, an important International truck feature, are incorporated in the design of this model.

THE 'ACE' SHOVEL

The Western Manufacturing Co., Detroit, announces a new power shovel, 'The Ace,' which was exhibited for the first time at the Atlantic City Road Show. The Ace is a full swing unit of a ⅜-yd. capacity, having many practical engineering features shown for the first time on a shovel of this capacity. The power plant is a 6-cylinder Hercules engine, model WXC, developing over 50 hp. at 1400 r.p.m., and provides more than ample power for the heaviest and most continuous service.

All shovel operations, swing, hoist, and crowd are hydraulically controlled by a single hand lever, the system being of the Lockheed type, the same as used in motor car brakes. This results not only in ease of operation and simplicity, but also eliminates all drag links, push rods, bell cranks, anchor pins, clevices and clevice pins, and for them substitutes trouble-proof copper tubing.

The brakes are applied by foot pedals and two hand levers control the caterpillar tracks.

Hoist and swing mechanism is mounted on a center steel casting with massive center bearing, permitting easy removal of drum or clutch mechanism. Any one of the four clutches may be removed without disturbing the other three. This accessibility is of distinct advantage in simplifying service.

The boom is of the extension type (from 17 to 30 ft) and is standard for all change-over units, crane, clamshell, trench hoe, dragline and magnet. A worm-driven power boom hoist is standard equipment and is controlled by hand lever and chain drive from the transmission. It is self-locking in any position. The transmission also provides two speeds in either direction for operating both the power boom hoist and the crawler tracks.

RAYMOND CONCRETE PILE CO. ANNOUNCEMENT

William Hugh Young, B. S. (CE) University of Georgia, has been appointed resident manager of the Raymond Concrete Pile Co., San Francisco, with offices in the Hunter-Dulin bdg. Young has been with the company since 1925.

CHICAGO BRIDGE & IRON WORKS EXPANDS

The Chicago Bridge & Iron Works, manufacturer of steel tanks and steel plate, has purchased the Reeves Brothers Co. plant at Birmingham, Alabama. This plant is located on a 40-acre tract, which was included in the purchase, and has a capacity of 4000 tons per month. It will be used by the Chicago Bridge & Iron Works to fabricate steel for erection at southern points and for shipment to the Pacific coast by water.

J. C. Vosburgh, formerly district sales manager at San Francisco, has been transferred to Birmingham to take charge of sales in that territory.

WIRE ROPE COMPANIES CONSOLIDATE

The American Cable Co., Inc., New York City, and the Hazard Wire Rope Co., Wilkes-Barre, Pa., both national concerns, have consolidated their forces and Pacific coast district, and are now located with their combined stocks at 425 Second st., San Francisco.

The American Cable Co. manufactures the 'Tru-Lay' brand of performed wire rope, which is in general use in the contracting and industrial fields. The Hazard Wire Rope Co. manufactures 'Olympic' brand 'Green Strand', armored (Gore patent), and improved flattened strand wire ropes.

George H. Luce, who has been Pacific coast district manager of the Hazard Wire Rope Co. and actively engaged in the wire rope business for the past 30 years, is now the directing head of both companies on the Pacific coast. E. A. Johnstone is Pacific coast manager of the American Chain Co., Inc., which is the parent company of the American Cable Co., Hazard Wire Rope Co., and various other associate companies.

C. H. & E. JOINS NATIONAL EQUIPMENT CORP.

The National Equipment Corp. announces the addition to its group of the C. H. & E. Mfg. Co., Milwaukee, manufacturer of saw rigs, pumps, hoisting machinery, material elevators, and mortar mixers. The C. H. & E. Mfg. Co. equipment is used extensively by contractors throughout the country in building operations. During the war, the firm's pumps were used overseas for draining trenches.

The National Equipment Corp., which became an operating company on January 1, 1930, includes the Koehring Co., manufacturer of pavers, mixers, power shovels, cranes, draglines, and 'dumptors'; the Insley Mfg. Co. of Indianapolis, manufacturer of excavators and concrete placing equipment; the Parsons Co., Newton, Iowa, producer of power trench excavating machinery; the T. L. Smith Co. of Milwaukee, manufacturer of mixers, pavers, and 'Weigh-mix'; and the Kwik-Mix Co. of Port Washington, manufacturer of small concrete mixers.

PORTLAND, ORE.—STATE—GRADING, SURFACING, ETC.

Bids received as follows by Oregon State Highway Commission, and action taken as stated:

(A) JACKSON AND KLAMATH COUNTIES—Contract awarded to Wren & Greenough, P.O. Box 138, Portland, $155,537 for Jenny Creek-Keno Section of Green Springs Highway, 27.1 miles roadway widening and broken stone surfacing. Bids on following items:

(1) 11,000 cu.yd. common excavation
(2) 5,000 cu.yd. solid rock excavation
(3) 50,000 sta.yd. overhaul
(4) 5,000 yd.mi. truck haul
(5) 11,000 cu.yd. selected borrow
(6) 25,000 yd.mi. haul select. borrow
(7) 300 lin.ft. 12-in. conc. pipe
(8) 280 lin.ft. 12-in. corr. pipe
(9) 24,000 cu.yd. base material
(10) 8,000 cu.yd. top material
(11) 7,000 cu.yd. screenings
(12) 6,800 cu.yd. 'A' material (stockp.)
(13) 6,800 cu.yd. 'B' material (stockp.)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	TOTALS
Wren & Greenough	.30	1.50	.02	.25	.30	.18	1.40	1.50	2.60	2.60	2.50	2.25	2.25	$155,537
W. D. Miller, Klamath Falls, Ore.	.60	1.00	.03	.25	.30	.16	1.50	1.50	2.62	2.65	2.25	2.50	2.50	159,116
Newport Const. Co.	.50	1.25	.05	.30	.40	.30	1.50	1.40	2.70	2.70	2.70	2.40	2.40	169,642
Willamette Contr. Co., Portland	.90	2.00	.10	.30	.60	.20	2.50	2.50	2.50	2.80	3.00	2.80	2.80	184,464

(B) LANE COUNTY—Contract awarded to Cochran Construction Co., 407 S. Syracuse St., Portland, Ore., $102,125 for 6.4 miles grading Glenada-Douglas County Line Section of the Roosevelt Coast Highway. Bids on following items:

(1) Clearing and grubbing
(2) 240,000 cu.yd. road. excavat.
(3) 310,000 sta.yd. overhaul
(4) 12,000 yd.mi. truck haul
(5) 1,500 lin.ft. 12-in. conc. pipe
(6) 1,300 lin.ft. 18-in. conc. pipe
(7) 320 lin.ft. 24-in. conc. pipe
(8) 250 lin.ft. 36-in. conc. pipe
(9) 1,000 lin.ft. 6-in. drain tile

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	TOTALS
Cochran Const. Co., Portland	$26,000	.25	.02	.20	1.10	2.20	3.25	6.50	.35	$102,125
Earl L. McNutt, Eugene, Ore.	31,200	.26	.02	.30	1.40	3.30	3.50	7.75	.50	113,347
Joplin & Eldon, Portland	31,000	.34	.02	.28	1.20	2.45	3.35	7.00	.40	130,367
Myers & Co., Portland	39,500	.32	.02	.20	1.40	3.00	4.25	8.50	.35	134,735
Newport Const. Co., Portland	31,800	.33	.04	.30	1.50	2.75	3.75	8.00	.50	136,525
Liesch & Tofte, Marshfield, Ore.	27,025	.37	.035	.22	1.63	3.23	4.20	8.10	.39	139,718
Myers & Goulter, Seattle	36,000	.39	.015	.25	1.40	3.00	4.00	8.00	.30	146,830
A. Guthrie & Co., Portland	30,000	.47	.03	.30	1.75	3.00	4.50	9.00	.35	166,265
United Contr. Co., Portland	33,000	.45	.04	.30	1.50	3.00	4.50	8.00	.40	166,990
J. A. Lyons, Portland	28,700	.48	.04	.30	1.25	2.50	3.50	7.50	.40	168,420
J. J. Dann, Portland	35,500	.48	.02	.25	2.00	3.00	4.50	9.00	.60	170,090

(C) CURRY COUNTY—Saxten & Looney, Corvallis, Ore., low bid at $104,332 for 10.83 miles regrading and resurfacing Denmark-Port Orford Section of the Roosevelt Coast Highway. Bids received from:

(1) Saxten & Looney, Corvallis, Ore. $104,332
(2) C. L. Camp, Medford, Ore. 109,030
(3) Hefty, Lundstrom & Johnson, Portland 114,237
(4) A. S. Wallace, Roseburg, Ore. 117,327
(5) Newport Const. Co., Portland 119,465
(6) Washburn & Hall, Portland 120,065
(7) Myers & Co., Portland $123,782
(8) H. G. Johnson, Roseburg, Ore. 132,210
(9) J. J. Dann, Portland 136,410
(10) C. R. Vaughan, Portland 139,944
(11) F. J. Kernan, Reedsport, Ore. 148,171
(12) Liesch & Tofte, Marshfield, Ore. 153,772

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Clearing and grubbing	$2200	$1000	$5500	$7200	$3600	$3500	$3700	$2000	$9500	$4550	$7500	$5000
62,000 cu.yd. common exc.	.51	.45	.47	.50	.45	.40	.48	.50	.57	.60	.50	.60
4,000 cu.yd. rock excav.	.80	1.50	.75	1.00	1.00	.90	.90	1.00	1.25	1.15	1.45	.90
37,000 sta.yd. overhaul	.03	.04	.03	.02	.03	.05	.02	.04	.05	.04	.04	.05
15,000 yd.mi. truck haul	.20	.30	.18	.30	.30	.30	.20	.25	.25	.25	.30	.22
3,000 cu.yd. select. borrow	.50	.40	.47	.50	.50	.35	.40	.65	.50	.50	.30	.45
5,000 yd.mi. haul borrow	.20	.20	.18	.20	.20	.20	.20	.25	.25	.25	.27	.22
35 M ft. b.m. lumber	37.50	40.00	80.00	60.00	80.00	60.00	60.00	80.00	65.00	70.00	70.00	60.00
750 ft. 12-in. conc. pipe	1.50	1.50	1.60	1.15	1.25	1.50	1.50	2.50	1.90	2.00	2.25	1.63
960 ft. 18-in. conc. pipe	2.50	2.50	2.80	2.25	2.50	3.00	3.00	3.50	3.00	3.50	3.25	3.23
18,000 cu.yd. base surf.	.80	.80	.94	1.00	1.26	1.20	1.20	1.28	1.10	1.34	1.54	1.635
4,500 cu.yd. top surface	.90	.90	1.00	1.00	1.26	1.20	1.25	1.28	1.10	1.39	1.54	1.625
5,000 yd. 1½-1-in. material (stockpiles)	.70	1.00	.98	.85	1.00	1.10	1.05	1.20	.85	1.17	1.54	1.65
5,000 yd. 1-½-in. material (stockpiles)	.70	1.00	.98	.90	1.00	1.10	1.20	1.25	.85	1.22	1.54	1.65
6,200 cu.yd. ½-⅛-in. material (stockpiles)	.70	1.00	.90	.95	1.00	1.20	1.25	1.25	.95	1.30	1.54	1.65
1,500 cu.yd. 1½-⅛-in. material (stockpiles)	.70	1.00	.94	.85	1.00	1.20	1.20	1.25	.85	1.17	1.54	1.65
70,000 yd.mi. haul (truck measure)	.16	.15	.16	.15	.14	.18	.17	.17	.20	.16	.16	.18
50,000 yd.mi. haul (pile measure)	.17	.18	.18	.17	.16	.18	.19	.20	.22	.18	.17	.18

(D) UNION AND UMATILLA COUNTIES—Contract awarded to H. G. Johnson, Roseburg, Ore., $108,670 for 14.5 miles broken stone resurfacing Kamela-Hilgard Sect. of Old Oregon Trail. Bids on main items:

(1) 22,000 cu.yd. subbase material
(2) 15,000 cu.yd. base material
(3) 4,700 cu.yd. top material
(4) 5,000 cu.yd. key materials
(5) 5,500 cu.yd. screenings
(6) 11,500 cu.yd. 2½-1½-in. material (stockpiles)
(7) 4,500 cu.yd. 1-1½-in. material (stockpiles.
(8) 4,800 cu.yd. ½-⅛-in. material (stockpiles)
(9) 105,000 yd.mi. haul broken stone (truck measure)
(10) 10,000 yd.mi. haul broken stone (pile measure)
(11) 4,000 cu.yd. earth filler
(12) 12,000 yd.mi. filler haul

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	TOTALS
H. G. Johnson, Roseburg	1.15	1.20	1.20	1.20	1.20	1.00	1.00	1.10	.17	.20	.40	.20	$108,670
A. L. Aukamp, Yakima, Wn.	1.25	1.25	1.25	1.25	1.25	.85	.85	.85	.20	.20	.25	.20	111,410
F. G. Redmon, Yakima, Wn.	1.25	1.25	1.25	1.25	1.25	1.25	1.25	1.25	.16	.25	.50	.16	116,290
Knute Lien, LaGrande	1.35	1.35	1.35	1.35	1.35	1.15	1.15	1.15	.16	.16	.25	.16	117,094
Lyon & Price, Spokane, Wn.	1.27	1.27	1.27	1.27	1.27	1.27	1.27	1.27	.17	.30	.25	.20	119,080
Wren & Greenough	1.45	1.45	1.45	1.55	1.55	1.15	1.15	1.15	.18	.18	.25	.18	126,092
Triangle Construction Co., Spokane, Wn.	1.32	1.40	1.40	1.40	1.60	1.10	1.40	1.90	.18	.18	.30	.20	127,262
J. J. Dann, Portland	1.53	1.53	1.53	1.53	1.53	1.08	1.08	1.08	.22	.22	.45	.22	135,058
Gerber & Doherty, Oregon City, Ore.	1.65	1.65	1.65	1.65	1.65	1.18	1.18	1.18	.17	.18	.30	.18	136,356
Milne & Dussault, Portland	1.50	1.50	1.50	1.50	1.50	1.50	1.50	1.50	.19	.20	.50	.20	137,830
C. Nyberg, Spokane, Wn.	1.67	1.67	1.67	1.67	1.67	1.15	1.15	1.25	.20	.22	.45	.20	141,562
Newport Construction Co., Portland	1.80	1.80	1.80	1.80	1.30	1.30	1.30	1.30	.18	.20	.30	.20	146,980
J. W. Feak, Tacoma, Wn.	1.93	1.93	1.93	1.93	1.93	1.62	1.62	1.62	.175	.19	.30	.20	160,793
Joslin & McAllister, Spokane	2.05	2.05	2.05	2.05	2.05	1.80	1.80	1.80	.20	.20	.30	.20	173,030

SACRAMENTO, CALIF.—STATE—CALAVERAS COUNTY—GRADING AND SURFACING

Larsen Bros., Box 274, Galt, who bid $45,494, low to California Division of Highways for 2.8 mi. grading and surfacing from 1½ mi. north to 1½ mi. south of Calaveritos Creek, CALAVERAS COUNTY. Bids from:

(1) Larsen Bros., Galt $45,494
(2) Mathews Const. Co., Sacramento 48,803
(3) Chigris & Sutsos, S. F. 50,087
(4) W. H. Hauser, Oakland 53,582
(5) Tieslau Bros., Berkeley 56,407
(6) Hemstreet & Bell, Marysville 55,660
(7) W. C. Colley, Berkeley 56,776
(8) M. J. Bevanda, Stockton $56,786
(9) Kennedy-Bayles Const. Co., Oakland 57,714
(10) A. J. & J. L. Fairbanks, South San Francisco 58,963
(11) A. Teichert & Son, Sacramento 62,105
(12) Lord & Bishop, Sacramento 67,586
(13) Average bid 55,800

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)
6.6 acres clearing and grubbing	$100	$110	$150	$350	$125	$150	$210	$250	$200	$125	$200	$260	$186
42,000 cu.yd. excavation	.48	.54	.61	.48	.55	.68	.70	.64	.65	.65	.66	.85	.625
50,000 sta.yd. overhaul	.01	.01	.01	.02	.015	.02	.015	.02	.01	.01	.01	.02	.014
575 cu.yd. structure excavation	1.25	1.25	1.75	2.00	1.25	1.50	2.00	1.50	2.00	1.25	1.60	2.25	1.63
3,330 cu.yd. un. cr. gravel or stone surf.	2.00	2.40	1.90	2.65	2.90	2.25	2.10	2.40	2.27	3.00	3.15	2.37	2.45
3,670 cu.yd. crusher run base	2.00	2.20	1.00	2.40	3.25	2.00	2.00	2.40	2.47	2.50	2.90	2.37	2.29
69 cu.yd. 'A' cem. conc. (structures)	24.50	24.00	22.50	30.00	25.00	25.00	24.00	24.00	30.00	29.50	26.00	29.00	26.10
4,350 lb. reinf. steel (structures)	.06	.06	.07	.06	.06	.06	.06	.05	.06	.06	.06	.07	.06
310 ft. 8-in. corr. metal pipe	.30	.50	.40	.30	.50	.50	.30	.50	.50	.40	.50	.50	.43
1,102 ft. 18-in. corr. metal pipe	.50	.70	.50	.50	.50	.65	.60	.50	.75	.55	.60	.75	.59
180 ft. 24-in. corr. metal pipe	.75	.85	.65	.70	.60	.75	.80	1.00	1.00	.75	.75	1.00	.80
50 ft. 30-in. corr. metal pipe	1.00	1.10	.75	1.00	.75	1.00	1.25	1.00	1.25	1.00	1.25	1.50	1.07
24 ft. 36-in. corr. metal pipe	1.25	1.25	1.00	1.50	1.00	1.00	1.50	1.00	1.50	1.20	1.75	2.00	1.33
72 ft. 42-in. corr. metal pipe	1.50	2.00	1.25	1.75	1.25	1.25	2.00	1.00	2.00	1.50	2.00	2.50	1.67
1.6 mi. new property fence	$450	$300	$525	$400	$450	$400	$500	$400	$550	$555	$575	$600	$476
2.4 mi. new hog-tight fence, Type 'A'	$700	$310	$525	$600	$500	$600	$600	$650	$650	$760	$800	$800	$625
1.6 mi. new hog-tight fence, Type 'B'	$700	$340	$525	$700	$675	$600	$700	$700	$750	$800	$900	$860	$687
6.7 M ft. b.m. sel. all-heart redwood timb.	95.00	88.00	85.00	$110	$120	95.00	$103	$110	$115	$100	96.00	$100	$101
9 M ft. b.m. redw. timb, all-heart struc.	90.00	79.00	85.00	$100	$120	85.00	98.00	$100	$115	95.00	92.00	$100	97.00
250 M gal. water applied to surfacing	2.50	2.00	2.00	3.00	2.00	2.00	1.50	2.50	2.50	2.00	3.00	3.00	2.33
149 stations finishing roadway	5.00	7.50	6.00	15.00	6.00	7.50	8.00	5.00	5.00	6.00	4.00	5.00	6.67
75 each monuments	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	4.00	3.00	2.50	3.00	3.04

HELENA, MONT.—STATE—OIL SURFACING—BEAVERHEAD, MADISON AND SILVER BOW COUNTIES

Contract awarded to C. A. Wagner Const. Co., Sioux Falls, So. Dakota, who bid $218,049 for 59 miles oil surfacing Dillon-Butte Road, Sections A, B, C, and D, in BEAVERHEAD, MADISON and SILVER BOW COUNTIES for State Highway Comm. Bids received from:

(1) C. A. Wagner Const. Co., Sioux Falls, S. D. $218,049
(2) Nolan Bros., Minneapolis, Minn. 227,199
(3) J. C. McGuire & L. T. Lawler, Butte, Mont. 228,009
(4) Wm. Hoops, Twin Falls, Idaho 232,767
(5) Stevens Bros., St. Paul, Minn. 234,943
(6) F. R. Hewitt, Spokane, Wash. $235,345
(7) Morrison-Knudsen Co., Boise, Idaho 243,089
(8) Lyon & Price and J. C. Compton 261,101
(9) S. J. Groves & Sons, Minneapolis 281,410
(10) Engineers estimate 219,102

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
1,028,000 gal. application of oil	.224	.0275	.02	.015	.025	.01	.026	.021	.025	.015
59.034 mile processing	$593	$333	$750	$845	$465		$630	$650	$750	$160
60,317 cu.yd. cr. gr surf. in top cor.	1.56	1.70	1.55	1.79	1.90	1.60	1.71	1.95	2.10	1.75
30,855 cu.yd. cr. gr. surf. in base cor.	1.56	1.60	1.55	1.21	1.535	1.45	1.66	1.95	1.80	1.60
3,736 cu.yd. gravel sub-base	.66	.75	.85	1.00	1.25	1.45	1.10	1.50	1.00	.75
8,950 cu.yd. binder	.20	.75	.40	.50	.12	.40	.45	.35	1.00	.40
8,950 cu.yd.mi. overhaul on binder	.20	.25	.25	.25	.12	.25	.23	.25	.20	.24
10,590 lin.ft. wire cable guard rail	.49	.80	.60	.65	.475	.50	.90	.55	.60	.60
4,200 cu.yd. stock piled gravel	1.56	1.70	1.55	1.15	1.90	1.60	1.21	1.50	2.00	1.60

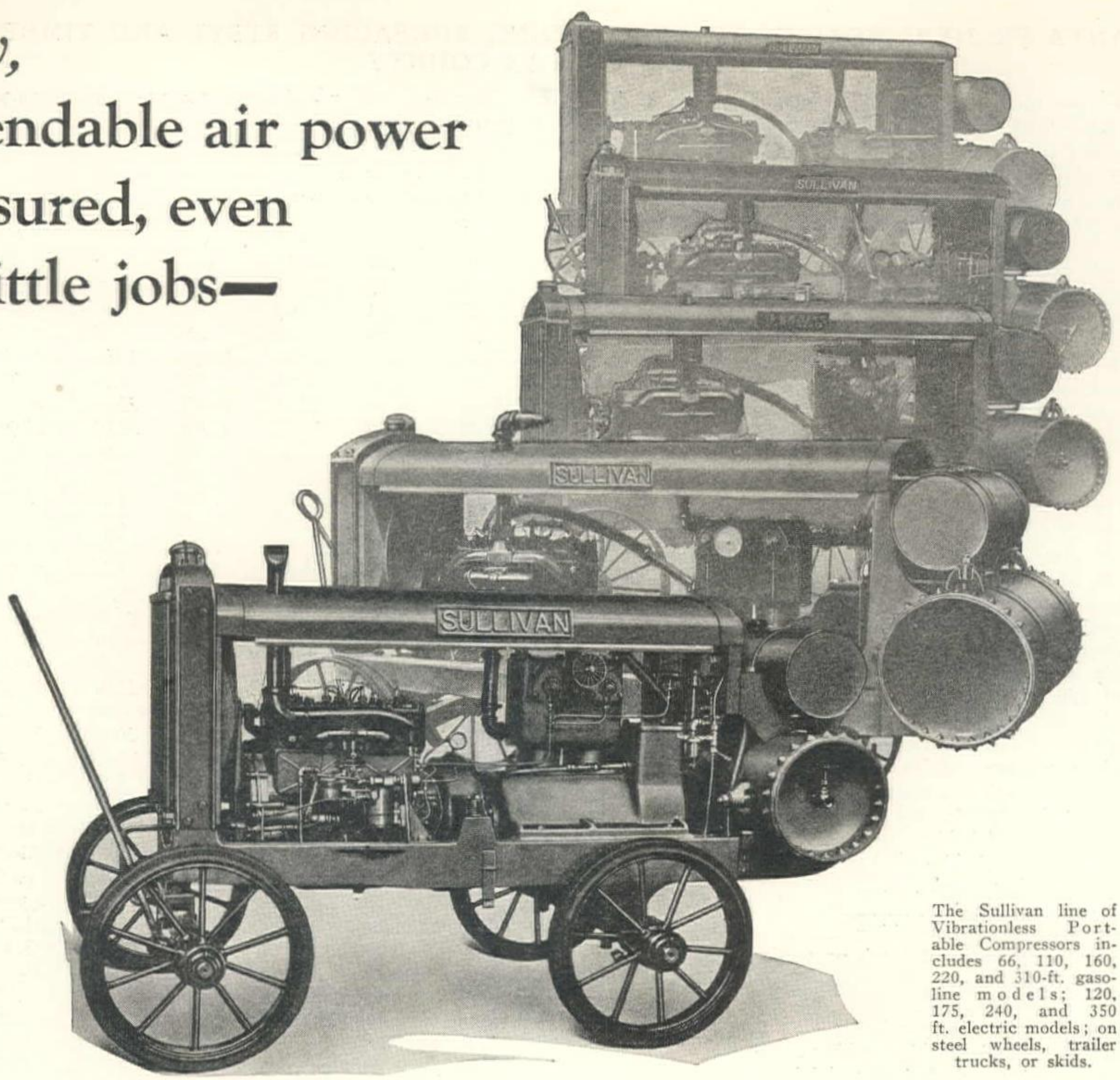
SANTA FE, NEW MEXICO—STATE—SANDOVAL COUNTY—GRADING, SURFACING AND STEEL BRIDGES

Contract awarded to Veater & Davis, El Paso, Tex., $193,002 for grading and surfacing 7.5 miles from Algdones to Domingo, and constructing three steel bridges in SANDOVAL COUNTY, for New Mexico State Highway Commission. Bids from:

(1) Veater & Davis, El Paso, Tex. $193,002
(2) T. J. Tobin, Albuquerque, N. M. 197,607
(3) Mt. States Const. Co., Pueblo, Colo. 200,266
(4) Armstrong & Armstrong, Roswell, N. M. 211,157
(5) Geo. Orr, El Paso, Tex. 211,700
(6) E. H. Honnen, Colorado Springs, Colo. 216,486
(7) John Mulligan, El Paso, Tex. 222,157
(8) Platt-Rogers, Inc., Pueblo, Colo. $222,685
(9) McClure & Sprague, Tucumcari, N. M. 230,868
(10) Lee Moor Contracting Co., El Paso 234,729
(11) Rawls & Wright, El Paso 237,344
(12) Yancy Const. Co., Abilene, Kansas 241,691
(13) Reynolds & Sutton, Tyler, Tex. 260,593
(14) Engineer's estimate 214,300

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)
158,067 cu.yd. excavation, unclassified	.20	.22	.19	.25	.27	.28	.345	.27	.38	.40	.35	.88	.39	.19
65,277 cu.yd. common borrow	.20	.19	.19	.25	.20	.18	.19	.20	.26	.21	.25	.25	.26	.17
288,824 sta.yd. overhaul	.03	.03	.03	.03	.03	.03	.03	.03	.03	.03	.03	.03	.03	.03
7.3 mi. scarifying and reshaping surf. course	$100	50.00	75.00	40.00	55.00	50.00	75.00	75.00	50.00	50.00	50.00	50.00	60.00	85.00
10,562 cu.yd. base course for oil processed surf.	1.30	1.20	1.50	1.65	1.45	1.50	1.25	1.50	1.50	1.25	1.30	1.65	2.00	1.60
2,628 cu.yd. binder	1.00	1.00	.90	.85	.65	1.00	.70	.60	.50	.75	.72	1.65	1.50	.85
1,000 cu.yd. Class 'A' concrete box culv. and siphons	20.00	18.00	18.20	20.50	21.50	18.50	19.00	23.00	19.00	20.50	22.50	23.00	21.50	20.00
102,166 lb. reinf. steel-conc. box culv. and siphons	.05	.05	.0555	.045	.055	.055	.05	.05	.055	.055	.055	.05	.055	.06
1 each reinf. conc. monuments and markers	15.00	15.00	22.00	15.00	15.00	25.00	15.00	25.00	20.00	15.00	15.00	20.00	15.00	15.00
78,349 lin.ft. galvanized barbed wire fence	.04	.05	.055	.045	.0525	.05	.05	.055	.06	.048	.0475	.045	.055	.05
14 each gates	18.00	14.00	15.00	14.00	20.00	12.00	18.00	15.00	18.00	18.00	20.00	15.00	20.00	18.00
4,732 cu.yd. excavation for structures	.75	1.00	.75	1.50	.65	.80	1.50	1.50	.70	.80	1.50	2.25	2.00	2.00
1,331 cu.yd. Class 'A' concrete substructure	18.00	22.00	18.60	19.00	20.00	18.80	19.00	23.00	20.00	20.50	23.00	20.00	21.50	23.00
860 cu.yd. Class 'A' concrete superstructure	20.00	19.00	21.90	22.50	23.00	22.00	21.00	23.00	19.00	23.00	23.00	20.00	21.50	23.00
298,484 lb. reinforcing steel	.05	.05	.0555	.044	.045	.055	.05	.05	.055	.055	.055	.05	.055	.06
512,911 lb. structural steel	.045	.0445	.051	.044	.045	.055	.05	.05	.0475	.05	.05	.042	.0575	.05
3,450 lin.ft. piling bank protection	1.35	1.10	1.45	1.20	1.50	1.50	1.40	1.00	1.25	1.50	1.35	1.60	1.25	1.50
8,302 lb. wire fabric bank protection	.10	.09	.12	.14	.11	.12	.10	.10	.10	.10	.10	.05	.10	.11
1,180 cu.yd. brush and rock bank protection	2.00	2.00	3.20	2.00	3.00	3.20	2.40	2.00	3.00	1.75	1.00	2.00	4.00	2.00
893 cu.yd. excavation for bank protection	1.00	1.00	.60	.60	.40	.50	1.00	.40	.55	.40	.50	1.00	1.00	.50
398 cu.yd. excavation for blanket protection	1.00	1.00	.50	.75	.50	.50	1.00	.40	.50	.40	.50	1.00	1.00	.50
115 cu.yd. Class 'A' concrete blanket prot.	18.00	21.00	13.55	15.00	17.50	15.00	15.00	20.00	13.50	16.00	16.50	18.00	20.00	15.50
1,500 lb. wire fabric blanket protection	.10	.10	.045	.14	.11	.05	.10	.10	.05	.07	.10	.04	.10	.10

Now, dependable air power is assured, even on little jobs—



The Sullivan line of Vibrationless Portable Compressors includes 66, 110, 160, 220, and 310-ft. gasoline models; 120, 175, 240, and 350 ft. electric models; on steel wheels, trailer trucks, or skids.

—Sullivan Adds the 66-ft. Vibrationless Compressor

Vibrationless Portable Compressors have given a new meaning to dependable air power service.

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You will find this new compressor a real profit maker on small jobs of rock drilling, spray painting, concrete or asphalt cutting, clay digging, tamping, riveting, caulking, cleaning—wherever a small amount of work is to be done with air, or where tools will be run intermittently.

Details of the New Vibrationless Compressor

The 66-foot "WK-312" has two cylinders 4¾x4 inches—is run by an 18 H.P. engine, and is good for 100 lbs. pressure.

It may be mounted on steel wheels (wt. 2500 lbs.) spring mounting with rubber tires; skids or two-wheel trailer.

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Vibrationless Compressor Catalog, No. 483-F.

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SANTA FE, NEW MEXICO—STATE—GRADING, SURFACING, STEEL AND TIMBER BRIDGES—COLFAX COUNTY

Contract awarded to Veater & Davis, El Paso, Tex., $137,227 for 13 miles grading and surfacing, and constructing steel and timber bridge, COLFAX COUNTY, for State Highway Comm. Bids from:

(1) Veater & Davis, El Paso, Tex. $137,227
(2) T. J. Tobin, Albuquerque, N. M. 150,747
(3) Mountain States Const. Co., Pueblo, Colo. 167,910
(4) McClure & Sprague, Tucumcari, N. M. 169,805
(5) Pople Bros., Trinidad, Colo. $178,290
(6) L. E. Smith & Co., Denver, Colo. 198,343
(7) Engineers estimate 179,814

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
61,467 cu.yd. excavation, unclassified	.19	.30	.32	.35	.35	.40	.40
115,019 cu.yd. common borrow	.19	.19	.23	.22	.20	.25	.20
6,886 sta.yd. overhaul	.03	.03	.03	.03	.03	.03	.03
507 mi.yd. overhaul	.20	.50	.30	.25	.30	.70	.20
13.7 mile scarifying and reshaping surface course	75.00	50.00	$100	50.00	$100	$100	75.00
24,688 cu.yd. cr. selected material base course oil processed	1.20	1.20	1.65	1.50	1.60	1.95	1.70
621 cu.yd. 'A' concrete box culverts and syphons	20.00	21.50	22.50	25.00	20.00	26.00	28.00
84 cu.yd. 'B' concrete metal pipe culvert headwalls	22.00	23.00	22.50	25.00	22.00	26.00	28.00
68,815 lb. reinf. steel concrete culv. and syphons	.05	.05	.06	.055	.06	.06	.07
2,579 lb. reinf. steel metal pipe culv. headwalls and spillways	.06	.05	.06	.055	.06	.06	.07
96 lin.ft. 18-in. corr. galv. metal culvert pipe	2.00	1.85	2.20	3.00	2.20	2.25	2.00
804 lin.ft. 24-in. corr. galv. metal culvert pipe	2.80	2.75	3.00	3.00	2.50	3.25	2.80
266 lin.ft. 30-in. corr. galv. metal culvert pipe	3.35	3.25	3.50	3.75	4.00	4.00	3.40
96 lin.ft. 36-in. corr. galv. metal culvert pipe	5.25	5.25	5.50	5.50	5.50	7.00	5.25
786 sq.yd. concrete pavement, spillways	2.75	2.75	2.80	2.50	6.00	3.00	3.50
36 cu.yd. 'B' concrete, spillways	19.00	21.00	22.00	16.00	20.00	30.00	28.00
1 each cattle guard	$650	$650	$650	$650	$100	$700	$700
220 lin.ft. woven wire fence guard	1.00	1.00	.90	1.00	.70	1.00	1.25
2 each reinf. concrete monument and markers	15.00	15.00	25.00	20.00	25.00	25.00	15.00
84,484 lin.ft. galv. barbed wire fence	.045	.05	.06	.06	.06	.06	.05
20 each gates	18.00	14.00	18.00	18.00	20.00	25.00	20.00
37,277 lin.ft. reconstructed fence	.02	.03	.04	.02	.03	.04	.03
1,286 cu.yd. excavation for structures	.80	2.75	1.00	2.00	2.50	5.00	2.00
333 cu.yd. 'A' concrete, substructure	19.00	23.00	24.50	26.00	35.00	26.00	26.00
119.7 M b.m. treated bridge timber superstructure	$140	$140	$130	$154	$165	$160	$155
22.8 M b.m. treated bridge timber substructure	$135	$145	$130	$154	$165	$160	$155
22,866 lb. reinforcing steel	.05	.05	.06	.055	.06	.06	.07
76.000 lb. structural steel	.08	.10	.084	.085	.0925	.08	.08
2,865 lin.ft. treated timber piling	1.40	1.20	1.35	1.55	1.75	1.75	1.50
377 cu.yd. brush and rock bank protection	2.50	3.00	3.00	3.00	7.00	5.00	2.00
90 cu.yd. 'C' concrete	18.00	18.00	21.00	16.00	20.00	26.00	24.00
369 cu.yd. earth fill	.35	.60	1.00	1.00	1.00	.50	.25
870 lb. galvanized wire mesh	.10	.10	.12	.10	.25	.20	.12
1,070 lin.ft. woven wire bridge railing	.90	.90	.90	.90	.75	1.00	1.10
141 cu.yd. crushed selected material base course	1.50	1.20	1.65	1.50	1.60	1.95	1.70

SANTA FE, NEW MEXICO—STATE—UNION COUNTY—GRADING AND SURFACING

Contract awarded to Everly & Allison, Las Vegas, N. M., $193,029, for 18 miles grading and surfacing from Des Moines to Grenville, UNION COUNTY. Bids received from:

(1) Everly & Allison, Las Vegas, N. M. $193,029
(2) Pople Bros., Trinidad, Colo. 193.579
(3) Veater & Davis, El Paso, Tex. 206.791
(4) McClure & Sprague, Tucumcari, N. M. 207,929
(5) J. W. Zempter & Co., Amarillo, Tex. $230,296
(6) L. E. Smith & Co., Denver, Colo. 418,373
(7) Engineer's estimate 210,511

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
23,685 cu.yd. excavation, unclassified	.40	.35	.70	1.00	.70	1.50	.35
221.996 cu.yd. common borrow	.24	.20	.24	.23	.25	.70	.22
179,068 sta.yd. overhaul	.03	.03	.03	.03	.03	.03	.03
8,166 mi.yd. overhaul	.20	.20	.15	.25	.32	.80	.25
18.4 mi. scarifying and reshaping surf. course	40.00	$100	$100	50.00	$100	$100	75.00
38.860 cu.yd. crushed selected material surf. course	1.55	1.80	1.75	1.50	2.10	3.40	1.95
882 cu.yd. Cl. 'A' concrete box culv. and siphons	22.00	20.00	22.00	23.00	25.00	28.00	26.00
20 cu.yd. Cl. 'B' conc. metal culv. pipe headwalls	22.00	20.00	21.00	23.00	26.00	28.00	26.00
94,452 lb. reinf. steel, conc. box culv. and siphons	.055	.06	.055	.055	.05	.06	.07
642 lb. reinf. steel, metal pipe culv. hdwlls. and spwy.	.055	.06	.055	.055	.05	.06	.06
334 lin.ft. corr. galv. metal culvert pipe, 24-in. dia.	3.60	2.50	3.30	3.20	2.75	3.50	2.85
426 sq.yd. riprap	.75	2.00	1.00	2.00	.60	2.00	1.00
1 each reinf. concrete monuments and markers	30.00	25.00	15.00	20.00	15.00	25.00	15.00
169.772 lin.ft. galvanized barbed wire fence	.055	.06	.05	.065	.05	.07	.05
40 each gates	15.00	15.00	18.00	18.00	15.00	20.00	18.00
10.343 lin.ft. reconstructed fence	.03	.04	.025	.03	.015	.04	.03
1.159 cu.yd. excavation for structures	1.50	1.00	1.30	.75	2.50	5.00	2.50
196 cu.yd. Cl. 'A' concrete substructure	21.00	20.00	21.00	21.00	22.00	28.00	24.50
220 cu.yd. Cl. 'B' concrete substructure	18.00	20.00	16.00	21.00	22.00	28.00	13.50
70.5 M b.m. treated bridge timber superstructure	$140	$140	$135	$153	$155	$160	$150
24.4 M b.m. treated bridge timber substructure	$140	$140	$140	$153	$155	$160	$150
23 867 lb. reinforcing steel	.055	.06	.055	.055	.05	.06	.07
197 cu.yd. rock fill	1.00	3.00	1.00	2.00	1.50	2.00	1.50
648 lin.ft. woven wire bridge railing	1.00	.70	1.00	.90	.85	1.00	1.10
110 cu.yd. cr. selected material surface course	1.55	1.80	1.75	1.50	2.10	3.40	1.95

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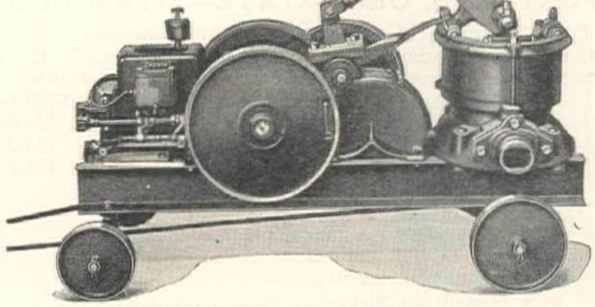

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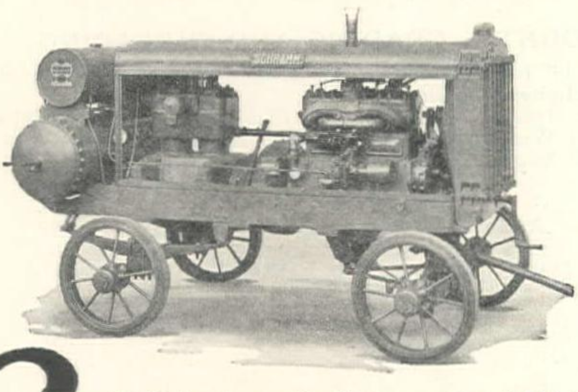

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SEATTLE, WASH.—CITY—CONCRETE—SIXTEENTH AVE. NORTHEAST

Contract awarded to Fiorito Bros., 3950 6th Ave. Northwest, Seattle, Wash., who bid $121,554 for improvement of 16th Ave. Northeast for City. Bids from three lowest bidders on main items as follows:

(1) 14,400 cu.yd. subgrading
(2) 3,280 lin.ft. armored intr. curb, 'A'
(3) 30,880 lin.ft. integral curb, 'A'
(4) 40,900 sq.yd. 6-in. conc. paving
(5) 15,840 sq.yd. 7-in. conc. paving
(6) 1,200 sq.yd. conc. alley crossings
(7) 2,880 lin.ft. 6-in. side sewers, vitr.
(8) 8,325 lin.ft. 8-in. cast-iron pipe, 'B'
(9) 440 lin.ft. 8-in. cast-iron pipe, 'C'
(10) 17 6-in. hydrants

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	TOTALS
Fiorito Bros., Seattle	.27	.40	.15	1.24	1.39	1.20	.90	1.44	1.50	114.00	$121,554
N. Fiorito, Seattle	.20	.35	.15	1.30	1.45	1.30	.80	1.35	1.44	114.00	121,870
J. B. Covello, Seattle	.25	.40	.18	1.30	1.50	1.30	.75	1.35	1.44	117.00	126,897

PORTLAND, ORE.—STATE—BITUMINOUS MACADAM SURFACING—KLAMATH COUNTY

J. C. Compton, McMinnville, Oregon, who bid $130,142, low bid to Oregon State Highway Commission, Portland, Oregon, for 43.6 miles bituminous macadam wearing surface in KLAMATH COUNTY, on The Dalles-California, Green Springs, and Klamath Falls-Lakeview Highways. Bids received from the following concerns:

(1) J. C. Compton, McMinnville $130,142
(2) J. F. Forbes, Olympia, Wash. 130,662
(3) Geo. French, Jr., Stockton, Calif. 133,283
(4) Skeels & Graham Co., Roseville 151,765
(5) Dunn & Baker, Klamath Falls $152,257
(6) J. W. Feak Const. Co., Tacoma, Wn. 155,498
(7) Guy F. Pyle, Eugene, Oregon 161,700

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
UNIT NO. 1—TYPE B3							
14.4 mi. preparing base macadam	50.00	$150	$100	$275	75.00	65.00	50.00
15,500 cu.yd. place min. aggregate	1.10	.44	.78	.90	1.15	1.40	1.20
34,000 yd.mi. haul min. aggregate	.20	.34	.18	1.75	.35	.38	.40
1,030 tons asphalt in place	25.50	30.00	29.90	32.50	28.00	25.00	30.00
UNIT NO. 2—TYPE B3							
4 mi. preparing base macadam	50.00	$150	$100	$275	75.00	65.00	50.00
4,300 cu.yd. place min. aggregate	1.10	.44	.78	.90	1.15	1.40	1.20
7,800 yd.mi. haul min. aggregate	.20	.34	.18	.18	.35	.38	.40
290 tons asphalt in place	25.50	30.00	29.90	30.50	28.00	25.00	30.00
UNIT NO. 3—TYPE B1							
10.2 mi. preparing base macadam	50.00	$150	$150	$350	75.00	65.00	50.00
6,250 cu.yd. place min. aggregate	1.15	.44	.78	.90	1.15	1.40	1.20
13,700 yd.mi. haul min. aggregate	.20	.34	.18	.18	.35	.38	.40
440 tons asphalt in place	25.00	30.00	29.90	32.50	28.00	25.00	30.00
UNIT NO. 4—TYPE B2							
15 mi. preparing base macadam	$125	$150	$300	$350	$150	$115	$150
200 M gal. sprinkling	2.50	5.00	2.50	5.00	4.00	3.00	3.00
12,700 cu.yd. place min. aggregate	1.10	.44	.78	1.00	1.15	1.40	1.20
25,300 yd.mi. haul min. aggregate	.20	.34	.18	.20	.35	.38	.40
860 tons asphalt in place	26.00	30.00	32.00	24.00	29.00	26.00	30.00

SACRAMENTO, CALIF.—STATE—CALAVERAS COUNTY—SURFACING

Contract awarded to Beerman & White, Builders Bdg., Stockton, $67,956 for surfacing with untreated gravel or stone from Murphy to Big Trees, CALAVERAS COUNTY, for California Division of Highways. Bids on:

(1) 15,200 cu.yd. gravel or stone surfacing
(2) 6,000 cu.yd. rock and screenings (stockpiles)

	(1)	(2)	TOTALS
Beerman & White, Stockton	3.33	2.89	$67,956
Chas. Harlowe, Jr., Oakland	3.22	3.17	67,964
Hemstreet & Bell	3.20	3.40	69,040
Larsen Bros., Galt	3.20	3.50	$69,640
W. H. Hauser, Oakland	3.40	3.40	72,080
M. J. Bevanda, Stockton	3.58	3.70	76,616

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

Contract awarded to J. N. Tedford, Fallon, Nevada, who bid $88,140 for 22.24 miles in PERSHING COUNTY from Woolsey to 2 miles south of Humboldt House, for State Department of Highways. Bids from:

(1) J. N. Tedford, Fallon, Nevada $ 88,140
(2) A. D. Drumm, Jr., Fallon, Nevada 91,858
(3) Dodge Bros., Inc., Fallon, Nevada 94,673
(4) Nevada Rock & Sand Co., Reno 100,354
(5) Isbell Construction Co., Carson City, Nevada $106,009
(6) Wm. Hoops, Twin Falls, Idaho 112,104
(7) Engineer's estimate 118,466

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
128,000 cu.yd. excavation	.20	.12	.20	.24	.25	.265	.30
59.122 sta.yd. overhaul	.05	.02	.05	.04	.01	.04	.04
22.24 mi. prepare subgrade and shoulders	75.00	50.00	$100	50.00	$100	60.00	$100
58,500 cu.yd. crushed rock or gravel	.75	.87	.85	.87	.94	.99	1.00
1,150 cu.yd. crushed rock or gravel (stockpiles)	.75	.90	.85	1.00	.94	1.10	1.00
256 cu.yd. 'A' concrete	30.00	30.00	30.00	32.00	35.00	35.00	35.00
133 cu.yd. 'B' concrete	30.00	30.00	30.00	32.00	35.00	35.00	35.00
1,730 ft. 18-in. corr. pipe (install)	.50	.50	.50	.50	.50	.50	.75
862 ft. 24-in. corr. pipe (install)	.50	.50	.50	.50	.50	.60	.75
98 ft. 30-in. corr. pipe (install)	.50	1.00	.50	1.00	.50	.75	.75
152 ft. 36-in. corr. pipe (install)	.50	.50	.50	1.00	.50	1.00	.75
24 ft. 24-in. corr. pipe (remove)	.50	.50	.50	1.00	.50	1.00	.75
5 cu.yd. cement rubble masonry	12.00	15.00	12.00	12.00	15.00	15.00	10.00
1 corr. pipe culvert extension	15.00	10.00	15.00	5.00	20.00	15.00	12.00
4 demolish headwalls	5.00	5.00	8.00	10.00	1.00	5.00	5.00

SEATTLE, WASH.—CITY—CONCRETE—SANDPOINT WAY

Contract awarded to S. A. Moceri, Inc., Thompson Bdg., Seattle, Wash., who bid $134,552 for improvement of Sandpoint Way for City. Bids from three lowest bidders on main items as follows:

(1) Clearing, lump sum
(2) 164,000 cu.yd. excavation
(3) 60 M b.m. wood walks
(4) 8,000 sq.yd. 8-in. reinf. conc. pav.
(5) 25,300 sq.yd. 8-in. conc. paving
(6) 215 cu.yd. extra conc. under pav.
(7) 5 catchbasins
(8) 200 ft. 36-in. conc. culvert

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	TOTALS
S. A. Moceri, Inc.	$ 6,500	.22	22.00	1.90	1.76	7.50	110.00	7.50	$134,552
Northwest Const. Co.	14,000	.21	24.00	1.80	1.65	6.50	90.00	6.50	136,655
Coluccio & Arcorace	7,500	.24	27.00	2.00	1.80	7.50	90.00	10.00	172,220

SANTA FE, NEW MEXICO—STATE—DONA ANA COUNTY—GRADING, SURFACING AND TIMBER BRIDGES

Contract awarded to A. O. Peabody, Deming, New Mexico, $147,334 for grading and surfacing 10 miles and constructing timber bridge from Garfield to Hatch, DONA ANA COUNTY, for State. Bids from:

(1) A. O. Peabody, Deming, New Mexico $147.334
(2) Dudley & Amesbury, El Paso, Tex. 154,156
(3) John Mulligan, El Paso, Tex. 154,595
(4) Lee Moor Contr. Co., El Paso $155,226
(5) Armstrong & Armstrong, Roswell, N. M. 160;796
(6) Engineer's estimate 169,688

	(1)	(2)	(3)	(4)	(5)	(6)
7,227 cu.yd. excavation, unclassified	.20	.215	.22	.25	.23	.25
134.530 cu.yd. common borrow	.17	.215	.19	.18	.23	.20
28,965 sta.yd. overhaul	.03	.03	.03	.03	.03	.03
6,904 mi.yd. overhaul	.40	.60	.40	.20	.40	.25
10.1 mi. scarifying and reshaping surface course	50.00	50.00	75.00	40.00	40.00	75.00
9,072 cu.yd. surface plating course	.45	.40	.70	.60	.45	.60
18,324 cu.yd. cr. gravel base course oil processed surf.	1.25	1.10	1.35	1.35	1.35	1.75
3,569 cu.yd. binder	.50	.40	.80	.75	.75	.85
1,052 cu.yd. Cl. 'A' concrete box culverts and siphons	20.00	22.00	18.75	22.00	23.50	22.00
23 cu.yd. Cl. 'B' conc. metal culv. pipe headwalls	20.00	22.00	20.00	18.00	40.00	22.00
118,282 lb. reinf. steel, concrete culv. and siphons	.055	.06	.05	.0525	.045	.055
605 lb. reinf. steel, metal pipe culv. hdwlls. and spwys.	.055	.06	.05	.0525	.05	.055
3,550 lin.ft. corr. galv. metal culvert pipe, 24-in. diam.	2.50	2.70	2.75	2.95	2.90	2.55
664 lin.ft. corr. galv. metal culvert pipe, 30-in. diam.	3.10	3.25	3.50	3.76	3.75	3.15
102 lin.ft. corr. galv. metal culvert pipe, 36-in. diam.	7.00	6.50	6.50	6.90	5.50	4.85
54 lin.ft. corr. galv. metal culvert pipe, 48-in. diam.	10.00	10.00	9.50	9.50	8.00	6.95
92,168 lin.ft. galvanized barbed wire fence	.047	.05	.05	.045	.045	.06
50 each gates	19.00	18.00	18.00	18.00	14.00	20.00
8,508 lin.ft. woven wire farm fence	.09	.10	.10	.07	.08	.10
55 lb. structural steel	.15	.20	.10	.15	.20	.10
238 sq.ft. fabric reinforcement	.05	.05	.05	.05	.06	.05
197.4 M b.m. treated bridge timber superstructure	$135	$135	$140	$145	$135	$150
17.9 M b.m. treated bridge timber substructure	$140	$135	$140	$145	$135	$150
5,640 lin.ft. treated timber piling	1.50	1.40	1.30	1.35	1.30	1.45
1,750 lin.ft. piling bank protection	1.50	1.40	1.30	1.40	1.30	1.45
3,656 lb. wire fabric bank protection	.10	.15	.10	.12	.15	.12
599 cu.yd. brush and rock bank protection	2.25	2.00	2.40	1.00	2.00	1.50
1,496 lin.ft. woven wire bridge railing	1.00	.90	.95	.90	1.00	1.10
213 cu.yd. crushed gravel base course	1.25	1.10	1.35	1.25	1.50	1.75

SAN RAFAEL, CALIF.—COUNTY—DURITE—CASCADES NO. 1

To Pacific States Construction Co., Call Bdg., San Francisco, $35,899 for improvement of streets in Cascades Improvement District No. 1, for Marin County. Bids from:

(1) Pacific States Const. Co., San Francisco $35,899
(2) Highway Builders, Ltd., San Anselmo 36,290
(3) California Const. Co., S. F. $36,478
(4) McDonald & Maggiora, Sausalito 37,489

	(1)	(2)	(3)	(4)
4,448 cu.yd. grading	.90	.62	1.20	1.50
14 ft. 8-in. corrugated pipe culvert	1.20	1.25	1.20	1.50
226 ft. 12-in. corrugated pipe culvert	1.60	1.50	1.75	2.50
132 ft. 15-in. corrugated pipe culvert	1.80	2.00	1.90	3.00
1,732 ft. concrete curb	.65	.65	.75	.75
3 concrete drain inlets	12.00	25.00	15.00	15.00
6 catchbasins	60.00	60.00	70.00	60.00
3 conc. and wood catchbasins	30.00	30.00	30.00	33.00
10 survey monuments	8.00	5.00	12.50	15.00
11,810 lin.ft. header boards	.10	.15	.10	.04
218,520 sq.ft. Dur-Emulse penet. pave	.13	.135	.125	.12

WATER SUPPLY SYSTEMS

TEMPE, ARIZ.—CITY—CAST-IRON PIPE SYSTEM

Arizona Concrete Co., Phoenix, Arizona, $17,388, low bid to City for water works extensions. Bids on:

(1) 915 ft. 6-in. Class 150 or equal cast-iron pipe
(2) 17,725 ft. 4-in. Class 150 or equal cast-iron pipe
(3) 815 ft. 2-in. Class 150 or equal cast-iron pipe
(4) 27 new fire hydrants (2 hose and 1 steamer nozzle)
(5) 46 new valves and boxes
(6) 6,500 lb. cast-iron specials

	(1)	(2)	(3)	(4)	(5)	(6)	TOTALS
Arizona Concrete Pipe Co., Phoenix	1.23	.69	.50	69.80	28.00	.07	$17,388
O. F. Fisher Co., Phoenix	1.03	.77	.50	62.80	21.03	.085	18,211
O. U. Miracle Co., San Diego	1.30	.92	.65	80.00	25.00	.08	21,853
Pacific Cons. Co., Phoenix	1.35	.93	.48	100.00	35.00	.10	23,068
Rex Mesny Co., Phoenix	1.36	1.07	.90	83.00	40.75	.28	26,876

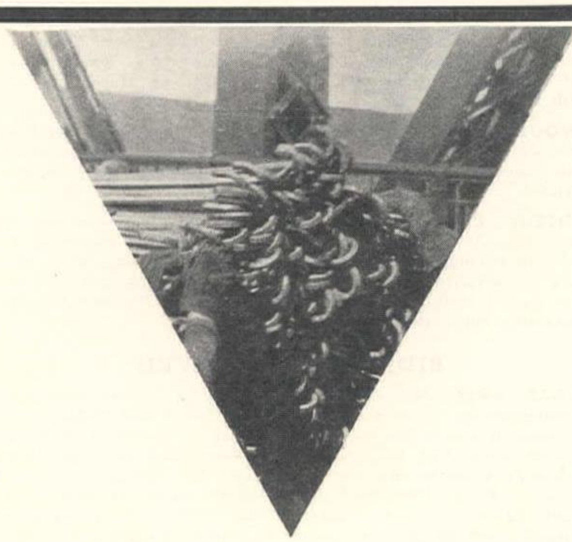
BRIDGES AND CULVERTS

HELENA, MONT.—STATE—STEEL—STILLWATER COUNTY

Contract awarded to W. P. Roscoe Co., Billings, Montana, who bid $77,792 for constructing steel bridge, consisting of one 484-ft. span, with two 43-ft. concrete approach spans over the Yellowstone River on Reed-Point Columbus Highway, STILLWATER COUNTY, work for State. Bids received from:

(1) W. P. Roscoe Co., Billings, Mont. $77,792
(2) Portland Bridge Co., Portland, Ore. 78,527
(3) Stevens Bros., St. Paul, Minn. 86,166
(4) McGuire & Blakeslee, Great Falls 89,928
(5) H. Pickus Const. Co., Sioux City, Iowa $ 99,112
(6) Missouri Valley Bridge & Iron Co. 111,090
(7) Engineers estimate 96,168

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
852 cu.yd. 'A' concrete	17.25	15.00	27.00	24.20	28.00	39.50	25.50
380.2 cu.yd. 'D' concrete	22.40	20.00	22.00	24.20	32.00	36.00	26.50
607,450 lb. structural steel	.067	.075	.064	.073	.075	.075	.08
8,400 lb. cast steel	.15	.10	.10	.19	.15	.14	.135
89,500 lb. reinforcing steel	.056	.06	.05	.063	.055	.05	.065
42 each 13-lb. cast iron drains, 4-in. diameter	5.00	5.00	3.00	3.50	6.00	5.00	4.50
1,233 cu.yd. foundation excavation	6.00	5.00	8.50	6.80	9.00	10.00	7.00



CONSTRUCTION NEWS SUMMARY

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

TABULATION OF AWARDS

Awards for the month of February, 1930 for Engineering Construction projects in the Far Western States total $17,188,000, as follows:

Paving	$ 4,485,000
Grading, highways	4,850,000
Bridges	1,062,000
Sewer construction	1,000,000
Water supply systems	1,380,000
Irrigation	140,000
Power development	500,000
Lighting systems	600,000
River and harbor work	171,000
Railroad construction	3,000,000
	$17,188,000

LARGE WESTERN PROJECTS

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

WORK CONTEMPLATED

Sewer for Guilds Lake, City of Portland, Ore.; $634,000.

Water system improvements in District 6, City of Los Angeles (Mar Vista Water District); $510,000.

Water system improvements for City of Los Angeles; $38,000,000.

BIDS BEING RECEIVED

Tunnel through Elysian Park, Figueroa St. extension, for City of Los Angeles; bids to Mar. 19; $800,000.

BIDS RECEIVED

Auditorium for City of Long Beach, Calif., R. E. Campbell, Long Beach, $742,000, low.

CONTRACTS AWARDED

Grading 7.1 miles from Castaic School to Canton Creek, LOS ANGELES COUNTY, for State of California, to Doering & Von der Hellen & Pierson, Berkeley, $537,629.

Customhouse for U. S. Treasury Department at Denver, Colo., to N. P. Severin Co., Chicago, $747,900.

Office building for Phoenix Title & Trust Co. at Phoenix, Ariz., to Wm. Simpson Construction Co., Los Angeles, $750,000.

Marine Hospital at Presidio, San Francisco, for Government, to Clinton Construction Co., San Francisco, $1,127,388.

Addition to Coliseum for City of Los Angeles to Edwards, Wildey & Dixon, Los Angeles, $457,858.

STREET and ROAD WORK

WORK CONTEMPLATED

HOLLISTER, CALIF.—City is considering paving South St., East St., Third St., and Line St., etc. A. M. McCray is City Engineer. 3-3

KING CITY, CALIF.—Plans by City Engr., H. F. Cozzens, Court House, Salinas, Monterey County, protests March 5 by City of King City, Monterey County, for paving streets with 5-in. concrete. Estimated cost $100,000. 2-21

LONG BEACH, CALIF.—Plans by City Engineer, bids soon for: (1) Coolidge St., 65th St., Neece St., etc., in north end of town west of Long Beach Blvd., involving 11,012 lin.ft. curb, 539 lin.ft. armor, 19,488 sq.ft. sidewalk, and water mains. (2) Plenty St., from Long Beach Blvd. to east city limits, involving 10,299 lin.ft. curb, 201 lin.ft. curb armor, 51,185 sq.ft. sidewalk, and water mains. (3) Alley east of Claremont Ave., between Ocean Blvd. and Second St., involving grading (lump sum), and 25,645 sq.ft. 6-in. concrete pavement. (4) Anaheim St., involving 13,076 sq.ft. concrete paving, water mains, and electroliers. 3-4

LOS ANGELES, CALIF.—Plans by County Surveyor, protests Mar. 17, for improving Orangewood Blvd., near San Gabriel Blvd. and Anaheim-Telegraph Road, involving 50,604 cu.yd. grading, 464,837 sq.ft. 6-in. and 186,978 sq.ft. 8-in. asph. conc. pavement, 130,498 sq.ft. 3½-in. sidewalk, 24,308 ft. 6 by 9 by 15-in. and 8690 ft. 6 by 10 by 18-in. curb, 102,710 sq.ft. gutter, 21,599 sq.ft. cross-gutter, 651,815 sq.ft. 4-in. dis. rock subbase, 17,619 ft. 8-in. and 6862 ft. 6-in. cement sewer. $231,686. 2-26

MONTEREY, CALIF.—Plans by H. D. Severance, City Engineer, protests March 11, for paving the Camino Bienvenida, Mirado, and Copa del Ora in the Mesa tract. The streets to be graded and surfaced with asphalt. 2-20

REDWOOD CITY, CALIF.—Plans by Geo. A. Kneese, County Surveyor, protests Mar. 17, for improving streets in Menalto Park, paving with 4-in. waterbound macadam base, 3-in. asphalt surface; $150,000. 1921 Act.

SAN DIEGO, CALIF.—Plans by City Engr., H. W. Jorgensen, protests soon for: (1) Redwood and Haller Sts., involving 34,809 sq.ft. 6-in. concrete paving, 170 ft. 6-in. cast-iron pipe, grading, etc.; (2) Voltaire St., involving 43,131 sq.ft. 6-in. asphalt paving, 231 ft. 6-in. cast-iron pipe, 1 hydrant; and (3) Polk Ave., involving 48,911 sq.ft. 6-in. concrete paving, etc. 2-21

BIDS BEING RECEIVED

PHOENIX, ARIZ.—Bids to 2 p.m., Mar. 21, by Arizona State Highway Commission for improving F. A. Projects 84-A and 76-Reo, the work to begin at end of pavement about 1 mile northwest of Marinette and extends about 14.5 miles toward Whittman, and the other begins at end of 84-A and extends about 7 miles to Hot Springs Junction. Work involves: F. A. PROJECT 84-A—151,000 sq.yd. preparation of subgrade; 22,000 cu.yd. additional material; 59,000 cu.yd.mi. haul additional material; 340,000 gal. oil applied to road; 14.3 miles mix, lay, and finish. F. A. PROJECT 76-Reo—74,000 sq.yd. preparation of subgrade; 1300 cu.yd. subgrade stabilizer; 4400 cu.yd.mi. haul of subgrade stabilizer; 147,000 gal. oil applied to road; 7 miles mix, lay, and finish. 3-3

PHOENIX, ARIZ.—Bids to 2 p.m., March 13, by Arizona State Highway Commission, Phoenix, Arizona, for surfacing and oil processing of Phoenix-Yuma Highway, F.A.P. 53-Reo, 23 miles of roadway, work involving: UNIT B—SURFACING, 70,700 cu.yd. surfacing, 210,530 cu.yd.mi. hauling of surfacing; UNIT C—OIL PROCESSING, 262,996 sq.yd. subgrade preparation, 577,927 gal. oil applied to road, 22.414 mi mix, lay, and finish, including rolling, 262,996 sq.yd. seal coat. 2-24

RIVERSIDE, CALIF.—Bids to 10 a.m., Mar. 17, by County for oil mix surfacing 5.5 miles Hemet-San Diego Highway from Winchester to Temecula. $30,000. 3-1

SACRAMENTO, CALIF.—Bids to 2 p.m., Mar. 19, by California Division of Highways for 1.9 miles grading San Bernardino between The Pass and two miles down Waterman Canyon, SAN BERNARDINO COUNTY, involving 26 acres clearing and grubbing, 219,000 cu.yd. roadway excavation, 241,000 sta.yd. overhaul, 1500 cu.yd. structure excavation, 520 cu.yd. 'A' conc. (structures), 78,800 lb. reinforcing steel, also corr. iron pipe, etc. 2-19

SACRAMENTO, CALIF.—Bids to 2 p.m., March 26, by California Division of Highways for 5.2 miles from Logandale to Willows, GLENN COUNTY, involving 2000 cu.yd. road excavation, 58,800 sq.yd. subgrade, 43,000 cu.yd. pit run gravel (subbase and shoulders), 11,240 cu.yd. 'A' concrete (pavement), 277,000 lb. reinforcing steel. 2-26

SAN DIEGO, CALIF.—Bids to Mar. 17 by City Clerk for improving Palermo Drive, involving 111,143 sq.ft. 6-in. asphalt paving, 90 ft. 4-in. cast-iron pipe, concrete sewer laterals. 3-1

SAN JOSE, CALIF.—Bids to 11 a.m., March 17, by County Clerk for improving Lawrence Station Road, oil macadam paving. 2-28

OLYMPIA, WASH.—Bids to Mar. 18 by State Highway Comm. for: KING COUNTY—8.1 miles paving of Pacific Highway, from Ken-Des Moines road to Seattle; PEND OREILLE COUNTY—3.4 miles grading and surfacing from Diamond Lake south on Pend Oreille Highway; WALLA WALLA COUNTY—4.5 miles of Inland Empire highway, grading and surfacing, between Lowden and Touchet road; CHELAN COUNTY—Construction of about 36 miles of bituminous treated road surface by the road mix method on state road No. 10, Chelan to Chelan-Okanogan county line, and Pateros to Malott in

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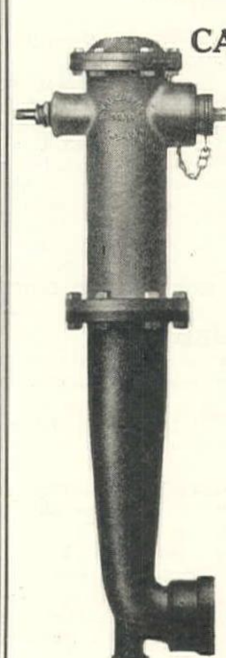

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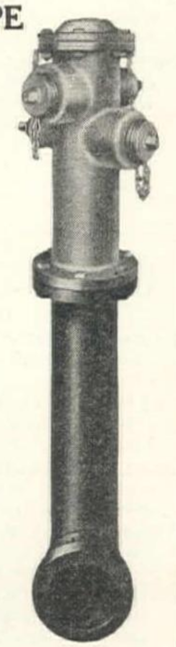

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OKANOGAN COUNTY, involving about 385,000 sq.yd. road surfacing; and BENTON COUNTY—Constructing about 26.9 miles of bituminous treated road surface by the plant mix method on State Road No. 3, end of concrete pavement 6 miles west of Kennewick to Prosser, involving approximately 286,000 sq.yd. surfacing; YAKIMA COUNTY—9.8 miles surfacing from end of paving to Carmack Bridge. 2-24

OLYMPIA, WASH.—Bids to Mar. 25 by State Highway Department, Olympia, Wash., for paving 6.4 miles between Ludlow and Port Townsend, with concrete, in JEFFERSON COUNTY, on Olympic Highway. 2-28

SEATTLE, WASH.—Bids to Mar. 21 by Board of County Commissioners, Court House, Seattle, Wash., for: District 3—10th Ave. N.E. and Sayles Road, paving, 2.34 miles, $50,000; District 3—Kirkland-Redmond, paving gaps, 0.5 mile, $10,000; District 2—Auburn-Black Diamond, paving, 1.06 miles, $25,000; and District 2—Enumclaw-Black Diamond, paving, 1.14 miles, $30,000.

SEATTLE, WASH.—Bids to Mar. 24 by Board of County Commissioners, Court House, Seattle, for: District 2—Kent Meredith, repaving, 0.85 mile, $20,000; District 3—Lincoln Ave. extension, grading, 1.88 miles, $30,000; District 3—Haller Lake, paving, 1.34 miles, $50,000; District 3—Meridian Ave., paving, 1.88 miles, $50,000; and District 3—Fifth Ave. N.E., paving, 2.25 miles, $50,000.

BIDS RECEIVED

BURBANK, CALIF.—Low bids as follows by City: (1) Gibbons & Reed Co., 221 E. San Fernando Blvd., Burbank, low bid at $11,220 for improving Brighton St. between Olive and Verdugo Ave., asphalt paving, water system; (2) Southwest Paving Co., Washington Bdg., Los Angeles, low at $47,932 for improving Glenoaks Blvd. between Eaton Drive and the city limits, concrete and asphalt paving, water system; and (3) Geo. R. Curtis Paving Co., 2440 E. 26th St., Los Angeles, low bid at $36,358 for improvement of Riverside Drive (west half) between Taft Ave. and Catalina St., asphalt paving and water system. 2-28

COMPTON, CALIF.—Geo. H. Oswald, 366 E. 58th St., Los Angeles, $91,125 low bid to City for improving streets west of Compton Ave., concrete paving, cast-iron mains. 2-21

LOS ANGELES, CALIF.—Low bids as follows by City: (1) Geo. R. Curtis Paving Co., 2440 E. 26th St., L. A., $229,968 low for Bellevue Ave. and Laveta Terrace Imp. Distr., by grading, concrete paving, all storm drain work, sanitary sewer, water system, concrete retaining wall; and (2) Dalmatin & Nikcevich, 841 W. 62nd St., Los Angeles, only bid, at $178,982, for improvement of streets in 218th St. and Haildale Improvement District, by grading, concrete paving, sanitary sewer, water system, etc. 2-28

DENVER, COLO.—Low bids as follows by State Highway Comm.: (1) E. Honnen, Colorado Springs, $45,801 low for grading and graveling northeast of Trinidad, LAS ANIMAS COUNTY; (2) H. C. Lallier Const. & Engr. Co., Denver, Colo., $76,199 low for concrete paving 2.5 miles west of Rocky Ford, OTERO COUNTY; and (3) New Mexico Const. Co., Denver, Colo., $145,876 low for concrete paving 7½ miles east of Greeley, WELD COUNTY.

LEWISTON, IDA.—Northwest Roads Co., Portland, Ore., low bid as follows for Warrenite Bit. paving streets for City: $15,197 for Dist. 20; $16,408 for Dist. 21; and $4830 for Dist. 22.

PORTLAND, ORE.—Low bids as follows by State: KLAMATH COUNTY—J. C. Compton, McMinnville, Ore., low at $130,142 for Klamath Falls Oiling Project, construction of 46 miles of bituminous macadam wearing surface near Klamath Falls. MALHEUR and HARNEY COUNTIES—J. C. Compton, McMinnville, Ore., low at $166,093 for Vale Oiling Project, construction of 11.4 miles of bituminous macadam wearing surface and application of 65.3 miles of bituminous surface treatment. (See Unit Bid Summary.) 3-1

PORTLAND, ORE.—H. G. Johnson, Roseburg, Ore., $71,000 low bid to State for furnishing 44,000 cu.yd. maintenance surfacing for State Highway Comm. in MULTNOMAH AND HOOD RIVER COUNTIES. Bids rejected. 3-1

CONTRACTS AWARDED

PHOENIX, ARIZ.—To Schmidt & Hitchcock, Phoenix, Ariz., $13,621 for improving Tenth St., paving with Warrenite and concrete, etc., for City.

BERKELEY, CALIF.—To Western Roads Co., 1305 28th St., Oakland, $1122 for paving with 7-in. asphalt parking area in Shattuck Ave. near Vine St. for City. 2-25

BERKELEY, CALIF.—To Lee J. Immel, 1031 Evelyn Ave., Berkeley, at $5986 for improvement of Boynton Ave. for City consisting of grading, macadam paving, etc. 3-4

BURBANK, CALIF.—To Gibbons & Reed, 221 E. San Fernando Blvd., Burbank, $45,027 for asphalt paving, water system, and storm drain on Front St. for City. 2-28

BURLINGAME, CALIF.—To Oakland Sewer Construction Co., 1003 85th Ave., Oakland, $7049 for improving Primrose Road for City, concrete sewers, concrete and asphalt paving. 3-4

LOS ANGELES, CALIF.—To Tryon & Brain, California Bdg., Los Angeles, who bid $38,219, as follows, to Board of Public Works, Los Angeles, for improvement of streets in the Anzac Ave. and 95th St. Improvement District: grading, 6-in. conc. pave., cement curb, sidewalk, sanitary sewer. 2-19

LOS ANGELES, CALIF.—To H. E. Doering & Vonder Hellen & Pierson, 2442 Cedar St., Berkeley, who bid $537,629 to California Division of Highways, Sacramento, for 7.1 miles grading from Castaic School to Canton Creek, LOS ANGELES COUNTY. (See Unit Bid Summary, Feb. 25th issue.) 2-26

OAKLAND, CALIF.—To Central Const. Co., Oakland Bank Bdg., Oakland, $7348 for oil macadam paving in rear of Transit Shed No. 2 for Port of Oakland. 2-26

PORTLAND, ORE.—To Saxton & Looney, Corvallis, Ore., $104,332 for 10.9 miles regrading and resurfacing in CURRY COUNTY, Denmark-Port Orford Sect., Roosevelt Coast Highway, for State. (See Unit Bid Summary.) 3-3

RIVERSIDE, CALIF.—To Hall-Johnson Co., 905 Westminster St., Alhambra, who bid $26,890 for improving Indiana Ave. from Washington St. and Arlington Ave., by excavation, 5-in. asph. conc. pave., 1½-in. asph. conc. surface, curb and gutter, conc. and corr. iron culvert, etc. 2-27

SACRAMENTO, CALIF.—To Beerman & White, Builders Bdg., Stockton, at $67,956 to California Division of Highways, Sacramento, for surfacing with untreated gravel or stone from Murphy to Big Trees, CALAVERAS COUNTY. (See Unit Bid Summary.) 2-25

SACRAMENTO, CALIF.—To Larsen Bros., Box 274, Galt, who bid $45,494 to California Division of Highways, for 2.8 miles grading and surfacing from 1¼ mile north to 1½ mile south of Caladeritos Creek, CALAVERAS COUNTY. (See Unit Bid Summary.) 3-4

SALINAS, CALIF.—Awards as follows by County: (1) To J. L. Conner, Monterey, $3797 for earth approaches to Lonoak and Pancherico Creek Bridges; (2) To Montfort & Armstrong, P.O. Box 402, Salinas, $16,125 for crushing and stockpiling broken stone on Carmel Valley Road; (3) To J. L. Conner, Monterey, $9109 for grading and surfacing Bitterwater Road; and (4) To A. Teichert & Sons, 1846 37th Ave., Sacramento, $33,300 for crushing and stockpiling rock in Dist. 3 and 4. 2-20

SAN FRANCISCO, CALIF.—To Peter J. McHugh, 466 36th Ave., S. F., $6710 for improving Clay St. at Market St., fencing, stop signs, conduit, concrete work, reinf. steel, vitr. culverts, 6-in. concrete base with 2-in. asphalt surface, etc. 2-26

SAN FRANCISCO, CALIF.—Awards as follows by City: (1) To C. L. Harney, 74 New Montgomery St., S. F., at $12,997 for improvement of Castro St. from 29th to 30th Sts., by curb, B conc., reinf. steel, pipe railing, vitr. pipe sewer, conc. paving, 6-in. conc. base with 1½-in. asph. surf.; (2) To A. G. Raisch, 46 Kearny St., S. F., at $907 for improvement of Ortega St. between 48th Ave. and The Great Highway, by curbs, paving with 6-in. conc. foundation and 1½-in. asph. conc. surf.; (3) To Peter McHugh, 466 36th Ave., S. F., at $744 for improvement of 21st Ave. between Noriega and Ortega Sts., by curbs, 6-in. concrete foundation and 1½-in. asphalt surface; (4) To Meyer Rosenburg, 1755 San Bruno Ave., S. F., at $5023 for improvement of Capitol Ave. from Lakeview Ave. to Thrift St., by cut, curb, sidewalk, vitr. pipe, conc. paving, conc. base with 2-in. asphalt surface; (5) To K. I. Dowdy, 91 Farallones St., S. F., at $2036 for improvement of Rivera St. from 32nd to 33rd Aves. and portions of 29th Avenue, work consisting of 7-ft. concrete strip paving, paving with 6-in. concrete base with 1½-in. asphalt surface, vitrified pipe sewers, etc.; (6) To A. G. Raisch, 46 Kearny St., San Francisco, who bid $3040 for improvement of Kirkham St. between 16th and 17th Aves., by concrete curbs, 12-in. vitrified pipe sewer, Y branches, and side sewers, 6-in. concrete base with 1½-in. asphaltic concrete surface; (7) To Chas. L. Harney, 74 New Montgomery St., San Francisco, who bid $3217 for improvement of 28th Ave. between Moraga and Noriega Sts., and of 31st Ave. between Judah and Kirkham Sts., by concrete curbs, side sewers, 6-in. concrete foundation with 1½-in. asphaltic concrete wearing surface; and (8) To L. J. Gallagher, 822 25th Ave., S. F., who bid $144 for improvement of Somerset St. between Silver Ave. and Silliman St., by construction of 1½-in. asphaltic concrete wearing surface. 2-19

SAN JOSE, CALIF.—Awards as follows by County to A. J. Raisch, Burrell Bdg., San Jose, for oil macadam paving: $3000 for Singleton Road; $10,850 for Dempsey Road; and $22,000 for Ferguson Road. 3-4

SAN MATEO, CALIF.—To Guerin Bros., 2940 San Jose Ave., S. F., $470 for grading East San Mateo Park for City. 3-4

SAN RAFAEL, CALIF.—To Pacific States Const. Co., Call Bdg., S. F., $35,899 for improving streets in Cascaded Dist. 1, involving grading, corr. pipe, paving with Dur-Emulse penetration paving. J. B. Piatt, Santa Rosa, is Engr. 2-24

SANTA CRUZ, CALIF.—To W. E. Miller, Santa Cruz, for improving Main St., involving grading, concrete paving, for City, bid of $3339. 2-19

SANTA CRUZ, CALIF.—To Thompson Bros., Santa Cruz, $17,023 for improving Walnut St., paving with concrete, 28 electroliers, etc., for City. 3-4

SEATTLE, WASH.—Awards as follows by City: (1) To D. J. Stevenson, Seattle, $75,006 for concrete paving, etc., Fairview Ave.; (2) To Fiorito Bros., Seattle, $130,629 for concrete paving, etc., Sixteenth Ave. Northeast; and (3) To S. A. Moceri, Inc., Seattle, $164,910 for paving Sand Point Way. (See Unit Bid Summary.)

HELENA, MONT.—Awards as follows by State: (1) Tom J. C. O'Connor, Missoula, $36,367 for 10 miles surfacing, JEFFERSON COUNTY; (2) To Collison-Bolven Co., Billings, Mont., $51,411 for 18 miles surfacing, PARK COUNTY; (3) To J. M. Carter, Billings, Mont., $38,391 for 13 miles surfacing, ROSEBUD COUNTY; (4) To C. A. Wagner, Sioux Falls, $217,770 for 41 miles surfacing and 59 miles oiling, BEAVERHEAD, MADISON AND SILVERBOW COUNTIES; (5) To Stevens Bros., St. Paul, Minn., $36,392 for 11 miles surfacing, CUSTER COUNTY; (6) To Stevens Bros., St. Paul, Minn., $39,308 for 34 miles oiling MISSOULA AND GRANITE COUNTIES; and (7) To L. T. Lawler, Butte, Mont., $24,082 for regrading, SILVERBOW COUNTY.

CARSON CITY, NEV.—To J. N. Tedford, Fallon, Nevada, who bid $88,140 to State Department of Highways, Heroes Memorial Bdg., Carson City, for 22.24 miles in PERSHING COUNTY from Woolsey to 2 miles south of Humboldt House, grading and surfacing. (See Unit Bid Summary.) 2-20

SANTA FE, N. M.—Awards as follows by State: (1) To Veater & Davis, El Paso, Tex., $193,009 for 7 miles grading, surfacing, and steel bridges, SANDOVAL COUNTY from Algodones to Domingo; (2) To A. O. Peabody, Deming, N. M., $147,335 for 10 miles grading, surfacing, and timber bridges, DONA ANA COUNTY from Garfield to Hatch; (3) To Lee Moor Contr. Co., El Paso, Tex., $92,284 for 9 miles grading and surfacing from Los Lunas to Belen; (4) To Veater & Davis, El Paso, Tex., $137,227 for 13 miles grading, surfacing, and timber and steel bridges from Raton to Springer; (5) To Veater & Davis, $148,926 for 5.5 miles grading, surfacing, and concrete and steel bridges from Santa Fe to Canoncito; (6) To Armstrong & Armstrong, Roswell, N. M., $95,820 for 15 miles grading and surfacing from Portales to Roswell, ROOSEVELT COUNTY; and (7) To Everly & Allison, Las Vegas, N. M., $193,029 for 18 miles grading and surfacing from Des Moines to Greenville, UNION COUNTY. (See Unit Bid Summary.)

PORTLAND, ORE.—Awards as follows by State: JACKSON AND KLAMATH COUNTIES—To Wren & Greenough, P.O. Box 138, Portland, who bid $155,537 for Jenny Creek-Keno Section of the Green Springs Highway, 27.1 miles of roadbed widening and resurfacing work and furnishing of broken stone in stockpiles; LANE COUNTY—To Cochran Construction Co., 407 S. Syracuse St., Portland, who bid $102,125 for Glenada-Douglas County Line Section of the Roosevelt Coast Highway, 6.4 miles of grading; and UNION AND UMATILLA COUNTIES—To H. G. Johnson, Roseburg, Oregon, who bid $108,670 for Kamela-Hilgard Section of the Old Oregon Trail, 14.5 miles of broken stone surfacing and furnishing broken stone in stockpiles. (See Unit Bid Summary.) 3-1

BRIDGES and CULVERTS

WORK CONTEMPLATED

SAN BERNARDINO, CALIF.—Plans by H. L. Way, County Surveyor, and call for bids will be issued March 10, for highway bridge on crest cutoff, on Upper Waterman Canyon in San Bernardino Mountains, 10 miles north of San Bernardino, consisting of three 40-ft. steel spans, 24 ft. clear width. 2-24

BIDS BEING RECEIVED

SACRAMENTO, CALIF.—Bids to 2 p.m., Mar. 19, by California Division of Highways for overhead crossing over Northwestern Pacific RR. at Forbes Station, MARIN COUNTY, involving 3500 ft. redwood piles, 88 M ft. BM redwood, 163 cu.yd. concrete, 20,100 lb. reinf. steel, and 41,500 lb. structural steel. 2-19

OLYMPIA, WASH.—Bids to Mar. 25 by State for: WHITMAN COUNTY—Inland Empire Highway, eastern route, construction of a reinforced concrete T-beam bridge over Union Flat Creek between Colton and Pullman; CHELAN AND DOUGLAS COUNTIES—Construction of a timber sidewalk 1710 ft. long on the bridge at Wenatchee over the Columbia River; and KITTITAS COUNTY—Widening existing arch bridges over Big Creek, Little Creek, and Yakima River between Easton and Cle Elum. 2-28

BIDS RECEIVED

EUREKA, CALIF.—Von der Hellen & Pierson, 2442 Cedar St., Berkeley, who bid $14,614, low for 2.5 miles north of Bridges Creek, construction of rubble masonry retaining wall over Red Mountain Creek, in MENDOCINO COUNTY, for Div. of Highways, Eureka. 2-28

LONG BEACH, CALIF.—John Simpson & Co., 701 Antonio Ave., L. A., $25,458 low for conc. retaining wall at Redondo Ave. and 36th Place for City. 3-3

PORTLAND, ORE.—Kuckenberg & Wittman, Board of Trade Bdg., Portland, $52,070 low bid to State for concrete bridge over Klamath River on Green Springs Highway at Keno, KLAMATH COUNTY. Bids rejected. 3-1

CONTRACTS AWARDED

OROVILLE, CALIF.—Awards as follows by County: (1) To T. H. Polk, Chico, $1805 for reinf. conc. bridge over Clear Creek; and (2) To T. H. Polk, Chico, $608 for reinf. conc. bridge on slough on Clear Road. 3-4

SACRAMENTO, CALIF.—To Fred J. Maurer & Sons, Eureka, who bid $10,880 to California Division of Highways, Sacramento, for constructing concrete and steel undergrade crossing under the tracks of the Northwestern Pacific R.R. at Loleta, HUMBOLDT COUNTY. 3-4

SACRAMENTO, CALIF.—To Jacobs & Pattiani, 337 17th St., Oakland, who bid $71,548 to California Division of Highways, Sacramento, for reinforced concrete bridge, 5½ miles north of Yreka, SISKIYOU COUNTY. (See Unit Bid Summary, Feb. 25th issue.) 2-25

STOCKTON, CALIF.—To J. E. Fitzsimmons, Rt. 1, Box 80, Lodi, who bid $9780 to San Joaquin County, for reconstructing Durham Ferry bridge over San Joaquin River on Durham Ferry Road. 2-25

HELENA, MONT.—Contract awarded to W. P. Roscoe Co., Billings, Mont., $77,792 for constructing steel bridge, consisting of one 284-ft. span and two 43-ft. concrete approach spans, over Yellowstone River on Reed Point-Columbus Highway in STILLWATER COUNTY for State. (See Unit Bid Summary.)

EVERETT, WASH.—To General Construction Co., Colman Bdg., Seattle, who bid $43,585 for construction of steel bridge over Sauk River, north of Darrington, for the County. 3-1

SEWER CONSTRUCTION

WORK CONTEMPLATED

CORONADO, CALIF.—Bond election April 14 by City to vote $60,000 for disposal plant, including sedimentation basin, pumping plant, and outfall. E. A. Ingham is City Engr. 3-1

FRESNO, CALIF.—Plans by City Engr., protests Mar. 20, for 1347 ft. 6-in. vitr. sewer in Roeding Heights. 3-4

GUSTINE, CALIF.—Bonds voted, $20,000, by City for sewer improvements. A. E. Cowell, 21 Maryland Ave., Berkeley, is Engr. 2-27

LAGUNA BEACH, CALIF.—Plans by A. J. Stead, City Engr., for main sewers, disposal and outfall for the City of Laguna Beach, on an area of about 1100 acres, work involving 22,000 ft. main sewer, disposal plant, 2 pumping plants, 3000 ft. outfall. 1911-15 Acts. 2-25

LOS ANGELES, CALIF.—Plans by C. E. Arnold, Chief County Storm Drain Engineer, Hall of Records, Los Angeles, and protests will be heard by County on March 10, for Drainage District 29, near Sherman, work involving in the main 9000 cu.yd. excavation, 2217 cu.yd. Class 'A' concrete, 40 cu.yd. Class 'B' concrete, 45 cu.yd. Class 'C' concrete, 257,745 lb. reinforcing steel, 22,000 ft. 18 to 72-in. reinf. conc. centr. spun pipe, 4000 ft. 27 to 72-in. spec. centr. spun pipe, cement, pipe, etc. 3-4

MADERA, CALIF.—Bond election in April by City to vote bonds, $20,000, to provide for sewer extensions on the north side of Fresno river, in the southern part of the City, and other sections not now served. A. M. Acton is City Engineer. 2-25

SAN MARINO, CALIF.—Plans by City Engineer, Wm. Chalmers, Braley Bdg., Pasadena, bids to be called soon by City of San Marino, for construction of a sewer in La Mirada Ave., Euclid Ave., Hermosa St., Las Flores Ave., etc., involving 9850 ft. 8-in., 388 ft. 15-in., 3023 ft. 18-in., 1055 ft. 21-in., 652 ft. 27-in., and 45 ft. 30-in. vitrified sewer. 3-1

PORTLAND, ORE.—Plans by City Engr., O. Laurgaard, for Guilds Lake Trunk Sewer, to be 9000 ft. long and will range in size from 62 by 62 in. to 104 by 104 in. It will drain the Balch Creek area of 1439 acres, and will run from 30th and Roosevelt Sts., to 31st St., to Industrial Ave., to 35th St., to B St., to 1400 ft. north of 35th St., thence east to the Willamette River. $634,000. 3-1

BIDS BEING RECEIVED

SAN DIEGO, CALIF.—Bids to 10 a.m., Mar. 17, by City Clerk for 1028 ft. 6-in. concrete sewer on J St. 3-1

BIDS RECEIVED

HEALDSBURG, CALIF.—A. W. Garrett, Healdsburg, submitted low bid as follows to the City for sewer improvements: using vitrified pipe, $6992; using concrete pipe, $6870. Work involves 7000 ft. 6-in. sewer, manholes, etc. 3-4

LOS ANGELES, CALIF.—M. Ramljak & J. Topich, 1447 Glendale Blvd., L. A., low at $49,774 to City for vitrified sewer in Motor Ave. between Forrester Dr. and Manning Ave. 2-28

CONTRACTS AWARDED

GLENDALE, CALIF.—To M. J. Simonovich, 1414 Hillcrest Ave., Los Angeles, who bid $21,495 to City of Glendale for construction of Bellehurst Hillslope sewer, involving vitrified pipe. 2-25

LOS ANGELES, CALIF.—To Contratto Bros., 2955 Cudahy St., Walnut Park, $136,615 for cement sewers in Belevedere Unit No. 2 for County. 2-26

WATER SUPPLY SYSTEMS

WORK CONTEMPLATED

FRESNO, CALIF.—Bonds voted by County Water Works District No. 1 in amount of $65,000 for water improvement, including deep wells and pumping plants in Forkner-Giffen Fig Gardens No. 2. Chris. P. Jensen is County Surveyor. 2-21

LOS ANGELES, CALIF.—Bond election by City April 29 to vote $38,000,000 for: $18,000,000 for purchase of Inyo and Mono County lands and water rights; $7,500,000 for tunnel from Mono basin to the present aqueduct system; $8,250,000 for dam and reservoir construction; $3,269,000 for distribution lines; and $600,000 for enlargement of the aqueduct. 3-3

LOS ANGELES, CALIF.—Bonds voted by Municipal Improvement District No. 6, City of Los Angeles, in amount of $510,000 for water system improvements in Mar Vista Water District. J. J. Jessup is City Engineer. 2-28

SAN DIEGO, CALIF.—Plans by H. W. Jorgensen, City Engr., for 376 ft. 4-in. and 1164 ft. 6-in. 'C' cast-iron pipe and 2 hydrants in Boundary St. Bids after Mar. 24. 3-1

BIDS BEING RECEIVED

PORTLAND, ORE.—Bids to 2 p.m., March 11, by Frank Coffinberry, City Purchasing Agent, City Hall, Portland, Oregon, for furnishing and delivering 3675 tons of cast-iron water pipe for Bureau of Water Works. 2-26

SALEM, ORE.—Bids to Mar. 14 by Public Works Engineering Corporation, Hunter-Dulin Bdg., San Francisco, for construction of a pumping station in the Willamette River, to be 18 by 18 ft. and 58 ft. high. Work involves: subaqueous foundations, requiring cofferdam to include 25,000 lb. interlocking steel sheet piling, 400 cu.yd. excavation, 295 cu.yd. 2000-lb. and 23 cu.yd. 3000-lb. concrete, 32,000 lb. reinforcing steel, 108 cu.yd. backfill; building to have steel sash and doors, steel stairs, clay tile roof; cast-iron piping and valves. Contract for pumping plant equipment will be let separately. 3-1

CAMAS, WASH.—Bids to 8 p.m., Mar. 11, by City for furnishing and installing 1870 ft. 6-in. and 7060 ft. 2-in. cast-iron pipe, valves, hydrants, etc. Stevens & Koon, Portland, are Engrs. 3-1

BIDS RECEIVED

TEMPE, ARIZ.—Arizona Concrete Co., Phoenix, Ariz., $17,388 low bid to City for cast-iron pipe system, hydrants, etc. 2-25

ALHAMBRA, CALIF.—Macco Const. Co., Clearwater, $8130 low for trenching, laying, and backfilling for 16,300 ft. 20-in. cast-iron pipe for City. 2-21

SAN DIEGO, CALIF.—Butterfield Const. Co., Box 157, San Diego, $12,800 for reconstructing Hodges Reservoir-San Dieguito Conduit for City. 2-26

TACOMA, WASH.—Bids as follows by City: PROPOSITION A—16,045 lin.ft. 44-in. diameter riveted steel pipe OR 42-in. diameter smooth bore steel pipe, bids as follows:

Birchfield Boiler Co., Tacoma	$ 88,223
Beall Tank & Pipe Co., Portland	98,239
Steel Tank & Pipe Co., Portland	102,134
Western Pipe & Steel Co., San Francisco	109,992

PROPOSITION B—16,045 lin.ft. 42-in. reinforced concrete pipe, bids as follows:

American Concrete Pipe Co., Tacoma (furnishing pipe only)	$111,475
American Concrete Pipe Co., Tacoma (furnishing and installing pipe)	127,520

2-28

CONTRACTS AWARDED

MESA, ARIZ.—To Pittsburgh-Des Moines Steel Co., Rialto Bdg., San Francisco, who bid $13,745 to City of Mesa for constructing a steel tower 138 ft. high and a 200,000-gal. capacity tank, for the City Water Dept. 2-27

ALHAMBRA, CALIF.—To U. S. Pipe & Fdy. Co., who bid $9153, as follows by City for furnishing: 3200 ft. 10-in. cast-iron pipe, class 2, lined, 18-ft. lengths, $4736; 1760 ft. 14-in. Class 200, deLavaud, 12-ft. lengths, $4417. 2-20

BEVERLY HILLS, CALIF.—To Pomona Pump Co., who bid $1826 to City for furnishing and installing one deep well centrifugal pump. 2-25

GLENDALE, CALIF.—To Orosel & Kitchen, 2143 Hyperion St., Los Angeles, who bid $88,540 to the City for a reinforced concrete reservoir in Brand Park, to have a capacity of about 10,500,000 gallons. 2-27

HANFORD, CALIF.—To Byron-Jackson Pump Co., Berkeley, $1263 for deep well pump and motor for City. 2-19

OAKLAND, CALIF.—To Steel Tank & Pipe Co., Berkeley, who bid as follows to East Bay Municipal Utility Dist.: (1) 5700 ft. ¼-in. thick, 24-in. electric welded sheet steel pipe, incl. special steel insulating sleeves, at $3.88 ft.; and (2) 4000 ft. ½-in. thick, 20-in. electric welded sheet steel pipe, incl. special steel insulating sleeves, at $2.75 ft. 2-27

SAN FRANCISCO, CALIF.—To Western Pipe & Steel Co., 444 Market St., San Francisco, for furnishing and installing two coagulation tanks for the Chenery Filter Plant at Clyde, Contra Costa County, for the Public Works Engineering Co., Hunter-Dulin Bdg., San Francisco. 2-24

MONMOUTH, ORE.—Awards as follows by City: (1) To Pacific States Cast Iron Pipe Co., who bid $1411 for furnishing 1850 ft. 4-in. and 625 ft. 6-in. cast-iron pipe; and (2) To Rensselaer Valve Co., who bid $536 for valves and hydrants. 2-28

SALEM, ORE.—To C. Dudley DeVelbiss, 354 Hobart St., Oakland, for furnishing and installing complete of a rapid sand type water filtration plant of 6,000,000 gallons daily normal capacity, together with ground improvements and miscellaneous construction work. Above work for the Public Works Engineering Corp., Hunter-Dulin Bdg., San Francisco. 2-24

ABERDEEN, WASH.—To Pacific States Cast Iron Pipe, $9499 for cast-iron pipe for City. 3-3

OMAK, WASH.—To Byron-Jackson Pump Mfg. Co., Berkeley, California, who bid $13,663 for pumping plant equipment for the Shell Rock Pumping Plant for the Omak Pump Company, Omak, Washington, to be three unit plant, 3950 g.p.m. 2-24

IRRIGATION and RECLAMATION

WORK CONTEMPLATED

IDAHO FALLS, IDA.—Bond election Mar. 18 by Idaho Irrigation Dist. to vote $65,000 for irrigation improvements.

RENO, NEV.—Application filed by Washoe County Conservation District, c/o King & Malone, Engineers, Cladianos Bdg., Reno, Nevada, for the appropriation of 50,000 ac-ft. per annum storage from Little Truckee River in Sierra County, for irrigation on 32,840 acres. The stored water to be transported through the Little Truckee River and Truckee to a distribution system now complete. Work involves: dam, earth fil, 142 ft. high, 700 ft. long on top. 2-19

BIDS BEING RECEIVED

TRACY, CALIF.—Bids to 8 p.m., Mar. 19, by Banta-Carbona Irrigation Dist. for improving distributing system, involving: ITEM NO. 1—15,000 cu.yd. excavation; ITEM NO. 2—Installing 10 redwood drops furnishing lumber and material for same; ITEM NO. 3—Installing 14 timber turnouts and furnishing lumber and material for same; ITEM NO. 4—One concrete turnout and furnishing material for same; ITEM NO. 5—One 30-in. concrete pipe road-crossing, and one 24-in. pipe road-crossing, and furnishing material for same; ITEM NO. 6—One metal flume, wooden substructure over main lift canal. 2-25

TURLOCK, CALIF.—Bids to Mar. 17, as follows, by Turlock Irrigation District for: (1) Up to 3 p.m., for Improvement District No. 23, as follows: SCHED. NO. 1, involving 24,076 sq.ft. 2-in. concrete canal lining Section No. 1, 71,806 sq.ft. 2-in. concrete canal lining Section No. 2; SCHED. NO. 2, 27 concrete structures, 30 cu.yd. concrete; SCHED. NO. 3, one highway siphon. (2) Up to 4 p.m., for Improvement District No. 36, involving 19,000 sq.ft. 2-in. concrete canal lining. (3) Improvement District No. 30, up to 3 p.m., involving: SCHED. NO. 1—About 800 lin.ft. of 24-in. low-pressure concrete pipe, either machine made or poured in place, 1½ cu.yd. of concrete in structure with one 24-in. Calco side gate in place; SCHED. NO. 2—3200 lin.ft. of 16-in. reinforced high-pressure concrete pipe in place, two 16-in. reinforced standpipes in place, a total of 38 ft., 20 lin.ft. of 16-in. metal pipe drain crossing, 6 cu.yd. of concrete. 2-24

FAIRFIELD, MONT.—Bids to 2 p.m., April 16, by Bureau of Reclamation, Washington, D. C., for construction of dikes No. 1 and 2 for the Pishkum Reservoir enlargement, Sun River project, Montana. Work involves 22,000 cu.yd. stipping foundations for dikes, 12 acres plowing of foundations for dikes, 340,000 cu.yd. placing materials in dikes. 3-3

ELLENSBURG, WASH.—Bids to 10 a.m., April 16, by Bureau of Reclamation, Ellensburg, Washington, for construction of earthwork, tunnels, and structures on Division No. 3 of the North Branch Canal, Kittitas Division, Yakima Project, Washington. The work is located near Kittitas, Washington, a station on the Chicago, Milwaukee, St. Paul & Pacific Railroad. Work involves in the main 118,000 cu.yd. excavation, 8000 cu.yd. backfill about structures, 3400 cu.yd. concrete, 84,000 lb. reinforcement bars. 3-3

BIDS RECEIVED

DENVER, COLO.—Hardie-Tynes Mfg. Co., Birmingham, Ala., $17,972 low bid to Bureau of Reclamation for two 54-in. needle valves for Deadwood Dam, Idaho. 2-28

CONTRACTS AWARDED

BAKERSFIELD, CALIF.—To Hartman Construction Co., Bakersfield, at $2500 for reinforcement of levee on east side of Chester Ave. and north side of Kern River for Kern River Levee District. 2-20

OROVILLE, CALIF.—Awards as follows by Oroville-Wyandotte Irrigation District: (1) To Redwood Mfgrs. Co., Hobart Bdg., S. F., for 2700 ft. 26-in. redwood stave pipe, 1000 ft. 22-in. redwood stave pipe, 4000 ft. 10-in. redwood stave pipe; and (2) Pipe laying will be done by P. M. King, of Oroville, and will cost about $1200. 2-24

TUNNEL CONSTRUCTION

BIDS BEING RECEIVED

LOS ANGELES, CALIF.—Bids to 10 a.m., Mar. 19, by Board of Public Works, City Hall, L. A., for 3 tunnels, Figueroa St. Ext., through Elysian Park, total length 996 ft., 46½ ft. wide and 28 ft. high. Work involves 851 ft. cross sect. 1, inc. tunnel excav., 100 ft. cross sect. 2, inc. tunnel excav., 45 ft. cross sect. 3, inc. tunnel excav., 1521 sq.yd. white glazed tile surface, 7349 sq.yd. plas. finish tunnel arches, lighting fixtures, portal walls and approach walls, storm drain and sanitary sewers, transformer vault and conduit, pedestrian subways, 184,531 sq.ft. 8-in. conc. pavement, 70,603 cu.yd. excav., exclu. of tunnels, 22,344 sq.ft. one-course walk, 2456 ft. wire fence, 439 cu.yd. Class F concrete, 382 cu.yd. Class C concrete. $800,000. 2-21

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LIGHTING SYSTEMS

WORK CONTEMPLATED

BAKERSFIELD, CALIF.—Plans by City Engr., protests Mar. 17, for installing 68 Union Metal Mfg. Co. electroliers on 17th St. 1911-15 Acts. 2-27

FRESNO, CALIF.—Plans by City Engr., protests Mar. 13, for: (1) Portions of Stanislaus St., O St., Blackstone Ave., by 137 electroliers, together with the necessary conduits and appurtenances, installed thereon; and (2) Portions of Fresno St., Howard St., and Divisadero St., by 76 electroliers installed, together with the necessary conduits and appurtenances thereof. 1911 Act. 2-25

GUSTINE, CALIF.—Bonds voted, $5000, by City to install street lighting system. 2-27

RICHMOND, CALIF.—Plans by E. A. Hoffman, City Engr., protests Mar. 10, for: (1) Electrolier street lighting system, installed on 23rd St. between Macdonald Ave. and the northerly boundary line of the City of Richmond, consisting of 43 Richmond Ornamental Lighting Standards, Two Light Design No. 1800, together with foundations, transformers, lighting unit, lamps, wires, conduits, cables, etc.; and (2) Electrolier street lighting system, to be installed on 6th St., 7th St., 8th St., and 9th St., consisting of 37 Richmond Ornamental Lighting Standards One Light Design No. 4500, together with foundations, series transformers, lighting units, lamps, wires, conduits, cables, appurtenances, and appliances. 2-25

RIVER AND HARBOR WORK

WORK CONTEMPLATED

HUNTINGTON BEACH, CALIF.—Bonds voted by City, $122,000, for: (1) Gunite repairs for 1400 ft. present pier, to be 25 ft. wide, $60,000; (2) Construction of 500-ft. extension to present concrete pier, to be 25 ft. wide, using centrifugal spun concrete piling, and concrete girders and beam for deck. Replacing of ornamental lighting system on old pier. $62,000. Merwin Rosson is City Engineer. 2-21

BIDS BEING RECEIVED

SAN DIEGO, CALIF.—Bids to 11 a.m., March 12, by City Purchasing Agent, A. V. Goeddel, San Diego, for construction of an extension to the Broadway pier. The project calls for an extension 200 ft. to the pierhead line, making the enlarged structure 1000 ft. long, 130 ft. wide. $100,000. Construction will be of precast concrete piles and flat slab deck. 2-24

RAILROAD CONSTRUCTION

CONTRACTS AWARDED

WINSLOW, ARIZ.—To Sharp & Fellows Contracting Co., Central Bdg., Los Angeles, for constructing 23 miles of second main line between Winslow and Joseph City, Arizona, for Santa Fe Ry. Work will involve roadbed grading, construction of concrete foundations for widening of two steel bridges, and construction of a number of timber bridges, culverts, and headwalls. 2-21

SAN FRANCISCO, CALIF.—To W. A. Bechtel Co., 206 Sansome St., San Francisco, for extension of side tracks in Feather River Canyon, at the following locations, work consisting of grading, tracklaying, and ballasting: Quartz, Bloomer, Berry Creek, Merlin, and Portola, Plumas County. Work involves 150,000 cu.yd. excavation (heavy). 2-28

MACHINERY and SUPPLIES

BIDS BEING RECEIVED

LOS ANGELES, CALIF.—Bids to 2 p.m., March 17, by Board of County Supervisors, Los Angeles, for furnishing 90,000 bbl. cement for the Tujunga Dam, known as the Hansen Dam. 2-27

CONTRACTS AWARDED

GLENDALE, CALIF.—To National Cast Iron Pipe Co., Los Angeles, who bid as follows for furnishing cast-iron pipe to the City of Glendale: 4800 ft. 20-in. 'B' pipe, $3.8625; 3600 ft. 24-in. 'B' pipe, $5.15; 2900 ft. 24-in. 'C' pipe, $6.165; 300 ft. 30-in. 'B' pipe, $7.525; 40 tons 'B' and 'D' fittings, $80 ton; 10,000 ft. 6-in. Class 250 cast-iron pipe, 64¢; 3000 ft. 12-in. Class 250 cast-iron pipe, $1.76. 3-1

NAPA, CALIF.—To American Cast Iron Pipe Co., S. F., $3179 for furnishing cast-iron pipe to City. 3-4

OAKLAND, CALIF.—To Pacific Coast Engineering Co., foot of 14th St., Oakland, who bid $8468 for furnishing dredge hull and ladder pipe for Oakland Port Commission. 2-26

SAN MATEO, CALIF.—To Richmond Sanitary Co., S. F., $535 for wrought steel pipe for City.

BUILDING CONSTRUCTION

WORK CONTEMPLATED

BEVERLY HILLS, CALIF.—Plans by B. M. Priteca, Architect, 411 W. Seventh St., Los Angeles, for a theatre building to be erected at the southwest corner of Wilshire Blvd. and Reeves Drive, Beverly Hills, for Warner Bros. Pacific Coast Theatres. Construction will be of reinforced concrete and steel, concrete slab floors and roof, tile and composition roofing, etc. 2-26

LOS ANGELES, CALIF.—Plans by Claude Beelman, Architect, 1019 Union Bank Bdg., Los Angeles, for a 12-story and basement Class A store and office building at 629 South Hill St., Los Angeles, for the Sun Realty & Finance Co. Bids will be called for shortly. Building will be 60 by 158 ft. Consolidated Steel Corp., Los Angeles, were awarded contract for furnishing and erecting structural steel. 2-26

BIDS BEING RECEIVED

CHICO, CALIF.—Bids to 2 p.m., March 25, by Geo. B. McDougall, State Architect, Public Works Bdg., 11th and P Sts., Sacramento, for general work, with separate bids on Heating, Plumbing, and Ventilating, and Electric Work for the Assembly Building, Chico State Teachers' College, Chico. The building will be a two-story steel and concrete frame structure, with balcony, brick and concrete walls, concrete floors, and tile and composition roofing. 2-26

KELSEYVILLE, CALIF.—Bids to 1:30 p.m., March 15, by Kelseyville Union High School District, Kelseyville, Lake County, for construction of a reinforced concrete high school building to cost $35,000. Plans from Wm. Herbert, Architect, Rosenberg Bdg., Santa Rosa. 3-3

BIDS RECEIVED

LONG BEACH, CALIF.—Low bids as follows by City for construction of a Municipal Auditorium at Long Beach, to be 400 by 185 ft., of steel frame construction, reinforced concrete walls and floors: GENERAL CONSTRUCTION—R. E. Campbell, 130 Linden Ave., Long Beach, $742,000 low; ELECTRIC WIRING—Baty Electric Co., 128 W. Fourth St., Long Beach, $76,000 low; PLUMBING—O. E. Ross, 521 E. First St., Long Beach, $74,789 low; and HEATING AND VENTILATING—Jones Heating Co., 28 E. Union St., Pasadena, $155,760 low. 2-27

OAKLAND, CALIF.—Alfred Olson, 631 Viona, Oakland, $118,378 low bid to Board of Education for auditorium and gymnasium at Maxwell Park School, brick and steel construction. 2-26

CONTRACTS AWARDED

PHOENIX, ARIZ.—To Wm. Simpson Construction Co., Architects Bdg., Los Angeles, for 11-story store and office building on Adams St. and First Ave., Phoenix, for Phoenix Title & Trust Co., reinforced concrete Class 'A'. $750,000. Lescher & Mahoney, First National Bank of Arizona, Architects. 3-1

TUCSON, ARIZ.—To R. H. Martin, Tucson, $72,764 for 12-room school building in the Elysian Grove tract for the Tucson Board of Education. Contract for plumbing and heating was awarded to Craycroft Plumbing & Heating Co., for $8000. 2-19

DENVER, COLO.—To N. P. Severin Co., Chicago, Illinois, who bid $747,900 for constructing 5-story custom house at Denver, Colorado, using limestone. Bids received by U. S. Treasury Department, Supervising Architect, Washington, D. C. 2-24

BIGGS, CALIF.—To Azevedo & Sarmanto, 920 O St., Sacramento, $36,207 for brick school for Biggs Grammar School Dist. 2-19

LOS ANGELES, CALIF.—To Edwards, Wildey & Dixon, Edwards Wildey Bdg., Los Angeles, $457,858 for addition to the City of Los Angeles Coliseum, of reinforced concrete construction, by removing wooden portion of coliseum and reconstructing same with reinforced concrete. 2-27

SACRAMENTO, CALIF.—Awards as follows by State Architect, Sacramento, for one-story steel frame building, brick and concrete walls, at State Agriculture Park: GENERAL CONTRACT to MacGillivray Constr. Co., Folsom Bdg. and 65th St., Sacramento, at $118,205 with alternatives; PLUMBING, to Luppen & Hawley, 3126 J St., Sacramento, at $9444; and ELECTRICAL WORK, to Latourrette-Fical Co., 907 Front St., Sacramento, at $2225. 3-3

SAN FRANCISCO, CALIF.—To Clinton Construction Co., 923 Folsom St., San Francisco, $1,127,388 for construction of the Main Building, Attendants' Quarters, and Boiler House and Laundry at the U. S. Marine Hospital at San Francisco. 2-28

OPPORTUNITY PAGE

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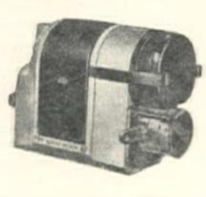

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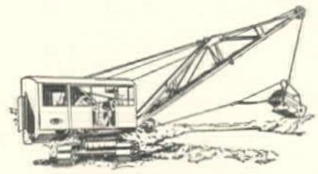

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Fidelity & Deposit Co. of Maryland
Glens Falls Indemnity Co.
Great American Indemnity Co.
Indemnity Insurance Co. of North America
Maryland Casualty Co.
New Amsterdam Casualty Co.
Rolph, James Jr., Landis & Ellis

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

Jacks, Lifting
Jenison Machinery Co.

Kettles, Tar and Asphalt
Bacon Co., Edward R.
Harron, Rickard & McCone Co.
Montague Pipe & Steel Co.
Peerless Mchy. & Mfg. Co.
Spears-Wells Machy. Co.
Young Machy. Co., A. L.

Leadite
Water Works Supply Co.

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

Locomotives (Electric, Gas and Steam)
Bacon Co., Edward R.
Garfield & Co.
Hackley Equipment Co., P. B.
Harron, Rickard & McCone Co.
Jenison Machinery Co.
United Commercial 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.
Young Machy. Co., A. L.

Mixers, Plaster
Harron, Rickard & McCone Co.
Jaeger Machine Works, The
Jenison Machinery Co.
Young Machy. Co., A. L.

Motors, Gasoline
Continental Motors Corp.

Motors, Gasoline (Continued)
Hercules Motors Corp.
Harron, Rickard & McCone Co.
Jenison Machinery Co.
Le Roi Co.
Wisconsin Motor Co.

Oxy-Acetylene Apparatus
Oxweld Acetylene Co.

Paints, Acid Resisting
Paraffine Companies, Inc., The
Wailes Dove-Hermiston Corp.

Paints, Metal Protective
McEverlast, Inc.
Paraffine Companies, Inc., The
Wailes Dove-Hermiston Corp.

Paints, Technical
American Bitumuls Co.
Paraffine Companies, Inc., The
Wailes Dove-Hermiston Corp.

Paints, Waterproofing
McEverlast, Inc.
Paraffine Companies, Inc., The
Wailes Dove-Hermiston Corp.

Pavers, Concrete
Foote Company, Inc.
Harron, Rickard & McCone Co.
Koehring Company
Smith Co., T. L.

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

Paving Plants
Bacon Co., Edward R.
Jaeger Machine Works, The
Jenison Machinery Co.
Madsen Iron Works
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.
Northwest Engineering Co.
Orton Crane & Shovel Co.
Thew Shovel Co., The

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

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
McEverlast, Inc.
Paraffine Companies, Inc., The
Wailes Dove-Hermiston Corp.

Pipe, Concrete
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.
Harron, Rickard & McCone Co.
Jenison Machinery Co.
W-K-M Company, Inc.

Pipe, Lock-Bar
Western Pipe & Steel Co.

Pipe, Preservative
Columbia Wood & Metal Preservative Co.

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

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

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

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

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

Pipe, Welded Steel
California Corrugated Culvert Co.
Lacy Manufacturing Co.
Montague Pipe & Steel Co.
Steel Tank & Pipe Co.
Union Tank & Pipe Co.
Western Pipe & Steel Co.

Plows, Road
Bacon Co., Edward R.
Galion Iron Works & Mfg. Co.
Hackley Equipment Co., P. B.
Jenison Machinery Co.
Spears-Wells Machy. Co.

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

Portable Lights
Oxweld Acetylene Co.

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

Power Units
Continental Motors Corp.
Harron, Rickard & McCone Co.
Hercules Motors Corp.
Jenison Machinery 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
Woodin & Little

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

(Continued on page 60)

OPPORTUNITY PAGE

CONTINUED

OFFICIAL BIDS

UNITED STATES DEPARTMENT OF THE INTERIOR

BUREAU OF RECLAMATION

Tunnels and Structures

Washington, D. C., February 18, 1930

Sealed bids (Specifications No. 508) will be received at the office of the Bureau of Reclamation, Ellensburg, Washington, until 10 o'clock a.m., April 16, 1930, and then publicly opened, for furnishing labor and materials and performing all work for the construction of earthwork, tunnels and structures on Division No. 3 of the North Branch Canal, Kittitas division, Yakima project, Washington. The work is located near Kittitas, Washington, a station on the Chicago, Milwaukee, St. Paul & Pacific Railroad. The principal items and the estimated quantities involved are as follows: 118,000 cubic yards of all classes of excavation; 8,000 cubic yards of backfill about structures; 3,400 cubic yards of concrete; placing 84,000 pounds of reinforcement bars; laying 2,600 linear feet of 18 to 72-inch precast concrete pipe; furnishing and erecting 43 M ft. b.m. timbering in tunnels; and installing 8,800 pounds of gates, gate lifts, structural steel and other metal work. 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, Ellensburg, Washington; Denver, Colorado; or Washington, D. C.

ELWOOD MEAD, Commissioner.

UNITED STATES DEPARTMENT OF THE INTERIOR

BUREAU OF RECLAMATION

Dikes

Washington, D. C., February 20, 1930

Sealed bids (Specifications No. 509) will be received at the office of the Bureau of Reclamation, Fairfield, Montana, until 2 o'clock p.m., April 16, 1930, and then publicly opened, for furnishing all labor and materials and performing all work for the construction of dikes Nos. 1 and 2 for the Pishkun Reservoir enlargement, Sun River project, Montana. The work is located about 15 miles north of Augusta, Montana, a station on the Sun River Branch of the Great Northern Railroad. The principal items and the estimated quantities involved are as follows: 22,000 cubic yards stipping foundations for dikes; plowing 12 acres of foundations for dikes; and placing 340,000 cubic yards of materials in dikes. For particulars, address the Bureau of Reclamation, at Fairfield, Montana; Denver, Colorado; or Washington, D. C.

ELWOOD MEAD, Commissioner.

NOTICE TO CONTRACTORS

Asphalt, Rock, and Meter Boxes

Sealed proposals will be received at the office of the East Bay Municipal Utility District, 512 Sixteenth Street, Oakland, California, until 8 p.m., March 12, 1930, and will at that hour be opened, for furnishing approximately 50,000 gallons of Grade 'E' hot asphalt, 4550 tons of crushed rock and screenings, and 5000 concrete meter boxes.

Specifications may be obtained upon application at Room 33, 512 Sixteenth Street, Oakland, California.

JOHN H. KIMBALL, Secretary.

Oakland, California, February 27, 1930.

OFFICIAL BIDS

NOTICE TO CONTRACTORS

Overhead Crossing and Grading

Sealed proposals will be received at the office of the State Highway Engineer, Public Works Building, Sacramento, California, until 2 o'clock p.m., on March 19, 1930, at which time they will be publicly opened and read, for construction in accordance with the specifications therefor, to which special reference is made, of portions of State Highway, as follows:

Marin County, an overhead crossing over the tracks of the Northwestern Pacific Railroad at Forbes Station (IV-Mrn-1-A), consisting of one 46-foot steel beam span and 190 feet of timber trestle on pile bents.

San Bernardino County, between The Pass and two miles down Waterman Canyon (VIII-SBd-43-A), about one and nine-tenths (1.9) miles in length, to be graded.

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

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

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

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

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

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

Dated February 19, 1930.

NOTICE TO CONTRACTORS

Sealed proposals will be received at the office of the State Highway Engineer, Public Works Building, Sacramento, California, until 2 o'clock p.m. on March 26, 1930, at which time they will be publicly opened and read, for construction in accordance with the specifications therefor, to which special reference is made, of portions of State Highway, as follows:

Glenn County, between Logandale and Willows (III-Gle-7-A), about five and two-tenths (5.2) miles in length, to be paved with Portland cement concrete.

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

OFFICIAL BIDS

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

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

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

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

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

Dated February 26, 1930.

THE BUYERS' GUIDE—*Continued from Page 58*

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.
Harron, Rickard & McCone Co.
Jaeger Machine Works, The
Jenison Machinery 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.

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

Reinforcing Bars
Pacific Coast Steel Co.
Soulé Steel Co.

Reinforcing Wire Fabric
Soulé Steel Co.

Reservoirs, Steel
Chicago Bridge & Iron Works
Western Pipe & Steel Company

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.
Harron, Rickard & McCone Co.
Jenison Machinery Co.
Lakewood Engr. Co.

Road Graders and Scrapers
Bacon Co., Edward R.
Caterpillar Tractor Co.
Galion Iron Works & Mfg. Co.
Jenison Machinery Co.
Spears-Wells Machinery Co.
West Coast Tractor Co.
Young Machinery Co., A. L.

Road Oil
Gilmore Oil Co.
Seaside Oil Co.
Shell Oil Co.
Standard Oil Co.
Union Oil Co.

Road Rollers
Bacon Co., Edward R.
Galion Iron Works & Mfg. C.
Hackley Equipment Co., P. B.
Huber Manufacturing Co.
Jenison Machinery Co.
Spears-Wells Machinery Co.

Roofing
Paraffine Companies, Inc., The

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

Saws, Portable
Harron, Rickard & McCone Co.
Ingersoll-Rand Co.
Jenison Machinery Co.
Young Machinery Co., A. L.

Scarifiers
Bacon Co., Edward R.
Jenison Machinery Co.
Le Tourneau Mfg. Co.
Spears-Wells Machinery Co.
West Coast Tractor Co.

Scrapers (Dragline, Fresno, Wheeled)
Bacon Co., Edward R.
Galion Iron Works & Mfg. C.
Harron, Rickard & McCone Co.
Jenison Machinery Co.
Killefer Manufacturing Co.
Sauerman Bros., Inc.
West Coast Tractor Co.

Screens, Sand and Gravel
Bacon Co., Edward R.
Bodinson Manufacturing Co.
Diamond Iron Works, Inc.
Harron, Rickard & McCone Co.
Jenison Machinery Co.
Link-Belt Meese & Gottfried Co.
Smith Engineering Co.
Young Machinery Co., A. L.

Screens, Sewage
Dorr Co., The
Link-Belt Meese & Gottfried Co.

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

Second-Hand Equipment
Atkinson Equipment Agency
Contractors Mchy. Exchange
Excavating Equipment Dealers, Inc.
Hackley Equipment Co., P. B.
Harron, Rickard & McCone Co.
Tieslau Bros.

Sewage Disposal Apparatus
Dorr Co., The
Industrial & Municipal Supply Co
Link-Belt Meese & Gottfried Co.
Wallace & Tiernan
Water Works Supply Co.

Sharpeners, Rock Drill Steel
Gardner-Denver Co.
Ingersoll-Rand Co.

Shovels (Electric, Gasoline, Steam)
American Hoist & Derrick Co.
Bacon Co., Edward R.
Bucyrus-Erie Co.
Garfield & Co.
General Excavator Co.
Hackley Equipment Co., P. B.
Harnischfeger Sales Corp.
Harron, Rickard & McCone Co.
Industrial Brownhoist Corp.
Jenison Machinery Co.
Link-Belt Meese & Gottfried Co.
Marion Steam Shovel Co.
Northwest Engineering Co.
Ohio Power Shovel Co.
Orton Crane & Shovel Co.
Osgood Co., The
Spears-Wells Machinery Co.
Speeder Machinery Corp., The
St. Louis Power Shovel Co.
Thew Shovel Co., The
Young Machy. Co., A. L.

Shovels, Hand
Harron, Rickard & McCone Co.
Jenison Machinery Co.

Sluice Gates
California Corrugated Culvert Co
Water Works Supply Co.

Spreaders, Gravel and Rock and Asphalt
Bacon Co., Edward R.
Galion Iron Works & Mfg. Co.
Jenison Machinery Co.

Standpipes
Chicago Bridge & Iron Works
Montague Pipe & Steel Co.
Pittsburgh-Des Moines Steel Co.
Western Pipe & Steel Co.

Steel Bands
Pacific Coast Steel Co.

Steel, Drill
Gardner-Denver Co.
Ingersoll-Rand Co.
Leitch & Co.
Rix Company, Inc., The

Steel Plates
Pacific Coast Steel Co.

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 Co.
Western Iron Works
Western Pipe & Steel Co.

Street Sweepers, Sprinklers, Flushers
Jenison Machinery Co.

Steel Joists
Truscon Steel Co.

Steel Windows
Truscon Steel Co.

Subgraders
Bacon Co., Edward R.
Blaw-Knox Co.
Harron, Rickard & McCone Co.
Lakewood Engineering Co.

Swimming Pool Equipment
California Filter Co., Inc.

Tanks, Air Compressor
Ingersoll-Rand Co.
Lacy Manufacturing Co.
Peerless Mchy. & Mfg. 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 Co.

Torches (Welding and Cutting)
Oxweld Acetylene Co.

Towers, Transmission
Pacific Coast Steel Co.
Water Works Supply Co.

Tractors
Caterpillar Tractor Co.
Cleveland Tractor Co.
United Tractor & Equipment Corp.
West Coast Tractor Co.

Tramways
American Steel & Wire Co.
Bacon Co., Edward R.
Leschen & Sons Rope Co., A.

Transmission Machinery, Power
Bodinson Mfg. Co.
Link-Belt Meese & Gottfried Co.

Transportation, Water
American-Hawaiian Steamship Co.

Trench Excavators
Cleveland Trencher Co., The
Garfield & Co.
Harnischfeger Sales Corp.
Harron, Rickard & McCone Co.
Jenison Machinery Co.
Link-Belt Meese & Gottfried Co.
Thew Shovel Co., The

Truck Cranes
Harnischfeger Sales Corp.
Harron, Rickard & McCone Co.
Jenison Machinery Co.
Universal Crane Co., The

Trucks
Fageol Motors Co.
International Harvester Co.
Kleiber Motor Co.
Sterling Motor Truck Co.

Tunnel Shovels
Bucyrus-Erie Co.
Jenison Machinery Co.
Marion Steam Shovel Co.

Turbines, Hydraulic
Pelton Water Wheel Co., The
Water Works Supply Co.

Turntables
Bacon Co., Edward R.
Harron, Rickard & McCone Co.
Jenison Machinery Co.

Unloaders, Car and Wagon
Bacon Co., Edward R.
Jenison Machinery Co.
Link-Belt Meese & Gottfried Co.

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

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

Valves, Hose Gate
Greenberg's Sons, M.

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

Washers, Sand and Gravel
Diamond Iron Works, Inc.
Jenison Machinery Co.
Smith Engineering Co.

Water Purification
California Filter Co., Inc.
Industrial & Municipal Supply Co.
Wallace & Tiernan
Water Works Supply Co.

Water Softeners
California Filter Co., Inc.

Water Supply Installations
California Filter Co., Inc.
Industrial & Municipal Supply Co.
Wallace & Tiernan
Water Works Supply Co.

Water Transportation
American-Hawaiian Steamship Co.

Water Wheels
Pelton Water Wheel Co. The
Water Works Supply Co.

Water-Works Supplies
American Cast Iron Pipe Co.
California Filter Co., Inc.
Industrial & Municipal Supply Co.
Wallace & Tiernan
Water Works Supply Co.

Welding Apparatus (see Torches)
Oxweld Acetylene Co.

Welding Equipment
Oxweld Acetylene Co.

Welding Rods and Wire
Oxweld Acetylene Co.

Welding Supplies
Oxweld Acetylene Co.

Well Casing
Montague Pipe & Steel Co.

Wheelbarrows
Harron, Rickard & McCone Co.
Jenison Machinery Co.

Windows, Steel
Truscon Steel Company

Wire Rope
American Steel & Wire Co.
Edwards Co., E. H.
Jenison Machinery Co.
Leschen & Sons Rope Co., A.

PROFESSIONAL DIRECTORY

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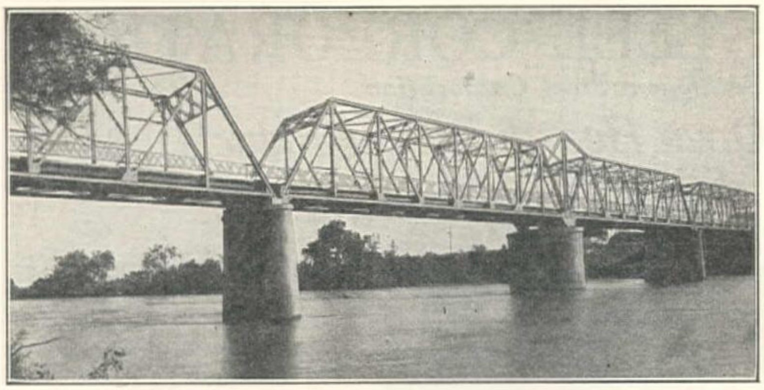

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