WESTERN CONSTRUCTION NEWS

ENGINEERING CONSTRUCTION IN THE FAR WEST

PUBLISHED SEMI-MONTHLY
VOLUME V NUMBER 24

SAN FRANCISCO, DECEMBER 25, 1930

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$3.00 PER YEAR

REPAVING OF SUNSET BOULEVARD, LOS ANGELES, EAST FROM HOBART BOULEVARD, SHOWING EXTENT TO WHICH STREET CROWN HAS BEEN LOWERED TO REDUCE CROSS SLOPE; W. F. CRAWFORD, CONTRACTOR

THE ANNUAL INDEX APPEARS IN THIS ISSUE

The HEAVIEST SHOVELS BUILT

MANY of the P & H Models are heavier than any other machine of similar rating. For instance Model 300-B, 5/8-yd. machine, weighs 48,000 lbs.; the model 600-A, 1-yd. machine, weighs 81,000 lbs.

P & H machines are heavy because all main frames, including carbody, revolving frame and corduroy frames, are heavy single-piece steel castings. This unit cast steel construction gives strength and rigidity that cannot be obtained with structural frames or combination cast and structural frames.

The carbody and tractions are much heavier than those employed on other machines. This heavy construction provides a solid foundation that permits the machine to travel through the deepest mud—or over rocks without danger of springing.

Unit cast construction preserves perfect alignment and cuts maintenance costs.

Structural Features that Mean Great Strength

Steel construction. All frames are single-piece castings. Engine is mounted directly upon revolving frame. Shafting of chrome-manganese steel, forged, heat treated and machined. Gears and pinions cut from heat-treated steel forgings. Drum clutches operated by power. Combined swing gear and roller path extra heavy steel casting. Heavy axles carry entire weight—no weight on drive shafts. P & H patented chain crowd—the most positive crowding motion known. Large size motors.

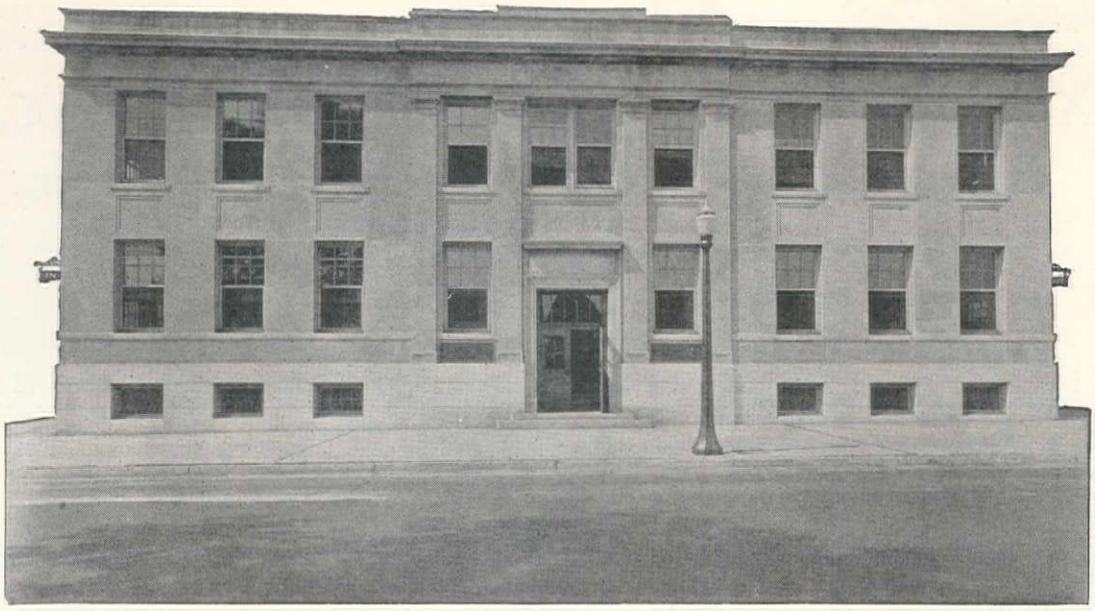
HARNISCHFEGER SALES CORPORATION
Established 1884
4490 W. National Ave., Milwaukee, Wis.
32 Beale St., San Francisco 2025 Santa Fe Ave., Los Angeles
ROBERT M. TAYLOR, Pacific Coast Manager
Service Stations, Complete Repair Part Stocks and Excavators
at San Francisco, Los Angeles and Seattle

A-559

P&H Gasoline · Diesel · Electric EXCAVATORS

LEADITE

Trade Mark Registered U.S. Pat. Office



Offices of the Philadelphia Suburban Water Company, Bryn Mawr, Penna.

Philadelphia Suburban Water Company —*uses* LEADITE *exclusively*

This well-known Water Company, one of the C. H. Geist properties, supplies a population of about 315,000 persons through approximately 900 miles of water mains.

It is a significant fact that they have USED LEADITE EXCLUSIVELY on approximately 230 miles of their water mains laid in the last 4½ years (sizes up to 24 in. inclusive, and pressures averaging 60 lbs. per sq. in.—with maximum considerably above that figure). In fact, even prior to 1925, this Company used LEADITE extensively.

The daily per capita consumption of water is slightly under 60 gallons, which includes Domestic, Commercial and Industrial users—also fire, flushing and municipal purposes. This figure also includes all losses by leakage. These figures are excellent proof of tightness of pipe lines.

Mr. Carleton E. Davis* is Manager of the Philadelphia Suburban Water Company.

*Mr. Davis is a Past President of both the American Water Works Association and the New England Water Works Association—also former Chief Engineer of Philadelphia Bureau of Water for 11 years.

The pioneer self-caulking material for c. i. pipe.
Tested and used for over 30 years.
Saves at least 75%.

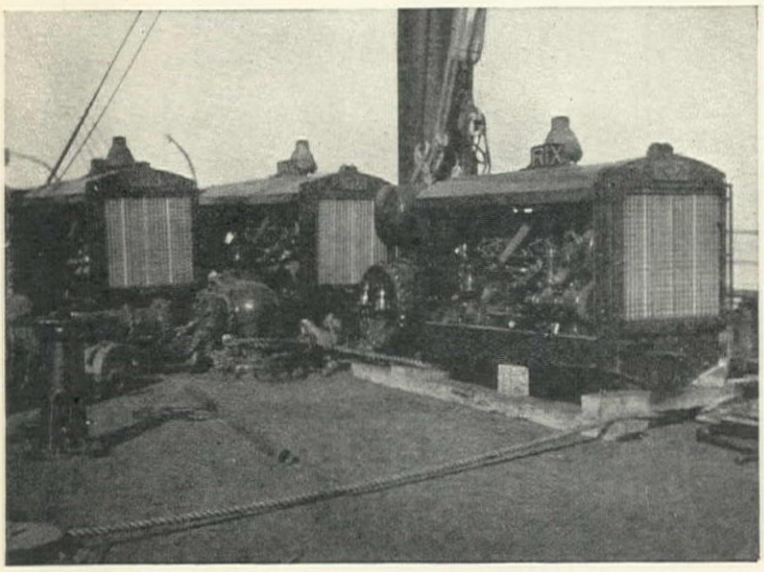
WATER WORKS SUPPLY COMPANY

501 Howard Street, San Francisco 2326 E. 8th St., Los Angeles
Water Works & Power Equipment Co., White Building, Seattle
THE LEADITE COMPANY—LAND TITLE BLDG., PHILADELPHIA, PA.

No Caulking

"Some Service"

RIX-SIXES play important role in salvaging $1,600,000 Tanker "TAMIAHUA"... ordered at 11 a.m., on ship in operation at 7:30 p.m....



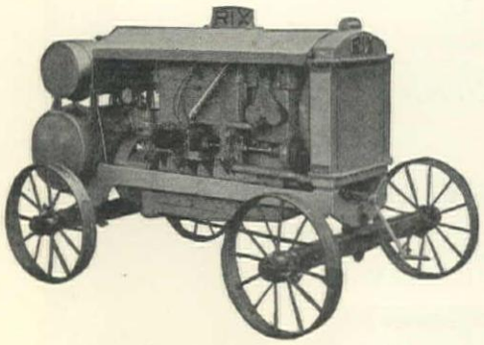
Partial view of battery of RIX-SIXES in action aboard the "Tamiahua"

THE salvage was a compressed air job . . . RIX-SIXES were used to force the water from the tanks and holds so as to float the ship. Merritt-Chapman & Scott brought six portable compressors from Los Angeles aboard the tugs Homer and Peacock. . . . On Monday, Nov. 17th, they required two more RIX-SIXES which were furnished immediately. On Monday, Nov. 24th, at 11 A.M. an SOS call was received for four more RIX-SIXES, which were shipped at once and at 7:30 P.M. these four units were in operation aboard the stranded Tamiahua. As Captains Johnson and Gardner said: "This was 'some service'!"

A Rix service engineer operated the twelve compressor units and rendered valuable aid to the salvors in hooking compressed air up to the bilge pumps, capstans, winches and steering gear.

The RIX COMPANY, Inc.

San Francisco Los Angeles
Portland Seattle



Rix-Six

PORTABLE AIR COMPRESSORS

The Compressor *with the* Super Charger

RIX Pioneer line includes compressors of all sizes for all purposes. Rix Co. are also agents for COCHISE Drills, and exclusive distributors for THOR Pneumatic Tools in Seattle territory.

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DEVOTED TO ENGINEERING CONSTRUCTION IN THE FAR WEST

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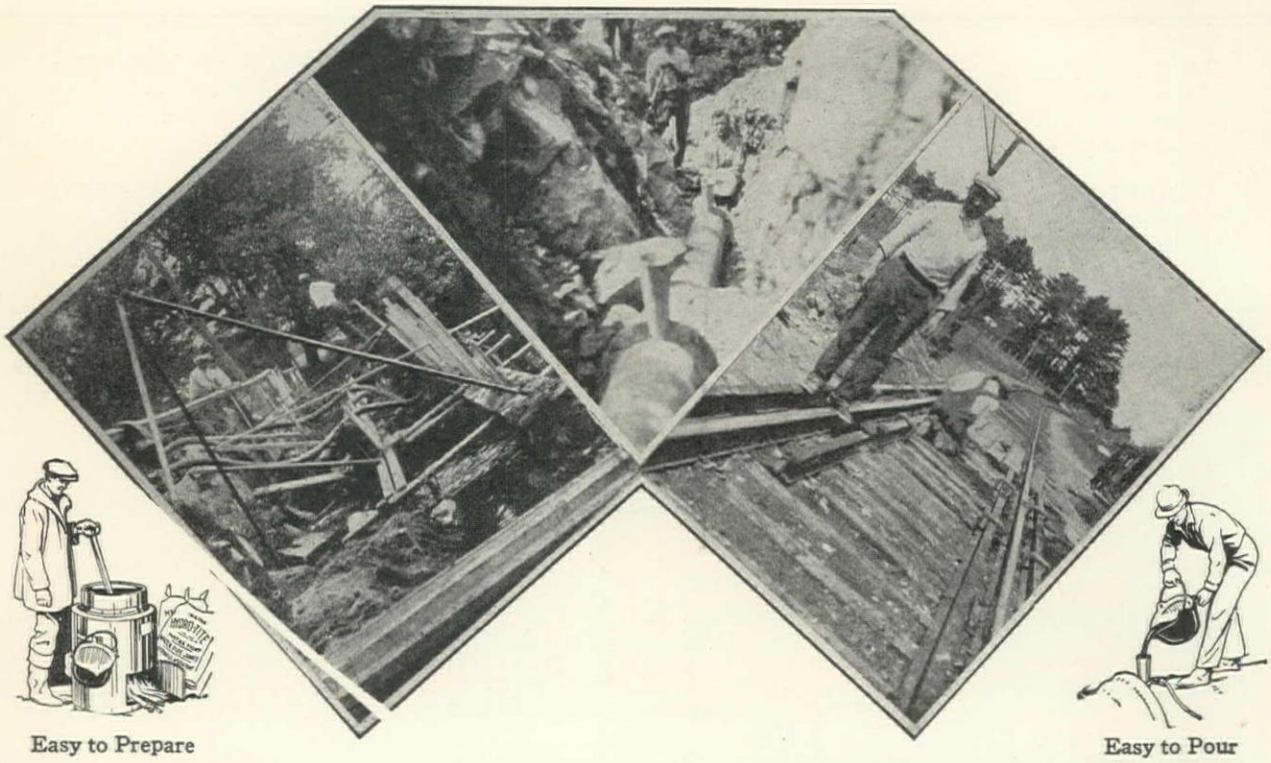

Easy to Prepare

Easy to Pour

UNDER ALL KINDS OF CONDITIONS

HYDRO-TITE MAKES BETTER PIPE JOINTS

THE pictures above show some of the worst conditions encountered when laying cast iron bell and spigot pipe. These were taken during the installation of twenty-one miles of pipe in a new water system. The picture on the left shows one of the wet sections. The center picture shows pipe being laid through ledge and the picture on the right is where the pipe is laid directly under the railroad track.

Hydro-Tite was selected as the joint material on account of its splendid record in meeting every joint requirement.

Joints made with Hydro-Tite are superior to lead—yet can be made at one-quarter the cost. They require no caulking—are easily made and are strong—tight and flexible. The proven dependability of Hydro-Tite for over 19 years has made its use sound engineering practice.

Hydro-Tite is now shipped in a new style cloth bag which has a heavy moisture proof liner. This insures dry material and a clean bag. If you are not one of the many users of Hydro-Tite we will be glad to arrange a demonstration. If you prefer we will ship you a bag for test or trial.

Write for literature and full information

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SAN FRANCISCO: 7 Front St. LOS ANGELES: 6800 Avalon Blvd.

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REG. U. S. PAT. OFF.

The MODERN JOINT MATERIAL

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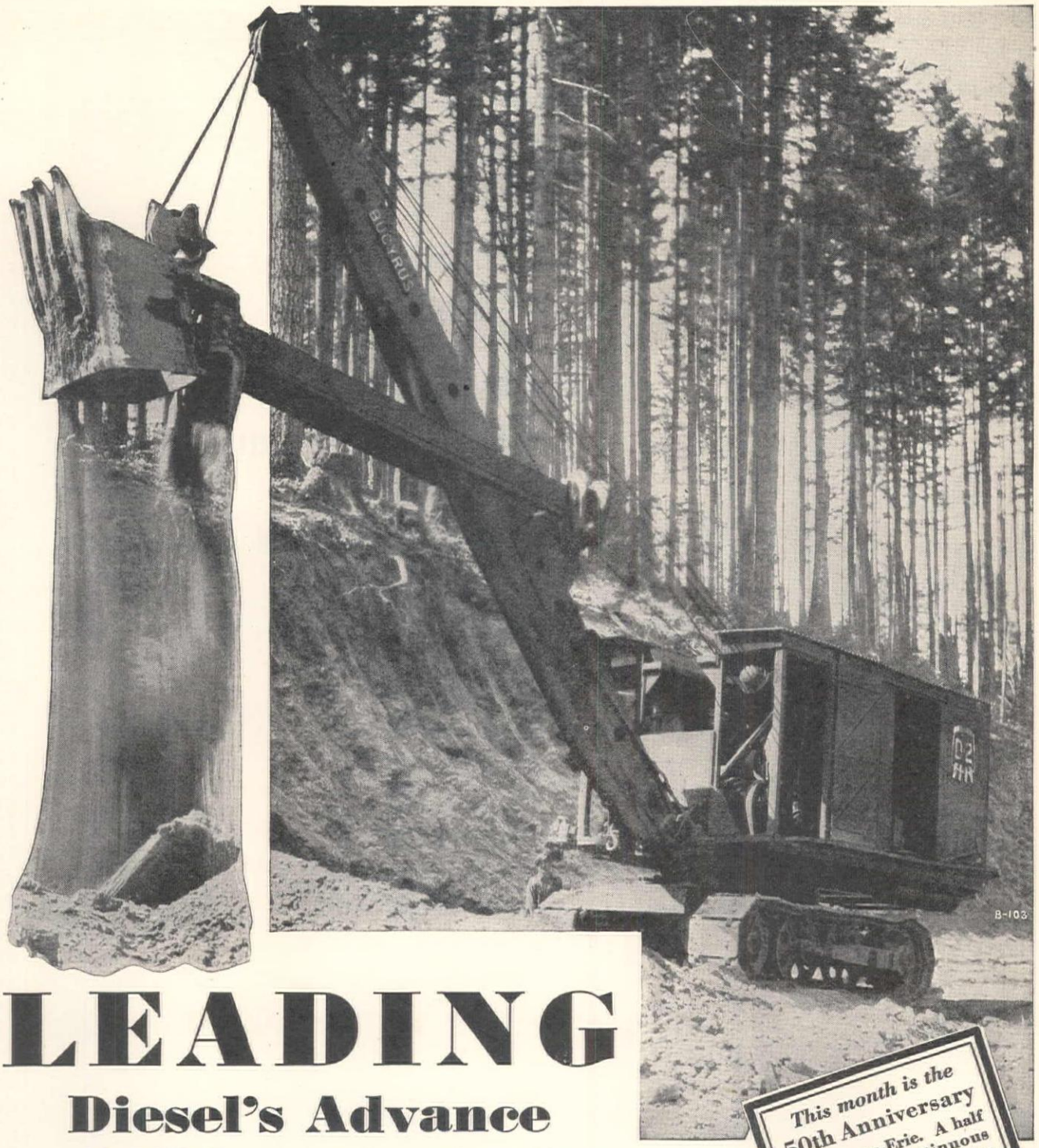

LEADING

Diesel's Advance

40,000 horse power strong!

When you buy a Diesel-powered shovel, dragline or crane, remember that Bucyrus-Erie built the first Diesel shovel and in eight years has filled orders for machines totalling more than 40,000 Diesel horse power — far more than any other maker. Bucyrus-Erie aided in developing better Diesel engines, and built rugged machinery specially designed to give you the fullest advantage of this form of power. 1/2, 3/4, 1, 1 1/4, 1 1/2-yard or larger *seasoned* Diesels to choose from. Send for specifications.

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

This month is the 50th Anniversary of Bucyrus-Erie. A half century of continuous service to excavator users around the world.

BUCYRUS-ERIE COMPANY, ***General Offices*: South Milwaukee, Wis. *Plants:* South Milwaukee, Wis.; Erie, Pa.; Evansville, Ind.**

• • •

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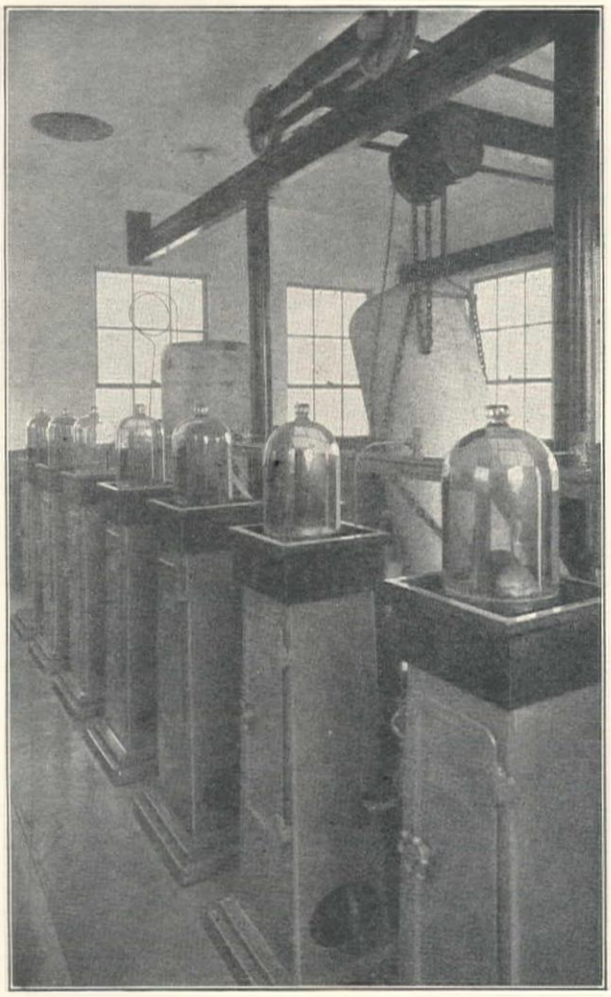
327 VACUUM CHLORINATORS



Seven W&T solution feed VACUUM CHLORINATORS (Type ASV) on the LOS ANGELES, Calif. Water Supply

FIFTY three cities are on the American Medical Association Honor Roll.

Fifty three cities with a typhoid death rate of tess than two per hundred thousand — and chlorination played a vital part in making this splendid record.

But — the significant fact is this — 327 W & T Solution Feed VACUUM CHLORINATORS are sterilizing the water supplies, disinfecting the swimming pools, chlorinating the sewage in these justly honored fifty three American municipalities.

Three thousand Solution Feed VACUUM CHLORINATORS are now in daily service.

Their ease of operation, their low maintenance costs have been proven. Their absolute dependability is attested by the record of these 327 machines.

NO VACUUM CHLORINATOR HAS EVER WORN OUT

Ask for Technical Publication 38

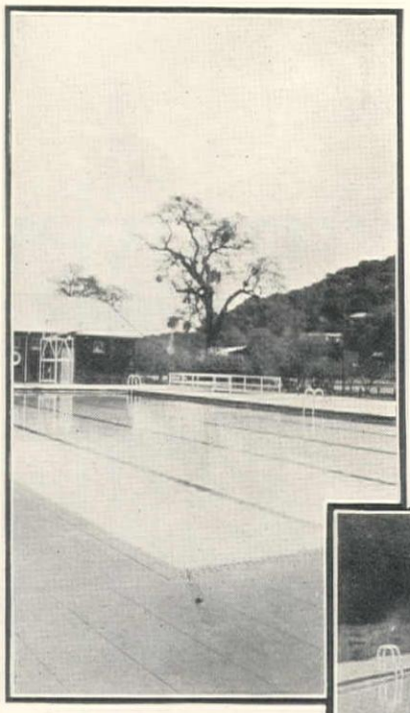
WALLACE & TIERNAN CO. INC.
Manufacturers of Chlorine Control Apparatus
NEWARK, N. J.
BRANCHES IN PRINCIPAL CITIES

A Product of

WALLACE & TIERNAN

"The only safe water is a sterilized water"

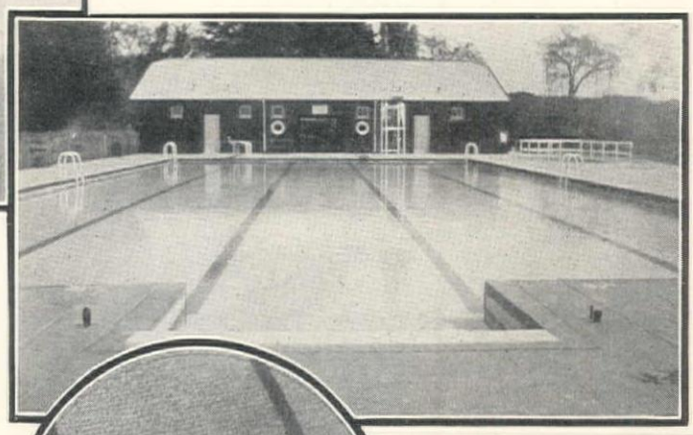
SA-26



CLEAR AS CRYSTAL IF WATER EVER WAS:

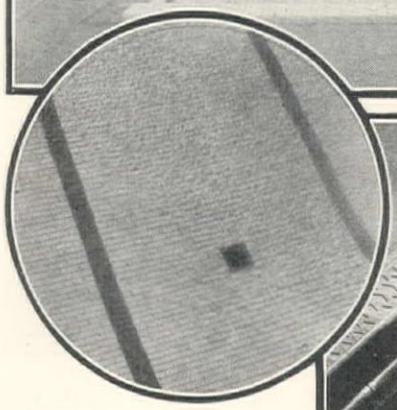
The Emporium Pool at Emporium, California, Filtered and Purified by California Filter Installation

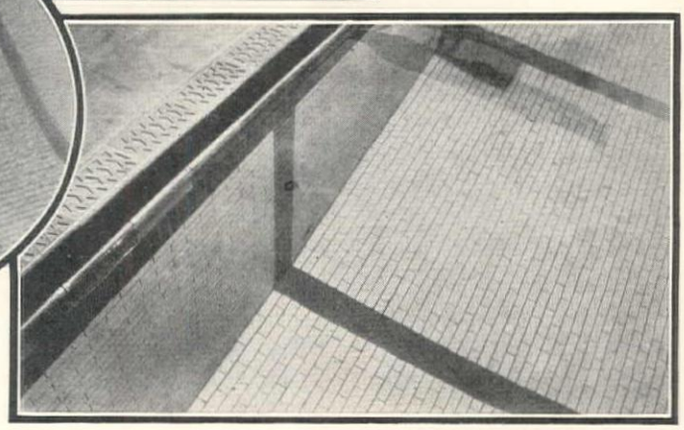
ABOVE AND RIGHT: *General view of Emporium Pool.*



BELOW: *Looking through 7½ ft. of water from the low dive.*

CIRCLE: *Looking down from the high dive, 10 ft. above surface, through 9 ft. of water.*





THE swimming pool for employees maintained by The Emporium, San Francisco department store, at Emporium, California, gives a striking demonstration of the effectiveness of filtration and chlorination in providing pure, absolutely clear water for swimmers.

This pool, of championship size, is 105 feet by 50 feet, with graduated depth from 3½ feet to 7½ feet. Its 200,000-gallon capacity is kept under constant circulation, and as the views above show, the water is so clear as to be hardly discernible except where the surface is rippled by the wind.

California Filter equipment is made to meet the needs of swimming pools of any size. Detailed information on all sizes and arrangements of filters is contained in our booklet No. 40, which we shall be glad to send on request.

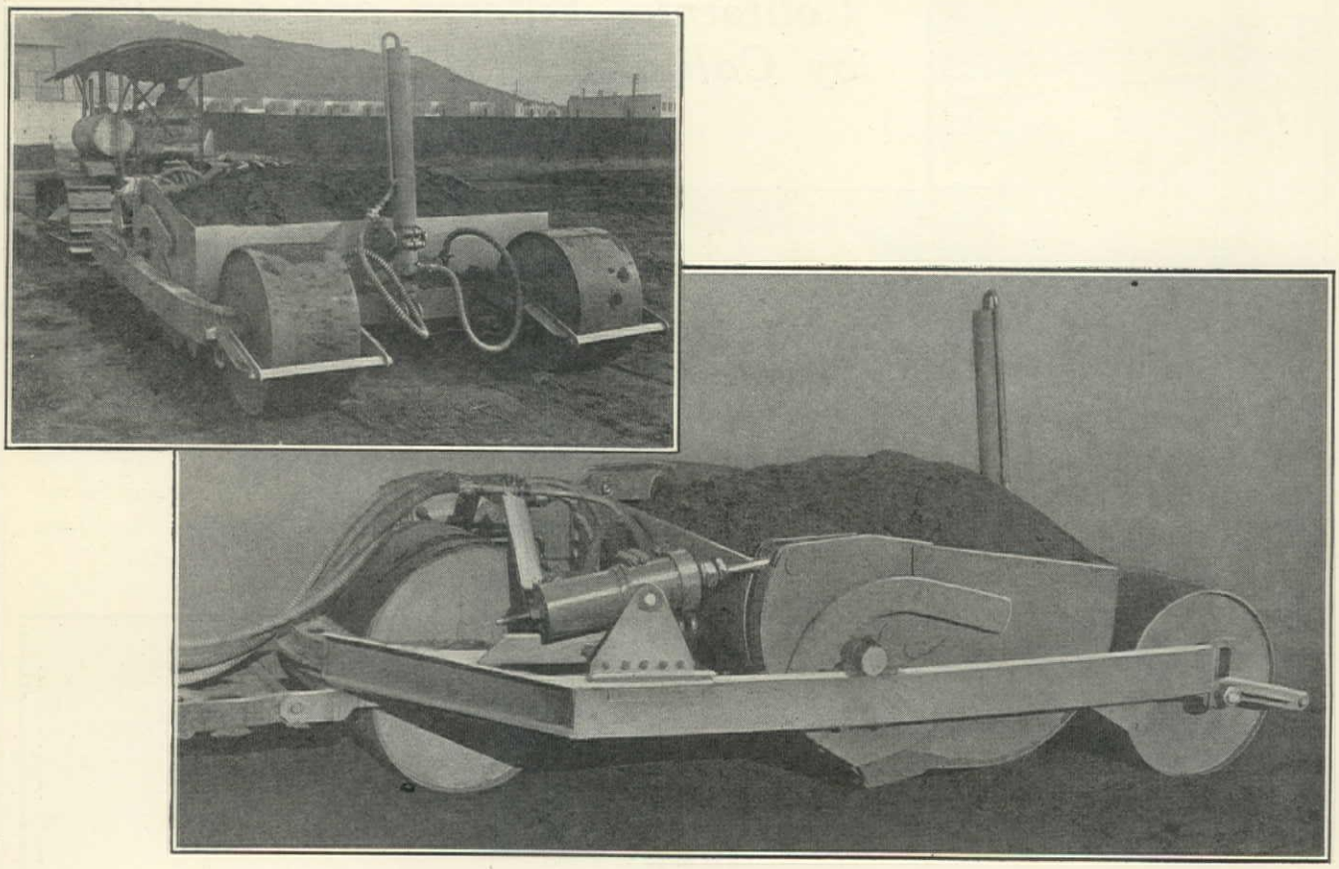
CALIFORNIA FILTER COMPANY, Inc.

981 Folsom Street, San Francisco

SEATTLE **LOS ANGELES**

Announcing the New Six-Yard...

Bodie Clamshell Dirtmover



THE Bodie Clamshell Dirtmover is the first to utilize the proven advantages of the clamshell principle in equipment of this kind. It is the third development in a line of Dirtmovers designed and built by this company, each having its particular applications for digging, transporting, spreading, filling and rolling in lowering earthmoving costs.

Based on known facts covering tractor speeds and costs of tractor operation, this new Dirtmover will load, carry and dump 375 yards in eight hours with a 1000-ft. haul at a cost not exceeding 11 cents per yard. The unit also serves ideally as a roller with its 25,000 lb. loaded weight and three wheels of 67" total width. It is equally efficient as a 7-yd. tractor wagon. Tracks are interchangeable with wheels.

Specifications: Capacity, 6 yds.; weight, 10,000 lbs.; wheels, front 36"x 27", rear 36"x 20"; bearings, Timken, with positive dust seals; frame, box section, electrically welded; operation, hydraulic cylinder; overall width, 10 ft.; turning radius, 20 ft.; lubrication, high pressure; bowl clearance (loaded), 7". Further details covering all types of Bodie Dirtmovers will be given on request. Inquiries promptly attended to.

We Challenge Comparison by Demonstration

BODINSON MFG.CO. INC. SERVICE * QUALITY

SAN FRANCISCO
SEATTLE

BODINSON
MANUFACTURING CO., Inc.
LABOR SAVING MACHINERY FOR EVERY SERVICE

BODINSON MFG.CO. INC. SERVICE * QUALITY

LOS ANGELES
OAKLAND

Brown Contracting Co., Chattanooga, Tenn., excavating at the approach to Avondale Tunnel, Chattanooga, Tenn.

Meeting Every Requirement of the Toughest Jobs - - -

The LIMA "101" meets every requirement of the toughest job. Its oversized construction and reserve power enables it to master every class of excavating suited to a shovel of 1¼ yard capacity.

No other shovel in the world offers so many profit making features. Pressed steel boom and dipper handle construction, one solid piece cast steel upper frame, single line hoist and Timken roller bearings at every vital bearing point, are but a few of the features that make the LIMA "101" the most popular shovel, dragline, crane and dragshovel on the market today

The Ohio Power Shovel Company

Division Lima Locomotive Works Incorporated

LIMA, OHIO

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LIMA "101"

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

Merry Christmas

Happy New Year

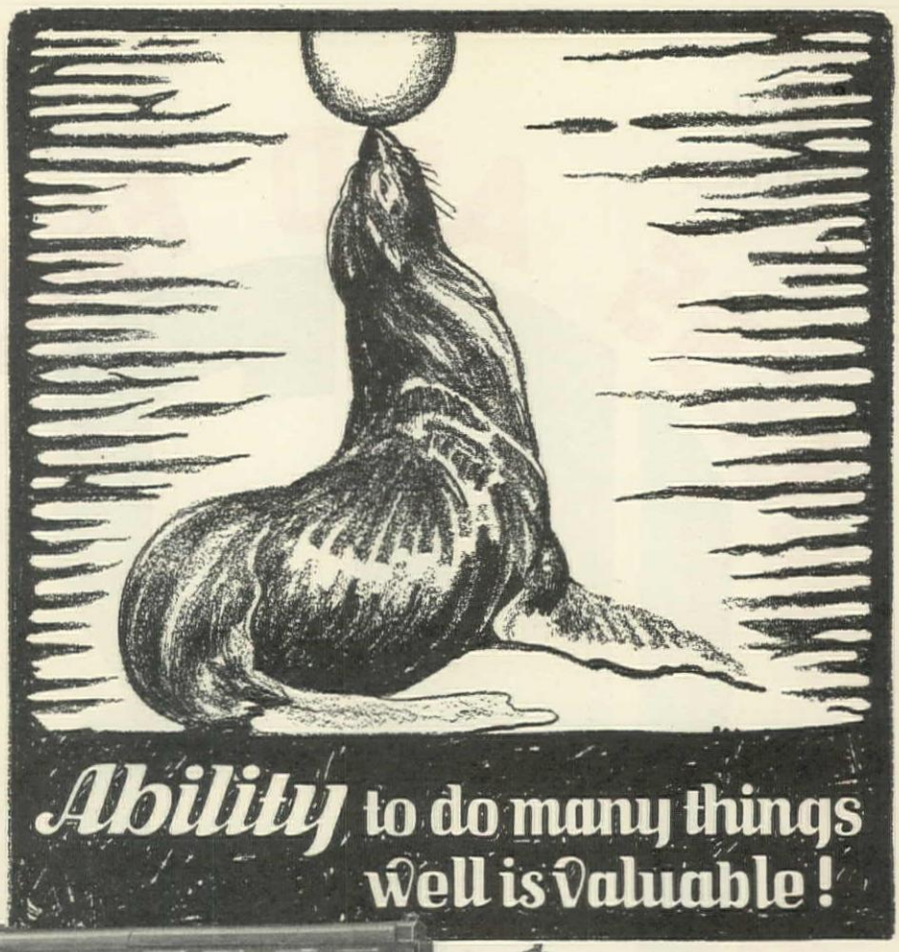
SUCCESS AND PROSPERITY · THE WHOLE YEAR 'ROUND ·

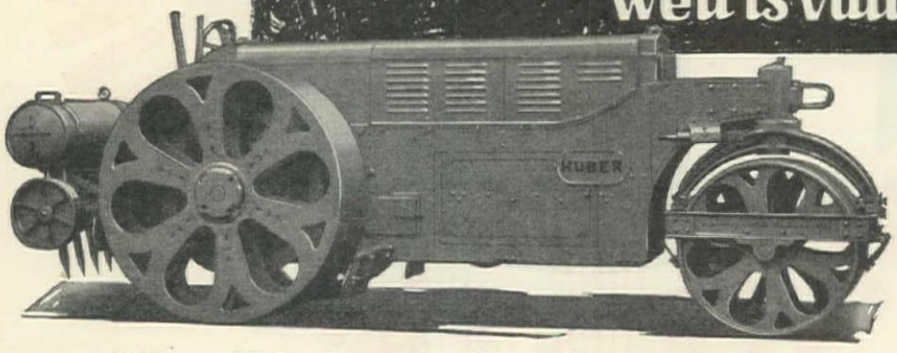
1931

That **1931** may be a Constructive and Prosperous year for the entire Construction Industry and that Bacon Equipment and Service may contribute its share towards "getting the job done — on time and at a profit" is the sincere wish of every member of the

EDWARD R. BACON COMPANY

17th and Folsom **Construction Equipment** **San Francisco**





You'll like a *Huber* because of its all-round ability to do all types of road work. It takes the place of a number of different pieces of equipment — and does the work efficiently and economically! A *Huber* with sprinkling attachment is ideal for rolling hot asphalt—with scarifier it tears up old roads and streets to any accurate depth —with grader blade it levels off old roads in a hurry—many operations *with one machine.* Made in sizes from 5 to 15 tons.

Write for the *New* HUBER Roller Catalog

EDWARD R. BACON COMPANY

17th and Folsom Sts., San Francisco **Phone HEmlock 3700**

HUBER MOTOR ROLLERS

When writing to THE HUBER MFG. CO., *please mention Western Construction News*

IN SAN FRANCISCO IT'S BACON

DISTRIBUTED BY
THE
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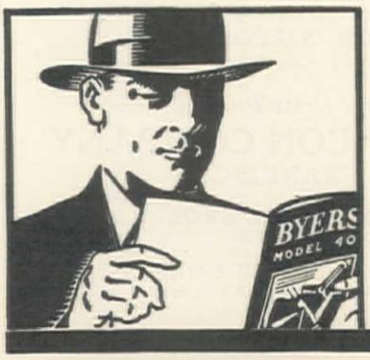
Folsom at 17th St.
SAN FRANCISCO, CAL.

BRANCHES AT
SACRAMENTO - SAN JOSE
OAKLAND - FRESNO
HONOLULU - RENO

Keep your Big Shovel for *Big Shovel Jobs* ▲ ▲ ▲

—and let a small shovel—Byers Model 40—earn the profit you deserve on small or short-time jobs. Then each of your machines will pay for itself the way you want it to. Half or ¾ yd. full circle rigs on very light excavations are expensive. In crowded quarters their bulk and tail swing make operations slow, clumsy—and costly.



Live weight not exceeding 10 tons complete allows Byers Model 40 to fit in and handle economically the countless small jobs which every engineer and contractor continually run up against.

Here's a rig that's built with all the construction and operating features found in finest 1 yd. shovels. On bank work or grading, car loading or digging deep footings, trenching or ditching—Byers Model 40 stands up to its job dependably, handling and digging at new low costs. You should learn more about Byers Model 40.

BYERS EXCAVATORS

The BYERS EXCAVATOR COMPANY
RAVENNA, OHIO

IN SAN FRANCISCO IT'S BACON

Mr. Contractor!

Do you know that the MASTER SCRAPER loads on a turn as easily as it does on a straight pull?

And has it ever occurred to you how many hard-earned DOLLARS you are losing whenever you work tractor scrapers that you cannot load on the turn?

FULL Loads Are PAY Loads

The MASTER will load on a turn, and YOU are LOSING hard-earned DOLLARS every day you move dirt without one.

Why not throw away those old, obsolete scrapers, TODAY, NOW, and get yourself a MASTER?

The MASTER Rotary Scraper will cut and skip, underspill, finish grade and level. Manual load control or Automatic.

"It moves the Earth"

Simple Design Rugged Construction
Easy Operation

Sold in Northern and Central California by:

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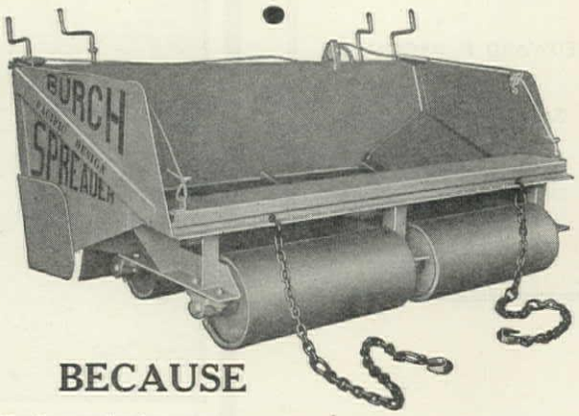
"It's MASTER Equipment, it MUST Be Better"

Mr. Engineer and Contractor

Why is the "PACIFIC DESIGN" BURCH SPREADER the best piece of equipment to use when placing Gravel, Macadam, or Asphaltic Concrete material

?



BECAUSE

It is entirely supported on rollers,
It has a bottom on which the material falls from the truck,
It pulls from under the load,
It makes a spread of uniform density and thickness,
It is adjustable to spread 7, 8, 9, or 10 feet in width,
It will make a perfect joint with the material previously spread,
It is easy to handle.

It is modern equipment for modern construction

Manufactured by
THE BURCH CORPORATION
CRESTLINE, OHIO

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R. P. LANE
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FRANCIS WANER COMPANY
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Factory Representative:

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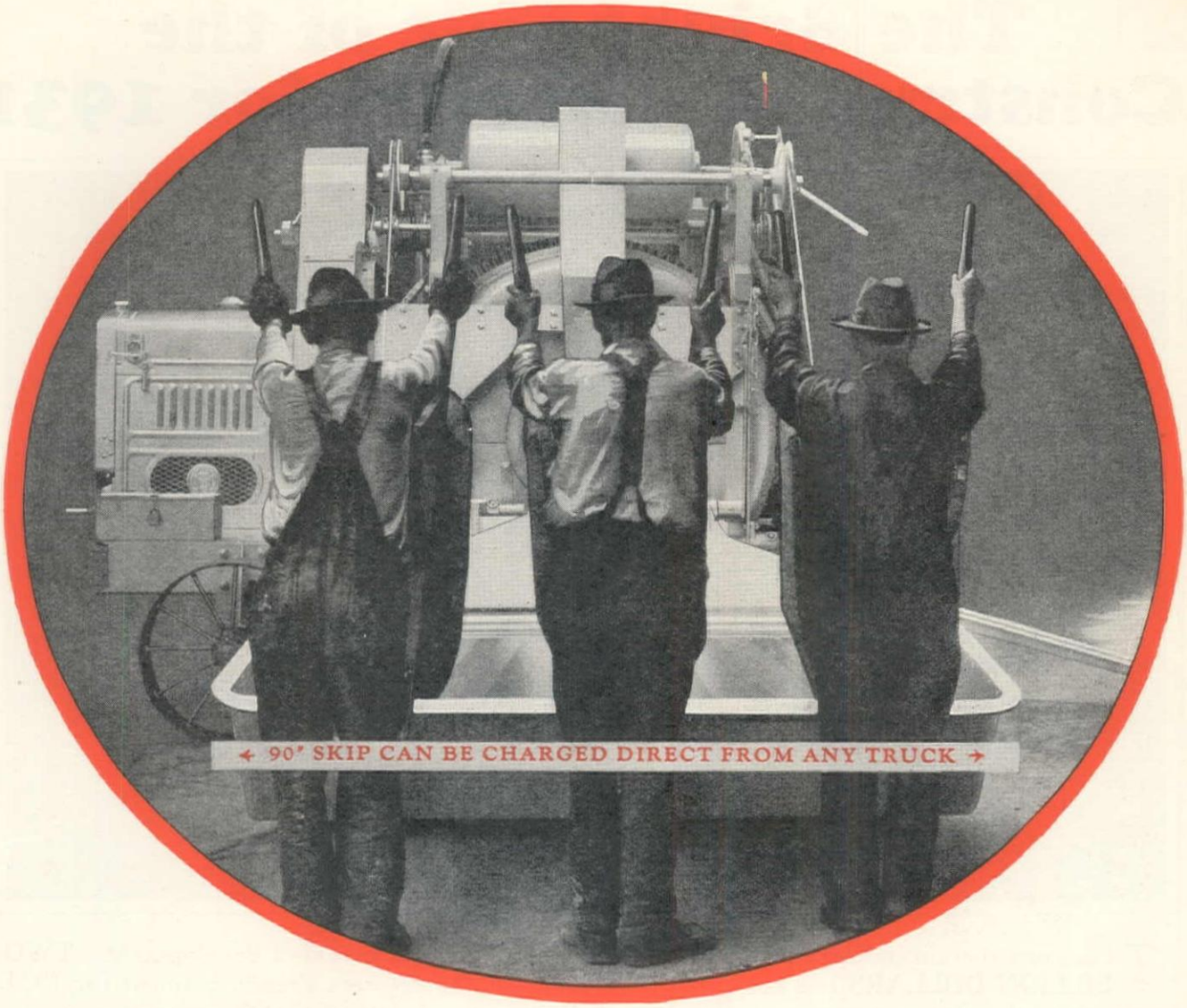
IT'S BACON IN SAN FRANCISCO



90" Skip Shaker Loader Makes Jaeger World's Fastest 14S Mixer!

This truck charging skip is optional equipment—at NO EXTRA COST!

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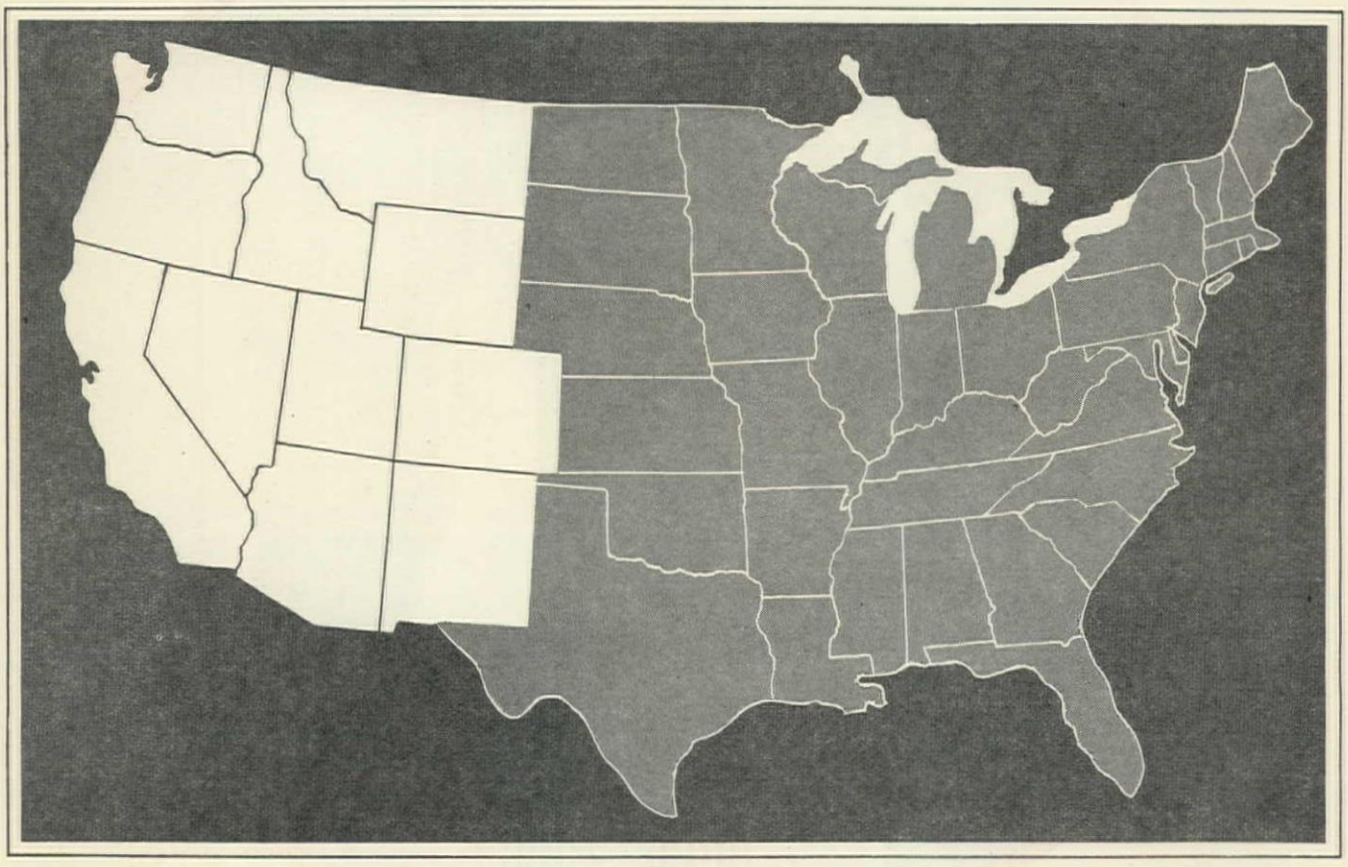
The Bright Side of the Construction Market for 1931



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State Highway programs in Eleven Far Western States for 1931 (money available from gas tax funds and bond issues)	$ 250,000,000
Street paving for Cities and Counties in Eleven Far Western States for 1931	225,000,000
Boulder Canyon project for U. S. Bureau of Reclamation (bids to be opened during February, 1931, for Hoover Dam, Tunnels and Power House, Railroad and Highway). (First Unit $70,000,000)	165,000,000
Colorado River Aqueduct for Metropolitan Water District, Los Angeles, bonds to be voted in April, 1931	200,000,000
Golden Gate Bridge across San Francisco Bay, call for bids to be issued immediately	35,000,000
Oakland-San Francisco Bay Bridge, War Department permit pending, construction to start during 1931	72,000,000
Richmond-San Rafael Bridge	12,000,000
Dam and conduit, Pine Canyon project for City of Pasadena, bonds voted, call for bids to be issued shortly	10,000,000
Sewer improvements for City of Phoenix, Arizona, call for bids to be issued at once	1,000,000
Harbor Improvements for State Harbor Commission at San Francisco, bonds issued $10,000,000; call for bids to be issued at once	$ 10,000,000
Power and Public Utility improvements in Eleven Far Western States for 1931	150,000,000
Hetch-Hetchy pipe-lines, call for bids to be issued early in 1931	12,000,000
Alameda-Contra Costa County Road District, California, tunnel and highway, to be under construction in 1931	5,000,000
Niles-San Francisco railroad for Western Pacific California Railroad, permit pending before Interstate Commerce Commission	8,000,000
Los Angeles City Water improvements, bonds voted, work to start soon	39,000,000
El Vado dam for Middle Rio Grande Conservancy District, Albuquerque, New Mexico, bids to be advertised in spring of 1931	1,600,000
Sanitary sewers for City of Los Angeles	5,650,000
Dam, reservoir, pipe-line, etc., for City of Santa Barbara	2,480,000
Bonds to be voted on in January for Roads and Streets in San Francisco	2,500,000
Total	$1,206,230,000

Western Construction News alone leads the way direct to this market

75% more editorial matter—60% more street and road work articles—70% more advertising—80% more paid circulation—than any other western construction paper

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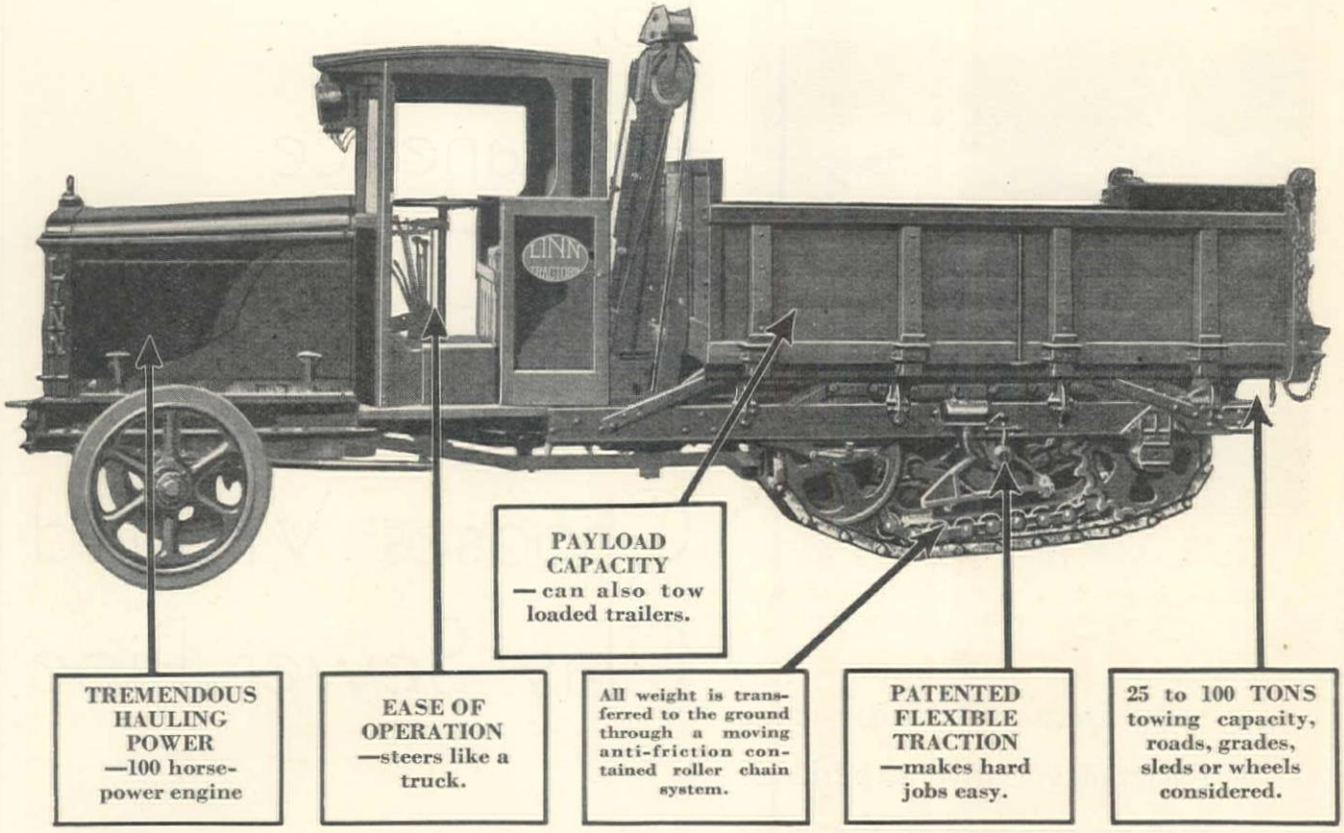

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Hamilton & Gleason	Denver, Colo.	C. & S. R. R. Const.
A. Guthrie Const. Co.	St. Paul	Echo Dam, Utah
Mulgrew & Sons	Dubuque, Iowa	Rock Island R. R. Const.
Standard Oil Co. of N. Y.	Boston	Northern Maine
List Construction Company	Kansas City, Mo.	Kansas City Southern R. R. Const.
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S. J. Groves & Sons	St. Paul	Conklingville Dam, N. Y.
Standard Oil Co. of Calif.	San Francisco	Texas Oil Fields
John F. Casey Co.	Pittsburgh	Allegheny River Blvd.
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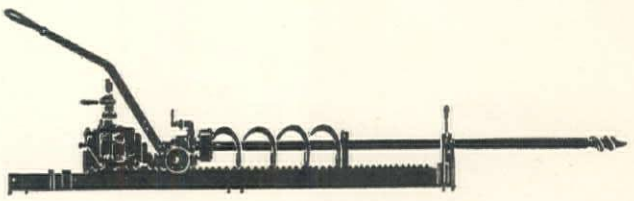
New PROGRESS IN PUBLIC UTILITY CONSTRUCTION



Hydrauger in use—boring under a double street and railroad—a distance of more than 100 feet. This remarkable new tool bores under thoroughfares, sidewalks, buildings, gardens—to lay pipe, condulets, drains and sewers—avoiding pavement-cutting almost entirely.

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A view of the sewage treatment plant at Fort Worth, Texas. When this plant was originally built, two Dorr Clarifiers were installed for sedimentation of trickling filter effluent. Recent changes included the installation of a Dorrco Bar Screen, of four Dorr Clarifiers for sedimentation of raw sewage, and the addition of three Dorr Digesters for sludge digestion. Hawley & Freese, Cons. Engrs.

A good time to Remodel Sewage Treatment Plants

IN the past few years there have been rapid advances in sewage treatment methods and equipment. This timely period for public work construction offers an excellent opportunity for modernizing existing plants.

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Improvements such as those suggested above have actually been carried out at many existing plants. Any city which undertakes such work at present is helping the unemployment situation, as well as providing greater health protection for its population. Our engineers will be glad to furnish full details to consulting engineers and municipal officials who are interested in a modernization program.

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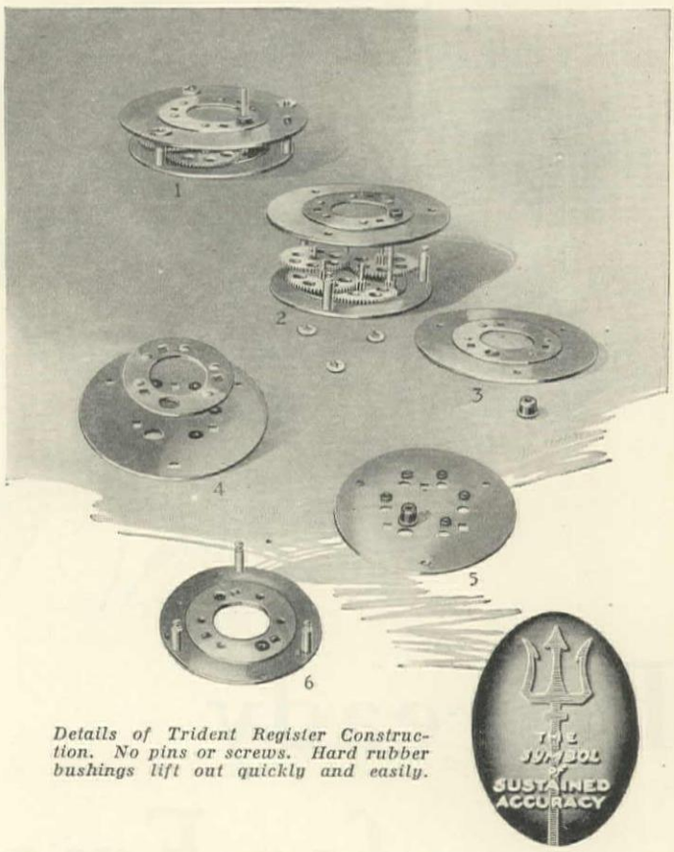

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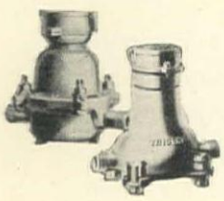

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The publishers of Western Construction News appreciate the support and cooperation of the engineers and contractors in helping us make the News the veritable Bible of the engineering-construction industry of the Far West. And, we also wish to thank our many advertisers who are using the News—the 'Paved Highway' direct to those contractors and engineers who are actually doing the work in this fast-growing western territory—and who are making possible the increased interest and value of its editorial pages. We wish you all a

Merrie Christmas and a Most Prosperous 1931

Recently the city council of San Diego, requiring the services of a consulting sanitary engineer, decided to advertise for bids from engineers for furnishing plans and specifications, on the same basis as bids on materials or construction—each bid to be accompanied by a certified check and the successful bidder to furnish a surety bond to guarantee his work. As these bids are to be opened and canvassed on December 22 (if any are submitted) while this issue is going to press—we cannot record here what action was taken.

San Diego Invites Engineers to Bid

Immediately after the 'Notice to Engineers' was published, the San Diego, Los Angeles, and San Francisco sections of the American Society of Civil Engineers, the national secretary of the Society, and various individual engineers, filed protests against this method of selecting and employing an engineer, pointing out that it is not only against the ethics of the profession but probably will result in the city securing an incompetent engineer.

We hope that all engineers refused to bid, for this method should be condemned by every engineer whether he is a member of the American Society of Civil Engineers or not.

This is not the first case of its kind—there have been a number of similar instances during the past few years, in the east as well as the west, and others that were narrowly averted. It was only last March that the city of Lima, Ohio, advertised for bids and received 16, many of the bids being submitted by engineers prominent in the profession and the Society; some engineers refused to bid.

Why have these cities adopted this method of employing an engineer? In almost every case a number of engineers have previously endeavored to obtain this employment, each securing the endorsement of at least one member of the city council and the backing of a number of prominent citizens. The qualifications, proposals, and fees of each were probably different. The council became confused and deadlocked on selection, and decided to 'open the specifications', so-to-speak, to all. Immediately, these same engineers who had been strenuously vying with each other to secure this employment, appealed to the American Society of Civil Engineers and other engineering associations to stop this dreadful violation of the ethics of the profession.

What does the city council think? Has this apparent inconsistence in ethics elevated the profession in the minds of the laymen? There is but one answer—No.

The selection of engineers by advertising for bids should be condemned, of course, but the profession must clean house first before it can hope to put an end to it.

Higher remuneration and greater respect can only be secured by each and every engineer adhering strictly to the ethics of the profession.

Montana Experiments with the Bituminous Road Mixer

By H. K. CHURCH

Junior Highway Engineer, Division of Management, U. S. Bureau of Public Roads

The state of Montana and the Hargrave Construction Co. of Spokane, Washington, have been experimenting with the Bituminous Road Mixer on a 60-mile road-oil mix project between Dillon and Butte.

Road-Oil Mixtures

A brief description of road-oil mixtures and construction methods is necessary to an understanding of the operation and value of the new machine.

In sparsely populated and relatively poor sections of the country, it is necessary to provide low-cost

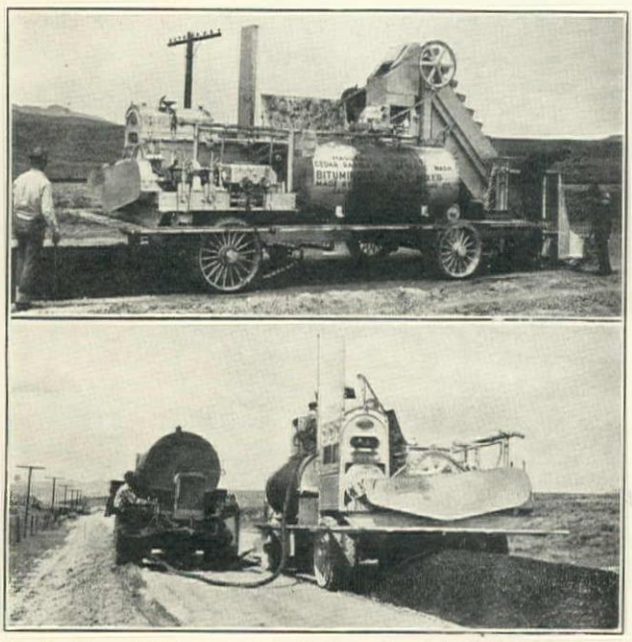


Fig. 1. The Bituminous Road Mixer. (Lower) Taking on Supply of Road Oil During Operation of Mixer

pavements. Low-cost bituminous construction is one solution to this problem. Two methods of construction are used. An existing gravel road may be scarified to provide the desired quantity of loose material, and the resulting metal processed with road oil to provide the wearing surface; or, gravel may be imported from local pits and processed with the road oil. In either case, the method of processing is the same.

The material is manipulated by tractor-drawn blade units or by motor-patrol units in a dry unmixed condition, and placed in a windrow along the center-line of the road. The windrow is flattened out by square blading to a width of about 10 ft., and the material is 'shot' with a pressure distributor, followed by a harrow unit. The 'shooting' is continued until the desired amount of road oil is incorporated into the metal. Manipulation then continues with the units in tandem until the material has taken on a uniform and black appearance, and until the desired consistence is attained. The manipulation consists essentially of a movement of the windrow back and forth across the road until all particles of metal are coated with the road oil. The material is then placed, or centered, along the center-line, and a single unit spreads the material to proper depth, width, and crown. Traffic compacts the material, and slight subsequent blading is necessary to preserve the crown desired. There are minor variations to this method of processing in the various States, but they are all pretty much the same. There is one drawback to this system—a constant ratio between amount of road oil and amount of metal is not possible. Entire confidence must be placed in the judgment of the inspector as to the proper amount of road oil to be added.

Let me outline the method from laboratory design to final compaction of material in the road. In the first place the designer, starting with the assumption that there are a given number of cubic yards of material per mile and that the material has a given gradation and other physical properties, decides upon a definite quantity of road oil per mile of pavement. The inspector tries to adhere to this figure, and he is generally thwarted on the following scores: first, the material never runs uniform in quantity, station for station and mile for mile, and never runs uniform in gradation; second, the flow of road oil from distributors, especially the gravity-type distributors, is apt

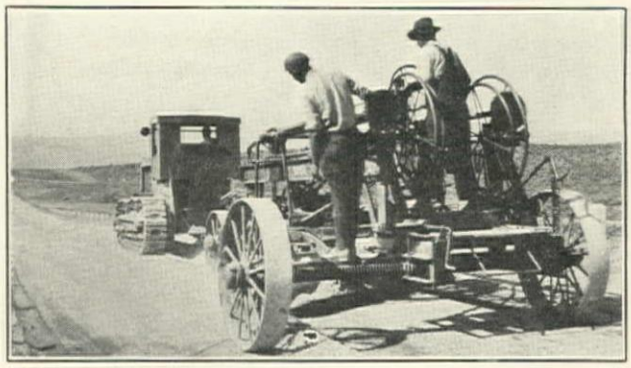


Fig. 2. Blading Road Metal Into Windrow in Center Ahead of Bituminous Road Mixer

to be variable and difficult of control. And so, excepting in the most exacting cases, there is a variable amount of road oil per square yard of material, by reason of the shortcomings of the older types of distributors employed by some state maintenance departments; and the material is also of various depths throughout the run of the distributor. If the two variables are compounded, they produce a highly variable road-oil content by weight of aggregate.

To this is added the important matter of gradation differences uncorrected during the course of the job. Such a situation is responsible for alternate bleeding and ravelling along a road-oil mix project, especially

when the mat, or wearing course of manipulated material, is thin. Prolonged manipulation does not serve to entirely eliminate this condition. The blade may displace a 50-ft. section, but the small section remains an integral part of the entire section. Furthermore, the transition from a fat to a lean section is sometimes not easily detected.

The Bituminous Road Mixer

For the contractor, this mixer is intended to eliminate several blade units, with a resultant economy in the substitution of the pugmill mixing of the mixer for the blade mixing of the manipulation units.

For Montana, this mixer is intended to eliminate

Fig. 3. Interior of Pugmill on Bituminous Road Mixer

the drawback cited relative to non-uniformity of mix, by batching metal and road oil together in definite quantities by weight.

Correlation of the Mixer and Other Equipment—In the state of Montana, it is the custom to develop the floor for the mixture by manipulation of the material over the base, rather than a 'tack coat' laid down by the distributor. Because of this method, five pieces of equipment are necessary in the new use of the mixer.

1. A blade unit for scarifying and moving the material into a windrow for pickup by the mixer.
2. The mixer for combining and mixing the road oil with the material.
3. A distributor to serve the mixer with road oil from the railroad car tankers.
4. A blade unit for manipulating the material and developing the floor thereby. (This unit is not to be considered in the nature of a manipulation unit for the purpose of mixing the material.)
5. A blade unit for laying the material, assisting in the manipulation, and maintaining the section during traffic compaction.

Mechanical Operation of the Machine—The operation of the machine as well as that of the secondary equipment, are shown in the accompanying illustrations.

The material is first scarified and shaped into a windrow along the roadway (see Fig. 2). The mixer then follows along the windrow, picking up the material, mixing it in a continuous pugmill with the road oil, and depositing the mixture in another windrow at the rear. The machine consists of five principal elements (see Fig. 1).

1. The prime mover—a Hercules 65-hp. 4-cylinder gasoline engine.
2. The pickup assembly—a bucket elevator with feeding fan blades mounted on the lower shaft, which has a capacity of 1.30 cu.yd. per min., allowing a safety factor of 63%.
3. The batching device—a tipple batcher which trips when the specified amount of material by weight has dropped into it from the elevator. The tipple actuates a piston pump which forces a definite quantity of road oil into the spraying manifold of the pugmill. The batcher is seen at the top of the elevator. The oil pump is on the other side of the machine near the batcher. Two 400-gal. tanks for road-oil storage are mounted on either side of the pugmill. Tanks are heated by kerosene burners.
4. The pugmill-mixing is accomplished by a continuous pugmill, with a length of 15 ft. and volumetric capacity, to the level which the material assumes under local conditions of mixing time, of 33.8 cu.ft. Fig. 3 illustrates the pugmill mixing action, with the spraying manifold for the hot road oil. The material enters at the upper end of the long pugmill at atmospheric temperature and is combined with the road oil at about 200° F. and the mixture leaves the lower end to be deposited in another windrow on the base. The speed of the elevator and the speed of the pugmill paddles bear a constant relationship to the speed of the motor, which in itself is constant.
5. The traction assembly—the driving wheels of the machine are connected to the motor by a clutch system which allows four road speeds: 2.0, 3.5, 5.0, and 7.0 ft. per minute. This latitude of road speeds is necessitated by the sizes of windrows which are encountered on various projects when the final mat is of different thicknesses.

Appraisal of the Road Mixer—From the standpoint of the contractor the economy of the machine, re-

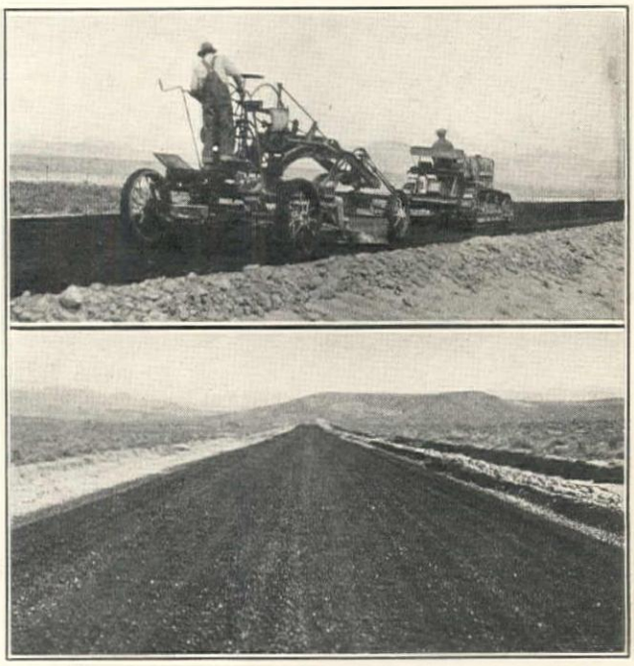


Fig. 4. (Upper) Spreading and Blading Road-Oil Mix Behind Bituminous Road Mixer. (Lower) Completed Road, Except That Shoulders Have Not Been Built

flected in its capacity, is the most important factor. The Division of Management, U. S. Bureau of Public Roads, makes no public attempt to compare or contrast relative costs of different methods, and the economical worth of the machine will have to be determined privately. However, certain production figures are offered for what they are worth.

The particular job was characterized by much rain and by some mechanical difficulties, which are always natural to a new machine and may be eliminated by redesign. The actual time distribution and production figures are tabulated as follows:

Tabulation of Time Distribution and Production Figures

	Hours	Per Cent
Total available working hours during the study period	795.0	100.0
Delay segregation		
Major delays (of more than 15 minutes)		
Unavoidable		
Rain	246.0	31.0
Mechanical trouble	114.0	14.3
Miscellaneous—mostly shutdown of machine pending state's determination of desired road-oil content and completion of sections by contractor	223.0	28.0
	583.0	73.3
Avoidable		
Lack of road oil in mixer tanks—distributor shortage on long haul	54.0	6.8
	54.0	6.8
Total of major delays	637.0	80.1
Minor delays (of less than 15 minutes)		
Unavoidable		
Mechanical trouble	1.0	0.1
Elevator clogged	2.1	0.3
Batcher trouble	7.9	1.0
	11.0	1.4
Avoidable		
Lack of road oil	3.5	0.5
Lack of fuel and oil	4.1	0.5
	7.6	1.0
Total minor delays	18.6	2.4
Total unavoidable delays	594.0	74.7
Total avoidable delays	61.6	7.8
Total all delays	656.6	82.5
Actual working time at 100% efficiency	138.4	17.5

Note: Attention is called to the low overall efficiency, and particular attention is called to the high percentage of unavoidable delays which is responsible for this low figure. The correct interpretation of this summary gives the following production information in terms of cubic yards and feet per hour on material running at 1040 cu.yd. per mile:

Production during the study period	6,530	cu.yd.
	6.28	mi.
	33,200	ft.
	cu.yd.	lin.ft.
Gross production per hour	8.2	42
Net rate, exclusive of unavoidable delays	32.5	165
Net rate, exclusive of all delays, a condition which is easily attainable	47.1	240

It is to be stressed that the production in cubic yards per hour is of more significance than the production in feet per hour, since the first figure may remain constant and the other figure variable for windrows of different sizes.

The maximum capacity of the machine is governed, as far as design features are concerned, only by the capacity of the elevators—1.30 cu.yd. per min. From a practical standpoint, the capacity is governed by the set of the pugmill blades, or, in other words, by the desired mixing time in order to give satisfactory mixing action.

From the standpoint of the state, efficiency is the prime consideration. With the production figure given, the mixing time for a given unit of material is 93 sec. The Division of Management formula for mixing efficiency of pugmills gives an efficiency index of 193. (California 2500-lb. asphaltic-concrete pugmills give but about 120 on a 45-sec. mix.) Additionally, uniformity determinations on the mixed material from the pugmill show a degree of uniformity which substantiates this index figure. On the local project, no difficulty is encountered in putting out a homogeneous black mixture when the road-oil content is kept at the figure ordinarily used in the manipulation method of mixing.

It has been stated that additional manipulation by blade units is required in order to develop the floor of the base for bond to the top wearing-course. The degree of manipulation is about one-sixth of that required in regular manipulation mixing. Because of the cold material, it is expedient to raise the road-oil temperature to about 200° F. in order to properly incorporate the road oil. It must be emphasized that the most important aspect of the machine, and that to which every engineer should direct his attention, is the bringing in of high-cost construction refinement into low-cost bituminous work—something which road-oil mix has sadly lacked.

Conclusions—The machine is the first of its kind, has operated on but one project, and is liable to several improvements which will increase its efficiency and very probably its production. Conclusions are futile. However, two remarks are given.

1. From the contractor's point of view, every new machine is worth investigation.

2. From the state's point of view, the machine is bringing the standards of a $20,000 pavement into the construction of a $3500 pavement. If the machine can compare favorably with the prevalent machines used in the construction of road-oil mix projects in the matter of costs, then the obvious is more miles of better mixed low-cost bituminous pavements per appropriation.

Editor's Note—The Bituminous Road Mixer is produced by the Iowa Manufacturing Co., of Cedar Rapids. Improvements to the machine include an increase in the size of power unit from 65 hp. to 80 hp. The tanks are insulated so that, under normal operating conditions, the temperature drop is small. On a test road in Blairsden, Iowa, north of the Lincoln Highway, four or five different types of bituminous binders were used, including Tarvia and asphalt.

Bids for Hoover Dam on Colorado River

Bids will be received up to March 4, 1931, by the Bureau of Reclamation at Denver, Colorado, for the Hoover dam, tunnels, and powerhouse in connection with the Boulder Canyon project on the Colorado river in Nevada and Arizona. The work is to be let in one contract and involves an arch-gravity type dam 727 ft. high above bedrock and 950 ft. long on crest; four diversion and power tunnels; two glory-hole spillway shafts; power outlets; and a 1,000,000-hp. power plant installation.

Plans will be available after January 10 from the Denver office of the Bureau.

River and Harbor Projects for 1931

In the $60,000,000 estimate submitted to Congress by the chief of army engineers for 1931 harbor and channel projects in the United States and its territories is a total of $5,186,500 for the Pacific coast. For maintenance, Coos bay, Oregon, is allotted $1,090,000 under this estimate.

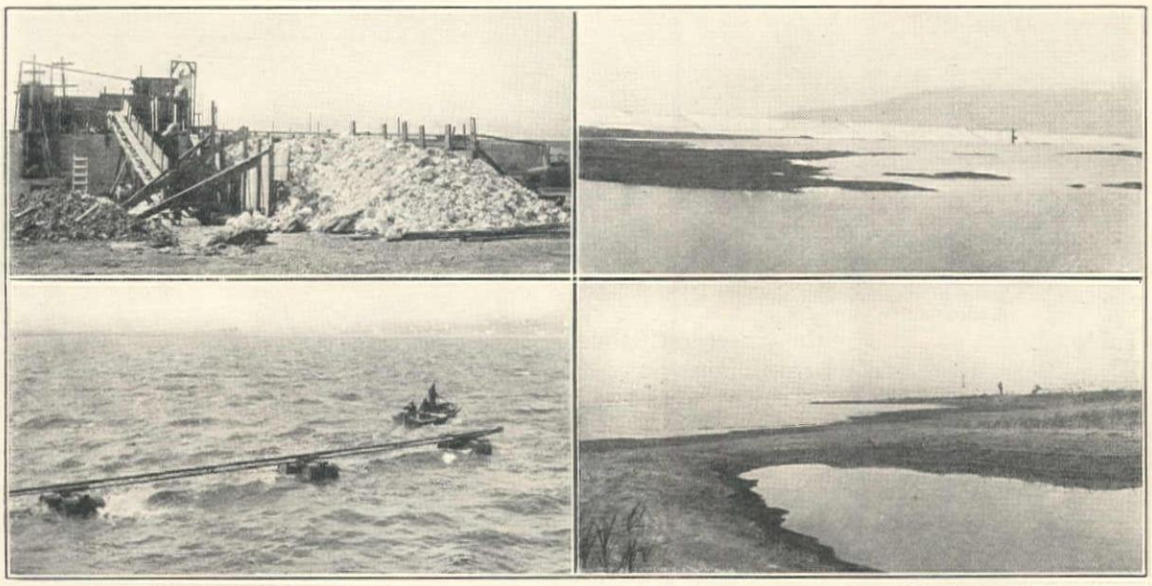
Sealing Chenery Reservoir

Novel Method Uses Bentonite Suspenion

By CHARLES H. LEE*

Consulting Hydraulic Engineer, San Francisco

Chenery reservoir, recently built by the California Water Service Co. near Clyde, California, (see **Western Construction News,** June 10th, 1930, issue), is located on a sedimentary formation overlaid by adobe soil. As was anticipated, there has been considerable loss by seepage through the bottom during the first few months of operation while seasoning of subsurface materials was in progress. Although appreciating that this loss would greatly diminish as the surrounding material became saturated and the water-table approached stable equilibrium, it was decided to attempt immediate reduction of the rate of loss, provided it could be accomplished within a cost limit represented by the capitalized value of pumping to the reservoir the water lost by leakage.



(UPPER LEFT) MIXING PLANT FOR BENTONITE SUSPENSION. (LOWER LEFT) TOWING SECTION OF PIPE-LINE INTO POSITION ON WINDY DAY. (UPPER RIGHT) NORTHWEST CORNER OF CHENERY RESERVOIR DURING FILLING OF SAME; BORROW PIT NO. 1 OVERFLOWING INTO BORROW PIT NO. 2. (LOWER RIGHT) SOUTHWEST CORNER OF CHENERY RESERVOIR DURING RECENT LOWERING OF WATER LEVEL, IMMEDIATELY FOLLOWING ISOLATION OF BORROW PIT NO. 4

After thorough field and laboratory study of the local conditions, an unusual method of sealing the reservoir was then adopted. This consists of impregnating and covering the leaky portions of the reservoir bottom with a layer of colloidal material which settles out from a suspension discharged under water just above the bottom. With treatment by this method, a reduction in leakage of about 60% has been accomplished, at a total cost of less than half of the allowable limit. The unit cost on an area basis was but a small fraction of the cost of lining by conventional methods.

Chenery reservoir is on a gently sloping alluvial plain bordering Suisun bay, an arm of San Francisco bay. It covers an area of 215 acres, approximately square, surrounded on all but a portion of the south side by a rolled earth-fill embankment. The embankment varies in height from 28 ft. at the northeast corner to zero where it merges into the higher ground near the center of the south side. The crest elevation of the embankment is +36.0 ft., and the lowest part of the undisturbed reservoir bottom is +10.0 ft. Material for embankment construction was obtained from borrow pits inside the reservoir along the north, west, and east sides (Diag. 1). These pits have an average width of 250 ft. and depth of 10 ft., the distance between the inner toe of the embankment and the edge of pits slightly exceeding 100 ft. The pits are backfilled to a depth of 2 ft. and have side slopes reduced to a 1:2 slope. Backfill material consists of adobe soil, spread but not rolled or compacted. The maximum reservoir capacity at elevation +33.0 ft. is 3130 ac-ft., or 1,000,000,000 gal.

Geology—The bottom of Chenery reservoir is composed of 3 ft. of typical Central California soils described in U. S. Department of Agriculture soil survey reports as Antioch clay loam and Dublin adobe. These soils when moist and compact are practically impervious, but in a wet, loose condition will pass water readily. When dry, they shrink and crack to a depth of 2 to 3 ft., but when moistened by rain or submerged, the cracks are closed by lateral swelling. The weight of the soil is sufficient to prevent appreciable vertical

*Member, American Society of Civil Engineers.

swelling, so that the soil in its natural state generally retains a dense, impervious character, even after long submergence. The dry soil, when broken up by ploughing or handling and left in a loose condition, will swell freely when wet, both horizontally and vertically, and is quite permeable after submergence. Over most of the reservoir, the soil is underlaid by an impervious clay subsoil 3 to 4 ft. thick. The formation underlying the soil and subsoil is a relatively porous, yellow, sandy clay, which, in the south portion of the reservoir, is in direct contact with the soil (Diag. 2). This clay varies in sand content in different parts of the reservoir bottom, from a slight amount of grit to almost pure sand.

Mechanical analyses of materials composing the bottom of the reservoir are shown on Diag. 3. These indicate the relative proportion of various sized particles in the soil, subsoil, and deeper formations. The greater proportion of large particle sizes in the underlying material is apparent. Permeability tests of these materials gave the following results:

Material	Description of sample	Coefficient of permeability (a)
Antioch clay loam	Undisturbed 3-in. core from 2-ft. depth, taken prior to first rains.	No flow at end of 3 days with hydraulic gradient of 700%.
Antioch clay loam	Same material air-dried, partly pulverized, tapped 25 times in placing, and saturated.	7.6
Antioch clay loam	Same material air-dried, not tamped or tapped in placing, and saturated.	20.4
Greenish white clay	Undisturbed 3-in. core from 4-ft. depth, taken prior to first rains.	0.011
Yellow sandy clay	Undisturbed 3-in. core taken from bottom of borrow pit during excavation.	2.28
Yellow sand	3-in. core lightly tamped, and saturated.	131.0

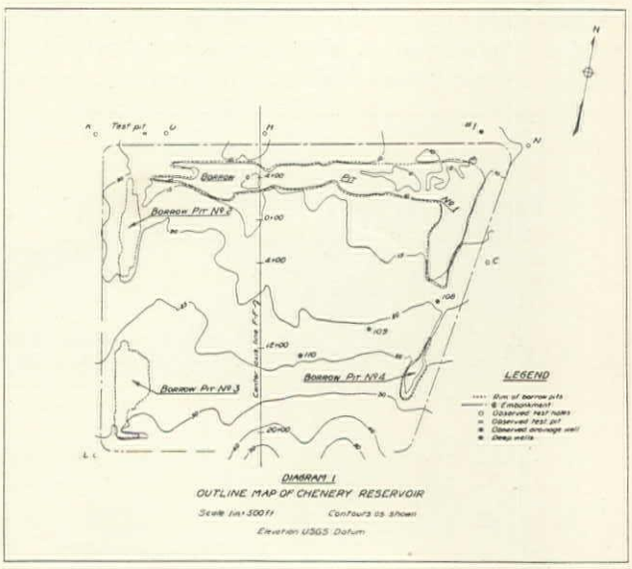
(a) gallons per square foot per day, with hydraulic gradient of 100% and temperature 60° F.

Water-Table—Prior to filling the reservoir, the water-table had been depressed by continuous pumping in wells operated by the company within and to the east of the reservoir site. The water-table elevation under the western portion of the site was –20.0 ft. to –25.0 ft. just prior to commencement of filling, and attained a level as low as –40.0 ft. along the east side. Static pumping level in deep wells within the reservoir site had no relation to the water-table due to intervening impervious clays and was –110.0 ft.

Operation History—Chenery reservoir was completed late in January, 1930, and filling commenced January 28, when Mallard pump station was put into operation. Pumping was continuous at the rate of 13,000,000 g.p.d. until May 19, when the water level reached +33.0 ft., and then intermittent until June 10, after which date salinity in the river water exceeded the allowable limit of 250 p.p.m. Draft commenced April 18, and was continuous thereafter, averaging 1,000,000 g.p.d. Accurate daily measurements of inflow, outflow, and reservoir stage were observed, and beginning August 5, a daily record of evaporation from a standard floating pan was kept.

Leakage—From studies made prior to commencement of filling, I estimated, on November 26, 1929, that the average rate of leakage from the reservoir during the first year of operation would be at the rate of 16.3 ft. depth per annum over the average submerged area, assumed at 137 acres. This depth is equivalent to 2,000,000 g.p.d. average leakage from the reservoir. It was also estimated that this quantity would become less each year, and finally, in the seventh year after operation commenced, reach a stabilized average value of 300,000 g.p.d. These estimates were based on known initial position of the water-table beneath and surrounding the reservoir, partial data for net porosity of underlying material, and assumed values for permeability coefficients of material and depth of active subsurface flow beneath the embankments.

The actual leakage from the reservoir has been computed weekly from measured inflow consisting of pumpage and direct precipitation, and measured outflow as draft and evaporation, the latter having been assumed prior to August 5, when the floating pan was established. The results have been somewhat erratic due to strong winds piling up water on the lee side of the reservoir for periods of several days, and to differences between assumed and actual evaporation and



other causes. The generalized average, as shown by the curve at the bottom of Diag. 4, is probably a close approximation of the actual values, and indicates an average loss for the six months, February to July, 1930, prior to sealing operations, of 3,250,000 g.p.d. This interval covers the period of highest stage, and the rapidly decreasing rate at the end of the period indicates a much lower average for the complete year, even without the sealing treatment. It is believed that the forecast rate of 2,000,000 g.p.d. would have been closely approximated by the actual figures if conditions had not been altered by sealing operations.

A study of the progressive rate of seepage loss in million gallons per acre submerged, during the period of filling of the reservoir, showed a steady decrease, broken by sudden and temporary increase during the filling of isolated dry borrow pits. A similar study based on acreage of borrow pits submerged, indicated a variation in seepage closely following the variation in head represented by the difference of elevation of water surface in the reservoir and in adjacent test wells, the latter being corrected for lag (Diag. 4). It was concluded from this and other evidence that most of the leakage was taking place through the bottom

and sides of the borrow pits. This conclusion has received confirmation during the period of falling reservoir stage by observing the rate of drop of water level in the untreated borrow pit No. 3 after isolation on September 15.

In accordance with these conclusions, it was decided to confine sealing operations to the borrow pits.

Selection of Sealing Material—Preliminary to selection of a method of sealing, thorough laboratory tests were made to ascertain the physical characteristics of materials underlying the reservoir. Tests included mechanical analysis with determination of silt and both particle and colloidal clay, permeability, porosity, initial moisture, specific gravity, volumetric shrinkage, hydrogen-ion reaction, microscopic examination, etc. Laboratory tests were also made of various possible methods of sealing the reservoir bottom. These experiments commenced nearly three months prior to completion of the reservoir and, as it was then thought possible that leakage might occur to underlying sand pockets through unhealed shrinkage cracks in the adobe soil as well as from borrow pits, methods for sealing the whole reservoir bottom were also studied.

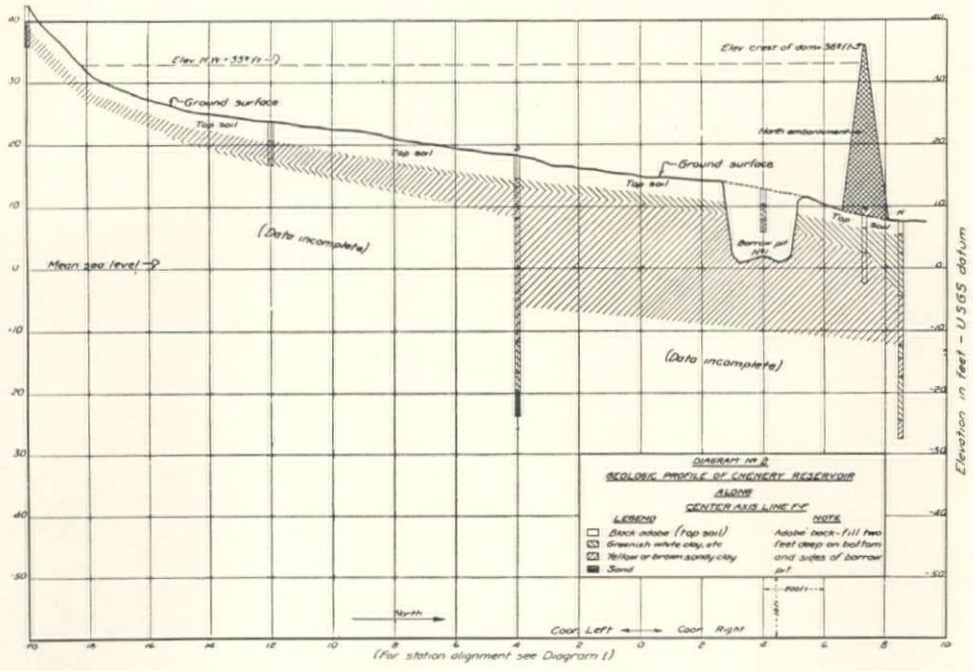
The methods investigated included mechanical treatment to break up porous channels through the adobe soil by way of old cracks rendered porous by sand or vegetation, consolidation by rolling, subsurface harrowing, chemical treatment, application of an admixture of sand to reduce shrinkage and cracking by formation of a surface mulch, and sealing the bottom by application of impervious soil coverings. One of the latter was finally selected as the cheapest, most easily applied, and certainly effective means of reducing leakage.

The considerations which governed the selection of a material, in order of importance, were as follows:

1. A material with a preponderant particle size smaller than that of the material in the formation to be sealed, and an important fraction with maximum particle diameter smaller than that of the voids in the material to be sealed.
2. A material which of itself, when deposited under water, would form an effective impervious layer upon the bottom.
3. Unit cost of material low enough to permit the use of a sufficient amount to give an effective seal without exceeding total cost limit for the completed work.
4. A material which can be quickly applied without interrupting the operation of the reservoir or changing the quality of the water.
5. Preferably, a material which after placing will stand dewatering and drying without permanent loss of impermeability.

There are numerous varieties of clay or clay-like materials which were found to fulfill these requirements more or less satisfactorily. The material finally selected was a type of bentonite having special qualities of rapid precipitation without the presence of an electrolyte and the formation of a bulky colloidal jel. This material, while not fulfilling the fifth requirement aforementioned, was otherwise satisfactory and will give a permanent seal as long as the borrow pits are not drained.

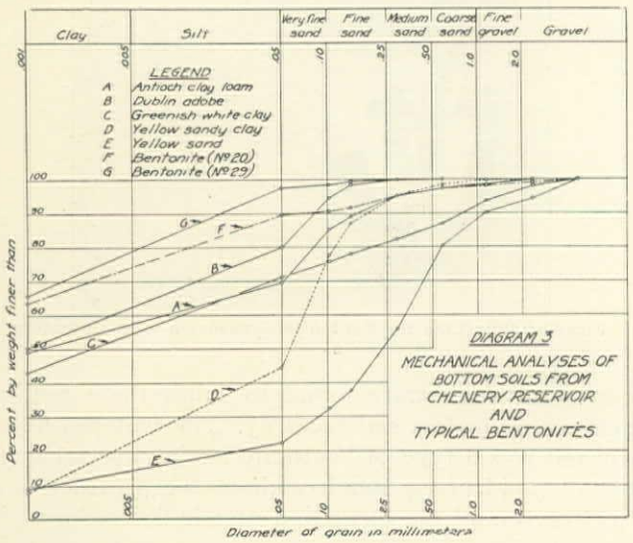
Floating Pipe-Line for Bentonite Suspension with Operating Barge at End



Bentonite is a claylike material containing 75% or more of the crystalline minerals montmorillonite or beidellite, formed by the devitrification and partial chemical decomposition of glassy, volcanic ash. These minerals are hydrous aluminum silicates combined

with alkali, or alkali earth oxides. It occurs in beds from a few inches to many feet in thickness, usually in Tertiary rock series. It is found interstratified with sands, clays, or shales, and frequently contains impurities in the form of silica sand. Although originally discovered in Wyoming, it has been found extensively in California, Nevada, and many other localities.

Most bentonites have a strong affinity for water, certain types absorbing from 8 to 15 times their original volume, with the formation of a slippery, plastic, gelatinous mass that resembles soft soap or mayonnaise. When agitated with water, a more or less permanent suspension results, except in the presence of an electrolyte. The effect of the latter is



to flocculate the particles, with rapid settling out of the flocs which accumulate with a honeycomb structure.

Bentonite contains very little amorphous jel, such as gives adobe soil its plastic and adhesive properties. It contains, however, a large percentage of finely divided crystalline particles, and it is these which give colloidal properties. The relative fineness of bentonite particles as compared with those of adobe soils is indicated by the mechanical analysis of a typical bentonite shown on Diag. 3.

Specifications for purchase of crude bentonite for use at Chenery reservoir provided that average samples from each carload should contain not more than 10% of grit and sand held by a 200-mesh sieve, and not more than 12% moisture at the point of shipment. Thorough laboratory tests were made on more than twenty varieties of bentonite to determine the relative value of each as a sealing material, and wide variation was found. Total purchases of bentonite from two deposits amounted to 450 tons.

Mixing and Placing—Preliminary tests indicated that crushed bentonite deposited in pea and smaller size upon the bottom of the reservoir would not knit together into an impervious skin without the use of an excessive quantity of material. A bentonite suspension, however, even if discharged at the surface as a jet, will sink to the bottom, spread out in a layer 2 to 3 ft. deep, until a certain degree of dilution is attained, and then settle to the bottom, forming an impervious colloidal layer. The method adopted for mixing and placing bentonite at Chenery reservoir was to prepare a suspension with specific gravity of 1.05 to 1.08, and pump this suspension through a 4-in. pipe-line floated on pontoons to a small barge, from which it could be discharged at the bottom through a drop line with bell nozzle at the end.

Due to the sticky character of bentonite when first wet, with a decided tendency to ball, and the desirability of having complete digestion of the crude material, it was found impractical to use any form of concrete mixer in preparing the suspension. The equipment finally selected was a 38-in. Devereux agitator operating at 130 r.p.m. in a 16,000-gal. tank. Crude bentonite was fed to the tank by a belt conveyor. During the first part of the work, two interconnected 16,000-gal. tanks were available, and the pump section was placed in the storage tank. This method permitted continuous filling and mixing, without excessive waste due to small lumps and flakes of undigested material being drawn into the pump suction. Later, when only one tank was available, it became necessary to resort to batch mixing, the charge being delivered to the tank immediately after the day's placing ceased, and mixed continuously until placing began on the following day. In this manner, waste was reduced to a minimum, without too great loss of time which could be otherwise used for placing.

The initial program of placing was to discharge the suspension at 50-ft. intervals along the top of the borrow pit side slopes. About 266 tons of material were placed in this manner. The suspension being heavier than water, it flowed down the slope, giving opportunity for absorption by the pores where active seepage was occurring. After reaching the foot of the side slopes, the suspension spread out over the bottom, generally following the slope of the ground. The direction of flow was greatly modified at certain times, however, by bottom currents induced by wind. After completely traversing the rims of borrow pits No. 1 and 2, the program was changed. The suspension was then discharged at points on the bottom spaced at intervals of 100 ft., and within areas where little or no bentonite had precipitated from the first program of placing. An additional quantity of 172 tons was thus deposited. The total area of borrow pits treated was 32.5 acres. After deducting for sand and moisture, the average rate of application of bentonite, including waste in the form of small undigested lumps, will be 9.7 tons per acre. This quantity could have been reduced by greater elimination of waste.

Difficulties—One of the principal difficulties arose from sand and grit included in the crude bentonite. This amounted to 15% of the aggregate shipping weight. It caused frequent interruptions due to the pump and pipe-line becoming clogged, as well as excessive wear upon the pump. It also represents an item of waste. Better results would be obtained with bentonite, which contains 5% or less of sand and grit held by the 200-mesh screen.

Small lumps and flakes of undigested bentonite in the mixing tank were a source of inefficiency and waste. These were extensively drawn into the pump suction and discharge line and fell to the bottom of

the reservoir with the sand, forming a small mound near each point of discharge. All such material is practically wasted, as the mounds have a far greater thickness than that necessary for the colloidal film, and thus represent an unnecessary accumulation of material which should be spread uniformly over the bottom. Batch mixing at night, or use of a storage tank with auxiliary agitator, are both helpful in reducing this source of waste.

Bottom currents induced by wind, and irregularity in the slope of the bottom were causes of uneven distribution of precipitated bentonite. When the direction and velocity of such currents were known, they could be used to advantage. It was also possible to utilize the trend of bottom slopes in securing uniform distribution. Such conditions require careful investigation in preparing a schedule for placing. Heavy winds prevailing throughout the summer have frequently delayed the work of placing, and at times have prevented any work on the reservoir for a period of a day or more.

The results of this bentonite treatment in reducing the leakage from Chenery reservoir have been determined from two standpoints: first, the extent of the layer of colloidal jel upon the bottom; and second, the actual reduction in leakage.

In order to determine the thickness of the colloidal layer, if any, a bottom sampler was devised by use of which a core can be cut from the bottom at any point, and immediately raised to the surface and inspected

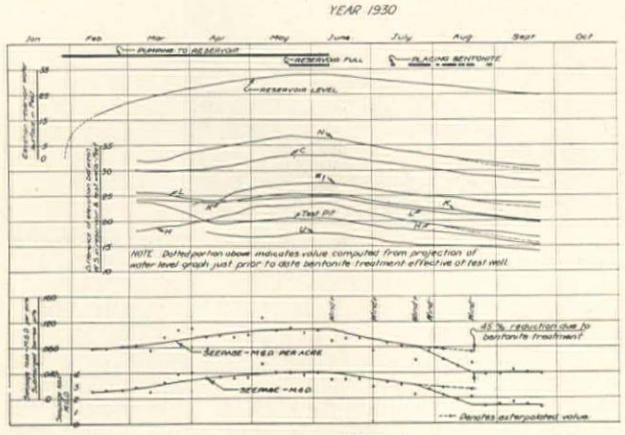


DIAGRAM A

NET REDUCTION IN SEEPAGE LOSS FROM CHENERY RESERVOIR RESULTING FROM BENTONITE TREATMENT

through the glass walls of an inner core barrel, without removal or disturbance. Systematic sampling of the bottom, after placing the first 266 tons of bentonite, showed rather unequal distribution. In certain areas, there was found a continuous colloidal layer overlying the surface of the backfill from ¼ to ½ in. thick, while in still other areas no deposit was found. The proportion of the bottom of borrow pit No. 1 and 2 effectively covered was estimated to be less than 50%. This bottom coverage was obtained almost entirely by discharge of bentonite suspension at the rim of the borrow pit. The remaining base areas were covered by direct discharge of 172 tons of bentonite at points on the bottom.

The weekly results of leakage computations are shown upon Diag. 4. These indicate a direct relation between quantity of leakage and net head, represented by the difference of water level in the reservoir and in test holes surrounding the reservoir after correction for lag in time of registration. The immediate effect of bentonite treatment in reducing leakage is clearly shown. Comparison of the projected rate of leakage before treatment, and actual rate after treatment, indicates a 45% reduction obtained by the application of 266 tons. The covering of the remaining

Bottom Sampler for Determining Distribution of Bentonite Seal

bare spots has shown a further reduction of 15%, or a total reduction of about 60% to date.

Future Development—Laboratory experiments with various other natural materials are now in progress, for the purpose of developing a sealing agent which will have the impermeable character of colloidal bentonite, without the undesirable qualities of shrinkage which accompany drying. With such a material, it will be possible to seal leaky reservoir bottoms which are subject to exposure at times of low-reservoir stage. Promising results have already been obtained, and it is expected that a satisfactory non-shrinking impermeable sealing agent will soon be available. This will greatly enlarge the field of usefulness of the method.

Personnel—The work of sealing Chenery reservoir has been under the direction of E. K. Barnum, vice-president and chief engineer, Public Works Engineering Corp., San Francisco, with J. D. Sperr, and later W. J. Ashley, as resident engineers. I was consulting engineer, recommended the use of bentonite, and developed the process and apparatus for application. Laboratory work has been handled by the Pacific Hydrologic Laboratory under my direction. Patents are pending on the novel features of the process, and the apparatus for carrying it out. C. T. Chenery is president of the Federal Water Service Corp., and Earl C. Elliott is president of the California Water Service Co., a subsidiary.

American Road Builders' Association

Annual Convention and Road Show, St. Louis, January 12-16, 1931

Highway construction occupies first place on the list of remedies for unemployment and industrial stabilization. Expenditures for 1930 on state, city, and county highway programs in the United States will reach a new high level of two billion dollars. With increased Federal Aid available and a National Congress favorable to acceleration of public works construction in all its departments, much larger highway expenditures are predicted for 1931.

The American Road Builders' Association, organized in 1902 for the furtherance of highway and street construction and maintenance, is a vital factor in the highway field. This association will hold its 28th annual convention and road show at the St. Louis, Missouri, Arena, the week beginning January 12, 1931. The estimated attendance at this instructive convention is 30,000, including a large delegation from the Far West. Particular attention has been given to the program and exhibits with a view to making the convention and road show of exceptional interest and value to contractors and engineers.

ST. LOUIS ARENA, SITE OF THE 28TH ANNUAL CONVENTION AND ROAD SHOW OF THE AMERICAN ROAD BUILDERS' ASSOCIATION, JANUARY 12-16, 1931

The association offers an excellent medium for the interchange of ideas on construction and equipment problems. At the convention and road show, the results of years of study and investigation are presented in comprehensive committee reports and all types of machinery and equipment, including new models and improvements, may be inspected and compared. In addition, many state highway departments and the Bureau of Public Roads will furnish exhibits depicting their progress. The various road show exhibits will completely fill the ground floor of the Arena and two adjacent exposition buildings.

Hotel facilities at St. Louis are good and the rates are reasonable. Reduced transportation fares have been granted and special trains, named after famous highways in their localities, will be run from numerous origin points in the United States and Canada.

The road show will actually open with a 'dress rehearsal' on Saturday morning, January 10, on Manufacturers' and Distributors' Day, arranged for the discussion of new developments in machinery, comparison of competitive products, and a discussion of 1931 business. The opening session of the convention will be held Monday morning, January 12, in the St. Louis Arena, a number of prominent speakers being heard. Following this, the road show will formally open to the delegates and general public.

Convention reports will be heard from the various committees, which include: general—highway finance, location, subgrades and pavement bases, grade crossings, airport drainage and surfacing, low-cost roads and bridges, legislation; equipment—snow removal and equipment, traffic control signals, central and transit-mixed concrete, guard rail, grading methods and equipment, survey of needs for and availability of maintenance equipment; city officials—assessments, design and construction, maintenance, traffic; county officials—finance and administration, regional plans and surveys, construction, maintenance.

Other features will include contractors' sessions and supper dance, road builders' banquet, the International Ball, a Pan-American smoker, special entertainment for the ladies, etc.

To those thousands who are privileged to attend the St. Louis meeting, an abundance of the latest information on the road-building art will be available firsthand.

Puget Sound Marine-View Drive, King County, Washington

By A. H. GOODWIN
King County Engineer's Office, Seattle, Washington

For many years a scenic drive along the shores of Puget sound from Blaine, Washington, on the Canadian border, to the city of Olympia, Washington, has been the dream of Northwest residents. Two years ago, officials of the several counties through which such a highway would pass, met and agreed to share the costs of constructing the 175-mile drive.

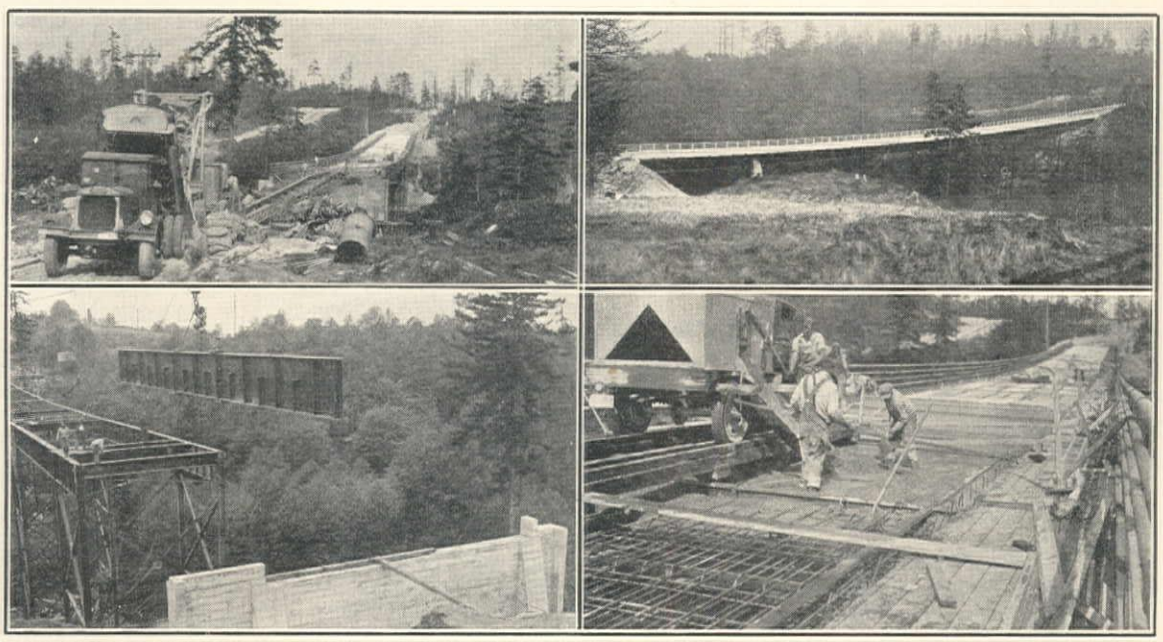
The alignment of this scenic route skirts the east shore of Puget sound at a variable altitude about 250 ft. above sea level, affording in most instances an unobstructed, sweeping panorama of Puget sound and the Olympic mountains. The motorists' paradise, it will attract the attention of visitors from all parts of the country and will ably display the possibilities of the Puget sound country, both from a recreational and a commercial standpoint.

King County Portion of Marine-View Drive—The portion of the Marine-View drive in King county is to be built in five divisions and will have a total length of 21⅓ miles of new construction.

Preliminary surveys were made by the King county engineering department, the first unit of the highway starting at a point on the Pierce county line and running north in King county to a connection with an existing road leading to Dumas bay. The new construction on this portion of the drive is 1⅓ miles long and includes a steel tower and girder bridge 552 ft. long, with a maximum height of 90 ft. The bridge has a concrete deck and galvanized guard and handrails.

Julia Gulch Bridge—A contract for this bridge was awarded to S. A. Moceri, Inc., Seattle, Washington, for $62,272, and work was started November 12, 1929. The bridge has a 24-ft. clear roadway, with a 6-ft. sidewalk, and was built over Julia gulch. As the gulch at this point has steep banks on each side, there was little excavation necessary (642 cu.yd.) and this was done by hand.

The bridge consists of ten sets of piers, two piers to a set, and will accommodate two 20-ton trucks. There was 326 cu.yd. of foundation concrete used in the pier footings, and 1100 lin.ft. of piling. Twelve steel girders were used, the six under the sidewalk weighing 13 tons each and those on the opposite side 12 tons. Each of the girders was 72 ft. long and 66 in. deep. The girders were furnished by the Star Steel & Iron Co., of Tacoma, Washington, who attended to the detailing, fabrication, and erection.



JULIA GULCH BRIDGE ON PUGET SOUND MARINE-VIEW DRIVE. (UPPER LEFT) FAGEOL TRUCK LOADING MIXER SKIP FOR FLOOR SLAB CONCRETE. (UPPER RIGHT) COMPLETED BRIDGE. (LOWER LEFT) THREE 13-TON GIRDERS PLACED, BARREL-PINNED, AND BOLTED IN 45 MINUTES, USING 2½-IN. CABLE. BRIDGE IS 90 FT. HIGH AT THIS POINT. (LOWER RIGHT) PLACING CONCRETE DECK. TRUCK-MOUNTED CONCRETE HOPPER TRAVELS ON TEMPORARY ROADWAY

Towers 24-ft. square were set on spread footings, except the two central towers which were set on piling capped with concrete. Footings were made of 1:2:4 class 'B' (State of Washington) concrete, 6 sacks to the cubic yard, while the roadbed and sidewalk concrete was a 1:2:3 mix, 6.84 sacks to the cubic yard. The deck averaged 8 in. thick on the shoulders and 10 in. at the center. There are no approaches to this bridge; the two retaining walls were constructed of 1:2:4 concrete. Every 8 ft. between the girders, 27-in. by 91-lb. I-beams were placed.

Plant mix concrete was poured by gravity, 7000

bbl. of 'Diamond' cement in cloth sacks being required for the Julia gulch bridge.

The guard rails consist of four-pipe galvanized handrail. These pipes were given an acetic acid wash to kill the galvanizing, then a coat of metal primer. Over the primer was painted a coat of amorphous graphite aluminum to increase the visibility. The steel structure was given a coat of brown Valdura over a shop coat of red lead, then a final coat of green Valdura.

The steel girders were placed by means of a high-lead operated by a three-drum, 16-hp. engine, having one loadline, one haulback line, and an outhaul line. By means of the high-lead, three girders aggregating 37 tons were placed, barrel-pinned, and bolted in 45 minutes.

Strength and simplicity were the principal considerations in the design of the Julia gulch bridge, the southern slope of which is on a vertical curve.

Section from Pierce County Line to Dumas Bay Road—A contract for the roadwork on the first section was awarded to the Erickson Paving Co., Seattle, Washington, for $13,900, and work was begun November 12, 1929. This contract calls for grading and gravel surfacing 1⅓ miles, including a 28-ft. roadbed and an 18-ft. gravel surface 6 in. thick. Major items in the contract are: 34,447 cu.yd. of roadbed and ditch excavation, 567 cu.yd. of approach and 66 cu.yd. of culvert excavation, overhaul (400-ft. free haul) 30,104 sta.yd., and 21,178 cu.yd. of roadbed and approach gravel surfacing. Erickson obtained the surfacing material from the Pioneer Sand & Gravel Co. at Tacoma.

Major equipment on the road contract included one 1¼-yd. Northwest gas shovel, one Caterpillar '60' tractor, one Stockton '80-12' grader, and three White trucks.

Dumas Bay-Lakota Section—A contract for the second unit of the Marine-View drive was awarded to Hallstrom & Hallstrom, Seattle, Washington, on October 3, 1930, at a bid of $55,000, and work was started immediately. The second unit of the drive lies between Dumas bay and Lakota, a distance of 1⅙ miles, and involves 53,000 cu.yd. of excavation and a steel tower and girder bridge 264 ft. long. This bridge, similar to the one over Julia gulch, has a maximum height of 65 ft., a 24-ft. roadbed, and a 6-ft. sidewalk; it is on an 80-ft. right-of-way.

Hallstrom & Hallstrom are using the following equipment for the road work: one 1¼-yd. Thew-Lorain power shovel, five 4-yd. International trucks, and three small concrete mixers (Lansing, Rex, and Wonder). Road construction is at an early stage and work on the bridge has not yet begun.

Dan Sansaloff, Tacoma, Washington, has a subcontract for clearing and grubbing on this section of the drive. Cement is being furnished by the Pacific Coast Cement Co., Seattle, and structural steel by the Star Iron & Steel Works, Tacoma.

Remaining Sections in King County—Upon completion of the second unit, there will remain a 5½-mile stretch to be constructed between the end of this contract and Des Moines, Washington. The next section to be built by King county will be a 6-mile piece just south of the city limits of Seattle, connecting with Fauntleroy blvd. This section will involve the erection of one more steel tower bridge in the vicinity of Seola beach, at an estimated cost of $50,000. Construction of this unit will start in 1931, leaving a final section of 6 miles in King county from the Seattle city limits north to the Snohomish county line.

According to Thomas D. Hunt, county engineer, under whose direction the King county portion of the Marine-View drive is being constructed, if the same amount of work can be done on this scenic highway each year as has been done in the past twelve months, the highway can be completed in four years at an estimated cost of $350,000.

Personnel—Thomas D. Hunt is county engineer of King county, D. L. Evans is principal assistant, T. P. Blum is bridge engineer, and A. J. McNeil is engineer in charge of projects on the Marine-View drive.

S. A. Moceri supervised the Julia gulch bridge contract, held by his company; Joseph Erickson was in charge of the Erickson Paving Co. work; and Hallstrom & Hallstrom handled their contract for the second unit direct.

S. A. Moceri sublet the concrete piers on the Julia gulch bridge to Lindstrom & Feigenson, of Portland, Oregon. The Star Steel & Iron Works, steel subcontractor, was represented by Edward Buck, steel erector; Fred W. Eck, chief draftsman in charge of shop details; and Lester E. Jensen, supervising engineer.

SAN GABRIEL DAM

Since the abandonment of construction of the $25,000,000 dam at the Forks site on the San Gabriel river, California, E. C. Eaton, chief engineer of the Los Angeles County Flood Control District, has been searching for suitable substitute sites. A contract was recently let to Cannon Bros. for core drilling one of three tentative sites below the Forks and 2 miles above the Pine Canyon damsite of the Pasadena Water Department, and another contract to McGuire & Young for exploration tunnels.

A friendly suit is to be instituted by the county to determine whether the $21,000,000 balance of the $25,000,000 San Gabriel dam bond issue can be used to build three dams instead of one. Included in this suit will be the sum of $1,250,000 left over from previous bond issues, which the District wishes to use on much needed additional flood control work.

U. S. Government engineers are surveying a route for a new high-level highway to be constructed from the mouth of San Gabriel canyon to the Forks site along the west bank, a distance of 12 miles, to replace the old highway on the east side along the streambed. The old highway also carries the San Gabriel dam construction railroad. Building of this new highway is necessitated by construction of the Pine Canyon dam and reservoir, soon to be started by the city of Pasadena. This highway will be financed jointly by the city of Pasadena and Los Angeles county and will then be turned over to the state.

Water Works Problems

Synopsis of Papers Presented at Eleventh Annual Convention, California Section, American Water Works Association, Hotel Huntington, Pasadena, October 29 to November 1, 1930

Pasadena Water Department, by Samuel B. Morris, superintendent and chief engineer. Morris gave an illustrated talk on October 30 describing the water works of Pasadena and the San Gabriel project, including the proposed Pine Canyon dam, as an introduction to the inspection trip held November 1.

Report of Metropolitan Water District of Southern California, by Frank E. Weymouth, chief engineer, Los Angeles.

The Colorado river aqueduct is of vital importance to Southern California, a region rich in everything except a bountiful water supply. Twenty years ago, Los Angeles felt the shortage of local water supply and there resulted the 250-mile Owens river aqueduct, built to deliver 400 c.f.s. continuous flow. Increase in population has outstripped all estimates and a new source of supply is needed, the only practicable and adequate one being the Colorado river. The Colorado river is 210 miles from Los Angeles at the closest point, and a mountainous desert intervenes.

Eleven southern coastal plain cities have combined for construction of a single aqueduct, the Metropolitan Water District of Southern California being formed in 1928. Three other cities have recently applied for membership and additional cities are expected to enter the district before construction of the aqueduct has started. Each member city in the district will participate in the cost and share the water in proportion to its assessed valuation.

As early as 1923, Los Angeles began investigating the Colorado as a source of water supply and commenced topographic mapping over a wide area, many data being available when the district organized and took over the work.

At Yuma, the elevation of Colorado river is 120 ft., increasing to 647 ft. at Hoover damsite. The Boulder Canyon reservoir will have a maximum water level of 1229 ft. and minimum of 950 ft. For convenient distribution delivery to the District, terminal reservoirs must be at least 800 ft. elevation. For diversion from lower reaches of the Colorado, the water must be pumped. Diversion from Boulder Canyon reservoir might allow gravity delivery at 400 or 500 ft. elevation, requiring pumping to the higher areas. Full gravity flow is possible only by going higher up the river for diversion—at prohibitive cost. The problem is to find an aqueduct line physically and economically feasible, which will deliver water to the District cities at a minimum cost per acre-foot. More than one hundred separate preliminary aqueduct lines have been projected in studying this problem. (The four routes recommended for careful study in the field were briefly outlined by Weymouth in the October 25th issue, p. 512 and 513.) The routes have many variations as to location, height of diversion, size and shape of conduits, gradients, points of delivery, pumping lift, power development, etc.

An ultimate aqueduct capacity of 1500 c.f.s. continuous flow is planned—with storage—no greater supply being obtainable from the Colorado. The Hoover dam and Boulder Canyon reservoir are depended on to provide water, desilt it, and supply power for the pumping lifts. Preliminary studies are based on horseshoe-shaped, concrete lined tunnels, flowing free. Pressure tunnels are proposed only for deep river crossings. Surface conduits are cut-and-cover type, modified horseshoe section, entirely buried, reinforced only at special points. Assuming that interruptions to operating time will aggregate 7% of that available, the conduits are designed for 1605 c.f.s. capacity.

The danger of salt contamination from deposits in the Boulder Canyon reservoir is negligible. The quality of water should not materially differ from the present river flow, which is now being used for city water supplies at Yuma, etc.—it will in fact be improved by storage. (See discussion of Colorado river water in October 25th issue, p. 515.) Sewage pollution, such as encountered in rivers traversing densely populated regions, is not a factor on the Colorado. It is not believed that the reservoir storage will be in danger of contamination by boron.

Although the district may not attempt to make retail deliveries of water, it must study the problem of furnishing a distribution system to the consumption centers. Various aqueduct routes are considered as terminating in a proposed enlargement of the Puddingstone reservoir of the Los Angeles County Flood Control District.

To date, topography has been taken over 30,000 square miles of desert and mountain area, various damsites on the Colorado have been surveyed and tested, terminal reservoirs have been investigated, geologic conditions studied over a wide area, projections and estimates made on aqueduct routes, preliminary plans made of many important features, financial problems considered, a power contract secured. After considering available facts, the consulting board recommended in December, 1929, that additional information be gathered preceding a final selection of the route. These recommendations have been met, the facts submitted, and a final selection of the route will soon be announced. Preparations can soon be made for a bond election to finance the aqueduct.

Note—On November 14, Weymouth submitted his report to the board of directors of the District who in turn referred it to the engineering board of review on November 25. The Weymouth report recommends that the Colorado river aqueduct follow the Parker route (No. 4, map, p. 513, October 25th issue), with its intake on the river at the Upper Parker damsite 150 miles south of the Hoover damsite. This aqueduct is 265.5 miles long and will cost $200,664,000. It is estimated that the average cost per acre-foot of water delivered to terminal reservoirs over a 40-year period will be $26.56. The aqueduct would serve an ultimate population of 7,500,000 and would require six years to construct, following two years of pre-construction activity. The board of review is now considering the report and will make its recommendations shortly. —Editor.

Protection of Water Mains Against External Corrosion, by K. H. Logan, electrical engineer, U. S. Bureau of Standards, Washington, D. C.

Protection of water mains differs somewhat from that of oil or gas mains because of the possibility of internal corrosion, large sizes of supply lines, and extensive use of cast-iron pipe. In 99 replies to a questionnaire sent prominent users of pipe (owners of 34,000 miles of cast-iron, gas, and water mains, and 4000 miles of steel mains) 28 indicated trouble from internal corrosion or tuberculation, 18 reported moderate external corrosion—mostly in cinder-filled ground—and one indicated serious corrosion in virgin soil. External corrosion of water mains is, apparently, not a serious problem in many localities. Although cast-iron water mains are usually laid with a thin coating of coal tar pitch and gas mains with no protection, immunity of water mains from external corrosion is not due to protective coatings. The total oil-line mileage in the United States is about 100,000, of which one-third has been coated with bituminous materials; the annual corrosion loss is $100,000,000. However, only a small percent of the oil lines show serious corrosion. Bureau of Standards studies of 46 soils, begun eight years ago, indicate that most soils under the test are not very corrosive.

Bare pipe will last a long time in many locations. Behavior of soil action on buried pipe and the need for protection in

any locality is the best indicator when new lines are considered. Through virgin territory, soil surveys by corrosion engineers are a means for determining corrosiveness. In soils having a pH below 7, there is a rough relation between total acidity and corrosiveness, and this holds for pH above 7 in the Pacific coast investigations. The first step in solving a problem of pipe protection is to determine where the line will be subject to corrosive soils, and what the character of these soils may be.

Pipe-line protection is an economic problem of the extension of pipe life necessary to justify a coating at a given cost. Performance data on each coating must be had. Investigations of coatings have shown in many instances that methods of application were inefficient, and the primary cause of failure on many coatings examined was soil stress. Soil stress—distortion of coating—is caused by pull of the adhering soil as it dries and shrinks, by pressure exerted when the soil moistens and swells, or by pressure of stones and clods, and is confined largely to heavy clay soils. The distorting action can be prevented by covering the protective coating with a rigid or semi-rigid sheath of wood veneer or thin sheet metal. The greater portion of the coatings investigated 'broke down' rapidly, rust or pits forming beneath them. Although pipe-line protection may be economical, care should be exercised in its selection.

The choice of a protective coating should be made on known properties and reaction to known soil conditions to be encountered, also on ability to secure proper application under given field conditions. At least partial specifications (as adequate as possible) should be employed, rather than mere selection on the basis of trade name. Certainly this procedure should be welcomed by the reputable manufacturers of pipe coatings for their own protection.

Electric-Welded Steel Pipe-Lines, by F. W. Hanna, chief engineer and general manager, East Bay Municipal Utility District, Oakland.

The District has used electric-welded and oxy-acetylene gas processes in pipe-line work for six years. In the Mokelumne project, 82.7 miles of steel pipe-line was laid across the San Joaquin valley between foothills of the Sierra Nevada and Coast Range. (The East Bay aqueduct, of which the Mokelumne line is a part, also contains three tunnels 8 ft. diam. and totalling 5.7 miles, and one 9-ft. diam. tunnel and a 9-ft concrete pipe aggregating 7 miles.) The Mokelumne line contains 58.6 miles of 65-in., 13.9 miles of 63-in., 9.1 miles of 61-in., and 1.1 miles of 54-in. I. D. pipe made from steel plates ⅜, 7/16, and ½-in. thick. The design working stress was 15,000 lb. per sq.in., with 90% longitudinal efficiency. Operating head ranges from 0 to 500 ft., much of it near the upper limit. About 71 miles of line is buried, average cover 3 ft., and the remaining 11 miles is supported on concrete piers, steel trestles, and redwood bents. Except on angles, the pipe is in 30-ft. sections, each composed of two steel plates joined by two longitudinal electric welds. On 74.4 miles of line, the sections have riveted joints, 4.7 miles oxy-acetylene butt-welded joints, 2.1 miles straight bump double fillet electric-welded joints, and 1.5 miles butt-strap double fillet electric-welded joints.

After rolling the plates and assembly and tack-welding at 3-ft. intervals along each side, welding was done inside the pipe section with automatic Lincoln welders. The welding head carried a carbon electrode and travelled along the seam, the edges being fused by an electric arc between this electrode and the pipe plates. An inside reinforcing bead was produced, and a smaller outside bead formed. With ½-in. plates and filler rods 5/16-in. thick, the speed was about 12 ft. per hour, using a current of 500 to 600 amp. and machine terminal voltages of 44 to 48. Many variable factors other than skill and experience of the operator entered into the problem, one being the composition of the filler rods. The arc tended to move persistently to one side of the seam, as the welding head was not provided with a solenoid. The longitudinal seams were welded, inspected for defects, repaired where necessary, and the pipe sections tested hydraulically to 50% beyond the specified working stress, while under this test being subjected to blows along each seam. The tested sections were scoured of scale and rust, heated to 450° F., removed and hammered, dipped vertically into a pit filled with melted asphaltic-tar compound, cooled, and wrapped with heavy felt.

On 8.3 miles, or one-tenth of the line, the sections were joined by gas and electric welding. For the butt-strap electric-welded types, the butt straps were fillet welded at the edges of the straps and at the edges of the pipe sections—four electric fillet welds per joint. On straight bump type electric-welded joints two fillet welds were used, one outside and one inside the pipe. With straight bump-welded joints, the spigot end of each section was placed in the bell end of the preceding section and brought tightly home, the pipe laid in stretches up to 690 ft. long, and joined at night when contracted by the drop in diurnal temperature with quadruple fillet-welded butt-straps. Outside welding of straight bump joints was done between 7 p.m. and 8 a.m. by two welders, as follows: (a) about 30 deg. downward each way from the top; (b) about 20 deg. upward each way from points 10 deg. below the ends of the horizontal diameter; (c) about 80 deg. upward from the lower end of the vertical diameter; and (d) about 50 deg. upward to fill in gaps between the first and second welded portions. The inside fillet weld was similarly made during daylight and finished before 7 p.m., the pipe being partly backfilled. The specified sequence and time of welding distributed the welding heat around the joints and profited by the uniform, circumferential temperature at night. A similar procedure was used for butt-strap electric-welded joints.

It is difficult in pipe of large diameter and thick plates to form a perfect field butt weld because of temperature differences between the top and bottom of the pipe. The East Bay aqueduct has operated successfully since June, 1929. It contains 870,000 lin.ft. of electric-welded longitudinal seams and 24,000 lin.ft. of circumferential seams in 82.5 miles of steel line. There have been 290 leaks in this length, mostly in ⅜-inch pipe, over 50% of these being mere pin holes and most of the remaining holes 1/8 to ¼-in. diam. in the weld metal. In the 894,000 lin.ft. of welding, the total length of defective welds thus far is 10 ft. There have been 18 cross cracks from 3 to 11 in. long and three splits (6, 11 and 60 in.) along welded seams in ½-in. plate.

Fundamental Considerations in Determining the Cost of Rendering Public Fire Protection Service, by Edward B. Mayer, assistant engineer, Department of Water & Power, Los Angeles.

What is a proper charge for fire protection and what line of attack should be made to improve the present condition whereby some large cities are discontinuing the charge and others relying only on hydrant rental?

The National Board of Fire Underwriters has adopted a standard schedule for grading the fire protection facilities of a municipality, classifying according to the probability of a conflagration. A system of weights and 32 items of grading is then used by the various insurance rating bureaus to determine fire insurance premiums for a locality (see abstract on 'Outline of Method of Rating Water Systems for Insurance Purposes' on p. 332, July 10th issue).

Public utility service has developed until it is practically free from competition, and the Government has assumed jurisdiction to regulate a balance between cost and income. Judicial rate fixing involves a detailed study of reasonableness of costs and efficiency of organization, effected through the various utility commissions. The California Railroad Commission has found that municipalities should pay a proper proportion of the total cost of fire protection utility service, depending on the amount of protection afforded. The inch-foot method of charging for service has been devised. The Wisconsin Railroad Commission has found that the two classes of service—general and fire—are coordinate, and each should be self-supporting as far as possible.

Definite rules cannot be established for apportionment of costs, as rates are frequently more than the traffic will bear. The different operations of a water department for the proper allocation of charges are four—source of supply, distribution, general, and commercial—each with appropriate subdivisions. The most charges affecting fire protection are in the distribution costs; some may properly belong to source of supply and general; commercial costs are little related to fire protection. Allocating Los Angeles costs to that per inch-foot, the 1928-1929 figure is $0.0081, the justifiable annual charge for this period being $1,232,826. As there is no substitute

for adequate water supply for large conflagrations, the principal public service for Los Angeles in 1928-1929 might be represented per capita as follows: public—$5.64; street lighting—$0.85; fire department—$3.94; and justifiable charge for fire protection from water works—$1.04.

In all cases, people pay a certain amount for fire insurance, plus additional amounts to various sources for protection of their property.

Each water system should be treated as a unit and the problems analyzed for what is found. Some cities of over 100,000 population make no charge for protection in lieu of consideration from the city government exempting them from taxes. Ohio requires that municipally-owned water works shall render free fire protection. Nebraska and Kansas have optional statutes for the collection of taxes within municipalities, from which can be paid charges for protection. The problem is apparently one of political prestige.

Two things should be done. A complete survey is needed of various and specific conditions regarding fire protection as they pertain to cities of the west coast. Payment should be insured of proper allocation of costs by sources of property to which they are applicable by levying a tax against which bills would be rendered. State legislatures should be urged to formulate laws leading to the levying of taxes in each district served by water works, the monies being deposited to the credit of the districts, and bills for fire protection paid at rates determined by disinterested authority.

Convention banquet address by George H. Fenkell, president, American Water Works Association.

The water works man aims to promote the interests of his works, to add to knowledge of his profession, to assist fellow employees to make personal advancement, and to obtain for himself compensation in accord with the service rendered.

The method of employee selection is of prime importance in municipal water works. Civil service, if properly administered, is an effort to employ, promote, and continue in service those best qualified to fill the positions. The employee wishes a reasonable compensation for his work, while the employer usually settles on a rate that is the lowest he can use to secure for the time being the needed service. A man is generally rated by his fellows according to salary received, or amount of money accumulated. As the water works man desires better public recognition, the test of any method employed to this end will be reflected in his income. An old-age pension fund, workmen's compensation, and group life insurance are all desirable features to promote the standard of living.

The water works art is changing so fast that only with difficulty can one keep informed on the latest practice and methods. Thus, the water works man desires financial support in obtaining various publications that relate to his work, in attending technical meetings, and engaging in society and committee work relating to subjects in which he is interested.

The executive is interested in adequate water rates so that, by economical administration, his department may be maintained in a good condition and the system extended to provide for the needs of a growing community. It is easier to effect economies with a private company than with a municipal department, as popular demand on the latter organization during periods of unemployment leads to the making of work for the jobless rather than effecting savings. In levying the income tax, the federal government maintains that the water department function is proprietary, whereas it is at least partly governmental. The water department management should collect and disburse its own funds solely for improving and operating the system—not for unintended purposes. Metering has done much to make water departments financially self-contained, for it leads to equitable rates and just methods for using the funds collected.

Although in American cities the function of a water department has been arbitrarily assumed to begin with the source of supply and end with the consumer's tap, it could be extended to cover part or all of the sewerage system. Then, the water rates might be increased to cover building and maintenance of sewers, making it possible for a municipality to issue general improvement bonds to a greater extent.

The operating engineer usually has so much routine work that engineering problems cannot be given the needed special study. This deficiency is a province of the specialist, or consulting engineer. While great advance has been made in the knowledge of the art of water supply, much remains to be done through experimental and research work on steel pipe coatings, advantageous use of reservoirs and standpipes, lessened color and taste of water, softening, hydrant flow surveys, breaks in mains, rainfall and runoff data at flood times, operation of coagulation or sedimentation basins, etc.

Some Problems of the Los Angeles Water Supply, by H. A. Van Norman, chief engineer and general manager, Bureau of Water Works and Supply, city of Los Angeles.

At the informal dinner on October 30, Van Norman described the work to be done under the recent $38,800,000 bond issue—primarily the development of the Mono basin supply to augment the Owens valley supply—for details of which see the May 25th issue, p. 259.

Water Rights in California, by W. G. Irving, attorney-at-law, Riverside.

On the premise that water in excess of the amount necessary to supply human wants is of little value, but water in amounts sufficient for that purpose is the price of life, the author of this interesting and scholarly paper traces the development of the water law of California from the days of '49. Dividing the water rights into those of riparian owners, of appropriators, and of owners of land overlying subterranean supplies, Irving gives the present-day definition of each right and cites from leading cases.

This paper will be published in full in an early issue.

Development of Deep Wells in Southern California, by D. A. Lane, Bureau of Water Works & Supply, Los Angeles.

About 80% of the Southern California water supply is from ground-water; constant lowering of the water table brings new problems. An outside source is needed to maintain the present demand and meet future requirements for water supply. Additional wells have been drilled over adjacent territory until many organizations are actively competing in water-bearing areas. In the southern part of Los Angeles, an auxiliary well supply has been put in and a novel plan attempted to prevent interference by drilling 16-in. wells to depths of 1002 and 1203 ft., perforating neither well above 840 ft. The static level of the deep wells is 5 ft. lower than old ones in this territory, and the new supply should remain fairly constant.

Three types of well drilling in use are: the standard rig with shoe and stovepipe casing in 3 to 4-ft. joints, perforated when landed; the 'gravel envelope' well drilled by standard rig and with standard casing; and the gravel envelope well drilled with a rotary rig and equipment. The gravel envelope types permit development of good producing wells in areas where sand or fine material prohibits standard drilling methods perforating all strata.

Engineers or superintendents should either personally identify the materials with the log, or else leave the matter of perforation to the driller. Proper perforation determines future production and value above other factors. Two types of perforators are the rolling disc (6 rows of holes) and the single blade; the latter type is safer. Ample time should be taken for perforation.

The city of Los Angeles uses a screw pump driven by a 125-hp. tractor engine for development, because this unit has flexible speed. Minimum speed at first prevents the well from breaking suction, and sand from clogging the bottom or the perforations, or both. When maximum speed has been reached, surging is commenced. This is an effective means of increasing production. In many places it is difficult to clean a well of sand after perforating. Air is often used to lift the free-flowing sand until the flow ceases and the developing pump can be used. Each well should be developed to maximum capacity regardless of the desired production as a constant draft. This is especially true on systems with small storage capacity or automatic pressure 'cut-ins'.

Each well is a separate and distinct problem and should be so studied.

Colorado River Project, by Creighton O. Waldorf, mining engineer, Beverly Hills.

The geological survey of the Grand Canyon of the Colorado

is revealed from the strata in its cliffs and gorges, going back to the most remote era. Archeozoic rocks were exposed as a land area, were dissected and sank, sediments of later geologic time being deposited. Alternate lifting and leveling occurred between Archeon and Carboniferous time. In early Silurian time, enormous detrital deposits were made, faulted, and flexed; later being raised with volcanic action accompanying; then eroded and submerged. About 4000 ft. of sandstones, limestones, and Carboniferous shales in horizontal layers show from the rim of the canyon down. Deposition extended to Tertiary time without any real break, and underlying beds sank deeply. The Cretaceous period closed with important vertical disturbances, and the Rocky mountains were uplifted. Deposition continued. After the Eocene period opened, the waters became fresh and a set of new displacements occurred, forming a great fresh-water lake with the Colorado river as the probable outlet. Fresh-water deposition reached 1200 to 5000 ft., the lake area rose, and erosion began which has continued to the present time. The Mesozoic sediments were removed, and near the last of the Miocene period the region was base-leveled. Volcanic action followed, with uplifting and major north-south faults.

The cutting power of the Colorado river in the Grand Canyon is out of proportion to that of a river in an arid climate, as it has plenty of water, the required declivity, and cutting tools. The gorge is being deepened rapidly. Geologists disagree as to the influence of faults in deciding the location of the present Colorado river channel.

Below the canyon is the Grand wash, and farther down the Hoover damsite. Above the Grand wash the fall is 8 ft. per mile, below for 500 miles to the Gulf it is 17 in. per mile. If the delta builds up one foot, then the river bed—being at grade level—must build up an equal height back to the Grand wash. This puts the river on top of a ridge of its own construction, and it is difficult to withstrain flood waters. The Colorado river delta receives a cubic mile of detrital every 5 to 8 years, and is probably sinking. When it first entered the Gulf, the head of the Gulf was in Coachella valley and the river entered along the easterly side 200 miles south. It built the delta entirely across the Gulf, formed an inland sea, and left the Imperial valley below sea level as the impounded waters evaporated. The delta is 47 ft. above sea level at the highest point between the Gulf and the Imperial valley. Major faults extend along the east and west sides of the valley, delta, and Gulf—it is a region of great seismic activity and is probably sinking. A dam anywhere on the Colorado river would arrest the flow of silt and retard building up of the delta, probably also arresting the tendency of this region to sink.

Maintenance Equipment for Water Works, by Cal R. Manbert, construction engineer, East Bay Municipal Utility District, Oakland.

This paper, written in a humorous and irrelevant style to ease the tension of the technical discussions, will be published in full in an early issue.

Reclamation of Treated Sewage, by R. F. Goudey, sanitary engineer, Bureau of Water Works & Supply, city of Los Angeles.

The Bureau of Water Works & Supply is successfully conducting an exhaustive series of experiments on the reclamation of treated sewage for the replenishment of underground water supplies. In fact, some of this sewage is being reclaimed to the 'nth' degree so that the resultant purified effluent is potable for domestic use.

Reclamation of sewage is not a question of sewage disposal, but is directly related to a legitimate increase in water supply. It involves a correct type of installation and a tone of operation far excelling that common to sewage treatment plants. The economical aspects of sewage reclamation are far reaching.

Two articles on the subject, describing the results sought and plant required, have been published in previous issues (September 25th and October 25th, 1930).

Grounding of Telephone Cable Sheaths to Water Pipes, by Ira D. Van Giesen, electrolysis engineer, Bureau of Water Works & Supply, City of Los Angeles.

This paper presents a contrary stand to the opinion of most water works men that the grounding of telephone cable sheaths to water pipes is a harmful practice and should be discouraged. Van Giesen logically presents the electrical theory involved and illustrates his negative stand with a number of interesting drawings.

This illustrated paper will be published in an early issue.

Relation of Politics to the Management of Municipally-Owned Water Systems, by F. M. Randlett, Pacific coast manager, Robert W. Hunt Co., San Francisco.

Some water works men who endeavor to run their business properly, encounter obstacles of every kind, largely due to the influence for political expediency rather than business efficiency. In municipally-owned plants, seldom is the total cost of water service fully represented in rates paid by the consumer. Politicians continually refer to lifting the tax burden and conserving natural resources, of which water is one. Generally, no charge is made for the water as a commodity, but the cost of collection and delivery must be paid, properly through a scientific rate-schedule. No method has ever been found to put the tax on anyone but the consumer. As the municipal government seldom has to keep accounts in accordance with public service commission rules, local politics may make use of the municipal utilities for its private benefit. If all municipally-owned public utilities were taxed, they would pay a considerable sum now carried by private business and personal taxes.

The so-called lower rates under muncipal ownership are not necessarily lower. If the total cost of service is not in the rate schedule, it must be made up from taxes on incomes or property, or from licenses, etc. Often, a policy of management has been forced in regard to rates and many other matters making it possible for some politician to assert that lower rates with better service and quality would be effected if he were in office.

All money from sale of water should be used in the same manner, whether the plant is municipally or privately owned, for operating, maintenance, insurance, taxes, interest, sinking fund, surplus, etc., and careful accounting made. Municipalities often ignore many of these items. Civil service for the municipally-owned utility designed to prevent elective officials from employing incompetent persons was never intended to keep them there regardless of efficiency or value. An employee who is qualified for his work, is efficient, and receives a salary as full recompense for his service, should be allowed to live how and where he chooses, despite many city charter provisions to the contrary. Where public ownership exists, the best form of control approaches the organization of a successful business corporation. Where the ordinary elected legislative body is in charge, there is no apparent answer to the problem. The American public seeks and will generally pay for good service and quality and, where it is lacking, seeks a substitute therefor, even to changing officials or programs. This seldom happens where an experienced and unhampered water works management can take its recommendation to a competent board or commission.

Bond elections often carry or fail for political reasons rather than because the true facts of the situation have been presented. Water works improvements and extensions should be made as the municipal growth requires, and be budgeted and programmed by experts—not delayed or advanced for political purposes. With an appointive commission, it has been necessary to have in charters compulsory clauses for setting aside a sinking fund on an actuarial basis, or fixing rates at the beginning of each fiscal year to pay for all legitimate costs pertaining to proper operation. The most efficient management is that not controlled or influenced by politics, but the one allowed to build, operate, and maintain the water works with ordinary business sense for the benefit of its customers—who are its stockholders.

Stand-by Charges for Water Works, by C. E. Thatcher, manager of commercial department, East Bay Municipal Utility District, Oakland.

A stand-by charge means a charge for readiness to serve, available to municipalities for fire protection. Until recently, little thought has been given to cost distribution and rate making in the operation of water works. A rate was fixed applicable to service rendered domestic and industrial consumers, and some revenue derived from a charge for fire

hydrants, street sprinkling, and sewer flushing. Growth of communities required water system expansions and rate increases leading to public utility commission investigations—showing generally that the systems were entitled to all the charges made.

To provide the regular domestic and industrial service, smaller mains are needed than to meet the additional fire protection services. The rendering of the latter service is distinct and should be separately charged against the municipalities on the premise that those who receive the benefit should pay for it. Taxpayers support a municipality and should pay for readiness to serve; this payment should not be asked, for instance, of the tenant of a rented house. To protect large areas carrying immense buildings, etc., increased facilities are required. It is difficult to equitably distribute the burden of the cost of water served each class of consumer.

The Wisconsin Railroad Commission a few years ago advocated establishment of a stand-by charge against municipalities and put it into effect in many cases, despite strenuous opposition. The average charge fixed for fire service in Wisconsin is 33% of the gross revenue of the water utility. Other commissions have allowed a charge for fire service facilities, the rate yielding a lower percentage return in most cases. The California Railroad Commission terms the charge against municipalities for fire service as a public use charge and has fixed it at about 7% of the gross revenue. The Commission apparently intends to lift the burden for such services from the general consumers and place it where it belongs, on the municipalities.

City-owned water works should be able to fix a charge for similar service and likewise lower the burden on the general consumer. They should not be required to furnish free service to the fire department at the expense of other consumers. The East Bay Municipal Utility District, having as its customers nine municipalities on the continental side of San Francisco bay, charges for stand-by service about 7% of its gross revenue.

The present trend is to relieve the ordinary user of water of all costs chargeable to other classes of service.

Billing and Collection Methods, by Carl K. Chapin, Pasadena.

Credit business has recently found a place of first importance in the commercial world and has brought a public stand against pressure for prompt payment of bills. There is being universally experienced greater and greater resistance to collections for the services supplied by water utilities. The consuming public can, however, be divided into responsible parties and a small percentage of credit 'racketeers.' Billing and collection methods should sift the one class from the other and preserve the good will of the major group.

The billing procedure alone should be speeded up by cutting the usual 7 to 8-day elapsed time between reading meters and mailing or delivering bills to 3 to 5 days. Turn-on and turn-off service should be conducted by smaller forces with light equipment. Closing bills should be made on a one-day schedule to prevent confused responsibility for several days of service.

Collections may be received through the mail, by cashiers, and by collectors, the most expensive method being the personal call. It usually costs five to ten times as much to care for window collections as it does by mail, and ten to twenty times as much to handle field collections as to use the office cashiers. A perfect identification system must be used to prevent unidentified ledger accounts on by-mail payments. The problem of returned checks deserves careful study to prevent intentional oversights by some business firms.

Poor pay customers can be guarded against by requiring deposits, guarantees, or guarantors, or bonds. Two-thirds of the money lost occurs on but one-third of the bad accounts. The best method of handling these customers may be the abrupt one of not letting them 'get away with anything'.

Cost Keeping and Budget Control, by F. M. Faude, vice-president, The Loveland Engineers, Inc., San Francisco.

The value of accurate cost records on construction and for some items of operating expense is now recognized by most water works officials in marked contrast to the attitude of a few years past. Proper cost keeping is more than a compilation of figures for transfer to the accounts of the water system, as it provides statistical data which may be of great value if the completed records are carefully analyzed. Proper and accurate cost records can be secured only through cooperation of storekeepers, foremen, superintendents, accountants, engineers, and the plant manager. The manager has the task of coordinating activities of the various departments to secure accurate results.

Cost records should include statements detailing any unusual conditions encountered which alter the costs in relation to a fair average for similar works; they should include indirect costs as well as the direct costs of materials and labor. These indirect costs frequently are a substantial portion of the total cost and should be separately listed.

Ordinarily, no construction should start until a work order has been prepared and approved by an official with authority. This work order should describe the project so that a check can be made on its extent, location, character of materials to be used, and description of facilities to be replaced; it should include a cost estimate and sketch of the proposed work—thus becoming the basis for an accurate cost record. Verbal authorizations for work are objectionable, as they permit expansion of the authorization beyond its original intent and lead to a 'fudging' of costs.

Accurate cost records require expenditures which are often objected to, but if kept within reasonable limits the value of the records outweighs their cost. Careful study of the records may result in improved working methods and consequent reduction in construction or operating costs.

The budget system is regarded as essential in the operating scheme, and secures control of expenditures. It sets definite goals for plant managers and other officials, coordinates expenditures with resources, allows the use of costs for control, encourages reduction in waste, assigns responsibility for expenditures, gives a warning of when to be cautious with expenditures, and serves as a measuring stick to compare performance with promises and estimates.

A budget system must have careful estimates of revenue and of operating expense, based on previous experience and adjusted to present conditions, gauging of material requirements, provision of funds to support projected improvements. Budgets must be flexible, yet adhered to as closely as possible.

Distribution Reservoir Design, by Chester A. Smith, Burns-McDonnell-Smith Engineering Co., consulting engineers, Los Angeles.

It is a primary engineering duty to see that reservoirs hold water.

A distribution reservoir is a tank or basin direct-connected to, or floated on, the normal pressure of a distribution system; it may be raised entirely above the ground (tank or standpipe) or constructed on elevated areas at about the ground surface. Design of earth-embankment, masonry-lined reservoirs includes many principles which should be considered for other types.

During preliminary investigations, accurate contour maps should be made of each available site, the needed capacity established, and the reservoir shape and approximate depths of excavation determined. Test pits or borings should determine the character of material in the excavation and of the soil beneath the bottom of the reservoir or under the embankment. Borings may show the need of considerable excavation wastage to secure good foundation or proper embankment materials, or that it is necessary to temper or mix varying materials from the excavation as they are placed in the embankment. The excavation and embankment slopes should not exceed the angle of repose when saturated—interior excavation slopes 1½:1, unless hard material and gunite lining; inside earthen embankment slopes 1½:1, or 2:1. Outside slopes on embankments should be 1½:1, or 2:1, or 2½:1 for high fills.

Ideal embankment material is a mixture of clay and sand, fine gravel, or decomposed granite, well pulverized, that will bind together when moistened and rolled. Clays, adobes, and some soft shales will swell when moist, and shrink and contract when dry. Some finely-divided silts or volcanic ashes are treacherous and will shrink or dissolve when moistened, flowing at low angles of repose, and water-tight lining is necessary for their use. For sudden changes in soil characteristics in excavation, or whenever a dry waterway runs through the reservoir, the cut should be deepened, refilled with satisfactory material, and compacted. All top soil to 6-in. depth should be stripped and wasted. Where it is feasible, the entire reser-

TABLE 1

Earth Embankment—Covered Reservoirs

(Compiled by Burns-McDonnell-Smith Engineering Co.)

Location	Year Built	Capacity (gal.)	Water Depth	Slopes—Inside	Slopes—Outside	Slab	Reinforcement	Expansion Joints	Total Cost (Dollars)	Cost Per Million Gal. (Dollars)	Type of Roof
Burbank, Calif.	1926	348,000	14′-0″	0.4 :1		6″	Wire mesh	Asphalt	13,716	40,000	Wood frame and paper. Rwd. columns
Riverside, Calif.	1913	500,000	16′-0″	1½ :1		6″	Steel bars	Asphalt	7,700	15,400	Wood
Pasadena, Calif.	1926	638,000	18′-0″	¼ :1		1½″	Wire mesh-gunite	None	11,992	18,885	Wood on rwd. col.
Pasadena, Calif.	1921	984,000	18′-0″	¼ :1		1½″	Wire mesh-gunite	None	14,538	14,800	Rwd. roof and col.
Pasadena, Calif.	1928	1,023,600	20′-0″	1 :1		3″	Wire mesh-gunite	None	18,403	18,000	Armco iron. Rwd. col.
Santa Barbara, Calif.	{1897} {1927}	1,500,000	20′-0″	1.4 :1	1½ :1	2″	Wire mesh	Asphalt	15,730	10,450	Paper on wood. Galv. iron pipe col.
Santa Barbara, Calif.	{1902} {1917}	1,500,000	20′-0″	1.4 :1	1½ :1	5″	Wire mesh	Asphalt	8,500*		Wood on pipe col. *Lining and roof only
San Diego, Calif.	1909	2,448,000	12′-0″	2 :1	1½ :1	4″	Steel bars		11,600	4,750	Wood on concrete col.
Burbank, Calif.	1930	2,500,000	20′-0″	2 :1	1½ :1	6″	Steel bars	Asphalt	38,346	15,450	Paper on wood. Rwd. col.
Riverside, Calif.	1913	3,000,000	16′-0″			6″	Steel bars	Asphalt	21,500	7,200	Wood
Glendale, Calif.	1929	3,500,000	30′-0″	{1½ :1} {2 :1}	2 :1	8″	Expanded metal	Copper	49,000	14,200	Paper on wood. Rwd. col.
Palo Alto, Calif.	1927	3,800,000	16′-0″	1.8 :1	2 :1	6″	Steel bars	Asphalt	37,566	9,900	Paper on wood. Conc. col.
Fullerton, Calif.	1922	5,000,000	13′-0″	2 :1	3 :1	4″	Wire mesh	Asphalt	49,350	9,900	Wood on conc. col.
Phoenix, Ariz.	1924	5,000,000	17′-4″	1¼ :1	3½ :1	6″	Wire mesh	Asphalt	46,600	9,340	Corr. iron on wood
Oceanside, Calif.	1929	5,000,000	17′-0″	1 :1	1½ :1	2″	Wire mesh-gunite		48,975	9,800	Twin res.—paper on wood. Conc. col.
Whittier, Calif.	1921	6,637,000	24′-0″	2 :1	2½ :1	{4½″ 6″}	Wire mesh	Asphalt	64,000	9,660	Wood on conc. col.
Pasadena, Calif.	1917	6,937,000	18′-0″	1 :1	2 :1	4″	Wire mesh	None	21,128	3,200	Rwd. on rwd. col.
Burbank, Calif.	1928	6,900,000	20′-0″	2 :1	1½ :1	6″	Wire mesh	Asphalt	67,436	9,800	Paper on wood. Rwd. col.
Glendale, Calif.	1920	7,500,000	20′-0″	2 :1	1½ :1	4″	Wire mesh	Asphalt	60,800	8,100	Wood on rwd. col.
Phoenix, Ariz.	1928	10,000,000	16′-0″	1 :1	3½ :1	6″	Wire mesh	Asphalt	88,800	8,880	Corr. iron on wood
San Bernardino, Calif.	1929	10,000,000	30′-0″	½ :1	1 :1	{2″ 4″}	Wire mesh-gunite	None	51,931	5,193	Metal on wood. 6″ pipe col.
Pasadena, Calif.	1925	10,277,500	20′-0″	1½ :1	2 :1	6″	Wire mesh	None	49,357	4,800	Wood on rwd. col.
Riverside, Calif.	1927	12,000,000	26′-0″	1½ :1	2 :1	2″	Wire mesh-gunite	None	60,000	5,000	Paper on wood. Conc. col.
Glendale, Calif.	1924	15,000,000	20′-0″	2 :1	2 :1	6″	Wire mesh	Asphalt	78,190	5,200	Wood on rwd. col.
Glendale, Calif.	1925	15,000,000	20′-0″	2 :1	3 :1	6″	Wire mesh	Asphalt	84,475	5,620	Wood on rwd. col.
San Bernardino, Calif.	1926	3,215,000	10′-0″	2½ :1	2 :1	4″			7,560	2,350	Galv. iron on wood. 4″ pipe col.

*Lined asphaltic oil

TABLE 2

Earth Embankment—Uncovered Reservoirs

(Compiled by Burns-McDonnell-Smith Engineering Co.)

Location	Year Built	Capacity (gal.)	Water Depth	Slopes—Inside	Slopes—Outside	Slab	Reinforcement	Expansion Joints	Total Cost (Dollars)	Cost Per Million Gal. (Dollars)	Remarks
Everett, Wash.	1916	1,225,000	16′-0″	1½ :1	2 :1	6½″	Steel bars		10,700	8,750	
San Diego, Calif.	1920	3,500,000	10′-0″	1½ :1	1½ :1	3″		Asphalt	29,324	8,400	
Lewiston, Idaho	1923	3,600,000	20′-0″	1¾ :1	1½ :1	{4″ & 2″ membr.}	Steel bars	Asphalt	43,760	12,150	
Lewiston, Idaho	1923	4,000,000	20′-0″	1¾ :1	1½ :1	{4″ & 2″ membr.}	Steel bars	Asphalt	42,700	11,700	
Salt Lake City, Utah	1915	5,000,000	20′-0″	1 :1	1 :1	6″	Steel bars	None	20,177	4,035	
Salt Lake City, Utah	1900	5,000,000	17′-4″	1½ :1	1½ :1	8″ & 10″		Asphalt	47,000	9,400	
Port Angeles, Wash.	1924	6,000,000	20′-0″	1¾ :1	2 :1		Steel bars	Asphalt	64,000	10,665	
Boulder, Colorado	1922	8,000,000	26′-0″	1½ :1	2 :1	5″	Steel bars	Asphalt	59,500	7,440	
Everett, Wash.	1916	10,000,000	20′-0″	1½ :1	2 :1	8″	Steel bars	Asphalt	80,000	8,000	
Salt Lake City, Utah	{1922} {1924}	10,000,000	30′-0″	1½ :1	1½ :1	6″	Steel bars	Asphalt	50,474	5,047	
Salt Lake City, Utah	1915	10,000,000	30′-0″	1 :1	1½ :1	6″	Wire mesh	Asphalt	45,774	4,577	
Grand Junction, Colo.	1923	13,500,000	20′-0″	1¾ :1	2 :1	Sides 6″ Floor 5″	Steel bars	Asphalt	74,000	5,480	Side lining—2 course and membrane
Portland, Oregon	1911	49,000,000	31′-0″	2 :1	2 :1	5″ to 9½″		Membrane over asph.	508,561	10,378	Twin reservoir
Flagstaff, Ariz.	1925	50,000,000	35′-0″	2 :1	1½ :1	Sides 4½″ Floor 4″	Steel bars and mesh	Asphalt	235,000	4,700	Side lining—3″ concrete—membrane and 1½″ gunite
Portland, Oregon	1911	76,000,000	21′-0″	2 :1	2 :1	5″ to 8″		Asphalt	547,890	7,209	Twin reservoir
Walla Walla, Wash.	1923	15,000,000	20′-0″	1⅛ :1	2 :1	7″	2 layers wire mesh	Copper and asphalt	251,764	16,900	Twin reservoir; earth emb. center wall
Fort Bragg, Calif.	1912	2-1,500,000	8′-6″	3 :1	1½ :1	None	No lining		4,677	1,560	Clay embankment; excav. 5′ deep

TABLE 3

Masonry Walls—Covered Reservoirs

(Compiled by Burns-McDonnell-Smith Engineering Co.)

Location	Year Built	Capacity (gal.)	Depth	Type	Floor Slab	Roof	Total Cost (Dollars)	Cost Per Million Gal. (Dollars)	Remarks
Russell, Kans.	1910	80,000	15′-0″	Ring tension	6″	3½″ conc. slab and beam	3,100	38,800	
Upland, Calif.	1925	200,000	14′-0″	Ring tension	4″	Wood	3,000	15,000	Roof, wood on conc. columns
Junction City, Kans.	1924	200,000	13′-3″	Ring tension		Concrete	7,000	35,000	15″ earth cover over conc. roof
Mt. Pleasant, Iowa	1914	205,000	12′-0″	Ring tension	8″	4″ concrete	4,150	20,000	
Santa Ana, Calif.	1926	250,000	18′-0″		6″	Concrete	4,700	18,800	
Whittier, Calif.	1926	300,000	10′-0″		4½″	Wood	5,800	19,350	
Kearney, Nebr.	1924	1,000,000		Ring tension		Concrete	15,000	15,000	
Livingston, Mont.	1917	1,000,000	13′-0″	Ring tension	8″	6″ concrete	27,507	27,507	High labor and material costs
Junction City, Kans.	1917	1,000,000	16′-0″	Ring tension	8″	4″ concrete	12,893	12,893	
Hibbing, Minn.	1914	1,000,000		Ring tension			17,082	17,082	
Mishawaka, Ind.	1923	1,500,000		Ring tension		Flat slab concrete	31,358	21,000	Heavy floor designed against up. water pr.
Rapid City, S. D.	1923	2,000,000		Ring tension					
Ponca City, Okla.	1925	2,000,000	14′-6″	Ring tension	6½″	Flat slab concrete	36,485	18,242	Two tennis courts on roof
Independence, Mo.		2,000,000	20′-0″		6″	Flat slab concrete			
Ft. Dodge, Iowa	1912	2,000,000	13′-6″	Buttress	8″	3½″ concrete	24,800	12,400	
Arkansas City, Kans.	1920	2,000,000	14′-0″	Ring tension		5″ concrete	53,940	26,970	Two tennis courts on roof
Del Mar, Calif.	1930	2,000,000	18′-6″	Ring tension	6″	Shake roof	27,129	13,560	
Mishawaka, Ind.	1928	3,000,000	19′-0″	Ring tension	6″	8½″ concrete	55,555	27,777	2′ earth cover over conc. slab
South Bend, Ind.	1911	5,500,000	20′-0″	Buttress	8″	6″ slab	61,700	9,400	Low labor and material costs in 1911
San Diego, Calif.	1909	17,000,000	19′-0″	Cantilever	4″	Wood, concrete col.	136,000	8,000	
Cedar Rapids, Iowa		8,000,000				Concrete	112,000	14,000	
Ventura, Calif.	1928	9,000,000	19′-10″	½ emb. and ½ st. wall	2½″ gunite	Concrete	140,922	15,658	Special concrete roof truss construction

Masonry Walls—Uncovered Reservoirs

Beaumont, Texas	1914	1,000,000	20′-0″	Buttress	6″	None	26,500	26,500	Center wall
Ft. Madison, Iowa	1917	1,000,000	16′-6″	Ring tension	8″	None	9,500	9,500	
Tucson, Ariz.	1921	1,609,000	12′-2″	Ring tension	8″	None	36,400	22,700	
Winfield, Kans.	1917	1,750,000	21′-0″	Ring tension	4″	None	16,700	9,600	Constructed on old reservoir floor and site
Leavenworth, Kans.	1914	5,500,000	20′-0″	Masonry	3″	None	45,000	8,250	Masonry walls and puddle clay

voir bottom should extend to solid natural soil. Otherwise, when suitable material is available for mixing, tempering, wetting, and compacting, the reservoir may be partly on filled ground.

All pipes entering the reservoir should be laid in trenches in original, firm soil, before placing any embankment, and should be designed to support the external load. Lines beneath high embankments should be cradled in concrete, with cutoff walls or collars every 20 to 30 ft. at right angles to the pipe and extending 1 ft. into the trench walls and bottom and above the natural ground level. A concrete collar or thickened slab is needed around the opening into the reservoir lining.

Safety of the reservoir depends largely upon the strength and solidity of the embankments. All top soil, roots, and permeable material should be stripped from the embankment site, the original earth plowed and harrowed, then moistened, rolled, and compacted. Excavated material for the embankment should be spread in uniform horizontal layers not over 6 in. deep, then moistened and cultivated; all 4-in. material, roots, wood, and other large organic particles being removed before compacting the embankment with a sheepsfoot roller. Density and tenacity of embankment material must be secured.

Concrete for reservoir lining should be dense, about 1:2:4, with low water-content for sloping walls, and 4-in. minimum slab thickness for walls and floors. Usually, a well proportioned and compacted 8-in. slab will serve for heads up to 40 ft. A number of reservoirs have been gunite-lined, 1½ to 4 in. thick; several have had a double concrete slab with fabric waterproof membrane. As the foundation and embankment should support the water pressures and superimposed loading, slab reinforcement is provided to care for temperature, curing, and drying stresses. The steel area should range from 0.2 to 0.4% of the cross-sectional area of the slab, and the steel well imbedded, being at the center for slabs 4 to 6 in. thick. Steel bars supported by chairs may be more satisfactory than woven or welded wire mesh reinforcement.

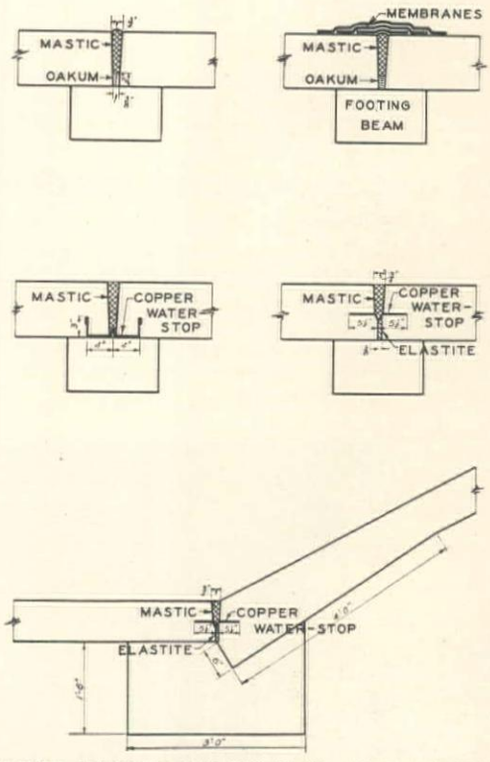
In reservoir construction, the 'expansion' joint becomes the 'movement' joint to care for contraction and expansion or unequal settlement of supporting earth. The joint provides a plane of separation so that free movement of two adjacent parts may occur—spacings of 35 to 40 ft. for well reinforced slabs and 15 to 20 ft. for cut-and-fill areas, are Smith's recommendation. Joints should allow movement and still remain watertight. One of the two principal types has a flexible metal stop or tongue of soft copper or lead, with the ends embedded in adjacent slabs. The other has a plastic or mastic filler compound, with a coal-tar pitch or asphaltum base, that will compress or expand with movement and yet keep the seal. At least one layer of cloth saturated with asphaltum or pitch, mopped on over the joint, extending about 1 ft. into adjacent slabs, provides additional seal. Mastic joints can be used up to 20-ft. head.

Admixtures or integral waterproofing materials, surface penetration or surface coatings of bituminous compounds, and impregnated membranes have been used for reservoirs. A dense 1:2:4 concrete developing 2000 lb. at 28 days is practically impermeable to moderate heads, and a good 6-in. slab should resist a 40-ft. head without waterproofiing. If the moistened concrete surfaces are exposed to freezing weather, they should be protected by dampproofing with bituminous surface penetrations or coatings.

For embankment-type reservoirs, a carefully designed underdrainage may be necessary to prevent damage or failure, as it relieves upward hydrostatic pressure and is a good indicator for leaks or changed conditions. Local conditions influence the design layout, but in general the drain pipes should be at the toe of the slope where the side wall lining joins the floor and near and parallel to floor expansion joints, with one or more lines across the face of high embankments. Drains should be sewer pipe or short lengths of cast-iron soil pipe laid with open joints and gravel-backfilled trenches. Soil conditions control the spacing of drains and necessary porous medium.

If the reservoir is constructed in a canyon so as to block the natural watercourse of the tributary drainage, ample provision should be made to by-pass the storm water and protect the banks from erosion, computing the drain capacity on the basis of maximum intensity. Brush, stones, and debris may be brought down by excessive rainfall. Auxiliary overflow openings to the reservoir may be necessary at higher elevations, with an outlet at a lower elevation leading to the waterway at the downstream side.

Main factors influencing construction cost are accessibility of site, amount and character of excavation, and local labor and material prices. Storm water diversion, drainage, landscaping,



Expansion Joints Used in Distribution Reservoir Design

beautifying grounds, fencing, etc., are added factors. Tables 1, 2, and 3 show construction costs. The cost per million gallons for embankment concrete-lined reservoirs with wooden roofs, is shown in Table 4. Tar paper or patented roofing of wood sheathing with redwood or concrete columns, including footings, usually costs 20 to 25c per square foot of roof area. For reservoirs up to 2,000,000 gal. capacity, a riveted plate steel structure may be less expensive than an earth embankment concrete-lined or ring tension concrete wall reservoir with or without roof.

TABLE 4

Cost Per M.G. for Embankment Concrete-Lined Reservoirs with Wooden Roofs

Capacity (gal.)	Cost per M.G.
500,000 to 1,000,000	$18,000 to $15,000
1,000,000 to 4,000,000	15,000 to 10,000
4,000,000 to 10,000,000	10,000 to 7,500
10,000,000 to 15,000,000	7,500 to 5,500

SAN FRANCISCO GETS A.S.AG.E. DIVISION CONVENTION

American Society of Agricultural Engineers, Land Reclamation Division—The annual meeting of this division of the Society will be held at the Hotel Whitcomb, San Francisco, January 6 and 7, 1931. Besides business meetings and the annual banquet, the following subjects will be discussed: (1) 'Reclamation and Development in the Sacramento-San Joaquin Delta', (2) 'The Conservation of Public Domain', (3) 'Economic Problems of Western Reclamation', (4) 'Utilization of Water and Power from Boulder Canyon Project', (5) 'Resume of Present Status of Facts and Opinions on the Relation of Forest Cover to Water Conservation', (6) 'Resume of Problems of Soil Erosion and How They Are Being Met', (7) 'Influence of Reclamation on Design and Development of Farm Machinery', (8) 'Soil and Reclamation in China', (10) 'Financing Reclamation'.

Construction Review

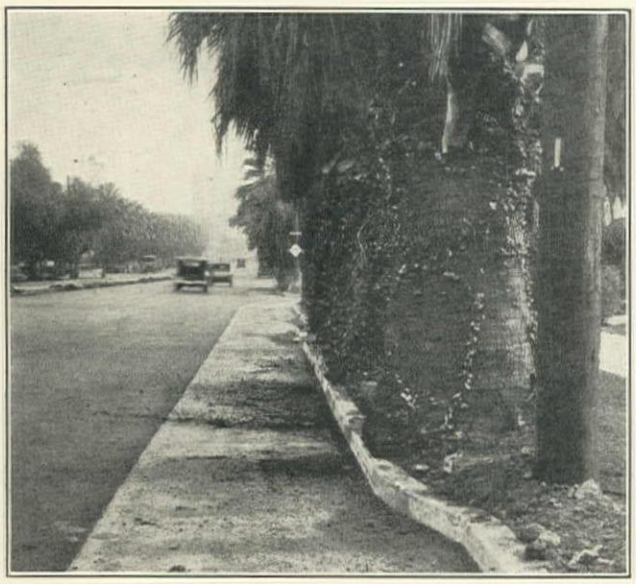
PAVING

By S. J. SANDERS
Editor, Daily Construction News Service

Progress is being made on important paving projects as follows:

CITY OF LOS ANGELES, CALIFORNIA

Cahuenga boulevard is the easterly of two main entries into the Hollywood business district from Cahuenga pass, and carries a large volume of traffic. In many places the roadway was only 40 ft. wide, making a bottleneck which is being eliminated under the present program. The new roadway will be 74 ft. wide, with an 8-in. pavement. Wilcox ave., Vine st.,



Details of Specially Designed Steel Armor Used in Place of Concrete Curb to Give Additional Clearance Around Trees on Sunset Blvd., Los Angeles

and Cole ave., included in the project, act as distributor streets to the south. Portions of these streets are being opened, widened, and paved to relieve traffic congestion. Franklin ave., serving as a distributor street for sections east of Cahuenga blvd., will also be widened and paved.

The Will F. Peck Co., Los Angeles, will complete the improvement of Cahuenga blvd. about April, 1931, contract price $813,613. Main items in the contract are as follows: grading—$57,500; paving (26,255 tons of asphaltic concrete)—$213,742; storm drains—$140,000; ornamental lighting system—$137,000; sanitary sewers—$88,000; house connections—$30,000; water system—$37,000; curb—$16,993; sidewalk—$30,793. (See July 25th issue, p. 42, for unit bid summary.)

On November 20, the entire project was 45% complete, various divisions being as follows: grading—60%, sanitary sewers—74%, storm drains—65%, curb, walk and gutter—50%, and pavement—30%.

Major equipment includes one Caterpillar '60' tractor; four Adams blade graders (one 12-ft., two 8-ft., and one 7-ft.); one Lakewood grader; two 1½-yd. Link-Belt gas shovels; one ¾-yd. Bucyrus-Erie steam shovel; one ¾-yd. Koehring gas shovel; one 1¼-yd. Koehring dragline; one MultiFoote 27-E paver; one Koehring 27-E paver; two Koehring 7-E mixers; one Fordson loader; one Fordson backfiller; one Killifer scarifier; one Killifer road ripper; one Austin trencher.

Eighth Street, originally laid out on a 60-ft. dedication with a 40-ft. roadway, is being widened to an 80-ft. dedication and a 56-ft. roadway. Offsets or jogs at Valencia st. and at Western ave. are eliminated by realignment, and the alignment between Whittier and Francisco st. is being changed to eliminate sharp curves. Where grade and alignment are unchanged, the existing pavement is being utilized, with a variable-thickness asphaltic concrete base laid to conform to the new street crown. Adjacent to the sections of existing pavement left in place, an 8-in. concrete base is laid, after which the entire roadway is topped with a 2-in. asphaltic concrete wearing surface. At

(Upper) Griffith Co. Placing Asphaltic Concrete on Eighth St., Los Angeles, Austin Tandem Roller in Foreground. (Lower) Griffith Co. Excavating with Parsons Trencher on South Broadway, Los Angeles

changes in grade and on relocations, the entire width of roadway is paved with an 8-in. concrete base and 2-in. asphaltic concrete wearing surface. Truscon curb armor is used throughout.

Two main-line sewers are being constructed, one on each side of the street between the curb and property line. Thus, it will not be necessary to cut into the roadway when house connections are installed. Extensive work has been done by the utility companies, the cost of power, light, and telephone conduits

averaging $11 per foot. The total expenditure for all conduit and mains will be $225,818.

The Griffith Co., Los Angeles, is improving 8th st., from Figueroa st. to Windsor blvd., contract price $571,591 and completion date February, 1931. On November 20, the entire project was 36% complete, with the following progress in various divisions of the work: grading—90%, pavement, curb and gutter —40%, sanitary sewers—80%, storm drain—70%. Main items in the contract are: grading—$72,900; asphaltic concrete pavement (26,255 tons)—$106,-540; concrete base (544,901 sq.ft. of 8-in.)—$76,286; storm drain—$47,500; sanitary sewer—$45,000; ornamental lighting system—$105,000; sidewalk—$38,361; gutter—$8000.

Major equipment includes two 1-yd. Bucyrus-Erie steam shovels, one Parsons ditcher, one Parsons backfiller, one Fordson loader, one Rix '6' compressor, three Koehring 1-sack mixers, twenty 5-yd. trucks, two Kelly-Springfield 3-wheel rollers, one Austin 3-wheel roller, 2 Austin tandem rollers, two Buffalo tandem

H. W. Rohl & Co. Placing Concrete with Smith-Insley Plant on Figueroa St. Tunnel, Los Angeles

rollers, one Parsons 15-ton crane, one Caterpillar '30' tractor, and one central mixing plant with a Rex drum.

Figueroa Street Tunnels—H. W. Rohl & Co., Los Angeles, placed the lining on their Figueroa st. tunnel contract with an Insley mast hoist and two Smith 28-S mixers. One portal of the main tunnel is on sidehill, with a limited operations area and a 40-ft. vertical drop. A 300-ton, 5-compartment steel bin was installed for aggregates and a weigh-box set under this bin immediately above the mixers. Three small tunnels, each about 450 ft. long, were dug above the main tunnel so that concrete could be chuted from the mast plant to the approximate center of the project. The heavy base section of the lining was poured while muck was being removed from the heading through the excavated portion of the main tunnel. Using a 90-second mix, the mast plant handled 1 cu.yd. per minute.

The Figueroa st. tunnels aggregate 996 ft. in length through Elysian park and are 46½ ft. wide by 28 ft. high. The main tunnel is 851 ft. long, the others being 100 and 45 ft., respectively. The contract price was $652,788,

Main and 90th Street Improvement District—George H. Oswald, Los Angeles, has recently completed his contract for paving, etc., in the Main and 90th St. Improvement District, contract price $436,129.

W. F. Crawford Uses Spiked Roller to Perforate Old Asphalt Pavement on Sunset Boulevard, Los Angeles

Major items in the project were as follows: grading—$25,000, lump sum; concrete pavement—376,815 sq.ft. of 8-in. at $0.165 and 966,971 sq.ft. of 6-in. at $0.1215; class 'AA' resurfacing—1,389,130 sq.ft. at $0.0125; sidewalk—90,000 sq.ft. at $0.10; unplastered curb—11,000 lin.ft. (heavy) at $0.40 and 10,500 lin.ft. (light) at $0.32; sanitary sewers—$100,000, lump sum; house connections—65,566 lin.ft. at $0.635; storm drain—$44,000, lump sum.

The main concrete plant contained one Oswald Bros. mixer with a capacity of 24 sacks or 105 cu.ft., handling up to 1800 tons of rock and sand and 5500 sacks of cement per hour. The bin for crushed rock and sand held four carloads of material and was fully portable. Three 1-yd. P&H clamshells were used on the main mixing plant and one ⅝-yd. P&H clamshell with a 27-E Koehring curb and sidewalk mixer. One 4 by 50-ft. belt conveyor was used for aggregates and one 2 by 30-ft. belt conveyor for cement; twenty-four 5-ton dump trucks were also used on the work.

South Broadway—The Griffith Co., Los Angeles, will complete a contract about March, 1931, for improving South Broadway from Pico blvd. to 41st st., contract price $486,270. Before actual improvements could be started, it was necessary to open the street from Pico to 41st place, which necessitated the removal or demolition of a number of buildings. On November 20, the entire project was 4% complete, with 35% of the grading and 15% of the sewer completed.

Main items include: grading—$43,350; sanitary sewer—$40,000; storm drain—$19,000; water system —$16,200; ornamental lights—$90,000; concrete pave-

ment—63,712 sq.ft. of 10-in. ($17,202) and 147,449 sq.ft. of 9-in. ($35,388) and 540,036 sq.ft. of 8-in. ($97,206); asphaltic concrete base (810 tons)—$4860, and 583,563 sq.ft.—$64,192.

Major equipment includes one Bucyrus-Erie 1-yd. steam shovel, one Parsons ditcher, one Buckeye backfiller, one Koehring 1-sack mixer.

Sunset Boulevard is one of the main east-west traffic arteries through Hollywood and is being widened from 60 ft. to 70 ft. Besides an average cross-fall of 15 in., this boulevard had a high crown, making an excessive slope on the lower side. The crown is to be lowered more than 1 ft., which, with the increased width, will greatly reduce the slope and will decrease the tendency for traffic to crowd toward the center.

W. F. Crawford, Culver City, will complete his contract about May, 1931, for improving Sunset blvd. from Normandie ave. to Hayvenhurst drive, contract price $563,642. Main items are: grading—$39,200; paving—$251,504; sanitary sewers—$77,000; house connections—$23,871; storm drain—$66,000; ornamental lights—$23,400; gutter—$36,483; curb—$15,783.

Major equipment includes two 1½-yd. Bucyrus-Erie gas+air shovels, one Kelly-Springfield 12-ton roller, one Acme 12-ton roller, one Caterpillar tractor, one Fordson tractor, 12 trucks, two Rex pavers.

J. J. Jessup is city engineer, R. W. Stewart chief deputy, D. M. True office engineer, and H. P. Cortelyou engineer of general construction for the city of Los Angeles.

CITY OF SAN FRANCISCO, CALIFORNIA

Sunset Boulevard, Sections C and D—The California Construction Co. will complete a contract about May, 1931, for section C of Sunset blvd. between

California Construction Co. Grading Sunset Boulevard, San Francisco, with Caterpillar-Drawn Ateco Scrapers and Guy Loaders

Noriega and Santiago st., contract price $103,844. Main items in the work include: excavation—116,200 cu.yd. at $0.18; imported borrow—122,300 cu.yd. at $0.12; asphaltic surface (2-in.) and 10-in. macadam base—193,600 sq.ft. at $0.135; asphaltic surface (2-in.) and 6-in. class 'F' concrete base—48,000 sq.ft. at $0.205; waterbound macadam pavement—90,800 sq.ft. of 4-in. at $0.025 and 45,800 sq.ft. of 6-in. at $0.035; concrete sidewalk—13,700 sq.ft. at $0.13; unarmored curb—13,600 lin.ft. at $0.45; redwood headers—18,200 lin.ft. of 2 by 6-in. at $0.07; brick manholes or catchbasins—17 at $100; black pipe conduit—1600 lin.ft. of 1½-in. at $0.40; loam—9940 cu.yd. at $0.90; manure—1860 cu.yd. at $2.50.

The California Construction Co. will complete a contract about May, 1931, for improving section D of Sunset blvd. from Noriega to Irving st., contract price $97,890. On November 25, the project was 13% complete, progress on various divisions being as follows: excavation—54%, borrow—6%, and sewers—50%. Main items in the contract include: excavation and imported borrow—195,300 cu.yd. at $0.15; asphaltic concrete surface (2½-in.) and 10-in. macadam base—192,900 sq.ft. at $0.14; asphaltic concrete surface (2½-in.) and 6-in. class 'F' concrete base—38,600 sq.ft. at $0.20; waterbound macadam paving—90,700 sq.ft. of 4-in. at $0.03 and 45,700 sq.ft. of 6-in. at $0.04; concrete sidewalk—13,500 sq.ft. at $0.13; unarmored concrete curb—13,400 lin.ft. at $0.45; redwood headers—18,200 lin.ft. of 2 by 6-in. at $0.07; brick manholes—15 at $100; black pipe conduit—2100 lin.ft. of 1½-in. at $0.40; loam—9920 cu.yd. at $0.90; manure—1860 cu.yd. at $2.50.

The two contracts are being worked as one project, using one dragline Caterpillar '60' tractor with 4-yd. Ateco scrapers and 9-yd. Guy loaders, Caterpillar '30' tractors with bulldozers and Ateco scrapers, etc.

M. M. O'Shaughnessy is city engineer of San Francisco and Clyde Healy is assistant city engineer.

CALIFORNIA STATE HIGHWAY PROJECTS

Fresno County—The Peninsula Paving Co., San Francisco, has completed a contract for 6.7 miles of grading and asphalt paving from Fowler Switch Canal to Fancher Creek, contract price $257,557. Paving began August 18 and was finished October 8, the production for 42 working days being 43,560 tons, or an average of 1037 tons per day.

Main items in the contract included: remove trees—157 at $10; clear and grub—6 acres at $50; roadway excavation—38,800 cu.yd. at $0.22; overhaul—46,600 sta.yd. at $0.01; imported borrow—61,400 cu.yd. at $0.40; structure excavation—1150 cu.yd. at $0.80; subgrading—38,100 sq.yd. at $0.14; class 'A' concrete in structures—190 cu.yd. at $20; asphalt concrete pavement—43,840 tons at $4.01; oil-treated surfacing—960 tons at $3.50; asphalt paint binder—53,800 sq.yd. at $0.01; fuel oil—2650 bbl. at $2.25; move and reset property fence—6.8 mi. at $275; remove concrete—1260 cu.yd. at $2; crusher-run base—7200 tons at $2.40. Equipment included one Northwest crane, one Northwest 1-yd. shovel, thirteen 4-yd. Autocar trucks, one Geiger 4000-lb. asphalt plant, three Galion spreader boxes, one Ord finisher, and four rollers.

E. E. Wallace is district engineer of district VI. California Division of Highways, at Fresno.

Los Angeles and Orange Counties—The T. M. Morgan Paving Co., Los Angeles, will complete a contract about July, 1931, for 3.1 miles of grading and concrete and macadam paving from Anaheim to Seal Beach, contract price $191,604. Rough grading is in progress and paving will not start for several months.

The following major equipment is being used: one Koehring 1¼-yd. shovel; one Caterpillar '60' tractor: one power fresno; twelve dump trucks; one 20-hp. tractor; one blade; one tractor with bulldozer; one

Barnes triplex pump; one Galion 3-wheel roller; two miles of 2½-in. water line.

S. V. Cortelyou is district engineer of district VII, California Division of Highways, at Los Angeles, and L. M. Ranson is district construction engineer.

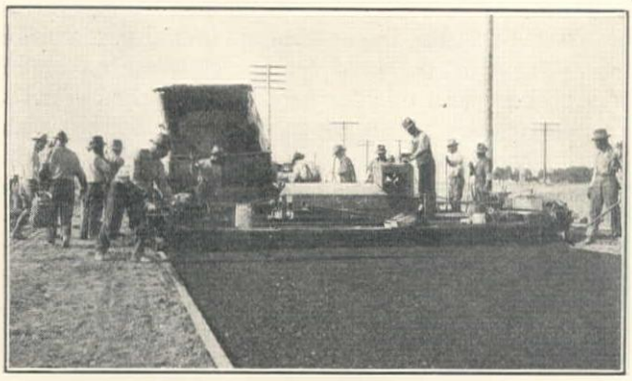
Orange County—The T. M. Morgan Paving Co., Los Angeles, will complete a contract about April, 1931, for 3.3 miles of grading and concrete paving from Seal Beach to Sunset Beach, contract price $98,432. Rough grading is in progress and paving was recently started.

Major equipment includes two 1¼-yd. draglines, one 30-hp. tractor, one 40-hp. tractor with bulldozer, fourteen dump trucks, one 3-wheel Austin roller, one C.H.& E. triplex pump.

S. V. Cortelyou is district engineer.

Sacramento County—Fredrickson & Watson, Oakland, and Fredrickson Bros., Stockton, have completed their contract for 2.6 miles of grading and concrete paving from south of Arno to the Consumnes river, contract price $89,029.

The equipment included one Northwest 1½-yd. shovel, two White trucks, four 6-wheel Sterling trucks, two Caterpillar '60' tractors, one Russell 'Super Mogul' grader, one Ateco scraper, one 75-yd. Johnson steel bunker and weighing batchers, one 27-E MultiFoote



Jones & King Placing Asphaltic Concrete Pavement Between Bretona and Dunnigan, Sacramento County

paver, two Ord finishers, one Austin roller, 13,000 lin.ft. of Blaw-Knox steel headerboard forms.

Sacramento County—Jones & King, Hayward, have completed their contract for 5.8 miles of 20-ft. asphaltic concrete pavement between Bretona and Dunnigan, contract price $129,575.

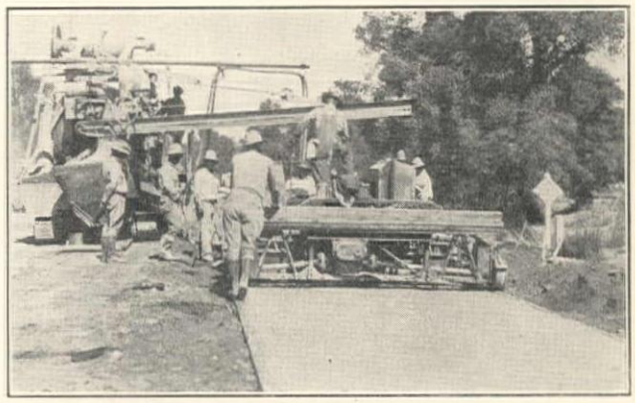
C. H. Whitmore is district engineer of district III, California Division of Highways, at Sacramento.

San Diego County—Jahn & Bressi, Los Angeles, have completed paving and are cleaning up on their contract for 5.4 miles of concrete paving from Balboa ave. to Torrey Pines road, contract price $171,425. Main items in the contract included: roadway excavation (slide removal)—5000 cu.yd. at $0.20; overhaul on slide removal—50,000 sta.yd. at $0.005; subgrade—96,000 sq.yd. at $0.08; class 'A' concrete pavement—19,900 cu.yd. at $7.40; reinforcing steel—455,000 lb. at $0.03; finishing—287 sta. at $5.

Principal equipment included one Koehring 27-E paver, two Ord 20-ft. finishers, fourteen batch trucks, one triplex pump with 29,000 ft. of 4-in. pipe-line, two Caterpillar '30' tractors, one 8-ft. blade, one scarifier, one 20-ft. Carr subgrader, one 12-ton 3-wheel Buffalo-Springfield roller.

S. V. Cortelyou is district engineer of district VII, California Division of Highways, at Los Angeles, and L. M. Ranson is district construction engineer.

San Diego County—Sander Pearson, Santa Monica, will complete a contract about April, 1931, for 11.2 miles of concrete paving from Viejas creek to Pine valley, contract price $338,287. On November 20, the paving was 50% completed and an average force of 88 men was employed on the work.



Sander Pearson Laying Concrete with Rex Paver and Lakewood Tampers in San Diego County Between Viejas Creek and Pine Valley

Main items in the contract are: roadway excavation—14,000 cu.yd. at $0.43; overhaul—180,000 sta.yd. at $0.005; subgrade—131,500 sq.yd. at $0.1175; class 'A' concrete—27,520 cu.yd. at $10.54; reinforcing steel—630,000 lb. at $0.036; finishing—590 sta. at $5. Principal equipment includes one Rex paver, two Lakewood tampers, one Carr subgrader, three scarifiers, one 12-ton roller, two Caterpillar '30' tractors, one 10-ft. and one 8-ft. blade, one Ventura rooter, one Northwest 1¼-yd. clamshell, two 3-in. triplex pumps and 59,000 ft. of 2½ to 4-in. pipe-line, seven batch trucks (Fageol and White), fifteen 10-ton G.M.C. trucks, five Standard 10-ton trucks, two Kimball 10-ton trucks, two Mack 10-ton trucks, and three Graham 1-ton trucks.

S. V. Cortelyou is district engineer.

San Luis Obispo County—The Cornwall Construction Co., Santa Barbara, will complete a contract about February, 1931, for 3 miles of grading and concrete paving from San Luis Obispo to the foot of Cuesta grade, contract price $130,828. This project considerably improves existing alignment and grades. The southerly mile consists of paving on a line change which was graded in 1928, the remaining work being on new alignment.

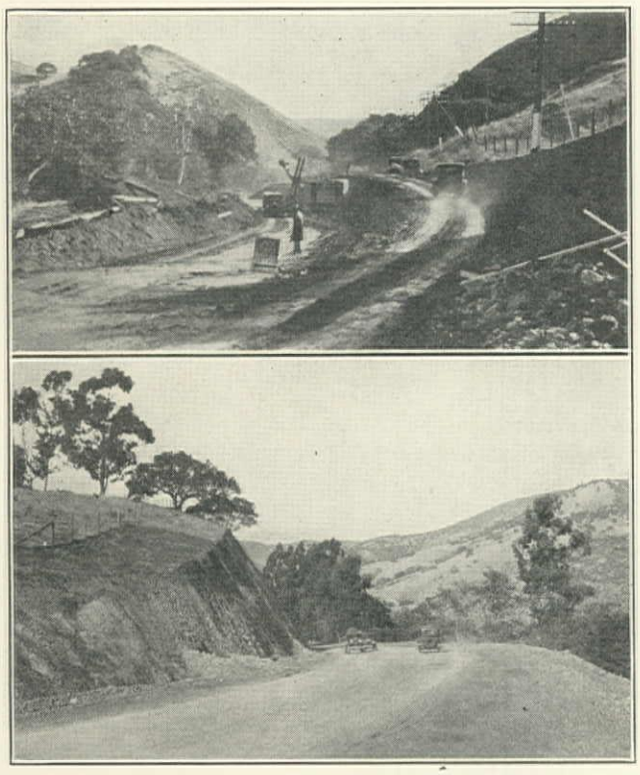
Main items in the contract include: roadway excavation—75,700 cu.yd. at $0.40; overhaul—850,000 sta.yd. at $0.01; structure excavation—1600 cu.yd. at $1; subgrade—35,000 sq.yd. at $0.09; concrete paving (9-7-9-in.)—7200 cu.yd. at $9.15; concrete in structures—260 cu.yd. at $20; reinforcing steel—189,000 lb. at $0.04; remove trees 12-in. diam. and larger—46 at $10; crusher-run base—400 tons at $2.25; new property fence—2.5 mi. at $500; fuel oil for shoulders—700 bbl. at $2; finishing—157 sta. at $5.

The following major equipment is in use—one

Koehring 1-yd. gas shovel, one Insley ¼-yd. excavator, one Koehring 27-E paver, one Koehring 13-E mixer, one Ord finisher, one Buffalo-Springfield 12-ton, 3-wheel roller, one Atlas wheel scraper, one Caterpillar '60' and one Caterpillar '30' tractors, one Monarch '30' tractor, five Fordson tractors, five 5-ton dump trucks (White, Reo, and Hug), one Ingersoll-Rand type 14 compressor, two Adams leaning wheel graders.

L. H. Gibson is district engineer of district V, California Division of Highways, at San Luis Obispo.

San Mateo County—The Basich Bros. Construction Co., Los Angeles, has completed one-half of a contract for paving through the city of South San Francisco. Equipment includes four 5-yd. and four 7-yd. trucks,



(Upper) Cornwall Construction Co. Grading with Koehring 1-yd. Gas Shovel between San Luis Obispo and Cuesta Grade. (Lower) Rough Grade on Cornwall Project Completed, Ready for Concrete Paving

one Ateco bulldozer, one ½-yd. clamshell, one Caterpillar '60' and one Caterpillar '30' tractors, one scarifier, two blades two 6-sack Ransome pavers.

J. H. Skeggs is district engineer, A. W. McCurdy is assistant district engineer, and E. G. Poss is district construction engineer for district IV, California Division of Highways, at San Francisco.

Santa Clara County—The Hanrahan Co., San Francisco, has practically completed a contract for 4.9 miles of grading and portland cement and asphaltic concrete paving from San Antonio ave. to Sunnyvale, contract price $204,904. Equipment includes two Caterpillar '60' and one Caterpillar '30' tractors, four 1½-ton and fifteen 5-ton trucks, two graders, three 12-ton and two 7-ton rollers, one Foote 6-sack paver, two 10-ft. and one 20-ft. Ord finishers, two P&H cranes, one Ateco scraper, two scarifiers, one asphalt plant.

J. H. Skeggs is district engineer.

C. H. Purcell is state highway engineer for California at Sacramento, and C. S. Pope is construction engineer.

LOS ANGELES COUNTY HIGHWAYS

Avalon Boulevard—G. W. Ellis, Los Angeles, will complete his contract about April, 1931, for improving 2.8 miles of Avalon blvd. by grading, concrete paving, corrugated pipe culvert installation, etc., contract price $203,440. The excavation was 20% complete on November 17. Major equipment includes one ¾-yd. gas shovel, three rotary scrapers, four 30-hp. tractors, one sheepsfoot tamper, one 3-wheel roller, and one grader.

Main Street Near Wilmington—Kovacevich & Price, Long Beach, will complete their contract about April, 1931, for improving Main st. north of Wilmington from 'S' st. to Olive st. (6.12 miles), contract price $293,104. The improvements include excavation, portland cement concrete pavement, asphaltic concrete base and surface, corrugated culvert pipe, etc. Work started June 4, and on November 17 all paving was completed except shoulders between the Wilmington city limits and Carson st.; excavation was 30% complete between Carson st. and Broadway; and paving was 25% complete between Broadway and Olive st. Equipment includes one clamshell crane, three graders, one subgrader, one 27-E paver, two pavement tampers, three 3-wheel and one tandem rollers.

Manchester Avenue—The Griffith Co., Los Angeles, will complete a contract about February, 1931, for improving Manchester ave. from Inglewood to Playa Del Rey, from Freeman ave. to Pershing drive, contract price $499,491. The improvements include excavation, curb and gutter, portland cement concrete pavement, rock sub-base and oiled subgrade, reinforced concrete pipe, corrugated metal pipe, vitrified clay pipe, and cast-iron pipe, etc. On November 17 the following progress had been made: rough grading—80%, fine grading—25%, paving—20%, curb—50%, gutter—50%, culverts and catchbasins—100%. Equipment includes two 30-hp. tractors, two blades, thirty head of stock with fresnoes, one subgrader, two 27-E pavers, one mechanical tamper and three rollers.

Geo. W. Jones is road commissioner, O. F. Cooley is assistant road commissioner, E. A. Burt is construction engineer, and G. W. Sprotte is assistant construction engineer for Los Angeles county; J. E. Rockhold being county surveyor.

SAN DIEGO COUNTY HIGHWAYS

Marron Canyon Road—Bert Noble, San Diego, has practically completed his contract for paving Marron canyon road, contract price $135,961. The pavement is of 8-5-8-in. portland cement concrete 18 ft. wide, laid in two strips. Expansion joints were placed every 75 ft., with two intermediate dummy joints. A redwood pile-and-plank bulkhead 2000 ft. long was placed alongside the roadway for protection against Buena Vista creek floods. There are 75,000 sq.ft. of 6-in. oil-macadam shoulders, a number of cast-iron embankment protectors, and 850 guard posts along the embankment.

A Koehring 27-E paver was used, batching being done at a central plant. The pavement was compacted with a Lakewood tamper, a concrete of exceptionally high strength and smooth riding qualities being obtained. Piling was placed to good advantage with a driver mounted on a Koehring shovel.

Ernest R. Childs is the county surveyor.

New Equipment and Trade Notes

FOUR WHEEL DRIVE TRUCKS

The Four Wheel Drive Auto Co., Clintonville, Wisconsin, manufactures 1½ to 7½-ton heavy-duty, high speed trucks in 4 and 6-wheel models for all hauling purposes. The four-wheel-drive principle permits heavy hauling over soft roads, or where there are no roads. The 1½, 2, and 2½-ton models have both 4 and 7-speed transmissions; the 3, 3½, and 4-ton models have a 5-speed transmission; and models of 5-ton or larger are equipped with 5 or 8-speed transmissions. The 8-speed transmission, a late development, is of planetary arrangement, and gives a reduction of 217:1 in low, with 8 forward and 2 reverse speeds. A special roller-mounted steering knuckle is provided with this line of trucks. Flexibility to meet demands of high-speed operation and ruggedness to resist the strains of overloading and rough going are combined in FWD engines.

The Edward R. Bacon Co., San Francisco, has been appointed FWD distributor for Northern and Central California.

C.H. & E. 'GOLDIGGER' DITCHER

The C.H. & E. division of the National Equipment Corp., Milwaukee, has developed a 'Goldigger' model 'A' ditcher for trenches from 3 to 6 in. wide and 0 to 48 in. deep. Digging speeds vary from 1 to 6 ft. per min., two speeds being available without changing sprockets and 36 by changing sprockets. Full multi-plane traction with low ground pressure permits

C.H.&E. 'Goldigger' Model 'A' Ditcher

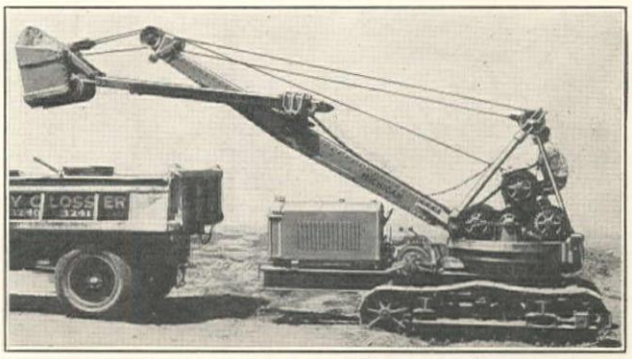
operation on wet soil without miring, and on lawns and parkways without injury to the grass. Operating levers have been centralized on one side of the 'Goldigger'. All moving parts, except the bucket line, are enclosed or protected by guards. Gears and sprockets are of heat-treated steel, the gears being enclosed in cases and running in oil. The oil in the main gear case is used for the hydraulic boom lift. Power for all operations is supplied by a 4-cylinder, 12-hp. engine.

Although only waist high, the machine ditches much faster than is possible by hand work and yet removes a comparatively small amount of dirt from the narrow trench. Backfilling is reduced to a minimum. The 'Goldigger' can be used in small spaces and where the clearances are scant. This equipment is said to have a wide range for gas service connections, high-pressure gas lines, small oil lines, ornamental street lighting and telephone cables, sprinkling and drain pipes in golf courses and airports, etc.

MICHIGAN 12-FT. POWER SHOVEL

The Michigan Power Shovel Co. (formerly the Detroit Power Shovel Co.) has moved from Detroit to Benton Harbor, where a 12-ft., full-circle loading, three-quarter digging, no-tail-swing convertible gasoline shovel will be manufactured at the plant of the Ross Carrier Co.

As the operating width of the new machine is less than 8 ft. —there being no tail swing—this shovel is said to be desirable for narrow cuts and on canal excavation, etc. To ease the work of the operator, a new patented clutch mechanism with hydraulic control for crowd, hoist, and swing, results in



The Michigan 12-ft. Full-Circle Loading, Three-Quarter Digging, No-Tail-Swing Convertible Power Shovel

finger-tip manipulation and increases the operating speed. The turn-table mechanism, with boom and dipper, is full-revolving, but the 35-hp. Allis-Chalmers tractor power plant remains stationary, thus further increasing the speed and efficiency of the shovel.

The Michigan shovel operates on a self-cleaning crawler track and weighs 10 tons. The dipper is of riveted plate construction, with cast steel back, and is reinforced by welding. The boom is of box type construction, 8 by 12-in., tapered at the end, and is 15 ft. long. The double dipper stick, of 3 by 5-in. steel tubing, is 11 ft. long. The crowd is operated by a reversible drum with chain, rack-and-pinion to the dipper stick. All continuous running shafts are mounted on ball bearings, as is the cast steel turn-table.

H. B. Ross, president of the Ross Carrier Co., is chairman of the board of directors of the Michigan Power Shovel Co.; W. E. Bernhard is president and chief engineer; D. H. Milliard is vice-president and sales manager; and Don C. Abbott is secretary-treasurer. Bernhard and Milliard formerly held similar positions with the Universal Power Shovel Co., of Detroit.

'CATERPILLAR' BULLETINS

The Caterpillar Tractor Co., Peoria, Illinois, manufacturer of track-type tractors and road machinery, has released several new educational booklets and advertising pamphlets. One of these is 'Building Roads' (form S.L.2030), a 68-page illustrated booklet telling how smooth, well drained roads in all parts of the world encourage commerce, trade, and education. 'The Caterpillar for Railroads' (form S.L.2013) is an illustrated pamphlet showing the many uses to which railroads put this tractor to gain the advantages of mobility, traction, and power that is not 'track-tied'. Railroads use Caterpillars for constructing drainage ditches, spreading and compacting subgrades, cleaning obstructed ditches and cuts with a dragline, clearing tracks of wrecks, etc. Forms S.L. 1929 and 1968 describe the use of Caterpillar leaning wheel graders.

WESTINGHOUSE WELDERS

The Westinghouse Electric & Manufacturing Co., East Pittsburgh, Pa., has developed a special portable 300-amp. single-operator welder, weight 3200 lb., for field and street service. This welder can be moved at road speeds and is adaptable for scattered work. A standard 'Flexarc' welding generator is coupled to a 4-cylinder gas engine operating at 1450 r.p.m. The generator operates on the variable voltage, constant current principle, with separately excited shunt field. The power unit, generator, exciter, and control, are enclosed

in a sheet metal canopy; the welded-channel base is mounted on pneumatic-tired wheels.

Westinghouse has also developed a 600-amp., single-operator 'Flexarc' motor-driven welder, designed to handle various sizes of electrodes, and available with electric motor or gasoline drive and in stationary or portable models.

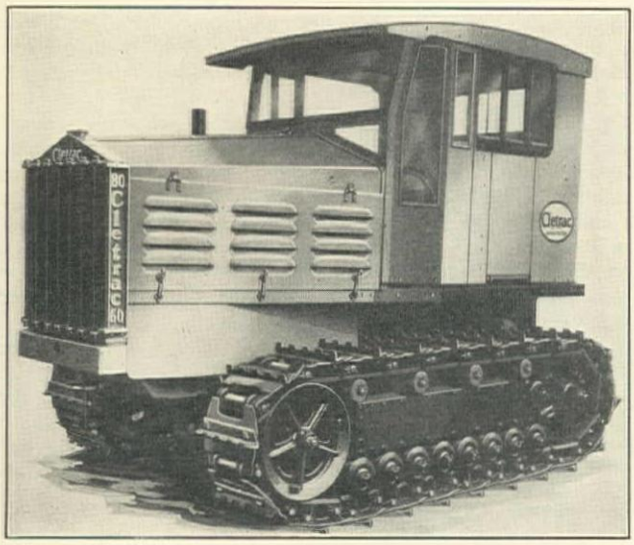
ORTHOTOLIDIN TEST IN W&T CHLORINATOR

Wallace & Tiernan research engineers have developed a new principle in automatic control of chlorination which is an outstanding advance in the art and is said to safeguard water supplies against sudden pollution. Orthotolidin tests control the chlorine flow in this apparatus and are automatically made at 10-minute intervals, the residual chlorine of the treated water being recorded on a chart. Fluctuations in flow or chlorine demand are reflected in varied residuals and immediately compensated for by the automatic controller.

The apparatus is available with full automatic residual chlorine control, or the residual recording unit may be secured separately for use with existing equipment.

CLETRAC '80-60' EQUIPPED FOR WINTER USE

The Cleveland Tractor Co., Cleveland, Ohio, has made improvements to its '80-60' Cletrac which render this machine especially attractive for winter use in cold climates. The conveniences added for winter operation include a completely enclosed cab, ice grouters on the tracks, an electric starter making it unnecessary for the operator to leave his protected position in the cab, and provision for quick installation of headlights if the tractor is required for night use.



Cletrac '80-60' Equipped with Cab and Other Conveniences for Winter Use

DOUGLAS FIR USE BOOK

The West Coast Lumberman's Association, Stuart bdg., Seattle, Washington, has released a 'Douglas Fir Use Book' containing design tables and supporting technical data. The book was prepared under the direction of Chester J. Hogue, in charge of the trade extension and field service department, and sells for $1.00 per copy.

FOUNDRY FOR LARGE SIZE 'MONO-CAST' PIPE

The American Cast Iron Pipe Co., Birmingham, Alabama, is completing a new 'Mono-Cast' centrifugal pipe shop for pipe from 14 to 24 in. diam., 16-ft. length, bell and spigot type. This plant will have a potential capacity of 200 tons of centrifugally cast pipe per shift and can be operated 24 hours per day.

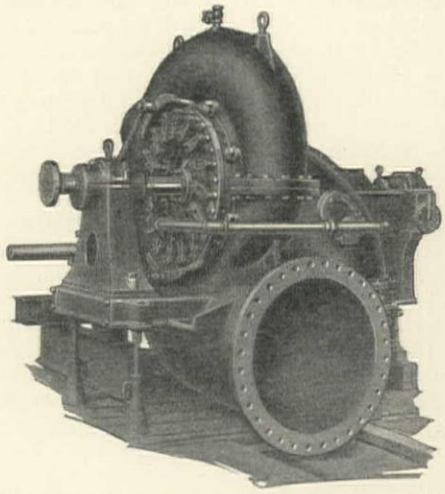
WILLARD H. DOW HEADS THE DOW CHEMICAL CO.

Willard H. Dow has been appointed president and general manager for The Dow Chemical Co., Midland, Michigan, succeeding the late Herbert H. Dow. The new president is a chemical engineering graduate from the University of Michigan, class of '19, and has had 11 years of practical chemical experience, serving for the past 8 years on the Dow board of directors.

The Dow Chemical Co. manufactures more than 150 products, including calcium chloride for dust prevention and concrete curing.

MUNICIPAL HYDROELECTRIC DEVELOPMENT FOR HYRUM, UTAH

The city of Hyrum, Utah, has completed a municipal hydroelectric development on Blacksmith's Fork river, with one horizontal type, automatically controlled generating unit developing 630 hp. at 600 r.p.m. under 82 ft. net effective head. The turbine and generator are connected by a shaft coupling. The turbine runner is solid cast bronze and has a specific speed of about 60; all working parts are bronze bushed and are lubricated by flat head, non-breakable alemite connections. Links between the turbine ring and gates are designed to break in case an obstruction gets into the gates when they are under governor control.



Leffel 630-hp. Turbine for Hyrum Municipal Hydroelectric Development

J. L. Anderson is engineer for the city of Hyrum, Utah. The James Leffel & Co., Springfield, Ohio, designed and built the hydraulic turbine.

HERCULES 'GELAMITE'

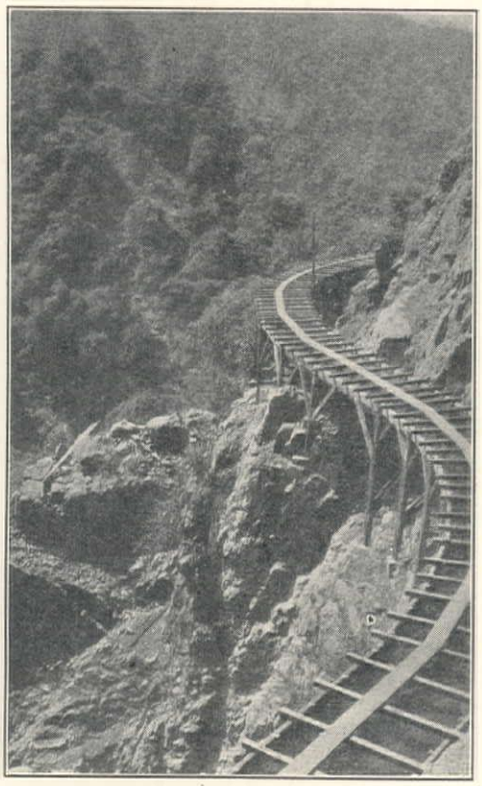
The Hercules Powder Co., Wilmington, Delaware, has released a booklet entitled 'Hercules Gelamite'. This new type of explosive described in the booklet is said to be an economical substitute for gelatine dynamites up to 60% strength. Its characteristics—water resistance, cohesiveness, plasticity, strength, safety, and suitable fumes—are reported to compare favorably with the gelatine grades.

INTERNATIONAL 'HYDRODARCO'

'Chemical and Mechanical Utilization of Activated Carbon in Water Purification' is the title of Technical Publication No. 6003 of the International Filter Co., Chicago. This bulletin deals with 'Hydrodarco', a special water purification carbon, and describes its field of usefulness in removing organic tastes and odors, free chlorine, organic coloring matter, and in the separation and removal of iron from water supplies. Principles to be followed in design and operation of equipment using activated carbon are stressed. Some operating data and nine illustrations are included in the 8-page booklet.

WILCOX, CRITTENDEN HEAVY HARDWARE CATALOG

Wilcox, Crittenden & Co., Inc., Middletown, Conn., recently issued an illustrated catalog of heavy hardware which is of particular interest to contractors.



Around Mountain Sides! Over Depressions! Across Wastelands!

ARMCO FLUMES (Lennon Type)

ARMCO Flumes (Lennon Type) deliver water quickly, and economically for irrigation, power, mining, and domestic supply, *without waste—without leakage—without loss.*

Armco Flumes (Lennon Type) are made of rust-resisting galvanized Armco Ingot Iron, so durable that it gives the assurance of long years of dependable performance.

Years of actual service prove that Armco Flumes (Lennon Type) are most economical. Our engineers will gladly aid you in water transportation problems. Write for prices and information on Armco Flumes.

California Corrugated Culvert Company

LOS ANGELES: 424 Leroy Street **BERKELEY: 417 Parker Street**

calco products

49

UNIT BID SUMMARY

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

STREET AND ROAD WORK

SACRAMENTO, CALIF.—STATE—SAN LUIS OBISPO COUNTY—GRADING AND ASPHALT PAV.

Peninsula Paving Co., Standard Oil Building, San Francisco, who bid $268,382, submitted low bid to the California Division of Highways, Sacramento, for 10.9 miles grading and asphalt paving in SAN LUIS OBISPO COUNTY from Paso Robles to the North Boundary, SAN LUIS OBISPO COUNTY. Bids received from the following concerns:

(1)	Peninsula Paving Co., S. F.	$268,382	
(2)	Hanrahan Company, S. F.	276,705	
(3)	Hemstreet & Bell, Marysville	277,553	
(4)	I. L. Ryder, San Jose	289,575	
(5)	Jones & King, Hayward	295,370	
(6)	Clark & Henery, San Francisco	302,850	
(7)	Steele Finley, Santa Ana	303,523	
(8)	Basich Bros. Const. Co., L. A.	310,748	
(9)	H. W. Rohl, Los Angeles	$311,376	
(10)	George H. Oswald, Los Angeles	312,014	
(11)	Valley Paving & Const. Co.	324,228	
(12)	A. Teichert & Sons, Sacramento	318,333	
(13)	O. A. Lindberg, Stockton	319,277	
(14)	Griffith Company, Los Angeles	323,395	
(15)	Macco Const. Co., Clearwater	350,826	

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

(A) 160,000 cu.yd. roadway excavation without classification
(B) 850,000 sta.yd. overhaul
(C) 5,900 cu.yd. structure excavation
(D) 83,800 sq.yd. subgrade for pavement
(E) 36,300 sq.yd. asphaltic paint binder
(F) 47,900 tons asphalt concrete
(G) 660 cu.yd. 'A' concrete (structures)
(H) 64,000 lb. bar reinf. steel (structures)
(I) 364 lin.ft. 8-in. corr. metal pipe
(J) 900 lin.ft. 18-in. corr. metal pipe
(K) 1,228 lin.ft. 24-in. corr. metal pipe
(L) 140 lin.ft. 30-in. corr. metal pipe
(M) 24 lin.ft. 36-in. corr. metal pipe
(N) 94 lin.ft. corr. metal pipe, clean and relay
(O) 1,750 cu.yd. remove and dispose of conc. in exist. pave. and struct.
(P) 2,800 bbl. fuel oil (shoulders)
(Q) 9.3 miles new property fence
(R) 1.8 mi. remove and reset prop. fences
(S) 780 lin.ft. laminated timber guard rail
(T) 4,120 lin.ft. moving and resetting guard rail
(U) 577 stations finishing roadway
(V) 108 monuments

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)
(A)	.25	.26	.35	.30	.25	.27	.36	.34	.35	.32	.32	.30	.35	.30	.30
(B)	.006	.005	.01	.005	.005	.01	.01	.01	.01	.01	.01	.0075	.015	.015	.009
(C)	.80	1.00	.75	.70	.75	1.00	.75	1.00	1.00	.80	1.20	.80	.75	1.00	1.00
(D)	.10	.09	.04	.08	.09	.07	.09	.07	.10	.09	.07	.09	.09	.10	.09
(E)	.01	.015	.02	.01	.015	.02	.01	.01	.02	.03	.018	.015	.04	.01	.056
(F)	3.52	3.78	3.40	4.00	4.27	4.25	3.87	4.12	4.00	4.15	4.41	4.45	4.25	4.30	4.87
(G)	21.00	20.00	20.00	20.00	20.00	18.00	22.00	22.00	20.00	18.00	22.50	18.50	22.00	24.00	20.00
(H)	.055	.05	.045	.0425	.045	.05	.045	.05	.05	.045	.05	.04	.05	.04	.05
(I)	.40	.50	.50	.50	.50	.50	.25	.50	.50	.50	.50	.40	.25	.75	.60
(J)	.40	.50	.50	.55	.50	.60	.25	.30	.50	.70	.50	.50	.50	.75	.70
(K)	.50	.75	.60	.55	.50	.80	.35	.30	.60	.95	.60	.75	.50	1.00	1.00
(L)	.65	1.00	.75	1.00	.50	1.00	.50	.30	1.00	1.50	.75	1.00	.50	1.00	1.50
(M)	.75	1.25	1.00	1.00	.50	1.50	.50	.40	1.00	1.50	.75	1.50	.65	1.00	2.00
(N)	.75	1.00	1.00	1.00	.75	1.00	.75	.40	1.00	1.10	1.50	.75	1.00	.50	2.00
(O)	2.00	1.50	2.00	1.00	.75	1.50	2.50	1.00	2.00	3.50	2.00	1.90	1.50	1.25	2.00
(P)	2.00	2.00	3.50	1.85	1.70	2.00	2.50	3.00	2.20	3.00	2.10	3.00	2.75	2.60	3.50
(Q)	$550	$450	$450	$400	$450	$400	$450	$325	$400	$428	$410	$400	$500	$400	$550
(R)	$250	$100	$250	$175	$300	$225	$150	$200	$400	$200	$225	$200	$250	$400	$350
(S)	1.20	1.00	1.00	1.00	.90	1.00	.90	1.00	1.00	.80	1.10	1.00	.90	1.00	1.25
(T)	.75	.25	.50	.50	.45	.40	.50	.70	1.00	.30	.35	.50	.50	.80	1.00
(U)	6.00	5.00	5.00	5.00	5.00	5.00	4.50	4.00	5.00	3.50	6.50	5.00	4.00	5.00	5.00
(V)	3.25	2.50	3.00	2.50	3.00	3.00	2.00	2.00	3.00	2.75	3.00	3.00	3.00	3.00	4.00

C. H. Purcell is Engineer of the California Division of Highways with headquarters at Sacramento.

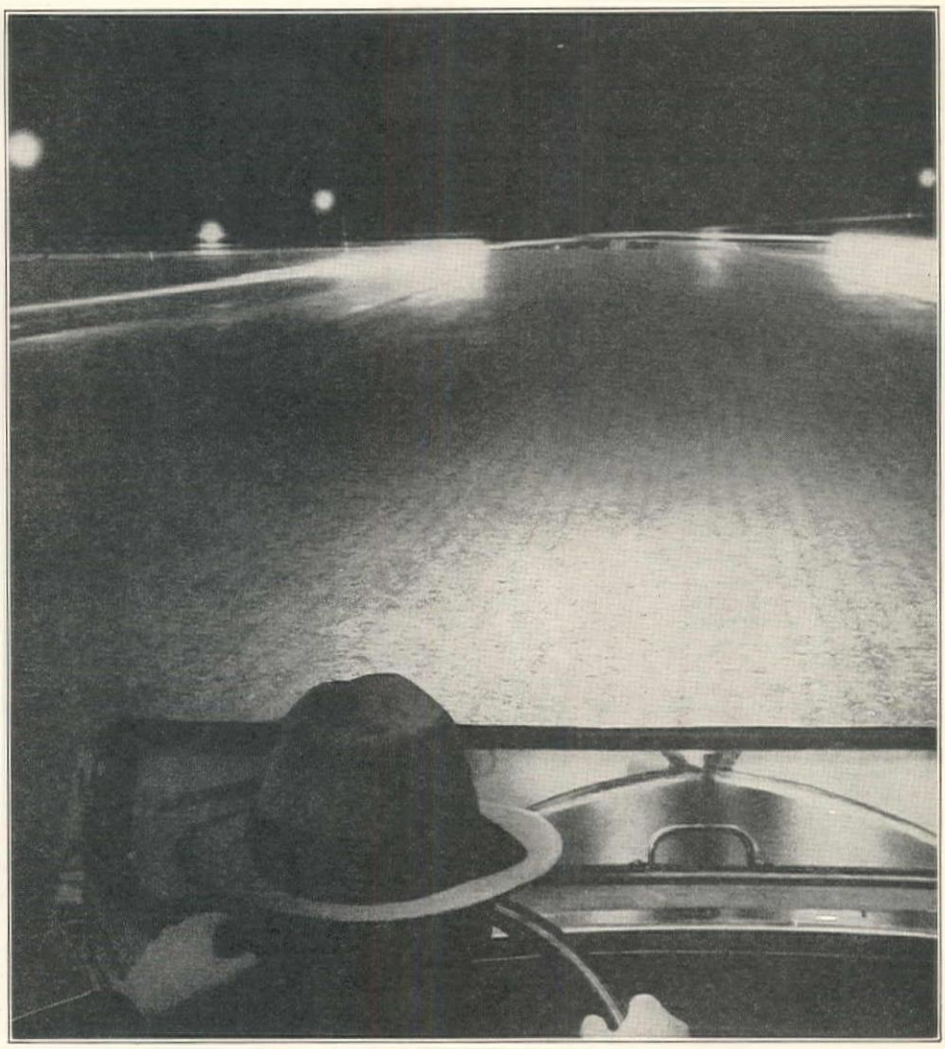
OAKLAND, CALIF.—CITY—FOOTHILL BLVD.—CONCRETE

M. J. Bevanda, Elks Building, Stockton, who bid $119,493, submitted the low bid to the City of Oakland, for the improvement of Foothill Boulevard between Park Street and Hollywood Boulevard. Bids received from the following concerns:

(1)	M. J. Bevanda, Stockton	$119,493	
(2)	Central Calif. Roads Co., Oakland	119,810	
(3)	Heafey-Moore Co., Oakland	125,700	
(4)	A. J. Raisch, San Francisco	127,827	
(5)	N. M. Ball, Berkeley	$128,104	
(6)	J. F. Knapp, Oakland	128,441	
(7)	J. H. Fitzmaurice, Oakland	140,743	

		(1)	(2)	(3)	(4)	(5)	(6)	(7)
486,393	sq.ft. grading	.015	.03	.037	.03	.025	.025	.035
713	lin.ft. conc. curb with steel curb guard	.60	.53	.60	.60	.60	.60	.80
15,733	lin.ft. conc. curb without guard	.40	.30	.40	.40	.35	.40	.50
475,428	sq.ft. conc. paving, 7-9-in.	.20	.19	.186	.20	.21	.21	.22
654	ft. 2 ft. 3 in. x 3 ft. conc. culvert	4.00	3.83	5.55	5.00	4.60	4.00	5.80
200	ft. 10-in. vitrified conduit	1.30	1.26	2.00	1.40	1.00	1.25	1.50
96	ft. 12-in. vitrified conduit	1.50	1.42	2.25	1.60	1.30	1.50	1.75
1,114	ft. 15-in. vitrified conduit	1.70	1.68	2.50	2.00	2.00	1.75	2.00
59	ft. 15-in. extra strength reinf. concrete conduit	2.60	2.10	3.25	2.50	2.20	3.00	2.50
67	ft. 18-in. vitrified conduit	2.25	2.10	2.95	3.00	3.00	2.25	2.50
202	ft. 21-in. vitrified conduit	3.00	2.73	3.25	3.50	2.40	2.75	2.00
818	ft. 24-in. vitrified conduit	4.00	3.30	3.75	4.00	3.00	3.25	2.25
6	inlets, 34-in. (cast iron frame cover)	50.00	53.00	40.00	40.00	40.00	30.00	60.00
1	storm water inlet, Type "A"	50.00	42.00	70.00	35.00	50.00	40.00	50.00
3	storm water inlets, 21-in.	40.00	42.00	40.00	30.00	40.00	25.00	50.00
13	storm water inlets, 34-in.	40.00	53.00	50.00	40.00	50.00	40.00	60.00
5	manholes, standard type	60.00	53.00	60.00	50.00	55.00	60.00	50.00
2	manholes, inlet type	65.00	69.00	60.00	65.00	30.00	75.00	60.00
1	15-in. lamphole	20.00	21.00	20.00	15.00	20.00	30.00	35.00

Non-skid, glare free pavements— Safe for night driving— Safe in any weather—



A SAFE INVESTMENT FOR PROPERTY OWNERS

ON CROWDED HIGHWAYS—at night—even in the rain you're lucky if you're skimming along Non-Skid Asphaltic Concrete pavement.

It's *safe*—because stone chips—coated with Asphalt and pressed right into the top coat—give your tires a sure, firm grip in any weather—at any traffic speed!

Asphaltic Concrete highways usually cost less to build than other pavements—always considerably less to maintain! McAdam Street, Oakland, California—paved in 1909—is still taking the hammering of heavy trucks with negligible repair costs! Scores more are serving faster and faster traffic after 15 or 20 years with practically no maintenance at all!

Wherever you go—from Washington to San Diego—Reno to Phoenix—you'll see *durable* Asphaltic Concrete Pavement. Investigate it.

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CALOL ASPHALT
A Standard Oil Product
FOR BEST RESULTS

Asphaltic CONCRETE NON-SKID PAVEMENT

When writing to STANDARD OIL COMPANY OF CALIFORNIA, *please mention Western Construction News*

PHOENIX, ARIZ.—STATE—GRADING AND BRIDGES—BENSON VAIL HIGHWAY

N. G. Hill & Co., 1344 E. McKinley St., Phoenix, Ariz., who bid $77,123, low bid to the Arizona State Highway Commission, Phoenix, Arizona, for the construction of Sections 18-D and E of the Benson-Vail Highway, near Benson, consisting of bridge, overpass, and 4 miles of grading and subgrade stabilizer. Bids received from:

(1) N. G. Hill & Co., Phoenix $77,123
(2) Packard & Tanner, Phoenix 80,481
(3) Lee Moore Contracting Co. 81,130
(4) Herbert F. Brown, Tucson 84,755
(5) Skousen Bros., El Paso $85,622
(6) Wm. Peper, Phoenix, Arizona 87,597
(7) Hodgman & MacVicar, Pasadena 86,907

		(1)	(2)	(3)	(4)	(5)	(6)	(7)
	FEDERAL AID 18-D—BRIDGE							
5,100	cu.yd. drainage excavation	.20	.20	.23	.25	.30	.45	.25
534	cu.yd. structure excavation	.90	1.00	.80	1.00	.75	1.00	1.00
7	cu.yd. 'AA' concrete	60.00	65.00	60.00	65.00	65.00	70.00	70.00
244	cu.yd. 'A' concrete	20.00	18.07	19.00	23.00	22.00	21.00	19.50
113	cu.yd. 'B' concrete	19.00	18.07	19.00	21.00	21.00	21.00	19.00
24,705	lb. reinforcing steel	.045	.047	.0425	.045	.0435	.04	.05
750	ft. wire and brush bank protect	2.00	1.50	3.50	.22	2.25	4.00	1.50
	FEDERAL AID 18-E—OVERPASS AND APPROACHES							
158	cu.yd. roadway excavation	.20	.20	.23	.35	.30	.90	.40
431	cu.yd. structure excavation	.90	1.00	.80	1.00	.75	.90	1.25
26,369	cu.yd. borrow excavation	.20	.22	.23	.23	.22	.24	.25
10	cu.yd. 'AA' concrete	60.00	65.00	60.00	65.00	65.00	70.00	70.00
442	cu.yd. 'A' concrete	22.00	23.50	23.50	23.00	25.00	22.50	23.00
9	cu.yd. 'B' concrete	19.00	18.07	19.00	21.00	21.00	22.50	19.00
67,548	lb. reinforcing steel	.045	.047	.0425	.045	.0435	.04	.05
108	ft. 24-in. corr. metal pipe	3.00	2.90	2.45	3.00	2.65	3.00	3.00
34	ft. 30-in. corr. metal pipe	4.00	3.70	3.00	4.00	3.75	3.50	4.00
385	ft. reconstruct fence	.03	.03	.02	.05	.03	.05	.05
2,200	ft. cable road guard	.80	.75	.65	.65	.75	.90	.70
20	each plate bridge seats	3.00	4.00	2.50	2.00	2.00	4.00	15.00
4	each expansion rocker bridge seats	45.00	65.00	47.00	50.00	45.00	45.00	50.00
	FEDERAL AID 18-E—ROADWAY							
139	squares clearing and grubbing	3.00	10.00	7.00	8.00	15.00	15.00	10.00
32,169	cu.yd. roadway excavation	.20	.35	.23	.35	.32	.25	.42
1,283	cu.yd. drainage excavation	.20	.20	.23	.25	.30	.45	.35
442	cu.yd. structure excavation	.90	1.00	.80	1.00	.75	1.00	1.00
25,462	cu.yd. borrow excavation	.20	.20	.23	.23	.20	.20	.22
1,525	cu.yd. subgrade stabilizer	.30	.60	.70	.90	1.00	.75	.70
561	cu.yd.mi. subgr. stabilizer, haul	.30	.20	.28	.25	.40	.16	.50
283	cu.yd. 'A' concrete	21.50	18.07	20.00	23.00	20.00	21.00	19.50
67	cu.yd. 'B' concrete	20.70	18.07	18.00	21.00	20.00	20.00	19.00
19,564	lb. reinforcing steel	.045	.047	.0425	.045	.0435	.04	.05
118	ft. 24-in. corr. metal pipe	3.00	2.90	2.40	3.00	2.65	3.00	3.00
292	ft. 30-in. corr. metal pipe	4.00	3.70	3.00	4.00	3.75	3.50	4.00
148	ft. 36-in. corr. metal pipe	5.00	6.00	4.80	5.00	5.50	5.00	6.00
14,806	ft. reconstruct fence	.03	.03	.02	.04	.03	.05	.05
6,646	ft. new line fence	.08	.06	.10	.07	.05	.12	.08
4,395	ft. cable road guard	.80	.75	.65	.60	.80	.90	.70
1,230	ft. rail bank protection	2.00	1.50	4.00	1.00	2.25	3.00	1.25
2	cu.yd. remove old concrete	5.00	10.00	10.00	1.00	10.00	7.00	5.00
	STRUCTURES OVER 20-FT. CLEAR SPAN							
456	cu.yd. drainage excavation	.20	.20	.23	.25	.30	.45	.35
399	cu.yd. structure excavation	.90	1.00	.80	1.00	.75	.90	1.00
3	cu.yd. 'AA' concrete	60.00	65.00	60.00	65.00	65.00	70.00	70.00
495	cu.yd. 'A' concrete	21.50	18.07	19.00	23.00	20.00	21.00	19.50
36,830	lb. reinforcing steel	.045	.047	.0425	.045	.0435	.04	.05
27	cu.yd. remove old concrete	5.00	10.00	5.00	1.00	8.00	7.00	5.00

SACRAMENTO, CALIF.—STATE—CONC. PAVING AND GRADING—SANTA BARBARA COUNTY

Gist & Bell, 148 East Eldorado, Arcadia, who bid $204,070, submitted the low bid to the California Division of Highways, Sacramento, for 2.8 miles grading and concrete paving in SANTA BARBARA COUNTY from Gaviota to 1 mile north of Las Cruces. Bids received from the following concerns for the construction of this project:

(1) Gist & Bell, Arcadia (low) $204,070
(2) Jahn & Bressi, Los Angeles 213,823
(3) Basich Bros. Const. Co., L. A. 218,285
(4) J. F. Knapp, Oakland 229,595
(5) Cornwall Const. Co., Santa Barbara $233,919
(6) Macco Construction Co., Clearwater 239,319
(7) J. G. Donovan & Sons, L. A. 253,630

		(1)	(2)	(3)	(4)	(5)	(6)	(7)
9	acres clearing and grubbing	100.00	150.00	67.00	400.00	220.00	200.00	150.00
107,000	cu.yd. roadway excavation	.48	.70	.50	.55	.66	.594	.83
255,000	sta.yd. overhaul	.01	.005	.015	.01	.011	.015	.01
8,350	cu.yd. structure excavation	.60	.75	1.00	1.25	1.00	1.25	1.30
25,500	sq.yd. subgrade	.09	.08	.10	.09	.09	.11	.10
6,850	cu.yd. Class 'A' concrete in paving	10.18	9.70	10.65	10.50	9.50	10.60	9.50
1,930	cu.yd. Class 'A' concrete in structures	16.00	15.00	19.00	20.00	17.00	18.00	21.00
318,700	lb. reinf. steel	.045	.037	.042	.045	.055	.046	.043
570	ft. 18-in. corr. pipe	.60	.40	.30	.50	.75	.70	.40
480	ft. 24-in. corr. pipe	.75	.50	.30	.60	1.00	1.00	.50
60	ft. 30-in. corr. pipe	1.00	.75	.40	.70	1.25	1.50	.60
122	ft. 48-in. corr. pipe	1.50	1.00	.50	1.00	1.75	3.50	.90
274	ft. corr. pipe (clean and relay)	1.00	1.25	.40	1.00	2.00	2.00	.70
2,100	cu.yd. remove and dispose of concrete (paving and str.)	2.00	1.50	2.00	2.50	2.75	4.00	2.70
70	cu.yd. cushion course	3.50	1.50	2.00	2.50	2.00	2.00	.60
2,000	tons crusher run base	2.90	2.50	2.40	2.50	3.00	3.00	3.00
160	cu.yd. rubble masonry (retaining wall)	7.00	4.00	9.00	12.00	10.00	10.00	12.00
5.7	miles new property fence	500.00	400.00	450.00	450.00	550.00	600.00	500.00
8,000	lin.ft. solid timber guard rail	.90	.70	1.10	1.00	1.25	1.00	.80
950	bbl. fuel oil (shoulders)	3.00	2.00	2.75	2.00	3.00	4.00	3.00
149	sta. finishing roadway	7.00	5.00	6.00	5.00	5.00	6.00	8.00
94	monuments	3.00	2.50	3.00	2.50	3.00	5.00	3.00

The State will furnish corrugated metal pipe.

PHOENIX, ARIZ.—STATE—CONCRETE PAVING—FLORENCE-TUCSON HIGHWAY

F. W. Teschke, 3172 Cahuenga Ave., Los Angeles, low bid to the Arizona State Highway Commission, Phoenix, Arizona, for Section 94A and 1 Reo of the Florence-Tucson Highway, consisting of 3 miles of concrete paving in the town of Florence. Bids received from: (A) Using Riprap Slope Walls and (B) using Concrete slope Walls:

	(1)	(2)
(1) F. W. Teschke, Los Angeles	$77,610	$77,095
(2) Stanley Jaicks Co., 1950 E. Fourth St., Tucson, Ariz.	78,807	77,082
(3) Miracle Const. Co.	$79,909	$79,199
(4) R. S. Black, Clifton, Ariz.	87,170	87,270
(5) Phoenix-Tempe Stone	88,104	87,879

FEDERAL AID PROJECT No. 94A

	(1)	(2)	(3)	(4)	(5)
6,131 cu.yd. roadway excavation	.25	.70	.45	.76	.50
507 cu.yd. structure excavation	1.00	.80	1.00	1.00	1.00
358 cu.yd. borrow excavation	.20	.50	.30	.40	.20
781 sta.yd. earthwork overhaul	.02	.05	.02	.05	.05
18,335 sq.yd. concrete paving	2.35	2.12	2.16	2.38	2.64
111 cu.yd. 'A' concrete	18.00	22.00	22.00	20.00	20.00
9,430 lb. reinforcing steel	.05	.06	.06	.08	.06
900 lin.ft. reconstruct fence	.05	.07	.07	.04	.08
Removing concrete pipe	20.00	50.00	5.00	25.00	20.00

FEDERAL AID PROJECT No. 1—REO

749 cu.yd. roadway excavation	.25	.70	.45	.76	.50
96 cu.yd. structure excavation	1.00	.80	1.00	1.00	1.00
4,165 cu.yd. borrow excavation	.25	.50	.30	.40	.20
8,005 sq.yd. concrete paving	2.00	2.12	2.16	2.38	2.64
13 cu.yd. 'B' concrete	16.00	22.00	18.00	19.00	20.00
48 lb. reinforcing steel	.10	.06	.06	.10	.06
980 cu.yd. plain riprap	6.00	4.00	4.25	5.00	3.00
300 cu.yd. grouted riprap (slope walls)	8.50	15.00	11.00	12.00	10.00
2,800 lin.ft. cable guard fence	.75	.70	1.15	1.00	.70
30 hogs channel deflectors	35.00	25.00	105.00	55.00	55.00
38 lin.ft. 24-in. corr. metal pipe	3.25	3.50	3.00	3.00	3.00
38 lin.ft. 36-in. corr. metal pipe	6.40	6.00	5.00	4.00	5.25
6,955 lin.ft. reconstruct fence	.05	.06	.07	.04	.08
Remove concrete pipe	20.00	50.00	5.00	20.00	20.00
ALTERNATE					
185 cu.yd. concrete (slope wall)	11.00	15.00	14.00	20.00	15.00

BRIDGES AND CULVERTS

COQUILLE, OREGON—COUNTY—STEEL, CONCRETE AND TIMBER

Contract awarded to Liesch & Tofte, Marshfield, Oregon, who bid $293,042 on Alternative B for the construction of a double leaf bascule bridge over the Isthmus Slough on the Marshfield-Eastside County Road near Marshfield, Oregon. Bridge consists of 1210 lin.ft. of concrete viaduct, one 113-ft. 4-in. steel deck truss span, one 165-ft. double leaf bascule span, and 225 lin.ft of wooden trestle. Bids received from:

(1) Liesch & Tofte, Marshfield	$293,042
(2) Union Bridge Co., Portland	293,350
(3) Oregon Bridge & Dredging Co.	312,479
(4) Lindstrom & Feigenson	316,459
(5) Gilpin Const. Co., Portland	318,419
(6) Portland Bridge Co., Portland	$326,325
(7) Pacific Bridge Co., Portland	327,990
(8) Pacific Coast Found. Co., S. F.	359,035
(9) Guthrie & Co., Portland, Ore.	370,999
(10) MacRae Brothers, Seattle	392,510

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
4,000 cu.yd. excav. bascule pier found.	7.00	7.00	7.75	7.50	7.50	6.00	5.75	6.52	12.50	11.50
23,000 lin.ft. bascule pier found. piling	.465	.40	.60	.45	.35	.70	.50	.565	.55	.50
7,500 lin.ft. Port Orford cedar pier protec. pile	1.02	.40	1.25	.60	1.00	.70	.65	1.76	.75	1.50
950 cu.yd. seal concrete	13.18	16.00	14.00	14.50	15.00	20.00	22.00	20.00	15.00	16.60
200 cu.yd. counter weight conc.	17.48	15.00	17.00	17.50	20.00	20.00	20.00	21.53	17.50	17.50
120,000 lb. steel rail reinforcement	.023	.01	.03	.01	.025	.01	.02	.025	.03	.03
452,000 lb. struc. steel	.0766	.075	.063	.08	.074	.08	.08	.0832	.09	.115
150 sq.yd. asph. plank wearing surf.	6.00	5.00	3.90	5.00	5.00	6.00	3.00	2.71	2.50	2.35
63,000 lb. machinery	.2225	.23	.29	.30	.30	.50	.28	.275	.27	.35
Electric equip. complete	$13,500	$14,000	$14,000	$13,500	$15,000	$15,000	$16,500	$15,200	$14,700	$14,850
Gates, lump sum	$250	$350	$400	$200	$500	$300	$350	$400	$300	$3600
2 pier houses	$850	$650	$2000	$1250	$1000	$1000	$2000	$1228	$1500	$2281
500 conc. balance blocks	.75	.50	1.00	1.00	1.00	.60	2.00	1.10	1.00	1.25
1,700 cu.yd. excav., approach footings	2.30	6.00	5.25	3.00	3.70	2.00	3.00	2.76	4.00	5.50
33,000 lin.ft. approach foundation piling	.37	.35	.34	.35	.32	.40	.45	.344	.30	.38
370 cu.yd. 'B' concrete	15.48	19.00	17.00	17.50	17.00	18.00	18.00	23.62	22.00	22.00
3,500 cu.yd. 'A' concrete	20.00	19.00	18.00	23.00	23.00	22.00	23.50	25.44	28.00	22.00
1,250 cu.yd. 'D' concrete	19.00	19.00	24.00	21.00	23.00	20.00	23.00	28.16	27.00	22.00
707,000 lb. metal reinforcement	.0367	.04	.043	.0375	.034	.035	.035	.042	.035	.05
73 M. ft. B.M. timber	55.00	75.00	75.00	70.00	75.00	70.00	70.00	83.50	63.00	60.00
225 ft. trestle superstructure	26.47	28.00	30.00	30.00	27.75	20.00	30.00	37.28	35.00	65.00
2,750 ft. conc. handrail	4.00	3.50	4.25	4.50	4.50	4.00	4.00	4.84	4.00	3.50

WATER SUPPLY SYSTEM

PHOENIX, ARIZ.—CONCRETE AND CAST IRON PIPE LINES, RESERVOIR, TUNNEL AND DETRITOR—CITY

Contract awarded to Schmidt & Hitchcock, 11th and Jackson Sts., Phoenix, Ariz., and American Concrete Pipe Co., Los Angeles, who bid $2,059,140 on Schedule A, complete project, Units 1 to 5, inclusive, based on Granite Reef Alternative and using centr. cast reinf. conc. pipe for supply conduit, cast iron mains with lead joints for distribution system, also construction of tunnel and 20,000,000-gallon reservoir, detritor, etc. Following are the main bids on the project:

CENTRIFUGAL CAST REINF. CONC. PIPE

(1) Schmidt & Hitchcock, Phoenix, Ariz., and American Concrete Pipe Co. (awarded)..... $2,059,140
(2) Elliott, Stroud Bros. & Seabrook (partial bid)
(3) R. A. Wattson, Los Angeles, and Miracle Const. Co., Phoenix, Ariz. (partial bid)
(4) United Concrete Pipe Co., Los Angeles..... $2,090,384

WELDED STEEL PIPE, PABCO-WRAPPED

(5) Schmidt & Hitchcock, Phoenix, Arizona
(6) Thos. Haverty Co., Los Angeles..... $2,086,689
(7) Utah Construction Company, San Francisco and Ogden, Utah

UNIT 1—Construct supply line from Intake on Verde river to reservoir:

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
2,150 lin.ft. 36-in. pipe	7.25	5.80	7.32	8.00	7.90	8.10	9.15
5,420 lin.ft. 48-in. pipe	11.25	8.90	11.93	12.00	11.80	11.20	11.75
150 ft. timbered and concrete-lined tunnel	48.00	37.00	66.00	48.00	48.00	43.35	50.00
350 ft. untimbered and concrete-lined tunnel	36.00	30.00	42.50	37.00	36.00	33.35	40.00
3,000 ft. Gunited tunnel	28.50	20.00	29.00	25.00	28.50	22.35	23.00
2,000 ft. unlined tunnel	22.50	16.50	23.00	22.00	22.50	20.35	19.00
14,900 ft. 48-in. pipe	11.20	8.90	11.08	10.75	11.80	10.85	11.75
2,200 lin.ft. 36-in. pipe	7.20	5.80	7.08	7.50	7.60	8.15	9.15
29,030 lin.ft. 48-in. pipe	10.65	8.90	10.79	10.75	11.25	10.70	11.75
4,000 lin.ft. 36-in. pipe	6.90	5.80	6.95	7.25	7.30	8.20	9.15
4 junction chambers, Detail N	$370	$650	$480	50.00	$370	$260	$300
8 junction chambers, Detail O	$1500	$450	$228	$1200	$1500	$2250	$1300
8 Tee connections, Detail P	$1200	$400	$500	$1250	$1200	$2250	$2350
1 manhole, Detail L	$300	$300	$120	$200	$300	317.50	$150
13 manholes and 4-in. air and vacuum valves, Detail K	$450	$450	$280	$400	$450	$495	$330
3 manholes and 8-in. air and vacuum valves, Detail K	$650	$590	$456	$450	$650	$650	$500
12 blow-off valves, Detail C	$150	$100	90.00	$150	$150	$100	$100
2 48-in. gate valves and manholes, Detail I	$2000	$2048	$1974	$2000	$2000	$1855	$2400
4 36-in. gate valves and manholes, Detail J	$1200	11.50	$983	$1300	$1200	$1020	$1200
60 ft. concrete enc. overcrossing	22.00	25.00	28.80	25.00	22.00	20.50	30.00
500 cu.ft. concrete piers	1.25	1.00	.90	1.00	1.25	.75	1.00
1,000 cu.yd. concrete foot and blank.	1.00	.90	.78	1.00	1.00	.60	1.30
39,930 lin.ft. 45-in. pipe	9.45	9.80	9.60	9.95	10.10	10.25	11.00
8,300 lin.ft. 36-in. pipe	6.90	6.90	6.73	7.00	7.40	8.15	9.15
3 junction chambers, Detail O	$1500	$450	$228	$1200	$1500	$2250	$1400
3 Tee connections, Detail P	$1200	$400	$500	$1250	$1200	$2250	$2400
30 ft. concrete enc. overcrossing, Detail G	22.00	25.00	28.80	25.00	22.00	20.50	30.00
400 cu.ft. 'B' concrete (piers), Detail G	1.25	1.00	.90	1.50	1.25	.75	1.00
500 cu.ft. 'C' concrete	1.00	.90	.78	1.50	1.00	.60	1.30
10 manholes, Detail L	$300	$300	$120	$250	$300	317.50	$150
5 manholes and 4-in. air and vacuum valves, Detail K	$450	$450	$288	$300	$450	$495	$330
6 blow-off valves, Detail C	$150	$100	90.00	$100	$150	$100	$100
1 48-in. gate valve, Detail I or	$2000	$2900	$1974	$2500	$2000	$1855	$2400
1 45-in. gate valve, Detail I	$2000	$2970	$1974	$2500	$2000	$1855	$2300
3 36-in. gate valves, Detail J	$1200	$1080	$982	$1400	$1200	$1020	$1200

UNIT 2—One 20,000,000 gallon capacity reservoir, water distribution tower, junction chambers, drains and sump, concrete control building and equipment:

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Construct reservoir, lump sum	$130,000	$108,860	$106,573	$119,000	$130,000	$136,000	$130,000
270 ft. 54-in. pipe	12.95	14.00	12.00	15.00	13.56	12.35	13.10
222 lin.ft. 48-in. pipe	11.15	12.50	11.00	12.00	11.70	11.20	11.75
Accessories as follows:							
1 Venturi Meter, 54-in. and indicator	$4500	$3450	$3360	$4800	$4500	$3800	$4300
1 54-in. gate valve, Detail I	$2700	$2580	$2292	$3000	$2700	$2315	$3000
2 48-in. gate valves, Detail I	$2000	$2050	$1700	$2500	$2000	$3710	$2400

UNIT 3—Supply line from reservoir to City limits:

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
8,710 lin.ft. 45-in. pipe	9.55	10.30	9.40	10.25	10.10	10.30	11.00
4,020 lin.ft. 36-in. pipe	6.90	8.25	6.71	7.25	7.40	8.35	9.15
17,550 lin.ft. 45-in. pipe	11.20	10.50	11.41	11.00	11.60	10.55	11.00
7,900 lin.ft. 42-in. pipe	10.60	9.20	10.72	10.00	11.00	9.60	10.25
16,023 lin.ft. 24-in. pipe	5.95	6.42	7.30	8.00	6.20	6.65	6.15
1 Junction Chamber, Det. O	$1500	$450	$220	$1200	$1500	$2250	$1400
1 T Connection, Detail P	$1200	$400	$500	$1250	$1200	$2250	$2400
2 48-in. elect. op. gate valves and manholes, Det. I	$3200	$2780	$2575	$3000	$3200	$2750	$3600
2 48-in. hand op. valve and manhole, Det. I	$3000	$2970	$2785	$2750	$3000	$2500	$2400
4 42-in. hand op. valve and manhole, Det. I	$2000	$2170	$1945	$2400	$2000	$2025	$2300
1 36-in. elect. op. valve and manhole, Det. J	$2700	$2650	$2445	$2000	$2700	$2335	$2900
8 24-in. hand op. valve and manhole, Det. A	$700	$645	$485	$750	$700	$650	$800
1 conc. overflow struct., Det. D	$950	$1425	$330	$1000	$950	$695	$1200
360 ft. 12-in. cast iron blow-off pipe, lead joints	3.50	3.50	3.00	3.00	3.50	2.50	3.00
2 12-in. gate valves and boxes	85.00	80.00	74.00	$100	85.00	$100	80.00
360 ft. 10-in. vitr. pipe drain	1.90	1.00	2.40	1.00	1.90	1.25	.50
1 16-in. valve and valve box	$200	$130	$185	$150	$200	$185	$275
9 8-in. gate valve and boxes	60.00	50.00	57.00	60.00	60.00	65.00	57.00

(Continued Next Page)

PHOENIX, ARIZ.—CONCRETE AND CAST IRON PIPE LINES, RESERVOIR, TUNNEL AND DETRITOR—CITY (Continued)

10 6-in. gate valve and boxes	45.00	30.00	38.00	45.00	45.00	25.00	44.00
6 2-in. corporation cocks	15.00	8.00	6.00	7.50	15.00	15.00	8.00
2 4-in. air and vacuum valve, Det. K	$450	$450	$275	$300	$450	$300	$330
1 6-in. blow-off, Detail C	$150	$100	90.00	60.00	$150	$100	$100
1 48-in. Venturi meter and register	$4000	$3680	$4410	$4000	$4000	$3900	$4000

Also various quantities of T's, bends, reducers and plugs.

UNIT 4—Constructing cast iron distribution mains in the City:

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
28,850 ft. 12-in. cast-iron pipe	2.80	2.40	2.35	2.65	2.80	2.52	2.60
2,530 lin.ft. 8-in. cast iron pipe	2.00	1.57	1.50	1.75	2.00	1.70	2.10
8,390 lin.ft. 6-in. cast-iron pipe	1.65	1.30	1.19	1.45	1.65	1.25	1.30
57,000 lb. cast iron fittings	.09	.0675	.06	.07	.09	.07	.07
41 gate valves and boxes, 12-in.	75.00	80.00	87.00	$100	75.00	85.00	$110
2 gate valves and boxes, 10-in.	65.00	72.00	80.00	80.00	65.00	78.00	$100
8 gate valves and boxes, 8-in.	45.00	49.00	58.00	60.00	45.00	56.00	70.00
68 gate valves and boxes, 6-in.	30.00	30.00	34.00	40.00	30.00	33.00	50.00
1 gate valve and box, 4-in.	20.00	23.00	26.00	30.00	20.00	24.00	32.00

Some of above bids on cast iron pipe, were on DeLavaud cast iron pipe, but award was based on Mono-cast iron pipe.

UNIT 5—Detritor:

	(1)	(3)	(4)	(5)	(6)	(7)
500 cu.yd. excavation	1.50	1.00	1.00	1.50	1.25	.50
Detritor complete	$35,000	$37,052	$39,500	$35,000	$38,830	$38,000

Bid of Elliott, Stroud Bros. & Seabrook on Unit 3 was based on Lock-Joint Pipe. C. C. Kennedy, Call Bdg., San Francisco is the Consulting Engineer.

SEWER CONSTRUCTION

REDWOOD CITY, CALIF.—VITRIFIED AND CAST IRON SEWERS, PUMPING AND DISPOSAL PLANT AT COLMA—COUNTY

Contract awarded to W. J. Tobin, 527 Balfour Ave. Oakland, who bid $108,390 for construction of sewer system for Board of Supervisors of San Mateo County at Colma, etc. Bids received from the following concerns:

(1) W. J. Tobin, Oakland $108,390
(2) Robt. B. McNair, Oakland 118,221
(3) M. J. Bevanda, Stockton 118,876
(4) P. & H. Const. Co., San Jose 120,484
(5) Chas. L. Harney, S. F. $122,792
(6) C. B. Cowden, San Francisco 125,376
(7) J. C. Hickey, Berkeley 127,430

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
65,470 lin.ft. 6-in. vitr. pipe	.62	.65	.70	.83	.70	.70	.84
1,550 ft. 8-in. vitrified pipe	.71	1.00	.80	.92	.80	.75	1.00
4,585 ft. 10-in. vitrified pipe	.92	1.20	1.09	1.06	1.00	1.00	1.20
2,760 ft. 12-in. vitrified pipe	1.00	1.30	1.20	1.22	1.10	1.10	1.30
5,370 ft. 15-in. vitrified pipe	1.70	1.70	1.70	1.56	2.00	1.60	1.85
100 ft. 12-in. concrete pipe	1.30	2.00	2.00	1.35	2.00	1.00	2.30
2,047 ft. 8-in. cast-iron pipe	1.60	1.80	2.00	1.64	2.00	2.00	1.90
200 ft. 14-in. cast-iron pipe	4.30	7.00	5.30	3.04	4.25	5.00	4.50
1,740 6 by 4-in. Y's	.40	.50	1.20	.60	.50	.50	.80
20 8 by 4-in. Y's	.50	.70	1.65	.75	.50	.65	1.00
70 10 by 4-in. Y's	.60	.90	2.25	1.00	1.00	.90	1.40
100 12 by 4-in. Y's	.75	1.10	2.90	1.25	1.00	1.10	1.80
50 15 by 4-in. Y's	.75	1.80	4.90	2.50	2.00	1.70	3.50
325 manholes	70.00	75.00	70.00	65.00	70.00	80.00	70.00
1 pump house and equipment	$6,132	$6,513	$6,500	$6,350	$7,500	$10,000	$5,200
1 disposal plant	$14,939	$16,600	$15,000	$13,760	$19,000	$18,000	$15,000

OAKLAND, CALIF.—VITRIFIED—CITY—LEONA HEIGHTS

John White, 3214 East 12th St., Oakland, who bid $13,948, submitted the low bid to the City Council of Oakland, Alameda County, for the construction of a vitrified pipe sewer in Leona Heights through Mills College. Bids received on the following items:

(1) 2,606 ft. 18-in. vitrified pipe sewer
(2) 1,160 ft. 21-in. vitrified pipe sewer
(3) 40 ft. 18-in. vitrified pipe with concrete jacket
(4) 20 ft. 21-in. vitrified pipe sewer with concrete jacket
(5) 16 manholes
(6) 3 8-in. drop lampholes
(7) 30 Y branches

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	TOTALS
John White, Oakland	3.14	3.53	3.64	4.03	75.00	15.00	1.00	$13,948
Robt. B. McNair, Oakland	3.45	4.15	4.50	5.00	94.00	30.00	3.30	15,964
R. H. Downer, Oakland	3.45	3.85	4.50	5.40	120.00	20.00	2.50	15,983
M. Murphy, Berkeley	3.20	5.40	6.00	8.00	100.00	40.00	3.00	16,982
W. J. Tobin, Oakland	4.00	4.60	5.00	5.00	80.00	25.00	2.00	17,691
Oakland Sewer Construction Co., Oakland	4.30	4.63	5.00	5.50	80.00	25.00	2.70	18,554
P. & H. Construction Co., San Jose	4.25	4.65	7.00	8.00	100.00	20.00	5.00	18,949
Fredrickson & Watson, Oakland	4.10	5.60	6.00	8.00	75.00	15.00	2.00	19,107
W. J. Schmidt, Berkeley	4.40	5.30	6.00	7.00	100.00	25.00	2.00	19,967

Bids have been taken under advisement, contract to be awarded shortly. Walter N. Frickstad, City Hall, Oakland, is the City Engineer of Oakland, and Frank C. Merritt is the City Clerk. This is a cash job.

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.

LARGE WESTERN PROJECTS

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

WORK CONTEMPLATED

Grading and concrete paving streets near Wilmington and Gardena for Los Angeles County. $475,000.

Golden Gate Bay Bridge over San Francisco Bay for Golden Gate Bridge and Highway District. $35,000,000.

Filtration plant, pumping plant, piping, meter, etc., for City of Great Falls, Mont. $300,000.

Earth-fill dam at Santiago Creek for Serra Irrigation District, Carpenter Irrigation District, and Irvine Company near Orange, Calif. $700,000.

Dotsero cutoff in Colorado for Denver & Rio Grande Western Railroad at Denver, Colo. $3,000,000.

Breakwater at Monterey Harbor, Monterey, for U. S. Engineer's Office. $610,000.

Cle Elum Dam at Cle Elum, Washington, for Bureau of Reclamation.

BIDS BEING RECEIVED

Wards at Laguna Honda Home for City and County of San Francisco. $450,000. Bids to January 21.

Hoover Dam, Tunnels, and Power House on Boulder Canyon Project for Bureau of Reclamation, Denver, Colo. Bids to Mar. 4. Cost $50,000,000 to $70,000,000.

Roof Wards at S. F. Hospital, S. F., for City and County of San Francisco. $365,000. Bids to January 21.

CONTRACTS AWARDED

Pipe-lines, reservoir, tunnels, etc., for City of Phoenix, Ariz., to Schmidt & Hitchcock, Phoenix, Ariz., and American Concrete Pipe Co., Los Angeles, $2,059,140.

James Lick Junior High School for City of San Francisco, to Anderson & Ringrose, San Francisco, $484,000.

STREET and ROAD WORK

WORK CONTEMPLATED

KING CITY, CALIF.—Plans by City Engr., H. F. Cozzens, for improving Mildred Ave., 5-in. concrete paving. Bids after Dec. 22. 12-12

LOS ANGELES, CALIF.—Plans by County Surveyor, J. H. Rockhold, protests December 29, for improving 7½ miles of streets near Wilmington and Gardena. Work involves 210,000 cu.yd. roadway excavation, 1,110,000 sq.ft. 9-7-in. conc. paving, 140,250 sq.ft. 8-in. concrete paving, 960,000 sq.ft. 5-in. disint. rock base, 305,000 sq.ft. 5-in. disint. rock base with rock and oil surface, 138,000 sq.ft. rock and oil surfacing, corr. pipe, reinf. conc. pipe. $475,000. 12-6

MENLO PARK, CALIF.—Plans by Bert J. Mehl, City Engr., protests Dec. 30, for improving College Way, University Drive, etc., involving 560,000 sq.ft. emulsified asphalt surfacing on waterbound rock macadam paving, vitr. sewer connections, corr. storm drain, curbs. $103,000. 12-11

MENLO PARK, CALIF.—Plans by Bert J. Mehl, City Engr., for: (1) Paving Pine and Cherry Sts. with emulsified asphalt surface on waterbound rock macadam base, to cost $15,000; and (2) Paving Crane, University Drive, and Johnson Sts. with emulsified asphalt surf. on waterb. rock macad. base, $25,000. 12-12

OAKLAND, CALIF.—Plans by Walter N. Frickstad, City Engr., for: (1) Masonic Ave. from Florence Ave. to Moraga Ave., etc., involving 11,673 cu.yd. excavation, 80,531 sq.ft. macadam paving, reinf. conc. conduit, corr. iron and concrete culverts, protests January 8; and (2) Patterson Ave. near Harbor View Ave., involving 4475 sq.ft. macadam paving, etc. 12-13

PALO ALTO, CALIF.—Plans by City Engr., J. F. Byxbee, Jr., protests Jan. 12, for improving Palo Alto Ave., Hale St., Pope St., Dana St., Forest Court, Addison Ave., Harker Ave., Pine St., Webster St., Embarcadero Road, Lane B East, Santa Rita Ave., Sherman Ave., Princeton St., Oberlin St., and Harvard Street. Work involves grading, approximately 330,000 sq.ft. 6-in. concrete paving, concrete curbs, concrete sidewalks, sanitary sewers, cast-iron water mains, gas mains, water valves, hydrant, concrete storm sewers, sewer and water connections, etc. 1911 Act. 12-16

SALINAS, CALIF.—Plans by County Surveyor, H. F. Cozzens, for 3 miles asphalt macadam surfacing Watsonville, San Juan Road through Los Carneros and Carpinteria Ranches. $25,000. 12-17

SAN FRANCISCO, CALIF.—Plans by City Engrs. Office, bids soon, for improving Montgomery St. from Union St. to Greenwich St., involving 3040 cu.yd. excavation, 1285 cu.yd. concrete (walls), 115,000 lb. reinf. steel, 23,600 sq.ft. concrete paving, vitr. sewers, cast-iron pipe, macadam paving, etc. 12-11

SAN LUIS OBISPO, CALIF.—Plans by L. W. Moore, City Engr., for improving Pacific St., paving with concrete. $100,000. 12-11

WILLOW GLEN, CALIF.—Plans by H. N. Bishop, Engr., Bank of Italy Bdg., San Jose, bids soon by City, for improving Willow St., Kotenberg and Blewett Aves, involving 1450 cu.yd. excavation, 274,460 sq.ft. grading, 119,000 sq.ft. 5½-in. and 115,000 sq.ft. 4½-in. asphalt paving, concrete sewer, corr. culverts, etc. $93,000. 1925 Act. 12-16

BIDS BEING RECEIVED

PHOENIX, ARIZ.—Bids to 2 p.m., Dec. 29, by Arizona State Highway for 9.3 miles Seligman Highway, F.A.P. 57, east of Pineveta, and 30 miles Globe-Safford Highway from Coolidge Dam to Bylas, F.A.P. 87B, work involving: F.A.P. 57, 1ST REO—17,800 cu.yd. subgrade stabilizer, 58,742 cu.yd.mi. subgrade stabilizer (haul); and F.A.P. 87B—350,000 sq.yd. preparation subgrade, 33,500 cu.yd. additional material (surf.), 72,300 cu.yd.mi. additional material (haul), 554,000 gallons oil, 30.0 miles mix, lay and finish. 12-8

DALY CITY, CALIF.—Bids to 8 p.m., Dec. 29, by City for excavation for reservoir, involving 6000 cu.yd. grading. 12-13

EL CENTRO, CALIF.—Bids will be received up to 11 a.m., January 7, by the Board of Directors of Joint Highway District No. 17, Court House, El Centro, County of Imperial, for the construction of a portion of the Julian-Kane Springs Road in IMPERIAL AND SAN DIEGO COUNTIES, starting at intersection with State Highway Commission of California Route 26, just north of the San Felipe Creek Bridge No. 5816, in Imperial County, and extending westerly to 'The Narrows' in San Diego County, a distance of approximately 25.49 miles. Work involves the following approximate quantities 74,017 cu.yd. common excavation, 128,077 sta.yd. overhaul, 1725 lin.ft. Type 'A' dykes, 65,811 lin.ft. Type 'B' dykes, 2075 lin.ft. Type 'C' dykes, 2750 lin.ft. Type 'D' dykes, 95,400 M b.m. in bridges, 3000 lin.ft. piling, 218 lin.ft. 18-in., 164 lin.ft. 30-in., and 132 lin.ft. 36-in. corr. culverts, 28.28 cu.yd. concrete headwalls, 5500 sq.ft. rock mat bank protection. E. R. Childs, Court House, San Diego, is Engr. 12-19

NEWPORT BEACH, CALIF.—Bids to 7:30 p.m., Jan. 5, by City Clerk for improving River Ave., etc., involving 140,000 sq.ft. 4-in. concrete paving, 7000 ft. 6-in. to 8-in. vitr. sewers, 5500 ft. 8-in. to 2-in. cast-iron pipe, valves, hydrants, etc. 12-9

OAKLAND, CALIF.—Bids to 12 m., Dec. 31, by City for improving Hampton Road, Liggett Drive, etc., involving 9874 cu.yd. excavation, 105,693 sq.ft. 6-in. concrete paving, reinf. concrete pipe conduit, corr. iron and conc. culverts. 12-15

PALO ALTO, CALIF.—Bids to 7:30 p.m., Jan. 12, by City for improving High St. from Lytton Ave. to Addison Ave., involving 70,000 sq.ft. asphalt paving, concrete and vitrified sewers, 8 electroliers, etc. 12-10

ROSS, CALIF.—Bids to 8 p.m., Jan. 8, by City Clerk for Bitumuls paving Chestnut Ave., Bridge Road, etc. $2000. 12-16

SAN FRANCISCO, CALIF.—Bids to 2 p.m., Dec. 30, by Bureau of Public Roads, Sheldon Bdg., S. F., for 8 miles Sect. F, Quincy-Beckwith Highway, Plumas National Forest, involving 29 acres clearing, 73,180 cu.yd. roadway excavation, corr. pipe, timber work, etc. 12-5

STOCKTON, CALIF.—Bids to 11 a.m., Jan. 5, by County for 3 miles of Peltier Road, grading, graveling, and oiling. 12-17

VENTURA, CALIF.—Bids to 11 a.m., Jan. 6, by County Clerk for west extension of Bardsdale Storm Ditch, involving 13,000 cu.yd. earth excavation. 12-6

BOISE, IDA.—Bids to 2 p.m., Dec. 22, by State for: (1) 7 miles from Parma to Fruitland, CANYON AND PAYETTE COUNTIES, involving 116,000 cu.yd. excavation, corr. pipe, etc.; and (2) CANYON COUNTY—7 miles from Caldwell to Notus, involving 87,000 cu.yd. excavation, 18,300 cu.yd. gravel surfacing, corr. pipe, etc. 12-12

PORT ORCHARD, WASH.—Bids to 10 a.m., Jan. 5, by County for 5 miles grading and gravel surfacing from Manette to Brownsville.

BIDS RECEIVED

OAKLAND, CALIF.—M. J. Bevanda, Elks Bdg., Stockton, $119,493 low bid to City for improving Foothill Blvd. from Park St. to Hollywood Blvd., grading, concrete paving, vitrified conduits, etc. (See Unit Bid Summary.) 12-18

SACRAMENTO, CALIF.—Low bids as follows by California Division of Highways: (1) Gist & Bell, 148 East Eldorado, Arcadia, $204,070 low for 2.8 miles grading and concrete paving in SANTA BARBARA COUNTY from Gaviota to 1 mile north of Las Cruces; and (2) Peninsula Paving Co., Standard Oil Bdg., San Francisco, $268,382 low for 10.9 miles grading and asphalt paving in SAN LUIS OBISPO COUNTY from Paso Robles to North Boundary. (See Unit Bid Summary.) 12-17

DENVER, COLO.—Low bids as follows by State: (1) LA PLATA COUNTY—Grant Shields Co., Bayfield, Colo., $30,000 low for 2 miles grading and graveling from Durango to Bayfield; (2) SEDGWICK COUNTY—J. F. Roberts & Sons, Denver, Colo., $15,100 low for 10 miles surfacing from Sedgwick to Colorado State Line; (3) W. F. Pigg & Son, Denver, Colo., $116,830 low for 15 miles grading and oiling near Cheyenne Wells, CHEYENNE COUNTY; and (4) N. M. Mongahan, Denver, Colo., $73,180 low for 4.5 miles grading and surfacing in MOFFAT COUNTY from Maybell to Craig.

PORTLAND, ORE.—Low bids as follows by State: MALHEUR COUNTY—Joslin & McAllister, Realty Bdg., Spokane, Washington, $90,143 low for widening grade and resurfacing 11.48 miles of the

Lancaster-Vale Section of the John Day Highway; LANE COUNTY—Kern & Kibbe, 290 E. Salmon Street, Portland, Oregon, $133,650 low for surfacing with broken stone and furnishing broken stone in stockpiles on 10.0 miles of the Berry Creek-Florence Section of the Roosevelt Coast Highway; and GRANT COUNTY—W. H. Puckett Company, Boise, Idaho, $51,920 low for regrading 3.4 miles of the Rock Creek-Valades Ranch Section of John Day Highway. 12-15

SALT LAKE CITY, UTAH—W. W. Clyde & Co. and J. W. Whiting, Springville, Utah, $117,822 low for 16 miles grading, surfacing, and bridge on Cisco-Colorado State Line Project, GRAND COUNTY, for State.

SEATTLE, WASH.—J. Paduano & Co., Seattle, $31,981 low for paving University Way for City.

CONTRACTS AWARDED

PHOENIX, ARIZ.—Awards as follows by State: (1) To N. G. Hill & Company, 1344 E. McKinley Street, Phoenix, Arizona, who bid $77,123 for the construction of Sections 18-D and E of the Benson-Vail Highway, near Benson, consisting of bridge, overpass, and 4 miles of grading and subgrade stabilizer; (2) To Stanley Jaicks Company, 1950 E. Fourth St., Tucson, Arizona, $77,082 for 3 miles concrete paving in Town of Florence on the Florence-Tucson Highway, using concrete slope walls; (3) To Skeels & Graham, Consolidated Bank Bdg., Tucson, Arizona, who bid $10,709 for douglas fir timber for ½ mile grading and timber bridge on Nogales-Patagonia Highway 8 miles north of Nogales; (4) To Gribble & Burke, 1242 S. Maryland Ave., Glendale, Calif., who bid $28,584 for 25 miles oil processing the Topock-Oatman Highway from Topock to Oatman. (See Unit Bid Summary.) 12-19

TUCSON, ARIZ.—To White & Miller, Yuma, Arizona, who bid $124,359 for 40.4 miles oiling of County Highways for County Commissioners, Tucson, Arizona. 12-18

HAYWARD, CALIF.—To Jack Casson, Hayward, $5335 to City for macadam paving Prospect and Warner Sts. 12-18

OAKLAND, CALIF.—To Ed. Bowman, 9017 B St., Oakland, $7400 for macadam paving 92nd Ave. from G to Russet. 12-12

OAKLAND, CALIF.—To Heafey-Moore Company, 344 High Street, Oakland, $83,516 to City for the improvement of Hopkins Street from Coolidge Avenue to High Street. Work consists of grading, paving with concrete, constructing concrete curbs, concrete sidewalks, vitrified pipe sewers, vitrified pipe conduits, manholes, etc. (See Unit Bid Summary, Dec. 10th issue.) 12-9

SACRAMENTO, CALIF.—To A. Teichert & Sons, 1846 37th St., Sacramento, who bid $6830 to the Board of Supervisors of Sacramento County for furnishing and placing crushed rock on Manzanita Ave. 12-16

SACRAMENTO, CALIF.—To Contoules Construction Co., P.O. Box 194, Yosemite, and 46 Collins St., San Francisco, who bid $212,284 to California Div. of Highways for grading and paving 10.7 miles with bit. macadam from San Felipe to Bells Station, SANTA CLARA COUNTY. (See Unit Bid Summary, Dec. 10th issue.) 12-5

SACRAMENTO, CALIF.—To A. Teichert & Sons, 1846 37th Street, Sacramento, who bid .032 per sq.ft. to City for furnishing and spreading 146,000 gallons of light Airport oil on Sacramento Municipal Airport. 12-12

SACRAMENTO, CALIF.—To V. R. Dennis Construction Co., P.O. Box 183, Station A, San Diego, who bid $227,453 to the California Division of Highways, Sacramento, for grading and paving 6 miles between Araz and Yuma, in IMPERIAL COUNTY. (See Unit Bid Summary, Dec. 10th issue.) 12-5

SALINAS, CALIF.—To W. A. Dontanville, Salinas, $6775 to City for concrete paving of Pajaro St. from Sausal St. to Lake St. 12-17

SAN FRANCISCO, CALIF.—To California Construction Co., Standard Oil Bdg., San Francisco, $45,081 for improving streets in Golden Gate Heights on Lawton St., Funston Street, 12th Ave., etc., for City, macadam paving, vitr. sewers and culverts. (See Unit Bid Summary, Dec. 10th issue.) 12-10

SAN FRANCISCO, CALIF.—To L. J. Cohn, 1 DeHaro St., S. F., $7441 for Topeka surfacing Pier 1 for State Harbor Comm. 12-18

SONORA, CALIF.—To W. C. Colley, 35 Northhampton Ave., Berkeley, $14,500 for 2½ miles grading, installing culverts and Bitumuls armor-plating on Montezuma Road for County. 12-8

VENTURA, CALIF.—Awards as follows by County: (1) To Silveria & Robbins, Ventura, who bid .0785¢ sq.ft. for 120,000 sq.ft. 5-in. oil macadam shoulders on 4 miles of Ventura Ave. near La Cross; and (2) To Silveria & Robbins, Ventura, $2.25 per ton for 4500 tons asphalt surfacing on 2 miles of Elisoe Road in Wheeler Canyon. 12-17

WATSONVILLE, CALIF.—To Granite Const. Co., Watsonville, $7993 for macadam paving Roosevelt St. for City. 12-11

DENVER, COLO.—To Dudley & Amesbury, El Paso, Tex., $146,980 for 13 miles grading Hondo-Mexcalero project in Lincoln National Forest, LINCOLN COUNTY, New Mexico, for Bureau of Public Roads.

BOISE, IDA.—To Sutherland & Burns, Missoula, Montana, $35,553 for 5.7 miles grading and gravel surfacing from Spencer south, CLARK COUNTY, for State.

PORTLAND, ORE.—Awards as follows by the State Highway Commission: COOS COUNTY—Contract awarded to Saxton & Looney, Corvallis, Oregon, who bid $122,195 for 13.6 miles of broken stone or crushed gravel surfacing, furnishing crushed materials in stockpiles, and grade widening on the Lakeside-North Bend Section of the Roosevelt Coast Highway; JOSEPHINE COUNTY—Contract awarded to Washburn & Hall, Portland, $129,860 for regrading and resurfacing 19.0 miles of the Redwood Junction-Caves Section of the Oregon Caves Highway; and LINN COUNTY—Contract awarded to Myers & Goulter, Burke Building, Seattle, $86,115 for grading 3.0 miles of the Bryant Hill-Trout Creek Section of the Santiam Highway. 12-15

SALT LAKE CITY, UTAH—Awards as follows by State Highway Comm.: (1) To Christenson & Gardner, Salt Lake City, Utah, $41,810 for 1.5 miles grading, surfacing, and steel bridge from Mills Junction to Tooele, TOOELE COUNTY; and (2) To Dodge Bros., Fallon, Nev., $183,400 for gravel surfacing 41 miles from Wendover to Knolls, TOOELE COUNTY. (See Unit Bid Summary, Dec. 10th issue.)

OLYMPIA, WASH.—To Colonial Bdg. Co., Spokane, Wash., $59,167 for 2.8 miles grading Grand Dalles to Spear Fish, KLICKITAT COUNTY, for State.

BRIDGES and CULVERTS

WORK CONTEMPLATED

OAKLAND, CALIF.—Plans completed by Southern Pacific Co., Southern Pacific Bdg., San Francisco, for the construction of the Seventh St. Subway in the City of Oakland. Structure is to be reinf. concrete with 167 ft. long barrel, 14-ft. vertical clearance, 23-ft. roadway with one 6-ft. sidewalk. Work involves 290,000 lb. structural steel, 240,000 lb. reinforcing steel, 41,700 sq.ft. waterproofing, 16,800 cu.yd. excavation, 677 cu.yd. concrete (ceiling slab), 3851 cu.yd. reinforced concrete, 368 cu.yd. concrete deck, 139 cu.yd. hand-rail concrete. Estimated cost $205,000. As soon as agreement with the City of Oakland is signed, bids will be called for by the Southern Pacific Company. 12-17

SAN FRANCISCO, CALIF.—Call for bids on the Golden Gate Bridge between Fort Point in the Presidio of San Francisco and Lime Point in Marin County, Calif., postponed pending settlement of locations for approach roads through military reservations. Bonds were recently voted by the Golden Gate Bridge & Highway District, Financial Center Bdg., San Francisco (Phone EXbrook 0116), in amount of $35,000,000 for the construction of the bridge. Project will be let in six divisions, as follows: approach roads; viaducts; piers; anchorages; structural steel for main span; and cables. The bridge proper is 6400 ft. end to end, with a center span of 4200 ft., two side spans of 1100 ft. each, a 1582-ft. viaduct on the south, a 910-ft. viaduct on the north, and approaches. The total length of the main bridge between plazas is 8943 ft. The clearances are 4105 ft. horizontally between piers and 220 ft. vertically above m.h.w. at the center. The bridge will contain 75,000 tons of structural steel and the foundations and anchorages will require 110,000 cu.yd. of concrete. The towers are 740 ft. above m.h.w., with glass-enclosed observation platforms at the tops, reached by elevators. The two main steel cables will each be 7700 ft. long, weighing 43,750,000 lb. when wrapped. Each main cable will contain 27,600 individual strands, eyebars being provided at the anchorages. The sag at the center of the span is 475 ft. Russell G. Cone, of the Tacony-Palmyra Bridge Co., Palmyra, New Jersey, will be resident engineer for the Golden Gate Bridge. 12-11

BOISE, IDA.—Plans by Comm. of Public Works, Boise, Idaho, and call for bids will be issued shortly, for the construction of a 300-ft. reinforced concrete arch bridge over Boise River on Capitol Boulevard (7th Street), Boise, Idaho. Work will consist of the construction of earth-graded approaches. 12-15

KLAMATH FALLS, ORE.—Plans were approved November 26 by the War Department, Washington, D. C., for the construction of a railroad bridge, to be 540 ft. long, across Link River at junction with Lake Ewauna within corporate limits of Klamath Falls, Oregon. Bridge is for the Central Pacific Railway Co. (Southern Pacific Co.), 65 Market St., San Francisco, to be of pile bent trestle timber construction, with fixed steel through girder spanning navigation opening. Girder can be lifted by derricks. 12-6

BIDS BEING RECEIVED

OAKLAND, CALIF.—Bids to 10:30 a.m., Jan. 6, by County for reinf. concrete bridge on Alvarado-Centerville Road. $10,000. 12-16

OAKLAND, CALIF.—Bids to 4:15 p.m., Dec. 30, by Board of Education for reinf. concrete retaining wall and grading at Maxwell Park School. 12-16

SANTA ROSA, CALIF.—Bids to 12 m., Jan. 13, by County for 140-ft. steel bridge over Sonoma Creek near Sonoma State Home, involving 185,000 lb. structural steel, 202 cu.yd. concrete, etc. 12-11

OLYMPIA, WASH.—Bids to 10 a.m., December 30, by the Washington Department of Highways for two bridges on the Bellingham-Austin Pass branch of State Road No. 1, between Warnick and Glacier, as follows: (1) 250-ft. bridge over Nooksack River, consisting of one 150-ft. steel span, two 50-ft. concrete girder approach spans, 24-ft. roadway with one 5-ft. sidewalk; and (2) 120-ft. bridge over Cornell Creek, involving 1 60-ft. and 2 30-ft. conc. girder spans, 24-ft. roadway without walks. 12-6

BIDS RECEIVED

TUCSON, ARIZ.—L. C. Lashmet, Phoenix, Ariz., who bid $8429 submitted the low bid to the County Supervisors, Court House, Tucson, Ariz., for constructing one creosoted wooden pile trestle bridge to be 184 ft. in length. Bids rejected as too high and project will be readvertised. 12-18

CONTRACTS AWARDED

MERCED, CALIF.—To C. C. Disney, Merced, $1360 for reinf. conc. bridge 226 over Mustang Creek on Looney Road for County. 12-10

SACRAMENTO, CALIF.—To J. H. Pomeroy & Company, Railway Exchange Building, Portland, and 251 Kearny Street, San Francisco, who bid $138,848 to the California Division of Highways for a steel bridge with concrete deck over the tracks of the Western Pacific Railroad and over north fork of the Feather River at Pulga, BUTTE COUNTY. (See Unit Bid Summary, Dec. 10th issue.) 12-13

SAN FRANCISCO, CALIF.—To Healy-Tibbitts Const. Co., 64 Pine St., San Francisco, $7315 for reinf. concrete trestle to support 44-in. pipe at Alemany Blvd. for City. 12-10

COQUILLE, ORE.—To Liesch & Tofte, Marshfield, Oregon, who bid $293,042 on Alternative 'B' to the County Court of Coos County for double-leaf bascule bridge over Isthmus Slough on the Marshfield-Eastside County Road near Marshfield. (See Unit Bid Summary.) 12-9

OLYMPIA, WASH.—To Colonial Bdg. Co., Spokane, Wash., $39,710 for reinf. conc. bridge over Walla Walla River near Wallula for State.

SEWER CONSTRUCTION

WORK CONTEMPLATED

FAIRFIELD, CALIF.—Estimates of cost being prepared by Engineer, A. M. Jensen, 68 Post St., S. F., preparatory to bond issue for outfall sewer for City. 12-6

NEWPORT BEACH, CALIF.—Plans made, call for bids during January, for sewers for City as follows: (1) Plans being prepared by Consulting Engineers, Currie Engineering Co., Anderson Bdg., San Bernardino, for sewage disposal plant, consisting of trickling filters and Imhoff tanks, to have 2,000,000 gallons per day flow; and (2) Plans being prepared by City Engineer, R. L. Patterson, for 10,000 lin.ft. of 24-in. sewer main to new plant and sewage pumping station. $185,000. Work is to be done under 1911 Act and 1915 Act. 12-12

OAKLAND, CALIF.—Plans by City Eng., W. N. Frickstad, City Hall, Oakland, for (1) 33-in. reinf. concrete sewer or a 33-in. concrete arch sewer on Grove St. from 26th St. to 28th St.; and (2) Sanitary sewer on Foothill, 84th Ave., Iris St., etc., involving 285 ft. 24-in. and 606 ft. 8-in. vitrified pipe, $3800. 12-16

SPARKS, NEV.—Plans by C. C. Taylor, City Engr., for sewer extensions west of Coney Island for City, $11,000. 12-16

BIDS BEING RECEIVED

LOS ANGELES, CALIF.—Bids to 2 p.m., Dec. 29, by County for storm drain on Grand Ave. near Glendora, involving 48 lin.ft. 60-in. double heavy reinforced concrete pipe, 715 lin.ft. 60-in. heavy reinforced concrete pipe, 12 lin.ft. 20-in. heavy reinforced concrete pipe. 12-11

MADERA, CALIF.—Bids to 8 p.m., Jan. 5, by City Clerk, for pumping for sewage disposal plant. A. M. Jensen, 68 Post St., S. F., is Engineer. 12-17

BIDS RECEIVED

OAKLAND, CALIF.—Low bids as follows by City: (1) M. Murphy, 1321 Milvia St., Berkeley, $8981 low for vitrified sewer in Adeline St. from 8th to 12th Ave, and (2) John White, 3214 East 12th St., Oakland, $13,948 low for vitrified sewer in Leona Heights through Mills College. 12-18

CONTRACTS AWARDED

BAKERSFIELD, CALIF.—To Stroud Bros. & Seabrook, Union Ave., Bakersfield, $1107 for concrete sewers in Blocks 241, 245, and 246 for City. 12-5

BERKELEY, CALIF.—To Martin Murphy, 1321 Milvia St., Berkeley, who bid $4670 to City of Berkeley for vitrified sewer in Third St. from Gilman to Camelia St. 12-16

REDWOOD CITY, CALIF.—To W. J. Tobin, 527 Balfour Ave., Oakland, $108,390 for vitrified and cast-iron sewers, pumping plant, and disposal plant at Colma for County. (See Unit Bid Summary.) 12-15

SALT LAKE CITY, UTAH—To Christensen, Gardner, Mullins & Wheeler, Vermont Bldg., Salt Lake City, $139,950 for sewer system in District 465, for City.

POWER DEVELOPMENT

BIDS BEING RECEIVED

SEATTLE, WASH.—Bids to 10 a.m., January 2, by Board of Public Works for furnishing and installing one 300-ton two-trolley traveling crane at the Diablo Power Plant on the Skagit River. 12-5

CONTRACTS AWARDED

SEATTLE, WASH.—To Ward Construction Co., 1218 North Alder St., Tacoma, Wash., who bid $279,847 to City of Seattle, Washington, for construction of substructure for the Diablo Powerhouse. 12-11

WATER SUPPLY SYSTEMS

WORK CONTEMPLATED

EXETER, CALIF.—City is contemplating following improvements: one 200,000-gallon storage tank, deep-well pump and motor, and water mains. 12-12

FAIRFIELD, CALIF.—Estimates of cost being prepared by Engr., A. M. Jensen, 68 Post St., S. F., preparatory to bond issue for cast-iron mains, valves, fittings, steel tank, and pumping plant for City. 12-6

MILLBRAE, CALIF.—Bond election Dec. 20 by Millbrae Public Utility District, Millbrae, San Mateo County, to vote $14,000 bonds for cast-iron pipe system, valves, hydrants, and one 30,000-gallon steel tank. Geo. A. Kneese, Stafford Bdg., Redwood City, is Engineer. 12-15

PALO ALTO, CALIF.—Bond election January 15 by the Santa Clara County Water Works District No. 1, to vote bonds in the amount of $27,500, for the construction of water system improvements to serve South Palo Alto. Plans and specifications are to be prepared by Consulting Engineers, Burns-McDonnell-Smith Engineering Co., Western Pacific Bldg., Los Angeles. 12-16

SACRAMENTO, CALIF.—Plans and specifications to be prepared by City Manager, Charles H. Dean, City Hall, Sacramento, for the construction of new sedimentation basin units at the Filtration Plant, City of Sacramento. 12-15

VALLEJO, CALIF.—Plans by City Engr., T. D. Kilkenny, for 13,000 ft. 24-in. to 20-in. cast iron pipe line from Fleming Hills Reservoir to City, to cost $75,000. 12-19

GREAT FALLS, MONT.—Plans by Engrs., Black & Veatch, Kansas City, Mo., and will be presented to the City of Great Falls, Montana, about January 1, with reference to the construction of improvements to the filtration plant, including settling basin, piping, flow meter, switchboard, electrical equipment, etc., to cost about $310,000. C. P. Wells is the City Engineer. 12-15

LA CONNER, WASH.—Plans by Engrs., W. C. Morse, Inc., Smith Tower, Seattle, Wash., for water system improvements, to cost $40,000. Work involves 25,000 lin.ft. water mains, one 200,000-gallon reservoir or tank. 12-10

SEATTLE, WASH.—Plans by City Water Supt., W. B. Severyns, City-County Bldg., Seattle, and calls for bids will be issued shortly for: (1) Two steel standpipes, each with capacity of 1,000,000 gallons, to be constructed at Fourth Ave. SW. and W. Trenton St., each to be 30 ft. high and 92 ft. diameter. Estimated cost $75,000; (2) Construction of 75,000,000-gal. capacity reservoir at West Barton St. and W. Cloverdale St., estimated cost $700,000; (3) Reconstruction of Cedar River-Pipe Line No. 1 from Warsaw St. to Beacon Hill Reservoir, work involving 8600 ft. 54-in. cast iron, steel, concrete or wood pipe, 200,000. 12-16

BIDS BEING RECEIVED

GRIDLEY, CALIF.—Bids to 8 p.m., Jan. 12, by City Clerk, J. L. Lewis, City Hall, Gridley, Butte County, for furnishing and installing one Diesel engine for the City Electric & Water Plant. 12-17

MARTINEZ, CALIF.—Bids to 11 a.m., Jan. 5, by County for drilling and casing well for County Water Dist. No. 1 at Brentwood. 12-5

OAKLAND, CALIF.—Bids to 8:30 a.m., January 5, by East Bay Municipal Utility District, 512 12th St., Oakland, for: (1) Furnishing cast-iron pipe as follows: 1000 lin.ft. 20-in. 'B', 9000 lin.ft. 16-in. 'B', and 40,000 lin.ft. 6-in. Class 'B' or Class 250 cast-iron pipe; and (2) Furnishing gate valves as follows: 400 6-in., 50 8-in., 20 10-in., 25 12-in., and 5 16-in. gate valves. 12-12

VANCOUVER, B. C.—Bids to 2 p.m., January 6, by City Purchasing Agent, City Hall, for 1000 fire hydrants and 5 gate valves, hub end, 18-in. 12-11

PORTLAND, ORE.—Bids to 2 p.m., December 29, by the City Purchasing Agent, Frank Coffinberry, Room 208, City Hall, Portland, Oregon, for the construction of the Ross Island Bridge mains and connecting links for the Bureau of Water Works. 12-15

BIDS RECEIVED

MONROVIA, CALIF.—American Pump Co., Los Angeles, who bid $1650, submitted the low bid to the City of Monrovia for furnishing a booster pump to be installed at the Ivey Ave. pumping plant. 12-17

SAN DIEGO, CALIF.—Miracle Construction Co., 4751 Monroe St., San Diego, who bid $5060, submitted the low bid to the City of San Diego for water system in blocks 71, 78, 98, 107 and 127 in City Heights, involving cast iron pipe, hydrants, etc. 12-17

SAN FRANCISCO, CALIF.—Byron-Jackson Pump Mfg. Co., Berkeley, who bid $2906, submitted the low bid to the Board of Public Works, City Hall, San Francisco, for furnishing and installing electrically driven centrifugal pumping plant, 5700 g.p.m., 10-ft. head, at San Francisco Mills Field Municipal Airport. 12-17

PORTLAND, ORE.—Plumbers Supply Co., who bid $5800, submitted low bid to the City of Portland for furnishing 100 fire hydrants to the City of Portland. 12-17

CONTRACTS AWARDED

PHOENIX, ARIZ.—To Schmidt & Hitchcock, 11th and Jackson Streets, Phoenix, Arizona, and American Concrete Pipe Co., Los Angeles, who bid $2,059,140 on Schedule 'A' (complete project, Units 1 to 5 inclusive, based on Granite Reef alternative) to City (on basis of centr. cast reinf. concrete pipe for main supply line) for constructing water system improvements for the City of Phoenix, Arizona. Work involves main supply line and tunnels, 20,000,000-gallon concrete-lined reservoir, supply line from reservoir to City, cast-iron distribution lines, valves, hydrants, and detritor. C. C. Kennedy, Call Building, San Francisco, is the Consulting Engineer. (See Unit Bid Summary.) 12-5

BEVERLY HILLS, CALIF.—Awards as follows by City: (1) To Marko Matich, 1436 W. 51st St., Los Angeles, $10,800 for pipe-line for water treatment plant No. 2; and (2) To Marko Matich, 1436 W. 51st St., Los Angeles, $14,700 for cast iron Maple Drive Pipe Line. 12-19

EL MONTE, CALIF.—To U. S. Pipe & Foundry Co., Los Angeles, who bid .563¢ per ft. for furnishing 1900 ft. 6-in. Class 150 deLavaud cast iron pipe to the City of El Monte. 12-17

LONG BEACH, CALIF.—To Grinnell Co. of Pacific, Los Angeles, 16¢ per ft. for furnishing 30,000 ft. 2-in. Bell & Spigot cast iron pipe to the City 12-18

LOS ANGELES, CALIF.—Awards as follows by City Purchasing Agent for cast-iron pipe: (1) To Pacific States Cast Iron Pipe Co., L. A., $61,480 for 22,500 ft. 8-in. pipe, by Feb. 1, .893¢ ft.; 22,500 ft. 8-in. pipe, by Mar. 1, .9175¢ ft.; and 22,500 ft. 8-in. pipe, by Apr. 1, .9175¢ ft.; (2) To National Cast Iron Pipe Co., L. A., 89¢ ft., total $20,025, for 22,500 ft. 8-in. pipe by January 1; (3) To Utility Equipment Co., Los Angeles, who bid $57,295 at $1.91 ft. for 20,000 ft. 12-in. cast-iron pipe f.o.b. Hewitt St. Yard and 10,000 ft. 12-in. cast-iron pipe f.o.b. Slauson and Compton Yard; and (4) To American Cast Iron Pipe Co., Los Angeles, who bid $27,500 for furnishing, f.o.b. Slauson and Compton Yard, 30,000 ft. 8-in. cast-iron pipe at bid of .917¢ ft. 12-6

RIVERSIDE, CALIF.—To A. L. Gabrielson, Arlington, Riverside County, who bid $7495 for furnishing and installing cast iron pipe water system in Gafford Gardens, work for the City of Riverside. 12-18

SACRAMENTO, CALIF.—To Rensselaer Valve Co., 55 New Montgomery Street, San Francisco, who bid $40 each, total bid of $4000, for furnishing 100 fire hydrants to the City of Sacramento. 12-8

SAN FRANCISCO, CALIF.—To E. J. Treacy, Call Building, San Francisco, who bid $27,101 to the Board of Public Works for cast-iron pipe system in Sunset Blvd. 12-10

WHITTIER, CALIF.—To Western Pipe & Steel Co., 5717 Santa Fe Ave., L. A., $2630 for furnishing steel pipe to City. 12-11

THE DALLES, ORE.—To Pacific States Cast Iron Pipe Co., Provo, Utah, who bid $8808 for furnishing and delivering pre-caulked cast iron pipe to the City of The Dalles, Oregon. 12-18

OLYMPIA, WASH.—To Pittsburgh-Des Moines Steel Company, who bid

$25,250 for furnishing and installing two 250,000-gallon elevated steel tanks in the east and south sections of the City, for City. 12-5

IRRIGATION and RECLAMATION

WORK CONTEMPLATED

EL NIDO, CALIF.—Plans by Engr., G. E. Winton, City Hall, Merced, for the construction of works for the El Nido Irrigation District, El Nido, Merced County, bonds for which were recently voted in amount of $135,000. Work involves: (1) 12 miles of main canal, involving 150,000 cu.yd. canal excavation, 65,000 sq.ft. 2-in. concrete lining; (2) 15 miles of lateral canals, involving 120,000 cu.yd. canal excavation; and (3) Construction of 24-in. to 48-in. siphons with headwalls, bridges, drops, stop-gates and sidegates, etc. 12-11

KNIGHTS LANDING, CALIF.—Permit has been granted to the T. J. Cummins Ranch Co., Knights Landing, Sutter County, for the appropriation of 5.96 cu.ft. per second water from the Sacramento River in Sutter County. Work involves the installation of the following works: Pumping plant with capacity of 5000 g.p.m.; 4800 lin.ft. of ditch, to be 20 by 4 by 3 ft. $7000. It is proposed to install the above by February 1, 1931. 12-13

ORANGE, CALIF.—Plans by Engr., A. Kempkey, Hobart Bdg., San Francisco, and will be forwarded at once to the State Engineer at Sacramento for approval, in connection with a rolled-fill earth dam with concrete spillway for the Serrano Irrigation District, the Carpenter Irrigation District, and the Irvine Company. The dam will be known as the Santiago Creek Dam and will be constructed on Santiago Creek near Orange, Orange County. Work involves 850,000 cu.yd. earth embankment, 8000 cu.yd. concrete (spillway). $700,000. Call for bids will be issued early in January, bids to be opened at a later date. 12-13

PALO ALTO, CALIF.—Permit granted to the Butano Land & Development Co., 401 Lytton St., Palo Alto, for the appropriation of .067 cu.ft. per second from Butano Creek in San Mateo County and .043 cu.ft. per second from springs in San Mateo County for domestic purposes. It is proposed to install work by March 1, 1931, as follows Small concrete diversion dam and small pump; 5300 ft. 4-in. steel pipe; 2700 ft. 2-in. black pipe. $11,000. 12-12

PEBBLE BEACH, CALIF.—Permit granted to the El Sur Land & Cattle Co., Pebble Beach, Monterey County, for the appropriation of 12 cu.ft. per second water from Big Sur River in Monterey County for irrigation on 1024 acres of land. Work is to start soon and involves: PUMPING PLANT—5400 gallons per minute; FORCE LINE, involving 3500 ft. 22-in. and 2000 ft. 16-in. riveted steel pipe; UPPER GRAVITY CONDUIT, work involving 6900 lin.ft. 18-in. and 6900 lin.ft. 14-in. concrete pipe; LOWER GRAVITY CONDUIT, work involving 6000 lin.ft. 20-in. and 6000 lin.ft. 16-in. concrete pipe. $56,000. H. F. Cozzens, and Wm. Davies, Court House, Salinas, Monterey County, are Engineers for the above project. 12-12

SAN FRANCISCO, CALIF.—Permit has been granted to B. P. Lilienthal, 351 California St., San Francisco, for the appropriation of 5 cu.ft. per second water from the Sacramento River for irrigation of 200 acres of land in Sutter County. Work involves: Pumping plant with capacity of 5300 gallons per minute; ditch to be 2500 ft. long, 12 by 2 by 3 ft.; 180 lin.ft. of 20-in. welded steel pipe. $5000. It is proposed to install the above by February 1, 1931. 12-12

PORTLAND, ORE.—Application filed by Fred J. Blakeley, Portland, Ore., and c/o Russell A. Harris, Atty., 604 Capitol National Bank Bdg., Sacramento, for appropriation of 25 cu.ft. per second water from Elliott Creek in Siskiyou County and Jackson County, Oregon, for irrigation of 6000 acres. Work involves: Diversion Dam—Rock fill, 8 ft. high and 20 ft. long; Storage Dams—Rock and earth fill, one at Little Lake 70 ft. high and 300 ft. long on top and one at Big Lake 40 ft. high and 190 ft. long on top; Ditch—8 miles, earth and rock, 8 ft. wide on top, 5 ft. wide on bottom, and 3 ft. deep; 15 miles 36-in. welded steel or wood pipe; Some tunnel, to be 4 ft. 6 in. by 6 ft. Cost $750,000. Powell & Wood, 12 N. Bartlett St., Medford, Oregon, are Engineers. 12-13

CLE ELUM, WASH.—Preliminary designs have been prepared by the U. S. Bureau of Reclamation, Wilda Bldg., Denver, Colo., with reference to the construction of the proposed Cle Elum Dam to be constructed at the outlet of Cle Elum Lake near Cle Elum, Washington. The structure as now contemplated with an earth and gravel fill dam, approximately 135 ft. high above streambed, involves: 1,200,000 cu.yd. of material. Outlet control will be through a 14-ft. internal diameter concrete lined tunnel in the right abutment. Spillway will be provided in a concrete lined open structure at the right end of the dam. Maturity of project is indefinite, as this is dependent upon the completion of satisfactory contracts with the irrigation district involved, covering the repayment for construction cost. 12-16

BIDS BEING RECEIVED

PLACERVILLE, CALIF.—Bids to 10 a.m., Dec. 30, by El Dorado Irrigation District for following for Webber Creek Dam: One 30-lb. cast-iron thimble, one 30-in. butterfly valve, two 5-in. air valves, one needle valve, and 795 ft. 30-in. single and double riveted ¼-in. plate steel pipe. 12-11

TURLOCK, CALIF.—Bids to 2 p.m., Dec. 29, by Turlock Irrigation Dist. for concrete canal lining in Dist. 41, 45, 49, 34, 38, and 58, to cost $90,000. 12-5

DENVER, COLO.—Bids to 10 a.m., March 4, 1931, by Bureau of Reclamation, Wilda Bldg., Denver, Colo., for the Hoover Dam, tunnels and power house in connection with the Boulder Canyon Project in Nevada. Work will be let in one contract and involves: 1,600,000 cu.yd. cut in dam; 1,900,000 cu.yd. tunnel and shaft excavation; 1,200,000 cu.yd. earth and rock fill for cofferdams; 4,400,000 cu.yd. concrete in dam, tunnel lining, power house, spillways, etc.; 228,000 cu.ft. grout; 190,000 lin.ft. grout and drainage holes; 5,500,000 lb. reinforcing steel; 1,900,000 lb. metal pipe and fittings; 32,500,000 lb. metal conduit (penstocks); 10,600,000 lb. structural steel (power house, etc.); 20,000,000 lb. gates and hoists. Government will furnish cement, steel, metal work, valves and hoists. DAM will be arch-gravity type, 727 ft. high above bedrock; crest length 950 ft.; crest width 45 ft.; base width 650 ft.; with two 6x6-ft. slide gates. FOUR DIVERSION AND POWER TUNNELS, 50 ft. diameter, total length 16,300 ft. SPILLWAY SHAFTS—Two glory-hole type spillways, 50-ft. diameter, capacity 200,000 c.f.s. POWER OUTLETS—Four 28-ft. diameter intake tower shafts and two 28-ft. tunnels and 40 needle valves, 72-in. diameter. POWER PLANT—Capacity 1,000,000 hp., involving twelve 85,000-hp. hydraulic turbines; twelve 11x10-ft. balanced valves; twelve 75,000-kva. generators with exciters; thirty-six 25,000-kva. 220,000-volt transformers; four 250-ton cranes, switchboard, machine shop, etc. Plans available after Jan. 10 from the Bureau of Reclamation, Denver Colo., or Washington, D. C. 12-17

DENVER, COLO.—Bids up to 2 p.m., December 26, by Bureau of Reclamation, Denver, Colorado, for one motor-driven gate hoist with motor and two gate assemblies complete for Pumping Stations No. 1 and 2, Minidoka Project, Burley, Idaho. 12-15

RAILROAD CONSTRUCTION

WORK CONTEMPLATED

DENVER, COLO.—Construction ordered December 12 by Interstate Commerce Commission for 41-mile Dotsero Cutoff in Colorado for the Denver & Rio Grande Western Railroad, Denver, Colorado. Cutoff extends from Orestod, elevation 6700 ft., on Moffat Road 128.4 miles west of Denver, to Dotsero, elevation 6167 ft., on the Denver & Rio Grande Western near Glenwood Springs. Construction of this cutoff will save 173 miles against Denver to Salt Lake via Pueblo. Cutoff will follow easy grade most of the way along Colorado River, maximum curvature 10 deg. and maximum grade 0.5%. No unusual construction difficulties are anticipated. Construction is to begin within 6 months and is estimated to cost $3,000,000, construction period to be about 9 months. A. O. Ridgway is Chief Engineer of the Denver & Rio Grande Western Railroad. 12-13

CONTRACTS AWARDED

VANCOUVER, B. C.—To W. C. Arnett, Vancouver Block, Vancouver, B. C., at approximately $260,000 for the construction of 8.5 miles of Kettle Valley Railway to connect the Okanogan Falls-Oliver Line with branch line from South Penticton to Skaha Lake, for the Kettle Valley Railroad Company. Work involves 120,000 cu.yd. solid rock excavation, 45,000 cu.yd. loose rock excavation, 155,000 cu.yd. hardpan excavation, 450,000 ft. b.m. timber (trestles), 20,000 lin.ft. of piling. 12-15

FLOOD CONTROL WORK

WORK CONTEMPLATED

LOS ANGELES, CALIF.—Preliminary estimates of cost are being prepared by Chief Engineer, E. Court Eaton, Los Angeles County Flood Control District, 202 North Broadway, Los Angeles, and will be presented to the Los Angeles County Flood Control District in the spring of 1931, with reference to the straightening of the lower channel of San Gabriel River at Alamitos Bay. Work includes 4800 ft. of excavated channel, involving 450,000 cu.yd. of excavation with riprapped channel, jetties and bridges. 12-10

RIVER and HARBOR WORK

WORK CONTEMPLATED

MONTEREY, CALIF.—Plans by U. S. Engineer's Office, Custom House, San Francisco, and call for bids will be issued in the spring of 1931, for rock mound breakwater to protect Monterey Harbor, Monterey County, providing a fishing boat anchorage. Breakwater will extend 1300 ft. northerly from point near the westerly line of Presidio of Monterey. Appropriation of $610,000 is available for this project (including overhead) and involves over 150,000 tons of rock and a concrete cap. 12-13

OAKLAND, CALIF.—Plans by Oakland Port Comm., Oakland Bank Bdg., Oakland, call for bids after January 5, for pier at foot of Webster St., involving: (1) Reinforced concrete pier, to be 285 ft. long, of reinf. concrete and concrete jacketed piles, $90,000; and (2) Construction of quay, to be 300 ft. long and 33 ft. wide, of reinforced concrete on concrete piling, $50,000. 12-9

BIDS BEING RECEIVED

LOS ANGELES, CALIF.—Bids to 10 a.m., January 7, by General Manager, Burt Edwards, Los Angeles Harbor Department, Room 405, Branch City Hall, San Pedro, for constructing and delivering a Diesel engine propelled pilot boat. 12-11

RICHMOND, CALIF.—Bids to 3 p.m., Jan. 8, by U. S. Engineer's Office, Custom House, S. F., for extension to training wall in Richmond Harbor, involving 81,000 tons of core rock and 18,000 tons of facing rock. 12-9

BIDS RECEIVED

LONG BEACH, CALIF.—Merritt-Chapman & Scott Corporation, P.O. Box 698, San Pedro, who bid $4.15 per ton, low bid to the City Manager for furnishing and placing stone for the west jetty, located on the west bank of the entrance channel. Work involves 4000 tons of stone. 12-15

RECLAMATION WORK

BIDS RECEIVED

SACRAMENTO, CALIF.—Bids as follows by U. S. Engineer's Office, Sacramento, for raising levee southerly of Yolano Station, Solano County:

Olympian Dredging Co., 249 First St., San Francisco..... .119 per yd.
F. C. Franks Contracting Co., 260 California St., S. F..... .119 per yd.
Engineer's estimate ..... .111 per yd.
Work involves 380,000 cu.yd. of earthwork. 12-8

SWIMMING POOLS

WORK CONTEMPLATED

EUREKA, CALIF.—Plans by Architect, N. Ackerman, Fourth and Commercial Sts., Eureka, for the construction of a swimming pool and buildings (semi-public) and Central Heating Plant (to house mechanical equipment) to be located at Eureka, for the Eureka High and Junior High School District. 12-18

MONTEREY, CALIF.—Plans by Architects, Swartz & Ryland, Spazier Bdg., Monterey, bids after Jan. 15, for reinf. conc. swimming poor and equipment for Monterey Union High School Dist. $20,000. 12-10

TUNNEL CONSTRUCTION

CONTRACTS AWARDED

VANCOUVER, B. C.—To Northern Construction Co., Ltd., and J. W. Stewart, Vancouver, B. C., for the construction of a tunnel to be 4600 ft. long and 22½ ft. high and 19 ft. to 16 ft. wide, work for the Canadian Pacific Railroad Co., Vancouver, B. C. This tunnel is to connect the Canadian Pacific Railway Co. right-of-way on Burrard Inlet with the False Creek Yards. 12-19

LIGHTING SYSTEMS

BIDS BEING RECEIVED

SAN LEANDRO, CALIF.—Bids to 8 p.m., Jan. 7, by City for 29 electroliers on Dutton Ave., $7000. 12-19

MACHINERY and SUPPLIES

BIDS BEING RECEIVED

PHOENIX, ARIZ.—Bids to 2 p.m., Jan. 6, by the U. S. Indian Field Service, Phoenix Indian School, 4100 Rhoads Circle, Phoenix, Ariz., for furnishing 30,000 board ft. 1x10 random lengths No. 1 common Douglas Fir, S4S. Specifications obtainable from U. S. Indian Service, Underwood Bldg., San Francisco, Calif. 12-16

MARE ISLAND, CALIF.—Bids to 10 a.m., Jan. 2, by Bureau of Supplies and Accounts, Navy Yard, Washington, D. C., for furnishing and delivering steel shapes for use at the Navy Yard, Mare Island. Specifications and additional information obtainable from Navy Purchasing Agent, 310 California St., San Francisco. 12-19

RENO, NEV.—Bids to 10 a.m., January 16, by the County Clerk, Court House, Reno, Washoe County, for furnishing one ½-yd. full swing gasoline shovel. 12-15

CONTRACTS AWARDED

SEATTLE, WASH.—To Washington Iron Works, 1500 6th Ave. South, who bid $6712 for furnishing 1 65-hp. full Diesel engine. Western Enterprise Eng. Co., L. A., $7160, next lowest bidder. 12-8

BUILDING CONSTRUCTION

BIDS BEING RECEIVED

BERKELEY, CALIF.—Bids to 2 p.m., Jan. 6, by State Architect's Office, Public Works Bdg., Sacramento, for reinf. concrete Kitchen and Commissary building and Boys' and Girls' Dormitory building at California School for Deaf. $200,000. 12-10

MONTEREY, CALIF.—Bids to 10:30 a.m., Jan. 2, by Constructing Quartermaster, Monterey Presidio, for mess halls, to cost $40,000. 12-9

OAKLAND, CALIF.—Bids to 3 p.m., Jan. 5, by the U. S. Supervising Architect, James A. Wetmore, Treasury Dept., Washington, D. C., for construction of foundation work only in connection with the new Postoffice and Custom House to be constructed at 18th and Jackson Sts., Oakland. Plans and specifications obtainable from Custodian, U. S. Postoffice, Oakland. 12-18

SAN FRANCISCO, CALIF.—Bids to 11 a.m., Dec. 29, by Constructing Quartermaster, Fort Mason, for reinf. conc. chapel at Presidio. $40,000. 12-9

SAN FRANCISCO, CALIF.—Bids to 2:30 p.m., Jan. 21, by Board of Public Works for 5-story reinf. conc. wards K and L at Laguna Honda Relief Home. $450,000. Hyman & Appleton, 68 Post St., S. F., are Architects. 12-10

SAN FRANCISCO, CALIF.—By University of California, Berkeley, for reinf. concrete and steel frame heating plant building to be constructed at Third and Parnassus Aves., San Francisco. William C. Hayes, Crocker First National Bank Bldg., San Francisco, is architect. 12-17

SAN FRANCISCO, CALIF.—Bids to 2:30 p.m., Jan. 21, by the Board of Public Works, City Hall, San Francisco, for constructing brick and steel frame roof wards to the San Francisco Hospital located on Potrero Ave. and 22d St., San Francisco, $365,000. 12-18

SAN JOSE, CALIF.—Bids to 11 a.m., Jan. 19, by Santa Clara County, for wood frame working men's cottage addition, to be located at the County Hospital Grounds, $20,000. Binder & Curtis, 35 W. San Carlos, San Jose, are the Architects. 12-16

BIDS RECEIVED

SAN FRANCISCO, CALIF.—Low bids as follows in connection with new Olympic Club building at Post and Mason St.: MECHANICAL WORK—O'Mara & Stewart, 218 Clara St., S. F., $417,809, low; and PLUMBING—F. W. Snook Co., 596 Clay St., S. F., $224,310 low. 12-18

CORVALLIS, ORE.—Following are the two lowest bids received by the U. S. Treasury Dept., Washington, D. C., for the construction of a postoffice building at Corvallis Oregon (1) Using Limestone; and (2) Using Sandstone: Hallbourne & Labahn, 844 Rush St., Chicago, Ill., (1) $102,000, (2) $104,000; A. F. Lundberg, St. Louis, (1) $103,700, (2) $105,700. 12-13

CONTRACTS AWARDED

BERKELEY, CALIF.—Awards as follows by University of California, Berkeley, for a 3-story reinforced concrete and stucco John M. Eshleman Memorial building to be located at University Campus, Berkeley: GENERAL CONTRACT—Awarded to J. J. Grodem, 1028 San Antonio Ave., Alameda, $116,995; PLUMBING, HEATING AND ELECTRICAL WORK—Turner Co., 329 Tehama St., S. F., $22,035. 12-17

SAN DIEGO, CALIF.—To F. F. Greenfield Co., 1808 W. Seventh St., Los Angeles, $103,720 to Bureau of Yards and Docks, Washington, D. C., for concrete, brick, hollow tile and steel metal aircraft shop at Naval Operating Base (Air Station), San Diego. 12-18

SAN FRANCISCO, CALIF.—Awards as follows by Board of Public Works for Class 'B' concrete, stucco, and terra cotta James Lick Junior High School at Noe, 25th, Castro, and Clipper Streets: GENERAL CONTRACT—To Anderson & Ringrose, 320 Market St., S. F., $484,000; MECHANICAL WORK—To Herman Lawson, 465 Tehama St., S. F., $37,000; ELECTRICAL WORK—To Alta Electric Co., 938 Howard St., San Francisco, $31,190; and PLUMBING—To Tuner Co., 329 Tehama St., San Francisco, $28,600. 12-5

SAN JOSE, CALIF.—Awards as follows by State Architect's Office, Public Works Bdg., Sacramento, for 2-story reinf. concrete and brick veneer gymnasium at San Jose Teachers College: GENERAL CONTRACT—To J. J. Grodem, 1028 San Antonio, Alameda, $97,995; PLUMBING AND HEATING—To W. F. Serpa, 497 No. 13th St., San Jose, $15,525; and ELECTRICAL WORK—To Gaubert Bros. Electric Co., 286 W. Santa Clara, San Jose, $6355. 12-5

STOCKTON, CALIF.—Awards as follows by State Architect, Public Works Bldg., Sacramento, for the construction of a 2-story and part basement reinf. concrete industrial building to be located at the Stockton State Hospital at Stockton, San Joaquin County: GENERAL CONTRACT—Awarded to Sorensen & Haggmark, 2652 Harrison St., San Francisco, who bid $69,223; HEATING AND PLUMBING—Contract awarded to Jos. C. Black, 721 W. Elm St., Stockton, who bid $14,900; ELECTRIC WIRING—Contract awarded to Collins Electric Co., 708 E. Market St., Stockton, who bid $3881. 12-19

SURETY BOND AND CASUALTY INSURANCE DIRECTORY

SURETY BONDS are required on all Public Work and are being required more and more on Private Contracts. The present day contractor must be in a position to furnish corporate surety bonds guaranteeing the fulfillment of his contracts. These companies are prepared to furnish such bonds promptly for experienced and responsible contractors. Communicate with one of them and arrange for your bond before you submit your next bid.

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THE BUYERS' GUIDE

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West Coast Tractor Co.
Worden Co., W. H.

Beams, Channels, and Angles
Pacific Coast Steel Corp.

Bins, Storage and Hopper
Bacon Co., Edward R.
Blaw-Knox Co.
Diamond Iron Works, Inc.
Heltzel Steel Form & Iron Co., The
Jenison Machinery Co.
Link-Belt Co.

Blades—Fresno and Graders
Solano Iron Works

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

Boilers
Montague Pipe & Steel Co.
Water Works Supply Co.

Bolts, Nuts and Rods
Claussen & Co., C. G.
Kortick Mfg. Co.

Bonds (Street) Bought
W. P. Bullock

Bonds, Surety
Aetna Casualty & Surety Co.
Associated Indemnity Corp.
Commerce Casualty Co.
Consolidated Indemnity & Insurance Co.
Detroit Fidelity & Surety Co.
Fidelity & Casualty Co. of N. Y., The
Fidelity & Deposit Co. of Maryland
Glens Falls Indemnity Co.
Great American Indemnity Co.
Indemnity Insurance Co. of North America
Maryland Casualty Co.

Bonds, Surety (Continued)
Massachusetts Bonding & Insurance Co.
New Amsterdam Casualty Co.
Rolph, James Jr., Landis & Ellis

Brick, Common
Gladding Bros. Mfg. Co.

Buckets, Elevator and Conveyor
Bacon Co., Edward R.
Industrial Brownhoist Corp.
Jenison Machinery Co.
Lakewood Engr. Co.
Link-Belt Co.

Buckets, Dredging
Haiss Mfg. Co., Geo.
Harnischfeger Sales Corp.
Owen Bucket Co.

Buckets, Excavating
Bacon Co., Edward R.
Bucyrus-Erie Co.
Haiss Mfg. Co., Geo.
Harnischfeger Sales Corp.
Industrial Brownhoist Corp.
Jenison Machinery Co.
Marion Steam Shovel Co.
Orton Crane & Shovel Co.
Owen Bucket Co.
Taylor & George
Williams Co., G. H.
Worden Co., W. H.

Buckets, Rehandling
Industrial Brownhoist Corp.
Jenison Machinery Co.
Lakewood Engr. Co.
Orton Crane & Shovel Co.
Owen Bucket Co.

Cableways
American Steel & Wire Co.
Bacon Co., Edward R.
Jenison Machinery Co.
Leschen & Sons Rope Co., A.
Worden Co., W. H.
Young Machy. Co., A. L.

Carbide
Union Carbide Sales Co., The

Cars, Industrial
Bacon Co., Edward R.
Jenison Machinery Co.
Lakewood Engr. Co.

Carts, Concrete
Bacon Co., Edward R.
Harron, Rickard & McCone Co.
Jenison Machinery Co.
Lakewood Engr. Co.
Ransome Concrete Machinery Co.

Castings, Iron and Steel
American Cast Iron Pipe Co.
Link-Belt Co.
U. S. Cast Iron Pipe & Fdy. Co.

Castings, Street and Sewer
U. S. Cast Iron Pipe & Fdy. Co.

Cement
Portland Cement Association

Chemicals
California Filter Co., Inc.
Great Western Electro-Chemical Co.

Chlorinators
California Filter Co., Inc.
Wallace & Tiernan
Water Works Supply Co.

Chlorine
Great Western Electro-Chemical Co.

Chutes, Concrete
Bacon Co., Edward R.
Haiss Mfg. Co., Geo.
Jenison Machinery Co.
Lakewood Engr. Co.
Ransome Concrete Machinery Co.

Clarifiers, Water
Dorr Co., The
Wallace & Tiernan Co.

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

Concrete Buckets
Jenison Machinery Co.
Young Machy. Co., A. L.

Concrete Curing
Concrete Curing Co.
Inertol Company, Inc.
McEverlast, Inc.

Concrete Forms
Bacon Co., Edw. R.
Blaw-Knox Co.

Concrete Roads
Portland Cement Association

Conveyors, Portable

Conveyors, Elevating and Conveying
Bacon Co., Edward R.
Bodinson Mfg. Co.
Jenison Machinery Co.
Link-Belt Co.

Cranes, Electric, Gasoline Locomotive
American Hoist & Derrick Co.
Austin Machy. Corp.
Bacon Co., Edward R.
Bucyrus-Erie Co.
Harnischfeger Sales Corp.
Harron, Rickard & McCone Co.
Industrial Brownhoist Corp.
Jenison Machinery Co.
Link-Belt Co.
Marion Steam Shovel Co.
Northwest Engineering Co.
Ohio Power Shovel Co., The
Orton Crane & Shovel Co.
Speeder Machinery Corp.
Thew Shovel Co., The
Universal Crane Co., The

Cranes, Tractor
Harnischfeger Sales Corp.
West Coast Tractor Co.

Cranes, Traveling
Harnischfeger Sales Corp.
Jenison Machinery Co.
Thew Shovel Co., The

Crushers
Austin Western Road Machy. Co., The
Bacon Co., Edward R.
Diamond Iron Works, Inc.
Guest Crushing Machines, Inc.
Jenison Machinery Co.
Smith Engineering Works
Young Machy. Co., A. L.

Crushers—Engines
Atlas Imperial Diesel Engine Co.

Culverts, Concrete
Portland Cement Association

Culverts, Metal
California Corrugated Culvert Co.
U. S. Cast Iron Pipe & Fdy. Co
Western Pipe & Steel Co.

Culverts, Part Circle
California Corrugated Culvert Co.
Western Pipe & Steel Co.

Culverts, Vitrified
Gladding, McBean & Co.
Pacific Clay Products

Curing, Concrete
Concrete Curing Co.
Inertol Company, Inc.
McEverlast, Inc.

Cutting Apparatus
Jenison Machinery Co.
Diamond Iron Works, Inc.
Haiss Mfg. Co., Geo.
Oxweld Acetylene Co.
Victor Welding Equipment Co.

Cutting Edges
Solano Iron Works

Dams
Ambursen Dam Co., Inc.

Derricks
Bacon Co., Edward R.
Jenison Machinery Co.
Young Machy. Co., A. L.

Diesel Engines
Atlas Imperial Diesel Engine Co.

Ditch Machinery
Bacon Co., Edward R.
Bucyrus-Erie Co.
Cleveland Trencher Co.
Harnischfeger Sales Corp.
Industrial Brownhoist Corp.
Jenison Machinery Co.
Link-Belt Co.
Marion Steam Shovel Co.
National Equipment Corp.
Northwest Engineering Co.
Ohio Power Shovel Co., The
Orton Crane & Shovel Co.
Thew Shovel Co., The

Draglines
Austin Machy. Corp.
Bacon Co., Edward R.
Bucyrus-Erie Co.
Harnischfeger Sales Corp.
Harron, Rickard & McCone Co.
Jenison Machinery Co.
Link-Belt Co.
Marion Steam Shovel Co.
National Equipment Corp.
Northwest Engineering Co.
Ohio Power Shovel Co.
Sauerman Bros., Inc.
Spears-Wells Machy. Co.
Speeder Machinery Corp.
Thew Shovel Co., The
Universal Crane Co., The
Worden Co., W. H.
Young Machy. Co., A. L.

Dragline—Diesel Engines
Atlas Imperial Diesel Engine Co.

Drain Tile
Gladding, McBean & Co.
Gladding Bros. Mfg. Co.
Pacific Clay Products

Drills, Rock
Bacon Co., Edward R.
Gardner-Denver Co.
Ingersoll-Rand Co.
Leitch & Company
Rix Company, Inc., The
Schramm, Inc.
Sullivan Machinery Co.

Dump Cars
Bacon Co., Edward R.
Jenison Machinery Co.

Dump Wagons
Le Tourneau Mfg. Co.
West Coast Tractor Co.

Engineers
Ambursen Dam Co., Inc.
Burns-McDonnell-Smith Engr. Co.
Hunt Co., R. W.
Porter, Geo. J.

Engines, Diesel, Gasoline and Steam
Atlas Imperial Diesel Engine Co.
Bacon Co., Edward R.
Continental Motors Corp.
Hercules Motors Corp.
Ingersoll-Rand Co.
International Harvester Co.
Jenison Machinery Co.
Le Roi Co.
Novo Engine Co.

Excavating Machinery
American Tractor Equipment Co.
Austin Western Road Machy. Co., The
Bacon Co., Edward R.
Bodinson Mfg. Co.
Bucyrus-Erie Co.
Caterpillar Tractor Co.
Cleveland Tractor Co., The
Excavating Equipment Dealers, Inc.
Haiss Mfg. Co., Geo.
Harnischfeger Sales Corp.
Harron, Rickard & McCone Co.
Industrial Brownhoist Corp.
Jenison Machinery Co.
Link-Belt Co.
Marion Steam Shovel Co.

(Continued on page 58)

OPPORTUNITY PAGE

CONTINUED

SHOVELS CRANES DRAGLINES PULLSHOVELS

Factory Rebuilt with New Machine Guarantee

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NORTHWEST ENGINEERING CO.

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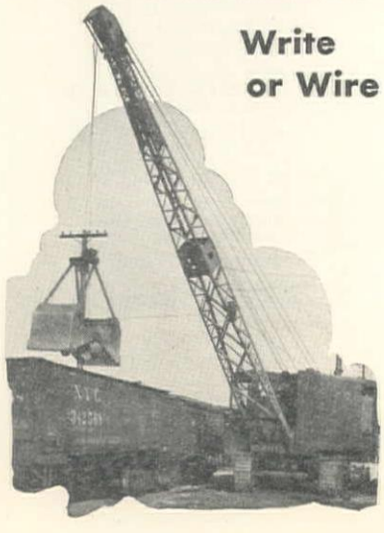

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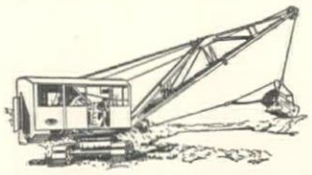

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TRUCK CRANES :: TRENCHERS
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3108 Jordan Road, Oakland, Calif.
Telephone ANdover 1943

SITUATIONS WANTED

CIVIL ENGINEER, 32, ten years' practical experience. Had responsible charge subdividing, road, bridge and municipal improvements. Instrument work computing and handle concrete. Prefer location state of Washington. Registered engineer. Can demonstrate that can get results and have horse sense. Now employed. Available two weeks' notice. Box 351, Western Const. News.

HELP WANTED

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

PRODUCTION MANAGER, for a company operating several scattered plants in California. The processes are comparatively simple and emphasis is laid upon ability to handle men for efficient results rather than upon technical ability. Applicants must have plant operating experience. Salary depends upon experience and ability. Apply by letter. Headquarters, San Francisco. R-3429-S.

ASPHALT ENGINEER, graduate civil engineer, single, not over 32, with experience on hot mixed type sheet asphalt, asphaltum concrete, penetration preventing by the grouting method, asphalt emulsions, ability to decide proper percentages of various grades of stone, sand, cement and asphalt to secure a road of maximum density, etc. Must be familiar with asphalt literature. Salary $3600-4000 a year. Apply only by letter. Location, India. K-333-W-2071-C-S.

PROFESSOR for school of industrial engineering at mid-western university, to teach various phases of printing. Must have had broad experience in printing and be acquainted with the printing industry. Position is likely to lead to development of research. Salary $5000 a year. Apply by letter. Location, Middle West. K-332-W-2034-C-S.

DESIGNING DRAFTSMEN OR ENGINEERS, two, technically trained for experimental engineering and development department. One, and preferably both, should have had experience with hydraulic machinery such as small size high pressure pumps or work of a similar nature. At least three or four years' experience since receiving engineering degree preferred. Apply by letter. Location, Middle West. X-9183-C.

ASSISTANT EDITOR, graduate, mechanical engineer with practical experience in steam refrigeration, maintenance and plant engineering. Salary $2500 a year. Apply by letter. Location, South. W-119.

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THE BUYERS' GUIDE—*Continued from Page 56*

Excavating Mchy.(Continued)
National Equipment Corp.
Northwest Engineering Co.
Ohio Power Shovel Co.
Orton Crane & Shovel Co.
Owen Bucket Co.
Sauerman Bros., Inc.
Shaw Excavator & Tools Co.
Speeder Machinery Corp., The
Thew Shovel Co., The
Universal Crane Co., The

Excavating Mchy.—Diesel Engines
Atlas Imperial Diesel Engine Co.

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

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

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

Filters, Water
California Filter Co., Inc.

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

Floating Roofs
Chicago Bridge & Iron Works

Flood Lights
Oxweld Acetylene Co.
Taylor & George

Flooring, Industrial
Paraffine Companies, Inc., The

Floors, Mastic
Wailes Dove-Hermiston Corp.

Flumes, Concrete
Portland Cement Association

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

Fluxes
Victor Welding Equipment Co.

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

Form Ties
J. M. Willard Co.

Freight, Water
American-Hawaiian Steamship Co.

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

Gates, Cast-Iron
California Corrugated Culvert Co.

Gates, Radial
California Corrugated Culvert Co.

Gates, Sheet Metal
California Corrugated Culvert Co.

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

Governors, Turbine
Pelton Water Wheel Co., The

Grader Blades
Solano Iron Works

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

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

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

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

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

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

Hydro-Tite
Industrial & Municipal Supply Co.

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

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

Jacks, Lifting
Jenison Machinery Co.

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

Leadite
Water Works Supply Co.

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

Locomotives, Electric, Gas and Steam
Jenison Machinery Co.

Lumber
McCormick Lumber Co.

Metal Lath
Truscon Steel Company

Meters, Venturi
Water Works Supply Co.

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

Mixers, Chemical
Dorr Co., The

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

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

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

Oxy-Acetylene Apparatus
Oxweld Acetylene Co.

Oxygen in Cylinders
The Linde Air Products Co.

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

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

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

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

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

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

Paving, Contractor
Warren Bros. Roads Co.

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

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

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

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

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

Piling
Pacific Coast Steel Corp.

Piling, Redwood
Union Lumber Co.

Pipe, Bell and Spigot
National Cast Iron Pipe Co.

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

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

Pipe, Centrifugal
National Cast Iron Pipe Co.

Pipe Clamps and Hangers
Kortick Mfg. Co.

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

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

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

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

Pipe, Flanged
National Cast Iron Pipe Co.

Pipe Line Machinery
Bacon Co., Edward R.
Harnischfeger Sales Corp.
Jenison Machinery Co.

Pipe, Lock-Bar
Western Pipe & Steel Co.

Pipe, Preservative
Columbia Wood & Metal Preservative Co.

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

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

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

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

Pipe, Vitrified
Gladding Bros. Mfg. Co.
Gladding, McBean & Co.
Pacific Clay Products

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

Plows, Road
Austin-Western Road Mchy. Co., The
Bacon Co., Edward R.
Jenison Machinery Co.
Spears-Wells Machy. Co.

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

Poles, Redwood
Union Lumber Co.

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

Power Units
Bacon Co., Edw. R.
Continental Motors Corp.
Hercules Motors Corp.
International Harvester Co.
Jenison Machinery Co.
Novo Engine Co.

Preservative, Wood, Metal, etc.
Columbia Wood & Metal Preservative Co.
Paraffine Companies, Inc., The

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

(Continued on page 60)

OPPORTUNITY PAGE

CONTINUED

OFFICIAL BIDS

UNITED STATES DEPARTMENT OF THE INTERIOR

BUREAU OF RECLAMATION

Hoover Dam, Tunnels and Power House

Washington, D. C., December 15, 1930

Sealed bids (Specifications No. 519) will be received at the office of the Bureau of Reclamation, Wilda Building, 1441 Welton Street, Denver, Colorado, until 10 o'clock a.m., March 4, 1931, and then publicly opened, for furnishing labor and materials and performing all work for the construction of the Hoover Dam, power plant and appurtenant works, Boulder Canyon project, Arizona-Nevada-California. The work is located on the Colorado River at the Black Canyon dam site, approximately 30 miles southeast of Las Vegas, Nevada, which city is on the main line of the Los Angeles & Salt Lake (Union Pacific) Railroad. The work includes the 730-foot dam, four 50-foot diameter diversion tunnels, coffer dams, power plant (not including installation of machinery), spillways and outlet works. The principal items and the estimated quantities involved are as follows: 1,800,000 cubic yards of all classes of open cut excavation; 1,900,000 cubic yards of tunnel and shaft excavation; 1,200,000 cubic yards of earth and rock fill in coffer dams and river channel protection; 4,400,000 cubic yards of concrete; 228,000 cubic feet of grout; drilling 190,000 linear feet of grout and drainage holes; placing 5,500,000 pounds of reinforcement bars; installing 1,900,000 pounds of small metal pipe and fittings; installing 32,500,000 pounds of large metal conduits; installing 10,600,000 pounds of structural steel; installing 20,000,000 pounds of gates, hoists 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, Las Vegas, Nevada; Denver, Colorado; or Washington, D. C. Specifications and plans may be obtained from any of these offices for $5.00, and remittance should be made payable to "Bureau of Reclamation".

ELWOOD MEAD, Commissioner.

NOTICE TO CONTRACTORS

Cast Iron Pipe

Sealed proposals will be received at the office of the East Bay Municipal Utility District, 512 Sixteenth Street, Oakland, California, until 8:30 a.m., January 5, 1931, and will at that hour be opened, for furnishing approximately 50,000 feet of cast-iron pipe of 20-inch, 16-inch, and 6-inch diameters.

Specifications L.S. 41 may be obtained upon application at Room 33 of the office of the District.

(Signed) JOHN H. KIMBALL, Secretary.
Oakland, California, December 11, 1930.

NOTICE TO CONTRACTORS

Valves

Sealed proposals will be received at the office of the East Bay Municipal Utility District, 512 Sixteenth Street, Oakland, California, until 8:30 a.m., Monday, January 5, 1931, and will at that hour be opened, for the purchase and delivery of 500 valves, in sizes 6-inch to 16-inch inclusive, for the Distribution System.

Specifications L.S. 42 may be obtained upon application at Room 33 of the office of the District.

(Signed) JOHN H. KIMBALL, Secretary.
Oakland, California, December 11, 1930.

NOTICE TO CONTRACTORS

Pig Lead

Sealed proposals will be received at the office of the East Bay Municipal Utility District, 512 Sixteenth Street, Oakland, California, until 8:30 a.m., Monday, January 5, 1931, and will at that hour be opened, for furnishing approximately 50 tons of pig lead.

Specifications No. L.S. 39 may be obtained upon application to the office of the District, Room 33.

(Signed) JOHN H. KIMBALL, Secretary.
Oakland, California, December 19, 1930.

NOTICE TO CONTRACTORS

Asphalt, Meter Boxes and Covers

Sealed proposals will be received at the office of the East Bay Municipal Utility District, 512 Sixteenth Street, Oakland, California, until 8:30 a.m., January 5, 1931, and will at that hour be opened, for furnishing approximately 30,000 gallons of Grade "E" hot asphalt, 4000 concrete meter boxes and 6000 concrete covers for meter boxes.

Specifications No. L.S. 44 may be obtained upon application at Room 33, 512 Sixteenth Street, Oakland, California.

JOHN H. KIMBALL, Secretary.
Oakland, California, December 19, 1930.

NOTICE TO CONTRACTORS

Surfacing

Sealed proposals will be received at the office of the East Bay Municipal Utility District, 512 Sixteenth Street, Oakland, California, until 8:30 a.m., Monday, January 5, 1931, and will at that hour be opened, for furnishing all material and performing all necessary work to repair approximately 40,000 square feet of the bituminous surfacing of street pavements where removed for the purpose of construction, maintenance, etc., of the distribution system, during the year 1931 only.

Specifications No. L.S. 45 may be obtained upon application to the office of the District, Room 33.

JOHN H. KIMBALL, Secretary.
Oakland, California, December 19, 1930.

NOTICE TO CONTRACTORS

Gasoline, Kerosene and Lubricating Oils

Sealed proposals will be received at the office of the East Bay Municipal Utility District, 512 Sixteenth Street, Oakland, California, until 8:30 a.m., Monday, January 5, 1931, and will at that hour be opened, for furnishing, during the year 1931, approximately 200,000 gallons of gasoline, 25,000 gallons of kerosene and 10,000 gallons of lubricating oils of various grades.

Specifications No. L.S. 43 may be obtained upon application at Room 33 of the office of the District.

JOHN H. KIMBALL, Secretary.
Oakland, California, December 19, 1930.

NOTICE TO CONTRACTORS

Grading and Surfacing

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 December 30, 1930, at which time they will be publicly opened and read, for construction in accordance with the specifications therefor, to which special reference is made, of portions of State Highway, as follows:

Kern County, between Harts Station and three miles east (VI-Ker-33-C), about three (3.0) miles in length, to be graded and portions surfaced with bituminous macadam.

Proposal forms will be issued only to those Contractors who have furnished a verified statement of experience and financial condition in accordance with the provisions of Chapter 644, Statutes of 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 December 3, 1930.

THE BUYERS' GUIDE—*Continued from Page 58*

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

Pumps, Dredging and Sand
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Jenison Machinery Co.

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

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

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

Pumps, Sewage Ejector
Industrial & Municipal Supply Co.

Pumps, Sludge
Dorr Co., The

Pumps, Water Works
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Pomona Pump Co.
Washington Iron Works

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Thew Shovel Co., The
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Chicago Bridge & Iron Works
Lacy Manufacturing Co.
Montague Pipe & Steel Co.
Pittsburgh-Des Moines Steel Co.
Western Pipe & Steel Co.

Steel, Structural
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Western Iron Works
Western Pipe & Steel Co.

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Jenison Machinery Co.

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Truscon Steel Co.

Steel Piling
Pacific Coast Steel Corp.

Steel Windows
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American Tractor Equipment Co.

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Western Pipe & Steel Co.

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California Corrugated Culvert Co.
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Pittsburgh-Des Moines Steel Co.
Western Pipe & Steel Co.

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Thew Shovel Co., The

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Valves, Gate
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Water Works Supply Co.

Valves, Hydraulic
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Victor Welding Equipment Co.

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Victor Welding Equipment Co.

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