WCN-06-1936

WESTERN CONSTRUCTION NEWS

WITH WHICH IS CONSOLIDATED
WESTERN HIGHWAYS BUILDER

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JUNE, 1936

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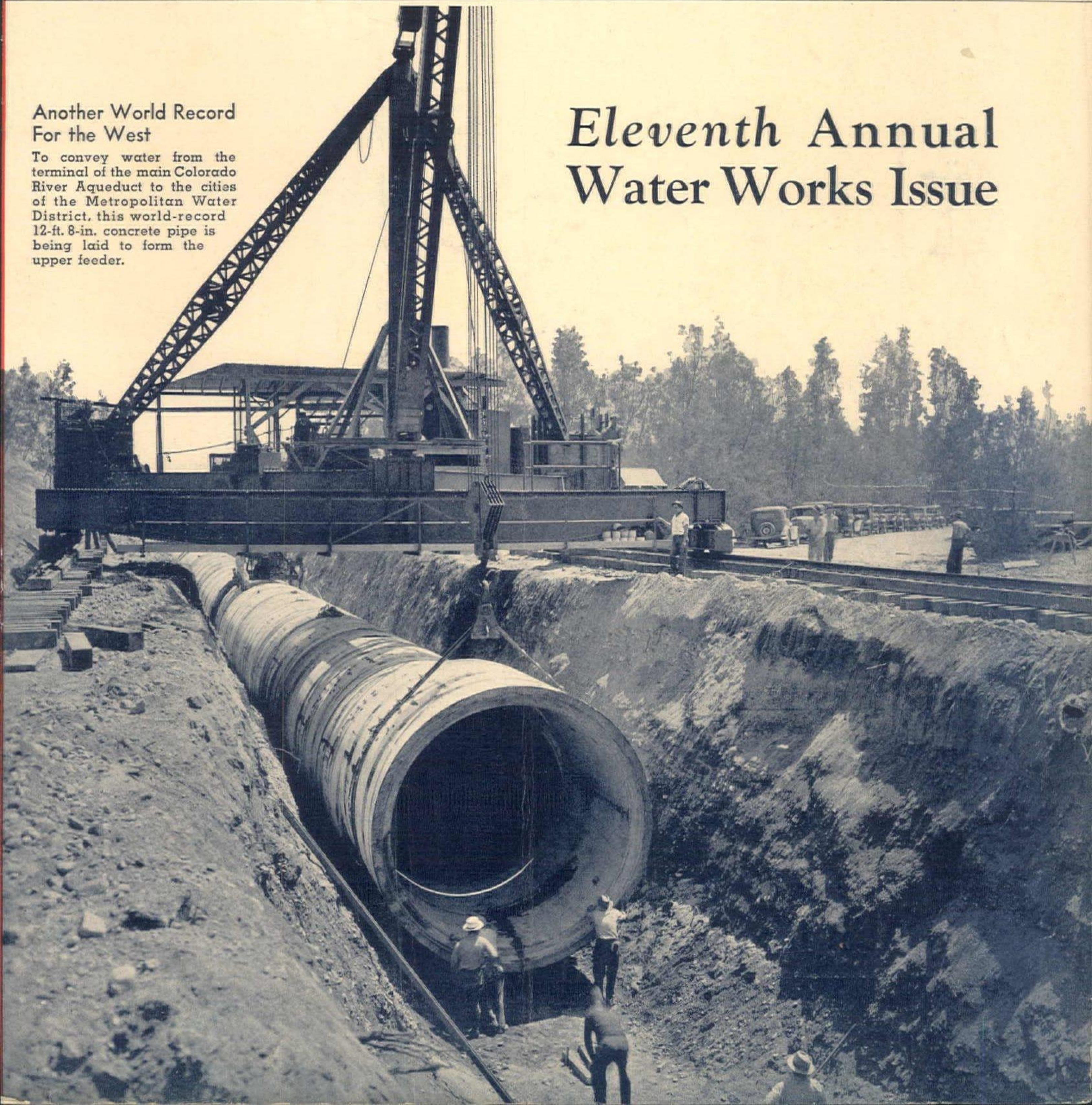
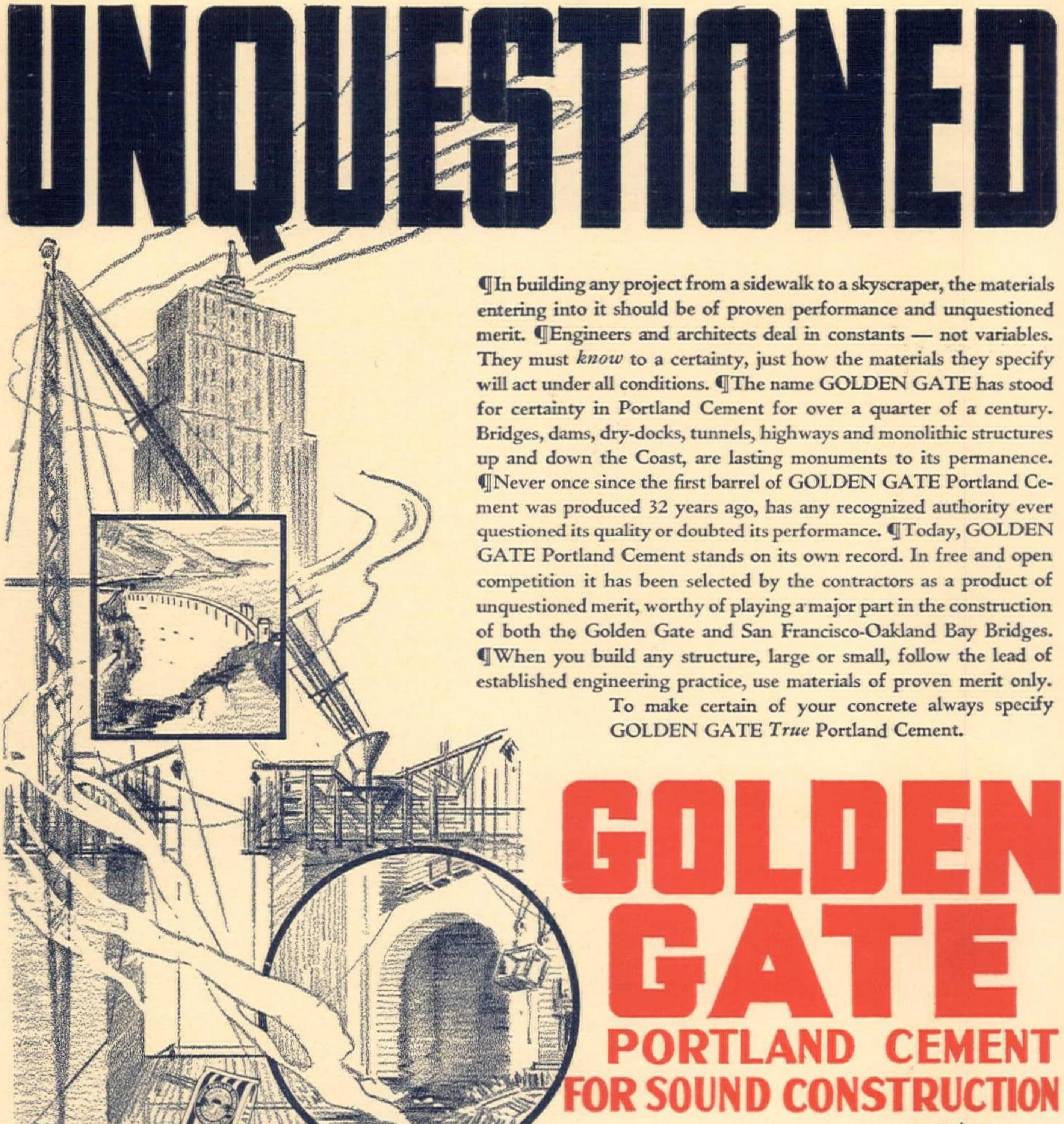


Eleventh Annual Water Works Issue

Another World Record For the West

To convey water from the terminal of the main Colorado River Aqueduct to the cities of the Metropolitan Water District, this world-record 12-ft. 8-in. concrete pipe is being laid to form the upper feeder.



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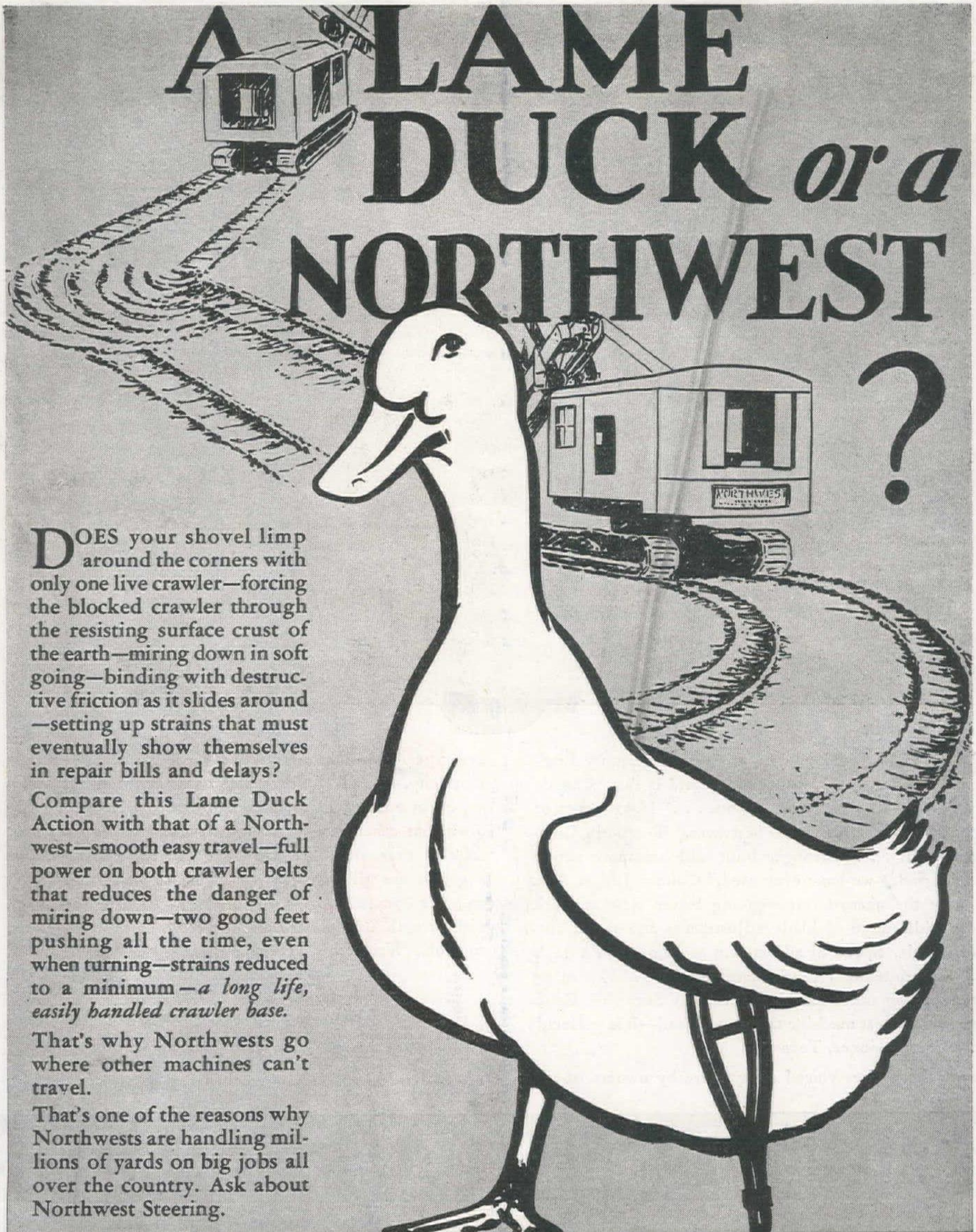

DOES your shovel limp around the corners with only one live crawler—forcing the blocked crawler through the resisting surface crust of the earth—miring down in soft going—binding with destructive friction as it slides around—setting up strains that must eventually show themselves in repair bills and delays?

Compare this Lame Duck Action with that of a Northwest—smooth easy travel—full power on both crawler belts that reduces the danger of miring down—two good feet pushing all the time, even when turning—strains reduced to a minimum—*a long life, easily handled crawler base.*

That's why Northwests go where other machines can't travel.

That's one of the reasons why Northwests are handling millions of yards on big jobs all over the country. Ask about Northwest Steering.

NORTHWEST ENGINEERING CO., 1727 Steger Bldg., 28 East Jackson Blvd., Chicago, Ill., U. S. A.

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NORTHWEST ENGINEERING CO.: 255 Tenth St., San Francisco; 3707 Santa Fe Ave., Los Angeles. REPRESENTATIVES: Pacific Hoist & Derrick Co., 3200 Block, 4th Ave. So., Seattle; Arnold Machinery Co., Inc., 149 W. 2nd St. S., Salt Lake City; Balzer Machinery Co., 1636 South East 6th Ave., Portland, Ore.; Neil B. McGinnis Co., 1401 S. Central Ave., Phoenix, Ariz.

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"You Can't Beat 'em"

...SAY HUNDREDS OF USERS

"THIS grader is far beyond any other," County Engineer, Ohio . . . "Handles nicely and is fast. Can do 30% more work," Contractor, Minn. . . . "Have operated graders 27 years—this is the best ever," Township Commissioner, Ill. . . . "Stronger built and has more action than any grader we have ever used," County Judge, Ark. . . . "Like the narrow frame giving better view of work and the wide range of blade adjustments and reach outside of wheels. Speed of adjustment saves a lot in a day's work," Superintendent Equipment, Mich. . . . "Has many advantages over other machines," County Surveyor, Calif. "Think it the finest machine that can be had—it is perfect," County Commissioner, Texas.

Such are the praises voiced everywhere by owners of the new-type Adams Leaning Wheel Graders. Their strength, simplicity, ease of handling and wider range of usefulness appeal at once to all practical road men. Because they do work that other graders cannot do and because they save a lot of time, do better work and increase production on any job, you will profit by putting these modern machines on your "payroll". . . Available in 12-ft. and 10-ft. sizes, with or without scarifier and with hand or power-operated controls. Write for complete descriptive catalog today.

J. D. ADAMS COMPANY

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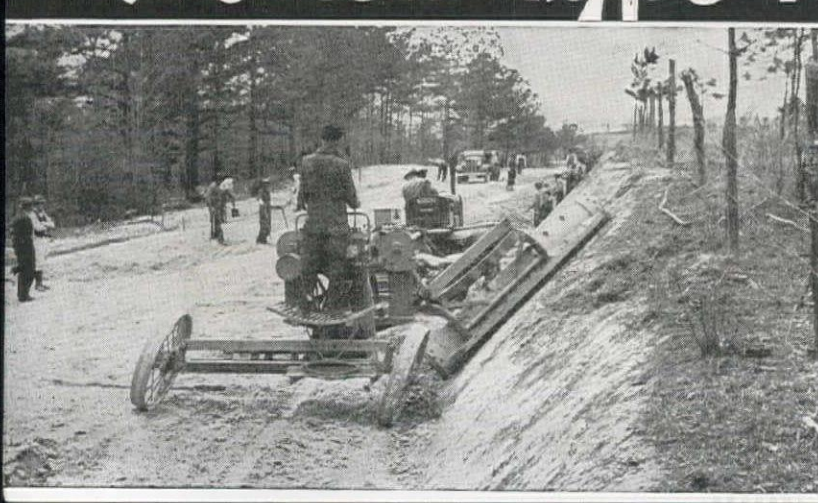
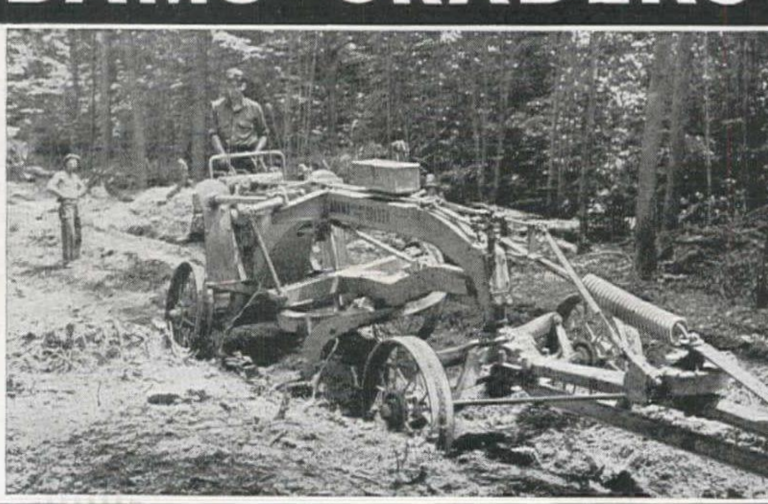
—the New-Type ADAMS GRADERS





Ten Years Ago

Items from the sixth month's issue of "Western Construction News," June, 1926.

Plans were completed and bids were about to be called for on the proposed dams and canals of the El Dorado Irrigation District near Placerville, Calif.

•

Construction of the Memorial Auditorium in Sacramento was well under way. The design of the building was featured by a movable or tilting floor section 78 by 113 ft.

•

The $3,000,000 Burnside Street bascule bridge across the Willamette River in Portland was formally opened for traffic on May 28, 1926.

•

Rapid progress was being made on the enlargement of the Big Meadows hydraulic fill dam in Plumas County, Calif. The dam was being raised 45 ft. by hydraulic-fill methods, increasing the capacity of Lake Almanor from 300,000 ac. ft. to 1,300,000 ac. ft.

•

Work on the Alameda estuary (Posey) tube connecting Oakland and Alameda was progressing rapidly. The cofferdam for the Alameda portal building had been completed and unwatered. The large, precast, reinforced concrete tube sections were being poured in drydock.

•

Awarding of a contract for 90 mi. of welded steel pipe on the Mokelumne River project of the East Bay Municipal Utility District to the Steel Tank & Pipe Co. of Berkeley, Calif., on a bid which called for pipe of 65 and 63-in. diameter with plates of ½, 7-16 and ⅜-in. thick caused some comment at the time. Plant tests, however, showed the welded sections to be entirely satisfactory.

•

Roy C. Hackley, who had recently joined Youdall Construction Co. of San Francisco, was named general superintendent on the company's contract for the construction of the Duboce tunnel in San Francisco.

SUBSCRIPTION RATES

The annual subscription rate is $2 in the United States and foreign countries where extra postage is not required. To Canada and to foreign countries where extra postage is necessary the annual rate is $3. Single copies 25 cents.

WESTERN CONSTRUCTION NEWS

WITH WHICH IS CONSOLIDATED WESTERN HIGHWAYS BUILDER

J. I. BALLARD, Editor

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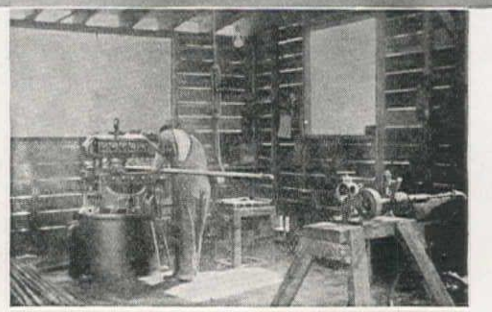
I-R Machines Speed Work

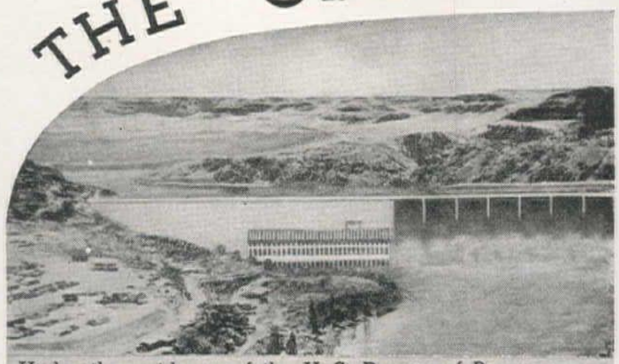
From the very first, extensive drilling was required, particularly after foundation rock was uncovered and the rock face was being made ready for the pouring of concrete. Many "Jackhamers" and paving breakers were used in this work.

Drill steel being resharpened in one of the several shops.



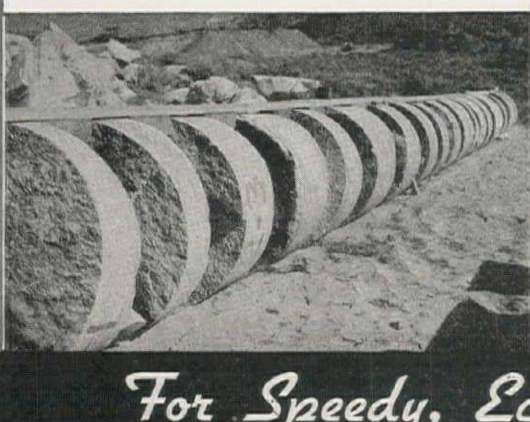
Where surface conditions permitted, wagon-mounted drifter drills were used. "Jackbits" are strung on wires in order of sizes used.

THE GRAND



Under the guidance of the U. S. Bureau of Reclamation, Grand Coulee Dam in Northeastern Washington is now being reared. Nearly 500 feet

"Calyx" drills are used to remove 36" cores from the foundation rock. Not only are these cores assembled and inspected for data on rock conditions, but geologists are lowered into the holes to actually see the rock formations. At the right is the drilling set-up for a 36" hole fifty-six feet deep.



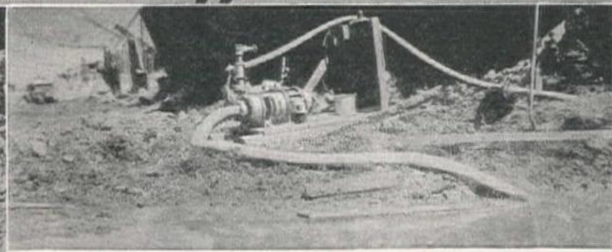
SPECTACULAR in size, unique in setting, and bold in conception, the Grand Coulee project has called upon the resourcefulness of the contractor for the solution of many construction difficulties.

Elsewhere in this magazine complete accounts have been given of the activities of the Mason-Walsh-Atkinson-Keir Company in the performance of the $29,000,000 contract for the first stage of the project. The gigantic conveyor system, and the huge cellular steel cofferdam naturally claim the lion's share of interest from the construction fraternity—

For Speedy, Economical Work Contractors Everywhere Rely On I-R Equipment—

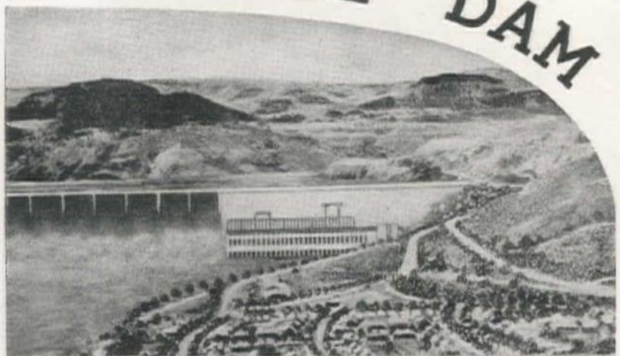
Compressors	Rock Drills	Furnaces	Jackbit Grinders	Drill Steel	Concrete Vibrators
Pumps	Sharpeners	"Jackbits"	Hoists	Hose	Pneumatic Tools

On World's Largest Dam

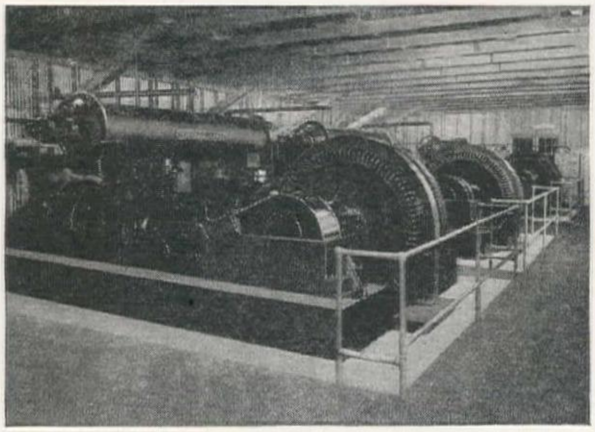


Many Motorpumps are used in handling water from sumps and drainage wells and for pumping out low spots. Motorpumps are built to stand rough treatment.

COULEE DAM



in height, this structure will contain $2\frac{1}{2}$ times the material and will generate half again as much power as Boulder Dam.



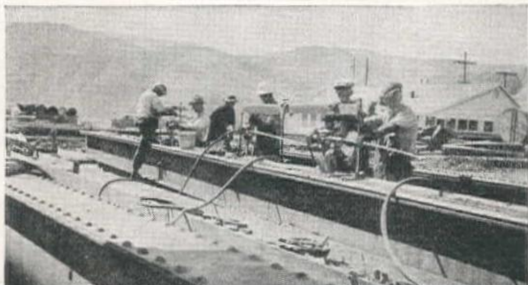
Air for drilling and general service is supplied by three Class PRE compressors located in the east side compressor house.

yet the "everyday" work of compressors, pumps, drills and pneumatic tools is vitally important to the smooth and efficient functioning of the contractor's plant. That this project has been reported to be months ahead of schedule is further testimony to the efficiency of the men and the machines at Grand Coulee.

Snapshots of a few of the I-R machines employed in this connection are shown on these pages. Ingersoll-Rand is gratified that its machines are permitted to play such an important part on outstanding construction projects throughout the world.

Sheet-steel piling connecting columns for the World's largest cellular-type cofferdam are "fabricated" in this busy yard.

Riveting hammers, drills, chipping hammers, holders-on, and Impact Wrenches are used constantly.



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Versatile Utility

Hauling Heavy Loads over Soft Ground Big tire traction—correct distribution of load with less dead weight—enable Trac-Truks to do more work by maintaining greater speeds on the runways, faster travel in spongy borrow pits and over soft fills with better flotation of heavy loads.

Wide Range of Selective Speeds for Heavy Pulls with Planetary Final Drive A wide range of selective gears and travel speeds are available in Trac-Truks which, with the aid of big tire flotation, move large capacity loads—much faster in higher gears, with planetary final drive, in notable comparison to the ability of ordinary equipment.

Easy Short Turning with Exclusive Steering Brakes Trac-Truks are built for quicker action on the straightaway and turning movements in and out when loading under a shovel or elevating grader. Their exclusive steering brakes are a big advantage in slippery going, making of sharp pivot turns.

No "Time Out" for Dumping There is no stopping, backing and wasting of time in placing the load with Trac-Truks. The dumping is done instantly while on the move and closing the doors is automatic with the Euclid marvelously smooth operating wheel wind.

Faster Dirt Moving with Greater Capacity With upwards of eight yards of pay dirt per trip—yardage builds up rapidly and unit costs go down accordingly. The extra production gained with Trac-Truk greater capacity adds up to a pleasing and profitable total at the end of the day and completion of the job.

Built for Performance with Lasting Endurance Trac-Truks are the result of well balanced design in power, traction, capacity and distribution of weight and are ruggedly built to withstand normal use and service of heavy duty hauling requirements with lasting satisfaction.

WHERE TRAC-TRUKS HAVE PROVED THEIR VERSATILE UTILITY—FOR LONG OR SHORT HAULS ON THE NATION'S BIGGEST JOBS

Mid-West Public Works

The building of Clear Creek Reservoir, Ft. Smith, Ark., constructing Sullivan Dam in Colorado, and the Sutherland and Columbus power projects in Nebraska are a few of the many jobs that bear witness of Trac-Truk reputation for moving dirt at lower cost.

T. V. A.

This large fleet of Government owned Trac-Truks are doing wonderful work in satisfying the discriminating demands of federal engineers.

Dam Construction

A fine example of popular preference for Trac-Truks is the purchase and use by George Brewster, Bogota, N. J., of nineteen Trac-Truks on the mammoth Mohawk Ohio Dam.

All-American Canal

Where Trac-Truks prove their great efficiency in fast dirt moving over long hauls ranging up to two and one-third miles one way.

Cape Cod Canal

With a grueling test made of the first Trac-Truk purchased, this fleet has grown to nine units as the result of acknowledged preference by a most exacting contractor.

Mississippi Levee

Embankments galore along the Mississippi stand as landmarks in attesting to Trac-Truk hauling efficiency and low cost results in levee work.

Iowa Railroad

Edward Peterson Company, Omaha contractor, was recently awarded the Burlington Railroad job and immediately eight Trac-Truks were selected and put to work to move more than a million yards.

★ *The present day position of high rank won by Trac-Truks and national prestige gained, have been accomplished over a relatively short period of time, which is significant in attesting to their outstanding quality and performance merit. Write for the further details required in accordance with your equipment needs and job conditions.*

EUCLID THE PIONEER

THE EUCLID ROAD MACHINERY CO.
CLEVELAND, OHIO U. S. A.

Here's the INSIDE STORY on Low Pumping Costs!

Constant C-140 is responsible for Permanent Savings on this Non-Tuberculating Pipe...

There's an "Outside" Story, too!

Scituate, Mass. installed Transite in 1932 to pipe water through salt marsh and river. Proving exceptionally resistant to corrosion, they have since used it on three more projects.

ISN'T THIS TRUE?

Since water pipe is laid solely for the purpose of carrying water, in the last analysis your investment is not in pipe but in water transportation facilities.

Why, then, in figuring the cost of a new main, should the yardstick be cost per foot of pipe? Isn't it much more logical to evaluate a water main primarily on its effectiveness as a water carrier?

And not solely on its effectiveness when new . . . all too often water mains are at the mercy of tuberculation, which constantly decreases the delivery capacity of ordinary pipe.

Can you afford, therefore, to pass up the savings in pumping costs offered by Transite Pipe . . . as already proved by hundreds of installations?

C-140 is the conservative minimum coefficient of Transite . . . not merely when first laid . . . not merely after five years or ten . . . but indefinitely.

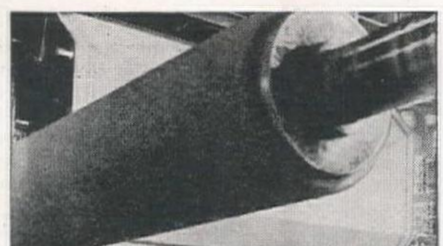
Made of asbestos and cement . . . and hence non-metallic . . . it is physically impossible for Transite Pipe to tuberculate. From the day

JOHNS-MANVILLE PRODUCTS

Johns-Manville

ENDING TUBERCULATION. In relatively few years tuberculation had seriously reduced the capacity of water lines at Belmont, Mass. Hence, for their recent Cushing Ave., project, they specified Transite, the *non-tuberculating* pipe.

INSTALLATION SAVINGS. A 16" line—an unusually deep trench; but lightweight Transite was laid down quickly, economically, without mechanical equipment. (W. Warwick, R. I.)



CLOSE-UP of one of the huge machines on which Transite Pipe is formed, under high pressure, into a dense, homogeneous structure, remarkably resistant to destructive agencies.

it comes off the polished steel mandrel that forms its smooth interior wall, this pipe's all-important value of C remains unchanged. High to start, its immunity to tuberculation keeps that coefficient high. And thus keeps pumping costs permanently low.

How Great are these Savings? The answer lies in a comparison of Transite's constant coefficient with one that drops steadily, due to tuberculation. Actually, in overcoming friction head, it costs only about half as much to pump against a coefficient of C-140 as against one of C-100. Project that over a period of years and you'll see the significance of our statements *on permanent savings.*

Do You Want All the Facts? An interesting series of hydraulic tables covers all the facts on this very important relationship between friction resistance and pumping costs. Based on the Hazen and Williams Hydraulic Tables, they establish the power needed to overcome loss of head due to friction in different sizes of pipe, carrying varying quantities of water, and with values of C from 60 to 140.

Send for these tables today . . . and also for a copy of the Transite Pipe brochure. Read the complete story of Transite's important installation and maintenance savings, as well as low pumping costs.

TRANSITE PRESSURE PIPE

An ASBESTOS Product

JOHNS-MANVILLE
22 East 40th St., New York City
Send me the Transite Pipe Brochure and Hydraulic Tables.

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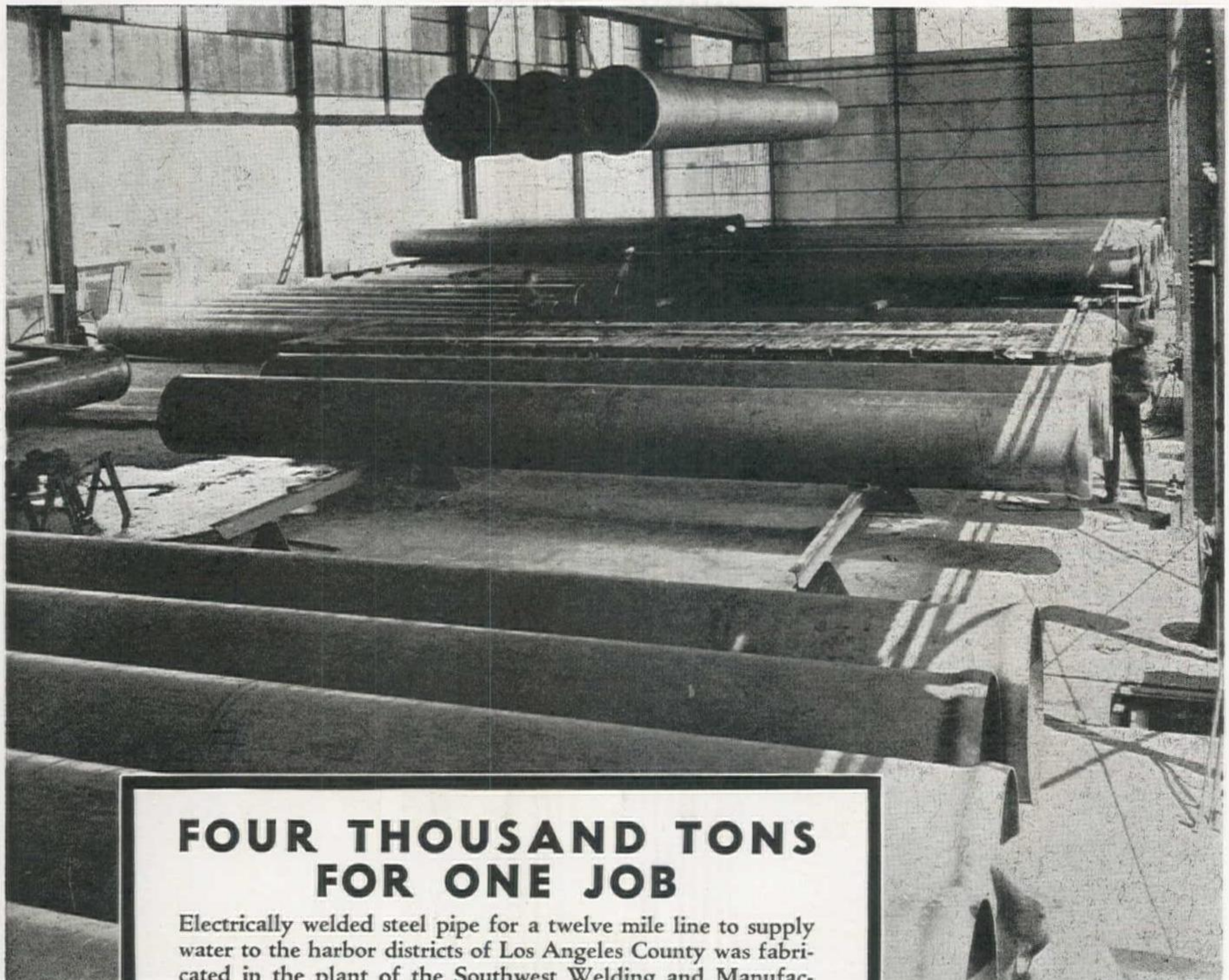


FOUR THOUSAND TONS FOR ONE JOB

Electrically welded steel pipe for a twelve mile line to supply water to the harbor districts of Los Angeles County was fabricated in the plant of the Southwest Welding and Manufacturing Company at Alhambra. More than two thousand lengths were required and delivery was made as wanted by the Bureau of Water and Supply.

A Quarter Century of Specialized Experience

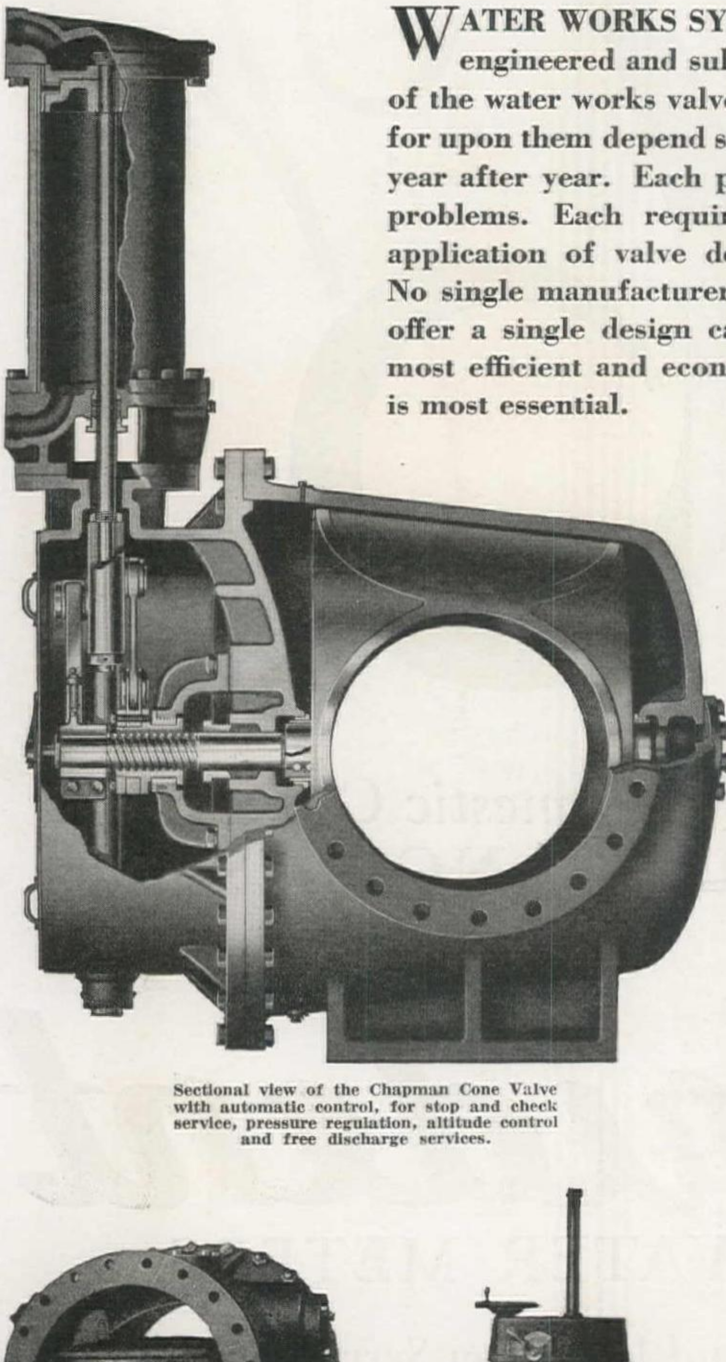
Our experience and facilities enable us to handle any engineering specification that involves fabrication and welding. Expert workmanship is assured on every job—big or little—all alike or all different—in any weldable metal. Correct technique applied in welding corrosion resisting alloys, stainless steel, nickel-clad and duralumin. Principal products include refinery stills, reaction chambers, heat exchangers, towers, piping and fittings.

Southwest Welding and Manufacturing Co., Ltd.
Alhambra, California

Pipe Specifications

Inside diameter, 31.4 inches. Thickness, 3/8 inch. Average length of sections, 30 feet. Total weight, more than 4015 tons. Capacity of line, 30,000,000 gallons in 24 hours, with a flow of 20 cubic feet per second. Pipe tested to 572 pounds per square inch. Service pressure, 80 to 175 pounds per square inch. H. A. Van Norman, Chief Engineer and General Manager; W. W. Hurlbut, Engineer of Water Distribution; Thos. Brooks, Superintendent of Street Main Construction.

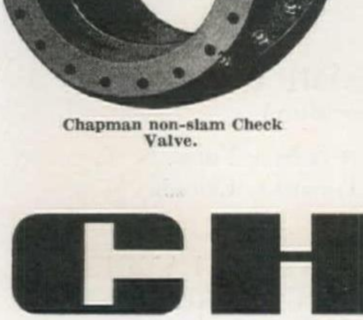
ENGINEERING . .



WATER WORKS SYSTEMS, to be successful, must be precisely engineered and substantially constructed. This is no less true of the water works valves which constitute the heart of the system, for upon them depend safety, efficiency and continuity of operation year after year. Each project presents its own series of hydraulic problems. Each requires careful engineering analysis and the application of valve designs which precisely fit the conditions. No single manufacturer of pressure regulators, for example, can offer a single design capable of meeting all the conditions in a most efficient and economical manner. A wider choice of design is most essential.

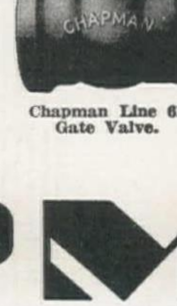
The recent affiliation of engineering and manufacturing facilities between the Chapman Valve Manufacturing Company and The Pelton Water Wheel Company was effected in order to provide, through either company, the widest choice of design in automatic water works valves. Chapman or Pelton designs are proposed in accordance with the specific functions of each in relation to specific operating requirements.

Sectional view of the Chapman Cone Valve with automatic control, for stop and check service, pressure regulation, altitude control and free discharge services.

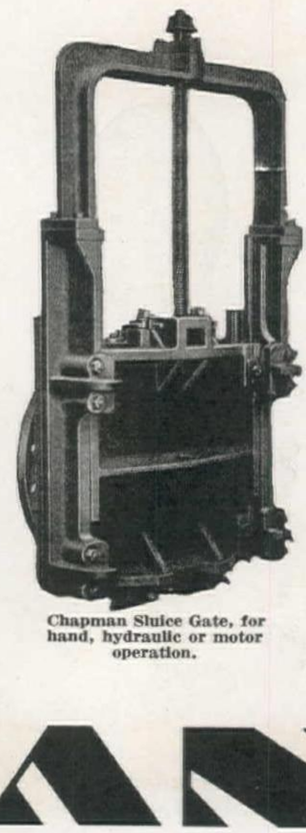


Chapman non-slam Check Valve.

Chapman Floor Stand for gate valve or sluice gate operation.



Chapman Line 61 Gate Valve.



Chapman Sluice Gate, for hand, hydraulic or motor operation.

CHAPMAN

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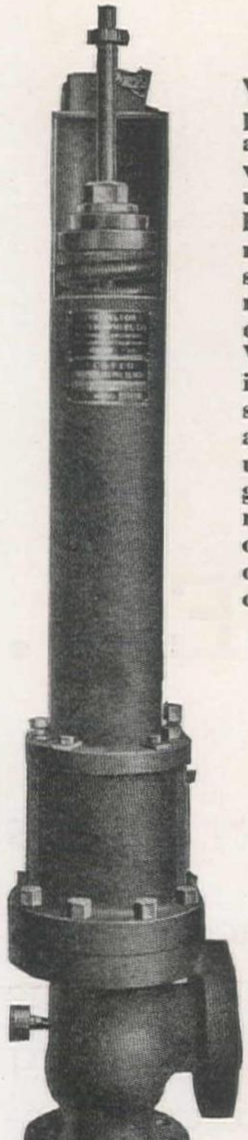
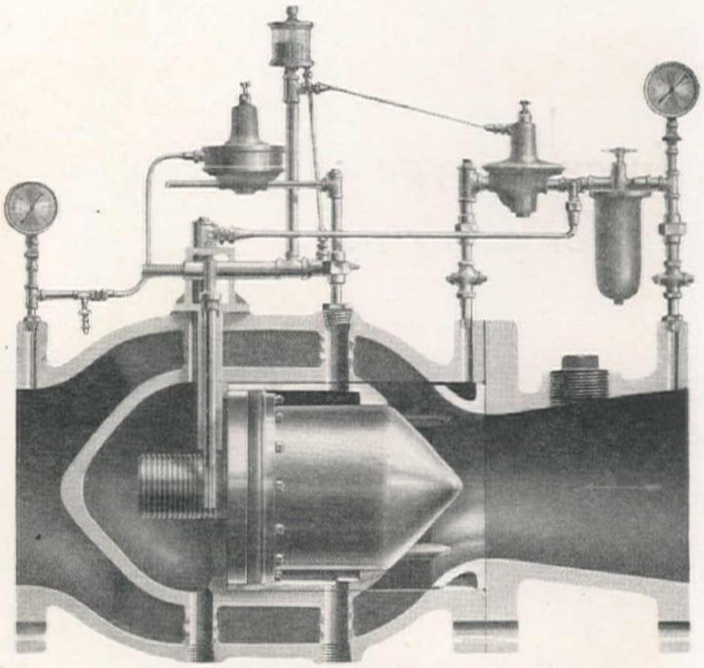
. . the First Consideration



Pelton Angle Type Surge Suppressor.

The Chapman Cone Type Valve, as illustrated on the opposite page, is recommended as an altitude valve, check valve, or pressure regulator under medium or low heads, being provided with control mechanism actuated by pressure, solenoid or mechanical means as the conditions require. The Larner-Johnson Valve, illustrated at the right, is recommended for similar services under higher heads and special conditions. This unit utilizes the balanced plunger principle with plunger movement parallel to the line of flow, and with automatic control suited to operating conditions.



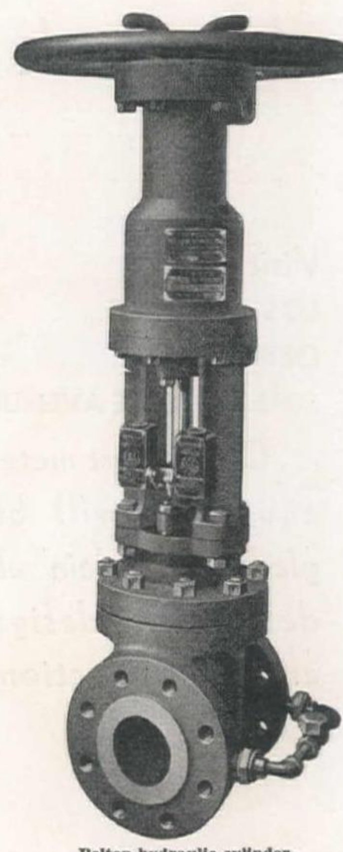
Larner-Johnson (balanced plunger) valve with Pelton control arranged for pressure regulation.

The Pelton angle type Surge Suppressor is another distinctive design, differing from other types since it opens with a decrease in pipeline pressure, remaining open to relieve the surge that follows. Its unique features commend its use on certain water systems to the exclusion of other types.

The Pelton differential hydraulic cylinder-operated gate valve is offered principally for installations where two or more pumps discharge into a common manifold, each being arranged to operate according to the individual characteristics of its pump and in a predetermined sequence.

Free discharge valves, air valves and flap valves complete the line of Chapman-Pelton valve products offered to the water works industry. Complete proposals are furnished through either company without obligation.

Your request for literature of other information will receive prompt attention.



Pelton hydraulic cylinder-operated Gate Valve.

THE PELTON WATER WHEEL COMPANY

HYDRAULIC ENGINEERS

120 Broadway, New York — 2929 Nineteenth Street, San Francisco — Paschall Station, Philadelphia

Exclusive Western Representatives for Baldwin-Southwark Corp., De La Vergne Engine Co., Cramp Brass & Iron Foundries Co., Woodward Governor Co., and Automatic Valve Division, Chapman Valve Manufacturing Co.

PELTON

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Spraying Barrett Concrete Curing Compound on freshly laid concrete to prevent rapid evaporation of moisture.

A coal-tar concrete curing compound backed by 82 years of experience . . .

Barrett Concrete Curing Compound has been developed by America's oldest and most experienced manufacturer of coal-tar products. It provides an effective concrete cure where structural design or shape makes usual methods of curing impractical.

Applied to surfaces of freshly placed concrete, it retards evaporation and assists in securing proper hydration of the cement. It remains in place indefinitely as a protective coating—an added advantage, especially when concrete is exposed to severe climatic conditions or to the disintegrating effects of active waters.

It is easy to apply—requires little equipment and can be successfully handled by inexperienced labor. A skilled Barrett Technical Staff will gladly furnish complete information and coöperate with you.

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FIELD SERVICE

Skilled Barrett field men will gladly work with you, combining their special knowledge and experience with your familiarity with local conditions.

THE TECHNICAL SERVICE BUREAU

of The Barrett Company invites your consultation with its technically trained staff, without cost or obligation. Address The Technical Service Bureau, The Barrett Company, 40 Rector Street, New York.

ARE you puzzled about what pump to use for a job that must be handled "just right"?

Then call the man from Fairbanks-Morse and see how much *more* he has to offer. He has not one or two but many types from which to select—centrifugals, rotary, steam, turbine—each one built to do a specific job and do it well.

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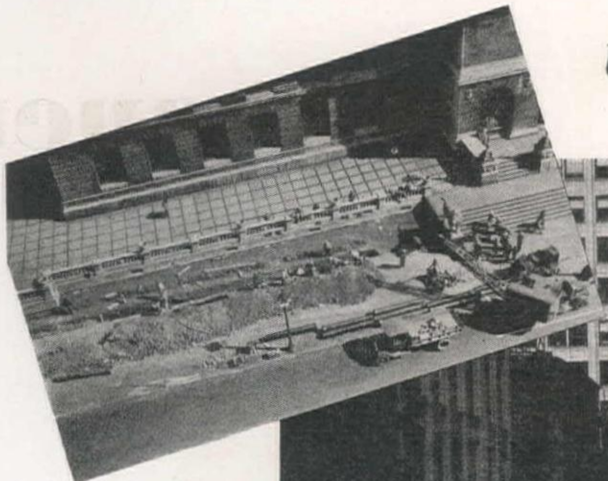

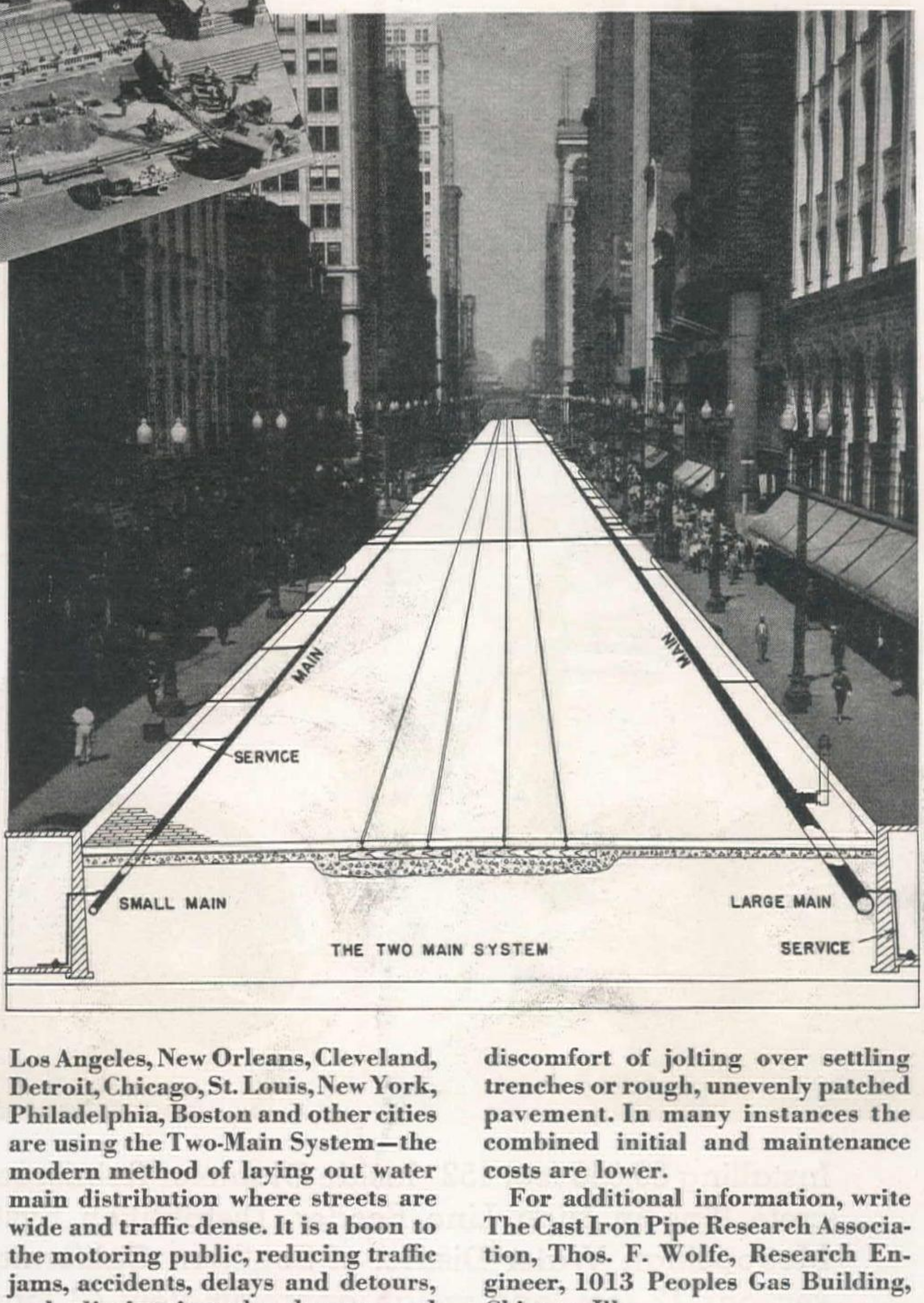

Upper photo shows typical Two-Main installation in grass plot behind curb. Photo-diagram at right shows method of installation in street where sub-sidewalk space is used for business purposes.

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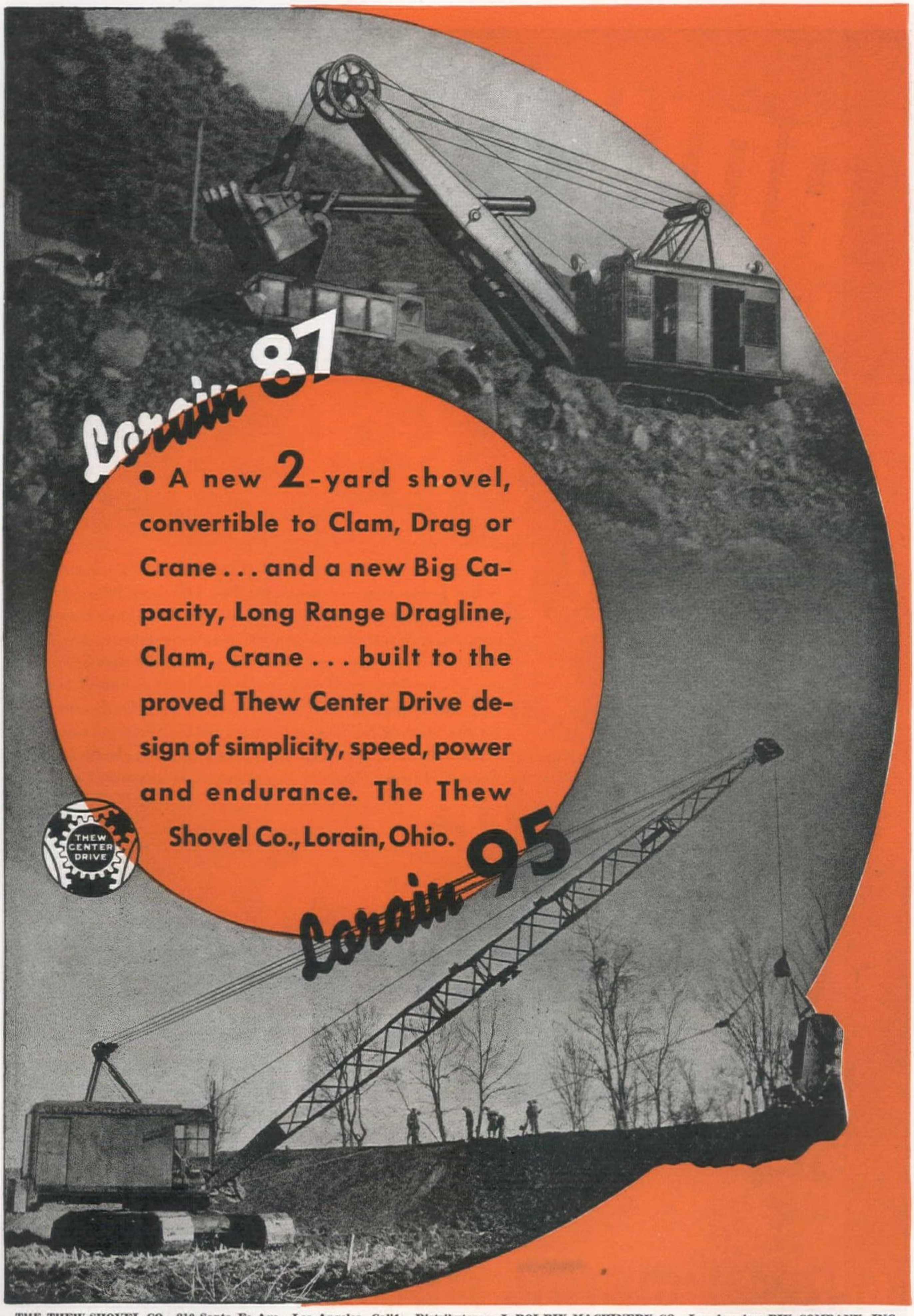
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(Above)
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• •

(Left)
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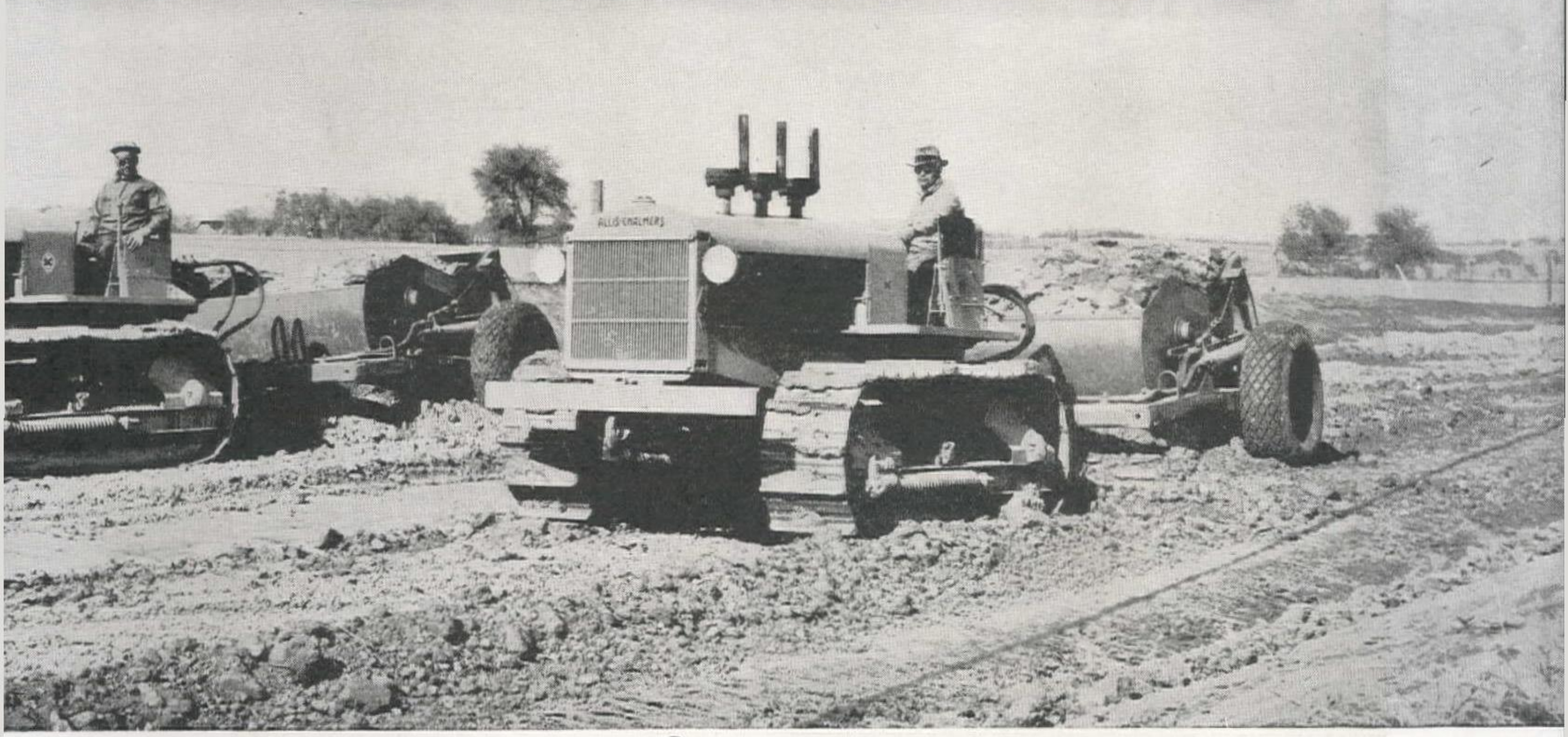

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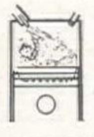
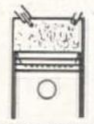
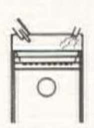


CONTROLLED FUEL INJECTION



PROPER MIXING BEFORE IGNITION



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CATERPILLAR *Diesel*

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June, 1936

WESTERN CONSTRUCTION NEWS

WITH WHICH IS CONSOLIDATED WESTERN HIGHWAYS BUILDER

Vol. 11, No. 6

J. I. BALLARD, Editor
G. E. BJORK, Northwest Editor
H. W. PYERITZ, News Editor

More Engineers Start Their Divergent Careers

AFTER four years of formal instruction another crop of embryo engineers has emerged to learn that not all problems can be solved by a quadratic equation. Some are headed for jobs in offices to find that neat tracing and detailing are still excellent prerequisites for good designing. Others will start for the field to learn the difference between dragging a tape through a thicket of scrub oak and the sophomore surveying problem of determining the height of the campus flag pole. The former group, with few exceptions, will bore deeper and deeper into the science of design and presume to fit materials of construction to these theories. The other will advance into the ranks of construction engineers, superintendents and contractors, and come to regard all but overall dimensions on drawings as unnecessary details, with notes on the number and size of reinforcing bars considered as a refinement only exceeded by senseless references to spacing. In far too many cases the paths of these two groups will continue to diverge without interruption, presenting one of the most serious problems faced by the civil engineering profession—the lack of broad, first-hand appreciation for the interrelated problems of design and construction.

The widening of this breach is almost inevitable, as the industry demands more and more specialization, and individuals concentrate their attention on getting ahead in their own field of design or field work, without having the time to get the other side of the picture. The designer is becoming much more technical than he was years ago, and the construction man now deals with equipment and machines to the point of becoming an assembler of materials on a strictly mechanical basis. The link between design and construction is steadily growing weaker and weaker, until there is danger that it will soon become missing altogether. Is there any possibility of giving graduates a glance at the whole, broad picture of design and construction before he selects his special field of work?

•

Things Not Found in Books

AS long as Western construction men continue to talk about the world-record driving of the diversion tunnels on the Boulder Dam project they will have cause to remember and admire the genius and skill of Floyd T. Huntington. His recent death removes one of the West's real construction specialists, and a man who probably had forgotten more about tunnel driving than has been written on the subject. Years of training and experience in this particular branch of construction made him as much an expert as the technician who spends a similar period at more formal study. It is extremely unfortunate that this type of job-acquired information, which is so essential to progress in the art of engineering, cannot be preserved for those who follow. Possibly this is asking too much, since the subject is one which can only be mastered through the route of hard experience, rather than gathered from books. Nevertheless engineering literature would be the richer if it included more of the type of information which would come directly from the field.

•

Another Idea Goes East

IT is becoming generally accepted that most new developments in the field of heavy construction originate in the West and travel eastward, but occasionally the East comes to this region to borrow an idea of more technical advance. This is the case with the use of snow surveys as a means of predicting seasonal stream flow. In the East snow accumulated during the winter acquires mostly skiing or nuisance value, and the main engineering concern is the getting rid of the resultant floods in the spring. Quite the opposite is the attitude in the West where snow packs constitute a valued natural resource, to be conserved and utilized with forethought and care. As a result of this value, the measure of accumulated snow on Western mountains and the use of this information in predicting the summer runoff has become recognized hydraulic engineering practice during the last two decades, following the pioneering and leadership of Prof. J. E. Church of the University of Nevada. Snow surveys have spread in the West to become the basis for more and more accurate estimates of runoff, used to distinct advantage in the fields of irrigation, hydroelectric power, flood control and water supply. Recently the use of this general method has been borrowed and applied to the utilization of the storage to be provided by Fort Peck dam. Further, Eastern engineers suggest broadening the idea to a national scope in connection with water resource planning. When it comes to studying water resources, conserving them and planning their widest application the West will always provide the advance thinking in engineering and construction.

•

Reviving an Old Subject—

THE start on the improvement program for sewage disposal by San Francisco and the completion of the several disposal plants by communities on the Peninsula directs attention again to the general problem of pollution in San Francisco Bay, which has been a subject of discussion by *Western Construction News* for several years. The continuing improvements made in sewage disposal along the coast of Southern California, the program under way by the City of Seattle and the strides taken by many eastern communities to protect and improve tidal waters reëmphasizes the importance of cleaning up San Francisco Bay if the surrounding communities are to maintain their shorelines and adjacent waters up to modern standards of harbor sanitation.

On the east side of the Bay from the industrial town of Pittsburg to San Leandro, a population of about one-half million disposes of raw sewage and untreated industrial wastes into these harbor waters. As the San Francisco program advances this pollution will becomes relatively more serious. Bayshore highways north and south from Oakland, one under construction and one planned, will further call public attention to the problem. Naturally, the problem is not one for immediate solution, but there is ample evidence that a comprehensive program for East Bay sewage disposal with proper treatment should be under consideration. Several years ago these communities met a common water supply problem with eminent success. If they are to maintain their position as modern cities of the West, it is time they combined their thinking to solve an equally pressing common problem in sanitation.

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WESTERN CONSTRUCTION NEWS
VOL. XI, NO. 6 • ELEVENTH ANNUAL WATER WORKS ISSUE • JUNE, 1936

Spence Air Photo

The West Welcomes A.W.W.A.

. . . a Convention Message *by* Pres.-Elect Hurlbut

THE water works fraternity in California and the West deem it a valued privilege to be hosts to the members of the American Water Works Association meeting in their fifty-sixth annual convention at the Biltmore Hotel in Los Angeles, June 8 to 12.

It was the writer's privilege ,in Chicago in 1933, to extend an invitation to the American Water Works Association to hold their 1936 convention in Los Angeles, and stress was laid on the fact that many engineering projects involving water supply on the Pacific slope were under construction and we felt that we had many things of interest in the West to show the water works engineer and operator from the East who will attend this convention.

One of the outstanding features in connection with water supply in the West and on the Pacific slope is the long distance transportation of the supply. It is necessary to go great distances, to cross deserts and bore through mountains, in order to transport to the more populous areas the element of water, upon which the future growth and prosperity of any community depend.

At the present time the aqueduct of the Metropolitan Water District of Southern California, from the Colorado River, is under construction; the extension of the Los Angeles Aqueduct to its Mono Basin Project is under way; San Francisco has but recently completed its Hetch Hetchy Aqueduct and many additions to its local distribution system are near completion. These projects transmit water from 150 to 350 miles from the source to the point of use.

Another important phase of the operation of water works in western America is the element of the necessity of conserving the supply. This is accomplished in water works of the West through a one hundred per cent metered control, both as to supply and consumptive uses.

The California Section of the American Water Works Association has grown to one of the foremost sections of the Association and through the wholehearted coöperation of this membership it has been possible to hold, for the second time, an annual national convention on the Pacific Coast.

Engineer of Water Works
Bureau of Water Works and Supply
City of Los Angeles
•
President-Elect
American Water Works Association

Los Angeles By Means of

Tunnel camps in the high Sierra house 200 men at the two portals and the two shafts used in driving the 11½-mi. Mono Craters bore.

WITH tunnel driving going forward at record breaking speed and more than 28,000 ft. driven on the 11½-mi. Mono Craters bore, the City of Los Angeles is making fast progress on its Mono Basin project to bring a supplemental water supply through the crest of the Sierra into the Owens River so that the present aqueduct can be operated at its full capacity of 480 sec. ft. throughout the year. Excavation is also proceeding on the site for the Grant Lake dam which will be built to provide the main storage on the basin side of the divide, to regulate the flow of the several small streams, before diverting this water through the main tunnel. Between the tunnel and the head of the Owens River aqueduct, the Long Valley dam is being built to provide 163,000 ac. ft. of additional regulation and storage. This steel-faced, rock-fill dam will contain 510,000 cu. yd. of fill. Excavation for the site is well advanced. With an estimated construction period of 3½ years the project is scheduled for completion about the end of 1937.

Historical

As early as 1915 Los Angeles began preliminary studies on the feasibility of securing a supplemental water supply for the Owens Valley aqueduct from Mono Basin. The general plan included: (1) the acquisition of physical properties and existing water rights, (2) the building of conduits, dams and tunnels necessary for the collection of the waters from the several streams in the basin and (3) the transmission of this water to the Owens River from where it could be delivered to the city through the existing aqueduct system. Hydrographic studies made of this project indicated that it is possible to secure from the Mono Basin a supply of water, which, when added to the supply in Owens River and the development of underground sources in the Owens Valley, would make it possible for the city to operate the aqueduct continuously at its maximum capacity of 480 sec. ft.

According to this study, during the period from 1906 to 1931, the average annual flow of all the Mono Basin streams was about 226 sec. ft., based on available information. Of this flow, 195 sec. ft. could have been diverted by the works now being constructed. During the 1923 to 1933 period, which was distinctly one of sub-normal runoff, the average flow of these streams was about 150 sec. ft., of which 140 sec. ft. would have been available for diversion.

Mono Basin characteristics

The Mono Basin, located about 350 mi. north of Los Angeles, in Mono County, Calif., is a mountainous area on the east slope of the Sierra Nevada about 22 by 47 mi. in size, at an elevation varying from El. 6,400 at Mono Lake to El. 13,000 at the highest peaks (see map.)

Most of the water supply comes from the west side of the basin, on the east side of the Sierra, with the runoff forming several small streams which empty into the lake, situated in about the center of the basin. In June, 1931, this body of water had an area of 86.6 sq. mi., exclusive of the two islands. The eastern side of the basin is very arid, mostly destitute of vegetation and not productive of sufficient water to reach far into the basin.

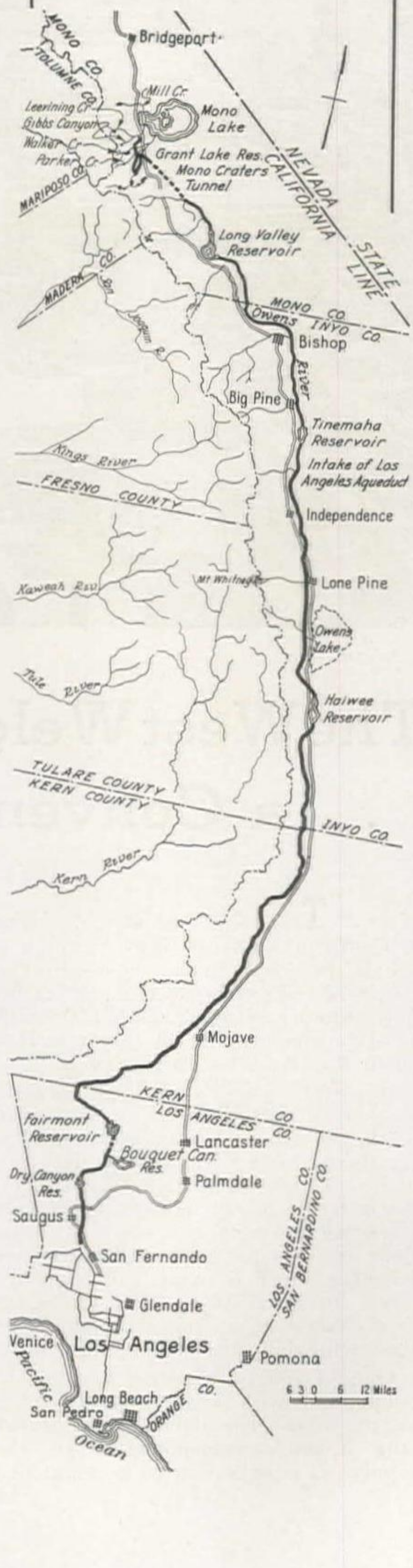
The principal streams of the west side of the basin are, in order of their importance: Rush Creek, North Fork Reversed Creek, Parker Creek, Walker Creek, Leevining Creek and several others. The flow of these streams constitutes practically the entire water supply of the basin and is the source being developed for the present project.

Plan of diversion

The Mono Basin collecting conduit is of varying capacity to carry the supply from the various streams along the route. The general type of conduit construction is shown in the drawing. From Leevining Creek to Walker Creek the capacity will be 300 sec. ft., increased to 325 sec. ft. at the latter creek. This capacity continues to the Parker Creek diversion where another 25 sec. ft. is diverted, making a conduit

MAP OF THE PROJECT

The present Owens Valley aqueduct is to be augmented to its capacity of 480 sec. ft. by water collected from streams in the Mono Basin and diverted through the Mono Craters tunnel. The new Long Valley reservoir will regulate this supply above the head of the aqueduct.



Taps Mono Basin Water 11.5-Mile Tunnel

Supplemental supply for municipality to be obtained by extensive program which includes diversion of several streams—Two dams under construction—Tunnel driving record of 90 ft. in 24-hr. period

capacity of 350 sec. ft. which continues into the Grant Lake reservoir.

Out of this regulating and storage reservoir is a gravity line, with the first 3,450 ft. in tunnel, followed by 3 mi. of trapezoidal conduit to the portal of the Mono Craters tunnel. The capacity of the system below Grant Lake reservoir will be 390 sec. ft., including the long tunnel.

From the east portal of the Mono Craters tunnel the water will flow down the Owens River about 30 mi. to the Long Valley reservoir, to be formed by the Long Valley dam. From this reservoir the supply will continue down the river to the existing intake of the Owens River aqueduct.

Mono Craters tunnel

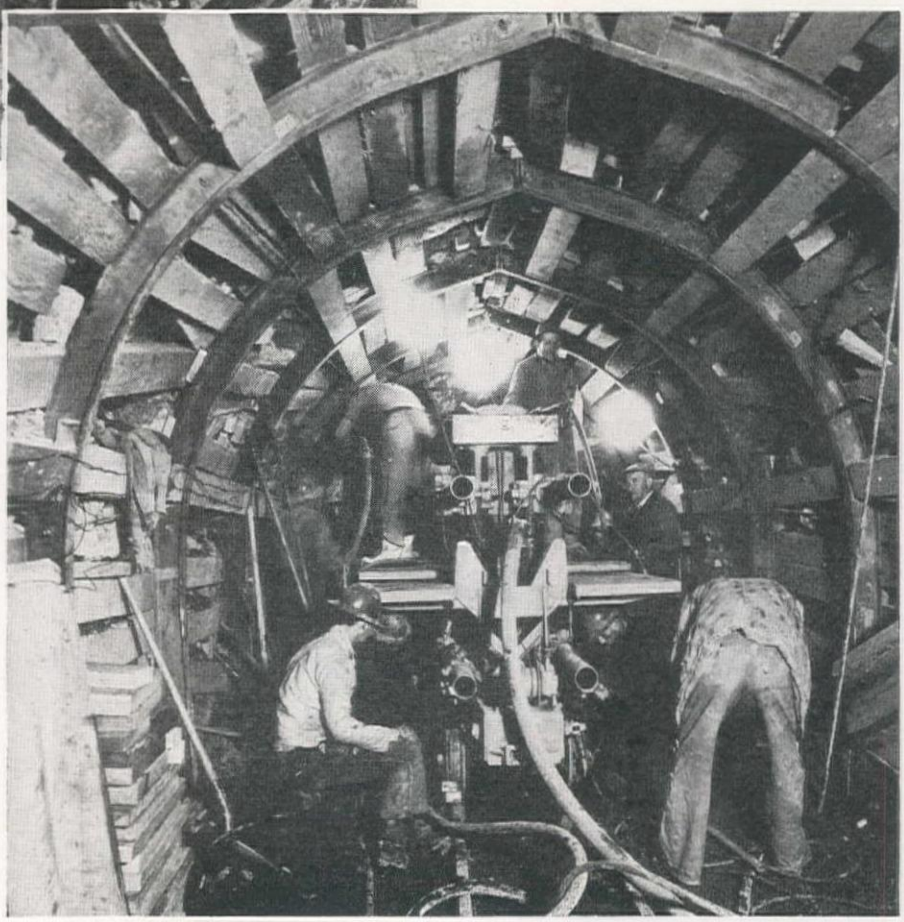
The Mono Craters tunnel, 59,812 ft. in length, is of 9-ft. section, wide horseshoe type, and will be concrete-lined throughout. Due to its length, two shafts are being sunk along its axis to shorten the required driving period. Excavation will be carried on from the six headings, two at each shaft and one each at the portals. The estimated time required to complete the Mono Craters tunnel is 3½ years.

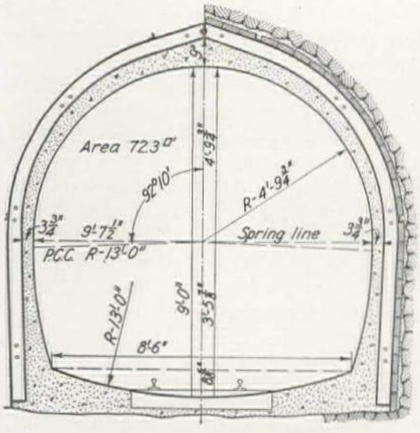
With the Mono Basin project authorized by the Board of Water and Power Commissioners July 3, 1934, actual drilling was started at West Portal on Sept. 24, 1934, and at the East Portal on Nov. 23 of that year. Excavation for sinking Shaft No. 1, which will have a depth of 895 ft. to tunnel grade, was begun on Nov. 28, 1934, and excavation work at Shaft No. 2 was started Feb. 8, 1935.

Shaft No. 2 was completed to a total depth of 362 ft., including muck pocket, in October, 1935, and drifting was begun immediately easterly from the shaft, and westerly from the shaft toward East Portal (Headings 4 and 5). On May 1, Shaft No. 1 had been sunk to a depth of 763 ft. and 13,317 ft. of excavation had been made from the West Portal (Heading No. 1), including 2,780 ft. of support. By that same date, 3,240 ft. had been excavated in Heading No. 4 (2,430 ft. supported), 1,838 ft. driven in Heading No. 5 (1,479 ft. supported). In Heading No. 6, the East Portal, 9,220 ft. of tunnel had been driven and 6,250 ft. of this was supported. In Grant Lake outlet tunnel, 2,923 ft., entirely supported, had been drilled.

Running line in the Mono Craters tunnel, which will be driven from the two portals and four headings from two shafts.

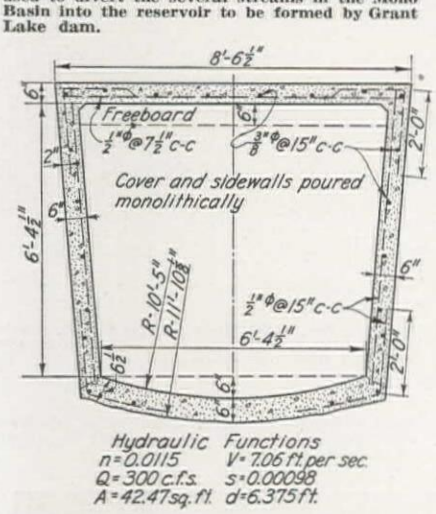
Drill carriage mounting four automatic-feed drills used to set hard-rock tunneling record of 90 ft. in 24 hr.





Cross section through Mono Craters tunnel showing dimensions and both lagged and unlagged steel rib supports. The bore will be concrete lined throughout.

Typical section through the collecting conduit used to divert the several streams in the Mono Basin into the reservoir to be formed by Grant Lake dam.



What is believed to be a new world's record for hard-rock tunnel driving was established at Heading No. 1 on April 29, 1935, when 65 ft. of tunnel was excavated in 24 hr. This was broken on May 17 and again on May 18 when an advance of 72 ft. in 24 hr. was made; further, on July 15, 1935, 90 ft. was made in Heading No. 1 in 24 hr. For the three months period, October, November, and December, 1935, tunneling progressed at the rate of 18.7 ft. per day per heading in four headings.

The construction program provides for continuous driving in three 8-hr. shifts for 6 days a week. Four 3½-in. automatic-feed drifter drills, mounted on a drill carriage built in the Water and Power Department shops, using 1¼-in. hollow, round, drill steel is used in each of the four headings now open. Six-inch compressed-air lines have been installed and ventilation is provided through 18-in., 14-gage pipe.

Conway muckers are in use at each face. These machines are especially designed with an overall width of 45 in. and use a manganese cast boom and dipper. Hauling is done in two-way side dump cars having a capacity of 70 cu. ft. The muck is moved out in nine-car trains hauled by storage battery locomotives. The track is 24 in. gage with 40-lb. rail, and the switches used at the face are the California type, portable jump switches, while ordinary one-way switches are used elsewhere.

Camps and access works

In addition to the survey camp established on Cain Ranch in January, 1930, there are four permanent construction camps along the tunnel line, each housing about 200 men. All camps are electrically lighted and all the kitchens are electrically equipped throughout. For heating, butane gas is used as fuel, the dormitories being equipped with hot air units while the other buildings are heated directly by gas stoves.

A recreation hall, with pool tables, library, and motion pictures has been built at each camp and every provision has been made for the comfort and welfare of the men. A general hospital, fully equipped, has been built at West Portal camp and a dressing station at each of the other camps, with doctors and surgical nurses in attendance at the hospital and nurses at the dressing stations.

Roads have been built to provide access to all the camps. A water supply for camps and construction use has been provided, and a 33 kva power transmission line has been erected from an existing Southern Sierras Power Co. plant on Leevining Creek to each camp. Telephone lines have been built to provide direct communication by telephone and teletype from Los Angeles headquarters to the project.

Because of heavy snow and deep drifts during the winter months, snowsheds have been erected at each tunnel portal to insure uninterrupted access.

Grant Lake dam

Engineering investigations indicated that Grant Lake is the most suitable reservoir site of large capacity in Mono Basin. The dam to form this reservoir will be located on Rush Creek at the narrows below Grant Lake. It will be of the earthfill type and rest on a morainal foundation. The structure will be about 85 ft. high above stream bed, and will create a reservoir of 48,000-ac. ft. capacity. Preliminary work up to May 1, 1936, consisted of stripping top soil at the damsite and digging a ditch to divert the waters of Rush Creek during the period of construction. About 284,000 cu. yd. of earth had been removed from the damsite and approximately 6,500 cu. yd. from the diversion channel on this date. The design of this structure, including such items as the foundation problems encountered, the testing program, percolation studies and spillway will be reviewed in design in an article in the next (July) issue of *Western Construction News.*

Long Valley reservoir

From the east portal of the Mono Craters tunnel, the water will empty into the Owens River and flow about 30 mi. into the Long Valley reservoir. This reservoir will store 163,000 ac. ft. with water surface at El. 6,781 ft. and have a surface area of about 5,000 ac. The dam, of the rock-fill type, will be located at the upper end of the Owens River gorge (see map.)

Crest of the structure will be at El. 6796.5, providing 15 ft. of freeboard and a height of 132 ft. above streambed. The top width will be 30 ft. and the length along the crest about 530 ft. Side slopes will be 1½ to 1 on the upstream side and 1¾ to 1 on the downstream. The upstream slope will be covered with an arc-welded steel facing on the upstream slope. The volume of the dam will be approximately 510,000 cu. yd. On May 1, 1936, about 310,600 cu. yd. had been stripped at the damsite.

Organization

The Mono Basin project is being carried out by the forces of the Los Angeles Bureau of Water Works and Supply, under the general direction of H. A. Van Norman, chief engineer and general manager. H. L. Jacques is construction engineer in direct charge of the work. E. A. Bayley is field engineer and H. P. Bliss is assistant field engineer.

It is estimated that an average of approximately 1,000 men will be employed over the 42-month construction period with a maximum of some 1,800 men at any one time.

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Colorado Water Surveys

TWO SURVEYS of water conditions in Colorado have been started recently by the U. S. Bureau of Reclamation to make a total of five such projects under operation in the state at the present time. One new survey for which $100,000 is allotted calls for a detailed investigation of the proposed transmountain diversion of the Blue River waters to the South Platte River. This work will include preliminary plans and estimates for the proposed diversion project. Thirty men are employed on this investigation.

The other new survey is the $150,000 detailed Western Slope survey, an investigation of a number of projects in the Colorado River basin of the state. Its purpose is to secure supplemental water for areas under irrigation. Forty men are at work on this investigation.

The three other surveys which have been in progress for some time are: The $150,000 Grand Lake-Big Thompson transmountain diversion investigation of geologic and economic conditions, now employing 40 men; the $100,000 Rio Grande survey of reservoirs in the San Luis Valley in the proposed transmountain water diversion from the San Juan Basin to the Rio Grande Basin, now employing 50 men; and the general land classification on the Western Slope, a preparatory program in progress in all Colorado River states in studying utilization of Colorado River water resources.

Water Shortage Problem Is Solved by City of Cheyenne

Years of drought necessitate development of supplemental underground supply—Meters replace old flat-rate system to conserve supply

By Z. E. SEVISON
City Engineer
Cheyenne, Wyoming

AFTER a five year threat of serious water shortage the City of Cheyenne, Wyo., has completed the development of a supplemental underground source which definitely assures an adequate supply, both for the present and the immediate future. Important features in this struggle against a four-year period of deficient precipitation included: (1) the installation of meters in place of flat-rate service, to reduce waste; (2) the restriction of irrigation and lawn sprinkling throughout the city from 1932 to 1934; (3) the use of CWA projects and ERA funds; (4) the search for an underground supply to supplement the existing supply. The following article reviews the events of the past five years leading up to the present developments and summarizes the program undertaken to meet the situation.

Water Supply of Cheyenne

Cheyenne is located in the extreme southeast corner of Wyoming, at El. 6,090. The municipal water supply is based on a prior right to the entire flow on Crow Creek. This stream has a watershed area of about 90.5 sq. mi. above the pipe line intake. (See map). The average precipitation at Cheyenne prior to 1931 was 14.6 in.; for the five years, 1926-1930, it was 18.3 in. and even during this period the two municipal reservoirs then available did not provide any surplus so that a third storage reservoir with 1,865 ac. ft. capacity was built in 1928-1930. In 1931 the annual precipitation dropped to about 12.7 in. and was followed by three more years of subnormal precipitation and runoff. Available records indicated a precipitation in the watershed about 3 in. greater than at Cheyenne.

The normal flow of Crow Creek is augmented by the storage of 11,686 ac. ft. in the three reservoirs already mentioned. From these reservoirs water is conveyed through two 20-in. gravity supply lines a distance of about 17 mi. to the Round Top filter plant, located on a small hill near the city. From the filter plant the supply lines continue a distance of about 2 mi. to the distribution system. Further reference to the filter plant will be made later in the article.

In addition to a rapidly increasing population which has reached about 20,000, the municipality, from its inception, has been under agreement to furnish water for the extensive shops of the Union Pacific Railroad. Further, the city supplies water to Fort Warren, a population of 3,600. Prior to the installation of metering, about three years ago, the daily water consumption was unusually high amounting to an average of about 260 g.p.d. per capita, with a summer peak of about 8,500,000 g.p.d., (500 g.p.d. per capita) when lawn watering was at its height.

The quality of the Crow Creek water is satisfactory from a bacteriological standard and the clarity and pallatability is above the average. The original filter plant was installed in 1915 for the purpose of producing a more uniform quality of supply. The operation of the plant up to the summer of 1935 had not been satisfactory as to uniformity of results, particularly during flood flows in the creek due to lack of adequate sedimentation basin and control equipment in the plant.

Beginning in the year 1931, precipitation in the Cheyenne region fell below normal, runoff declined severely and the draft from the storage reservoirs created a serious problem.

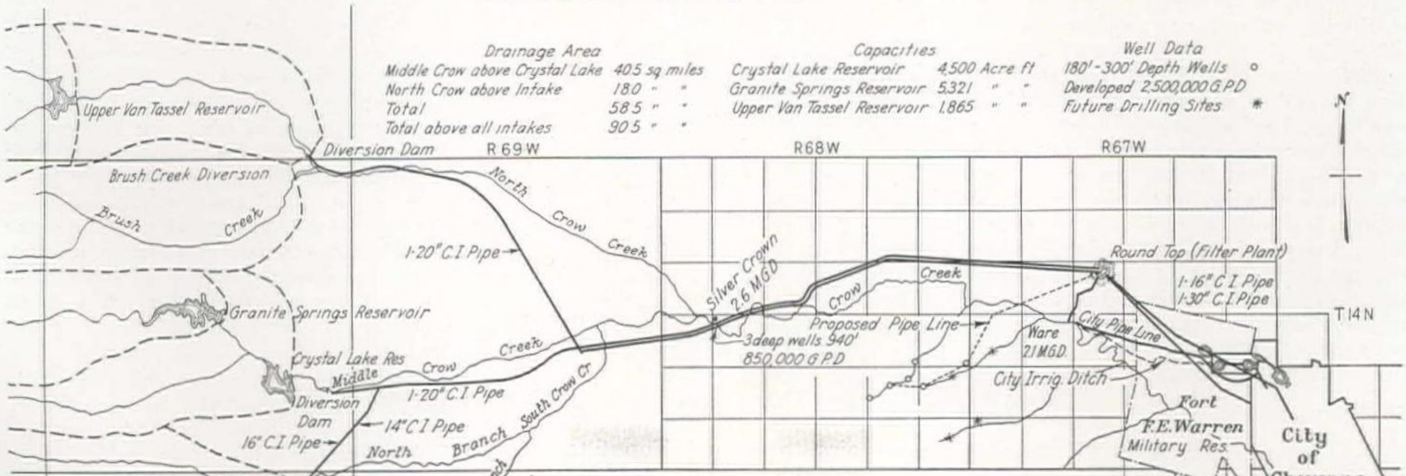
1933 Program

A study of the water supply situation was made during the spring of 1933 and a program adopted which included: (1) construction of two pumping plants, one at Ware and one at Silver Crown (see map) to draw the subsurface supply from Crow Creek; (2) the installation of meters throughout the city and the elimination of flat-rate service, and (3) rigid restrictions on the use of municipal water for irrigation and lawn sprinkling.

In June, 1933, the city made application for a PWA loan and grant of $750,000 for extensive improvements to the existing water supply system. During that summer, while the PWA red tape was being unwound, the shortage of water became so acute that preliminary work was started at one of the pumping plants and on the installation of meters. At that time, in an effort to secure immediate action on the PWA application, the request was reduced to include only the cost of metering and the emergency pumping plant. The application was eventually denied on the basis that part of the coöperative funds had already been spent by the city on this urgent, emergency work.

During July, 1933, a contract was let for furnishing 3,500 meters of various sizes. Because of the cost involved, about 700 of these were set in curb boxes and the remainder in basements. During the fall of that year the CWA was used extensively in this work.

Water supply system of Cheyenne showing drainage areas, reservoirs, cast iron mains and the location of the newly developed wells.



Pumping plants installed

At Silver Crown, where the main supply lines from the reservoirs crossed the creek, a simple pumping plant was installed to obtain surface and subsurface flow. A small concrete diversion dam was built to intercept flow in the stream-bed gravels and an 8-in. centrifugal pump of 2½ m.g.d. capacity, belt driven from a 75 hp. gasoline engine, was installed to discharge into the existing supply lines. In addition to the creek flow, three shallow wells into subsurface gravel were connected with this same pump. This plant was placed in operation May 31, 1933 at a cost of about $7,000 (including wells). The plant operated continuously during 1933, delivering about 1½ m.g.d. at a cost of 1 cent per thousand gallons for operating charges.

At another location nearer the city on the same creek (Ware pumping plant) an 18-in. perforated pipe was laid across the valley of the stream at a depth of about 4 ft. into the hard-pan underlaying the gravel of the stream. This trench was backfilled with gravel to complete the infiltration works. Electrically driven pumps of 1.4 m.g.d. capacity were installed, at a sump near this gallery discharging against a head of 250 ft. through a 14-in. steel pipe 6,700 ft. long to the filter plant.

These two pumping plants, the work of installing meters, and the restrictions against irrigation constituted the principal features of the improvement program during 1933.

COMPARISON OF FLAT-RATE AND METERED WATER RATES IN CHEYENNE

Old flat-rate charges per year

1 to 4 rooms	$10.00	Bathtub, each	$5.00
5 or 6 rooms	11.00	Water closet, each	5.00
7 or 8 rooms	12.00	Garage, each car capacity	1.00
9 or 10 rooms	13.00	Irrigation, 66 ft. front or less	5.00
11 or 12 rooms	14.00		

Present meter rates per month

Minimum $1.25 per month for 1,000 gal. or less.
Next 100 gal. or fraction @ 25c.
Next 6,000 gal. @ 20c. per 1,000 gal. or fraction.
Next 22,000 gal. @ 15c. per 1,000 gal. or fraction.
Next 20,000 gal. @ 10c. per 1,000 gal. or fraction.
Next 150,000 gal. @ 8c. per 1,000 gal. or fraction.
Next 300,000 gal. @ 7c. per 1,000 gal. or fraction.
All over 500,000 @ 6c.
Minimum on meters 3-in. or over, $15 per month.

1934 program

In 1934 the serious drought continued with most of the local creeks dry. During this season the city tried developing springs in Granite Canyon with Federal Drought Relief funds but only about 3,000 g.p.d. were obtained.

During this year the restrictions on water use continued, the broader aspects of the problem were studied from several angles. The depletion of the storage continued.

An ERA Drought Project was initiated in June under the direction of the writer with Dr. S. H. Knight of the University of Wyoming as consulting geologist. In order to explore the possibilities of an underground supply, additional wells were started at Silver Crown and Ware with the Fox Hills sands as the objective in each case. The Silver Crown well was carried to a depth of 940 ft. and pumping tests showed a production of 350 g.p.m. on which basis this well was equipped with pump driven by an 85 hp. Diesel engine early in 1935. The Ware drilling encountered bentonite beds approximately 350 ft. in thickness and was finally abandoned at 670 ft. without appreciable production.

1935 program

By January, 1935, with the drought still in effect, all streams were dry and the city storage had been reduced to only 218 m.g., or about a 90-day supply. Further, the two pumping plants installed in 1933 at Silver Crown and Ware could only be operated on a part time basis because of the declining water table. In May, 1935, the first real precipitation in four years occurred when the storage had been further reduced to 195 m.g.

In February of that year, prior to a heavy precipitation in April, the situation was considered so serious by the writer, who had recently assumed the position of city engineer, that the drilling of additional wells was recommended and authorized by the city commission. It was the writer's opinion that underground supplies could be obtained which would be sufficient to meet present demands and those of the immediate future, at a cost which would be far less than proposals which had been made to construct an aqueduct from the mountains about 70 mi. to the west. The present program of well development was authorized upon this recommendation. Five rigs were put in operation on continuous shifts and well drilling operations have been carried out under the writer's direction during the past year.

In March a flowing well of 240 m.g.d. capacity, located about midway between Ware and Silver Crown, was brought in and used during the remainder of the year. Tests on this well indicated that it could be pumped at a rate of 500 g.p.d. With the success of this first shallow well tapping the underground gravel layers at a depth of 167 ft., additional wells were drilled to depths of from 180 to 300 ft., using ERA funds. Although some did not prove successful and had to be abandoned, a production of 2,500,000 g.p.d. was developed in this immediate vicinity.

Four additional wells to depths over 900 ft. were put down at Silver Crown as part of this Drought Relief Program with a production at this point from the three best producers of 850,000 g.p.d. These three wells are alongside the gravity flow line from the reservoirs to Round Top filter plant and deep well pumps set at 350 ft. pump directly into this line.

As a result, there is now available, from an underground source of water near the mains leading to the filter plant, a supply from the three deep (940-ft.) wells at Silver Crown and shallow wells (180-ft. to 300-ft.) above Ware, a supply of 3⅓ m.g.d. This is a sufficient supply in itself, for the minimum requirements of 2.6 m.g.d. for the city without using the pumping plants or the reservoir storage of the surface supply.

This well supply is not yet in use because the physical hookup has not been completed or required as a result of the recent precipitation. However, the program calls for the completion of this well installation and present plans call for its extensive use until the storage reservoirs have been completely refilled. At that time, the city will be in a position to use the surface runoff, surface storage and the pump supply in the most economical balance.

As a result of the emergency pumping and the precipitation during the last half of 1935, the city reservoirs had a storage December 31, of 2,150,000,000 gal., which was the largest reserve available in these reservoirs since records were established.

Filtration plant

Operating problems at the filtration plant, aggravated by inadequate settling basins and improper control equipment, were not improved by the low stage in the reservoirs during the drougth period which resulted in severe test and odor problems.

Filtering problems were re-studied during this period and the use of sodium aluminate to supplement the regular alum treatment was instituted. The most important result of this change was to materially reduce the amount of wash water which is wasted. With the water shortage as acute as it was in Cheyenne the reduction of wash water from filter beds was an important factor.

Under the previous routine of using 1,200 lb. of alum on the 5 m.g.d. filters, the wash water required per day was 720,000 gal. and the taste and odor remained a problem. With the treatment changed to the addition of 75 lb. of sodium aluminate, the alum charge was reduced to 700 lb. with the elimination of tastes and odors and a reduction in the wash water to 240,000 g.p.d. This modification in the use of chemicals resulted in the saving of $3.70 per day for the chemicals and 500,000 gal. of wash water per day.

Present situation

At present the consumption of water in Cheyenne averages about 3,550,000 g.p.d., with an anticipated peak of 8,000,000 gal. during 1936, and although it is difficult to evaluate use in per capita terms, this consumption amounts to about 175 gal. per capita which is only about 70% of the consumption on the old flat-rate basis. However, an ample water supply has now made possible a reduction of 50% in the meter rates during the irrigation season. With this reduction in effect the total income of the water department will approximate $130,000 per annum which is practically the same as under the old flat-rate system.

This development program in addition to solving the critical water shortage situation at Cheyenne has the added interest of demonstrating the probabilities of an economical supply in arid regions heretofore considered as entirely dependent on surface supplies. Engineering and geological studies will be justified in localities where costs of surface development are high and quantities limited, with the objective of finding a water supply from underground sources, in adequate amount at a reasonable cost.

The Distribution System for the Colorado River Aqueduct

A progress review of the present program for delivering water to the member cities of the Metropolitan Water District of Southern California

By JULIAN HINDS
Assistant Chief Engineer, The Metropolitan Water District of Southern California

THE main Colorado River Aqueduct of The Metropolitan Water District of Southern California will terminate in Cajalco Reservoir, about 10 mi. southwest of Riverside, Calif. From this point the water is to be conveyed to the member cities by a system of laterals comprised of steel and precast concrete pipe lines and concrete-lined tunnels. Present plans provide that detailed distribution shall be made by the water departments of each member city, but the system for wholesale distribution from Cajalco to each city is being built by the District.

This distributing system will consist of a "high line" at a relatively high elevation and one or more lines at lower elevations. The first development is to consist of the high line and such laterals and portions of future lines as are required to make initial deliveries to all cities of the District. The initial expenditure is to be kept to the minimum consistent with good design and adequate service during the early years of operation. Each city will be supplied either directly or through an exchange agreement with some other member city. Additional units in the distributing system are to be added as the demand for water increases.

That portion of the high line situated between the Cajalco Reservoir and the eastern boundary of the City of Glendale is practically all under contract and several portions are actually under construction. The location of this portion of the system is shown in detail on the map. The designed capacity of the line is 750 sec. ft. from Cajalco to the end of Schedule 7-P (see map) near the town of San Dimas. From this point a small lateral will be constructed to supply the present need of the Orange county cities and an additional branch to the middle Los Angeles area will be built at some future time. West of this point the line capacity is 509 sec. ft.

The first 2.3 mi. of the line running north away from the Cajalco Reservoir is to be of precast reinforced-concrete pipe 11 ft. 8 in. in diameter. The major portion of this line will operate under moderately low heads but toward the northern end the head runs up to a maximum of 250 ft. For heads under 75 ft. a plain mortar joint type of precast pipe with cage reinforcement is used, and for heads over 75 ft. cage and steel cylinder reinforcement with lock-joint rings is used. This reach of pipe is under contract to the American Concrete and Steel Pipe Co., but no construction work has been started to date.

Following this first section of concrete pipe is a steel siphon 10.3 mi. long, which extends through the outskirts of the town of Arlington, across the Santa Ana River, and on north to the Jurupa Hills. This pipe crosses the Santa Ana River on a bridge consisting of five 50-ft. approach spans and three 181-ft. steel truss-bridge spans. The operating heads on the steel pipe vary from 20 ft. to 485 ft. Diameters of the steel pipe vary from 9 ft. 8 in. to 11 ft. 6 in. and plate thicknesses vary from 17/32 in. to 31/32 in. This pipe line will contain 30,700 tons of steel. Contract for this work has been awarded to the Western Pipe and Steel Co. and fabrication of the pipe is now in progress. Pipe laying is expected to start early in June. Some work has been done on the bridge piers.

The steel siphon just described is followed by 13.4 mi. of 11 ft.-8 in.-diameter reinforced concrete pipe, operating under heads varying from 25 ft. to 200 ft. Joint and reinforcing details for this pipe are the same as described for the pipe leading out of Cajalco Reservoir, except that for a short distance cage reinforcement is used with lock joints under low head on account of foundation conditions. This work is under contract to the American Concrete and Steel Pipe Co. The manufacture and laying of the pipe, now actively in progress, are described in the following article in this issue.

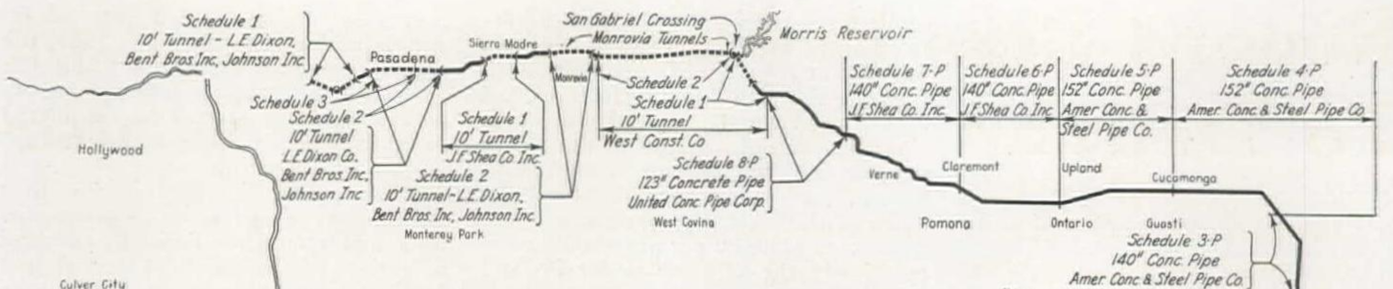
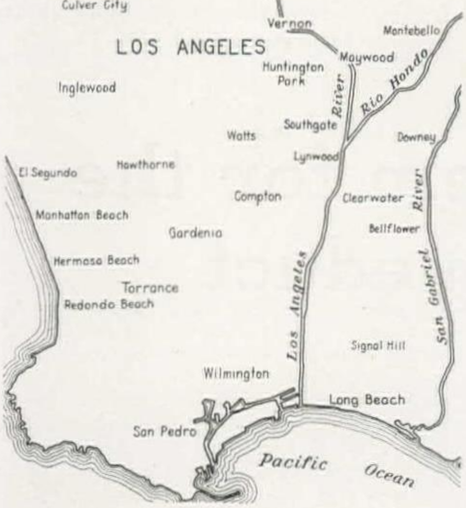
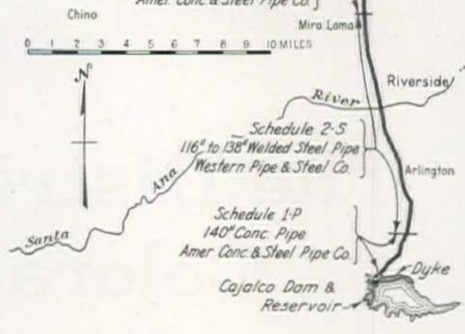
Next comes a length of 10.9 mi. of low-head precast concrete pipe, using cage reinforcement and lock joints. This length is under contract to the J. F. Shea Co., Inc., who have practically completed the installation of their construction plant and expect to begin the manufacture and placing of pipe at an early date. This length carries the line up to the point from which the temporary turnout to Orange county cities is proposed.

Beyond this follows a 4.6-mi. length of 10 ft. 3 in.-diameter reinforced concrete pipe, operating under moderately-high heads throughout, with a maximum operating head of 240 ft. This pipe is provided with bar and cylinder reinforcement and lock joints throughout its entire length and is under contract to the United Concrete Pipe Corp. Their construction plant has been completed and the manufacture of pipe sections begun.

Tunnel sections

The pipe lines just described are followed by the Monrovia tunnel No. 1, 10 ft. in diameter, 1.5 mi. long, and operating under a slight pressure, which leads the water through an arm of the San Gabriel Mountains into the San Gabriel Canyon, a short distance downstream from the Morris Reservoir. Monrovia tunnel No. 2, 0.8 mi. long, runs up the river from a point near the outlet of Monrovia tunnel No. 1 to afford a connection with the reservoir. These two tunnels are being constructed by the West Construction Co. Excavation has been completed and the placing of concrete lining is under way.

From the west portal of Monrovia tunnel No. 1 a concrete siphon 9 ft. 8 in. in diameter and 450 ft. long carries the water across the San Gabriel

Work under contract on the distribution system for the Colorado River Aqueduct. Cajalco reservoir is considered the terminal of the main aqueduct line. The type of construction and the contractors are indicated. Locations of the other feeder lines are not definite at this time.

River. The contract for this siphon has not been let.

The siphon discharges into Monrovia tunnel No. 3, which is 6 mi. long and will have a finished inside diameter of 10 ft. This tunnel likewise will operate under a slight pressure and is being constructed under contract with the West Construction Co. It is approximately 60% excavated.

Following this tunnel is a short siphon 9 ft. 8 in. in diameter, 600 ft. long, across Monrovia Canyon, the contract for which has not been let. This siphon delivers into Monrovia tunnel No. 4. This tunnel is 1.5 mi. long and is of the same size as the other Monrovia tunnels. The eastern portion operates under low pressure, but toward the western extremity ground conditions made it necessary to depress the line, so that the head runs up to a maximum of 280 ft. The concrete lining will be fully reinforced and in order to insure water-tightness a steel diaphragm is to be provided in the western portion.

West of Monrovia tunnel No. 4 the line leads across a farming area and through the towns of Sierra Madre and Pasadena. Under ordinary conditions this line would have been entirely of steel or concrete pipe. However, careful study of conditions indicated the advisability of placing portions of this line through the congested parts of Sierra Madre and Pasadena in tunnel, to avoid serious inconvenience to residents along the proposed route.

As a result of comparative bids, it was found that tunnel in these particular portions could be constructed for about the same cost as a large pipe line in open trench. Accordingly, a contract was let the J. F. Shea Co., Inc., for 1.2 mi. of such tunnel in the City of Sierra Madre and a contract to L. E. Dixon, Bent Brothers, Inc., and Johnson, Inc., for 3.3 mi. under Mountain St. in Pasadena. These tunnels are to be 10 ft. in finished diameter, will operate under pressure, and will be lined with reinforced concrete. Both of these tunnels have been excavated and are now being lined. Experience has confirmed the propriety of using this type of construction in these particular locations.

These tunnels lie from 30 ft. to 70 ft. below the surface. The ground forms a compact alluvium, firm enough to be free from caving, easy to excavate, and practically free from water. The excavation of the Pasadena tunnel was started Feb. 19, 1935, and finished on Feb. 22, 1936, with an average monthly progress of 1,475 ft. The best monthly progress was 2,185 ft. and the best daily progress was 93 ft. The Sierra Madre tunnel was excavated on a two-shift basis, with an average progress of 25 ft. per shift. In February, 1936, 50 shifts advanced the tunnel 1,500 ft., an average of 30 ft. per shift. The maximum for three consecutive shifts was 108 ft.

The space between the west end of Monrovia tunnel No. 4 and the Sierra Madre tunnel, and between the Sierra Madre tunnel and the Pasadena tunnel, will be closed with steel or concrete pipe lines 9 ft. 8 in. in diameter, the contracts for which have not been awarded.

The Pasadena tunnel ends on the bluff just east of the Arroyo Seco Valley, near the Pasadena Rose Bowl. The valley will be crossed by a 9 ft. 8 in. diameter pipe line 2,000 ft. long, contract for which has not been let. From the end of this siphon the line is carried through the hills toward Glendale in San Rafael tunnels Nos. 1 and 2, which are connected by a short pipe line. The tunnels, which are to be 10 ft. in diameter, will operate under a slight pressure. They are being constructed under contract by L. E. Dixon Company, Bent Brothers, Inc., and Johnson, Inc. Excavation on these two tunnels is about 58% completed.

To complete the system, it will be necessary to construct a temporary line from a point near San Dimas to the Orange County cities; also, a connection will be required from some point in the eastern part of Pasadena to supply the City of San Marino. The Pasadena tunnel passes the Sunset Reservoir of Pasadena's distribution system, at which place delivery to Pasadena will be made. The lines leading to Los Angeles, Compton, Long Beach, and Torrance will take out at the end of San Rafael tunnel No. 1 and lines to Glendale and Burbank, from the end of San Rafael tunnel No. 2. Unless an exchange agreement is made, lines to Beverly Hills and Santa Monica likewise will be taken from the end of San Rafael tunnel No. 2. Plans for all these branch lines are well under way, but detailed drawings have not been prepared.

This work is being carried on under the direction of F. E. Weymouth, as general manager and chief engineer, with R. B. Diemer in direct charge.

This type of work on the distribution system, which involves the fabricating and laying of precast concrete pipe sections 12 ft. 8 in. in diameter, is reviewed in detail in the following article.

Record Size Precast Concrete Pipe To Deliver Colorado River Water

Fabrication and laying operations for 12 ft. 8-in. diameter sections weighing 42 tons—Wall thickness of 13 in.—Each pipe contains 20½ cu. yd. of concrete and about 2½ tons of steel

THE FABRICATION and laying of 42-ton sections of 12-ft. 8-in. diameter, reinforced concrete pipe, the largest precast pipe of record, is the outstanding feature of the work now under way on the distribution system for the Colorado River Aqueduct being built by the Metropolitan Water District of Southern California. The mammoth pipe sections on the present work have a 13-in. wall thickness, contain 20½ cu. yd. of concrete and from 2 to 2½ tons of reinforcing steel. The general program on the main aqueduct line from Parker dam to Cajalco reservoir has been reviewed in numerous articles in *Western Construction News* and is assumed to be familiar to our readers. Construction and handling of the precast concrete pipe for the main distribution feeder is reviewed in this article.

The general plan for distributing the Colorado River supply from the terminal reservoir to the member cities of the district has been outlined in the preceding article, which included a map showing the line of the main upper feeder. For the purpose of contract letting, this line was divided into several sections of tunnel and eight pipe line schedules between Cajalco reservoir and Pine Canyon reservoir. These schedules were also indicated on the map.

At the present time, Schedules 4 and 5-P of the contract held by the American Concrete & Steel Pipe Co., Los Angeles, constitute the only part of the pipe line work which has advanced to the point where all stages of the operations can be described. Extensive fabricating plants are being built by the United Concrete Pipe Corp., and J. F. Shea Co., Inc., and work on these contracts will be under way in the near future. Also, the Western Pipe & Steel Co., has started fabrication of the 10 mi. of welded steel pipe for its contract, and has begun construction of supporting piers for the Santa Ana River crossing. At a later date, these other operations will be reviewed in *Western Construction News* with reference to the differences in procedure from the work described in this article.

Design of the pipe

The type of reinforced concrete pipe described in this article is used for heads up to a maximum of about 75 ft., with a mortar joint. Between 75 and 250-ft. heads, a Lock-Joint is used in place of the mortar joint. From 250 ft. up to a maximum of 485 ft. (Santa Ana River crossing), the line will be built of welded steel pipe. External loading varies from a 4-ft. minimum cover (specifications requirement) to a maximum of about 15 ft. The reinforcing steel to take care of both internal and external loads follows the usual design practice of an inner circular cage and an outer eliptical cage.

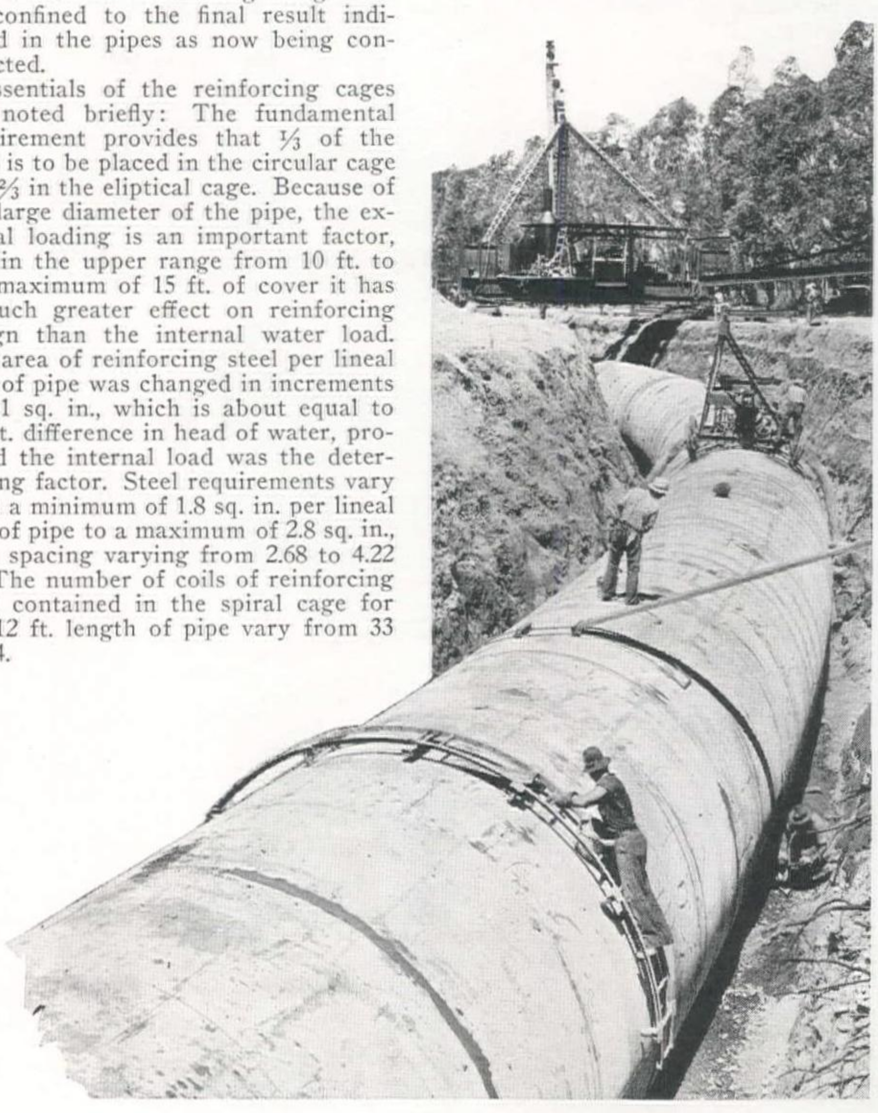
Because of the unprecedented size of this pipe, the District made extensive design studies to determine the most economic arrangement of steel and built one 144-in. experimental siphon (Little Morongo Canyon) on the main aqueduct to further study problems of construction and handling. The details of these technical studies do not form a part of this general review and the statements concerning design will be confined to the final result indicated in the pipes as now being constructed.

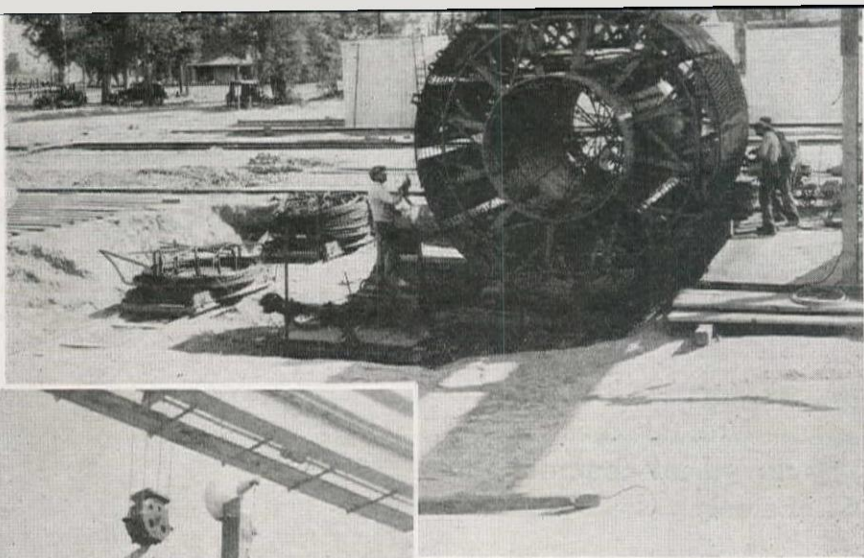
Essentials of the reinforcing cages are noted briefly: The fundamental requirement provides that ⅓ of the steel is to be placed in the circular cage and ⅔ in the eliptical cage. Because of the large diameter of the pipe, the external loading is an important factor, and in the upper range from 10 ft. to the maximum of 15 ft. of cover it has a much greater effect on reinforcing design than the internal water load. The area of reinforcing steel per lineal foot of pipe was changed in increments of 0.1 sq. in., which is about equal to a 4-ft. difference in head of water, provided the internal load was the determining factor. Steel requirements vary from a minimum of 1.8 sq. in. per lineal foot of pipe to a maximum of 2.8 sq. in., with spacing varying from 2.68 to 4.22 in. The number of coils of reinforcing steel contained in the spiral cage for the 12 ft. length of pipe vary from 33 to 54.

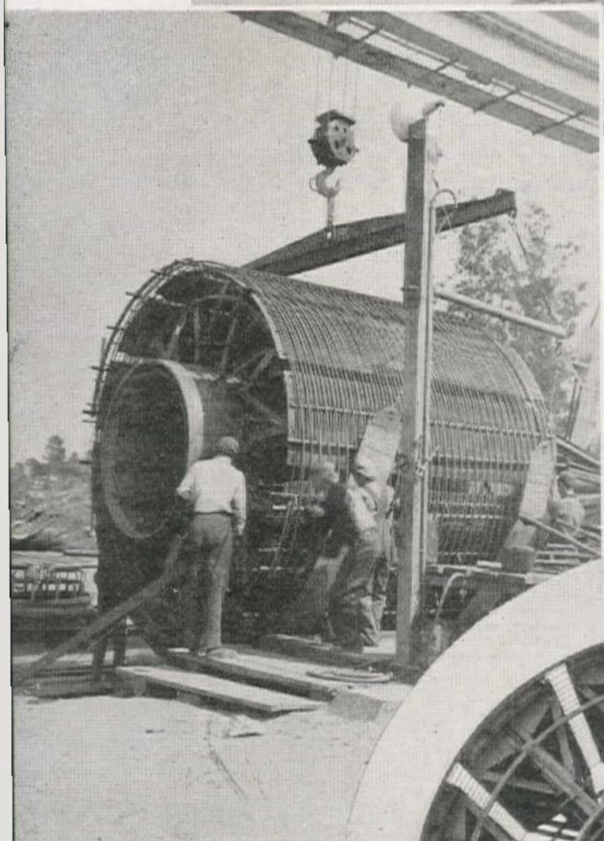
The reinforcing steel varies from ½ in. round to ¾-in. round bars, in 1/16 in. intervals. The details of this reinforcing steel was left to the contractor, only the general requirements being set forth in the specifications. General arrangement of the reinforcing cages and the detail of the joint at the ends of the pipe are shown in the accompanying drawing.

One other important phase of design was included in the studies made by the District; this is the poured concrete cradle placed after the pipe is in position in the trench. Proper bearing for these large diameter sections was found to have unusual importance and particularly the side thrust resulting from the wedge action of the backfill material in the sides of the trench. To meet these requirements specifica-

Putting the finishing touches on a completed section of the line, prior to backfilling the trench. The laying derrick appears in the background. On the pipe is the carriage which distributes concrete under both sides of the pipe to form the supporting cradle. Man in the foreground is mortaring a joint from a ladder which moves on wheels along the pipe.



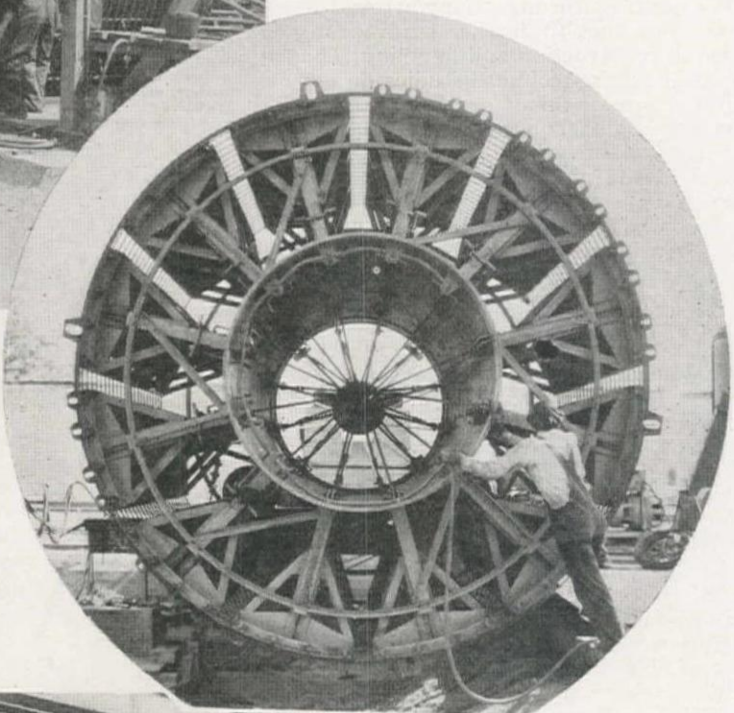




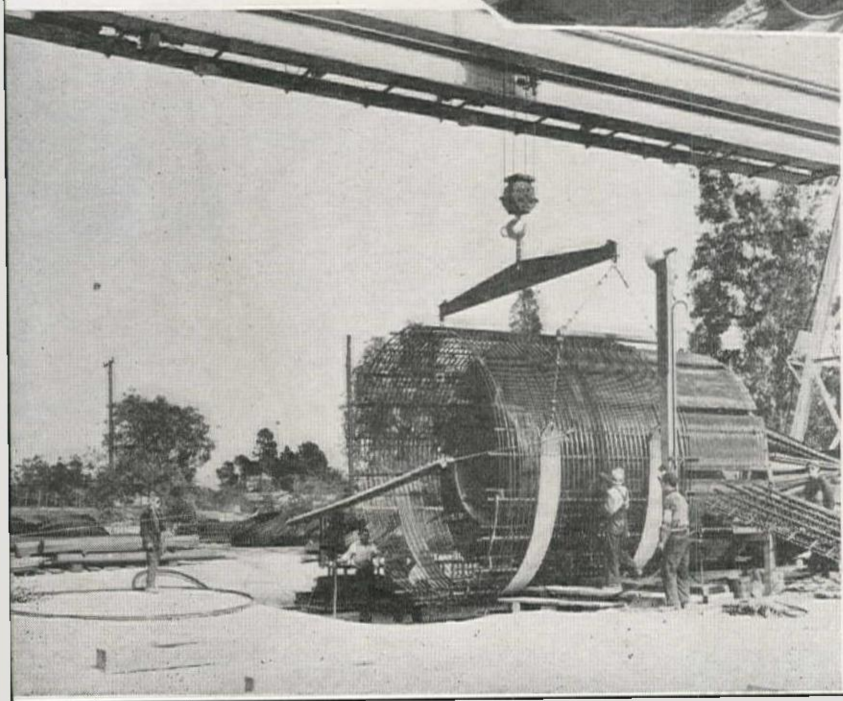
From 6-ft. reels the ½-in. to ¾-in. reinforcing rods are wound onto the mandrel which turns at about 4 r.p.m.

With both cages wound, four spacer bars are spot welded to hold the unit while it is removed for complete welding.

Air inflating the sections of fire hose under seven segments of the mandrel to hold them in correct position for winding a cage. When the cage is completed this air pressure is released to loosen the cage for removal.



Heavy canvas slings from the gantry are used to remove the cage. A small air hoist is used to pull the cage off the mandrel. The cage, still in the slings, is then moved to the pit where the rest of the spacer bars are placed and spot-welded as shown on page 181.



tions call for a cradle of poured concrete of at least 100°, with special conditions increasing the section of cradle to a maximum of 180° as field conditions require.

Preparation of steel

Steel of intermediate grade from the Columbia Steel Co. mill at Torrance is brought directly to the plant of the Soulé Steel Co. in 24-in. diameter coils of 200 to 250 ft. lengths. This steel consists of plain round bars from ½ to ¾ in. in size. In the Soulé plant these bars are rewound and welded into lengths sufficient to wind one of the two spirals for each 12-ft. pipe. As the coils are rewound the ends are electrically butt welded and each weld is tested to 35,000-lb. per sq. in. (specifications) before winding. The large coils are 6 ft. in diameter and contain from 1,600 to about 2,000 ft. of bar, depending on the size. These coils are trucked to the field casting plant.

Casting plant

For constructing the 16 mi. of precast pipe for their several schedules, the American Concrete & Steel Pipe Co. has built a fabricating plant costing about $250,000, near Rochester. Practically all the equipment used in the manufacture and installation of this large diameter pipe has been designed and constructed specially for the job. Much of this special equipment has been designed and erected at the company's own shops and some of the new equipment has been patented. From this plant, the pipe is being handled by trailer to the line for nearby schedules and present plans call for moving the sections by railroad for the schedule near Cajalco reservoir.

The plant was carefully designed and constructed for straight-line production and the efficient manufacture of 16 pipe lengths per day. The principal functions carried out at the plant are: (1) cage winding and welding; (2) concrete mixing; (3) form handling and pipe casting, and (4) curing.

Cage winding—A segmented, cantilever mandrel of proper size to provide circular cages of 13 ft. diameter and 12 ft. long is used to wind the reinforcing spirals. This machine, designed and built by the contractor, is shown in the illustrations. The drum is operated by a 15 h.p. electrical motor and turns at a normal speed of slightly more than 4 r.p.m.

The 6-ft. coils of reinforcing steel are delivered at one side and the continuous bar is unwound and fed through a machine which travels at a fixed rate along the side of the drum and unwinds the steel at a rate corresponding to the turning of the cage. These relative speeds are established and maintained by variable-speed mechanisms to produce the desired pitch for the spiral. The machine that unwinds the coils is designed to take all of this load, leaving only the turning of the drum to be done by its drive motor.

When the first turn of the cage has been completed it is spot-welded in order to form a closed wing, and then the spiral is finished in one continuous operation. Special rims are then added to both ends of the drum and triangular chairs are introduced over the cylindrical cage, at opposite sides of the drum, to produce the eliptical cage. The unwinding machine is returned to its original position and the process repeated, completing the elliptical cage as a single operation.

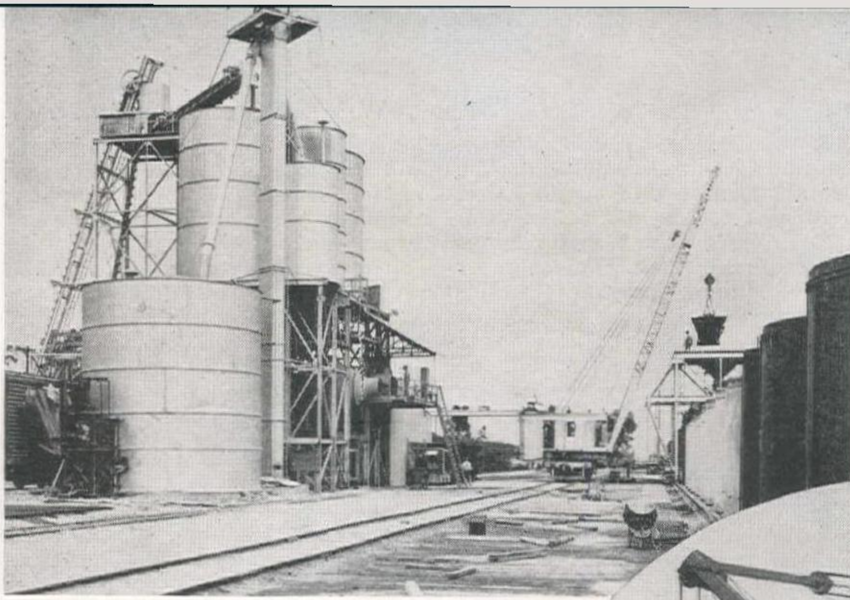
With the winding completed, four ¼x1½-in. longitudinal spacer bars are placed where the two spirals have about the same diameter and spot-welded at a sufficient number of points to permit the completed cage to be removed from the drum. It is loosened by collapsing seven of the segments of the mandrel which are maintained in correct position by lengths of firehose inflated by air pressure. When the air pressure is released from these sections of the hose, the cage is loose on the drum. It is removed by a 60-ft. gantry crane (see illustration) using two heavy canvas slings, aided by a small air hoist that pulls the cage off the drum.

This gantry deposits the completed cage on a set of slack belts in a shallow pit where it is rotated and eighteen more spacer bars are added and spot-welded to the cages. This welding is done with a group of portable Lincoln Electric machines. Operators are not officially qualified welders because the work does not necessitate more than tacking. The winding and welding of one complete cage takes about 1 hr. The steel in the completed cage varies from about 2 to 2½ tons. When sufficiently tack welded, and the extra joint reinforcing added, the completed cages are picked up by the gantry and set on end, ready for placing in the forms.

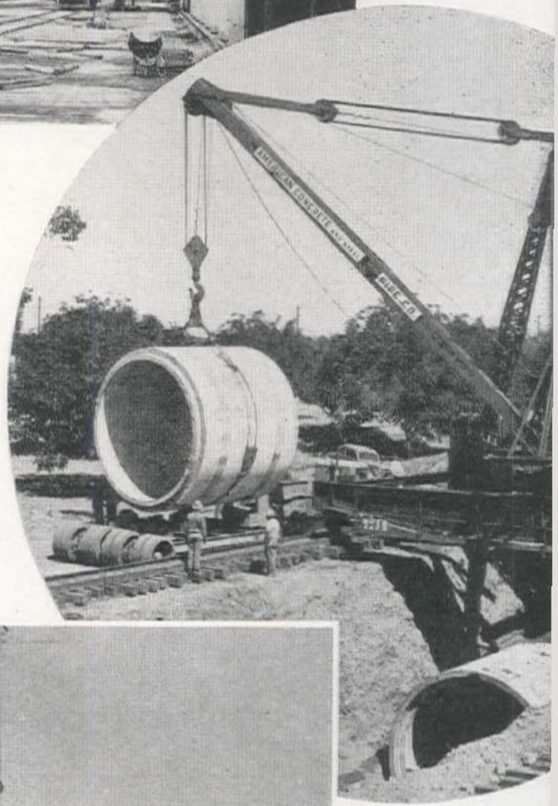
Concrete plant—The concrete plant is of standard, modern design and includes all of the refinements for the production of a uniform and a high quality grade of concrete. Aggregate is trucked to the plant from commercial producers and elevated to steel bins over the batchers and machines which are supported on a structural steel frame, permitting gravity production of concrete. Aggregate includes sand, fine gravel (¼ to ½ in.) and coarse gravel (½ to 1⅛ in.) Original specifications provided a maximum size of 1½ in., but difficulty in getting this rock around the reinforcing bars resulted in reducing the size to a maximum of 1⅛ in. Bulk cement is delivered by railroad car and elevated to a steel silo.

The material is batched by weight, using modern accumulating scales provided with automatic photoelectric cell control and interlocking mechanism to assure the weight specified. Batched material is discharged directly into a 4-yd. Davis mixer which empties into 2-yd. buckets transported on a platform car hauled by industrial locomotive. With the usual production of 16 lengths of pipe per day, this plant is scheduled to turn out about 320 cu. yd. in 16 hrs. (two shifts.)

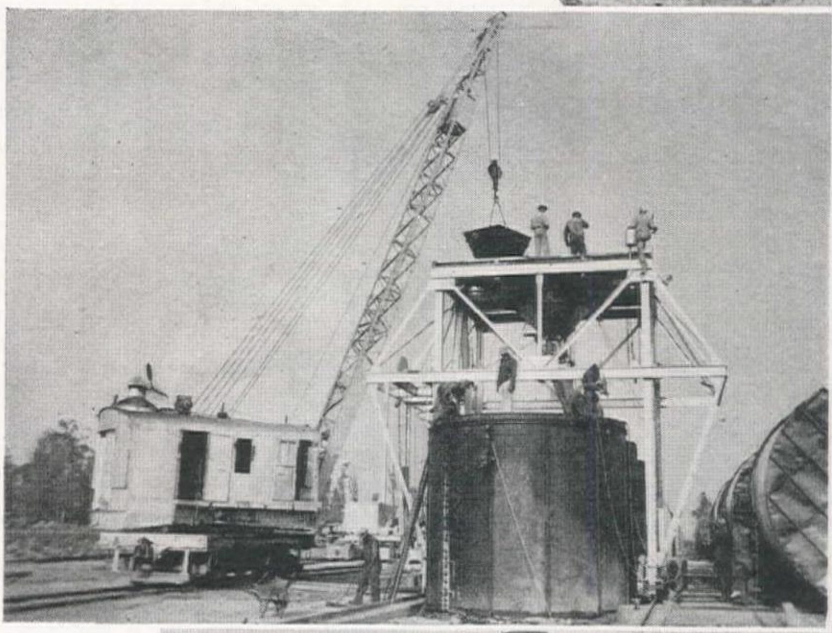
Casting—The casting yard was laid out on the basis of manufacturing 16



Concrete mixing plant with 4-yd. mixer. Batches are moved by industrial railroad to the locomotive crane which handles the 2-yd. buckets to the forms.



At the trench the pipe sections are lifted from the trailer and lowered by derrick mounted on 48-ft. gage track spanning the trench.



A pouring gantry with hopper and swivel spout is used for casting the pipe. The gantry moves on tracks spanning the line of base plates for the forms.

From the curing yard, the pipes are moved to the field after 12 days by low-bed trailer. Note the pipe spiders which are kept in during the curing and handling.

pipe sections per day in a 16-hr. period. The single line of 48 fabricated-steel bottom rings set on permanent concrete bases extends in both directions from the mixing plant. This number of rings is required by the specifications which provide that pipe cannot be turned from a vertical position for a 72-hr. period after casting. On the plant side of this line of base rings, extends the track for the locomotive crane and the concrete train. On the other side of the casting line are the timber rollways where the pipes are cured. The casting line is spanned by a gantry which is used in placing concrete and in turning the pipes into a horizontal position.

Handled by locomotive crane, the steel cages are set on the base rings over the inside form and the outside form placed to complete the preparations for the pour. The steel forms are cleaned and oiled between pours in accordance with usual procedure. The first shift in the morning strips the forms from the 14-hr. old pipes and erects forms for the next pour. The second shift makes the pour of the daily schedule of 16 pipes.

With the forms ready, concrete is brought to the pipe being cast and the 2-yd. buckets are lifted by the crane and discharged into the hopper on the top of the pouring gantry. This concrete discharges through a swivel spout which is moved around the pipe to add about a 1-ft. depth of concrete in the form per 2-yd. bucket. Three external-type vibrators are used on the outside form while concrete is being placed and are moved up as the concrete rises in the form. With the completion of the 20½ yd. pour, for the pipe, the gantry moves to the next pipe and the concrete is stirred and worked into position. This constitutes the most unusual and important phase of the pipe casting.

As a result of long experience in production of concrete pipe, the American Concrete & Steel Pipe Co. has experimented for a number of years in the elimination of surface defects and the production of a concrete surface without pockets. Last year in a production of large sized pipe on a Tacoma water supply project, the company developed a system of internal agitation along the walls of the forms which has resulted in the almost complete elimination of air and water pockets, a thorough compacting of the concrete and a marked reduction in surface defects. This system has been expanded and used on the present project with excellent results.

The procedure consists of rotating long square steel bars along the inside of the forms. These bars are moved along the forms as they are rotated at about 700 r.p.m. by small air motors, similar to those used in driving hand tools. These rods, which are ½ in. sq. reinforcing steel, have small sections of the same type of bar welded to them longitudinally at intervals to assist in the agitating of the concrete and to aid in moving the rod along the form. A crew of five trained men operate these compacting and finishing rods for a period of about 20 min., going along both the inside and outside forms.

Curing—After the concrete has been vibrated and the pipe section completed, steam is introduced on the inside of the pipe from permanent underground steam lines. This steam curing and heating effect continues during the night, and in the morning the outside steel form has been raised to a temperature of about 100° F. through the 13 in. of concrete. The outside form is then stripped and the pipe is left standing on the base ring

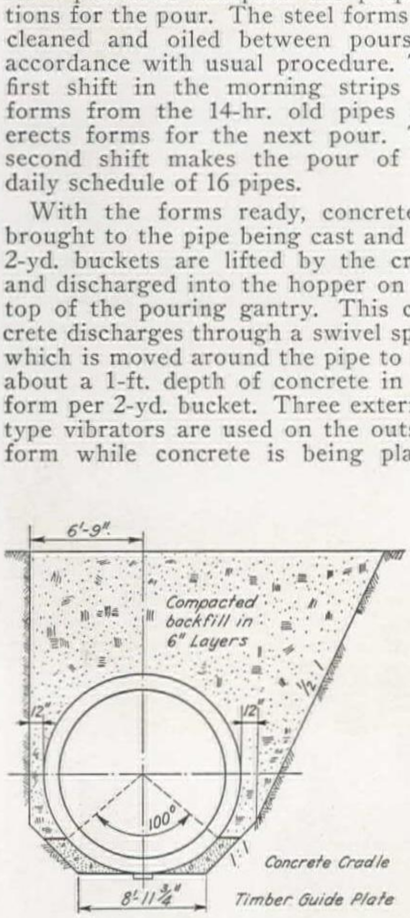
Finishing the surfaces of a pipe, using an air rotated steel rod, moved along the sides of the forms. This procedure, immediately following casting, eliminates air and water pockets and reduces surface defects. The operator is standing on the top of the inside form.

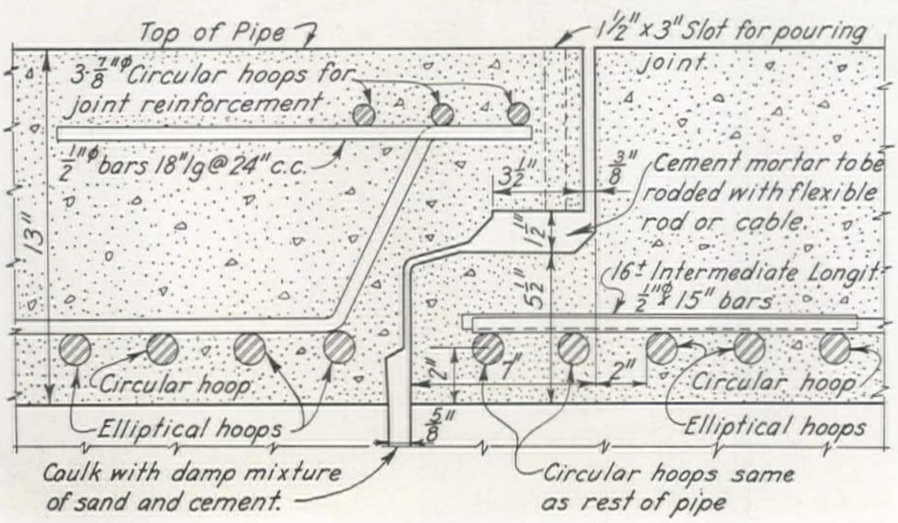
for the remainder of the 72-hr. period. Immediately after the forms are stripped, a coal-tar curing compound is applied to the outer surface of the pipe, followed by a coat of whitewash to reduce the heat absorption. This curing system was reviewed in some detail in *Western Construction News,* August, 1935.

When the 72 hr. have been completed, the same gantry used in pouring the concrete, tips the pipe into a horizontal position, after a system of expanding pipe spiders has been placed on the inside of the pipe. After tipping, the sections are rolled onto timber sills in the storing yard. Timber and sheet metal heads are placed over both ends of the pipe and a sprinkler introduced on the inside. This water cure from the inside continues for a 12-day period. The sprinkler is regulated by a clock timing device which provides a 15-sec. sprinkling period during a 20-min. cycle. At the end of this curing period, the pipe is ready to be moved to the trench.

Pipe Handling—The pipes are loaded at the curing yard onto specially designed low-bed trailers built by the Utility Trailer Manufacturing Co. On these trailers, the pipe sections are hauled by trucks to the point of placement. In loading the pipe, care is used in placing the sections so that they will be in proper position and placed directly into the trench without requiring any future turning. These truck-and-trailer units, with their 42-ton load, travel at a speed of about 8 to 10 mi. per hr. over a construction road built and maintained by the contractor on the right-of-way.

Trench excavation in the agricultural territory where operations are





Position of pipe in trench (left) showing the poured concrete cradle, clearances allowed, the sloped side for open country and the straight side for a braced trench in developed areas. Details of the mortar joint (below) and the steel at the ends of the sections.

now in progress, is done by dragline maintaining unsupported slopes on about ½:1. The material stands well if the interval of time is not too long and if it is sprinkled occasionally to keep it from raveling. The trench is opened up only a short distance ahead of the laying crew. Excess material is trucked away to disposal areas and the back-fill is left on the bank.

The pipe is handled from trailer to trench by a stiff-leg derrick mounted on a structural steel frame spanning the trench and supported on 48-ft. gauge tracks. These tracks are set on timber ties and are moved ahead by the derrick as required. The derrick is of stiff-leg design with the hoisting machinery of American Hoist and Derrick Co. design. It is counterweighed at the back and designed to handle a load of 50 tons.

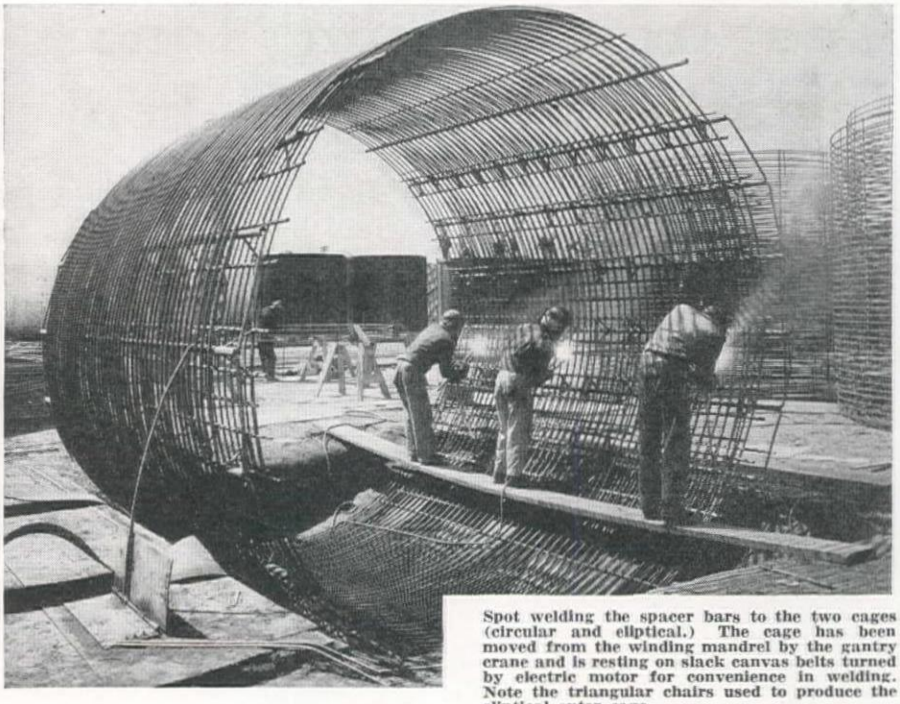
Pipe is picked up with a single sling, the original plan for a second steadying line having been found unnecessary. Set into position in the trench directly on the ground, the pipe is pulled into position by a jack hooked into the joint space of the pipe previously laid. This laying operation is done extremely fast considering the size of the section, and the entire process from the time the truck and trailer arrive to the final placing of the section to proper line and grade requires only about 15 min. Sixteen pipes are usually laid in about 8 hr.

Prior to the mortaring of the joints, the cradle concrete is deposited using a paving mixer operating on the bank, discharging into a hopper moved along the top of the pipe, with discharge chutes down both sides. The completion of the joints between the pipe sections constitutes the remaining step. By reference to the drawing showing the details of the joint, it is noted that there is a caulking space on the inside of the pipe, an open ring near the center of the wall and a further space along the outside. The inner ring is caulked tight with a damp mixture of sand and cement applied by hand in three stages. The placing of this mortar in several steps is designed to reduce cracking.

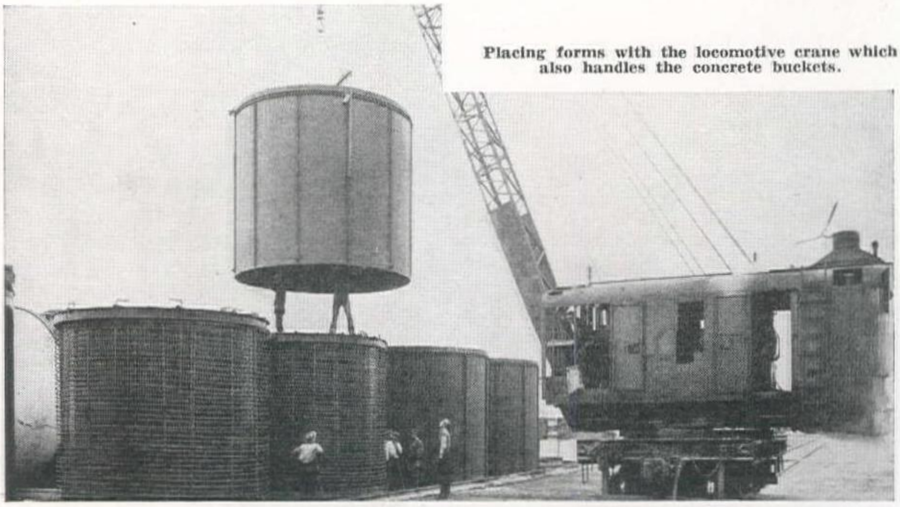
On the outside, the space is similarly filled, a paper strip having been placed under the joint at the bottom to prevent the cradle concrete from entering this space. After the inside and outside mortar courses have been applied, the inner ring is filled with a cement mortar grout applied through a hole at the top of the pipe and rodded with a flexible cable to insure the complete filling of this joint ring.

Organization—H. H. Jenkins, vice-president of the American Concrete & Steel Pipe Co., is in general charge of the construction work. He is assisted by W. A. Whiting, general superintendent. Donald Rankin is superintendent in charge of the fabricating plant, and J. S. McConnell is in charge of installation operations.

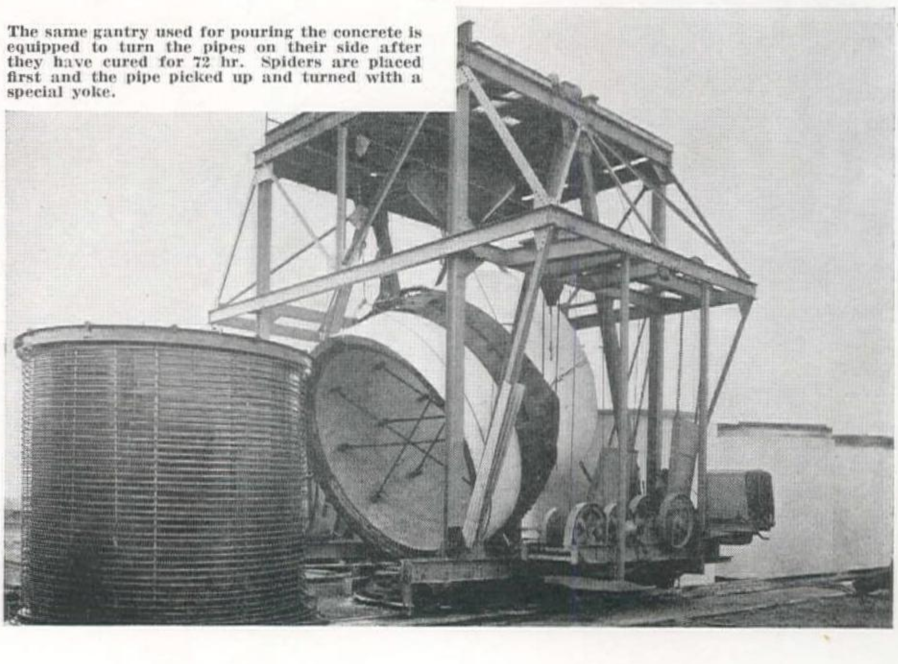
The personnel of the district directing this work was mentioned in the previous article.



Spot welding the spacer bars to the two cages (circular and elliptical.) The cage has been moved from the winding mandrel by the gantry crane and is resting on slack canvas belts turned by electric motor for convenience in welding. Note the triangular chairs used to produce the elliptical outer cage.



Placing forms with the locomotive crane which also handles the concrete buckets.



The same gantry used for pouring the concrete is equipped to turn the pipes on their side after they have cured for 72 hr. Spiders are placed first and the pipe picked up and turned with a special yoke.

Cast Iron Pumping Line Installed by WPA Labor

Three miles of 18-in. pipe laid by Antioch, Calif. to provide improved line between river pumping plant and storage reservoir

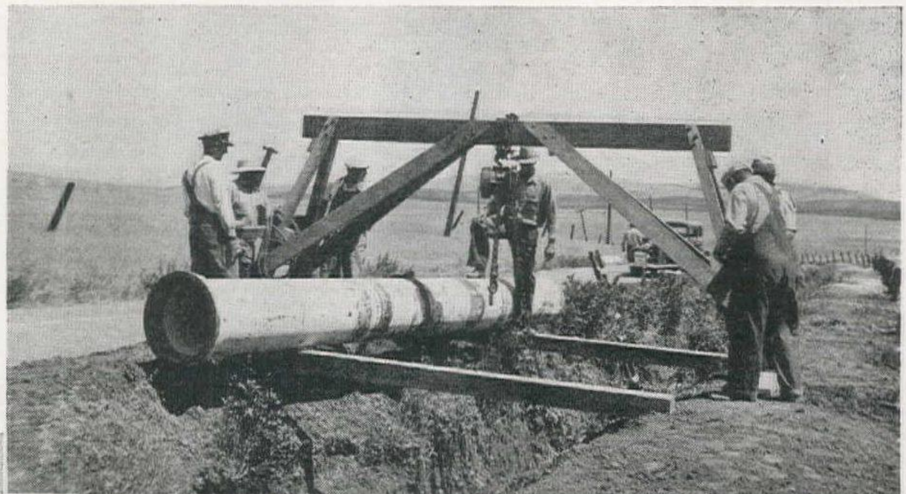
TO IMPROVE the facilities for filling the reservoir which provides the water supply used by Antioch, Calif., during the summer months, a 3-mile line of 18-in. cast iron pipe is being installed from the river pumping station to the 200,000,000-gal. reservoir in the hills behind the city. Work is being done with WPA labor and all operations of trenching and pipe laying are carried out by hand. Completion of the work will enable the city to fill this storage reservoir in a shorter period of time, with resulting economy in pumping costs.

Prior to 1926, the town of Antioch, located at the junction of the Sacramento River and upper San Francisco Bay, obtained its municipal water supply from wells, supplemented by water pumped directly from the river and filtered. Increasing use of the river flow for irrigation resulted in the gradual encroachment of salt water from the bay into the water adjacent to Antioch, until this source of supply became unfit for domestic use during the summer and fall period of low flow in the river. This situation resulted in the building of the reservoir and pumping plant about nine years ago.

The project consisted of a pumping plant on the bank of the river, a 3-mi. pumping line and a 200,000-gal. reservoir located in the hills south of the town, at an elevation of about 160 ft. above the town. The reservoir was formed by a small earth dam. Water is pumped from the river into the reservoir during the winter and spring, and then, when the river water becomes brackish during low flow (usually June to October) is returned to the city through the same line.

Both the water pumped directly from the river and the return flow from the storage reservoir first go through sedimentation basins providing a retention period of from 5 to 6 hr., are then treated with chemicals, chlorinated, and passed through three pressure filters before being pumped to a 100,000-gal. elevated steel storage tank. From this tank, it flows into the city distribution system. Naturally, the supply from the reservoir is considerably less turbid than the water pumped directly from the river, but the same treatment is given to both supplies.

When this installation was put in city funds were strictly limited, and the project had to be carried out with available financing. The 14-in. pipe line laid from the pumping plant to the reservoir was of relatively thin steel wrapped with a protective coating. Present evidence indicates that this wrapping was not adequate and did not provide the necessary protection against existing ground conditions. During the last year or two, considerable trouble has developed with leaks in this line, particularly during pumping when the reservoir is being filled. This has tended to prolong the pumping period, in addition to making heavy maintenance costs.



Using only hand equipment, this WPA crew of six rolls the 2,600-lb. lengths of pipe across the road and lowers them into the trench with a chain-block in a time of about 20 min. per length. Note the weed-grown condition of the trench which was originally dug several weeks before by hand labor.

In 1935, the condition of the pumping line became so serious that the city made application to the PWA, to finance the replacing of this line and enlarge the pumping facilities. The plans called for the installing of 18-in. cement lined, cast iron pipe. This project was one of those which was subsequently approved by the PWA authorities, but was too late to secure any funds. In spite of this setback, the city determined to go ahead with the project, because of the increasingly serious condition of the pipe line, and voted a bond issue sufficient to cover the entire cost of the work.

After the bond issue had been voted, and the pipe purchased by the city, the WPA approved an application to supply the labor for carrying out the work. Excavation operations, using WPA labor, began about February with a force of from 50 to 60 men employed on the usual 30-hour week basis to dig

A crew of about 60 WPA laborers excavated the entire 3-mi. line by hand. The crew is shown clearing out the trench, excavated several weeks before, after they had been taken off for emergency flood work.

the trench by hand. With an initial trench width of about 3 ft. and a 2-ft. minimum cover, this work represented the removing of more than 7,000 cu. yd. of material. The trench was dug on the existing right-of-way immediately adjacent to the existing pipe line.

Work advanced rapidly, considering the hand labor method, until a period of heavy rains in March. With the trench excavated for about half its length, these rains resulted in caving the banks, seriously damaging the work already done. Further, because of the flood conditions in the delta area at that time, as a result of the rains, the WPA authorities took the organized crew and used this labor for levee strengthening work. The pipe line project was practically shut down for several weeks, and during this time the existing excavation became badly choked with weeds and material continued to slough into the trench. About the middle of May, the crew returned to this project and the condition of the trench has necessitated the removal of at least as much material again as was excavated in the original operation.

Pipe laying procedure

Pipe laying operations, considering the labor difficulties and the fact that no machinery is available to handle the 18-ft. lengths of 18-in. cast iron pipe, are carried out with considerable efficiency and speed. Pipe was strung along the side of the road opposite the trench, where the line runs beside the county road. The laying crew of six men must roll these pipe sections, which weigh about 2,600 lb., across the road and onto timbers placed across the ditch. The crew then moves the timber A-frame, shown in the accompanying illustration, and lowers the pipe into position with the chain block. These operations require an average of about 20 minutes, and the laying of three lengths of this pipe per hour by this method is considered very good time.

Following the laying crew, the joints are made with poured lead and the usual fine caulking. The lead is melted in a portable unit, consisting of a gas burner operated on bottled gas. To date, the pipe line has not been tested to the point where the efficiency of the WPA laying and jointing procedure can be determined.

At the river pumping station, this improvement program will be concluded by the installation of a pump and motor unit designed for a capacity of 3,700 gal. per min. against the pumping head (static) of 160 ft. A new intake line from the river to the pumping plant will also be included, which will be laid with Duroline pipe.

With the conclusion of this project, it will be possible to fill the reservoir during a six weeks' pumping season, as compared to the 4 or 5 mo. required to fill the reservoir with the existing equipment and pipe line. The more efficient plant and shortened operating season will reduce pumping costs by a marked degree. Although this was an important factor, the principal reason for the present installation was the fact that the existing line was requiring so much maintenance that it was difficult to get the reservoir filled during the available season. Aside from this change in the pumps and pumping line, the water supply system will operate as outlined in the opening statement.

The work is being carried out under the direction of George Oliver, city engineer of Antioch. The supervision of the pipe line work for the city is in direct charge of P. K. Biglow, water superintendent. The estimated cost of the improvement, as planned by the city, prior to the WPA supplying the labor, amounts to $88,000. The cast iron pipe was furnished by the U. S. Pipe and Foundry Co.

Pacific Northwest A.W.W.A. Holds Annual Convention

Meeting at Aberdeen is attended by 150—Papers cover diversified program

THE 150 assembled delegates to the ninth annual meeting of the Pacific Northwest Section of the American Water Works Association, held in Aberdeen, Wash., May 14-16, were provided with a diversified program of round table discussions, technical papers, entertainment and an inspection tour of nearby water works, pulp mill, plywood plants. Officers chosen for the coming year include: Chairman, A. H. Labsap, water superintendent of Longview, Wash.; vice-chairman, M. H. McGuire, manager of McMinnville, Ore., water and light department; trustee, H. D. Fowler, Seattle water superintendent; secretary-treasurer, Fred Merryfield, assistant professor, civil engineering, Oregon State College.

The informal round table discussion, presided over by H. D. Fowler, covered several phases of water works practice. Controversial opinions were expressed on the subject of joint material for cast iron pipe, some preferring lead and prepared joint material and others being in favor of quick-setting cement because of its cheapness. Members generally agreed that frequent inspections and periodic packing of fire hydrants was highly desirable. Regarding the use of paints, recommendations were made by T. H. Judd, Washington Water Power Co. engineer of Spokane and E. A. Knittel, water superintendent of Lynden, Wash., for bituminous paint applied on a thoroughly cleaned surface for protecting standpipes. Regarding the location of water mains, G. G. Paine, city engineer of Everett, Wash., suggested that new mains be laid in parkways to eliminate pavement cutting. Other discussions included methods of collecting delinquent water charges and repair and inspection of meters.

Aberdeen's water supply

The history of the development of the Aberdeen water department was

A. H. Labsap, water superintendent of Longview, Wash., who was elected chairman of the Pacific Northwest Section of the A. W. W. A. for the next year.

ably told in a paper by S. C. Watkins, superintendent, who traced the construction steps from its early beginning to the present time. One of the earliest systems, laid in 1886, consisted of bored-out logs which were joined together with wrought iron thimbles. During the excavation of a sewer line in 1932, nearly 50 years after the installation of this primitive line, several sections were unearthed and they were in excellent condition and seemingly fit for further service.

In 1892, Stewart Creek was adopted as Aberdeen's new water supply and in 1903 additional water was taken from Charley Creek. In need of additional and better quality of water the city constructed a new 22-mi. 28-in. diam. wood-stave line from the upper Wishpah River. In 1926, it was deemed advisable to make available a large supply of water, not necessarily potable, for industrial consumption and a 3-mi. 7-ft. diam. concrete lined tunnel was driven and a 2-mi. 54-in. wood-stave pipe was laid to tap waters of Wynooche River. This supply line, of 85 m.g.d. normal capacity, delivers water to Lake Aberdeen distributing reservoir.

Since 1930, when a survey was made of the domestic supply line for required replacement, about 14 mi. of the original wood-stave pipe has been replaced by a parallel line of the same material at a cost of about $2.25 per ft. using city-crew day labor. The domestic water supply line discharges into Fairview reservoirs from which 12, 16 and 20-in. distribution lines lead over the city.

Prorating fire protection costs

The gradual acceptance of cost as the basis of charge for fire protection has emphasized the need for uniform adoption of a method by which the cost can be determined. This was the theme of a paper presented by Sidney J. Benedict, assistant engineer, Portland Water Bureau. The basis of cost in Portland is based upon E. C. Williard's 1922 plan and consists of prorating plant costs upon the percentage obtained by the ratio of the required fire flow to the maximum daily demand for all purposes. Definite rules for determining the fire flow have been established by the National Board of Fire Underwriters and take in account the consumption according to the character and congestion of buildings. Also the Water Works Manual offers recommendations covering prorated costs of appurtenant structures such as reservoirs, filter plants, etc.

In Portland, 19.6% of the total water bureau costs are charged to fire protection or a per capita cost of $1.06 (312,000 population) and an annual hydrant rental of $50.00. These figures are lower than for other cities of similar size. Mr. Benedict stated that the average return for fire protection is still not equal to service costs but the trend is towards this basis.

Watershed protection and control

A detailed paper on protecting watersheds from contamination and increasing the quantity of water was presented by G. M. Irwin, city engineer and water commissioner of Victoria, B.C. To protect Victoria's 42-sq. mi. of watershed, persons entering the area are required to pass physical examinations and procure written permission from the commissioner. Stringent rules must also be observed regarding disposal of all waste in the drainage basin.

Several references were introduced showing the effect of vegetation in Southern California and Colorado watersheds on the water yield. It was generally agreed that forests do not necessarily conserve the water supply although erosion and consequent silting of reservoirs is hastened on cleared land. Several test areas showed a greater run-off after deforestation and that erosion depended on the ground covering and type of soil.

Business principles

Business principles of sound municipal utility management was a subject discussed from various angles by J. W. McArthur, general superintendent of the Eugene, Ore., water board. Fundamentally, utilities are created by a desire to have suitable services at less cost, although lately, it is the lure of profits to a corporate city. It was contended by Mr. McArthur that service should be furnished at cost to consumers and that free service should be eliminated, whether it involved an individual or another municipal department. The need for freedom from politics was also stressed. Proper and definite policies should be adopted by the management on financing and debt retiring, long term budgeting, depreciation, sound accounting, rate making, and rendering of efficient service.

Water rates in the Northwest

Four elements should be considered in establishing water rates, according to G. B. Schunke, Seattle water department accountant. These are: (1) operating expense; (2) maintenance expenses; (3) interest on funded debt, and (4) adequate reserve for depreciation. The maximum demand imposed on a utility must be considered in rate making as well as the cost of actual delivery. Issuance of bonds for plant costs provide the most equitable method of providing absolute parity with reference to "demand" or "ready to serve" charges. A municipal water utility should be operated as a mutual enterprise to insure fair rates to all consumers.

W. A. Kunigk, superintendent of the Tacoma water division, presented an illustrated talk on "Reconstruction and Extension of Tacoma's Green River Gravity Water Supply Line." This project was reviewed in an article in *Western Construction News*, November, 1935.

A brief review of Washington's PWA water works program since its 1933 inception was given by E. R. Hoffman, state PWA engineer. In 1933, allocations amounting to $3,000,000 were made and in 1935, on the 45% grant basis, $860,000 was provided. Applications, now on file in Washington, D.C., amounting to $1,100,000, are pending further congressional PWA appropriations. A resolution was passed by the association urging additional PWA funds.

Water Softening Plant Installed

WITH the distinction of being the first installation of its type to be placed in service on the Pacific Coast, a new water softening plant has recently been completed by the California Water Service Co. to serve the City of San Mateo. The plant, designed by J. A. Wade, chief engineer of the company, has an output of 1,000,000 g.p.d. and reduces the hardness of the water from 663 p.p.m. to 100 p.p.m. Operations of the plant, which runs continuously day and night, include filtration as well as water softening.

A complete laboratory is maintained at the plant under the direction of Nathaniel J. Kendall, chemist and chief plant operator. K. W. Brown, sanitary engineer in charge of the water company's purification plants, has charge of the new plant.

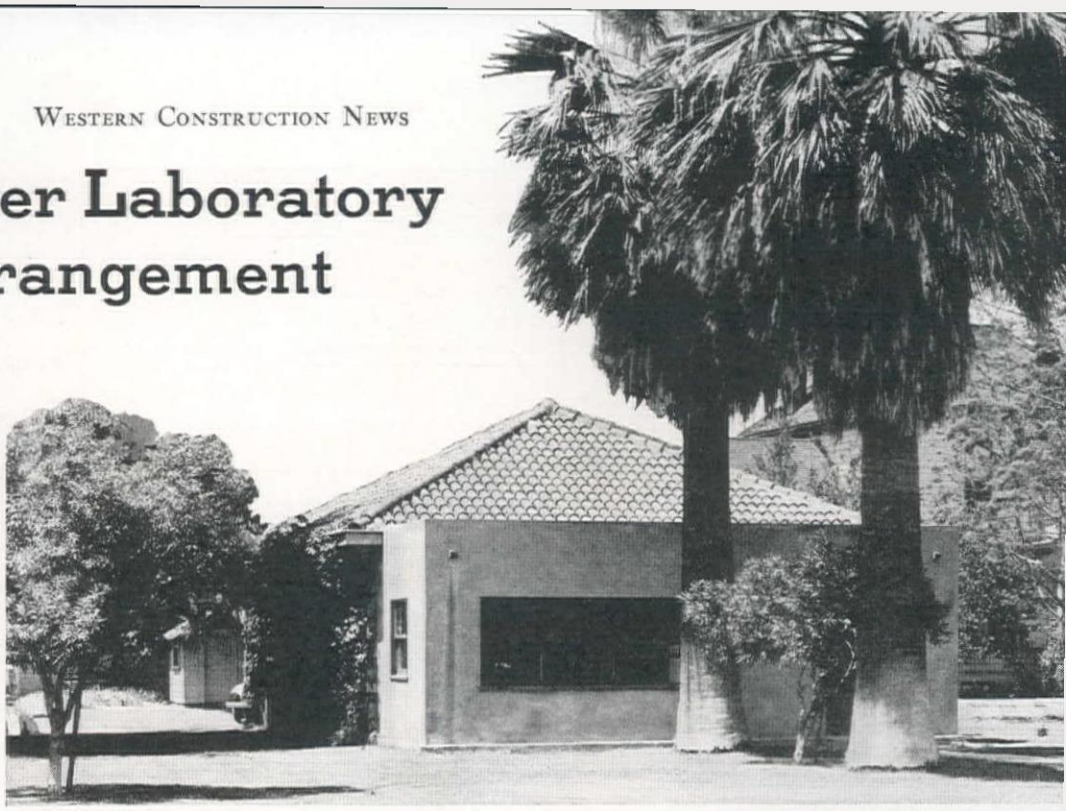
•

The present wage scale paid on Colorado State Highway work during the 1936 season will be: $1.10 an hr. for skilled labor; $0.70 for semi-skilled; $0.55 for unskilled labor within a 50-mi. radius of Denver, and $0.50 for unskilled labor in other sections of the state.

A Modern Water Laboratory of Efficient Arrangement

Space used to greatest advantage for routine and research investigations—Photomicrography equipment and dark room provided

By KENNETH W. BROWN
Sanitary Engineer
California Water Service Company
Stockton, California



Remodeled and enlarged from an old pumping plant, the laboratory building presents a pleasing appearance in keeping with the surrounding residential area. The pumping pit has been converted into a basement for dark room and photomicrography equipment.

WITH studied regard for certain adjectives which are frequently overworked in California descriptions, the laboratory and the laboratory program of the California Water Service Company, when compared to others in the West, can only be described as unique and the work diversified and unusual. For those who are not familiar with the organization, it may be noted that the California Water Service Co. serves more than 25 communities in that state, from Redding on the north to Redondo in the south, and is affiliated with the Peoples Water and Gas Co. which serves six communities in Oregon and Washington. The two companies together maintain general offices in San Francisco and the laboratory in Stockton.

The Stockton laboratory is pleasantly situated in a residential area, occupying a building which once served as a pump station. The structure was enlarged last year to provide more room and better facilities for our present program. There are two laboratory rooms, one for bacteriological and the other for chemical work, and two offices. In the rear of the chemical laboratory is a shipping and receiving room where express deliveries and pickups are quickly and conveniently handled. In the basement, which was originally the pump pit, there are tools, an adequate work bench, an optical bench for photomicrography, and a well equipped dark room.

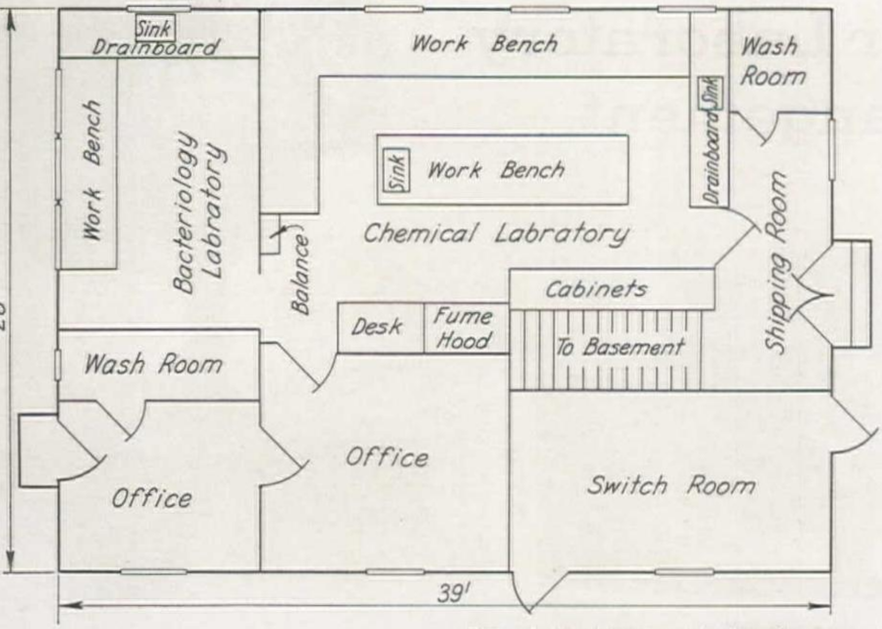
So far as actual space is concerned, both laboratory rooms are comparatively small. Each of them, however, is practically ideal in design, accessibility, and general utility. The bacteriological section, for example, is only 9 ft. wide by 15 ft. long, yet it is arranged to include a work bench with plenty of room, a sink and drainboard equally as satisfactory, and space for an electric refrigerator in addition to the usual incubator and sterilizers. This may appear to be a lot of equipment in a small space but in reality there is actually room for as many as three people to work comfortably and without falling all over each other.

The chemical laboratory, 15 ft. wide by 23 ft. long, showing the bench for titration at the far end. Note the flat doors for the cupboards which are neater and easier to keep clean than the panel type.

In the chemical room, which is considerably larger but equally well occupied, the available floor space is 15 ft. wide by 23 ft. long. In this room, as shown in the accompanying drawing, there are work benches along one side, at one end, and in the center. At the other end there are a sink and drainboard, and on the other side storage shelves and cupboards, a fume hood, and a desk. Aisles are a little narrow but not objectionably so, the room as a whole being compact, accessible, and exceptionally satisfactory for the type of work we are doing.

At the end of the chemical room, occupied by a balance and a work bench, practically all of the bench space is devoted to titration equipment. As shown in the accompanying illustration, standard solutions are placed on a shelf and pumped to burettes by a rubber aspirator bulb on each bottle. Burettes are held in place by a novel clamping device, one end of which is inserted in a hole drilled in the shelf and the other is a spring clamp holding the burette and allowing unobstructed readings along the entire scale. The complete assembly is neat and serviceable, and simplifies the frequent task of making a long series of titrations.

Two features of the bench construction are worth mentioning. The first, one ordinarily provided but occasionally overlooked, is that of a suitable toe space. This does away with unsightly marks at the bottom and also adds to the comfort and convenience of working close to the bench. The



Plan of the laboratory showing the compact arrangement of the rooms and equipment. The shipping room provides for convenient pickup and delivery of materials and samples.

second feature is that of flat-slab type doors on the cupboards. These are cut from ordinary ¾-in. plywood and are lipped the same as drawers, resulting in a flat surface easier to clean and more attractive in appearance than the ordinary panel type door. To prevent warping, which should also be considered when using plywood for this purpose, the doors should be painted on both sides.

Plywood of the same thickness is also used for the fume hood, the window of which is hung on a Pullman-type sash. The inside of the hood is painted with acid proof paint, which so far appears to be entirely satisfactory. Fumes are removed by means of an inexpensive exhaust fan rather than by a blower made of corrosion resisting material. It was felt that the cheaper fan could be replaced occasionally and that this would be preferable to installing an expensive blower.

Walls are covered with either plaster or plywood, depending on which happened to be the most suitable for each location. All surfaces are finished in a pale ivory, thus assisting lighting conditions and at the same time avoiding the reflected glare of plain white. Bench tops are finished in flat black rather than acid proof stain because the latter is hard to apply and is less attractive in appearance than the flat black. A little extra care is required to avoid damage from spilled chemicals but aside from that the flat black surface is the most satisfactory.

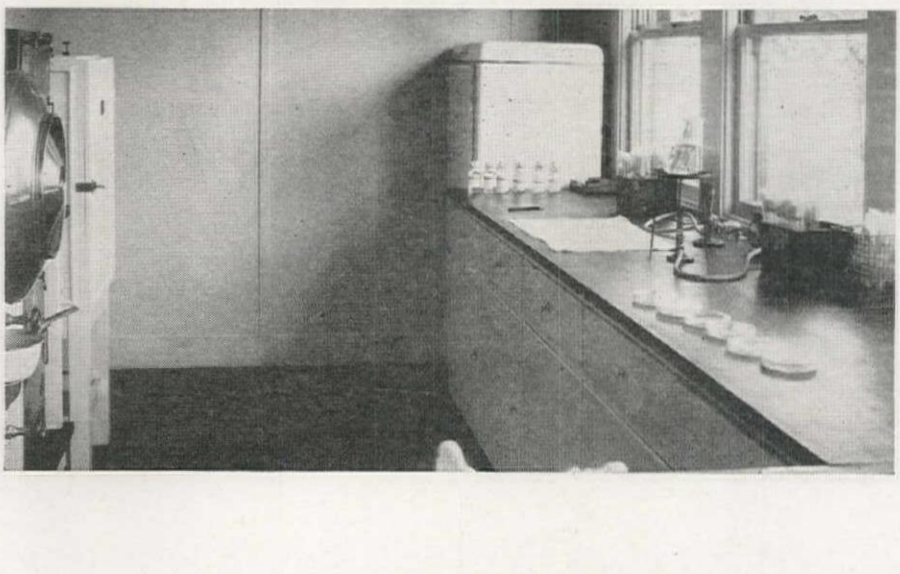
Laboratory equipment

Equipment for both chemical and bacteriological work is confined to absolute essentials. In the bacterological section, for example, there is a standard steam sterilizer, two dry-heat ovens, a Thelco incubator, and an electric refrigerator. The only items in any sense out of the ordinary are the copper baskets used for holding broth tubes in the sterilizer and incubator. These are divided into six sections, each one of which holds five large tubes, and are considerably more convenient than most of the baskets and holders used for the same purpose. Batches of media are made weekly, the volume being such that the only dehydrated material used is that for eosine methylene blue agar.

Equipment for chemical work is limited to that required for ordinary types of water and mineral analyses. As a matter of fact, facilities for this work are nothing more than barely adequate and will be improved upon as we develop our laboratory program.

There is one item of unusual interest and utility—the optical bench for photomicrography. This is home-made, but nevertheless a highly suitable device which is used whenever it is desirable to obtain a photograph of organisms from sources of supply, reservoirs, or distribution systems. Reports and records prepared with the assistance of these pictures have been especially valuable in our work with various types of iron bacteria.

Bacteriology laboratory showing bench, standard sterilizer, incubator and the electric refrigerator.



Laboratory program

In a general sense the analysis program for each district of the company is maintained in accordance with an established schedule, the frequency of sampling depending on the character of the supply and the type of analysis to be made. Unless otherwise modified, a minimum program calls for a complete chemical analysis once a year of a sample representative of the entire supply, a partial chemical analysis once a year of each source of supply, and bacteriological examination once a month of a series of samples either from sources of supply or from representative points in the distribution system.

Schedules for each district vary over a considerable range. At some locations, aside from filter and softening plants where daily control analyses are made in the plant laboratories, and where past records show more or less fluctuation in quality, partial chemical analyses for hardness, alkalinity, and chloride content are made once a month and occasionally even more frequently. In other words, the program is designed to keep in touch with every possible change in the character of each supply.

Bacteriological schedules likewise vary over a wide range, sampling in some instances being as frequent as once a day. As a general rule, the frequency depends on a sanitary survey and the known quality of the supply in question. Where surrounding conditions are satisfactory and wells are adequately protected against either surface or subsurface contamination, checks are made no more frequently than once a month.

Surface supplies, however, whether chlorinated or filtered, or both, are checked once or twice a week. Furthermore, all types of supplies, in case laboratory tests show water of questionable quality, are either taken out of service or checked once a day until results show water of unquestionable quality.

Where findings necessitate taking a well out of service, which is usually requested by a wire or telephone call to the district manager, a sanitary survey is made as soon as possible and arrangements made to correct conditions possibly responsible for contamination. Where nothing is obviously wrong, which is usually the case, the well is given a strong dose of hypochlorite, allowed to stand for a day or two, pumped to waste, and then retested before going back into service. This procedure is almost always effective in bringing about the required improvement.

Fixed or minimum schedules for each district are almost invariably enlarged upon: Contamination, whether real or apparent, develops and necessitates more frequent checking; a domestic consumer complains for some reason or another and wants the water checked both chemically and bacteriologically; an industrial concern needs more information about the water and its relation to their particular requirements; or a new well is drilled, requiring an analysis as each water-bearing stratum is penetrated.

For reasons such as these it is inevitably necessary to vary and enlarge established schedules. Last year, with a staff consisting of one full-time chemist and one part-time laboratory assistant, a total of about 100 complete chemical, 300 partial chemical, and 2,600 bacteriologic analyses were completed.

In spite of the comparatively heavy routine schedule, the laboratory function is by no means limited to the making of water analyses. Some of our other activities, past and present, are as follows:

1—Preparation of standard solutions for purification plants and laboratories. Furnishing such solutions as silver nitrate, soap, and ortho-tolidine involves considerable work in itself. Something of this kind, however, is far less expensive and a lot more satisfactory than purchasing solutions through a supply house.

2—Research work on iron bacteria. Considerable time has been devoted to a study of these organisms because of their prevalence in some of the company supplies.

3—Research work on corrosion. Unusual aspects have been studied on a small scale whenever available information appeared inadequate.

4—Investigation of taste, odor, and dirty water problems. Most of these require special analyses and study on a small scale.

5—Laboratory scale study of various softening and filtration problems. Of especial interest in this connection is the thorough investigation and testing of various zeolites.

6—Analysis of chemicals used for water purification. This feature is becoming increasingly important and is one which will lead to greater efficiency in operation and economy in purchasing.

7—Maintenance of chlorination equipment. This is a subject in itself and can only be referred to briefly. Efficiency in operation and economy in the purchase of new parts are brought about by overhauling all of our panel type machines, either solution or dry feed, once a year. The taking apart, assembling and testing, are done at the laboratory, and necessary repairs generally taken care of by a local machine shop. This program has proved itself well worth while and has definitely decreased the cost of maintaining chlorination equipment.

Corner of the chemical laboratory showing storage cabinets, fume hood and desk. All walls in the laboratory are ivory colored, providing good lighting conditions without glare.

There is another interesting chapter which might be told, if space and time permitted, of the many problems that come to the laboratory for solution. Among them have been scale and corrosion troubles in steam plants and central heating systems, difficulties in producing good ice, sediment in beer and carbonated beverages, and questions too numerous to mention on the relation of drinking water to various physiological disturbances.

Intermountain Water Supply Projects

SEVERAL water works projects have started or resumed recently in Colorado, Wyoming and Utah. The Colorado Springs city water works project, started some time ago, but discontinued for several weeks because of lack of money, has been resumed. The PWA contract for the construction of the earth-fill steel-faced Catamount Creek dam on the north slope of Pike's Peak was awarded the Ed. H. Honnen Construction Co., of Colorado Springs for $386,789.50, last month. The American Bridge Co., Chicago, secured the contract for the steel face. Work will start immediately. The structure is similar in design to the Crystal Creek dam built by the municipality last season. This structure was described in *Western Construction News*, March, 1936, by City Engineer Frank O. Ray.

The Thomas C. Davis Construction Co., of Springerville, Utah, has started work on the Mayfield, Utah, water system, having secured the contract for about $40,000.

The Vernal, Utah, $33,000 water system project is being constructed by Mullins and Wheeler of Vernal. Work was recently started on this project. Work on the $10,000 Glendale, Utah, water system has also been started by Maxwell, Anderson and Carpenter.

Lining of the pioneer bore of the Moffat tunnel by the Utah-Bechtel-Morrison-Kaiser Co. was scheduled for completion about June 1, on the Fraser River water diversion project. Bids on another tunnel for this project were to be called early in June. This 2,200-ft. tunnel is to carry the flow of Little and Big Vasquez Creeks into the main bore to join the Fraser River waters. These creeks are to be flumed across a canyon and conveyed through the mountain by the 8-ft. tunnel. In addition to the tunnel, this project calls for: 5 mi. of canal, a 1700-ft. steel siphon, one 900-ft. steel siphon, and two dams eleven feet high, to be located on the creeks. The general features of this transmountain diversion development were outlined in *Western Construction News*, December, 1935.

Contracts also were to be let about the last of May on the $1,500,000 Williams Fork water diversion project which the PWA approved May 22. This is a part of Denver's sewage disposal project, the waters to be used for dilution of the effluent of the sewage disposal plant (*Western Construction News*, April, 1936).

The diversion also requires two collection canals totaling 16,000 ft., and a compensatory reservoir just above the mouth of the Williams Fork River.

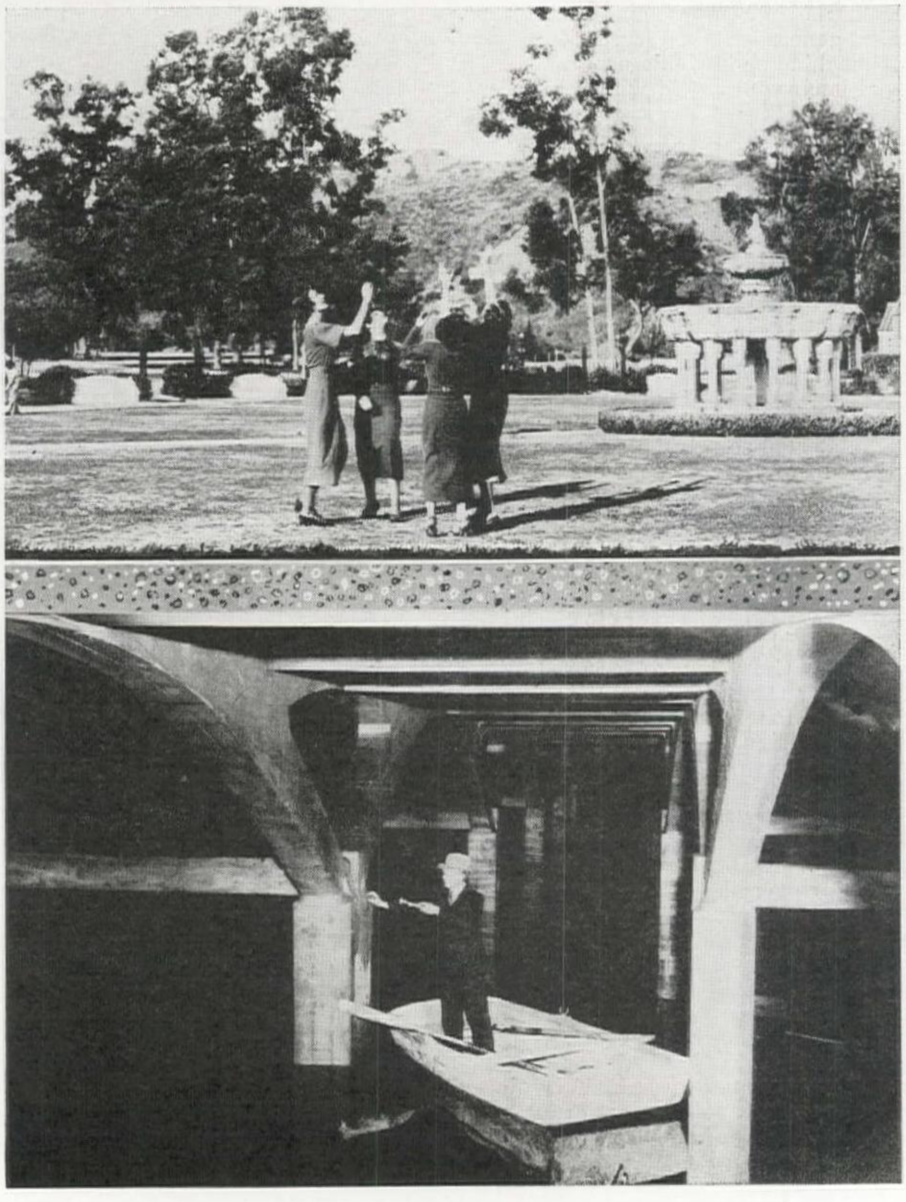
Reservoir Roofs Utilized For Park and Recreation

Two distribution structures in Beverly Hills, Calif., covered and improved to use space otherwise wasted, and eliminate the usual unsightly roofs

By ARTHUR TAYLOR
Taylor & Taylor, Consulting Engineers
Los Angeles, California

ROOFS of reservoirs in built-up metropolitan areas are both an eyesore to adjacent residents and a waste of valuable space. If the conditions offer any possibility for use, serious consideration should be given to adapting the design of the cover for supplementary use as a playground, park, recreation area as was done on two reservoirs in Beverly Hills, Calif. Open reservoirs for local storage of domestic water supply may be dismissed without much consideration because they are decidedly outdated and not in accord with modern practice. Open to contamination in many forms, it is only the sterilizing power of chlorine which permits their use. In spite of this safety factor, open surfaces on distribution reservoirs present a mental flavor of dust, bird droppings and malicious contamination by man.

The mere covering of a reservoir for the protection of the water supply results in a useless and unsightly structure of wood, iron, roofing material or concrete. It is the forethought which provides for using this area which is the important factor. In the City of Beverly Hills, California, two distribution reservoirs have been roofed for definite uses: One provides nine concrete tennis courts illuminated for night play, and the other has been made into a formal park. The reservoirs are of 8,000,000 gal. capacity each and the one used for the tennis courts has a surface area of about 200x390 ft.



Composite view showing concrete supporting structure and the formal park occupying the roof. Drainage in the troughs of the barrel arches and the even temperature aid in maintaining a fine lawn throughout the year.

The reservoirs were constructed with floors and sloping walls lined with reinforced Gunite. The supporting structure for the roof of the reservoir used for a park consists of three hinged arches 10-ft. on centers. The decking between the supporting structures consists of a series of 10-ft. span, barrel arches of 2-in. Gunite with a rise of 12-in. in 10-ft. In the trough of this series of arches tile drain and gravel afford drainage for the top soil applied over the entire area of the "corrugated" roof. As a result of the good drainage and the uniform temperature controlled by the large body of water under the roof, a beautiful lawn can be maintained throughout the year.

Alternate bids on the usual beam, girder and slab deck proved the arch construction to be about 15% lower in cost. No trouble from expansion and contraction has been experienced in the roof structure.

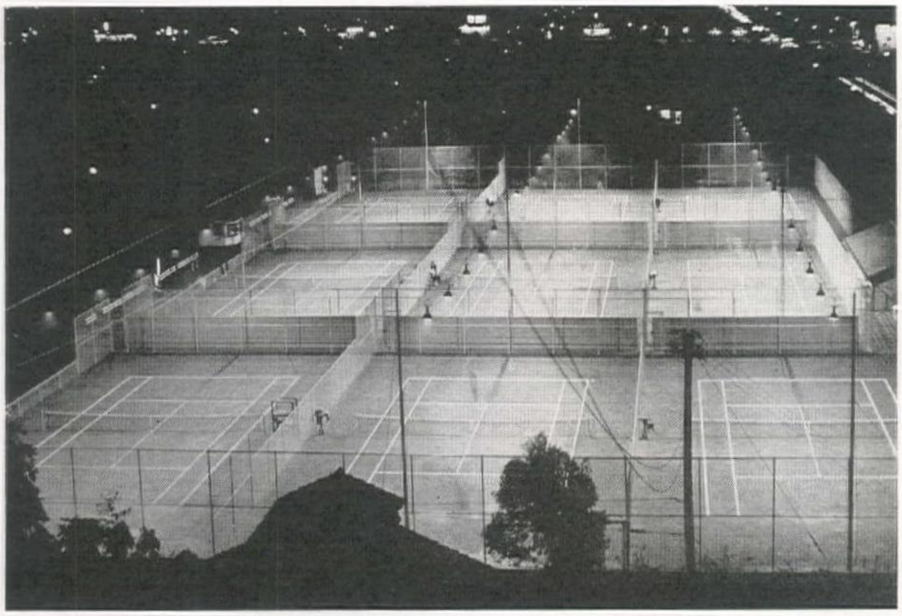
This reservoir is situated in a small valley surrounded by hills occupied by expensive homes. In place of looking down on the customary unsightly reservoir roof, these residents now see a formal park which blends into the landscape and is pleasant to the eye.

The roof over the reservoir used for the tennis courts, is of barrel arch type, but instead of being supported by longitudinal arch trussing, the 10-ft. barrel arches of 3-in. poured concrete are supported on beams and columns 19½-ft. on centers. These columns, instead of being supported on piers, bear on a continuous inverted T-beam as a footing which, in turn, bears on the original Gunite floor of the reservoir.

Over this entire "corrugated" roof a fill of sand and decomposed granite was placed, drained in the troughs of the arches. On this fill was placed a 3½-in. slab of reinforced concrete for the playing area of the tennis courts. Surface drainage on the courts was provided by varying the thickness of the fill, but in no case is the sand fill less than 3-in. in thickness over the crowns of the arches. The surface slabs were poured monolithic in half-courts, bounded by rubber expansion joints.

There is every indication that the life of these courts slabs will be extremely long because the large body of slow moving water varies only about three or four degrees in temperature, day or night and from winter to summer. Absorbing some of the summer and day temperatures and giving up this heat during the winter or night, the water acts to prevent a wide range of temperature in the slab, thus reducing the range of periodic expansion and contraction.

The roof stands about 4-ft. above the surface of the surrounding ground, but a planting of shrubs and trees eliminates the feeling that the courts are raised. On the windward side, a 10-ft. fence backs a 25-ft. width of promenade



Nine concrete tennis courts built on the roof of a 200 x 390-ft. distribution reservoir. Few of the players are aware that they are playing over 15 ft. of water.

which is equipped with benches, chairs and tables, and the dispatcher's office.

The courts are acid-treated to a dark reddish brown, which is easy on the eye. Backstops at the end courts are 16-ft. high of woven wire fencing, and the interfencing is 12-ft. high. Lanes are provided at the ends of the courts, making it unnecessary to pass across an end court to reach one in the center. A solid wall 7-ft. high to shut off the court beyond divides the end lanes. This is a much praised feature seldom found on group courts.

Lighting is provided with a single stand overhead system consisting of a 1,000-watt lamp over each net and two 1,500-watt lamps over each half court, at a height of 30-ft. By a careful selection of the type of lamps and proper length of adapters, used in the reflectors, a uniform illumination of 15-ft. candles has been obtained over the entire court.

At the opening days, when the courts were first placed in use, it was interesting to observe the reactions of the visitors. Only a few of the most observing were apparently aware of the fact that they were standing over a 15-ft. depth of water in a reservoir. Some others, noting that they climbed several steps to reach the courts thought the area had been raised for landscaping effect or for drainage.

The courts are now turned over to the Beverly Hills playground department and are open, together with the other municipal courts, to the public at nominal fees for both residents and non-residents. This work was part of a $126,000 water works improvement project, financed with the aid of a PWA grant. It was the first PWA project of the 1933 appropriation to get under way in California.

Designing, engineering and supervision has been under the direction of Taylor & Taylor, consulting engineers, Los Angeles.

Solving a Taste Problem In Salt Lake City Water

Tree leaves in the fall cause trouble met by adjusting the chlorine-ammonia treatment ratio —Origin and character of taste studied

By AMBER G. KNIGHT
Sanitary Engineer, Water Department
Salt Lake City, Utah

IT is possible to furnish water so palatable that a city water department is put to serious disadvantage to keep it that way, for when the least taste occurs it is instantly and vehemently decried. This was the case in Salt Lake City—the city of many canyons—whose water is famous for its palatability. Late in October, 1935, numerous complaints concerning tastes began coming in to the water department. An investigation revealed that leaves from trees falling into the open stream channels were decomposing and imparting tastes and odors to the water.

The department was anxious to determine the type of leaf which was responsible for the major tastes and odors in the water, and the following investigation was made: Infusions of oak, maple, cottonwood, willow, boxelder, and mixed leaves were made by using one-eighth ounce of leaves in one liter of distilled water.

Color reaction to ferric chloride: 1 c.c. of $FeCl_3$ solution was added to 100 c.c. portions of extract from the above leaf infusions. The color reaction was as follows:

Leaves	Colors Imparted to Water	
Oak	Inky black	Tannate precipitate
Mixed	Dark brown to black	Tannate precipitate
Maple	Dark brown	Tannate precipitate
Cottonwood	Olive green	
Willow	Light green	
Boxelder	Yellow	

Two drops of chlorine solution was added to 50 c.c. of the following for taste determination:

Intensity of Taste	Extract	Taste Reaction
1st	Cottonwood	Phenolic and chlorinous
2nd	Oak	Tannic chlorinous and bitter
3rd	Oak	Tannic and chlorinous
4th	Maple	Tannic and bitter
5th	Willow	Slightly phenolic and chlorinous
6th	Boxelder	Mildly bitter

Solutions were made to determine the origin of the taste predominating in the water. This was done in the laboratory by making a solution of tannic acid dissolved into 50 c.c. of water. A phenol solution was also made by dissolving three-tenths of a gram of phenol in 50 c.c. of distilled water. To both solutions was added two drops of Cl_2 solution. It was then tasted. The taste of this solution was almost identical with the cottonwood leaf solution, to which chlorine had been added. The tannic acid solution tasted and smelled like the oak leaf solution to which Cl_2 had been added. Of the two, the phenol solution was stronger and not unlike the taste which occurred in the water supply.

It was found that the mixture of leaves which fell into the creek channels reacted with chlorine to give chloro-phenol tastes. The leaves from the cottonwood trees contain more of the phenol compounds than any of the six types of leaves or the combination of all leaves examined in this study.

Immediate relief from this condition was brought about by adjusting the chlorine and ammonia ratio. The normal ratio of chlorine and ammonia is: chlorine 4, ammonia 1. This was changed to a ratio of: chlorine 2, ammonia 1. Within twenty-four hours the tastes were dispelled and complaints discontinued.

Better screening facilities were recommended and types of screens, both stationary and revolving, were investigated. It was found that keeping the leaves, especially the cottonwood leaves, out of the intake basins, tanks, weirs, and forebays would eliminate chloro-organic tastes. It was also recommended that all cottonwood growths be cut away from the streams and intakes. Also, that all tank men use the utmost care in pulling the screens so as not to allow leaves to fall back into the supply, and that all forebays, tanks, and basins be cleaned frequently during the leaf season.

Western Installations of Cement-Asbestos Pipe

Current data concerning installations of this material, with some initial reports on service—Corrosive soil has been important factor in its selection

DURING the past few years a relatively new material to the West has come into use in the field of water supply engineering on several municipal systems, as well as for railroads and industrial plants. Manufactured from asbestos fibres and portland cement, this type of pipe has several unusual characteristics, including the important quality of being highly resistant to corrosion. In the interest of our readers in the field of water supply engineering, *Western Construction News* has collected information from some of these local installations, and presents the following brief review of the use of this material in the West.

The combination of asbestos fibres and portland cement for the manufacture of pipes was first carried out on a commercial basis in Italy in 1913, although the combination had been used in that country for some years previously. During the year 1916, about 13,500 ft. of this type of pipe were placed in service in Italy. Since that time, the production of this material has spread to many countries, including the United States, although the largest use is still in Italy, where more than 28,000,000 ft. have been put into service. About 8,000 miles of this type of pipe have been installed throughout the world for a variety of uses, including water supply mains. The manufacturing rights for this product in the United States were secured by the Johns-Manville Corp. in 1929, and the first installations were made shortly thereafter. The product is sold under the name of Transite pipe.

One of the first lines of cement-asbestos pipe to be placed in service in the West.

Manufacturing Process

In manufacturing this pipe, the asbestos fibres and portland cement is mixed and then built up on a revolving steel mandrel as a continuous process to the required wall thickness. Pressure rolls then consolidate and bond these layers. The asbestos fibres act as reinforcing in the mixture adding to the toughness and tensile strength. Removed from the mandrel the pipe is water cured for 7 days.

As a result of its composition, the pipe has reported qualities of: (1) high resistance to corrosion; (2) freedom from tuberculation, and (3) is not subject to electrolysis. Under certain ground conditions, these characteristics become important factors.

In laying the pipe, the joints between lengths are formed by pure rubber rings held in place by a sleeve, or coupling, of the same material as the pipe. The two rubber rings used to form the joint are placed in the proper position on the pipe and then a jack is used to pull the collar into its final position, which rolls the rings to a point on either side of the joint. This joint is water tight and possesses flexibility to allow considerable movement.

As to the durability of this type of joint, which is one of the most frequent concerns of water supply engineers, Prof. Thorndyke Saville, department of hydraulic and sanitary engineering, New York University, made a statement several years ago that "the rubber ring in the joint of water pipe is practically indestructible provided it is conserved from the damp and protected from light."

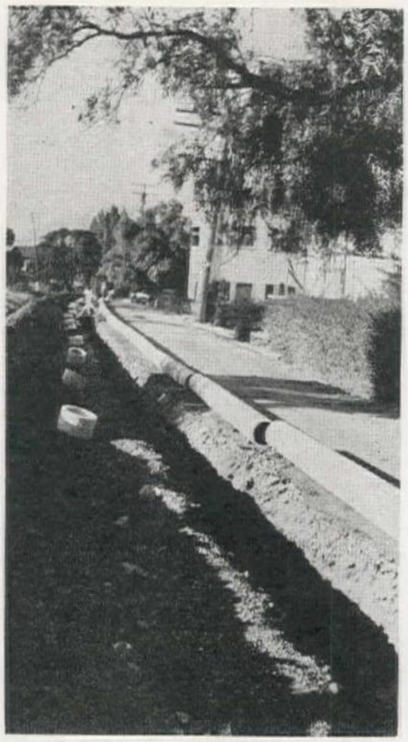
Use in the West

A partial list of some of the larger installations of this pipe in the West is presented in the accompanying table.

One of the first, and probably the most extensive use of this pipe has been in the system of the East Bay Municipal Utility District. The district has made a study of the material and its properties. Some of the results of the district's investigations, supplemented by reports obtained from other users, are reviewed briefly in the following:

On the system of the East Bay Municipal Utility District, and among several of the other western users, the initial installation was made to meet

Lengths of pipe are connected with collars of the same material using pure rubber rings to produce a water-tight joint. This Western installation was made last year.



Some of the Larger Installations of Cement-Asbestos Pipe in the West

	First Used	Length of Pipe (ft.)	Size of Pipe (in.)
East Bay Mun. Util. Dist.	1934	7,500	4–12
Lompoc, Calif.	1934	8,000	3–10
Palo Alto, Calif.	1935	10,000	6–8
Jackson, Calif.	1935	2,000	4–6
San Diego, Calif.	1935	1,000	4
Duncan, Ariz.	1935	5,000	2–4
Pacific Gas & Electric Co.	1934	10,000	3–12
Stanford University	1935	2,100	8
American Potash & Chem. Co.	1934–35	20,000	2–24
Ordway, Colo.	1934	56,000	8
Bureau of Recl. (Parker Dam)	1935	3,300	4–6
National Park Service (Yellowstone)	1935	10,000	8–10
U. S. Indian Service (Ariz.)	1935	6,300	4
Railroad water supplies	1934–35	5,000	3–12

Placed in proper position on the pipe, the rubber rings and the collar are pulled into place by a jack. The rings flatten as they roll under the collar.

severe corrosion conditions. In another case, an installation was made to carry a water line through old mining dumps from cyanide plants where corrosion was particularly severe. Following an initial installation of this type of pipe to meet severe ground conditions, several western users have subsequently extended this use to other locations on a basis of strict price competition.

The quality of freedom from tuberculation during use, and the resulting permanence of its carrying capacity, as reported by the manufacturers, has not been demonstrated in western installations because of the short period of time, and the fact that no definite results are yet available. This characteristic is probably considered as an additional intangible advantage by those using the pipe.

Along the east shore of San Francisco Bay, the ground consists of filled marshes and sloughs where the natural ground surface is only four or five feet above high tide. Water pipes in these locations are usually laid below the high tide level, and are in constant contact with saturated soil consisting largely of decayed vegetable matter with a pH ranging from 6½ to 7½. The nature of this soil makes it highly corrosive to metallic pipe, and this type of material in the past has had a useful life of only six months to about six years.

In such highly corrosive areas, which decrease in severity at a distance from the shoreline, it is necessary to protect metallic pipe with some type of covering. This requirement materially increases the cost of installation, and is not always satisfactory.

With the natural desire to obtain a corrosion resistance material, either in the form of the pipe itself or a protective coating, cement-asbestos pipe was installed in short trial sections in these locations by the East Bay Municipal Utility District. The first section was laid in May, 1933, in a soil known to be highly corrosive. This trial installation consisted of about 50 ft. of 8-in. pipe and five sleeve joints. At the time of the installation, a ¾ in. service branch was tapped into the pipe while it was under pressure. This test tap was made with good success, and subsequent hammering on this branch failed to loosen it or produce any leaks.

This trial installation has been exposed periodically for inspection, the last observation being made April 9, 1936. The external surface of the pipe had softened to a depth of about .003 inches. Some of the rubber joint rings were removed, and although these rings had taken a permanent set, with the cross section remaining oval instead of circular, the rubber did not appear to have lost any of its original elasticity.

Since making the test installation in 1933, ten permanent installations of pipe have been laid. These installations total about 7,500 ft. with pipe sizes ranging from 4 to 12 in. The oldest of these permanent installations is about one year. Total orders placed by the district aggregate about 34,000 ft., with the material carried in stock, as indicated in the accompanying illustration.

When this type of pipe is used to replace sections of cast iron main which have been bonded to relieve electrolytic action, care must be taken to properly bond to nearby conduits, such as gas mains. Otherwise, there may be some destruction as a result of electrolysis to both the remaining iron water pipes and the gas mains. The requirements for such bonding can only be determined by local tests.

Small Filtration Plants for Southern California Water

Existing facilities utilized to overcome serious problems with iron and sulphur bacteria—Palatability of product is accomplished

By C. P. HARNISH
Chief Engineer, American States Water Service Company of California

MUCH has been written about the water resources of Southern California, including the vast basins underlying most of the populous area surrounding Los Angeles, and the great projects for bringing distant waters into this area to augment local supplies. Little has been said, however, about the quality of these waters. The quality of the Colorado River water has been the subject of some discussion, but that of the local underground supplies, which, after all, will continue to be the major source, is taken more or less for granted.

In the coastal plain area where so much of the Los Angeles metropolitan development is concentrated, the quality of the ground waters is apt to be less satisfactory than that of the upper basins closer to the primary mountain sources. As the water percolates gradually seaward, it absorbs more mineral content, and the later accretions from the overlying surface areas, as they find their way into the underground strata, add other undesirable elements. So, these coastal plain waters are found usually, though not always, hard, averaging about 200 p.p.m. but running up to over 500 p.p.m. in certain localities. Organic troubles caused by various forms of iron and sulphur bacteria are also common.

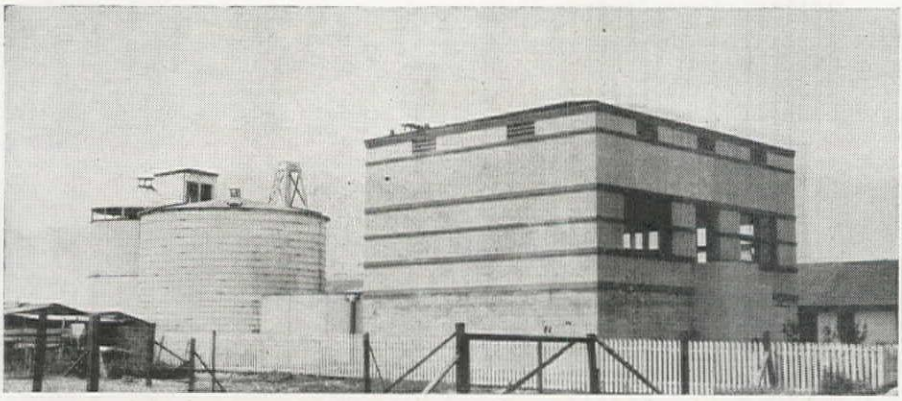
It is rather surprising that the only treatment plants for improving these supplies in the whole metropolitan area, of a character that can be "pointed to with pride" to visitors in the profession, are two in Beverly Hills and one in the Harbor District of Los Angeles. Southern California is surely destined to become much better acquainted with the science and art of water treatment before many years.

In addition, there are three other filter plants for public supplies, designed and built recently upon much more economical lines by the American States Water Service Co. of California, a company serving a population of 200,000 in thirty communities. Being built for a privately owned utility, they simply had to be economical.

These three plants, all different in plan, were designed to cope with heavy infections of the troublesome iron and sulphur bacteria, and were aimed particularly at palatability of the final product. They all had to start with existing facilities, which had to be used, and had to be flexible enough to permit of future expansion and ultimate softening. It is thought that these plants might be forerunners of many others in Southern California at locations where, for one reason or another, permanent construction of the highest order would be ill-advised, or financially out of the question, and yet a decided improvement in the quality of the water was required.

Manning Plant

One of the filter plants constructed was at what is known as the Manning Plant in the Palms-Culver City district, west of Los Angeles. This plant that is somewhat unique in that it was built



Truro plant where problems caused by iron and sulphur bacteria have been solved by aeration, ferric chloride coagulation and filtration. Chlorination at a high rate is followed by dechlorination with sulphur dioxide to remove any taste from the well supply.

up by utilizing an ill-assorted group of existing structures, which, despite this handicap, resulted in a worthwhile improvement at very reasonable cost.

The water was high in hydrogen sulphide and carbon dioxide and would become quite murky upon standing. A small but sufficient content of both iron and manganese was present to support the hardiest and most luxurious growth of filamentous bacteria that could be found anywhere. It was evident that a thorough sort of treatment would be required here, and the plan as finally evolved comprised aeration, coagulation with alum, sedimentation in an existing basin, and sand filtration in a gravity type filter.

The filter was installed in an old abandoned reservoir about half of which was reserved as a filter room and pump room; the other half was converted into a clear well and waste water sump by constructing some new concrete walls. An ordinary redwood tank was assembled as a filter tank by installing suitable underdrains and wash water troughs and filling with properly graded gravel and silica sand.

The results obtained have been very gratifying with no unusual difficulties experienced in operation. Water leaves the plant devoid of objectional features and is really a palatable product. Apparently, aeration removes most of the hydrogen sulphide, and also causes the iron and manganese to precipitate. A heavy chlorine dosage added as the water enters the sedimentation basin, oxidizes the organic compounds and the tastes and odors. The colloidal sulphur which causes the murky color is also partially oxidized, with the balance collected in the flocular precipitate formed by the alum. This floc also absorbs the oxidized organic matter and dead bacteria which precipitate in the sedimentation basin, or are retained on the filter, with iron and some of the manganese being disposed of in a like manner.

The filter plant, as such, is not much to look at for no expense was incurred in architectural embellishment, but after all the "proof of the water is in the drinking." The total cost of labor and material for the filter plant installation was held to $8,500. The capacity of the plant is .75 m.g.d., which can readily be doubled if required. This cost does not include that of the existing facilities, which were already available, but these would have had to be abandoned and written off the books unless the water were satisfactorily treated.

Truro plant

Another of these recent filter plants is at the Truro plant in the Lennox territory in the southwesterly part of the coastal plain. A new source of supply was required in this area and was located following some considerable time spent in geological investigations. A well was carefully drilled, testing each water bearing stratum for quality of water. A good, soft supply of ample capacity was obtained which, except for a slight indication of hydrogen sulphide, was considered palatable. An aerator was constructed to remove the hydrogen sulphide and to settle out the sand, the water being then passed into a redwood storage tank from which it was pumped into the mains.

Everything seemed to be lovely for about six months and then a slimy growth began to appear in the aerator and storage tank, and soon found its way out into the distributing mains. The odor of hydrogen sulphide increased at the plant, and more and more numerous complaints came from consumers. Investigation showed that the same old common foe—iron and sulphur bacteria—again had to be combated, so chlorination was tried, followed by dechlorination with sulphur dioxide. The organic content of the raw water was definitely increasing and this simple treatment was not entirely satisfactory. There were certain local reasons why there could be no compromise on the quality of this water, so it was apparent that a filter plant would have to be constructed.

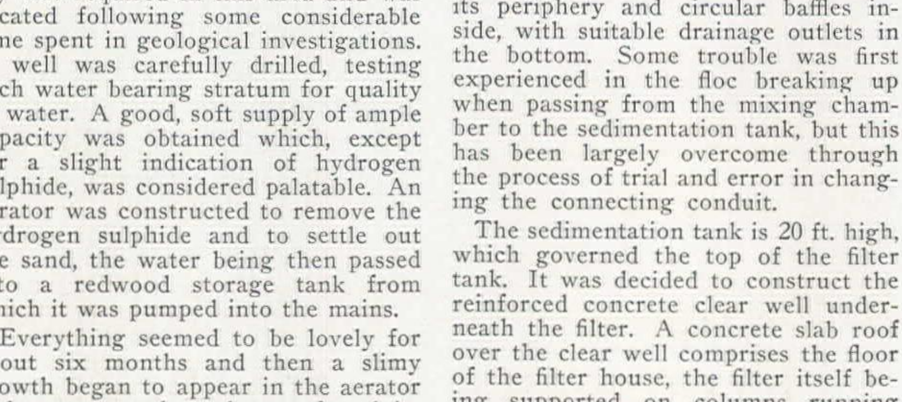
Gravity sand filtration seemed to be the best answer. The steel tank aerator was converted into a mixing chamber; air was used for agitation, supplied by a rotary blower. Ferric chloride was used as the coagulant, and for storing this chemical an 8-ft. diameter concrete pipe was set on a concrete base and lined with protective coating. At first the ferric chloride solution was elevated by air lift into a small wooden tank mounted above the mixing chamber, and from there fed by gravity.

This procedure was later abandoned and a small, hard rubber, direct acting pump installed for injecting the ferric chloride. Floculated water was passed from the mixing chamber into the redwood storage tank which was converted into a circular sedimentation basin by constructing a trough around its periphery and circular baffles inside, with suitable drainage outlets in the bottom. Some trouble was first experienced in the floc breaking up when passing from the mixing chamber to the sedimentation tank, but this has been largely overcome through the process of trial and error in changing the connecting conduit.

The sedimentation tank is 20 ft. high, which governed the top of the filter tank. It was decided to construct the reinforced concrete clear well underneath the filter. A concrete slab roof over the clear well comprises the floor of the filter house, the filter itself being supported on columns running through the floor. Only one filter tank was set up in the initial installation, but space and foundations have been provided for a second tank. The water passing through the filter spills by an aerating device into the clear well, from which it is pumped into the distributing system.

For the wash water pump a short deep-well turbine pump was hung into

Sentney plant showing the first three activated carbon filters for municipal service to be installed on the Pacific Coast. The plant is entirely automatic, except for backwashing.



the clear well and the waste wash water is conveyed into a steel tank for settling. At the start of operations, this waste water was passed to the sewer, but later a small wash water return pump was installed to return this water and part of the sludge into the mixing chamber to mingle with the fresh raw water. Chlorination is applied at a high rate with a residual carried clear through the plant into the clear well to prevent after growths. The water is dechlorinated by sulphur dioxide before being pumped into the distributing mains, since most consumers used to well waters object very strenuously to the taste or smell of chlorine.

No particular operating problems have been encountered after all equipment was properly adjusted. The total cost of this filter plant, shown in the accompanying illustration, was approximately $15,000 for an initial capacity of about 1 m.g.d., which is expected to be doubled within the next year at much less cost.

Sentney plant

The third plant in this group (really the first to be constructed), is the activated carbon filter plant known as Sentney, in Culver City. This installation consists of a battery of three pressure filters charged with granular activated carbon, having a capacity of 1.25 m.g.d. These were the first activated carbon filters for municipal service installed on the Pacific Coast and were reviewed by the writer in *Western Construction News*, April, 1934.

The filters, shown in the accompanying illustration, were designed to filter downward at the rate of 3½ gal. per min. per square foot of surface. The results obtained from these filters were entirely satisfactory from the time they were first put into operation. The effluent is pure, clear and palatable, without any trace of organic tastes or odors, nor that of chlorine which is applied very liberally to the raw water.

After some months of operation it was found that backwashing with water was not capable of keeping the filters clean, resulting in an accumulation of dead organic matter. It was found necessary to inject air into the backwash water by means of a rotary blower, and by this means the beds are now kept in a satisfactory condition. There has been some loss in carbon, most of which occurred during the early periods of operation. The cost of the carbon filters was approximately $10,000, and the chief operating cost, representing mainly the depletion of the carbon, has been computed at approximately $3 per million gallons of water treated. The plant is automatic in operation except for backwashing.

The experiences here indicate that activated carbon filters are not at all out of the question for many municipal supplies troubled with organic tastes and odors, provided the water to be treated is clear and doesn't carry too great an organic load. Otherwise, sand filtration, preceded by coagulation and sedimentation, will be required—a more complex procedure, but thorough.

A Summary of Chlorination . . . Progress and Methods

Reviewing the development of this important feature of water supply engineering and noting its many fields of use in 1936

By W. J. O'CONNELL, JR.
Wallace & Tiernan Sales Corporation
San Francisco, Calif.

TODAY engineers, sanitarians and public health officials recognize chlorination as a standard means of obtaining any or all of the following results:

(a) Destruction of pathogenic bacteria known to be present in water—the classic example being B. Typhosus.

(b) Control of non-pathogenic bacteria and aquatic growths — for example, slime and algae growths.

(c) Insurance against chance contamination; that is, where water from protected watersheds or wells is chlorinated before there is laboratory evidence of pollution.

(d) Prevention of bacterial growth resulting in objectionable by-product production such as hydrogen sulphide in sewers.

(e) Oxidation of organic matter; say for color removal and taste reduction.

The use of ammonia in conjunction with chlorine in the process that might well be called "chlor-amination" is the proper modern procedure to be followed when sterilization is the prime objective. There is some evidence that chlorination of liquids having limited types of organic material in suspension gives some coagulation of the suspended particles. Generally, chlorine enters the field of coagulation in combination with iron and iron salts. One particular iron chlorine salt, namely, ferrous chloride, is used, not as a coagulent, but to remove hydrogen sulphide from water and sewage after it has been formed.

Apparatus

Chlorine control apparatus can be classified as follows, according to the form in which chlorine is discharged:

1. Dry gas measurement and dry gas diffusion.
2. Solution feed apparatus.
3. Hypochlorite feeders.
4. Chemical feeders — dry and solution.
5. Generation by and direct use of chlorine from electrolytic cells.

Under each of these classifications there are all degrees of design development including:

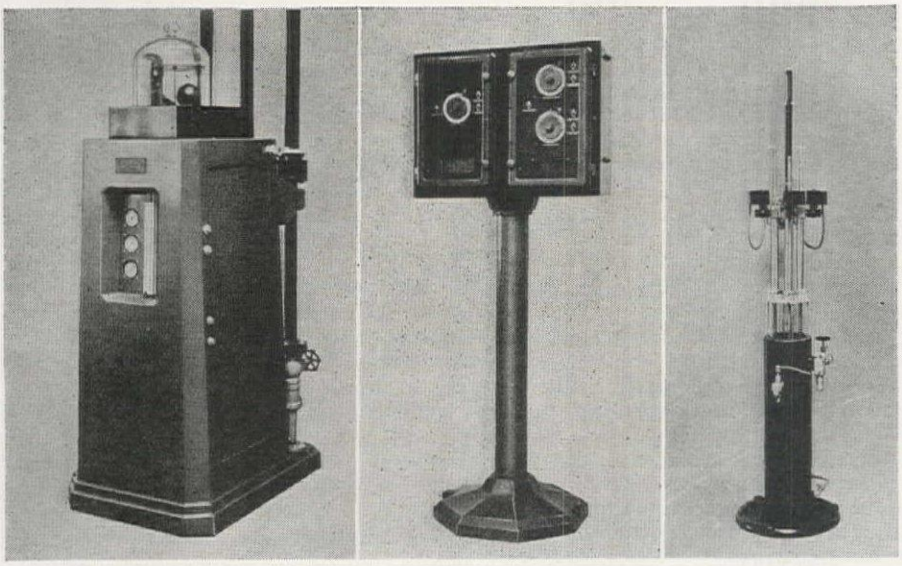
1. Flow measurement under pressure.
2. Flow measurement under vacuum.
3. Manual control of rates of flow.
4. Start and stop of chlorine flow as gas or in solution.
5. Complete automatic control of chlorine flows proportional to flows being chlorinated.
6. Intermittent chlorination for desliming.
7. Combinations with numerous hydraulic and electrical control devices—pilot and signal systems, and program clock controls.

Historical

Prior to 1917 all kinds of schemes of chlorination were tried, using bleaching powder, hypochlorite, and chlorine gas. In some cases chlorine generated by large electrolytic cell installations was directly applied for sterilization. The Ortho-tolidin test for "residual chlorine" was worked out. Arguments waxed hot over "adding chemicals to water" and whether "long time" storage was preferable to chlorination. The economy of using chlorine gas and the superiority of "solution feed" chlorination became recognized. Control apparatus consisted of all imaginable mechanical combinations of pressure reducing valves, orifices, manometers, absorption towers, injectors, mechanical devices for automatic rate of flow control, and devices related to loss of weight measurements. The first interest in the combined use of chlorine and ammonia was recorded. This early use of chloramines was due to the high price of chlorine in Canada and was directed toward reducing costs of chlorination. War use of chlorine for sterilization of grossly polluted field water supplies established chlorination as an essential part of water treatment practice.

From 1917 to 1926 most of the problems of chlorine flow measurement were solved with the invention and development of the "vacuum type" chlorinator. In this period a few experimenters were looking at chlorine as something more than a sterilizing agent. Recognition was accorded to the importance of chlorinating swimming pools, the value of chlorination for reducing contamination of bathing beaches and chlorination for the improvement of streams or natural waters in general, wholly apart from regard for any subsequent domestic use of these waters.

Sterilization was recognized as a type of reaction in itself, and one not to be wholly explained in terms of oxidation. The use of the oxidizing power of chlorine in the practice of super-chlorination and dechlorination was established and is the predecessor of present work toward improvement



Examples of modern chlorination equipment.

For measuring, dissolving and applying chlorine in amounts up to 2,000 lb. per 24 hr. the W & T Master Vacuum Chlorinator (left). Special pilot and program devices for automatic operation add to chlorine economy, and where rates of chlorine application or periods of chlorination can be set on a timed schedule the program control unit (center) provides for effecting control. Operated either by the program control unit or by direct wiring to circuit groups of pumps the rate controller (right) can be used to vary the rate of chlorination depending on the number of pumps in service.

of water taste and quality over and above the improvement in quality by sterilization. Chlorine was used to eliminate nuisance and tastes from growths of non-pathogenic organisms such as iron-manganese bacteria in pipes or algae in reservoirs.

Present day uses

Since 1926 chlorine has been shown to be of value for a great number of incidental uses, particularly ones that result in savings of many dollars. The classifications of these uses are familiar but their specific nature is interesting and follows under:

(a) Sterilization of;

1. Domestic water supply distribution systems in efforts to reduce the hazard from contamination through small undiscovered cross connections.

2. New pipe lines.

3. Temporary water supplies by emergency super-chlorination when the normal water supply is cut off by floods, hurricanes, earthquakes, fires, explosions, etc.

4. Large scale sterilization of recreational waters.

(b) Elimination of non-pathogenic bacterial growths by chlorination;

1. Where slime growths build up on the inner walls of pipe lines and reduce the carrying capacity of the pipes.

2. Where "dead end" rust and taste complaints are traced to organic growths similar to those of "iron bacteria."

3. Of filters to minimize clogging and slime growths on the surface—true for either water plant or sewage plant filters.

4. Of any type of heat exchangers, such as ammonia condensers, steam condensers, refinery and industrial still condensers, to eliminate slime fouling or to prevent growths from restricting cross-flow of air through cooling towers.

5. Of sewage plant effluents to decrease their "biochemical oxygen demand."

6. Of paper mill stock systems to prevent general fouling and losses due to bacterial decomposition of stock or felts.

(c) Insurance;

1. Against chance pollution of domestic water supplies — particularly well water supplies.

2. Against "nuisance" lawsuits.

(d) Elimination of objectionable by-products of bacterial activity, such as;

1. Hydrogen sulphide and sulphuric acid in lines carrying polluted water or sewage—either to end odor nuisance or pipe disintegration.

2. Tubercles and slime formed by "iron bacteria" and similar organisms thus preventing "biological corrosion" that occurs due to the decomposition of these growths and formation of "concentration cells."

3. Masses of slime that accumulate in paper mill stock systems and cause "slime spots" in the finished paper.

(e) Oxidation of organic matter to;

1. Reduce color of water—in conjunction with coagulation and filtration.

2. Separate and coagulate organic matter in sewage or in strong trade wastes containing organic acids, proteins, blood, etc., as in packing house wastes.

(f) "Chlor-amination";

1. For water sterilization without taste production and for actual reduction of tastes of raw water, by proper order and ratios of chlorine and ammonia application.

2. In sterilizing swimming pools to minimize complaints from bathers and to permit more latitude in water treatment.

(g) Use of iron-chlorine salts and chlorinated coagulant;

1. As ferrous chloride, to react with and eliminate hydrogen sulphide previously formed in a water or sewage. (Scott Darcey Process.)

2. As ferric chloride, to coagulate water and sewage over a wide pH range. (Ferric chloride is made by the Scott Darcey Process or by chlorination of copperas.)

3. To obtain sludge or clay chlorinated or reactivated by chlorination in order that it can be added to water or sewage before coagulation.

The trend in chlorine control apparatus and installation layouts is toward automatic duplicate apparatus selected and designed as a carefully planned feature of water-works, sewage disposal, industrial and power plant design. More attention is being paid to insuring maximum efficiency and reliability of chlorination and users are recognizing the value of specially designed housings and chlorine solution distribution piping arrangements.

Future developments

It is probable that the future will see continued emphasis on duplication of control apparatus where sterilization is the main purpose of chlorination. Automatic chlorine control apparatus to proportion chlorine applications according to flows and to variations in "chlorine demand" along with auxiliary and pilot devices for recording purposes and to obtain most flexibility in control are the next obvious steps in equipment development. The use of iron-chlorine combinations in coagulation of water and sewage is altering the position of "chemical treatment."

Research might well be directed toward determining the exact nature of some of the more complex chlorine-ammonia reactions. This along with collections of mass data on variations in "chlorine demand" of different waters would help our understanding of the whole subject of chlorination. It is safe to predict that the principles of the "intermittent desliming process" will be as generally understood and applied by technicians concerned with heat transfer problems in industrial fields as its principles are now understood and used by operating organizations of central generating stations. More consideration might well be given to prevention of "biological corrosion" by chlorination.

Extremely accurate control of chlorination, particularly in combination with ammonia and of processes of super-chlorination and dechlorination, should have a real place in plans for improvement of water quality from an aesthetic standpoint, and it is in this field that most progress should be made in the next few years.

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Construction of a cofferdam across the Taylor River has been started with the renewal of work on the Taylor Park dam this season. This work will result in diverting the river through an 1,100-ft. diversion tunnel, which was completed late in 1935. The project was shut down for several months during the winter season, but is scheduled for completion during 1936. General features of the work, and progress made during the 1935 season were reviewed in *Western Construction News*, Feb., 1936.

Water-wheel Operated Valves On Hetch Hetchy Lines

Hydraulic-motors used to control the flow of water on the San Francisco system—Pressure in the lines used for power

By FRANK S. ISAACS and A. P. MALLEY
Engineering Division, Water Department
San Francisco

THE Bay Crossing Division of the Hetch Hetchy aqueduct consists of two parallel pipe lines and three submarine pipes. These pipes vary in size from 42 to 76 in. in diameter and extend from the Irvington portal of the Coast Range tunnel in Alameda County down to San Francisco Bay; crossing the navigable channel of the bay at the narrow Dumbarton Strait with submarine pipe laid about 70 ft. below the water surface (*Western Construction News,* Sept. 1935).

The westerly end of the submarine pipes enter a concrete caisson where they connect to vertical riser pipes, there being three riser pipes installed at present in the caisson, with space provided for a future submarine and riser pipe.

At the top of the caisson the riser pipes connect to two pipe lines extending across a bridge from the caisson to the westerly shore line of the bay. The pipe lines then continue, passing through Redwood City and connect to Pulgas tunnel, from which the water is discharged into the upper Crystal Springs reservoir of the San Francisco Water Department in San Mateo County.

These pipe lines require gate valves for operating and controlling the flow of water and at present there are fifteen hydraulic-motor operated gate valves ranging in size from 36 to 48 in. in diameter. There are six valves installed in a valve house at the easterly end of the submarine pipes and six valves installed in the caisson at the westerly end.

The gate valve operating mechanisms are driven by impulse water wheel turbines of 30 h.p.; there are two water wheels at each valve, with buckets and nozzles facing opposite directions. These wheels are on the same shafts and separated by a baffle plate. The water to the nozzles is admitted through a control valve, which can be operated both manually and automatically. One nozzle is for the opening operation and the other nozzle is for the closing operation.

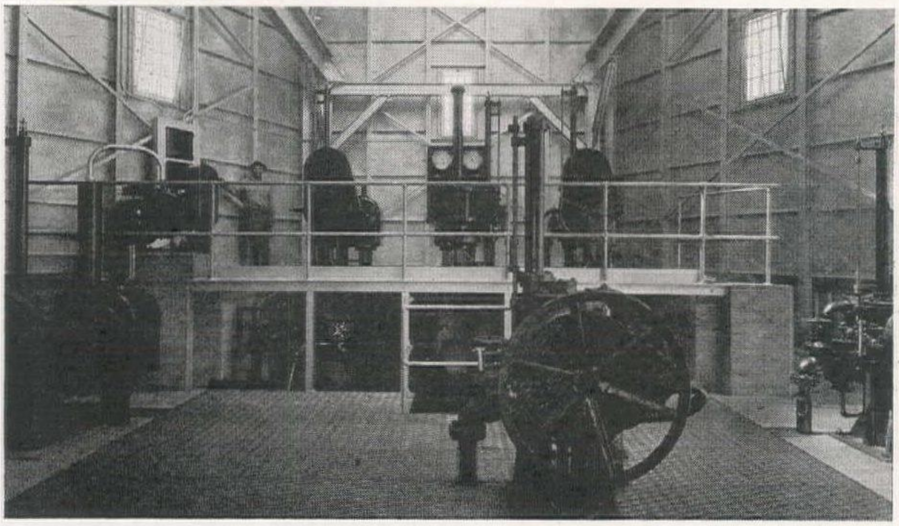
The rather high horsepower output of the motor is the result of the dual condition of operating pressures; with Hetch Hetchy water flowing in the pipe lines the maximum pressure is equal to 175 lb. per sq. in., whereas with the standby Niles reservoir in operation (Hetch Hetchy water shut off) the pressure in the pipe lines is reduced to 70 lb. per sq. in. Therefore, when the water wheel turbines were designed for sufficient horsepower to operate the gate valves at reduced pressures, this resulted in excessive horsepower for the maximum operating pressure of 175 lb.

As it was considered undesirable to use any pressure reducing device, which might fail and throw the full pressure on the water wheel turbines, these turbines and the whole operating mechanism, as well as the gate valves proper, were designed to withstand the stresses produced by the water motors at the maximum pressure of 175 lb.

There are two different types of hydraulic motor operated gates, those which are used in the pipe line proper have their hydraulic motors mounted directly on the valve yokes with an operating platform around the valve. The water wheel shaft is directly connected through gearing to the worm gear shaft which operates the valve stem.

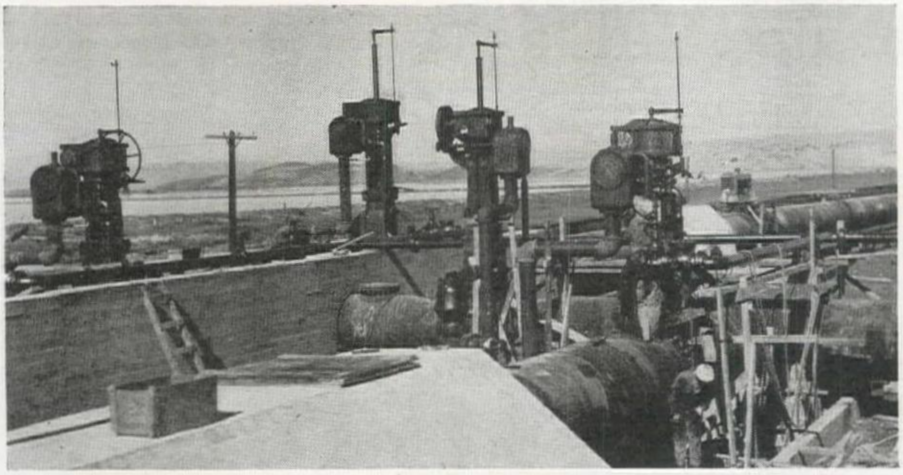
The gate valves installed in the caisson have these hydraulic motors mounted on separate floor stand pedestals. These pedestals are located at the top of the caisson on an operating platform and connect to the worm drives of the respective gate valves, through shafts, mitre gear boxes and flexible couplings. The 36-in. gate valves in the riser pipes in the caisson are installed in horizontal positions and all other valves are installed in vertical positions. Both of these types of installations are shown in the accompanying illustrations.

Water necessary to operate the hydraulic motors is obtained from the connected pipe lines, and this control piping is so arranged that with water pressure on either side of each pipe line it is possible to operate any and all of the gate valves. The control valves are provided with a limiting device which automatically shuts off the water from the hydraulic motors at the end



Valve operating level in the caisson (above), with five of the hydraulic-motors, governors and gears. Motors are designed to operate on either 175-lb. or 70-lb. pressure, depending on whether main-line or standby source of water is in the lines.

Forty feet below the operating level are the valves (below.) The opening and closing mechanism of the horizontal unit is operated by worm gear driven through a shaft from the water motor above. These riser pipes are in the lower section of the caisson.



Four valves in a group at the east end of the Bay crossing lines. Each hydraulic motor is connected by piping to the line on both sides of the valve.

of either the opening or closing strokes of the valves.

Discharge water from the hydraulic motors cannot be put back into the pipe lines and had to be wasted. As most of the valves were installed in the vicinity of the shore line of the bay, this condition offered no problem, except in one case where one of the hydraulic-motor operated gate valves was installed in the pipe near a residential district of Redwood City, where it was necessary to connect the discharge water outlet to a sewer.

The shortest time required, if necessary, for opening or closing the valves ranges from 20 to 40 min., depending on the size of the valve and the operating pressure.

Before accepting and deliveries all valves were subjected to exhaustive operating tests, during which the revolutions of the water motors were recorded at various pressures and with balanced and unbalanced conditions on the gate valve discs. The pull on the rim of the hand wheel was measured with a spring scale and at no time did this pull exceed the limit prescribed by the specifications which was 50 lb., with 70 lb. per sq. in. unbalanced pressure on the gate valve disc.

It was found during the testing of the valves that a minimum pressure at which the water motors would operate at all, was approximately 15 lb. per sq. in. It was also found that with no pressure on the disc the force on the rim of the hand-wheel when the valve was operated manually was approximately 4 lb. This remarkable ease of operation is due to the fact that a liberal use of anti-friction bearings was made throughout the design of the worm gears, stem nuts, mitre gears, etc., and to the high quality of workmanship carried out in all component parts.

The decision to use hydraulic-motor operated gate valves for the 1934-35 construction of the No. 2 pipe of the Bay Crossing Division is the result of satisfactory performance of the three existing hydraulic operated valves which were installed in 1924 by the Hetch Hetchy Water Supply for the No. 1 pipe line. However, this decision was not reached until an exhaustive study was made for using the standard power operated gate valves, manufactured by various gate valve companies. Electric motor operated valves were not considered, as no electric power was available at most of the installation sites, and the standby charges would be considerable. The hydraulic cylinder operated valves were unsuitable as they did not fit the existing conditions in the caisson and on the pipe line, their excessive height would require housing structures of prohibitive dimensions.

Therefore, plans and specifications were prepared for competitive bidding for hydraulic-motor operated gate valves. The low bidder was the Chapman Valve Manufacturing Co. and the contract was awarded to this company. This company manufactured the gate valves proper, in conjunction with the Pelton Water Wheel Co., which designed and manufactured the hydraulic motor operating mechanisms.

Edward G. Cahill is manager of utilities, San Francisco Public Utilities Commission. N. A. Eckart is general manager and chief engineer of the water department and I. E. Flaa is hydraulic engineer.

Northwest Sewage Group Holds Annual Meeting

Second convention of Association held at Aberdeen, Wash.—Plants and problems are described

THE SECOND annual meeting of the Pacific Northwest Sewage Works Association, held at Aberdeen, Wash., on May 13, was featured by presentation of several outstanding papers and a round-table discussion, presided over by R. E. Koon, Portland consulting engineer. Thirty-seven members were present. Officers elected for the coming year include: President, Roy M. Harris, state sanitary engineer of Washington; first vice-president, R. E. Koon; second vice-president, R. F. McLean, water and sewer superintendent, Walla Walla, Wash.; secretary-treasurer, (re-elected) Fred Merryfield, Ass't Professor of Civil Engineering, Oregon State College, Corvallis.

The need for licensing of sewage plant operators by state health departments was brought out by E. French Chase, Seattle sanitary engineer. Following an extended discussion on the need for qualified sewer-rental laws for financing sewage plant construction and operation, a resolution was adopted recommending a study be made by the Washington State Planning Commission regarding enactment of suitable legislation. A resolution was also adopted urging continuance of PWA rather than WPA in an attempt to provide finances for needed sewage installations. In financing plant and operating costs at Yakima, Wash., where a new plant is nearing completion, A. B. Collins, city engineer, stated that service charges would be incorporated with domestic water charges.

A talk on "Characteristics and Treatment of Sulphite Waste" was presented by R. G. Tyler, Professor of Civil Engineering, University of Washington, who discussed the problems involved and the possible treatment and alleviation. Sulphite liquor, a waste by-product of the wood pulp industry, creates a major pollution problem along the Oregon and Washington coast area where many wood pulp factories are located. Studies made at University of Washington on reduction of the waste by anaerobic fermentation with samples seeded with salt and fresh water muds indicated that decomposition is similar to biological reduction of sewage solids with a resultant production of carbon dioxide and methane. Studies were also made of the effect of sulphite waste on fish and shellfish, especially at Shelton, Wash., and tests revealed that the sulphite by-product destroyed the food of this specie of marine life. A typical analysis of sulphite liquor shows:

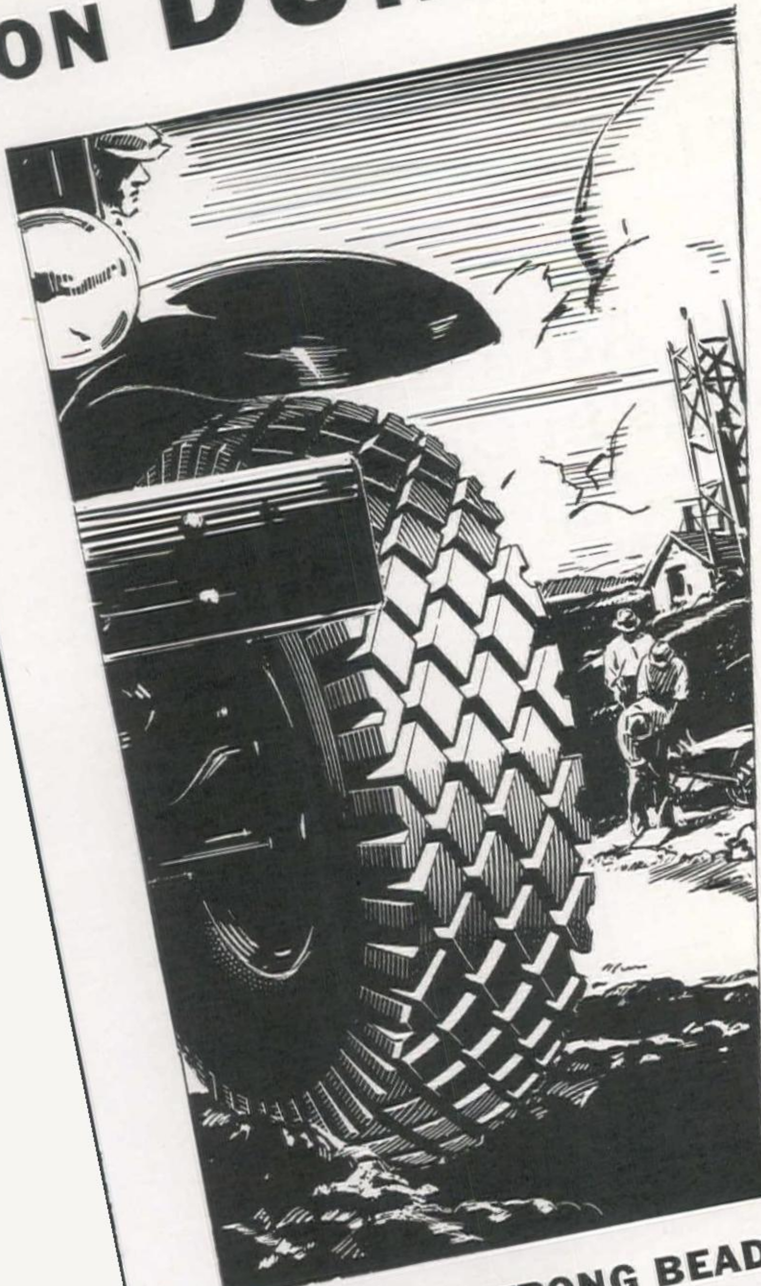
Total solids	118,000 p.p.m.
Residue on ignition	19,010 p.p.m.
Total volatile acids	5,310 p.p.m.
Calcium (CaO)	7,240 p.p.m.
Total sulphur	10,290 p.p.m.
Oxygen demand	110,000 p.p.m.
Sugars	20,150 p.p.m.

Experiments indicated that this waste could probably be handled with ordinary city sewage provided the dilution ratio was not less than 1:6 or 1:8.

Walla Walla sewage plant

Several problems encountered in the operation of Walla Walla's 3½-yr.-old, $240,000 sewage plant, which employs primary sedimentation, sludge diges-

WHAT A BEATING BEADS* TAKE ON DUMP TRUCKS!



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Improved High Profile Goodyear Truck Tires are made with heavy, braided-wire beads, securely tied in by the plies of the tire. And your truck tires need strong, dependable beads just as an athlete needs strong ankles.

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***EXTRA STRONG BEAD CONSTRUCTION**

To provide strength for heavy loads, swaying loads, high loads, Goodyear truck tires have an extra-strong, heavy, braided-wire bead—wide and securely tied in by the plies of the tire. This construction insures a firm seating of tire on rim. The larger size truck tires have dual beads.

GOOD YEAR TRUCK TIRES money savers

When writing to The Goodyear Tire and Rubber Co., *please mention Western Construction News* tion, filtration by trickling filters and chlorination, were informally discussed by R. F. McLean, plant superintendent. In 1935, improperly screened cannery waste, consisting of fibrous pea hulls, resulted in formation of a relatively dry scum on the top sludge in the digester. This trouble was overcome by installation of 6-mesh screens at the canneries. During periodic cleaning it was discovered that dehydrated lime, administered to raise the pH, had deposited in the bottom of the digester. The solution to this problem was the substitution of hydrated lime.

Gas from the digester is used for incineration of screenings and for heating all plant buildings. The per capita per year cost of operation, exclusive of amortization costs, amounts to 17 cents. The gross return from sale of sludge as fertilizer amounted to only $40 last year. Plant costs are paid by the city water department.

Sewage plant design features

In a talk covering special features of sewage treatment plant design, John W. Cunningham, consulting engineer of Portland, pointed out the rapid progress and changes made during the past decade involving the general adoption of mechanical equipment and the development of patents on both machinery and processes. The trend is towards standardization of design although in some instances it is doubtful whether small mechanized plants are desirable from an economic viewpoint. Since efficient operation is highly necessary, mechanical equipment is usually justified by virtue of the fact the plant will probably be better operated since neglect of machinery is self-evident and therefore induces the operator to adequately maintain his plant. In designing a plant careful consideration must be given to process patents although it appears doubtful if such patents should ever have been granted.

Treating Seattle's sewage

Seattle, like many larger communities, has economically disposed of its sewage by discharging it into the nearest body of water. In 1922 the state health department ordered a cleanup of Lake Washington, a large fresh body of water skirting Seattle's city limits, into which 32 sewers were at one time discharged. Lake Union and Ballard district sewers, previously dumping into Lake Union and Lake Washington Canal, are now intercepted and discharged into Puget Sound. A 12-ft. sewer, representing about 60% of the sewered area, discharges into Puget Sound at Fort Lawton, where there are continuous outgoing currents. Several sewers are discharged into the bay at West Seattle and Magnolia Bluff and into Duwamish River, which empties into the Sound near the industrial district.

Prevailing shoreward currents around West Seattle in some instances wash this sewage back on adjacent public and private beaches. Studies indicate that eventually an intercepting sewer must be built along the entire West Seattle waterfront for concentration of sewage at one point for treatment. Tentative plans provide for three disposal plants: one serving the area west of Duwamish River; the second for sewage discharging into Duwamish River and the Bay south of Lake Union; and a third for the Fort Lawton sewer. Sewage from the new Henderson Street trunk sewer, serving a population of 15,000 in the Ranier Valley district, will have to be treated before being discharged into Duwamish River at Michigan Street. This plant, estimated to cost $500,000, will complete the intercepting system along Lake Washington consisting of fifteen pumping units and one disposal plant and which will ultimately cost about $4,000,000.

Three Oregon plants

A paper on the design and construction of the nearly-completed sewage treatment plant projects at Medford, Ashland and Talent, Ore., was presented by K. V. Hill, resident engineer for Greely & Hansen of Chicago, consulting and designing engineers for all three plants. Construction of these PWA financed plants, providing for complete treatment consisting of clarification, oxidation and disinfection, became urgent because of the low summer flow of Bear Creek, the natural drainage course for the three communities. Due to irrigation diversion, which reduced the creek's flow to 2.5 sec. ft., the flow was insufficient for the dilution of wastes of 20,000 persons living in the 296-sq. mi. drainage basin.

A detailed review of these plants prepared for *Western Construction News* will be published in a forthcoming issue.

Striping Adds Safety to Highways in California

Development of this phase of highway engineering and review of the current practice during the past decade

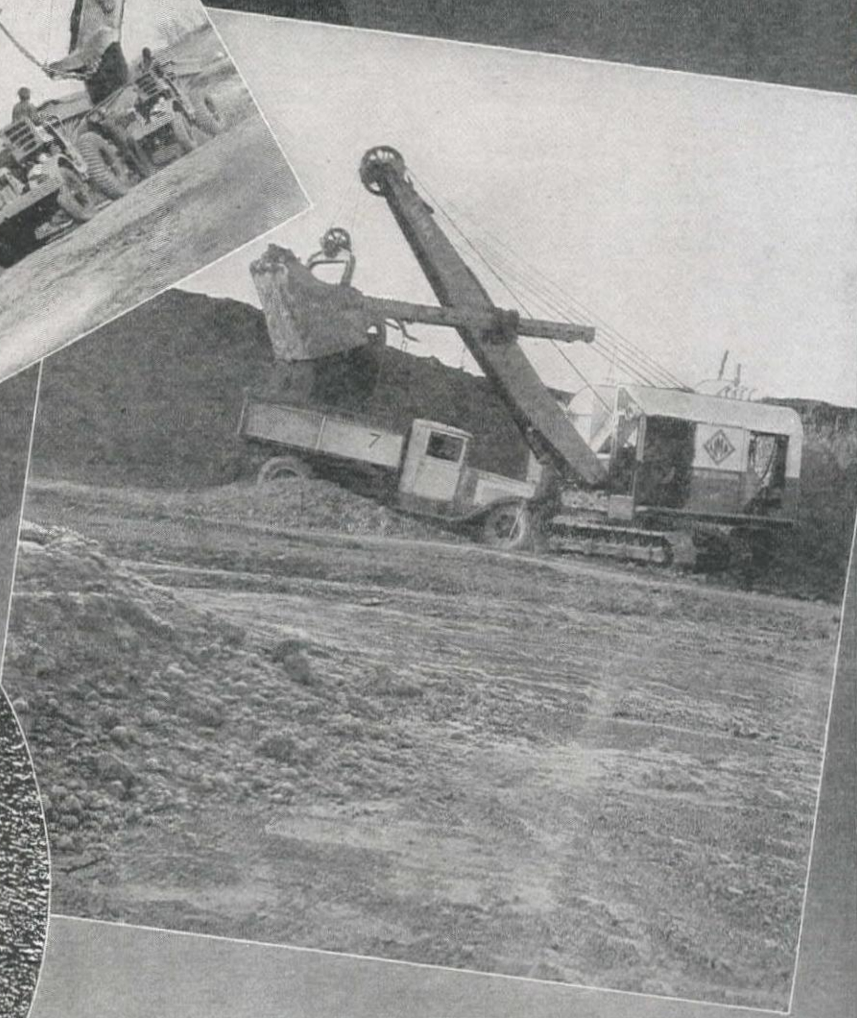
Highway engineers agree that the striping of highways has developed into one of the most important safety devices for the protection of the motoring public. The California Division of Highways has done a relatively large amount of this work during the past few years and, as a result, has developed equipment, practices, and material which should be of interest to other state highway engineers and municipal engineers throughout the West. To bring this subject to date, *Western Construction News* is presenting in the following condensed review of California practices.—Editor.

IN the early days of highway construction, the necessity for highway striping was not as essential as it is today, because motoring speeds and the volume of traffic in that period had not reached the point where safety devices were as important as they are today. Furthermore, many modern highway conveniences, the desirability of which was recognized in those early years, could not be adopted as standard practice because funds at that time were so limited. The California Division of Highways has endeavored to develop all phases of the state highway system to parallel the ever-increasing speed and volume of highway traffic. In this program, highway striping has become a recognized part of the Division's

Modern striping machine used by the California Division of Highways. Propelled by the truck, which carries the paint tank and compressor, this machine stripes about 18 miles per day when operated by an experienced crew.

Another LIMA

for WESTERN ASPHALT PAVING CORPORATION
SIOUX CITY, IOWA



FOLLOW THE TREND

Another repeat order proving that LIMA meets every requirement of steady, economical digging. Western Asphalt Paving Corporation, Inc., Sioux City, Iowa, took delivery of their first LIMA in 1935. This year their contracts warranted another machine. The finished performance of their first LIMA proved to them that to choose LIMA is to choose wisely.

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MAS ARE BUILT IN CAPACITIES FROM 3/4 TO 3 YARDS operations and a brief review of California practice is described in the following.

The purpose of the traffic stripe is to divide the pavement into definite traffic lanes. This results in lessening traffic confusion, reducing accidents, increasing road capacity, expediting traffic movement (especially at road intersections), and helps to separate slow-moving, heavy-duty vehicles from lighter, fast-moving cars. During foggy or stormy weather, traffic stripes greatly increase safety of driving. The benefits derived from traffic lines are therefore obvious. The cost of efficient traffic striping in California has been reduced to a reasonable amount by developments of the Division of Highways, and no important road is left without its proper lane markings. Width of pavement and volume of traffic, fog areas and road alignment all help to determine proper striping policy.

History

Probably one of the earliest users of the traffic stripe in modern United States highway construction was the state of Pennsylvania, which specified the use of an inlaid traffic stripe of Topeka (black pavement) in its concrete highways about 1917.

In California, generally, a 4-in white stripe is used to divide the pavement into two or more traffic lanes. On new portland cement concrete pavement, a raised stripe of emulsified asphalt and fine screenings is often applied to guide traffic until the pavement surface darkens, at which time white lacquer is applied to the raised stripe. Standard markings are also painted at railroad crossings and other hazardous locations. Particular study has been given to transition of stripes from two, to three or four-lane pavements, and standard plans have been developed for these operations, by the maintenance department. Both vertical and horizontal curves are marked with a double central stripe when the sight distance is less than will permit safe passing at prevailing speeds, and caution signs are erected at suitable locations warning traffic not to cross these double stripes.

Traffic stripes on California pavements began in 1926, when small hand-operated machines were used for applying stripes. This machine consisted of an 8-gal. paint tank and small compressor mounted on a hand-propelled carriage. Delays of mixing the lacquer and filling the tank permitted placing of only about 4 mi. of stripe per day. Through experimental work by maintenance department and the research and testing laboratory, the amount and quality of white lacquer required for efficient striping was determined. In 1932 specifications were prepared for lacquer which were similar to those now used in the 1935 Standard Specifications shown in the accompanying table. The lacquer is required by specification to meet the following test requirements:

Test requirements

(1) *Drying Time.*—When the lacquer is applied to an asphalt pavement at the rate of fifteen (15) gallons per mile, it shall dry without tracking in from fifteen (15) to thirty (30) minutes. Panels of different materials will be dipped in the thoroughly mixed lacquer, the surplus paint allowed to drain and then placed in a vertical position and maintained at a temperature from seventy degrees (70°) to ninety degrees (90°) F. and the drying time noted. The drying time thus determined shall not exceed thirty (30) minutes.

(2) *Covering.*—Panels of bright tin marked by painting two diagonal black lines one-half inch in width from opposite corners, with one coat of drop black in oil, thinned with turpentine and dried so as to obtain a suitable body to give proper brushing, flowing, and covering properties, and wood panels of white pine painted in the same manner as the tin panels will be prepared and allowed to dry for forty-eight (48) hours. The lacquer to be tested will then be painted by hand upon both the tin and wood panels and after seventy-two (72) hours, the diagonal black lines shall not be visible through the lacquer coating.

(3) *Bend Test.*—Clean, plain tin panels three (3) millimeters to four (4) millimeters thick and ten (10) centimeters by fifteen (15) centimeters in size will be painted by hand and allowed to dry for seventy-two (72) hours, and then bent rapidly over a rod one-half inch in diameter. There shall be no more than slight cracking of the paint film as a result of the bending.

(4) *Water Test.*—Plain panels prepared as in the bend test are placed in cold water at room temperature for forty-eight (48) hours; other panels are placed in hot water at two hundred degrees (200°) F. for one hour; and still others are placed in boiling water for fifteen (15) minutes. After having been removed from the water, there shall be no marked disintegration of the lacquer on any of the panels at the end of two hours.

(5) *Bleeding Test.*—When the lacquer is painted at a rate equivalent to fifteen (15) gallons per mile upon specially prepared asphalt disks containing an excess of asphalt, no discoloration of the paint film when dry should take place.

It has been found that about 10 gal. of lacquer are required for each mile of 4-in. re-striping, and from 10 to 15 gal. per mi. when applying new stripes, depending on the type of pavement surface.

COMPOSITION OF WHITE TRAFFIC LINE LACQUER

Pigment

Titanium oxide	24%–25% (by weight)
Barium sulphate	76%–75% (by weight)

Pigment shall be a precipitated product.

Solvent

Raw tung oil (china wood oil)	15% by volume
Normal butyl alcohol	17% by volume
Acetone	34% by volume
Denatured alcohol formula No. 1	34% by volume

The butyl alcohol, acetone, and denatured alcohol shall be mixed and then the wood oil shall be added to form a clear solution at 70° F.

Gum Vehicle

Gum (East Indian D.B.B.)	35%–37% by weight
Solvent (as above)	65%–63% by weight

Lacquer

Pigment (as above)	42%–45% by weight
Gum vehicle (as above)	58%–55% by weight

NOTES.—The lacquer shall be mill ground and shall conform to the following composition: Five gallons of amyl acetate shall be added to each 500 gal. of the finished product. Sufficient Prussian blue shall be added to the oil to overcome the yellowish tint.

Thinner furnished for use in cleaning the paint spray shall be used the same nature as the volatile vehicles used in manufacturing the lacquer. Thinner shall consist approximately of one part acetone and two parts No. 1 denatured alcohol.

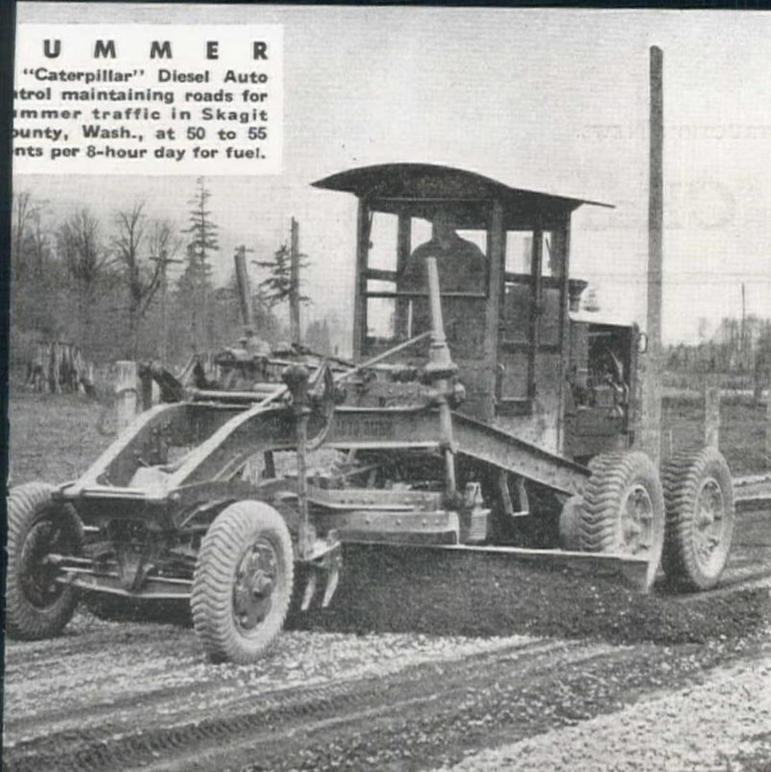
Machine used

Each of the eleven highway districts is now supplied with up-to-date striping equipment, and some 5,000 mi. of highways have been single, double or triple striped, totaling about 8,000 stripe-miles annually. The San Francisco and Los Angeles districts operate striping machines continuously. This new equipment was developed by the equipment department and consists of a paint tank and compressor mounted on a light truck, and the spraying unit propelled in front of the truck, as indicated in the accompanying photograph. Rubber-tired wheels with 8-ft. wheel base are used with easily controlled pointed or guide for securing a uniform line.

A considerable mileage of striping is done by contract each year in addition to that done by state forces, and efficient equipment has also been developed by several contractors. The pavement to be striped is first cleaned with compressed air and, after painting, the fresh line is protected while drying by small markers. An experienced crew will place an average of 18 mi. of stripe per day at a cost of $20 to $25 per mi. for restriping, and about $30 for new stripes. Spotting a new line costs from $6 to $8 per mi. In general, white lacquer stripes are renewed yearly, although on heavily travelled roads near large cities, stripes are renewed at least twice a year.

Another type of traffic stripe which has been used experimentally in heavily travelled suburban areas by the California Division of Highways consists of a white cement marker, about 1x6-in. in section, cast in place during construction of portland cement concrete pavement. However, this type of stripe has not been adopted as standard.

C. H. Purcell, is state highway engineer of California and G. T. McCoy is assistant state highway engineer. T. H. Dennis is maintenance engineer and T. E. Stanton is materials and research engineer.



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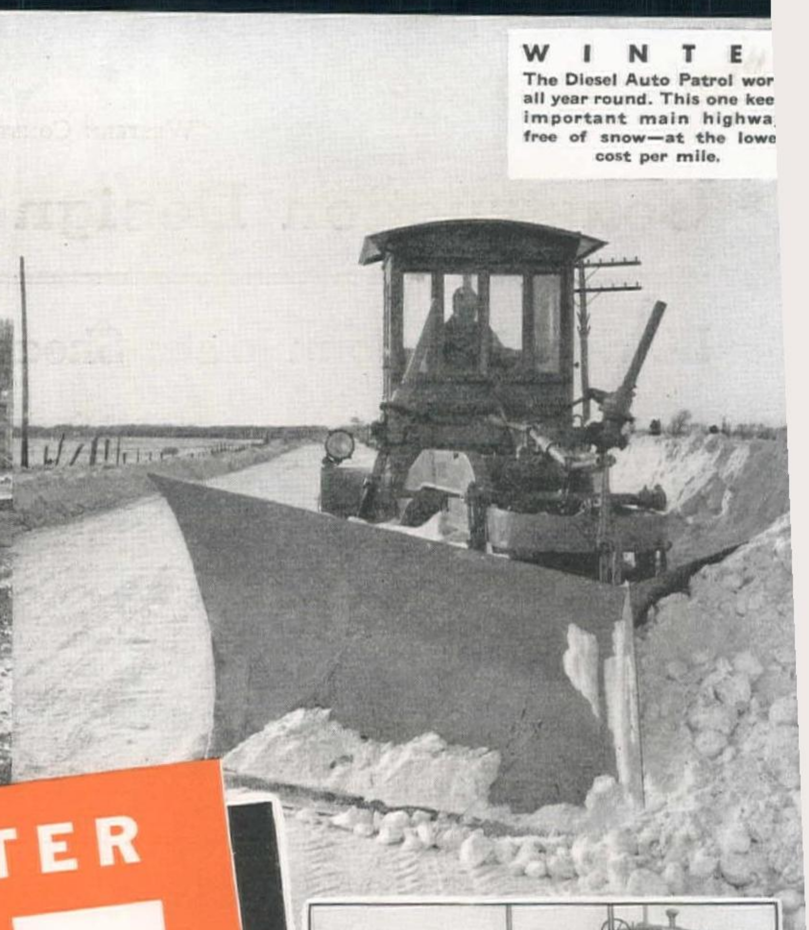
"Caterpillar" Diesel Auto trol maintaining roads for mmer traffic in Skagit ounty, Wash., at 50 to 55 nts per 8-hour day for fuel.



WINTE
The Diesel Auto Patrol wor all year round. This one kee important main highwa free of snow—at the lowe cost per mile.

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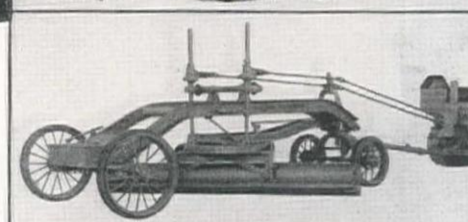
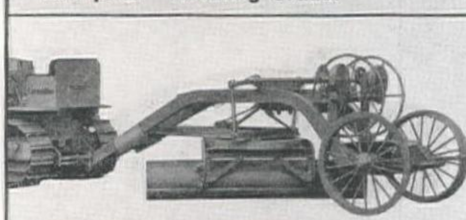
The "Caterpillar" Diesel Auto Patrol is first choice for maintenance work on thousands of miles of American roads today. Big fuel savings and rock-bottom up-keep costs make it extremely economical to operate. "Caterpillar" advanced design —proper balance, full visibility, dependable power-operated controls—makes possible fast, accurate performance, more trips per day, better results each trip. Ask a dealer for the whole SHOW-DOWN on "Caterpillar" Road Machinery. Caterpillar Tractor Co., Peoria, Illinois, U. S. A.

"Caterpillar" Diesel Auto Patrol

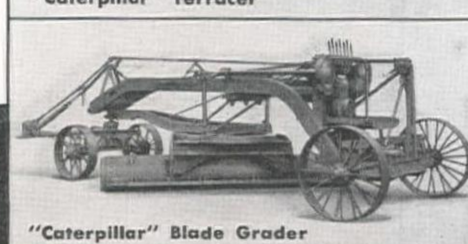


"Caterpillar" Trailer Patrol

"Caterpillar" Elevating Grader



"Caterpillar" Terracer



"Caterpillar" Blade Grader

CATERPILLAR

Construction Design Chart

IX. Spans for Form Joists: Shear

By JAMES R. GRIFFITH
Professor of Structural Engineering
Oregon State College

SOME readers may protest that 72 lb. per sq. in. is too conservative for the allowable maximum shearing stress in form lumber. If such is the opinion, the accompanying chart can be adapted to any allowable value by a direct ratio. If it is considered advisable to use an allowable stress of 120 lb. per sq. in. for the maximum horizontal shear, the allowable span as found from the chart may be increased by the factor $\frac{120}{72} = 1.67$.

As in the previous chart for flexure of joists and studs, two lines intersecting on the "support" are necessary for a solution of the accompanying chart. Lines have been drawn on the chart indicating the solution for the same conditions assumed in the last problem:

Height of concrete = 2 ft.,
Spacing of studs = 24 in.,
Size of studs = 2 x 4 S4S

From the chart it will be seen necessary to space the wire ties at 9 in. for shear if 72 lb. per sq. in. is the allowable maximum. If, as previously explained, it is considered advisable to use an allowable shearing stress of 120 lb. per sq. in., the allowable spacing of the ties would then be

$$9 \times \frac{120}{72} = 15 \text{ in.}$$

In order to check the accuracy of the chart, the following solution is given using the allowable spacing of ties of 15 in.

Total span load, $W = 2 \times 300 \times \frac{15}{12} = 750$ lb.

Total shear, $V = \frac{5}{8} \times 750 = 469$ lb.

Maximum unit shear, $v =$

$$\frac{3 \times 469}{2 \times 1.625 \times 3.625} = 119 \text{ lb. per sq. in.}$$

This checks the assumed allowable shear of 120 lb. per sq. in. used in obtaining the allowable spacing of ties of 15 in.

An exact analysis of the moment and shear distribution in a wall stud is difficult if not actually impossible. For example, in the mathematical analysis of a continuous beam, we must assume knife edge supports, a condition both impractical and impossible to obtain in actual construction. The use of wire ties possibly approaches the condition of knife edge supports.

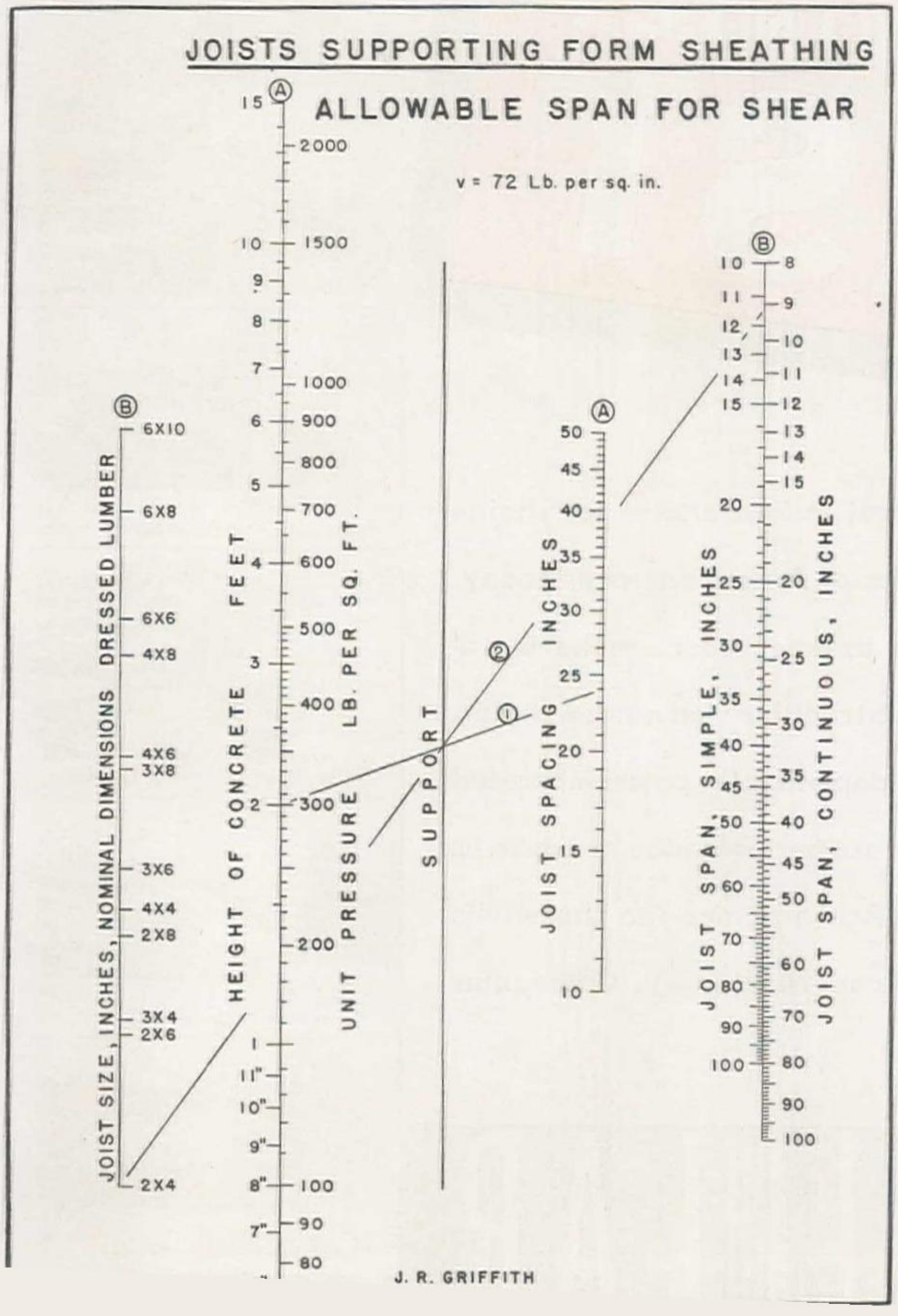
In order to relieve my own curiosity I made an analysis of a form stud attempting to parallel actual working conditions as nearly as was possible. The pressure from the concrete was considered to increase uniformly from one end of the stud to the other. The approximate values for maximum moment and shear were taken, as in the construction of the charts, to be

$$M = \frac{wL^2}{10}$$

$$V = \frac{5}{8}\, wL$$

with w as the average unit load on the span. Under these conditions the more accurate solution indicated maximum moments and shears of from 5 to 13% in excess of those found by the approximate method.

I personally feel that when using approximations of somewhat dubious results, I am justified in being a little conservative in the use of working stresses. In contrast to this attitude, I know of at least one authority recommending the use of an allowable maximum horizontal shearing stress of 200 lb. per sq. in. for form lumber. Yet, the Forest Products Laboratory gives as a "basic stress for clear material" a value of 120 lb. per sq. in. for coast Douglas fir in shear (Wood Handbook, 1935, Supt. of Documents, Washington, D. C.). The allowable working stress for timber is obtained by reducing this basic stress by specified percentages depending upon the variations of imperfections found by grading rules.



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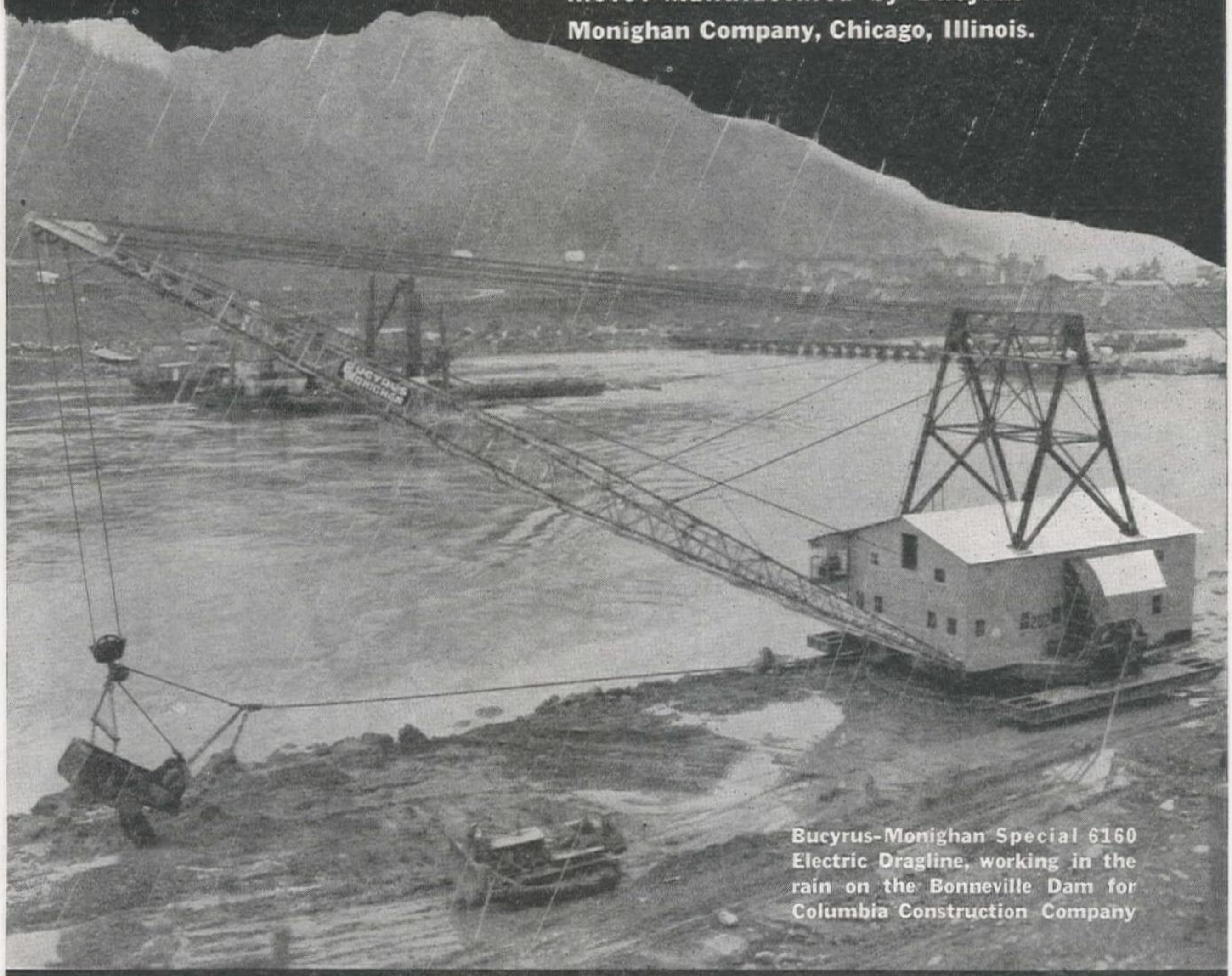
ignores rainy weather, soft ground and treacherous footing. It has a double set of supporting surfaces . . . more than double the bearing utilized by other types of draglines. When digging it is supported only on its large-area base. When walking, it is supported partly on the walking treads and partly on the base. Treads and base get fresh bearing surfaces for every move! Manufactured by Bucyrus-Monighan Company, Chicago, Illinois.



Bucyrus-Monighan Special 6160 Electric Dragline, working in the rain on the Bonneville Dam for Columbia Construction Company

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Extensive Reconditioning of Sacramento Streets

Planing operations on 500,000 sq. yd. improves riding qualities and adds to life of pavement

By CHARLES R. BLOOD
Assistant City Engineer
Sacramento, Calif.

STREET maintenance work in Sacramento, Calif., during the past season, has included rather extensive operations in planing and restoring the surface on more than 500,000 sq. ft. of old asphaltic concrete pavement. The work has been carried out with a combination heater and planer which includes a strike-off operation with one continuous forward motion. The results which were sought and obtained included: (1) improvement of riding quality, (2) removal of excess seal coat and fats from the surface and, (3) the providing of a nonskid surface for the safety of traffic.

The accompanying table indicates the location of different work, the type of original pavement and its condition, and the treatment required in the resurfacing process.

Job No. 1 (see accompanying table) was on L Street, passing the old historic Fort Sutter, where two blocks of pavement had become badly shattered due to poor drainage, and it was decided in 1934 to tear this street up and replace it under an SERA project. To make use of the maximum amount of hand labor, the paving materials replaced were of the plant mix cut-back type, workable at atmospheric temperatures during the rainy season. The pavement placed under these unfavorable conditions had rutted badly under traffic. The planing restored the riding quality, and the heat seemed to harden the surface, which is now ironed out and sealed over satisfactorily.

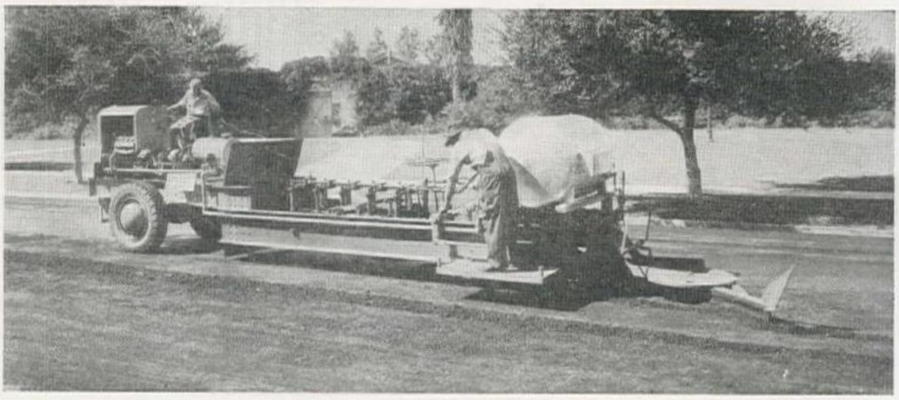
Jobs Nos. 2 and 3 were on asphaltic concrete streets, on which the surface had polished under traffic and become dangerous in damp and wet weather. In planing these sections we had in mind the removal of existing irregularities, and the preparation of the surface for an application of light armor coat. Two operations of this planer removed the heavy seal coat and left a very satisfactory mosaic of the larger rock. A thin tack coat of emulsion was sprayed on, and over this about ½ in. of surface cut-back mix was spread and rolled. This surface course was not sealed, and has given a very satisfactory non-skid texture. This had been a very effective and inexpensive treatment, and has made a dangerous section of the highway both safe and smooth.

On Job No. 3 a thin spread of sand was placed over the surface before the heat was applied, and this made a very effective non-skid treatment at much lower expense than that of placing a surface mixture. Where there were no curbs and gutters the excess material was bladed over the header boards on to the earth shoulders, and this has helped to keep the shoulders from raveling.

Job No. 4 was on a 5½-in. two-coat asphaltic concrete pavement with a seal coat. The surface or top course of this was very rich in asphalt, and had softened and rolled up under traffic and the heat of the summer sun. It was intended to plane this excess seal coat off and develop a mosaic of larger rock to which we could bind an armor coat of ½ to ¾-in. rock. However, after the planing operations the riding quality was found to be restored and the seal coat so satisfactory that it was decided to let traffic use this street without further treatment and defer for a year or more the placing of an armor coat.

Job No. 5 was done as an extra, after seeing the satisfactory results of this work under the original contract. This

Combination heater and planer at work reconditioning street paving surface in Sacramento.



DATA ON STREET RECONDITIONING WORK IN SACRAMENTO, CALIF.

Job No.	Location	Type of Original Pavement and Condition Before Treatment	Treatment and Results Obtained
1	L Street	Reconstructed by SERA hand labor during rainy season 1934. Cutback plant mix, badly corrugated under heavy traffic.	Three trips of machine restored surface to smooth uniform grade and cross section. Heat seemed to harden the surface.
2	Folsom Boulevard	Two-course bituminous concrete with heavy hot oil seal; had a few corrugations but highly polished, slippery and very dangerous to traffic in wet weather.	Two trips of machine removed seal coat, leaving a satisfactory mosaic of large rock in surface course.
3	Stockton Boulevard	Same as No. 2, except seal coat not so fat, but the seal was uniformly spread over the surface.	Before planing, a thin layer of sharp sand was spread and one trip of planer was made. The sand absorbed the excess bitumen and was bladed to one side. The remaining sand blended with the bitumen, giving an excellent non-skid surface.
4	16th Street	Same as No. 2, with a heavier seal coat, badly corrugated and had run into rolls very badly.	Two or three trips of machine restored surface to smooth uniform subgrade and cross section and in addition removed the excess fats and left a true mosaic.
5	M Street	Two-course Warrenite with bad lateral and longitudinal corrugation shoved up due to heavy truck traffic on our hot summer days. This pavement was twenty-five years old and received extremely heavy traffic.	One trip of machine restored the riding qualities and stopped the progressive growth of the corrugations. The surface was cut without tearing or fracturing. Patches of various kinds were levelled without injury.

old Warrenite pavement was corrugating and rolling under the heavy traffic, and the warm summer sun, to an extent that it was feared heavy failures would result unless something was done to smooth up the surface. It is interesting to note that with one complete operation of the planer, the riding quality was satisfactorily restored, that the progressive growth of corrugations was retarded, and it is believed that this street can take the traffic for another season without further treatment.

The planing of these pavements has been a beneficial and inexpensive maintenance operation in the writer's opinion, and, no doubt, has added many years of life to pavements that are being subjected to heavy traffic.

As a result of this maintenance, more work has been planned, including the stripping of an asphaltic surface course from a cement concrete base.

The machine is a two man self-propelled and self-contained unit, using butane or propane gas for heating. The burners are arranged so that the head may be kept constant and the working speeds varied to meet the type of surface to be planed, without oxidizing the planed material or the untouched low spots.

The contractor averaged 21,000 sq. ft. of finished work per day. The total work done was about 583,000 sq. ft. at a price of 9/10 cents per sq. ft. Regular department employees were used and WPA labor was employed to pick up and dispose of the material planed off.

The machine may also be used to true up the first or base course of a new pavement after laying, to lower the construction costs and eliminate mechanical finishing, raking, etc. The idea is, of course, to reduce costs and improve riding quality and durability of the pavement, as irregularities ordinarily left in the base will be eliminated and the top course will have the benefit of being laid on a true base.

The machine used on this work is a combination heater and planer built by the Spears-Wells Machinery Co. of Oakland, Calif. The reconditioning work was done under a contract awarded to A. Teichert & Son.

Highway Program of Colorado

COLORADO'S long proposed extensive highway program is finally underway, following sale of $10,000,000 of highway anticipation warrants May 19 on a net interest basis of 2.62 per cent to Otis & Co., a syndicate which included several Colorado concerns and 29 firms outside the state. The 1936 budget for expenditure of the money was started immediately and was scheduled for Governor Johnson's signature about June 1, if he approved.

(Continued on Page 50)

Personally speaking....

B. C. LEADBETTER, formerly division engineer on the Colorado River Aqueduct, is in direct charge of the driving of the San Jacinto tunnel on the same project. The work is being carried out by the forces of the Metropolitan Water District.

J. Perry Yates has moved from the Parker Dam project to the Oakland office of Six Companies, Inc.

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George Lewis, formerly chief engineer of the Moffat Tunnel Commission, has recently been appointed a member of the Colorado Industrial Commission.

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B. M. Richardson, who has been with the bridge department of the Montana State Highway Commission, has recently moved to a new position with the bridge department of the Colorado State Highway Department in Denver.

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James B. Girand, Jr., has recently been appointed City Engineer of Phoenix, Arizona. Mr. Girand is a consulting engineer in Phoenix, and several years ago, served as assistant superintendent of the water department in that city.

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Maurice L. Dickinson, formerly with the Hetch Hetchy project of the City of San Francisco, in the capacity of assistant hydraulic engineer, has recently accepted a position as associate designing engineer with the dam department of the Tennessee Valley Authority, with headquarters at the Knoxville office.

•

H. V. R. Thorne, who served as superintendent in charge of work on the El Vado dam for the Middle Rio Grande Conservancy District in New Mexico during the entire construction period, is now with the Utah Construction Co., serving in a similar capacity on the Pine View dam being built by the Bureau of Reclamation near Ogden, Utah.

•

J. A. Bumgarner has been elected president of the California Association of County Engineers. Mr. Bumgarner has been engineer of Butte County for eight years in charge of all engineering work, which includes a unified system of county highways. Prior to that time, he was assistant county engineer for several years. Nat H. Neff of Orange county, was elected vice-president, and Lloyd Bowman, of Santa Cruz county, was elected secretary. These elections took place at the recent meeting of the Association in Eureka. The 1937 convention will be held in Sacramento.

•

B. W. Steele, senior engineer in the Denver office of the Bureau of Reclamation, in charge of dam design, recently left the Bureau to take charge of the engineering design department of the Tennessee Valley Authority, with headquarters at Knoxville. Mr. Steele will have supervision over the engineering and technical features of the designs for Pickwick Landing, Guntersville, Chickamauga, and Fowler Bend dams, as well as all other design work relating to highways, railroads, bridges, and other features in connection with these projects. The Bureau of Reclamation did the design work on the Norris and Wheeler dams, now nearing completion, but the expanded program of the Authority includes so many additional projects that a distinct design department has been created to handle this work. During his sixteen years' service with the Bureau of Reclamation, Mr. Steele has been directly connected with the design of the dams built by that organization, particularly the large structures designed and built during the past few years.

B. W. STEELE

Superintendents on the Job. . .

G. A. Griffin will be superintendent in charge of work on the Ephraim tunnel on the Sanpete Project in Utah this summer. Contract for the job is held by Morrison-Knudsen Co. of Boise, Idaho. Work had been stopped during the winter due to heavy snows.

•

W. McKinley is superintendent on a $135,576 contract for levee construction on the Feather River in California for Reclamation District 784. Contract for the work is held by the Macco Construction Co., of Clearwater, Calif. Fred McKinley is foreman on this job.

•

John Scarlett will be superintendent in charge of construction of the Macy Street Subway in Los Angeles, contract for the job being held by Bent Bros., Inc., of Los Angeles, California. L. T. Grider, general superintendent for the company, will act in a supervising capacity.

•

F. K. Mittry will act as superintendent in charge of construction of Caballo Dam, on the Rio Grande Project, New Mexico. Contract for the job was awarded the Mittry Bros., Los Angeles, Calif., on their bid of $957,018. P. O. Carver will be assistant superintendent and E. C. Swanner, timekeeper.

•

Al Hughes is superintendent in charge of a contract for a plant-mix, bituminous mat, road job in Washington County, Idaho, recently awarded Morrison-Knudsen Co., Inc., of Boise, Idaho. This work is under the direction of Jesse S. Smith, manager of the company's paving department.

•

C. E. Sides, formerly camp superintendent at the Long Canyon camp on the Colorado River Aqueduct, has been transferred to the Cabazon shaft on the San Jacinto tunnel on the same project to succeed Frank Laird as construction superintendent. Mr. Laird is reported to have accepted a position as construction superintendent on a project in the east.

•

Roy Johnson has been named by Morrison-Knudsen Co. of Boise, Idaho, to act as superintendent on that company's contract for raising and strengthening existing levees and constructing new levees along the Sacramento River near Colusa, Calif. H. B. Laughlin is office manager. W. H. Puckett, vice-president of the company, will be in general charge of the work.

D. D. Skousen and **N. J. Skousen** will be general superintendents on two contracts recently awarded Skousen Bros., of Albuquerque, New Mexico. The first of these contracts for 5½ mi. of highway grading, surfacing, drainage structures, etc., is in charge of D. D. Skousen with Guy Gibson acting as structure superintendent. The second contract for 10 mi. of highway work is in charge of N. J. Skousen with E. R. Hise acting as structure superintendent. Both jobs are located on U. S. Highway Route 66 in McKinley County, New Mexico.

Obituaries . . . . .

Floyd T. Huntington, one of the best known tunnel superintendents in the West, and the man who was directly in charge of driving the diversion tunnels on the Boulder Dam project, died in a sanitarium at Colfax, Calif., May 21, at the age of 50. Mr. Huntington had been ill for several months, leaving his work as superintendent on the Colorado River Aqueduct project to enter the sanitarium last year. Born in California, his work on tunnel projects carried him into many of the western states and Mexico. During the World War he served overseas. Although his early tunnel experience was in the field of mining, he became directly connected with construction work after the World War, when he took charge of the penstock tunnel job on the Skagit project for Seattle. During 1923-25, he was foreman on the Big Creek project of the Southern California Edison Co., being advanced to tunnel superintendent the second year. Following this experience, he spent some time in South America on hydroelectric and railroad tunneling. On his return to this country, he became a special representative for the Ingersoll-Rand Co. on the sale of tunnel-driving equipment. From this position, he was loaned to the Six Companies Inc., to take the position of tunnel superintendent on the diversion tunnels for the Boulder Dam project. His accomplishments on this work, the records established, and the unusual methods developed, are well known to all construction men in the West. Following this work, he moved on to the Colorado River Aqueduct project, and was superintendent for the Walsh Construction Co. on its contracts near the river end of the work.

•

George Bailey McLeese, traveling engineer inspector for the PWA in Utah, Idaho, Wyoming and Colorado, died April 15, at the age of 37, at the Veterans' Hospital in Salt Lake City. Mr. McLeese had previously served as engineer inspector for the State of Utah on a number of major projects. He graduated from the University of Utah in 1924.

•

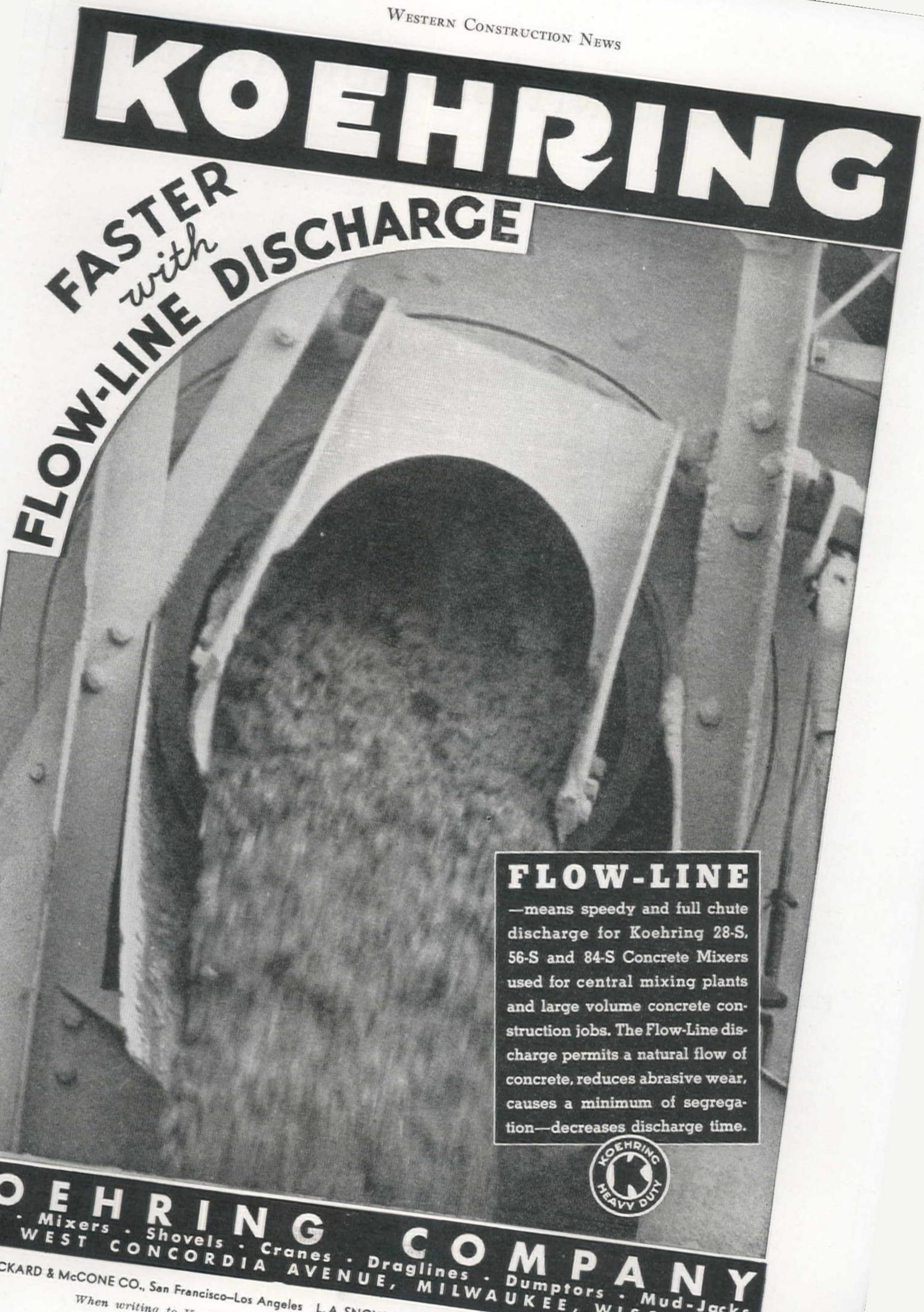
W. A. Farish, civil engineer of Wickenburg, Ariz., died April 29.

Broderick & Bascom Rope Company Celebrates Sixtieth Anniversary—Thirty Years on Coast

The Seattle factory of Broderick & Bascom Rope Co. celebrated the sixtieth anniversary of the company at a gathering in April. This meeting, consisting of members of their sales organizations, not only commemorated the sixty years Broderick & Bascom have been in business, but also marked the thirtieth anniversary of the Seattle factory.

In attendance were representatives from distributing organizations in Washington, Oregon, California, Idaho, and Montana. From St. Louis, David Larkin, general manager, and A. A. Grosse, cashier, were the representatives.

On April 1 the meeting was devoted to a dinner and general get-together at the Benjamin Franklin Hotel (illustrated).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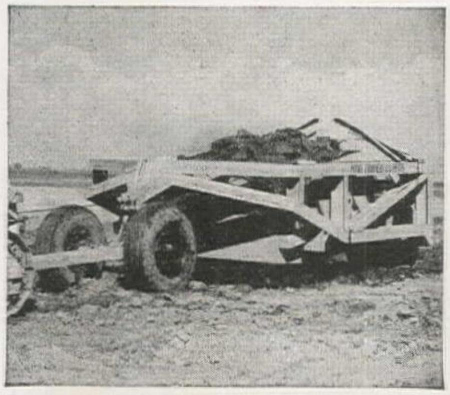

Austin-Western Announces New 5-Yard Scraper

A new, low-cost, single cable scraper, for use with tractors of thirty-five to fifty horsepower, has just been announced by the Austin-Western Road Machinery Company of Aurora, Illinois.

The new scraper is low priced and the manufacturers claim savings in operating costs. The front and rear of the pan are in the same plane while digging, and the earth moves back freely with the forward travel of the tractor. The wheels are placed so that they travel within the six-foot cut of the scraper instead of on either side.

This machine performs every operation of digging, carrying, and dumping through the action of a single cable mounted on a vertical winch which requires no fair-lead, and is automatically locked in place when the clutch is in neutral. This control permits the scraper to be coupled and ready for operation in a brief time, and represents a saving in cost of maintenance.

The scraper cuts to a depth of 6 inches and spreads the load evenly to any depth up to 9 inches. Because the load dumps forward and spreads the material, it is possible to operate two scrapers in tandem; the rear scraper does not climb a mound of earth left by the first.

Digging and dumping clearance eliminates choking between the cutting bit and the front gate and, regardless of overloading, the scraper can be dumped easily while the tractor is traveling in high gear.

•

First Aid Kit

A canvas belt or pocket kit, measuring 4 x 3 x 2 inches and weighing only 10 ounces, contains complete first-aid treatment for snake bites and common injuries encountered outdoors. The kit was developed primarily for use by workers in petroleum fields, foresters, and construction crews, whose task take them into snake-infested territories.

The snake-bite kit contains everything required for proper first-aid treatment in accordance with modern medical recommendations. An antiseptic bottle is handy for treatment of wounds and bruises. The first-aid kit contains an assortment of dressings and treatments most frequently required. All units in the snake-bite kit and first-aid kit are unbreakable.

Descriptive circular may be obtained free from the manufacturer, E. D. Bullard Company, 275 Eighth St., San Francisco.

UNIT BID SUMMARY . . .

Note: These Unit Bids Are Extracted from Our Daily Construction News Service

Sewer Construction. . . . . .

San Francisco, Calif.—City—North Point Sewer

Contract awarded to Sibley Grading & Teaming Co., 65 Lander St., S. F., $122,247, by Dept. Public Works, S. F., for const. the Marina-North Point Discharge sewer, under Spec. DPW 18.935. Totals on: (A) Concrete portected steel pipe, (B) Asbestos cement pipe.

		(B)	(A)
(1)	Sibley Grading & Teaming Co.		$122,247
(2)	Eaton & Smith	$155,117	134,619
(3)	W. J. Tobin, Oakland		134,751
(4)	MacDonald & Kahn Co., Ltd.		$141,850
(5)	M. J. Lynch, S. F.	$134,370	143,960
(6)	Barrett & Hilp, S. F.	208,625	185,400

	(1)	(2)	(3)	(4)	(5)	(6)
8,090 ft. 30" I. D. discharge sewer, ALT. "A"	12.00	13.40	13.18	13.00	14.00	19.00
8,090 ft. 30" I. D. discharge sewer, ALT. "B"		15.60			13.00	21.50
1,500 ft. 30" sewer in tunnel, ALT. "A"	10.90	11.10	12.00	13.00	14.00	11.00
1,500 ft. 30" sewer in tunnel, ALT. "B"		12.90			13.00	13.00
L. S. outfall gate structures	$600	$1,938	$350	$3,500	$1,000	$500
L. S. anchors at tunnel portals	$1,614	$1,419	$500	$3,000	$3,000	$2,200
8 ea. manhole vaults & appurtenances	$510	$267	$600	$560	$300	$700
L. S. vent pipes	$1,275	$1,820	$1,600	$3,400	$2,000	$2,000
280 lin. ft. 12" vitrified sewer	2.00	5.00	3.00	5.00	2.00	8.00
220 lin. ft. 10" vitr. culvert or side sewer	1.90	2.50	2.50	5.00	2.00	10.00
3 ea. brick manholes	90.00	$100	95.00	$100	$100	$150

Dam Construction. . . . .

Phoenix, Ariz.—Government—Concrete—Bartlett Dam

Contract awarded to Barrett & Hilp, 918 Harrison St., San Francisco, and Macco Construction Co., 815 Paramount Blvd., Clearwaetr, Calif., $2,227,495, low to Bureau of Reclamation, Producers Bldg., Phoenix, Ariz., for const. of the Bartlett Dam, Salt River Valley project, Arizona, on the Verde River, about 35 mi. from Phoenix, under Spec. No. 674. Dam will be multiple arch type, approx. 240 ft. high; 950 ft. long; 200,000 ac. ft. storage capacity. Work to start in 30 days and be completed in 1,000 days. Bids from:

(1)	Barrett & Hilp, S. F., and Macco Const. Co., Clearwater	$2,227,495
(2)	Bent Bros., Dixon & Johnson, L. A.	2,630,989
(3)	General Const. Co. & J. F. Shea	2,730,255
(4)	Jahn & Bressi & Wood & Bevanda	2,837,955
(5)	Walsh Const. Co., L. A.	$2,869,007
(6)	Lynn Atkinson, L. A.	2,936,250
(7)	Guy F. Atkinson Co., S. F.	2,973,520
(8)	Utah Construction Co., S. F., and Winston Bros., L. A.	3,103,965

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Lump Sum diversion & care river	$10,000	$17,500	$25,000	$60,000	$30,000	$50,000	$25,000	$100,000
140,000 cy. common exc. (dam)	.33	1.35	1.00	1.50	1.00	1.00	1.46	1.60
75,000 cy. rock excav. (dam)	1.93	5.20	4.00	4.00	4.50	5.00	4.30	4.00
10,000 cy. common exc. (spillway)	.33	3.30	1.50	3.00	.72	1.00	.75	.70
112,000 cy. rock excav. (spillway)	2.00	3.30	1.50	3.00	1.80	2.50	2.50	1.80
2,000 cy. backfill	1.33	1.00	1.50	1.00	.53	1.50	.50	.80
2,000 ft. drill grout holes to 25'	1.33	.75	2.50	1.00	.70	1.00	1.00	1.00
7,000 ft. drill gr. holes 25' to 50'	2.33	2.00	2.75	2.00	1.75	2.00	2.00	2.00
20,000 ft. drill gr. holes 50' to 100'	3.00	2.00	3.25	3.50	1.75	4.00	2.50	2.50
20,000 lb. inst. grout & dr. pipe & ftgs.	.08	.03	.10	.10	.18	.10	.15	.10
43,500 cu. ft. pressure grouting	1.07	1.00	1.00	1.00	1.05	1.50	1.00	1.00
500 ft. drill drain. holes to 25'	3.67	3.00	1.00	7.30	2.80	3.00	3.00	2.00
1,800 ft. 4" sewer pipe uncem. jts.	.40	.30	.80	1.00	.60	.50	.75	.50
3,200 ft. 6" sewer pipe uncem. jts.	.67	.45	.90	1.00	.75	.75	1.00	.60
200 ft. 8" sewer pipe uncem. jts.	.80	.60	1.00	1.00	1.00	1.00	1.50	.80
700 ft. 4" sewer pipe uncem. jts.	.40	.20	1.50	1.00	.65	1.00	1.50	1.00
325 cy. porous concrete	13.34	5.20	8.00	8.00	9.00	6.00	10.00	10.00
250 lin. ft. drill weep holes	.67	1.50	1.00	1.00	1.00	1.00	1.00	1.00
6,200 ft. drill holes, anch. & gr. bars	.80	.75	1.00	1.00	1.15	1.00	1.00	1.00
10,000 cy. concr. (str. & buttr. ftgs.)	5.48	5.50	7.00	10.00	8.65	7.00	9.00	8.50
85,500 cy. concr. (str. & buttr.)	9.11	8.50	11.00	9.00	11.33	11.00	12.00	12.50
5,300 cy. concr. (arch. & slab cutoffs)	5.27	5.80	7.25	10.00	9.65	7.00	9.00	8.50
35,000 cy. concr. arches	9.91	8.50	11.50	9.00	11.40	11.00	12.00	12.50
11,000 cy. concr. grav. sec. & wall	5.34	6.30	8.00	9.00	9.15	7.00	7.00	8.00
125 cy. concr. parapet	35.62	30.00	50.00	30.00	25.30	30.00	30.00	25.00
9,200 cy. concr. sp. str. below floor	9.91	8.00	10.00	10.00	9.15	10.00	10.00	11.50
1,600 cy. concr. sp. str. above floor	25.00	14.50	10.00	10.00	9.15	10.00	10.00	11.50
2,900 cy. conc. floor sp. chann.	7.20	6.00	25.00	20.00	19.50	20.00	20.00	24.00
2,200 cy. concr. spway channel	11.03	10.00	9.50	11.00	12.35	10.00	12.00	12.00
70 cy. concr. saddle dam	16.00	14.00	27.00	30.00	17.35	30.00	20.00	30.00
5,800,000 lb. place reinf. steel	.015	.015	.02	.02	.0225	.02	.015	.02
9,000 sq. yd. spec. finish conc. surf.	2.00	1.00	1.00	.50	.50	1.00	.50	.60
325 sq. yd. place bonded concrete	2.00	1.00	2.00	1.00	1.50	1.50	1.00	2.00
8,800 ft. inst. met. seal. strips	.33	.60	.30	.25	.50	.50	.50	.40
1,500 sq. ft. inst. contrac. jt. filler	.13	.25	.12	.25	.45	.15	.60	.40
1,650,000 lb. inst. spillway gates, etc.	.027	.03	.02	.03	.025	.02	.015	.025
500,000 lb. install gate hoists, etc.	.027	.025	.015	.03	.03	.02	.02	.03
274,000 lb. inst. trashrack metalwork	.027	.02	.01	.025	.015	.025	.015	.015
484,000 lb. inst. gates & cond. linings	.027	.023	.015	.02	.03	.02	.02	.02
5,000 lb. install control apparatus	.04	.025	.05	.10	.12	.05	.15	.08
26,000 lb. inst. bulkh. gate, mech., etc.	.027	.02	.02	.05	.10	.02	.05	.03
142,000 lb. inst. valve pipe & guides	.027	.02	.02	.03	.03	.02	.02	.025
115,000 lb. inst. needle valve & opr. mech.	.0325	.025	.02	.05	.0325	.04	.02	.02
60,000 lb. inst. cranes & crane rails	.0325	.025	.04	.03	.025	.02	.03	.02
111,000 lb. inst. met. stairw. & ladders, etc.	.027	.04	.07	.05	.10	.04	.05	.05
20,000 lb. inst. pipe handrail	.027	.07	.20	.10	.10	.05	.05	.09
350 sq. ft. inst. metal doors	.67	.75	1.00	1.00	.50	1.00	1.00	.80
1,150 sq. ft. inst. met. sash windows	.20	.20	1.00	.50	.40	.75	.50	.60
500 lb. inst. window operators	.67	.20	1.00	.10	.40	.20	.40	.20
8,500 lb. inst. met. floor plates, etc.	.02	.02	.05	.10	.04	.02	.05	.10
12,000 lb. inst. misc. metal work	.04	.10	.06	.05	.08	.02	.10	.10
4,300 sq. ft. inst. roofing & flashing	.37	.20	.25	.50	.25	.25	.10	.30
Lump Sum inst. elec. circuit & appar.	$2,000	$2,500	$1,000	$1,000	$3,200	$1,000	$2,500	$1,500

Aluminum Wheelbarrow

A newcomer to the construction gang is this modern wheelbarrow. Made of aluminum, it weighs barely 32 pounds. It handles a full-size load without a creak, yet is light enough to permit a noticeable difference in handling. Its aluminum construction creates no problem of rust. Manufactured by the Sheet Aluminum Corp., Jackson, Mich.

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Sullivan Aftercoolers

Sullivan Machinery Company, Michigan City, Ind., announces a new bulletin (No. 88-W) describing the company's line of compressed air After-coolers.

Features stressed are the multipass design, which insures maximum cooling efficiency from the water available, the use of a built-in separator which effectively removes from the air the water and oil condensed in the After-cooler and the provisions made for quick easy cleaning of the cooling tubes.

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New Goodrich Tires

Three new high-pressure "Super-Traction" truck tires by the B. F. Goodrich Company have just been added to the line, according to an announcement from the principal offices in Akron, Ohio. The sizes are 30 x 5, eight ply; 32 x 6, eight ply, and 32 x 6, heavy duty, 10 ply. The first two take 75 pounds of air pressure, the latter 80 pounds.

Since introduction of the Super-Traction type of truck tire, with a deeper tread, designed mainly for off-pavement use, the popularity of this type tire for truck operations has consistently increased, say company officials.

•

Deane Goes South

Randolph F. Deane, West Coast Manager for Thew Shovel Company and Universal Crane Company, both of Lorain, Ohio, has removed to Los Angeles, where he will maintain an office at 810 Santa Fe Avenue. The address of Mr. Deane's San Francisco office has been changed to 582 Sixth Street.

Denver, Colo.—City—Ralston Creek Earth Dam

Contract awarded to United Const. Co., Winona, Minnesota, $1,041,251, by Board of Water Comm., Denver, Colorado, for constructing the Balston Creek Dam, outlet works and spillway to be located about 20 mi. northwest of Denver, Colorado. Bids from:

(1) United Const. Co., Winona....$1,041,252
(2) Peter Kiewit Sons, Omaha.... 1,224,567
(3) Martin Wunderlich, Jefferson.... 1,297,575
(4) Benjamin Foster Co., N. Y.... 1,367,538
(5) Guy F. Atkinson Co., S. F.... 1,370,828
(6) S. J. Groves & Son, Minneapolis..$1,379,713
(7) S. S. Magoffin, Inc., Adrian.... 1,399,394
(8) Winston Bros., Minneapolis.... 1,414,524
(9) M. E. Carlson, Denver.... 1,424,045
(10) Peter Seerie, Denver.... 2,039,562

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
L. S. care of water	$2200	$20000	$10000	$53000	$25000	$7500	$15000	$25000	$4000	$30000
120,000 cy. stripping	.22	.30	.25	.20	.25	.25	.40	.27	.25	.37
103,500 cy. exc. fdn. core	.12	.30	.30	.20	.25	.35	.36	.27	.25	.90
25,600 cy. exc. cutoff trench	.83	.80	.50	1.00	.59	.60	.60	.61	.93	2.00
1,350 cy. exc. cutoff walls	2.96	2.00	1.50	2.00	1.75	2.00	2.00	2.00	3.00	6.00
78,000 cy. exc. spillwy. struc.	.75	.35	.30	.66	.35	.35	.36	.60	.38	1.25
4,200 cy. exc. open cut	.37	.75	.50	1.30	.50	.50	.50	.80	.40	1.50
4,100 cy. tunnel excavation	$15	8.50	8.50	5.70	8.00	$15	$15	4.25	$10½	$15
350 cy. exc. st. outlet pipe	2.96	2.00	.50	1.30	1.50	1.00	1.00	.55	1.00	1.50
4,050 cy. exc. canal-structure	.30	.75	.30	.66	.50	.65	.36	.35	.25	1.50
1,900,000 cy. spillw. bor. excav.	.142	.23	.22	.25	.33	.30	.28	.296	.23	.23
500,000 cy. exc. from pits	.165	.24	.22	.27	.33	.25	.28	.296	.23	.27
50,000 cy. rk. exs. bor. pits	.95	.50	.40	.90	1.00	1.00	.95	1.25	2.00	1.25
1,456,500 cy. emb. u & d portions	.03	.06	.08	.08	.04	.06	.06	.09	.105	.19
719,300 cy. emb. sel. core	.10	.06	.13	.08	.05	.06	.06	.10	.125	.25
41,300 cy. rip-rap upface	.22	.50	.80	.28	.50	.35	.25	.12	.75	1.50
17,400 cy. cobblestone downface	.22	.50	.80	.28	.60	.40	1.00	.12	.75	1.00
83,000 cy. rock fill, downtoe	.20	.40	.65	.28	.50	.30	.20	.11	.30	.75
2,350 cy. riprap upstream face	.52	2.50	4.00	.66	3.00	2.00	2.00	2.50	3.00	5.00
1,660 cy. conc. cutoff walls	15.32	$18	$18	$15	9.00	$11½	$13	12.00	$13	$21
640 cy. conc. in parapet wall	21.50	$18	$20	$20	$13	$16½	$16	18.50	$15	$27
1,240 cy. conc. tunnel lining	40.47	$20	$20	$30	$12½	$20	$20	$16	$16	$22
160 cy. conc. walls, etc., in tun...	$40	$22	$25	$30	$20	$20	$20	$16	$21	$40
315 cy. conc. anchor blocks	$20	$22	$18	18.60	9.00	$12½	$20	$10	$15½	$25
450 cy. conc. walls, etc.	$30	$17	$25	$23	$17	$25	$16	$27	$16½	$24
50 cy. conc. floor valve house	$18¼	$11	$20	$23	9.00	$14¼	$13	$11	$10½	$19
25 cy. conc. balcony house	16.85	$21	$35	$23	$18	$20	$20	$30	$20	$26
20 cy. conc. line supports	60.34	$24	28.00	$23	$15	$20	$20	$30	16.00	$30
1,660 cy. conc. weirs spillway	16.50	$14	16.60	$13½	9.00	$16½	$16	$13	22.00	$22
1,580 cy. conc. spillw. slopes & chute	$17	$12½	14.00	$15	$10	$12½	$16	$11	19.00	$21
560 cy. conc. spillway floor	12.60	$12	13.00	$10	7.00	$10½	$13	$11	13.00	$19
350 cy. conc. stilling basin	7.00	$13	12.00	$12	7.00	$10½	$12	$11	16.00	$22
300 cy. conc. flume, rack & transit	20.92	$20	15.00	$27	$15	$14½	$16	$15	22.00	$25
100 cy. conc. line outlet canal	19.58	$14	15.00	$20	$10	$15	$15	$11½	16.00	$22
50 cy. porous conc. drain trenches	12.69	$20	15.00	$14	8.00	8.00	$10	6.50	10.00	$18
30 cy. grout arch of tunnel	53.78	$30	30.00	$40	$50	$30	$50	$32	$100	$50
479,400 lb. reinf. steel	.05	.05	.06	.05	.04	.06	.06	.05	.05¼	.065
248,000 lb. steel outlet pipe	.09	.10	.085	.12	.08	.12	.10	.095	.085	.09
14,350 lb. trash rack metal work	.13	.10	.085	.13	.09	.10	.15	.065	.09	.12
29,100 lb. structural steel	.10	.08	.09	.16	.06	.12	.10	.08	.095	.08
275 lin. ft. pipe railing	4.81	3.50	3.00	2.50	3.50	4.00	4.00	3.00	2.75	4.00
755 lin. ft. 6" pipe in tunnel	5.34	3.40	4.00	4.00	3.00	4.00	5.00	3.00	4.00	5.00
250 lin. ft. 2" grout pipe, tunnel	.43	.25	.40	.30	.25	.20	.50	.25	.20	.30
2,400 lin. ft. 1" pipe	1.78	.70	.50	1.50	.60	1.00	1.00	.55	.50	3.00
92,000 lb. inst. gate, conduit, etc.	.06	.04	.02	.05	.02	.05	.03	.03	.03	.12
173,000 lb. inst. valves, meter, pipe	.04	.025	.02	.05	.02	.05	.04	.035	.03	.10
280 lin. ft. 1" copper wire	1.48	1.00	.60	1.30	.50	1.00	1.00	.65	1.75	1.50
2,500 lb. misc. metal work	.21	.15	.25	.40	.15	.15	.20	.30	.14	.20
365 ft. 6" vitr. pipe, tunnel	.62	1.25	1.50	1.50	.65	.50	1.25	1.10	2.00	1.50
170 ft. 6" vitr. pipe, valve house	1.33	1.00	1.50	1.30	.65	1.00	1.25	1.00	1.30	1.25
200 ft. 12" vitr. pipe, valve house	2.40	1.50	2.00	1.70	.70	1.75	2.00	1.75	1.30	2.00
205 ft. 4" vitr. pipe, spillw. chute	1.72	1.50	1.00	1.20	1.10	.80	1.00	1.55	1.70	1.25
945 ft. 6" vitr. pipe, spillw. chute	1.86	1.50	1.50	1.30	1.25	1.00	1.25	1.75	1.75	1.50
250 ft. 8" vitr. pipe, spillw. chute	2.06	1.60	1.75	1.60	1.30	1.25	1.50	1.90	2.00	2.00
30 ft. 4" C.I. pipe, gate chamber	2.96	2.00	1.50	1.30	1.50	1.00	2.00	1.50	2.00	3.00
1,450 ft. copper water stops	.59	.50	.50	.70	.60	.50	1.00	.50	.50	1.00
Lump Sum valve house	$2413	$1500	$1800	$2700	$2000	$2500	$3000	$1300	$2000	$3000
Lump Sum gauge house	$379	$200	$250	$1400	$150	$250	$350	$200	$1000	$500
3,785 sq. yd. dry rock paving	1.15	1.00	2.00	1.00	1.50	1.50	2.00	2.00	2.00	3.00
75 cy. riprap about structures	2.59	2.50	3.00	3.20	2.50	1.00	4.00	1.50	5.00	6.00
4,850 sq. yd. rubble conc. paving	1.70	1.75	3.00	2.75	2.50	2.00	4.00	2.50	3.00	5.00
240 sq. yd. cobblestone paving	1.15	1.00	1.50	2.40	1.75	1.00	2.00	1.50	1.50	4.00
104 cy. gravel fill	6.36	3.00	3.00	4.00	2.50	2.50	3.00	2.75	2.00	2.00
7,,300 sq. yd. coating tunnel	.44	.22	.15	.15	.10	.20	.50	.16	.10	.25
10 M ft. b. m. temporary timber	$75	$75	$75	$75	$75	$75	$75	$75	$75	$75

Street and Road Work . . . . .

Sacramento, Calif.—State—Grading and Asphalt Concrete Paving—Yolo County

Contract awarded to A. Teichert & Son, Inc., 1846 37th St., Sacramento, $157,485 by Calif. Div. of Highways, Sacramento, for 3.5 mi. grading and asphalt concrete paving betw. Yolo Causeway and "M" St. Subway, in YOLO COUNTY, Calif. Bids from:

(1) A. Teichert & Son, Inc....$157,485
(2) Union Paving Co., S. F.... 159,184
(3) Heafey Moore Co., Oakland....$183,537

	(1)	(2)	(3)
3,000 M gal. water	1.50	.80	1.50
22,000 cy. rdwy excav.	.40	.26	.55
30,000 sta. yd. overhaul	.01	.02	.01
1,850 cy. struc. excav.	1.00	1.00	1.00
51,000 cy. impor. borrow	.45	.45	.65
780 cy. remov. conc.	1.25	2.00	2.50
3.55 mi. grade detour rd.	$400	$500	$1,000
37,000 sq. yd. prep. subgr.	.09	.10	.10
188 sta. fin. roadway	7.00	5.00	$15
7,600 ton untr. cr. grav.	1.70	2.00	2.00
4,200 cy. salv. surface	.65	.70	1.25
112 ton liq. asph. SC-2	$15	$20	$15
190 ton sand	2.25	3.00	2.00
18 ton liq. asph. 90-95	$25	$25	$25
210 ton screenings	2.75	3.50	2.50
28,000 sy. asph. paint bind	.025	.02	.02
16,150 ton asph. conc. base	3.47	3.60	3.60
7,340 ton asph. conc. surf	3.86	3.80	3.80
2,800 lb. reinf. steel	.10	.10	.06
55 cy. "A" concrete	$25	$20	$35
20 cast steel f & c	$40	$50	$35
8 ft. 12" c. m. p.	1.50	1.75	3.00
2,618 ft. 18" c. m. p.	1.65	2.00	1.75
116 ft. 36" c. m. p.	5.00	6.00	7.50
139 ft. clean & relay c. m. p.	1.00	.60	1.50
246 ft. clean & salv. c. m. p.	.75	.60	1.00
4 remove & reset headw.	$25	$10	$20
120 ft. lam. guardrailing	1.50	1.50	1.50
10 culvert markers	3.00	2.00	3.00
16 guide posts	3.00	2.00	3.00
10 rem. & reset guidepost	1.50	1.00	2.00
41 monuments	3.00	3.00	3.00

Mixers Charged and Discharged Same Opening

Recently the T. L. Smith Company, Milwaukee, Wis., introduced a new arrangement whereby two, three or four Smith tilters can discharge into a central hopper, by charging and discharging through the same drum opening. It is said that such a layout provides for a more compact set-up. Only one set of batchers is required to charge all mixers, and a saving is effected in the overall height of the mixing plant.

Each mixer has an automatically operated feed chute which seals the drum opening and permits the batcher turn head to be moved to the next mixer immediately after the drum is charged. The flow between batcher and mixer is practically in a straight line, therefore the aggregates enter the drum faster. Displaced air escapes through the other drum opening. It is not necessary to back-tilt the mixers excessively to insure fast charging.

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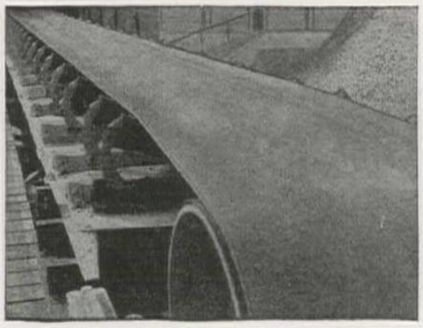


Shrinkage Reduced in Self-Curing Rubber

The Self-Vulcanizing Rubber Company, Inc., Room 519-B, 605 W. Washington Boulevard, Chicago, Ill., announces an important development and refinement in its plastic rubber. The shrinkage of its cold, self-curing process has been reduced to about one-third that heretofore common in the application of rubber coatings and linings.

The improved Selfvulc Plastic is thus more practical for all rubber coating or lining work, and especially for rebuilding the surfaces of conveyor belts which have been worn down by the abrasion of the materials carried. The decreased shrinkage results in longer life for the rubber, and elimination of strains between the rubber coating or lining and the surface to which it is applied.

River and Harbor Work.....

Sacramento, Calif.—Government—Levee Work

Contract awarded to Morrison-Knudsen Co., 319 Broadway, Boise, Ida., $204,580, by U. S. Engineer Office, P. O. Bldg., Sacramento, for raising and strengthening existing levee and const. new levee along Sacramento River between Moulton Weir and a point ¼ mi. downstream from the bridge across the Sacramento River at Colusa, a distance of 10.3 miles. Bids from:

(1) Morrison-Knudsen Co. $204,580
(2) D. McDonald, Sacramento 211,813
(3) Boyce & Igo, Baton Rouge, La. 244,459
(4) Geo. Pollock Co., Sacramento $249,142
(5) Olympian Dredging Co., S. F. 280,721
(6) A. Teichert & Son, Inc., Sacram. 283,472

	(1)	(2)	(3)	(4)	(5)	(6)
938,000 cu. yd. levee embankment	.185	.199	.23	.24	.269	.272
80 ft. 8" corr. ir. pipe, 16 ga. & coup.	1.28	1.30	1.65	1.50	1.30	1.60
170 ft. 18" corr. ir. pipe, 12 ga. & coup.	3.71	3.05	3.38	3.25	2.84	3.80
1,488 ft. 24" corr. ir. pipe, 12 ga. & coup.	4.73	4.20	4.50	4.00	4.52	4.80
606 ft. 30" corr. ir. pipe, 12 ga. & coup.	6.06	5.40	5.75	5.00	5.45	6.00
242 ft. 36" corr. ir. pipe, 12 ga. & coup.	7.25	6.30	7.00	6.00	6.57	7.40
44 ft. 42" corr. ir. pipe, 10 ga. & coup.	8.25	8.00	9.00	7.00	9.51	8.00
266 ft. 48" corr. ir. pipe, 10 ga. & coup.	10.75	10.00	11.00	8.50	10.68	10.00
240 ft. 18" steel soilproof pipe, 12 ga.	2.85	2.00	3.50	2.00	2.60	2.80
24 ft. 28" steel soilproof pipe, 12 ga.	4.40	3.00	4.00	3.50	2.92	4.00
50 ft. 30" steel soilproof pipe, 12 ga.	5.15	4.00	4.50	3.80	3.32	4.50
136 ft. 36" steel soilproof pipe, 10 ga.	5.90	5.00	6.00	4.75	5.11	6.00
2 corr. ir. cutoff bulkheads, 32 x 32", 12 ga.	7.50	8.00	10.00	7.00	10.93	8.50
4 corr. ir. cutoff bulkheads, 49½ x 50", 12 ga.	10.50	11.00	15.00	10.00	14.71	12.00
4 corr. ir. cutoff bulkheads, to steel pipe	10.50	11.00	15.00	10.00	14.71	12.00
30 corr. ir. cutoff bulkheads, to corr. ir. pipe	10.50	11.00	15.00	10.00	14.71	13.00
1 corr. ir. cutoff bulkh. to 28" steel pipe	10.50	11.50	15.00	10.00	14.71	13.00
8 corr. ir. cutoff bulkh. to 30" corr. ir. pipe	10.50	12.00	15.00	10.00	14.71	13.50
2 corr. ir. cutoff bulkh. to 30" steel pipe	10.50	12.00	15.00	10.00	14.71	13.50
4 corr. ir. cutoff bulkh. to 36" corr. ir. pipe	15.40	15.00	20.00	15.00	20.50	18.00
2 corr. ir. cutoff bulkh. to 36" steel pipe	15.40	15.00	20.00	16.50	20.50	18.00
2 corr. ir. cutoff bulkh. to 42" corr. ir. pipe	22.00	21.00	30.00	20.00	26.67	25.00
6 corr. ir. cutoff bulkh. to 48" corr. ir. pipe	22.00	21.00	30.00	20.00	26.67	25.00
1 ea. 8" Calco #100 gate	6.75	5.20	10.00	8.00	9.64	9.00
1 ea. 18" Calco #100 gate	50.25	39.00	25.00	45.00	50.59	50.00
3 ea. 24" Calco #100 gate	58.50	53.00	40.00	60.00	78.61	38.00
1 ea. 228" Calco #100 gate	130.50	100.00	125.00	110.00	97.05	120.00
1 ea. 18" Calco #101 gate, 12' frame	37.80	42.00	50.00	40.00	31.20	45.00
1 ea. 18" Calco #101 gate, 18' frame	51.00	51.00	60.00	55.00	42.00	60.00
1 ea. 24" Calco #101 gate, 4' frame	36.80	40.00	50.00	40.00	30.00	45.00
2 ea. 24" Calco #101 gate, 8' frame	38.75	43.50	50.00	44.00	32.00	50.00
8 ea. 24" Calco #101 gate, 10' frame	46.00	47.00	56.00	45.00	37.80	58.00
4 ea. 24" Calco #101 gate, 12' frame	47.30	50.00	60.00	48.00	39.00	60.00
2 ea. 30" Calco #101 gate, 12' frame	78.10	70.00	82.00	75.00	64.00	85.00
2 ea. 30" Calco #101 gate, 16' frame	86.50	75.00	100.00	80.00	71.00	95.00
1 ea. 36" Calco #101 gate, 6' frame	74.50	70.00	90.00	70.00	63.00	90.00
1 ea. 36" Calco #101 gate, 12' frame	89.95	78.00	100.00	84.00	73.80	100.00
1 ea. 36" Calco #101 gate, 14' frame	91.60	80.00	100.00	86.00	75.00	100.00
1 ea. 42" Calco #101 gate, 10' frame	123.05	100.00	125.00	115.00	100.00	140.00
1 ea. 48" Calco #101 gate, 10' frame	145.00	120.00	150.00	130.00	119.00	150.00
1 ea. 48" Calco #101 gate, 12' frame	146.25	123.00	150.00	140.00	122.00	160.00
1 ea. 48" Calco #101 gate, 14' frame	146.25	126.00	155.00	142.00	124.00	160.00
10 10" concrete pipe	2.20	2.00	1.33	1.00	3.50	2.00
450 ft. BM Oregon Pine lumber	100.00*	.06	80.00*	.06	.17	.06
* Price per 1,000.						
Remove Existing Structurs as follows:						
1 job reinf. concr. culv. 5' x 2.5'	37.50	27.00	50.00	100.00	215.00	90.00
1 job reinf. concr. wingwalls	13.60	10.00	25.00	15.00	36.50	9.00
1 job reinf. concr. spillbox	13.60	10.00	25.00	15.00	14.00	9.00
1 job reinf. concr. culvert	146.25	100.00	50.00	65.00	251.00	43.00
1 job reinf. concr. cutoff wall	44.00	15.00	40.00	40.00	29.00	12.00
1 job reinf. concr. spillbox	146.25	75.00	75.00	85.00	236.00	68.00
1 job reinf. concr. spillbox	146.25	60.00	70.00	70.00	201.50	60.00
1 job reinf. concr. well	73.40	150.00	60.00	110.00	70.00	25.00
1 job reinf. concr. culvert	146.25	200.00	60.00	8.00	270.00	110.00
1 job reinf. concr. spillbox	45.00	100.00	75.00	45.00	111.00	70.00
1 job reinf. concr. spillbox	73.50	200.00	100.00	130.00	174.00	120.00
1 job reinf. concr. culvert	73.50	150.00	60.00	90.00	174.00	90.00
1 job reinf. concr. culvert	37.50	120.00	50.00	25.00	180.00	75.00
2,900 lin. ft. county road surfacing	1.50	.18	.87	.35	.35	.40
1 job reinf. concr. spillbox	146.25	100.00	100.00	70.00	237.50	65.00
1 job wooden culvert	45.00	10.00	50.00	25.00	29.00	6.00
1 job reinf. concr. culvert	73.50	100.00	75.00	80.00	277.00	70.00
1 job reinf. concr. culvert	45.00	75.00	100.00	40.00	139.50	37.00
1 job reinf. concr. culvert	73.50	85.00	100.00	55.00	316.00	55.00
1 job steel pipe	37.50	25.00	50.00	20.00	14.00	25.00
Remove and reinstall existing structures:						
1 job two 24" Calco #101 headg. & frames	29.50	100.00	100.00	80.00	49.50	50.00
1 job one 12" surface irrig. valve	35.00	10.00	50.00	20.00	42.50	9.00
1 job one 24" #105 headgate & frame	45.00	40.00	75.00	35.00	12.00	25.00
1 job one 30" #101 headgate & frame	45.00	50.00	100.00	45.00	35.50	30.00
130 cu. yd. "A" reinf. concrete	25.00	24.00	35.00	25.00	27.00	35.00
20 cu. yd. "B" misc. concrete	25.00	20.00	28.00	12.00	20.00	20.00

Street and Road Work

Sacramento, Calif.—State—Grading and Plant Mix Surfacing—Contra Costa County

Contract awarded to Granfield, Farrar & Carlin and John Carlin, 67 Hoff Avenue, S. F., $306,236, by Calif. Div. of Highways, Sacramento, for 3.2 mi. grad. and pl. mix surf. on cr. run base betw. Broadway Tunnel and 2 mi. west of Lafayette, in CONTRA COSTA COUNTY, Calif. Bids from:

(1) Granfield, Farrar & Carlin and John Carlin, S. F. $306,236
(2) A. Teichert & Son, Inc. 325,917
(3) Union Paving Co., S. F. $348,301
(4) George Pollock Co., Sacramento 397,232
(5) Heafey Moore Co., Oakland 433,589

	(1)	(2)	(3)	(4)	(5)
171 sta. clearing and grubbing	60.00	60.00	70.00	150.00	50.00
2,700 M gallons water	1.00	1.00	1.00	1.00	3.00
512,000 cu. yd. roadway excavation	.24	.26	.33	.35	.40
1,350 cu. yd. ditch & channel excavation	1.25	.75	1.00	2.50	3.00
2,400,000 sta. yd. overhaul	.005	.005	.002	.005	.005
7,600 cu. yd. structure excavation	1.50	1.25	1.50	2.50	3.00

"I can't say enough IN PRAISING THE LAST MARION I BOUGHT" SAYS *Joseph Breen*

THE BREEN CONTRACTING CO.
New York City

"We are thoroughly acquainted with the splendid performance of Marion shovels. We bought our first Marion 12 years ago and have owned several of them. But the last one we bought—a Marion 371 Clutch Type machine—takes the prize. It's doing things we little dreamed a shovel of its size and capacity would do. Its first job was handling 1500 cu. yds. of rock per day on an apartment foundation at 183rd Street and Fort Washington Avenue, New York City—a real test for any shovel."

MARION

CLUTCH TYPE EXCAVATORS

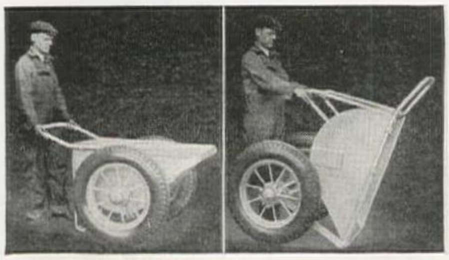
A MACHINE FOR EVERY MATERIAL HANDLING JOB

FROM 3/4 CUBIC YARD UP

WRITE FOR BULLETIN DESCRIBING MARION FEATURES

THE MARION STEAM SHOVEL COMPANY
MARION, OHIO, U. S. A.

The Marion Type 371—Clutch Type Excavator—equipped with a 1¾ cubic yard dipper—and owned by the Breen Contracting Co., New York City. Handling rock on an apartment foundation site.



Improved Cart

A new C M C "dumpover" pneumatic-tired cart has been announced by the Construction Machinery Company, Waterloo, Iowa.

By a development in the construction of the chassis, the entire tray is dumped as far over as needed without the wheels or axle moving from the ground. This eliminates, the manufacturers state, hoeing, shoveling, and bumping.

Made in three convenient sizes—6½ cu. ft., 9 cu. ft., and 11 cu. ft. capacity. All equipped with *standard size balloon tires.* Write Construction Machinery Company, Waterloo, Iowa, for literature and prices.

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Oregon Thew Distributors

Thew Shovel Company, Lorain, Ohio, have announced the appointment of A. C. Haag & Company, Inc., Portland and Salem, as Oregon distributors for Thew shovels, cranes, and draglines; and that a stock of new machines and a full stock of parts will be maintained at the Portland headquarters of the Haag Company. The Haag people will also act as distributors for Universal Crane Company of Lorain.

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Leschen Seattle Office

Leschen Wire Rope Co. have recently established a branch office at 2244 First Avenue South, Seattle, Washington; and appointed Charles P. Kofron, Northwest Manager. Mr. Kofron is an experienced wire-rop man, having been with the Leschen Company in various capacities for many years.

Leschen has long maintained a branch office and warehouse at San Francisco and a warehouse at the foot of Sheridan Street, Portland, under the direction of F. J. deVry, Pacific Coast Manager. Distributors will continue to supply Leschen products to the industrial trades.

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LeRoi-Rix Co. Organized

A recent announcement was made in Los Angeles of the organization of the LeRoi-Rix Machinery Co., with headquarters at 810 Santa Fe Avenue. The new organization will take over the accounts handled by the Los Angeles Branch of The Rix Company, Inc.

H. S. (Stew) Warnock is manager. Present accounts include Thew shovels, Universal cranes, Macwhyte wire rope, LeRoi engines, LeRoi-Rix compressors, and other equipment items. Complete service and parts will be available.

50 cu. yd. remove concrete	2.00	4.00	10.00	5.00	5.00
171 sta. finish roadway	7.00	5.00	5.00	10.00	7.50
25,300 tons cr. run base	1.65	1.64	1.25	1.75	2.00
12,400 tons mineral aggreg. plant mix surf.	1.75	1.78	1.50	2.50	2.50
480 tons liq. asph. MC5 or extr. hvy. pl. mix	18.60	17.50	20.00	18.00	14.00
78 tons liq. asph. MC2 prime coat	18.60	22.00	20.00	19.00	20.00
53 tons liq. asph. MC3 seal coat	18.60	22.00	20.00	19.00	25.00
555 tons screenings seal coat	2.00	3.00	3.50	3.00	3.00
37 tons liq. asph. SC1-A (shoulders)	11.25	20.00	20.00	13.00	14.00
25 tons liq. asph. SC-2 (shoulders)	12.25	21.00	20.00	14.00	15.00
156,000 lb. reinforcing steel (structures)	.045	.045	.05	.05	.05
1,550 cu. yd. "A" concrete (structures)	17.75	22.00	20.00	15.00	20.00
260 cu. yd. rubble masonry	10.00	15.00	15.00	15.00	15.00
1,300 ft. 8" corr. metal pipe	.90	1.00	1.25	.90	1.00
200 ft. 12" corr. metal pipe	1.20	1.25	1.50	1.10	1.20
480 ft. 15" corr. metal pipe	1.40	1.50	2.00	1.30	1.40
1,900 ft. 18" corr. metal pipe	1.80	1.70	2.25	1.50	1.60
446 ft. 24" corr. metal pipe	2.40	2.65	3.00	2.30	2.40
240 ft. 60" corr. metal pipe, 8 gauge	13.00	13.50	18.00	12.00	14.00
188 ft. 60" corr. metal pipe, 10 gauge	11.50	11.50	16.00	10.00	14.00
276 ft. 72" corr. metal pipe, 8 gauge	15.50	15.00	18.00	15.00	20.00
6,400 ft. 8" pef. metal pipe underdrains	.90	1.00	1.10	.85	1.00
850 cu. yd. rockfilling material (underdr.)	1.50	3.75	3.50	1.50	3.00
420 lin. ft. clean & salvage culverts	.50	.90	.50	.75	2.00
350 lin. ft. clean & relay culverts	1.00	1.00	.50	1.50	2.00
23 ea. spillway assemblies	15.00	15.00	20.00	20.00	15.00
120 ea. culvert markers	2.50	2.50	2.00	2.50	2.00
400 ea. guideposts	2.50	2.50	2.00	3.00	2.00
6.5 mi. new fence	600.00	700.00	600.00	600.00	750.00
6 ea. drive gates	15.00	20.00	20.00	20.00	15.00
2 ea. manhole frames and covers	90.00	100.00	40.00	30.00	100.00
1 only remove bridge	350.00	75.00	300.00	125.00	75.00
115 ea. monuments	3.00	3.00	3.00	2.50	3.00

Los Angeles, Calif.—State—Grading and Paving—Orange County

Contract awarded to Gibbons & Read, 221 E. San Fernando Blvd., Burbank, California, $166,313 low to Calif. Div. of Highways, Los Angeles, for 2.7 mi. grading and concrete paving between Gypsum Creek and Riverside County Line, ORANGE COUNTY, Calif. Bids from:

(1) Gibbons & Reed, Burbank $166,313
(2) Griffith Co., Los Angeles 168,278
(3) Oswald Bros., Los Angeles 174,467
(4) J. E. Haddock, Pasadena $192,781
(5) Daley Corp., San Diego 198,595
(6) United Concrete Pipe Corp. 233,696

	(1)	(2)	(3)	(4)	(5)	(6)
140 sta. clearing & grubbing	$17.50	$15.00	$25.00	$25.00	$30.00	$35.00
2,350 M gallons water	1.40	1.00	1.00	1.00	1.50	1.00
145,000 cu. yd. roadway excavation	.27	.33	.36	.45	.38	.49
2,700 cu. yd. struc. excavation	.65	1.50	.90	1.50	1.50	1.30
2,500 cu. yd. ditch & chan. excav.	.30	.45	1.20	1.00	1.50	1.00
1,400,000 sta. yd. overhaul	.005	.005	.005	.005	.004	.01
11.5 tons "E" asph.	23.00	20.00	30.00	22.00	25.00	30.00
32,000 sq. yd. subgrade pavement	.09	.11	.10	.11	.15	.13
140 sta. finish roadway	6.00	7.00	3.50	5.00	10.00	10.00
470 tons min. aggr. plant mix	3.00	3.20	3.75	4.00	2.25	3.50
24.5 tons liq. asph. MC 5	16.00	14.00	15.00	15.00	17.00	20.00
50 tons same, SC 2	9.00	12.00	8.00	11.00	10.00	15.00
560 tons liq. asph. SC-2	9.00	7.50	8.00	8.20	10.00	13.00
46,000 sq. yd. mix & shape shoulders	.045	.05	.045	.07	.055	.07
50 tons liq. asph. 90-95	18.00	20.00	18.00	17.50	18.00	20.00
600 tons screen. seal coat	3.00	3.50	2.50	3.00	2.10	3.00
6,300 cu. yd. "A" concr. pavem.	8.10	7.00	7.50	7.50	7.15	8.48
12,800 ea. pavement dowels	.12	.12	.11	.13	.15	.12
88,000 lb. reinforcing steel	.05	.05	.053	.045	.05	.05
175 lb. bronze expansion plates	.33	.35	.35	.40	.60	.50
600 cu. yd. "A" conc. structure	22.00	20.00	18.00	18.50	21.00	19.00
9 cu. yd. "F" conc. railing	55.00	75.00	50.00	50.00	60.00	75.00
540 lin. ft. 8" corr. metal pipe	1.00	1.00	1.00	.90	1.00	1.00
1,100 lin. ft. 24" corr. metal pipe	2.60	2.75	2.50	2.40	2.50	2.50
650 lin. ft. 30" corr. metal pipe	3.10	3.25	3.00	3.00	3.00	3.00
60 lin. ft. 36" corr. metal pipe	4.80	5.00	5.00	4.70	4.40	6.00
80 lin. ft. 42" corr. metal pipe	5.50	8.00	6.00	5.65	6.00	7.00
20 each spillway assemblies	15.00	13.00	15.00	14.00	15.00	15.00
100 ft. remove & relay C. M. P.	.75	.60	.75	1.50	2.00	2.00
650 ft. remove and salvage C. M. P.	.20	.60	.50	1.00	1.50	1.00
80 ft. laminated guardrail	1.00	1.50	1.25	1.00	1.50	1.00
600 each guideposts	1.50	1.50	1.75	2.00	2.50	2.00
52 culvert markers	1.50	2.00	2.00	2.50	2.50	2.00
1 mile new fence	$450	$500	$600	$600	$450	$650
3.0 mi. move & reset fence	$160	$300	$500	$500	$175	$500
2,950 ft. bank protection fence	4.25	3.75	3.50	4.00	8.50	9.40
1 detour bridge	$1,000	$900	$800	$1,000	$1,000	$1,250
230 cu. yd. remove concrete	4.00	5.00	6.00	3.00	12.00	3.00
60 each monuments	2.50	1.50	3.00	3.00	3.00	2.00

Phoenix, Ariz.—State—Grading—Navajo County

Contract awarded to Lee Moor Contracting Co., Bassett Tower, El Paso, $160,220, by Arizona State Highway Comm., Phoenix, for 10.7 mi. grading, draining roadway about 7 miles northeast of Navajo County Line, and about 70 miles northeast of Globe, NAVAJO COUNTY, FLH 6-A. Bids from:

(1) Lee Moor Contracting Co. $160,220
(2) Fisher Construction Co. 161,973
(3) Pearson & Dickerson, Inc. 163,521
(4) H. J. Hagen, Globe, Arizona 168,225
(5) Skousen Bros., Albuquerque $168,909
(6) Ken Hodgman 169,454
(7) Packard Contracting Co., Phoenix 183,390

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
107,120 cu. yd. roadway excavation	$.67	$.66	$.70	$.60	$.75	$.65	$.82
5,681 cu. yd. drain. excavation	.67	.66	.31	.60	.60	.55	.50
7,817 cu. yd. slides & overbreakage	.5025	.495	.525	.45	.5625	.4875	.615
3,478 cu. yd. struc. excavation	1.50	1.50	2.00	1.50	2.00	1.50	2.00
46,432 sta. yd. overhaul	.025	.03	.025	.03	.03	.03	.04
590 cu. yd. mi. haul	.50	.30	.50	1.00	.20	.40	.50
68,854 cu. yd. imported borrow	.22	.18	.16	.30	.18	.25	.20
13,980 cu. yd. imp. borrow haul	.40	.29	.37	.50	.20	.40	.40
732 cu. yd. "A" concrete	23.00	25.00	24.00	30.00	25.00	24.50	25.00
77,062 lb. reinf. steel	.046	.05	.05	.05	.055	.06	.05
2 ea. grating for drop inlet	15.00	30.00	12.50	25.00	12.00	10.00	9.00
1,918 lin. ft. 24" corr. metal pipe	2.60	2.65	2.50	2.50	2.80	3.00	2.70
390 lin. ft. 30" corr. metal pipe	3.25	3.20	3.50	3.25	3.40	4.00	3.40
256 lin. ft. 36" corr. metal pipe	5.00	4.92	6.00	5.25	5.70	6.00	5.40
148 lin. ft. 42" corr. metal pipe	5.75	5.63	8.00	6.00	6.50	8.00	6.30
270 lin. ft. 48" corr. metal pipe	6.60	6.42	10.00	8.00	9.00	12.00	7.20

Ground Broken for North Approach to G. G. Bridge

GROUND breaking ceremonies on May 10 marked the formal start on the north approach to the Golden Gate Bridge at the entrance to San Francisco Bay. Governor Merriam was in attendance, in addition to representatives of local municipalities and counties interested in the project, and officials of the U. S. Army.

The project will provide a modern 4-lane traffic artery connecting the end of the bridge with the existing state highway at Waldo Point. This new highway will be 3½ mi. long, and will include a 1,000-ft. tunnel. The route will by-pass the town of Sausalito, the terminal of the existing Redwood Highway, with ferry connections to San Francisco, but a line will be provided to give Sausalito access to the bridge.

Because of the rough topography of the Marin county hills, the work involves one of the heaviest grading projects to be undertaken by the California Division of Highways. The project was divided into a grading and surfacing job, and a separate contract for the 1,000-ft. tunnel and approach. The grading contract was awarded to Macco Construction Co. of Clearwater, Calif., and involves the moving of 1,752,000 cu. yd. of roadway excavation; 12,500 cu. yd. of excavation for structures, and 475 cu. yd. of concrete for draining structures. The heavy duty bituminous treated crushed rock surfacing to be placed on the new roadbed will involve 51,000 tons of crushed rock and 325 tons of asphalt. It is estimated that the total cost on this contract will amount to about $895,000.

Contract for the construction of the tunnel was awarded to T. E. Connolly of San Francisco, and involves the driving of the 1,000-ft. bore, which provides a roadway 42 ft. wide between curves, with a 3½-ft. sidewalk on one side. Height of the tunnel on the center line is 29 ft. Near the portals, the concrete lining has a 3-ft. thickness at the crown, and this lining decreases to a thickness of 2 ft. at the crown throughout the greater portion of the tunnel where excavation is in solid rock. The work will include 60,000 cu. yd. of roadway excavation, 51,000 cu. yd. of tunnel excavation, 2,800 cu. yd. of concrete in the lining and 1,000,000 lb. of structural steel.

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Thew Appoints Rix

On May 16, The Rix Company, Inc., 582 Sixth Street, San Francisco, announced their appointment as distributors for Thew Shovel Company and Universal Crane Company, in the Northern California-Nevada territory. They are now equipped to render full Thew and Universal service, with a complete stock of parts and new machines in San Francisco. M. L. (Monty) Hewitt is manager for Rix.

25,888 lin. ft. crown ditches	.05	.05	.06	.05	.07	.05	.07
682 cu. yd. cement rubble masonry	16.00	20.00	16.00	18.00	15.00	18.00	18.00
372 ea. roadguard posts	2.50	2.40	2.25	2.50	2.00	2.50	2.80
112,340 lin. ft. standard line fence	.055	.07	.075	.075	.065	.08	.07
4 each standard wire gates	3.00	7.70	6.00	5.00	10.00	10.00	5.00
1,350 hours rolling	3.00	3.00	2.75	3.00	2.50	3.50	3.00
66 ea. right-of-way markers	3.00	2.50	2.50	3.00	3.00	2.50	2.50
188 ea. guide posts	2.50	2.25	2.00	2.50	2.00	2.50	2.50

San Francisco, Calif.—Government—Grading—Sierra and Nevada Counties

Award recommended to J. R. Reeves, R. D. No. 3, Box 100, Sacramento, $95,265, by Bureau of Public Roads, San Francisco, for 4.267 mi. grading Section B of Route 27, the Sierraville Hobart National Forest Highway, Tahoe National Forest, SIERRA and NEVADA COUNTIES, Calif. Bids from:

(1) J. R. Reeves, Sacramento....$ 95,265
(2) Isbell Constr. Co., Reno, Nev.... 105,332
(3) Larsen Bros., Sacramento.... 121,096
(4) M. J. B. Constr. Co., Stockton....$123,479
(5) Engineers' Estimate.... 93,690

	(1)	(2)	(3)	(4)	(5)
30 acres clearing	250.00	300.00	300.00	190.00	250.00
74 acres cleanup clearing	120.00	75.00	200.00	85.00	75.00
114,500 cu. yd. unclass. excavation	.44	.55	.60	.70	.50
9,400 cu. yd. borrow excavation	.25	.40	.60	.47	.35
2,070 cu. yd. structure excavation	2.25	1.50	1.00	2.00	1.50
163,000 sta. yd. overhaul	.02	.02	.02	.015	.01
1,200 cu. yd. mile borrow haul	.20	.15	.20	.30	.15
44 lin. ft. 8" corr. metal pipe	2.00	1.25	1.00	1.40	1.10
674 lin. ft. 12" perf. corr. metal pipe	2.15	1.50	1.50	1.75	1.40
714 lin. ft. 18" corr. metal pipe	2.65	2.00	2.00	2.45	2.00
986 lin. ft. 24" corr. metal pipe	3.65	2.75	3.00	3.50	2.90
144 lin. ft. 30" corr. metal pipe	5.00	3.00	4.00	4.50	3.50
84 lin. ft. 36" corr. metal pipe	6.50	5.00	6.00	6.50	5.70
64 lin. ft. 48" corr. metal pipe, 12 ga.	8.00	7.50	10.00	9.50	6.80
70 lin. ft. 48" corr. metal pipe, 10 ga.	10.50	8.00	11.00	11.50	7.90
110 lin. ft. 60" corr. metal pipe	13.50	9.00	12.00	15.50	12.00
181 cu. yd. crushed rock or grav. backfill	4.00	4.75	4.00	5.00	3.00
200 sq. yd. mortar backfill seal	.27	.50	2.00	.50	.30
158 cu. yd. "A" concrete	25.00	32.00	30.00	35.00	25.00
12,070 lb. reinforcing steel	.05	.07	.07	.07	.07
1,365 lin. ft. type 1 protection ditch	.20	.20	.25	.31	.25
480 lin. ft. 8" welded steel pipe, 12 ga.	1.50	2.00	1.00	1.50	.80
120 lin. ft. 8" welded steel pipe, 7 ga.	2.00	3.00	2.00	2.40	1.30
82 ea. right-of-way monuments	3.50	4.00	3.00	3.00	3.00

Sacramento, Calif.—State—Grading and Asphalt Concrete Paving—Tehama County

Contract awarded to Peninsula Paving Co., 9 Main St., S. F., $218,181, by Calif. Div. of Highways, Sacramento, for 10.2 mi. grad. and asph. conc. pav. betw. Corning and Proberta in TEHAMA CO. Bids from:

(1) Peninsula Paving Co., S. F....$218,181
(2) Hanrahan Co., San Francisco.... 221,918
(3) Union Paving Co., S. F.... 223,116
(4) Bodenhamer Const., Oakland....$244,411
(5) A. Teichert & Son, Inc.... 246,753
(6) Oswald Bros., Los Angeles.... 249,115

	(1)	(2)	(3)	(4)	(5)	(6)
1,590 M gallons water	1.50	1.00	1.25	1.25	2.00	2.00
51,700 cu. yd. roadway excavation	.28	.17	.35	.26	.24	.30
700 cu. yd. ditch & channel excav.	.60	.70	1.00	1.00	.75	1.25
2,260 cu. yd. struc. excavation	.80	.95	1.00	.90	.80	.90
117,000 sta. yd. overhaul	.01	.005	.01	.01	.005	.005
2,550 cu. yd. remove concrete	2.00	1.55	1.50	1.50	1.25	1.50
122,500 cu. yd. imported selected material	.36	.33	.43	.44	.52	.43
529 sta. finish roadway	5.00	7.50	10.00	6.00	7.00	2.50
25 tons liq. asph. ROMC 3 or 4	20.00	28.00	30.00	22.50	25.00	26.00
4,800 sq. yd. prep., mix & shape shoulders	.10	.05	.10	.10	.10	.08
24,870 tons asph. conc. leveling course	3.10	3.35	2.80	3.40	3.19	3.57
14,045 tons asph. conc. "A" surface course	3.10	3.59	3.00	3.80	3.78	3.82
80,500 lb. reinforcing steel	.05	.055	.048	.05	.045	.055
4,800 lb. steel I-beams	.08	.06	.10	.08	.06	.075
730 cu. yd. "A" concrete	21.00	21.40	17.00	22.00	21.00	22.00
2,466 lin. ft. 12" corr. metal pipe	1.25	1.25	1.80	1.25	1.20	1.25
134 lin. ft. 18" corr. metal pipe	1.50	1.65	3.00	1.60	2.00	1.60
1,142 lin. ft. remov., clean & relay pipe culv.	.40	.65	1.00	.60	.60	.50
541 lin. ft. remov.. clean & salv. pipe culv.	.40	.50	1.00	.50	.50	.30
168 lin. ft. laminat. guardrailing	1.25	1.00	1.50	1.00	1.00	1.50
62 ea. culvert markers	2.00	2.00	3.00	2.50	2.50	1.50
34 ea. remove & salvage guideposts	2.00	.60	1.00	1.00	.50	1.50
1,690 sq. yd. asph. paint binder	.05	.03	.05	.03	.05	.05
93 ea. monuments	3.00	3.00	3.00	3.00	3.00	3.00

Carson City, Nev.—State—Grading and Surfacing—Nye County

Contract awarded to Utah Const. Co., Box 726, Ogden, Utah, $133,191, by Nevada State Highway Comm., Carson City, Nev., for 29.81 mi. cr. grav. or stone surf. betw. Tonopah and Calloways on Rt. 4, Sec. C2, C3, D1 in NYE CO., Nev. Bids from:

(1) Utah Const. Co., Ogden, Utah....$133,191
(2) Isbell Const. Co., Reno.... 149,393
(3) Dodge Const., Inc., Fallon.... 149,670
(4) Heafey Moore Co., Oakland....$174,940
(5) Pacific Const. Co., Reno.... 176,518
(6) Engineer's estimate.... 161,015

	(1)	(2)	(3)	(4)	(5)	(6)
90 acres clearing and grubbing	8.00	10.00	5.00	15.00	20.00	10.00
70 lin. ft. remove culvert pipe	.50	1.00	1.00	.50	.50	.50
2 ea. remove culvert headwalls	5.00	4.00	5.00	10.00	10.00	5.00
134,950 cu. yd. roadway excavation	.20	.29	.27	.29	.28	.25
141,230 sta. yd. overhaul	.02	.02	.02	.02	.02	.02
48,450 cu. yd. select borrow	.32	.35	.30	.38	.35	.35
23,677 cu. yd. imported borrow	.25	.29	.28	.33	.30	.30
1,900 cu. yd. struc. excavation	1.00	1.00	1.00	1.00	1.00	1.00
29.81 mi. subgrade	75.00	$100	$100	$110	$150	$100
29.81 mi. finish roadway	$100	$100	$100	$200	$200	$100
42,450 cu. yd. select. matl. surface	.42	.35	.50	.63	.60	.60
62,370 tons cr. grav. or stone surface	.48	.50	.50	.63	.67	.60
297 cu. yd. "A" concrete	28.00	32.00	27.00	29.00	30.00	30.00
154 cu. yd. "B" Concrete	25.00	31.00	27.00	29.00	30.00	30.00
34,960 lb. reinforcing steel	.08	.07	.07	.07	.07	.07
1,800 lin. ft. 18" corr. metal pipe	1.85	2.10	2.50	2.40	2.75	2.50
2,514 lin. ft. 24" corr. metal pipe	3.00	3.00	3.50	3.00	3.50	3.00
55 cu. yd. handlaid riprap	4.00	6.00	4.00	7.00	5.00	5.00
100 ea. monuments	2.50	3.50	3.00	4.00	4.00	4.00

Colorado Highways

(Continued from Page 206)

The remaining $15,000,000 of highway anticipation warrants, which the state legislature authorized sold, will be disposed of later this year, it is indicated, as Governor Johnson says every dollar of the $25,000,000 will be appropriated and budgeted before he goes out of office next January. The present plan is to call the highway advisory board into conference in November to draw up the 1937 budget which will be financed by the $15,000,000.

First important work after the bond sale was the signing of the 10,000 one thousand dollar warrants by three officials—the governor, the state highway engineer and chairman of the advisory board. Several days were required for this work done personally by the three.

Sale of the highway tax anticipation warrants also terminated the controversy between state and federal authorities on the issue of the Clear Creek canyon road. The plan of the Federal Government was accepted and work was to start immediately on building a new $1,500,000 28-ft. highway through Clear Creek canyon on the Denver-Idaho Springs route. There will be 3,000 ft. of tunnels on this project.

The state plan for improving the present route to Idaho Springs over Floyd Hill has been approved, and work will probably start at once, for which $500,000 will be allotted.

Projects already started in the state, or to be started soon, provide improvement of 215.38 miles of road at a cost of $6,874,020, which comes out of the highway department's regular budget.

The Driscoll Construction Co. of Pueblo is getting a good start on the $197,205 gravel surfacing project of 6.289 mi. between Canon City and Salida. Frank M. Kenney, Denver, has started work on the .331 mi. of bridge and approaches in Colorado Springs which he was awarded for $103,659.

Work on the $109,891 bridge and gravel approach project between Strasburg and Anton being carried out by the Ed. Honnen Construction Co., is now more than half completed. A Federal Aid concrete paving job was started on 1.58 mi. of highway west of Denver recently by the Monarch Engineering Co., which took the contract for $126,605. Gravel surfacing for an 8-mi. project between Matheson and Ramah ($167,441) by the Owen, Babb, Thorkildsen Co., is over half completed.

The gravel surfacing and bridge project between Evans and La Salle being carried out by M. E. Carlson, Denver, for $171,545, is nearly half finished. The Larson & Kronze Construction Co. is at work on the 2.097-mi. gravel surfacing and railroad underpass project between Pueblo and Ordway. Henry Shore of Grand Junction recently received the contract for 1.325 mi. of gravel surfacing and bridge between Rifle and Meeker on a bid of $63,855.

Street and Road Work......

Helena, Montana—State—Grading & Oil Surfacing—Fergus County

Contract awarded to Tomlinson-Arkwright Const. Co., Great Falls, Mont., $168,135, by State Highway Comm., Helena, Montana, for 11.735 mi. grading, surfacing, etc., on Secs. B and E of the Lewiston-Grass Range Road and 0.308 mi. surf. with cr. gravel and roadmix oiling road approaches to overcrossing of the C. M. St. P. & P. Railway Co.'s tracks 2 miles west of Lewiston, FERGUS CO. (FAP 229 B and 235B), Montana. Bids received from:

(1) Tomlinson-Arkwright Const. Co. $168,135
(2) J. L. McLaughlin, Great Falls 181,269
(3) Inland Const. Co., Omaha 187,182
(4) Thomas Staunton, Great Falls 187,828
(5) C. A. Wagner Const. Co., Sioux Falls 189,966
(6) James Crick, Spokane 199,440
(7) S. J. Groves & Sons Const. Co. $199,672
(8) Frank J. Haas, Great Falls 200,851
(9) S. Birch & Sons Const. Co. 206,305
(10) Peter Kiewitt Sons Co., Omaha 210,705
(11) J. C. Maguire Const. Co., Butte.... 220,004
(12) Engineer's estimate 195,786

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
163,482 cu. yd. exc. and borrow	.25	.24	.26	.30	.30	.28	.32	.28	.30	.23	.35	.27
1,248 cu. yd. struc. excav.	1.00	1.00	1.40	1.00	1.00	1.50	1.25	1.00	2.00	1.50	1.00	1.00
187,180 sta. yd. overhaul	.01	.01	.01	.02	.01	.02	.02	.02	.01	.02	.02	.01
672 ft. 15" cor. met. pipe cul.	1.35	1.50	1.60	1.25	1.50	1.70	1.50	2.00	1.50	2.00	1.75	1.35
732 ft. 18" cor. met. pipe cul.	1.80	1.90	1.90	1.25	2.00	2.00	1.85	2.50	1.75	3.00	2.25	1.80
284 ft. 24" cor. met. pipe cul.	2.25	2.75	3.00	2.10	2.50	3.00	2.75	3.00	2.50	4.00	3.00	2.60
216 ft. 30" cor. met. pipe cul.	3.00	3.15	3.60	2.75	4.00	4.00	3.50	3.50	3.00	5.00	4.00	3.80
238 ft. 36" cor. met. pipe cul.	4.25	5.50	5.50	5.00	5.00	6.00	5.00	4.50	4.30	6.00	6.50	5.00
834 ft. relay cor. met. pipe	.50	1.50	.60	.50	.50	1.00	1.00	1.00	.50	1.00	1.00	.75
174 ft. 18" C. M. P. siphon	2.25	2.50	2.40	1.80	3.00	3.00	2.25	2.00	2.10	3.50	3.00	2.60
64 ft. 24" C. M. P. siphon	3.00	3.50	3.50	2.55	4.00	4.00	3.25	3.00	2.80	4.50	4.00	4.00
56 ft. 18" rein, concr. pipe	4.00	3.00	3.00	2.40	3.00	3.00	2.50	2.00	3.00	4.00	2.50	2.50
48 ft. 24" rein. concr. pipe	4.75	4.00	4.00	3.10	4.00	5.00	3.50	2.00	4.00	5.00	3.50	3.50
67.96 cu. yd. "A" concrete	$25	$30	$33½	$30	$25	$45	$30	$30	$35	$30	$30	$35
4,424 lb. reinf. steel	.08	.08	.08	.09	.08	.10	.10	.10	.10	.07	.10	.10
34,460 cu. yd. gr. subbase mtl	.70	.80	.90	.85	1.10	1.20	.80	1.10	1.05	1.20	.85	.70
40,405 tons A top crst. cr. grav.	.95	1.25	1.30	1.15	.80	1.10	1.30	1.10	1.35	1.50	1.25	1.35
4,350 cu. yd. binder	.25	.25	.30	.10	.50	.20	.30	.30	.30	.20	.30	.30
8,700 mi. yd. overh'l (bind'r)	.25	.10	.15	.10	.20	.10	.20	.15	.40	.20	.15	.15
310 hrs. roll subbase	3.00	3.00	4.00	2.00	3.00	3.00	3.00	5.00	2.00	3.00	3.00	3.00
L. S. prov. & m'nt'n water pl.	$200	$150	$300	$100	$250	$400	$400	$300	$100	$200	$250	$300
1,060 M gallons water	2.50	2.50	1.50	2.00	3.00	2.00	3.00	3.00	2.50	3.00	2.50	3.00
289,027 gal. apply MC3 asphalt	.105	.09	.085	.10	.10	.09	.085	.09	.099	.10	.12	.11
12.043 mi. processing	$700	$900	$850	$800	$800	$800	$900	$750	$600	$700	$1,000	$1,000
21,194 gal. seal ct. oiling	.11	.10	.10	.10	.11	.12	.10	.10	.106	.12	.13	.12
14.54 MFBM treated lumber	$120	$130	$122	$130	$125	$150	$120	$200	$110	$100	$100	$120
0.17 MFBM untr. lumber	$120	$130	$110	$130	$100	$150	$120	$200	$100	$100	$100	$115
30 ea. 20' tr. timb. piles	$25	$28	$32	$30	$40	$40	$35	$30	$25	$30	$25	$36
6 ea. 25' tr. timb. piles	$30	$35	$40	$35	$50	$45	$40	$35	$30	$35	$30	$40
L. S. clearing and grubbing	$500	$150	$200	$150	$1,500	$500	$1,800	$6,500	$1,000	$1,000	$2,000	$1,000
1,750 tons stockp. gravel	.95	1.25	.90	1.15	1.00	1.10	1.35	1.10	1.35	1.50	1.25	1.25

Bridges and Culverts ......

Phoenix, Ariz.—State—Concrete Subway—Navajo County

Contract awarded to Tanner Construction Co., 10 Outwest Bldg., Phoenix, $103,995, by Arizona State Highway Commission, Phoenix, for construction of a reinforced concrete subway under the A. T. & S. F. Railway tracks located at Winslow, on the Winslow-Pine Highway, WPGM 107, NAVAJO COUNTY. Bids from:

(1) Tanner Const. Co. $103,995
(2) Pearson & Dickerson 106,548
(3) Phoenix-Tempe Stone Co. 117,907
(4) F. D. Shufflebarger, Albuquerque....$120,906
(5) Heuser and Garnett, Glenedale 135,302
(6) Daley Corporation, San Diego 142,779

	(1)	(2)	(3)	(4)	(5)	(6)
14,414 cu. yd. struc. excavation	$.45	$.54	$.40	$.55	$.90	$1.22
50 cu. yd. drainage excavation	.60	1.28	.30	.65	.50	.90
1,654 sta. yd. overhaul	.04	.025	.03	.05	.03	.05
3,041 cu. yd. mi. haul	.50	.38	.25	.40	.20	.36
1,706 cu. yd. select material	1.00	.90	1.65	1.50	1.00	2.40
2,240 lin. ft. comb. curb & gutter	1.17	1.54	1.50	1.80	1.50	2.40
85 lin. ft. single curb (Type G)	1.00	.51	.90	1.25	1.00	1.80
41 lin. ft. single curb (Specl Detail)	1.00	1.15	1.10	1.25	1.25	1.50
2,077 sq. yds. 6" concr. pavement	2.30	2.50	2.50	2.80	5.00	3.00
43 cu. yd. Class AA concrete	70.00	65.00	75.00	70.00	60.00	75.00
1,535 cu. yd. Class A concrete	17.00	19.00	22.00	21.75	25.00	22.00
776 cu. yd. Class D concrete	17.00	19.00	25.00	21.50	27.00	23.00
347,615 lbs. reinf. steel bars	.05	.045	.05	.05	.055	.055
128 lin. ft. 18" C. M. P.	1.65	1.92	1.75	1.75	2.00	1.50
30 lin. ft. 12" part circle culvert	2.50	3.00	2.25	1.75	1.00	2.50
28 lin. ft. 36" part circle culvert	4.20	6.00	6.00	2.85	3.00	6.00
9 each right-of-way markers	4.00	3.85	3.00	4.00	3.00	2.50
Lump sum 3 street lights & connections	$770	$800	$800	$660	$650	$750
78 cu. yd. rock backfill	2.15	5.00	2.50	2.50	4.00	5.00
2.490 lin. ft. 4" vitr. clay pipe	.37	.32	.42	.35	.50	1.10
Lump sum subway pylon	$500	$650	$350	$500	$250	$425
Lump sum remove & rebuild stone wall	$1,100	$1,600	$350	$2,000	$400	$2,100
Lump sum reconstruct sewer	$2,500	$2,500	$1,800	$3,000	$2,500	$5,400
800 lin. ft. lead seal	.85	.90	.80	1.20	.80	1.20
Lump sum membrane & asph. plant waterpr.	$4,600	$4,176	$5,000	$4,000	$4,200	$4,200
Lump sum electric lighting system	$2,700	$2,758	$2,800	$2,700	$2,200	$2,650
Lump sum pump & pumping equipment	$5,950	$3,485	$5,500	$5,500	$4,200	$4,000
512 tons plant mix	6.15	4.50	5.00	6.50	7.00	8.00
25 tons cutback asphalt	27.00	22.00	27.50	35.00	22.00	50.00
1 ton emulsified asphalt	45.00	65.00	75.00	65.00	50.00	75.00
50 tons screenings	3.70	6.50	3.00	5.00	4.00	6.00
Lump sum removal of rock terrace, etc.	80.00	$200	$200	$175	$300	$150
195 sq. ft. removal concr. sidewalk	.06	.05	.06	.06	.10	.15
79 lin. ft. removal of concr. curb	.60	.20	.30	.30	.10	1.00
Lump sum removal of buildings	$920	$1,725	$1,900	$1,400	$2,000	$2,100
5,400 sq. ft. 4" concrete sidewalk	.20	.17	.20	.22	.15	.24
40 M gals. sprinkling	2.00	1.50	1.50	2.00	1.50	2.50
40 hours rolling	4.00	3.25	3.50	6.00	3.00	5.00
19 each guide posts	2.00	2.50	2.50	3.00	2.00	2.50
Lump sum removal of shade trees	$185	$125	$150	$150	$300	$300

CONSTRUCTION

. . . . a 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 . . . . .

WORK CONTEMPLATED

The Narrows Bridge at Vancouver, B. C., involving 11,000 tons steel. Est. cost $6,000,000.

Floating drydock, 1,016 ft. long, 165 ft. beam, 75 ft. depth for Bureau of Yards & Docks, Navy Dept., Pearl Harbor, T. H. Bids will be received in the fall of 1936. Est. cost $10,000,000.

Six undergrade crossings at Niles for Calif. Div. of Highways. Bids to June 10. Est. cost, $700,000.

Reconstruct Grays Harbor South Jetty for U. S. Engr. Office, Seattle. Bids to June 11. Est. cost $4,000,000.

600,000 cy. concrete in main Conchas Dam, San Miguel County, New Mexico, for U. S. Engr. Office, Tucumcari, N. M. Bid call to be issued about June 15, to be opened later.

Bids have been received, but successful bidders have not yet been announced by Shell Oil Co., L. A., for 304 mi. new steel oil pipeline. Est. cost $4,500,000.

Multiple arch type Bartlett Dam on Verde River for Bureau of Reclamation, Phoenix, low bidder Barrett & Hilp, S. F. & Macco Const. Co., Clearwater, $2,227,495.

Gravel dam with welded steel plate face for Colorado Springs, Colo., low bidder, Ed Honnen, Colorado Springs, $386,789.

CONTRACTS AWARDED

Synchronous motors for Colorado River Aqueduct pumping plants by Metropolitan Water Dist., L. A., to (1) General Electric Co., L. A., $693,758 for 6 motors; ;(2) Allis-Chalmers Mfg. Co., L. A., $288,400 for 3 motors, and (3) Westinghouse Electric Mfg. Co., L. A., $784,562 for 6 motors.

Water works improvements for Sheridan, Wyoming, totaling $647,943 awarded to 12 separate contractors—see W.C.N. summary for details.

Caballo Dam, Rio Grande Proj., New Mexico, for Bureau of Reclamation, El Paso, Texas, to Mittry Bros., L. A., $957,018.

Structural steel for plant enlargement for Consolidated Aircraft Corp., San Diego to Consolidated Steel Corp., L. A., $600,000.

3.2 mi. grading and plant mix surf. betw. Broadway Tunnel and Lafayette for Calif. Div. of Highways to Granfield, Farrar & Carlin, S. F., $306,236.

Levee work for U. S. Engr. Office, Sacramento, to Morrison-Knudsen Co., Boise, $204,580.

Steel deck truss bridge across Santa Margarita River by Calif. Div. of Highways, to C. W. Wood, Stockton, $175,529.

10.7 mi. grading, etc., near Navajo County Line, by Arizona Highway Comm., to Lee Moor Constr. Co., Phoenix, $160,321.

Macy Street Subway, by City of Los Angeles, to Bent Bros., Inc., L. A., $274,378.

Undergrade crossing at San Leandro St., Oakland, by Calif. Div. of Highways, to Bodenhamer Const. Co., Oakland, $214,065.

Ralston Creek earth dam, by Board of Water Comm., Denver, to United Const. Co., Winona, Minn., $1,041,251.

Two wharves at Yerba Buena Shoals for S. F. Public Utilities Comm., to Healy Tibbitts Const. Co., S. F., $331,600.

Hangars at Hickman Field, T. H., for U. S. Army, to Robert E. McKee, L. A., $1,240,000.

Street and Road Work . . . . . .

CALLS FOR BIDS

SACRAMENTO, CALIF.—Bids to 2 p. m., June 10, by Calif. Div. of Highways, Sacramento, for: (1) ALAMEDA COUNTY—2.4 mi. grad. and cr. run base and plantmix surfacing, betw. Folger Ave. and Camelia St., involving: 20,000 cu. yd. roadway excavation; 31,700 cu. yd. imported sel. matl.; 25,000 ton crusher run base; 9,690 ton min. aggr. plant mix surf.; 484 ton liq. asph. MC5 or ex. hvy.; 555 ton stone screenings; 7,700 ton riprap. (2) SACRAMENTO COUNTY—0.6 mi. grad. and asphalt conc. and concrete paving betw. "C" St. and American River, involving: 3,100 cu. yd. structure excavation; 1,880 ton asph. conc. base and level. crs.; 1,430 ton asph. conc. type A surf. crs.; 1,025 cu. yd. "A" conc. pavement. (3) SAN FRANCISCO COUNTY—for furn. and planting various varieties of trees and shrubs, grading and planting lawn, and furn. and installing a water system in San Francisco at 5th Street Plaza in SAN FRANCISCO COUNTY, Calif. (4) ALAMEDA and CONTRA COSTA COUNTIES—for 3.1 mi. grade and cr. run base and plant mix surf. betw. Camelia Ave. and San Pablo Ave., involving: 155,000 cu. yd. roadway excavation; 5,500,000 sta. yds. overhaul; 35,000 ton crusher run base; 15.800 ton min. aggr. plantmix surf. (5) TUOLUMNE COUNTY—for 2.4 mi. grade and roadmix surface on untreated cr. grav. or stone base betw. 3½ mi. east of Sullivan Creek and Pooleys, in TUOLUMNE COUNTY, Calif. Work involves: 53,000 cu. yd. roadway excavation; 8,250 ton cr. grav. or stone base; 4,000 ton min. aggr. roadmix surf. (6) PLACER COUNTY—for 7.1 mi. graded and plant mix surfaced or crusher run base betw. 4½ mi. N.E. of Tahoe City and Nevada State Line in PLACER COUNTY, Calif. Work involving: 39,000 cu. yd. excavation; 11,100 cu. yd. imported borrow; 20,000 ton cr. run base; 13,700 ton min. aggr. plant mix.

SAN MATEO, CALIF.—Bids to 8 p. m., June 15, by City Clerk, San Mateo, for grading, paving and const. curbs, gutters, sidewalks and sewers on North Fremont St., North Grant St., North Humboldt St., and East Santa Inez Avenue. Work involves: 120,000 sq. ft. 4-in. rock base and 2-in. armor coat. 5-12

WOODLAND, CALIF.—Bids to 8 p. m., June 15, (tentative date), by City Clerk, City Hall, Woodland, Calif., for paving 3 blocks on Main St., betw. Elm and Second St., Route 7, involving: 40,702 sq. ft. 4-in. grav. subbase; 4-in. emuls. stabilized slurry base and 2-in. emuls. asph. premix surf. (hot aggregate type). Est. cost $9,275. 5-19

BIDS RECEIVED

LOS ANGELES, CALIF.—Gibbons & Reed Co., 221 San Fernando Blvd., Burbank, $166,313, low to Calif. Div. of Highways, L. A., for 2.7 mi. grad. and conc. paving, betw. Gypsum Creek and Riverside County Line in ORANGE COUNTY, Calif. 5-7

LOS ANGELES, CALIF.—Oswald Bros., 366 E. 59th St., Los Angeles, $18,164, only bid to Calif. Div. of Highways, Los Angeles, for grade and concrete and asph. concrete pav. roads within grounds at Camarillo State Hospital, VENTURA COUNTY. 5-21

LOS ANGELES, CALIF.—George Herz, P. O. Box 191, San Bernardino, $63,603, low to Calif. Div. of Highways, Los Angeles, for 19.4 mi. plant mix surf. slow curing type and seal coat applied at various locations, in SAN BERNARDINO and RIVERSIDE COUNTIES, California. 5-21

LOS ANGELES, CALIF.—George R. Curtis Paving Co., 2440 E. 26th St., Los Angeles, $29,887, low to Calif. Div. of Highways, Los Angeles, for 6.8 mi. shoulders, plant mix surf. on bitum, macadam, betw. Castaic School and Piru Creek, LOS ANGELES COUNTY, Calif. 5-21

LOS ANGELES, CALIF.—B. G. Carrol, 4396 Maryland St., San Diego, $61,720, low to Calif. Div. of Highways, Los Angeles, for 1.3 mi. grade and concrete pavement, about 2.2 mi. west of Indio, in RIVERSIDE COUNTY, Calif. 5-21

LOS ANGELES, CALIF.—George R. Curtis Paving Co., 2440 E. 26th Street, Los Angeles, $143,965, low to Calif. Div. of Highways, Los Angeles, for 9.8 mile concrete pavement widening between Seal Beach and Newport Beach in ORANGE COUNTY, Calif. 5-21

SACRAMENTO, CALIF.—N. M. Ball Sons, P. O. Box 404, Berkeley, $43,671, low to Calif. Div. of Highways, Sacramento, for const. 1.5 mi. of which 0.5 mi. is grading and cr. run base surface (plant mix); about 0.6 mi. to be widened and borders of cr. run base, and reconstr. fences; also const. a reinf. conc. bridge betw. 4 mi. north of Willows and 1 mi. south of Artios in GLENN COUNTY, Calif. 5-18

SACRAMENTO, CALIF.—Palo Alto Road Materials Co., 465 California Ave., Palo Alto, $24,401, low to Calif. Div. of Highways, Sacramento, for 24.6 mi. apply roadmix surf. treatment to shoulders and portions to be surf. with armor coat, betw. the westerly boundary and 4 mi. east and betw. Yetten and Lemon Cove, TULARE COUNTY, Calif. 5-20

SACRAMENTO, CALIF.—Fredericksen & Westbrook, Lower Lake, Calif., $29,750, low to Calif. Div. of Highways, Secramento, for 5.6 mi. grad. and apply peneration oil treatment betw. 4 mi. east of Beckwourth and Ede's Ranch, in PLUMAS COUNTY, Calif. 5-20

SACRAMENTO, CALIF.—Basich Bros., 2055 S. Normandie Ave., Torrance, Calif., $119,350, low to Calif. Div. of Highways, Sacramento, for 9.1 mi. of grade and bitum. treatment, selected materials surface between 2 mi. south of Rush Creek and 2 mi. north of Leevining, in MONO COUNTY, Calif. 5-20

PORTLAND, ORE.—Bids received as follow by Oregon State Highway Comm., Public Service Bldg., Portland, Ore., for: (1) MARION COUNTY—Saxton & Looney and J. S. Risley, 324 Henry Bldg., Portland, $42,019, (tar) low, for 5.8 mi. resurf. and oil mat. surf. treatment on Cottage Farm-Aumsville Sec. of Silver Creek Falls and north Santiam Secondary Highway. (2) MARION COUNTY—R. O. Dall & Warren Bros., Inc., Aberdeen, Wn., $59,718, (tar) low, for 9.7 mi. resurf. and oil on Rocky Point School-South Falls Sec. of Silver Creek Falls, Secondary Highway. 5-23

SEATTLE, WN.—L. J. Dowell, Inc., 1437 Elliott Ave., W. Seattle, Wn., $41,083 and alternate $43,031, low to Board of Public Works, Seattle, for constr. paving, sewers, watermains, hydrants, and conc. sidewalks on Franklin Ave., East Prospect St., E. Galer St., E. Garfield St., E. Blaine St., E. Howe St. and Eastlake Ave. 5-11

CONTRACTS AWARDED

PHOENIX, ARIZ.—To Tanner Construction Co., Phoenix, $36,328, by Arizona State Highway Comm., Phoenix, for 3.9 mi. grading, draining roadway, beginning about 25 mi. east of Showlow and extends N.E. toward Concho on the Showlow-Concho Highway, WPSO 104-A, Sch. 4, APACHE COUNTY. 5-9

PHOENIX, ARIZ.—To Lee Moor Contracting Co., Phoenix, $160,221, by Arizona State Highway Comm., Phoenix, for 10.7 mi. grading, draining roadway about 7 miles northeast of Navajo County Line and about 70 miles northeast of Globe, in NAVAJO COUNTY, FLH 6-A. 5-9

FRESNO, CALIF.—To Valley Paving & Construction Co., Bank of America Bldg., Fresno, $11,982, by City Clerk, Fresno, for const. sidewalks, curbs, gutters and asphaltic concrete pavement on "O" St., betw. Stanislaus and Fresno streets. 5-7

FRESNO, CALIF.—To Rexroth & Rexroth, 2110 C, Sta. "A," Bakersfield, $9,798 by District Engineer, Calif. Div. Highways, State Highway Bldg., Fresno, for 32.6 mi. landscaping highway roadsides betw. Greenfield and Pierce Road; betw. Bush St. in Tulare and the So. City Limits of Kingsburg; and betw. Highland Ave. and the North City Limits of Fowler in KERN, TULARE, and FRESNO COUNTIES, Calif. 5-4

HANFORD, CALIF.—To Union Paving Co., Call Bldg., San Francisco,, $38,002, by Clerk of the Board of Supervisors, Hanford, for widening and resurfacing a portion of County Highway on 11th Ave., Hanford and Armona avenues. 5-6

LONG BEACH, CALIF.—To Sully Miller Contracting Co., 1500 W. 7th St., Long Beach, $26,623 by City Council, Long Beach, for paving Ocean Blvd., from Belmont Ave. to 72nd Place, Long Beach. 5-4

LOS ANGELES, CALIF.—To Parish Bros., 239 Constance Ave., Santa Barbara, $14,520, by Dist. Engineer, Calif. Div. of Highways, Los Angeles, for 15.4 mi. shoulders to be constr. of imported borrow betw. Routes 183 and 179, and betw. Route 60 and Santa Ana River, in LOS ANGELES and ORANGE COUNTIES, Calif. 5-18

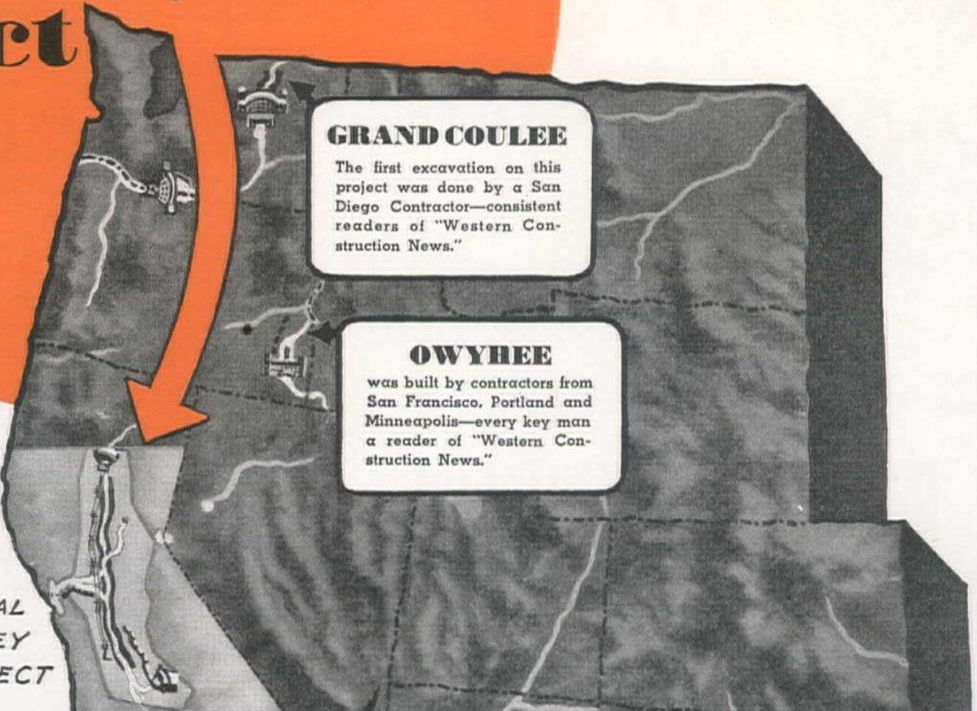
LOS ANGELES, CALIF.—To R. E. Hazard & Sons, P. O. Box 1438, San Diego, $88,083, by Calif. Div. of Highways, L. A., for 76.5 mi. roadmix surf. treatment betw. Vidal and Rt. 58, and betw. Doble and 20 mi. N.E., and betw. Route 26 and 11.5 mi. north in SAN BERNARDINO and RIVERSIDE COUNTIES, Calif. 5-12

LOS ANGELES, CALIF.—To Oilfields Trucking Co., Box 751, Bakersfield, $13,081, by Calif. Div. of Highways, State Bldg., L. A., for 27.6 mi. roadmix surf. tr. betw. Temescula River Bridge and southerly boundary betw. Sage and 4.2 mi. south of Hemet in RIVERSIDE COUNTY, Calif. 5-4

MARYSVILLE, CALIF.—To E. F. Hilliard, 1355 43rd St., Sacramento, $10,297, by Calif. Div. of Highways, Dist. Engineer, Marysville, for 48.2 mi. applying oil tr. between Downieville and Route 83; betw. 7.1 mi. north of Truckee and 5.7 mi. north of Nevada-Sierra County Line; and betw. Sierraville and Calpine, in SIERRA and NEVADA COUNTIES, Calif. 5-4

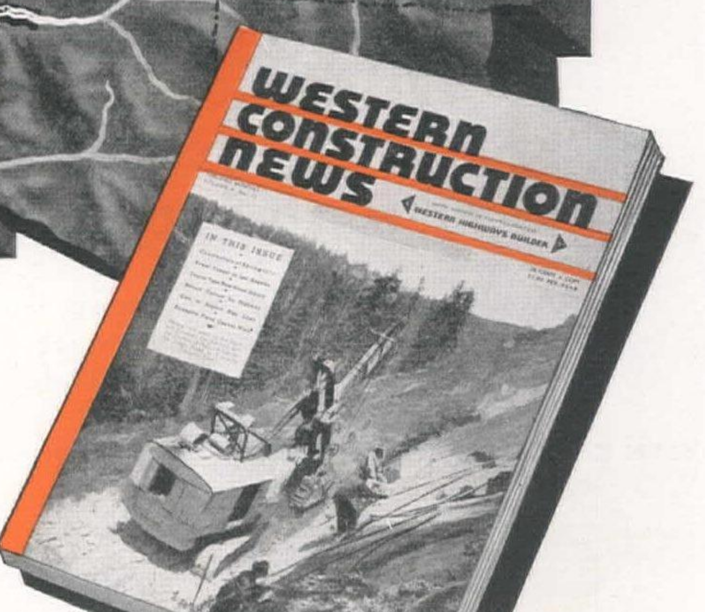
OAKLAND, CALIF.—To Independent Construction Co., 46th and Clement streets, Oakland, $52,325, by Port of Oakland, for paving roadway to serve 504 ft. extension to Transit Shed No. 2 at Outer Harbor, under Constr. "B," PWA Docket 1395. 5-19

who will buy the equipment for *this* $170,000,000 project?



BONNEVILLE
is being built by contractors from Oakland, Boise, San Francisco, Ogden and Seattle—all of these contractors are subscribers to "Western Construction News."

BOULDER DAM
was built by contractors from San Francisco, Portland, Ogden, Boise and Oakland. Without exception, each was a subscriber of long standing to "Western Construction News."



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PALO ALTO, CALIF.—Award recommended to A. J. Raisch, 358 Lincoln Ave., San Jose, $27,117 (subject to PWA approval), by City Clerk, Palo Alto, for improvement to Page Mill Road; Oregon Avenue; Middlefield Road; and Palo Alto Avenue. 5-5

SACRAMENTO, CALIF.—To Union Paving Co., Call Bldg., San Francisco, $145,532, by Calif. Div. of Highways, Sacramento, for 8.8 mi. crusher run base ana plantmix surface betw. Kyburz and Strawberry in EL DORADO COUNTY, Calif. 5-18

SACRAMENTO, CALIF.—Awards as follows by Calif. Div. of Highways, Sacramento: (1) YOLO COUNTY—A. Teichert & Son, Inc., 1846 37th St., Sacramento, $157,485, for 3.5 mi. grad. and asph. concrete paving, betw. Yolo Causeway and "M" Street Subway. (2) MODOC COUNTY—To C. F. Fredericksen & Sons, Lower Lake, Calif., $18,959, for 32.9 mi. oil treatment applied to portions and seal coat applied to entire project between Hot Creek and Cedarville Mt., and betw. southerly boundary and Alturas. 5-18

SACRAMENTO, CALIF.—To Granfield, Farrar & Carlin, & John Carlin, 67 Hoff Ave., S. F., $306,236, by Calif. Div. of Hwys., Sacramento, for 3.2 mi. grad. and pl. mix surf. on cr. run base betw. Broadway Tunnel and 2 mi. west of Lafayette, in CONTRA COSTA COUNTY, Calif. (See Unit Bid Summary). 5-15

LOS ANGELES, CALIF.—To Griffith Co., L. A. Railway Bldg., Los Angeles, $26,825, by Board of Harbor Comm., Los Angeles, for asph. concrete pavement on various roadways, shed floors and wharf decks in the Harbor area, under Spec. 595. 5-22

MONROVIA, CALIF.—To J. H. Coombs, 428 N. Myrtle St., Monrovia, $13,067, by City Clerk, Monrovia, for improving Mayflower Ave., Huntington Drive to Duarte Ave. 5-21

SAN FRANCISCO, CALIF.—To A. D. Schader, 144 Spear Street, San Francisco, $11,297, by State Board of Harbor Commissioners, San Francisco, for constructing paving and track work, etc., for a bulkhead wharf at Piers 44 and 46. 5-21

SAN FRANCISCO, CALIF.—To A. D. Schader, 144 Spear St., S. F., $11,297, by State Board of Harbor Commissioners, San Francisco, for constructing paving and track work, etc., for a bulkhead wharf at Piers 44 and 46. 5-14

SAN FRANCISCO, CALIF.—Award recommended to J. R. Reeves, R. D. No. 3, Box 100, Sacramento, $95,265, by Bureau of Public Roads, San Francisco, for 4.267 mi. grading Sec. B of Route 27, the Sierraville-Hobart National Forest Highway, Tahoe National Forest, SIERRA and NEVADA COUNTIES, Calif. 5-9

SAN LUIS OBISPO, CALIF.—To Lambs Transfer Co., 828 Cowles St., Long Beach, $12,038, by Dist. Engineer, Calif. Div. of Highways, San Luis Obispo, for 40.6 mi. liquid asphalt furn. and applied to existing roadbed between one mi. east of Pozo and Kern County line, in SAN LUIS OBISPO COUNTY, Calif. 5-4

VALLEJO, CALIF.—To A. G. Raisch, 1 DeHaro St., San Francisco, $123,-096, by City Clerk, City Hall, Vallejo, for repaving portions of Georgia, El Dorado, Napa, York, Sonoma, Marin, Florida and Tennessee streets, in Vallejo. 5-22

DENVER, COLO.—To Henry Shore, P. O. Box 658, Grand Junction, Colo., $63,855, by State Highway Dept., Denver, Colo., for 1.325 mi. grading and gravel surfac. on S. H. No. 13, betw. Meeker and Rifle in RIA BLANCO COUNTY, Colo. Com. FAP 187-B & 282-BR. 5-22

BOISE, IDAHO—Contracts awarded as follows by Comm. of Public Works, Boise, Idaho, for: (1) NEZ PERCE COUNTY—(WPSO 223)—To Morrison-Knudsen Co., Boise, Idaho, $46,113, for 5.445 mi. grad. and surf., etc., on Reubens-Melrose Road betw. Reubens and Melrose. (2) NEZ PERCE COUNTY—(WPSS 196)—To James Crick, 3104 N. Monroe St., Spokane, Wn., $83,663, for 2.897 mi. grad., crushed rock surf., etc., on Arrow-Deary Highway, from Arrow north. 5-11

BOISE, IDAHO—To Quinn-Robbins Co., Boise, Idaho, $59,985, by Comm. of Public Works, Boise, for 6.172 mi. grad. and grav. surf. on Payette-Emmett Highway, PAYETTE COUNTY, Idaho. 5-18

BOISE, IDAHO—To A. O. Thorn, Springville, Utah, $37,464, by Comm. of Public Works, Boise, Idaho, for 4.198 mi. grad., drain, 35-ft. timber bridge and surfacing on Burley-Paul Road, between Burley and Paul in CASSIA and MINIDOKA COUNTIES, Idaho, under Project No. WPSO 219-A & WPMS 219-B. 5-18

HELENA, MONT.—Contracts awarded as follows by State Highway Comm., Capitol Bldg., Helena, Montana, for: (1) LAKE COUNTY (NRS 102-E)—To C & F Teaming & Trucking Co., Butte, $35,548, for 2.667 mi. grad. and surf., etc., on Sec. E of the Flathead Lake E. Shore Road. (2) YELLOWSTONE COUNTY (NRS 296-B)—To C & F Teaming & Trucking Co., Butte, Mont., $34,265, for 5.094 mi. grad. and surf., etc., on Sec. B Billings-Broadview Rd. (3) PRAIRIE COUNTY (NRS 302-A Unit 2 and Unit B 3)—To Woodward & Johnson, Chinook, Montana, $28,788, for 11.383 mi. regrading, resurf., etc., on Sec. A and B of Terry-Brockway Road. (4) ROSEBUD COUNTY (WPSO-362)—To Frank J. Haas, Harrison, Montana, $42,488, for 2.587 mi. grading and surfacing, etc., on Colstrip-Lame Deer Road. 5-11

HELENA, MONT.—Contracts awarded as follows by the State Highway Comm., Capitol Bldg., Helena, Montana, for: (1) POWDER RIVER COUNTY—(NRH-334, A Units 1 and 2)—To Martin Wunderlich, 219 E. High St., Jefferson City, Mo., for 8.423 mi. grading, const. small drainage struc., and constr. of panels of treated timber pile trestle bridges on Sec. A, Crow Agency-Broadus Road, who bid $52,217. (2) STATE PROJECT ER-A4PR-317—To Charles Shannon, Butte, Montana, $26,710, for furnishing and installing six 20-ton platform scales together with grad. and surf. approach driveways at 6 different locations on State Highway. 5-11

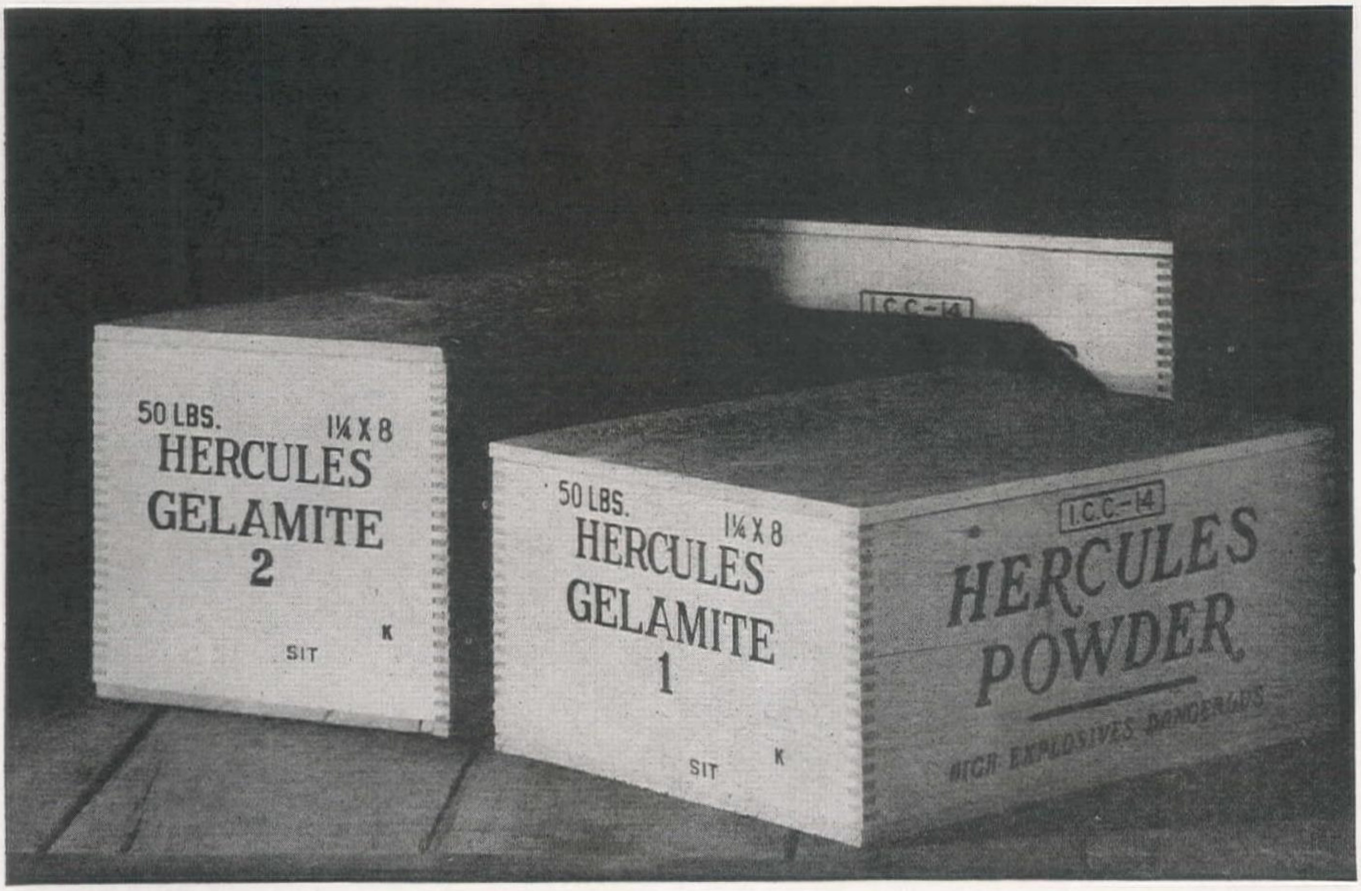
CARSON CITY, NEVADA—To Isbell Constr. Co., P. O. Box 2351, Reno, Nevada, $54,794, by Nevada Highway Comm., Carson City, Nevada, for 9.82 mi. grad. and surf. betw. Blair Jct., and 10 mi. south, Rt. 47, Sec. A, in ESMERALDA COUNTY, Nevada, WPSS 150. 5-15

CARSON CITY, NEVADA—To George French, Jr., Box 107, Stockton, $68,941, by Nevada Highway Comm., Carson City, Nevada, for 8.16 mi. cr. grav. or stone surf. betw. 15 mi. N. of Elko and Dinner Sta. in ELKO COUNTY, Nevada., WPSS 134-B. 5-16

PORTLAND, ORE.—Award recommended to C. V. Wilder, Blaine, Wash., $36,049, by Bureau of Public Roads, Portland, Oregon, for constr. or improving the south fork Stillaguamish clearing and partial grading project 7-D, Natl. Forest Road Project located in Mt. Baker National Forest, SNOHOMISH COUNTY, Washington. 5-22

PORTLAND, ORE.—Award recommended to Martin Wunderlich Co., 219 E. High St., Jefferson City, Mo., $136,582, by Bureau of Public Roads, Portland, Ore., for 5.455 mi. grad. the Glacier Natl. Park Transmountain Highway side reconstr. grad. and drain. (Avalanche Creek to Lake McDonald Hotel Sec.) Proj. NR-1-A, Unit 1, in Glacier Natl. Park, FLATHEAD COUNTY, Montana. 5-22

PORTLAND, ORE.—To Orino, Birkemeier & Saramel, Bonneville, Ore., $112,890, by Oregon State Comm., Portland, Oregon, for 0.83 mi. grad. and bitum. mac. surface on Bonneville-Eagle Creek Section of the Columbia River Highway, in MULTNOMAH COUNTY, Oregon, FAP 174-C and 174-D. 5-23



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PORTLAND, ORE.—Contracts awarded as follows by Oregon State Comm., Public Service Bldg., Portland, Oregon, for: (1) MULTNOMAH COUNTY—To Warren Northwest Inc., P. O. Box 5072, Portland, Ore., $92,617, for 12.53 mi. pavement planing on 3 Secs. of State Highway. (2) UMATILLA COUNTY—To Babler Bros., 2407 N.W. 28th Ave., Portland, Oregon, for 18.9 mi. oil mat surf. treatment and 7.2 mi. resurfacing on Nye Junction-Camas Valley Section of Pendleton-John Day Highway. 5-23

SALT LAKE CITY, UTAH—To B. D. Palfreyman, Provo, Utah State Road Comm., Salt Lake City, Utah, for 1.931 mi. grav. surf. road from Garden City, south, WPH 108-C, in RICH COUNTY, Utah. 5-9

SALT LAKE CITY, UTAH—To L. A. Young, Richfield, Utah, $58,871, by State Road Comm. of Utah, Salt Lake City, for 3.337 mi. gravel surfaced road between Vine St., and Draper on 9th East, WPMS No. 174 in SALT LAKE COUNTY, Utah. 5-16

OLYMPIA, WN.—Awards as follows by the Director of Highways, Olympia, Wn., for: (1) WHITMAN, GARFIELD, ADAMS and PENDOREILLE COUNTIES—To Morris Bros., Burlingame, Wn., $83,184, for 110.7 mi. const. bitum. tr. surface on State Roads No. 3, 6 and 11, Sec. 1, Colfax to Parvin Road; Sec. 2, Colfax North; Sec. 3, Dusty East; Sec. 4, Dusty to Central Ferry; Sec. 5, Dodge to Central Ferry; all on State Road No. 3; Sec. 6, Ritzville to Franklin County Line on State Road No. 11; Sec. 7, Lost Creek to Metaline Falls; Sec. 8, Metaline Falls to B. C. Line, both on State Road No. 6, State Project. (2) KLICKITAT COUNTY—To Diesel Oil Sales Co., 2155 Northlake Ave., Seattle, $18,479, for 26.2 mi. const. bitum. tr. surface on State Road No. 8, Lyle to Maryhill Junction. 5-7

OLYMPIA, WN.—Awards as follows by the Director of Highways, Olympia, Wn., for: (1) CIALIAM COUNTY—To Allen & Govan, Box 105, Olympia, $29,976, for 3.8 mi. clearing, grading and surfacing on State Road No. 9, Lake Sutherland to Elwah River. (2) OKANOGAN COUNTY—To Joslin & McAllister, 3038 E. Trent Ave., Spokane, $12,433, for manufacturing and stockpiling mineral aggregates and cr. stone surfacing on State Road No. 10, Brewster to B. C. Line, State project. (3) PACIFIC and WAHKIAKUM COUNTIES—To J. F. Forbes, 110 E. Union Ave., Olympia, $44,991, for 31.0 mi. const. bitum. tr. surface on State Road No. 12, Sec. 1, South Bend to Palix River, Sec. 2, Greenhead Slough to Bear River; Sec. 3, Johnson's Landing to Grays River Town. (4) CHELAN COUNTY—To James Cogle, 901 West Lake Ave., Seattle, $68,149, for 0.7 mi. grading and concr. paving on State Rd. No. 12, West Sunnyslope, Wilkinson Corner and Monitor Hill Revisions. (5) WHITMAN COUNTY—To Brent Sturgill Co., Marsing, Idaho, $52,499, for 3.4 mi. clearing, grading and draining on State Road No. 3, Colfax south. 5-7

PORT ORCHARD, WN.—To Diesel Oil Sales Co., 2155 Northlake Ave., Seattle, $15,502, by County Engineer, Court House, Port Orchard, Kitsap County, Wn., for improvement of the following projects: (1) 3 mi. non-skid seat treatment on Port Orchard-Horse Shoe Lake Road and 3 mi. of Permanent Highway No. 1, Annapolis to Waterman. (2) 0.9 mi. roadmix type treatment on Permanent Highway No. 1, Port Orchard to Annapolis. (3) 5 mi. bitum. surf. on Long Lake Road. (4) 8.3 mi. surf. on an alternate bid basis with either light bitum. treatment. or Road Mix type treatment of County Roads on Bainbridge Island. 5-8

SEATTLE, WN.—Contracts awarded as follows by Board of Public Works, Seattle, Washington, for: (1) To Queen City Const. Co., 603 - 18th Ave., South, Seattle, $25,830, for Paving west side of Railroad Ave. betw. Union St., South and Madison St. (2) To Northwest Const. Co., 3950 Sixth, N.W., Seattle, Wn., $5,323, for Paving 20th Ave., N.W., and other streets. 5-8

SOUTH BEND, WN.—Award to Graham Bros. & Medley, Chehalis, Wn., $8,843, by Board of Pacific County Commissioners, South Bend, Wn., for improvement of Secondary Road, Project No. 28. 5-21

Bridges and Culverts

WORK CONTEMPLATED

NEWPORT BEACH, CALIF.—Application has been made by Louis W. Briggs and J. A. Beek to U. S. Engineer Office, 751 S. Figueroa St., Los Angeles, for War Permit to construct a vehicular bridge across Harbor Island Channel, Newport Bay from Harbor Island, to the mainland northerly thereof. Bridge, with total length of 179.44 ft. is to extend betw. the proposed bulkhead lines along harbor island Channel. It is to be a fixed type structure with wooden deck supported on concrete piles, except that the central span is to be supported on timber piles. The central span will have a clear width of 20 ft. and a vertical clearance of 14.5 ft. above mean lower low water. 5-20

CALLS FOR BIDS

SACRAMENTO, CALIF.—Bids to 2 p. m., June 10, by California Division of Highways, Sacramento, Calif., for * undergrade crossing structures under the S. P. & W. P. Railroad tracks and construct 1 bridge and 2.89 mi. grade and conc. paving and plant mix surfacing on crushed run base near Niles, ALAMEDA COUNTY, Calif. Work involves: 110,000 cu. yd. excavation; 11,690 cu. yd. struc. excavation; 1,200,000 sta. yd. overhaul; 7,300 ton min. aggregate, plant mix; 2,430 cu. yd. "A" conc. std. pavement; 635 cu. yd. "B" conc. thick pavement; 853,000 lb. reinforcing steel; 7,722 cu. yd. "A" conc. structures; 365,000 lb. structural steel; 1,048,000 lb. furn. and paint struc. steel; 1,650 lin. ft. furn. tr. D. F. piles and T. P.; 4,544 lin. ft. furn. steel piles and T. P. 5-12

SACRAMENTO, CALIF.—Bids to 2 p. m., June 10, by Calif. Div. of Highways, Sacramento, for an overhead crossing over the tracks of the S. P. R.R. at Jibboom St. in City of Sacramento, SACRAMENTO COUNTY, Calif. Involving: 1,555 cu. yd. "A" concrete (struc.); 870,000 lb. carbon struc. steel; 64,000 lb. silicon struc. steel; 15,130 ft. furn. tr. D. F. piles, inc. T. P. 5-19

SAN FRANCISCO, CALIF.—Bids to 2 p. m., June 16, by Bureau of Public Roads, Federal Office Bldg., S. F., for making culvert repairs to Oglesby Canyon culvert, section A (portion) Rt. 32, Placerville-Lake Tahoe Natl. Forest Highway, EL DORADO COUNTY. Inv. 53 cy. D. conc. 5-22

BIDS RECEIVED

SAN FRANCISCO, CALIF.—Sibley Grading & Teaming Co., Ltd., 65 Lander St., S. F., $54,555, low to Dept. Public Works, S. F., for const. Harrison St. Viaduct over Beale Street. 5-6

CONTRACTS AWARDED

PHOENIX, ARIZ.—To Ken Hodgman, 714 Plymouth Road, San Marino, $44,724, by State Highway Comm., Phoenix, for const. concrete and steel bridge, grading, draining and oiling roadway, which begins at St. Johns and extends northeast about 1 mile on the St. Johns-Sanders Highway, WPSS 113-B, APACHE COUNTY. 5-9

PHOENIX, ARIZ.—To Tanner Const. Co., 10 Outwest Bldg., Phoenix, $103,995, by Arizona State Highway Comm., Phoenix, for construction of a reinforced concrete subway under the A. T. & S. F. R.R. tracks, located at Winslow, on the Winslow-Pine Highway, WPGM 107, NAVAJO COUNTY 5-9

YUMA, ARIZ.—To David H. Ryan, 1615 Fern St., San Diego, $155,447, by Bureau of Reclamation, Yuma, Arizona, for construction of a railroad bridge on Station 1029, a highway bridge at Station 1035, and the Araz Wash overchute at Station 1042 of the All-American Canal, Boulder Canyon Project, Arizona-California, Nevada, under Specification No. 665. 5-16

VANCOUVER, B. C.—Plans and specifications are being completed and call for bids will be issued in August to be opened in September, 1936, by John Anderson, Royal Bank Bldg., Vancouver, B. C., for constructing the Narrows Bridge to have 1,500 ft. main center span and 575 ft. side spans, involving 11,000 tons of steel. Estimated cost $6,000,000. 5-7

LOS ANGELES, CALIF.—To D. A. Loomis, 676 Salem St., Glendale, $17,022, by Calif. Div. of Highways, Los Angeles, for overhead crossing over A. T. & S. F. Railroad tracks, consisting of one 37 ft.; two 34 ft.; and two 8 ft. spans 1 mile north of Box Springs in RIVERSIDE COUNTY, Calif. 5-22

LOS ANGELES, CALIF.—To Alonzo J. Frazier, 952 Poplar St., Puente, $9,400, by County Board of Supervisors, Los Angeles, for a reinforced concrete and steel bridge over Eaton Wash and Lower Azusa Wash. 5-6

LOS ANGELES, CALIF.—To C. W. Wood, Box 49, Stockton, California, $175,529, by Calif. Div. of Highways, Los Angeles, for constructing a steel deck truss bridge with concrete deck across Santa Margarita River, about 2½ miles north of Oceanside, consisting of two 167 ft. 6-in. spans, two 67 ft. cantilever spans and two 30 ft. 6-in. plate girder approach spans, in SAN DIEGO COUNTY, Calif. 5-8

LOS ANGELES, CALIF.—To Bent Bros., Inc., 418 S. Pecan St., Los Angeles, $274,378, by Board of Public Works, Los Angeles, for construction of the Macy Street Subway. 5-9

LOS ANGELES, CALIF.—To E. S. and N. S. Johnson, P. O. Box 240, Pasadena, $19,000, by County Board of Supervisors, L. A., for construction of a reinforced concrete arch bridge on Camp Bonita-Prairie Forks Road, over the East Ford of the San Gabriel River, under Cash Contract No. 0B449. 5-16

SACRAMENTO, CALIF.—To Poulos & McEwen, 2522 - 17th St., Sacramento, $61,728, by Calif. Div. of Highways, Sacramento, for overhead crossing over tracks of Great Northern Railway, consisting of a steel and timber struc. with concr. deck and approx. 0.54 mi. grading and roadmix surf. roadway in LASSEN COUNTY, Calif. 5-8

SACRAMENTO, CALIF.—To Bodenhamer Const. Co., 1101 - 75th Ave., Oakland, Calif., $214,065, by Calif. Div. of Highways, Sacramento, for an undergrade crossing under S. P. & W. P. Railway tracks at San Leandro St., in Oakland, ALAMEDA COUNTY, Calif. 5-11

HELENA, MONT.—Contracts awarded as follows by State Highway Comm., Helena, Montana, for: (1) MUSSELSHELL COUNTY—(WPGH-33, Unit 3)—To Callison & Dolven, Inc., Billings, Mont., $70,886, for steel and conc. overpass over C. M. St. P. & P. Railroad tracks to be 167 ft. 9 in. long, located 1½ mi. S.W. of Roundup on Farreltown-Roundup Road. (2) MUSSELSHELL COUNTY—(FAP-33, Units 4 and 5)—To Cahill & Mooney Const. Co., Butte, $51,643, for const. a 5-span 229 ft. steel and conc. bridge over the Musselshell River, 2 mi. S.W. of Roundup, and grad. and surf. 0.332 mi. approach road. (3) PRAIRIE COUNTY—(NRS 302-A Unit 3)—To Walter Mackin, Plentywood, Mont., $24,926, for constructing a 2-span 50-ft. treated timber pile trestle bridge at Sta. 193 plus 25, and a 9-span 362-ft. 6-in. steel and treated timber pile trestle bridge over Cherry Creek, on Sec. A, of the Terry-Brockway Road. (4) MISSOULA COUNTY—(WPMS-374-B)—To Portland Bridge Co., Yeon Bldg., Portland, $154,514, for constructing a 7-span 503-ft. 2-in. steel and conc. bridge across the Missoula River on the Orange St., by-pass in Missoula, incl. grad., surf., etc., 0.127 mi. approach road along Harris St., betw. the bridge and Broadway Street. 5-11

SALT LAKE CITY, UTAH—To Bowers Building Co., 1033 S. State St., Salt Lake City, Utah, $56,527, by the Utah State Road Comm., Salt Lake City, for constr. a steel beam and concrete underpass struc. and approach under Bamberger Electric Railroad at North Farmington in DAVIS COUNTY, Utah, WPGM 136-a and WPGS 136-A and S. P. 136-A; 0.647 miles of road to be constructed. 5-9

SALT LAKE CITY, UTAH—To Clyde & Co., Springville, Utah, $39,613, by State Road Comm. of Utah, State Capitol, Salt Lake City, for constr. of conc. underpass and 0.795 mi. approach on Proj. No. WPGH 75-F at Cliff, in EMERY COUNTY, Utah. 5-16

Water Supply Systems . . . . .

WORK CONTEMPLATED

LOS ANGELES, CALIF.—Plans and specifications are being completed and bids will be received on the following approximate dates by D. P. Nicklin, purch. agent, Dept. Water & Power, Los Angeles, for construction of pipelines, pumping plants, buildings and miscellaneous work and materials. Additions and replacements to chlorinating equipment. Bids to October 1. Stone Canyon Western Ave. trunk line bids being received for pipe, etc., bids to be called on installation. 10,100 lin. ft. 52-in. steel pipeline, Havenhurst Ave., Roscoe St., to Van Owen St., bids to August 4 (pipe, valves, enamel, etc.), September 15 (installation). 765 lin. ft. 24-in. steel pipe, Inlet to Sawtelle Pressure Break Reservoir, bids to May 30 (pipe), July 10 (installation). 37,300 lin. ft. 24-in. and 36-in. steel pipe, Van Owen, Cantara and Radford streets, bids to August 4 (pipe, valves, enamel), September 15 (installation). 5,870 lin. ft. 16-in CIP Ventura Blvd. Shoup Ave., to Woodlake Ave., bids to May 29 (pipe, etc.), July 22 (installation). 14,540 lin. ft. 16-in. and 24-in. CIP, L. A. Central and 7th streets, bids to June 9 (pipe, etc.), July 22 (installation). Riverside Drive pumping plant. Bids to July 20. 1,400 lin. ft. 40-in. steel pipe, Elysian Reservoir Outlet. Bids to July 29 (pipe, etc.), Sept. 11 (installation). 2,100 lin. ft. 30-in. steel pipe—Buena Vista pump plant to San Fernando Road, bids to June 29-Aug. 5. York Blvd. pumping plant, bids to June 19. 11,530 lin. ft. steel pipe,

Ventura Blvd. to Topham St., bids to Aug. 28-Oct. 12. Los Felix pump station, bids to Aug. 15. Highland Park Tank, bids to June 19. West Hollywood Tank, bids to September 3, Mead Reservoir. Bids to June 4. Silver Lake Lower and Outlet, bids to August 15. Materials to be purchased include steel and cast iron pipe, enamel, valves, pumps, and miscellaneous items. 5-16

MARTINEZ, CALIF.—The voters of Contra Costa County, voted over 8 to 1 in favor of forming the Contra Costa County Water Dist.; comprising the cities of Martinez, Pittsburg, Antioch, Concord, Oakley and an unincorporated area. The construction of the Contra Costa Canal (a part of the Central Valley Proj.) betw. Knightsen & Port Chicago, a distance of 30 mi. at an est. cost of $2,500,000, will supply water to the dist. 5-7

SHERIDAN, WYOMING—Plans and specifications are being completed and call for bids will be issued during June to be opened at a later date by City Clerk, City Hall, Sheridan, Wyoming, for Sections "A" and "B" of municipal const. of an earthfill dam, estimated cost $60,000, and a small concrete diversion dam. Est. cost $8,500. 5-23

BIDS RECEIVED

LOS ANGELES, CALIF.—Loverich & Konjevod, 5303 N. Hartwick St., L. A., $69,619, low to purch. agent, Dept. Water & Power, L. A., for constr. of a concrete wall, fence, paving and miscell. items of work at the Hollywood Reservoir. 5-23

CONTRACTS AWARDED

LOS ANGELES, CALIF.—Award as follows by Metropolitan Water Dist., Los Angeles, for synchronous motors for Colorado River Aqueduct pumping plants, under Spec. No. 153: (1) To General Electric Co., 5201 Santa Fe Ave., L. A., $693,758, for 6 ea. motors, Gene pumping plants. (2) To Allis-Chalmers Mfg., 458 S. Spring St., L. A., $288,400, for 3 ea. motors, Iron Mountain Pumping Plant. (3) To Westinghouse Elec. & Mfg. Co., 420 S. San Pedro St., L. A., $784,562, for 6 ea. motors for Eagle Mt. and Hayfield Pumping Plants. 5-16

SAN FRANCISCO, CALIF.—To E. J. Treacy, Call Bldg., San Francisco, $50,659, by Dept. of Public Works, City Hall, San Francisco, for installation of Mission District Extension to Auxiliary Water System for fire protection. 5-20

FIRTH, IDAHO—Contract awarded, subject to PWA approval, to Niels Fugal, Pleasant Grove, Utah, $3,362, by City Clerk, Firth, Idaho, for constr. only of water distribution system. 5-11

SALEM, ORE.—Award recommended (subject to PWA approval) to Kern & Kibbe, 42 E. Salmon St., Portland, Ore., $111,590, by City Recorder, Salem, Oregon, for const. a 10,000,000 gal. capacity reinf. concrete reservoir and for furn. certain pipe and pipeline materials. 5-5

SEATTLE WN.—To Queen City Construction Co., 603 - 18th Ave., South, Seattle, Wn., $5,413, by Board of Public Works, Seattle, Wash., for laying watermains on 41st Avenue So., and other streets. 5-8

SEATTLE, WN.—Awards as follows by Board of Public Works, Seattle, Wn., for constructing a watermain on E. Marginal Way from Michigan St., to a point 1,000 ft. south of Purcell Ave., and on Michigan St., from 1st Ave. So., to E. Marginal Way: (1) To Puget Sound Mchy. Depot, 322 - 1st So., Seattle, Wn., $40.076, for SCHED. A. (2) To American Cast Iron Pipe Co., Smith-Tower, Seattle, Wn., $7,592, for SCHEDULE B. (3) To Pacific Water Works Supply Co., Inc., Atlantic St. Dock, Seattle, Wn., $1,907, for SCHEDULE C. 5-18

SHERIDAN, WYOMING—Awards as follows by City Clerk, City Hall, Sheridan, Wyo., for constructing the following water works improvements or furnishing materials for same: (1) To Basil Dean, Sheridan, $58,639 for const. settling basin, filtering plant and storage tank. (2) To Olson Mfg. Co., Boise, Idaho, $88,638, for constr. 13 mi. 16-in. steel pipeline. (3) To J. E. Crum, Casper, Wyo., $112,247, for constr. 4 conc. storage reservoirs. (4) To Barnett-Record Co., Minneapolis, $35,318, for repairs and extensions to distribution system and $9,524 for reconstructing gravity supply line. (5) To U. S. Ronde, Sheridan, $5,000, for unloading materials. (6) To U. S. Pipe & Foundry Co., Chicago, $79,000, for furn. cast iron pipe. (7) To Western Pipe & Steel Co., S. F., $238,000 for furn. steel pipe. (8) To Hendrie & Bolthoff Co., Denver, $10,000 for furn. valves and fittings. (9) To Sheridan Iron Works, Sheridan, Wyo., $4,600 for gates, culverts, etc. (10) To Pioneer Lumber Co., Sheridan, Wyo., $1,977 for paints. (11) To Colorado Builders Supply Co., Denver, $3,300, for woven wire fencing. (12) To Denver Sewer Pipe & Clay Co., Denver, $1,700 for Clay products. 5-22

Sewer Construction . . . .

CALLS FOR BIDS

DENVER, COLORADO—Bids to 11 a. m., June 10, by Manager of Improv. and Parks, City-County Bldg., Denver, Colo., for constr. of a sewage treatment plant. Est. cost $1,171,000. 5-11

BIDS RECEIVED

SAN FRANCISCO, CALIF.—A. G. Raisch, 1 DeHaro St., San Francisco, $4,884, low to Constructing Quartermaster, Fort Mason, Calif., for repairs to sewers and drainage systems at Letterman Hospital, Presidio of San Francisco, Calif. 5-20

SUNSET BEACH, CALIF.—J. C. Hickey, 320 S. Palm Ave., Alhambra, $86,998, low to Sunset Beach Sanitary District, Sunset Beach, for construction of a sewage disposal plant and sewer system. 5-20

GRAND COULEE, WN.—J. M. DeBlasio, Yakima, Wn., $13,988, low to City Clerk, Grand Coulee, Wn., for 15,770 ft. 6-in., 8-in. and 12-in. sewer pipe, fittings and manhole, and 408 ft. of flume. 5-20

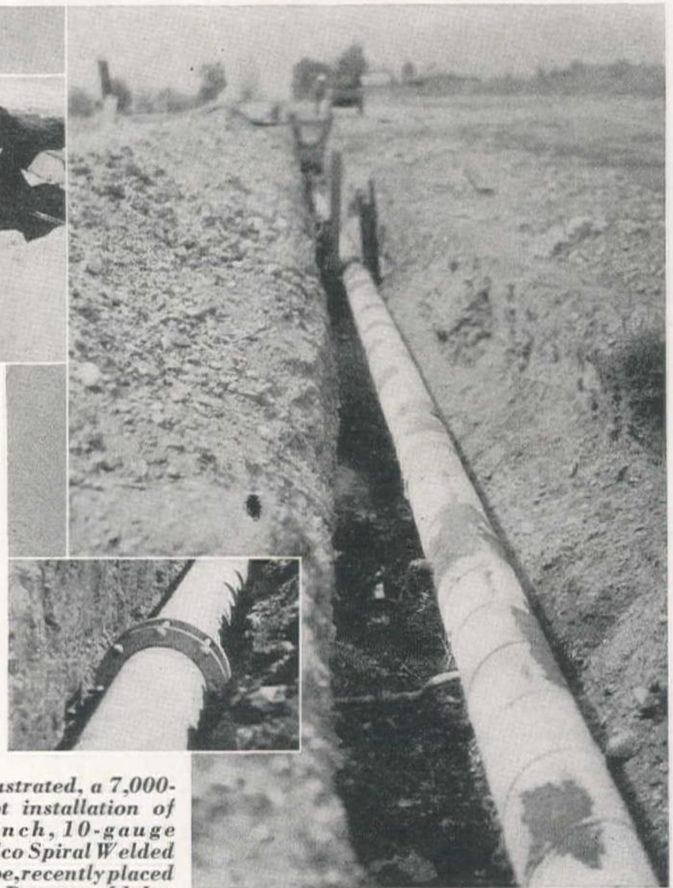
CONTRACTS AWARDED

MONTEREY PARK, CALIF.—Contract awarded, subject to PWA approval, to Case Construction Co., 905 Westminister Ave., Alhambra, $28,139, by City Clerk, Monterey Park, for construction of a pumping plant and intake and discharge lines for Sanitary Sewer System, located in and outside the city limits of Monterey Park. 5-11

SALINAS, CALIF.—To W. E. Greene, 32 Willow St., Salinas, Calif., $3,885, by City Clerk, Salinas, Calif., for constructing a pumping station and the installation of centrifugal sewage pumps in Sausal Street in City of Salinas. 5-6

SAN FRANCISCO, CALIF.—To Sibley Grading & Teaming Co., 65 Lander St., San Francisco, $122,247, by Dept. of Public Works, San Francisco,

Field joints may be welded as shown above, or made with standard couplings as shown below.



Municipalities and Water Companies Agree on

CALCO

Illustrated, a 7,000-foot installation of 8-inch, 10-gauge Calco Spiral Welded Pipe, recently placed by Downey, Idaho.

Spiral Welded Pipe

for Economy *and* Efficiency

Calco Spiral Welded Pipe (formerly known as Spi-Weld) has no laps, rivets, or projections of any kind on its inner surface, having one smooth, butt-welded spiral seam, as strong as the metal itself; that's why water flows with a minimum of friction loss. Here is a truly "stream-lined" pipe, one that reaches high efficiency in the conveyance of water. Light in weight and easily handled, its installation is simple and economical. And because it gives long, maintenance-free service, Calco Spiral Welded Pipe holds down the cost of bringing water from source to point of use. Write for interesting details of construction and names of municipalities and water companies all over the West who use Calco Spiral Welded Pipe.

CALIFORNIA CORRUGATED CULVERT CO.
Berkeley Los Angeles

THE R. HARDESTY MANUFACTURING CO.
DENVER, COLO.
Salt Lake City, Utah Pueblo, Colo.
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WESTERN METAL MFG. CO.
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WASHINGTON CORRUGATED CULVERT CO.
Formerly the
Spokane Culvert & Tank Co.
Incorporated 1910
Seattle Spokane

H. H. HAZELWOOD, Representative
P. O. Box 777, Olympia, Wash.

for constructing the Marina-North Point Discharge sewer, under Specification No. DPW 18.935. (See Unit Bid Summary.) 5-20

SEATTLE, WN.—To Queen City Construction Co., 603 - 18th Ave., South, Seattle, Wn., $2,318, by Board of Public Works, City-County Bldg., Seattle, Wn., for laying sewers in 4th Ave., South. 5-8

River and Harbor Work . . . . .

WORK CONTEMPLATED

SACRAMENTO, CALIF.—Plans and specifications have been completed and call for bids will be issued within the next few days, to be opened at a later date, by the U. S. Engineer Office, Sacramento, for 7.2 mi. levee work along easterly side of Sacramento River, from 0.3 mi. north of Moulton Weir, upstream to where the Princeton-Butte City Road crosses the east levee of the Sacramento River, under Cir. Prop. 1105-36-250. Involves 390,000 cu. yd. earth embankment. 5-20

PEARL HARBOR, T. H.—Plans and specifications are being completed and bids will be received in the early fall of 1936 by the Bureau of Yards and Docks, Navy Dept., Washington, D. C., for constructing a new floating drydock for Pearl Harbor, T. H. The drydock is to be 1,016 ft. long, 165 ft. beam, 75 ft. depth, 20 ft. width on side walls and 16 ft. depth bottom pontoon of 35,000-ton hull displacement, 50,000-ton maximum. Probably to be constructed in a building basin, but alternate bids will be received on end launching or side launching. Transverse girders will be in three parts—length of the largest is about 60 ft. with a maximum weight of 102,000 lb.; the largest plate, 56 ft. ¼-in. thick—100th inch wide, the largest shape Bethlehem H section 240 56, ft. long. The heaviest part is a complete Diesel engine with generator, weighing about 110,000 lb. Est. cost $10,000,000. 5-21

CALLS FOR BIDS

SEATTLE, WN.—Bids to 2:30 p. m., June 11, by U. S. Engineer Office, Seattle, Wn., for dredging a channel 100 ft. wide and 12 ft. deep in Swinomish Slough betw. Saratoga Passage, through LaConner into Padilla Bay, ending about 3 mi. east of Anacortes, Wn., work involves 2,235,000 cu. yd. dredging. 5-21

SEATTLE, WN.—Bids to 3 p. m., June 11, by U. S. Engineer Office, Federal Bldg., Seattle, for completing the reconstruction of the Grays Harbor south jetty, at an estimated cost of $4,000,000. Work involves: 235,000 lin. ft. douglas fir piling; 2,215 M ft. b.m. lumber; 54,500 lb. drift bolts; 111,800 lb. machine bolts and washers; 144,000 lb. boat and wire spikes; 522 ton 65 lb. rail; 16,900 railroad ties; 6 ea. turnouts complete; 84,000 lin. ft. 5-8-in. wire cable; 2,800 ea. steel straps; 5,570 ea. metal pile shoes; 7,500 ea. anti-rail creepers; 300 cu. yd. embankment; 1,290,020 ton stone in jetty. 5-16

BIDS RECEIVED

SAN FRANCISCO, CALIF.—Healy Tibbitts Constr. Co., 64 Pine St., S. F., $44,962, low to Public Utilities Comm., San Francisco, for furnishing and erecting hydraulic plants for ferry slip on Shoals Fill, Yerba Buena Island, San Francisco Bay under SHOALS CONTRACT No. 3. 5-20

CONTRACTS AWARDED

OAKLAND, CALIF.—To E. T. Lesure, 87 Ross Circle, Oakland, $49,240, by Port of Oakland, for superstructure other than structural steel frame for 270 ft. extension of Transit Shed at Outer Harbor, Oakland, Calif. 5-19

SACRAMENTO, CALIF.—To Morrison-Knudsen Co., 319 Broadway, Boise, Idaho, $204,580, by U. S. Engineer Office, Sacramento, for raising and strengthening existing levee and const. new levee along Sacramento River betw. Moulton Weir and a point ¼ mi. downstream from the bridge across the Sacramento River at Colusa, a distance of 10.3 mi. (See Unit Bid Summary). 5-12

SAN FRANCISCO, CALIF.—To Malott & Peterson, 3221 - 20th St., S. F., $25,371, by Public Utilities Comm., S. F., for P & B process covering of untreated piles in ferry slips on Yerba Buena Shoals in S. F. Bay under Contract No. 4. 5-13

SAN FRANCISCO, CALIF.—To Healy Tibbitts Construction Co., 64 Pine St., San Francisco, $331,600, by Public Utilities Comm., S. F., for one wharf for passengers (3 slips) and one freight wharf (1 slip) at Yerba Buena Shoals, under Contract No. 2. 5-13

Dam Construction . . . .

WORK CONTEMPLATED

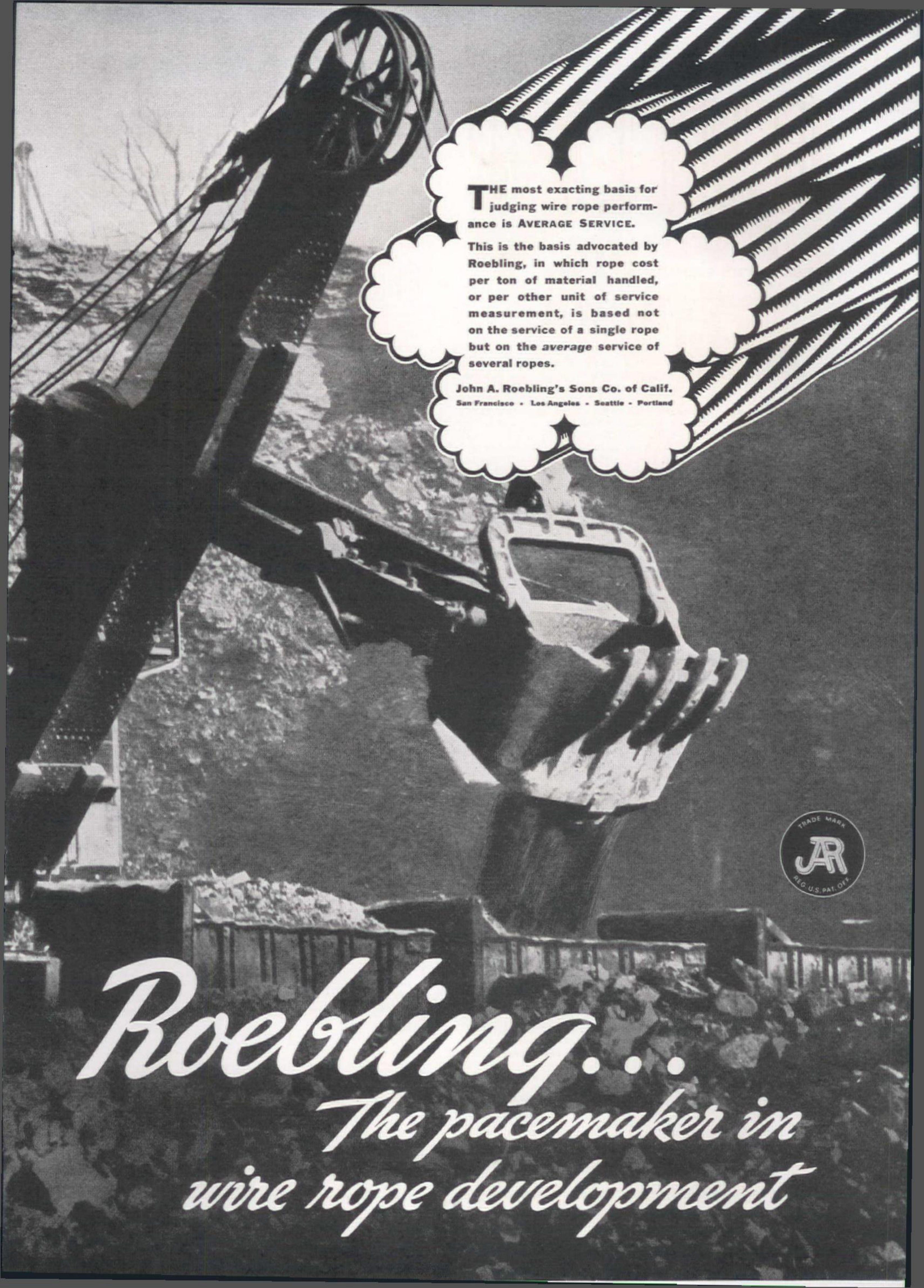
TUCUMCARI, NEW MEXICO—Plans and specifications are being completed and call for bids will be issued about June 15, to be opened at a later date by U. S. Engineer Office, P. O. Box 518, Tucumcari, N. M., for constr. of the main Conchas Dam, located across the So. Canadian River, ¼ mi. below its confluence with the Conchas River, SAN MIGUEL COUNTY, New Mexico. Dam is to be concrete gravity main section, 220 ft. high, and 1,160 ft. long, containing conduits for drainage of reservoir and an overfall spillway 300 ft. long. Work involves: 600,000 to 700,000 cu. yd. concrete and all incidental work; Circular No. 88 (Information No. 5) giving preliminary details is obtainable from above. 5-18

CALLS FOR BIDS

NATIONAL CITY, CALIF.—Bids to 10 a. m., June 10, by the California Water & Telephone Co., National City, at which time and place they will be privately opened and read, for the construction of the Judson Reservoir Dam. Work is located in Quarter Section 116 of National Ranch, about 1 mi. southeast from Chula Vista, Calif., and comprises the construction of an earthfill dam of a crest length of 690 ft. and maximum height of 60 ft. above original ground, together with appurtenant works, consisting of outlet tower, overflow structure and spillways. 5-22

BIDS RECEIVED

PHOENIX, ARIZ.—Barrett & Hilp, 918 Harrison St., San Francisco, and Macco Construction Co., 815 Paramount Blvd., Clearwater, Calif., $2,227,495, low to Bureau of Reclamation, Producers Bldg., Phoenix, Ariz., for const. of the Bartlett Dam, Salt River Valley project, Arizona, on the Verde River, about 35 mi. from Phoenix, under Spec.


THE most exacting basis for judging wire rope performance is AVERAGE SERVICE.
This is the basis advocated by Roebling, in which rope cost per ton of material handled, or per other unit of service measurement, is based not on the service of a single rope but on the *average* service of several ropes.
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No. 674. Dam will be multiple arch type, approx. 240 ft. high; 950 ft. long; 200,000 ac. ft. storage capacity. Work to start in 30 days and be completed in 1,000 days. (See Unit Bid Summary). 5-16

COLORADO SPRINGS, COLO.—Ed. Honnen, Box 391, Colorado Springs, $386,789, low to City Clerk, Colorado Springs, for constructing a granitic gravel dam, with ¼-in. electric welded steel plate face, conc. lined spillway, concrete outlet tunnel, etc., involving 340,000 cu. yd. earth fill. 5-19

CONTRACTS AWARDED

DENVER, COLO.—To United Construction Co., Winona, Minnesota, $1,041,-252, by Board of Water Comm., Denver, Colo., for constructing the Ralston Creek Dam, outlet work and spillway to be located about 20 mi. northwest of Denver, Colo. (See Unit Bid Summary.) 5-18

EL PASO, TEXAS—To Mittry Bros., 5531 Downey Road, Los Angeles, $957,018 by Bureau of Reclamation, El Paso, Texas, for construction of the Caballo Dam, Rio Grande Project, New Mexico, Texas, under Spec. 672. 5-4

Irrigation and Reclamation . .

BIDS RECEIVED

ASHTON, IDAHO—Nevada Const. Co., Nevada, Missouri, $66,490, low to Bureau of Reclamation, Ashton, Idaho, for clearing the Island Park Reservoir site, Upper Snake River project, Idaho, under Spec. No. 681. 5-6

ONTARIO, ORE.—Otis Williams & Co., Vale, Oregon, $13,551, low to Bureau of Reclamation, Ontario, Oregon, for construction of structures, North Canal laterals 45.4 to 49.4-0.0, Dead Ox Flat Div., Owyhee project, Oregon-Idaho, under Spec. No. 791-D. Work is located near Ontario, Oregon. 5-22

ONTARIO, ORE.—Morrison-Knudsen Co., Inc., Boise, Idaho, $16,421, low to Bureau of Reclamation, Ontario, Oregon, for constr. structures, North Canal laterals, N.C. 43.2 system, Dead Ox Flat Div., Owyhee project, Oregon-Idaho under Spec. No. 790-D. Work is located near Ontario, Oregon. 5-22

CONTRACTS AWARDED

LOS ANGELES, CALIF.—To Diamond Drill Constr. Co., 1825 E. Slauson Ave., Los Angeles, $8,110, by U. S. Engineer Office, Los Angeles, for drilling and coring of about 21 exploration holes aggregating about 1,080 ft. in length and performing exploratory excavation of about 200 cu. yd. material at two dam sites in Sabino Canyon, Arizona, under Project No. 614. 5-15

Railroad Construction . . . . . .

CONTRACTS AWARDED

LOS ANGELES, CALIF.—To Bennett & Taylor, 1978 S. Los Angeles St., L. A., $112,600, by General Manager, Harbor Comm., Los Angeles, for construction of a railroad electric interlocking plant at East Thenard and W. Thenard streets, LOS ANGELES, to control movement of trains over six crossings on the L. A. Municipal Terminal R.R. Belt Line track extension, Wilmington District, under Spec. No. 947. 5-8

SAN FRANCISCO, CALIF.—To Morrison-Knudsen Co., 1121 Title Guarantee Bldg., Los Angeles, by Southern Pacific Co., 65 Market St., S. F., for grading and constructing of Roadbed for Railroad line and grade change, about 1.79 mi. long, in Caliente Canyon, betw. Caliente and Ilmon Stations, KERN COUNTY, Calif., under Plan "B" involving: 190,000 cu. yd. excavation; 1,600 M gals. water. 5-14

Pipeline Construction . . . . . .

WORK CONTEMPLATED

GREAT FALLS, MONT.—The Home Oil & Refining Co., Great Falls, Mont., has completed plans for construction of a 100 mi. oil pipeline betw. the company refinery in Great Falls, and the Pondera and Cut Bank oil fields. Est. cost $675,000. 5-20

CONTRACTS AWARDED

LOS ANGELES, CALIF.—Award to Lang Transportation Co., 5501 Santa Fe Ave., L. A., by Texas Co., 929 S. Broadway, L. A., for an oil pipeline betw. Kettleman Hills and Estero Bay. Total estimated cost $1,500,000. 5-5

Miscellaneous. . . . .

BIDS RECEIVED

PORTLAND, ORE.—Winslow Marine Railway & Shipbuilding Co., Inc., Seattle, Washington, $18,397, low to Engineer Office, 306 Customhouse, Portland, Ore., for dry-docking, cleaning, painting and repairing U. S. seagoing hopper dredge CLATSOP. 5-15

S-A

Railroads, too, cut costs with S-A Conveyor Systems

Two Men Produce 150 cubic yards of Ballast per hour for Western Pacific

This plant designed and built complete by S-A Engineers for **Utah Sand and Gravel Products Corporation,** and is operating on Western Pacific lines at Sand Pass, Nevada, producing 150 cu. yds. of finished ballast per hour (count the men). The plant proper is operated and maintained by two men; a third man loads cars.

This plant uses S-A Pacific Timken carriers for the belt conveyors handling large size rock. The balance of the conveyors are S-A, Northwest carriers alemite lubricated, using either six-inch or four and one-half inch ball bearing rolls. Screen is a S-A vibrator four feet wide, nine feet long, double deck. All frames on the plant are steel built and shipped to the job ready for assembly, thus making the plant semi-portable so that it can be moved to new locations on Western Pacific lines, if the occasion requires.

1. View of complete plant, showing receiving hopper and grizzly in the foreground. Closed circuit crushing and screening section in center. Steel loading bins and stock pile in background.

2. View of crushing and screening section of plant, showing closed circuit conveyors and vibrating screen on right.

3. Two finished material conveyors running from under screen to loading tanks and waste fines conveyor running to storage on right.

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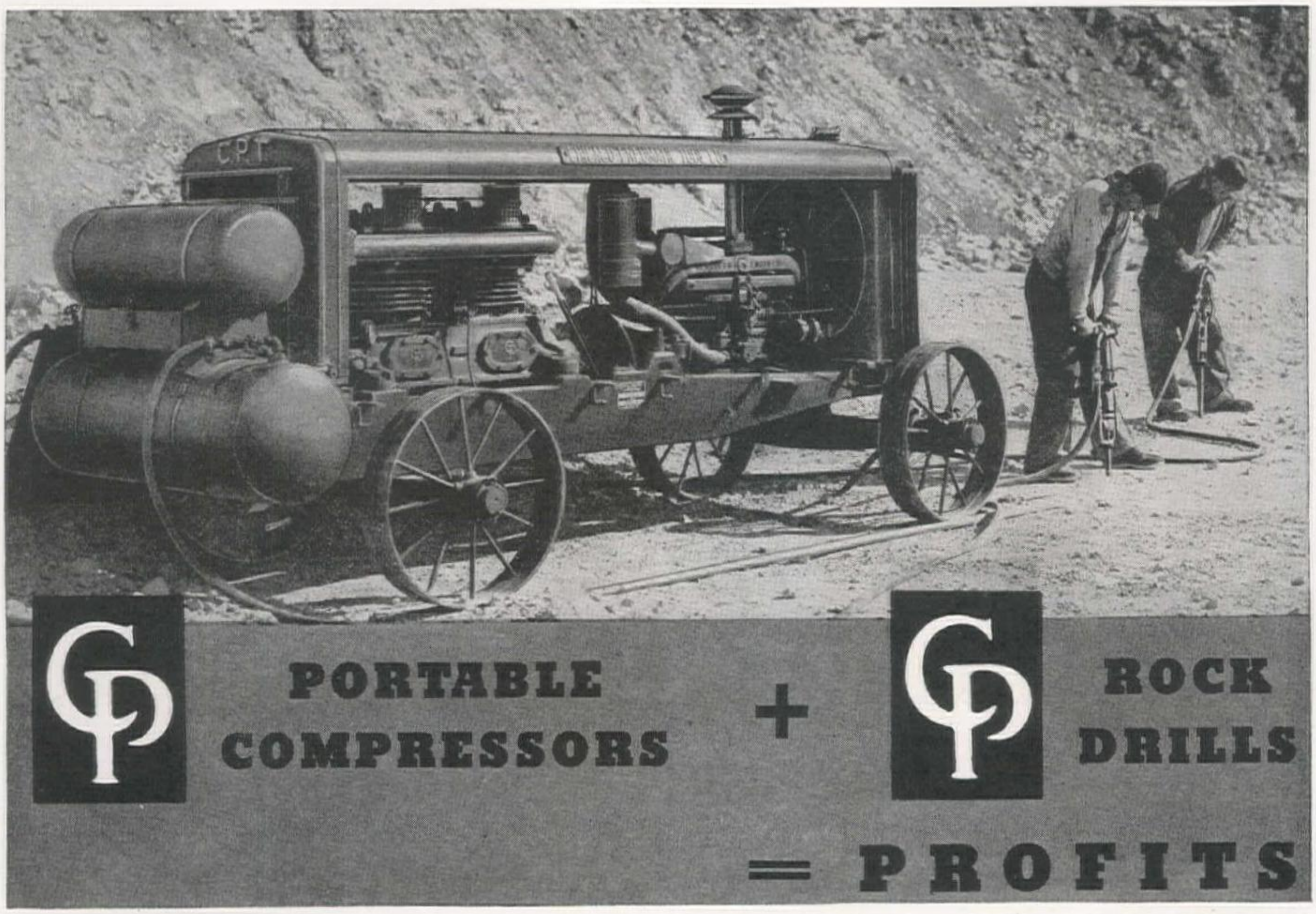

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High compressor efficiency and high drilling speed, dependability and low maintenance cost, backed by a strong service organization, enable CP Compressors and CP Drills to return profits to Contractors, Quarries and others the world over.

Write for Bulletin 758 which describes these outstanding compressors — gasoline and Diesel-driven — and for Bulletin 850 describing CP Sinker Drills.

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of Cleaning Cast Iron Pipe . . .
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Guarantees to bring Tar Coated Pipe to within 95% original coefficient of carrying capacity. Every water works superintendent should test his pipe lines for frictional loss and know definitely the cause for high operating costs. Then when trouble is ascertained, lines should be cleaned by

The National Water Main Cleaning Co.

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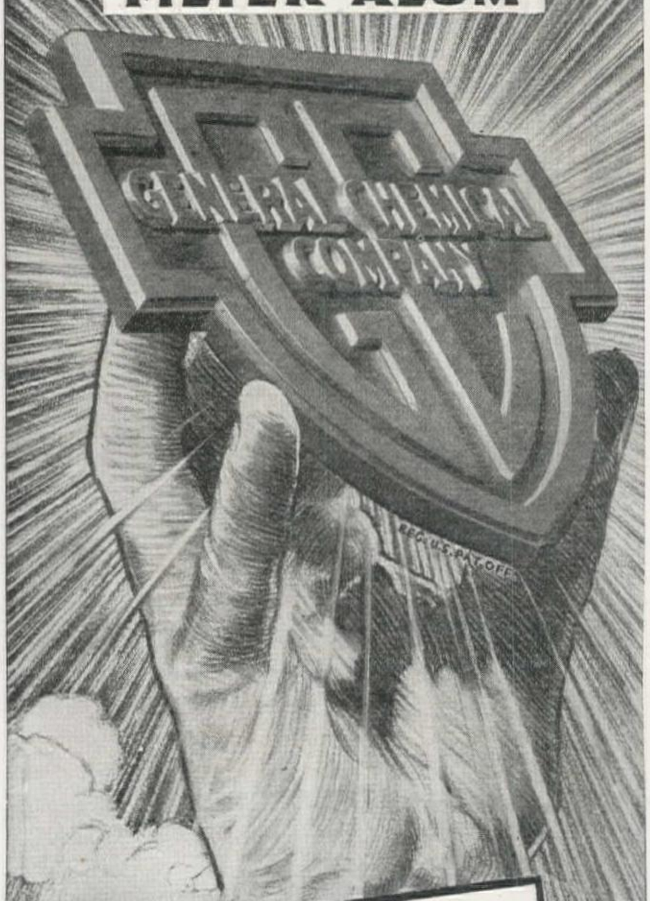

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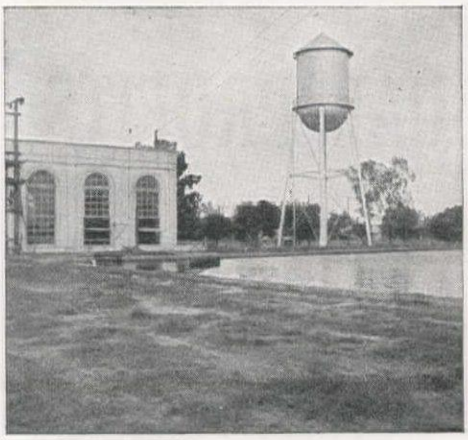
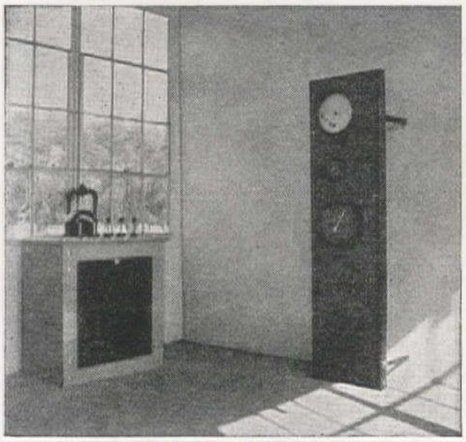
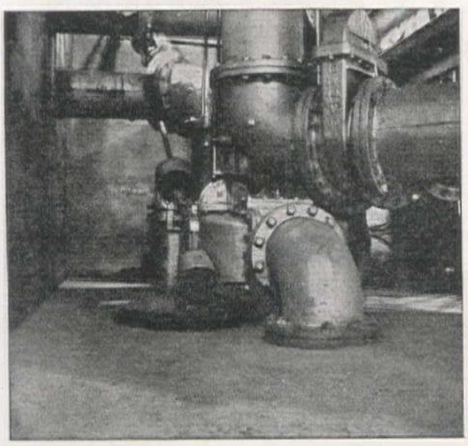
BOOTHS 17 and 18

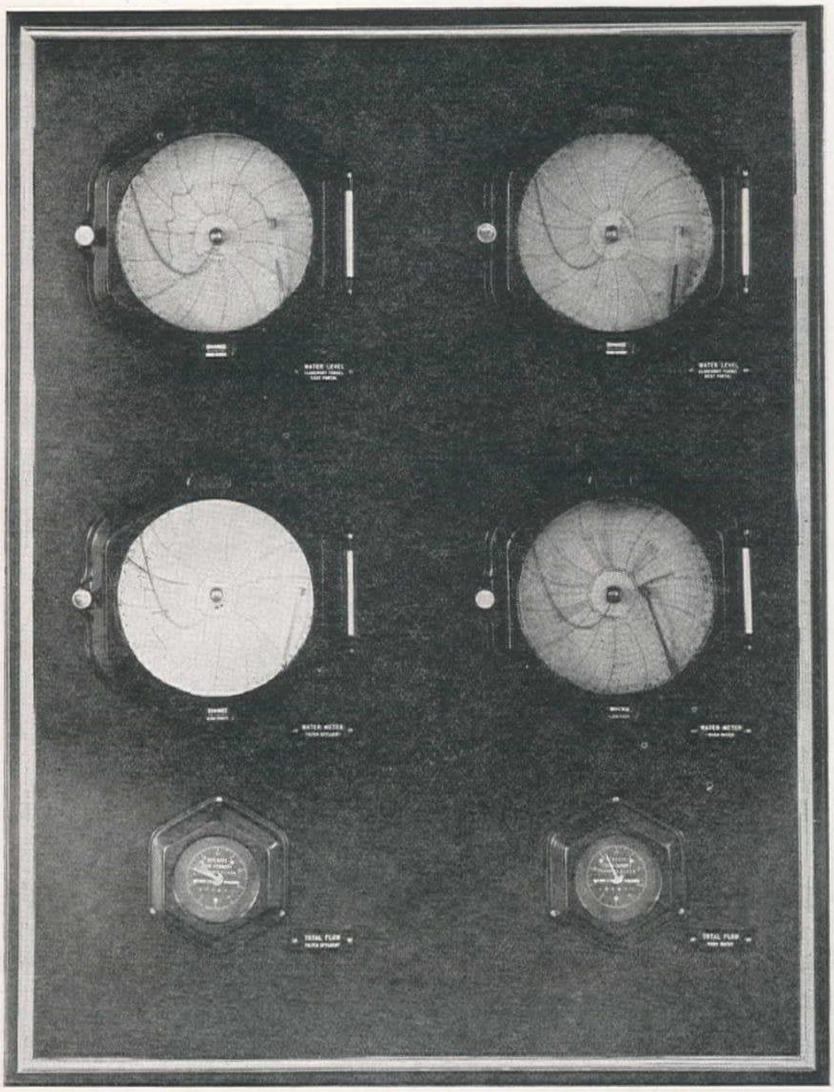
Builders men will be in Booths 17 and 18 ready to display and discuss the latest Venturi developments: a new Venturi Register-Indicator-Recorder; equipment for metering and controlling nearby or distant flows, elevated tank or reservoir levels, and gate and valve positions; new designs for sewage meters; and "Proportioneers" devices for accurately feeding chlorine or other chemicals in proportion to flow.

(Below) Three views of Brawley, California, Filtration Plant, where five Venturi Direct-Acting Controllers and a Chronoflo Register-Indicator-Recorder are installed.









Chronoflo Panel Board at Orinda Filter Plant, East Bay Municipal Utilities District, Oakland, California. Chronoflo Instruments shown: record water level at East Portal of Claremont Tunnel; at West Portal of Claremont Tunnel; record and totalize filter effluent; and record and totalize wash water flow.

West or East "Builders" means up-to-the minute water works metering and controlling equipment

At Los Angeles, Water Works men from east, west, north, and south will rub shoulders, sharing with each other experiences in the furnishing of potable drinking water to America.

From whatever State they come, they will have in common a knowledge of Venturi Metering and Controlling equipment which "Builders" has furnished to help them operate their plants more efficiently.

Illustrations on this page show some installations of late developments of Builders equipment — installed (above) at East Bay, Orinda, California, and (at left) at Brawley, California. Among many other West Coast installations in successful operation are: San Francisco, Portland, Seattle, Morris (Pine Canyon) Dam, and a group of large penstock Venturi Meters installed by Southern California Edison.

If unable to attend the convention, write for information.

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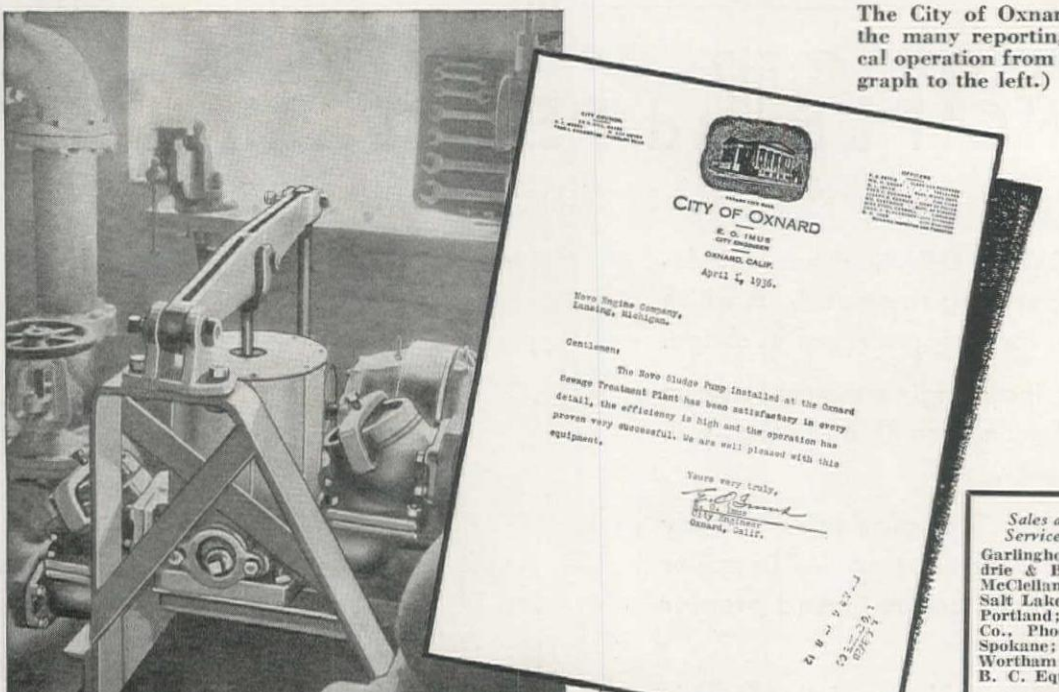
Give the Right Answer

City Engineers, Sanitary Engineers, and Consulting Engineers are finding in the Novo Roller Ring Sludge Pump the right answer to their pumping problem.

The City of Oxnard, California, is among the many reporting trouble-free, economical operation from the Novo Pump. (Photograph to the left.)



The roller ring principle employed has proven a sensational success on every installation.

It is a clean installation, economical in operation, requires less horsepower, and valves last three times as long.

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Made in the West . . . . for Use in the West

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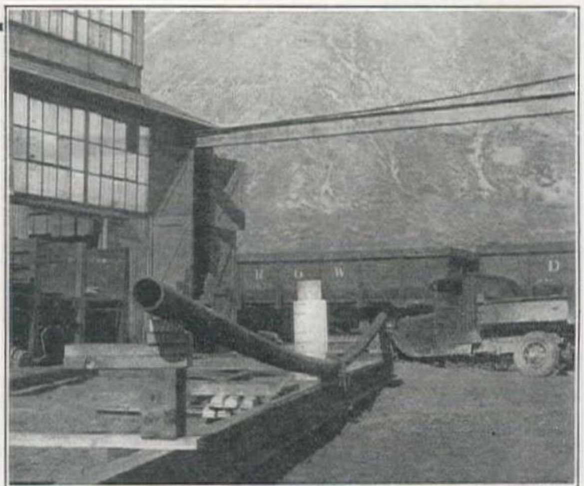

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Designed and produced by Special Engineers having 35 years' experience with America's leading makes of Valves and Hydrants. Conform to A. W. W. A. specifications in all particulars.

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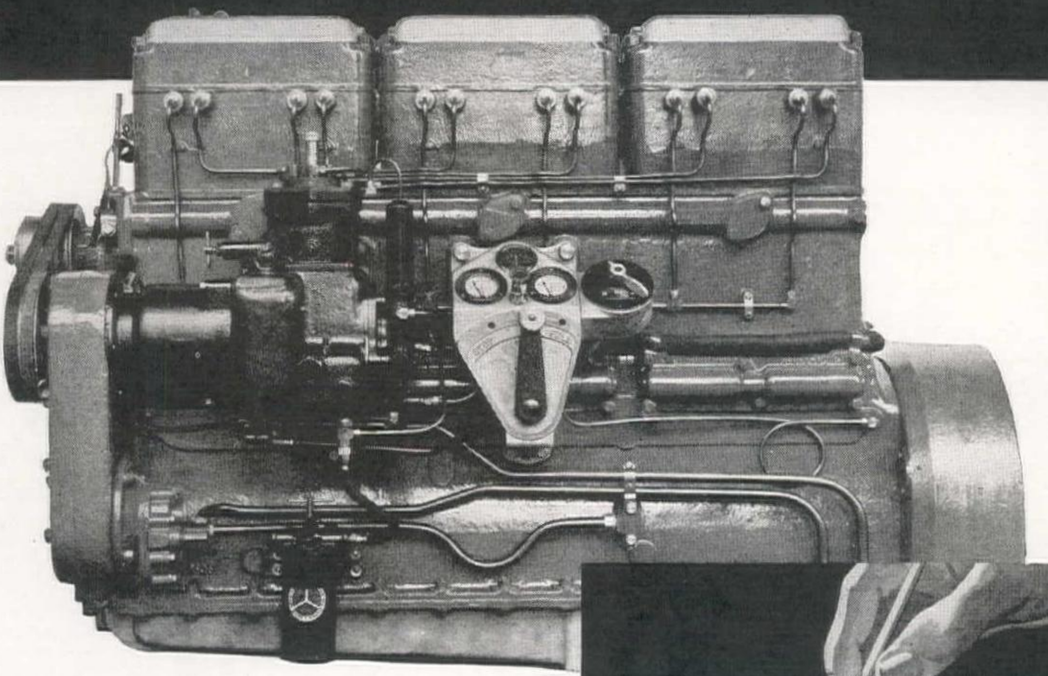
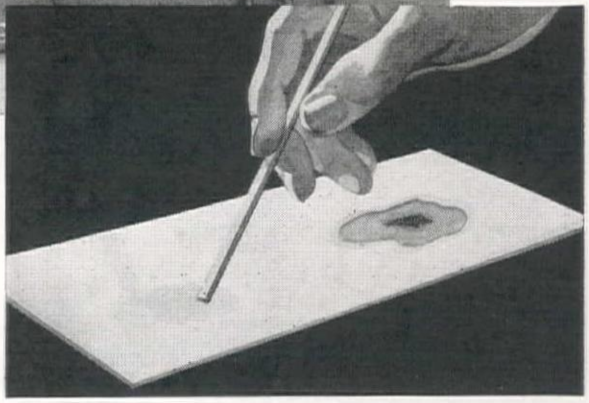
ASSOCIATED MOTOR DIESEL FUEL

pays for itself in the repairs it saves





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Use Associated Motor Diesel Fuel and end frequent overhauling. All dirt, asphaltum, gum and carbon that clog nozzle tips have been removed from this high-volatility fuel. Associated's distillation process leaves all impurities and trouble makers behind. Every metered-drop that sprays into the cylinder is pure fuel. There is nothing to gum needle-point openings, where trouble so frequently begins. In fact, Associated Motor Diesel Fuel provides excellent lubrication for close-fitting pump plungers. It protects against wear.

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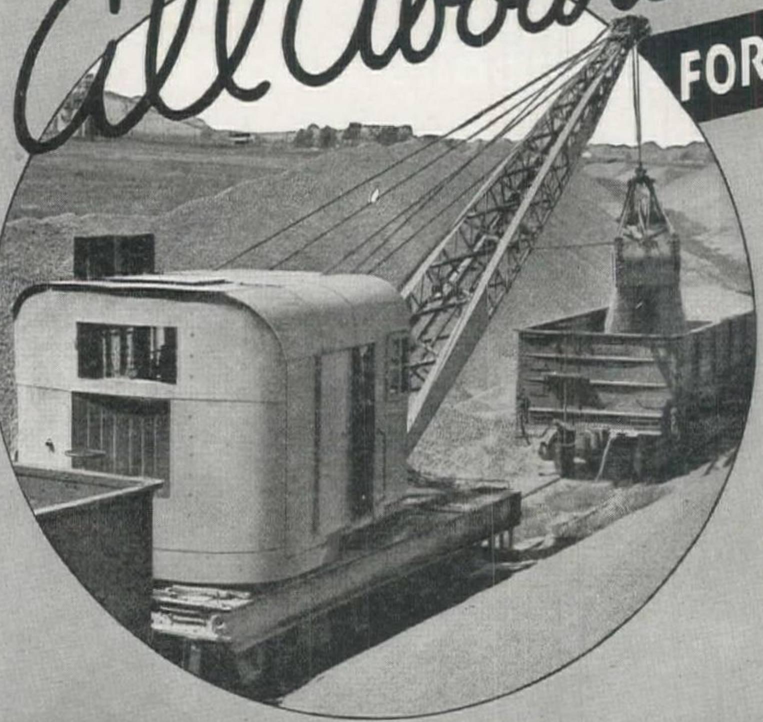
All Aboard -- FOR GOLDEN GATE BRIDGE



Practically all of the aggregate for the 260,000 cubic yards of concrete used in the Golden Gate Bridge piers and anchorage was furnished by Pacific Coast Aggregates, Inc.

Handling such a tonnage of materials is no child's play, but it was just a part of regular routine for the 26 Industrial Brownhoist Diesel and steam cranes owned by this great west coast company.

Not the least interesting part of these cranes' records is the savings effected by the modern Diesel cranes over the operating costs of the steam machines on identical work. We have this information available, if you wish it, for any type of service.

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1

2

STEEL PLATE WORK

WELDED OR RIVETED

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The accompanying pictures will give you an idea of the wide variety of work regularly being built by our organization on the Pacific Coast. The vast amount of experience we have acquired in designing, fabricating and erecting virtually every conceivable type of steel plate work is your best assurance of speed . . . quality . . . and complete satisfaction on any job you may be contemplating. Our nearest office will be glad to give you estimating data and quotations on cost—elevated storage tanks a specialty. Experienced Pacific Coast erection crews always at your service.

(1) 300,000-gal. water storage tank for Veterans Hospital at West Los Angeles. (2) 104-ft. dia. steel reservoir at McCloud, Calif.; Mt. Shasta in the background. (3) A Hortonsphere pressure holder for sewage gas at a treatment plant. (4) 100,000-gal. elevated water tank for American Can Co., at Sacramento, Calif. (5) Six 6,000-cu.-ft. ore bins at Sierra Magnesite Co. mine near Gustine, Calif. (6) 9-ft. dia. pipe for Owyhee River Siphon near Nyssa, Oregon.

4

5

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3

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6

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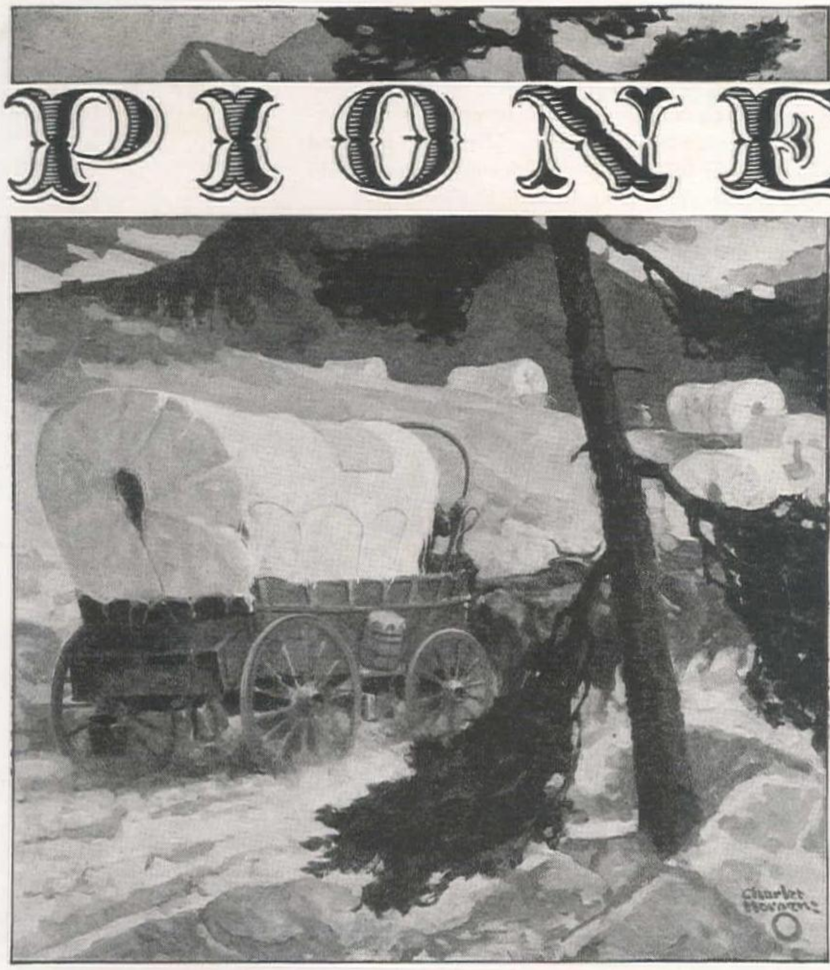

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Ferric Chloride is the most powerful dewatering agent known to condition sewage sludges for filtration, incineration, or fertilizer manufacturing. The Pennsylvania Salt Manufacturing Company offers a complete Ferric Chloride Service.

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Page Engineering Company
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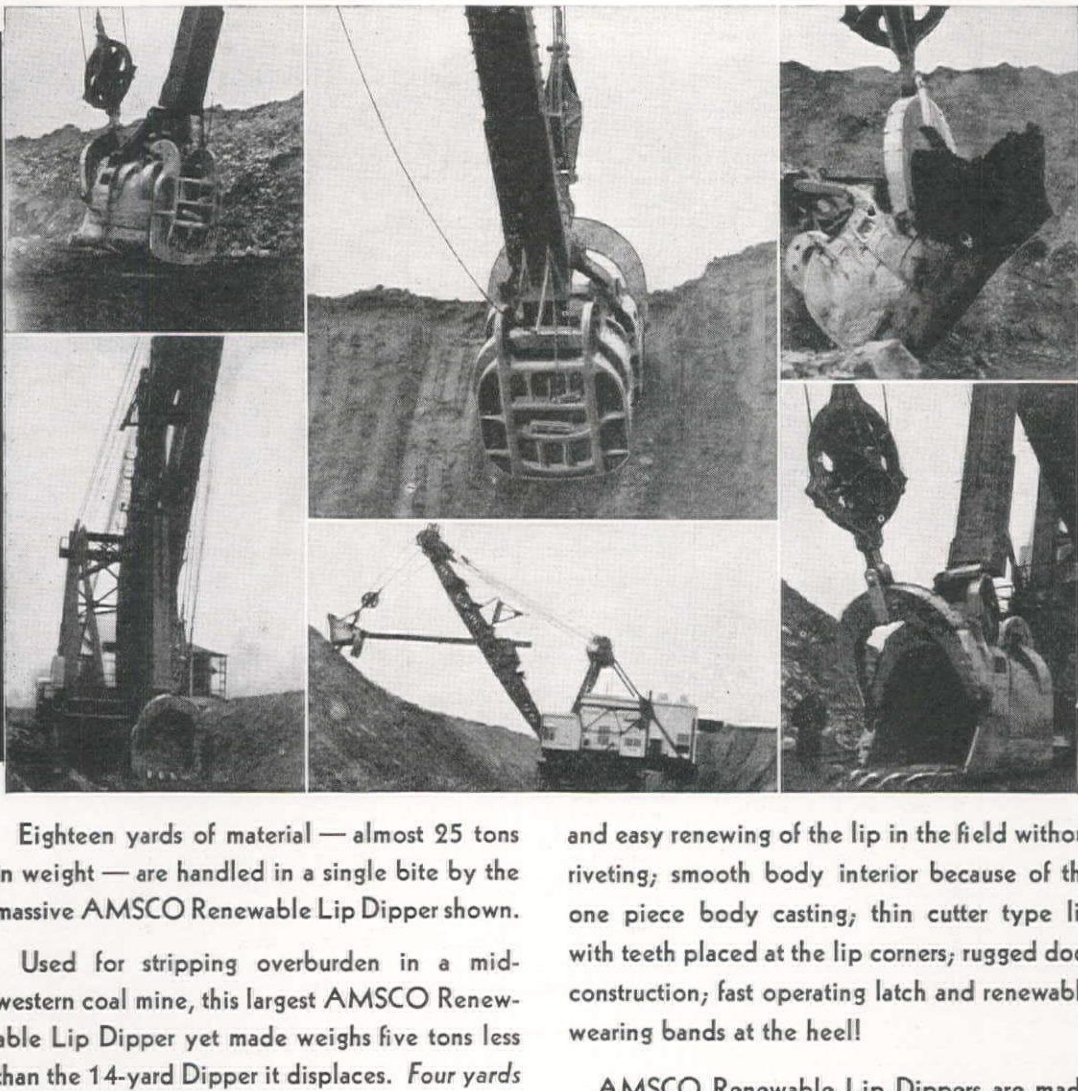
18 yards at a bite!



Eighteen yards of material — almost 25 tons in weight — are handled in a single bite by the massive AMSCO Renewable Lip Dipper shown.

Used for stripping overburden in a midwestern coal mine, this largest AMSCO Renewable Lip Dipper yet made weighs five tons less than the 14-yard Dipper it displaces. *Four yards greater capacity—five tons less dipper weight for the shovel to swing, means big savings in power required—plus a greatly increased yardage handled!*

AMSCO Renewable Lip Dippers are made in all sizes from ½ yard to 18 yards. They feature: faster filling that takes less shovel power; quicker dumping that speeds up loading; quick and easy renewing of the lip in the field without riveting; smooth body interior because of the one piece body casting; thin cutter type lip with teeth placed at the lip corners; rugged door construction; fast operating latch and renewable wearing bands at the heel!

AMSCO Renewable Lip Dippers are made for all makes of shovels with or without bail and with back lugs arranged to fit any type of dipper stick.

Write your shovel maker or our nearest office for complete details. It may cost less to buy a new AMSCO Renewable Lip Dipper than to operate your old worn dipper. Get the facts!

Another 18-yard AMSCO Dipper has just been ordered by this user!

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Screens, Vibrator
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(See Opportunity Section)

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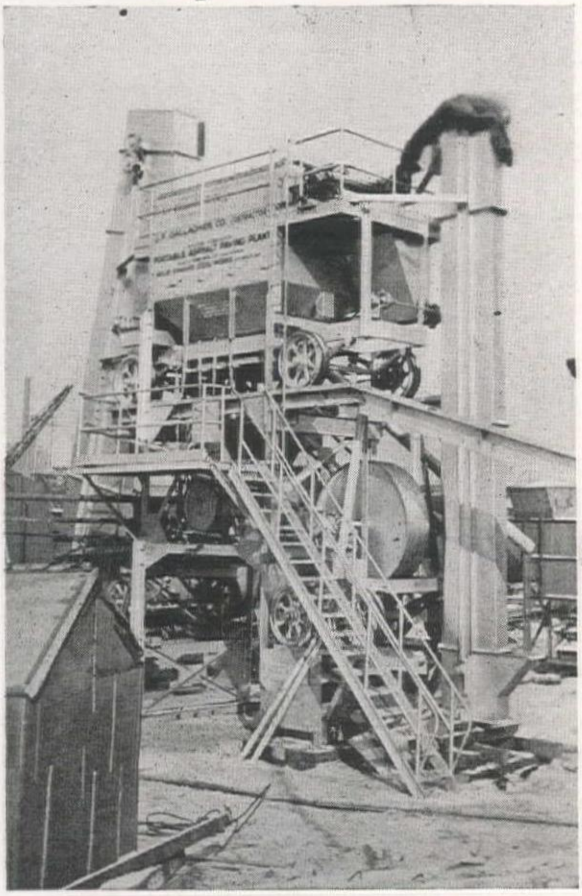

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