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FEATURED THIS ISSUE

40-hour concrete pour for
3,000-cu. yd. tremie seal

Design features for the
WASHO test road in Idaho

Breastboard jumbo supports
tunnel face with 16 jacks

How Albuquerque is paving
2,500 blocks of streets

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CONSTRUCTION

Volume 27

APRIL 1952

Number 4

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FRONT COVER

SIX YARDS OF TREMIE CONCRETE head for the bottom as Stolte & Harrelson pour a 3,000-yd. seal at the trunnion pier site for the new San Leandro Bay Bridge, a single-leaf bascule span at Alameda, Calif. Details of the 40-hr. pour, and of some precedent work, appear on pp. 59-61. *Staff photo.*

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Published Monthly by
KING PUBLICATIONS

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San Francisco 5, Calif.
Telephone YUkon 2-4343

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Single Copies, 35¢

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Entered as Second Class Matter at the
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ASHO Test Road—Lessons from failure

Engineering progress is advanced whenever destructive tests are applied to a designed structure and the results are studied. Such destructive testing is essential if the time-honored idea of economy in engineering construction is to be furthered. Over-design is never questioned as to adequacy, but sound engineering recognizes excess materials and labor as an economic waste. Some engineers go so far as to say that ten per cent of all engineering structures should fail in the interest of adding to fundamental knowledge, as well as to prove that design is running close to minimum costs. Obviously, this drastic means of destructive testing is infeasible when dealing with human lives and public property, but the principle is worthy of use in modified form.

Work is about to start on the test road sponsored by the Western Association of State Highway Officials to study basic design for bituminous roads, particularly under the impact of legal-limit and greater loads. This test road is designed to produce progressive failure so that the relationship between factors of design, loads and length of service can be evaluated. However, this very failure presents a serious problem in public relations.

Engineers are prone to become so engrossed in their work they neglect the fact that occasionally the public takes a peek over their shoulders to see what they are doing. Because the public is always interested in highway work, and with the added concern of the trucking groups, there will undoubtedly be much newspaper and general public observation of the road test. It is logical for the observations of these laymen to be based on the idea that engineers are building a road to see if it will stand up under truck traffic. Evidence of destruction will be accepted as indicating failure of the test, and so reported, unless these non-technical observers are informed otherwise. All casual visitors and particularly newspaper representatives should be properly informed on the test program and the value engineers secure from failures.

Further, the situation presents an excellent opportunity for another step in good public relations for highway engineers. It is a chance to emphasize that an occasional indication of inadequacy in highways should not be looked upon as failure but rather as a mark of proper economy. The public wants more and more miles of roads for its gas tax. By over-design the highway engineer could eliminate failures, but his objective is to produce the most miles for the gas-tax-payers' dollar. Thus the ASHO test road presents a fine opportunity to educate the public into the principle of engineering design which spends public funds wisely and without waste.

Newspapers and engineering

Just as the daily press is often inclined to help the legal profession by trying cases before the courts can act, so are the newspapers equally inclined to aid in solving engineering problems by powers of deduction and wishful thinking. It is true there are non-technical factors affecting engineering projects, but on the general adequacy of proposed work or the comparison of one against another, the engineering profession has its work complicated and rendered difficult in those cases where newspapers are inclined to decide matters that logically can be answered only after engineering study and evaluation of all physical facts.

Penalty for saving steel

Those in the steel industry who continued to advise engineers and contractors that the shortage was not going to follow the pattern pronounced by the administration must take quiet satisfaction in current developments. With restrictions being lifted on several types of construction in the coming quarter, and more steel promised in the following months the predictions that came from within the industry are proving correct. Of course structural steel is still tight, but by fall there appears evidence that steel will no longer be the bottleneck of construction. At present the most serious problem is that faced by designers who followed the wishes of the administration in trying to draw plans which conserved steel. They have acceded to the demand of the Government to cut down on critical steel, only to find that with designs completed and prepared for bidding they are in an unfortunate position. The designs they prepared might not have been their preference and it is now expensive to make changes. Thus, a penalty has been inflicted on some engineers who observed the spirit of the restrictive order.

Spring—and equipment ideas

In spite of restrictions and controls on materials the manufacturers of construction equipment and materials are providing more than their usual number of new ideas, models and designs this spring. As an indication of the continuing ingenuity and the faith of these producers in the future of construction, even under the existing restrictions, this issue carries a surprising number of announcements of new ideas and improvements on old ones. Each month the columns of the New Literature and New Equipment sections represent the market place for announcements selected by the editors to stimulate design and facilitate construction. Only as these ideas are brought to the attention of all will progress of the industry take advantage of the contributions which the producers of the equipment make available to designers and constructors.

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3,000-YD. TREMIE SEAL

Traveling on a special timber trestle 280 ft. long to reach a 64 x 98-ft. cofferdam, transit-mix trucks of Henry J. Kaiser Co. team up with Stolte & Harrelson to conduct a 40-hr. pour for the new San Leandro Bay Bridge trunnion pier

WITH THE POURING of a 3,000-cu. yd. tremie seal over a 40-hr. period, the high point was reached last February in trunnion pier construction for a single-leaf bascule bridge at Alameda, California. The large area of the trunnion pier, which will house bridge operating machinery below sea level, required a cofferdam 64 ft. wide and 98 ft. long, bracing for which was positioned as a single unit last December. Tacked over and connected to a temporary timber trestle, the steel framework also supported transit-mix trucks supplying 4 tremies for pouring the 15-ft. seal.

The new bridge spans the entrance to San Leandro Bay between metropolitan Alameda and Bay Farm Island, site of the Oakland municipal airport. It is being built by Stolte & Harrelson, a joint venture composed of Stolte, Inc., of Oakland, and The Duncanson-Harrelson Co. of Richmond, California. Replacing a 3-truss swing span built in 1881, oldest movable bridge in the state highway system, the new structure will increase the clear channel width from 120 to 92 ft., and provide a 4-lane divided roadway 58 ft. wide, plus a 6-ft. median strip, curbs and walkway. Contract for the work, \$1,631,057.80, was awarded in April 1951 and is scheduled for completion in December of this year.

Substructure

From short approach fills at north and south sides of the channel, the bridge is being built on 22 bents of concrete piles, normally 9 piles per bent, with more provided near the flaring southerly approach. Five bents at the north side lead to the trunnion pier, 16 bents at the south lead to the rest pier of the new bascule span. Altogether, 220 piles are involved, ranging in length from 72 to 100 ft. Construction last year included construction of the fills and driving most of the 24-ton piles, omitting those near the trunnion pier to maintain maneuvering room for barges in subsequent cofferdam operations. Last year saw also the driving of 370 timber piles within the cofferdam area.

Precedent excavation at the cofferdam site penetrated from El. -10 (mud line)

to El. -42, the design base for the tremie seal, which in its turn would rise 15 ft. to El. -27. An area roughly 70 x 100 ft. (at El. -42) was excavated, using both a derrick barge clamshell and suction dredging. Following this work, the 370 timber piles were driven and cut off at El. -26.5. An exception was a series of 24 piles, which were cut off at El. -19, for the reason that they were to support the cofferdam bracing.

These 24 piles, situated in pairs, constitute 12 bearing points, formed by bridging the piles with needle beams of 14-in. WF steel. These were secured by railroad spikes drifted into the piles and bent over the needle beam flanges. Timber softeners of 3 x 10-in. section topped each needle beam to receive the cofferdam bracing, maintained in position by gravity alone.

Cofferdam bracing

Since the bracing structure was to be barged into position, raised by cranes, and then lowered onto its pile bearing points, it was built on barges to begin with. Two of these were required to accommodate the 145-ton assembly, fabricated at Duncanson-Harrelson's Richmond yard by the structural steel subcontractor, Judson Pacific-Murphy Corp. of Emeryville. The framework is 63 ft., 10 in. wide, 98 ft., 4 in. long, and 22 ft. high, built in three levels. Bottom wales are 24 WF 100 steel, intermediate wales are 18 WF 96, and top wales are 10 WF 49. These divide the framework into upper and lower bays that are each 11 ft. high. Columns are 10 WF 22.9 steel. Auxiliary bracing, as needed, and diagonal members are composed of both 10 WF 22.9 steel and doubled angles. In plan, the structure is divided into 28 bays, 4 wide and 7 long. Transversely, the outer bays are 16 ft., 6 in. wide, the central ones 15 ft. Longitudinally, the end bays are 13 ft., 9 in. long, the others 14 ft. All connections are bolted to permit economical salvage at the close of the work.

As a part of the special construction facilitating the coming tremie seal pour, a narrow timber trestle was constructed to the east of the new bridge alignment, projecting 280 ft. from the northerly

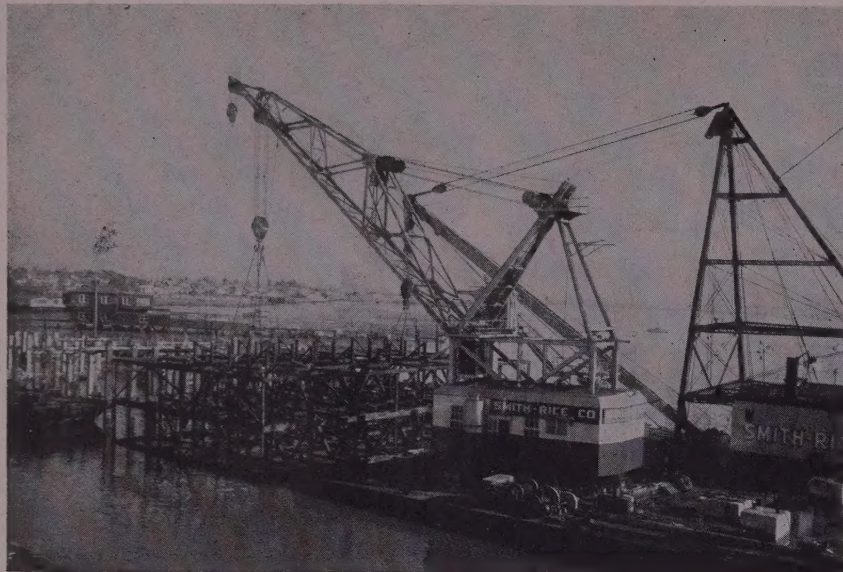


approach fill to the trunnion pier cofferdam site. The trestle is 16 ft. wide, constructed on timber pile bents (3 piles each) spaced at 10-ft. centers. It is the site of the contractor's office; also, in December, it provided a convenient transit point for use in "shooting in" the cofferdam bracing. For this purpose also, another point was established on the northerly approach fill, giving good angular control of the operation.

Floating cranes

The job of setting the cofferdam bracing was subcontracted to the Smith Rice Co. of San Francisco. Two floating cranes were employed for the work, each of 100-ton capacity, and on December 20 they went to work. Even with the barges aligned by transit and anchored securely, further winch adjustment of mooring lines was necessary to achieve exact positioning. After an initial lift by the two cranes, the barges were towed out and the cofferdam bracing lowered away to rest on the 12 prepared bearing points. Final alignment was checked and okayed by divers.

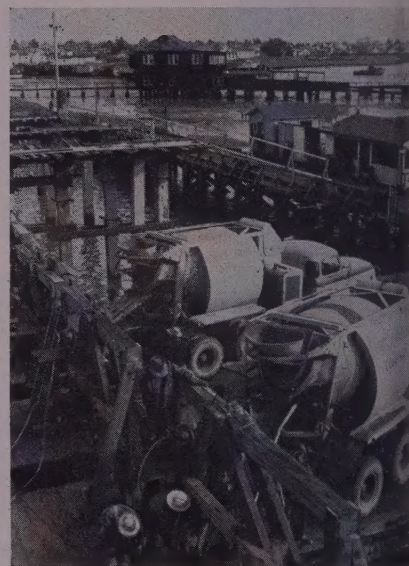
With the bracing resting at El. -19, it had a clear freeboard of 3 ft. Above its central bays, however, short steel columns rise 6 ft., 8 in., and in subsequent weeks these received a timber decking, 12 x 12-in. caps, 4 x 12-in. stringers, and 4 x 12-in. planks, giving a deck elevation of 12 ft. Over the two central lines of bays this decking was solid from end to end of the cofferdam, except for the 2 westerly bays and 2 parallel slots 3 ft. wide centered longitudinally above the



ABOVE—Cranes lower cofferdam bracing into position at site of trunnion pier. Note steel columns projecting from bracing, on which timber deck was later built.

ABOVE RIGHT—Charging a tremie, transit-mix concrete nearly fills the hopper before its weight forces a tremie plug down, displacing the column of sea water.

RIGHT—From crane employed to move these gallows frames that support tremies, contractor's trestle is seen, connecting northerly bridge approach fill to cofferdam.



remaining bays (see picture). Decking here was in the form of movable covers, so that openings might be provided for spotting the tremie pipes. Outer bays were undecked. After the cofferdam piling had been driven, a deck connection was made with the contractor's trestle, completing the access route for tremie concrete.

For the cofferdam walls, standard DP-2 sections of sheet piling 60 ft. long were used, a total of 236 at 16-in. centers around the rectangular template described by the wales of the cofferdam bracing. Coincident with pile driving, dredging was necessary to pump out about 10 ft. of mud which had drifted into the site since first excavation. The cofferdam completed, all was ready on February 18 for pouring the tremie seal.

The pour

For actual conduct of the pour, 4 gallows frames were built to support the tremie hoppers and pipes. Mounted on each was an air hoist for fast control of the block and tackle by which the tremie was suspended. By raising the tremie slightly, the hoist operator could decrease the back pressure of concrete already in place around the buried lower end of the pipe and speed up the flow of concrete being poured. Quick release of the hoist would allow the tremie to sink again between transit-mix truck loads, assuring that the tremie remained buried and that no diluting sea water entered the pipe. Two of the gallows frames were completely symmetrical and stood on the timber deck, straddling the slots over the central cofferdam bays. The outboard frames, straddling undecked bays, stood with one leg each on the deck and on the top wale of the bracing inside the cofferdam.

For charging tremies, various customs

prevail to assure positive displacement of sea water by concrete. Burlap is used, sewer balls are ideal. On this job, 26 buoyant plugs were fashioned of plywood (see cut), having rubber flanges to give a tight fit in the tremies. It was expected that each plug would rise up through the concrete as it slumped from under the tremie, break into the surrounding water, and float up for recovery. In practice this was not the case. Many plugs became waterlogged after few uses, or were hung up in the concrete, and over half were lost.

Access problem

The first four bays poured, being at the west end of the cofferdam and undecked, posed an access problem. To solve it, extra hoppers and chutes were used. In all subsequent locations, the transit-mix trucks were able to discharge directly into the tremie hoppers. Concrete was poured at the outset (8:00 a. m. on February 18) into the central bays at the west end of the cofferdam. From these positions, concrete slumped to each side and also toward the opposite end of the cofferdam, and the pouring continued until soundings showed concrete to El. -33. To fill in above this elevation to El. -27, concrete flowed in from tremies suspended above the corner bays. After satisfactory depth of seal had been gained clear across the west end, the operation proceeded easterly, concrete being poured first in the outboard bays as the gallows frames were advanced. Center-bay concrete was poured to fill in as necessary. A slope of 15 to 1 was estimated for fresh concrete in the immediate vicinity of the tremies, steepening at the extremes of the mass. Concrete was first detected in the north-east corner of the cofferdam on the second morning, February 19, when the

nearest point of pour was some 42 ft. to the west and the operation still had 1 hr. to go.

The tremies, suspended from the gallows frames, were each 14 in. in diameter, actually pipe pile sections of steel $\frac{1}{4}$ in. thick. For the first pouring on the west, the two central tremies were 47 ft. long. Later, when they were being raised and moved into adjoining bays, they were burned off to a length of 40 ft., the same as the other two tremies.

Between cofferdam bays the tremie had to be lifted completely clear of all bracing, using a 35-ton floating crane provided by Duncanson-Harrelson. For this work each tremie was "two blocked and secured to its gallows frame by passing a chain sling. The air hoist could then be uncoupled and the hose thrown clear, leaving the gallows frame and attached tremie an independent unit for handling by the crane (see pictures).

Transit-mix concrete was scheduled from two plants of Henry J. Kaiser Co. the Fifth Avenue plant in Oakland and the San Lorenzo plant. For tremie pouring, the mix was sanded to give an al

Progress of pouring of the tremie seal

Time	Cu. yd. in previous hour	Total cu. yd. in place
February 18		
8 AM	0	0
9	42	42
10	94½	136½
11	75	211½
12 Noon	93	304½
1 PM	70½	375
2	87	462
3	93	555
4	79½	634½
5	75	709½
6	75	784½
7	87	871½
8	82½	954
9	61½	1,015½
10	63	1,078½
11	87	1,165½
12 Midnight	73½	1,239

February 19

1 AM	60	1,299
2	93	1,392
3	58½	1,450½
4	76½	1,527
5	81	1,608
6	76½	1,684½
7	76½	1,761
8	82½	1,843½
9	82½	1,926
10	79½	2,005½
11	87	2,092½
12 Noon	84	2,176½
1 PM	85½	2,262
2	99	2,361
3	81	2,442
4	78	2,520
5	88½	2,608½
6	76½	2,685
7	79½	2,764½
8	66	2,830½
9	75	2,905½
10	49½	2,955
11	30	2,985
12 Midnight	24	3,009

able 6- to 8-in. slump. The ideal curing conditions underwater, however, are estimated to result in a 3,000-psi concrete. No admixtures were used. Twelve trucks were initially involved, 4½ cu. yd. capacity from Oakland and 4½-yd. capacity from San Lorenzo. Shortly after starting the pour, the number of trucks was increased to 14, 8 from the former plant and 6 from the latter, and it remained until completion of the operation at 11:45 p. m. on February 19. Total time was 39 hr., 45 min.; total yardage was 3,008.

The Oakland trucks, traveling 4.74 mi. and from the plant averaged 17.4 min. outward bound, with 9.1 min. at the pouring site. The return trip and loading at the plant, together, averaged 26 min. For San Lorenzo trucks, the total cycle time was 61.8 min., including 8 min. on the job. The trip to the job averaged 9.45 mi. and required an average 24.6 min. For returning empty, however, the trucks were able to use the existing bridge between Alameda and Bay Farm Island (posted for 12 tons), thereby shortening the distance to 8.28 mi. The return time, including time at the plant, averaged 29.0 min.

Observations during both mornings of the operation showed that two trucks

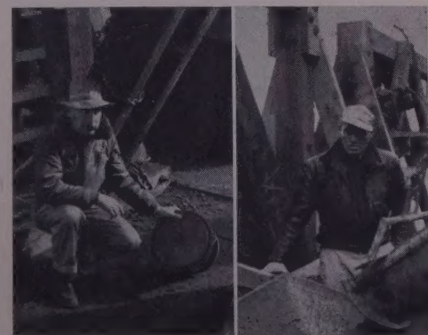
were actually delivering at all times. This meant usually that a third one, loaded, had a short wait before it might be accommodated. Stolte & Harrelson were prepared to handle a maximum of 100 cu. yd. per hr. Actually, the high rate of delivery, achieved the second afternoon, was 99 cu. yd. The low point, late at night, was 58½. The overall average rate was 77 cu. yd. per hr., as shown by the accompanying tabulation. This average was significantly dragged down during the last three hours by congestion at the east end of the cofferdam and by the need for careful control of the "topping off" pours. Overall average for the 2,830½ cu. yd. placed in the first 36 hr. was 78½ cu. yd. per hr.

Cofferdam completion steps

With one of the longest continuous tremie seal pours in the San Francisco Bay area completed, the contractor had remaining before him the following principal items of work involving the cofferdam and its bracing:

1. Unwatering.
2. Transfer of the cofferdam bracing weight from its pile bearing points to steel columns based on the tremie seal, at El. -27.
3. Cut off of timber piles within the cofferdam and placement of a reinforced concrete foundation slab 7 ft. thick

BUOYANT plywood tremie plugs separated first tremie concrete charges from sea water below. State bridge department engineer Guy Mancarti, shown at left with one of the plugs, reported 50% losses of the plugs during the operation. At right is "Buck" Fink, superintendent for Stolte & Harrelson during the 40-hr. pour.



ABOVE—Secured by a chain sling to its gallows frame, a tremie is lowered by crane into its new position as the pour progresses eastward.

RIGHT—Swung aloft by 35-ton crane, this tremie and frame is controlled by tagline in spotting over its new position.



above the tremie seal for the pier.

4. Forming of trunnion pier walls within the cofferdam, and pouring of trunnion pier walls. Horizontal cofferdam bracing will pass through these forms and the concrete poured.

5. Stripping of trunnion pier wall forms. Wood blocking will then be wedged between the bare walls and the cofferdam itself, taking all lateral loads off the steel bracing.

6. Cutting of steel cofferdam bracing where it passes through the pier walls and patching of the concrete at these points.

7. Flooding of the cofferdam, water entering only the annular space between trunnion pier walls and the cofferdam sheet piling.

8. Removal of sheet piling and dismantling of the steel cofferdam bracing, leaving in place only the structural concrete cell of the trunnion pier, ready to receive its machinery and other operating appurtenances of the bascule span to follow.

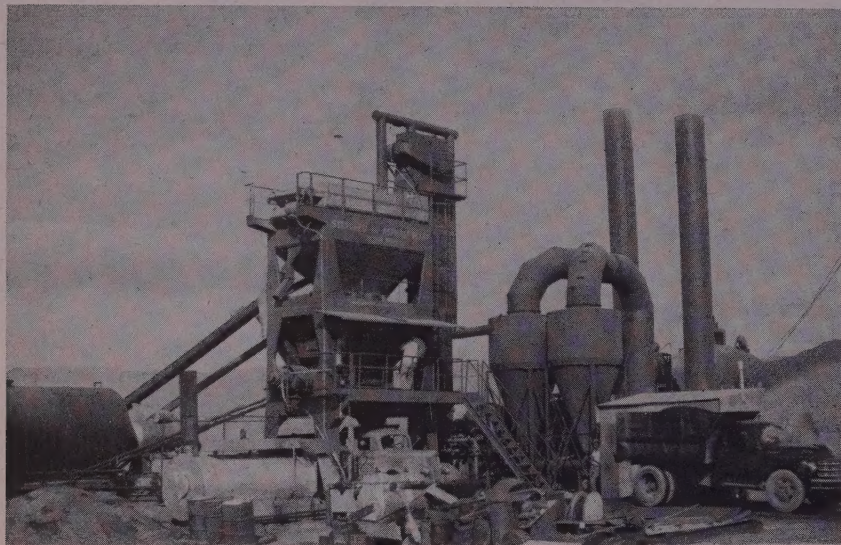
Personnel

Known as the San Leandro Bay bridge to the bridge department of California's Division of Highways, the project has J. E. Burke as resident engineer, assisted by E. R. Higgins and (until March) Guy D. Mancarti. On the job for the Division of Highways is M. O. Clemens. For Stolte & Harrelson, the project manager is C. T. Morton, and the superintendent is G. W. "Buck" Fink. Engineers for the contractor are R. F. Dashiell, Bob Newton, and (until March) M. W. Milot. Foremen are Anton Grevstad, Ernie Burgstahler, and E. E. "Curly" Lewis. George Mitchell supervised crane operations for Smith Rice Co. when the cofferdam bracing was positioned last December.

The pour was marked by a single personnel casualty, that of a transit-mix truck driver from the Oakland plant of Henry J. Kaiser Co. Late at night on February 18 he left his cab to control the discharge of concrete from his truck and literally "walked off" the deck into the water below! He was fished out, unhurt, with a ladder.

**Population increase in Albuquerque of 174%
in 1940-50 decade results in —**

High-gear street paving program



City out-grew its street system in expanding from an area of 20 to 56 sq. mi. — Work financed by paving districts—Asphalt surfacing designed with 3-in. base course and 1 1/2-in. top

MAJOR production unit is this 4,000-lb. Standard Steel plant of Wylie Brothers fired by natural gas and electrically operated. The plant was set up at the gravel pit. Average haul from plants to street was 4 mi.

TO MEET a population growth of 174% in the 1940-50 decade the City of Albuquerque is carrying out a street paving program totaling 2,500 blocks. The project was active last year, with 1,383 blocks (55%) paved and will be completed this season, following a suspension during January and February because of weather conditions. Financing is through paving districts with the contractors paid in 10-year coupon bonds backed by the property in each district.

Problem of growth

Albuquerque, New Mexico, has grown in population from 35,448 (1940 census) to 97,012 (1950 census), an increase of 61,564 in ten years. The metropolitan area is now estimated to have a population of 146,000, and the area of the city has increased from approximately 20 sq. mi. to 56 sq. mi. in this same period. The

last paving program of any size ended in 1929. Since that time the only paving that has been done has been block-to-block paving by city forces. The small asphalt plant belonging to the city is used mainly for patching work.

From these figures it can readily be seen that the city was outgrowing its existing paved streets. In the spring of 1950 the City Commission decided to embark on a major program, and it was estimated that 2,500 blocks of paving would be needed to keep pace with the expansion of the city.

Herkenhoff & Turney & Associates, consulting engineers of Albuquerque

By T. G. BROWN

Bituminous Engineer
Herkenhoff & Turney & Associates
Consulting Engineers
Albuquerque, N. Mex.

and Santa Fe, were retained as consultants by the city. Preliminary work was started in June 1950 and the first contract was let in December of the same year. With the program more than half completed, it is estimated that the remainder of the work can be finished in 1952.

Financing and contracts

The Albuquerque paving program is financed under the laws of the State of New Mexico which permit incorporate towns to form paving districts, assess benefits against the property owners for paving, curb and gutter, grading, and other incidentals. The work is paid for by the issuance to the contractor of 10-year negotiable coupon bonds at par (without supplementation by gasoline tax moneys) bearing 5% interest. The bonds are issued after the work has been completed and accepted by the city and

Summary of total cost by dates, contractors, total bids and unit prices on paving

Date of Award	Contractor	Total Amount	Bids on 3-in. Base Course		Bids on 1 1/2-in. Surface Course	
			Square Yards	Unit Price*	Square Yards	Unit Price†
December 18, 1950	Allison & Haney	\$ 449,920.12	154,750	\$0.89	154,750	\$0.55
March 15, 1951	Allison & Haney	342,115.38	133,000	0.93	133,000	0.65
February 6, 1951	Wylie Brothers	362,562.54	144,850	1.09	144,850	0.60
April 13, 1951	M. M. Paul & Son	230,138.28	95,000	0.81	95,000	0.66
May 31, 1951	Allison & Haney	281,630.87	128,168	0.85	128,168	0.64
August 21, 1951	Allison & Haney	361,578.68	122,400	0.89	122,400	0.70
July 19, 1951	Wylie Brothers	292,961.34	139,200	0.81	139,200	0.57
November 27, 1951	Allison & Haney	318,159.15	104,000	0.86	104,000	0.64
September 18, 1951	Wylie Brothers	487,649.83	209,500	0.89	209,500	0.65
October 26, 1951	Allison & Haney	418,054.35	163,500	0.90	163,500	0.67
Grand Total		\$3,544,770.54	1,394,368		1,394,368	

* Average bid price by totals for 3-in. asphaltic base course was \$0.878 per sq. yd. Average bid price per sq. yd. in. was \$0.293, for base course.

† Average bid price by totals for 1 1/2-in. top course was \$0.6314 per sq. yd. Average bid price per sq. yd. in. was \$0.421, for surfacing.

er a 30-day free pay period during which the property owners has the option of making payments in cash. These bonds are not general obligation bonds; they are backed by the property of the paving district.

The cost of the paving districts, already let to contract, have varied in size from \$290,000 to \$487,000. First bids were opened Dec. 18, 1950, and the dates of award, names of contractors, and amounts of the lettings are shown in the accompanying table. Work was awarded to the low bidder in all cases. The largest number of bids received at any one letting was nine, and the least number was six.

Bid prices for base or binder course and top or surface course are itemized in another table. On a tonnage basis (all bids received on square yard basis) the cost analysis for base and top course comes:

	Tons of Hot Mix	Gallons of Asphalt
1-in. base course....	220,993	2,391,339
1/2-in. top course..	109,172	1,575,103
Totals	330,165	3,966,442

Average quantity of asphalt per ton of base course = 10.82 gal. Average quantity of asphalt per ton of top course = 15.38 gal.

The average bid price per sq. yd. of base course was \$0.878, and converted to tons, the cost equals \$5.535 per ton. Average bid price for top course was \$6.314 per sq. yd., and converted into tons, the cost per ton equals \$8.064. The average for top and base courses would be \$6.38 per ton. The unit bid price per sq. yd. for bituminous surfacing includes: aggregate, asphalt, mixing, hauling, laying, rolling, and general cleanup. Curb and gutter (438,637 lineal feet) averaged \$1.35 per lin. ft. Grading, removal of obstructions, adjusting sewer lines and manholes totaled \$773,115.

Design of the mix

There are two distinct soil conditions encountered in Albuquerque. Part of the city is located in the valley of the Rio Grande and the remainder is located on the mesa above the river. The soil in the flats along the river is sand interspersed with some clay and silt, while the soil on the mesa is made up of clay, silt, and some gravel.

At the beginning of the planning stage, a large number of soil samples were lifted and tested in the laboratory for various constants, including liquid limit, plastic limit, plastic index, per cent #200. Also California Bearing Tests were run on the various soils. The results of the soils studies revealed that a 3-in. base mix leveling or base course together with a 1 1/2-in. surface or top course would be best suited to the overall type of soil encountered. The earlier paving project (1924-29) used this combination and very good results were obtained.

The next step was to design a mix to make use of local aggregates. There is an abundance of sand and gravel located on the foot of the mesa that rises above the valley. These deposits of sand and gravel are clean, but contain little material passing the #40 sieve. This condition



TYPICAL OPERATIONS on the street. Top—One of the two Adnun machines of Allison & Haney which were often worked in tandem. Bottom—Barber-Greene operated by Wylie Brothers.

was corrected by importing fine blow sand from the nearby hills. In one of the pits used the overburden could be used to obtain the necessary #40 material.

A design study using samples from the various local pits was made by use of the Marshall Method of Design. The average characteristics of the resulting mixes are presented in a table.

Construction operations

There are four hot mix plants located in Albuquerque, but only three of them have been used in the present paving program. They are described briefly as

follows:

1—Standard Steel Plant (new 1951)—Allison & Haney.

Capacity of the pug mill is 5,000 lb. The plant is equipped with 4-bin gradation unit, oversize dryer, using natural gas for heating aggregates, and natural gas to heat oil in circulation system, which in turn heats the asphalt in storage tanks. The entire plant is electrically operated. Cold aggregate feed is of the tunnel and conveyor type. Daily capacity (8 hr.) is 1,200 tons.

2—Standard Steel Plant (new 1951)—Wylie Brothers.

Average sieve analysis and specifications for materials

Sieve size	Base Course Mix % Passing	Surface Course Mix % Passing	Albuquerque Paving Program Specifications	
			Base Course % Passing	Top Course % Passing
1 1/2"	100	—	100	—
1"	84	—	70-95	—
3/4"	75	100	55-85	100
1/2"	—	88	—	82-100
3/8"	—	81	—	68-90
#4	48	67	30-60	50-79
#10	—	52	—	36-67
#40	20	28	10-30	17-44
#80	—	17	—	9-29
#200	6	6	3-10	3-8
% of 85-100 penetration asphalt by total weight.....	4.8	6.3	4.5-6.5	5.0-7.5

NOTE: 100-120 asphalt used in base course on several contracts, but later 85-100 used in both base and top courses.

The capacity of the pug mill is 4,000 lb. with 4-bin gradation unit. Standard size dryer for this capacity plant; heating facilities are the same as the Allison & Haney plant. The cold aggregate feed is of trap and pan type. Daily capacity (8 hr.) is 1,000 tons.

3—Madsen Plant (new in 1930)—M. M. Paul & Son.

The capacity of the pug mill is 3,000 lb., with standard dryer, 3-bin gradation unit. The aggregate is heated by oil and steam atomized. The plant is electrically operated. Cold aggregate feed consists of trap and pan feeder. Daily capacity (8 hr.) is 500 tons.

Combined daily output when all three plants were running was 2,700 tons. All three plants are located at gravel pits which furnished all the aggregate with the exception of filler material that was imported from the nearby hills.

The asphalt was hauled to the different plants from a central unloading point located in the south siding yards of the Santa Fe Railroad. The material in the cars was heated partly by steam furnished by the railroad company and partly by boosters. Hot mix for the various contracts was mixed at the central plants and hauled to the job in trucks. In colder weather tarps were used on all trucks. The average haul from the various plants was approximately 4 mi.

The material was spread by laydown machines on a prepared base that had received a prime coat of MC-1, using 0.3 to 0.5 gal. per sq. yd. A tack coat of RC-2 was applied to the hot mix base course where required to obtain a satisfactory bond for the top course. This tack averaged 0.15 gal. per sq. yd.

The contractors on the combined jobs used five laydown machines as follows:

Allison & Haney—2 Adnun pavers.
Wylie Brothers—1 Adnun and 1 Barber-Greene.
M. M. Paul & Son—1 Adnun.

Average Characteristics of asphalt mixes

	Base Course	Top Course
Mixing temperatures.....	280-295	280-295
Stability by Marshall Test	1700	1530
Density (theoretical maximum)	2.45	2.40
Density (average field)	93%	94%
Aggregate voids filled with asphalt	63%	72%
Voids in compacted mix	7%	6%
Marshall flow value.....	10	15
Weight per cu. ft. (compacted)(lb.)	142	141

The compression immersion test on the bituminous mix (wet-dry ratio) was 70%. It is general practice to introduce an additive to the asphalt cement when this ratio is less than 75%, especially when using siliceous materials. However, it was decided not to use the additive, but to seal the mat at a later date if stripping developed. To date there has been no evidence of stripping action.

A design mix was established for each job and all mixes were required to conform to the following range of tolerance:

Passing No. 4 and for larger sieves	plus or minus 5%
Passing No. 10 to 40 sieves inclusive	plus or minus 4%
Passing No. 80 sieve.....	plus or minus 3%
Passing No. 200 sieve.....	plus or minus 2%
Bitumen	plus or minus 0.3%
Temperature of mixture on delivery	plus or minus 20 deg.

Allison & Haney used their two Adnun pavers in tandem part of the time. Wylie Brothers used their two machines on separate streets as it was found, due to the different construction of the Adnun and Barber-Greene machines, a better job was obtained by using one type of machine on both the base and top course. M. M. Paul used his one Adnun to lay both the base and top

course. The resulting lay-down on contracts was above the average; this was due to experienced operators, good supervision, and plenty of experienced rakers.

Minimum equipment used in rolling each course of hot mix was an 8-ton tandem roller for the initial rolling and a 10-ton tandem roller for the final back rolling. When the tonnage exceeded 125 tons an hour the contract was required to place another roller on the job. This number of rollers obtained the proper compaction to maintain desired densities.

The overall calibre of the construction was very good and to date no failures either in subgrade or quality of the mix have developed.

Personnel

Herkenhoff & Turney & Associates are in charge of the entire paving program, preliminary surveys, assessment plans, tests, inspection, final computations of quantities, and final acceptance of the work. For this firm Gordon Herkenhoff is chief engineer in charge of operations; Fay Guthrie, office manager; Alfonso Delgado, chief draftsman; T. G. Brown, bituminous engineer; Fred Goldsworthy, construction engineer.

All tests were performed by the Albuquerque Testing Laboratory operated by W. C. Wagner, with Dave Loyd in direct charge as testing engineer.

The contractors' operations were directed by: Allison & Haney—Re Powell, superintendent; Wylie Brothers—Marshall Wylie, general superintendent; M. M. Paul & Son—Jack Paul, superintendent.

For the City of Albuquerque the paving program was planned and carried out by: Clyde Tingley, chairman of the city commission; C. E. Wells, city manager (retired Jan. 15, 1952); Edmund Engle, present city manager; E. Betts, city engineer.

Los Angeles contractors charge job delays and waste caused by city inspectors

WITH UNUSUAL FORTITUDE, contractors who do work for the City of Los Angeles have made a move toward eliminating inefficiency and waste resulting from high inspection costs and unnecessary delays. The charges were made in the name of the Public Improvement Contractors Association, a newly-formed association of those contractors who carry out contracts under the direction of the Los Angeles Department of Public Works. The first fireworks occurred at a luncheon sponsored by the new association to which members of the Los Angeles City Council were invited.

A number of contractors made comments at the luncheon meeting. Typical were those made by S. A. Cummings, vice president of the new organization. He described one of his own projects, for a two-block paving job, that was not passed by the city inspector for four

months. Contract cost was \$6,900, while the inspection fee turned out to be \$1,080, or 17% of the job cost. Lack of cooperation between two bureaus of the Department of Public Works was cited as the cause for this and other delays and resultant high inspection cost. These bureaus are the Bureau of Inspection and the Bureau of Engineering. Cummings claimed that there is a variation of 25% or more in the cost of doing a job for the City as compared to the County of Los Angeles.

L. J. Garrie, talking before the luncheon group, stated that "on-the-job conditions require on-the-job decision by both bureaus, but the bureaus refuse to communicate with each other orally, and the job must be shut down until written change orders on plans and specs are received from the Bureau of Engineering and transmitted to the Bureau of Inspection, and thence to the

contractor." According to press reports the relationship between the two bureaus is the result of political squabbling between Mayor Bowron of Los Angeles and Lloyd Aldrich, City Engineer, who opposed Bowron in the last mayoral election.

Some contractors were quoted as saying they refuse to bid on city jobs because the high inspection costs and possible delays make the work too unpredictable, and crews sometimes refuse to work on city projects. One casual company reportedly has notified the Board of Public Works that it would no longer bond contractors on city jobs until there is a change in the conditions under which the contractors operate.

A PILOT PLANT is soon to be constructed in Omaha, Neb., which will provide an economical means for converting sea water into drinking water. Refining Co. will build the plant, using a barometric or natural vacuum invented by Peter Jones of Los Angeles.

field work is starting. Here are details on the—

WASHO test road design features

Construction starts at the site in Idaho for the test sections of plant-mix surfacing on various depths of gravel to develop information for flexible pavement design under truck traffic

Because of its importance to the field of highway engineering in the West—and this includes country roads and city streets—the WASHO test road has wide and significant interest. During the present period just prior to the start of construction the subject has been discussed at several conferences of highway engineers. To put the basic facts on record at the start of the actual building of the road, the paper given by G. Bryce Bennett, Acting Materials Engineer, Idaho Department of Highways, before the Utah Highway Engineering Conference, is presented in slightly condensed form.—Editor

FIELD WORK on the WASHO Test Road is scheduled to start this month at the site near Malad in southeast Idaho. The program of building and testing two oval tracks built with gravel base supporting a plant-mix asphaltic surface is being sponsored by the Western Association of State Highway Officials. Construction will be carried out under a contract let to Carl E. Nelson Co. of Logan, Utah, and the technical studies during the tests will be made by the Highway Research Board. The program is designed to produce fundamental data which will aid in the design of a flexible type of pavement in the Western states, with special reference to service under truck loads.

Before outlining the features of design and construction, a brief review of the history of this important highway test program will tend to give proper credit to the sponsoring organization.

Word of history

At its March 1950 meeting in Salt Lake City the executive committee of WASHO discussed the building of a test road with flexible pavement. The subject was discussed further in the Standards Committee of AASHO in December 1950 at Miami. The annual meeting of WASHO, June 1951 at San Francisco passed a resolution setting up such a test road program. It was decided that the road should be located in either

southeast Idaho, southwest Wyoming or northern Utah. This area was considered to be representative of large areas of Western country as regards climatic and soils conditions. The Standards Committee of WASHO was then asked to pick the exact location and to draw up plans and specifications for construction. An Advisory Committee composed of one member from each participating state was appointed.

The test road is being financed by contributions from the member states of WASHO. Participating states are California, Colorado, Idaho, Nevada, New Mexico, Oregon, Texas, Utah, Washington and Wyoming. Montana and Arizona were unable to participate because of legislative restriction. Also participating will be the Bureau of Public Roads, Highway Research Board and highway users. The latter, such as the Truck Division of the Manufacturers Association and the Petroleum Industry, will furnish equipment and supplies to be used in carrying on the test.

Construction of the test section and conduct of the testing will be carried on by the Highway Research Board of the National Academy of Science. The Research Board has designated an advisory committee containing primarily the same members as the WASHO Advisory Committee plus representatives of

the petroleum industries, truck manufacturers, highway users groups and other interested groups to advise them on matters pertaining to the test.

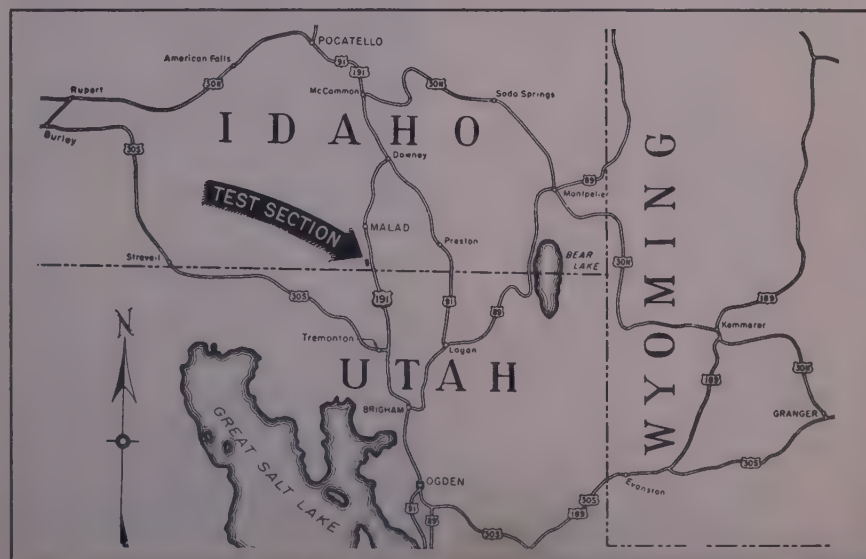
July 13 and 14, 1951 the standards committee visited the various proposed locations for the test sites—two sites in Utah, one in Wyoming and one in Idaho. The site in Idaho 2 mi. north of the Utah line and 10 mi. south of the town of Malad, on U. S. 191 was selected. It is approximately midway between Ogden, Utah, and Pocatello, Idaho.

Agreement on plans

The standards committee met in San Francisco last August and presented preliminary plans and specifications to the advisory committee for their comments. After considerable discussion and compromise the committee agreed on the primary features of a physical plan and method of procedure. Discussions of this group brought out forcibly the wide divergency of design methods and criteria among the engineers and states of the West. The plan presented by the standards committee had proposed a two-lane road with turn-arounds at each end, but after much discussion it was decided that two oval test tracks would be more efficient. The oval test track with two parallel lanes connected at the ends permits test trucks to operate practically all the time on the test sections, permits traffic to travel in one direction only, and shortens the sections providing better uniformity in subgrade soils, drainage, etc.

The general area of the site is cultivated irrigated land. Terrain is nearly level sloping on about a 1% grade across the test section. This area has an average

SITE of the test section is about midway between Ogden, Utah, and Pocatello, Idaho.



annual precipitation of 15 in., with about 1.5 in. per month from October to May and an inch or less during the summer months. Elevation is about 4,400 ft. Temperatures range from 100 in the summer to 20 below zero in the winter, and the frost line varies from 18 to 36 in., depending on the winter with an average of about 24 in. Soils are very uniform, being a clayey silt A-4 bordering on an A-6.

Determining thicknesses

Preliminary planning indicated the need for constructing the test section to present day practices of design and field work. Combined thickness of surfacing and base would be calculated by various design criteria assuming a traffic volume of 4,000 vehicles per day—1,000 commercial vehicles, 400 of which are 3-axle or heavier trucks. This design thickness would be used as a median and base thickness would be varied both ways to provide several thicknesses of base over the basement soil.

Several Western states were sent samples of the soil and the gravel to be used for base and surfacing material. Design thickness of base plus flexible pavement for the road averaged about 18 in. The advisory committee decided that five different thicknesses of base should be provided—zero, 4, 8, 12, and 16 in. of pit-run gravel base. The base is capped with a total of 6 in. of $\frac{3}{4}$ -in. crushed gravel material and asphalt pavement. Two thicknesses of asphalt plant-mix pavement are to be provided on each oval. A 2-in. asphalt pavement with 4 in. of $\frac{3}{4}$ -in. crushed gravel as base will be used on one section. The other section will have a 4-in. asphalt pavement with 2 in. of $\frac{3}{4}$ -in. crushed gravel as base.

Subgrade soil evaluation from the several states that have reported were very close: Idaho—17 in. combined surfacing and base. California—16 to 17 in. combined surfacing and base. Texas—8 to 10 in. combined surfacing and base. New Mexico—17 in. combined surfacing and base.

Estimates of failure

California Division of Highways presented a table predicting the number of passes of each type load required to produce obvious failure or measurable distortion on each portion of the test section. This estimate is based on certain assumptions as to moisture condition of the subgrade soil. The relationship shown by these figures is very interesting, assuming a saturated subgrade the number of 18,000-lb. single-axle wheel loads required to produce failure are estimated to be:

4-in. plant-mix surfacing and 2-in. base.....	28
4-in. plant-mix surfacing and 6-in. base.....	550
4-in. plant-mix surfacing and 10-in. base.....	17,000
4-in. plant-mix surfacing and 14-in. base.....	560,000
4-in. plant-mix surfacing and 18-in. base.....	28,000,000

Apparently the number of repetitions of load varies to a logarithmic scale with

GENERAL INFORMATION ABOUT THE WASHO TEST ROAD

Estimated construction cost	\$202,000
Estimated testing cost.....	\$100,000
Length of each test section.....	1,900 ft.
(Two test sections per oval)	
Total out-to-out length of test oval.....	3,200 ft.
Total distance around test oval	6,605 ft.
(Distance traveled in one trip)	
Right-of-way width 250 ft., with 395 feet at turn-arounds.	
Asphaltic road material estimate:	
Prime for plant mix, RC-1.....	0.27 gal. per sq. yd.
Mix for plant mix, 120-150 pen.....	4.8% by weight
Mix for plant mix in stockpiles, SC-3.....	4% by weight

the thickness, and tends to emphasize the difference between, say, 10-in. base and 14-in. base. A very few inches difference one way or the other may spell the difference between success or failure of a road.

Efforts for uniformity

Every effort will be made to secure uniformity during construction. The top 2 ft. of the subgrade soil will be compacted to a uniform density of not less than 90% Standard AASHO. In fills the soils used will be controlled carefully to insure uniformity under the entire test section. Grading and compaction of the pit-run gravel base will be carefully con-



G. BRYCE BENNETT, member of the Advisory Committee of WASHO, is Materials Engineer for the Idaho Department of Highways. The accompanying description of the test road design is adapted from a paper presented by Mr. Bennett at the Utah Highway Engineering Conference.

trolled also. No attempt will be made to use extra compaction or any other special construction feature. Rigid control will be exercised to provide uniformity in all phases so that two nearly identical test tracks can be obtained.

Choice of the site was excellent with regard to the soils which are extremely uniform over the area. An extensive soil survey was made and all the soils under

the test sections classify as A-4 (HR Classification). The test results indicate that the average soils has a Liquid Limit of about 35, Plastic Index of about 10 and per cent passing No. 200 sieve about 86.

The asphalt pavement on the main test section is to be constructed to Idaho Standard Specification as "Plant Mix Bituminous Surface Course," Class "C" using a 120-150 penetration asphalt cement. This specification provides that the material be mixed in a stationary plant and be laid with a paving machine. Gradation of the aggregates is controlled as follows:

$\frac{3}{4}$ -in.	100% passing
$\frac{1}{2}$ -in.	48-58% passing
No. 10	30-40% passing
No. 200	3-9% passing

In the plant operation the material is split on a $\frac{1}{4}$ -in. screen and recombined in proper proportions before being mixed. An RC-1 applied at 0.27 gal. p. sq. yd. will be used to prime the surface below the pavement. No seal is to be provided on the mat.

Testing program

The testing program will consist of running trucks of various loadings each in a separate lane until the desired degree of failure has been obtained. For truck loadings will be used: single axle loads of 18,000 and 22,400 lb., and dual axle loads of 32,000 and 40,000 lb. Speed of test trucks will probably be about 30 miles per hour.

Instrumentation is being provided to the Highway Research Board, and will include the recording of static and dynamic deflections of the surface, base and subgrade. Pressure cells and moisture cells will be placed in strategic locations. Details on the testing program will be developed later.

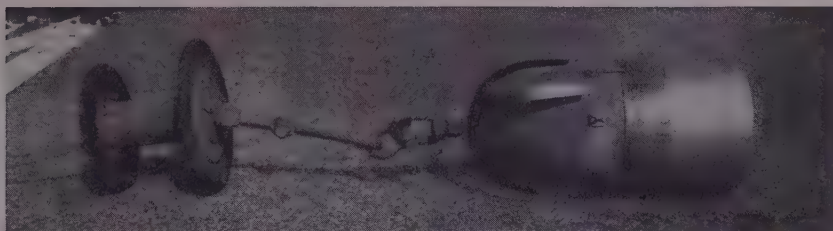
Schedule for construction and tests

It was originally hoped that construction could begin last fall and be completed before winter. A number of factors combined to prevent carrying out that schedule. However, a contract has been let to Carl E. Nelson Co. of Logan, Utah, for construction of the road. Work will begin as soon as weather permits, probably during April. Testing should begin in late summer. At present it is planned that testing will continue until winter and will be completed during the spring of 1953.

This test road is not designed to produce all the answers on asphalt pavement construction in the West. In fact it will only be a start toward the solution of many problems. It will indicate the relative stability of several roadway design thicknesses when built of certain materials and tested under controlled conditions. Information regarding progress of the test program will be released periodically by the Highway Research Board.

Should the test road fail?—and what will the public think? See our editorial discussion on page 57.

Lining a 60-year old steel pipe with this



WORKING UNDER SEVERE conditions, a concrete lining was recently placed in a 60-year-old, 14-in. in-walled steel water pipe for the City of Monrovia, Calif. The lining was placed by Pipe Linings, Inc., a subsidiary of American Pipe & Construction Co., using a method known as the "Tate" process in which a steel mandrel spreads the mortar around the inside of the pipe and dehydrates it as it is placed. About 1,000 lin. ft. of pipe was lined in this job. Originally laid in 1887 the steel pipe annually carries water at rates up to 500 gpm. from a series of wells to Monrovia's water distribution system. Since its installation the line had been in constant use and in addition to undergoing general deterioration had been subjected to pounding from heavy moving loads which caused it to become out-of-round and flattened in many places. It had developed many small leaks. Rather than replace the line, a lining would restore and provide a usable supply main.

Unusual conditions

In carrying out the lining operation the contractor encountered conditions which were far from usual for such projects. Since the line's original installation the area through which it passes had been subdivided into a residential district with relatively expensive homes surrounded by extensive landscaping. Normally this type of pipeline passes along streets or through open country, but the Monrovia line goes directly through the subdivision, passing along property lines, generally within 5 or 6 ft. of the homes, and across gardens and trees planted to shrubbery. Generally excavations for the lining operations had to be made in lawns or gardens, under the watchful eyes of homeowners. Considerable more cleanup work was required and care had to be exercised at all times to disturb no more plantings than necessary. The Monrovia Park Department carried out the task of replacing and repairing lawns and shrubbery. Getting up the lining equipment so close to the houses also limited working area.

Short lengths to be lined

Another factor not normal to such operations was the short lengths of the pipe that could be lined from a single set-up. Usually excavations are made and the line opened to permit work on 100-ft. sections in a single operation. However, when the area was subdivided

Severe conditions encountered in placing mortar lining with Tate process in a water line serving Monrovia, Calif.

curving streets were put in. At points where these streets cross the water line the pipe was cut and lowered 5 to 6 ft. below its original elevation. At such drops a short piece of pipe, ranging from 5 to 8 ft. in length, with a 45-deg. elbow at each end, was installed to connect the original line with the lowered street-crossing section.

As the lining mandrel cannot pass around such sharp angles it was necessary to cut the pipe and remove the short sections and connecting elbows. These sections were lined by hand. Because of these frequent street crossings, sections that could be lined in a single operation were held down to an average of about

CLEANING TOOL (left) for removing rust and scale. After cleaning, a proving mandrel (right) is pulled through the section to test for obstructions that would stop the lining mandrel.



180 ft. These short lengths required the contractor to move his equipment oftener and consequently added to the time required for the project. In addition to the numerous street crossings, the lengths that could be lined in a single operation were further reduced at several locations where the pipe had been flattened to such extent as to prevent the passing of the lining mandrel.

Lining operations

Steps in the lining operations consist of: (1) Excavating a section of trench and opening the pipe by removing a short piece; (2) cleaning the pipe to remove scale and rust by scraping, followed by a squeegee; (3) proving pipe's roundness to insure unobstructed movement of the lining mandrel; (4) preparing concrete and loading it in pipe; (5) lining; (6) connecting pipe and backfilling.

Two crews, one for excavation and one to do the lining were used on the project. As the excavation crew could keep well ahead of the lining gang it was also able to carry out excavation work on a similar project a short distance from Monrovia.

Working in one direction, excavations were made and the pipe opened by removal of a piece about 4 ft. long at points between which the lining could be placed in a single operation. Excavations generally were 6 ft. square and from 3 to 7 ft. deep to the bottom of the pipe. At the street crossings the piece removed would be the complete connecting section with the elbows at each end. A torch was used in cutting out the pieces of pipe.

Winch at each opening

To pull the various tools through the pipe a truck-mounted winch was established at each opening, or end of the section to be lined. By using two winches the contractor could maintain control of the cable and pull the hook back for the next step in the operation. In addition to the winch, each of the two trucks was equipped with a stiff boom used as a light crane in handling the tools. Working from the "head" end a stiff wire was pushed through the section of pipe to pick up the cable from the winch at the "tail" or pull end.

Cleaning pipe

To insure proper adhesion of the concrete and prevent further deterioration



of the inner surface of the pipe it was necessary to remove as much scale and rust as possible, and clear out water from the low spots. The tool used to scrape and clean the interior consisted of six circular disks (see photo), each disk having 14 sets of spring-steel scrapers. Each set of scrapers had three blades bent at the ends to carry out the scraping action. The six circular sections were held in line by short pieces of cable which permitted flexibility.

Squeegee removes scrapings

After the scraper had been pulled through the pipe it was removed and the cable connection returned to the head end. A squeegee, consisting of six rubber disks slightly larger in diameter than the pipe, was next connected to the cable and pulled through to remove material loosened by the scraper. As it was desirable to have the pipe reasonably dry for adherence of the concrete, the squeegee was passed through as many

SEQUENCE OF LINING

(top to bottom at left)

CLEANING OUT scrapings and water was accomplished with the rubber squeegee, shown here being inserted into pipe.

MIXING the charge of mortar calculated to line the prepared section and dumping it down hopper into pipe.

PLACING the lining mandrel into the pipe behind the charge of mortar. There is no tail-cable on this lining tool.

END OF THE PULL, showing the baffle which came through ahead of the mandrel.

as three or four times. Due to the following cable connected at the rear of the squeegee it was possible for it to work while traveling back to the head end.

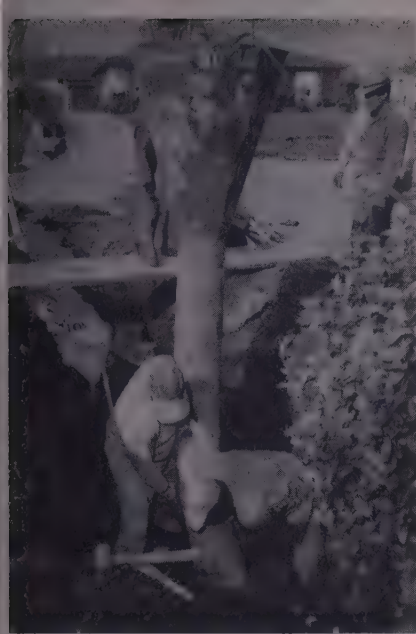
Checking pipe

When the pipe was cleaned a "proving" mandrel, the same shape as the lining mandrel but $\frac{1}{2}$ in. larger in diameter ($\frac{1}{2}$ in. smaller than pipe diameter) was pulled through to make sure there were no obstructions to impede progress of the lining mandrel. Should a lining mandrel become jammed it would have been necessary to remove the concrete and begin lining operation again.

In event the proving mandrel hung up while being pulled through the pipe the location of the jam was determined and an excavation and pipe opening was made at this point. In one instance where the prover became stuck it was discovered that a post had been driven down on the pipe, flattening it about 5 in. out of round.

Loading pipe

Pipe in fair condition and without any irregularities is usually given a uniform lining $\frac{1}{4}$ in. thick. However, due to the condition of the pipe at Monrovia a lining $\frac{1}{2}$ to 1 in. thick was placed. When ready to begin lining the amount of concrete required for the section was calculated.



LOADING SPOUT being connected to pipe opening. Cables were connected through the spout to pull plunger and force concrete into pipe.

puted. A circular baffle with a hole that permitted the cable to pass freely through its center was then placed at the proper distance in the pipe to hold the concrete in a mass ahead of the mandrel. Generally, for a 300-ft. section of 14-in. pipe the baffle is placed about 35 ft. in from the opening. Placing the baffle was accomplished by means of a shackle on the end of the pull cable that would not pass through the hole in its center. The follower cable, with a mark showing the desired distance, was connected to the shackle and followed the baffle into the pipe to be halted when the mark reached the pipe opening. The shackle was then pulled back to the opening leaving the baffle in the desired position.

The mortar was mixed and loaded into the pipe by means of a spout connected to the opening. In connecting

DIRECTING the job were Joe Carreia, superintendent (right), and Hugo Clapp, assistant superintendent.



the spout to the opening the cable from the head winch was passed through it and connected to that from the pull or tail winch. By having the cables connected through the spout it was possible to pull a plunger through the spout and push the concrete into the pipe, clearing the opening. After the pipe was loaded the two cables were disconnected, leaving the pull cable extending through the concrete and out of the pipe, and freeing the head cable for removing the spout.

Lining pipe

The actual lining was accomplished by means of a circular steel mandrel, 13 in. in diameter or 1 in. smaller than the pipe. (For pipe in good condition a mandrel only $\frac{1}{2}$ in. smaller than the pipe is used.) This mandrel (see photo) is bullet-shaped and equipped with four guide springs at its nose to keep it centered in the pipe. The rear section is hollow and contains perforations which permit the release of water from mortar as it is pressed against the pipe wall.

As the mandrel is pulled through the pipe it moves against the mass of concrete held against it by the rubber baffle. In effect, this baffle acts as a movable plug to keep a steady pressure against the concrete that, in turn, offers resistance to the mandrel and passes around its nose. As the amount of concrete in the mass decreases the mandrel overtakes the baffle until at the end of the section being lined it is only a few feet behind it. As the mandrel was 1 in. smaller than the pipe the lining placed has a nominal $\frac{1}{2}$ -in. thickness, but due to the condition of the pipe this thickness varies.

At the beginning of the "pull" the loading spout was removed and the

mandrel quickly placed in the pipe to prevent any loss of mortar. Moving through the pipe at an average of 10 ft. per minute its progress was observed by either light reflected from mirrors or a flashlight. When liner and baffle reached the end of the section they were removed and the opening finished by hand. No follower cable was used with the lining mandrel. Normally little more than one section was lined in a working day.

Hand work

In finishing the open ends of the pipe a workman with a short piece of dowsing would smooth the concrete and bring it to a uniform thickness flush with the end of the pipe. Lining the short section removed to open the pipe and the short sections connecting the pipe to the street crossings was also done by hand. In lining these, the sections of pipe were laid across horses, and mortar inserted. Using a long dowel or round wooden rod the workman would spread the concrete over the lower half of the pipe in a uniform thickness. When this concrete had set sufficiently the pipe was rolled over and the operation repeated on the remaining half.

When the new lining had reached a satisfactory hardness the pieces of pipe were replaced and connected with a collar and by welding, and the excavation was backfilled.

Equipment used in the lining project consisted of two $1\frac{1}{2}$ -ton flat bed trucks each equipped with Gar Wood winches and 400 ft. of True Lay cable, an Essick mortar mixer and the lining tools.

City engineer for Monrovia is A. A. Blakesley. Joe Carreia was superintendent for Pipe Linings, Inc., with Hugo Clapp as assistant superintendent.

New book covers surveying and mapping methods

TVA ANNOUNCES publication of its Technical Report No. 23, "Surveying, Mapping and Related Engineering," which covers TVA's experience in this specialized engineering field.

Among the more important phases of this branch of engineering discussed in the report are: control and adjustment of surveys, planimetric and topographic surveying and mapping, reservoir surveying and mapping, land acquisition engineering, utility relocations, grave removal operations, and military mapping. A chapter on miscellaneous surveying and mapping covers aggregate source surveys and investigations, mine and mineral surveys, archeological exploration surveying and mapping, recreational development surveys and maps, damage claim investigations and surveys, local flood protection surveys, shore line improvement for malaria control, and malaria control map preparation.

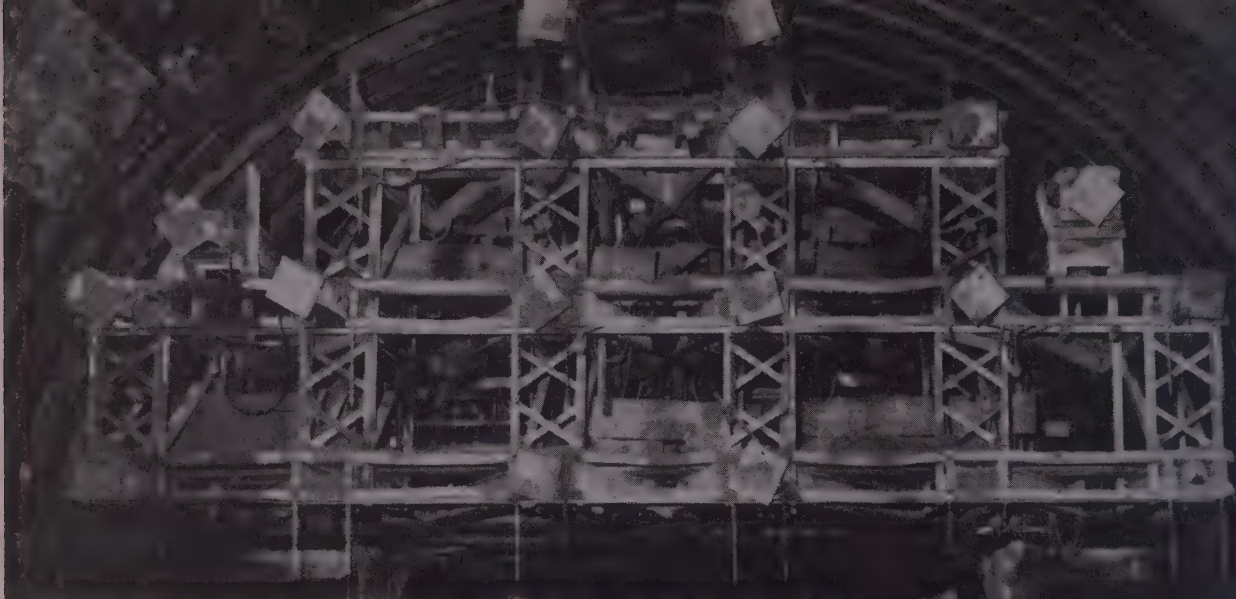
Some time-tested, some new

Most of the methods discussed in the report have been time tested, but many of them have been used perhaps for the first time in the particular combination

described. On TVA's first construction project—Norris Dam—an innovation in surveying and mapping practices was instituted. In order to speed up the cadastral surveys for the purchase of reservoir land, aerial photographs enlarged to a predetermined scale were used as plane table sheets. Both time and money were saved by this procedure, although it has now generally been replaced by improved applications of photogrammetry. The preparation of five-color topographic quadrangle maps from aerial photographs is discussed and illustrated by color plates in the report.

The appendixes cover map reproduction; typical field instructions and survey control data bulletin; typical survey computation forms; typical contract for aerial photography; typical legal instruments used in utility relocations; and typical documents, forms, and related material used for grave removal operations.

"Surveying, Mapping and Related Engineering" may be applied for from the TVA Treasurer's Office, Knoxville, Tenn., for \$2.25. It contains 416 pages including eight color plates and 132 illustrations.



This unique breastboard jumbo developed by Morrison-Knudsen features driving procedure for the Broadway Tunnel in San Francisco where —



160-ton push supports tunnel face

THE MORRISON-KNUDSEN CO., Inc., design for a "breastboard jumbo," executed to facilitate the company's work in driving San Francisco's Broadway Tunnel, should stand as a landmark in the progress of tunnel driving practice. Working from the new jumbo, first put into service last September, three shifts of miners are currently moving forward at a rate of about 14 ft. per day in a section 34 ft. wide and 24 ft. high, having a radius of 14 ft., 3 in. above the spring line.

Preliminaries

Commenced in May 1950, the project encompasses two vehicular bores, each 1,364 ft. long, piercing Russian Hill on a maximum grade of 3%, ascending toward the west. With approach cuts included, the work stretches out over an alignment totaling 3,300 ft., from Powell Street west to Polk. For structural independence the bores are about 35 ft. apart except near the portals; the relationship is shown schematically on the accompanying progress chart. Preliminary work outside the tunnels proper, right-of-way considerations, and a structural description of the project appeared in *Western Construction* for December 1950, pp. 63-65; further information in February 1952, pp. 90-91.

The contractor's original intention in driving each bore was to excavate a crown drift, two wall plate drifts and two foot block drifts. These would in turn be winged out to permit placement of 10 WF 54 plumb posts and arch ribs (on 2- to 4-ft. centers, depending on ground conditions). Following installation of this support, the central core would be excavated. In actuality, the contractor never encountered the true hardrock mining conditions upon which this scheme was predicated, and the mode of excavation was necessarily changed.

Only two drifts

In the final scheme, excavation to full tunnel section has been preceded only by the driving of foot block drifts 9 ft. wide. In height these extend about 1 ft. above spring line (9 ft.), just enough to permit placement of wall plates and 12 x 12-in. timber caps on the plumb posts. A steel fabrication change was involved here, inasmuch as the original wall plate line had been planned for a point above spring line along the arc of each rib. Thus, 6-ft., 10-in. arcs of 10 WF 54 steel had to be cut from all plumb posts and welded instead to the half-arch rib sections.

The 4 foot block drifts, supported by

steel plumb posts on the outside of each projected tunnel section and by timber posts on the inside, have been supported by extensive lagging and blocking throughout their length, and by placement of spiling over all caps before shooting and mucking of each 6-ft. round. Numbering from north to south, the northerly main bore between drifts 1 and 2 is complete, except for tile. However, until such completion, excavation of drift 3 was held back in order not to disturb the ground closest to the north tunnel. Near the center of the project a stub was driven from drift 4 over to the alignment of drift 3, and excavation of the latter drift has proceeded successively east and west to meet portions driven earlier a short way from the portals. (See progress chart.) The presence, however, of the existing length of drift 3 near the east portal permitted early operation of the breastboard jumbo in full-face excavation.

Holding the face

In general description of the breastboard jumbo's function, a far-fetched analogy might be made to the shield employed in mining under pressure. The jumbo itself is jacked forward from completed steel tunnel sets, through the action of 4 hydraulic rams, each a circu-

lar piston of 11½-in. diameter, backed by a pressure of 1,100 psi. In turn, through operation of 16 similar but smaller jacks arranged across its own face, the jumbo supports the tunnel face against caving. These latter jacks are of 6¼-in. diameter, each working at 650 psi. Their action is distributed by means of universal-jointed plates which hold individual timber breastboards against the face. Conceivably, all jacks might be brought to bear. Actually, several of these may be retracted at a time in order to permit air-spade excavation in their immediate vicinity.

Design of the jumbo

A brainchild of Lyman Wilbur, vice president of Morrison-Knudsen Co., Inc., the jumbo was built by the Noble Co. of Oakland, Merritt M. Mason of that organization being the engineer principally involved in its design and construction. Shipped in sections, the jumbo was assembled in the northerly bore of the Broadway Tunnel last September and worked its way west until holing through last January 12. Partially dismantled and trucked around the hill again (see picture), it is now in the southerly bore, having progressed about 5 stations since January 23.

The main jumbo frame consists of two longitudinal trusses, connected across a 20-ft. width by 12 WF 27 members. The truss chords are 12 WF 27 steel, the top one 40 ft., 4 in. long and the bottom one 32 ft., 8 in., resulting in an overhang at the rear of about 8 ft. Vertical and diagonal members of the trusses, forming bays 6 and 8 ft. long and 8 ft. high, are structural tees cut from 6 WF 27 steel. The whole frame is supported at the four corners by 18 WF 50 columns 11 ft., 5½ in. high. This dimension was determined by the clearance needed for an Eimco rocker shovel operating beneath the jumbo.

The jack assembly frame cantilevers forward from the main jumbo frame a distance of about 10 ft., and may be considered as a configuration of 8 cells, 5 across the bottom "layer" and 3 across

the top. This is well illustrated in the head-on view of the jumbo accompanying this article. The overall relationship of the jack assembly frame to the main jumbo frame is best shown in the picture of the jumbo as it was moved from the north to the south bore last January. The bays of the jack assembly frame are each 4 ft. high and 5 ft. wide, giving a total height and width of 8 ft. and 25 ft., respectively. The total height of the jumbo is increased by the two topmost jacks positioned above the upper bays. Vertical framing of the front end is composed of 6-in., 8.2-lb. channels, and longitudinal framing of 8-in., 11.5-lb. channels. These latter occur in pairs, back to back, the reason therefore to be covered in later paragraphs. The framework is stiffened in each of three horizontal planes by diagonal members, variously 8-in., 11.5-lb. channels and 8 WF 31 steel. These are seen in the front view of the jumbo, the channels being those forming an X in each center bay.

Braced against ribs

Short transverse members project from the jumbo just back of the jack assembly frame—directly over the front legs—to provide support for holding, or moving, jacks, which act diagonally to the rear and bear against the completed tunnel support. There are 4 of these jacks, 2 per side, the upper ones being close to the jumbo, the lower ones positioned farther out in order to engage rib steel where the clear tunnel width is greater.

Maximum dimensions of the jumbo are, with breastboard jacks retracted, about 53 ft. in length, 25 ft. in width, and 23 ft. in height.

The jacks, cylinders and rams are received in the "slots" between longitudinal channels of the jack assembly, and the only positive connection consists of a pin at the rear end of each cylinder. The ram pistons are essentially 9-ft. lengths of 3½-in. seamless steel tubing, but these lack resistance to buckling. Hence, the nose of each ram is fitted with a plate, and extending back there-

from on each side is an 8-in., 11.5-lb. channel 9 ft., 8 in. long, which moves with the piston. These channels are connected across the top of the ram by a continuous cover plate 3/16 in. thick, 7½ in. wide, and the same length as the channels. Intermittent stiffening connects the bottom flanges of the channels, under the ram. This is made up of 3/16-in. bar stock 2 in. wide. The entire protective and stiffening assembly moves integrally with the ram (clearing the outside of the hydraulic cylinder as the jack retracts), and the side channels are in intimate contact with the fixed longitudinal members of the jack assembly frame. An 8-ft. stroke is possible with these breastboard jacks. Generally, the working stroke doesn't exceed 4 or 5 ft.

Directional jacks

Of the 16 breastboard jacks, 12 are directionally fixed; their action is horizontal and in line with the tunnel axis. The two topmost jacks, however, and two atop the outer bays of the jack assembly frame rest at a slight angle with the horizontal. Necessarily they must be free to move in the vertical plane, because forward motion of the jumbo as these jacks act against the tunnel face tends not only to compress their rams but also to rotate them upward. For this reason, the cylinders of these jacks are restrained by horizontal pins, and the rams themselves rest in and slide upon adjustable cradles at the front of the jumbo. After a move of the jumbo, which raises a ram off its cradle, the cradle may be raised so that subsequent retraction of the ram from the tunnel face does not allow it to fall free to its former position.

The breastboard jacks are actuated by hydraulic pressure in cylinders of 6¼-in. inside diameter. This pressure, 650 psi., is the equivalent of 319,000 lb. of total thrust forward. The holding jack cylinders are 11½ in. in diameter, and are actuated by 1,100 psi. This total thrust amounts to 457,000 lb. Thus, it is possible for the holding jacks to be extended even against full action of the breastboard jacks. In fact, this is the normal operation of the jumbo, permitting its advance to a new position (in increments of 4 ft.) while maintaining complete breastboard protection across the tunnel face.

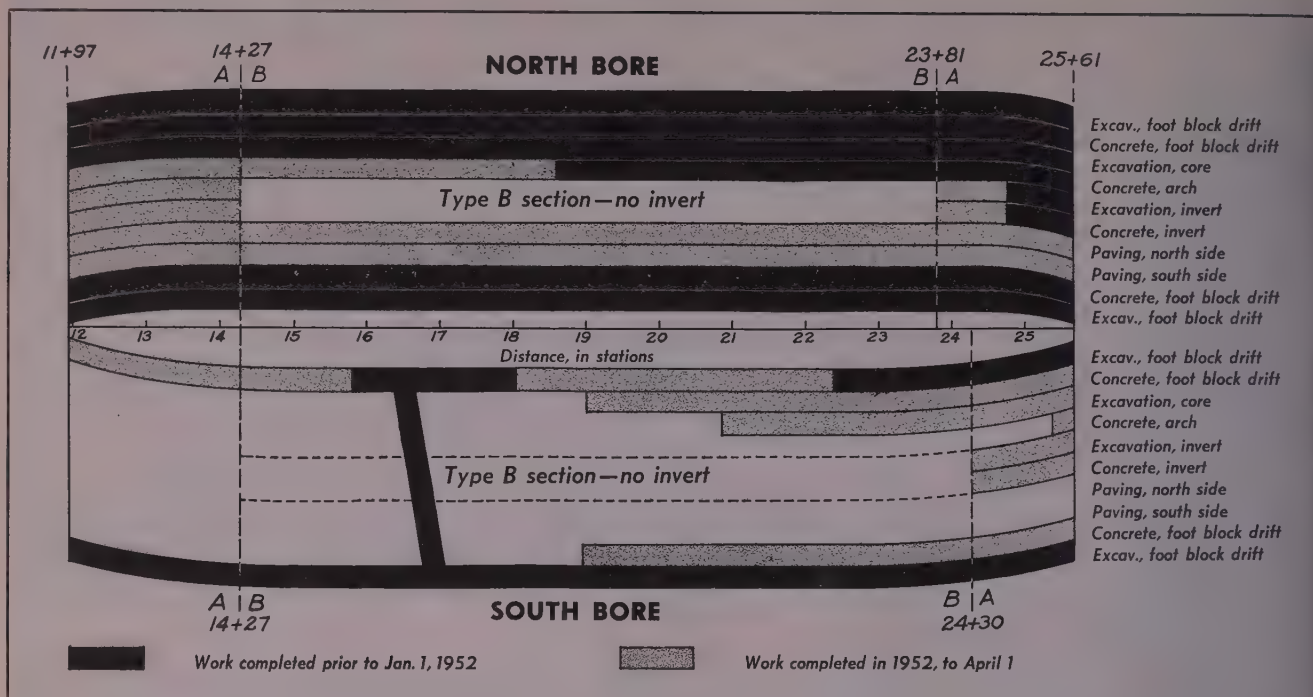
Control system

The jacks are all controlled from a central operating gallery located between main frame trusses of the jumbo and just behind the jack assembly frame. Operating orders are here received by loudspeaker from microphones maintained on top of and beneath the jumbo. The hydraulic power unit is located directly behind the operating gallery. It is a 150-gal. unit, specified by the Noble Co. and built from stock items by The Rucker Co., also of Oakland. Two electric motors actuate the system, a 10-hp. A. O. Smith motor (220/440 v., 60 cycle, 1,200 rpm.) and a 15-hp. General Electric (of like characteristics).

In addition to electric energy for this power unit and for lighting, the jumbo is furnished compressed air for opera-

WITH LEGS CUT OFF, the jumbo is moved on dollies back to the east portal to start work on the south bore. This trip took only 4 hr. and trucks were used as brakes on San Francisco hills. Main truss framing is shown. The move as a complete unit saved days of dismantling and re-assembly.





BROADWAY TUNNEL PROGRESS—Chart maintained by the contractor to indicate advance of the individual operations. Excavation of main cone has been completed in north tunnel and is approaching half-way mark in the second.

tion of an air tugger and for the air-motor powered hydraulic arms on a pair of rail-borne "rib tote cars" that run on top of the jumbo frame. Their use will be described as part of the jumbo operational sequence. Altogether, the jumbo and its machinery weigh about 50 tons. This weight is carried on four 2-wheel trucks having double-flanged roller bearing wheels that ride on track of 20-ft. gauge.

Operating cycle

The cycle of operation of the jumbo might be said to commence when it has first been secured in a new position, breastboard jacks compressed and the rig close in against a newly excavated face. At such time, powder crews ascend the jumbo to drill and load the new round. The purpose of blasting is not to move the material but, rather, only to shake it up and ease the subsequent task of miners moving in with air spades. As a consequence, breastboards are not removed in the vicinity, but are maintained to hold the face nearly intact.

Using swede drills, the miners sink a more or less random pattern of 4- to 6-ft. holes. The number ranges from 4 to 40, located in the crown and, as necessary, for some distance right and left down the sides of the face toward the wall plate line. If more than one shot is needed, these lower holes are loaded and set off after the crown. Now, with the jumbo lighting system extinguished and the miners working by portable illumination, the holes are each loaded with from ½ to 2 sticks of 45% powder and fused with 1- to 7-ms. delays which restrict the shot to a total of 2 holes at a given instant. This procedure holds down the jolt to a practical minimum. After the

shot, no extra ventilation is required since the tunnel is of such large section. The miners can regain their positions and, once light is restored, commence work immediately.

Great care is taken in the early phases of excavation, as successive relief of hydraulic pressure on various breastboards frequently permits extensive caving of the disturbed ground. Even when the miners put their air spades into action, very slight activity is required to chip off large slabs of material. The work progresses, of course, from the top down, with about 8 miners spread across the face at one time. As the operation proceeds, a 4-ft. depth is mucked in the vicinity of each breastboard, which is then replaced in the new position. Crown bars, lagging, ribs, and collar bracing are placed in quick succession. Allied operations, including material supplying, steel placement, and jack control, engage about 12 men, a total of about 20 on or about the jumbo

Stockpile on jumbo

Steel rib sections, raised by operation of an air tugger on top of the main frame of the jumbo, are stockpiled by suspension in chain slings from completed tunnel sets. Similarly, timber is hoisted up and piled wherever there is space. Crown bars and lagging are placed just ahead of the steel, the forward end of crown bars being supported on the top edge of breastboards placed high against the face and held by the jacks. Custom-cut timbers are available on the spot, as a power saw is operated under the jumbo. Its table is supported on the right side, between front and rear jumbo legs.

On top, the jumbo is fitted with two cable-drawn "rib tote cars," which ride

longitudinally on rails of 3-ft. gauge. These are aligned just outboard of the two top jacks. The height differential between main jumbo frame and jack assembly frame is made up by mounting the rails on continuous channel sections which are in turn supported atop the main frame on a series of stubby steel bents—in effect a trestle. The tote cars, drawn by cables led to the air tugger, convey rib steel forward to the face as needed, bridging the gap between end of jack assembly frame and actual tunnel face above the projecting jacks by means of a double-extending mechanism. This permits a portion of the tote car to overshoot the car itself, which is stopped at the end of the track.

Setting steel

Steel so carried forward is then lowered to right or left and seated on the wall plate. It slides easily off the tote car via rollers on the car and is restrained in the process by a gantline run from the winch to the low end of the steel. With two half sections roughly in position, hydraulic arms on the tote cars are raised and the steel forced into final position against the crown bars (see picture). If necessary, a king-size shim, or dutchman, is provided to separate the two half sections at the crown and assure tunnel dimensions from "in to in" of steel as specified by the City. Connections are bolted, at crown, at wall plate, and between sets, which are maintained at proper spacing over the entire arch by collar bracing of small angle stock.

Mucking the cone

Below the jumbo, an Eimco 104 rocker shovel mucks the face and loads out trucks that remove the material for dis-



WORKING from the top level of the jumbo, a round of holes in the crown is loaded. Top jacks can be seen and the stockpile of timbers.



SUPPORTED on the tote-cars, the sections of steel ribs are moved forward to the face. View is from the face, and the right-hand jack has been removed and the one at the left is retracted.



LOOKING DOWN the ringed-out opening where the rib will be lowered to the wall plate. Note the jack (No. 6) in position and the supporting timbering.

In addition to passes straight at the face, the shovel is able to turn and work at an angle, the areas to left and right where fallen material all but buries the foot block drifts. The jumbo overcomes its front wheel by the complete rotation of the jack assembly frame, plus massive advance measured by the extended jacks. So, as far as the shovel is concerned, the jumbo is never hard

against the face, and adequate maneuvering space is assured. Trucks are successively end- and side-loaded by the shovel, the truck drivers being well able in the big bore to spot their machines as required.

In clearing the face for operation of the rocker shovel, it is necessary to remove the timber plumb posts on the in-board side of foot block drifts, and also the caps and spiling they support. Spiling is weakened by a line of holes drilled through it along the side of a 12 x 12-in. cap, using a power auger. This is done when most of the overburden above it has been mucked, and the weakened spiling can then be broken off safely. Caps are weakened where they connect to plumb posts and are removed by means of a wire cable choker led to the rocker shovel. Plumb posts, drilled through as near their foot blocks as possible, are similarly moved. Jumbo clearance is such that caps impede its movement, but plumb posts are occasionally still in place beneath the jumbo after a move, before it is convenient to remove them.

Cycle of operations

During the progress of these blasting, mucking, and supporting operations the jumbo has been "consolidated" in its new position in preparation for the next move. As the cycle commenced, its forward jacks were compressed against the face and its after jacks were extended. Now, the jumbo's reaction is transferred to screw jacks manually turned up

against the tunnel sets, as a safety measure, and the hydraulic rams are moved ahead. One at a time they are eased, retracted, and then extended again to bear on tunnel sets closer to the face. The rams actually bear against special plates that engage several ribs to spread the load (see picture).

Upon completion of this operation, and also of all work possible at the face from the present position, the jumbo is ready to move. A path is cleared along the tracks for a distance of 5 or 6 ft., and the shifter gives the command, "Move forward with the jumbo!"

The breastboard jack pressures are unchanged, but the holding jacks, having a greater possible total thrust, now prevail. The jumbo moves forward, hydraulic system aquake as the breastboard jacks are slowly forced to compress. The move continues for the better part of 5 min., until the desired 3 or 4 ft. of progress are achieved. Then, "Stop the jumbo!"—the cycle is complete.

Personnel

On the job for the City of San Francisco, George Partridge is resident engineer on the Broadway Tunnel, and Tom Mullaney is chief tunnel inspector. The project manager for Morrison-Knudsen Co., Inc., is Lou Wheeler, assisted by Harry Kirmond. Project engineer is John Erdle, office engineer is Gerry Eide, and office manager is Dan Butler. Tunnel superintendent is Carl Larson, building superintendent is George Coen. Jim Miller is master mechanic.

Ralph G. Wadsworth is City Engineer for the City and County of San Francisco and Sherman P. Duckel is Director of Public Works.

MOVING THE JUMBO forward while maintaining breastboard pressure is done with four main jacks bearing against plates engaging several ribs.



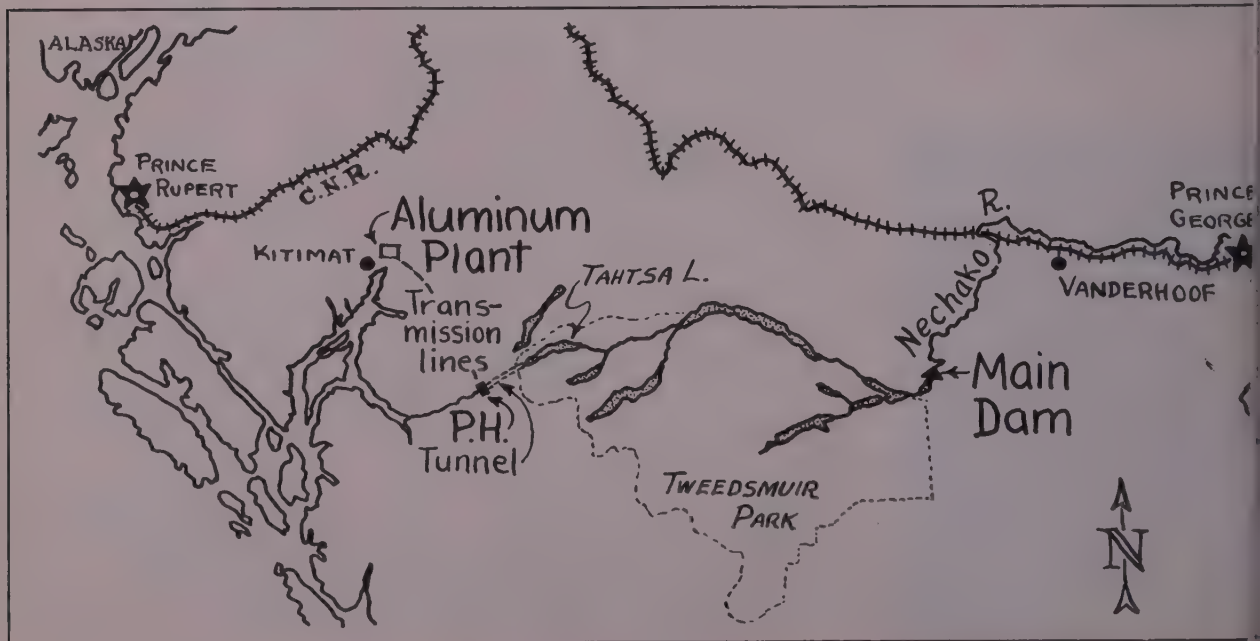


Developing HYDRO POWER FOR ALUMINUM in British Columbia

Multi-million dollar construction program involves dams, a 10-mi. tunnel, power plant in a mountain, transmission line, refinery, harbor facilities and a city which will double the aluminum output of Canada

MOUNTAINS rising from the coast of British Columbia (left) will be pierced with a 10-mi. tunnel. Work is under way at the face for an adit.

LOCATION sketch shows principal features of the project from the main dam on the east to the aluminum plant at the west end of the development. Kitimat is 400 mi. northwest of Vancouver.



COUNTING DEMAND for aluminum and the hydroelectric potential in British Columbia are a combination that has produced a multi-million-dollar construction project being carried out by the Aluminum Company of Canada, Ltd., about 400 mi. north of Vancouver. The program, which was started last year and will be active during the next three seasons, involves the following features for the production of hydroelectric power: (1) a 300-ft. rock dam and smaller dams, (2) a 10-mi. tunnel, and (3) a 420,000-hp. power plant (about the size of a small city) to be built inside a mountain. Power from this development will be delivered a distance of 50 mi., crossing a 2,600-ft. mountain range to a plant which will be built on tidewater to produce aluminum. Work opened up on the geological features of the program last season and the hydroelectric end of the program is being done under contract to Morrison-Knudsen Co. of Canada, Ltd. at the Kitimat plant, which will include the building of a modern city for an ultimate population of 50,000, the construction of structures and harbor facilities for ocean vessels, is being handled by Kitchell Constructors, a group of eight contracting firms in British Columbia. Production of aluminum is scheduled to begin in 1954 and the output from this undertaking will about double the present aluminum production in Canada. The ultimate program, including all phases, may represent a total cost reaching \$500,000,000.

Background

Deep power and facilities for ocean transportation are the major requirements for any large scale aluminum industry. Reduction of raw aluminum ore to the form of aluminum oxide can be accomplished by chemical and heat processes, but the final release of metallic aluminum requires an abundance of cheap steady electric power. As an illustration of the requirements, 1 hp. of electric power operating continuously for one

year is required to produce 700 lb. of aluminum.

The continuing search of the Aluminum Company of Canada for development sites in their expanding program has been well-known to the government of British Columbia. Engineers of the company were first invited to look over potential sites in British Columbia about five years ago. In 1948 the first reconnaissance was made over two drainage areas which combined the necessary features of large power potential with deep-water access. One of these areas was the Chilco branch of the Fraser River, located about 150 mi. north of Vancouver. However, this particular branch of the Fraser is considered an important area by the salmon industry and further study of the hydroelectric potential was abandoned for this reason.

Going farther north to the area designated as Tweedsmuir Park, this preliminary survey examined the Nechako River, another branch of the Fraser, which flows from the west into the Fraser at a junction near the town of Vanderhoof. The Nechako River heads up in a series of long, narrow tributary lakes connected by short stretches of river, with headwaters at the crest of the range only 80 mi. from the coast. A dam in a narrow canyon of the Nechako, where it flows northeast to join the Fraser, would raise and control the water level in this extensive area of lakes. This stored water could be diverted to a 10-mi. tunnel driven through the mountain range to where a 2,600-ft. drop is available for power generation. To complete the necessary development a plant site was necessary on deep water. This was found at Kitimat, the site of an old Indian village located only about 75 mi. by air from Prince Rupert, and about 100 air-line miles from the southern tip of Alaska.

The following year the Aluminum Company made available \$1,000,000 for detailed surveys of this program. The region is inaccessible and much of this

work was carried out with the aid of airplane transportation and helicopters delivered survey parties and supplies over the rugged area. Not only was topography required, but also information on stream flow, annual precipitation and snow conditions. This latter point was essential because the transmission line was required to extend over a 5,000-ft. mountain range where icing conditions and rugged terrain presented severe problems.

The following season, even before the company had formally decided to undertake the program, some preliminary construction was done, particularly a 10-mi. length of road from tidewater to the powerhouse site.

General plan of attack

Construction of the entire hydroelectric end of the program was awarded to the Canadian division of Morrison-Knudsen and work was started with a rush at several points last season. Access to the main dam site on the Nechako River required about 50 mi. of rugged road work upstream from the nearest rail point of Vanderhoof on the Canadian National Railroad.

Construction of this road was sublet to Mannix, Ltd. of Calgary. The contractor made extreme efforts against adverse conditions to complete this road for moving in tons of equipment and supplies to the dam site before the spring thaw. If this could have been accomplished, hauling over the frozen ground would have expedited initial work at the site. However, the unusually early spring of 1951 multiplied problems as road work and hauling were carried out through deep mud.

Later during the season the work was completed on this access road, which now provides a gravel, year-around highway from the railroad to the dam site. Mannix, Ltd. built a major camp at the site for the construction of a rock-fill dam 300 ft. high and scheduled to contain more than 3,000,000 yd. of ma-

SCHEMATIC drawing shows the diversion from Lake Tahisa through a 10-mi. tunnel to a 2,600-ft. power drop. The power house will be located in the mountain. An adit will make four faces available for driving the tunnel.



terial. Work at this site will be active during the next two years.

The next important point of attack was to acquire access to the upper end of the 10-mi. tunnel (see drawing) which will deliver storage from the system of lakes to the power drop. This intake portal was even more inaccessible at the head end of Lake Tahtsa. It was finally reached by a long access road to the lower end of the lake, with barge transport to the tunnel portal site. This access enables work to be started at the upper end of the main tunnel.

The lower end of the project, including the powerhouse site and the downstream end of the tunnel, was reached from the western end of the project, upstream from Gardner Canal, which is tidewater. The 10-mi. construction road built in 1950 provides this access.

To speed work on the tunnel, which is the key to progress on the project, an adit is being driven to the tunnel line so that two additional headings can be opened up. This center adit is located at Horetzky Creek, about 6 mi. east of the major camp at the powerhouse site. A road to the adit camp was completed

last year and driving is well under way. One of the features of construction at the powerhouse end is an aerial cableway which provides access to the tunnel portal from the elevation of the powerhouse.

Plans call for the power plant to be located inside of the mountain at the lower end of the penstock. Ultimate development in this power plant will total 1,600,000 hp., with equipment for 500,000 hp. to be installed initially.

Delivery of power from the plant to the reduction works will be over a 50-mi. transmission line which climbs a 5,000-ft. mountain barrier, cut by deep valleys that will require long spans for the conductors. Engineering problems on this transmission line dictated the building of a test span. This span was studied last winter to determine the effects of storms under icing conditions.

Work at Kitimat

Work at the Kitimat end of the program has been at a more leisurely pace because not as much time will be required for construction of the plant and the town as will be needed for the hydro-

electric development. The site is a Indian village located at the head of Douglas Channel.

Dock facilities will be provided for ocean-going vessels bringing alumina to Kitimat for processing. This raw material for the Kitimat works will come from bauxite ore in British Columbia which is semi-processed at Jamaican before being delivered by the ship to the form of aluminum oxide. This preliminary processing is designed to save shipping space since 4 lb. of bauxite is required for 1 lb. of aluminum, while only 2 lb. of processed material is required.

The aluminum works at Kitimat will have a size sufficient to produce up to 100,000 metric tons of aluminum a year which is about equal to the present aluminum production in Canada. It is possible that secondary industries may develop in the Kitimat vicinity. The size of the town site is being planned for an ultimate population of 50,000.

Personnel

Engineering and construction personnel are too numerous to be mentioned in detail in this preliminary review of the development.

McNeely DuBose, vice president of the Aluminum Company of Canada Ltd., has been one of the most active executives of the program for the Aluminum Company of Canada. P. E. Kelly is project manager for the company with headquarters in Vancouver.

For Morrison-Knudsen Co. of Canada Ltd., preparation of design plans and the supervision of all operations have been under the direction of C. P. D. vice president of the parent company and president of International Engineering Co. A. O. Strandberg is in charge of all field construction of Morrison-Knudsen on the project.

Kitimat Constructors is a joint venture firm including eight contracting companies of British Columbia. They are: Emil Anderson Construction Ltd., Hope; Bennett & White Construction Co., Ltd.; B. C. Bridge & Dredging Co., Ltd.; Campbell-Bennett Ltd.; Dawson & Hall Ltd.; Dawson-Walsh Co., Ltd.; General Construction Ltd., and Marwell Construction Ltd., all of Vancouver. J. B. Carswell is chairman of the board of the group. Harry M. Whiting is project manager and Harry Wade is assistant project manager.

Students offered research jobs at Washington State

FOUR POSITIONS as research assistants for students desiring to advance toward the degree of Master of Science in Sanitary Engineering are now available at The State College of Washington's Department of Civil Engineering. These positions will involve half-service during the academic year with a stipend of \$1,200 for the nine and a month period. Full time positions will be available during the summer months at a salary of \$250 per month.



WORK on a drill jumbo advances the tail-race tunnel that will extend from the powerhouse inside the mountain to the Kemano River.



IN THE CANYON of the Nechako River, where it flows northeast before joining the Fraser River, a rockfill dam will control storage in the series of lakes. The cofferdam at the dam site is shown at the time of diversion.

Air-entrained concrete for use in sea water

Tests on-the-job supply data on the design of the mix, the problem of control, the consistency of volume of air and the slump, with a summary of the advantages secured

By PAUL J. FLUSS

Testing Engineer

State Board of Harbor Commissioners for
Port of San Francisco

SUCCESSFUL USE of air-entrained concrete in high-cement content mixes requires rigid control of all factors. With this care in the design of the mix, the field testing of trial mixes and strict supervision to insure uniformity from batching to placement, the results will be a concrete of greater workability and reduced segregation. These conclusions were obtained from observations during extensive testing of concrete placed in casting jackets for the tops of piles (both concrete and timber) used on pier construction by the Board of State Harbor Commissioners in San Francisco waterfront work. One of the major projects on which air-entrained concrete for jackets was used was reviewed in *Western Construction*, October 1951.

General problem

Most of the structures used in harbor construction in San Francisco rest on piles that are exposed to destructive attacks. While wood piles have to be protected from marine borers down to the mud line, concrete piles show deterioration mostly above the lowest tide elevation. For these reasons the use of concrete jackets for both types of piles has been common practice of the Port of San Francisco.

Structural as well as economic considerations have been favoring concrete piles. Therefore, only the experience pertaining to the extension jackets used on concrete piles, will be considered in this article. The main purpose of these jackets is to:

1. Secure the proper elevation, without cutting off the piles,



JACKETS slipped down over concrete piles provide protection in the tidal range and also allow for establishing grade without cutting off piles.

2. Protect the piles above the lowest water line, since the wetting and drying action of the tide, constantly bringing in and depositing minute quantities of sulfates contained in sea water, deteriorates the concrete and finally attacks the reinforcing steel members, and

3. Give added protection to the pile heads in case they are weakened by invisible cracks due to hard driving.

Troubles in casting

Dimensions and steel reinforcing of the pile jackets, as well as the collapsible inner forms used by the Port of San Francisco, are shown in the accompanying illustrations. The outer forms are open at the top and the concrete is poured and vibrated down along the sides—between outer and inner forms—until it joins in the center of the bottom section. There are several openings at the bottom of the inner forms so that the flow of the concrete can be observed.

Since the thickness of the concrete in the jackets is only 4 in., with serious obstruction by the steel, the casting of these jackets was quite troublesome in the past. The only solution in the days before World War II was the use of concrete with a high slump. Data on typical jobs prior to 1941, taken from available records, show the following

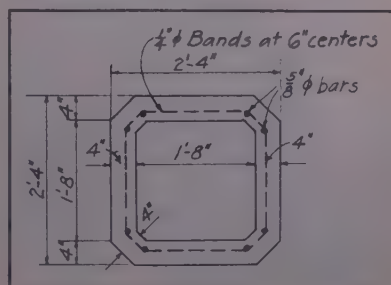
mix design: Fixed proportion by weight of one part cement to 4 or $4\frac{1}{2}$ parts dry aggregate of $\frac{3}{4}$ -in. maximum, which theoretically should result in a cement content of $7\frac{1}{2}$ to 8 sacks per cu. yd. of concrete. In actual operation this mix had to be adjusted—by addition of water—to a consistency which made it possible to get the material properly into the forms. The unlimited use of added water not only caused quite an increase in the water-cement ratio, but also a corresponding decrease in the cement content.

As a consequence, segregation trouble and possibly higher shrinkage developed and the compressive strength of the concrete was in the range of only 2,800-3,600 psi. after 28 days.

Characteristics of mix

Material	Volume	Weight
7.14 sacks cement.....	3.43	671
Dune sand	.72	125
Top sand	6.45	1,070
Gravel, $\frac{3}{4}$ x $\frac{1}{4}$ -in.....	10.32	1,745
37 gal. water.....	4.94	308
$4\frac{1}{4}\%$ air	1.14	—
	27.00	3,919

CROSS-SECTION of jacket indicating problem of placing concrete from top to flow down side walls to fill the bottom of the form without segregation.



Based on the recognized investigations by different agencies and especially the work done by the California Division of Highways, the use of an air entraining agent was considered in 1948. The purpose was: (1) obtain a workable mix at the lowest possible water-cement ratio that could be placed at a low slump despite the mentioned adverse conditions, (2) avoid segregation, and (3) gain additional protection against the action of the sulfates contained in the sea water.

After a few trial mixes, it was decided to use 1 oz. of air entraining agent per sack of cement and to add it at the mixer. The mix design was based on $7\frac{1}{2}$ sacks

Record of tests demonstrates consistent results of air-entraining

Date of Test	Per cent Air	Slump (inches)	Strength (psi.) 28 days
1950			
Sept. 13	4.0	3	4,280
" 19	3.5	2 1/2	4,370
" 20	4.0	3 1/2	3,880
" 21	5.0	4 1/2	3,900
" 26	4.5	4 1/2	3,620
Oct. 5	5.0	4 1/2	3,460
" 13	4.0	2 1/4	4,290
Nov. 1	3.6	4	4,030
" 30	4.2	3 1/2	3,950
Dec. 18	4.2	3 1/2	4,660
1951			
Jan. 8	3.9	3 1/2	4,760
" 16	4.6	3 1/2	4,120
" 19	4.4	3 1/2	4,240
" 23	3.8	3 1/2	4,480
Feb. 5	4.6	3 1/2	4,360
Average	4.2%	3 1/2	4,160

cement, 42% sand, 58% gravel (1/4 to 3/4 in.) and 37 gal. of water, assuming approximately 3% air. Grading of the aggregate was rather similar to that used later in 1950, which is indicated in the accompanying table.

Though a tight control of the aggregates (gradings and moisture contents) as well as of the mix (air content, unit weight, and slump) was exercised only an acceptable uniformity could be obtained. The concrete was supplied by a ready-mixed concrete plant that had a tremendous turnover of aggregates, while the jacket pours were intermittent. As a result control was always lagging behind, so that it was neither possible to adjust the mix, nor to do any experimental work.

As a result the record for a six months' period showed an air content varying from a high of 5.8% to a low of 2.9% and slumps varying from 6 1/2 in. to 3 in. Compressive strengths averaged 4,613 psi. at 28 days, but varied from 3,975 to a high of 5,650.

In the latter part of 1950 another project was awarded which called for a sizable number of concrete extension jackets. This is the project previously referred to and described in detail in *Western Construction*, October 1951.

On this job conditions were more favorable, because the work could be based on previous experience and the concrete was to be supplied by a small batch plant, where uniformity of the aggregates was assured and good control of the mix was possible.

After a tentative mix design was selected several batches were run to: (1) adjust for optimum workability at minimum water content, and (2) study the effect of varying the amount of air entraining agent and/or water content. Though the compiled data are too few to be conclusive, it appeared that a variation in the amount of air entraining agent from 5/8 oz. to 2 oz. per sack of cement did not bring about too great a change in the air content, unless it was accompanied by at least a slight increase or decrease in the water content. Fur-

thermore, at the same amount of air entraining agent, an increase in water content gave not only higher slumps but also greater air content.

It was determined that the use of 1 oz. of air entraining agent—added at the mixer—resulted in the desired air content of approximately 4% and a slump of 3 1/2 in., which gave excellent workability and kept the water content down to 37 gal.

Uniform results

The grading of the aggregates was not much different from that used in 1948. The final mix design was based on: 7.14 sacks cement, 41% sand, 59% gravel (1/4 to 3/4 in.), 37 gal. of water and approximately 4% air.

Table 6 shows the air contents (taken with the Press-Ur-Meter), slumps and 28 days compressive strengths.

The final table indicates the remarkable uniformity of results in securing the specified amount of air. Not only did the per cent of entrained air have an average of 4.2 as compared to the specified 4.0,

TOP—Inside forms in a stack showing toggles which permit collapsing and removal. The raised, circular opening allows for observing when the concrete has completely filled the bottom of the form.

BOTTOM—Completed jacket which was cast with concrete containing 4% air with a 3 1/2-in. slump and an average 28-day strength of 4,160 lb.



Materials and design of the mix AGGREGATE GRADING Averages

Per cent passing sieve size	Gravel 3/4" x 1/4"	Top Sand	Dune Sand
3/4" -----	94	—	—
3/8" -----	34	—	—
#4 -----	4	97	—
#8 -----	—	78	—
#16 -----	—	57	—
#30 -----	—	33	99
#50 -----	—	12	82
#100 -----	—	2	7
#200 -----	—	1/2	—
Specific Gravity			
(BSSD) -----	2.71	2.66	2.79
% Absorption			
-----	1.5	1.6	1.0

but the variation from the specified per cent was held within relatively close limits. The same applied to the slump and the average of 3 1/2 in. was held consistently in the last seven samplings.

The lower average compressive strength at 28 days, as compared to results obtained in 1948 (4,160 compared to 4,613) was not only due to the lower cement content, and consequently higher water-cement ratio, but also to the fact that a slower curing brand of cement was used. This was borne out by the fact that 90-day test cylinders taken of a few pours could not be broken at 6,000 psi., the capacity of our testing machine. These cylinders were afterwards tested for absorption and gave uniform results of 2.7%.

Observations and conclusions

Use of an air entraining agent in high-cement content mixes has the following merits: (1) It gives much greater workability to low-slump mixes than can be obtained with conventional concrete thus assuring a desired, or necessary low water-cement ratio and (2) it prevents segregation.

The elapsed time is much too short to reach a conclusion, or even voice an opinion regarding any possible improvement in durability of high-cement concrete for harbor construction due to the use of an air entraining agent.

Widely publicized test results and findings prove that air entrainment increases the resistance of concrete to sulfate attacks. But it has also been established that high-cement content concrete—if properly designed and used the specified low water-cement ratio—is dense and durable enough to withstand their destructive action. Whether any additional protection against sulfate attacks, gained by the use of an air entraining agent, justifies the costs involved, is a question which will have to be decided in the future.

To insure success, the use of an entraining agent requires: (1) A tentative mix design and preferably to mixes with subsequent adjustments in actual operation, (2) constant rigid control of all factors, having a bearing on the air content, such as sand grading, water content, mixing time, length of haul, etc., and (3) proper control of concrete properties such as air content, slump and compressive strength.

UTAH PLANS FIRST FREEWAY

Concentrated in Salt Lake City and the area north to Ogden and south to Provo are one-third of the people and cars in the state—Present highways and city arterials are inadequate and a limited access highway is in the planning stage

By

E. G. JOHNSON

Chief Engineer

State Road Commission

Salt Lake City

Utah



ALONG THE WASATCH FRONT from a point north of Ogden, south through Salt Lake City, to beyond Provo is concentrated one-third of the population and one-third of the automobiles in the State of Utah. Present highways are inadequate along this "main line" of Utah and the planned solution to the traffic problem will be the state's first freeway project. Studies have been made of the most feasible location for a limited access route through Salt Lake City, with a connection extending to the west of U. S. 40. The problem and present plans for the solution are outlined in the following.

Word of history

In 1909 the state legislature created the State Road Commission. The duties of the commission were relatively simple and during the first year of its existence no attention was concerned chiefly with the details of mapping the roads of the state. Designation of the state highway system actually began in 1910. The initial appropriation was for \$27,000 which was to be distributed on the basis of \$1,000 for each of the then existing counties. From this small beginning the highway system of the State of Utah has grown during the following four decades, and today faces a major problem in the metropolitan area north and south of Salt Lake City.

Traffic near Salt Lake

The extent of the concentration of population and related factors in the vicinity of Salt Lake City is evidenced by the fact that the Salt Lake Urban Area contains approximately 85 sq. mi. compared to 82,356 sq. mi. for the state, or 0.1%; but within this area is concentrated almost one-third of the people and automobiles in the state. In addition to these local traffic generators, Salt

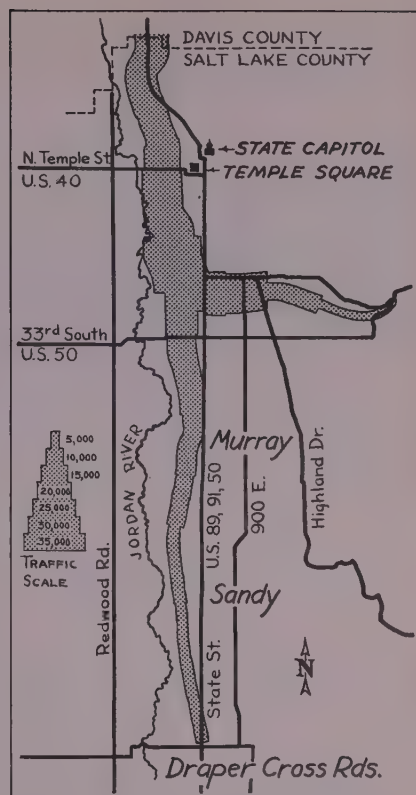
Lake is a hub from which radiate the major north-south, east-west highways through the state. Two of which, U. S. 91 and U. S. 40 to the west and connecting with U. S. 30S to the east are a part of the National System of Interstate Highways

The rapidity of traffic growth is indicated by state vehicle registrations; from 1920 to 1949, a thirty year period, passenger car registration in Utah increased 466%, and during the same period, commercial vehicle registrations increased 800%.

An automatic traffic counter on U. S. 91 about 18 mi. south of Salt Lake recorded an average daily traffic volume of 3,212 vehicles in 1937, while in 1951 the traffic had increased to 7,755 vehicles, an increase of 141%. At the Salt Lake-Davis County line to the north the average daily traffic in 1937 was 5,144 vehicles and in 1951, 19,000 vehicles, an increase of 269%.

The congestion on the major routes becomes particularly acute in such urban centers as Salt Lake City. Although many of the major streets in the Salt Lake City area have 132-ft. rights-of-way, they are carrying traffic far in excess of practical design capacities. Based upon criteria in the "Highway Capacity Manual" prepared by the Highway Research Board, demand in 1947 on most of the major municipal intersections was in excess of 100% of design capacity based upon the thirtieth peak hour. Many were in excess of 150%. No effort has been made to adjust these figures to 1951 volumes inasmuch as once the design capacity has been exceeded, volumes alone are not indicative of demand. That is, as traffic volumes exceed practical highway capacity, traffic is forced to alternate routes if available and traffic volumes tend to stabilize. For example, on Highland Drive, a two-lane road on which an automatic traffic recorder was installed near 30th South in 1946, traffic volumes increased approximately 16% each year over the preceding year until 1950 when the increase was only 9%, and 1951 actually showed a slight decrease over 1950 despite the fact that growth in the southeast section of the city continued unabated during the latter two years.

It is evident that some form of traffic relief is desirable today and mandatory in the immediate future.



POTENTIAL TRAFFIC on the proposed expressway system in Salt Lake County. Chart was prepared by the Utah State Road Commission's highway planning division in cooperation with the Bureau of Public Roads.

The State Road Commission has been aware of this condition for some time. The advent of World War II precluded the possibility of doing much in the way of road construction or improvement even if funds had been available. After the war, when construction was resumed certain sections such as the Point of the Mountain and the Bountiful-Farmington were built, others have been programmed for improvement, but the major need through Salt Lake County still remains.

A limited study was made early in 1946. In addition numerous traffic volume counts were made as a continuing activity to keep current traffic trends. All these studies indicated that for a major portion of the highways traffic volumes exceeded practical capacities, resulting in undue delay, accidents and driving fatigue. The problem of improvement of these deficient road sections may be broadly divided into two groups, the urban sections and the rural sections; however, both must be considered together to integrate into a unified system.

The engineering problem

From an engineering standpoint there were two obvious answers: increase the capacities of the present highways or build new ones. In this area, as is common in other urban areas in Utah and other states, the principal highways are lined with commercial enterprises. This ribbon type of development extends

along U. S. 91 from the north to the south urban limits (Davis County line to Midvale), and along a major portion of U. S. 40 to the east, and U. S. 40 and 50 to the west. Such roadside development, besides adding to the moving traffic congestion by the stopping, starting and turning maneuvers, makes it economically prohibitive because of property damage to increase the capacity of existing highways by the purchase of additional right-of-way and the construction of multi-lane highways.

The result is that new locations must be selected for new traffic facilities. As a basis for the choice of such a location a traffic study of the Salt Lake Metropolitan Area was conducted in 1946 and a report published in 1947 by the Division of Highway Planning, to determine the economic justification of various proposed locations. In other words the study was made to pre-determine the probable traffic volumes on such proposed roads.

The initial phase of the freeway study was limited to what was then considered to be the metropolitan area; that area between 53rd South on the south to approximately the Salt Lake-Davis County line on the north and the Jordan River on the west to Wasatch Boulevard on the east. Initially the three municipalities of Salt Lake City, South Salt Lake and Murray were considered as separate urban areas. It early became apparent that there existed in reality only one problem as far as the Salt Lake area was concerned, and a consolidated area known as the Salt Lake Urban area was designated.

This report also indicated that contrary to popular belief, a by-pass route was not the solution to the traffic problem in this area. Salt Lake City, in common with other cities in the United States in the same population group, is a major traffic attraction and generator. It was found by this study that 86.5% of the traffic approaching Salt Lake was destined for the Salt Lake Metropolitan area, and for traffic approaching Salt Lake by way of U. S. 91, from the north and south, 91.5% had this area as a destination.

Because of traffic's desire to enter the Salt Lake downtown business area it is evident that any new traffic facility should provide a direct route as near to this major destination as is economically feasible.

Use-benefits

One determination of the economic feasibility of a new route is a comparison of use-benefits to construction costs, sometimes referred to as the benefit-cost ratio. To determine use-benefits it is necessary to know the potential traffic volumes on the proposed new facility. A comparison of operating costs for these vehicles can then be made on the city streets and on the new facility.

It was apparent without a detailed engineering study that the proposed line would have to be constructed somewhere to the west of the general downtown business area in order to minimize property damage and to serve adequately the industrial area. For compar-

A problem in concentration ...

IN ADDITION to having highway problems common to all states of the West — more demands than funds — Utah is faced with a particular problem. Its people are concentrated in an area which is the commercial, industrial and political center of the state, making it the focal point on most intrastate traffic as well as the crossroads of major interstate routes. For several years studies have been under way for the solution to the resulting highway problems. Planning has been advanced recently since E. H. Johnson took over the duties of chief engineer. As a subject which is of interest to highway engineers throughout the entire West, Mr. Johnson was asked by *Western Construction* to prepare an article to bring the subject to date. His review of background and status of planning was released for publication at the same time he presented the material as a paper before the Annual Utah Highway Engineering Conference.

—Editor.

ative purposes of preliminary benefit-cost ratios two generalized lines were assumed, one in the vicinity of 2nd West and one in the vicinity of 6th West. Based upon the potential use of these two locations the annual benefit in 1947 would have been \$840,000 for the West line compared to \$950,000 for the East line, a difference of only \$150,000 for the East line.

It only required a brief comparison of the right-of-way and the construction costs on the two proposed lines to indicate that it would require many times more than the potential benefit differences to construct the East line because of excess property damage and structure costs. The savings of \$840,000 in 1947 would be in excess of \$1,000,000 today because of the increase in traffic volumes and operating costs. Assuming only a 5% traffic increase each year over present volumes this amounts to \$29,500,000 in a twenty-year period. This is a minimum figure based on tangible savings.

Selecting the line

Based on traffic data analysis field parties began a detailed investigation of a feasible location. Opposition was encountered immediately by many local-interest groups in the northwest part of Salt Lake City where the proposed line went through an old and established residential area. It was the desire, in general, of these groups that the freeway be located directly against the railroad in this area. However, the railroads wanted an area left between the freeway and their tracks for future development of warehousing and manufacturing facilities. Engineering considerations also limited the nearness of the freeway

to the railroad tracks to hold with reasonable limits the grades to overheight structures. At the same time a good benefit-cost ratio prevented the removal of the freeway too far from the desired lines of travel.

After several years of discussion major differences were reconciled and compromise route selected which was approved by the Salt Lake City Commission. Opposition which was incurred in this section was more or less true of other developed areas through which the proposed freeway route was suggested although not to the same degree and at the present a tentative route has been selected for the remainder of the north-south line and part of the east-west line.

Although the general location of the north-south line has been formally occurred in by the Salt Lake City Commission and informally by the other political subdivisions concerned, there will undoubtedly be many minor revisions before final construction.

At the present time the selected route follows the general location indicated by the diagram of "Potential Traffic" the north-south route and the connection to the east. No surveys have been made east of the former prison grounds; however, the line will probably follow along the south side of the canyon, make a connection with present U. S. 91 in the vicinity of the Stillman Bridge near the mouth of Parley's Canyon.

It was found in the Salt Lake Metropolitan Traffic Study that the major desired lines of travel are to the downtown business area. The freeway location from approximately 9th South northward lies to the west and is separated from this area by the major railroad lines. In order to obtain the maximum use of the facility it is necessary to make provision for motorists to enter and leave this general business area. It therefore will be necessary to provide four major access points together with railroad separations, one from 13th South to 5th South and 2nd West, one in the vicinity of 4th South, one at North Temple, the vicinity of 2nd West, and one at 5th North. Additional access points may have to be constructed so that traffic entering or leaving the freeway will not congest and restrict the full capacity of the highway.

Design

To render the best possible traffic service, the new facility has been designed as a freeway, which is defined as an expressway with full control of access. Such a facility through an urban area presents many design problems. Where topography permits freeway lines are often depressed, and cross movements made by means of overhead structures. In some instances it is necessary to elevate the freeway and overpass a major road and railroad cross traffic. Because of the comparatively high water table and other engineering considerations the latter is the general design for the Salt Lake facility.

The freeway has been proposed generally as a four-lane divided highway.

Concluded on page 144



Longer and stronger runways

at a Marine Corps airfield

MODERN MILITARY aircraft, heavier, more powerful, and with ever increasing wheel loads require longer and stronger runways, which has necessitated improvements at most air bases. One such extensive improvement project brought about by these bigger and faster planes is the modernization of the USMC Air Station, El Toro, California, into a master jet field. The improvements are currently being carried out under the direction of the Eleventh Naval District, with the work being done under a \$6,490,000 contract by Messers and Bevanda Constructors and J. Teichert & Son, Inc.

Site and improvements

Airbase facilities at El Toro consist of five runways set in a figure four pattern with two parallel runways extend-

Modernizing program at El Toro brings lengths up to 8,000 ft. and includes adding more base and surfacing—Contractor develops screed on motor grader to speed placing hot-mix leveling course

ing east and west, and two extending north and south. The fifth acts as the diagonal of the figure four and extends in a southwest-northeast direction to intersect the ends of the east-west and north-south runways. One of each set of parallel runways is surfaced with portland cement concrete and one is paved with asphaltic concrete. The diagonal runway and the taxiways are of asphaltic

concrete. All runways are 250 ft. wide and vary from 5,700 to 7,200 ft. in length. The length of the asphaltic concrete runways totals 19,100 ft., and the lengths of the concrete runways total 12,300 ft.

Improvements being made during the current program consist of:

1. Extension of the three runways to 8,000 ft. by construction of about 5,600 ft. of 250-ft. width, 10-in. reinforced

PROCESSING PLANT producing crusher-run and select material. The crusher run of minus 3-in. is loaded directly for hauling to the job, and the select is stockpiled.

SPLITTING DEVICE which permits the full stream of minus 3-in. material to be divided by this operator into varying amounts for direct crusher run, or for further processing into select material.





AFTER LEVELING, the top 12 in. of soil-in-place is pulverized (top) and compacted to 95% to provide the sub-base. On existing asphalt runways, a tack coat is applied (bottom) and bottom-dump wagons spread select material in a 5-in. layer.

concrete pavement, and about 5,060 lin. ft. of 10-in. concrete pavement in varying widths for taxiways and warm-up areas.

2. Strengthening existing concrete runways by placing an overlay of a minimum of 4 in. of asphaltic concrete.

3. Strengthening existing asphaltic concrete runways and taxiways by placing an overlay of a minimum of 5 in. of crusher run material plus 3 in. of asphaltic concrete.

4. Establishment of safety zones roughly 1,000 by 1,500 ft. in size at the ends of the four major runways.

5. Construction of runway shoulders 125 ft. wide of crusher run material compacted and treated with penetration asphalt.

6. Relocation of 23,000 ft. of existing road passing around perimeter of field to make room for these extensions, and construction of 26,000 ft. of new road having a 24-ft. roadbed with 6-ft. shoulders and a 3-in. asphaltic concrete surface.

7. Drainage work and installation of new and improved types of airfield lighting, and replacement of most of the existing electrical wiring in the lighting system. Part of the drainage and all of

the electrical work is being done by sub-contractors.

As a base for the widespread and varied operations the contractor was permitted to establish a "contractor's yard" on the station. In this yard, surrounded by a 6-ft. wire fence, are the batch plants, aggregate stockpiles, shops, offices and general assembly area. Located in the least congested area of the air station, relatively easy access is available to the construction sites.

The station remains in full operation during the present construction work and close cooperation between the contractor and base personnel is mandatory in determining which runway or area may be worked at a specific time. This is due to climatic conditions and wind directions which dictate the runways that can be used.

Earthwork

To provide material for the subgrade beneath the runway extensions and the relocated road, the 5-in. layer placed on existing asphaltic concrete runways, and the imported crusher run for shoulders and end zones, the contractor opened a borrow pit on a hillside a short distance north of the air station. Adjacent to the

pit, and on a lower elevation, a plant was set up capable of producing 1,000 ton of select and 1,800 tons of crusher-run material per day. Material in the pit is a decomposed granite with occasional layers of below specification clay. This clay required some shifting of pit operations.

Material is loaded at the pit by shovel and hauled in 16-yd. end-dump units to the plant hopper at the pit's edge. From the hopper material falls to a 3-in. screen. The oversize material, scalped by this screen, falls directly into a crusher. After passing through the crusher it is combined with the material that passes the screen, and conveyed to the top of the second section of the plant.

Leaving the conveyor at the top of the second section of the plant the material passes a simple splitter (see photo that divides the stream with part going into a hopper to be used as crusher run and the other part moved by conveyor to another set of screens for processing as select material. This latter material is carried from the splitter to a 2-in. screen and the oversize is fed into a small roller crusher and then passes back to the screen. Material passing the 2-in. screen falls to a 3/8-in. screen for removal of fines. In processing the select material about 20% of the fines are removed.

Crusher run material falls directly from the hopper into bottom-dump unit for hauling to the job. Select material is

BATCHING of concrete aggregate was carried out in these two plants: (top) a Noble automatic 2 1/2-yd. plant to dry-batch for the paver, and (bottom) a Johnson plant with Hardy automatic scales to supply the transit mix trucks.



backpiled until needed and then loaded dragline into bottom-dump hauling units.

Due to the lengths of the runways one of the hauls from plant are as long 9,000 ft. one way.

Total excavation and fill on the project involves moving some 700,000 cu. yd. material. The majority of this is required in leveling for the runway extensions and the end zones where cuts up to 5 ft. in depth have been required. Tractors and scrapers are being used for most of this work and when the job is completed they will have handled some 3,000 cu. yd.

Base and subgrade

After initial leveling of the subbase the next step in the work of runway extensions consists of pulverizing the

grade is 1% with a maximum rate of change in grade of 0.3% per 100 lin. ft. Transverse grades are held to an upper limit of 1½%.

Strengthening of the existing portland cement concrete runways, 5,500 and 6,700 ft. long, is being accomplished by placing a 4-in. minimum layer of asphaltic concrete (plant mix) in two lifts. The first, or leveling course, is being placed with an improvised spreader made by equipping a standard motor grader with spreading frame and screeds. The second lift, or wearing surface is placed with conventional equipment.

While not providing the finished job yielded by conventional equipment the improvised spreader is capable of placing the leveling course at the rate of about 200 tons per hour. In adapting the

eliminate minor variations and obtain uniform grades.

The work is proceeding at the rate of about 1,500 tons per day which is equal to an area of about 3,000 sq. yd. Top day production reached 2,518 tons of material.

Asphaltic runways

Existing asphaltic concrete runways are being strengthened by applying a tack-coat of 85-100 penetration asphalt, a 5-in. minimum layer of select graded material followed by a 3-in. layer of new plant mix asphaltic concrete.

In carrying out this operation the runway is power broomed and the tack coat applied by distributor. The bottom dump hauling units are then assembled a short distance from the work area to be able to move at near top speed when discharging their loads. As only a 5-in. layer of imported material is required it is desirable to have the hauling haul units moving at a relatively high speed when dumping. This speed is such that the spotter is required to move down the runway on the run to be in position to signal following units. After material is dumped it is spread with motor graders and rolled with both steel and pneumatic tired rollers. The layer of plant mix is placed in the conventional manner.

Due to the difference in thicknesses of the overlays on existing runways a leveling course of new asphaltic concrete material is required at intersections of existing runways and taxiways. This material is sometimes as much as 8 in. in depth.

Asphaltic material being used on the project involves some 255,000 tons of plant mix, 2,400 tons of MC-1 penetration asphalt, and 50 tons of asphalt emulsion. The material for the surface and leveling work is classified in U. S. Navy specifications as an "A-mix" with a 1-in. maximum size aggregate and 6% asphalt. A "B-mix" with ½ in. maximum aggregate is being used in the transition areas.

Runway extensions

Standard paving procedures are being used in construction of runway extensions, taxiways and warmup areas. This work involves some 2,000,000 sq. ft. of 10-in. concrete reinforced with welded mesh with ¾-in. size wire. This pavement is placed on the previously described subgrade.

Concrete is Type G in U. S. Navy specifications and is designed for 4,000 lb. in 28 days. An average 1.4 cu. yd. batch contains 30 gal. water, 855 lb. cement, 1,723 lb. sand (—¾ in.) and 3,008 lb. of coarse aggregate consisting of 913 lb. of —3 in. to 1½ in., 1,399 lb. of 1 to ¾ in., and 699 lb. of —1 to ¾ in. Concrete is placed at a 2-in. slump. Concrete is dry-batched in the contractor's yard area. Production has been averaging 650 yd. placed per day.

The general paving method is to place 25-ft. alternate lanes, returning in 7 days to pour the fill-in lanes. About 6,000 ft. of header board is being used on the project and finishing equipment is equipped with interchangeable wheels, steel and rubber tired, which enables it



DB-DEVELOPED SPREADER and leveler for plant-mix base course. This motor grader was equipped with an 18-ft. width of screed and was able to spread up to 200 tons of material per hour.

ative soil to a depth of 12 in. and compacting to 95%. On this base is placed a 3-in. layer of select material in 3-in. lifts and compacted to 95%.

To reduce danger of aircraft over-shooting the paved runways, safety zones roughly 1,000 by 1,500 ft. in size are being established at the ends of the four major landing strips. After leveling, these zones are treated with a pulverizer to a depth of 12 in. and compacted by deepfoot rollers to 95%.

On the shoulders the inner 50 ft. of the 125-ft. width is built up of 12 in. of pulverized and compacted base over which is placed a 12-in. layer of select material. The outer 75 ft. of the shoulder is pulverized and compacted only to a 4-in. depth under the imported base material.

Runway improvements

Runway design was based on a load of 3,000 lb. per wheel at 250-psi. tire pressure. Plans were made and the depth and types of material required to strengthen the runways were computed for this load. Maximum allowable longitudinal

grader for this work the blade was removed and in its place a spreading frame 35 ft. long and 10 ft. wide was installed. The spreading frame surrounds the grader and contains three sets of adjustable screeds. These screeds are shaped like two sides of a triangle with one point forward and the other pointing towards the back of the frame. As this frame is attached to where the blade normally would be the same control in changing the angle of operation is maintained. Another factor aiding the speed of operations with this spreader is that when turning or moving the machine the frame can be lifted clear of the ground, enabling the motor grader to move at normal speeds. Generally the spreader is operated with a crew of five shovelers or rakers. To receive the material trucked from the hot plant some 12 mi. from the air station, a 10-ft. spreader box was fastened to the front of the frame. Due to irregularities in the existing pavement a leveling-course depth of more than 4 in. is required in some areas. The improvised spreader is also being used in some of the transition areas to

to ride on either header boards or previously laid pavement.

For inserting the reinforcing mesh a 7-in. course is poured and vibrated, the mat is then placed and the paver moves back to pour the top 3 in. The pavement is vibrated again after which the finishing crew moves in. The final surface is broomed and curing compound applied. The project involves 68,000 cu. yd. of concrete.

Joints

One of the interesting features of the runway extensions are the construction joints. Longitudinal joints are at 12½-ft. centers providing for one on each side of a 25-ft. width of slab and one in the center as it is poured. Three types of transverse joints are used with weakened planes of 2½ in. placed at 15-ft. intervals. Every 45 ft. a doweled construction joint is set which consists of 25 steel dowels 22 in. long and 1¼ in. in diameter. A transverse expansion joint is inserted into this sequence every 225 ft. All joints are filled with rubber jointing compound and covered with sand to keep the curing material from reaching it. It has been found that if the curing compound entered the joints the filler

material would not properly adhere to the concrete during expansion and contraction.

To provide for runoff from areas outside the air station as well as parts of the station a 3-barrelled reinforced concrete box culvert 3,500 ft. long is being constructed. Each barrel is 4½ ft. by 6 ft. with expansion joints at 75-ft. intervals. For construction of the culvert fabricated steel form sections that are moved ahead on dollies are being used. In operation the invert is poured, vertical reinforcing set, and then the steel forms, made in 37½-ft. sections, are moved ahead and set up. The remainder of the steel is then set, followed by placing concrete for the sides and top. Forms are collapsible for moving ahead. Additional drainage consisted of 30,000 ft. of reinforced concrete pipe with catch basins spaced at 400-ft. intervals. This work was carried out under a subcontract to the joint venture team.

Contractor's and Navy personnel

Grimes, Hood and Irish are subcontractors for installation and renovation of the electrical system. A joint venture consisting of Consolidated Rock Co., and Graham Bros. are supplying aggregate

Equipment at El Toro

- 20 D8 Caterpillar tractors and dozers
- 8 RU and FU carryalls
- 8 Model 12 Caterpillar motor patrols
- 2 DW-20 Caterpillar earthmovers
- 5 Tournapulls
- 8 Double-drum sheepfoot tampers
- 11 Buffalo-Springfield rollers, 2- and 3-wheel
- 4 Rollers, pneumatic
- 1 Barber-Greene finishing machine
- 1 Asphalt spreader on Caterpillar Model 12 motor patrol
- 1 Model 34-E DD Rex paver, with subgrader, spreader and finishing machine
- 2 20-ton truck cranes
- 2 Model 80-D Northwest shovels and cranes
- 14 Euclid trucks
- 9 Water trucks, 3,000- to 4,000-gal.
- 1 Lowbed transport truck
- 2 Rock crushing plants, complete



THE CONTRACTORS—Matt Bevanda, seated and Vincent Bressi, principals of Bressi and Bevanda Constructors who hold the \$6,490,000 general contract for the work at El Toro.

THE NAVY—Directing engineering operations on the project are (left to right): Lt. (jg) H. W. Flippen, Comdr. T. B. McGlashen, Lt. Comdr. W. R. Jenkins and Lt. Comdr. J. C. Young, of the Eleventh Naval District.



gate and cement. Sully, Miller and Swigert are supplying the plant with asphaltic material. O. J. Porter Company is directing the soil studies and testing.

Captain A. I. Flaherty, CEC, USN, is officer in charge of the project. Commander T. B. McGlashen, CEC, USN, is resident officer in charge of construction. Lt. Comdr. W. R. Jenkins is ARON Project engineer for the Eleventh Naval District is Jack E. Davis. J. A. Kean is superintendent of construction and V. Bruce is senior inspector.

G. C. Weeshoff is project manager. Bressi and Bevanda Constructors and A. Teichert & Son, Inc. Roy J. Hill is general superintendent and Robert Skinner and Dominic J. Bressi are excavation and structure superintendents respectively. Other key men include L. Wright, project engineer; E. G. Byrd, office manager, and A. L. Hamm, master mechanic.

Two English firms win Western contracts

TWO ENGLISH FIRMS entered the Western construction picture last month.

For the first time during construction of McNary Dam on the Columbia River an English firm submitted the lowest bid for a phase of the project. The low bid by Ferranti, Ltd., Lancashire, England, of \$1,055,000, was for nine transformers to be fabricated and installed in the McNary powerhouse. Other bidders were Maloney Electric Co. of St. Louis, \$1,432,000, and Allis-Chalmers Mfg. Co., \$1,450,000.

The first foreign equipment to go into the Folsom Dam power plant on the American River in California will result from a low bid of \$302,900 by the English Electric Company. The bid is for an 80,000-kva. transformer. The firm's bid was low of five, and was the only one stating that delivery would be made within the time specified. Ferranti, Ltd., was the second lowest bidder. Other bidders were Westinghouse Electric, General Electric and Allis-Chalmers.



he story of traffic on the Carquinez Bridge —

Will it be a **TWICE TOLLED TALE?**

By

**SENATOR
RANDOLPH COLLIER***

*Chairman, Committee on Transportation
and Interim Committee on Highways,
Streets and Bridges
California Senate*

LACK OF ADEQUATE traffic facilities across Carquinez Strait has long been one of the worst bottlenecks in California's internal transportation system. The Strait lies to the northeast of San Francisco Bay and is the passage for all river flow from California's Central Valley, drained by the Sacramento and San Joaquin rivers. U. S. Highway 99, one of the important transcontinental highways, crosses Carquinez Strait. For many years all traffic, both rail and highway, was carried across the Strait by ferry. Consequently, the completion of the Carquinez Bridge in 1927 was regarded in California as perhaps the most significant single highway improvement of the decade.

The Carquinez Bridge ranks among the world's foremost structures. Later construction of the more famous Golden Gate Bridge and of the San Francisco-Oakland Bay Bridge have caused many to forget that the Carquinez structure is still one of the really great bridges of the world. Its two 1,100-ft. cantilever spans exceeded in length in California only the East Bay cantilever span of the Bay Bridge. Constructed at a cost of about \$8,000,000, the Carquinez Bridge was a major bridge-building achievement.

Originally a toll bridge

The bridge was completed by the American Toll Bridge Co. in May 1927

*Senator Collier is noted as an authority among California legislators for his comprehension of the state's problems and needs in highway financing. His advocacy of an additional \$1,000,000,000 (possibly by bond issues) for California highway construction in the decade 1950-1960 was summarized in his signed article appearing in *Western Construction* for June 1950, pp. 81-82.—Editor.

and was opened to traffic in the same year. It was operated as a toll bridge by its private owners until September 1940, when it was purchased by the California Toll Bridge Authority. During less than 5 years of state ownership, the tolls that were collected retired the \$6,850,000 of indebtedness incurred by purchase of the bridge, and the structure became toll-free in August 1945. Retirement of the revenue bond issue in such a short time was due in large part to the tremendous increase in defense traffic to military installations such as Mare Island Navy Yard, Travis Air Force Base at Fairfield, and numerous other bases in the Sacramento and Marysville areas.

Traffic concentration

The bridge now carries most of the traffic between the San Francisco Bay area and Vallejo, the Sacramento Valley, the Napa Valley, and, via U. S. Highways 40 and 50, the entire intermountain West. The route is also used by business and commercial traffic en route to the Pacific Northwest via Redding and Red Bluff. It is still a vital link between the strategic Bay area and essential military installations. As these are now reactivated and expanded, it is reasonable to expect Carquinez Bridge traffic again to display the accelerated increases that occurred during World War II.

Within a few years, the planned four-laning of U. S. Highway 40 will be com-

INCREASING TRAFFIC congestion and numerous accidents have focused attention on two of California's critical highway deficiencies, (1) the inadequate width of 3-lane Carquinez Bridge and (2) the hazardous sub-standard connecting highway to Richmond. Because of difficulties in financing needed improvements, there is little prospect that these deficiencies can be corrected in the foreseeable future unless tolls are re-imposed.

plete from Carquinez Strait to a point several miles east of Colfax in the Sierra Nevada. Also, a considerable length of State Route 29 has been developed in the last few years as a four-lane freeway between Vallejo and Napa. Other recent improvements, which will lead to increased traffic, are planned or have recently been completed for U. S. Highway 99W, for U. S. Highway 50 east of Sacramento, and for other highways in the Sacramento Valley. Thus, the three-lane Carquinez Bridge has become one of the most serious bottlenecks in the entire state highway system, and traffic frequently backs up, bumper to bumper, for 2 mi. on either side of the narrow structure.

Traffic hazard

The bridge itself has been the site of a number of spectacular truck and automobile accidents. The sharp curve at the south approach trestle is especially dangerous: 8 people were killed there in less than two years. To render an already unsafe situation even more haz-

The approach—"a crooked line of death traps"

THE 14-MI CONNECTING highway (U. S. 40) between the Carquinez Bridge and Richmond, although four lanes throughout, is one of the most obsolete roads in the state. Its design standards—that is, limited vertical sight distance, sharp curvatures, inadequate shoulders, continuous roadside development, and lack of a median strip—reflect the practices of 30 years ago and serve to emphasize the advance of automotive transportation far beyond the financial capacity of highway construction agencies to keep up.

The road can best be described as one crooked line of death traps. Ribbon commercial development along several miles of the highway, particularly at Pinole, Rodeo, San Pablo, and near Richmond, makes traffic subject to the delay, hazard, confusion, and congestion of a major city street. The highway is not wide enough to permit construction of a median strip; head-on collisions occur frequently. Several sharp curves also contribute to the traffic hazard. Numerous traffic signals and a dangerous railroad

crossing add to the delay and confusion. The high accident rate has forced imposition of a 45-mph. speed limit for the entire 14 mi., except where 25- and 35-mph. limits prevail.

To correct the critical deficiencies of this outmoded highway, plans were developed during World War II for an entirely new freeway on new alignment from the present terminus of the Eastshore freeway in El Cerrito (just south of Richmond) to the Carquinez Bridge. Plans and specifications for almost all the required bridges and separation structures were completed and practically ready for bidding. However, due to lack of funds and because of many other pressing highway needs in the area, it was necessary to defer construction of this freeway indefinitely. Available highway construction funds have been devoted instead to extension of the Eastshore freeway in the south toward San Jose, and to improvement of State Route 24 from the Broadway low-level tunnel (Oakland) toward Walnut Creek, Pittsburg, and Antioch.

ardous, this "deadman's curve" on the trestle is directly over the main-line tracks of the Southern Pacific. Officials of the railroad have expressed grave concern that a large truck might plunge off the bridge and fall on the tracks in the path of a high-speed train. They were particularly alarmed only a few months ago when a truck-trailer combination did crash through the bridge rail and fall within a few feet of the tracks. Thus, with the present dangerous bridge approach, the threat is always present of a major catastrophe involving a disastrous train wreck.

Legislature requests investigation

Due to frequent accidents and traffic jams, the inadequate width of the Carquinez Bridge became the subject of concern in California's legislature nearly 7 years ago. Assembly Resolution No. 314, adopted on June 16, 1945, directed the State Division of Highways to investigate the possibility of building additional traffic facilities across Carquinez Strait.

In conformance with this resolution, the first of a series of reports on the Carquinez problem was published by the Department of Public Works in January 1947. This report compared the economies of (1) erecting a parallel bridge for one-way traffic and (2) adding a second deck to the present structure. Later, the feasibility of cantilevering additional roadways from each side of the main truss of the existing bridge was also investigated as an alternative to the double-deck scheme. These additional roadways would be restricted to passenger vehicle use and would be supported by outrigger extensions. The present roadway between the trusses would be

reserved for truck and bus traffic.

The most economical plan was then (1947) estimated to cost about \$10,000,000, including a tunnel connection to Rodeo, 2½ mi. to the southwest. However, all gas tax revenues were earmarked for other purposes in 1947. Since funds were not obtainable to finance the work, no action could be taken. To date, no definite conclusion has been reached as to which of the three schemes would be most desirable from the standpoint of cost, engineering practicability, and national defense. Also, it now appears that the minimum cost would be about \$20,000,000.

Gas tax funds won't do

Contrary to the belief of many people, gas tax funds available for new highway construction in northern California are strictly limited by law. Only 45% of all highway construction funds may be expended in the northern counties; 55% is reserved for the southern counties. Furthermore, priority must be given to needs for maintenance, right-of-way, engineering, minor improvements, and the like. As a result, the net amount available for new construction in the northern counties (from Fresno to the Oregon border) is currently between \$25,000,000 and \$30,000,000 per year. This money must be distributed for projects in 45 different counties. Because of the numerous critical deficiencies in other counties, the amount which can be spent each year in Contra Costa and Solano counties alone (site of the Carquinez Bridge) is limited to about \$2,000,000.

In addition to the Carquinez Bridge itself, time has shown the 14-mi. connecting highway to Richmond to be woefully inadequate. Described else-

where on these pages, this stretch of S. Highway 40 has been proposed for reconstruction to freeway standards on an entirely new alignment, by-passing several small communities and commercial developments that hamper traffic on the present route. Since this freeway would cost from \$15,000,000 to \$20,000,000, and the bridge widening another \$20,000,000 (including the Rodeo tunnel connection), it is clear that both freeway and bridge cannot be financed in the foreseeable future from gas tax funds.

Tolls are logical

Because of the expanse of San Francisco Bay, and the mountainous surrounding terrain, it has often been necessary to turn to other methods of financing needed highway improvements, particularly the long over-water crossings. The Dumbarton, San Mateo, Hayward, San Francisco-Oakland Golden Gate, Carquinez, and Antioch bridges, and the Sears Point toll road were all constructed as toll projects. The Broadway low-level tunnel (Oakland) between Alameda and Contra Costa counties and the Posey Tunnel under the estuary between Oakland and Alameda were financed from bond issues. Several Bay area highways have been constructed by joint highway districts. Among proposed projects, the Richmond-San Rafael bridge, a new Bay crossing from San Francisco, a new Oakland estuary tube, and a new north approach to the Golden Gate Bridge will all be financed directly or indirectly by tolls. Therefore, toll financing appears to be the most logical and practical means of paying for necessary bridge and highway improvements in the vicinity of Carquinez Strait.

It should be emphasized that no other highway bridge project in California is as costly as the necessary Carquinez Bridge widening has ever been financed by gas tax revenues. All have been paid for by tolls or bonds. For purposes of comparison, the original \$8,000,000 cost of the Carquinez Bridge (1927) is almost three times the cost of the most expensive highway bridge ever financed from gas tax revenues in this state. With this in mind, it would be unreasonable to look to gas tax sources for the \$20,000,000 required to widen, double-deck, parallel the Carquinez Bridge.

Tolls are feasible

Existing legislation, the California Toll Bridge Authority Act, would permit immediate financing of the desperately needed bridge widening at Carquinez Strait, and also the essential freeway connection to Richmond. Indeed, it appears to be the only practical method except for the unlikely event of passage of a state general obligation bond issue. Assuming only present traffic volume and an estimated toll of 25 cents per vehicle, revenue bonds up to a total amount of \$40,000,000 to \$50,000,000 for the bridge improvements and for the Richmond-Carquinez freeway could readily be amortized. It is believed that any remaining required funds for freeway

Concluded on page 98

HOW IT WAS DONE...

HOW suspended scaffold saved job time and money

AS A RULE, heavy duty swing scaffolding comes into its own for skyscraper construction where the erection of stationary scaffolding to reach the top towers would be uneconomic. But there are other situations where the suspended platform is highly practical. A current project of the Cahill Construction Co. is an excellent example of one such situation.

The problem was to add a floor to the newly-completed six-story Cahill Building at Sacramento and Sansome streets in San Francisco. It would have been annoying to the tenants in the occupied lower floors of the building to construct stationary scaffold from the ground up, and, after consultation with Beatty Scaffolding Inc., it was decided that a heavy duty suspended scaffold would provide a sufficiently large and rigid platform to accommodate marble workers and brick masons, and would be considerably more economic.

A standard Beatty suspended scaffold machine with a platform width of 5 ft. was erected around three sides of the building—a total of approximately 250 ft. Steel cantilever beams, spaced 7 ft. apart, were projected from the parapet wall, secured on the roof side with U-bolt steel rods.

Cable cast steel pulley rope—with a breaking strength in excess of 8,000 lb. which is many times the amount required for the load under actual working conditions—was suspended from the cantilever beams and wound around winch drums at the platform level. Extra security is provided by two pawls on the drum mechanisms which positively lock them. The cable cannot slip nor can it be unwound without hand release of the locking pawl.

Marble workers of the Vermont Marble Company were first on the stage, hoisting their supplies on a material trolley and carrying them by dolly to the working area.

Foreman E. C. Van Kirk reports that the job of pouring, setting and grouting the marble panel 6 ft. 2 in. high and approximately 250 ft. long was done in three weeks' time, using 4 setters and 6 helpers. He considers this excellent time and credits the comfortable working conditions and safety of the scaffold in part for the good record.

Marble workers will be followed on the scaffold by Harry E. Drake Company brick masons. Final step is the cleaning and finishing of the marble panels, which will be done by lowering the scaffold, floor by floor to the ground.

AT RIGHT: View of the heavy-duty suspended scaffold around three sides of the Cahill building (250 ft.). This technique gave a comfortable working platform for addition of building's top floor—without the inconvenience which scaffolding from the ground up would have caused tenants.



Harry Berg, superintendent of the job for Cahill Construction Co. was pleased that the scaffold could be constructed at the seventh floor working level, rather than following the usual practice of raising the stage from the ground. This short cut meant a saving

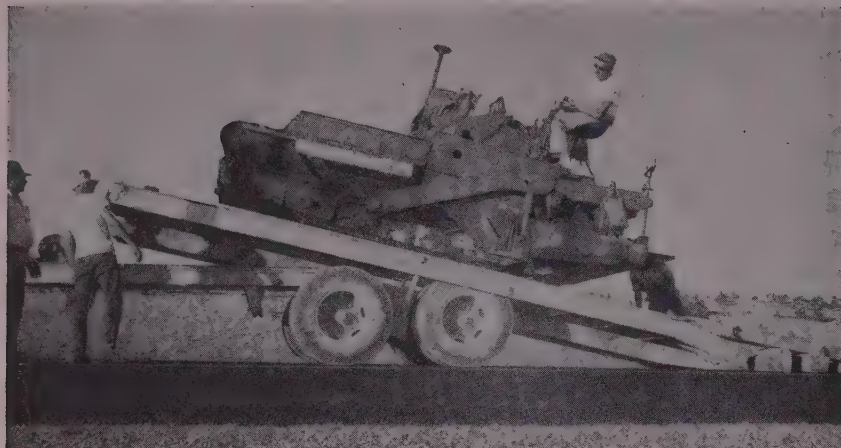
of at least two days in time and labor.

Where it is necessary to protect workmen from danger of materials falling overhead, Beatty's suspended scaffolds come equipped with overhead protection attachments consisting of angle iron frames on which planks may be laid.

AT RIGHT: Workers use the Beatty scaffold to set marble panels on top floor of the building. Guard fences are secured to steel guard rail posts which are attached to the drum frames of the scaffold machine.



HOW tilt-trailer moves paver; speeds patching operation



FOR PATCHING sections running from 200 to 1,000 ft. in length prior to resurfacing a 28-mi. portion of a state highway in central Oregon, Babler Bros. and Rogers Construction Co., Portland, took advantage of a tilt trailer that permitted quick loading and unloading of a Barber-Greene paving machine. This preliminary patching, which required 5,000 tons of mixed asphaltic material, was carried out from one end of the job to the other before the paver commenced the resurfacing operation.

In operation the tilt trailer carrying

the paver would arrive at the area to be patched, the trailer tipped and the paver would move off under its own power. As the paver reached the end of the patch area the trailer would be set in position and tipped with the lower edge touching the road. As the paver completed the patch it would keep moving and crawl up on the trailer. As the paver slowly passed the center of balance on the trailer its weight would cause the bed to return to a horizontal position. Once loaded, it could quickly be taken to a new patching area.

HOW proper conveyor belt care decreases your maintenance costs

INCREASED SERVICE LIFE and decreased maintenance cost are dividends that result from investing proper care in belting used on conveyor installations. Thermoid Company, manufacturer of conveyor belting, has completed a study of factors contributing to excessive wear. Under the direction of Newell Perry, belting engineer, the study singled out loading conditions as a prime factor in belting deterioration.

The loading point is a danger zone. Both existing and proposed installations should be regarded with the intention of creating "ideal" loading conditions.

One of the basic requirements for low-rate belt wear is to see that material loads the belt while moving in the same direction and at the same speed as the belt. Where this requirement has not been satisfied, installations have shown excessive belt wear due to abrasion created at the loading point.

When lumpy material is being carried, an attempt should be made to have such material cushioned by a prelaid layer of fines. A screen or "grizzly" at the bottom of the loading chute or, in some instances, an oval or "fishtail" notch cut in the lip of the chute will satisfactorily deposit a layer of fines over the belting,

providing protection against bruising.

At the same time, the velocity of loading-material flow should be controlled by pitching the loading chute properly. If this is not feasible, a baffle of iron or wooden bars should be constructed in the chute so as to reduce the speed of material flow onto the belt. However, the minimum rate of this flow should still be sufficient to maintain delivery.

In no instance should a material strike the belt directly above a solid pulley because the resulting hammer-anvil action will quickly render the belting unusable. The chute should be located so that material will strike the belt between idlers. However, in cases where heavy material is being loaded, it may be necessary to load directly over rubber-covered or pneumatic idlers.

In some cases, impact of the load between idlers will set up belt vibration. Resultant chattering may depress the belt sufficiently to allow material to escape under the skirt-boards. This may be prevented by locating the chute so that loading material will strike the belt far enough ahead of the tail pulley to allow insertion of at least one belt-steadying carrier pulley.

Construction of loading chute skirt-

boards and flexible skirts should be carefully considered. Skirt-boards should be long enough to settle the material before it leaves the loading area. Flexible skirts are preferably improvised from rubber-covered edges of belting remnant. The remnants should be placed so that the rubber-covered edge contacts the belting. Should this be reversed, and the exposed-fabric edge of belt remnant placed against the moving belt, grit will collect in the fabric.

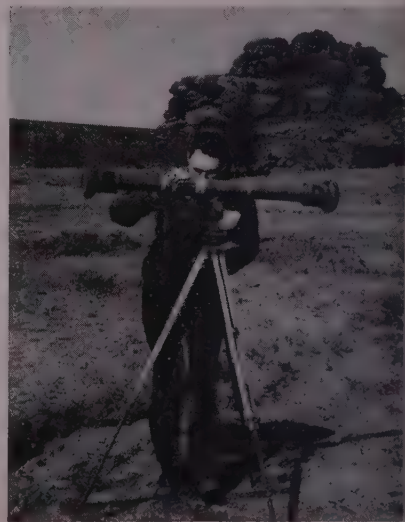
Vertical spacing between chute skirt boards and belt increases toward the open end of the chute. Thus the width of flexible skirts, as cut from a belt remnant, should increase toward one end. This construction allows uniform contact between the flexible skirt and belt over the entire length of the chute skirt and minimizes spillage around the loading point. At the same time, wedged lumps of material can be worked free by the forward motion of belting.

Summarizing, the life of your belting depends upon these five important conditions of loading:

1. Loading material should discharge at the same speed and in the same direction as that of belt movement.
2. Lumpy material should be cushioned on belting by a prelaid layer of fines.
3. Chute discharge should strike between closely-spaced carrier pulleys or where heavy material is encountered should strike directly over rubber-covered or pneumatic idlers.
4. Falling distance from chute to belting as well as discharge velocity of material should be minimized.
5. Chute construction should be such as to settle the load properly without allowing spillage or jamming of material around the chute outlet.

Range finder for surveying

Surveyors plotting Union Pacific's new westbound route between Cheyenne and Dale Creek, Wyo., use this army range finder to speed determination of distances. Through a peep-sight, the surveyor focuses the lenses at either end of the horizontal tube on a distant point; distance measured by triangulation.



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Full schedule of sessions at AGC convention in Detroit

OVER 1,000 contractors convened in Detroit, Mich., February 28 for the 33rd annual convention of the Associated General Contractors of America.

Following a full business schedule, the contractors passed important resolutions and elected a new slate of officers to serve in 1952. The focal point of discussion centered on the increase in government controls which led the group to recommend strongly that controls over construction activity be relaxed and abolished as soon as possible consistent with the needs of national defense, and that sufficient warning of control relaxation be given in order that advanced planning for needed projects can be effected.

The discussion of highway construc-

tion before the convention brought out the results of a survey conducted by the American Association of State Highway Officials which shows the need for the expenditure of \$32,000,000,000 on the federal-aid highway system alone over the next ten years. The AGC feels that this is a conservative estimate of the needs and recommends to Congress that it adopt the recommendation of AASHO for a federal-aid highway authorization of \$810,000,000 for each of the fiscal years 1954 and 1955 as the minimum essential to prevent further deterioration of the highway system.

Right of judicial review

As a result of the Wunderlich decision rendered by the Supreme Court in No-



ARTHUR S. HORNER, Denver, Colo., contractor, is the 1952 president of the AGC.

Lt. Gen. Pick restates Engineers' policy on alternate bids to AGC

ADDRESSING a general session of the 33rd annual convention of the Associated General Contractors, held at Detroit in February, Lt. General Lewis A. Pick, Chief of Engineers, restated the position of the Corps of Engineers in regard to evaluation of alternate bids. The recently adopted procedure has caused much controversy since its inception, particularly in the determination of low bidders for three Army warehouse construction projects in the West. All bids were rejected for a job at Auburn, Washington, last November. Contracts for two other jobs, at Sacramento Signal Depot and Sharpe General Depot (Stockton) in California, were awarded to low bidders on the original designs, although alternate designs had been accompanied by even lower bids.

The following is a single, continuous quotation from General Pick's remarks before the AGC convention and constitutes his entire coverage of the subject at that time:

"In regard to bids and bidding procedure, I want to explain our procedure in inviting and awarding alternate bids. There has been a great deal of misunderstanding concerning this policy which was recently adopted by the Corps of Engineers. This procedure permits the submission of bids based on alternate materials and methods of construction in place of those provided for in the standard Government specifications.

"The practice was adopted in an effort to take advantage of all possible economies in construction. The Congress and the Department of Defense have been approached by many sponsors of designs and special methods of construction differing from standard plans. These sponsors claim their materials and/or systems of construction will result in lower costs. We cannot deny them the

opportunity to bid their alternates in competition with the standard design since there is no way of establishing in advance of the bid opening whether they can be provided at a lower cost. No contractor is required to submit a bid on an alternate material or method of construction and there is no need for him to employ engineering or architectural service for this particular purpose.

"Before submitting a bid on an alternate design, a contractor should determine whether his design conforms to the basic limiting dimensions, physical criteria of the buildings, and to general standards specified by the Corps of Engineers. Alternate bids must be accompanied by the bidder's plans and specifications in sufficient detail to permit evaluation by the contracting officer. Drawings must indicate the portions of the design at variance with standard plans. The alternates must also be comparable in appearance and equivalent in quality, life expectancy, fire resistance, insulation, maintenance economy, structural soundness and completeness of equipment, fixtures and accessories to those required in the Government plans.

"Determination as to the acceptability of alternates will be made by the contracting officer. His decision is final. All of these conditions are clearly set forth in the invitation to bid.

"Generally, we expect that the low bid will be based on our standard designs because these designs have been adopted only after extensive study and with the belief that they represent the most economical means of providing the desired facilities. At no time does this procedure place a burden on contractors desiring to limit their bids to standard plans. This practice will be continued until experience shows that it is not producing the desired results."

ember 1951, interpreting the "dispute clause" (Article 15) of the Standard Form of Government Contract to mean that the determination of a department head is final, and that there can be no recourse to the courts in disputes involving questions of fact unless fraud on the part of the government is alleged and proved, the AGC feels that Congress should pass legislation to prevent the destruction of the competitive contract method. Such legislation, the convention recommends, should give the courts the right of review over unjust or unsubstantiated decisions by contracting officers or agencies, and declare null and void any provisions which deny the parties the rights of judicial review.

Contract renegotiation

The following recommendations were made to the Renegotiation Board in the belief that they will serve the best interests of government agencies and will lead to contractors making excess profits: (1) exemption by classes of construction contracts, of types of work carried out by the government not directly related to national defense, of exemption of contracts or subcontracts to be performed outside the U. S. or Alaska, (3) exemption of construction contracts awarded after competitive bidding which have no immediate connection with national defense, (4) that the board permit the contractor the option of being renegotiated on an overall basis for all renegotiable work, on a completed contract basis, or to use measures other than income tax returns when losses are carried forward or back, so that it is equitable to permit any of the partners to a joint-venture to offset losses which they might have on other projects subject to renegotiation against the profits which might be made by the joint-venture.

Alternate design

In line with traditional policy contractors urge that the Department

Continued on page 116

ASPHALT PAVING DESIGN ADVANCES

Here are the latest techniques, as presented by the men who are the vanguard

CONTINUING ADVANCES in asphalt paving design and construction techniques were spotlighted recently at the annual meeting of The Association of Asphalt Paving Technologists, held this year in Cincinnati, Ohio. Brief abstracts of papers presented at the meeting are presented here, as prepared by Jewell R. Benson, special projects engineer for The Asphalt Institute. Titles of the papers appear in boldface type.

Reading, Rolling and Control of Surface Tolerances in Asphaltic Concrete Construction, including the Base Course

The author, S. C. Funk, described design specifications and procedures used to obtain close tolerances of course thicknesses, final grade and smoothness. A tolerance of $\frac{1}{4}$ in. of grade and cross section was required, with a tolerance of ± 0.16 in. measured with a 16-ft. straightedge required for the finished surface. Hand-raking methods used in finishing macadam surfaces and the use of three-wheel and hump rollers in finishing asphaltic concrete produced the required surfaces. All lower courses were placed to greater width than succeeding upper courses to provide adequate stability. The sub-base was constructed 18 in. wider than the wearing surface. No side forms were used, trenching and wider depths making forms unnecessary. The grade and contact of surface maintenance of the macadam used as a haul road during construction, and subsequent preparation of this surface for asphaltic concrete was discussed.

History of the Design and Construction of the Runways at the Naval Air Station, Alameda, Calif.

The author, Lt. George A. Pierce, described recent runway extension and recreation construction, including hydraulic fill, the design of the pavement including a 3-in. asphalt emulsion and sand mix sub-base, an 8-in. rock and gravel base and a two-course, 3-in. hot-mix asphaltic concrete surfacing. Plate bearing tests were used in design.

Comparison of Marshall and Unconfined Test Results

Correlation of Marshall test data and tri-axial test data had been discussed in previous paper. The authors, J. F. McLaughlin and William Goetz, indicated that data obtained by the Marshall and unconfined compression appear to be correlatable to a reasonable degree. The Marshall slow valve is also indicated to be correlatable to the internal angle of

friction determined by the tri-axial test. An important conclusion derived from test data indicated that some tests obtained from unconfined specimen tests might eliminate some mixes which would have satisfactory service performance. Neither Marshall stability nor Marshall flow, used alone, was believed adequate to prevent pavement brittleness; both used together, gave data for a flexible design of a mix.

Density Versus Stability

The authors, Francis N. Hveem and B. A. Vallerga, first emphasized that density, permeability and compaction were not synonymous, and that stability was related to none of the three. Comparisons between laboratory and service-compacted specimens were noted. Data relating to Hveem Stabilometer, Cohesimeter, Specific Gravity and voids as affected by the Triaxial Institute and the double plunger method of compaction, were given. It was indicated that specimens made by the Kneading compactor (Triaxial Institute) more closely approached density and structure obtained in the final pavement than specimens made by the double plunger method. It was noted that the "stability" of various asphalt mixes was a function of the rate of loading and that in standing loads, as parked cars, the stability of the mix was essentially only the stability of the aggregate mixture itself.

The Measurement of Voids in Bituminous Mixtures by Means of Pressure

Accurate void and volume data were described by J. M. Rice as obtained by a unique two-chamber device in which air under pressure in one space of known volume released into the second space by a valve, permitted the calculation of volume of material previously placed in the second space by application of Boyle's Law of Gases. The device was described as originally conceived by Bailey Tremper of the Washington Highway Department. Data were given on results obtained from the test, particularly in calculation of voids in asphalt mixtures, and a comparison of these data with data obtained by more conventional means. The data indicated a high degree of accuracy was obtained. The method is simple and rapid.

Compaction Methods and the Structure of Granular Plastic Materials

The authors, Victor A. Endersby and B. A. Vallerga, reviewed some fundamentals of compaction and particle arrangement and discussed results ob-

tained with kneading (Triaxial Institute), Marshall, Double Plunger and Gyratory compaction. The double-plunger method is indicated as the least sensitive of all compaction methods tested. As an example of the effect of type of compaction, the kneading compaction gave an optimum asphalt of 5½%, while all other methods gave from 6% to 8%. Specific gravity values of compacted specimens showed similar differences. The kneading compactor gave, for nearly every function, more pronounced "peaks" in test curves. An important conclusion of the test work was that the method of compacting the specimen may exert more influence on the test result than the method of test itself.

An Automatic Temperature Control Regulator for Ring and Ball Softening Point

A novel instrument was made for softening point determinations in which a gas flame was regulated in intensity through valves operated by a synchronous motor and gear chain, giving automatic control for temperature rise, as described by H. P. Hopps, Jr.

A Rational Design for Bituminous Paving Mixtures with Curved Mohr Envelopes

The author, Norman W. McLeod, discussed the meaning of "rational design" stating that such design permitted determination of supporting pavements directly in terms of pounds per square inch. The effect of pneumatic tires toward confining, as well as spreading the surface layers, was discussed. According to the author, a flexible-type surface stable in thin layers, may fail in thicker layers because of certain induced stresses. The restraining effect of the base course may be important in such cases. The author discussed benefits obtainable from a multi-pressure, compartmented tire, the inner tire having a high pressure, the outer a low pressure. Mohr Envelopes having curved rather than straight line, functions, and the interpretation of such curves in pavement design, was discussed.

Studies in Stabilization of Fine-Grained Soils with SC-oils by the Modified Bearing Test Procedure

The function of SC-type oils in stabilizing soils was described, together with the results of stability tests on four soil types, all fine grained with appreciable clay content, using naphthenic, paraffinic and resinous base oils. The tests indicated that the highest degree of stabilization was obtained with the paraffinic base oil, in this paper by Arnold J. Hoiberg and Marshall Brown.

The Hardening Properties of Asphalt

The results of tests made on various cutback and cement type asphalts, in which both Ottawa sand briquettes and $\frac{1}{8}$ -in. and $\frac{3}{8}$ -in. thick films of asphalt were aged at 325 deg. F., were described by J. T. Pauls and J. Y. Welborn. The tests indicated appreciable changes in asphalt consistency, solubility, ductility and other properties could occur at this

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temperature. The possible effect of gregate temperatures, as well as mix temperatures above 300 deg. on so asphalts, was emphasized.

The Gyratory-shear Method of Mold Asphaltic Concrete Test Specimens, Development and Correlation with Field Compaction Methods

Tests made by the Texas Highway Department indicated that at high loadings of specimens under ordinary piston and cylinder methods, excessive degradation of aggregate and failure to obtain desired densities frequently occurred. Many types of compaction, including Bureau of Public Roads Vibratory Method, were tried but none was found satisfactory. In the gyratory method finally developed by the department from which satisfactory asphalt-aggregate specimens were obtained, the upper piston was manually gyrated during application of static load, using two handles rigidly fixed to the upper piston for the purpose. To permit such manipulation, low initial static pressures were used. The authors, Lawrence Ortolano and Harry J. Sandberg, showed good correlation between their gyratory compacted and actual pavement specimens.

TWICE TOLLED TALE?

... begins on page 98

way construction could be obtained from gas tax sources.

To offset the 25-cent toll, estimated savings in decreased accidents, vehicle operating costs, and in travel time, would amount to almost 30 cents per vehicle. Of this, the fuel saving alone would amount to about 10 cents. The time required to drive from Vallejo to the northerly end of the Eastshore freeway would be reduced from about 20 min. to about 15 min. Frequent traffic jams, which now cause delays of from 10 to 45 min. at the Carquinez Bridge, would be eliminated.

Action needed now

The Carquinez Bridge widening project, the Richmond-Carquinez freeway, is urgently needed now, and the need is increasing with the reactivation of military bases to the north and east. Financing must wait until funds become available from gas tax sources, the delay of 10 to 15 years is inevitable before the project can be completed. Use of toll financing, bridge and freeway improvements can be built now, can pay off the indebtedness incurred, and can become again free facilities—all before construction would be completed using gas tax funds. Because of the great volume of traffic across the bridge, the project would be a sound and attractive undertaking for revenue bond type financing.

The continuing growth of population and traffic in California and the West and the vital strategic importance of the route make it imperative that steps be taken without delay to eliminate the Carquinez bottleneck.

The Dalles bridge project halted as Government takes land title

LEgal ACTION has been taken by the Portland District Office, Corps of Engineers, to secure title to 65 ac. of land which includes the site of the bridge at The Dalles, Oregon, now approximately one-third completed. The Government contends that the land is necessary for construction of The Dalles Dam across the Columbia River. This action will not only affect the contract for the bridge being carried out by Guy F. Atkinson Co., but will necessitate the relocation of the structure to a downstream site.

The situation has a long history involving the interests of the counties on either side of the Columbia River served by a ferry for many years. A bond issue was voted to purchase the existing ferry and construct the interstate bridge at the site. The proposed construction of the dam was taken into consideration at the time the bridge site was selected and according to plans existing at that time the bridge was located and planned to eliminate possible interference with the dam during construction and operation. In March 1950 permit was granted to Wasco County, Oregon, to construct the bridge following revisions in the original plans to eliminate conflict with the dam.

Bridge contract history

Recommendation for construction of The Dalles Dam had been made to Congress the previous year by the Chief of Engineers, but authorization for the structure was not made by Congress until May 1950. In the meantime, revenue bonds totaling \$3,000,000 had been sold to Wasco County to finance the bridge and construction contract was awarded. About this same time money was made available by Congress for more detailed plans for The Dalles Dam. With these funds the Corps of Engineers constructed and tested hydraulic models and these tests indicated that the spillway could be moved down stream for reasons of geology to improve operation of the spillway. This change in dam location provided definite interference between its spillway and the bridge. In the meantime, Guy F. Atkinson Co., working under its contract, had completed piers and fabrication of steel for the superstructure was under way.

The Corps of Engineers had indicated that the bridge can be retained in its

present location but would have to be built across the spillway of the dam. The county has rejected this suggestion since it would delay completion of the bridge until the finish of the dam project, or a matter of several years.

Alternative—new site

The alternative was the selection of a new site and the court action to take over the approach areas in the name of the federal government has now precipitated such a change in location.

It is possible that the relocation could

be arranged to include some spans of the same length as those planned at the original site, which would permit use of the steel now being fabricated.

Opinions indicate that the difficulty was inevitable and that both sides of the controversy were acting in good faith during the preceding months. Permit for the bridge was secured from proper authorities and was acceptable based on original plans of the dam. Changes in dam design resulted from further engineering studies which could not be undertaken until Congress authorized the project and appropriated preliminary funds for its construction. The resulting information necessitated the relocation of the dam spillway and this in turn required the change in the bridge project. Completion of the bridge as originally planned and placed under contract was scheduled for late this summer.

ALASKAN WAY VIADUCT SPEEDED BY CONCRETE MIXER TRUCKS

Right under the noses of through-traffic on the present Alaskan Way, Seattle, Wash., International Harvester Co.'s LF-192 trucks equipped with concrete mixer bodies are hauling all ready-mixed concrete for the structure. Six-wheelers of the Glacier Sand & Gravel fleet and similar units employed by the Pioneer Sand & Gravel Co., in action above, transport concrete in 4½-cu. yd. agitator bodies from central mixing plants to pouring sites where loads are emptied in buckets. Cranes, mounted on spiderlike gantry frames hoist the concrete to project levels. When completed, the double-decked viaducts will provide 2½-mi. elevated north-south bypass of downtown Seattle.



Steel pipe specified for Portland's water line

SETTLING A DEBATE as to whether a 25-mi. long conduit will be constructed of steel or reinforced concrete pipe, the Portland City Council advertised for bids on the new \$5,000,000 Bull Run water supply line and specified only steel pipe.

Plans drawn by Ben S. Morrow, general manager and chief engineer of the city's water bureau, and consulting engineers called for use of the steel pipe. When the ordinance for advertising for bids on the project was being considered by the city council, an objection to the ordinance was entered by the United

Concrete Pipe Corporation of Los Angeles. The firm strongly urged that alternate bids be specified in the plans, chiefly in view of the substantial savings that would result from use of reinforced concrete pipe. The firm pointed out that more than \$250,000 could be saved by using the concrete pipe in the 14-mile center section of the line, and that a local sub-plant could easily be set up to manufacture the pipe in Portland.

Morrow explained to the council that Portland has received "very excellent service" from three existing steel pipelines, one constructed in 1894 and to be replaced partially by the new conduit. According to Morrow, steel will permit lower maintenance costs for the new line because it is flexible, easy to repair and

connect up and lighter in weight. He also pointed out that the decision favor of steel would not rule out competitive bidding because Portland has a number of steel fabricating plants.

When bids were opened for the project last month, Kuckenberg Construction Co., Portland, was low at \$4,985,000. Miller & Co., Los Angeles, was second low, at about \$10,000 above the Kuckenberg figure. Four other bids ranged up to \$5,783,000.

Construction on the project, which represents one of the biggest single contract jobs in Portland's history, will commence this spring, with about a year allowed for completion.

USBR calls bids for several major projects

BIDS ON SEVERAL major projects were issued by the Bureau of Reclamation during the month.

Invitations went out late in February for construction of Palisades Dam power plant and road relocation on South Fork of the Snake River in Blaine County, Idaho. The prime contract calls for construction of an earthen dam, 114,000-kw. power plant and 21.5 mi. of road relocation. The dam which is to have 16,000,000 cu. yd. excavation, is to be 2,100 ft. long, 40 ft. wide at the crest, 260 ft. high and 2,300 ft. wide at the base.

The call for Lost River channel improvements on the Klamath Project, about 50 mi. from Klamath Falls, Ore., was issued on March 14. Work involves channel enlargement of the Lost River in Upper Langell Valley to improve river course, excavation of 6 mi. of channel to 4,000 cfs. capacity, and improvement of 1 mi. of existing 4,000-cfs. channel excavated under a previous contract.

March 18 calls were issued for Mohawk Canal and Dike on the Colorado Project in Arizona. Work is located near Roll, Arizona, and includes construction of about 8 mi. of unreinforced concrete lined Mohawk canal of 135 to 300-cfs. capacity; 8 mi. of Radium Hot Springs flood protection system including diversion or drainage channel and dikes, reservoir dikes and overflow channel, etc.

Power plant equipment installation for the Colorado-Big Thompson Project near Estes Park, Colo., was the subject of calls issued on March 19. The job involves installation of equipment for completion of building interiors for Flatiron and Pole Hill power plants. The 80,000-kva. Flatiron plant will require installation of two 48,000-hp. turbines and related equipment. The 35,000-kva. Pole Hill plant will require installation of one 47,500-hp. turbine.

March 3 calls were issued for Davis Switchyard and transformer for the Davis Dam Project, Arizona. The erection of 69-kv. steel structures for installation of transformer circuit for power plant to switchyard, and 69-kv. switchyard installations at Davis power plant are involved.



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Utah highway conference states' plans

Highway ENGINEERS and construction men from the intermountain states assembled March 3 in Salt Lake City for the thirteenth annual Highway Engineering Conference and Road Show. The event was sponsored by the University of Utah with the cooperation of the Utah State Road Commission, Intermountain Branch of the Associated General Contractors and the Utah Motor Transport Association.

During the three-day conference the assembled group heard papers covering current activities and programs of several state highway departments, reports on the use of materials in highway construction and the latest developments in construction and maintenance equipment.

One of the highlights of the conference was a luncheon address by Walter W. Belson, director of public relations of the American Trucking Association. For this address the group, joined by some 150 legislators and public officials. Terming his talk "non-controversial," Belson presented the group with startling statistics showing phenomenal growth of the trucking industry during the last three decades. In delivering a report on the WASHO road to be built this spring near Pocatello, Idaho, G. Bryce Bennett of the Idaho Department of Highways stressed the need for the project as a means to find the answers to the highway damage problem and for computing design data for future roads. The paper presented by Mr. Bennett appears in this issue on pages 65 and 66.

Other principal reports on current activities of state highway departments were "Utah's Initial Freeway Project," by E. G. Johnson, chief engineer, Utah



Pictured at the conference are, left to right: R. P. Jones, manager, stabilizer division, Harnischfeger Corp.; Julien R. Steelman, president, Koehring Co.; Ralph K. Stiles, executive vice president, Austin-Western Co., and Professor A. Diefendorf, head of the Civil Engineering Dept., University of Utah.

State Road Commission; "Wyoming Highway Department's New F.M. Radio System," by Thurman Sherard of the Wyoming Highway Department, and "Trends in Highway Research and Planning in Colorado" by R. E. Livingston, planning and research engineer, Colorado State Highway Department.

Papers were also presented on the use of rubber in highway construction, soil cement, asphalt in hydraulics, materials control and soil tests.

While delivering a paper on "Proper Selection of Grading Equipment," Ralph K. Stiles, executive vice president,

Austin-Western Co., told the assembled group that the grader supply situation was clearing up and that most makes should be available in the latter part of 1952. Other representatives of leading equipment manufacturers speaking at the conference were R. P. Jones, manager, stabilizer division, Harnischfeger Corp., and Julien R. Steelman, president, Koehring Company.

During recesses between presentation of the technical papers the conferees examined some 100 pieces of major construction equipment displayed by local distributors.

Two bills face lawmakers S. F. Bay crossing

THE LONG DISCUSSED "second crossing" of the San Francisco Bay is the subject of two new bills presented by Senator Randolph Collier and Assemblyman Richard J. Dolwig in the California Legislature.

Under the Collier Bill the myriad of engineering detail connected with the northern crossing would be left to the California Toll Bridge Authority and the Army and Navy, rather than being specified by the legislators. Tentatively, the San Francisco terminus of the bridge would be at Army St., since all available information indicates that this would be the most logical site. If the Army or Navy objected to this site, however, the bill would not prohibit a shift of location.

In line with the policy of flexibility which characterizes the Collier Bill, the type of crossing will not be specified in the proposal. A "crossing" will be required to throughout, permitting Toll

Bridge Authority engineers to specify the type of crossing.

An appropriation of \$1,500,000 is carried in the bill. These funds would be used to bring plans and surveys on the southern crossing proposal up-to-date with those already available on the parallel span proposal.

Difference in bills

The Collier Bill is quite different from the Dolwig Bill which is out of committee in the Assembly. This is the proposal which calls for an "earth-filled causeway with a tube or locks" across the Bay with the San Francisco terminus at Army St., and the East Bay terminus at Bay Farm Island. This proposal also gives final say in type and location to the military. It was thought that the Navy, however, would object to any solid fill crossing north of the Navy yard. A high-level steel structure would meet no Naval objections, according to Representative Franck Havenner in Washington, but acquisition of steel for a structure of this type would present problems at the present time.

Albeni Falls powerhouse bid at \$8,607,240

A FIVE-FIRM JOINT VENTURE submitted the low bid of \$8,607,240 for construction of the Corps of Engineers' Albeni Falls hydroelectric powerhouse on the Pend Orielle River.

The five-firm venture is composed of Donovan Construction Co., St. Paul, Minn.; Foley Bros., Inc., St. Paul; Winston Bros., Minneapolis; C. F. Lytle Co., Sioux City, Iowa, and James Construction Co., St. Paul.

Work to be done

Donovan and James are at present partners in the first stage construction on the dam. Second stage construction involves building the powerhouse in the right channel and connecting it with the section of the dam crossing the central island at the dam site. Cofferdam construction is also included in this section. Approximate quantities include 160,000 cu. yd. solid rock and 18,000 cu. yd. common excavation.



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HELTZEL ON THE JOB ON THE PENNSYLVANIA TURNPIKE

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Heltzel Type One for aggregates and Type E-2 for bulk cement were set in line for continuous truck drive-through. Using dual batchers, 2-batch trucks were loaded in one stop and 3 and 4-batch trucks in only two stops.

Type One—Capacities: 52, 72, 85 and 100 tons; used with 1½-cu. yd. Universal Batchers or 2½-cu. yd. Dual Batchers.

Type E-1*—Capacities: 100 and 200 bbls.

Type E-2*—Capacities: 300 and 400 bbls.

*Used with 14-cu. ft. Dustless and 28-cu. ft. Dual Dustless Batchers.

Capacities may be increased with hopper extensions and recirculating tanks.



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WARREN, OHIO

Engineer manual discusses reinforced concrete design

A NEW ENGINEERING MANUAL just published by the Concrete Reinforcing Steel Institute, Chicago, greatly simplifies many of the problems in designing reinforced concrete structures.

The new book, "CRSI Design Handbook," is the only book of its kind. It streamlines the process of designing reinforced concrete structures by eliminating most of the computational problems. Answers to complex stress and load problems are all worked out in the manual, and are read directly by simple reference to tables. Given load and span data, the designer can quickly obtain the necessary concrete outlines and reinforcing steel information. For years it has been possible to select structural steel members directly from such tables. Now, with the "CRSI Design Handbook," pre-designed reinforced concrete members can for the first time be obtained in the same simple manner.

The tables should be of considerable assistance to designers in roughing out preliminary outlines and in making comparisons, but will not replace the judgment of a competent structural engineer.

Designs are based entirely upon the 1951 ACI Reinforced Concrete Building Code, with a couple of exceptions: (1) the maximum positive moment in spans was taken as $wl^2/11$ instead of the $wl^2/14$ in the Code; and (2) square footings are based upon the recommendations of the University of Illinois in the Journal October-November 1948. Bond computations are based upon deformed bars meeting ASTM A305-5 at 0.10f_c. Plain round bars or bars meeting ASTM A305-50T cannot be used satisfactorily with the values given.

The new handbook was prepared under the direction of the Committee on Engineering Practice of the Concrete Reinforcing Steel Institute. It contains 412 pages, and covers the following subjects: Floor Systems; Columns; Footings; Retaining Walls; Area Walls. A separate section contains miscellaneous tables and lists engineering diagrams and formulae.

Price of the new manual is \$5.00. It may be obtained from Concrete Reinforcing Steel Institute, 38 S. Dearborn St., Chicago 3, Illinois.

Crowd witnesses The Dalles Dam construction begin

A CROWD of 5,000 persons gathered recently at the ceremonies marking the start of construction of the \$350,000,000 The Dalles Dam. The dam will have an installed capacity of 1,092,000 kw., more than twice that of Bonneville Dam, and will add more than 6,000 persons to the population of The Dalles area during the five-year construction period. A six-ton explosion of dynamite on the Washington shore opposite the big eddy, signaled the start of this mammoth project.

Of special interest to buyers of highway equipment—

Costs, construction, maintenance...

Subjects of 5th Annual June Highway
Issue of *Western Construction*

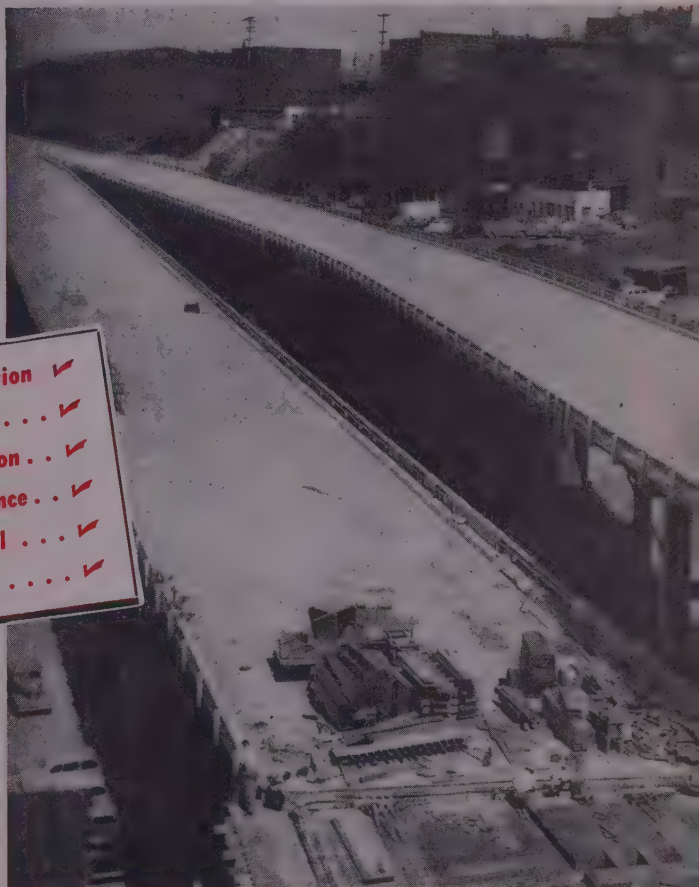
Typical big street and highway job in West.

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ASCE centennial conclave in Chicago this summer

PEGGED on the centennial celebration of the American Society of Civil Engineers, a conclave of some 25,000 engineers from all professional branches will be held in Chicago late this summer. Headquartered at the Conrad Hilton Hotel between September 3 and September 13, the gathering will feature historical presentations as well as technical sessions, symposia and panels, by engineers from 51 American and foreign engineering societies.

Sponsorship of the centennial convention is headed by the ASCE, which was formed in New York City on November 5, 1852. Joining with the ASCE in planning for the coming observance are its four associate "founder" societies, AIME, ASME, AIEE, and AICHe—all members of the Engineers Joint Council. Active planning is in the hands of a special corporation formed for the job, the Centennial of Engineering, 1952, Inc.

From an attendance of 12 at the November 1852 meeting, the ASCE has grown to a current membership of 3,000, according to William N. Carr, executive secretary. These are scattered through 73 local sections in principal U. S. cities, and in a total of 123 student chapters at engineering schools. Embracing all specialties within the field of civil engineering, the society conducts its technical affairs through 14 technical divisions that cover various phases of engineering design, planning, economics, and construction.

Society chapters in the West include Alaska, Arizona, Colorado, Hawaii, Intermountain, Los Angeles, Montana, New Mexico, Oregon, Sacramento, San Diego, San Francisco, Seattle, South Dakota, Idaho, Spokane, Tacoma, and Wyoming—having a total membership of 7,700. San Francisco Section has the distinction of being the oldest local section chartered in 1905. Prior to that time society affairs were transacted through its single New York organization.

National president of ASCE in 1952 is Colonel Carlton S. Procter. Lenox Lohr, of Chicago's Museum of Science and Industry, is president of the Centennial of Engineering, 1952, Inc.

USBR hydro plants in West set production record

BUREAU OF RECLAMATION hydroelectric plants in the West produced a record total of 23,077,177,403 kw-hr of electricity during 1951 and established a new peak output of 4,512,106 kw. The peak includes a record-breaking performance of 2,226,000 kw. by Grand Coulee Dam plant on December 31. Output of power brought more than \$1,000,000 into the Federal Treasury compared with \$36,369,470 from the output of 20,226,581,000 kw-hr of power in 1950. The peak output in 1950 was 3,915 kw., nearly 600,000 kw. under 1951's performance.



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MM WHEELERS Load Faster...Dig Better!

MM exclusive UTIL shuttle gear gives instant reversing of all 6 speeds — offers you foremost value in modern high-speed tractor loading and dozing. All tractor and engine parts are larger . . . more durable and are completely built in MM plants. This results in reduced cost of MM Wheelers for their weight and capacity, plus the assurance of exacting quality control. Heavy-duty design and conservative power rating at low engine speeds permit continuous full load operation in any gear . . . added capacity without over-loading!

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MM Wheeler-Loaders have extra large double-acting hydraulic cylinders and bucket control that permits *successful* subsurface digging. Solid saddle mounting of loader on built-in mounting pads and hydraulic down pressure permits powerful bucket crowding action and increases traction on rear driving wheels. Accurate bucket control also permits carrying a grade. Attaching equipment for MM Wheelers is expressly engineered to produce a *complete operating unit and finest, single-package performance!*



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"No Job
too Big—

No Job
too Small"



Headway reported on Alaskan Eklutna project

AN AVERAGE HEADWAY of 45 of hard rock per day has been achieved by excavation crews working on the 4 mi. tunnel through Goat Mountain Alaska, part of the \$17,348,865 Eklutna hydroelectric project of the Bureau Reclamation. About two hundred men are working for Palmer Constructors three adits of the project.

Work began on October 11, 1951. 200-ft. deep shaft was sunk into the mountain about 1,000 ft. from Eklutna Lake. Crews were digging in two directions by the middle of January—going 60 ft. toward the lake and 90 ft. toward the other side of the mountain. Excavation on the lake side of the mountain handled by elevator. Excavated material from the third adit at the power plant end of the tunnel is wasted on the slope where the plant's 1,250-ft. penstock will be constructed. Completion time on the tunnel is 1,050 days.

Palmer Constructors is a joint venture of Peter Kiewit Sons' Co., Coker Construction Co., and Morrison-Knudsen Co., Inc., who performed this work during a cold Alaskan winter with temperature averaging 35 deg. below zero on the outside and a few degrees above freezing inside the tunnel.

Engineers call bids on Garrison Dam spillway

U. S. ARMY ENGINEERS issued an invitation for bids late last month for the construction of initial portion of spillway for the Garrison Dam and Reservoir Project. Bids to be opened May 15.

The construction site, which is accessible by railroad and highway, is located in McLean County, North Dakota, on the Missouri River, approximately 75 mi. northwest of Bismarck, and 65 mi. southwest of Minot.

Contract work will consist of constructing the entire spillway, except for the spillway stilling basin, including prestressed reinforced concrete bridge across the spillway; also the furnishing and installation of twenty-eight 29 40-ft. tainter gates. Spillway is approximately 1,350 ft. wide at the crest and narrows to a chute width of 800 ft. Over all length of concrete construction along center line of spillway is approximately 1,800 ft. Work should be completed September 1955.

Denver railroad tunnel might take automobile traffic too

ARRANGEMENTS are being made in Denver for a group of professional engineers to study the feasibility of converting the Moffat tunnel into use for both railroads and motor vehicles. Present the tunnel is accommodating only railroad traffic. If the committee finds the proposal to be practical, the state legislature can then negotiate for a lease with the Moffat tunnel commission.

NEWS

IN BRIEF

Housing turbo-generator at Lacombe, Colo., power plant

PROJECT to house Colorado's largest single turbo-electric generator is now under way at Public Service Co.'s historic Lacombe power plant. While wrecking crews are ripping away brick, steel and concrete walls and foundations at the southeast corner of the plant, walls of the new generator room extension are rising nearby. This new West-house generator will develop 66,000 kw. of electric power. The present structure was expanded in 1948 to house its present high-pressure-steam turbine generator, rated at 44,000 kw. The plant will be renamed Zuni, and its two units will produce 110,000 kw. The Zuni boiler will generate steam at 10-lb. pressure and a temperature of 500 deg. F.

Group will represent Spokane construction industry

NEW COMMITTEE, sponsored by the Spokane, Wash., Construction Council, has been formed to represent all segments of the construction industry in the Spokane area. The committee will serve as members architects, engineers, general contractors, specialty contractors, home builders and others. According to committee chairman Russell Babcock, the group's principal purpose will be to promote the exchange of new ideas and information on raw materials, methods, trends and needs which are revolutionizing design and construction; to give the people of the Spokane area advantages of new materials and methods; to promote and support the Spokane construction industry, and to provide a means for exchange of information.

\$360,000,000 for Alaska jobs this season

SPRING IN ALASKA sets off a \$360,000,000 start in this season's defense construction. Seventy-three active construction contracts, in varying percentages of completion, come out of winter hothouses to launch the 1952 construction season, and the Corps of Engineers will unwrap about seventy more contracts during the year.

Several thousand migrating workers are expected to take employment with firms now holding the partly completed construction contracts with value in excess of \$190,000,000. These projects are carried over from previous seasons and have been buttoned up during the four winter months with only interior work progressing: construction of a station hospital, \$7,500,000, Grove, Shepherd,

Wilson and Kruger, New York; construction of a central heating and power plant, \$10,000,000, Patti-MacDonald, Kansas City, Mo.; outside utilities and railroad trackage, \$7,400,000, Morrison-Knudsen Co., Inc., Boise, Idaho; family quarters, \$6,200,000, and outside utilities, \$8,500,000, Peter Kiewit Sons' Co., Omaha, Neb.; family quarters, \$5,500,000, Boen-Sealand Co., Seattle; enlisted men's barracks, \$9,500,000, Anderson, Montin, Benson; composite housing building, \$5,800,000, Haddock Engineers, Oceanside, Calif., and a heating and power plant, \$4,100,000, Wyatt and Kipper, Seattle, Wash.

The increased interest of contractors in Alaska defense jobs is shown in figures which indicate that in March 1951 an average of 4.0 bidders appeared at openings while recent openings have had an average of 9.6 bidders. The Corps of Engineers reports that some 350 newly interested U. S. contractors have written for this year's competitive bidding schedule.

Electric brain to guide volume of Denver traffic

MOVEMENT of Denver citizens who walk or ride through the city's downtown section will soon be controlled by an "electric brain." This "brain," a masterpiece in cybernetics, will switch lights in the business section in accord with traffic volume. Device will automatically tabulate traffic flow data each six minutes and will change the timing of lights if needed by impulses sent through its electronic nervous system. City Traffic Engineer Henry Barnes spent two years designing the mechanical brain; 1½ years building it.

In San Diego—it's water! water! water!

THREE MAJOR WATER issues went to the voters of San Diego, Calif., recently and all three returned victorious by wide margins.

Two of the proposals concerned the long-talked-about Navy construction and use of the \$18,000,000 San Diego aqueduct's second barrel, which will double the supply of Colorado River water received in San Diego. The city promises the government priority on the second barrel supply according to the terms of the agreement. Heavy existing military installations and future plans make more water a necessity in the San Diego area.

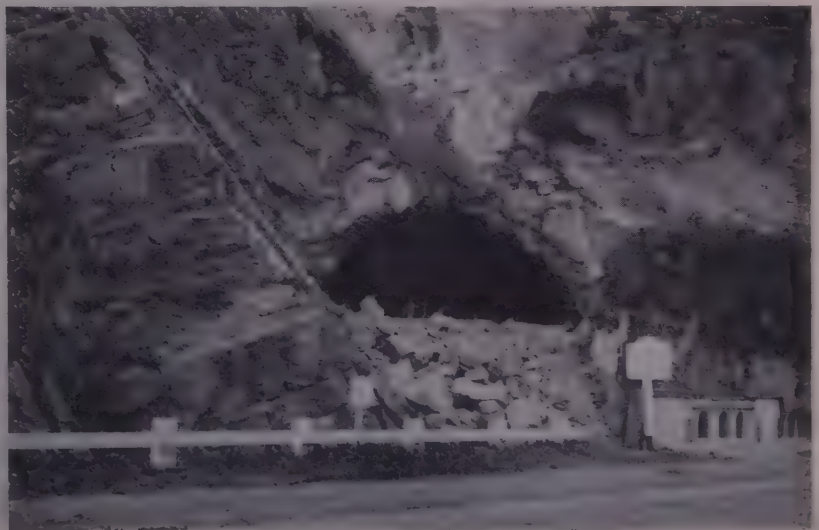
Many more votes than the necessary two-thirds majority were given the \$6,500,000 bond issue which would complete the Sutherland Dam on the San Dieguito River, which was abandoned after the foundations were constructed 25 years ago. Some of the funds would be used to acquire lands adjacent to the river preparatory to construction of a transmission line from Sutherland Dam to San Vicente Reservoir, San Diego's main reservoir.

\$400,000 sewer project starts in Oregon City this summer

WORK IS EXPECTED to start this summer on a \$400,000 interceptor sewer and sewage treatment plant at Oregon City, Ore. Contract for engineering and supervision of the project goes to Stevens & Thompson, Portland engineering firm. Bids for equipment are being called in April; for general construction, early in June.

HOLING THROUGH AT GAVIOTA GORGE TUNNEL

BORE OPENING on the Gaviota Gorge tunnel about 30 mi. north of Santa Barbara, Calif., is pictured below. The tunnel, which will put two more lanes on Highway 101, the Coast Highway, will be 420 ft. from portal to portal on a 1,200-ft. radius curve. After the holing through of the left drift and completing core removal, crews took out the bench section of the tunnel bore. The project was reviewed in *Western Construction*, March, pp. 79-81. Rhoades-Shofner Construction Co., Inc., holds the California Division of Highways' contract.



On the New Jersey Turnpike

...MONOTUBES

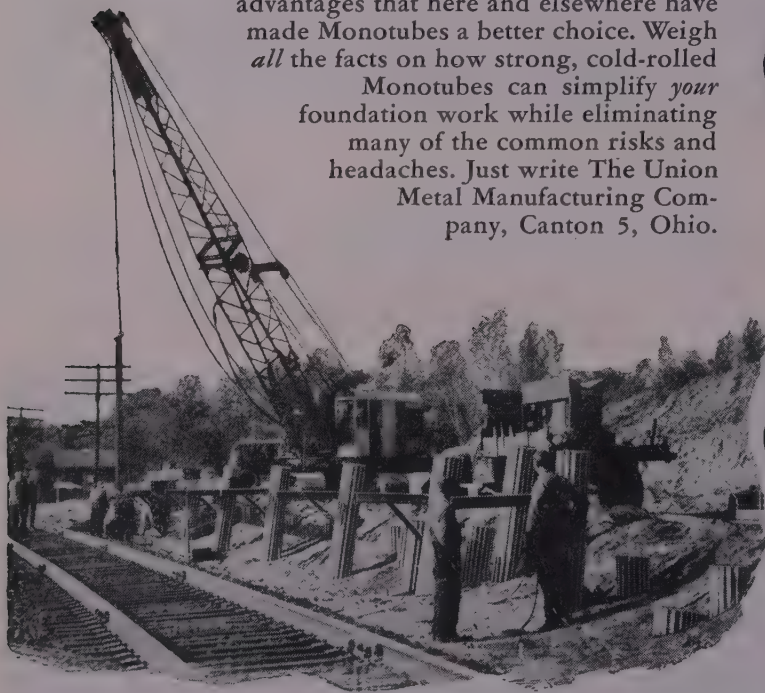
for simplified, speedy foundation work

THESE and many other overpasses play a vital part in making the New Jersey Turnpike a "Miracle Highway". And, versatile Monotube piles went into *all* types of overpass construction—because they offer unique advantages.

For example, speedy construction was possible with light weight Monotubes, installed with fast, mobile driving equipment. There was minimum time loss in moving between the widely separated structures. *On* the job, Monotubes saved still more time and money due to their ready extendibility, simplified field splicing, easy cut-off and minimum waste . . . and, due again to their light weight that speeded locating and driving to any required depth.

These are only a few of the key advantages that here and elsewhere have made Monotubes a better choice. Weigh *all* the facts on how strong, cold-rolled

Monotubes can simplify *your* foundation work while eliminating many of the common risks and headaches. Just write The Union Metal Manufacturing Company, Canton 5, Ohio.



OVER
RAILROADS



OVER
WATER



OVER
HIGHWAYS



UNION METAL

Monotube Foundation Piles

GOING'S ROCKY

...but it just keeps 'dozin' along!



You can see what conditions were like on this road-building job near Henrieville, Utah. The altitude's 7,000 feet. In 2½ miles, about 160,000 cu. yds. 85% rock had to be moved. To move it, Whiting & Haymond relied heavily on "Caterpillar" units—among them, this D8 Tractor with No. 8U Bulldozer. Supt. A. H. Cranmer said: "'Cat' Diesel Tractors are tops for work of this nature. With the amount of rock we had here, they stood up to it all day long and it never hurt them. Our 'Caterpillar' Dealer took care of us in grand shape."

Mr. Cranmer makes two good points. First, "Caterpillar" units stand up under tough going. Second, you get good service from your "Caterpillar" Dealer. However, it's just common sense not to wait until the last minute to call on him. Have him rebuild parts *before* wear damages them beyond repair. And see that your rigs get proper maintenance attention on the job. That takes only a few minutes a day, but it's an important factor in adding many *extra* working hours to the life of your sturdy "Caterpillar" equipment.

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\$3,000,000,000 federal aid urged for next 10 years

IN ADDRESSING the Association of Highway Officials of the North Atlantic States recently, Paul B. Reinhold, president of the American Road Builders' Association, urged adoption of a \$3,000,000,000 yearly federal aid program for rehabilitating our highways, during the next ten years. He stated that our present highways are inadequate and are not being replaced or modernized fast enough to keep pace with current mounting vehicular traffic. He asserted that it was necessary to build civilian highways on a scale that would accommodate the possible military needs of the country. Although he opposed the idea of a special network of military

highways, he stressed the importance of highways in our defense efforts for use in transporting workers and supplies.

Mississippi water sought for N. Mex. highland

A PLAN to bring Mississippi Valley water to the highlands of New Mexico was called for recently by Patrick J. Hurley. The giant project would divert flood water of the upper Missouri and Mississippi rivers to the dry regions of the Southwest. The project would generate its own electricity and could later be run by atomic energy. This plan would not only provide valuable flood protection but would also increase employment for years to come.

A big indoor cement job in Butte, Montana

SERVICES of all available cement finishers and hod carriers in Butte, Anaconda and Deer Lodge, Montana, were required to complete work on the monolithic base for Butte's civic center rink. This project, said to be largest indoor concrete pouring job ever carried out in Montana, required 300 cu. yd. of concrete to be poured on a non-schedule over the 200 x 86-ft. rink. Crews worked in 6-hr. shifts with standbys taking over during lunch periods.

New location needed for Libby Dam construction

A NEW LOCATION for the proposed Libby Dam on the Kootenai River, northwestern Montana is being sought by Army Engineers, in order to less problems of backing water into Canada. Dam will be about 2,000 ft. long and will cost an estimated \$263,000,000. Capacity will be more than 1,000,000 k.

Grand Coulee generators get accidental dousing

SEVEN of Grand Coulee Dam's 18 generators were put out of commission recently when water got into the bearings. Generators were flooded when valve at the wrong end of a draft tube inside the dam, was opened by mistake. Water then rushed out of the draft tube through a manhole, then poured through a ventilator tube into a gallery leading to the two big powerhouses flanking the mile-long dam. Flood also put out operation electrical circuits that normally operate various motors needed to shut off the water. The failure threw heavy load on the Northwest power pool.

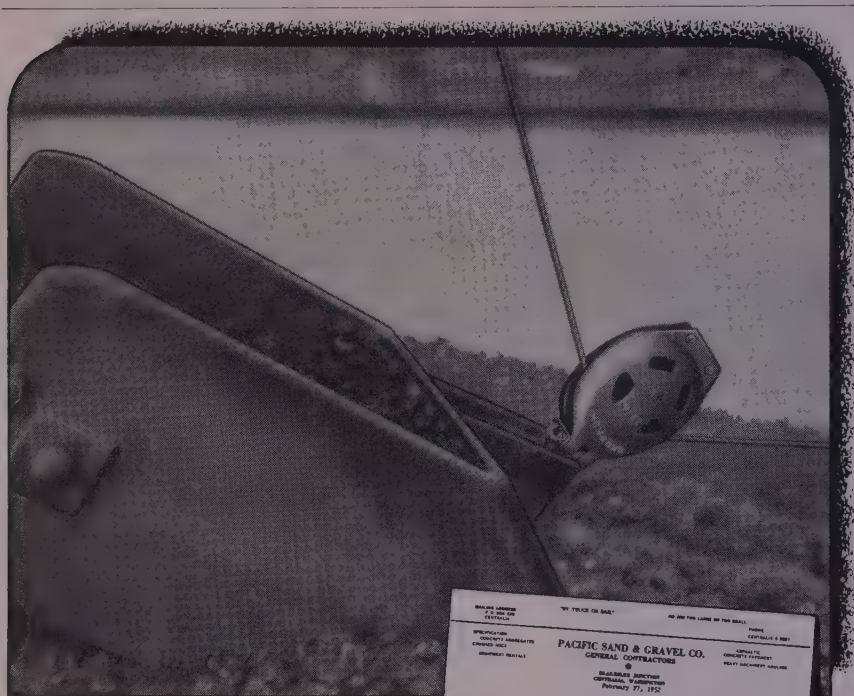
McNary Dam gets two of world's largest turbines

AT McNARY DAM on the Columbia River, two of the world's largest turbines are in the process of being installed.

More than 3,000 men are now at work on the completion contract which is scheduled to end in December of 1954 when the first generator hits the line with another following every three months. McNary Dam Constructors Inc., a joint venture, hold the \$60,000,000 contract.

Work will be curtailed when the Columbia River floods the cofferdam area this spring. Sam Neff, resident engineer for the Corps of Engineers, said the project can now be called 50% complete.

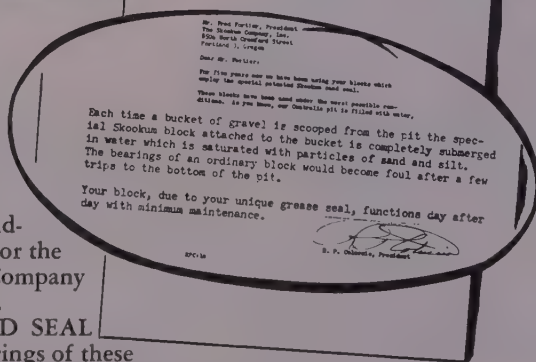
Discovery of an ancient buried river channel, deeper than the existing one, means that construction of the Washington and Oregon shore abutments included in the contract will have to be extended 1,000 ft. upstream to prevent dangerous seepage which might otherwise occur.



submarine block...

The Skookum 2218 block, shown above, works half the time submerged in sand and silt-saturated waters for the Pacific Sand and Gravel Company of Centralia, Washington. Skookum's patented SAND SEAL effectively guards the bearings of these submarine blocks from abrasive particles in the water.

Regardless of your requirements, Skookum either has the blocks you need, or will build to your specifications.



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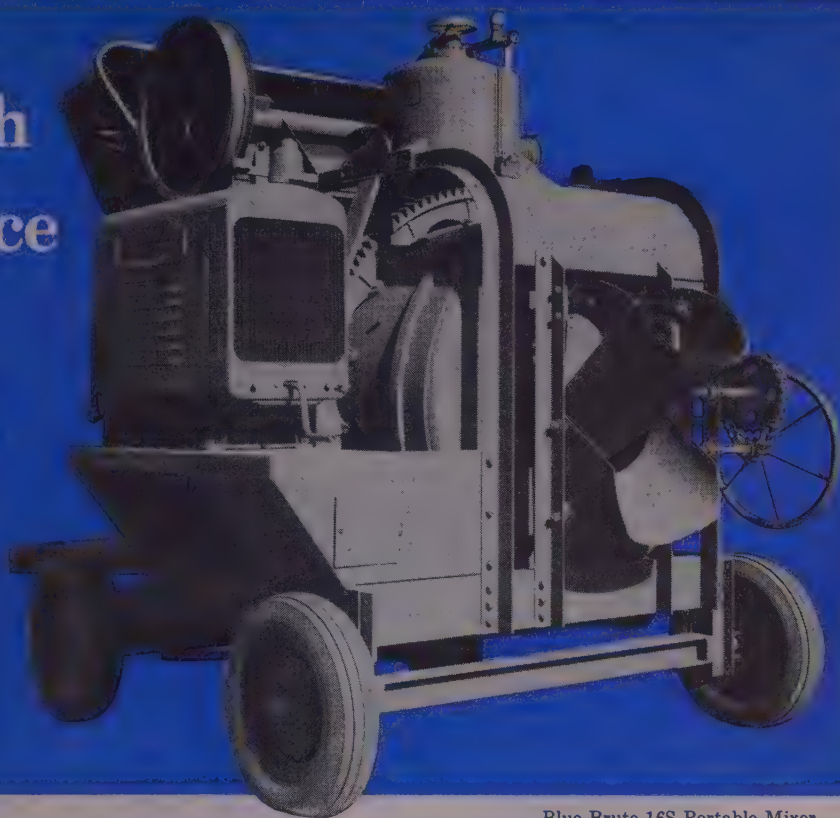


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How much
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Blue Brute 16S Portable Mixer

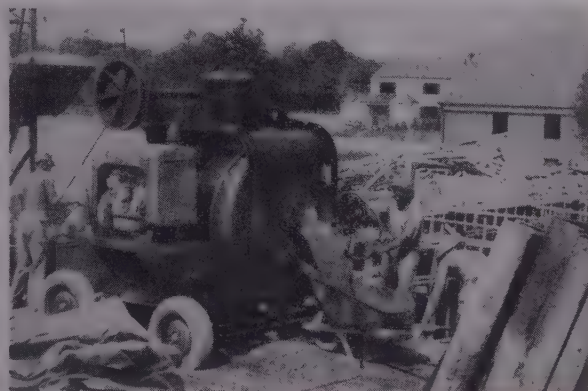
... Unless you're a Blue Brute user, it's probably more than you think!

Idle boast? Ask any one of the thousands of mixer owners who have standardized on Worthington what they think!

- ... Ask about the *famous Worthington mixing action* that results from complete turning of the concrete three times in each revolution of the drum.
- ... And the *water system*—an exclusive spiral cut-off syphon type with no rubber to deteriorate.
- ... And the *drum-drive gear* of one-piece semi-steel, machined inside to a true circle.
- ... And the *skip cable winding shaft* mounted in self-aligning bearings with grooved spools for longer cable life.
- ... And the *automatic clutch knockout and brake* that hold skip in discharge position when power loader is raised to top.
- ... And the *self-cleaning skip vibrator* that speeds discharge.
- ... And the *water-cooled engine* with the radiator that faces the discharge side—or about the *air-cooled* model also available.
- ... And about the *solid welded roller sub frame* that assures correct alignment of rollers.
- ... And the *two-piece discharge chute* that's out of the way during mixing.

Whether you choose the 16S—the big four wheel job—or the smaller two or four wheel 11S, you'll be taking the best step you can towards boosting output and lowering operating costs. Remember, Worthington has designed and built mixers for nearly a century.

Worthington Corporation, formerly Worthington Pump and Machinery Corporation, Construction Equipment Division, Dunellen, New Jersey.



ON THE JOB, BLUE BRUTE PORTABLE MIXERS give you top quality concrete *where* you want it, *when* you want it. They make it easy for you to accurately schedule pours in advance. Above mixer is 11S.

R.2.1



If It's A Construction Job, It's A **BLUE BRUTE** Job

WORTHINGTON

Construction Equipment

Builder claims discovery of atom bomb-proof material

AN ATOM BOMB-PROOF material is claimed to have been discovered by Hal B. Hayes, one of America's foremost house-builders. New building material is of natural clay and unnamed chemicals, and is claimed to be able to withstand anything but a direct hit by an atomic bomb. Material has tremendous shock and fire resistance. A system for replenishing the oxygen taken out of the air by the atomic explosion would be added to shelters made of this fantastic new material in order to prevent suffocation which usually takes place after such an explosion. Hayes offered to build a model shelter at the Atomic Energy

Commission's Nevada proving grounds in order to show American citizens that they will not have to go underground to live through an atomic attack.

Engineers' budget bulges with a few "extra" million

ARMY ENGINEERS were "quite surprised" recently when they noted that the Bureau of the Budget had appropriated an additional \$25,300,000 for the construction on Chief Joseph Dam in Washington. The Engineers had requested only \$17,800,000 in additional funds. Seems that the appropriators thought the extra moneys would mean power could be available sooner.

AGC CONVENTION

... begins on page

Defense, etc., refrain from soliciting bids for construction with alternate designs submitted by the bidder, and refrain from soliciting all bids on the same design to assure maximum competition, avoid favoritism and continue the traditional practices of the construction industry.

New officers

Arthur S. Horner, A. S. Horner Construction Co., Denver, is the new elected president of the association, succeeding Glen W. Maxon of Maxon Construction Co. Horner's firm is well known throughout the West in heavy construction. He is active in the Colorado Society of Engineers as well as the AGC Contractors Association of Colorado and many other civic groups.

C. P. Street, McDevitt & Street Co., Charlotte, N. C., is the new vice president. Several Westerners will serve three-year terms as directors; they are Edward O. Earl, San Xavier Rock Sand Co., Tucson, Ariz.; Charles Harney, Charles L. Harney Co., Inc., San Francisco; James B. Kenney, James B. Kenney, Inc., Denver; Paul Vernon, Vernon Bros. Co., Boise, and J. P. Gibbons, Gibbons & Reed Co., Salt Lake City.

Code commission bill in Arizona Senate

A BILL calling for a five-man state building code commission to regulate and improve construction practices in Arizona was proposed recently in the state senate. Commission members would be appointed by the governor with consent of the senate, and would have power to test materials and issue reports, to require that buildings used for public assemblies be constructed in compliance with the code, to subpoena witnesses, and to enjoin unlawful construction.

Arizona parlor game

WHEN SANTA FE DAM southwest of Williams, Ariz., overflowed at 12:30 p. m. on February 14, it ended a guessing contest among townspeople that started when heavy rains and snow began to cover the hills in January. Winner was O. B. Sutton, Jr., who set the overflow time at 1:30 p. m.

So. Calif. Equipment Directory

EXCAVATING and Grading Contractors Association recently issued its 19th Equipment Directory covering the Southern California area. This directory, which is obtainable only by affiliation with the Association, is a leather-bound, loose-leaf handbook listing excavating, paving and grading equipment owned by the EGCA members in the entire area.

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Says: BILL CLEMENS of Northboro, Mass., TS 300 operator for BAYER & MINGOLLA Construction Company of Worcester, Mass.

BILL ADDS, "What we need on this job is a dozer for each machine because I make my haul, spread my load and am back waiting on the dozer every trip."



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Here's Another Operator's Viewpoint

Donald A. LaVigne of Worcester, Mass. says, "I've run every kind of scraper made and I'll take LaPlant-Choate any day. They're not only fast, they're safe. Another thing about them, I don't feel all beat up after running one all day. No more tiring than driving my car."

Don operates one of Bayer & Mingolla's fleet of six TS 300 Motor Scrapers.



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BUILDING PRACTICE MANUAL—by White

Down-to-earth building techniques and fundamentals are well covered by Roy W. White in this easy-to-read book. Although capable of being a textbook, "Building Practice Manual" should also find an audience among experienced builders and contractors. It contains useful information on building materials. Elementary in its first pages in that it delves into the fundamental mathematics of the field—with appropriate drawings, how-to-use information, etc.,—its second part is devoted to a valuable guide for estimating quantities of building materials for a given job. The emphasis throughout is on small commercial structures, but it contains advice that could also be applied to larger projects. Material cost estimating is also considered. Published by D. C. Heath and Co., Boston. 307 pages, 6¼ x 9¼. Price \$4.85.

RIGID FRAME FORMULAS—by Kleinlogel

This is the first printing in English of A. Kleinlogel's classic in the field of structural engineering. It has been enlarged in this printing to include a storehouse of valuable information on reactions, shears and moments, 19 different loadings for each frame, 19 different loadings for each girder, fixed or hinged supports, supports at the same or different levels, rectangular rigid frames, triangular rigid frames and rigid frames with parabolic girder and many others. It is unique for a book which discusses all single-span types of rigid frames in that the formulas for bending moments and reactions may be used even without advanced training in structural analysis. The book also offers those who are trained, a quick method for computing displacements of structures, and rigid frames can be used as units in dealing with cases of more highly indeterminate structures. This is a handbook filled with graphic studies that should aid the structural engineer and find a prominent place in his library. Published by Frederick Ungar Publishing Co., New York. 460 pages, 6¼ x 9¼. Price \$10.00.

SOUTHERN PACIFIC—by Wilson and Taylor

Subtitled "The Roaring Story of a Fighting Railroad," this book is the factual story of an engineer's dream—to push a railroad across California's giant Sierra Nevada Range to form the West's largest rail network. This is a lively story of action, filled with construction adventure, and it is all the more interesting because it is true. It is actually a tribute to engineering ability and human foresight, and it is good reading. Published by McGraw-Hill Book Co., Inc., New York. 256 pages, 6¼ x 9¼. Price \$4.50.

STRUCTURAL GEOLOGY OF NORTH AMERICA—by Eardley

A picture of a continent—inside and out—is presented by A. J. Eardley in this thorough geological study which took ten years to complete. The size of the book (its broad width) opens the way for a presentation of diagrams and maps, etc., which could not ordinarily be por-

NEW BOOKS

trayed. No mountain range, basin, etc., escapes the author's attention, and the detailed studies of the constitution of geological structures should interest and aid engineers. This is certainly the most complete picture of the North American continent ever compiled in one work, and it makes interesting and informative reading. Published by Harper & Bros., New York. 624 pages, 11½ x 8½. Price \$12.50.

THE RISE OF THE SKYSCRAPER—by Condit

Here is a story, well told by Carl W. Condit, about an era in modern building history. As the title implies, the book tells the advent in American architecture of the functional steel skyscraper. The author tells of the development of the Chicago school of architects who instigated this swing to the towering structure which most successfully meets the demands of a growing populace. Along with the story of the architectural developments, the author brings in the materials, innovations and techniques which made the skyscraper a reality. This is an excellent history of an era whose mark is still apparent in most of our large cities. Photographs of some of the structures are contained in the book. Published by The University of Chicago Press. 255 pages, 6¾ x 9¾. Price \$5.00.

HOW TO SUPERVISE PEOPLE—by Cooper

Any man who finds himself in a position to give orders to others would do well to read this book on the subject by Alfred M. Cooper. This is the 3rd edition of this popular book which offers a good deal of practical advice on the difficult problems of supervising people. The helpful information contained in the book should make supervisors more thoroughly understand the importance of proper instruction and the way it is given. The proper issuance of instructions makes them easier to give and easier to follow. Published by McGraw-Hill Book Co., New York. 254 pages, 5¾ x 8¾. Price \$3.75.

TRACTORS AND THEIR POWER UNITS—by Barger, Carleton, McKibben and Bainer

The combined efforts of four experts in the tractor field, E. L. Barger, W. M. Carleton, E. G. McKibben and Roy

Bainer—have produced this excellent book on tractors and their power units. Here is theoretical and performance data. The book discusses the various types of tractors and what can be expected of each; the component parts, accessories and maintenance expectations of tractors. Owners and operators of tractors would have a difficult time thinking of a question that the author have not already answered in this practical book. The diagrams, tables and photographs included are valuable supplements to the textual material. Published by John Wiley & Sons, Inc., New York. 496 pages, 6 x 8½. Price \$4.50.

PRESTRESSED CONCRETE—by Magnel

In this book Gustave Magnel reports the tremendous developments in prestressed concrete and seeks to inform the reader on the knowledge of the subject which has been gained. The book contains conversions from the metric system, by Charles C. Zollman. The work offers suggestions to contractors on using prestressed concrete in certain structures. This is not a quick review of the subject, but rather a thorough picture of the substance and its present status and future potentialities. Tables and diagrams are interspersed in the text to illustrate the study in a point-by-point fashion. Contractors will find this book a source of worthwhile information on the prestressed concrete technique. Published by Concrete Publications, Ltd., London. 300 pages, 6¾ x 9¾. Price \$3.00.

HIGHWAY ENGINEERING—by Ritter and Paquette

This is a textbook in which L. J. Ritter, Jr., and R. J. Paquette take highway engineering in a step-by-step manner from the ancients to the modern. It is not entirely devoted to technical details since it discusses the history, the administration and the financing, etc., of highways in its initial chapters. After the introductory chapters, there are many others devoted to planning, drainage, soil testing, types of surfacing, surveys and plans—in short, the book takes the highway from its talking stages to completion in an interesting and informative way. Published by The Ronald Press Co., New York. 720 pages, 6¼ x 9½. Price \$6.50.

FOREST MANAGEMENT is a new book by Arthur Meyer, Arthur B. Recknagel and Donald D. Stevenson, which presents an interesting discussion of the field of forest management and its implications on forest supply. The techniques of forest management are important to users of timber, and the field itself is an interesting one. Published by The Ronald Press Co., New York. 298 pages, 6½ x 9½. Price \$6.00.

FOREST INVENTORY is a somewhat technical book on the measurements and means of evaluating growth statistics of America's forests. The new aerial approach to measurement of forests is discussed along with the need for coordinating material with measurements derived from other means. Stephen H. Spurr is the author. Published by The Ronald Press Co., New York. 476 pages, 9¼ x 6¼. Price \$8.50.

Books reviewed in this section are made available by J. W. Stacey, Inc., retailers of technical books (stores at San Francisco and Denver). You may obtain a copy of any book reviewed this month by sending an order to J. W. Stacey, Inc., c/o Western Construction, 609 Mission St., San Francisco 5, California.

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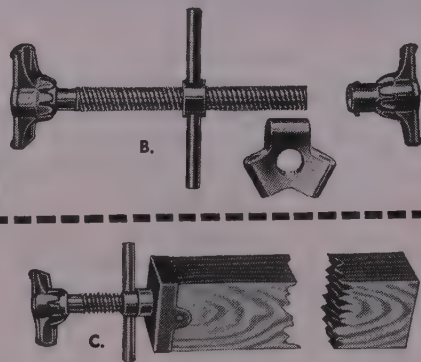
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Wellton-Mohawk repayment contract is \$42,000,000

A \$42,000,000 repayment contract with the Wellton-Mohawk Irrigation and Drainage District has been signed—the largest single contract of its kind yet negotiated by the Bureau of Reclamation.

The contract requires the District to repay the cost of the irrigation system serving the Wellton-Mohawk division of the Gila project along the Gila River east of Yuma. The estimated cost of the project averages \$560 an acre, repayable over a 60-year period, preceded by a 10 year development period.

Under the contract the Bureau of Reclamation is constructing the Wellton-Mohawk, Wellton, and Mohawk canals, three main pumping plants, distribution system, protective works and drainage works. Works already constructed to serve the Wellton-Mohawk division and the balance of the Gila project include Imperial and Lagun dams on the Colorado River above Yuma, and the Gila gravity main canal. Imperial Dam also is the diversion structure for the All-American canal, through which irrigation water is carried to the Yuma project in southwestern Arizona and southeastern California and the Imperial and Coachella valleys in California.

Water for the Wellton-Mohawk division's 75,000 acres of irrigable land will be diverted at Imperial Dam into the Gila gravity main canal, then into the 18½-mile-long Wellton-Mohawk canal which leaves the main canal about 15 miles below the dam. The Wellton-Mohawk canal will carry the water into three branches, the Mohawk and Wellton canals, and then to the lateral system. The first water from the system is expected to flow onto the division's land this spring.

P. G. and E. plans Calif.'s largest generating plant

LARGEST generating plant in California is soon to be constructed on a 23 acre site at Pittsburg by Pacific Gas & Electric Co. This four-unit plant will increase the company's California generating capacity by 16% and will cost \$8,020,000. Construction includes a 600,000 kw. steam-electric plant and new transmission lines which will reach as far as Fresno County. Company expects to have two turbine generating units in operation by 1953 and the other two by 1954.

Elko, Nev. sewage plant

A \$275,000 bond issue was approved by residents of Elko, Nev., for construction of a sewage disposal plant. Crews and equipment are expected to start construction this spring. The partial use of city material will aid in the reduction of costs. Brown and Caldwell, San Francisco, hold the contract.

ENGINEERS ON THE MOVE

Hard Livingstone, superintendent of San Bernardino City Water Department, retires after 33 years of service. He is being replaced by **Leslie A. Hosegood**, assistant superintendent, subject to Civil Service approval.

C. D. Phelps and **Larry Lothspeich** will manage the Whitman County, Wash., highway department on an interim appointment until **Wayne Arrath** is released from duty with the U. S. Army. Phelps is a retired professor from Washington State College and Lothspeich is a former employee of state highway department as well as the county department.

The newly created post of executive vice president of the Portland Cement Association goes to **Carl D. Franks**, who has been vice president of the association since 1948. In his new capacity, Franks will exercise the duties of the president in the absence of that official. The position of PCA president was left vacant by the death of **Frank T. Sheets** last November, and has not yet been filled. Franks has been a member of PCA since its founding in 1916.

Fred F. Van Atta is now acting secretary-treasurer of the American Concrete Institute. He has been assistant secretary since 1946. Van Atta replaces **Harvey Whipple**, who becomes editorial consultant.

Three divisions of the Idaho Operations Office, U. S. Atomic Energy Commission, are affected by a reassignment of functions. **Walter H. Brummett, Jr.**, the contract coordinator, becomes director of the Contracts and Supply Division. This gives him direction of the Administrative Operations Branch, which was formerly included in the Finance Division. The branch includes procurement and supply. In addition the new division's activities will include warehousing, formerly administered by the Division of Maintenance and Communication Services. The reassignment puts under one division the allied functions of warehousing and procurement, and in addition, centralizes contractual activities, both for services and for supplies.

The Redding, Calif., subsection of the American Society of Civil Engineers is now a part of the Sacramento, Calif., section, after approval by the board of directors.

After 22 years of service as Sacramento, Calif. City Engineer, **Fred J. Klaus** is retiring. Klaus came to Cali-

fornia in 1901 from Ogden, Utah, and began his work with the Los Angeles Gas and Electric Co. He then served in railroad construction and irrigation work. He was later chief engineer for the East Bay Water Co. in Oakland, Calif., for over 20 years. In 1930 he became chief engineer of Sacramento.

F. M. Roberts, formerly with the Soil Conservation Service in Walla Walla, Wash., is now an engineering specialist with the service in Ephrata, Wash., on the Columbia Basin Project.

Appointment of **Stephen D. Bechtel, Jr.**, to the post of manager of the pipe line division of Bechtel Corp., is announced by the firm. Bechtel has served as field officer on some of the firm's most rugged piping assignments. He has recently been coordinating field survey and engineering operations preparatory to the Trans-Mountain Oil Pipe Line for Canadian Bechtel, Ltd.

Kenneth J. Bentley, formerly office engineer with the Texas State Highway Department, is now a structural test engineer for Chance Vought Aircraft.

Phillip M. Noble, formerly resident engineer on Long Lake Dam and canals in the vicinity of Ephrata, Wash., is now in charge of contract administration on canals and laterals in the Othello-Warden area on the Columbia Basin Project for the Bureau of Reclamation. He is section head of contract construction section 10.

W. J. Quinn is now construction engineer on Kirwin Dam for the Bureau of Reclamation. He was previously field engineer on the relocation of the C. B. & Q. railroad at Trenton Dam, Trenton, Neb.

James M. Chadick is now assistant project engineer for the Corps of Engineers on construction of an earthfill dam at Isabella, Calif. He was formerly materials engineer on the Folsom Dam Project.

The newly created post of Assistant Chief Engineer, Metropolitan Water District of Southern California, goes to **Robert A. Skinner**. He joined the District in 1933 as assistant engineer, and in 1943 he became office engineer. **Harris V. Crawshaw**, senior engineer, will take over Skinner's old post.

William E. Waste, executive vice president of the Bechtel Corp., and San

Francisco Bay Area Council, Inc., chairman for the past two years, is now vice president at large of the council. He succeeds **Carl F. Wente**. **William H. Park**, Oakland District Manager of the Pacific Gas and Electric Co., becomes the 1952 vice president.

Robert V. Killewich is office engineer in the Juneau, Alaska, office of the Bureau of Public Roads. He replaces **V. W. Blackwell**, who resigns after 20 years of service.

Col. John H. Skeggs is retiring after a fabulous career with the California Division of Highways in state highway building in the nine San Francisco Bay Area counties. It was over 30 years ago that Skeggs came to the Bay Area from the Los Angeles, Calif., district and faced the problem of preparing over 700 mi. of highways, which at that time were about 15 ft. wide, for the onslaught of commercial growth. Under the Colonel's guidance the Bayshore Freeway, main link to the southern Peninsula cities, was constructed along with the approaches to the two San Francisco Bay bridges which he designed. The Colonel leaves a record of progress behind him in District IV, and many of the future projects now scheduled will be part of the master plan he instigated.

David J. Powells is field engineer for Chicago Bridge and Iron Co. at Richland, Washington.

T. McCarty is now District III engineer at Albuquerque for the New Mexico State Highway Department. McCarty, who was formerly assistant district highway engineer at Las Vegas, succeeds **E. H. McGill**, who recently retired. At the same time the following shifts were made: **R. P. Nelson** will be McCarty's assistant in Albuquerque. He is a surveying engineer. **G. C. Lassetter** becomes secondary roads engineer. Replacing Nelson is **C. H. Muchmore**, assistant district engineer at Santa Fe.

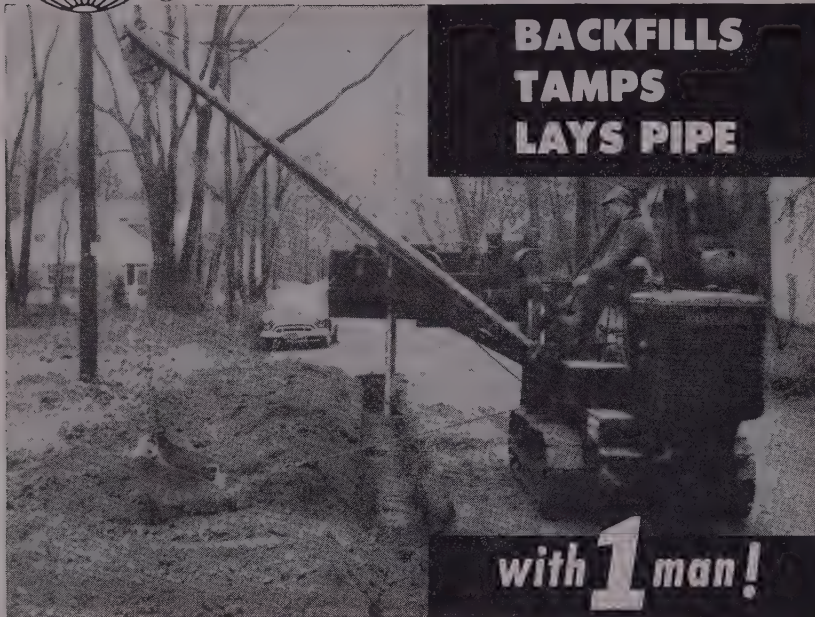
Carl P. Vetter, Bureau of Reclamation, chief of Region 3 Office of River Control, Boulder City, Nevada, is the new chairman of the U. S. Committee of the International Commission on Large Dams. This is an international organization for advancing engineering techniques for building and operating high dams all over the globe.

John Loosely becomes city engineer in Roseburg, Ore. He resigns his post as deputy city engineer in Astoria to accept this new position, which marks the first time Roseburg will have a city engineer.

William E. Willey, who completed a two-year study on extra truck lanes needed for passing trucks on uphill highways, receives a masters degree in civil engineering from the University of Illinois from which he graduated about 20 years ago. Willey is an Arizona state



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engineer of economics and statistics. His study results were presented to the National Academy of Sciences in Washington. Willey recommended an extra passing lane going uphill for passing trucks and this plan has been adopted by many states.

George N. Miles transfers to a new position as District Engineer in the Denver, Colo., district for the State Highway Department. Miles, who was formerly district engineer for the department at Grand Junction, replaces Harvey T. Stitt.

Kenneth Gilbert is now chief of the construction branch, Engineering and Construction Division for the Atomic Energy Commission's Los Alamos field office.

With the resignation of Ira S. Stinson as chief engineer in Glacier National Park, Ed Bossler will take over as acting engineer.

Raymond M. Rogers is now city engineer of Arcadia, Calif. He replaces Henry Ross.

B. L. Mendenhall is now the Bureau of Reclamation's project manager at the Riverton Project in Wyoming. He was formerly assistant construction engineer with the transmission division of the Bureau at Bismarck, N. Dak.

Lester C. Walker, who was engineer in-charge of River Basins, Chicago Regional Office of the Federal Power Commission, retired from his post. He will do consulting work in Idaho in connection with irrigation and other water resources activities. Walker was concerned with the Missouri River Basin Development and had worked on many other project preliminaries during his public career.

R. E. Lemmon is now an inspector for Ebasco Services, Inc., on Cabinet Gorge Dam. He was previously field engineer for Donovan-James at Albeni Falls Dam, Idaho.

Professor A. Diefendorf, University of Utah Civil Engineering Department, was reelected Western regional vice president of the American Road Builders Association.

Peter Gregory is the new city engineer and building inspector of Elko, Nevada, replacing L. T. Dozey, who resigns.

Murray W. Mosser, chief of the District Corps of Engineers legal branch, Albuquerque, N. Mex., resigns to accept a position on the personnel staff of Duquesne University. Other changes in the branch are: appointment of H. E. Murray as construction division chief, and transfer of F. A. Gruver, former chief, to the operations division, a newly organized post.

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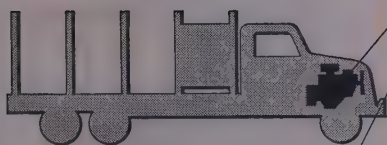
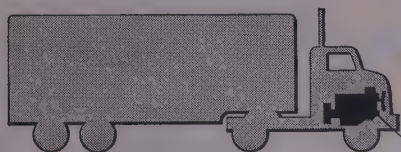
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ELECTIONS 1952

The Associated Engineers of Spokane—Officers for 1952 are: Ivan A. Shirk, president; Robert E. Tobin, Harold Kirkemo, R. E. Blasen, Albert Gruber, Harold A. Halstead, Sr., and Carl Johnson, vice presidents, and Wilbur L. King, secretary-treasurer.



Shirk



Harrison

Tacoma Chapter, AGC—Officers for 1952 are: J. A. Harrison, president; L. B. Macdonald, vice president; P. F. Stevens, treasurer, and C. W. Todd, secretary-manager.

Central California Chapter, AGC—Officers for 1952 are: Frank F. Burrows, president; Melvin Gautier, vice presi-

dent; Bert O. Summers, treasurer, and F. G. Corker, secretary-manager.

Engineers Club, San Jose, Calif.—Officers for 1952 are: Ted Wilson, president; Gerry Wilson, vice president, and Bob Roll, secretary-treasurer.

Structural Engineers Association of No. California—Officers for 1952 are: John J. Gould, president; G. A. Sedgwick, vice president; Art B. Smith, Jr., secretary; Franklin P. Ulrich, treasurer; Robert P. Moffett, assistant secretary, and William K. Cloud, assistant treasurer.



Gould



Gordon

Tacoma Engineers Club—Officers for 1952 are: Walter S. Gordon, president; Conant Dodge and W. D. Smith, vice presidents; Harold A. Hagestad, secretary-treasurer, and John W. Judy, executive committeeman.

CALENDAR OF MEETINGS

May 2-3—**ASCE, All California Sections of the American Society of Civil Engineers**, annual joint conference, San Diego, Calif. Arizona and Utah Sections invited to attend.

May 6-8—**4th Highway Transportation Congress of the National Highway Users' Conference**, Washington, D. C.

June 5-7—**Western Association of State Highway Officials**, Annual Meeting, Olympic Hotel, Seattle, Wash.

June 16-21—**American Society of Civil Engineers**, Denver Convention, Cosmopolitan Hotel, Denver, Colo.

June 23 to July 5—**4th Institute of Northwest Resources**, Oregon State College Campus, Corvallis, Ore.

June 23-27—**American Society for Testing Materials**, Annual Meeting, New York City, New York.

August 24-27—**58th Annual Congress of the American Public Works Association**, Los Angeles, California.

September 3-13—**American Society of Civil Engineers**, Centennial Celebration, Conrad Hilton Hotel, Chicago, Ill.

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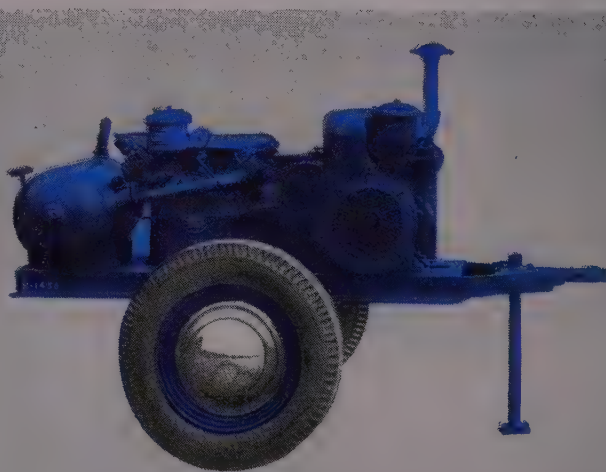
It's 30 cu ft of air power, ready and willing to tackle the host of building jobs that can be powered by air.

You'll find this Worthington Blue Brute portable air compressor has the same stamina as bigger Blue Brutes—60 cu ft and larger—and the same top quality of design and construction.

Ruggedly built 2-stage compressor. Light over-all weight for convenient towing, easy spotting. Worthington's famous Feather* Valve. Spring-mounted axle. Telescoping leg support. Special industrial model available for use in limited space.

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*Reg. U. S. Pat. Off.



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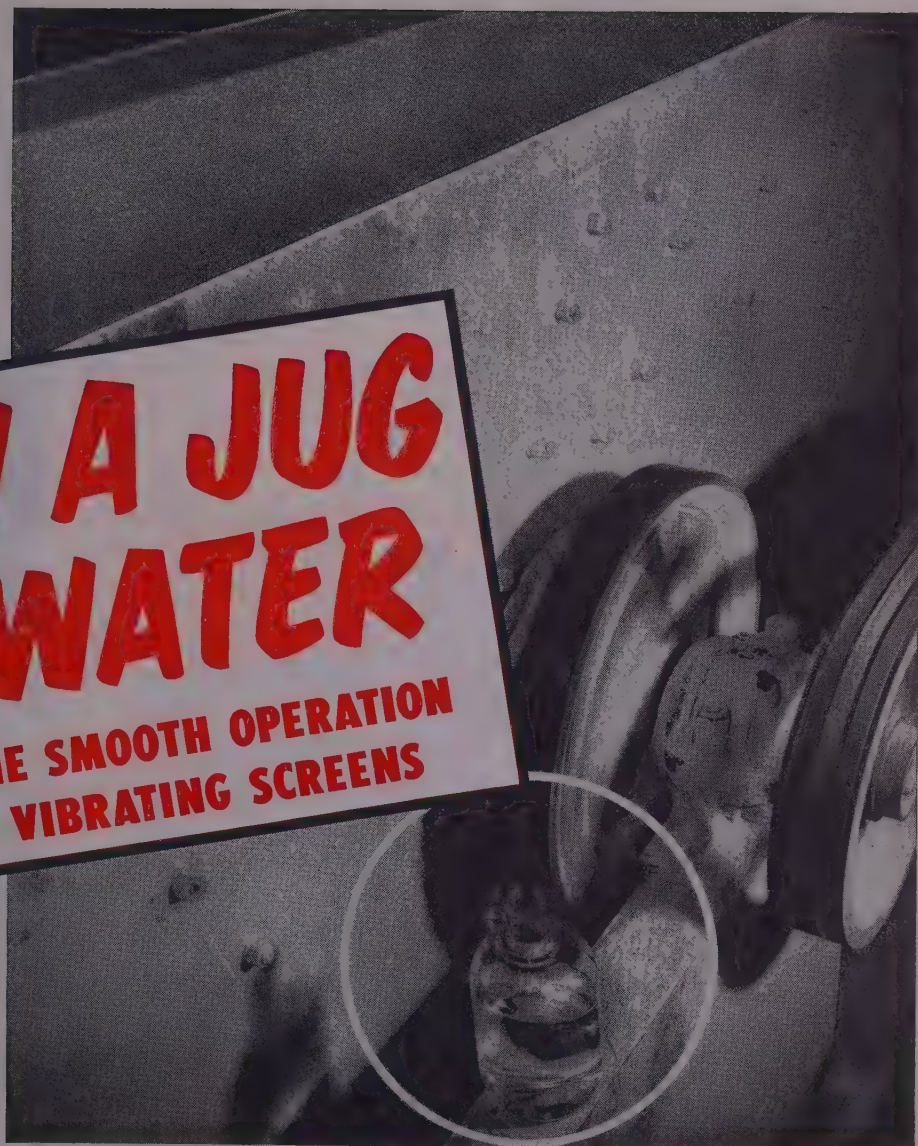
WORTHINGTON



H.17

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DEATHS

John Griffith, 73, retired building contractor, died January 27 in Los Angeles, Calif.

William D. Greenlee, 54, structural engineer in Los Angeles, Calif., died February 2.

Charles A. Pelletier, 82, retired construction engineer, died February 9 in his Los Angeles, Calif., home.

Karl B. Kumpe, 69, retired engineer and general contractor of Los Angeles,

Calif., died January 21 in the American Hospital in Paris.

Pierre H. Haumont, 69, engineering draftsman and building contractor, died February 17 near Needles, Calif. Haumont was a resident of Arizona.

Erastus (Pat) Wetzell, prominent building contractor in Salt Lake City, Utah, before moving to California, died February 17 in Hayward, Calif.

Frank H. Walker, 95, former assistant superintendent of construction on Highway 66, died February 1 in his Ashland, Wash., home.

MANY POUNDS OF PILES



A FEW of the 670 tons of Bethlehem Pacific's steel H-piles being used in Francisco in the abutment and pier foundations for the new \$3,500,000 18th to Bryant St. Overpass project are pictured above. The piles, from 40 to 50 ft. long, have been driven to 150-ft. depth at this location because of the earth's softness. The 50-ft. lengths of piles are welded together to reach the firm depth. Chas. Harney, Inc., holds the California State Division of Highways contract.

\$11,000,000 transmission line for San Fernando

CONSTRUCTION of an \$11,000,000 transmission line across western San Fernando Valley received the authorization of the Board of Water and Power Commissioners of Los Angeles, Calif., at the same meeting the board authorized acquisition of 21 mi. of right-of-way needed for the project.

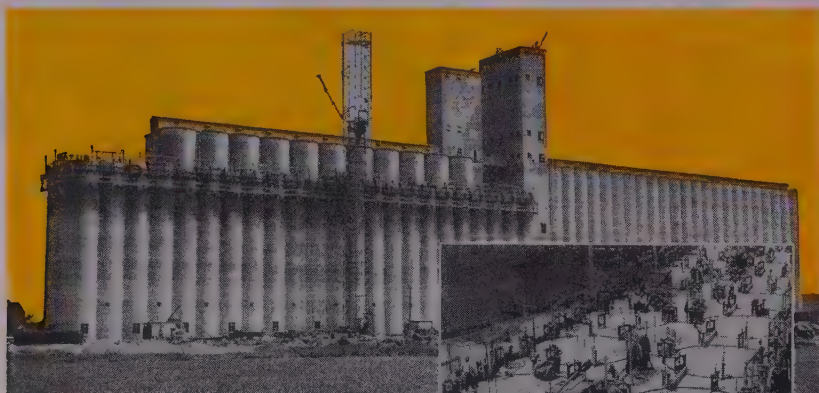
Details of the project

Power will be transmitted to Station J, which will be erected at Parthenon near Wilbur Ave. This is the anticipated center of future power needs in the valley. The line will use existing right-of-way by being joined with the new Van Nuys Steam Plant and to hydroelectric plants along the Los Angeles Aqueduct and Owens Gorge River. In addition, station J will be hooked to the main power of Los Angeles by running the line across the Santa Monica Mountains. This will provide a dual source of power in case there is an emergency need.

Inspection tour

A careful tour of the proposed transmission line route was made by the Los Angeles City Council's Water Power Committee. The three members were responding to the protests of residents in a housing tract in Tarzana where 50 families would be moved from their homes to allow for construction of 150-ft. poles.

The line is necessary to provide power for the expanding San Fernando Valley population which grew from 112,000 in 1940 to 310,960 in 1950.



337' x 48' slip-form deck used to pour addition to Farm Bureau grain terminal at Canal Winchester, Ohio. Once a minute, 192 screw jacks were turned to raise entire forms 15/100". Carts, served from central hopper, distributed concrete to the continuously rising forms.

How to pour a 1,200,000 bushel basket — in one piece

By a continuous pour of 6,000 cu. yds. of ready-mixed concrete, into slip-forms raised on jackrods at the rate of .15" every minute, this elevator addition was completed in 168½ hours. The 24 bins, each 20' in diameter and 127' high, and interstitial walls, covering a 337' x 48' area, form one monolithic structure without joint or seam.

Because concrete design envisions a homogeneous material, of numerous elements completely mixed, the ready-mixed concrete industry certifies by Rating Plate those truck mixers and agitators which have the proper design, capacity, drum speed, mixing action and water control necessary to produce a homogeneous concrete of uniform strength.

Look for this Badge of Dependability on Truck Mixers:

You have a right to insist on this Rating Plate on any truck mixer that serves your jobs. It is available to all who comply with the quality standards established by the National Ready Mixed Concrete Association and the Truck Mixer Manufacturers Bureau.



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CHAIN BELT COMPANY
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CONCRETE TRANSPORT MIXER CO.
St. Louis, Mo.
THE JAEGER MACHINE COMPANY
Columbus, Ohio

THE T. L. SMITH COMPANY
Milwaukee, Wis.
WORTHINGTON PUMP & MACHINERY CORP.
Dunellen, N.J.

SUPERVISING THE JOBS

G. Royther is superintendent on construction of the Episcopalian Church in Hermosa Beach, Calif. The project is getting under way and will cost \$2,000.

Construction of Hoag Memorial Hospital in Newport Beach, Calif. is under supervision of **Ken C. Ulrich**, who is project manager for Means & Ulrich. **Roy Pounds** is carpenter superintendent, and **Al Markel** is labor superintendent.



Don McGuire, left, is concrete superintendent for Vinson Construction Co. and **Don Mulhervon** is project superintendent on construction of the Queen's Creek tunnel in Superior, Arizona.

Birch & Sons has **H. P. Bosworth** as superintendent on the \$548,708 construction of outside utilities at Elmendorf Air Force Base in Alaska. This is a Corps of Engineers project.

G. Brown is general superintendent for Fred J. Early, Jr. Co., Inc., on the \$30,000 construction of sewage treatment plant facilities at Pittsburg, Calif. **Don Craft** is general foreman. **Stanley Miller** is office engineer.

Construction of the education center for San Diego City Schools in San Diego, Calif., is under the supervision of **Paul Everton** with **Richard Koch** as assistant. **M. H. Golden** Construction Co. holds the contract and the job is nearing completion. **W. E. Lance** is finisher foreman and **A. Woolhouse** is in charge of the office.

Elmer Herman is general superintendent for Western Area Housing Co. on a big housing project for the U. S. Navy at Kearney Mesa in San Diego, Calif. **Fred Wild** is assistant superintendent, **R. Garnett** is carpenter foreman and **Phil Johnson** is general foreman.

Jim Dykstra is general superintendent of Allison Honer Co. on the \$2,000,000

State School for the Deaf at Riverside, Calif. **Irwin Kind** is project manager. **Ken Brazier** is carpenter foreman, **Jeff Heroth**, labor foreman, and **Jim Hastings**, general foreman on the job. **Richard Honer** is office manager. **Ralph Chase** is office engineer.

Construction of the Sherwood Bridge and approaches on Secondary State Highway No. 14-A in Mason County, Wash., is under the supervision of **Fred Nygren**. **L. A. Dewey** is carpenter foreman for Alex Robertson Co. on the the \$123,172 project.

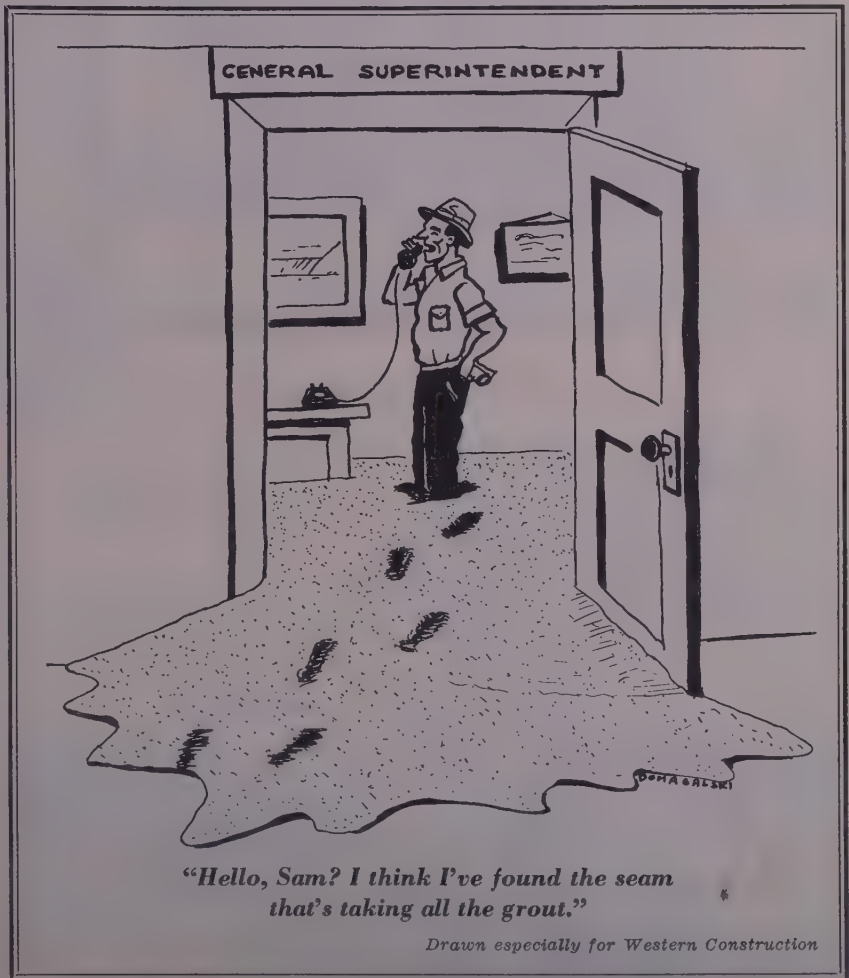
Construction of the \$2,000,000 Sears Roebuck & Co. store in San Diego, Calif., is under the supervision of **Guy C. Jack**. **Sam Brock** is assistant superintendent. **Francis Shaw** is carpenter

superintendent, with **Bill Kemp** and **Al Adamske** as carpenter foremen. **Refugio Roble** is cement finisher foreman and **George Roberts** is labor foreman. **Will Rogers** is electrical foreman and **Paul Windward** is office manager for L. C. Anderson, contractor.



Rhoades-Shofner Construction Co. has, left to right: **H. Allinder** as tunnel superintendent, **F. Clary** as walker and **E. McElroy** as shifter on construction of the Gaviota Gorge tunnel near Santa Barbara, Calif.

Down-time Dopes. by Domagalski



Construction of the Pittsburg Elementary School in Pittsburg, Calif., is under the supervision of **Carl Largon** with **Ray Jackson** as foreman. California Builders Co., Inc., holds the \$447,000 contract.

General construction for the Fiberboard Corp. at Antioch, Calif., is under the supervision of **Joe Nusbaum** with **Harold Pedler** as his assistant. Swinerton & Walberg holds the \$500,000 contract.

Construction of the freeway between Pittsburg, Calif., and Antioch, Calif., is under the supervision of **G. W. Premo** as project manager and **J. E. Neville** as assistant superintendent. Peter Kiewit

Sons' Co. has **H. J. Olsen** as structural superintendent, **E. J. Dagget** as grade foreman and **R. E. McClarrinon** as general foreman, along with **O. A. Saalfeld**. **F. T. Payne** is utilities superintendent and **Jack Sneed** is master mechanic. **F. L. Welch** is grade foreman and **Jim Peckinpaugh** is excavation superintendent. **W. A. Madison** is a general foreman. **T. E. Martin** is mechanic foreman, and **W. E. Baldrige** is lubrication foreman. **J. F. McLaughlin** is job engineer and **O. K. Hoepfner** is office manager.

Bud Ames is general superintendent for Wohl-Calhoun Co. on constructing panel forms for a building for French Fish Cannery, Terminal Island, Calif. **Charlie Hanson** is carpenter foreman,

Leon Williams is labor foreman, a **Ray Stevenson** is steel foreman.

Harold J. Fossedal is superintendent for Don F. Shaw, contractor, on the addition to Pathé Laboratories in Hollywood, California. This is a \$1,500,000 project.

Sewer and water main construction Davis-Monthan Air Force Base in Arizona is being supervised by **Elmer Cluqust**. **W. J. Monahan** is another foreman for Alex Robertson Co. on a \$749,919 job.

F. W. Wheelwright is superintendent for Wheelwright Construction Co. on the \$132,601 construction of Coal Creek Bridge and approaches in Utah.

Bruce McDonald is job superintendent for Griffith Co. on the \$366,000 construction of highway along Airport Avenue. **Glen L. Morin** is structure superintendent and **Ronny Harrington** is carpenter foreman. **J. W. Cole** is resident engineer for the State of California, and **J. Casey** is bridge engineer.



ABOVE: **Bob Gomerson**, left, is concrete foreman and **Art Taylor** is paving superintendent for Bressi & Bevanda on construction of the El Toro Marine Base runway extensions, near San Diego, Calif.

BELOW: On the same project are, left right: **Frank Wood**, finisher foreman; **Playcheck**, header board foreman; **B. Westfall**, equipment foreman; **Joe T. van**, steel foreman. Kneeling: **Sam Loro**, inspector, and **Dick Damon**, Hot Process superintendent.



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AEA**

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job for less!**

These men are building El Toro Marine Base Runways

Contractors Bressi & Bevanda and A. Teichert & Son, Inc. are joint venturers on construction of longer and stronger runways at El Toro SMC base in Calif. Pictures of key personnel appear on this page and the one preceding it. Details of the project are contained on pages 1-84 of this issue.

(All captions read left to right unless otherwise indicated.)

BELOW—E. G. Byrd, office manager; Roy J. Hill, general superintendent; Robert J. Skinner, excavation superintendent and Dominic J. Bressi, structural superintendent.



LEFT—William Paxson, assistant chief of party with Jim Hall, chief of party. Both are on the contractor's engineering staff.

RIGHT—Stuart Volk, seated, is in charge of operations for Consolidated Rock and Graham Bros. in supplying aggregate and concrete. Gene Volk, standing, is his assistant.



ABOVE—Jack E. Davis is project engineer representing the Navy and J. A. Keane is superintendent of construction.



LEFT—G. C. Weeshoff is project manager for the joint venture.



ABOVE—Frank Ahlgren, asphalt paving superintendent; Leonard Laney, engineering assistant, and L. G. Wright, project engineer. Right: I. A. MacDonald, aggregate plant superintendent; A. L. Hamm, master mechanic, and C. P. Gonzales, grading foreman.



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ment. This rope has *extra* resistance to crushing and abrasion . . . stands up under rough going. It saves you time and cuts costs.

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CONTRACTS

A Summary of Bids and Awards for Major Projects in the West

Alaska

\$7,000—Anderson-Montin-Benson, 234 Central Bldg., Seattle, Wash.—Low bid for construction of a field house at Eielson Air Force Base; by C. of E.

\$16,600—S. S. Mullen, Inc., and Benson Chandler, 621 9th Ave. N. Seattle—Low bid for construction of 150 housing units at Anchorage; by Alaska Housing Authority.

\$4,191—Patti-MacDonald, 3829 W. Pine Blvd., St. Louis, Mo.—Low bid for construction of communication facilities near Anchorage; by C. of E.

\$10,548—Reed & Martin, Inc., Box 451, Fairbanks—Low bid for construction of elementary schools at Ladd and Eielson Air Force Bases; by C. of E.

Arizona

\$18,366—Arizona Sand & Rock Co., P. O. Box 596, Phoenix—Low bid for grading, draining, select material, aggregate base and bituminous road mix beginning at a point on U. S. Alternate 2 about 11 mi. southwest of Sedona and extending southeasterly to Oak Creek, a distance of approximately 2¾ mi.; by St. Hwy. Dept.

\$25,518—Fisher Contracting Co., P. O. Box 4035, Phoenix—Low bid for 1.2 mi. of grading, draining, subgrade seal, select material, aggregate base and bituminous surface treatment, beginning about 8 mi. east of Ashfork; by St. Hwy. Dept.

\$27,820—Fisher Contracting Co., P. O. Box 4035, Phoenix—Low bid for grading, draining, subgrade seal, select material, aggregate base and bituminous surface treatment over about 3 mi. of roadway, located about 75 mi. northwest of Globe on U. S. Highway 60; by St. Hwy. Dept.

\$35,590—Larsen Contracting Co., P. O. Box 1790, Phoenix—Low bid for grading and draining and select material about 9 mi. of Superior and extending southeast for a distance of about 2½ mi.; by St. Hwy. Dept.

\$26,885—Dale Payne, 2345 West Thomas Rd., Phoenix—Low bid for grading, draining, subgrade seal, select material and bituminous surface treatment beginning at the town of Duncan and extending southeasterly to the New Mexico State Line, about 2½ mi.; by St. Hwy. Dept.

\$14,263—Phoenix-Tempe Stone Co., P. O. Box 1670, Phoenix—Low bid for draining, select material and bituminous road mix extending from a point on State Highway 84, 3 mi. east of Casa Grande, east to State Highway 87, approximately 11.5 mi.; by St. Hwy. Dept.

\$27,521—Pioneer Constructors, P. O. Box 2768, Tucson—Low bid for grading, draining, select material, aggregate base and bituminous plant-mix, northwest city limits of Tucson; by St. Hwy. Dept.

\$20,095—Vinson Construction Co., P. O. Box 930, Phoenix—Low bid for furnishing and placing aggregate base and portland cement concrete pavement on roadway through tunnel, and furnishing concrete lining of the tunnel, which is located about 1¾ mi. northeast of Superior at the new Queen Creek Tunnel; by St. Hwy. Dept.

California

\$1,380,300—Ellis W. Barker, Ness Bldg., Salt Lake City, Utah—Award for construction of a Chico Junior High School in Chico; by Boards of Education.

\$161,302—Baun Construction Co., 324 Princeton St., Fresno—Low bid for 6 mi. of grading and surfacing on cement treated base on Poplar Road, between 6 mi. south of Poplar and Poplar, Tulare County; by St. Div. of Hwys.

\$1,762,482—F. W. Case Co., 7700 Balboa Ave., Van Nuys—Award for enclosing walls, warehouses and miscellaneous construction, Sharpe General Depot, Lathrop; by C. of E.

\$1,386,336—Fredrickson & Watson Construction Co., and M & K Corp., 873 81st Ave., Oakland—Low bid for grading and paving with portland cement concrete on cement treated subgrade and plant-mix surfacing on cement treated base, plus construction of a grade separation structure and 3 pedestrian overcrossings and furnishing highway light and traffic signals between Army St. and 17th St., about 1.3 mi. in length, San Francisco; St. Div. of Hwys.

\$2,748,157—Guy H. Hall, 310 30th St., Bakersfield—Award for construction of a high school at Chester and Douglas Sts., Bakersfield; by Kern County Union High School District.

\$394,536—Healy-Tibbitts Construction Co., 411 Brannan St., San Francisco—Low bid for construction of the Bay Shore Freeway trunk sewer, San Mateo; by City of San Mateo.

\$65,000,000—Kaiser Engineers, 1924 Broadway, Oakland—Award for construction and design of additions to steel plant facilities, Kaiser Steel Mill, Fontana; by Kaiser Steel Co.

\$126,004—Lars Oberg, 4982 Valley Ridge Ave., Los Angeles—Low bid for construction of a reinforced concrete girder bridge across Etiwanda-San Seavine Flood Control Channel about 8 mi. east of Ontario, San Bernardino County; by St. Div. of Hwys.

\$1,222,895—George V. Peterson and Jack W. Baker, 617½ Santa Monica Blvd., Los Angeles—Low bid work on Santa Ana Freeway, including: a combination railroad underpass and highway separation structure, a railroad underpass, a pump house, a drainage storage box, and reinforced concrete retaining walls to be constructed; 0.3 mi. of grading and portions to be surfaced with portland cement concrete pavement on cement treated subgrade and asphalt concrete on imported base material, acceleration and deceleration lanes, frontage roads and streets to be surfaced with plant-mix surfacing on imported base material, Los Angeles County; by St. Div. of Hwys.

\$186,921—Standard Dredging Corp., 108 W. 6th St., Los Angeles—Low bid for dredging harbor and channel entrance at Port Hueneme; by Department of the Navy.

\$218,199—Stolte, Inc., 8451 San Leandro St., Oakland—Award for construction of interceptors and force main sewers, Pacific Grove; by City of Pacific Grove.

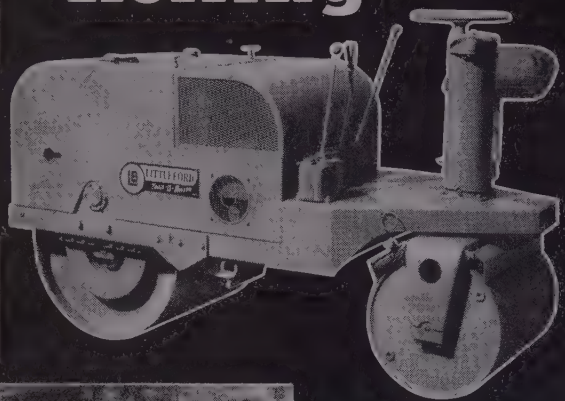
\$109,785—Ted Swartz, Glenbrook Park, Grass Valley—Low bid for grading, placing imported borrow, and applying penetration treatment and seal-coat between 4 mi. east of Browns Valley and 0.9 mi. east and between 7 mi. east of Stanfield Hill and Frenchtown Rd., about 2.8 mi. in length, Yuba County; by St. Div. of Hwys.

\$122,748—A. Teichert & Son, Inc., 1846 35th St., Sacramento—Low bid for constructing borders, shoulders and base of untreated rock base and the central portion of the roadbed to be surfaced with plant-mix surfacing, between 2.5 mi. north of Vacaville and Midway; by St. Div. of Hwys.

\$232,759—Thomas & Sullivan, 461 Market St., San Francisco—Low bid for laying Sutro water main in San Francisco; by Public Utilities Comm.

\$1,200,700—Clyde W. Wood & Sons, Inc., 6900 Tujunga Ave., North Hollywood—Low bid for construction of a reinforced concrete bridge, plus grading and surfacing with plant-mix surfacing on cement-treated base between Gaviota and Gaviota

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HALL-PERRY MACHINERY CO.....Butte, Montana
LUND MACHINERY CO.....Salt Lake City, Utah
SHRIVER MACHINERY COMPANY.....Phoenix, Arizona
SMITH BOOTH USHER COMPANY.....Los Angeles, Calif.
YUKON EQUIPMENT COMPANY.....Seattle, Washington

Gorge, about 3.2 mi. in length, Santa Barbara County; by St. Dept. of Hwys.

Colorado

\$200,843—Colorado Constructors, Inc., 726 W. 39th Ave., Denver—Low bid for earthwork, canal lining and structures for the Hill Canal, Estes Park-Foothills Power Aqueduct, Colorado Thompson Project; by USBR.

Idaho

\$124,237—Barnhart & Wheeler, P. O. Box 1107, Pocatello—Low bid for construction of a roadway and a road-mix bituminous surface on 9.0 mi. of the Bruneau-Duck Valley Highway in Blaine County; by St. Dept. of Hwys.

\$505,185—Carbon Bros., 3430 N. Cook, Spokane, Wash.—Low bid for construction of a roadway and a road-mix bituminous surface on 7.5 mi. of the Nez Perce Highway between Craig and Mohler in Lewis County; by St. Dept. of Hwys.

\$211,910—Mountain States Construction Co., Inc., Highway 1, Pocatello—Low bid for construction of the roadway and a road-mix bituminous surface on 9.0 mi. of the Dayton-Red Rock between Oxford and Red Rock in Bannock and Franklin counties; by St. Dept. of Hwys.

\$42,965—Duffy Reed Construction Co., Box 1092, Twin Falls—Low bid for construction of a roadway and bituminous surface treatment on 4.9 mi. of the Highway U. S. 30 from King to Ely in Elmore County; by St. Dept. of Hwys.

New Mexico

\$125,349—J. H. Ryan, P. O. Box 15, Albuquerque—Award for 0.6 mi. of work on the West Central-Albuquerque section of U. S. 66 in Bernalillo County; by St. Hwy. Dept.

\$104,316—Wylie Contracting Co., 1009 N. 3rd St., Albuquerque—Award for construction on the Loving-East road to be 5.1 mi. in length on State Highway 387; in Eddy County; by St. Dept.

Oregon

\$346,087—Acme Construction Co., Eugene—Low bid for construction of the Suicide Creek-Pacific Highway section of Coos Bay-Roseburg highway, Douglas County. Job consists of grading and paving; by St. Hwy. Comm.

\$134,211—Babler & Rogers, 4617 S.E. Milwaukie Ave., Portland—Low bid for grading and oil-mat surfacing between Powell Butte and Deschutes County line on the Powell Butte Second Highway, Crook County; by St. Hwy. Comm.

\$164,320—Donald M. Drake Co., 904 Lewis Bldg., Portland—Low bid for construction of bridges over Tualatin River on West Portland-Hubbard highway, Washington County; by St. Hwy. Comm.

\$267,180—Funderburk Construction Co., Sutherlin—Low bid for grading and oil-mat surfacing the Long Rock-Bridge-Creek section of the North Umpqua County rd., Douglas County; by St. Hwy. Comm.

\$731,139—E. L. Gates, Inc., 444 Center St., Salem—Award for construction of the Winchester Bay-Clear Lake unit, Winchester Bay-Forest Boundary section of the Oregon Coast Highway and south of Winchester Bay, Douglas County; by St. Hwy. Comm.

\$196,630—Carl M. Halvorson, Inc., 218 Builders Exchange Bldg., Portland—Low bid for construction of a bridge, Hood River crossing, Columbia River Highway, Hood River County; by St. Hwy. Comm.

\$152,125—Heavy Hauling Co., Astoria—Award for construction of the N. unit, Princeton-Folly Far section of the Diamond

and Rome-Princeton highways about 8 mi. south of Crane. Consists of 10.5 mi. of grading and oil-mat surfacing, also including approximately 3,150 cu. yd. maintenance material in mobile, Harney County; by St. Hwy. Comm.

0445—**R. A. Heintz Construction Co.**, 211 N.E. Columbia by Portland—Low bid for grading and structures on the Jones Ferry Road-Willamette River unit, Barbour Blvd.-White Hall section of the West Portland-Hubbard Highway in Washington and Clackamas counties; by St. Hwy. Comm.

0487—**Roy L. Houck & Son**, Salem—Low bid for construction of the Hayesville School-State Street unit, Salem by-pass section of the Pacific Highway east of Salem, including 3.54 mi. of grading main highway; 2.23 mi. of grading frontage roads and oil-mat rock base and oil-mat surface on frontage roads, Marion County; by St. Hwy. Comm.

0440—**Inland Construction Co.**, Milwaukee, Wis.—Low bid for construction of the Eagle Creek section of the Clackamas Highway about 3 mi. north of Estacada, including 0.3 mi. grading and oil-mat surfacing on frontage roads and construction of 1 reinforced concrete bridge; by St. Hwy. Comm.

0477—**Vernie Jarl**, Gresham—Award for construction of 1st Ave. service roads section of the Pacific Highway East, City of Portland, including 0.67 mi. grading and paving of service roads and ramps, Multnomah County; by St. Hwy. Comm.

0409—**Tom Lillebo**, Reedsport—Award for construction of bridge at Reedsport over Scholfield Creek on Oregon Coast Highway, Douglas County; by St. Hwy. Comm.

0442—**Tom Lillebo**, Reedsport—Low bid for the construction of a bridge over Silverton Rd., Sunnyview Ave. and Garden Lane on the Salem by-pass in Marion County; by St. Hwy. Comm.

0410—**Lockyear & White**, Longview, Wash.—Low bid for construction of the Shogren overcrossing, Columbia River Highway, Wasco County; by St. Hwy. Comm.

0444—**John A. Logan**, Portland—Low bid for grading and oil-mat surfacing the Catching Slough-Enegren Ferry section of the Copps River Secondary Highway in Coos County; by St. Hwy. Comm.

0400—**Joe Lundberg Construction Co.**, 3220 E. Republican, Ellensburg, Wash.—Low bid for construction of sewage treatment plant additions, Pendleton; by City of Pendleton.

0436—**McNutt Bros.**, 351½ E. Broadway, Eugene—Award for construction of the Chenoweth Park-Oakland Junction unit, Chenoweth Park-Deady section of the Pacific Highway about 1 mi. north of Oakland, including 2.52 mi. of rock base and paving, and reinforced concrete box culverts, Douglas County; by St. Hwy. Comm.

0446—**Parker-Johnson Co.**, 2002 S.E. Clinton, Portland—Low bid for construction of the Rock Creek Bridge, Mosier overcrossing and Mosier Creek Bridge in Wasco County; by St. Hwy. Comm.

0400—**Rogers Construction Co.**, 11760 N.E. Glisan, Portland—Award for construction of the Shogren-Rowena Creek unit, over The Dalles section of the Columbia River Highway, about 0.5 mi. east of Mosier, including 3.23 mi. grading and rock base, Wasco County; by St. Hwy. Comm.

0442—**Rogers Construction Co.**, 11760 N.E. Glisan, Portland—Low bid for paving the Stout Creek-Mill City section of the Santiam Secondary Highway in Marion County; by St. Hwy. Comm.

0466—**F. L. Somers**, P. O. Box 938, Klamath Falls—Award for Modoc Point-Barkley Springs unit, Modoc Point-Algoma section of The Dalles-California highway about 9 mi. north of Klamath Falls, Klamath County; by St. Hwy. Comm.

0448—**Western Electrical Construction Co.**, 1233 N.W. Lovejoy St., Portland—Award for construction of St. John's Substation additions, and miscellaneous work; by Bonneville Power Administration.

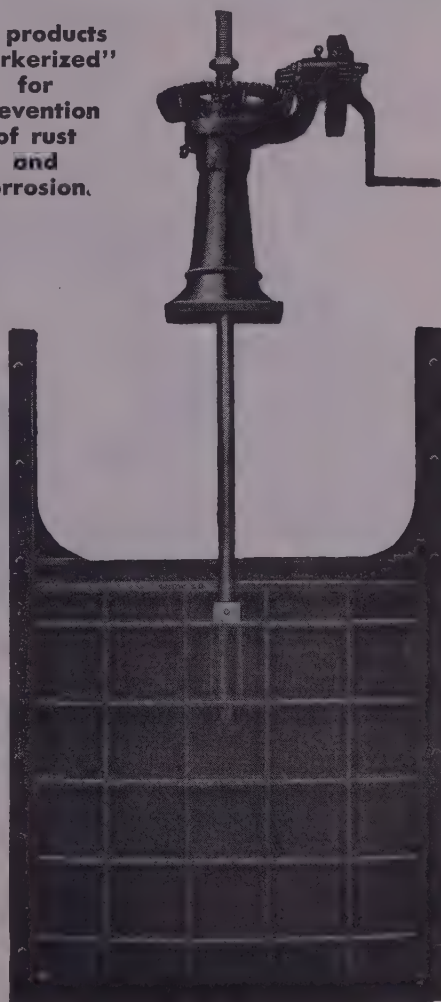
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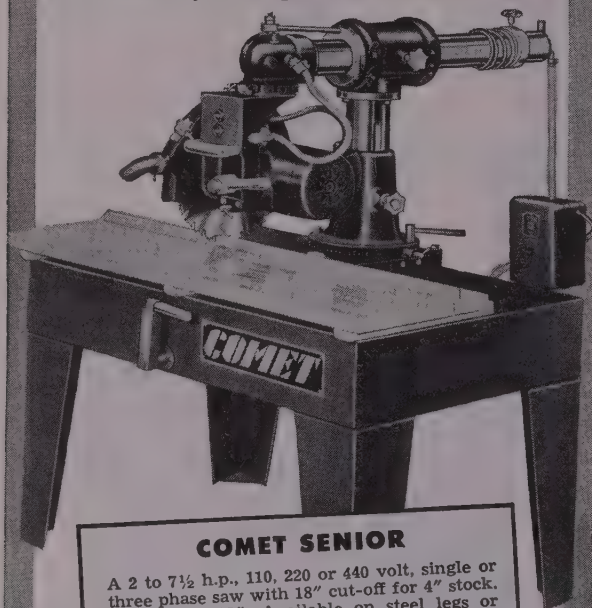
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G029

\$959,913—**Leo S. Wynans, Inc.**, 3201 N.E. Broadway, Portland—Low bid for construction of a 20-room high school structure in Forest Grove; by Forest Grove School District.

Utah

\$318,931—**W. W. Clyde & Co.**, Springville—Award for construction of a 2-in. road-mixed bituminous surfaced road between Hinckley and Skull Rock Pass, 33.5 mi. in length, Mil County; by St. Rd. Comm.

\$227,225—**W. W. Clyde & Co.**, Springville—Award for construction of the Chicken Creek-Levan road; by St. Rd. Comm.

\$112,409—**F. R. Knowlton & Son**, Layton—Low bid for construction of a concrete bridge over a 20-ft. span between Haw's Creek and Deweyville, Box Elder County; by St. Rd. Comm.

\$265,881—**Whiting & Haymond**, Springville—Low bid for construction of 2-in. road-mix bituminous surfacing, and a concrete bridge over 20-ft. span, between Gusher and La Point, Uinta County; by St. Rd. Comm.

Washington

\$262,900—**Anderson Bridge Construction Co.**, 4130 So. Adams, Tacoma—Award for construction of the Kalama River Bridge on Primary State Highway No. 1, Cowlitz County; by St. Dept. of Hwys.

\$1,500,000—**Barrett & Hilp**, 918 Harrison St., San Francisco—Award for construction of a 1-story warehouse building, Seattle; by Seattle Warehouse Co.

\$1,109,750—**Bennett-Campbell, Inc.**, Seaboard Bldg., Seattle—Low bid for construction of a 3-story, 8,500-sq. ft. reinforced concrete hospital addition, Public Health Service Hospital, Seattle; by General Services Administration.

\$1,259,000—**Bennett-Campbell, Inc.**, Seaboard Bldg., Seattle—Low bid for the rehabilitation of buildings at Ft. Lawton, C. of E.

\$39,749,990—**Columbia River Constructors**, 603 Hoge Bldg., Seattle (joint venture)—Low bid for construction of the powerhouse and intake structures at Chief Joseph Dam, Bridge River; by C. of E.

\$158,200—**Duncan Construction Co. and Commercial Builders Inc.**, Moscow, Idaho—Low bid for Lake Lenore Pumping Station, Nos. 1 and 2 and intake and connecting channels, Columbia River Project; by USBR.

\$241,840—**Erland & Bickle**, 8265 No. Barthwick Ave., Portland—Award for 1.9 mi. construction on Woodland east section, Secondary State Highway No. 1-8; by St. Dept. of Hwys.

\$852,815—**Intermountain Plumbing Co. and Henry L. Horton**, O. Box 293, Connell—Low bid for Saddle Gap and PE-17 pumping plants Area P-1 and laterals, Area P-13, Columbia River Project; by USBR.

\$636,216—**K. F. Jacobsen & Co., Inc.**, 1601 N.E. Columbia River, Portland, Ore.—Award for 4.7 mi. of paving from Castle Rock to Toutle River, Cowlitz County; by St. Dept. of Hwys.

\$207,500—**Lockyear & White, Inc.**, P. O. Box 637, Longview—Award for construction of Coweman River Bridge superstructure and approaches, Cowlitz County; by St. Dept. of Hwys.

\$9,368,994—**MacDonald-Woodworth-Wright**, 1717 S. Tacoma Way, Tacoma—Low bid for construction of 40 barracks buildings at Ft. Lewis; by C. of E. (Bidder design: \$9,262,993).

\$2,769,550—**Myers & Major**, Vancouver—Low bid for the construction, management and financing of 300 housing units on Whidby Island, Wash.; by Thirteenth Naval District.

\$244,535—**Seattle Contracting Co.**, 101 Nickerson St., Seattle—Low bid for paving alleys in Central Park addition to Seattle, plus other paving; by City of Seattle.



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Colorado's Leadville Tunnel is nearing completion

LEADVILLE TUNNEL in Colorado, a \$2,000,000 project launched in 1943, is near completion. This drainage tunnel, which represents more than two miles of drilling including laterals, was put through to unwater many of Lake County's once-famous lead and zinc mines so that they may again produce metals. Under an agreement with property owners, royalties will be collected on minerals made accessible, produced and sold as a direct result of the drainage project undertaken by the U. S. Bureau of Mines. Utah Construction Co. completed the last phase of the project.

Rip-rap for Grand Coulee



A new 2½-yd. Link-Belt shovel, powered by a 275-hp. Model NHS-600 Cummins diesel torque converter unit, loads a 36TD Euclid dump truck at the site of Grand Coulee Dam in Washington. Pacific Bridge Co., the equipment owner, has the contract for rip-rap work on the face of the dam.

B. C. Aluminum plant job spurs equipment sales

SALES of construction equipment are expected to reach a new high mark in British Columbia this year. Very heavy volume was established in 1951, but dealers believe that the business will far exceed these figures by the end of this year. Bulldozers, concrete mixers, air compressors, earth movers, pneumatic drills, trucks and other equipment are in demand in connection with major industrial development projects under way in the province.

The big problem today is not securing orders, but being able to deliver the merchandise. It is reported that there is over \$1,000,000 worth of trucks in use on the Nechako dam phase of the Aluminum Company's hydro power development (see article in this issue), and this is but one aspect of this huge project. There are major hydroelectric and pulp and paper projects commencing or planned for immediate start in the province. Power shovels are in especially heavy demand and in short supply.

UNIT BID PRICES

Selected bid abstracts for Western projects

Sewerage

Clay pipe main line sewer and connections

California—Los Angeles County—County. George Dakovich, Monterey Park, submitted the low bid of \$26,835 to the Board of Supervisors for construction of sanitary sewers in Woods Ave. and other right of Unit prices were as follows:

(1) George Dakovich	\$26,835	(5) Mike Ramljak Co.	\$30
(2) Charles Burch	27,182	— O'Shaughnessy Construction Co.	31
(3) S. S. Zarubica	27,215	(6) Engineer's estimate	21
(4) A. R. Milosevich and Son	30,087		

	(1)	(2)	(3)	(4)	(5)
2,470 lin. ft. 8-in. E.S.V.C.P. main line sewer	3.00	3.00	3.05	3.60	4.00
4,950 lin. ft. 8-in. S.S.V.C.P. main line sewer	2.60	2.65	2.70	3.00	2.70
80 lin. ft. 6-in. E.S.V.C.P. house connection sewer	3.00	3.00	2.45	2.50	3.00
340 lin. ft. 6-in. S.S.V.C.P. house connection sewer	3.00	2.75	2.40	2.50	2.60
27 only brick sewer structures	185.00	190.00	185.00	185.00	200.00
1 only trap manholes	250.00	250.00	235.00	250.00	300.00
1 only break into exist. struct. and reconstr. to form new channel in base	50.00	100.00	75.00	50.00	100.00

Irrigation

Repair of concrete floor slabs in canal outlet

Washington—Columbia Basin Project—USBR. Cherf Brothers Construction Co., Ephrata, submitted low bid of \$64,324 for repair of floor slabs in the feeder canal pump discharge outlet transition, Columbia Project. Unit prices were as follows:

(1) Cherf Brothers Construction Co.	\$ 64,324	— David Nygren	\$ 9
(2) Pacific Bridge Co.	68,795	— Hall-Atwater Co.	12
(3) Don Akins, Inc.	69,232	— George Chicha	15
(4) George V. Holte and Co.	69,902	(6) Engineer's estimate	17
(5) Scheumann & Johnson	72,297		

	(1)	(2)	(3)	(4)	(5)
375 cu. yd. removing conc. from the transition	18.50	30.00	15.00	16.50	20.00
1,100 cu. yd. removing earth cushion from the transition	5.70	3.00	4.75	10.00	2.00
200 lin. ft. repair of underdrains	3.50	4.00	5.00	4.00	10.00
7,850 lin. ft. drilling holes for anchor bars and grouting bars in place	.64	3.30	.75	.90	2.00
20 lin. ft. extending 8-in. diam. sewer line	3.70	14.00	4.00	4.00	25.00
1,475 cu. yd. concrete in floor slabs	17.42	5.00	21.00	18.00	17.00
2,205 bbl. furn. and handling cement	6.00	5.00	6.50	5.50	6.00
85,600 lb. placing reinforcement bars	.074	.10	.07	.07	.07
Lump sum, furn. and installing misc. metalwork	60.00	300.00	115.50	100.00	100.00

Earthwork, concrete lateral lining and structures

Arizona—Gila Project—USBR. Macco Corporation, Paramount, Calif., submitted the low bid of \$1,099,033 to the Bureau of Reclamation for earthwork, concrete lateral lining, and structures, Unit 1, Mohawk Irrigation System, Wellton-Mohawk Division, Gila Project. Unit prices were as follows:

(1) Macco Corporation	\$1,099,033	(3) Marshall, Haas & Royce	\$1,200,000
(2) Morrison-Knudsen Co.	1,127,697	(4) Engineer's estimate	1,110,000

	(1)	(2)	(3)
373,000 cu. yd. excavation for laterals	.26	.30	.34
190,000 cu. yd. compacting embankments	.67	.60	1.00
100,000 sta. cu. yd. overhaul	.01	.06	.05
14,100 cu. yd. excavation for structures	2.50	1.15	2.00
14,400 cu. yd. backfill about structures	.65	1.44	1.00
7,900 cu. yd. compacting backfill about structures	4.75	2.91	3.00
211,300 sq. yd. trimming earth foundations for concrete lining	.30	.50	.50
1,180 cu. yd. concrete in structures	125.00	106.00	100.00
45 cu. yd. concrete in paving slabs	60.00	106.00	80.00
9,800 cu. yd. concrete in lateral lining 2 in. in thickness	21.00	22.00	25.00
2,440 cu. yd. concrete in lateral lining 2½ in. in thickness	20.00	22.00	30.00
20,200 bbl. furnishing and handling cement	.745	6.70	6.50
83,000 lb. furnishing and placing reinf. bars	.14	.17	.25
60 sq. ft. furn. and placing ½-in. elastic filled matl. in joints	2.30	3.00	3.00
285 sq. ft. furn. and placing 1-in. elastic filler matl. in joints	4.40	4.00	4.00
1,650 lin. ft. placing 4½-in. and 6-in. water stops in joints	1.00	1.50	3.00
14 M.B.M. furn. and erecting untreated timber in structs.	280.00	385.00	300.00
3,000 lin. ft. furn. and laying 30-in. diam. std.-str. concrete-culvert pipe	11.50	13.40	10.00
590 lin. ft. furn. and laying 42-in. diam. std.-str. concrete-culvert pipe	18.50	21.00	18.00
230 lin. ft. furn. and laying 48-in. diam. std.-str. concrete-culvert pipe	22.50	25.00	21.00
320 lin. ft. furn. and laying 54-in. diam. std.-str. concrete-culvert pipe	26.50	30.00	26.00
130 lin. ft. furn. and laying 60-in. diam. std.-str. concrete-culvert pipe	31.00	36.00	31.00
330 lin. ft. furn. and laying 66-in. diam. std.-str. concrete-culvert pipe	36.50	42.00	40.00
310 lin. ft. furn. and installing 12-in. diam. conc. irrigat'n pipe vertically	2.50	3.00	3.00
2 bends fabricating bends in 18-in. diam. std.-str. conc.-culvert pipe	48.00	45.00	50.00
8 bends fabricating bends in 24-in. diam. std.-str. conc.-culvert pipe	50.00	65.00	50.00
122 bends fabricating bends in 30-in. diam. std.-str. conc.-culvert pipe	51.00	76.00	50.00

Continued on page 142



Super-portable, the Flex-Plane Detroit Special can be pulled from the forms and

fashioned into a completely mobile trailer in 10 seconds: Telescopic, this machine has

the widest range of working widths available today.

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and excessive wear to an absolute minimum — assures even finishing job.

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Note compact, low slung design. Transportation wheels are retracted. Heaviest masses of concrete are handled with ease.



Ruggedly constructed, the Detroit Special has reversible screeds that are mounted outside the frame for greater accessibility.

Step toward Canadian gas in Pacific Northwest

PACIFIC NORTHWEST Pipe Line Corp., Houston, Tex., has filed with the Federal Power Commission a plan whereby it would import Canadian natural gas for the Pacific Northwest. The plan would also call for that firm to buy natural gas from an American supplier in the midwest and ship into Canada so it will be available for the eastern part of that country. This swapping plan was substituted for Pacific Northwest's earlier proposal to build a 2,175-mi. pipe line from Texas to the state of Washington at a cost of \$174,186,602. Present plan calls for the firm to build about 828 mi. of pipe line, mostly in Washington. Under the plan, Pacific Northwest would import 250,000,000 cu. ft. of gas daily from Alberta into Washington. About 25,000,000 cu. ft. would be returned to Canada at the Washington-Canadian border. Company would purchase 225,000,000 cu. ft. of gas daily from Panhandle Eastern Pipe Line Co., Kansas City, to be redelivered to Canadian Natural Gas Pipe Lines, Ltd., for transmission into Ontario and Quebec.

Action taken on Calif.'s Feather River project

CALIFORNIA'S gigantic Feather River Project, which has been in the talking stage for some time, is now the object of some serious activity. The end of the stalemate came when the State Assembly appropriated \$800,000 for preliminary investigation of the site, and California applied to the Federal Power Commission in Washington, D. C., for permission to build and operate the development.

Authorization of the project was voted by the legislature in 1951, but no monies were voted at that time to carry out preliminary work.

Funds voted by the law makers will go toward surveying and mapping the area involved. This means relocation of certain highways and railroads and county roads in the area as well as exploration of the Oroville Dam area, and topographic strip maps from the South San Joaquin Valley to the Mexican Border.

The 80-page brief presented to the Federal Power Commission by the State Water Project Authority covered the approximate costs of elements in the project. Cost of Oroville Dam was pegged at \$342,626,000 and the power plant at \$64,509,000. If the permit is granted, California State law permits issuance of revenue bonds to cover the costs involved.

The Feather River Project would be larger than the Central Valley Project constructed by the Federal Government. Water would be diverted from the Sacramento Valley to as far south as San Diego County. Oroville Dam and reservoir, to be located in Butte County, would be 710 ft. high, with base thickness 750 ft., and crest length 5,700 ft. Capacity of the power plant at the dam would be 440,000 kw.

UNIT BID PRICES... CONTINUED

24 bends fabricating bends in 42-in. diam. std.-str. conc.-culvert pipe	77.00	107.00	50.00	52
8 bends fabricating bends in 48-in. diam. std.-str. conc.-culvert pipe	90.00	112.00	75.00	60
10 bends fabricating bends in 54-in. diam. std.-str. conc.-culvert pipe	100.00	135.00	75.00	68
2 bends fabricating bends in 60-in. diam. std.-str. conc.-culvert pipe	105.00	178.00	100.00	75
10 bends fabricating bends in 66-in. diam. std.-str. conc.-culvert pipe	115.00	170.00	100.00	82
3,200 lb. furn. and installing misc. metalwork	.95	.65	1.00	
86,250 lb. furn. and installing metal slide gates	.60	.60	.70	
12,000 lb. furn. and installing radial gates and hoists	.90	1.10	1.50	
100 cu. yd. removing concrete in existing structures	12.00	12.50	10.00	20

Cut and cover conduit

Oregon—Deschutes Project—USBR. G. T. Gentle, Portland, submitted the low bid of \$63,818 to Bureau of Reclamation for cut and cover conduit, North Unit Main Canal, Deschutes Project. Unit prices were as follows:

(1) G. T. Gentle	\$63,818	(4) Ramsey Construction Co.	\$79,
(2) Charles R. Schmiedeskamp	71,792	(5) Engineer's estimate	73,
(3) Lee Hoffman	77,912		

	(1)	(2)	(3)	(4)	(5)
800 cu. yd. excav., common, for structure	2.40	2.25	3.50	2.50	2
250 cu. yd. excav., rock, for structure	5.00	6.00	20.00	12.00	6
2,300 cu. yd. backfill about structure	.40	.45	2.30	.75	3
150 cu. yd. compacting backfill about structure	2.00	2.25	5.00	3.00	3
40 cu. yd. riprap	10.00	12.00	8.00	15.00	8
60 sq. yd. dry-rock paving	4.00	5.00	10.00	7.50	7
600 cu. yd. reinforced concrete	78.70	90.00	85.00	96.50	90
30 cu. yd. plain concrete	55.00	30.00	30.00	95.00	30
920 bbl. furnishing and handling cement	6.90	8.00	8.35	6.75	6
51,000 lb. placing reinforcement bars	.07	.08	.07	.09	0

Tunnel

Pavement through Arizona's Queen Creek Tunnel

Arizona—Pinal County—State. Vinson Construction Co., Phoenix, submitted the low bid of \$527,995 to the State Highway Department for furnishing and placing aggregate base and portland cement concrete pavement on the roadway through the new Queen Creek Tunnel, northeast of Superior. Unit prices were as follows:

(1) Vinson Construction Co.	\$527,995	(3) Western Constructors, Inc.	\$546,
(2) Fisher Contracting Co.	536,371		

	(1)	(2)
30 M. gal. watering (CIP)	5.59	11.00
10 hr. rolling	15.00	11.00
1,082 ton aggregate base (CIP)	3.00	2.50
5,316 sq. yd. concrete pavement (CIP)	8.00	7.50
10,812 ton Class "A" concrete (including cement) (for walls and roof)	29.50	28.45
5,800 ton Class "A" concrete (including cement) (for overhead and backfill)	9.00	15.00
497 cu. yd. Class "A" concrete (including cement) (for curb and gutter)	37.00	33.00
493,905 lb. reinforcing steel (bars) (CIP)	.16	.14
1,328 lin. ft. whistling stripe	.60	.50
1,739 sq. yd. ½-in. gunite with "gun finish" (CIP)	2.50	3.00
9,640 sq. yd. portland cement painting (CIP)	.85	.76

Streets and Highways

Grading, drainage and asphaltic concrete paving

Washington—Benton County—State. Curtiss Gravel Co. & D-H Paving Co., Spokane, received an award from the State Department of Highways on their low bid of \$847,335 for construction along 7.0 mi. of Primary State Highway No. 3, Richland Junction to Kennewick. Unit prices were as follows:

(1) Curtiss Gravel Co. & D-H Paving Co.	\$847,335	— Pieler Construction Co.	\$ 982,
(2) Peter Kiewit Sons' Co.	882,325	— L. E. Hoback, E. H. Sussex and	
(3) Sather & Sons	906,105	Goats & Brennan	1,024,
(4) F. R. Hewett Co.	923,615	— Kuckenberg Construction Co.	1,051,
(5) White Bros. Co.	938,652	— Roy L. Bair & Co.	1,056,
(6) Erickson Paving Co.	949,926	— J. A. Terteling & Sons, Inc.	1,083,
— Rogers Construction Co.	981,894	— Parker-Schram Co.	1,139,

	(1)	(2)	(3)	(4)	(5)
Lump sum, clearing and grubbing	\$10,000	\$6,000	\$12,000	\$15,000	\$12,000
278,110 cu. yd. common excav. incl. haul of 600 ft.	.30	.27	.35	.31	.35
282,085 cu. yd. common borrow incl. haul of 600 ft.	.25	.28	.35	.31	.29
545 cu. yd. common trench excav., incl. haul of 600 ft.	1.75	2.25	1.00	1.00	2.00
400,090 cu. d. stas. overhaul	.015	.015	.02	.02	.01
4,762.6 M. cu. yd. stas. overhaul	4.00	4.00	4.50	5.00	4.00
5,292 cu. yd. structure excav.	1.75	1.60	2.00	2.50	3.00
2,500 cu. yd. stripping borrow and surf. pits, incl. haul of 600 ft.	.25	.20	.25	.30	.25
109 days pneumatic tired roller	60.00	50.00	45.00	48.00	55.00
105 days tamping roller	50.00	65.00	45.00	48.00	55.00
90 days mechanical tamper	30.00	36.00	30.00	40.00	45.00
7,755 lin. ft. slope treatment Class A	.15	.10	.10	.15	.15
754.2 stas. (100 ft.) finishing roadway	12.00	9.50	12.00	15.00	12.00
13,300 M. gal. water	1.50	1.50	1.00	1.75	1.70
59,415 ton cr. stone surf. top course	1.10	1.30	1.11	1.05	1.12
77,155 ton cr. stone surf. base course	1.05	1.20	1.00	.95	1.07
129,405 ton ballast	.90	1.00	.90	.85	.95
6,100 ton cr. cover stone in stockpile	.80	.80	.90	.75	.90

Continued on page 144

up to 25% more production

with *Speed-o-Matic* controls

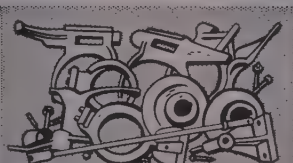


WESTERN NEW YORK GRAVEL AND CONCRETE CORP., Batavia, N. Y., uses a Link-Belt Speeder LS-52 dragline to move hundreds of yards a day out of this gravel pit. Full-hydraulic controls reduce time lags and operator fatigue—steps-up production as much as 25%.

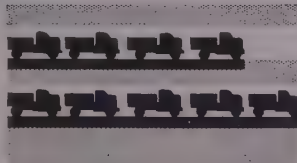
Here are Link-Belt Speeder PLUS FEATURES that work for you



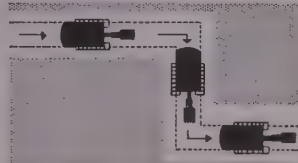
Speed-o-Matic Controls—fully hydraulic! You "feel" the load all the way. Simple, easy—fingers instead of muscles do work.



Eliminates up to 150 parts—cuts friction, no worn bushings, pins, links or clutch toggles to put you "down."



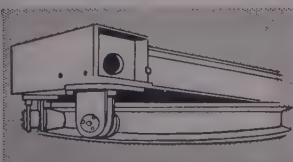
Up to 25% more production—fast operating cycle steps up output and profits. Effortless control keeps operator fatigue down.



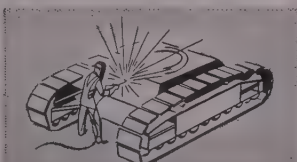
Turns on a Dime. Either track can drive or be locked independently. Hydraulic control gives instant response.



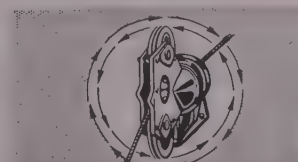
Convertibility—designed for peak production as shovel, crane, dragline or trench hoe. Convert in field—quickly, easily.



Hook Rollers—Cone-shaped for true rolling. Reduce roller and roller path loads—eliminate center pin pull.



All-Welded Stress-Relieved Construction—extra strength without extra weight. Resists impact, twist. Field service simple.



Full Revolving Fairlead—mounted in anti-friction bearings—gives perfect cable lead. Large sheaves assure long cable life.

LINK-BELT SPEEDER

CORPORATION

12,794

Builders of the most complete line of shovels, cranes and draglines
CEDAR RAPIDS, IOWA

UTAH PLANS FIRST FREEWAY

... begins on page 79

with 10-ft. shoulders on the outside, two 12-ft. lanes, a 4-ft. wide shoulder and where topography permits a 28-ft. median. The wide median would permit the construction of two additional traffic lanes when traffic volumes warrant.

Structures and access roads will be designed to accommodate approximately twice the 1951 potential traffic in order that the facility will be adequate from a traffic standpoint for twenty years.

Even though the construction of the proposed freeway is economically justified, and will return in use-benefits much more than construction costs, the majority or all of the use-benefits in terms of dollars that results from the construction of an improved highway facility accrue to the motorist, and are not available initially for construction purposes, and in any event, do not begin to accrue until the facility is built. In addition, depending on the benefit-cost ratio these "savings" would normally require several years to equal construction costs.

Two general methods of financing are possible:

1. By use of current revenue.
2. By borrowing.

Even if more revenue were obtained from increased road-user taxes it would be several years before a significant amount would be available for construction purposes. In the meantime, traffic-needs demand immediate attention. Stop-gap improvements are economically wasteful in that though they may extend the time of meeting a problem, they are never a solution. The money spent in stop-gap work would be better spent on permanent improvement.

It appears that the only practical way in which motorists may immediately enjoy the benefits of improved facilities is to borrow sufficient money to construct such facilities and repay the costs from the savings accruing from their use. Of course the savings accruing to the motorist are not available in whole or in part for construction until a portion or all of such savings have been transferred from the motorists to the authority responsible for construction. Such a transfer may be made by a general road-user tax, or a limited road-user tax. The general methods of repaying highway bonds are:

1. Pledging state credit, either wholly or limited to state-wide road-user revenue, or
2. Pledging the tolls charged for use of specific facilities.

It is apparent that no "pay-as-you-go" program can finance such improvements without radical changes in our present methods of distributing road-user revenue state-wide without regard to source. Federal-aid grants are limited and it is unlikely that present grants will be increased to an appreciable extent. Considering the urgency of the need, it appears that a bond issue is the only practical method of meeting the financing requirements.

UNIT BID PRICES ... CONTINUED

TYPE I-1 ASPHALTIC CONCRETE PAVEMENT

20,114	ton	Class C wearing course	5.45	5.00	5.50	6.35	6.18
20,114	ton	Class L leveling course in place	5.45	4.80	5.50	6.05	6.18
14.1	mi.	preparation of untreated roadway	150.00	200.00	150.00	250.00	180.00
2,500	cu. yd.	new fine mineral aggregate	1.50	2.00	1.50	1.40	2.65
233.0	ton	asphalt cement MC-3 prime coat	40.00	45.00	41.00	45.00	40.00

OTHER ITEMS

570	cu. yd.	top soil	2.50	1.00	2.00	1.00	1.00
4,085	lin. ft.	cement conc. curb and gutter	2.00	3.00	2.50	2.80	2.65
840	lin. ft.	Type A precast white reflecting curb	3.25	2.25	3.00	3.50	2.65
360	lin. ft.	Type C precast white reflecting curb	3.25	3.15	3.00	3.50	3.00
130	cu. yd.	gravel backfill for foundations	2.50	3.70	2.00	3.00	3.00
250	cu. yd.	gravel backfill for drains	3.00	4.50	3.00	4.00	3.00
436.4	cu. yd.	concrete Class A	55.00	62.00	67.00	72.00	70.00
1.8	cu. yd.	concrete Class C	55.00	62.00	80.00	90.00	100.00
43,720	lb.	steel reinforcing bars	15	16	13	15	12
3	only	removing junction boxes	25.00	25.00	15.00	50.00	25.00
500	sq. yd.	removing cement conc. pavement	1.00	1.20	1.00	1.00	.70
660	sq. yd.	removing oiled surface	.50	.30	.50	.50	.30
4	only	reflector units, complete in place	10.00	15.00	15.00	50.00	10.00
90	lin. ft.	bit. ctd. corr. met. culv. pipe No. 16-ga., 8-in. diam. Type No. 2	2.50	3.00	3.00	2.50	2.50
400	lin. ft.	conc. or V.C. drain pipe, 8-in. diam.	1.00	1.00	1.50	1.50	1.60
33	lin. ft.	conc. or V.C. drain pipe 12-in. diam.	1.50	2.00	2.00	2.00	3.00
4,552	lin. ft.	plain conc. or V.C. sewer pipe, 8-in. diam.	.90	1.25	1.50	2.00	1.25
3,867	lin. ft.	plain conc. or V.C. sewer pipe, 12-in. diam.	1.40	1.85	2.30	2.50	2.00
2,970	lin. ft.	std. reinf. conc. culv. pipe, 18-in. diam.	3.50	3.95	3.50	3.75	4.00
66	lin. ft.	plain corr. met. culv. pipe No. 14 ga., 24-in. diam.	4.50	6.00	6.00	6.00	6.00
112	lin. ft.	plain corr. met. culv. pipe No. 12 ga., 54-in. diam.	18.00	20.00	20.00	15.00	17.00
98	lin. ft.	plain corr. met. culv. pipe No. 10 ga., 60-in. diam.	25.00	27.00	28.00	25.00	26.00
13	only	catch basins	100.00	185.00	175.00	165.00	100.00
1	only	manhole	250.00	235.00	300.00	200.00	300.00
33	only	reinforced concrete spot posts	14.00	11.00	12.00	10.00	10.00
77	only	reinforced conc. right-of-way markers	5.00	6.00	5.00	8.00	7.00
38	only	monument cases and covers	25.00	45.00	25.00	50.00	45.00
10,180	cu. yd.	special loose riprap	2.00	2.90	2.50	1.85	2.00
350	cu. yd.	special loose riprap in place from stockpile	1.25	2.00	1.50	1.50	1.30
3	cu. yd.	hand placed riprap	25.00	25.00	8.00	20.00	20.00
Force account, remov. and replac. water, sewer and irrigation lines not shown as paymt. quan. on plans			\$5,000	\$5,000	\$5,000	\$5,000	\$5,000

Plant-mix surfacing; removal of existing pavement

California—Los Angeles County—State. G. J. Payne Co., Inc., submitted the low bid of \$16,740 to State Division of Highways for removing the existing pavement and placing plant-mix surfacing on all .6 mi. in Los Angeles, on Santa Monica Blvd. between Seward St. and Gower St. Unit prices were as follows:

(1) G. J. Payne Co., Inc.	\$16,740	(3) Vernon Paving Co.	\$18,000	
(2) Griffith Co.	17,744	(4) Schroeder & Co.	18,000	
		(1)	(2)	(3)
11,500 sq. yd. pavement removal	.80		.89	.83
8 ton asphaltic emulsion (paint binder and sl. ct.)	50.00	57.00	55.00	6
1,410 ton min. aggr. (P.M.S.)	4.00	4.75	5.57	
75 ton paving asph. (P.M.S.)	20.00	4.75	5.57	

Crushed rock stockpiling in Idaho

Idaho—Idaho County—State. Materne Bros., Spokane, Wash., submitted the low bid of \$60,690 to State Department of Highways for furnishing crushed rock in stockpiles North and South of Grangeville. Unit prices were as follows:

(1) Materne Bros.	\$60,690	(4) Thruston Story	\$71,000		
(2) F. H. DeAtley & Co.	60,700	(5) Engineer's estimate	60,700		
(3) J. F. Konen	68,240				
		(1)	(2)	(3)	(4)
10,000 ton cr. rock in stockpile 3/4-in. max., Site 1.....	1.37	1.30	1.76	1.40	
2,000 ton cr. rock in stockpile 3/4-in. max., Site 2.....	1.37	1.30	1.46	1.40	
14,000 ton cr. rock in stockpile 3/4-in. max., Site 3.....	1.50	1.40	1.63	1.85	
15,000 ton cr. rock in stockpile 3/4-in. max., Site 4.....	1.50	1.70	1.66	1.90	

Pit run gravel surfacing in Wyoming

Wyoming—Johnson County—State. Mullinax Engineering Co., Sheridan, received an award from State Highway Department on its low bid of \$8,192 for pit run gravel surfacing and miscellaneous work approximately 6.5 mi. of the Greub-Mayoworth Rd. Unit prices were as follows:

(1) Mullinax Engineering Co.....	\$ 8,192	(4) Stenek & Malloy	\$13,000		
(2) L. C. Scott	11,384	(5) Wyoming Improvement Co.....	16,000		
(3) Big Horn Construction Co.....	11,960				
		(1)	(2)	(3)	(4)
8,400 cu. yd. pit run gravel base course (4-in. max.)		.38	.50	.55	.85
1,600 cu. yd. pit run gravel base course (2-in. max.)		.50	.74	.65	.75
30,000 cu. yd. mi. haul of surfacing material		.14	.20	.21	.22

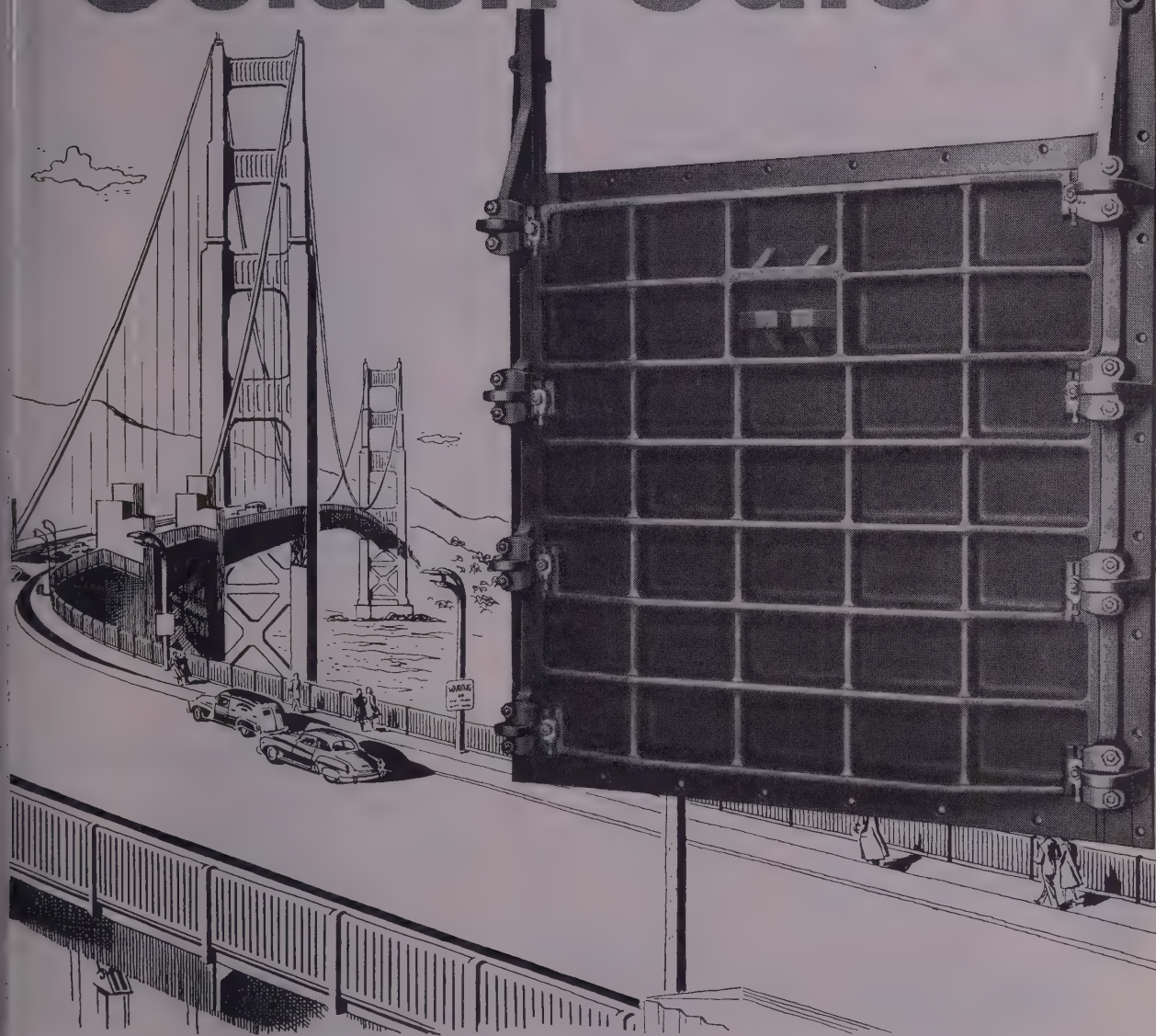
Road-mix surfacing on imported cement-treated base

California—Kern County—State. Claude C. Wood Co., Lodi, submitted the low bid of \$423,642 for grading and surfacing with road-mix surfacing and bituminous treated surfacing on imported base material on Allen Rd. and Santa Fe Wy., between Rosedale Ave. and State Route 139, about 10.3 mi. in length. Unit prices were as follows:

(1) Claude C. Wood Co.	\$423,642	(5) Harms Bros.	\$460,000
(2) Dicco, Inc.	433,099	(6) Clyde W. Wood & Son, Inc.	49,000
(3) Close Building Supply	433,685	— Osborn Company	55,000
(4) Louis Biasotti & Son	433,737		

Continued on page 146

There's More Than One "Golden Gate"



There's also **CHAPMAN'S** *Standard* **SLUICE GATE**

It's the gate that starts paying back its cost the minute installation begins . . . because it makes the job so quick and easy, with its interchangeable parts that need no match-marking.

And it's the gate that *keeps on paying* . . . by unfailing, instant response to control . . . and by keeping maintenance costs down out of sight.

If repairs and new parts should eventually be needed, here again is the time-saving advantage

of interchangeable replacements.

In sum, you can't get more thoroughgoing economy in equipment of this type . . . that's plain to see, on the books of hundreds of projects, the country over. See what *you* can save with Chapman Standard Sluice Gates (with any type of control you want) . . . send for Catalog 25. The Chapman Valve Mfg. Co., Indian Orchard, Mass.

The Chapman Valve Manufacturing Company
INDIAN ORCHARD, MASSACHUSETTS

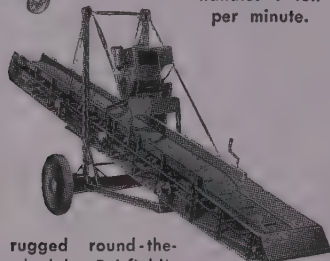
Move it Fast!



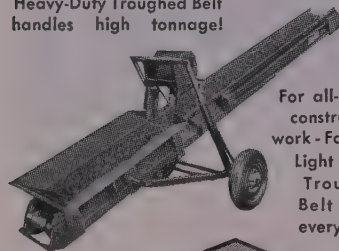
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UNIT BID PRICES ... CONTINUED

	(1)	(2)	(3)	(4)	(5)
Lump sum, clearing and grubbing	\$2,500	\$5,000	\$5,000	\$3,100	\$3,000
40,000 cu. yd. roadway excav.	.40	.35	.38	.50	.55
1,020 cu. yd. structure excav.	3.25	3.00	3.00	2.00	4.50
102,000 sta. yd. overhaul	.01	.01	.02	.005	.01
108,600 cu. yd. imp. subbase matl.	.98	1.10	1.05	1.25	1.05
47,000 cu. yd. I.B.M.	.98	1.10	.95	1.15	1.05
63,500 sq. yd. scarifying exist. suri.	.025	.01	.08	.04	.05
Lump sum, dev. water sup. and furn. watering equip.	\$10,500	\$13,000	\$6,000	\$3,000	\$7,000
23,500 M. gal. applying water	2.00	1.25	2.25	1.25	1.50
544 sta. finishing roadway	12.00	4.00	12.00	7.00	10.00
5,700 bbl. portland cement (C.T.B.)	4.00	4.20	4.25	4.80	4.25
230,000 sq. yd. mix. and compact. (C.T.B.)	.10	.15	.10	.10	.15
465 ton liquid asph., SC-3 or 4 (bit. surf. treat.)	22.00	22.51	19.00	21.00	22.90
57,000 sq. yd. prep. mix. and shap. suri. (bit. surf. treat.)	.13	.10	.11	.085	.20
230 ton liquid asph., SC-2 (pr. ct.)	23.50	22.00	21.00	23.00	25.50
1,480 ton liquid asph., SC-4 or 5 (R.M.S.)	22.00	21.50	20.00	21.00	22.50
27,000 ton min. aggr. (R.M.S.)	1.75	2.00	1.85	1.95	2.25
173,000 sq. yd. mix. and compact. (R.M.S.)	.10	.09	.10	.07	.11
65 cu. yd. Class "A" P.C.C. (struct.)	85.00	60.00	100.00	80.00	100.00
8 cu. yd. Class "A" P.C.C. (curbs and gutters)	60.00	50.00	85.00	60.00	60.00
506 lin. ft. 18-in. corr. met. pipe (14 ga.)	5.50	5.00	5.00	4.20	4.50
4 lin. ft. 24-in. corr. met. pipe (14 ga.)	20.00	12.00	5.70	6.50	9.00
76 lin. ft. 30-in. corr. met. pipe siphons (14 ga.)	13.75	8.30	6.20	9.00	9.50
50 lin. ft. 36-in. corr. met. pipe (12 ga.)	14.75	11.00	10.00	10.00	12.00
288 lin. ft. 48-in. corr. met. pipe (12 ga.)	18.50	13.50	12.40	13.00	16.00
3 ea. field jts. for 30-in. corr. met. pipe siphons	30.00	45.00	30.80	55.00	35.00
1 ea. remov. and resett. headwall	50.00	150.00	250.00	50.00	100.00
3,500 lb. bar reinf. steel	.18	.11	.17	.14	.20

Bridge and Grade Separation

Erecting structural steel overcrossing in Arizona

Arizona—Yavapai County—State. Allison Steel Manufacturing Co., Phoenix, submitted the low bid of \$23,370 to the State Highway Department for furnishing and erecting the structural steel on the White grade separation structure, located at the new junction of the Rock Springs-Prescott Highway with Prescott-Ashfork Highway, near the northeast city limits of Prescott. Unit prices were as follows:

(1) Allison Steel Manufacturing Co.	\$23,370	(3) Dail Construction Co.	\$29
(2) Acme Steel Co.	24,844	(4) Western Constructors, Inc.	30

	(1)	(2)	(3)
165,631 lb. structural steel (furnish and erect) (CIP)	.1411	.15	.179

Small structural steel bridge

Washington—Cowlitz County—State. Lockyear & White, Inc., Longview, received an award from the State Department of Highways at \$207,500 for construction of Cowenaw River Bridge, superstructure, approaches on Primary State Highway No. 1. Unit prices were as follows:

(1) Lockyear & White, Inc.	\$207,500	(6) General Construction Co.	\$223
(2) Arthur Fralick Co.	212,180	— Sealand Construction, Inc.	223
(3) S. S. Mullen, Inc.	215,202	— Peter Kiewit Sons' Co.	227
(4) Hamilton Builders	215,798	— State Construction Co.	232
(5) Anderson Bridge Construction Co.	220,440	— M. P. Butler	232

	(1)	(2)	(3)	(4)	(5)
800 cu. yd. structure excavation	800	12.00	15.00	19.00	15.00
1 day mechanical tamper	70.00	75.00	48.00	100.00	100.00
745 cu. yd. concrete, Class A	24.00	73.00	71.00	63.00	70.00
105 cu. yd. concrete, Class B	74.00	50.00	58.00	63.00	70.00
200,000 lb. steel reinf. bars	.095	.11	.105	.11	.12
480,000 lb. structural carbon steel	.215	.22	.21	.225	.22
5,400 lb. cast steel	.50	.60	.50	.52	.60
12 only bridge drains complete in place	65.00	65.00	72.00	70.00	75.00
75 only steel pile splices	34.00	40.00	41.00	38.00	40.00
110 only driving steel piles	90.00	75.00	143.00	95.00	110.00

Modifying 16th St. viaduct in Denver

Colorado—Denver County—State. Western Paving Construction Co., Denver, submitted the low bid of \$84,919 to the State Highway Department for modifying the viaduct at the west end of 16th St. to the Valley Highway. Unit prices were as follows:

(1) Western Paving Construction Co.	\$84,919	— C. L. Hubner Co.	\$97
(2) Hutcheson Construction Co.	89,979	— Frank M. Kenney	97
(3) Peter Seerie, Inc.	95,213	— Northwestern Engineering Co.	101
(4) James B. Kenney	96,310	— Colorado Constructors, Inc.	102
(5) Lindstrom & Williams	97,343	— Peter Kiewit Sons' Co.	104
(6) Engineer's estimate	100,483	— Gardner Construction Co.	110
— JH-NM Monaghan & Assoc. Cos.	97,397	— Western Foundation Construction Co.	124

	(1)	(2)	(3)	(4)	(5)
Lump sum, clear and grub	450.00	500.00	150.00	2,500	500.00
Lump sum, remove portion old struct.	\$8,000	\$6,000	\$21,000	\$12,500	\$10,000
Lump sum, wreck det. trestle	\$1,200	750.00	\$1,200	\$1,000	\$2,500
415 lin. ft. remove res. handrail	6.90	15.00	3.00	5.00	15.00
6 ea. trans. and set 8-in. trolley	40.00	25.00	32.00	100.00	50.00
Lump sum, remove obstructions	275.00	250.00	150.00	\$2,500	750.00
12,000 cu. yd. uncl. excavation	.53	.45	.62	.60	.40
30 cu. yd. yd. dry rock excav. (str.)	7.00	6.00	3.50	3.00	5.00
460 cu. yd. dry com. excav. (str.)	2.50	1.50	2.50	3.50	2.00
10 cu. yd. wet rock excav. (str.)	12.00	7.50	10.00	3.00	6.00
10 cu. yd. wet com. excav. (str.)	12.00	3.00	10.00	7.50	5.00
280 cu. yd. struct. backfill, Cl. 1	2.00	1.75	.60	1.50	2.00

Continued on page 148



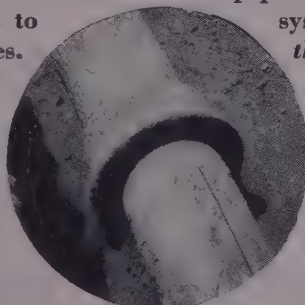
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To a tax-burdened public the statement that cast iron pipe is the "taxpayers' friend" is more than a mere figure of speech. To most waterworks engineers it is a cold fact. They know that cast iron pipe in water distribution systems has saved, and continues to save, millions of dollars in local taxes.

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This cast iron water main installed in Richmond, Virginia, 120 years ago, is still in service. Over 35 other cities have century-old cast iron mains in service.

CAST IRON

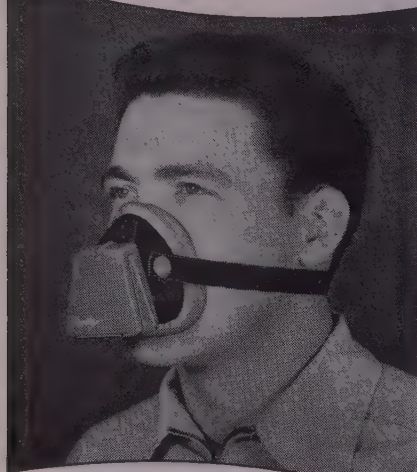
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- ★ **U.S. Bureau of Mines Approval**
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UNIT BID PRICES

CONTINUED

	(1)	(2)	(3)	(4)	(5)
30 hr. mechanical tamping	7.50	7.00	5.50	10.00	6.00
80 hr. roll, tamping roller 2U	12.00	9.00	15.00	12.50	12.00
30 hr. roll, F.W. roller	9.00	8.00	12.00	9.50	8.00
10 hr. roll, R.T. roller	7.50	7.00	12.00	8.00	7.00
1 ea. furn. tamping roller 2U	150.00	100.00	100.00	200.00	150.00
1 ea. furn. F.W. roller	75.00	75.00	50.00	100.00	150.00
1 ea. furn. R.T. roller	50.00	75.00	50.00	100.00	150.00
90 M. gal. wetting	2.00	1.50	3.75	2.00	2.75
85,000 sta. yd. sta. yd. overhaul	.01	.01	.02	.02	.01
3,000 yd. mi. yd. mi. overhaul	.17	.20	.10	.20	.20
500 ton gravel, cr. rock surf. C	2.00	2.00	2.60	2.20	3.00
20 ton asph. (120-150 penn.)	30.00	27.50	27.50	33.00	25.00
500 gal. asph. rd. matl. MC (prn.)	.23	.19	.21	.25	.20
300 gal. asph. rd. matl. RC	.30	.19	.22	.23	.20
340 ton plant mix oil pr. sur.	4.00	7.00	5.00	4.50	6.40
35.7 m.ft.bm. untr. bridge timber	300.00	355.00	335.00	290.00	300.00
624 cu. yd. Class "A" conc.	47.00	50.00	47.50	50.00	50.00
43,600 lb. reinf. steel tr. and pl.	.045	.04	.038	.035	.045
44,000 lb. trans. alt. and pl. reinf. st.	.075	.09	.085	.045	.065
221,000 lb. struct. steel, trans. and erect.	.03	.037	.0175	.035	.05
367 lin. ft. untr. timber piling	2.25	1.60	.85	2.00	2.25
392 lin. ft. steel pile, trans. and dr.	3.75	4.00	3.50	4.00	5.00
160 lin. ft. 8-in. per. C.M.P. U.D. 8-ft. tr.	7.50	6.00	4.00	8.00	5.00
70 lin. ft. conc. comb. curb and gutter	2.50	2.75	5.00	2.50	2.25
2 ea. dr. pipe conc. fl.	50.00	7.50	7.50	45.00	40.00
30 lin. ft. 1 1/4-in. el. cond. jct. boxes	2.00	2.50	1.25	2.00	3.00
30 lin. ft. 12-in. reinf. C.P.SS. (2-ft. - 4-ft.) ..	6.00	6.00	4.00	5.00	5.00
1 ea. manholes, Type 1, 7-ft. deep	350.00	250.00	150.00	400.00	300.00
1 ea. No. 12 inlet grt. and fr.	250.00	200.00	100.00	100.00	175.00
1 ea. fireproof stl. doors	320.00	300.00	150.00	300.00	275.00

Dam

Kirwin Dam foundation construction

Kansas—Missouri River Basin Project—USBR. Cook Construction Co., Jackson, Miss., submitted low bid to Bureau of Reclamation of \$1,226,246 for Kirwin Dam foundation construction, Solomon Div., Missouri River Basin Project. Work includes earthwork; clearing, classification of material, explosives and blasting, open-cut excavation (general); excavation for foundation of dam; borrow areas; disposal of excavated materials. Embankment: earth fill in dam embankment, zone 1, including preparation of foundations, material placing, moisture control, rollers, rolling, payment; sand and gravel fill in dam embankment, zone 2, dumped fill in dam embankment, zone 3. Unit prices were as follows:

(1) Cook Construction Co.	\$1,226,246	— J.H. N-M Monaghan & Assoc. Cos.	\$1,670,
(2) Utah Construction Co.	1,361,750	— A. Teichert & Son, Inc.	1,683,
(3) List & Clark Construction Co.	1,403,918	— S. J. Groves & Sons Co.	1,907,
(4) Colorado Constructors, Inc.	1,418,340	— The Hinman Brothers Construction Co.	1,953,
(5) Western Contracting Corp.	1,420,372	— Platte Valley Construction Co.	1,972,
— K. S. Mitty Construction Co.	1,471,192	— Amis Construction Co. and San Oro Construction Co.	2,063,
— Perry McGlone Construction Co.	1,521,710	(6) Engineer's estimate	1,122,
— C. F. Lytle Co.	1,515,900		
— Morrison-Knudsen Co., Inc.	1,659,380		
— John P. Abramson Construction Co.	1,665,160		

	(1)	(2)	(3)	(4)	(5)
Lump sum, care of river during construction and unwatering foundations	\$50,000	\$418,000	\$380,000	\$400,000	\$380,920
75,000 cu. yd. excav., stripping borrow, area 1	.30	.36	.30	.20	.31
500,000 cu. yd. excav. for found'n of dam, first 500,000 cu. yd.	1.00	.50	.60	.45	.55
500,000 cu. yd. excav. for found'n of dam, over 500,000 cu. yd.	.50	.29	.45	.40	.55
538,000 cu. yd. excav. in borrow area 1 and transportation to the dam embank., first 538,000 cu. yd.	.35	.32	.30	.35	.29
538,000 cu. yd. excav. in borrow area 1 and transportation to dam embank., over 538,000 cu. yd.	.25	.18	.27	.23	.29
616,000 cu. yd. earthfill in dam embank., zone 1, first 616,000 cu. yd.	.06	.25	.15	.22	.12
616,000 cu. yd. earthfill in dam embank., zone 1, over 616,000 cu. yd.	.06	.14	.11	.18	.12
70,400 cu. yd. sand and gravel fill in dam embank., zone 2	.06	.10	.07	.15	.05
93,400 cu. yd. dumped fill in dam embank., zone 3	.03	.05	.05	.10	.03

Airport

Parking aprons and taxiway at Lowry Air Force Base

Colorado—Denver County—Corps of Engineers, Western Paving Construction Co., Denver, submitted the low bid of \$74,457 on schedule 1 and \$39,780 for schedule 2 to the Corps of Engineers for construction of parking aprons and taxiway at Lowry Air Force Base, Denver. Unit prices were as follows:

SCHEDULE 1—GRADING AND PAVING PARKING APRONS AND TAXIWAY

(1) Western Paving Construction Co.	\$704,457	(4) Schmidt Construction Co.	\$782
(2) Northwestern Engineering Co.	758,428	(5) Engineer's estimate	668
(3) Colorado Constructors, Inc.	770,384		

PARKING APRONS

	(1)	(2)	(3)	(4)
Lump sum, moving existing building	\$1,800	\$2,000	\$2,000	\$1,000
40,271 cu. yd. excavation	1.10	1.00	1.50	1.23
7 ea. remove existing manhole	200.00	200.00	200.00	50.00

Continued on page 150

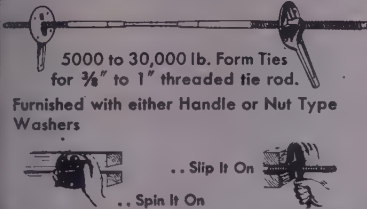


UNIVERSAL CONCRETE ACCESSORIES "TOPS" IN CONCRETE FORMING

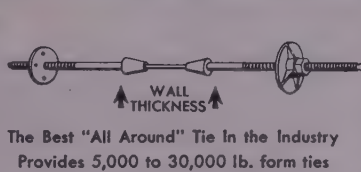
A COMPLETE LINE FROM 1 SOURCE

FORM TIES

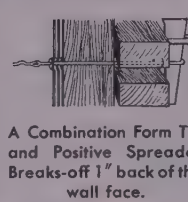
STANDARD SPIROLOC



SPIROLOC CONE NUT ASSEMBLY



The TWISTEYE

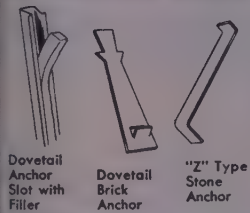


The FORM CLAMP

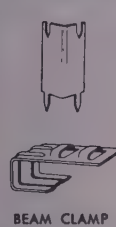


BUILDING SPECIALTIES

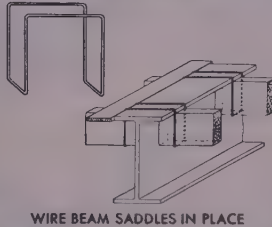
BAR SUPPORTS



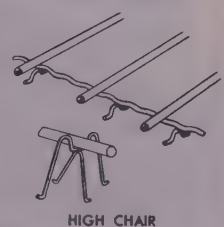
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WIRE BEAM SADDLE



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UNIT BID PRICES... CONTINUED

	(1)	(2)	(3)	(4)
10 ea. remove existing inlet	200.00	200.00	200.00	25.00
2 ea. backfill existing inlet	50.00	125.00	100.00	25.00
1,040 ea. tie down anchor	15.00	13.00	10.00	15.00
57,920 ton subbase course	2.40	2.47	2.65	2.90
37,070 ton compacted aggregate base course	3.15	3.99	3.25	3.75
1,180 ton bituminous base course	10.00	9.28	9.75	9.25
17,600 gal. asphalt cement, AP-3	.14	.162	.15	.17
15,100 gal. bituminous tack coat	.24	.25	.18	.30
46,760 gal. bituminous prime coat	.17	.20	.18	.17
14,309 ton bituminous binder course	8.80	9.28	9.75	9.25
14,779 ton bituminous surface course	8.80	9.28	9.75	9.25
381,860 gal. asphalt cement AP-1	.14	.162	.15	.17
Lump sum, seeding (approx. 20.1 acres)	\$13,386	\$12,000	\$15,000	\$10,000

TAXIWAY

	(1)	(2)	(3)	(4)
2,979 cu. yd. excavation	1.10	1.00	1.50	1.23
1 ea. remove existing manhole	200.00	200.00	200.00	50.00
3,080 ton subbase course	2.40	2.47	2.65	2.90
1,930 ton compacted aggregate base course	3.15	3.99	3.25	3.75
600 gal. bituminous tack coat	.24	.25	.18	.30
2,440 gal. bituminous prime coat	.17	.20	.18	.17
691 ton bituminous binder course	8.80	9.28	9.75	9.25
691 ton bituminous surface course	8.80	9.28	9.75	9.25
18,140 gal. asphalt cement, AP-1	.14	.162	.15	.17
Lump sum, seeding (approx. 3.9 acres)	\$2,614	\$2,400	\$3,000	\$2,000

SCHEDULE 2—STORM DRAINAGE

(1) Western Paving Construction Co.	\$39,780	(4) Schmidt Construction Co.	\$48,
(2) Northwestern Engineering Co.	39,996	(5) Engineer's estimate	28,
(3) Colorado Constructors, Inc.	40,874		

PARKING APRONS

	(1)	(2)	(3)	(4)
184 lin. ft. storm drain, 8-in. pipe	5.50	6.00	4.50	5.50
196 lin. ft. storm drains, 12-in. pipe	7.00	8.00	6.00	10.00
316 lin. ft. storm drains, 18-in. pipe	8.50	10.00	8.00	14.00
1,372 lin. ft. storm drains, 24-in. pipe	12.50	12.00	11.00	18.00
11 ea. storm drain manhole	\$1,000	\$1,000	\$1,200	\$1,000
13 lin. ft. manhole, extra depth	100.00	100.00	150.00	100.00
2 ea. apron inlet	\$1,550	\$1,500	\$1,400	800.00
3 ea. area inlet	320.00	400.00	600.00	400.00

TAXIWAY

1 ea. storm drain manhole	\$1,000	\$1,000	\$1,200	\$1,000
2 lin. ft. manhole, extra depth	100.00	100.00	150.00	100.00

Miscellaneous

Equipment rental rates—dump trucks; crawler tractors; wheel-type tractor with front end loader

California—San Luis Obispo County—State. Hubbs Bros., Colton, received a contract from the State Division of Highways in drawing by lot for rental rates per hour on two 5½ to 7 cu. yd. approximate capacity dump trucks with power hoists and steel bodies to be completely operated, fueled and maintained. Bids were as follows:

Bidders	Make	Year	Rental Per Hour
Hubbs Bros., Colton, Calif.	Truck "A" Ford	1947	P.U.C. Rate
	Truck "B" Ford	1947	P.U.C. Rate
Mel H. Corippo, Paso Robles, Calif.	Truck "A" Ford	1952	\$5.78
	Truck "B" Ford	1952	5.78
H. G. Iliff and Son, Santa Maria, Calif.	Truck "A" Ford	1950	5.27
	Truck "B" International	1951	5.27
Robert E. Shaw, N. Palo Alto, Calif.	Truck "A" GMC	1951	5.28
	Truck "B" GMC	1952	7.38
Valley Paving & Constr. Co., Pismo Beach, Calif.	Truck "A" GMC	1951	5.27
	Truck "B" GMC	1951	5.27
McNall Building Materials, Santa Barbara, Calif.	Truck "A" International		5.50
	Truck "B" International		5.50

California—San Luis Obispo County—State. La Vern P. Crosby, Pismo Beach, received an award from the State Division of Highways for bid for furnishing one tractor, wheel type, equipped with front end loader having a capacity of approximately 1 cu. yd. Bids were as follows:

Bidder	Make	Year	*Rental Rate Per Hour	**Transportation Lump Sum
La Vern P. Crosby, Pismo Beach, Calif.	Minneapolis-Moline	1949	\$8.75	\$ 10.00
Fesler Constr. Co., Santa Maria, Calif.	Hough	1946	9.50	50.00
McNall Bldg. Matl., Inc., Santa Barbara			NO BID	

*Includes fully fueled and maintained equipment complete with operator.
**Equipment from the Vendor's Headquarters to the City of San Luis Obispo and return to Vendor's Headquarters at completion of work.

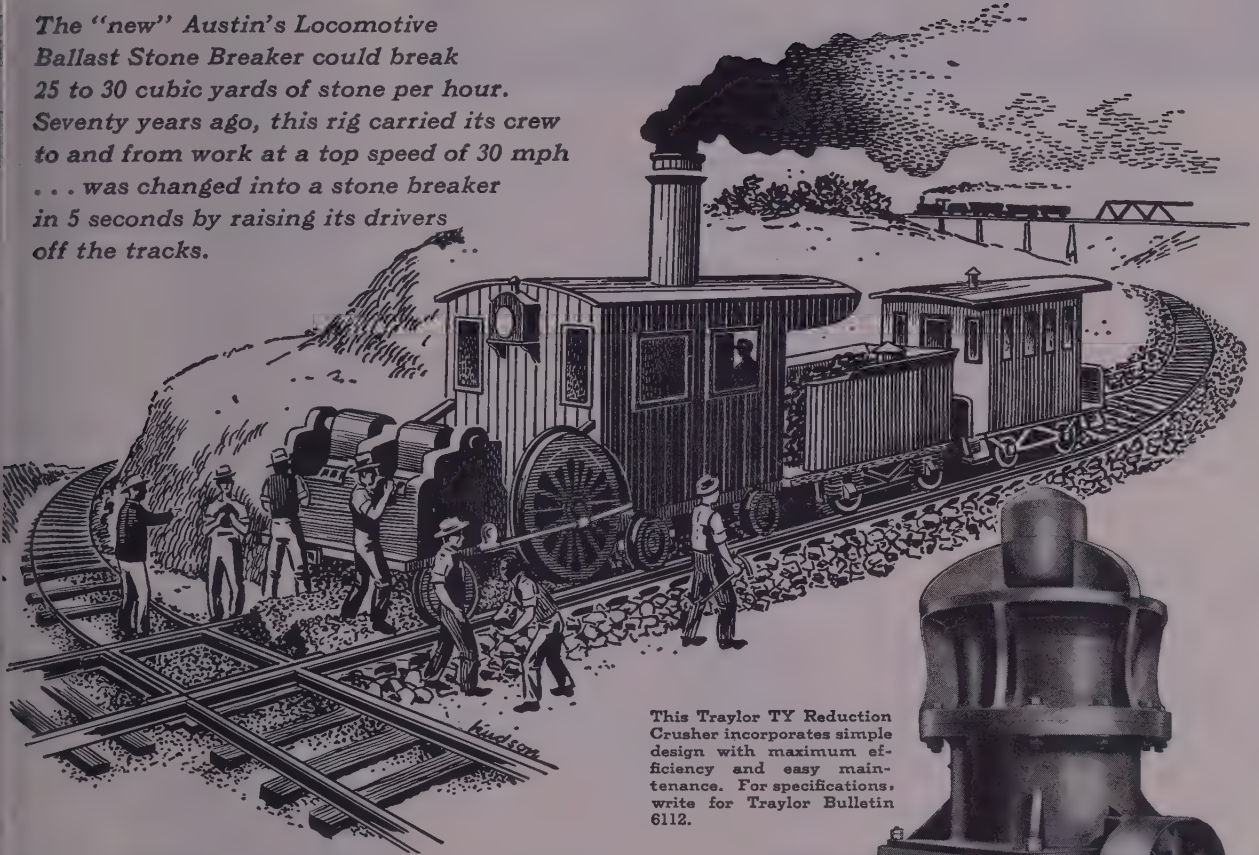
California—San Luis Obispo County—State. Valley Paving & Construction Co., Inc., Pismo Beach, received an award from the State Division of Highways for furnishing one crawler type tractor with steel plates, equipped with front end loader having a capacity of approximately 1 cu. yd. Bidding was as follows:

Bidder	Make	Year	*Rental Rate Per Hour	**Transportation Lump Sum
Valley Paving & Construction Co., Inc., Pismo Beach, Calif.	Caterpillar	1951	\$7.90	\$150.00
Madonna Const. Co., San Luis Obispo, Calif.	Caterpillar D-4	1946	8.94	125.00
McNall Bldg. Matl., Inc., Santa Barbara	International	1950	9.50	19.50
Fesler Constr. Co., Santa Maria, Calif.			NO BID	

*Includes fully fueled and maintained equipment complete with operator.
**Equipment from the Vendor's Headquarters to the City of Santa Barbara and return to Vendor's Headquarters at completion of work.

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NEW LITERATURE

401

Emergency piping repairs product selector

Dresser Manufacturing Division of Dresser Industries, Inc., is offering a four-color, laminated wall chart showing "The right product for every piping need." Just a glance at this "Handy Product Selector" will answer your question in regard to couplings, clamps, fittings and repair devices for pipe of every kind and size. The chart is available in two sizes—22 x 34 in.—with tinned top and bottom for convenience in hanging, and a smaller 10½ x 16-in. chart.

402

How to use "Presdwood," a new form liner for smooth-surface concrete

In a well-illustrated, 8-page folder just released by the Masonite Corporation, the firm tells the characteristics and potentials of concrete form Presdwood—a grainless, wood panel material, made entirely of wood fibers, for use as form liner or structural form board in the

production of smooth-surfaced concrete. The folder contains specifications, diagrams and photographs designed to aid the reader in determining the many uses and advantages of the product. This should be a helpful piece of literature for the construction library.

403

Bulletin available on three-wheel rollers

Illustrations and information pertaining to 8-, 10-, 12-, and 14-ton 3-wheel rollers, gasoline and diesel, by Huber Manufacturing Co. are available in this new 2-color, 10-page bulletin. A comprehensive explanation of the various parts assembled in a roller and a description of the general purpose duties of the units are included in this informative booklet, No. H-150.

404

'52 edition of lumbermen's "Where-to-Buy" available

This is a log of the membership of the West Coast Lumbermen's Association. This year's 48-page directory shows record membership. Pertinent details on

405

Masonite hardboards—a folder and a gadget

Here is a booklet entitled "1,000 Uses for Masonite Hardboards," and a "Dial-it-Right" instruction wheel which automatically matches the job with the correct materials on one side—and the correct nails for the job on the other. The booklet offers a very good selection of hardboard applications with full specifications, descriptions and diagrams. Together, the 24-page booklet and instruction wheel provide an interesting how-to-do-it package which should interest those in architectural design and construction. The last page of the booklet lists other bulletins on specialized construction needs. Masonite Corporation is offering the information.

each of the 297 operations named, designed and arranged to help the lumber buyer, are included in this valuable publication. Information covers capacity, facilities, species and lumber items manufactured, as well as a growing list of lumber by-products. Lumber buyers would do well to include this offering in their libraries.

406

Guide to heavy-duty forms for airport paving jobs

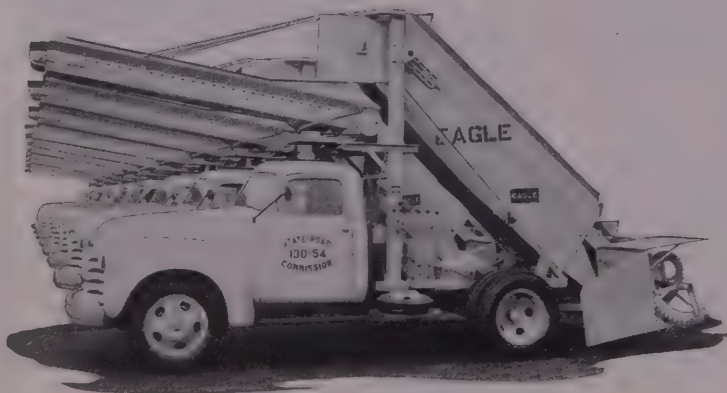
The new Blaw-Knox Heavy-Duty Self-Aligning Paving Form, which was developed especially for airport paving, is included in a new 12-page bulletin. Blaw-Knox Division of Blaw-Knox Co. Bulletin 2370 explains the need for self-aligning paving forms in sizes above 12 in., and any height specified to meet the present day airport paving requirements. Thicker pavement slabs necessary to withstand the concentrated wheel loads of heavy bombers and cargo planes. Diagrams show the advantages in permitting rapid form setting, and the exclusive self-aligning features of Blaw-Knox paving forms are fully described. Detailed construction features, including the quick-operating lock-joint slip plates for connecting the forms, are contained in the bulletin. Complete specifications on forms from 8 in. x 8 in., to 12 in. x 12 in., are included, with additional engineering specifications and suggested purchasing specifications.

407

"Cat" tractor attachment illustrated catalog

Printed in two colors and featuring tractor tools for use with Caterpillar built tractors and equipment, this 6-page booklet should find a place in the library of equipment owners and operators. Pictorial and verbal descriptions give a complete line of Hyster Company tools and illustrations are given to show practical applications of the equipment, multiply tractor uses and increase tractor production.

FLEET OWNERSHIP SPEAKS FOR ITSELF



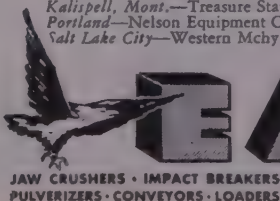
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Spokane—Western Mch. Co.
Los Angeles—Four Wheel Drive Pac. Co.
San Francisco—Four Wheel Drive Pacific Co.
Denver—Liberty Truck & Parts Co.
Phoenix—Neil B. McGinnis Eqt. Co.



EAGLE

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408

Ready mastic spraying pump

The way in which a speedier handling materials from heavy mastics to enamels and lacquers is accomplished by the Shelburne Hi-Vol pump is explained in literature available from A. Shelburne. Qualities which make the pump easy to handle and control along with other interesting facts are in the bulletin.

409

Protective concrete pipe coating

Here is a complete description of the properties and uses of Rexon Coating No. 2, the chemically resistant concrete pipe coating. Contractors and maintenance engineers should find this bulletin an interesting reading since it explains the way in which the coating protects concrete pipe against the chemical attack of sewage and industrial wastes and is virtually inert to all acids, alkalis, oils and solvents. Specifications are included in this bulletin, published by Hamilton Cement Manufacturing Co.

410

Reading alidades adjustment

For the benefit of engineers in the field, W. & L. E. Gurley Co. offers this 8-page pocket-size service booklet. Helpful information for use of the alidade in both exploration and map making, as well as detailed instruction on alidade surveying and the use of the Beaman Stadia Arc are included in Service Booklet C. The second half of the booklet deals with alidade adjustments, and includes section on parallax, striding level, cross-level rectification, collimation, control lever, gradienter, circular level,

compass needle, finder sights and Beaman Stadia Arc index. Surveyors shouldn't miss this one!

411

Geophysical exploration guides

Two bulletins are available from Fisher Research Laboratory, Inc., on geophysical exploration service in construction and mining problems and the portable seismograph equipment for near-surface exploration. Fisher handles sales and service for Midwestern Geophysical Laboratory, and these brochures offer a clear picture of the ways in which the equipment and exploration method can aid you in your job operations.

412

Wrought iron

"Proof by Performance" is the title of an illustrated 8-page booklet just released by A. M. Byers Co. The publication describes in a non-technical manner, a number of installations in which wrought iron gave outstanding service over long periods of time.

413

Scraper story

Complete details on Bucyrus-Erie's most recent edition—the B-113 scraper are contained in the firm's newest bulletin. Illustrations, specifications and diagrams make this bulletin a complete view of the new master earthmover.

414

Tunnel ventilation talk

The construction of Spiratube-M and Ayratube tunnel ventilation is discussed in this 8-page brochure released by

415

Fuel savings by diesels

Fuel saving qualities of Cummins Diesels over gasoline engines are calculable in dollars by using the new cost comparator prepared by Cummins Engine Co., Inc. This is a slide-rule calculator which will allow the power user to quickly determine the yearly savings that can be realized through the use of Cummins Diesels for all types of applications. The cost comparator is based on fuel savings experienced by operators during the 33 years Cummins Diesels have been used for heavy-duty jobs. For the truck owner, one scale is on a mileage basis. Diesel fuel-gasoline price differentials, as well as the increased miles per gallon gained by Cummins Diesels are considered. The reverse side of the slide-rule shows savings on an hourly basis for industrial and marine power users.

Flexible Tubing Corp. The flexibility and versatility (Spiratube is used for either suction or exhaust) are stressed. Photographs and cross-section diagrams give the reader a chance to see the advantages of this ventilating system. The lightweight, easy handling and easy coupling and installation features are fully explained. The bulletin includes an air friction chart for straight Spiratube along with complete specifications.

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Address _____

Position _____

Organization _____

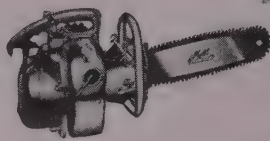
Make Costly Manhours More Productive with Portable Power Tools

Mall

Less sweat, less muscle, less end-of-the-shift fatigue but more work done — all this adds up to keeping the job on schedule and netting a better return on your contract when Mall Power Tools take over the hard work. Men like the "feel" of these husky, dependable tools and the contractor likes the low-cost maintenance and high scoring heavy-duty service — backed by over 30 years' experience in tool design, production and field testing.



MALL VIBRATORS — Mall concrete vibrators produce better finished concrete at minimum cost. Pneumatic, electric or gasoline engine models. Write for Bulletin 2022.



MALL CHAIN SAWS — Dependable cutting power for hard, soft, wet, dry or frozen wood. Pneumatic, electric or gasoline engine types. 12" to 144" capacity. Write for Bulletin 2066.

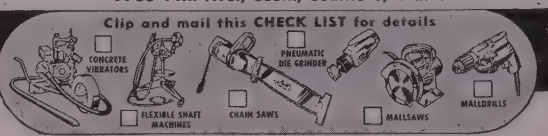


MALL DRILLS — Mall Drills have perfect balance, are built for years of service. Pneumatic or electric power. Capacities 1/4" to 1 1/4". Write for Bulletin 2073.

West Coast: 5316 Santa Fe Avenue, Los Angeles 58, California
7783 14th Ave., South, Seattle 8, Wash.

Mall
TOOL COMPANY

7706 S. Chicago Avenue
Chicago 19, Illinois



A 7031-1/2A

416

Technical book catalog

The 1952 Catalog of Pocket Size Dollar Technical Data Books is now available from Lefax Publishers. Over 2,000 subjects are listed covering every known branch of engineering. Each handy, loose-leaf book contains approximately 140 pages of reference material that can be carried in the pocket for convenient reference right on the job. Those who might be interested in this sort of data will find the free catalog interesting reading. The books themselves cost \$1.00.

417

'52 Waco file folder

Completely revised and containing all standard Waco literature, catalog sheets and test data is the new Waco file folder just announced by Wilson-Albrecht Co., Inc., steel scaffolding equipment manufacturer. Made of heavy enamel cardboard stock, the 8 1/2 x 11-in. folder is a permanent file for monthly mailings of Waco literature and other information pertinent to scaffold erection, use, safety measures, etc. At least 12 of these mailings will be made to file folder holders during 1952.

418

"Cat" D-2 catalog

In 32 pages, Caterpillar Tractor Co. offers this close look at the mechanical features of the diesel D2 tractor. Pictures of the various applications along

with point-by-point explanation of the mechanical features make this book a must for D2 owners and operators. A complete set of specifications is included for reader convenience. Typical jobs are shown, along with reports from D2 owners. More than 60 pictures are contained in the catalog.

419

Washer costs cut

In a well-presented brochure aimed at engineers, designers and mechanics, Saginaw Bearing Co. offers the cost-cutting methods of washer replacement. The convenience of not having to dismantle machines to install new thrust bearings when Sabeco split thrust washers are used is explained. A dimension sheet of washer requirements which you fill out and return to the firm for solution is contained in the brochure.

Literature briefs . . .

420

BACKFILLER - TAMPER - SIDE CRANE—The Cleveland Trencher Co. offers this 4-page bulletin on the one-man-operated machine which backfills as it tamps as it travels.

421

DRILLING LONG HOLES?—If you are interested in a procedure for drilling long holes varying in depth from 20 to 150 ft., Rock Bit Sales and Service Co.

is offering this 4-page bulletin on tungsten carbide Rok-Bits and long hole drilling tools.

422

HOIST AND BODY LINE—Here's a 6-page illustrated folder on the hoist and body lines produced by The Perfection Steel Body Co. for heavy duty trucks.

423

WORDS ON WELDING — Ranki "C-X", a new hard-surfacing welding rod and a new method of hard surface overlay for millhammers and like applications are announced simultaneously in bulletin C-X released by Ranki Manufacturing Co.

424

MASONRY DRILLING—This 6-page folder, published by New England Carbide Tool Co., Inc., shows and tells readers how they can drill any size hole in any masonry material with the right bit for the job.

425

SNOW REMOVAL BY "CAT" — "Snow Removal" is a new publication of the Caterpillar Tractor Co. which tells how, with a few attachments, a CAT motor grader becomes a large-capacity snow removal unit.

426

PROTECT MOVING PARTS—Here's a 4-page folder describing a chemical treatment called Rustshield 2, which produces an oil-retaining rustproof surface for moving metal parts. Published by Octagon Process, Inc.

427

PROTECTIVE PLASTIC PAINT—Characteristics, applications and methods of use of the tough, corrosion-resistant Corrosite protective plastic paint is now available from The Corrosite Corp. The bulletin points out how Corrosite protects against salt water corrosion and other similar conditions.

428

TORCH CARRYING—In a collection of pictures and well-written text, this bulletin tells the advantages of National Welding Equipment Co.'s torch design features.

429

GRANDSTAND PLAY—A brochure is available from Pittsburgh-Des Moines Steel Co. describing the principal features of steel deck grandstands.

430

GOING UP—The thirty trips an hour feature of American Hoist & Derrick Co.'s portable material elevator is fully explained in a catalog now available from the firm.

431

YOUR WIRE ROPE NEEDS — A Leschen & Sons Rope Co. is offering a Wire Rope Handbook which tells where Flattened Strand can best fit into your job requirements.

432

CRUSHING GUIDE—Lots of crushing facts are contained in this guide 27 now offered by Mines Engineering &

Equipment Co. This guide, plus bulletins 273 and 274 will provide a good picture of the capacity, costs and quality of the Smith crusher line.

433

TROWEL CHANGES—The features of Master Vibrator Co.'s Turn-A-Trowel, which provides instant changing of trowels, are explained in Catalog 939, now available.

434

POWER MAGIC—That's the title of Wisconsin Motor Corp.'s new booklet which tells about Wisconsin powered compressor-sprayers.

435

AFTER BLASTING—Why Primacord detonating fuse offers you more safety in blasting operations is explained in literature made available by Coast Manufacturing & Supply Co.

436

ROADS THAT LAST—This is the title of the new booklet offered by The Foote Co., Inc., which tells all about the features of the Adnun black top paver for cheaper stone spreading.

437

SOIL COMPACTING COST CUTTER—Bulletins on the Vibro-Plus Terapac Soil Compactor are now available from Vibro-Plus Products, Inc.

438

ARC WELDING—Studies in Structural Arc Welding, released by The Lincoln Electric Co., are available upon request to designers and engineers writing on letterheads.

439

CONSTRUCTION CONVEYORS—Here's a catalog on construction conveyors with high capacity at low cost. The Fairchild Engineering Co. offers the catalog.

440

CRANE CARRIERS—Literature is available on Maxi crane carriers in several different models. Six Wheels, Inc., is offering the information.

441

ENGINEERING INSTRUMENTS—Time-saving engineering equipment manufactured by Henry Wild, Surveying Instrument Supply Co. of America, Inc. is pictured and described in a catalog available from the firm.

442

VERMICULITE SPECS—Vermiculite Institute offers new standard specifications for vermiculite plastering and acoustical plastic. The 12-page booklet covers the application of vermiculite plaster base coats to all types of lath and masonry bases, solid partitions, etc.

443

DIESEL DESIGN FEATURES—Design and operation features of the Nordberg, one, two and recently introduced three cylinder Type 4FS diesel engines are illustrated and described in a new 2-page, two-color bulletin published by Nordberg Manufacturing Co.

Four Reasons . . .



U.S. PAT. NO. 1948410

Why "NEWTYP" Gives Top SUCTION HOSE Performance

1. SPECIAL REINFORCED ENDS lend added strength and resistance to flexing wear back of the couplings, and provide a sturdier, more durable section under the clamps. Ends are colored in bright red for easy identification.
2. KINKPROOF CONSTRUCTION assures full-capacity bore under suction and discharge, always . . . the hose will not buckle or collapse. If accidentally crushed by heavy equipment, it can be rounded into shape again with mallet or hammer.
3. EXTREME FLEXIBILITY with comparative lightness in weight, make "NEWTYP" easy to handle, even in longest lengths.
4. INSEPARABLE BONDING of tube, carcass and cover, by patented process, insures extra long service life under severest working conditions.

"NEWTYP" SUCTION HOSE, STYLE R-35, is made in sizes 1" to 1½", I. D., in maximum lengths of 100 feet; and sizes 2" to 4", I. D., in maximum lengths of 50 feet.



Contact Our Nearest Branch for Further Details and Prices



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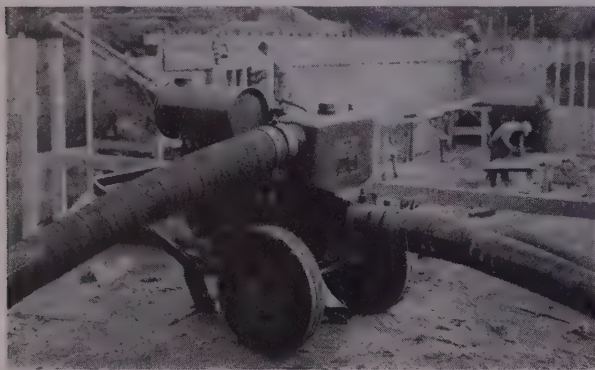
NEW EQUIPMENT

More information on any of the items in this section may be obtained by using coupon on page 153.

444

Contractors pumps designed for increased utility on the job

Four features have resulted from the extensive research behind the creation of this new contractors pump by Marlow Pumps: (1) Simplicity of construction which reduces the



number of parts to a minimum, insures simplicity of operation and maintenance; (2) fast, high and dependable priming provide maximum air handling ability to obtain fast starts, even when pump is placed well above water; (3) maximum efficiency and dependability; (4) maximum trash handling ability with clearances through the check valve impeller and diffuser passageways should be as great as possible. The years of research and pilot model testing that have gone into this pump should make it stand up to highest specifications in action.

445

Check this ripper! — penetrates 60 inches in tough material

Weighing in at 15 tons, and capable of penetrating 60 in. in tough material, this heavy duty ripper will take the combined drawbar pull of six of the largest tractors now on the



market. It will rip any laminated or foliated material. The center is designed for three depths of penetration—60, 48 and 36 in.; the outside teeth for two depths—48 in. and 36 in. The ripper has a wide range of applications and in many cases will

take the place of explosives for shattering material too hard to be handled by scrapers or shovels. Overall width is 9 ft., length, 25 ft., 6 in., and height, loaded for shipping, 9 ft., 9 in. Peterson Tractor & Equipment Co. is the manufacturer.

446

Tamper smashes backfilling costs with featured triplex action

This Triplex backfill tamper, by Gunderson-Taylor Machinery Co., offers contractors the work of five men in the work of one man and one machine. It is fast in that it gives 75 sq. in. of effective compaction area pounded and vibrated at the same time, resulting in 5 times the speed of work by one man. It gives 20% higher lifts and still meets specifications. It is easy to control and gives a systematic coverage of compaction area. Only 1/2 in. vertical movement of the unit allows ease of control, and the machine is safe since the wheelbarrow-like handles hold the butts away from the operator's feet. Operated by a standard 105-cfm. portable air compressor. Available as a complete unit and as a mounting.



447

Loader offered for multi-purpose use on any dump truck

Consisting of an attachable shovel or magnet, arms, and hydraulic equipment, this Hykap loader makes any truck to which it is attached multi-purpose. The loader can be used



as a hydraulic lift platform for loading drums, crates, etc. and for lifting materials into trucks in crane-like operations. The Hykap is mounted on the rear of the truck body and is operated by controls on top of the truck cab or from auxiliary controls on the side of the truck. Loader is put into action by engaging a fork attached to the truck transmission, and by slipping a four-fingered attachment over the steering wheel. Available attachments include a shovel (bucket), a 29-in. magnet, and a set of heavy chains for lifting containers. Manufactured by Efficient Equipment, Inc.

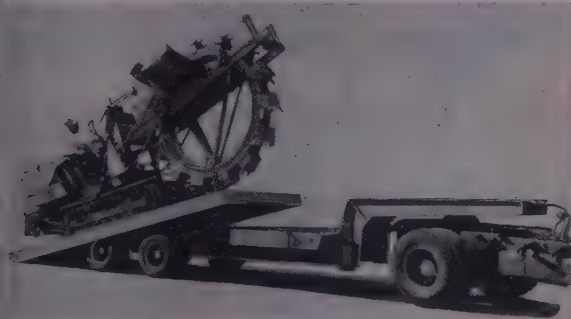
Interchangeable parts offered for lightweight clay-digger

Featuring an optional inside or outside trigger, closed trigger or latch retainer, choice of five chucks for square, hexagon, or combination hexagon and round shank steels, the new Thor No. 16 Digger weighs 20 lb. It is 19½ in. long and equipped standard with chuck to take steels with ¾-in. square by 2¾-in. long shanks. Optional chucks take ¾-in. hexagon by 2¾-in. shanks; 7/8-in. hexagon by either 2¾-in. or 3¼-in. long shanks, and combination .882 hexagon and 1.027 round by 3¼-in. long shanks. Accessories available in these shank styles include clay spades or scoops, flat chisels, saw tooth chisels, moil points, narrow chisels and steel blanks. Independent Pneumatic Tool Co. is the manufacturer.



Booseneck-type trailer loads, unloads in 5 minutes—without skids or blocking

Available in 14, 18 and 22-ton capacity, the new Model TA trailer is of tandem axle design, with 96-in. width of platform, which tilts into loading position by releasing a



single pin lock at the front of the platform. Two double-acting hydraulic cylinders "cushion" load during tilting. After load is driven or winched into place, platform locks automatically in horizontal position for hauling. Only one man is needed for loading or unloading the machine. Trailer carries eight tires with extra wide base rims—available with either

ILLUSTRATED BROCHURES GIVE BEDROCK INFORMATION DATA

Free well illustrated material describing the refraction seismic method of subsurface exploration upon request. These pages of detailed information are of value to lay and professional readers interested in foundation problems. Detailed Bibliography also available.

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In The Mail Today

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RESEARCH LABORATORY
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A McKIERNAN-TERRY FOURSOME...

*teams up
for speedy*
**PILE
DRIVING
and
PULLING**

A McKiernan-Terry Pile Hammer driving steel foundation piles for the Housatonic River Bridge from the 80-ft. boom of a truck crane. Mariani Construction Co. was the contractor.

Here's bridge-building teamwork . . . McKiernan-Terry style! On the new Housatonic Bridge connecting Derby and Shelton, Conn., four pieces of McKiernan-Terry equipment were teamed up by the contractor for fast pile driving and extracting.

McKiernan-Terry 9-B-3 and 10-B-3 Double-Acting Hammers drove 40 to 65 feet steel piles to refusal in rock for four piers and the east abutment. Piles were punched down on a 1 in 6 batter from large crane rigs.

Cofferdam steel piles, 40 feet in length, were driven by a McKiernan-Terry Double-Acting No. 7 Hammer and quickly removed with a McKiernan-Terry E-4 Pile Extractor.

You, too, can get all the pile-driving versatility you need with the wide range McKiernan-Terry line. It includes 16 sizes of single-acting and double-acting hammers and 2 sizes of double-acting extractors. Write for bulletin.

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TERRY**

McKIERNAN-TERRY CORPORATION
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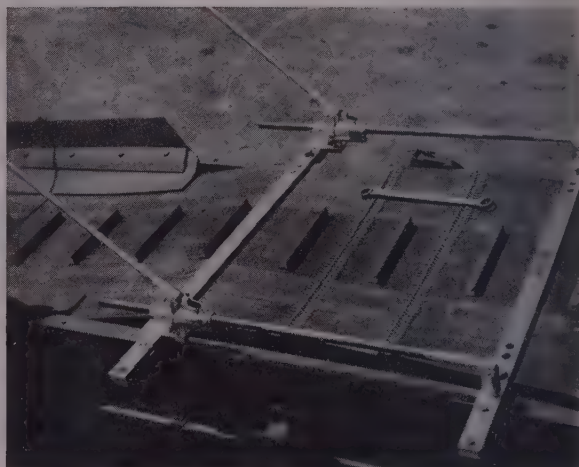
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BRANCHES & DISTRIBUTORS IN KEY WESTERN CITIES

air or vacuum brakes. Three lash hooks on each side included as standard equipment. Manufactured by LaCrosse Trailer Corp.

450

Conveyor belt changes speeded with convenient belt stretcher



Down-time on changing conveyor belts can be considerably lessened by this new tool, the Far-Pul Stretcher. The two ends of the belt to be pulled together usually demand a tremendous amount of effort and time, but one man can now handle the operation rapidly. The ends, which are firmly gripped between two bolted plates, are connected with two jacks on an adjustable bar; one on each side of the belt (see illustration). The process of bringing the loose ends together requires only the minimum pumping of the jacks, and each jack controls its side of the belt, permitting an accurate measurement of the stretched belt. The tool is made in varied sizes, by Crawford Equipment Co., to fit belt widths from 8 in. to 36 in.



Dragline, Clamshell, Custom-Built Buckets Stone and Wood Grabs

WELLMAN Williams Type

MORE YARDAGE PER DAY

● Elimination of excess materials and careful weight distribution permit rapid, rhythmic operation of Wellman Dragline Buckets. Operators can cover a wider digging radius with this streamlined bucket.

Built of special alloy steel, using strong welded design, Wellman buckets provide strength and stamina for long-term economy. Perforated designs also available. You'll do better with Wellman.

Want Facts? Write for free descriptive bulletins

THE WELLMAN ENGINEERING COMPANY

7000 Central Avenue • Cleveland 4, Ohio

ARIZONA—Lee Redman Company, Phoenix, Ariz.

CALIFORNIA—Coast Equipment Company, San Francisco, Calif.

OREGON—P. L. Crooks & Co., Inc., Portland 10, Oregon

WASHINGTON—Construction Equipment Corp., Spokane, Wash.
Clyde Equipment Company, Seattle, Washington

Where only the best is a bargain!

On a really tough hauling job, a truck's either got it, or it hasn't.

You either make money or you lose it. Only the *best* truck engineered for the job is a bargain for the operator.

That's why you see so many Internationals on tough jobs. That's why you'll be money ahead to see your International Truck Dealer or Branch and get the *best* truck engineered for your job. Why not make it *soon*?

INTERNATIONAL HARVESTER COMPANY • CHICAGO

Get the facts about International's features:

- All-truck engines—exclusively for truck work—built in the world's largest truck engine plant.
- The "roomiest, most comfortable cab on the road"—the Comfo-Vision Cab designed by drivers for drivers.
- Super-steering system—more positive control, easier handling and 37° turning angle.
- Traditional truck toughness that has kept International first in heavy-duty truck sales for 20 straight years.
- 115 basic models . . . everything from 1/2-ton pickups to 90,000 lbs. GVW off-highway models.
- America's largest exclusive truck service organization.



International Harvester Builds McCormick Farm Equipment and Farmall Tractors . . . Motor Trucks . . . Industrial Power . . . Refrigerators and Freezers

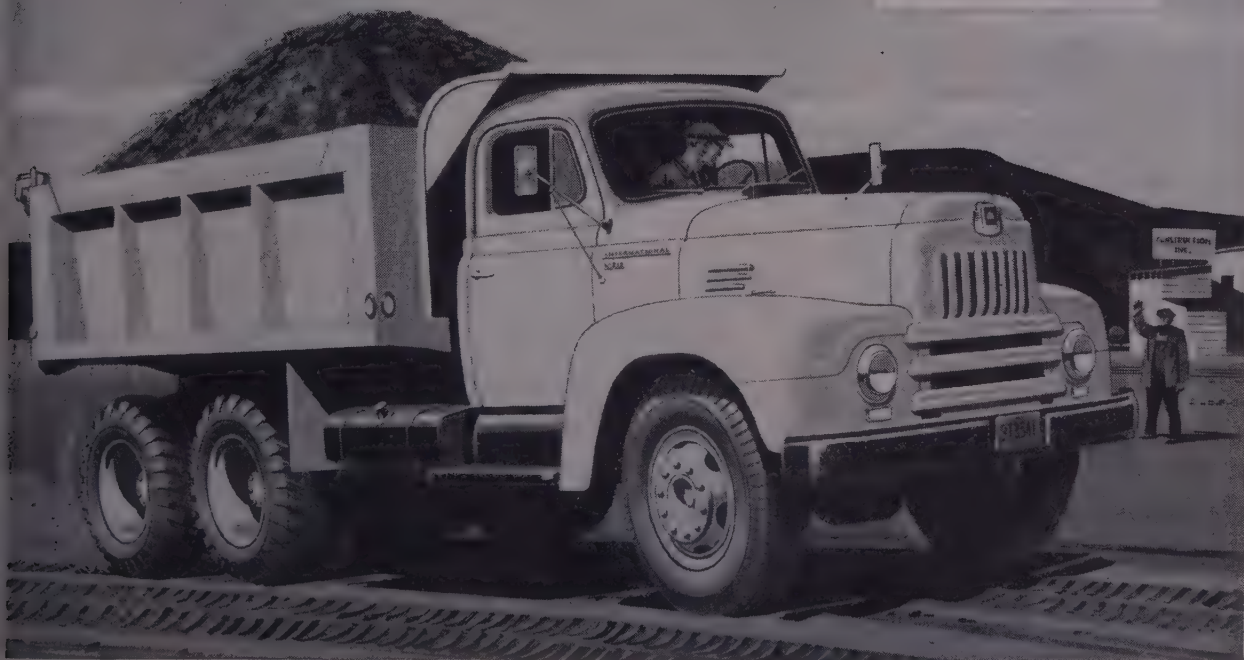
INTERNATIONAL



TRUCKS

"Standard of the Highway"

Model LF-210, 157-in. wheelbase,
8-yard dump body, 37,000 lbs. GVW



451

4-wheel drive tractor-shovel with 1 cu. yd. bucket

This four-wheel-drive Payloader Tractor-Shovel with 1 cu. yd. bucket is



powered by a 60-hp. diesel or 54-hp. gasoline engine. Tremendous traction and flotation are assured by the four

pneumatic tires being the same size all around. Rear wheel steer with power booster plus short wheel base makes it easy to operate the machine and gives it high maneuverability. The model has four speeds in both directions. Bucket is hydraulically controlled by "finger-tip" action. The Frank G. Hough Co. is the manufacturer.

452

Indoor, outdoor heater gives 140,000 Btu.

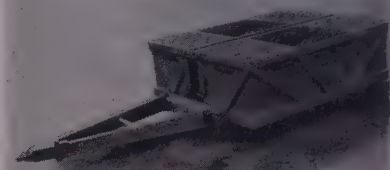
Said to employ an entirely new principle of forced-air circulation and offering 140,000 Btu., this new heat machine is offered by Fageol Heat Machine Co. By blowing warm air out of the machine's base along the floor, it creates

a 6-ft. high heat blanket and eliminates the necessity for heating vast overhead areas in order to keep workers comfortably warm. This concentration of heat is said to reduce heating costs as much as 90%. It sprays heat from sides across the floor. It burns furnace type fuel oil of No. 3 or lighter grade or kerosene. No chimney or flue is required, and the unit is self-contained. A 6-gal. fuel tank is attached, and wheels are attached for easy portability.

453

Roller well-suited to jobs requiring extreme compaction

This 200-ton compactor goes right to work testing fills on air base runways, on other jobs where extreme compaction is a necessity. It is designed in two



halves, each half being provided with two tires and arranged to oscillate independently to follow the undulation of the fill exactly. Each of the four tires is designed to carry a load of 100,000 lb. Specially built wheels are equipped with Timken bearings and grease seals. Construction permits removal of the wheel assembly through the top of the roller frame to facilitate tire repairs. The roller of the roller is equipped with an extension tongue, permitting use of propeller tractors at either end. A 15-hp., 4-cylinder gasoline engine driving hydraulic pump supplying 5,000 psi. for 10-in. hydraulic cylinder is furnished at the rear of the roller. Empty, the roller weighs 77,000 lb. Cast iron ballast blocks weighing 2,500 lb. each, equipped with lift loops, and made to fit ballast compartments closely, give a ballast weight of 323,000 lb., and a total weight of 400,000 lb. Shovel Supply Co. is the manufacturer.

454

Camel-back boom designed for use with crane excavators

This new heavy-duty, camel-back boom will increase the reach of the



yd. crawler, Model 66, to 26 ft., 3 in. grade level, and allow a digging depth of 17 ft., 3 in. The camel-back feature permits the operator to make a clean

Save... switch to WARSOP drills and breakers

It's real economy

- ★ Low Initial Cost
- ★ Low Maintenance Cost
- ★ Low Operating Cost
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No Battery • Positive Dual-Fan Cooling
Variable Speed Control • No Springs
Completely Self-Contained

There's real Savings when you use Warsop Portable Rock Drills and Breakers on all types of construction and demolition work. With Warsop hard-hitting power tools you need no cables, no hose. Compact and light in weight, they are easily transported from job-to-job. Wherever you have breaking or drilling jobs that require only one or two machines figure to use WARSOP. You'll save time, labor and equipment costs.

Write for descriptive folders and specifications.

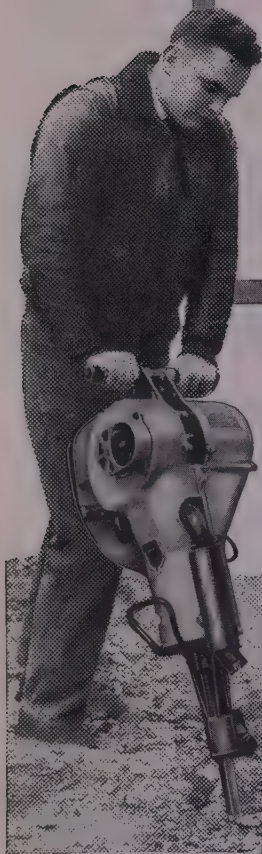
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WARSOP
S 6 BREAKER

WARSOP
ROCK DRILL



ical backwall to maximum depth. All operating efficiency is increased it gives greater dumping height. Over is also reduced. Wayne Crane Division, American Steel Dredge Co., is the manufacturer.

455

Self powered locomotives use in tunnels

Powered by a 45-hp. engine which runs through a torque converter is this unit from the Mancha Storage



tery Locomotive Division of Goodrich Manufacturing Co. Running speeds from 3½ to 7½ mph., depending on the drawbar pull demand. Model 100 is operating in a metal mine on 14-in. gauge. It has overall dimensions 42-in. width, 55-in. height and 9-ft., 6-in. length. Exhaust gases are effectively conditioned by a water scrubber to prevent causing any discomfort to underground personnel.

456

6-ft. blade rotates full 360 deg.

Whether pulling or pushing action is possible with this new 6-ft. blade, by Terry Ferguson, Inc. The moldboard is



in. The blade can be rotated a full 360 deg., and angled either to the right or left 15, 30, 45 and 60 deg.—whether in forward or reverse position. A scarifier, grading plates, blade extension and grader wheel are some of the attachments which increase the usefulness of the multi-purpose blade. Hydraulic control adjusts depth of cut, or raises the blade to transport position. The blade aids in grading, grading, road maintenance and snow removal jobs. Attachments are available.

457

Three new Ford engines announced

Three new Ford engines are now on the market. The "317" is rated at 140 hp. at 2,800 revolutions per min. It is a V-8 with 3.8-in. bore and 3.5-in.

Buda Model HBQ 270° Turntable Mounted Earth Drill



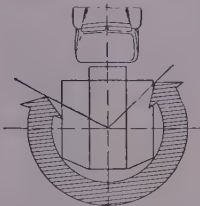
solve more HOLE DRILLING PROBLEMS

WITH BUDA EARTH DRILLS AND ACCESSORIES

NEW!

QUICK, EASY LOCATION

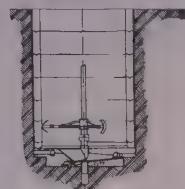
Turntable mounting of Earth Drill permits drilling at any point in 270° arc around the unit.



NEW!

HOLE PROTECTION IN UNSTABLE SOIL

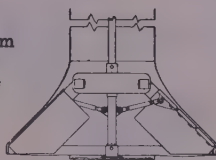
Helix and Caisson Undercutter Combination permits drilling and casing hole in 1 operation



NEW!

DRILL FOUNDATION PIERS

Belling Tool enlarges bottom of bored hole to assure more bearing area and positive anchorage of concrete



NEW!

FASTER, EASIER SOIL SAMPLING

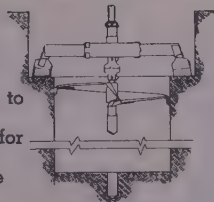
Permits procurement of uncontaminated samples with minimum amount of disturbance to depths of 100 ft.



NEW!

DRILL LARGER ACCESS HOLES

Reaming Tool enables standard Earth Drill to enlarge hole up to 60" dia.—eliminates need for specially built, heavy, expensive equipment



ANGLE DRILLING 45° FROM VERTICAL

Hydraulic Controls provide adequate adjustment to vertical in difficult terrain and ability to dig angle or anchor holes.

Write for Bulletins giving diameter, depth and type of work for which equipment is needed. The Buda Company, Harvey, Illinois

BD-9

Nation-Wide Service

FORNACIARI CO., Los Angeles 21, Calif.; COAST EQUIPMENT CO., San Francisco 1, Calif.; RAY CORSON MACHINERY CO., Denver 9 Colo.; SAWTOOTH CO., Boise, Idaho; WESTERN CONSTRUCTION EQUIPMENT CO., Billings, Mont.; SIERRA MACHINERY CO., Reno, Nevada; CONTRACTORS EQUIPMENT & SUPPLY, Albuquerque, New Mexico; CONTRACTORS EQUIPMENT & SUPPLY, El Paso, Texas; HOWARD-COOPER CORP., Portland, Oregon; ARNOLD MACHINERY CO., Salt Lake City 1, Utah; HOWARD COOPER CORP., Seattle, Washington; J. D. EVANS EQUIPMENT CO., Rapid City, S. Dak.; SIMSON-MAXWELL LTD. Vancouver, B. C.

BUDA

COAST TO COAST

stroke. The "279" is rated at 125 brake hp. at 2,800 rpm. It also is a V-8 and has a 3.56 bore and 3.5-in. stroke. The "215" is a 6-cylinder engine rated at 93 brake hp. at 2,800 rpm. It has a 3.56-in. bore and a 3.6-in. stroke. More horsepower per cubic inch displacement, reduction in piston travel, and greater economy are claimed for the three new models, by the Tractor and Industrial Engine Division of Ford Motor Co.

458

Large structural timbers cut by new type hand chain saw

Structural timbers too large for circular power saws are easy prey for this new



"Smooth-Cut" chain saw, a product of Mall Tool Co. The thin chain guide and narrow, special toothed chain, produces

extremely smooth and precise finish cuts for jointing beams and architectural supports of all kinds. Its light weight of 20 lb. permits one-hand use. A helper's handle can also be attached so two men may saw sharp angles for fittings with ease in one swift operation. The cutting bar is 18 in., and models are available for either 115 or 230 volt AC-DC current. The saw will operate off a portable generator, and it can be run over 200 ft. from its power source with extension cords.

459

Bearing lubricant extends range of operation

Texaco High Temp Grease, said to considerably extend the efficient range of operation of ball, roller, and plain bearings at high temperatures, is announced by The Texas Company. The new grease exceeds established military and industrial standards in affording unusual protection at temperatures up to 300 deg. F. for continuous operation and 350 deg. F. for intermittent operation. Tests have revealed that this new grease has excellent oxidation resistance, and other desirable characteristics for high temperature operation.

460

2-kw. lightweight 1-cylinder generating set from Sheppard

This new 2-kw. light weight generating set has a capacity of 2,000 watts, at 1,800 rpm. This unit is also available in

AC as well as DC, and in all standard voltages. This unit is designed to replace as much as 1,000 lb. of batteries in marine installations. The entire unit weighs 395 lb., and is powered by a single cylinder Sheppard diesel engine. Manufactured by Sheppard Diesels.

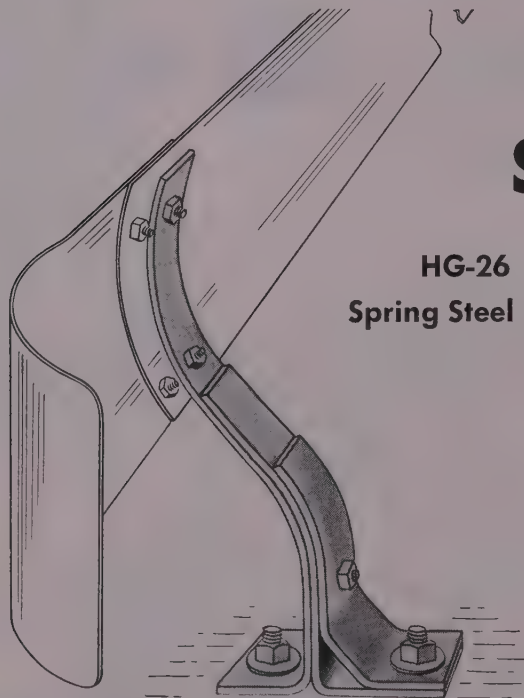
461

Many features combined in new electric excavator

The shovel on this new excavator has a lower boom section rigidly connected to the A-frame. It is an integral part



the machine. Widespread boom feet eliminate sway braces. The upper boom section is pin-connected to the lower boom section and suspended from the A-frame by fixed length bridge struts.



HG-26
Spring Steel Post

U. S. HIGHWAY GUARD RAIL SPRING STEEL POST

formed of special-analysis alloy spring steel, and heat-treated to insure maximum elastic resistance and impact strength. Firmly bolted to a concrete base, yet can be easily replaced at minimum cost.

Write for folder describing different types of U.S. Highway Guard Rail installations and specifications.

Manufactured by



UNITED STATES SPRING & BUMPER CO.

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dipper handle is tubular and free to rotate in a cylindrical saddle block which contains rubber cushions to absorb shock loads during plugging of the engine. Crowd and retract are accomplished by twin ropes, and the crowd machinery is located at the forward end of the revolving frame instead of on the side. The shovel is fully convertible to a grapple, with the drag and hoist functions operated by independent electric motors. The caterpillar mountings are designed for sturdy construction and low-cost maintenance. Bucyrus-Erie Co. is the manufacturer.

462

Fasteners offer consistency in anchoring steel, concrete

Held straight in the barrels of Ramset and other powder-actuated tools by an plasticized red tip, Tru-Set fasteners provide greater penetration from the same amount of powder. The red tip propels the fasteners into the work, virtually eliminating the need for manual tightening of fasteners. Automatic priming of tool barrels, greater power control, and efficient operation are other features. Ramset Fasteners, Inc., is the manufacturer.

463

Self-readable steel tape at reasonable prices



Pictured above is "Boss Wyteface," new self-measuring tape made by Keuffel & Esser Co. It offers all-weather service, a self-sweeping reel-like winding handle with less friction. Notched finger grips make for easy handling. It has black markings on a white background with the foot markings in red. Priced in the West at slightly higher than \$4.90 for 50-ft. lengths and \$7.95 for 100-ft. lengths.

464

Continuity tester for switchboards, control panels

This new continuity tester permits tracing of circuits without the need of wire connections, as it provides its own power from penlite batteries. The tester, a product of Ideal Industries, Inc., may be used in noisy areas, because it uses a signal light indicator which illuminates the point of contact. It requires only one hand, leaving the other hand free to hold circuit diagrams or blueprints. No larger than a penlite flashlight, this tester will find many uses for electricians, and building and plant maintenance men. It comes equipped



Concrete Culverts, Sewers and Storm Drains

There are always plus values for you when you specify concrete pipe for your culverts, sewers and storm drains.

In addition to longer life, more carrying capacity and greater strength, you are assured of prompt delivery on the job from a local manufacturer using local materials and local labor . . . **made Right in your own district.**

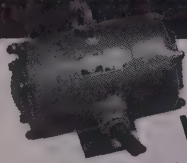
For desired specifications and the name of your nearest manufacturer member, write to Department C.

Western CONCRETE PIPE Association

CS50-1

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It's equipment of a thousand uses—
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—for vibrating tables or screens in packing, sorting or testing—
—for effective noiseless vibration in casting, mixing or loading—in fact, wherever a vibrating impact is useful, VIBRO-PLUS offers these exclusive advantages: Greatest ease of attachment—unsurpassed versatility—extreme lightness of weight—and real "heavy duty kick." Tell us your vibrating problems—we'll send you the proper bulletins.

*Reg. U. S. Pat. Off.

VIBRO-PLUS PRODUCTS INC.

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with a 4-ft. cord and alligator clip. When not in use the test lead is detached, eliminating any chance of exhausting the batteries.

465

New Ford truck line features design for heavy-duty jobs



The new Ford Series F-6 truck cab and chassis is designed for heavy duty hauling. The 160-hp., 239-cu. in. V-8, and 112-hp. Big Six engines are available as the power units for the Series F-6 Ford trucks. Ford Motor Co. is the manufacturer.

466

Arc welder feed nozzles more durable with cemented carbides

The installation of cemented carbide bushing inside the conventional feed nozzle tip for automatic arc welding increases the life of the nozzle tips up to 20 times. Wear is no longer a problem and burning effect is greatly reduced.

For example: where coiled electric wire is especially abrasive, brass nozzles had to be replaced 6 to 8 times per week. Carbide protected nozzles are giving service life of 3 months and better. In addition to increased life, a more uniform narrow weld can now be maintained, as accurate guidance of the wire—formerly difficult once wear developed—is no longer a problem. This is a product of Carboly department of General Electric Co.

467

Two new mixer sizes added to Rex line

Two new sizes of the Rex Model Mixer, a product of Chain Belt Co., now available. The new sizes are the 5 and 7-cu. yd. models. Design gives

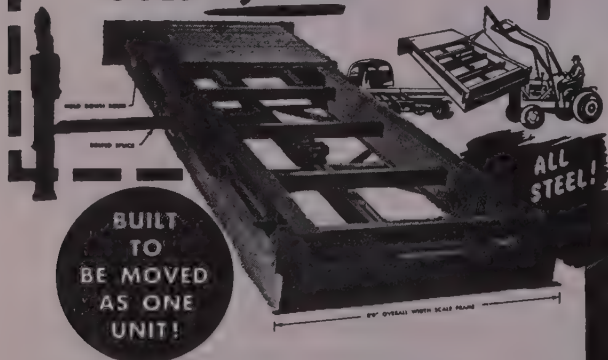


machine the ability to put water over cab and drum against back of for better weight distribution. This makes possible the greatest legal

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MURPHY Portable CONTRACTOR'S SCALE

GOES Anywhere!



This rugged, all-steel, heavy duty scale is a proven time saver and money saver for contractors, road builders, and material handlers! Scale can be hauled completely assembled by simply removing tip end of transverse lever at bolted splice and tightening hold down bolts (see photo). No dismantling or reassembling! No wasted motion in moving from job to job!

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20-Ton 20' x 9'
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Other capacities and platform sizes built to suit.

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White Oil Jacketed Kettles for Heating Elastic Joint Filler

Joint filling compounds containing rubber, for elasticity, must have indirect heat application. They melt at 375° and must not exceed 425°. White Model F-10 kettles maintain this temperature accurately by an oil jacket which transfers heat to the compound.

White kerosene burners are safe and dependable, easily controlled. Hand operated agitator. Insulated housing.

Other models for pavement maintenance have FIRE-PROOF tops. Hand or engine sprayers. Made in several sizes.

Write for Catalog

Elkhart 24 **White Mfg. Co.** Indianapolis

on any given truck. Although this is end loading machine, the rear end is used to prevent spilling of concrete in jets and highways. There is assurance the user will never have to lubricate, maintain, or replace a seal for the life of the machine.

468

air-operated mounting clamp needs vibrator attachments

Designed to speed up attachment of external vibrators to load, the air-operated mounting clamp is advantageous even only short periods of vibration are required. Requires no lengthy installation, since specially designed jaws grip firmly on to suitable steel members at an exposed angle. Multiple uses are claimed for this clamp, such as in tunnel lining where the vibrator can be used at will—in unloading trucks where lengthy time required in attachment of the vibrator previously made operation impractical. Viber Company is manufacturer.

469

new power package for motor crane carriers

Offering greater horsepower and better operating efficiency, the engine used in the new power unit is an industrial application of the White Model A Mustang engine. It is a 6-cylinder, 4-cu. in. unit with 4½-in. bore by 5-in. stroke rated 184 hp. at 3,000 rpm., with accessories to permit ready conversion. The White Motor Co. is the manufacturer.

470

new ditch digger works with any farm tractor

This new ditch-digging machine will dig a 10-in. to 14-in. ditch, 6 ft. deep, at rate up to 3 ft. per minute, depending



on soil conditions. The "Pow-R-Digger" is trailer mounted and uses direct drive from the tractor power take-off. It is a one-man operation from tractor seat and is simple to install by merely hooking onto the drawbar power take-off. The machine is best used for laying pipe, gas, water and sewage lines, and for digging foundation trenches. Vermeer Mfg. Co. is the manufacturer.

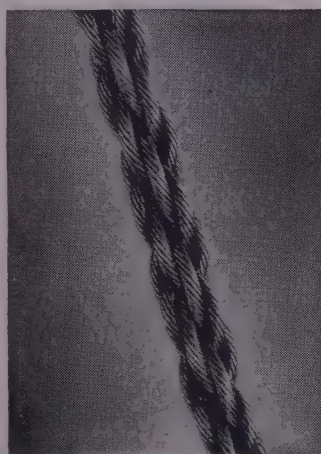
471

new model available in direct current arc welders

Available in 150 and 200 ampere sizes, the new Model GA "Wasp" direct current arc welders are especially suited to



Knot It! Kink It! ...IT WON'T HURT A Tuffy SLING!



Patent No. 2,454,417

Get your FREE Tuffy 3-ft. sample sling and see for yourself how Tuffy's patented braided wire fabric makes an extra flexible sling. Tie it in knots, kink it, then see how easily it is straightened without damaging it in any way.

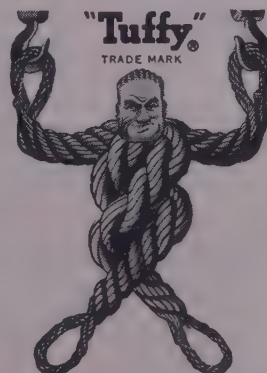
The reason is Tuffy's unique construction. (See enlarged photograph). Scores of wires are stranded into 9 parts, then machine woven into a wire fabric that has unusual flexibility and strength. Even cutting one of the 9 parts will not cause stranding.

11 Types of Tuffy Slings Available

There's a Tuffy Sling for your needs. If not, Union Wire Rope engineers will help work out special slings. Each one is proof-tested to twice its safe working load and the safe working load is stamped on metal tag attached to each sling. If you have your own rigging loft, Tuffy fabric is available by the reel.

MAIL COUPON FOR YOUR FREE SLING

See for yourself that all the things we claim for Tuffy Slings are true. A free 3-foot sample is yours for the asking. Just mail the coupon and your Union fieldman will deliver yours to you.



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Specialists in Wire Rope, Braided Wire Fabric and High Carbon Wire
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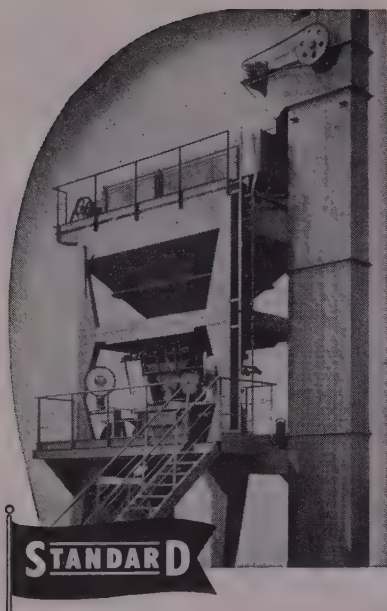
Gentlemen: Please have my Union Wire Rope Fieldman deliver my free Tuffy sling sample.

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DC straight Polarity Heliwelding with Thor-Tung. Excellent commutation at all settings, plus the advantages of self-excitation and split-pole, cross-field design provide good operations at all current settings. Continuous overlap from each current range to the next provides a wide, unbroken range of welding current—30 to 250 on the 200-ampere welder and 20 to 185 on the 150-ampere machine. These lightweight models are products of Air Reduction Pacific Co.

472

Steel clamps for mounting light, heavy wall conduit

Fabricated of ductile, malleable steel and designed with one slip hole, taking up to 1/4-in. diameter screws, these new



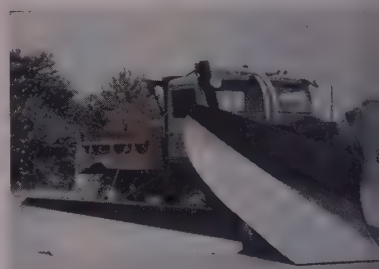
Hercules Steel Clamps are designed for mounting light and heavy wall conduit.

They are zinc plated after fabrication thus affording a neat finish. High ridges on these new clamps give them unusual strength. The size is stamped on each clamp. Victor Spies is the manufacturer.

473

Snow fighter available in V-8 motor truck model

This new model of the Walter S. Fighter features four-point power drive, powered with a V-8 engine



developing 200 hp. Tractor type transmission offers six forward speeds of efficiency with single lever control, giving a fast high gear and powerful gears for all emergencies. Maximum traction is maintained during all operations, and the Walter Suspended Drive offers high ground clearance, less unsprung weight, mounted springs and great resistance strength and wear capacity. Walter Motor Truck Co. is the manufacturer.



3 ADVANTAGES IN BARNES

"33,000 For 1" Pumps
THAT CAN AVOID
HEADACHES

**NO SOFT SPOTS
TO WEAR ON
WATER SEAL**

**NO
RE-CIRCULATING
CHAMBER TO
CLOG**

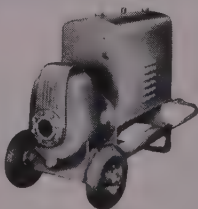
**NO COSTLY
REPAIRS TO
KEEP PUMP
VOLUME UP**

The wearing parts on the Barnes Super Seal are hardened steel. No soft spots to wear. Grease seal is automatically lubricated, and pump can be run dry without damage to pump or seal.

Barnes "33,000 for 1" Pumps do not have either a re-circulating chamber or port. Cement-water, stones, etc., will not clog the pump.

Simple impeller adjustment takes up wear of impeller. It is simple and inexpensive to restore pump to its original capacity and performance of high vacuum readings.

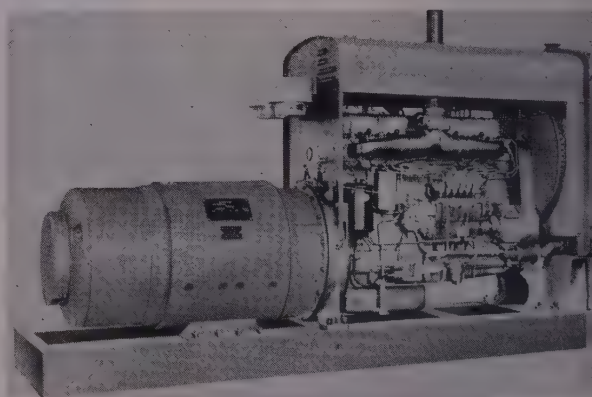
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NEWS of

DISTRIBUTORS AND FACTORY BRANCHES

Barber-Greene appoints two assistant sales managers

Harold W. Newton and William C. Gifford are new assistant sales managers at Barber-Greene Co. Newton will be



Gifford

Newton

Assistant sales manager of the conveyor division. Gifford is now assistant sales manager in machine sales. Both men joined the Barber-Greene Co. in 1936 and have held valuable positions in their previous firms with the firm.

H Seattle branch adds staff additions

J. H. Sturgeon, Northwest district manager for Harnischfeger Corp., Pacific Division, announces two additions to the Seattle, Washington, staff. George J. Giersch, formerly with the Boeing Company as industrial engineer is appointed assistant manager. He will later assume a sales position. Ray Giersch transfers from the Milwaukee, Wis. office to the Seattle branch as service engineer and will be in charge of the products.

To join Bay Cities sales staff

Frank Sullivan and "Speed" Martin recently joined the sales force of Bay Cities Equipment, Inc., according to Al Johnson, Jr., general manager. Sullivan was formerly with Gardner-Denver Co., and will specialize in air equipment. Martin is well-known in equipment circles in the Northern California area.

Pittsburgh-Des Moines opens Los Angeles office

Pittsburgh-Des Moines Steel Co. opens a new Los Angeles, Calif., sales office at 6399 Wilshire Blvd. R. C. Boss, formerly with the firm's Santa Clara plant will be in charge of the new office.

Marquette opens warehouse in San Francisco area

Located at 3637 Adeline St., Emeryville, Calif., is the new service warehouse of Marquette Manufacturing Co., Inc.

All Marquette arc and gas welding and automotive service equipment will be available at the new location. Arvid V. Hedlund, West Coast district manager, will head the new facility. A similar warehouse was recently opened in the Los Angeles, Calif., area.

Osgood-General appoints Western service representative

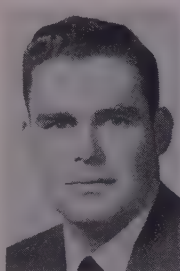
Emmett Smith, Jr. is service representative for Osgood and General in California, Oregon, Washington and the northwest counties of Idaho and Montana. Smith will headquarter at the San Francisco parts depot, 420 Bayshore.

Merrill-Brose staffer

George Brose, vice president and general manager of Merrill-Brose Co., Oakland, Calif., announces the appointment of Wes Andersen to the sales staff. He will cover Contra Costa County and part of Alameda County.

"Cat" personnel shifts

J. A. Justeson, for the past seven years assistant western sales division manager for Caterpillar Tractor Co., San Leandro, Calif., is new eastern sales manager



McNamara



Zeigler

with headquarters at Peoria, Ill. He is succeeded in San Leandro by Frank McNamara, who has been the company's district representative with headquarters at Sacramento, Calif. Justeson succeeds W. S. Zeigler who takes over the duties of assistant director of sales for Caterpillar during the absence of J. W. Mohler, on leave to the National Production Authority.

U. S. Rubber expands Western facilities

A new plant to expand the facilities for the manufacture and sale of rubber latex and plastic materials on the West Coast has been completed on Telegraph Rd. in Los Angeles, Calif., by the Naugatuck Chemical Division, U. S. Rubber

Co. The plant will be the division's Western sales headquarters. It will contain customer technical service laboratories, facilities for the compounding and storage of natural and synthetic latex, and facilities for warehouse resins, plasticizers, etc.

New Insley Mfg. Co. dealer

The Bay Equipment Co., Richmond, Calif., is the new distributor for Insley Mfg., according to Ray Smith, president. The firm will cover the Bay Area and the coast counties in No. Calif. It also handles Manitowoc Engineering Works, Wooldridge Mfg. Co., and Worthington Pump and Machinery Co. lines.

Euclid branch manager changes

A. E. Sorensen, formerly manager of the Northern California branch of the Euclid Road Machinery Co. at Emery-



Sorensen

McDonald

ville, Calif. is now manager of the firm's new branch at Monrovia, Calif., near Los Angeles. The new branch is already serving Southern California and Southwestern Nevada. P. A. McDonald, formerly Euclid district manager in Minnesota and the Dakotas, succeeds Sorensen as manager of the company branch at Emeryville.

Parkinson Tractor, Idaho gets Pioneer distributorship

Parkinson Tractor Co. of Idaho Falls, Idaho, will represent Pioneer Engineering Works, Inc., in Clark, Fremont, Butte, Jefferson, Madison, Teton, Bonneville, Bingham, Power, Bannock, Caribou, Oneida, Franklin and Bear Lake counties, Idaho. Feenaughty Machinery Co. of Boise continues to serve the Western and northern sections of the state with the exception of the county of Lemhi. Westmont Tractor and Equipment Co., Missoula, Mont., continues to serve Lemhi.

Rucker's new quarters

The Rucker Manufacturing Co., maker of hydraulic power and control systems, moved into larger quarters at 4516 Hollis St., Oakland, Calif., March 5. The new plant contains 12,000 sq. ft. and provides space for machine tools, welding, paint spray booth and assembly lines, etc. The firm makes Rucker fluid power systems. The Rucker Co., sales associate of the firm, remains at 4228 Hollis St.

Sterling in Denver

Sterling Electric Motors, Inc., Los Angeles, Calif., announces the opening of a new district office in Denver, Colo.,

and the appointment of James R. Hughes as district manager. The new Denver office will service the industrial, commercial and agricultural requirements for electric power drives in Colorado, New Mexico and part of Wyoming, Nebraska and Texas. The office is located at 1726 Champa St., Denver, Colo.

Westinghouse expansion complete

Completion of an expansion program at the Western headquarters plant of Westinghouse Electric Corp. in Sunnyvale, Calif., is announced by the firm. The program included the addition of three new buildings, costing \$600,000 and providing the firm with 1,162,000 sq. ft. of total floor space.

Brooks rejoins sales department at Bucyrus-Erie

After serving 17 months in the U. S. Army, R. P. Brooks is returning to his position as sales engineer with the Seattle, Wash. office of Bucyrus-Erie Co. Brooks was called back into the service as a Captain with the Corps of Engineers.

Straub appoints Universal Equip. as new B. C. distributor

Exclusive representative for Straub Manufacturing Co., Inc. in British Columbia, Alberta and The Yukon is Universal Equipment Co., 2015 W. 44th Ave., Vancouver, B. C. The firm will

distribute Straub's line of Kue-Ken jaw crushers, Kue-Ken gyratory crushers, Rib-cone ball mills and other crushing and mining machinery.

Coast Equipment Co. headquarters

Coast Equipment Co. is now located in new quarters at 444 8th St., San Francisco. The new location pictured below



gives the firm more than 1¼ acres of space with expanded parts and service departments. Lloyd E. Cole joins the sales staff of the company to cover the Fresno, Calif. area. Coast Equipment Co. handles the lines of American Hoist & Derrick Co., Chain Belt Co., W. E. Grace Mfg. Co., Joy Mfg. Co., Kohler Co., Lincoln Engineering Co., Pioneer Engineering Works, Thew Shovel Co., Vulcan Iron Works and Wellman Engineering Co.

Hines of Anderson-O'Brien heads GM diesel sales

Robert J. Hines, sales engineer of Anderson-O'Brien Co., 746 E. Washington Blvd., Los Angeles, Calif., has been named as the 1951 leader in GM diesel engine sales in the South Pacific zone by Detroit Diesel Engine Division General Motors. The South Pacific zone includes the states of Arizona, Nevada and California. Hines with zone win throughout the country will be honored March 13 at a banquet in Detroit will be presented with a ring and a diploma of merit by W. T. Crowe, Detroit Diesel's general manager.

Pioneer Rubber ups Jackson to S. F.

Harry T. Jackson, manager of Pioneer Rubber Mills' Los Angeles, Calif. branch for the past 11 years, is promoted to assistant general sales manager in San Francisco main office of the firm. William S. Long succeeds Jackson in Los Angeles.

Republic Supply sales meet



Pictured above, at the Republic Supply Co.'s sales convention in Los Angeles, Calif., are, l. to r.: Robert L. Temple, industrial sales manager; W. Dale Russell, p. and gen. sales mgr., and Robert Deshon, asst. gen. sales mgr. More than 50 salesmen attended the annual meeting.

Goodall Portland branch in new location

The Portland, Ore., branch of Goodall Rubber Co., formerly located at 1303 N.W. Kearney St., has taken new quarters at 1111 N.W. 16th Ave., Portland. Under the continued management of Jink Williams, this is one of five branch offices and warehouses handling the firm's line of rubber hose, belting, boots and clothing, etc.

Heil Equipment sales manager

Paul G. Glandville, former manager of General Truck Sales Co., San Francisco, is the new sales manager of Heil Equipment Co., San Francisco.

Exec. shifts at Consolidated Western

Consolidated Western Steel Division of the U. S. Steel Co. announces executive changes. P. M. Cobb, former vice president in charge of sales for San Francisco, Calif., district is now vice president in charge of sales. R. W. Seely, vice president located at

"COMMERCIAL" STEEL TUNNEL SUPPORTS



To build for permanency use COMMERCIAL STEEL SUPPORTS

For permanent stability in any kind of ground, you'll find **COMMERCIAL Tunnel Supports** are stronger and last longer . . . Your future tunnel projects will benefit materially—both in lower cost and faster schedules with **COMMERCIAL** supports . . . These easy to install supports are available in every size and radii for every job . . . Details upon request.

THE COMMERCIAL SHEARING AND STAMPING CO.
YOUNGSTOWN 1, OHIO

wood plant is now vice president assistant to the president with division-wide responsibility for engineering, planning, industrial relations, etc.

Union opens new parts warehouse in Phoenix

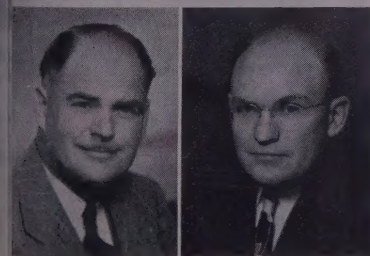
Marion Power Shovel Co. is opening a new parts warehouse to serve Arizona, California, Nevada and western New Mexico. Located at 1017 North 22nd Ave.,



Phoenix, the building measures 40 x 80 ft. and is of pumice block construction. It is located on a 50 x 200-ft. lot paved with blacktop at the front, side and rear of the building. A front entrance accommodates two-ton trucks and large vans admitted in the rear. Hal A. Fisher, manager of the new facilities. Ernest Riggs, Jr., district manager, will also maintain offices at the new location.

Interstate Tractor & Equipment personnel changes

Wyrle H. Hunter, vice president in charge of the Portland, Ore., store of Interstate Tractor and Equipment Co.,



Hunter

McNeill



Holmes

Zanon

has been named to the position of executive vice president. Thomas McNeill, Salem, Ore., store manager, who became vice president and director last April, replaces Hunter as Portland store manager. E. F. Holmes, Longview store manager, takes over management of the Salem store, and Louis A. Zanon moves to the managership of the Longview store.

NEWS of MANUFACTURERS

New Lull Mfg. Co. plant

Lull Manufacturing Co. announces that it now occupies a new plant at 314 W. 90th St., Minneapolis 20, Minn.

Columbia-Geneva Steel sets new Western sales area

Establishment of a new sales district, with headquarters in Denver, Colo., is announced by Columbia-Geneva Steel Division of U. S. Steel Co. Colorado, Montana, New Mexico and Wyoming. Herbert E. Fryer is manager of sales for the new district.

Change in U. S. Steel district supervisors in West

James L. Craddock is now district supervisor of the Pacific Coast and Rocky Mountain Audit District of United States Steel Co. He replaces John T. S. Byrne, who is promoted to the position of district supervisor of the Pittsburgh, Pa., steel producing district.

Chairman of Contractors Pump Bureau named at meet

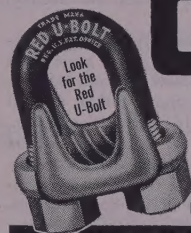
R. D. Houghton was named chairman of the Board of Directors of the Contractors Pump Bureau, an affiliation of the Associated General Contractors of

Riggers PLAY IT SAFE on "high wire" jobs!



... that's why they demand **GENUINE**

CROSBY CLIPS



Drop-forged, hot-dip galvanized wire rope fasteners
SIZES FOR 1/4" TO 3" WIRE ROPE
DISTRIBUTORS EVERYWHERE

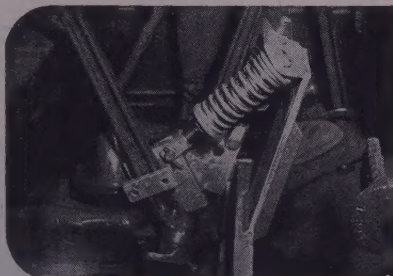
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Step-up manpower efficiency and save **TIME** and **MONEY** with Silver Steering Boosters. This cleverly engineered attachment reduces the required pull on clutch steering levers from 125 pounds to less than 15 pounds! It permits the opening of

clutches "full travel." It also reduces slipping of clutches and increases the life of brakes by eliminating their excessive wear.

Equip your tractor now! with Silver Steering Boosters . . . for increased life and greater operating efficiency.



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COMPLETE YOUR TRACTORS

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Silver Steering Boosters are easily installed by any mechanic in 30 minutes. No difficult adjustments and no alterations to be made on your tractor.

Easily Operated . . .

Powerful springs and absolute mechanical operation reduce operator fatigue to a minimum.

Installed In 30 Minutes
... no adjustments or alterations necessary

WITH SILVER STEERING BOOSTERS

Silver Booster MANUFACTURING COMPANY
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NEW ZEALAND GOVERNMENT MINISTRY OF WORKS ROXBURGH HYDRO-ELECTRIC POWER PROJECT

COMPLETION OF CONSTRUCTION OF DAM,
SPILLWAY, POWER HOUSE AND OTHER
ASSOCIATED WORKS

It is desired to engage a civil engineering contracting firm to complete construction of the Roxburgh Project.

The work is of considerable magnitude and tenders will be considered only from contractors of world-wide reputation in this class of work.

Formal tender documents will be available to interested contractors from the Secretary, Tenders Board, Ministry of Works, Box 8015, Government Buildings, Wellington, New Zealand, towards the end of April, 1952.

Tenders will close with the Secretary of the Tenders Board at 4 p. m. on Tuesday, 24th June, 1952.

Copies of a preliminary statement describing the main features of the project are available now at the New Zealand Government Trade Commissioner's Office, Dupont Circle Building, 1346 Connecticut Ave., N.W., Washington 6, D. C., and also at the New Zealand Government Travel Commissioner's Office, 153 Kearny St., San Francisco, California. This preliminary information is given now so that contractors desiring to submit tenders may make early arrangements to visit the site and gain an appreciation of local conditions.

Applications from bona fide contractors for formal documents to be despatched to them as soon as they are available for issue should be made to the Secretary of the Tenders Board at the above address.

ENGINEERS

Attractive opportunities for Mechanical, Electrical, and Structural Engineers with design experience on heavy industrial projects.

write

Bechtel Corporation

Dept. C, 220 Bush Street
San Francisco, California

POWER PLANT ENGINEERS...

We Offer You

1. A substantial staff position with an outstanding construction and engineering firm nearly 50 years standing, located in New York.
2. A salary in line with your experience and ability.
3. An opportunity to advance.
4. A liberal employee benefit program.

Are you qualified to fill one of the positions listed below?

• CONSTRUCTION SUPERINTENDENTS

Must have considerable recent experience in steam-electric or hydro power plant construction and be thoroughly qualified to direct work, prepare construction reports and specifications for subcontracts. Graduate engineers preferred.

• STRUCTURAL ENGINEERS

Graduate engineers specializing in design and construction of power plant and industrial structures. Must be thoroughly experienced in all phases of structural design, correlated with architectural design; planning, assignment of work, writing of specifications and requisitioning of materials. Applicants should have field and office structural experience.

• MECHANICAL ENGINEERS

Graduate engineers experienced in plant design, economic studies, specification work, report writing and heat balance studies of modern utility power plants. Must have ability to supervise engineering staff.

Send Resume to Dept. 2-D, P. O. Box 226, Church Street Station
New York 8, N. Y.

America. Houghton is president of the Rice Pump and Machine Co. The Bureau establishes and maintains technical standards subscribed to by fourteen manufacturing members.

Blaw-Knox's Lehman retires

Chester H. Lehman, identified with Blaw-Knox for over 12 years announces his retirement as executive vice president. He will continue as a director and vice chairman of the board.

New LeRoi Co. president

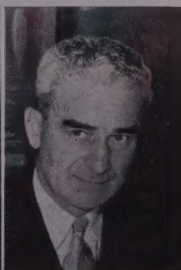
T. O. Liebscher is the new president of LeRoi Co., gas and gasoline engine manufacturers. Liebscher has been with the firm 11 years. He was formerly executive vice president.

Koehring's new chiefs

J. R. Steelman is the new president, and E. A. Brugger vice president and general manager of Koehring Co. Steelman succeeds G. E. Long who will re-



Brugger



Steelman

main as chairman of the board of directors. Both men have served with the firm for many years.

B-L-H names Ehrgott assistant vice president

The appointment of Paul R. Ehrgott as assistant to the resident vice president of Baldwin-Lima-Hamilton Corp. announced by the firm. Ehrgott will serve as sales manager in charge of sales of shovels of 3 yd. capacity and larger. J. W. Hardesty is appointed manager of small shovels and cranes.

Allis-Chalmers expansion

Board of directors of Allis-Chalmers Manufacturing Co. has granted \$2,000,000 for increased facilities and

FOR SALE

1,000 gal. capacity Oil Distributor
with full circulating boom and extensions up
to 12 feet. Price \$1,500.00 complete.

1,000 gal. capacity Oil Distributor
with full circulating boom and extensions up
to 12 feet. Price \$1,500.00 complete.

Heating retort complete with Dean Bros.
4 x 6 steam pump. Price \$1,250.00.

H.P. Farquhar Boiler complete with Oil
burner and national generator, 32 volt ca-
pacity for lights. Price \$850.00.

One-half yard Link-Belt Speeder Shovel.
Price \$3,750.00

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Complete New Paving Outfit including
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delivered New from factory summer and
fall of 1951 and is not War Surplus.
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get a job, fill a position, buy or sell a
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equipment, try and ad in this space. Rates
reasonable. Results surprising. Write Classi-
fied Dept., WESTERN CONSTRUCTION, 609
Mission Street, San Francisco 5, Calif.

Angfield, Ill., works, Tractor Divi-
sion. More than 300,000 sq. ft. of manu-
facturing floor space, and the necessary
machine tools for increased production
crawler tractors, motor graders, and

Huge Kaiser pig iron expansion

A \$65,000,000 expansion program
that will increase Kaiser Steel Corp.'s
pig iron output by 50% and raise
steel ingot production by more than
1% is announced. Principal facilities
in Kaiser Steel's latest move to boost
Fontana, Calif., metal output are: A
third blast furnace to smelt 438,000
tons of pig iron per year; a ninth
open hearth steel making furnace to
add 156,000 tons of steel ingots an-
nually; ninety additional by-product
blast ovens to turn out 408,000 tons
of coke annually; two additional
stands in the present hot strip mill
and major additions to equipment
and housing at company-owned iron
ore and coal mines. The blast furnace
major facility in the program—is
scheduled for completion in the
spring of 1953.

STOP that WATER

WITH FORMULA NO. 640. A clear liquid which penetrates 1"
or more into concrete, brick, stucco, etc., seals—holds 1250
lbs. per sq. ft. hydrostatic pressure. Cuts costs: Applies quickly
—no mixing—no cleanup—no furring—no membranes. Write for
technical data—free sample. Haynes Products Co., Omaha, Neb.

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48 Pieces, 70 feet long
Section II new (deep arch)

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D-8 Caterpillar, Serial No. 1H-8803-SP with:
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Hyster D8N towing winch,
Isaacson straight blade cable dozer.

D-8 Caterpillar, Serial No. 8R8876 with:
Model R-1-S-8 Isaacson straight
blade cable dozer,
Hyster winch HRN.

DULIEN STEEL PRODUCTS, INC. of Washington

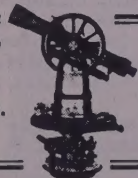
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- 1—#95 Diamond Portable Crushing and
Screening Plant with Feeder Conveyor
and Hopper.
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- 1—27 C.Y. Jackleg Bin.
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- 200' 24" Pioneer Conveyor.

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repair parts will be included in the pro-
gram.

Simpson Logging spurs national hardboard promotion



Miller

Simpson Logging
Co., Seattle, Wash.,
plans national sales
and promotion of a
new hardboard, All-
wood, manufactured
by Oregon Lumber
Co. The entire pro-
duction of the hard-
board will be sold
through the Simp-
son organization.
Robert T. Miller
heads the newly
formed Simpson
hardboard department. Miller comes to
Simpson with 25 years of experience
with Masonite Corp.

2

FOR SALE

NEW GENERAL MOTORS, DIESEL GENER- ATORS . . . 60 kw., 440 or 220

volt, 60 cycle. These generators
are mounted on skids in original
crates. Have 90 hp., model 60438
General Motors engines and 60
kw. General Electric Generators,
complete with voltage and amper-
age switchboard. Attractive Price

—Contact—

Coast Manufacturing & Supply Company

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PIONEER SCREENING PLANT

CONSISTING OF

- ONE (1) PIONEER 30' x 50' Portable Con-
veyor complete with Belt mounted
on Hydraulic Cradle Truck with
Tumbler Shaft Drive, with Tail
Shaft extended for driving Feeder.
- ONE (1) PIONEER 4' x 12' Vibrating
Screen, two-deck with 3" square
openings.
- ONE (1) Bin Mounting.
- ONE (1) Motor Mounting.
- ONE (1) V-Belt Drive.
- ONE (1) Model 30R Rock Feeder complete
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- ONE (1) 21 Yard Steel Bin on Rigid Legs.
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- ONE (1) Sloping Grizzly with 8" spacing.
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This plant has screened less than 30,000
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BOTTOM DUMP WAGONS

MARTIN GREEN

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facturing for Trailmobile, Inc., is the
newly appointed eastern vice president
of the Truck Trailer Manufacturers' As-
sociation.

Columbia Steel asst. v. p.

Robert B. Freeman is promoted to the
position of vice president in charge of
operations, Columbia-Geneva Steel Di-
vision, U. S. Steel Co. Charles H. Fitz-
wilson succeeds Freeman as chief metal-
lurgical engineer.

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Practical, Down-to-Earth Welding Rods
Alloys as they are supposed to be

Corrosion Resistant—
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