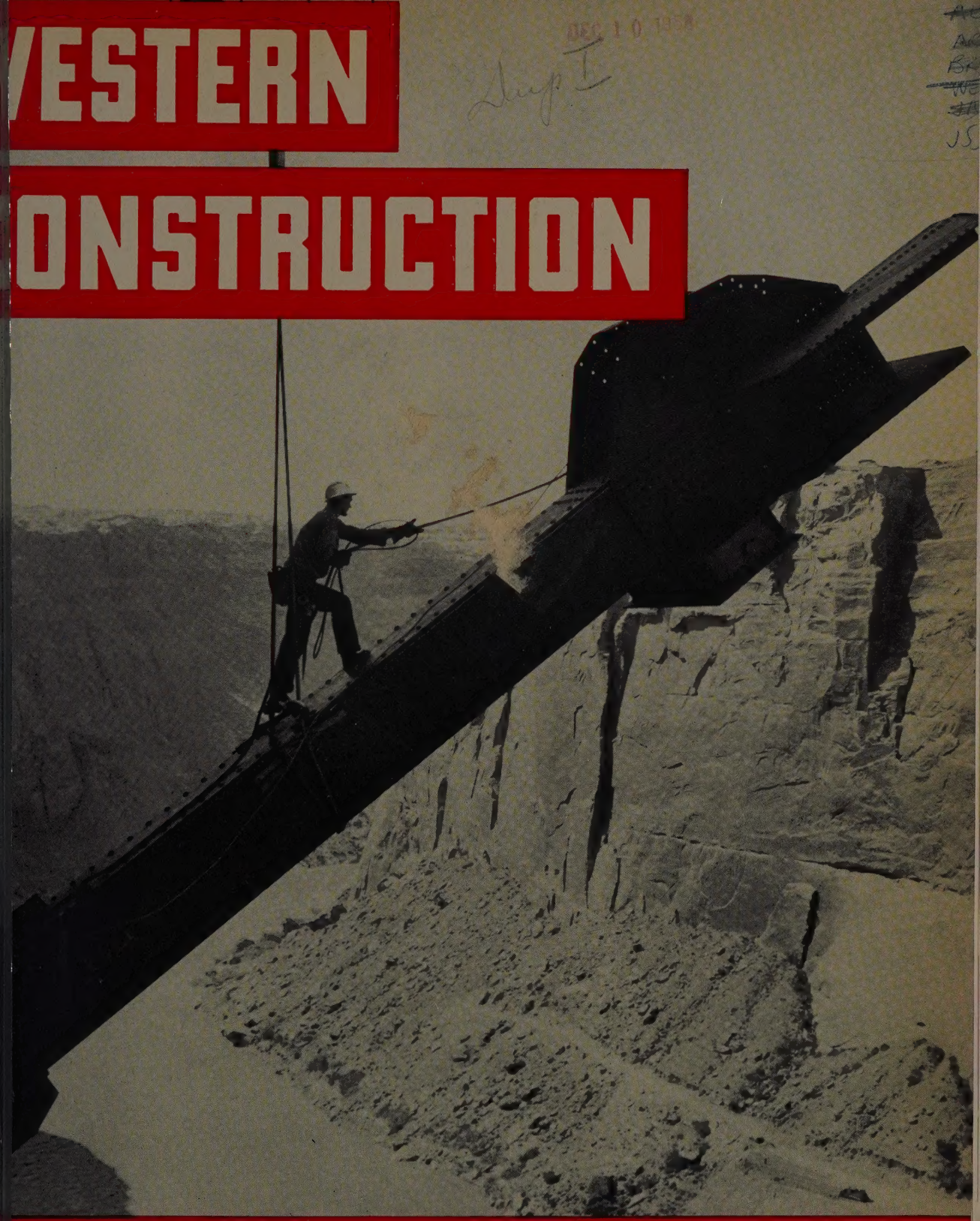
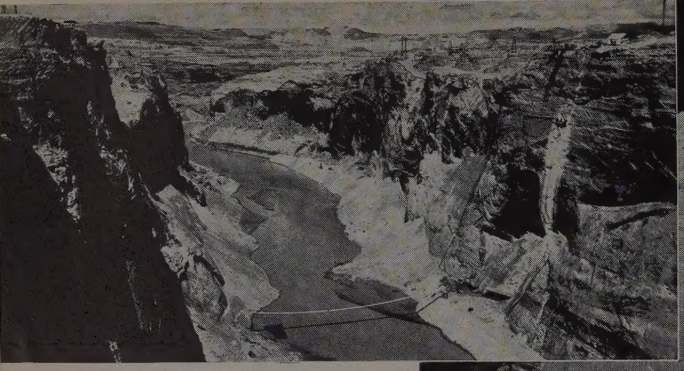
VESTERN CONSTRUCTION

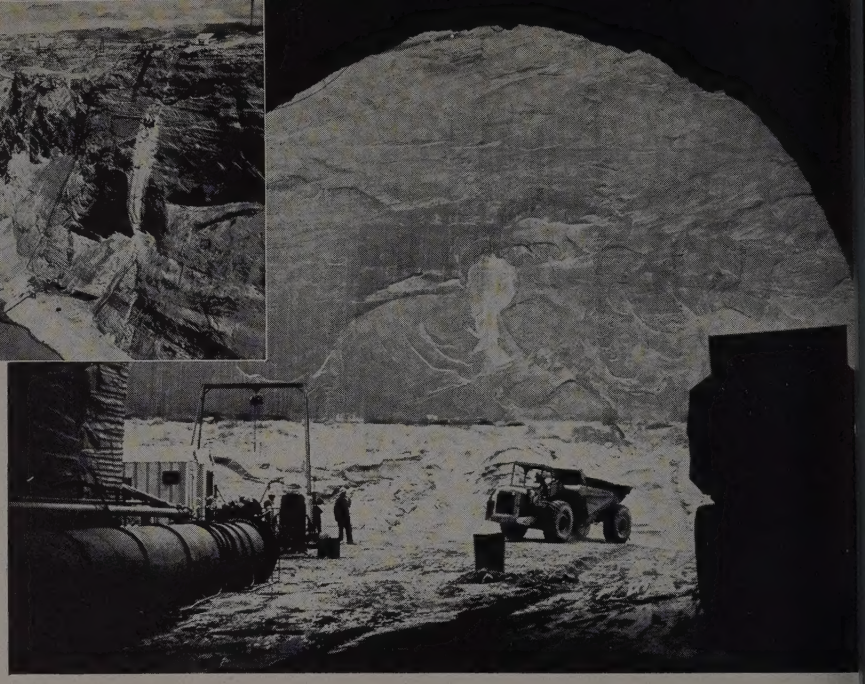


DECEMBER 1958

GLEN CANYON DAM ISSUE

A special 23-page report on all phases of current operations





SECOND LARGEST DAM IN THE U.S., at Glen Canyon, Ariz., will incorporate two of these 2,800 ft. diversion tunnels. Frazier-Davis equipment runs dependably, stays on the job, thanks to the Texaco Simplified Lubrication Plan.

Glen Canyon tunnel borings nearing completion with Texaco Plan

Only 6 lubes needed to keep Frazier-Davis equipment working dependably

This is Frazier-Davis Construction Company's job: to bore the east side diversion and service tunnels, with a combined length of 2½ miles, through the walls of Arizona's Glen Canyon. It's a vital project, part of the Bureau of Reclamation's $760 million development of 10,000 square miles of arid land. On a job as big as the Glen Canyon Dam, on-time completion of every phase is absolutely essential. And that puts a priority on dependable equipment performance.

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Texaco Regal Oil R&O—prevents formation of rust and harmful deposits in compressor systems.

Texaco Universal Gear Lubricant EP—keeps differentials and transmissions running smoothly at low cost.

Texaco Marfak Multi-Purpose 2—protects wheel bearings, chassis, water pumps against dust, moisture and wear.

Texaco Track Roll Lubricant—prolongs the life of crawler mechanisms.

Texaco Rock Drill Lubricant—guards against wear and rust whether drills are running or idle.

Ask a Texaco Lubrication Engineer to help you simplify your lubrication problems and reduce costs. Just call the nearest of the more than 2,000 Texaco Distributing Plants in the 48 States, or write The Texas Company, 135 East 42nd Street, New York 17, N. Y.

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(PARTS, INVENTORY, PRODUCTION, DOWNTIME, MAINTENANCE)

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WESTERN CONSTRUCTION

KING PUBLICATION

December
1958
Vol. 33 No. 12

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GATHERING TOGETHER the information presented in this issue required months of editorial effort, including a week spent at the job site by *Western Construction's* Managing Editor, Bob Byrne. The articles could not have been prepared without the generous cooperation of the U.S. Bureau of Reclamation, Merritt-Chapman & Scott Corp., Kiewit—Judson Pacific-Murphy Corp., and various subcontractors. Over 2,500 photographs were studied before selecting those shown here.

The combination of authoritative articles by key construction personnel with field reports by our own staff has resulted in a project profile of unusual completeness.

FRONT COVER*—A steelworker walks up the first piece of steel set for the arch of the Colorado River Bridge, the nation's highest arch bridge. Key to erection was an unusual "tilting tower" cableway.** ***Photo by Frank Jensen

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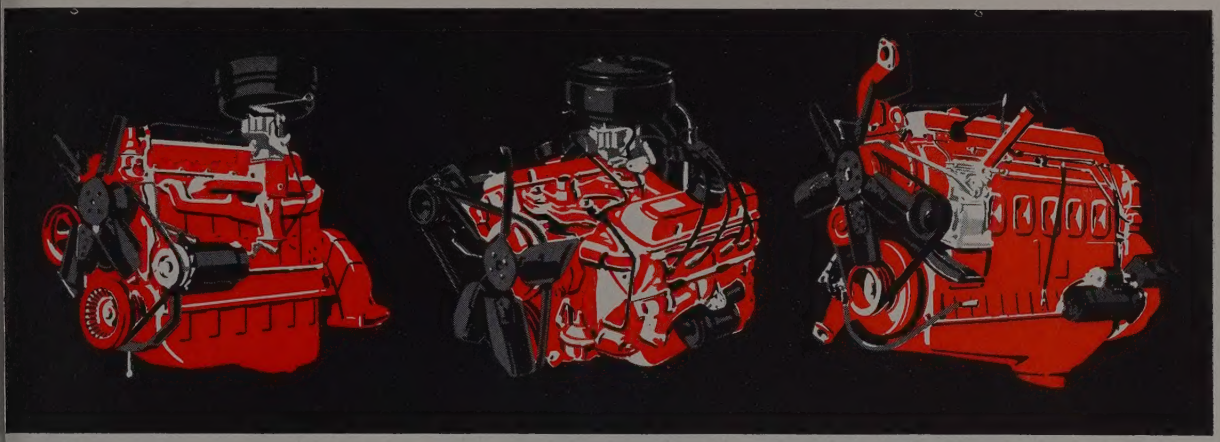

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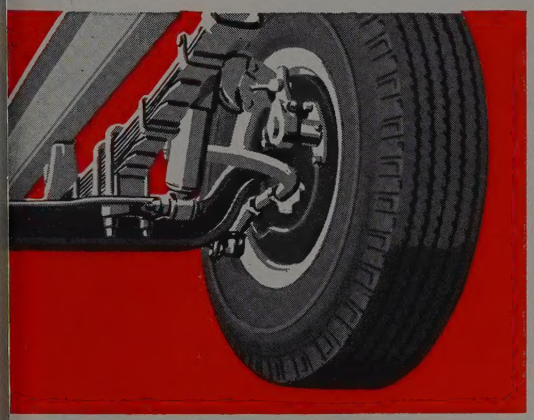
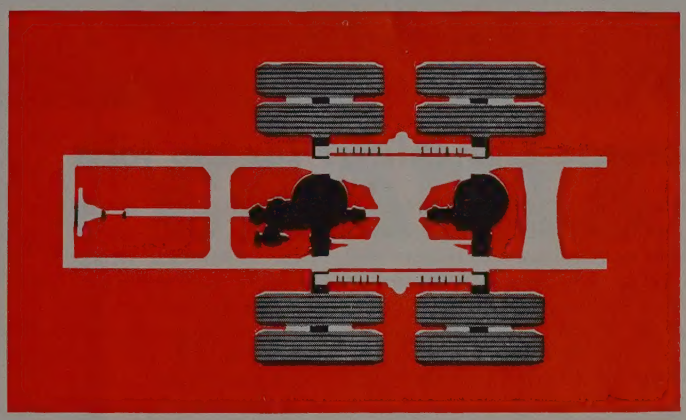
You have the finest selection of top-efficiency gasoline and diesel engines—all designed to get maximum payload there on time with less engine wear and tear. For example, a GMC pickup with standard 3.07 fast ratio cruising axle runs at 623 revolutions less per mile. It provides overdrive performance at no extra cost—yet gets there just as fast with far less strain on valves, pistons and bearings.





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NEW EQUIPMENT

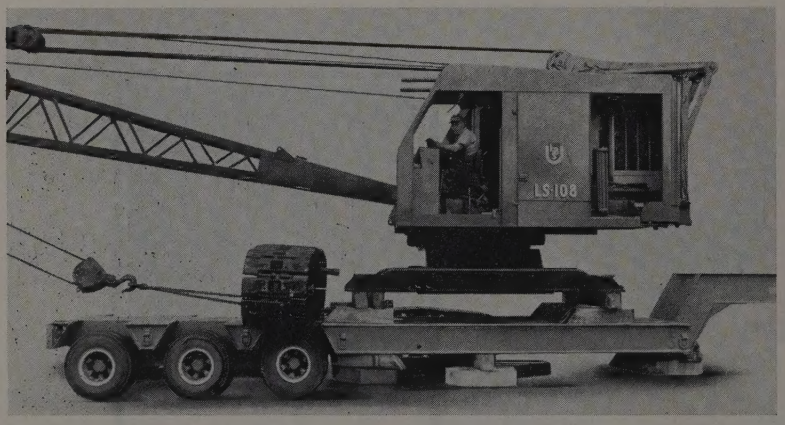
Obtain more information on these new developments in construction equipment by circling the corresponding numbers on reply postcard.

Parsons Trenchliner for big jobs

The Parsons 420 Trenchliner, designed especially for pipeliners who must handle cross-country and other big trenching jobs, is now in production by **Parsons Co.** Giant digging wheel has three speeds, 115, 215 and 300 ft. per min. A multiplicity of digging speeds range from 15 in. to 25 ft. per min. Double-action hydraulic rams actuate the wheel for roading and grading.

Bucket widths are 36, 42, and 48 in. Optional sidecutters increase trench widths to 40, 46, and 52 in. Maximum depth of trench is 7½ ft. Hydraulically driven, 36-in. conveyor belt is reversible.

Weighing approximately 42,000 lb., the 420 has traveling speeds, ranging from 1 to 2.5 mph. Power is obtained from a 120-hp., 1,500-rpm. International Harvester diesel engine; Caterpillar diesel engine is optional. . . . ***Circle No. 151***



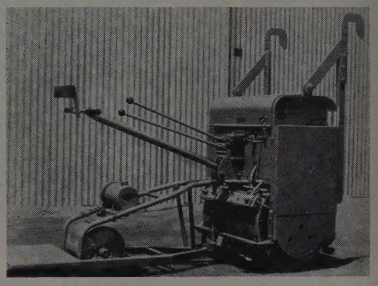
40-ton crane strips in 2 hr.

A new, 40-ton crawler machine that lifts and walks with more than its own weight is now offered by **Link-Belt Speeder Corp.** For fast, job-to-job transport, it can be stripped down to an 8-ft. width and approximately 32,000 lb. within 2 hr.

With a crawler base that is 15 ft. long and over 14 ft. wide (with 42-in. shoes), the new LS-108 has a spread-eagle stance that gives it exceptional stability. It offers as standard equipment, Speed-o-Matic power hydraulic controls, two-speed travel in either direction with hydraulic power steering, independent rapid boomhoist and retractable high gantry that also removes the counterweight under power. Optionals include such benefits as reversing clutches for either or both main drums, third drum, hydraulic controlled swing brake, engines with torque converters and elevated cab. . . . ***Circle No. 152***

Rides the vibrating roller

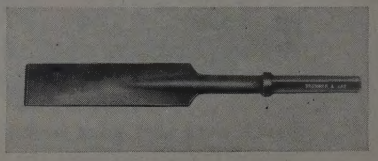
An attachment is now available which makes a ridable unit out of the vibrating roller of **Essick Manufacturing Co.** This is



the VR-28W roller and the new attachment allows the operator to control the machine while riding. From the 16 x 24-in. platform, the operator has all controls in convenient positions. The attachment is light weight and can be added by one man, requiring no tools to connect or disconnect. . . . ***Circle No. 153***

Frozen ground and soft rock

The long heat-treated blade of the **Brunner & Lay** digging chisel is particularly suited for use in fro-



zen ground and in cutting soft rocks such as shale. The tool is available in three shank sizes of 1, 1⅛, and 1¼ in. Blade size of the smaller tool is 3 x 10 in. and the others are 3 x 12 in. . . . ***Circle No. 154***

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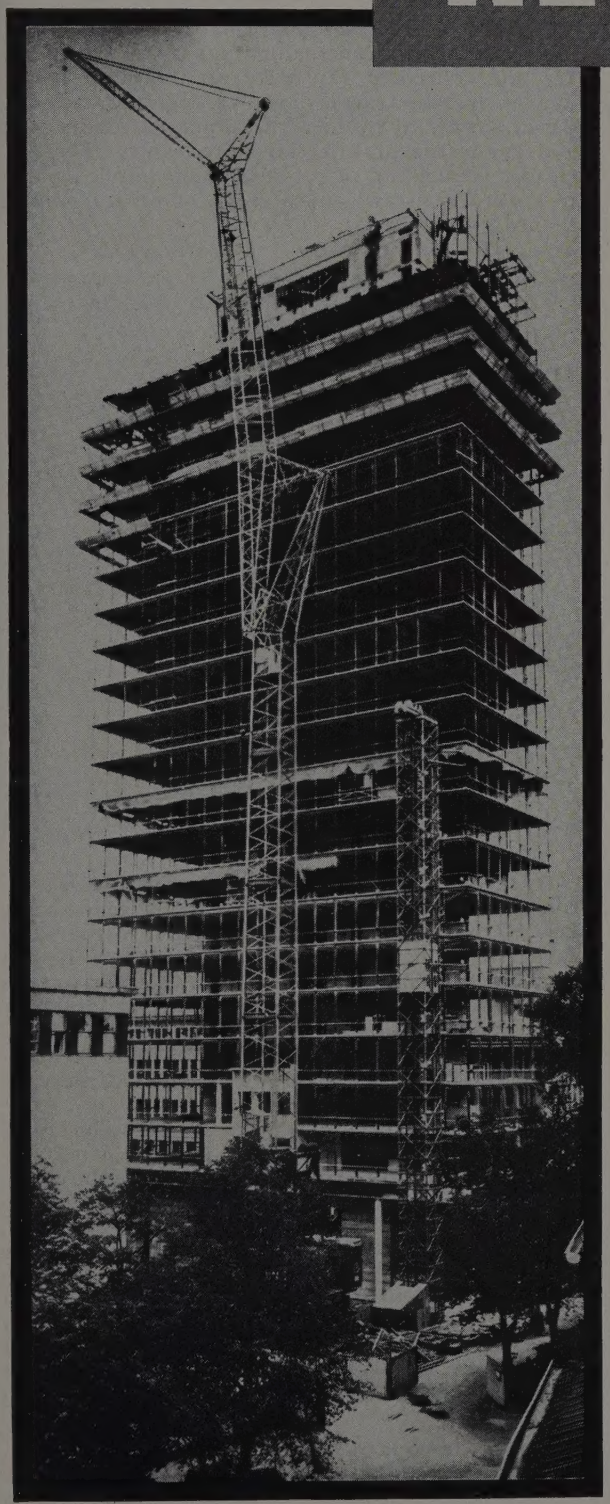

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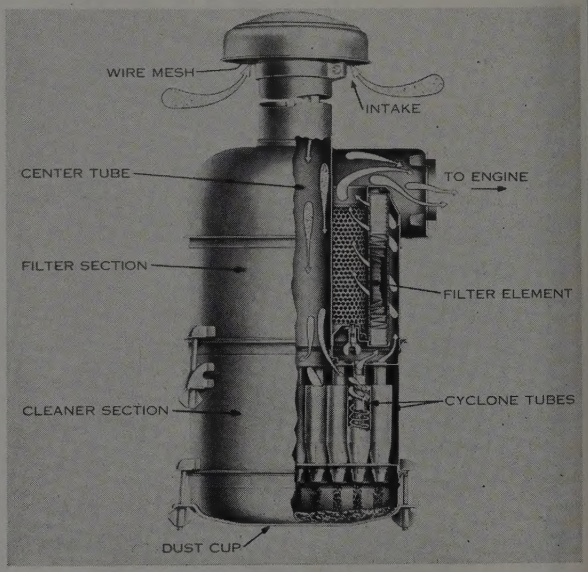
... for more details, circle No. 14 on Reader Service Postcard

Dry air filter developed for Cat DW's

A new dry type air cleaner of unparalleled efficiency and simplicity has been developed for use on Cat DW20 and DW21 Tractors, according to an announcement by **Caterpillar Tractor Co.** Proven through extensive testing on land clearing and construction, the cleaner removes 99.8% of all dirt from the diesel's intake air. It is fully effective at any engine speed and is designed to speed servicing and reduce maintenance.

A disposable resin impregnated cellulose filter, multi-cyclone precleaner, aluminum center tube, housing and collecting tray make up the cleaner unit. During operation, air is drawn through the stack cap, passes downward through the aluminum center tube and enters the multi-cyclone precleaner. The precleaner is made up of two aluminum spirals (similar to a spiral staircase) and a group of vertical, funnel shaped nylon tubes.



As the air enters the spirals it begins to swirl, setting up a centrifugal action. The dirt particles, being heavier than air, are forced to drop out of the nylon tubes into the collecting tray. About 95% of the dirt particles are removed at this point. Air then travels upward through small aluminum tubes set inside the nylon funnel sections to the resin impregnated cellulose filter element. The element removes the remainder of the dirt and the clean air is directed into the intake manifold of the diesel engine.

The dry type air cleaner is designed to reduce time required for maintenance. Moreover, the cost of replacement elements is considerably less than the cumulative cost of oil and man-hours necessary for servicing oil bath types.

The new units also eliminate the danger of engine damage resulting from infrequent servicing. When the paper element becomes plugged, the engine will lose power and begin to smoke. This visual warning acts as an automatic reminder that the cleaner must be serviced, and offers positive protection against carryover of dirt into the engine. . . . *Circle No. 155*

(Turn to page 98 for more New Equipment. New Literature can be found on page 96.)

Passing the Word to Contractors

SOMETIMES it is necessary for an interested third party to "pass the word". Contractors of these Western states should be told that construction equipment distributors are going to tighten up on the financing of sales. The need has been pointed out again and again through surveys conducted by the Associated Equipment Distributors, and reinforced by urgings from banks and financial houses.

What might appear to be a selfish move on the part of equipment distributors will be good for the entire construction industry. First, it will result in distributors capable of supplying better service to contractors and customers. Second, it will tend to make it more difficult for unqualified persons to get into contracting and the unsuccessful ones to remain as a disturbing factor. Lastly, the resulting rise in contracting standards will provide engineers with better bidders.

The construction equipment distributor represents the key in this chain reaction. His financing fantasies have resulted from: (1) strenuous competition within distributor ranks, (2) rapid obsolescence of construction equipment, and (3) the ever increasing millstone of trade-ins.

Competition among distributors, as in all forms of business, tends to progress toward "anything for a sale" attitude. This has its parallel in the contractor who bids without profit merely to keep his organization intact. Both lead to business suicide. Groups of AED members have been told in the past with repeated recent emphasis that they have been remarkably ingenious in developing means for securing sales by the shakiest of financial arrangements. Financing schemes are varied, fancy, and lacking in sound business judgement.

The rapid advance in the development of construction equipment enters the picture at this point. Improvements come so fast that contractors with older fleets are placed at a distinct disadvantage in bidding new jobs. They are eager for the economy they can secure from new machines to put them back in a competitive position. On the other hand, the trade-in value goes down as fast as the improvements go up. Adequate maintenance of the older units is not enough; care of machines will assure their efficiency, but obsolescence creeps up. Even successful contractors and old customers are frequently caught in this position and turn to distributors for newer machines, without the trade-in value or sufficient cash to swing a legitimate deal. At this point the distributor remembers the competition down the street and develops a payment program which can be rationalized as being reasonable, and adds to his inventory of trade-ins filling the back yard.

There is a tendency among distributors to complain about this trade-in or used equipment problem. Much as the distributor would like to have contractors and manufacturers assist in financing the disposal of junk this is probably a forlorn hope. The problem is one that distributors must meet without much assistance.

The selling of equipment must return to the level of reasonable profit for distributors. The result can and will improve their service to the users of equipment, and tend to prequalify contractors. The construction industry will then have bidders who will execute work efficiently and at lower costs.

The start in this logical sequence remains with the distributors and this is to inform Western contractors that they must be prepared for a new and more realistic attitude from the sellers of construction equipment.

Jim Ballard

Vernon (Stub) Faber doing a rough grading operation on a highway widening project inside the city limits of Milwaukee, Wis. The machine is an Austin-Western Super 99 with 6-wheel drive and 6-wheel steer.

"I've operated every make of grader and this A-W Super 99 outperforms them all"

says Vernon (Stub) Faber

As a "boomer" grader operator, Vernon (Stub) Faber has spent the past 16 years on construction jobs all over the country. He has run every make of grader under almost every conceivable operating condition. There isn't much he doesn't know about graders.

Here's what Stub Faber has to say about the A-W Super 99: "I've operated every make of grader, and this A-W Super 99 outperforms them all. It's maneuverable, and you can see everything from an Austin-Western—this is very important for finish grading. The A-W actually speeds up a grading operation because it does not have to slow down for the grading of intersections. I like the A-W for slope grading, too. With the hydraulically controlled blade, you don't have to leave your seat to change the blade, and the all-wheel steer gives you a good grip on the slope."

Preference for A-W graders is the rule, rather than the exception, among the contractors and experienced operators who know them best. They know that you can take an A-W more places, do more jobs, move more dirt, and handle it more easily than any competitive machine. The answer is A-W years-ahead design. Find out more about it. Write today for free booklet.

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WESTERN CONSTRUCTION

DECEMBER 1958

AN ARTIST'S CONCEPTION OF THE HUGE BUREAU OF RECLAMATION PROJECT AFTER COMPLETION IN 1962

Glen Canyon Dam Issue—*a foreword*

IN THE REMOTE reaches of northern Arizona and southern Utah, a few miles south of the point where the Colorado River slices across the border, is Glen Canyon. Here the river, silt-laden and unpredictable, has carved a twisting, 800-ft. deep gorge through the pink sandstone, as if warming up for the big effort downstream at Grand Canyon.

This sun-baked and forbidding land, for untold centuries inhabited only by the Navajo Indian, is the scene for the latest and largest challenge to the constructive forces of men.

The parched plateau, the river banks, even the brilliantly colored canyon walls, are swarming with silver-helmeted construction men and the mighty machines which are their tools. Explosions shatter the desert silence, entire towns are being built, tendons of glistening steel split the sky and connect the facing canyon walls.

The Glen Canyon Dam Project is rapidly taking shape. Keystone of the Bureau of Reclamation's vast Upper Colorado River Storage Project, it follows in the tradition of such historic dams as Hoover, Grand Coulee, and Shasta.

It will tower well over 700 ft. above bedrock, and will contain nearly 5,000,000 cu. yd. of carefully controlled concrete. A reservoir 186 mi. long will be created, profoundly altering the character of the arid wasteland. The 900,000-kw. power plant will infuse the region with new vitality.

Wide highways join the once isolated project to cities to the south and west; more roads are on the drawing boards. A new field of economic and recreational opportunity is being opened up to the American people.

Because the work at Glen Canyon typifies the drama and scope of Western heavy construction developments, and because the project is a proving ground for new methods and equipment, we offer to the construction industry of the West this special report on the nation's largest single job.

Previous articles in Western Construction

Aug. 1956—Review of Upper Colorado River Storage Project
Feb. 1957—Pre-bid look at Glen Canyon by L. N. McClellan, Chief Engineer, Bureau of Reclamation
June 1957—Unit bids, Glen Canyon Dam
July 1957—Diversion tunnel
Nov. 1957—Access roads
Feb. 1958—Constructing Page, Ariz., by M. E. Trenam, Chief Construction Engineer, Bureau of Reclamation
March 1958—Suspension footbridge
July 1958—Aggregate exploration
July 1958—Cableways
Sept. 1958—Heavy media gravel plant
Oct. 1958—Completing access roads

A review of construction progress

Construction activity at huge project in remote location moves toward river diversion in February and concreting in November of 1959. Bureau of Reclamation builds a new community in Arizona.

By L. F. WYLIE
Project Construction Engineer
Glen Canyon Unit
Region 4
Bureau of Reclamation

CONSTRUCTION of the Glen Canyon Unit of the Colorado River Storage Project began on July 1, 1956, with assignment of a nucleus of personnel to the Bureau of Reclamation office located temporarily at Kanab, Utah. The site of the dam, on the Colorado River about 75 mi. east of Kanab, was one of the most isolated areas in the nation. No roads to the area existed and access by Jeep was extremely difficult. The nearest railhead is at Flagstaff, Ariz., 135 mi. to the south.

The most urgent initial problem was that of access, to permit delivery of materials to the site. This problem was initially solved by construction of temporary roads, pioneered through the desert to both sides of the river, followed by construction of temporary airstrips on each side of the river, providing ready access to the site and a means of crossing the canyon to engineers, surveyors and prospective bidders. Contracts were awarded for a permanent alternate U.S. Highway No. 89 from Bitter Springs, Ariz., crossing a steel arch bridge at the dam site, and continuing to Kanab, Utah. This work was shared by the states of Arizona and Utah and the U.S. Bureaus of Reclamation and Public Roads. All except the bridge are now completed and are in use. The bridge is scheduled for completion in January 1959. A permanent airport, suitable for use by commercial aircraft, is in operation.

Immediately following authorization, work was begun on drilling at the dam site to complete geological data required for design work, on water analysis, and on plans for the new town of Page to house construction workers. Preparation of designs and specifications for the dam and power plant was accelerated.

Since early diversion of the river to permit work on the river bed was essential, a contract was awarded on Oct. 1, 1956, to Mountain States Construction Co. for drilling the right diversion tunnel. This contract has been completed.

On Apr. 29, 1957, award was made to Merritt-Chapman & Scott Corp. of the prime contract in the amount of $107,955,522, the largest single construction contract in the history of the Bureau of Reclamation. This contract provides for diversion of the river and construction of the dam, power plant structure, and switchyard area. It is scheduled for completion by Mar. 6, 1964. Installation of equipment will be accomplished under a future contract.

To date, the prime contract is approximately 25% complete. The right diversion tunnel, 2,740 ft. in length, is nearly completed. It will handle the initial diversion of the river on closure of the cofferdams, scheduled for February 1959, before the spring run-off begins. The left diversion tunnel, which is approximately 2,900 ft. long and about 34 ft. higher in elevation than the right tunnel, has been drilled through. Work on the twin spillways is well under way. Since these tunnels incline downward and connect with the diversion tunnels, it is important that they be completed as far as possible before diversion of the river. After diversion, material from the spillway tunnels will have to be taken out through the top. All diversion and spillway tunnels will be concrete lined. Excavation above the water-level of the keyways for the dam is progressing rapidly; they have now been cut down about 400 ft., or approximately half of the estimated total depth of 800 ft. from the canyon rim to bedrock under the river.

The prime contractor has also completed a roadway tunnel from the canyon rim to the power plant area near the toe of the dam. This tunnel, approximately 10,000 ft. in length, will be used for access to the construction area at river level and for servicing the power plant

PAGE, ARIZONA, is located about 2 mi. from the dam site and will be the home of the engineering and construction forces for the next few years. It will eventually be the permanent residence of the operating personnel. The prime contractor has built a 25-bed hospital.

after construction. At present, all materials and personnel are being lowered to the bottom of the canyon by means of cableways and elevators or "monkey-slides". The contractor has also completed a small tunnel from the switchyard area on the right rim down to the power plant area, to be used for control cables.

In preparation for the placement of massive concrete, estimated at about 5,000,000 cu. yd., great emphasis has been given to studies of aggregate sources and composition of concrete. The only good source of aggregate which has been found near the dam site is on Wahweap Creek, 5½ mi. from the site. The prime contractor has pilot screening and light and heavy media separation plants in operation at the site of the deposit. These are being used at present to supply aggregate for tunnel lining. Larger plants will be built to produce material for the dam. The present light and heavy media separation plant consists of two units. The first removes lightweight material from screened aggregate of No. 4 to 1½-in. size, and the second unit separates lightweight material from No. 8 to No. 4 material. The processed material is trucked to permanent stockpiles near the dam site.

The contractor has a small concrete mixing plant in operation now and will construct a large plant during 1959, with six 4-yd. mixers, for supplying the mass of concrete. The first concrete placement in the dam is scheduled for November 1959. A contract for 3,000,000 barrels of cement was awarded to the American Cement Corp. on Apr. 3, 1958.

Pozzolanic material will be included in the concrete mix to improve the quality and reduce the amount of cement required. Approximately 220,000 tons of pozzolan will be required, under a contract awarded on June 30, 1958, to J. G. Shotwell.

The new city of Page, Ariz., built on a mesa 2 mi. from the dam site, provides a view in all directions of breath-taking scenery. It is growing rapidly, with a present population of about 5,000, of which over 700 are school children. Housing facilities include over 800 trailers. The prime contractor is constructing 19 four-unit multiple-type housing units, has several dormitories for employees, and will have nine residences for key employees. The Bureau of Reclamation has completed 50 temporary and 100 permanent residences and has an additional 100 of the permanent type under construction. These homes will be rented by Bureau personnel during construction and the permanent houses will be rented by operation and maintenance personnel after completion of the construction.

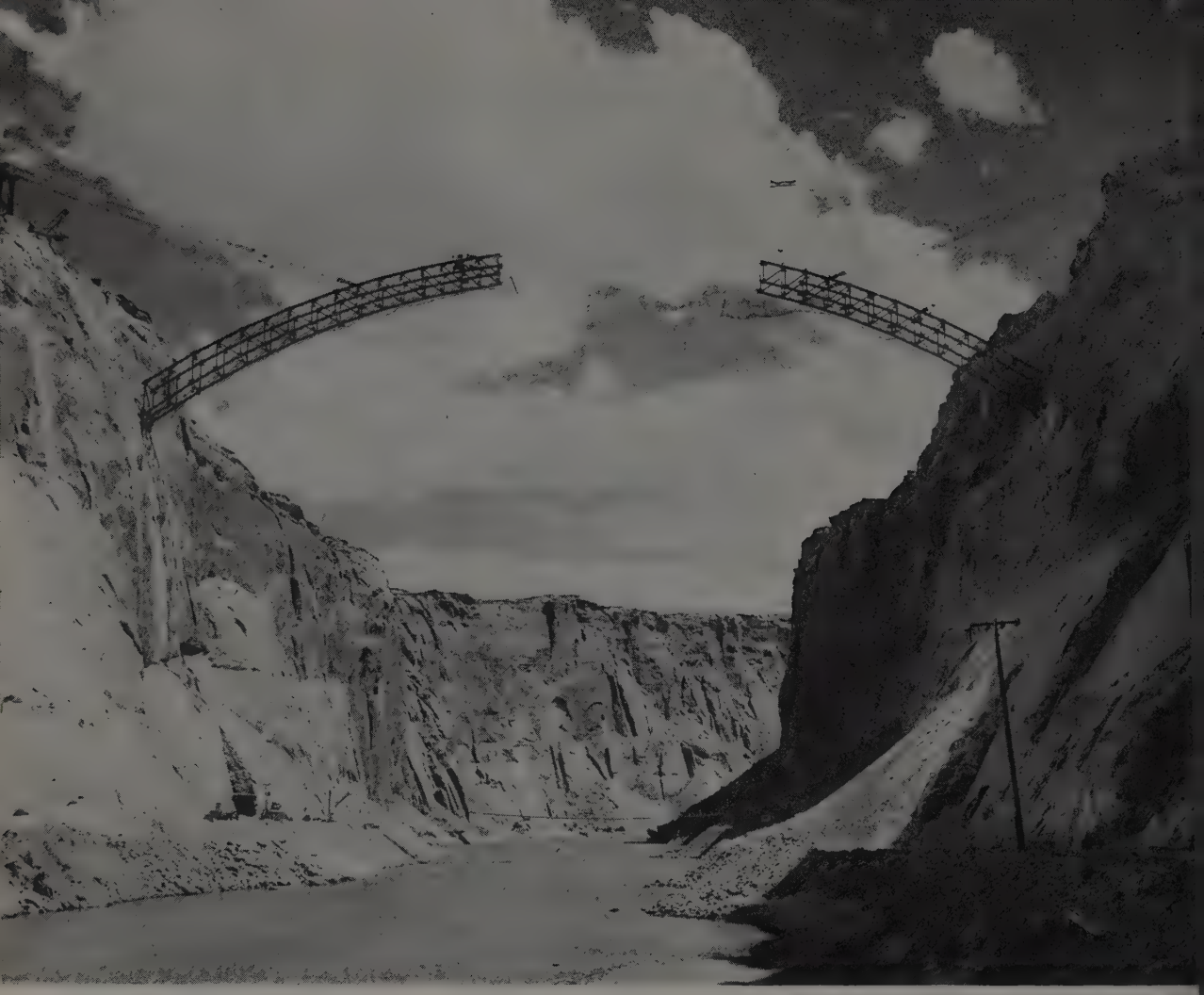
TYPICAL on all large public projects is the dedication ceremony. This one is in honor of the completion of the access road from Kanab, Utah. Governor George Clyde is speaking. Seated (l. to r.) are: Scott Brandon, Kanab Chamber of Commerce; Harmon C. Steed, Mayor of Kanab; Gus Backman, Salt Lake Chamber of Commerce; Francis Feltch, State Road Commission; Ernest H. Balch, State Road Commission; Ellis L. Armstrong, then Director of Highways, now Commissioner of the Bureau of Public Roads; Wallace F. Bennett, U. S. Senator; W. J. Smirl, State Road Commission; and Arthur Watkins, Senior Senator, of Utah.

Merritt-Chapman & Scott Corp. has completed a 25-bed hospital for use by all Page residents. Other buildings which have been completed include a telephone building, post office, bank, school, grocery stores, and a number of shops, some of temporary construction. The Government has constructed a warehouse and municipal office building and will soon award contracts for an administration building and a combined police-fire-garage building.

Utilities are essentially complete and in operation. These include a water system which pumps, filters, and treats Colorado River water, and stores it in a 3,000,000-gal. reservoir. It is then pumped into a 150,000-gal. elevated tank from which it flows into the distribution system. A sewage treatment plant and sewer lines are also operating.

The assistant commissioner and chief engineer of the Bureau of Reclamation, at Denver, Colo., Grant Bloodgood, as contracting officer is responsible for designs, specifications, and construction. The regional director, E. O. Larson, at Salt Lake City, is responsible for policy, administration and other matters. In the field, the project construction engineer represents the contracting officer. The principal members of his staff include: the assistant project construction engineer, Vaud E. Larson, a pioneer in the Reclamation investigations in the Glen Canyon area; Howard E. Fink, chief of the Office Engineering Division which is responsible for field design and specification work, contract administration, materials control, construction programs, construction reports, and budgets; Byron B. David, chief of the Field Engineering Division, with responsibility for surveys, inspection, concrete control, and supervision of construction; Thomas L. Steele, city administrator, whose function with respect to the new town of Page is similar to that of a city manager; and James H. Fordham, administrative officer, who handles such matters as personnel, procurement, property management, field accounting, and office services. As of Nov. 1, 1958, the Bureau of Reclamation field office included 230 employees.

VAUD E. LARSON
Asst. Project Construction Engineer



Building the Colorado River Bridge

The project manager for the builders of the world's highest steel arch bridge at Glen Canyon Dam tells the story of planning and construction.

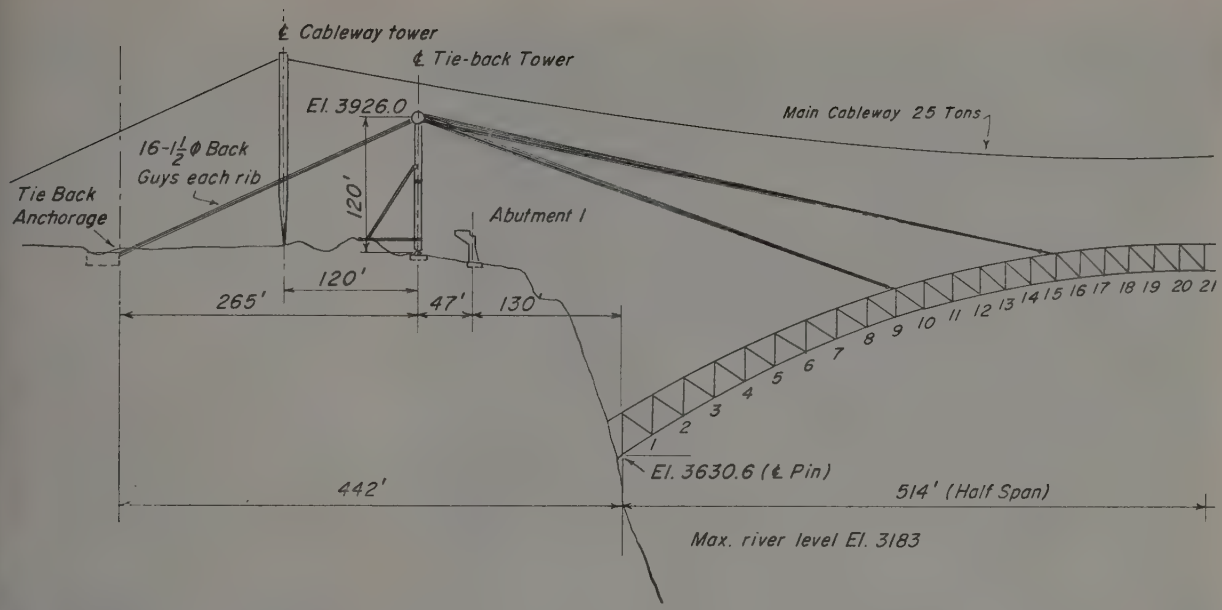
By FRANCIS J. MURPHY
Project Manager
Kiewit—Judson Pacific-Murphy

BY JANUARY 15, just a few weeks away, we hope to see the first traffic cross the Colorado River Bridge, a full 6 months ahead of schedule. For the builders of Glen Canyon Dam completion of the bridge will mean that the site is no longer split in two. For the American public it will mean the opening up of a vast region of unusual beauty and economic potential. Arizona and Utah will join hands at last across a long-impassable canyon.

The Colorado River Bridge has been one of the most interesting and challenging projects we've ever tackled. We've had big bridge projects before, like the one across the Columbia River at The Dalles which had a large cantilever main span and 36 girder approach spans, and the Richmond-San Rafael Bridge across San Francisco Bay which took 50,000 tons of steel. But building the Colorado River Bridge has been an experience in a separate class.

I first got a look at the site in October of 1956, along with Phil Murphy, president of Judson Pacific-Murphy Co. (division of Yuba Consolidated Industries) and Tom Paul, vice president of Peter Kiewit Sons' Co. We wanted to have a first hand look before deciding whether or not to submit a bid. There was an air strip at the site so we rented a light plane at Las Vegas, Nev., rather than make the difficult 75-mi. overland trip by 4-wheel drive Jeep from Kanab, Utah.

At that time the only sign of life at the site was a tent set up by the Mountain States Construction Co., which was preparing to drive the right diversion tunnel. But the remoteness of the project area didn't stop us from deciding almost at once to try to get the bridge job. We knew it could be built and we knew that we usually come out best on jobs that are too tough to attract many bidders. And we were strongly attracted to the idea of sending the world's highest steel arch across



ERECTION SCHEME is shown in this simplified drawing. Tie-back cables ran over towers made of bridge steel used after arch was closed. Cables ended at arch in yokes containing jacks which permitted tension to be varied. Main cableway could be tilted 20 ft. to either side.

that awesome canyon.

It was very apparent that before construction work on the bridge could begin there would have to be a better means of access. Bureau of Reclamation officials explained to us how the states of Utah and Arizona were preparing to push good roads in from Kanab on the west and from Flagstaff in the south. The Bureau itself would build the roads over government property. As it turned out, construction work on these roads proceeded very rapidly and they were ready when we needed them.

The Judson Pacific-Murphy Corp., which has its steel fabricating facilities in Emeryville, Calif., prepared the estimate of the fabricating costs while the Peter Kiewit Sons' Co. estimated the concrete work. After we were awarded the contract my particular responsibility was to find the most economical way to build the bridge.

We were successful bidder on December 19, 1956, at $4,139,277 with 870 working days to complete the job including painting. Close behind was the only other bidder, Bethlehem Pacific Coast Steel Corp.

My first step was to contact the engineering consulting firm of Earl and Wright in San Francisco for assistance in making the estimate and solving the field problems.

When the contract was awarded we appointed Bill Choate, a veteran of Shasta Dam, as superintendent, and Al Tokola of Earl and Wright, as project engineer. In the course of the next 3 or 4 months the three of us met many times to work out the details of erection problems, consulting with other people in the Judson Pacific-Murphy organization, notably Bill Ziegler and Rod Chisholm, veterans of the Richmond-San Rafael Bridge project.

We had no trouble deciding how the arch would be supported during construction. It would have to be tied back by cables from the top. Falsework from the bottom was out of the question because of depth of the canyon. Our big problem was choosing between a cableway and traveling cranes riding on the arch for erection of the steel. My feeling was that a cableway was not necessarily the best piece of equipment to erect the structural steel. A cableway gave us only mediocre service on a steel arch bridge we once built outside of Crescent City, Calif. Bill Choate on the other hand insisted from the start that the Colorado River Bridge could best be built by a cableway or cableways. We eventually agreed and as the job turned out, cableways were definitely the correct method. A big disadvantage in the use of travelers was the additional deadload of between 150 and 175 tons which would have to be supported by our tie-back system.

AUTHOR of this article, Francis J. Murphy, (right) project manager for joint venture Kiewit—Judson Pacific-Murphy, confers with veteran Bill Choate, project superintendent.

FIRST BRIDGE STEEL, the ponderous skewback bearing, is lowered by the main cableway. Workmen guide it into place on twelve 2¾-in. anchor rods sunk into concrete skewback, or abutment. Excavating cave for skewback was one of the toughest jobs.

NEXT PIECE to be placed was the lower chord on the west side. Note 16-in. diameter pin fastened to end of chord which will secure chord to skewback bearing. The safety net, visible in lower right, contributed to the job's remarkable safety record. All steel was brought to project from Judson Pacific-Murphy's fabricating shops 800 mi. away in Emeryville, Calif. Steel traveled by rail to Flagstaff, Ariz., then 135 mi. by truck.

The trouble with a cableway is that it has only one hook. Since there was so little access from one side of the canyon to the other we agreed that we definitely would need two hooks—one for men and material and one for setting steel. We couldn't afford to have the main hook tied up whenever we had to transport men or material across the river. We finally decided to use two cableways, one with fixed towers and 12½-ton capacity for transportation and one with 25-ton capacity for setting steel. The fixed access cableway was located 10 ft. from one edge of the bridge and the main cableway was located on the center line.

The problem here was that the bridge is 40 ft. wide and some provision would have to be made to enable the main cableway to set steel on either truss. We considered having one or both of the towers travel on a track and we considered luffing or tilting one or both of the towers. We eventually came up with a scheme of luffing both towers which worked out very well.

Because of the different elevations on each side of the canyon, one tower was 165 ft. high and the other one 150 ft. The towers were mounted on two pins at right angles to each other so they could be tilted either forward or backward or to either side. The towers were luffed by means of side guys rather than adjoining masts. The towers lay into limiting pennants when luffed to the maximum.

There is not much literature available on designing cableways and Earl and Wright had to work out many of the problems with little to go on. For example, cableway carriages used in pouring concrete usually have 16 or more wheels to reduce wear on the main gut and on the wheels. But since our operation was slower than pouring concrete our carriage contained only 12 wheels. The speed of our cableway was designed on the basis of 400 ft. per min. rather than the more usual 800 to 1,400 ft. per min. We found that in the 10 months the cableway was in operation wear was not excessive on the gut, a 3-in. lock coil made by U. S. Steel.

The small transportation cableway required only one operator but the large luffing cableway took three, one for the main hoist and one on each side to control luffing.

The span of the 25-ton cableway was 1,540 ft.

Further details on the cableways were given in an article in *Western Construction* in July of 1958.

Fabricating the members

Fabrication of the arch started in October of 1957 in the shops of Judson Pacific-Murphy in Emeryville, Calif., under the direction of Rich Murphy. The longest chords were 54 ft., the shortest 27 ft. Most of the members were built-up sections of angles and plates of carbon alloy steel. Rivets were used throughout the arch, ranging in size from 1⅛ in. in diameter to ⅞ in. in diameter.

The vertical posts, floor beams, and stringers required normal fabrication but the arch chord members had to be milled to within 1/10,000 of an inch tolerance. The vertical milling machine used for this is one of the finest in the West.

Before the steel was shipped to the job site it was laid out on the ground and completely assembled in the form of 4 half arches. In normal practice only 3 or 4 panels

would be laid out, and as members were removed from one end new members would be added to the other until the entire structure was checked. But on this job the dimensions were so critical and it was so necessary to make sure that everything went together smoothly at the site that we assembled 21 panel points, half the arch, before knocking it down for shipment. With the arch assembled on the ground, it was possible to introduce the proper rise and camber by making physical measurements. When everything was correct, the subpunched holes were drilled full size and shop rivets installed. Open holes were left for field connections. Before shipment, the steel was sandblasted and given a coat of paint in the Emeryville shops. The inaccessible surfaces of the steel received three coats of paint.

The steel was shipped by railroad 800 mi. to Flagstaff, Ariz. Trucks and trailers took it the remaining 145 mi. to the job site where it was yarded and stored at an assembly area about 300 yd. from the end of the bridge.

Obtaining workmen

While living in a trailer van our crew constructed two 30-man barracks, probably as fine a barrack-type accommodation you will find on any construction job. We made arrangements with the Mountain States Construction Co. to share a mess hall and we contracted with concessionaire Willard Wood Co. to prepare the food for both ourselves and the Mountain States Construction Co.

When the general dam contractor, Merritt-Chapman & Scott, moved into the area we built for them about 20 buildings (barracks, mess hall, and shops). We also constructed for MC&S the suspension foot bridge across the canyon, part of their temporary plant, and the large main cableway towers. We also will supply all reinforcing steel for the dam.

Although we anticipated considerable difficulty getting men to work in such an isolated area, we found that by building good living quarters and furnishing better than average food we did not experience much trouble. Our key men came from the San Francisco Bay area but the bulk of the crews were furnished out of the Phoenix, Ariz., union halls. Since the project is located in the Navajo Indian Reservation the Bureau of Reclamation very properly requested that we hire as many Indians as possible. As a result much of our unskilled labor was Indian.

TIE-BACK CABLES hold arch in position as closure point is neared. Cage on auxiliary cableway is used to carry men and tools. Carriage of main cableway is visible above highest point of arch. Faintly visible in background is main cableway tower, luffed to right.

Excavating skewbacks

Making the excavations in the face of the canyon walls for the concrete foundations or skewbacks was very troublesome. As we began work it became evident that the rock had weathered on the west side to a point where it was unsafe and we received a change order from the Bureau of Reclamation to remove about 9,500 cu. yd. of rock. Removal of this rock meant that we had to increase the size of the skewbacks and the anchor rods behind them.

To start drilling for the skewbacks it was difficult to get a foothold. We elected to use regular jackhammer drills mounted on a quarry bar rather than using jib drills from a platform as we planned earlier. Workmen were supported in bosun's chairs which made the work look extremely hazardous. However, by taking the necessary precautions it developed to be no more hazardous than other methods. Blasting was done with light charges to avoid disturbing adjacent rock.

When we had excavated the cave on each side to the prescribed size we drilled holes an additional 30 ft. into the rock and grouted in dowell anchor rods. Then we placed reinforcing steel and poured the concrete with the main bridge base plate or grillages in place. The critical operation was of course locating the base plates.

Spectacular surveying

We handled all our own surveying and established our own controls independent of the Bureau of Reclamation. The survey crew which did our preliminary work is called the Tri-Dam surveyors after the California project where they first worked together. Chief of party was Homer Castania.

Each member of the surveying crew was an exceptionally good high scaler and their operations on the face of the cliff were phenomenal. While hanging by manila lines they would often have to take the readings with the surveying instrument legs inserted into crevices, resting on tiny ledges, or supported on reinforcing bars stuck into the cliff. The Tri-Dam surveyors left after four months of work. Miscellaneous surveying on the remainder of the job was handled by a crew under the direction of Winniford Choate, nephew of the superintendent. The surveying done by both crews was amazingly accurate considering the near impossible conditions. The accuracy can best be shown by the error of closure at the center of the arch which was a mere ¼ of an inch.

The tie-back system

We could have accommodated an error of closure up to 8 in. because of our unusual tie-back system. The tie-back cables ran over 120-ft. high towers on each side which provided better leverage for the higher parts of the arch.

The accompanying drawing shows how the tie-back cables supported the arch during construction.

A total of 48,340 ft. of 1½-in. bridge strand was used for the tie-back cables. The maximum number of lines in use at any one time was 72.

The most unusual feature of the tie-back system was the jacks which enabled us to vary the tension in the lines. The jacks were located in strong-backs at the point where the cables tied on to the arch. By means of the jacks we could adjust the tension in any two lines by whatever amount we wished down to 1/1,000 of an inch if necessary. This enabled us to raise or lower the arch as necessary to make the final closure.

The jacks were 100-ton Watson-Stillmans in which we used water instead of hydraulic fluid to lessen the possibility of making the steel slippery. We considered buying electric pumps but we finally decided on manual jacking because we were able to compute everything so closely we didn't feel much jacking would be required. We never needed more than two or three men to do the jacking.

BOTH CABLEWAYS are used at once to set 162-ft. long vertical column. Process is described at right.

The jacks were not only used during the closures but also to adjust the tie-back lines to equalize tension during the erection operation. As erection proceeded new tie-back cables were set forward and the previous ones released. The rear cables were extended and set ahead later on. The jacks were used to remove the tension in the rear lines thus transferring the load to the forward lines. We operated in such a way that we never had to jack tension into a line, thus minimizing the jacking required.

The gages on the jacks showed that actual loads never varied more than 5% from theoretically computed loads. When the two half arches met in the middle and were pinned at the top chord the tie-back cables were released and the entire arch was allowed to support itself. At this time it was in effect a 3-hinged arch—that is, there were two 16-in. pins at the skewbacks at the canyon walls and a 20-in. pin at mid-span. However, the bridge was designed as a 2-hinged arch with no hinge at the center. To remove the center hinge, which was used for simplifying the closure, jacks were placed in the lower chords at mid-span and a specified amount of load was jacked into the bottom chord. This load varied with the temperature and the live load that was on the bridge at the time. Shims were used after the correct load was in effect and the bottom chord was drilled and riveted, after which the pin in the upper chord became fixed.

The specifications allowed high strength bolts to be used on the deck system of the bridge and that is the method of connection we used. In tightening the high strength bolts we used the turn-of-the-nut method which we feel is the fastest and best procedure.

The largest piece of steel placed was a 162-ft. long vertical column near the canyon walls. This column could have been built by placing one section at a time and making splices with the column in place. However, Bill Choate came up with the idea of placing the entire member, weighing 29 tons, at one time by using both cableways simultaneously. The pickup points of the column were determined to keep the load distribution proper between the two cableways. The column was moved horizontally from the top of the canyon. Then with a man stationed at the cliff edge giving signals to the hoist operators the huge member was slowly tilted to a vertical position and set in place. For this operation it was necessary to luff the towers of the main cableway to the maximum. The system worked very well and was used for all the large vertical columns.

Final operations

The question of forming the concrete deck also took considerable study. We eventually elected to use leave-in-place steel forms. This would eliminate stripping which would be a rather dangerous operation, and also would cut down on labor expenses which are considerable for an isolated project of this sort.

(Continued on page 50)

Colorado River Bridge Engineering Data

Length of arch	1,028 ft.
Length of roadway (abutment to abutment)	1,271 ft.
Width	40 ft.
Rise of arch	165 ft.
Carbon steel in arch	800 tons
Alloy steel in arch	1,550 tons
Carbon steel, exclusive of arch	1,175 tons
Height of roadway above max. water surface	680 ft.
Concrete in roadway	1,030 cu. yd.
Cost of bridge	$4,139,277
Date contract awarded	Jan. 1957
Completion date	Jan. 1959
Longest chord	54 ft.
Shortest chord	27 ft.
Longest vertical column	162 ft.
Size of tie-back cables	1½ in.
Length of tie-back cables	48,340 ft.
Number of tie-back cables	72
Diamter of pins at skewbacks	16 in.

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CONSTRUCTION PLANT —

To build a $108,000,000 dam and powerplant in six years requires a vast complex of temporary facilities.

THE DRAWING on this page shows most of the construction plant Merritt-Chapman & Scott plans to build in order to complete the dam and powerplant within the allotted time.

The drawing, for the sake of clarity, omits the diversion tunnels, spillways, and cofferdams, which are shown in the drawing on page 59. To best understand the characteristics of the job site and the construction facilities, the two drawings should be compared with the aerial photograph on page 46 and the artist's sketch of the completed project on page 29.

In green are shown some of the transportation facilities. At the left is the 25-ton cableway used in driving and lining the two diversion tunnels which lowers materials and equipment to the canyon floor. Adjoining it is the suspension footbridge, which for a long time was the only way to cross the canyon. Regularly scheduled buses stop at each end of the bridge to carry workmen to various spots in the project area.

Also in green are the personnel elevators, or "monkey slides", which transport workmen, light materials and tools 800 ft. from the top of the canyon to the bottom. The footbridge and elevators are pictured and described on page 44.

The two 50-ton cableways at the right, which will place concrete in the dam and powerplant starting about next November, operate independently of each other. The longer one is higher than its companion and can pass over it. The towers are pictured on page 54.

The aggregate source is located about 6 mi. to the north (left in the drawing) and is brought to the stockpiles by truck. The 80-ft. high aggregate stacker, made by Pioneer, is at the lower left. Note that three stockpiles are for material that has passed through the heavy media separation plant.

The word "Wet" on the conveyor belt leading to the batch plant indicates that the aggregate is sprayed with ice-water in a covered tunnel for cooling purposes.

TUNNELS—

BEFORE the contract for the dam and power plant was awarded the Bureau of Reclamation got work started on the west diversion tunnel. Mountain States Construction Co. of Denver won the contract for their bid of $2,452,000, in October of 1956. The drilling and shooting phase of the operation was subcontracted to Northwood, Inc. of Vancouver, B. C., and the mucking-out to Theo Wood Construcion Co., Salt Lake City.

After Merritt-Chapman & Scott received the prime contract for the dam and powerhouse in April 1957, the east diversion tunnel, the two spillways, and the 10,000-ft. powerhouse access tunnel were subcontracted to the Frazier-Davis Construction Co. of St. Louis. Frazier-Davis turned over the drilling of the right spillway tunnel to Northwood.

The jumbo used in the west (right) diversion tunnel moved on large rubber wheels rather than being mounted on a truck. It covered the full face with 4 decks mounting from 2 to 5 drills on each deck. Total of 15 drills were generally used, with 200 to 250 holes for each round. The average hole was 16 ft. deep, with 18-ft. cut holes in the center. Gold Medal 40% powder was used and less than 3/4 lb. per cu. yd. was required. Each round pulled about 15 ft. or 600 cu. yd. The average advance in 200 days was 13 ft. per day.

The specifications called for 1,818 ft. of unlined tunnel, 43 ft. 6 in. in diameter, and 950 ft. of unlined tunnel, 46 ft. 6 in. in diameter. The concrete lining was carried out by Merritt-Chapman & Scott. The lining is complete on the right diversion tunnel and nearly complete on the left.

An unusual feature of the driving of the tunnels was the use of one-use bits manufactured by the Western Rock Bit Co., in Salt Lake City. The bits are thrown away rather than resharpened when they become dull. The bits averaged about 48 ft. in the sandstone.

Lining the tunnels so that the interior bore is 41 ft. in diameter is done with steel forms manufactured by Blaw-Knox. The huge circular forms are carried on a rail-mounted gantry which can be lowered hydraulically when the forms are moved ahead. The same forms are now being used to line the left diversion tunnel.

TUNNEL JUMBO used by Mountain States Construction Co. to drive the right diversion tunnel was mounted on pneumatic tires and featured platforms which raised to pass mucking machines.

TUNNEL FORMS, made by Blaw-Knox, were used to line diversion tunnels. All steel, they were carried on a rail-mounted collapsible gantry. Tunnels were over 45 ft. in diameter.

During lining, concrete is brought from the temporary batch plant now in operation on the top of the west side of the canyon by the cableway. The concrete buckets are placed on an elevated platform where they are emptied into Koehring Dumptors for transportation into the tunnel. A double Pumpcrete machine handles the final placement of concrete through trap doors in the steel forms.

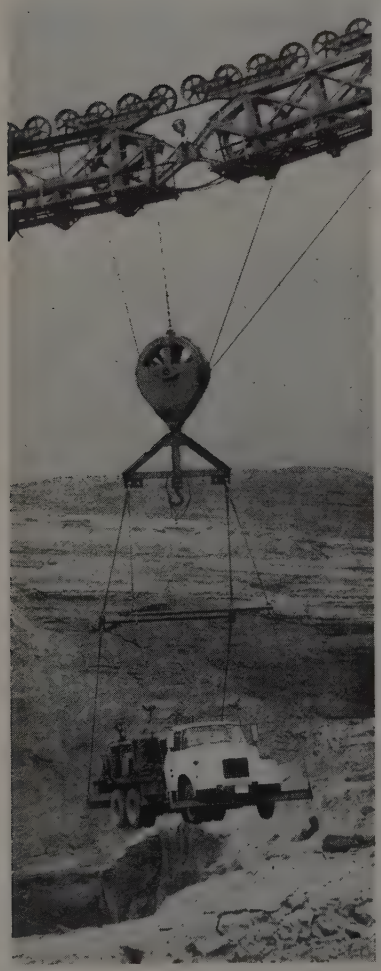
The inverts are poured first, then the rest of the lining is placed. In the west diversion tunnel the Pumpcrete was used to place the concrete for the invert but in the east tunnel the Koehring rubber-tired Dumptors are dumping their loads directly before the screeds. This is possible in the east tunnel because the rock is of a slightly different nature and will not fracture under the weight of the rigs.

The powerhouse access tunnel, which emerges at river level, a short distance upstream from the outlet of the left diversion tunnel, was drilled by the Frazier Davis Co. The tunnel, except for 700 ft. of 2% grade, rises at the constant slope of 8%. Despite this steep slope it takes 10,000 ft. before it emerges at the top of the canyon. The tunnel is located about 100 ft. from the canyon wall and contains numerous curves as it follows the configuration of the canyon wall. Every 500 ft. a ventilation and mucking adit was punched through the wall. Muck was simply dumped out these adits and allowed to fall into the river.

A contract for surfacing the floor of the tunnel has been awarded to W. W. Clyde & Co. of Springville, Utah.

TRANSPORTATION —

The canyon splits the site into four parts, east, west, upper and lower. Cableways, elevators, and cranes are used to move men, materials, and machines.



TWICE A DAY this International Harvester lube truck is lowered to the bottom to service equipment working on diversion tunnels.

EVERYONE will heave a sigh of relief when the steel arch highway bridge spanning the canyon is completed in February. For the first time, workers will be able to drive private cars and construction equipment from one rim to the other without having to make a 200-mi. highway trip.

The 700-ft. deep, 1,000-ft. wide gorge has been more than just a nuisance and an expense; it has a profound effect on the overall construction operation. It effectively divides the project into 4 parts—the east, west, upper, and lower.

The importance that the highway bridge has to the project can be sensed by the closeness with which everyone watches its progress. Whenever anything of importance happens, like the setting of the first steel or the closing of the arch, there is always a great display of oratory and hat waving.

Crossing the canyon

At present there are four ways to get men and materials from one rim of the canyon to the other. The bridge contractor, Kiewit—Judson Pacific-Murphy, has 2 cableways, one with a capacity of 25 tons and the other with a capacity of 12½ tons. About 1,000 ft. upstream is a 25-ton capacity cableway and a suspension foot-bridge owned by the general contractor, Merritt-Chapman & Scott. At the bottom of the canyon are 2 lightweight suspension foot-bridges for personnel traffic. Nearing completion are the 2 giant 50-ton capacity cableways with traveling head and tail towers which will be used for placing concrete in the dam.

The high-level suspension footbridge was built early in the job to relieve the cableways of the necessity of transporting personnel from one side to another. The $200,000 structure was subcontracted by MC&S to Kiewit-JPM and J. A. Roebling's Sons Corp. The 1,280-ft. bridge is hung from two 100-ft. high structural steel towers on six 1¾-in. carrier cables. There are eight 1-in. deck cables, 4 hand rail cables, and 64 ⅝-in. suspender cables. For anchoring the span from the bottom, two 1¾-in. cables, similar to the carrier cables, were anchored into the walls of the canyon. The walkway consists of wire mesh.

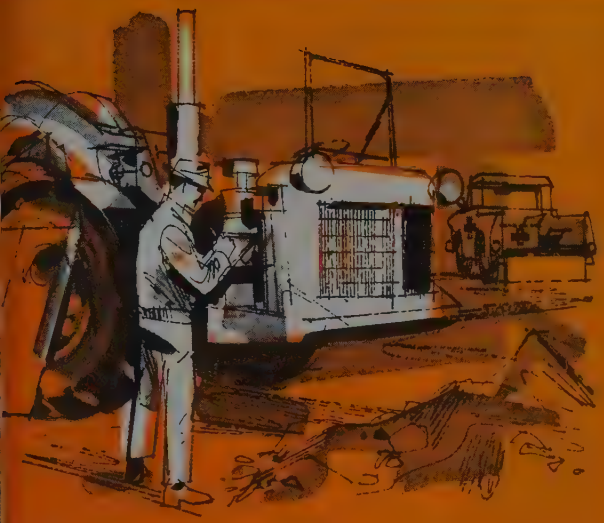
Luffing cableway

An unusual feature of the 25-ton cableway being used by the bridge contractor, which will be taken down when the bridge is completed as it is located on the center line of the roadway, is its capacity to tilt 20 ft. in either direction. This feature enables it to set all the steel for the 40-ft. wide bridge.

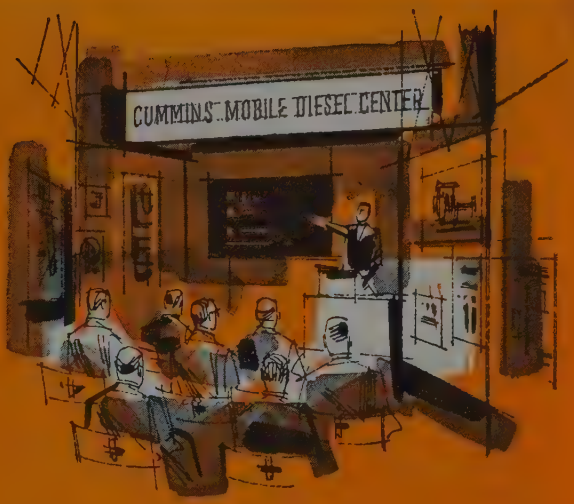
The MC&S cableway upstream is used mainly for servicing the construction of the two diversion tunnels. This cableway has lowered to the bottom of the canyon a great deal of heavy equipment, including tractors, scrapers, and trucks. At present there is no other way to get equipment to the bottom of the canyon. The powerhouse access tunnel may be used as an access to the canyon floor.

For transporting men and light materials from the rim to the bottom of the canyon are a number of man-elevators or "monkey-slides". Two of these elevators are made by the Skagit Iron Works. They are both located on the east side. One serves the inlet of the

(Continued on page 44)

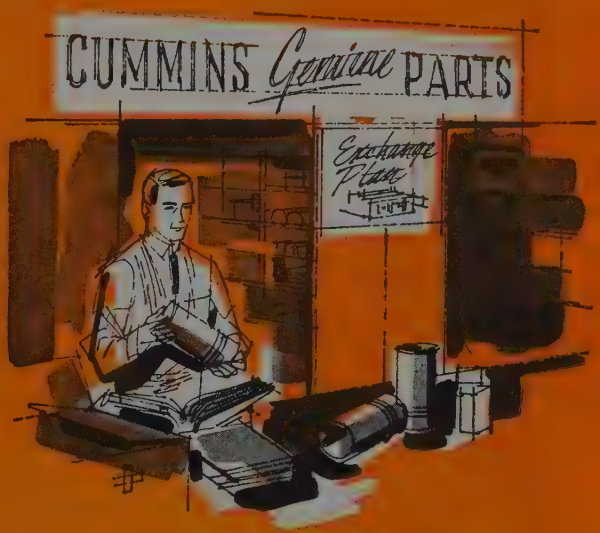


INSPECTIONS The Cummins Two-Inspection System for off-highway diesels provides a pre-delivery and an on-the-job check in the machine, to protect your power investment.



SERVICE SCHOOLS Cummins experience is made available through factory-conducted courses and traveling schools, teaching the proper care and servicing of your Cummins diesel.

MOBILE SERVICE Many Cummins Distributors offer the extra service of a mobile parts unit. Parts are delivered to job-site. Customers can have this service on a regular routine basis.



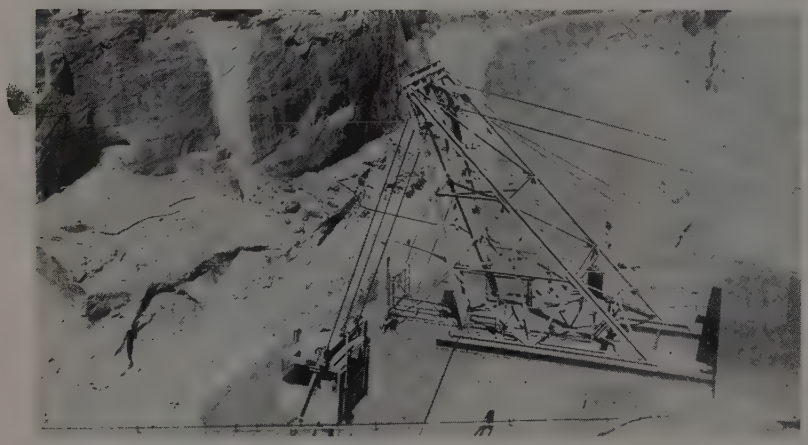
UNIT EXCHANGE PLAN This special plan cuts repair costs. Worn units can be exchanged, usually, on the spot. A complete stock of genuine Cummins Parts is always on hand.

When you're a Cummins Diesel owner, you can be sure of getting the kind of service that will keep that engine working profitably "round the clock." That's because your Cummins Distributor is an expert in the business—devoted exclusively to the sale and service of diesel engines.

By the same token, the Cummins Engine Company is devoted exclusively to the building of diesel engines—and has been for more than a quarter of a century. This combined experience assures you of dependability and performance, plus top notch service. No wonder more and more contractors specify their power and standardize on Cummins. It's easy to standardize! Cummins makes 32 diesels available—from 100 to 600 h.p.—for every type of construction machine.

CUMMINS MORE PROFIT
gives you the big plus

SUSPENSION FOOTBRIDGE has mesh walkway to minimize wind resistance. Newcomers find it disconcerting to look between their shoes and see the river 700 ft. below.



PERSONNEL ELEVATORS made by Skagit Iron Works shuttle men up and down canyon. Electrical controls eliminate need for operator. Elevators are in almost constant use.

ACCESS ROADS across desolate desert were first order of business. Shown is a Barber-Greene paver working on the Bitter Springs road leading to the job from the south.

TRANSPORTATION

(Continued from page 40)

diversion tunnel and the other the outlet. Electrical controls at the top and bottom of the lift eliminate the need for a hoist operator.

Personnel elevators

Two smaller elevators are located on the west side, one serving the inlet of the right diversion tunnel and the other leading to the ledge on which the permanent batch plant will be constructed. Two more of the larger elevators are now under construction, one to serve each keyway. The keyways have progressed about 300 ft. on each side and the raising and lowering of men by platforms supported from cranes at the top has become awkward.

Some of the elevators have wheels on each side of the cage and run on two parallel guide cables, while the cage is raised and lowered by a third cable. Others run on steel channel-iron rails.

Among the "firsts" in construction equipment developments attributable to the solution of problems at Glen Canyon was the successful introduction of dynamic braking on heavy-duty derrick hoists where lowering loads from great heights is a serious potential problem.

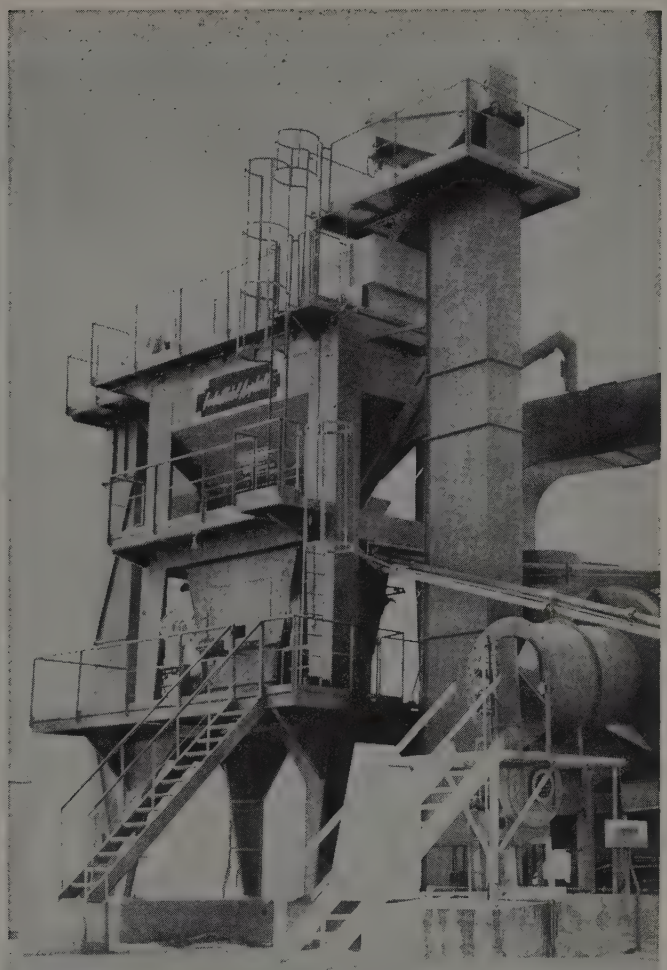
Dynamic braking

Dynamic braking was a development of Skagit Steel & Iron Works of Sedro-Woolley, Wash., on the G-95 Skagit hoists furnished for the derrick installation which moved materials and equipment over the brink to the canyon floor 700 ft. below in the initial phases of the project.

Dynamic braking, now a standard feature of various types of Skagit hoisting equipment, embodies a forward and reverse drum operation with a torque converter drive. It handles heavy loads up or down with the engine throttle only; it eliminates drum braking by the operator during the hoisting cycle; it provides continuous duty lowering of heavy loads without over-heating of engine, torque converter or hoist brakes and is available in sizes to suit various applications.

On the Glen Canyon job, the G-95 derrick hoist with dynamic braking was used to handle loads up to 30 tons and to lower these loads 700 ft.

AMERICA'S NUMBER ONE ASPHALT PLANT!



Successful contractors throughout the nation recognize the *STANDARD model R-M* as *AMERICA'S NUMBER ONE ASPHALT PLANT* because of its superior design and quality.

Big — Fast — Rugged — Clean — Economical — describe the STANDARD model R-M Asphalt plant with its king-size capacity — Super-Lift dryer (with saw-tooth lifter) — heavy duty, Hi-Speed mixer — Simplex push-button batching control — positive control of liquid asphalt — over-size elevator and vibrating screen — are some of the *many money making features* assuring higher production with less maintenance for successful contractors — everywhere!

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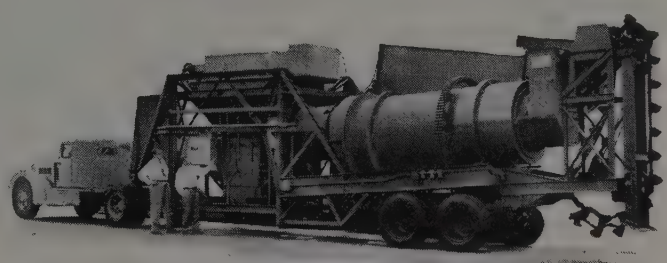

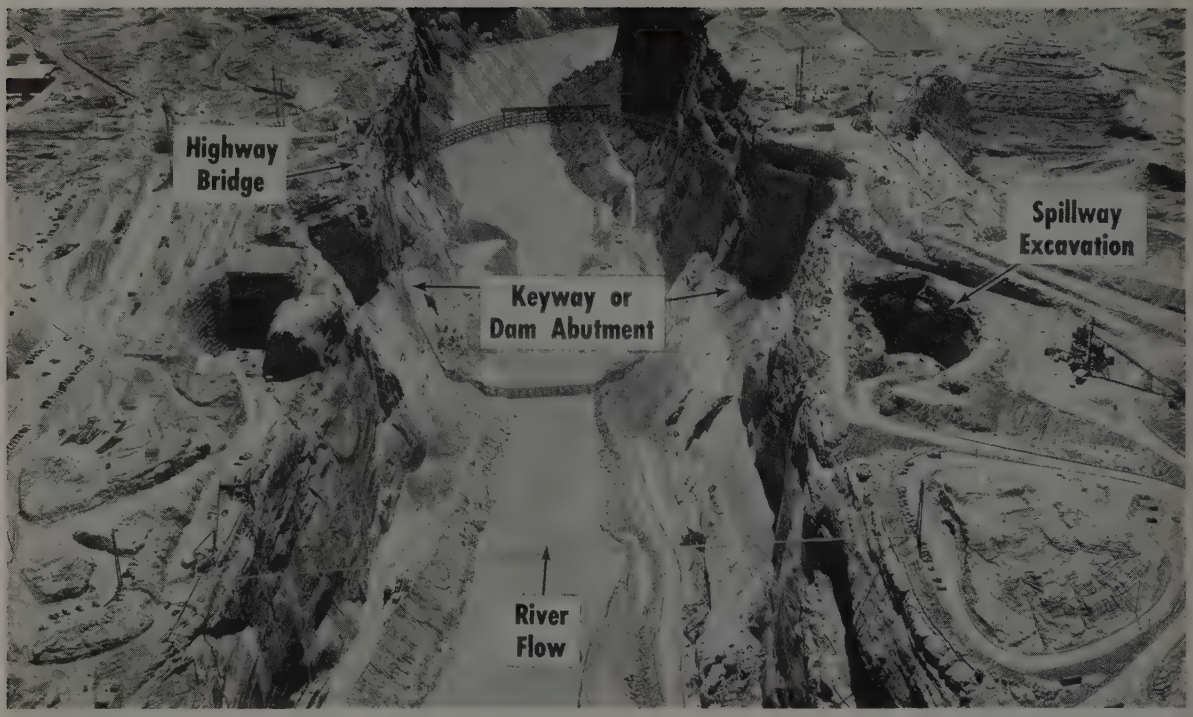

EXCAVATION—

keyways and spillways

THE NATURE of the rock of the canyon has required the use of a great number of rock bolts. High scalers on the right bank, where the most severe rock spalling has occurred, have installed about 1,500 bolts. On the left bank about 12,000 rock bolts were installed in the diversion and access-road tunnel roof and arch. Northwood, which drilled the right diversion tunnel and is now working on the right spillway tunnel raise, has installed 280,000 lb. of bolts, to date. The majority of bolts are manufactured by Bethlehem Pacific and are of the expansion shell type which are ½ in. to 1 in. in diameter and up to 8 ft. long.

The excavation for the keyways and dam and power plant foundations totals about 2,500,000 cu. yd. Using a cycle of drilling, shooting and shovel loading, the keyways on each side of the canyon have been taken down more than 300 ft. at the present writing.

When keyway excavation started Merritt-Chapman & Scott put its fleet of 20 new International Harvester Payhaulers to work hauling the muck away for roads and other uses around the site. The plan was to use the Payhaulers until the haul road became too steep. The maximum grade was expected to be about 18%. But the big rigs took the 18% grade without much trouble, so the excavation continued until the haul road reached 20%. By keeping the haul road gravelled, well compacted and watered, it was found that the big Payhaulers could be used efficiently until the haul road became an impossible 23%. One of the tricks discovered in using the trucks on steep grades was to keep the load in a range which was not too heavy to stall the truck, nor too light to allow the wheels to slip.

Since the trucks have been taken off the excavated material is dozed and shoveled over the side and allowed to drop freely to the bottom where it is used to build roads along the river and stock-piled for the cofferdams.

The batch plant will be located at the center-of-mass on an excavated shelf next to the west keyway 190 ft. below the top of the canyon. The entire rock surface of the excavation surrounding the batch plant will be covered with wire mesh anchored to a concrete slab at the top of the canyon wall as a protection against accidents resulting from falling rock.

In the keyways, drilling in the soft sandstone is very fast. Using Gardner-Denver Air Trac, the contractor has been averaging about 50 ft. per hr. on holes 3¼ in. in diameter. As on other parts of the job one-use throw-away rock bits

LARGEST steel supports ever rolled for a tunnel are in place at the spillway openings. During placement a pillar of rock was left to help hold roof in place. Sets are 15WF167.

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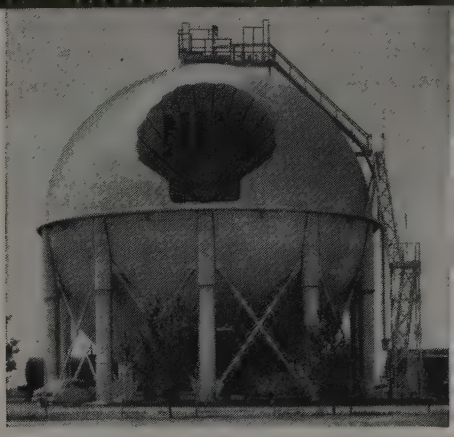
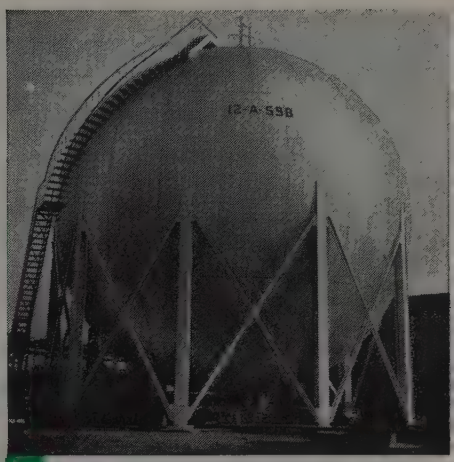
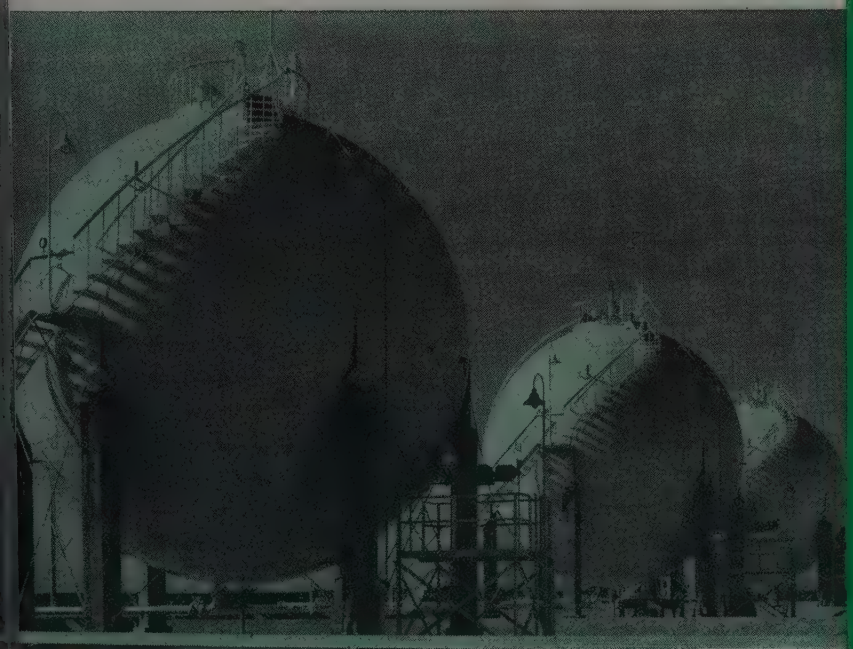


Ammonia. 64 ft dia, 55 lb working pressure



Isobutane. 50 ft 6 in. dia, 60 lb working pressure



Gasoline. Three 2500 bbl spheres, 30 ft dia, 20 lb working pressure

Liquefied chlorine. Cutaway view of insulated storage sphere

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are used to good advantage. The Liddicoat bits average over 70 ft. before they are discarded.

The majority of the holes are drilled 16 ft. deep and 7 ft. on centers in both directions. They are loaded with about 12½ lb. of Du Pont Hicap bag powder. Experiments were conducted with straight fertilizer grade explosives but in the soft rock they were found too hard to control.

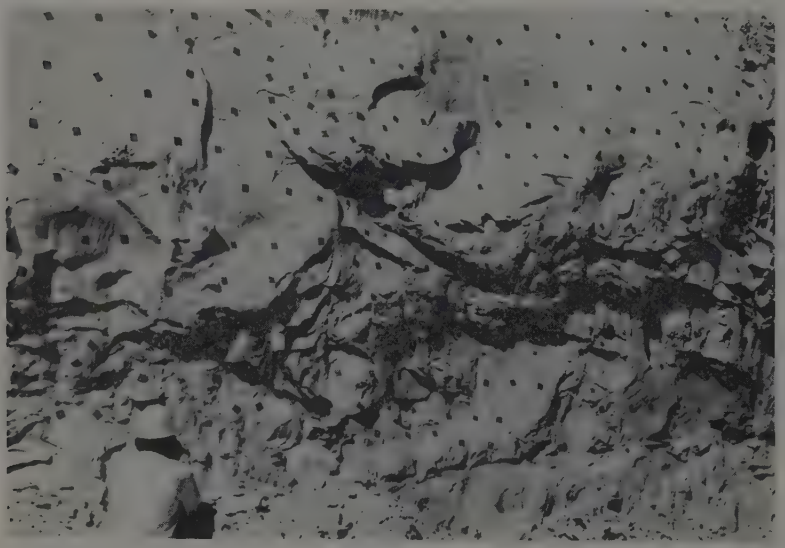
The row of holes next to the wall is lightly loaded with Primacord and five sticks of 1¼ x 8 in. 40% Red Cross Du Pont dynamite sticks. The sticks are placed about every 2 ft. in the hole. This is done simply by lowering the first stick in on a Primacord, pushing somt dirt in the hole, dropping in the next stick, etc. The holes are detonated by millisecond delay caps from 0 to 8, with the Primacord holes going last to clean the walls.

Foundation and grouting tunnels are being driven into the keyways as they are excavated. The tunnels are driven about 250 to 350 ft. deep. There will be three in each keyway.

The foundation tunnels are 6 ft. 4 in. wide and 8 ft. 4 in. high. When beginning one of the tunnels, a wagon drill with the mast horizontal is used to line drill the outline. Holes are sunk 12 ft. deep on 2-in. centers. Blast holes within this pattern are 6 ft. deep spaced 20 in. apart horizontally and 24 in. apart vertically with a 5-hole center burn group.

The line holes are not loaded, but the others are loaded to the collar with 30% extra strength Du Pont powder. During the mucking operation electric hoists fastened to Sullivan pins sunk into the roof are used to lift cars up from the narrow gage track for passing. The cars are pushed out by hand.

LIMA SHOVEL loads a fleet of I-H Payhaulers during excavation of right keyway. The Payhaulers were kept on this job until the haul road became an impossible 23%.



ROCK BOLTS by the thousands are being used on the canyon walls and in the tunnels to hold rock slabs in place. In this photo the workman is giving directions to a hoist operator at the top concerning the position of the highscaler who is barely visible in lower left center. Most rock bolts used are a product of Bethlehem Pacific Coast Steel.

Spillways

The spillway raises are 50-ft. diameter tunnels descending at an angle of 55 deg. to a junction with the diversion tunnels at about the mid-point of the diversion tunnels. When the dam is completed mass concrete will be placed as an upstream plug at this point of juncture to seal off the upper half of the diversion tunnels.

Northwood, Inc., the subcontractor for the right spillway raise, first excavated upward a 7 x 14-ft. pilot shaft. A conventional 6 x 7-ft. manway was constructed of timber lagging up one side of the shaft as excavation proceeded. The manway housed the air and water lines, ladder, and a material bucket. The entire 7 x 14-ft. area could be drilled from a platform on top of the manway with 2 Atlas Copco stopers. Using 6-ft. holes, Northwood averaged 8 ft. per day for 71 days. Average powder factor was 2 lb. per cu. yd.

At the bottom of the shaft is a steel chute with three 8-in. air-actuated cylinders for the gates.

The 55-deg. slope of the tunnel is steep enough so that the muck will feed by gravity. The automatic chute loads three S7 Euclids which carry the muck out of the diversion tunnel to the waste areas.

When the shaft was completed the contractor began drilling and shooting on the full face of the 50-ft. spillway raise starting at the top and using the pilot shaft to dispose of the muck.

Air is supplied by one Gardner-Denver 900 rotary compressor and ventilation is supplied by one Joy 30-hp. fan.

Northwood is using four crawler mounted drills, two Ingersoll-Rands

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and two Gardner-Denvers. Holes are 12 ft. deep on 4-ft. centers and are loaded with an inexpensive bag powder made by Hercules. A relatively high gas producer, it has never before been used on underground construction.

One-use rock bits made by Western Rock Bit in Salt Lake City are used and last about 80 ft.

Thirty-two steel sets are required at the top of the spillway to support overhead rock. The top of the spillway flares outward in a parabolic curve.

One result of this enlarged opening is that the first few sets are 115 ft. long, probably the largest ever used in a tunnel, definitely the largest ever bent for tunnel support by the manufacturer, Commercial Shearing & Stamping Co. The sets are 15-in. wide flange beams weighing 167 lb. per ft. Each of the big steel arches is a different length and each succeeding one is curved to a smaller radius and is set at a steeper angle.

The biggest single problem the contractor had was probably the engineering involved in setting the footblocks. The bearing surface of each concrete footblock slopes in two directions and every one is different.

When excavating the large opening a stout pillar of rock was left in place at the middle to support the roof until the first few steel sets were placed. A Gradall was a big help in reaching hard-to-get-at spots.

EXCAVATION of the skewbacks for the Colorado River Bridge was a difficult task. Men are shown with quarry bars on which drilling equipment was mounted. Small charges were used to avoid disturbing adjacent rock. Hazardous operation was completed without mishaps.

Placing steel sets

The idea which enabled Northwood to stay in the black on this awkward phase of the operation was to excavate enough material to enable the steel sets to be placed from the inside out. This provided more room in handling the sets as the spillway gets larger as it nears the portal. Also they were able to support each steel set against the one previously placed.

The sets were placed in 20-ft. sections by three cables passing through pulleys secured to the roof and operating from separate air hoists. A small Coffing hoist was used to pull the sections together.

A rock plug will be left in the bottom of the spillway shaft where it joins the diversion tunnel and the pilot shaft will be plugged with concrete. This is to prevent water surging upward into the spillway shaft. In 1962 or thereabouts when the diversion is plugged, the remaining rock will be excavated to form a smooth transition elbow. The spillway tunnels will be lined with concrete by using Blaw-Knox steel forms.

Northwood personnel

For Northwood, Ernie Moore is project manager; John W. Perme is project engineer, and Royal Sornsen is field engineer.

ARCH BRIDGE

(Continued from page 36)

On each side of the banks of the stream below the bridge are protective tunnels of Armco corrugated steel pipe. The tunnels allow personnel to pass beneath the bridge without the danger of being struck by falling objects. It's the result of a recommendation of a safety committee which was established on the job by the Bureau of Reclamation. Each contractor has a representative on the committee and the committee has weekly meetings. Although the decisions of the safety committee were not binding on any of the contractors, generally anything that was agreed on at meetings was carried out.

The safety record for a hazardous project of this sort was quite remarkable. There were no fatalities and only a few lost-time injuries. A safety net suspended from the arch at all times saved the lives of three men. It is a very satisfying thing to see a man come out of the net and lose only 5 minutes work in a day rather than his life.

The author was project manager for Kiewit—Judson Pacific-Murphy, a joint venture. Superintendent was William Choate, project engineer was Al Tokola, and assistant project engineer was Eero Hekkanen. James McKeown was assistant job superintendent in charge of cable tensioning. Lee Boswell was erection superintendent. Howard Garner, Joe Fogliatti and "Red" Hall were in charge of riveting.

Robert Sailer, head of the bridges section in the Bureau of Reclamation Denver office, designed the bridge. Bridge inspectors were Howard Perkins and Walter C. Chubbuck.

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Barber-Greenes produce 274,000 tons of mix for access road at Glen Canyon Dam

Two Barber-Greene Continuous-Type Asphalt Plants produced over a quarter million tons of mix for the vital, 26-mile access road to the Glen Canyon Dam site in Arizona. The plants maintained a combined output of 560 tons per hour.

The new Model 848-A Plant (above) mixed high-type asphaltic concrete at 210 tons per hour. The other plant produced base mix at 350 tons per hour. This consistent high production allowed the contractor to produce and lay a total of 165,000 tons of base mix and 109,000 tons of asphaltic concrete in record time.

Two Barber-Greene Finishers easily kept pace with the fast-moving construction schedules. Operating speeds averaged 40 feet per minute, and 7% grades were negotiated regularly, despite 30-ton pay loads in some of the supply trucks.

The new Model 879-B Finisher offers a new transmission, higher speed tamper, new crawlers, and new power unit.

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EQUIPMENT—

REMOTENESS DICTATES self-sufficiency, and master mechanic Art Moren has a machine shop and warehouse which are probably the best equipped in the West. The maintenance shop alone is a Butler building which measures 201 x 60 ft. The machine shop has a variety of equipment which makes almost any repair imaginable possible right on the job. The warehouse has an inventory of parts worth more than $400,000. Only half of this, however, is owned by the contractor. The rest is sold on an over-the-counter basis by two manufacturers who have large amounts of equipment on the project, International Harvester and Cummins. International has an inventory of parts costing about $150,000, while Cummins has about $50,000 worth of parts on the job.

All vehicles are supplied with rubber by the B. F. Goodrich Co.

MC&S keeps its inventory by the Cardex perpetual draw card system, while International Harvester is using the Diebold circular card file system.

Included in the machine shop equipment is a J. J. McCabe lathe which can turn a 10-ft. long piece of material 40 in. in diameter; a La Blanc Regal 15-in. lathe; a Gould Eberhardt shaper; a Van Norman milling machine; a Soleberg drill press; a Carlton radial drill; and a K. R. Wilson hydraulic press. Overhead is a 10-ton traveling Shaw Box crane. In the shop and out in the field are about 15 Hobart welding machines.

In the summer months the air temperature often reaches 110 deg. To protect equipment from overheating several modifications have been made. On truck engines electric switches have been installed which shut the engine off when the engine temperature reaches 200 deg. or when the oil pressure drops below 20 psi. To enable engine cooling systems to function at greater efficiency, holes have been drilled in water jacket thermostats so that more water can pass.

MAJOR EQUIPMENT
Merritt-Chapman & Scott

20	International Harvester Payhaulers
9	International Harvester TD 24 tractors
4	Caterpillar D9 tractors
1	2400 Lima crane
2	1601 Lima cranes
1	3500 Manitowoc crane
4	Marion shovels
2	43M Marion truck cranes
2	Lorain truck cranes
5	Euclid bottom-dump trucks
3	Mack transit-mix trucks
12	Mack trucks
12	20-ton Cook Brothers bottom-dumps
2	Fruehauf trucks
3	Mack tractors
3	International Harvester tractors
2	1700 Joy stationary compressors
8	600 Joy compressors
4	630 Joy compressors
2	125 Joy compressors
2	600 Gardner-Denver compressors
2	600 Ingersoll-Rand compressors
6	Koehring Dumptors
3	Double Pumpcrete machines
2	Wayne busses
6	International Harvester flat beds
6	International Harvester service trucks
3	International Harvester fuel trucks
2	International Harvester grease trucks
36	International Harvester pick-ups

MERRITT-CHAPMAN & SCOTT has a very well equipped machine and maintenance shop because of the isolation of the project. Major repairs can be handled without much difficulty.

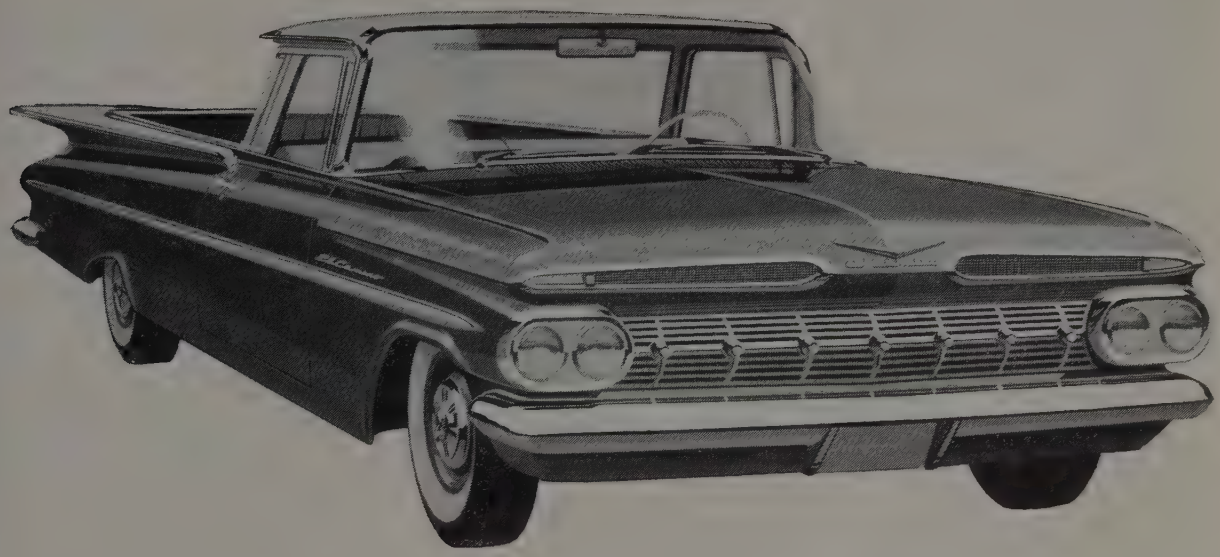
SUBCONTRACTORS have large machines at work also. Here is a LeTourneau-Westinghouse Model D rear dump at work for Frazier-Davis, subcontractor for the underground work.

In addition to high temperatures, severe dust conditions have been a maintenance problem particularly in the underground work. In severe dust conditions a new dry-type air cleaner made by the Farr Company of Los Angeles was found to be much more effective than oil bath air cleaners. The unit contains a centrifugal cleaner which collects the larger particles of dust and discharges them back to the atmosphere with the exhaust gases from the engine. A pleated dry paper cartridge collects any fine particles that escape the centrifugal cleaner. The unusual cleaner requires practically no maintenance.

The preventive maintenance program depends on daily reports from the operators, check lists which are followed at various engine hours, and a careful record of labor and parts. A folder is kept on each piece of major equipment which will travel with it to the next project and which contains all pertinent records.

Servicing equipment in the field are two grease trucks fitted with air-powered Alemite equipment for supplying water, anti-freeze, and all the necessary oils and greases.

Chevrolet's new El Camino combines fresh beauty with a husky pickup box that's 76¼" long, 64¼" wide.



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**Optional at extra cost.*

This 1959 Chevrolet Series 100 heavyweight provides 48,000-lb. G.C.W. . . . comes equipped with big 230-h.p. Workmaster V8 engine!

NEW MIGHT, NEW MODELS, NEW MONEY-SAVING POWER!

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COMMUNICATIONS—

A GOOD SYSTEM of communications is essential on a project that is 67 mi. from the nearest town and is split in two by a deep gorge. The network of telephones and radios at Glen Canyon is one of the most extensive ever developed for a construction project. There are about 65 telephones connecting field offices throughout the project, about 30 vehicles equipped with 2-way radios, and 10 consoles connected by wire to a centrally located 60-ft. high antenna. In addition, Mountain States Telephone & Telegraph Co. has brought in lines from the outside to connect the project to its overall system and has set up an exchange at Page.

When the project first started relay stations were set up to connect the job to Kanab 67 mi. to the west and Flagstaff, 125 mi. to the south. These relay stations have been dismantled, however, as the project is now connected by good roads and telephone lines.

Responsible for the system of job communications is the Morgan Electric Co. of Seattle, subcontractors to Merritt-Chapman & Scott for all electrical aspects of the work.

In addition to the interoffice telephones and 2-way radios, there are about a dozen small soundpower systems connecting spotters to high scaling hoist operators and cableway operators.

The radio equipment is manufactured by General Electric, the telephones by Kellogg.

The big difficulty which was encountered during early stages of the project was that the 2-way radios could not transmit or receive satisfactorily from the bottom of the canyon. Also, because the project is rather spread out, the normal range of good reception, 5 to 10 mi., was sometimes insufficient. For this reason a 60-ft. antenna was erected on a hilltop overlooking the project and 10 consoles were connected to it by wire. Operators of consoles can reach the bottom of the canyon easily as well as any other point in a 25-mi. radius.

In the telephone network at several key locations Teletalks are used rather than conventional telephone fixtures. The Teletalk consists of a small loud speaker and microphone which can be mounted several feet away from the operator, thus giving him full use of his hands. This is a great convenience for the operators of hoists and cableways.

MERRITT-CHAPMAN & SCOTT's emblem, the "Black Horse Flag" flies over the contractor's office building on the west side.

CABLEWAY TOWERS for placing concrete in the dam are now complete and 4-in. diameter lock coil guts have been strung between them. Lines cutting diagonally across pictures are tie-back cables used during bridge construction. At left is landmark called "Beehive Rock".

The accompanying table gives a good idea of the extensiveness of the communications system.

For the Morgan Electric Co., Morgan H. Duffy is general superintendent. General foremen are Bud Starkey, Joe Housley, and Nick Hightower.

Inter-Office telephones

Project manager (A. R. Bacon)
Batch plant (Gus Larson)
Ironworker foreman (Max Bingham)
Carpenter shop (West Side)
Carpenter shop (East side)
Carpenter supt. (Whitey Candaux)
Cost department (Tom Anderson)
Field engineer (Jack Desart)
Electrical shop (Maintenance)
Electrical shop (East side)
Electrical supt. (M. Duffy)
Electrical warehouse (Van Ness)
East side canyon bottom
East side office (J. Lewis)
East footbridge
East downstream portal
East warehouse
Engineering (A. H. Griffin)
Engineering (Nicholson & Moore)
East tunnel upstream
First aid—West side
First aid—East side
Grease shack (J. Brown)
General supt. (F. Jones)
Labor relations (D. Goodwin)
East guard shack
West guard shack
Excavation—East (E. Gilson)
Hanecke, Martin
Headtower—hoist house
Excavation supt. (Ken Hayes)
Judson Pacific-Murphy
Purchasing agent (Al Lundberg)
East dispatcher (Jim Lewis)
Timekeeper (Ed Monk)
Mail room
Master mechanic (Art Moren)
Upstream monkey slide
Nat. Mechanical Contractors
Pumpcrete machine
Powerhouse (Grady Butler)
Riggers (Glen Roper)
Truck dispatch
Safety engineer (Nick Carter)
Asst. supt. (Sid Stewart)
Telephone repairs
Shift superintendent (Bob Test)
Tire shop
Tailtower
Warehouse (C. Borup)
Warehouse (East side)
Warehouse (West side)
Webb, Bill
West tunnel (Lou Lloyd)
West portal
West downstream portal
West footbridge
West keyway

Two-way radio consoles

Main office
Shop—Art Moren
Expediter—S. Corns
East side office
East side warehouse
N. W. portal
Electrical warehouse
West side warehouse
S. E. portal
Pipe shop

Radios are installed in 27 vehicles

(More Glen Canyon on page 59)

DIVERSION—

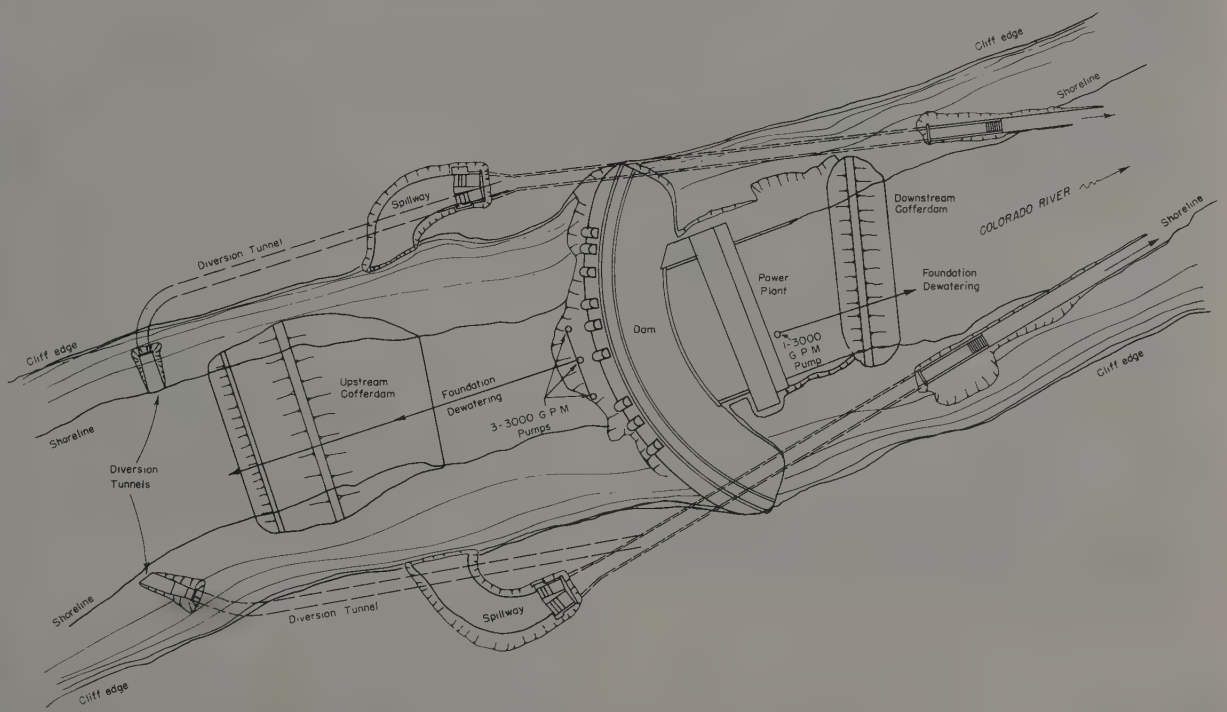
Material stockpiles and earthmoving equipment are ready to rush cofferdams across the river. Twin 41-ft. diameter tunnels will take the flow.

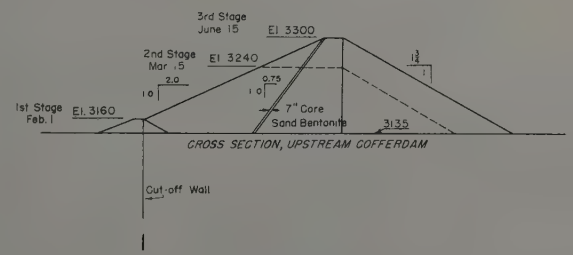
EARLY THIS SPRING, perhaps in February, the Colorado River will be diverted around the dam site through two 41-ft. diameter diversion tunnels as shown in the simplified drawing below. Stockpiled material from the tunnels and from the keyways is already waiting on the shores for use in the cofferdams. When the cofferdams are closed the flow in the river will be about 3,000 cfs.—just a trickle compared to recorded flood flows of 190,000 cfs.

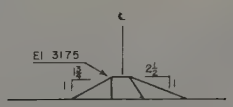
The diverted river will run first through the right diversion tunnel because the elevation of its invert at the intake portal is 35 ft. lower than the left diversion tunnel. This will enable work to continue in the left tunnel—mucking out the spillway shaft and lining the tunnel—while the low flow in the river is carried through the right tunnel. In this way excavation for the dam foundation can start without having to wait for the completion of both tunnels. By the time the flow in the river grows beyond the capacity of the first tunnel—in April or May—the second tunnel will be ready and cofferdams will have been enlarged.

First step in the diversion will be to remove the earth barrier guarding the intake of the right tunnel. This alone will divert perhaps one-third of the flow. Then a small arm of earth or turning dike will be built out from the shore just below the tunnel portal to direct still more of the stream into the tunnel. By diminishing the flow in this way, construction of the main cofferdams will be simplified.

The contractor will then dewater the dam foundation area and keep it dry with four 3,000-gpm. pumps placed as shown in the drawing. The equipment will continue building on the upstream cofferdam until it is 140 ft. high. Imperviousness will be provided by a 7-ft. zone of bentonite.







LOCATION AND CROSS-SECTIONS OF COFFERDAMS

DIVERSION PLAN is shown in the above simplified drawing. (For a complete picture of the job site, see also the drawing on page 38 and the photograph on page 46.) For the next few months the level of the Colorado River will be at its lowest and it will be during this period that the river will be diverted. Stockpiles of material from diversion tunnel and keyway excavation are ready on each side of the river, waiting for the big push. The cross-sections show how much larger the upstream cofferdam is than the downstream dam, and how it will be enlarged in stages. When project is completed cofferdam material will be spread out rather than removed from canyon bottom.

two high-speed LIDGERWOOD

General view of highway bridge under construction across the Colorado River at Glen Canyon Dam, Arizona.

Lifted by Lidgerwood cableway hoist, a steel section swings into place to close the highway bridge arch.

Judson Pacific-Murphy Corporation are the contractors for this bridge.

CABLEWAYS

. . . largest of their type . . . will handle 12-yd concrete buckets at Glen Canyon

● **A third Lidgerwood cableway and an additional Lidgerwood diesel cableway hoist are also being used on this vast dam and highway bridge project.**

Again, as so often in the past, Lidgerwood cableways and hoists have been selected for the heavy and fast lifting jobs on a project that is making engineering history.

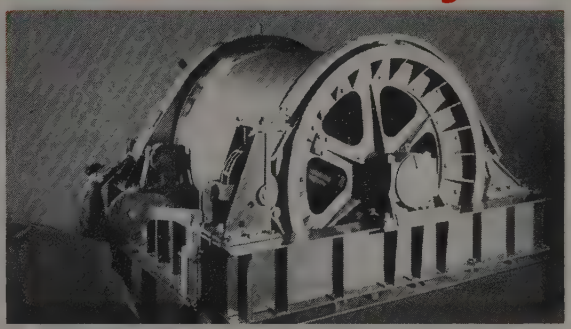
Soon at Glen Canyon, Merritt-Chapman & Scott Corp. will put into operation two 50-ton Lidgerwood electric cableways which will be handling 12-cubic yard concrete buckets at high speed . . . the first time buckets of this size have been employed in dam construction.

Already at work on the project is a 25-ton Lidgerwood electric cableway, being used by Merritt-Chapman & Scott Corporation for preparatory work and lowering equipment. Judson Pacific-Murphy Corporation, contractors for the Glen Canyon Highway Bridge, are using a Lidgerwood diesel-powered hoist to operate a cableway for placing steel.

THE PAY LOADS ON THE BIG JOBS ARE HANDLED BY LIDGERWOOD EQUIPMENT

AT SHASTA DAM, *seven* 25-ton Lidgerwood High-Speed Cableways were used to speed construction.

AT HOOVER DAM, *five* 25-ton Lidgerwood High-Speed Cableways were used. The 150-ton permanent cableway also built for this project by Lidgerwood is the largest cableway ever built.

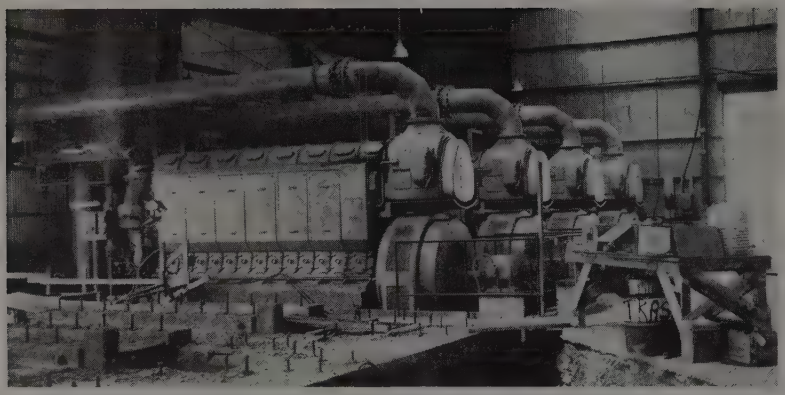


The two sets of Lidgerwood 50-ton high-speed electric hoists, carriages, etc., largest of their type, now being erected at Glen Canyon. *Main cableway hoist (top), conveying cableway hoist (bottom).*

Built for handling 12-cubic yard buckets of concrete in normal service (a work load of 31 tons), they will carry occasional loads of 50 tons in lowering and hoisting machinery and equipment.

Normal hook speed on a four-part line will be 600 FPM, and normal haul speed along the main cable will be 1200 FPM, with empty bucket speeds 10% to 15% greater.

POWER—



FOUR FAIRBANKS MORSE diesel engines, with exhaust silencers and intake filters, generate power for construction plant and town of Page. At left are foundations for 10 more units.

MERRITT-CHAPMAN & SCOTT, under its contract, is required to generate power for its construction and other requirements, for the Government, and for the town of Page.

The power plant now in operation on the project distributes power throughout the job on a grid system which enables everything to keep operating despite isolated breaks in line.

As in all desert regions, electrical storms are a problem. Morgan Electric has installed hundreds of arresters at key points in the network to dissipate the energy of lightning when it strikes the system.

The powerhouse is located in a 70 x 180-ft. Armco steel building. The diesel engines will provide a peak supply of 23,000 hp. for about three years.

In operation in the powerhouse are four Fairbanks Morse opposed 12-cylinder piston engines, type 38-D 8⅛. Each turns out 1,960 hp. at 720 rpm.

The Westinghouse generators are rated at 1,700 kva. (All switchgear is being manufactured by Westinghouse.)

The engines are powered by Standard Oil special burner fuel, which is a lower grade than diesel. Each engine takes about 65 gal. an hour.

The contractor is presently installing 10 more generating units. manufactured by English Electric. They are D-16 diesel engines which turn out 1,850 hp. at 720 rpm. The English Electric generators are rated at 1,379 kva.

All engines are turbocharged.

The Fairbanks Morse engines have exhaust silencers.

Since the English Electric engines draw their air from inside the building, and the high ambient temperatures would cut down efficiencies by about 10%, the contractor plans to air-condition the power plant building.

The following list shows the horsepower needed to generate electricity for the maximum requirements of the various phases of the project.

Batch plant—680
Aggregate plant—1,520
Work shops—160
Dewatering excavation—600
Water supply—2,000
Cableways—600
Air compressors—1,200
Lights—540
Monkey slides—40
Living quarters—1,080
Page—1,600
Refrigeration plant—3,870

In the fourth quarter of 1959 it is expected that the horsepower connected load to the power plant will increase sharply from 4,500 to 15,000. This will occur when the batch plant begins operating, which will require a sudden increase in the power requirements of many other phases such as the aggregate plant, the refrigeration plant, and the water supply.

Power plant superintendent is Grady Butler.

CONCRETE—

AGGREGATE for the 5,000,000 cu. yd. of concrete which is required for the dam will be produced by a plant located 6 mi. north of the job site. Using electrical resistivity methods and exploratory test pits, the contractor explored more than 13,000,000 tons of aggregate in the Wahweep Creek area, a tributary to the Colorado.

About 10% of the aggregate must be beneficiated to separate out the heavy aggregate for use in exterior concrete, which is subjected to weathering action. An unusual flotation process will be used for this as explained in an article in this magazine in the September 1958 issue. The No. 4 to No. 8-in. sand fraction will be

HEAVY MEDIA separation plant, equipped with Barber-Greene conveyors, isolates heavy aggregate for use in exterior concrete. Process is rare for a construction project.

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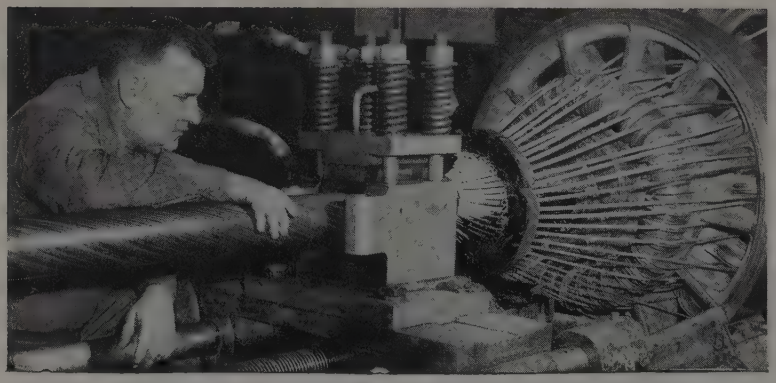
WORKING 700 ft. above the river, workmen make adjustments on pulling rigs before hauling the largest lock-coil cable ever made 2,000 ft. across canyon. Note "jewel" on cable end. Cable can carry 50-ton loads during concrete placement for the dam.



LOCK-COIL cable is shown leaving stranding machine at U. S. Steel's plant in Trenton, N. J. Outer cover of cable is made of 48 lock wires; core contains total of 312 wires.

beneficiated with equipment manufactured by Western Machinery Co. of San Francisco, while the No. 4 to 1½-in. sizes will be processed by equipment built by Southwestern Engineering Co. of Los Angeles.

The contractor investigated several means of transporting the aggregate to the storage stockpiles next to the batch plant at the dam site: a narrow-gage railway, a conveyor belt, and trucks. The railway idea was eliminated first while the other two took considerable study. It was finally decided that a conventional bottom-dump truck hauling operation was the most economical. This is mainly due to the fact that the maximum grade between the two points is only 1½%. If the difference in elevation were greater the conveyor would become more competitive as it could be operated by gravity alone, in addition to the fact that the trucks would have a harder time making the haul.

The main aggregate plant will be in operation several months before the concrete placement starts, scheduled for November of 1959.

A conveyor belt will be used to transport the material 2,000 ft. from the deposits to the plant, a difference in elevation of 300 ft.

The permanent batch plant is being manufactured by the Noble Company of Oakland, Calif. It will contain 6 Smith mixers of 4-yd. capacity arranged in a circle. All aggregate in the storage silos will flow by gravity to the mixers, which are located below the eventual crest of the dam.

The huge fully automatic concrete mixing plant will probably be the largest ever built. Located over the mixers will be 3,000 tons of aggregate storage in eight compartments, and two 700-bbl. batching silos. At the edge of the cliff and connected to the plant by air slides will be seven 10,000-bbl. capacity cement and pozzolan silos, each 30 ft. in diameter. From the base to the top of the re-screening tower, the plant will measure 217 ft. Its construction will begin in the spring of 1959.

The maximum capacity for the plant will approach 480 cu. yd. per hr.

Specifications require that the temperature of the concrete when it is being placed shall be between the temperatures of 40 and 50 deg. F. To meet this specification a refrigeration plant is being assembled by Lewis Refrigeration Co. of Seattle. Cool air will be forced through the plus No. ¾ aggregate silos, the incoming conveyor belt carrying aggregate will pass through an insulated tunnel where cold water will be sprayed on it, flaked ice will be mixed with the concrete, and cold water will be circulated through pipes in the mass concrete.

The present batch plant is a C. S. Johnson with two Koehring 4-yd. tilting mixers. The plant has a 300-bbl. cement silo and a capacity of 100-125 yd. per hr.

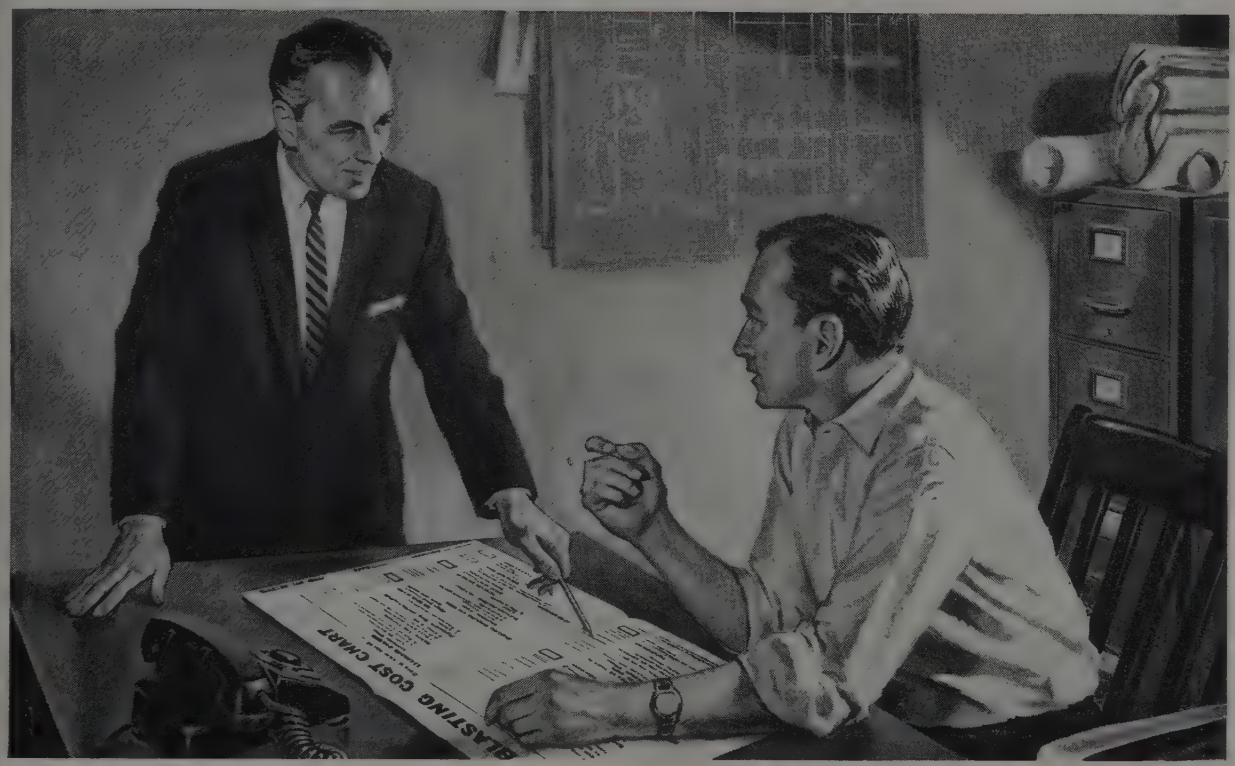
The plant is fully automatic and has a switch by which the operator can select any one of ten mixes.

The main job presently being handled by this temporary batch plant is production of concrete for use in the lining of the diversion tunnels. The pounds in a typical 4-yd. lining mix are as follows: cement—1,492; sand—4,507; ¾—3,270; 1½—2,893; 2½—2,995; water—803; pozzolan—8.06; A. E. H. (Protex)—4.5 oz.

Contract to supply 3,000,000 bbl. of cement has been awarded to the American Cement Corp., of Los Angeles. The low bid was less than $3.25 a bbl. or $9,740,000 for the total. To supply the cement a new mill is being built at Clarkdale, Ariz., 140 mi. south of the dam site, with Fisher Construction Co. as general contractor.

Concrete will be placed with two 50-ton cableways with traveling head- and tail-towers. Load carrying cables are 4-in. lock coils, the largest ever made, a product of U. S. Steel.

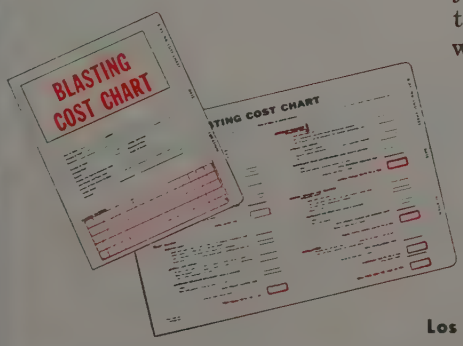
TRUE
WHAT ARE YOUR ^ BLASTING COSTS?



Get a complete profit picture with new, free Blasting Cost Chart! Let the Atlas Man show you how

Explosives costs alone don't always determine value of a blast. The explosives used have a direct effect on drilling, digging, hauling and crushing costs. Now, a free, simplified computing method—developed by Atlas, gives you a true, complete cost analysis of profits, without involved bookkeeping.

The Atlas Blasting Cost Chart enables you to protect or improve your profits. What's more, it's yours without cost and you can keep your figures confidential. The Atlas representative nearest you will be glad to show you how it works—without obligation.



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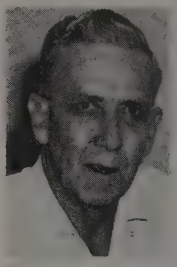
A. R. BACON

Key personnel—Glen Canyon Dam Project

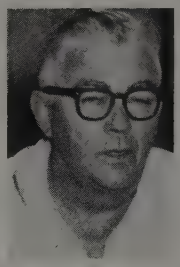
Merritt-Chapman & Scott Corporation

General Contractor

L. E. HOYNES

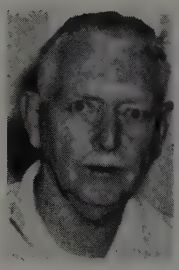


FORREST JONES

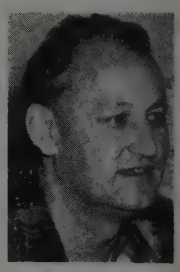


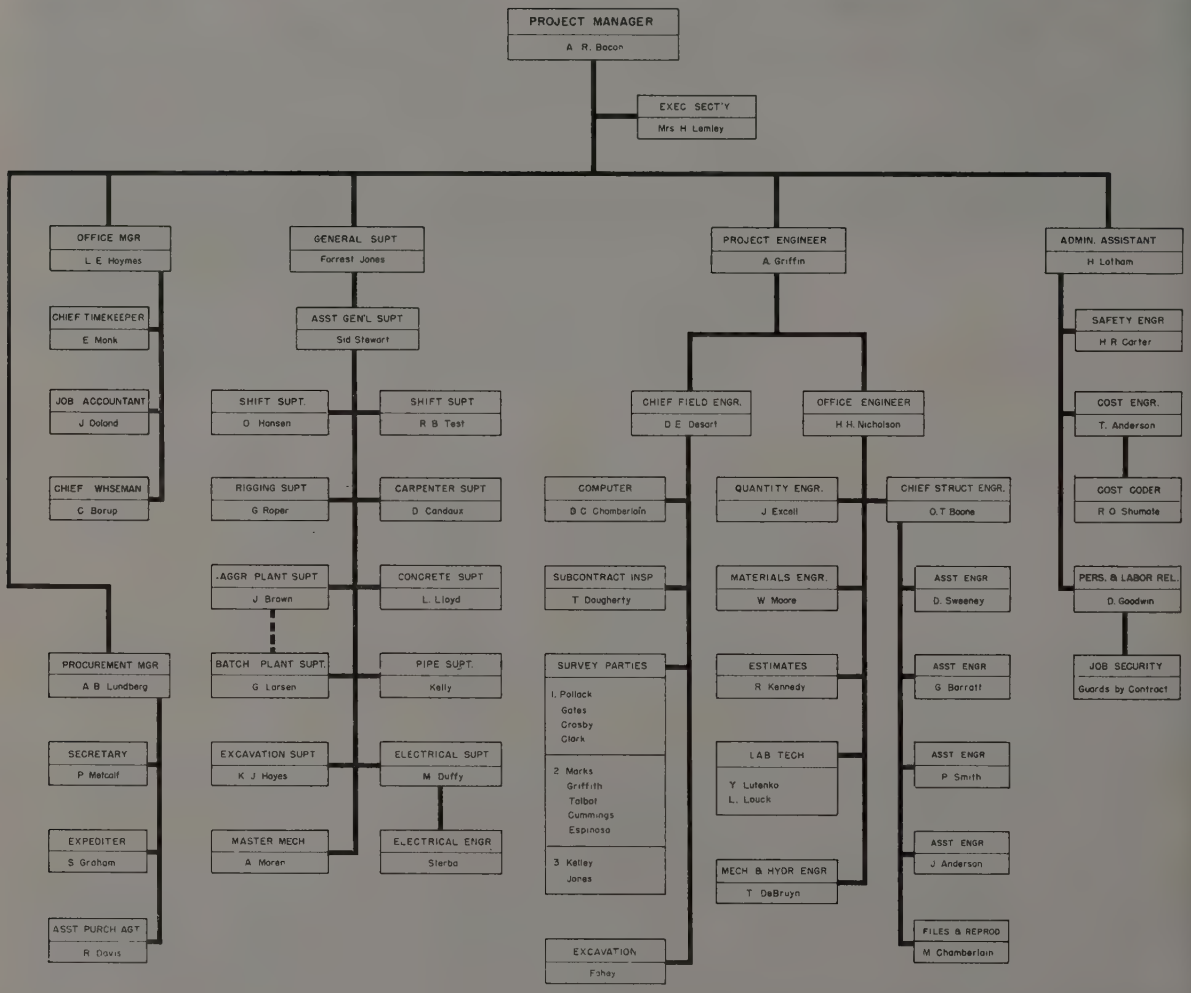
SID STEWART

A. H. GRIFFIN



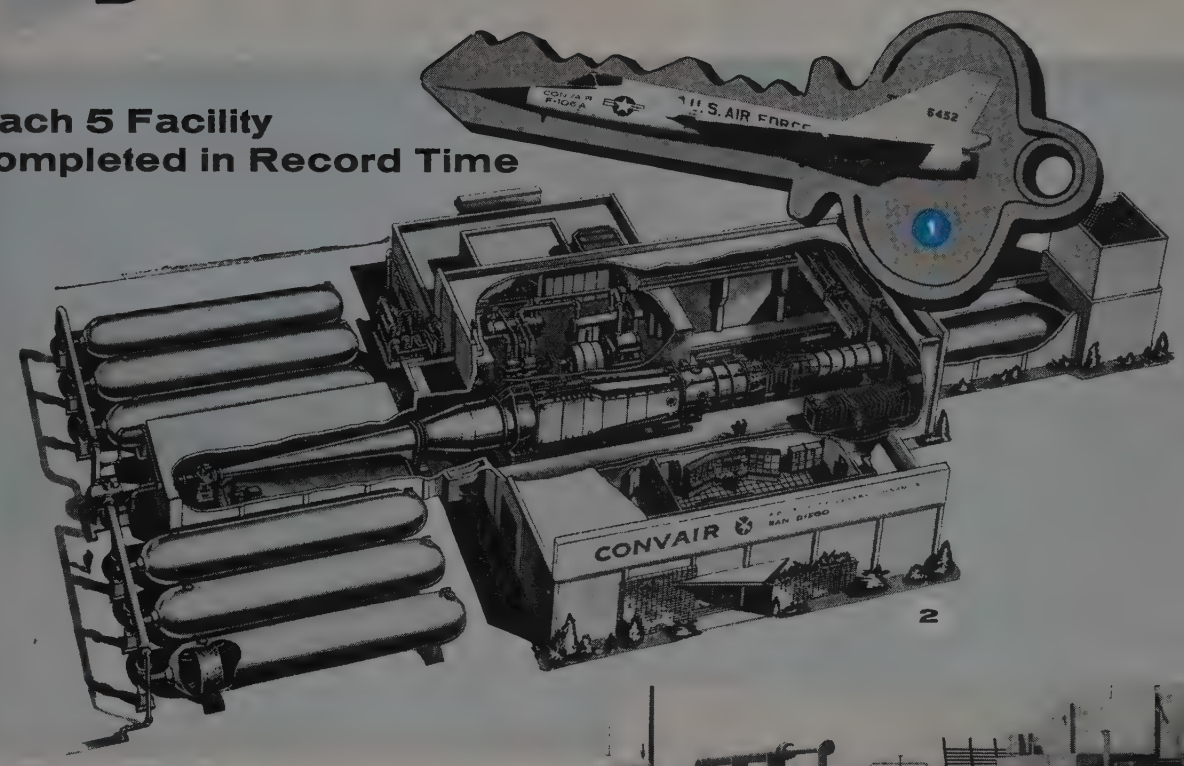
H. LATHAM

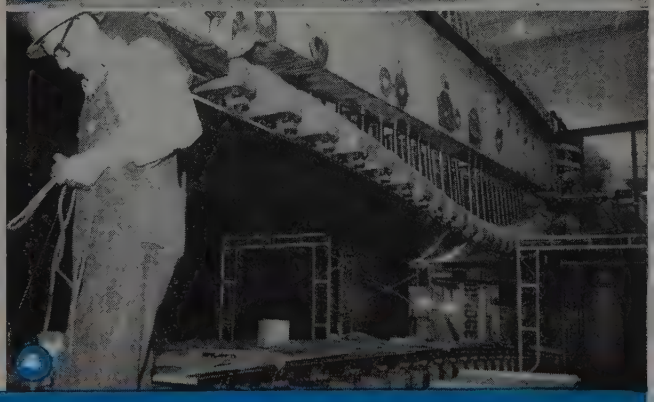




CB&I turns the key on construction of Convair Supersonic Wind Tunnel

Mach 5 Facility Completed in Record Time





B&I specialists, working in cooperation with *Flui ne* Engineering Corporation, handled the engineer-, fabrication and assembly of this country's first urn-key" supersonic wind tunnel. Built for Convair vision of General Dynamics Corporation, the inter-ttent *blow-down* type tunnel is capable of simulating eeds that range from Mach 0.5 to 5 (five times the eed of sound).

This $3,500,000 project for Convair is one of several ersonic test facilities in which the coordinated ilities of CB&I are playing a major role. These ne engineering, fabrication and erection services can vide *you* with the benefits of *one source craftsman-p in steel*—with which CB&I has served industry, ence and government for almost seven decades. ite our nearest office for a copy of the *Convair Story*.

E62CB

-106 A **Delta Dart,** supersonic all-weather rceptor being manufactured by Convair for United States Air Force.

Sketch shows major components of CB&I-built 3,700 H wind tunnel at Convair plant, San Diego, California.

Six CB&I-built tanks store air at 600-psi for inter-ent blow-down type tunnel.

Tunnel "throat" or nozzle is comprised of flexible es to generate flow from Mach 1.6 to 5—was precision

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WESTERN CONSTRUCTION NEWS

Closing gap in U.S. Highway 101

DESIGN approval has been secured from the Corps of Engineers for a bridge to be built across the Columbia at Astoria. This crossing from Astoria to Megler, Wash., would provide for the first time a highway extending along the Pacific Coast (U.S. 101) from Mexico to Canada without interruption by ferry.

The project has been in the planning stage for considerable time and required the consent of both the Navy and the Army Engineers. A recent revision in design, with a 198-ft. vertical clearance, has been completed to comply with all Federal restrictions and the permit has been issued for construction to begin within two years. If construction is not started within this specified time the permit could be extended.

The project will be a joint effort of the Oregon and Washington highway departments, with Oregon carrying out design and construction while Washington would handle financing and subsequent operations. The structure would be a toll bridge and additional studies are being made to indicate financial feasibility under current conditions, as a supplement to a full report prepared several years ago.

Bruces Eddy Dam enters active stage

BRUCES EDDY DAM took on an active project status in the construction progress report of the Army Engineer District, Walla Walla, with the mailing out of invitations for bids on exploratory drilling at the proposed site 1.9 mi. upstream from the mouth of the North Fork on the Clearwater River near Ahashka, Idaho. Diamond drilling and core borings on both sides of the canyon will help determine the design of the dam. The Corps is also utilizing preliminary data secured by the Washington Water Power Co. during its site exploratory work and study made in 1955.

Under present plans, Bruces Eddy Dam will be 570 ft. in effective height and will create a reservoir with a gross storage of 2,460,000 ac. ft. In its design, Bruces Eddy will be made to include log passing facilities for the marketing of large amounts of merchantable timber in the area. Storage of logs in the reservoir would be permissible and movement through the reservoir would be by log rafts with open river driving through the natural channels. It is contemplated that the log passage facilities will be originally installed and constructed by the Federal government with all cost of operation and maintenance being borne by owners of the logs being moved past the dam under contractual arrangement.

NEW PUBLIC WORKS DIRECTOR

T. F. BAGSHAW, newly appointed director of the State Department of Public Works and Chairman of the California Highway Commission. He succeeds *C. M. Gilliss*, who resigned to become Los Angeles County road commissioner. An official of the Department and associated with the Highway Commission for more than five years, Bagshaw was assistant director at Sacramento since January 1957.

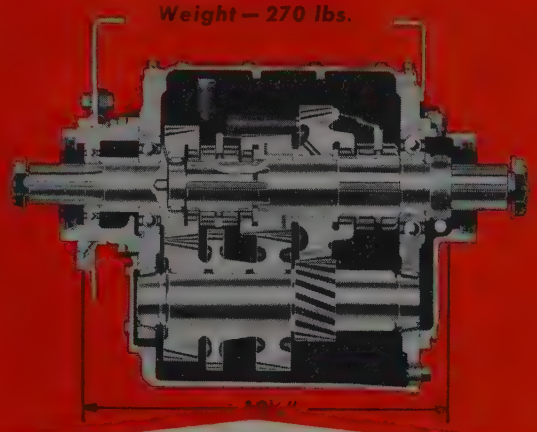
STUDYING MODEL FOR SKAGIT RIVER DIVERSION PLAN

Discussing the results of the hydraulic studies of the proposed plan for diverting the Skagit River for the second-stage construction of Seattle City Light's high Gorge Dam are (left to right) City Light superintendent *Paul J. Raver*, chief civil engineer *C. Ray Hoidal*, professor *Harry H. Chenoweth* of the University of Washington School of Civil Engineering, chief engineer *Herbert V. Strandberg* and professor *Eugene P. Richey*.

Prineville Dam contract

A $2,614,944 contract has been awarded by the Bureau of Reclamation to Keystone Construction Co. and Associates for building Prineville Dam, on the Crooked River in central Oregon. The low bidder will have two years and four months to complete the job.

Model 3-A-65
Weight — 270 lbs.

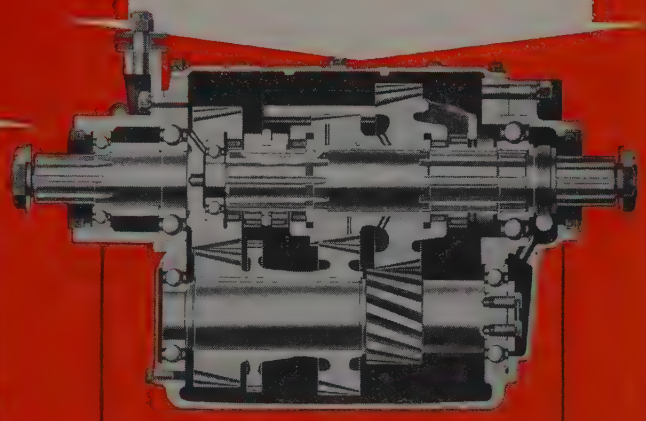


92 Series (Heavy-Duty)

MODEL	RATIOS		
	High	*Medium*	*Low*
3-A-92	.75	1.00	2.09
3-B-92	.84	1.00	1.24
3-C-92	.75	1.00	2.64
3-D-92	.75	1.00	1.24
3-E-92	.84	1.00	2.09
3-F-92	.84	1.00	2.64
3-G-92	1.00	1.327	2.09
3-H-92	1.00	1.327	2.64

65 Series (Medium-Heavy-Duty)

MODEL	RATIOS		
	High	*Medium*	*Low*
3-A-65	.754	1.00	2.221
3-B-65	.804	1.00	1.239
3-C-65	.754	1.00	1.239
3-D-65	.804	1.00	2.221
3-E-65	.804	1.00	1.74
3-F-65	.754	1.00	1.74
3-G-65	1.00	1.32	2.221
3-H-65	1.00	1.32	1.74



Model 3-A-92 · Weight — 350 lbs.

22¾"

Now ...the most complete line of 3-speed AUXILIARY Transmissions

The Fuller Manufacturing Company now offers the most complete line of three-speed auxiliary transmissions . . . for transport, logging, construction, mining and crane carrier services . . . at lower prices than competitive units in a comparative capacity range.

The extremely rugged heavy-duty 92 Series has been completed by the addition of 5 new sets of gear ratios, Models 3-D-92 through 3-H-92. Four new sets of gear ratios, Models 3-E-65 through 3-H-65 have been added to the medium heavy-duty 65 Series.

Split Gears and GO

The expanded line of three-speed auxiliary units includes splitting ratios, both underdrive and overdrive. With these splitting ratios, the engine can operate at maximum horsepower through a full range of vehicle speeds. Ideal for over-highway operation, the extra gears allow faster schedules, greater profits.

Deep Reductions

Deep reductions, in combination with splitting ratios, offer maximum flexibility both on and off-highway where the deep reduction is required for extreme grades and soft footing, and where splitting efficiency is required for traffic conditions.

Longer Equipment Life

With engines working in the most efficient torque and horse-power range, there is less lugging . . . less wear . . . and greater fuel economy. Result: lower maintenance costs, less downtime, longer engine and transmission life.

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FULLER MANUFACTURING CO. Transmission Division • Kalamazoo, Mich.
Subsidiary, Eaton Manufacturing Company

Unit Drop Forge Div., Milwaukee 1, Wis. • Shuler Axle Co., Louisville, Ky. (Subsidiary) • Sales & Service, All Products, West. Dist. Branch, Oakland 6, Cal. and Southwest Dist. Office, Tulsa 3, Okla.

. . . for more details, circle No. 31 on Reader Service Postcard

California highway budget approved

THE California Highway Commission has adopted a state highway budget for the 1959-60 fiscal year with $491,000,000 for construction, including rights-of-way. The budget requires that the legislature take action to retain highway user taxes at their present levels instead of allowing some of them to drop back on Jan. 1, 1960. Present law provides for the gas tax to be changed from 6c per gal. to 5½c on that date.

There is an 18% increase in the 1959-60 budget over the current one. The increase comes mainly from the apportionment of Federal Aid for Interstate System highways on the basis of each state's actual needs instead of on the previous area-population-post road mileage formula. Congress' decision to follow the needs formula raised California's share of Interstate apportionments from less than 6% of the national total to about 10%.

The Federal Aid apportionment to California for 1959-60 is $302,020,852, of which $252,779,750 is for the Interstate System. The original 1958-59 Federal Aid apportionment, based on the old formula, was $163,409,763, of which $115,365,437 was Interstate. These were increased last April to $197,077,767 and $126,959,953, respectively.

Major sources of state-collected highway revenue expected in the 1959-60 budget include: $233,070,000 in gasoline taxes (up $3,000,000 from the previous year's estimate); $44,337,000 from motor vehicle fees, and $20,000,000 from use fuel (diesel) tax.

The $491,000,000 in the budget for state highway construction purposes includes: Major construction and improvement (contracts plus engineering), $356,977,000; rights-of-way, $127,500,000; contingencies (normally available for construction purposes), $6,645,403; resurfacing program, $5,000,000; minor improvements, $800,000.

Proposed expenditures for state highway purposes other than construction include: Maintenance, $36,200,000; buildings and plants, $10,000,000; administration, $9,800,000; statewide highway planning survey, $3,000,000; maintenance of San Francisco Bay area state-owned toll bridges, $2,200,000; and honor camps, $1,750,000.

The 1959-60 budget contains a number of items which are only partly financed in a single fiscal year. This two-year budgeting was provided for by legislation enacted in 1957, and was first used in the 1958-59 budget. This procedure has proved successful in placing particularly large and complex projects under contract without tying up heavy amounts of highway funds in a single budget item.

State Highway Engineer G. T. McCoy informed the Commission that right-of-way acquisition and plans had already been completed on some of the projects included in the new budget, and that these projects could be advertised for bids beginning in mid-November.

EBMUD construction plans

CONSTRUCTION ACTIVITY resulting from a successful $252,000,000 bond issue election moves a step closer, according to the East Bay Municipal Utility District. The district has awarded a contract to Kaiser Engineers for study of location and design for the new Briones Dam and the proposed Lafayette tunnel.

In the case of the tunnel the engineering study will indicate route, size and a cost estimate. In the case of the dam, Kaiser Engineers will review and check the field investigations made by engineers of the district and will review present designs and prepare an estimate of construction costs.

Colorado improves U. S. 40

COLORADO is improving an important link in U. S. Highway 40. At a cost estimated at more than $2,000,000, about 4.7 mi. of widening will be awarded for a job on the west side of Rabbit Ears Pass. A year ago work was started on a previous improvement section which provided a passing lane on the west side of the pass covering a distance of 3 mi. The new project will bring the improvement program up to within 7 mi. of the summit of this important pass.

Northwest program of Army Engineers

CONTRACT BIDS will be invited by the four districts of the North Pacific Division, Corps of Engineers, on civil works estimated to cost $70,000,000 during the fiscal year ending June 30, 1959, according to Col. Allen F. Clark, Jr., Division Engineer. Bid calls will be issued by the Portland, Walla Walla, Seattle and Alaska districts on 54 major civil works projects involving an expenditure of more than $35,000,000 between now and the end of the fiscal year. Most of the larger contracts are continuing, however, and involve commitments of about $160,000,000 extending over a period of several years.

The Portland District will invite bids on 22 major items of work estimated to cost $33,300,000 when carried to completion. The Walla Walla District will consider bids on 27 major contract items costing $112,900,000 when completed. Seattle District will ask bids on three major works aggregating about $11,100,000, and Alaska District will call contract figures on two projects costing an estimated $1,400,000.

The work program includes river and harbor dredging, dam construction, design and installation of turbines and generators, levee and bank protection work, construction of buildings, paving and landscaping, exploratory drilling and numerous other items.

Included in the program are three contract items involving dam construction costing over $10,000,000 each; two are in the Walla Walla District and one in the Portland District.

The Walla Walla District will open bids early in June, 1959, on the John Day Dam north shore construction contract, including navigation lock, spillway dam, north shore fish ladder and a portion of the S. P. & S. railway relocation. The district will open bids about April 1 on the Ice Harbor Dam north shore construction contract, including navigation lock, right abutment, spillway bays and north shore fishway.

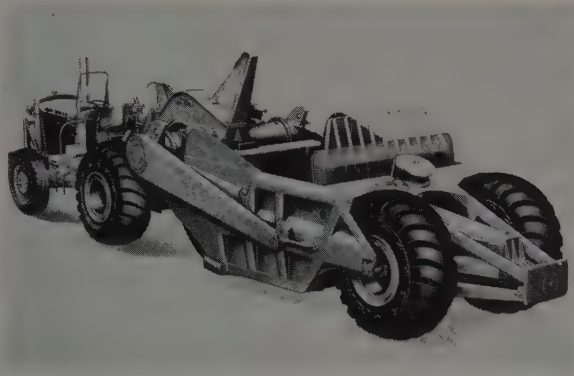
The Portland District's only contract item in the $10,000,000-or-over bracket calls for construction of the dam outlet works and power intake for Cougar Reservoir on the South Fork of the McKenzie River. Bids are scheduled for opening February 3.

The Seattle District opened bids November 21 on construction of a rock-fill dam, spillway, outlet works and administration building at Howard A. Hanson (Eagle Gorge) Dam on the Green River in western Washington.

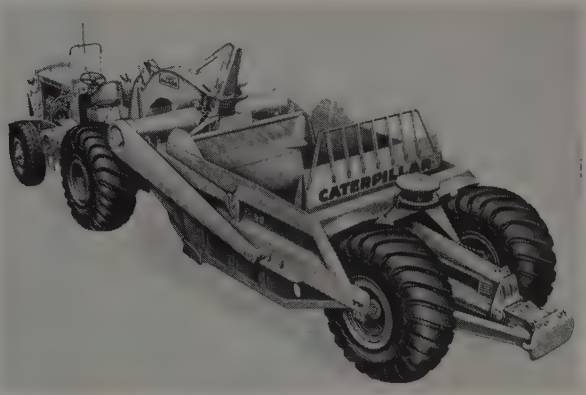
CATERPILLAR'S PROJECT PAYDIRT

PROJECT PAYDIRT pays off for you...

NOW 2 SCRAPERS FOR THE DW20!



The new LOWBOWL
NO. 482
24 cu. yd. struck
34 cu. yd. heaped



The popular LOWBOWL
NO. 456
18 cu. yd. struck
25 cu. yd. heaped

To broaden the profitable uses of the high-speed DW20 four-wheel Tractor, Caterpillar now offers a big new LOWBOWL Scraper—the No. 482, rated at 24 cu. yd. struck, 34 cu. yd. heaped.

The popular No. 456, rated at 18 cu. yd. struck and 25 cu. yd. heaped, remains in the line. As a result, this provides you with a choice of two sizes of rugged, heavy-duty scrapers to better match the DW20 to the material and haul conditions on your job.

In short, here's where each scraper will fit best for maximum production at lowest cost per yard: The No. 482—in good loading conditions and haul roads of minimum grades and low rolling resistance. The No. 456—on adverse grades and average-to-high resistance haul road conditions.

In addition to the Cat No. 482 and No. 456 Scrapers, a complete Athey wagon line is available for use with the DW20. Whatever the job, you'll find the right earthmovers for it at your Caterpillar Dealer. See him today for complete facts about the big new No. 482.

Caterpillar Tractor Co., San Francisco, Cal.; Peoria, Ill., U.S.A.

Additional facts about the No. 482

Like all developments of Caterpillar's PROJECT PAYDIRT, the No. 482 has been thoroughly tested in the field. Its high capacity offers the increased production essential to profitable performance on today's big jobs. It uses 33.5 x 33 (26-PR) tires. It is cable operated for fast, accurate control. Its three-piece "Spacesaver" draft frame can be disassembled to provide a shipping width of only 11′ 6″—three inches narrower than the No. 456. Its new bowl lift design and new push block arrangement increase loading and dumping efficiency. And its sturdy, simplified construction delivers many hours of trouble-free operation with minimum maintenance.

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PROJECT PAYDIRT:

Caterpillar's multi-million-dollar research and development program—to meet the continuing challenge of the greatest construction era in history with the highest production earth-moving machines in the field.

Slurry seal news from Montana

IN THE ISSUE of February 1958, K. E. Bainum, assistant city engineer of Billings, Montana, reviewed the use of slurry seal on the runways of their municipal airport. Having noted the more recent discussion of the subject (August 1958) indicating current developments of the Los Angeles County Road Department, Bainum wrote to WESTERN CONSTRUCTION as follows:

"It was with considerable interest that I noted the review of slurry seal results as carried out by the Los Angeles County Road Department. Your mention of our last year's project in the August issue prompts me to furnish a brief further report.

"I think it might be summed up rather quickly by stating that we propose to award a contract for 185,000 sq. yd. of additional slurry sealing at our municipal airport. This will more-or-less seal everything which we were unable to take care of last year.

"We are well pleased with the condition and durability of the slurry placed last fall. Granted, we had a rather mild winter with only a minus-five degree recorded as the lowest temperature at the weather bureau located at the airport. These results are all the more gratifying inasmuch as this mild winter was followed by long and wet spring through which the seal held up wonderfully. I am fully convinced that this method of sealing offers an economical solution to countless agencies faced with the necessity of saving asphaltic surfaces with a minimum budget.

Specs and methods

"We find ourselves in complete agreement with the statements from Los Angeles County in your August review that the material specifications and methods of application seem to offer few, if any, opportunities for change. We will, however, use SS-1h (SS-2) emulsified asphalt in the coming work. The aggregate specs will be the same, but a closer inspection will be maintained for any stray particles exceeding the maximum sieve size. These leave a very visible welt or blister as they pass under the rubber wiping screed. No appreciable harm, but it does not add anything to the appearance of the job.

"We shall also schedule the work areas to prevent traffic from having to cross or work in the sealed area until the material has dried sufficiently to prevent tracking or marking permanently. Here again, no damage is done, but it simply detracts from the extremely consistent surface texture the slurry seal affords."

Alaskan asphalt surfacing

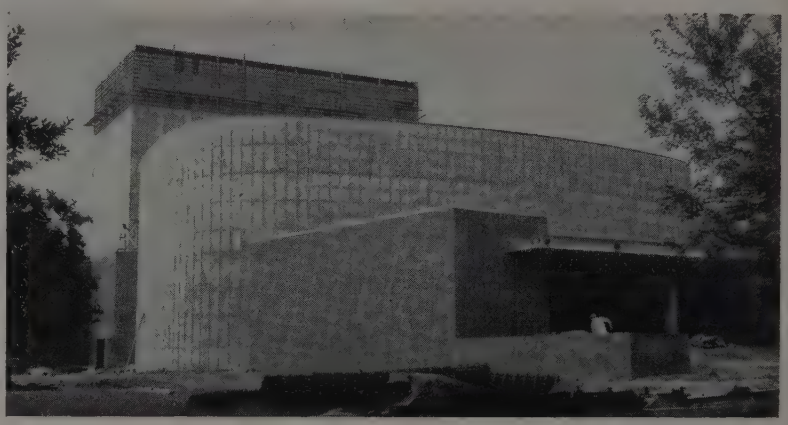
ASPHALT surfacing on a total of about 70 mi. of highway in Alaska will be carried out next season if bids are accepted at the regional office at the Bureau of Public Roads. Bids were to be opened October 21 for two contracts which provide for surfacing from Midway Lake to the Canadian border. The work will be let under two contracts which include crushed aggregate base, asphalt prime coat, surface treatment and some bituminous curbing. Most of the work will be carried out next season and completion date is December 1, 1959.

Private highway for 100-ton hauling units

MONSANTO Chemical Co. will build a private road between its phosphorus plant at Soda Springs, Idaho, and its phosphate mine 11.2 mi. away. The road, to be constructed by Morrison-Knudsen Co., will enable use of special carrier units capable of hauling 75 tons of ore each trip. The new carrier units are being specially designed by Mack Truck Co. and will consist of a tractor unit, a two-axle trailer, and a four-axle trailer. Each unit, 75 ft. long, will have a gross weight of about 100 tons. The truck units are believed to be the largest highway haulers in the United States.

The road will be 26 ft. wide. A 2½-ft. phosphorus slag ballast will form the base to be capped with a 6-in. layer of mixed crushed slag and quartzite chips and topped with a 4-in. layer of crushed slag and binder.

Forming wall with three curves



FORMING A concrete wall that has three rates of curvature is a task that requires careful pre-planning. That was one of the problems that faced the Carver Construction Co. when they tackled the Modesto Junior College Auditorium job at Modesto, Calif.

The job was difficult due to the curved walls of the main auditorium. The walls have three rates of curvature, namely, the bank at 136-ft. radius, the sides at 112-ft. 6-in. radius and a smooth transition curve between.

Universal Form Clamp Co. and the contractor worked out the forming system for the curved walls before bid time. Due to the pleasing appearance obtained, the architect, Harry J. Devine of Sacramento, approved the use of panels on the stagehouse as well. The curved surfaces have vertical rustication marks at 1-ft. 6-in. centers.

Carver, after consulting with Universal's engineering staff, decided upon 2 x 3-ft. Uni-Form panels placed in a horizontal position so that the rustications fell on the joints and at the intermediate points. Special ties were inserted after the forms and rustications were placed.

Johnny Skaggs was the superintendent on this job and Harold Johnson was the inspector.

NEW SOULE' 20'-25' STEEL BUILDINGS

New 20′ and 25′ wide Soulé Buildings make perfect temporary structures for construction sites. Use them as job shacks, equipment garages, bunk houses and warehouses. They offer the same low initial cost, ease of erection, ruggedness and versatility of larger Soulé Buildings. And what's best is their ease of dismantling to move to new sites! Get the facts about these multi-use 20-25 Soulé Buildings right away.

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ALASKA Newsletter

By CLIFFORD S. CERNICK, Fairbanks

THE ATOM AGE – Events in Alaska's construction industry move so rapidly that occasionally we may lose sight of developments which are earth-shaking in more ways than one. As a newsman and long-time reporter for *Western Construction*, I feel that perhaps the most important construction news story that has come across my desk in the past decade is the announcement that atomic power will be used to blast out a harbor at Cape Thompson on Kotzebue Sound. Use of atomic power to move a mass of dirt approximating the size of the Great Pyramid from the bottom of the sea opens up vast new possibilities – and new problems – for the construction industry. Leaders in the industry might begin thinking about the potential of atomic power and what its uses might be in the atomic era we have entered. For this reason, the construction industry should be more than a little interested in the atom blast planned at Cape Thompson, which is 250 mi. south of Point Barrow. The project is scheduled tentatively for the summer of 1960.

IDEAL LOCATION – No better location for the big blast could have been chosen. Only a handful of natives live in the Cape Thompson region. The danger from fallout thus can be controlled by evacuating the few residents of the area. The big blast will open up coal deposits in the area as well as provide a deep-water harbor. Several charges will be simultaneously detonated to provide an access channel 2,000 yd. long. A turn-around basin also is planned. This is slated to be 1,000 ft. wide and 2,000 yd. long. The announcement made by Sen. Henry Jackson of Washington state discloses that the blast will be equivalent to a few millions of tons of TNT. It has been estimated that the overall job would cost anywhere from 25 to 95 million. Success of this "big blast" on Alaska's Arctic "frontier" could be the signal for the use of atomic power for excavation on similar jobs elsewhere – including work on dams and roads.

NEW STATE'S BUDGET – One indication that construction activity will continue to increase under statehood comes from the budget figures for the new state. Although the state legislature will make actual appropriation of funds, the Territorial budget director has prepared estimates of the funds that will be needed and these run as high as $40,000,000. Although this figure will probably be pared down some by economy-minded legislators, it's believed the new budget will be an all-time high, and a good percentage of the cash will continue to be spent on construction.

ALASKA HIRING—Alaska hiring of carpenters for Alaskan jobs was among the topics scheduled for discussion at the international convention of the Carpenters and Joiners of America. Lewis Dischner, president of the Alaska Council, said in Fairbanks that he would introduce a resolution to that effect at the convention in St. Louis, Mo. Dischner said many of the jobs in southeastern Alaska are being filled through Seattle union locals rather than Alaska locals. "We believe Alaska locals should have this function," he said. Approximately 4,800 carpenters are represented by the 13 locals of the Alaska Council.

ON THE WATERFRONT—Five new channel and harbor projects in southeastern Alaska have been scheduled by the U. S. Army Engineer District. The projects are part of the District's civil works program. The new Alaskan projects are expected to have a total cost of nearly $3,000,000. Largest of the five projects in the 1959 program will be dredging of Gastineau Channel. This project goes up for bid in January and will have an estimated total cost of about $1,150,000. In March, bids will be advertised for channel work on Neva Strait in the Sitka area, a job which will cost in the neighborhood of $400,000. Jobs in the 1959 civil works program already under contract include dredging of a small boat basin at Skagway and channel dredging at both Dry Pass and Rocky Pass.

SEASON OF SNOW—Winter has come to Alaska, putting a deep freeze on a great deal of outside construction activity, except in southeastern Alaska where temperatures are fairly mild. Mobility in Alaska suffers badly in the heart of winter. Travel is difficult, even dangerous. A typical recent example of what can happen on Alaska's frozen highways is the case of the three large flat-bed trailer trucks which recently left Anchorage to transport lumber to Tok Junction and Ft. Greely. One of the big trucks became marooned in axle-deep snow at Haines, the other two were not able to reach Haines and the drivers took shelter in a roadhouse until better driving prevailed. Heavy snows in the high Alaskan passes have often stranded motorists for hours. In areas where temperatures can plunge to 40 and 50 below zero in a very short time, such delays can be fatal unless the driver is equipped to "sit it out" and wait for help to arrive. Traffic is extremely light and on some sections of the highway, several hours may pass before a car comes along. Here's a tip you can file away if you're planning to do any highway travel in Alaska during the winter months: Don't head out unless you have the following minimum items in your car—a good tow chain, a warm parka and gloves, a sleeping bag, a shovel, sand and emergency rations. It's true, you may never need it, then again if the need arises only once in an emergency situation, compliance with this tip could well mean the difference between life and death.

WINTER-PROOF WATER – What happens to a city's water system when the temperature plummets to 40 or 50 below zero? Fairbanks utilities officials had to find the answer to that question when they installed a municipal water system. The solution they hit upon may be of value to those concerned with utility projects in other cold weather areas. Water to supply Fairbanks' needs comes from deep wells and is routed through the condenser system of the municipal utilities plant. There it is heated to about 50 degrees before being turned into a nearby treatment plant for purification. Four booster pumps are used to keep water constantly flowing through the mains at the rate of about three feet per second. To make sure that there will be no interruption in the flow, auxiliary gasoline pumps are kept on standby, ready to take over in event of electrical failure. The key to the success of the system lies in the constant circulation and preheating.

BIGGEST HOTEL—Biggest commercial construction project in Alaska is the new 600-room Anchorage-Westward hotel scheduled for construction in Anchorage. The impressive new building will tower 16 stories—making it Alaska's tallest "skyscraper." Two hotel corporations in Anchorage were merged to make the project possible. Included in the plans for the swank new hostelry are public meeting rooms, drive-in parking facilities, and several stores and offices. Cost of the new structure was not announced.

CONSTRUCTION NEWS NUGGETS—Walter J. Hickel, millionaire Alaska builder, has teamed up with a Texas oilman to build and develop Alaska real estate properties. First project, according to Hickel, will be a large downtown office building in Anchorage . . . The Army Engineers has called for bids on clearing of 250 ac. of land at Clear, with work to be completed by Feb. 28 . . . Japan is giving much thought to further development of Alaska's resources, particularly coal . . . Alaska is now the fastest growing area under the American flag. The annual 12-month average growth of the Territory since 1950 has been 64% over the previous year. Statehood is expected to accelerate that growth.

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More awards due at California air base

BEFORE the end of January, 1959, the Corps of Engineers plans to award contracts for $9,000,000 more of construction on the Vandenberg Air Force Base. Plans call for bids on 12 separate projects with estimated costs ranging from $4,500 to almost $3,000,000. At the end of that period a total value of construction at this missile base will be nearly $62,000,000. Nature of the new work is not specified but will probably include fuel storage facilities, additional launchers, assembly buildings and access roads.

During October the first of the Atlas Missile service towers, 12 stories high, was completed in record time by Vinnell Steel, Inc., operating as a subcontractor for Fredericksen & Kasler and Stolte, Inc. The officer in charge indicated that erection of this tower had been carried out and completed in a shorter time than ever before allowed for this type of tower.

HAWAII Report

By ALAN GOODFADER, Honolulu

RECORD IS SET—Civilian construction has set a record high on Oahu, with the results of three months of building still to be counted. At the end of September, the City building department had issued 7,764 permits for construction valued at $81,377,174. In all of 1957, the City issued 5,754 for building valued at $78,303,339. Last year was a record year here. In September alone, the City issued permits for $14,267,015, an increase of about $10,000,000 over the August total. Most of the increase was in permits for about $8,000,000 worth of construction for the $12,000,000 Ala Moana shopping center now abuilding.

SHUT-DOWN AVERTED—At the shopping center, a last-minute union-contractor compromise averted a shut-down of construction threatened by the AFL-CIO Brotherhood of Carpenters and Joiners. The union had demanded talks concerning contract conditions with the Hawaiian Land Co., subsidiary of Hawaiian Dredging & Construction Co. which is developing the shopping center. Hawaiian Land had demanded that an NLRB election be held to see if workers wanted the Carpenter's union as their representative. In the compromise, the union agreed to postpone its talk demands and the company agreed to an election overseen by an impartial umpire. A district judge was picked as umpire and in the vote a majority of the carpenters on the job picked the union as their representative.

NEW PROJECT STARTS—As the shopping center—Hawaii's biggest project now under construction—moved on ahead of schedule, the booming construction industry here was given another shot in the arm. Ground-breaking ceremonies were held for an oil refinery which will eventually cost $40,000,000. Prime contractor for the process equipment will be Hawaiian Dredging and the Bechtel Corp. E. E. Black, Ltd., is the contractor for the office, warehouse, shop, laboratory and auxiliary buildings. Some 400 to 600 men will be employed at the job, earning about $10,000,000 in two years. The refinery is expected to be the hub of a new Oahu industrial area on what is now desolate coral lands west of the Barber's Point Naval Air Station. The refinery is scheduled to begin operation in two years.

VOLUME UP—Even before work on the refinery started, construction volume in the Territory was running $50,000,000 ahead of last year, according to the General Contractors' Association of Hawaii. The association put the volume from January through September at $159,467,152, compared to $108,182,214 in the same period last year. This didn't include more than $10,000,000 in governmental and armed services construction in the Pacific. The number of construction men at work swelled to 11,000—a record number.

ANOTHER FIRST—MacDonald Engineering Co. and Hawaiian Dredging used the slip-form method for the first time on the Islands in October to build ten 110-ft. high grain elevators. Working around the clock from Oct. 6 to Oct. 12, about 110 men made the pour. Mike Karr of MacDonald was job superintendent, and A. C. Croze of Hawaiian Dredging was project manager. The contractors are now erecting a head-house atop the silo.

ALSO NEW—Hawaiian Dredging also is involved in the first use of a new structural form that is expected to improve breakwater construction. The firm is contractor on the $1,000,000 Nawiliwili Bay, Kauai, breakwater repair job. It is casting and using 18-ton tri-bars, which are placed on the ocean-facing side of the breakwater to form protective cover. The tri-bars are concrete forms made of three cylinders standing on end and joined at the middle by a 3-joint projection. The idea was the brainchild of Robert Q. Palmer, chief of the planning and reports branch here of the Army Engineers.

STEEL MILL IN WORKS—Plans have been announced for construction of the Territory's first steel mill, a $1,500,000 job. The mill is to be in operation next summer. Not only will the project mean

more work for contractors, but it will give them a close source of reinforcing bars. Plans are to use locally gathered scrap steel and Canadian ingots to produce 10,000 tons of reinforcing bars the first year. Capacity is expected to rise to more than 25,000 tons of bars by 1961. Contractors are expected to use an estimated 20,000 tons of imported bars this year.

HARBOR CONSTRUCTION—The Territorial Board of Harbor Commissioners has approved construction of a $3,000,000, one-berth passenger-cargo terminal at Honolulu's Pier 6. The pier will be 860 ft. long with a pier shed of 100,000 sq. ft. containing parking facilities on the first floor and a visitors' gallery above that. Completion date will be in mid-1960. The commissioners still are considering other Honolulu harbor expansion plans.

DREDGING TO START—Bids will be called about Jan. 1 for dredging of Honolulu's second entrance channel. Dredging work is expected to start in February. It is estimated about 2,500,000 cu. yd. will be removed. In September, work is expected to start on a bridge to be built in connection with the harbor entrance project. The contracts are being let by the Army Engineers. Over on Hawaii, C. K. Buckert, Ltd., of Honolulu, and Gibbons & Reed Co. of the Mainland hold a $689,642 contract for construction of a Kawaihae Harbor breakwater. Completion date is June.

HIGHWAY WORK—The Territorial Public Works Department has announced that its highway program swung into high gear during the fiscal year ending June 30. The 22 federal-aid projects under contract during the year totaled $19,812,153 in estimated final costs. This was an increase of about $2,740,000 over the year before. The jobs will add about 27 mi. to Hawaii's improved Federal Aid Highway system. Another 6 mi. of projects included such things as widening, landscaping and other improvements. In general works projects, some 33 jobs cost $4,400,000 during the year.

TANAKA LOW—J. M. Tanaka was low bidder on the largest contract ever awarded here on a Federal Aid highway project. He offered to do a combination of three jobs for $2,719,672. He will build 1½ mi. of approach road to the trans-Koolau Wilson Tunnel in one job, a .46-mi. stretch of approach road in the second, and a .58-mi. stretch of approach road in the third. In other Territorial projects, Fong Construction Co.'s bid of $239,369 was low on a contract to reconstruct 6.5 mi. of Kamehameha Highway, and Richard K. C. Tom was low bidder at $97,800 for demolition and alteration work in connection with construction of the Nuuanu Highway.

BORE PUNCHED THROUGH—E. E. Black, Ltd., and Gibbons & Reed Co. have punched through footing drifts to both portals of the second bore of the Wilson Tunnel through the Koolau Mountains. The drifts joined about 400 ft. in on the Kalihi side of the 2,800-ft., $3,800,000 bore.

Two applications to FPC for hydro projects

TWO APPLICATIONS for hydroelectric projects have been announced by the Federal Power Commission.

A public utility district in Pend Oreille County, at Newport, Wash., has filed for a license on a project to be located on the Pend Oreille River in Washington. The project would include an arch dam about 285 ft. high, two tunnels about 2,500 ft. long and a powerhouse with four 75,000-kw. generators. The application did not indicate the cost of the proposed work. This project conflicts with an application filed by the City of Seattle for the Boundary Project.

The Placer County Water Agency, Auburn, Calif., has amended its application for permit to build a hydroelectric project on the Middle Fork of the American River. The work would include reservoirs on the head waters of the river with tunnels, conduits, power plants and regulating reservoirs at lower elevations. Installed capacity is estimated at 230,000 kw. The present application takes over the permits and rights filed by Placer County in 1951. The amended application deletes from the original proposal the works licensed by FPC as part of the Sacramento Municipal Utility District's project.

Tacoma's two-dam plan

THE City of Tacoma continues to study its two-dam power project on the Cowlitz River. Work on this project started with the building of the Mayfield Dam, which was suspended during a long controversy with fishing interests. With the controversy ended, a new study and cost estimate was prepared by Harza Engineering Co., indicating that the cost estimate for completion had increased slightly more than 5% since the original estimates. On the other hand, the consulting firm indicated that if design of the Mossy Rock Dam could be changed from concrete to rock-fill, a substantial savings would result to the city.

When the original estimate was made, plans included the installation of three generators in each of the two power locations. At the present time, based on load increases, the Public Utility Board is considering increasing the installation to four generators in each plant. Approximately $11,000,000 has been expended by the City of Tacoma already on the project.

Campus work in Oregon

CONSTRUCTION work on college campuses in Oregon has been authorized that will total approximately $8,000,000. Among the individual projects which form this extended program will be two dormitories at the state college campus in Corvallis, estimated to cost a total of about $3,000,000. As another part of the program plans are under preparation for a $2,750,000 building at Portland State College.

Montana okays concrete for Interstate route

PORTLAND CEMENT CONCRETE has been authorized by the Montana Highway Commission for 58.3 mi. of proposed Interstate system highway in the state. Authorization of concrete is believed to be the first by Montana. Asphalt has been previously specified for 120 mi. of Interstate route in the present construction program.

In another change of regulations, the commission will accept, in the future, the financial statements of contractors prepared by qualified accountants. Previously the commission only accepted statements prepared by certified public accountants.

My WORK BULL 202 RIG digs flush-with-the-wall excavations I used to have to do by hand!

"No more costly hours of backbreaking hand digging for me! My Work Bull 202 Rig digs flush alongside buildings, walls, and fences and in other 'tight' locations that are inaccessible to any other machine!

"And, that's only **one** of the reasons I say my 202 is '**right** on the job'! Just take a look at all these profit-building features!"

Unitized tractor, loader, backhoe! All three elements – Work Bull 202 Tractor, Davis Loader, and Davis Backhoe – are designed to power-match one another! They perform with money-saving efficiency, because they operate as a single co-ordinated unit. You get more reach with a 202 Rig, because the Loader's pump and mounting are built-in... no protruding front bumper. You work with accuracy, safety, and speed, because close fit all the way around provides better visibility.

The Davis Backhoe attaches directly to the Loader frame, and uses the same hydraulic system! Continuous 200° operating arc lets you dig where other rigs can't reach!

Quick and agile on the job-site! Powerful 40-hp, high-torque engine delivers more sure-footed lugging power than any other tractor in the utility class... gives the 202 the ability to keep on producing when other tractors fail! Dual-range transmission with six speeds forward and two reverse lets you match speed and power to your project. Full-time power steering and individual turning brakes let you dart in, finish a job, and be quickly on your way!

Power-matched attachments provide unsurpassed versatility! Your Davis Loader converts into an angle dozer, crane, fork lift, or scarifier right on the building site... saves you the time and expense of contracting out specialty jobs or doing them by hand!

Low-price package! Despite its many superior performance features, the Work Bull 202 Rig is priced so you can afford the best!

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In Utah: **Lund Machinery Co.,** 2350 South West Temple, Salt Lake City, Utah; **Thompson Lumber & Hardware Co.,** 2380 South 1900 West, Ogden, Utah.

In Colorado: **McCrory Oil Co.,** 1101 River St., Canon City, Colo.; **Kennedy Equipment Co.,** Cortez, Colo.; **Modern Farm Service,** 357 Mountain Ave., Berthoud, Colo.

In New Mexico: **Durand Tractor and Equipment Co.,** 929 Fourth St., S. W., Albuquerque, N. M.; **Leeper Equipment Company,** Box 155, Farmington, N. M.

In Texas: **The Myers Company,** 140 North Cotton, El Paso, Texas.

Large Denver Post Office

THE $6,859,000 Post Office building in Denver, now under construction, will establish several "firsts" in design and field operations. The concrete and steel structure, 400 ft. long and 235 ft. wide, will be the largest building in square footage ever built in Denver; it will be the largest lease-purchase building ever erected by the Post Office Department and it will be the largest air-conditioned building in Denver.

The structure will be the largest single building ever built by Leavell & Co. and will be the second largest building constructed in the nation for purely postal activities in the past 15 years. Clearing of the building site near Denver's Union Station began in July and construction is expected to be completed by February 1960.

Low bids and contract awards

ARIZONA

Isbell Construction Co., Phoenix, submitted a low bid of $1,348,215 for 4.1 mi. of grading and surfacing on the Casa Grande-Tucson highway, near the Salt River crossing, east of Globe in Gila County. **Royden Construction Co.,** Phoenix, submitted a low bid of $715,682 for 10.4 mi. of grading, structures and surfacing on the Casa Grande-Tucson highway west of the Pima-Pinal county line in Pinal County. A low bid of $480,434 was submitted by **Martin Construction Co.** of Tucson for grading and surfacing on 2.8 mi. of the Superior-Winkelman highway in Pinal County. **Heuser & Garnett** of Phoenix submitted a low bid of $320,664 for 1.6 mi. of grading, draining and surfacing on the Gadsen-Yuma highway, Yuma County. A low bid of $191,740 was submitted by **San Xavier Rock & Sand Co.,** Tucson, for grading, surfacing and structure on the Picacho-Florence Junction highway and Picacho overpass in Pinal County. **Mohamed Earthmoving Contractor** of Phoenix submitted a low bid of $167,659 for 1.6 mi. of grading and surfacing on the Buckeye-Phoenix highway, city of Buckeye in Maricopa County. A low bid of $120,-808 was submitted by **Heiskell Construction Co.,** Phoenix, for grading, draining and surfacing 5.3 mi. of the Casa Grande-Maricopa highway near the town of Maricopa in Pinal County. **Hagen Construction Co., Inc.,** Globe, submitted a low bid of $115,823 for construction of the Pinal underpass on the Oracle Junction-Globe highway in Gila County. **Tiffany Construction Co., Inc.,** Phoenix, submitted a low bid of $105,794 for grading and surfacing 2.1 mi. of the Scottsdale road in Maricopa County.

CALIFORNIA

A $7,576,081 contract was received by **Ukropina-Polich-Kral** of San Gabriel for construction of 17 bridges, including overcrossing and undercrossing structures and interchange ramps, 10 retaining walls and 2 pumping plants on 4.9 mi. of 8-lane divided freeway on the Harbor Freeway in city and county of Los Angeles. **Diversified Builders, Inc.,** of Paramount received a $4,790,000 contract for the general construction of State Office Building No. 2 at Los Angeles. A $4,-957,417 contract was received by **Guy F. Atkinson Co.** of South San Francisco for grading, structures and surfacing on 2.3 mi. of the San Diego Freeway in Los Angeles and Culver City, Los Angeles County. **Griffith Co.,** Los Angeles, received a $3,226,190 contract for 7.7 mi. of grading, structures and surfacing 4-lane freeway on U. S. 99 north of Herndon in Fresno and Madera counties. A $2,959,-006 contract was received by **Gordon H. Ball, Gordon H. Ball, Inc., Ball & Simpson** and **Lew Jones Construction Co.,** Berkeley, for grading and paving to construct 2.5 mi. of 4-lane freeway and 7 structures in city of San Jose, Santa Clara County. **N. P. Van Valkenburgh Co.** of El Monte received a $2,403,000 contract for construction of roads, parking areas, power, water systems and various prefabricated metal buildings and related work at the Naval Missile Test Center, and Point Arguello site at Point Mugu. A $1,213,980 contract was received by **R. E. Hazard Contracting Co.** and **W. F. Maxwell Co.** of San Diego for 1.3 mi. of grading, structures and surfacing in city and county of San Diego. **O. K. Mittry & Sons** of Gardena submitted a low bid of $1,321,341 for earthwork, structures and surfacing for relocation of Trinity County Road, Trinity River Division, Central Valley Project. **Madonna Construction Co.,** San Luis Obispo, received three contracts for roadwork in Santa Barbara, Monterey and San Luis Obispo counties: $1,151,385 for 2.5 mi. of grading, paving and structures on U. S. 101 in Santa Barbara County; $717,087 for 6.1 mi. of grading and surfacing near Cholame and the Kern County line in San Luis Obispo County, and $189,850 for 4 mi. of grading and surfacing north of Carmel Valley road in Monterey County. **Silva & Hill Construction Co.** of South San Gabriel received a $1,086,311 contract for 4.8 mi. of grading, structures and surfacing to provide a 4-lane expressway on U. S. 60 in Riverside County. A $452,094 contract was received by **Granite Construction Co.** of Watsonville for 2.1 mi. of constructing drainage facilities on ten locations on U. S. 101 in Mendocino and Humboldt counties. **L. B. Wells Construction Co.,** Visalia, submitted a low bid of $366,071 for 9.2 mi. of grading and surfacing in city and county of Tulare. **Matich Constructors** of Colton received a $365,974 contract for 3.4 mi. of grading and surfacing in city of Yucaipa in San Bernardino County. A $336,901 contract was received by **Stecker & Scott** of Burbank for reconstruction, repair, and drainage facilities on sections of U. S. 101 and State Rte. 128, southeast of Boonville in Mendocino County. **Phoenix Construction Co., Inc.,** of Bakersfield, received a $259,188 contract for 2.7 mi. of grading and surfacing northeast of Shandon in San Luis Obispo County. **A. Teichert & Son, Inc.,** Sacramento, submitted three low bids for roadwork in Calaveras, Butte and San Joaquin counties: a low bid of $327,222 for 2.8 mi. of grading and surfacing southwest of Murphys in Calaveras County; $206,692 for grading, structures and surfacing in city of Chico, Butte County, and $154,368 for 4 mi. of grading and surfacing on Durham Ferry road in San Joaquin County. **Arthur B. Siri, Inc.,** of Santa Rosa received a $250,715 contract for repairing storm damaged portions of U. S. 101 at several locations south of Willits in Mendocino County. A low bid of $243,652 was submitted by **Silberger Constructors, Inc.,** of Riverside for 7.6 mi. of grading and paving in city and county of Riverside.

COLORADO

A. S. Horner Construction Co., Inc., Denver, submitted a low bid of $655,491 for construction of via-

duct over Missouri Pacific Railroad, Highway 1 in city and county of Pueblo; and a low bid of $422,911 for structures and approaches between Ft. Morgan and Brush in Morgan County. **Northwest Engineering Co.** of Denver submitted a low bid of $439,469 for structures, grading and surfacing on 17 mi. on the Pagosa Springs-Durango S. H. 10 in Archuleta County. A low bid of $185,549 was submitted by **Schmidt Construction, Inc.,** of Arvada for 4.2 mi. of grading, structures and gravel surfacing on S. H. 317 between Hamilton and Pagoda in Moffat County. **Colorado Constructors, Inc.,** of Denver submitted a low bid of $158,143 for grading and surfacing S. H. 14 between Walden and Muddy Pass in Jackson County. A low bid of $174,522 was submitted by **Latimer Construction Co.,** Denver, for 1 mi. of grading and surfacing S. H. 8 in Denver County. **Western Paving Construction Co.,** Denver, submitted a low bid of $138,356 for asphaltic concrete overlay on 2.7 mi. on Valley Highway in Denver County. **Peter Kiewit Sons' Co.,** Denver, submitted a low bid of $919,783 for grading, structures and paving, Adams City to Barr Lake in Adams County. **Gardner Construction Co.,** Glenwood Springs, submitted a low bid of $213,829 for grading and structures east of Milliken in Weld County. **Roberts Paving-Western Construction Co.** of Denver submitted a low bid of $2,071,662 for grading and paving between Agate and Limon, in Elbert County.

IDAHO

Earl L. McNutt of Eugene, Ore., received a $1,219,448 contract for grading, structure and surfacing on 5.5 mi. of U. S. 95, John Day-Slate Creek highway in Idaho County. A $228,822 contract was received by **Pickett & Nelson** of Idaho Falls for grading, surfacing and other related work on various locations in Lemhi County. **Aslett Construction Co.** of Twin Falls received a $640,231 contract for grading, surfacing and structures on 2.9 mi. of Interstate Highway 15, Truchot Road-South Blackfoot, in Bingham County. **Carbon Bros.** of Spokane, Wash., received a $304,961 contract for reconditioning, grading and surfacing and construction of drainage structures on 10.4 mi. of S. H. 43, Latah County line north, in Shoshone and Latah counties. A $421,175 contract was received by **Duffy Reed Construction Co.** of Twin Falls for structures and surfacing on S. H. 38, Buist Jct.-Bannock County line, in Oneida and Power counties. **Jack B. Parsons** of Smithfield, Utah, received a $112,728 contract for 4.8 mi. of grading and surfacing on the Lanark road in Bear Lake County.

MONTANA

F. & S. Contracting Co., Butte, received a $1,793,114 contract for 5.6 mi. of grading, structures and surfacing on the Shelby-West Side road in Toole County. A $846,797 contract was received by **Riedesel Construction Co.** and **Schye & Sullivan** of Billings for construction of two bridges on the Superior east and west road in Mineral County. **S. Birch, Inc., & S. Birch & Sons Construction Co.** of Great Falls received a $740,565 contract for 5.2 mi. of grading and surfacing the Armington-Lewistown road in Cascade County. **Schye & Sullivan** of White Sulphur Springs received a $621,693 contract for 1.2 mi. of grading, structures and surfacing on the Terry-Glendive highway in Dawson County. A $572,121 contract was received by Roth Con-

struction Co. of Rapid City, S. Dak., for 9.6 mi. of grading, draining and surfacing on the Circle-Sidney highway in Dawson County. **Hilde Construction Co., Inc.,** of Great Falls received a $568,333 contract for 9.8 mi. of grading, draining and surfacing on the Plains-Elmo highway in Sanders County. A $445,944 contract was received by **Bud King Construction Co.,** Missoula, for 6.8 mi. of grading and surfacing on the Adobe (Laurel) road in Yellowstone County. **S. S. Mullen, Inc.,** of Seattle, Wash., received a $414,863 contract for 2.2 mi. of grading and surfacing the Phillipsburg-Anaconda highway in Deer Lodge County. **C. B. Lauch Construction Co.** of Great Falls received a $336,280 contract for 2.9 mi. of grading, structures and surfacing on the Armington-Lewiston highway in Cascade County. **Billings Blacktop Co.** and **Gibson Construction Co.** of Billings received a $299,154 contract for 11.8 mi. of grading, surfacing and draining on the Ringling-Martinsdale road in Meagher County. A $277,028 contract was received by **Kiely Construction Co.,** Butte, for 7.7 mi. of grading, surfacing and bridge construction on the Moiese-Charlo-Nine Pipe highway in Lake County. **O'Brien Construction Co.** of Great Falls received a $268,140 contract for 6 mi. of grading and surfacing on the Fairfield-Power highway in Teton County. **Wm. W. Strever** of Billings received a $239,753 contract for 8.7 mi. of grading and surfacing on the Shawmut-Hedgesville highway in Wheatland County. A $194,196 contract was received by **J. F. England's Sons, Inc.,** of Rapid City, S. Dak., for 6.3 mi. of grading and surfacing and small drainage structures on the Armells Creek-Hays-Harlem highway in Phillips County. **Wickens Brothers** of Suffolk received a $193,979 contract for grading and surfacing on 7.6 mi. of the Red Lodge-Columbus road in Carbon and Stillwater counties. **C. B. & S. Construction Co.** of Ephrata, Wash., received a $450,982 contract for grading, structures and surfacing on 2.6 mi. of the Garrison-Helena highway in Powell County.

NEVADA

Silver State Construction Co. of Fallon received two contracts for roadwork in Washoe and Esmeralda counties: $1,349,737 for 4.2 mi. of grading, surfacing and structures on Interstate Highway 80, east of Sparks in Washoe County; and $284,934 for 9.7 mi. of grading, surfacing and related work on State Route 2 between California-Nevada state line, west of Lida, in Esmeralda County.

NEW MEXICO

A $1,472,735 contract was received by **Jack Adams** of Santa Fe for 8.9 mi. of grading, surfacing and structures on the Torrance-Guadalupe County line road east in Guadalupe and Torrance counties. **Skousen Construction Co.** and **D. D. Skousen & Son** of Albuquerque received three contracts for roadwork in Socorro and Catron, Rio Arriba and Quay counties: $876,063 for grading, surfacing and structures on 13.9 mi. of the Datil-East and West road in Socorro and Catron counties; $726,056 for 6.3 mi. of grading, surfacing and structures on the Dulce-Gobernador road in Rio Arriba county; and $220,581 for 5 mi. of grading, surfacing and structures on the Logan-Nara Visa road in Quay County. **J. W. Jones Construction Co.** of Albuquerque received a $404,969 contract for 1.5 mi. of grading and surfacing in city of Carlsbad, Eddy County. **Jackson Construction Co.** of Rocky Ford, Colo., submitted a low bid of $204,396 for channelization of the Rio Grande Albuquerque area, Middle Rio Grande Project.

OREGON

Roy L. Houck & Sons and **Roy L. Houck Sons' Corp.** of Salem submitted a low bid of $1,683,463 for grading and paving the North Albany Jct.-Lebanon road section on the Pacific Highway in Linn County. **Natt McDougall Co.,** Portland, received a $1,126,788 contract for grading and surfacing on the Linn County line-McKenzie River section of the Pacific Highway in Lane County. **Twin City Construction Co.** and **Clarence Braden,** Pasco, Wash., submitted a low bid of $792,571 for grading, structures and paving the Gwynn undercrossing-Jonesboro and Tunnel-Namorf sections of the Central Oregon Highway in Malheur County. **Hamilton & Thoms, Inc.,** of Eugene submitted a low bid of $641,485 for 6 bridges and 2 crossings on the Pacific Highway in Linn County. A low bid of $407,386 was submitted by **Hannan Bros. Co.,** Portland, for grading, structures and paving in Multnomah County. **White Bros. Construction Co., Inc.,** of Walla Walla, Wash., received two contracts for highway work in Douglas County: $351,967 for grading and paving the North Oakland Jct.-Sutherlin Jct. section of the Pacific Highway; and $270,577 for grading and paving the Comstock-Anlauf section on the Pacific Highway. Two contracts were received by **Peter Kiewit Sons' Co.** of Vancouver, Wash., for bridge construction in Josephine and Linn counties: $329,936 contract for construction of 4 bridges on the Rough and Ready Creek-Dwight Creek section of the Redwood Highway in Josephine County; and $311,314 for bridge construction on the Tallman Branch and Bond Butte overcrossings on Pacific Highway in Linn County. **J. C. Compton Co.,** McMinnville, submitted a low bid of $305,388 for grading and paving on the Big Eddy-Rufus section of the Columbia River Highway in Wasco and Sherman counties. **C. R. O'Neil** of Creswell submitted a low bid of $279,664 for grading and surfacing the Bullards Bridge-Bandon section of the Oregon Coast Highway in Coos County.

UTAH

Morrison-Knudsen Co., Inc., of Salt Lake City submitted a low bid of $972,011 for grading, surfacing and structure on 2.6 mi. on Highway 80N, Morgan toward Devils Slide in Morgan County. Two low bids were submitted by **W. W. Clyde & Co.** of Springville: $275,628 for 4.4 mi. of grading and surfacing from Three Lakes toward Mt. Carmel Junction in Kane County; and $560,876 for 3.4 mi. of grading and surfacing and one structure on Highway 15 in Washington County. **M. Morrin & Son Co., Inc.,** of Ogden submitted a low bid of $560,814 for 3 structures between the Salt Lake-Davis County line and North Bountiful in Davis County. **Wangsgaard-Peterson Construction Co.,** Logan, submitted a low bid of $293,996 for 8.5 mi. of grading and surfacing near the Carbon-Emery County line in Carbon and Emery counties. A $239,047 contract was received by **Maurice Rasmussen Co.** and **D. W. Brimhall Corp.** and the **Johnson Co.** of Murray for 10.6 mi. of grading and surfacing the Beaver-Millard County line in Millard County. **Mark B. Garff, Ryberg & Farff Construction Co.,** Salt Lake City, submitted a low bid of $253,753 for construction of one bridge on the Weber River west of Ogden in Weber County. **Allred & Mitchell Construction Co.,** Altamont, submitted a low bid of $148,854 for

bridge construction over Grassy Trail Creek near Sunnyside Junction in Carbon County. A low bid of $118,653 was submitted by **Herbert Plewe Construction Co.**, Salt Lake City, for construction of cable suspension bridge over the Green River near the Flaming Gorge Dam site in Daggett County. **W. W. Clyde & Co.**, Springville, submitted a low bid of $698,000 for 7.5 mi. of grading and surfacing the Provo River-Haydens Fork Route in the Wasatch National Forest in Summit and Duchesne counties.

WASHINGTON

Northwest Construction Co. of Seattle received a $1,797,426 contract for 5 mi. of grading and surfacing in city of Tacoma, Pierce County. **Osberg Construction Co.**, Seattle, received a $1,069,758 contract for 5.7 mi. of grading and surfacing, Cedar River to North River in Pacific County. **Lige Dickson Co.** of Tacoma received a $897,151 contract for 1.8 mi. of grading and surfacing on the Tacoma Freeway in city of Tacoma, Pierce County. A $768,317 contract was received by **C. E. Oneal, Inc.**, of Ellensburg for structures, grading and surfacing on S. H. 18, near Ritzville in Adams County. A $404,227 contract was received by **Wilder Construction Co.** of Bellingham for construction of the Chuckanut Drive Interchange in Skagit County. **George W. Lewis** and **Thompson Construction Co.** of Kennewick submitted a low bid of $234,316 for earthwork, concrete lining and structures, Wahluke Branch Canal, Columbia Basin Project. A $185,287 contract was received by **Pacific Sand & Gravel Co.**, Centralia, for 1.3 mi. of grading and surfacing, Salkum to Mill Creek in Lewis County. **Hardisty Construction Co., Inc.**, Vancouver, received a $165,925 contract for 1.7 mi. of grading and surfacing of Vancouver city streets, in Clark County.

WYOMING

Taggart Construction Co. of Cody received two contracts for highway work in Uinta County: $859,900 contract for grading, structure and surfacing on 3.8 mi. of the Evanston-Ft. Bridger road; and $679,936 for 3.7 mi. of grading and surfacing and one structure on 4-lane divided interstate highway. A $679,981 contract was received by **Etlin E. Peterson** of Casper for bridge construction over Snake River and miscellaneous work on the Jackson Wilson road in Teton County. **Big Horn Construction Co.**, Sheridan, received a $490,116 contract for grading and surfacing portions of the Gillette-Douglas road, in Converse County. A $397,363 contract was received by **J. H. Beckman Construction Co.**, Sioux Falls, S. D., for grading, surfacing and structures on 7.7 mi. of Orin Jct.-Lusk road in Niobrara County. **Riedesel-Lowe Co.** of Cheyenne received a $255,573 contract for grading, surfacing and structures on 7.6 mi. of 4-lane divided interstate highway in Uinta County. A $241,135 contract was received by **W. E. Barling, Inc.**, Meeteetse, for grading, surfacing and related work on city streets of Powell in Park County. **Charles M. Smith**, Thermopolis, received a $125,172 contract for grading, structure and surfacing on the Cody-Powell road in Park County. **Woodward Construction Co.** of Rock Springs received a $117,225 contract for grading, surfacing and related work on the Jackson-Wilson road in Teton County.

ENGINEERS and CONTRACTORS

Norman D. Baumgart has been assigned as soil-cement engineer of the 5-state Rocky Mountain region of the Portland Cement Association. Baumgart, an employee of PCA at its general offices in Chicago since 1952, will work out of the regional office in Denver, Colo. He will offer technical assistance on soil-cement problems in Colorado, Wyoming, Montana, New Mexico, Utah, and El Paso, Texas.

Norman D. Baumgart

Several reassignments of resident engineers to highway jobs under construction by Western contractors are reported by the Utah State Road Commission.

Linden Fiack, to an 8.5-mi. grading project on U. S. 6 and 50 near Sunnyside, Wangsgaard-Peterson Construction Co.; **Sheridan Fiack,** plant-mix bituminous surfacing in Ogden, Waterfall Construction Co.; **William Marsden,** concrete and steel bridge over the Weber River in Ogden, Garff, Ryberg & Garff Construction Co.; **Ross A. Slye,** construction of cable suspension bridge near Flaming Gorge Dam site, Herbert Plewe Construction Co.; **J. D. Ryan,** grading 5.5 mi. of road across Green River, State Highway 260, James H. Wardle Construction Co.

R. Karl Jones, right-of-way fence and gates, Sumitt-Wasatch county line, Ford Construction Co.; **Edward D. Kennelly,** first phase of North-South Salt Lake City Freeway, Weyher Construction Co.; **Merrill H. Carlson,** 157-ft. long concrete structure and grading 2.6 mi. near Devils Slide, Morrison-Knudsen Co., Inc.; **Robert Wheadon,** surfacing 4.5 mi. on U. S. 89, W. W. Clyde & Co.; **J. D. Hilton,** laying 2½-in. bituminous surfacing, Beaver-Millard county line, Maurice Rasmussen, D. H. Brimhall & Johnson Co.

* * *

Appointment of **George E. Battey, Jr.,** as office engineer for the Los Angeles office of the Portland Cement Association is announced by **John M. McNerney,** district engineer in charge at Los Angeles. For the past two and a half years Battey has been a field engineer in the area for PCA. Prior to joining the organization, he was an engineer for the California Division of Highways for five years.

George E. Battey, Jr.

W. F. DILLINGHAM, accepts a Navy commendation certificate from *Rear Adm. E. J. Peltier,* **CEC USN, Chief of the Bureau of Yards & Docks, on behalf of Hawaiian Dredging & Construction Co., Ltd., oldest and largest general contracting firm in the Pacific Ocean area. W. F. Dillingham is chairman of the board of HD&C, of which *Lowell S. Dillingham* is president, and *P. E. B. Wainwright* is chief engineer. *C. W. Watson* is general superintendent of building construction and currently is project manager of a $30,000,000 shopping center under construction by Hawaiian Land Co., a wholly owned subsidiary of Hawaiian Dredging & Construction Co.**

CALENDAR

Jan. 14-15—The Beavers, fourth annual awards dinner, Los Angeles, Calif.

Jan. 19-22—American Road Builders' Association, annual convention, Dallas, Tex.

Jan. 25-29—Associated Equipment Distributors, annual meeting, Conrad Hilton Hotel, Chicago, Ill.

Jan. 28-30—The Institute of Transportation and Traffic Engineering, annual California Street and Highway Conference, Berkeley campus of the University of California.

Feb. 5-7—National Western Mining Congress and Centennial Mining Celebration, Denver, Colo.

Feb. 8-13—American Society of Civil Engineers, annual convention, Los Angeles, Calif.

26 Mack six-wheeler trucks with 5½-yard mixer bodies, plus four Mack tractor-trailer units to haul aggregate, handle the big part of the hauling requirements of Acme Ready Mix Concrete Co., of Rockford, Illinois. Mack quality construction pays dividends in operating economy and low maintenance costs, enabling Acme to handle both large and small jobs profitably.

From front bumper to rear axle...

QUALITY-BUILT for PROFITABLE HAULING

Ask the men who really know—the men who operate Macks—about the advantages they get from Mack quality construction. They'll tell you about the unexcelled economy ... minimum down time ... the extra years of dependable service —that add up to truly profitable operation.

Mack quality begins with Mack-built major components—front and rear axles, engines, frames, transmissions and brakes—which are made to the highest standards in the industry ... with Mack features like the exclusive Balanced Bogie with Power Divider for positive traction under severe weather and terrain conditions ... and extends to Mack cabs, which offer the utmost in driver visibility and comfort, easy access to all working parts, and minimum upkeep requirements.

You'll find that Mack quality construction shows up in every phase of operation—and, where it really counts, in net profit figures. Check with your Mack branch or distributor today to find out how Macks' profit-making capabilities can best be put to work for you. Mack Trucks, Inc., Los Angeles, Denver, San Francisco, Seattle, Portland, Salt Lake City, Albuquerque.

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SUPERVISING the jobs

Clarence "Stub" Durbin, partner in the contracting firm of Durbin Brothers, is supervising the grading on his firm's $206,245 contract on the Trail Creek bridge section of the Crater Lake Highway in Jackson County, Ore. Assisting as grading foremen are **K. B. Smith** and **Lewis Butler.** Contract includes also paving and one structure. Ausland Construction Co. is erecting the bridge, and Hughes & Dobbs Co. is doing the crushing. Work started in July.

* * *

Charles S. Goss is general superintendent for the combine of E. L. Yeager Co., Bert C. Altfillisch, Altfillisch Construction Co., who were the successful bidders on 4.3 mi. of grading and surfacing 4-lane divided freeway and 11 structures on the Riverside Freeway near Colton, Calif. Project engineer on the $3,759,042 project is **Bill Gilbert. George Pope** is excavating superintendent, while **L. E. Anderson** is structures superintendent. Resident engineer for the State is **Jim Erwin.** Started in July, work is scheduled for completion next July.

* * *

Ed Cunningham, superintendent for Goodfellow Brothers, Inc., is in charge of the work of relocating a forest road from Packard Creek to Hills Creek, Middle Fork Willamette River near Oakridge, Ore. The U. S. Forest Service road is being built above reservoir level on side slopes of mountain range at a cost of $878,796. **Nels Christophersen** is foreman and **L. K. Terry** is field engineer. The work has been going on since May under the overall direction of **Robert Goodfellow** as project manager, and is expected to be finished about May next year.

* * *

Galen Zimmerman is project manager for Thomas Construction Co., holder of a $372,530 contract for construction of bridge, grading, and surfacing approaches in San Benito County, Calif. **Andrew Cathey** is in charge of the grading and paving, while **Moreland Hunsaker** is bridge superintendent. Scheduled for completion by the end of the year, work has been going on since August.

* * *

Lonnie E. Smith is acting as general superintendent on a contract recently awarded to his firm covering construction of concrete bridge over the Snake River on State Highway 51 between Bruneau and Mountain Home, Idaho. Among the key personnel working on the $251,402 job are: **John Cox,** office; **George McGinnis,** welder and truck driver; **Raymond Carter,** carpenter; **James R. Smith,** carpenter and pile buck; **Robert Johnston,** operating engineer; **Victor Romey,** carpenter-foreman; **Larry Craggs,** truck driver; **Frank Willms,** welder, and **Morris W. Bardsley,** carpenter. The job started in August and will run for approximately a year.

* * *

Chris Hulls is Fisher Contracting Co.'s project superintendent on contract for 9 mi. of grading, draining,

Regman *Hulls*

and placing 6 in. of select borrow topping on a section of the Pine-Winslow National Forest Highway in Coconino County, Ariz. Field office manager on the $394,305 project is **Don Regman.** Work started in September, but will be halted by snow, and completed in the spring of 1959.

* * *

D. A. Wagner, superintendent, assisted by **D. Boom** and **L. Vosika,** foremen, has just finished a grading and surfacing job in Wasatch National Forest in Utah for Woodward Construction Co. who won the contract on a low bid of $111,000.

* * *

K. N. Baird, superintendent for Woodward Construction Co., has been in charge of a $229,905 grading and surfacing job on Rock Springs road, Sweetwater County, Wyo. Assisting Baird as foremen were **K. Handlos** and **F. Baldwing.**

* * *

George "E" Fowler, project manager, and **"Bud" Redding,** superintendent, are in charge of building a construction camp for Morrison-Knudsen Co., Inc., and Patti-MacDonald Construction Co. at Clear, Alaska. Other top men are **Ralph Morava,** supervising engi-

(Continued on page 90)

BILL CLARK and *E. W. Clinkenbeard,* superintendent and foreman respectively for J. N. Conley. Both men have been in key positions on this contractor's grading operations on new freeway south of Albany, Ore., involving 1,300,000 cu. yd. of earth fill.

Here's the all-purpose four-wheel-drive INTERNATIONAL Travlall. Take it anywhere on any construction job—you'll find a dozen new uses for it every day. The weather-tight Travelall has more loadspace than other wagons. It carries 8 husky construction workers or a full load of tools and equipment fully weather-protected all day. On or off the road the Travelall has plenty of power and traction. Its accurate, positive steering and road-hugging qualities makes all driving easier and safer. See and drive a four-wheel-drive Travelall soon.

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JOB SUPERINTENDENT LEON FELTON, left, heads the construction crew working on 6 mi. of grading and surfacing on the Wickenburg-Kingman highway on Route 93 in Yavapai County, Ariz. This work is being done at a cost of $328,523 by Haumont Contracting Co., headed by *Pierre H. Haumont, Jr.*, right. Job has been under way since September, earmarked for completion next January.

neer; **Fred V. Swanson,** chief estimator, and **Darrell F. Baker,** estimator. Contractor started on this $2,657,827 job in September, and expects completion by mid-February next year.

* * *

Edward Bernd, foreman, and **William H. Pidcock,** crusher foreman, are in charge of a $522,715 job of grading, structures, and surfacing on 8.5 mi. on State Highway 3 in Weld County, Colo. Herren-Strong Co. has the contract.

* * *

Don Duke is superintending a $157,306 contract in Reno, Nev., for Isbell Construction Co., covering grading and paving a portion of state highway.

* * *

James N. Leinbach, superintendent for Fred H. Slate and E. C. Hall Co., is supervising the job of adding two lanes to existing 2-lane highway, making 4-lane divided highway on U. S. 99 north of Newberg, Wash. Foreman on the 3.4-mi. grading and paving is **Velton Case. George Edwards** is mechanic. The job has been in progress since September and is expected to be finished the fall of 1959.

* * *

Nils B. Oberg, project manager; **William B. Thomas,** job superintendent; **John C. Allison,** chief engineer; **Leonard Swanson,** chief estimator, and **Roy V. Silver,** office manager, comprise the chief supervisory personnel of Oberg Construction Corp. and Oberg Bros. Construction Co., recently awarded contract by the State of California for construction on Ventura Freeway. The contract for 3.9 mi. of 8-lane freeway and 15 structures on U. S. 101 in the city and county of Los Angeles went to Oberg on a low bid of $5,226,495. In progress since September, the work is scheduled for completion about April 1960.

* * *

Don Kimbal is supervising the general work of constructing a 2-story gymnasium at the California State Polytechnic College in San Luis Obispo, Calif. A year-long project, work started in September. Maino Construction Co. successfully bid the job at $1,097,200.

* * *

John E. "Stub" Vejtasa is supervising a recent award to Stanley H. Arkwright, Inc., covering 11.5 mi. of grading, surfacing, and draining on the Crow Agency-Hardin highway in Big Horn County, Mont. The $1,685,369 project has the following requirements: grading, 1,500,000 yd.; gravel, 750,000 tons; plant-mix, 85,000 tons; oil, 1,750,000 gal.; and miscellaneous structures. Principal foremen are **Alfred Weber,** structures; **F. P. "Pete" Eby,** dirt; **Forrest Strand,** gravel, and **Marvin Brown,** hot plant. The contractor reports that work on this job started Sept. 24 and will require 400 working days.

* * *

Fred H. Sawyer, superintendent, and **Kenneth "Dutch" Glentzer,** structure superintendent, are key men in the operations of Gordon H. Ball, Inc., and Ball & Simpson at the Marine Corps Air Station at El Toro, Calif. The work is costing $2,076,876 and covers extension of runways, concrete paved; a 1,000,000-gal. steel reservoir; landing sys-

tem, and related construction. With March 1959 the target date, construction started in July.

* * *

Neil Stewart is superintendent in charge of a recent award to Wells-Stewart Construction Co., for grading and surfacing on U. S. Highway 95 in Lyon County, Nev. The $259,529 job involving 12 mi. of resurfacing started Aug. 15.

* * *

Ward W. White is Peter Kiewit Sons' Co.'s project superintendent on $8,394,835 construction on the Ventura Freeway in Los Angeles County, Calif. Other key personnel working for Kiewit on this highway job, which covers 4.5 mi. of grading and surfacing and construction of 17 bridges, include **Russell L. Davis,** project engineer, **C. B. Smith,** structure superintendent, **Norman L. Barnes,** assistant structure superintendent, **J. D. Brown,** mechanical superintendent, and **Ralph Kline,** office manager. Scheduled for completion in March 1960, work has been under way since June.

* * *

Angello Ozzello is superintending for J. P. Elliott & Co. a $127,000 job of 6.6 mi. of grading and surfacing the South Fork-Lake City route in Gunnison National Forest in Hinsdale County, Colo. **Clyde Williams** represents the Bureau of Public Roads as engineer.

* * *

Claude Ford is superintending another of J. P. Elliott & Co.'s road jobs in Colorado. This is for grading, structures and surfacing on 4.9 mi. east of Sliver Cliff in Custer County. **Joe DeGani** is mechanic, and **Art Nordyke,** grade foreman, on the $242,435 contract.

* * *

Harry E. Norgaard, supervisor, is in charge of Norgaard & Hilling's recent award at $430,379 for 7.8 mi. of grading and surfacing on the Culbertson-Plentywood and Culbertson-Sidney highway in the city of Culbertson, Mont. **Boyd Finnicum** is foreman. Job started in August and is scheduled for completion about June next year.

* * *

Dick Smith is project manager on the 1st stage construction of Willard Dam and reservoir on the Weber Basin Project in Utah, involving 2,200,000 cu. yd. of dirt. The $1,101,150 contract got under way in June and will finish in December, according to M. H. Hasler Construction Co. and H. C. Smith Construction Co., holders of the contract.

MASTER MECHANIC®

Tips on battery care

By ROBERT H. HAWKINS
Manager
Central Division, Service Department
Caterpillar Tractor Co.

MACHINE OWNERS have come to expect convenience and dependability when starting diesel engines in all weather, regardless of temperature extremes. Some machines come equipped with gasoline starting engines while others depend on cranking the diesel with electric starting motors. Even gasoline starting engines often have their own direct electric starting systems. In fact, most electric starting systems are dependent on one source of power—the storage battery.

A storage battery has a limited capacity (the quantity of electricity which can be taken from it in a given period of time) just as a water storage tank can maintain a flow of so many gallons per minute for only a certain number of minutes. The capacity of a battery (sometimes called its electrical size) is usually listed in "ampere-hours." This term is used to specify the amount of current a battery will deliver continuously for a definite number of hours or minutes. Capacity depends on how well the battery is constructed, its age, the size of the plates, and how many plates are assembled in each cell.

Why do storage batteries run down? Frequently the problem is the same as with any storage system: If more is taken out than is put back in, the reservoir for storage ultimately becomes empty. Added electrical load, such as lights, heaters, two-way radios, sometimes impose more drain on the system than can be replaced by the generator. There are other reasons. The first is age. After many hours use, the storage capacity is reduced. A second reason may be internal faults which continually drain off the electrical supply. Finally, improper maintenance and operation make a battery "age" quickly.

Any battery requires some attention for continued satisfactory service. Here are a few necessary rules for its care:

A most important step in extending battery life is a periodic check of the electrolyte or water level. Nearly all storage batteries have a reserve space for water in the top above the plates, and most battery manufacturers recommend that water be added until it is ⅜ in. above the plates. Be careful not to overfill the battery because this allows the electrolyte to splash out and corrode all metal it contacts. Continued overfilling will result in so much loss of acid that the electrolyte may no longer be strong enough for the battery to deliver the required energy to crank the engine. If the battery requires water more often than once every two weeks, the charging rate is too high.

Keep Battery Clean

Wash the battery occasionally with a "baking soda" solution (one pound of soda to one gallon of water) to neutralize the acid which is present on the case, and then rinse it with a stream of cold water. Cleanliness also includes the terminals. Wire brush them until corrosion is removed and then coat them with petroleum jelly.

CLEANLINESS COUNTS

Keep Battery Charged

Maintain the battery in a normal state of charge—the specific gravity should be above 1.225—by keeping the generator output and voltage regulator in proper adjustment.

Never let a battery remain in a discharged condition for an extended period of time. The discharge action of a battery sulphates the plates but this can be driven off if the battery is charged soon after discharge. However, if the battery is allowed to remain too long in a discharged condition, the sulphate becomes hard and is very difficult, if not impossible, to drive off the plates during charging.

Batteries have much longer service life if they are kept at or very near full charge at all times. In normal operation of equipment, some discharging and charging of the battery takes place continuously, but the battery is not discharged to a great extent at any time. However, cycling a battery (regularly discharging it almost completely and then recharging it) will seriously affect its service life.

Prevent Freezing

In cold weather, never add water at the end of a day's run. Instead, add water in the morning just before starting or right after starting. In this manner, the water will be thoroughly mixed with the acid by the end of the day's run and freezing of the electrolyte will be prevented.

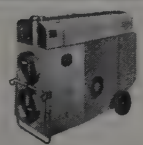
Allow Rest

Never use the electric starter more than 30 sec. at a time and then allow approximately 2 min. between cranking cycles. The brief "rest period" allows the battery plates to cool and allows the battery to recuperate sufficiently to again deliver a surge of power.

After emergency use or accidental energy loss, such as leaving the lights on overnight, it might be necessary to "quick charge" the battery. No particular fault can be found with "quick charging" or "hot charging" methods providing the manufacturer's instructions are closely followed.

Storage Procedures

Storage batteries which are not in use will lose their strength gradually (the rate of discharge depends upon the temperature) when left on the shelf or stored in machines for an extended period of time. The higher the temperatures, the greater the loss of energy. To keep them up to strength and ready to use, recharge any batteries in storage when their specific gravity drops to 1.240. A fully charged battery will show a hydrometer reading of 1.270-1.280.



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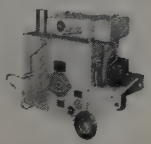

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"THRIFTY" MODEL
Oil fired. Electric motor powered. Up to 165,000 BTU capacity. Low price!

▲ **15 HERMAN NELSON "DE LUXE"** heaters were used in building a new Yorktown plant addition for Virginia Electric & Power Company. Heaters were operated continuously day and night, in mud, rain and snow. They were used for curing concrete, and to protect valves and piping. Contractor is Stone & Webster Engineering Corporation.

◀ **ZERO COLD OUTSIDE,** yet comfortably warm inside, thanks to Herman Nelson "Utility" heaters. Project is a new dormitory at William Woods College, built by John Epple Construction Co., Columbia, Mo.

◀ **GLASS BLOCK INSTALLATION** goes right on in sub-freezing cold. A Herman Nelson "De Luxe" directs hot air to the freshly laid blocks. Contractor is Todd-Basehore Co., Cleveland, Ohio.

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Oakland, Calif.	Edward R. Bacon Co.
Sacramento, Calif.	Edward R. Bacon Co.
Seattle, Wash.	A. H. Cox & Co.
Everett, Wash.	A. H. Cox & Co.
Portland, Oregon	Loggers & Contractors Machinery Co.
Eugene, Oregon	Loggers & Contractors Machinery Co.
Casper, Wyoming	Studer Tractor & Equipment Co.
Denver, Colorado	Western Machinery Co.
Grand Junction, Colorado	Western Machinery Co.
Spokane, Washington	Western Machinery Co.
Billings, Montana	Montana Power & Equipment Co.
Helena, Montana	Montana Power & Equipment Co.
Reno, Nevada	Sierra Machinery Co., Inc.

. . . for more details, circle No. 43 on Reader Service Postcard

NEW LITERATURE

To obtain free copies of literature described in this section, circle the corresponding numbers on reply postcard.

Unusual new compacter

A bulletin is available from the **Wacker Corp.,** describing a new 115-lb. compacter for all kinds of backfill, including clay, which delivers ten blows per sec. The machine is self-propelled and is operated by one man. Variable speed controls allow variation of percussion rate from 450 to 650 blows per min. The shoe raises 3 in. off the ground for each blow. The bulletin contains photographs and specifications. *. . . Circle No. 156*

Powder-cutting concrete

A description of a relatively new process for cutting through concrete is contained in an illustrated 8-page booklet now available. The process, called powder-cutting, utilizes iron powder fed into an oxygen-cutting flame. The iron particles greatly increase the temperature of the flame, enabling it to cut through many materials easily, including concrete. The booklet describes the results which can be expected, the methods commonly used, and the equipment required. Powder-cutting is especially well adapted for demolition jobs. The disadvantages as well as the advantages are listed. The booklet, available free by circling the appropriate Readers Service Card number, is published by **Linde Company, Division of Union Carbide Corporation.** *. . . Circle No. 157*

Portable pump bulletin

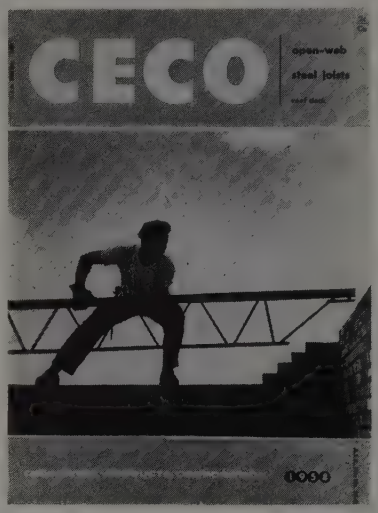
Portable sump pumps and portable sludge pumps are described in a new bulletin issued by the **Chicago Pneumatic Tool Company.** The pumps described are all highly portable, the heaviest weighing only 130 lb. Full specifications in operating characteristics are given. *. . . Circle No. 158*

California highway towing laws

In order to help contractors understand California laws governing the towing of equipment over the state highways, the **Essick Manufacturing Co.** has published a booklet on the subject. Entitled, "Moving contractors' equipment on the highways," it is available to all contractors who request it. The points of clarification pertain to the requirements for stop lights, tail lights, directional signals and running lights as applied to "Special mobile equipment," under which classification are concrete and plaster mixers, compressors, sprayers, etc. *. . . Circle No. 159*

Open-web steel joists

Ceco open-web steel joists for construction of floor and roof systems are fully described in a new 36-page manual. The manual contains descriptions and diagrams of



the various types of joists, including shortspan, longspan, and electro-channel, which has the top chord replaced by a hollow tube which serves as a structural member and as an electrical duct. The manual also shows available dimensions, properties and allowable loadings, complete specifications and recommended handling and erecting procedures. Copies are available on request from the **Ceco Steel Products Corporation.** *. . . Circle No. 160*

Welding supplies catalog

A new 52-page welding supplies and accessories catalog is available from **Air Reduction Pacific.** Illustrated with over 100 photographs, the booklet covers Airco's complete line of fluxes and ferrous and nonferrous rods for gas welding; and accessory items including protective clothing, goggles, electrode holders, spark lighters, cable, hose, weld cleaning tools, cylinder trucks, and many other items. *. . . Circle No. 161*

Data on equipment leasing

A new 20-page analysis of the advantages of equipment leasing, including several case histories, has been published by the **United States Leasing Corp.** Printed in color, the brochure contains extensive charts and statistical analyses of equipment leasing. Copies are free. *. . . Circle No. 162*

Basic surveying booklet

For 25 cents you can obtain a 34-page booklet which describes the fundamentals of surveying. It describes in simple terms how to set up an instrument, how to use the level or transit for laying out angles, building lots, determining contour lines, setting offset stakes, setting batter boards, running straight lines, establishing vertical lines, reading vernier scales, focusing, field signals, and surveyors' terminology. Several pages of the booklet are devoted to a description of the surveying instrument made by the publisher of the booklet, **David White Instrument Company,** 2051 North 19th Street, Milwaukee 5, Wisconsin. For your copy send a quarter directly to the David White Company.

The 1959 Dodge truck line

Information is now available from the **Dodge Truck Co.,** on its 1959 models. The new trucks feature 6 and 8-cylinder engines with 11 different horsepower ratings ranging from 113 to 234. Maximum gross vehicle weights on the new models range from 5,100 to 49,000 lb.—an increase of 3,000 lb. for tandems—and gross combination weights up to 65,000 lb.

The half-ton models feature new large brakes with a total lining area of 192 sq. in. Dual headlights are standard on most models. Two new 318-cu. in. V8 engines with an 8.25 to 1 compression ratio are offered. Air brakes with a total lining area of 920.75 sq. in. are standard on the T900 models. *. . . Circle No. 163*

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BEATTY SCAFFOLD . . . featuring Beatty patented "Snap-Lock," the greatest labor-saving device in scaffolding history. Open frame design to prevent accidents and provide easy access. Tubular cross braces for strength and low maintenance. Steel or aluminum.

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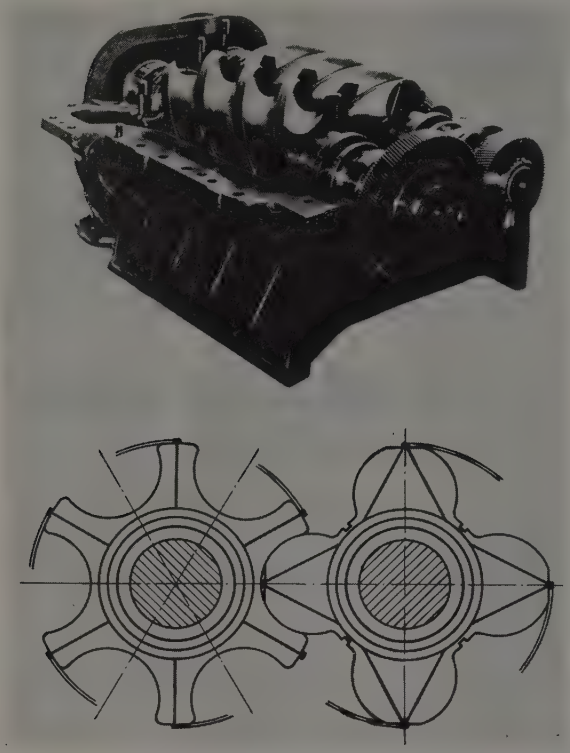
. . . for more details, circle No. 44 on Reader Service Postcard

NEW EQUIPMENT

Obtain more information on these new developments in construction equipment by circling the corresponding numbers on reply postcard.

Rotary-screw compressor by Atlas Copco

Introduction of a completely new line of rotary-screw compressors — two-stage twin-rotor types that offer extremely high air delivery rates in an unusually compact design — has been announced by **Atlas Copco Pacific Inc.** Two years of exhaustive field testing have preceded marketing of the new series, which is of particular interest to construction and



industry with continuous heavy-duty air requirements. Models currently available offer a standard capacity range of 5,500 to 19,000 cfm. at 120 psi.

The advanced design compressors have intermeshing four-lobe male and six-lobe female rotors. As the rotors turn, these lobes create an intake suction, reduce the volume, and compress the air in a smooth and continuous operation. Lubrication of the rotors is unnecessary as they never touch each other or the casing. This operating feature assures a completely oil-free air supply, as well as reducing maintenance to a minimum.

The machine will make possible many new compressed air applications. In addition to considerably less installation space being required, foundation and installation costs also are reduced substantially. Operating speeds of 3,600 rpm. and the vibrationless design makes possible a complete selection of economical motive power. ***. . . Circle No. 164***

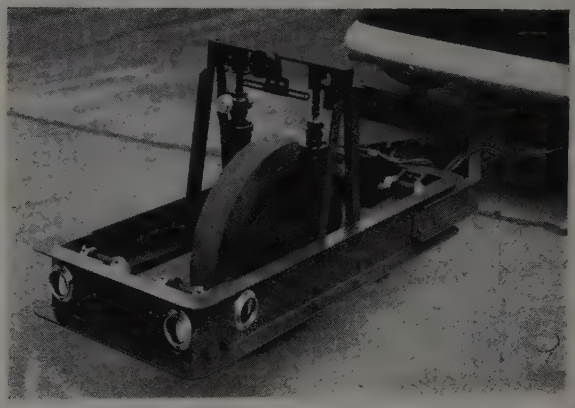
Road roughness tester now available

An inch by inch profile of the surface of a road, airstrip, or pavement area is now available in permanently recorded form, with the announcement of the availability of the Model CT-444 Road Roughness Indicator by **Soiltest, Inc.**

Using the Road Roughness Indicator, the results of roughness measurements for types of pavement surfaces used on highways, city streets, airstrips and floors are reported, analyzed and correlated with the design features, age of the pavement and methods used in constructing these surfaces.

Providing for the smoothest surface possible is one way of guaranteeing the longest life possible for the nation's highways. Smoother, bumpless surfaces also provide better braking power for the motorist. Safety and tire economy for the general public are increased when road authorities check new pavement with the Road Roughness Indicator.

The unit consists of a test trailer, ramp, electronic controls and recording unit and a panel instrument



truck. The test trailer is towed by a specially modified panel truck at a constant speed (usually 20 mph.). Variations on the pavement profile cause the smooth, highly sensitive test tire to raise and lower as it rolls along the pavement.

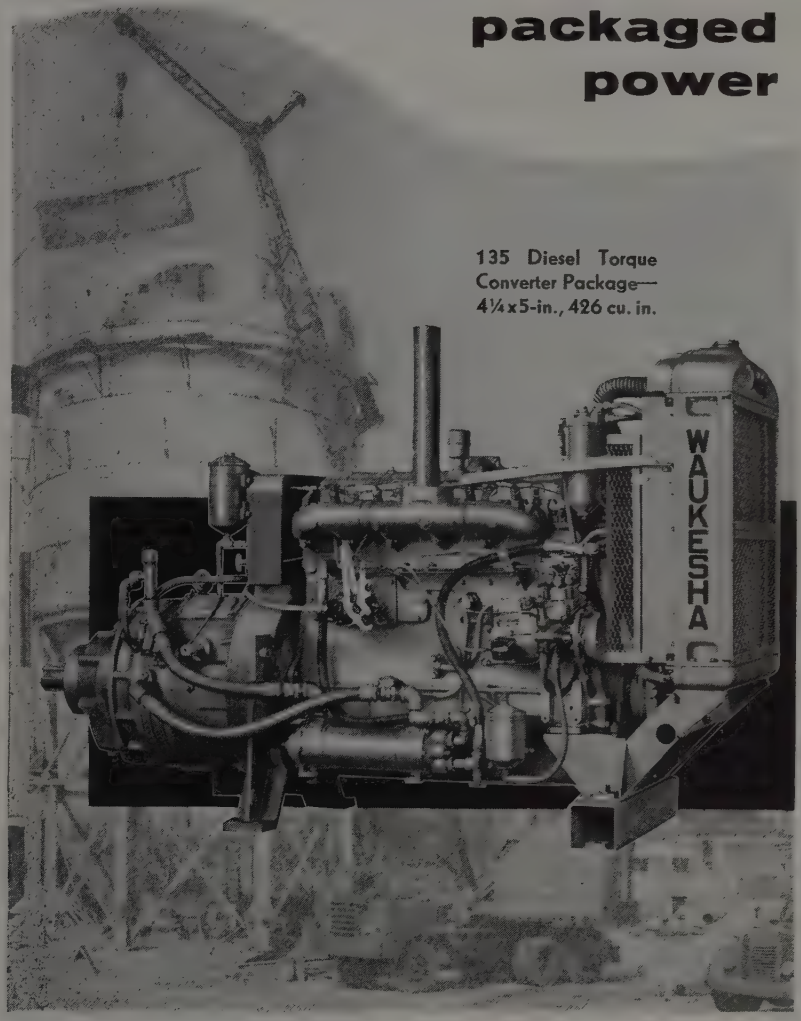
This vertical movement is converted into electronic impulses which are relayed to the instrument panel in the truck. These data are recorded to provide a roughness index in terms of inches of roughness per mile. At the same time, an oscillograph recorder plots a permanent record of the pavement profile.

The accumulation of these deflections in a mile of pavement is expressed in terms of "inches of roughness per mile." A total of 65 in. per mi. is considered remarkably smooth pavement.

Mounted inside the panel truck are an instrument console, swivel chair for the operator, shelf units for mounting electronic controls, interior lighting, loading ramps, storage ramps, and all of the instruments required to operate and calibrate the Road Roughness Indicator. ***. . . Circle No. 165***

WAUKESHA

engine torque converter packaged power



Diesel • Gas • Gasoline—20 hp to 1200 hp

for torque converter application in shovels, cranes and hoists; trucks and tractors—the result of Waukesha's 15-year development program in this field. Torque converters eliminate shock to driving and driven mechanism; prolong life of equipment; boost output work 10 to 40%. Power, automatically matched to the load, is delivered smoothly without stalling.

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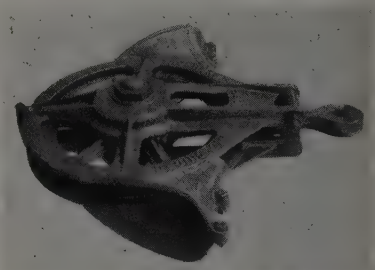
. . . for more details, circle No. 45 on Reader Service Postcard

Shrouded block by Sauerman

Sauerman Durolite blocks are now available with shrouded housing to insure the proper seating of the running rope. Design of the shrouding also prevents rope from binding at the throat of the block, reducing breakage and cable wear.

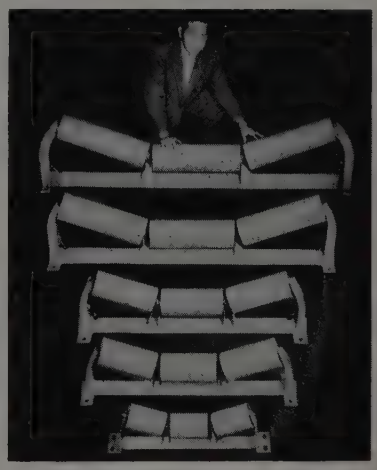


These shrouds of **Sauerman Bros., Inc.,** are especially recommended where blocks operate in a horizontal plane with the resulting tendency for the rope to leave sheave grooves. The blocks are made of the same high alloy steel used in the Durolite block frames providing durability with lightness in weight.

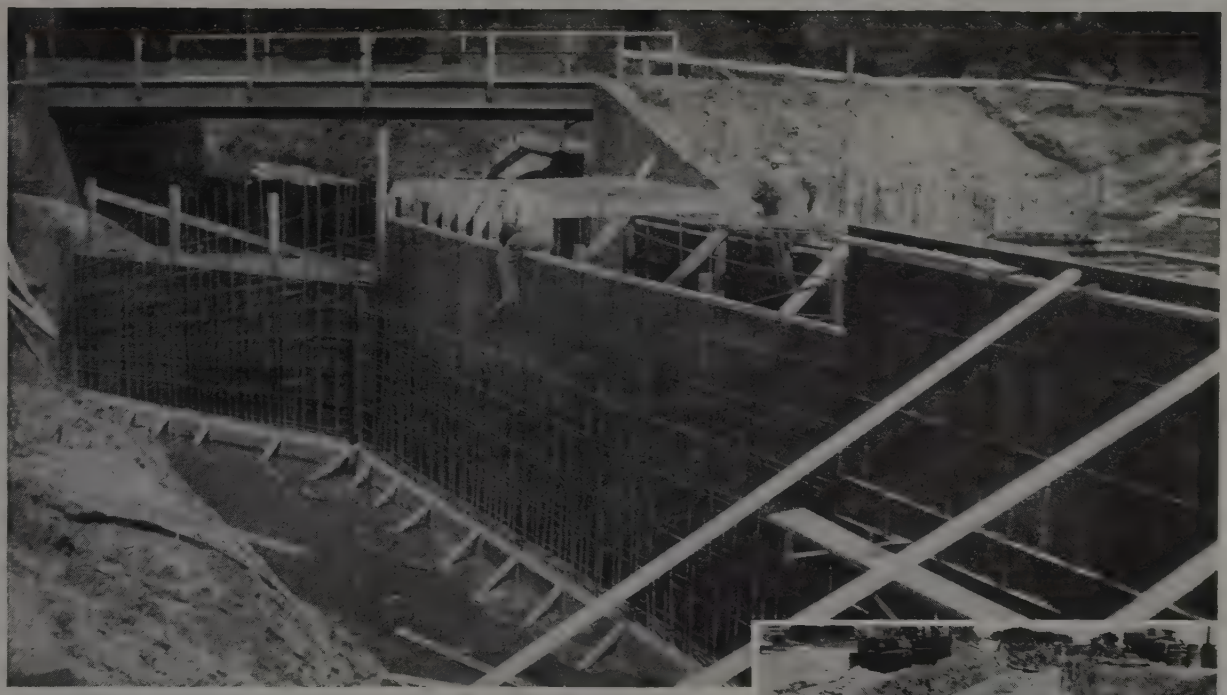
. . . Circle No. 166

Belt conveyor idlers by Link-Belt

An expanded and new line of belt conveyor idlers is being introduced by **Link-Belt Co.** The line is in five series with widths ranging from 14 to 84 in. This increases the



number of idler variations which Link-Belt manufactures from 38 to 64. The new series, designated Series 5000 through 9000, makes it possible to match exactly the idlers for specific operating requirements on all belt conveyor applications. A wide range of types is available in most of the new series. In addition to flat, 20-deg. and 45-deg. troughed rollers, others are provided with



forming Bridges, Culverts, Piers?

UNI-FORM *PANELS*

Save LABOR, MATERIAL, TIME!

Simple mechanical assembly and pre-engineered techniques for handling virtually any forming condition make UNI-FORM Panels your best bet for fast, low cost forming. Successful contractors everywhere are using the UNI-FORM system to form bridges, overpasses, culverts, piers and abutments, because their experience has shown that UNI-FORM Panels give them the speed, flexibility and economy required to handle this complex type of forming at the lowest possible cost.

Let us prove our point. Send a set of plans for detailed forming specifications, recommendations and cost analysis. There's no obligation, of course.

P1501

UNIVERSAL FORM CLAMP CO.

Concrete Form Specialists Since 1912

1238 North Kostner Avenue, Chicago 51, Illinois

DISTRIBUTORS

UNIVERSAL EQUIPMENT CO.
1549 EASTLAKE AVENUE
SEATTLE, WASHINGTON

UNIVERSAL FORM CLAMP CO.
13210 SOUTH FIGUEROA AVENUE
LOS ANGELES, CALIFORNIA

UNIVERSAL FORM CLAMP CO.
2051 WILLIAMS STREET
SAN LEANDRO, CALIFORNIA

Here Are The Basic Elements:

. . . for more details, circle No. 47 on Reader Service Postcard

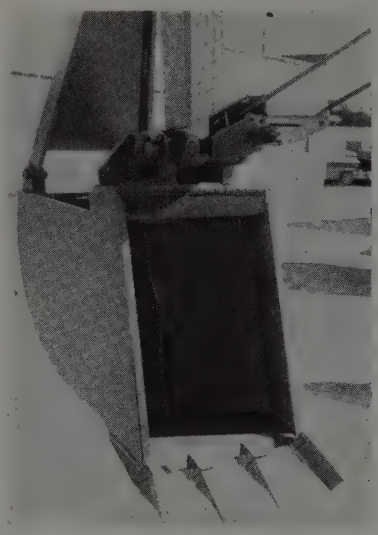
rubber cushioning for use at the loading points. These idlers are filled with grease at the factory and can be installed without further lubrication. ... *Circle No. 167*

Portable batching plant by Aeroil

A portable concrete batching plant available in 3½ and 6-yd. sizes has been announced by **Aeroil Products Co.** The weigh hopper is fabricated in abrasion resistant steel and features an easy method of introducing cement to the batch. The plant is mounted on four wheels for transport and is available for either gas engine or electric drive. Water meters are optional equipment. Total weight is about 7,500 lb. with overall width of 7 ft. and length of 36½. ... *Circle No. 168*

Special rock backhoe bucket

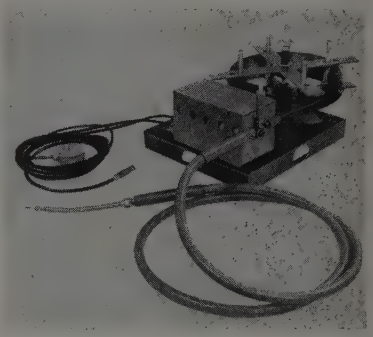
Schield Bantam Co. has announced the availability of a heavy-duty rock bucket for its goose-neck backhoe attachment. The 25-in. bucket features heavy-duty construction throughout. Side bits are 1 in. thick and the bottom bit 1½ in. thick. The new bucket, weighing 725 lb. is ideal for digging in extra tough ground conditions and



rock. The bucket is adaptable to Bantam's goose-neck backhoe design on either the carrier-mounted, crawler-mounted, or self-propelled cranes-excavators. Complete specifications and prices are available on request. ... *Circle No. 169*

Welder for hard facing

Designed particularly for the effective application of hard surfacing materials, the Porta Weld machine has been introduced by **Hensley Equipment Co., Inc.** This is the

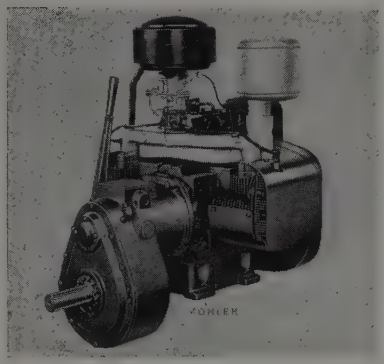


first product in the welding field built by the company which manufactures tractor rolls and construction equipment parts.

The company has designed a machine that combines several advantages. The entire machine is mounted on a sturdy base and provides for accommodating the standard reels. It is extremely light in weight —only 57 lb. with cable—and has the further advantage of simplicity in controls. ... *Circle No. 170*

Heavy-duty engine by Kohler Co.

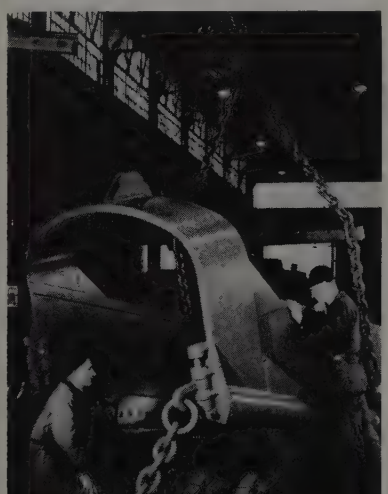
Air cooled and with a rated 24 hp. at 3,200 rpm, a new heavy-duty engine has been announced by



Kohler Co. It is designed particularly for applications which require heavy starting loads and low power take-off speeds. Model K660CR is equipped for either a crank starter or a 6 or a 12-volt starter generator. *. . . Circle No. 171*

New line of Williams buckets

Built in 3, 4 and 5-yd. sizes for heavy duty service, **Williams Bucket Division** of Wellman Engineering Co. has a line of new dragline buckets. All buckets in the new line have



arch and lip built from heat-treated T-1 steel for strength and wearing qualities. Chains are of heat-treated alloy steel. As an indication of the added weight for strength, the new 3-yd. model weighs 6,700 lb. compared to the standard Williams dragline bucket which weighs 5,785 lb. All wear points are protected by skid bars and wear plates. Perforated models are available for wet service. *. . . Circle No. 172*

Ford has big tractor-loader

A tractor-loader with two and a half times the lift capacity of any previous Ford loader unit is announced by **Ford Motor Company**'s Tractor and Implement Division. This economical new unit is designed to close a gap between currently available medium capacity industrial power equipment and high cost, high capacity, special-purpose earth-moving and construction equipment now on the market.

Larger and heavier than the Ford general-purpose tractors, the new machine, with a 7,000-lb. capacity front axle and heavy weight-bearing frame has unequalled ruggedness. Its strength and capacity to withstand batterings and shock-loads is derived from a new concept of isolating the driver, engine, hydraulic pumps, and steering system from members of the tractor which take the biggest beating.

A massive grille and bumper encloses and protects headlights, cooling system, hydraulic reservoir and pump. An all-power steering system has a steering wheel requiring less than a complete turn to go from straight ahead to full right or full left. It provides quick maneuverability and isolates the driver from kickback.

A foot throttle, allowing the operator to over-ride his hand-set operating speed, gives him faster shuttling and frees his right hand to control the loader. The "step-on" feature and low height of the tractor make access to the seat fast and easy. The operator's visibility forward and alongside the tractor is unimpaired by cross bracing and steering rods. Loader support members are low and diagonally anchored to the side of the tractor.

The tractor's work-proved Ford "Red Tiger" engine develops 42.5 drawbar horsepower in the gasoline models. A diesel engine for outstanding economy also is available. The tractor's shipping weight is 3,800 lb.

Ford's new loader, developed for use with this tractor, has a capacity at least a quarter of a ton greater than equipment in a comparable price range. With a 2,500-lb. capacity, 5,500-lb. break-away limit, lift height close to 11 ft., and regular material bucket sizes of 5/8 and 3/4 yd., the super-size loader enables an operator to move and load loose material fast with minimum fatigue.

Hydraulic power for the loader comes from an independent "universal" hydraulic package, including oil reservoir, pump, oil cooler, filter and control. This package can be obtained as a factory installation. *. . . Circle No. 173*

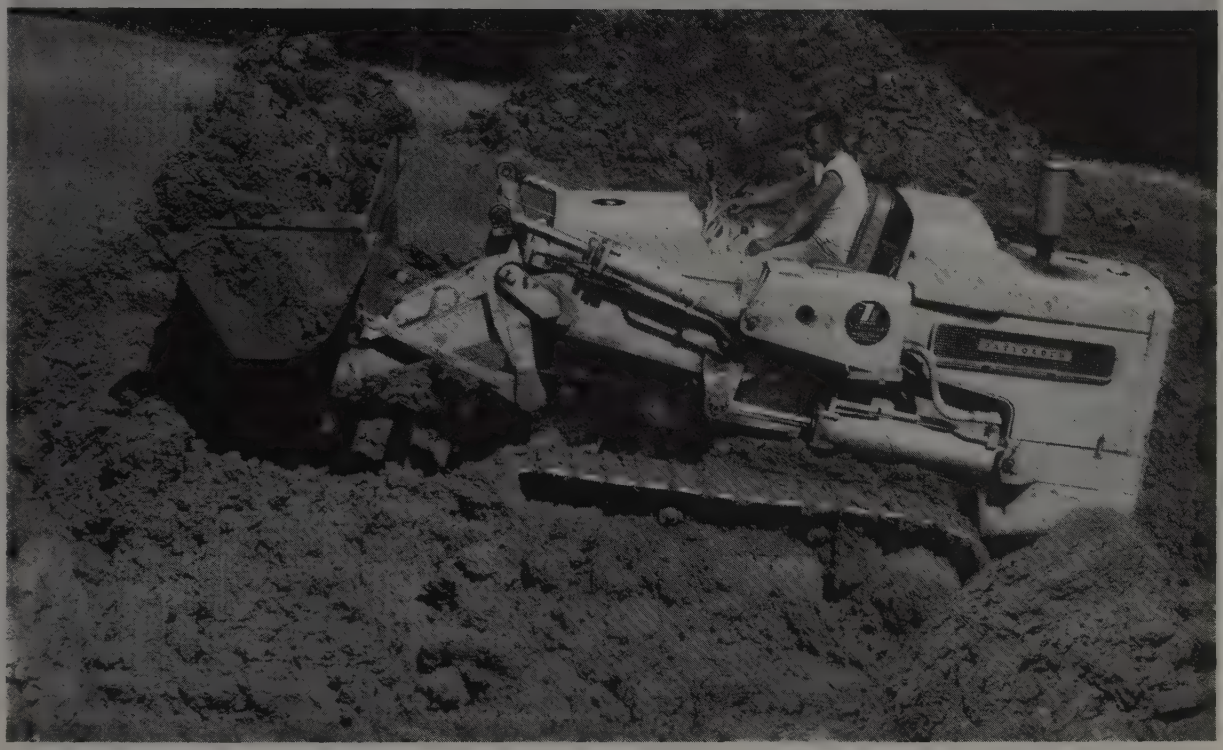
Light weight and slow speed

Described as the lightest (2,250 lb.) and slowest (1,600 rpm.) rotary air compressor on the market, **Le Roi** has added a fourth unit to its new line. Rated at 125 cfm., the new Model 125RG2 is a sliding vane type two-stage compressor with an in-line cylinder arrangement. It is powered through direct drive by a Le Roi engine.

. . . Circle No. 174

(More New Equipment on 116)

"Model 12... Finest track-type shovel ever designed" says R. L. Shepherd, Shepherd Construction Co., Muscatine, Iowa



"On the basis of its performance for us, we are looking forward to buying another Model 12 'PAYLOADER' soon", says the owner of Shepherd Construction Co. "Because of its great versatility, it has our recommendation as a money-making tool for both large and small contractors."

"We've used our Model 12 on every conceivable type of job since January, 1957, and found its performance excellent in every way. Of all the wonderful improvements on the Model 12, we feel its center seating takes the spotlight. It makes the machine ride easy and provides excellent vision.

"The Model 12 has the finest bucket action we have ever used. Excavating from a solid bank, we've loaded out 8 to 9 yd. trucks with 3 passes in 2-minutes time. The normal bucket load is always 2-yds. plus. Its flotation is exceptionally good because the loaded bucket is balanced by the rear-mounted engine. All this along with its fine operating diesel engine, large torque-converter and power-shift transmission (master clutch eliminated) enables the Model 12 to give us a production record of which we are very proud."

FOR PROOF — ask for a Model 12 demonstration or write for your copy of an informative 8-page bulletin. The Frank G. Hough Co., Libertyville, Ill.

HOUGH®

THE FRANK G. HOUGH CO.
LIBERTYVILLE, ILLINOIS
SUBSIDIARY — INTERNATIONAL HARVESTER COMPANY

THE FRANK G. HOUGH CO., 707 Sunnyside Ave., Libertyville, Ill.
Please send more data on the new Model 12 "PAYLOADER" to:

Name _____
Title _____
Company _____
Street _____
City _____ State _____

12-C-3

. . . for more details, circle No. 51 on Reader Service Postcard

News of DISTRIBUTORS

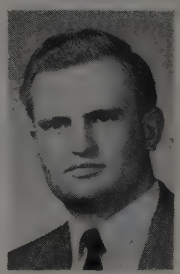
Denver plant under construction

Construction of the new plant of Power Equipment Co., Denver, is fast moving toward completion. The change in location from 3440 Brighton Blvd. to a 7-ac. site on East 62nd Ave. at Valley Highway North is being made to obtain larger quarters for the purpose of giving its customers even better service than in the past. Being built at a cost of $500,000, the 24,000-sq. ft. fully equipped plant is expected to be ready for occupancy early in the new year. The service and parts departments will each have four times the present space, and a large area is designed for increased parts inventory and servicing equipment. Modern air-conditioned offices are in the plans as well as ample display and parking facilities.

Founded in 1938, Power Equipment Co. has in the past twenty years become one of the largest handlers of contractors equipment in the Rocky Mountain area, distributing the products of Allis-Chalmers Manufacturing Co., Northwest Engineering Co., Schield Bantam Co., and others. A branch is located at Grand Junction for the convenience of users of heavy construction equipment in that section.

Harlan Smith manager of Boise distributorship

Appointment of Harlan W. Smith as director-manager of Southern Idaho Equipment Co. of Boise



Harlan W. Smith

is announced by S. L. Cate, president. Smith, former Northwest sales representative for the Construction Machinery Division of Allis-Chalmers Manufacturing Co., replaces Steve T. Collins, Jr., presently managing another company in Northern California.

Clyde acquires another line

Clyde Equipment Co., Seattle, has just taken on distribution in western Washington for the Dixie portable dredge manufactured by Service Machinery Corp. of North Miami, Fla.

Wyoming distributor named

Wilson Equipment & Supply Co., Cheyenne, Wyo., has been named Le Roi Division, Westinghouse Air Brake Co., distributor for Wyoming.

Dealer appointments by Napco

R. J. Rayback, construction equipment sales manager for Napco Industries, Inc., Minneapolis, Minn., announces that franchises on the versatile four-wheel drive, four-wheel steer, industrial Crab Tractor which was introduced ear-

Design of traveler permits vehicular operation through tunnel while form is in place. In addition Blaw-Knox developed and built a concave screed for the tunnel invert.

Concrete Forming time cut by 33% on Trinity Dam Diversion Tunnel

Single Blaw-Knox Tunnel Form moving on rubber-tired traveler is handled by six man crew

More than 30,000 cubic yards of concrete have been poured in the construction of the 2,570 foot long, 28-foot diameter diversion tunnel at the Trinity Dam Project at Lewiston, California. To speed forming operations, Trinity Dam Contractors chose two specially designed Blaw-Knox Tunnel Forms, each 50 feet long, equipped with two rubber-tired travelers each.

The Blaw-Knox Forms can be set, stripped, and reset without disassembling any of its components. Each set of wheels is equipped with a ratchet device to permit steering of the traveler around horizontal curves. Despite its weight, the form is moved by two men operating hand winches. Elevation is controlled by a series of hydraulic jacks, and sidewall adjustments are made with steamboat ratchets. Telescoping pipe spreaders support sidewalls during pouring.

With these specially designed units, Trinity Dam Contractors poured every day, alternating between forms, allowing 16 hours set-up time. Using other methods, a maximum of only two pours a week would be possible. Guy F. Atkinson Company is sponsor of the $49,000,000 joint venture. Other joint venturers are: M. J. Bevanda Co., Inc., Chas L. Harney, Inc., Ostrander Construction Company, A. Teichert & Son, Inc. and Trepte Construction Co.

You can put the know-how of Blaw-Knox Steel Forms Engineers to work on your concreting problems. You'll get the benefit of 40 years experience translated into versatile, rugged equipment designed to help increase your profits. Call on the Blaw-Knox Steel Forms Consultation Service for planning help now. There's no obligation, of course.

BLAW-KNOX

BLAW-KNOX COMPANY

Blaw-Knox Equipment Division · Pittsburgh 38, Pa. · Phone STerling 1-2700

. . . for more details, circle No. 53 on Reader Service Postcard

ly in 1958 have been granted to the following Western construction machinery dealers: Western Machinery Co., Phoenix, Ariz.; Smith Booth Usher Co., Los Angeles, Calif.; Western Machinery Co., Denver, Colo.; Western Machinery Co., Salt Lake City, Utah; and to International Agencies & Machinery Co., Vancouver, B. C.

WEMCO names seven distributors

WEMCO, San Francisco, has named Cramer Machinery Co. of Portland as distributor for its aggregate equipment in Oregon and southern Washington. James W. Schriver is Cramer president, and A. B. Bruschke, sales manager. R. L. Harrison Co., Inc., Albuquerque, N. Mex., will distribute the WEMCO line in the New Mexico counties on the southern border. R. L. Harrison is president.

Western Machinery Co. Industrial Sales Division offices in Phoenix, Salt Lake City, Denver, and Spokane have been appointed to distribute WEMCO products. The Phoenix office, managed by J. P. Keller, will cover Arizona. Colorado will be served from the Denver office, managed by H. A. Myers. The Salt Lake City branch, managed by L. T. McGuire, will distribute WEMCO in eastern Nevada, Utah, and southern Idaho. The Spokane office will be distributor for western Montana, eastern Washington, and northern Idaho.

Clark appoints new dealer in Washington

Liftco, Inc., Seattle, Wash., has been appointed to sell and service the line of fork trucks, straddle carriers, powered hand trucks and towing tractors produced by the Industrial Truck Division of Clark Equipment Co. The distributorship will handle the line in Washington, northeastern Oregon, western Montana and part of Idaho.

Western dealer appointments

Additional dealer appointments for Massey-Ferguson Industrial Division products in the West are announced: Guenther Tractor Co., Inc., Pasco, Wash.; Clark County Dairymen's Co-op., Battle Ground, Wash.; Mid-Valley Equipment, Visalia, Calif.; Island Equipment Co., Sacramento, Calif.; Haas & Associates Implement Co., Great Falls, Mont.; B & M Farm Store, Pocatello, Idaho; Kennedy Equipment Co., Cortez, Colo., and Leeper Equipment Co., Farmington, N. Mex.

Lima Austin-Western 111 Crushing and Screening Plant, owned by Ronald Weaver, Dansville, Mich. High-grade specification material is being produced at an average rate of 1000 cu. yd. per 9 hr. shift.

"Lima Austin-Western will outlast and outproduce"

Says Ronald Weaver

Ronald Weaver, Dansville, Mich., has owned and operated a Lima Austin-Western 111 Crushing and Screening Plant since January, 1953. With his 4-man crew, he works all year 'round, producing specification material meeting county and State requirements.

Mr. Weaver says: "I have owned and operated other plants, and I am convinced that over a period of time a Lima Austin-Western will outlast and outproduce other comparable machines. I depend on this plant to show a reasonable profit, and it has produced all that can be expected.

"It is truly a portable machine. Not long ago I moved the 111, power plant, feeder, two dump trucks, dragline, bulldozer and other miscellaneous equipment 20 miles. The time involved in dismantling the equipment, loading, setting up, and resuming operation was only 3 hours.

"The quality of the equipment is shown by the fact that it has never required a major overhaul since it went into operation 5 years ago. But the most obvious reason for buying and using Lima-Austin-Western is the fine relationship and cooperation between not only the dealer and the operator, but more important, the manufacturer, the dealer and the operator."

Get the high-tonnage, low-cost Lima Austin-Western story from your nearby distributor . . . or write direct.

LIMA AUSTIN-WESTERN Crushing, Screening and Washing Equipment

BALDWIN · LIMA · HAMILTON

CONSTRUCTION EQUIPMENT DIVISION • LIMA, OHIO

5829

Edward R Bacon Company, San Francisco, California; **Columbia Equipment Company,** Portland, Oregon, Seattle, Washington, Spokane, Washington; **N. C. Ribble Company,** Albuquerque, New Mexico; **Smith Booth Usher Company,** Los Angeles, California; **Western Machinery Company,** Salt Lake City, Utah; **Western Machinery Company,** San Francisco, California; **Keremi Tractor & Equipment Company,** Cheyenne, Wyoming, Casper, Wyoming; **Hall-Perry Machinery Company,** Billings, Montana, Butte, Montana, Great Falls, Montana; Missoula, Montana; **Engineering Sales Service, Inc.,** Boise, Idaho; **Macdonald Equipment Company,** Denver, Colorado; **Graid Equipment Company,** Reno, Nevada; **Western Machinery Company,** Phoenix, Arizona, Tucson, Arizona.

. . . for more details, circle No. 55 on Reader Service Postcard

HERB MAYER, Director, Region 11; *Beal Shaw*, past-director of the same Region; *Jack How*, also a past-director of Region 11. Mayer directed this year's conference.

IRV KRAEMER; "Andy" Anderson, National President of AED; *Al Garlinghouse*, past president; *W. G. Bowman*, administrative assistant from Chicago headquarters.

AED, Region II, holds conference

WITH a record attendance and a message from "Andy" Anderson, national president, the Associated Equipment Distributors of Region 11 held their annual conference at Ojai, Calif., October 23-25. The conference was carried out under the general direction of H. J. Mayer, Director of Region 11. Two half-day general sessions and one spent in round-table discussions represented the serious business of the conference, with the remaining time devoted to the annual golf tournament and other social events.

In addition to the national president, the AED headquarters were represented by Jack Randle, field secretary, who gave his customary report on observations made in his regular visits to AED chapters, and W. G. Bowman, who was carrying out a special assignment in looking over convention facilities in Los Angeles for a national meeting two years in the future.

A message of sharp analysis on "Today's Sales Financing" was presented by E. H. Thrower, vice president, CIT Corp., from San Francisco. His remarks pointed out that distributors are emphasizing volume of sales with a declining regard for adequate financing and their own futures. He admitted that distributors had been particularly ingenious in devising new

methods of financing the sales of equipment, but these have wandered from business judgment.

Beal Shaw, past director of Region 11 and national chairman of the AED Insurance Trust, reviewed the existing plans and its benefits.

The always interesting question of the relationship between contractor and distributor was reviewed by J. P. Cagle, vice-president of A. Teichert & Son and the past president of the Southern California Chapter, AGC. The outlook for 1959 in construction volume and trends was presented by James I. Ballard, Editorial Director, *Western Construction*.

New lines and new resident rep

Graid Equipment Co., Reno, Nev., reports the acquisition of the lines of Koehring of California and Central Engineering Co., also the addition of Tony Abbott as resident sales and service man in the Las Vegas, Nev., area. His headquarters are at 1857 Leonard Lane, Las Vegas.

Prominent N. W. distributor dies

John P. Studebaker, president of Washington Machinery Co. of Seattle, died recently. He was a well known figure in construction equipment circles in the Northwest. Hil Berglund has succeeded him as head of the company.

Two distributorships announced

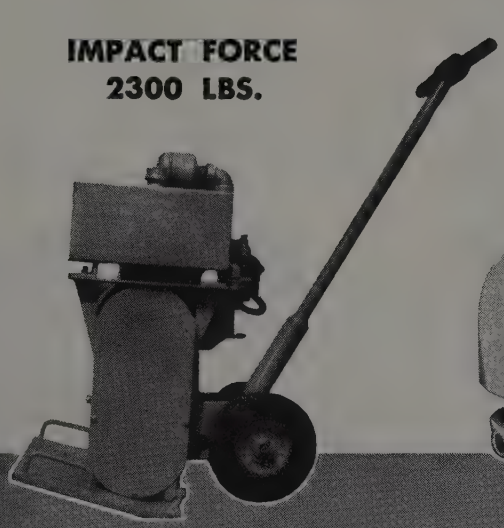
Constructors Equipment & Supply Co., Fresno, Calif., has been appointed a stocking distributor for Pacific Mercury electric plants. Also announced is the appointment of Electric Tool & Supply of Los Angeles to distribute the equipment in that area.

LYNN PARROT and ***Chuck Hamilton*** **of Hamilton Engine Sales, Inc., Portland, examine the extendible tracks on 700 Series crane during recent visit at American Hoist & Derrick Co.'s factory in St. Paul, Minn. With them are** ***Gunnar Johnson,*** **service manager, and** ***Pat Bradley,*** **distributor sales manager of American. Hamilton Engine Sales is the recently appointed distributor for American's products in Oregon, and five counties in southern Washington.**

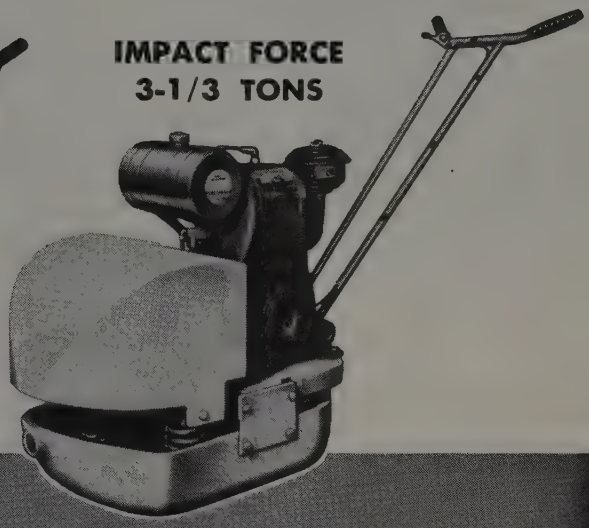
Are You Having Compaction Problems?

BACKFILL SINKING? SLABS CRACKING?

. . . Eliminate with a Terrapac Vibratory Compactor!



TERRAPAC CM-15



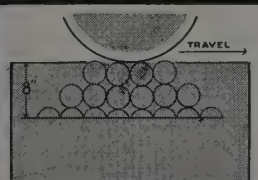
TERRAPAC CM-20

Small, self-propelled, one-man operated, heavy-duty vibratory tampers now enable you to really compact crushed stone, sand, gravel, etc. without bringing in 10-20 ton static rollers. . . . They are also ideal for small asphalt jobs including patch work. . . . The CM-15 will compact lifts up to 12 inches, while the CM-20 penetrates up to 30 inches — in one or two passes. . . . Prove it to yourself — on your own job. . . . To arrange a demonstration, contact your local Vibro-Plus distributor or write to us direct.

Ad 41-57

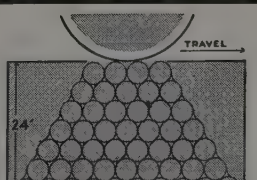
SPECIFICATIONS

	Impact	Frequency VPM	Travel Speed	Weight
CM-15	2300 lbs.	2350	up to 55′ per min.	242 lbs.
CM-20	6600 lbs.	2000	up to 75′ per min.	950 lbs.



CONVENTIONAL STATIC COMPACTION

Static rollers, relying on weight alone, produce friction forces between soil particles causing bridges to form. Terrapacs break bridges for deep compaction.



TERRAPAC DYNAMIC COMPACTION

Vibratory energy breaks frictional forces binding soil particles together, allows soil to sift down producing uniform densities at greater depths.

VIBRO-PLUS PRODUCTS, INC. — STANHOPE, NEW JERSEY

Western Machinery Company, Phoenix, Arizona
Smith Booth Usher Company, Los Angeles, California
West Coast Engine & Eqpt. Co., Berkeley, California
Air Rentals, Inc., Denver, Colorado
Sawtooth Company, Boise, Twin Falls, Idaho Falls, Idaho
Seitz Machinery Co., Inc., Billings & Great Falls, Montana
Andrews & Andrews Equipment Co., Portland, Oregon
Foulger Equipment Co., Salt Lake City, Utah
Andrews Equipment Service, Spokane, Washington
Moss Equipment & Supply Co., Casper, Wyoming

WORLD'S LEADING MANUFACTURER OF VIBRATORY EQUIPMENT FOR OVER TWO DECADES

. . . for more details, circle No. 60 on Reader Service Postcard

MANUFACTURERS

Galion promotes Troyer and Little

The Galion Iron Works & Mfg. Co. of Galion, Ohio, announces the appointment of William R. Troyer

Troyer

Little

as sales manager of Galion's special products division, and Porter Little as supervisor of sales and service training on graders and rollers.

Engineering promotion by Intrusion-Prepakt

Appointment of Roscoe C. Jennings as assistant chief engineer is announced by Intrusion-Prepakt, Inc., Cleveland. The company specializes in the construction and maintenance of heavy concrete structures and foundations.

New type forms built to Western standards

Metalform Inc., Los Angeles, reports the development of a heavy-duty form in both steel and aluminum, offering to Western contractors a high quality, light-weight form along with clamps designed to hold the forms in pouring position. In addition, Metalform offers engineering, design and consulting services for all types of form needs. Howard Morrissey, company president, has been associated for many years in the construction equipment field in California in sales and engineering, presently owning Morrissey Equipment Inc. of Los Angeles. Marv Brown, company secretary-treasurer, provides the engineering, design and manufacturing know-how.

Atlas Powder transfers Dale MacDonald to West

Dale A. MacDonald has been appointed a sales representative in Atlas Powder Co.'s San Francisco explosives sales district. He has been a technical representative in the company's explosives sales department in Wilmington, Del., since returning to the company last year from military service.

Wire rope representative in Los Angeles announced

William R. Warda has been named district representative for Broderick & Bascom Wire Rope

William R. Warda

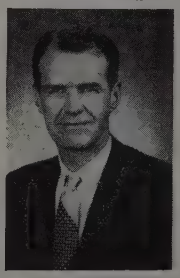
Co., manufacturer of wire rope, wire rope slings and wire rope fittings. He will cover Southern California operating out of the Los Angeles Division Branch, 2441 Hunter St., Los Angeles 21, Calif. R. H. Boag is Los Angeles district manager.

Raybestos-Manhattan moving

Raybestos-Manhattan, Inc., announces the construction of new warehouse and office facilities located at 168 Beacon St., South San Francisco, Calif. The modern 10,000-sq. ft. warehouse will be headquarters for both the Manhattan Rubber, Packing and Textile divisions located at 131 Mission St., San Francisco, and the automotive friction materials handled by the Raybestos Division located at 600 Fulton St., San Francisco. The new building is of tilt-up concrete construction, designed for an additional 4,000 sq. ft. of space for later expansion. The new headquarters will be ready for occupancy in early December.

Link-Belt promotes two in sales

The promotion of two men to new sales managerial positions in Link-Belt Speeder Corp., Cedar



Van de Roovaart

N. V. Chehak

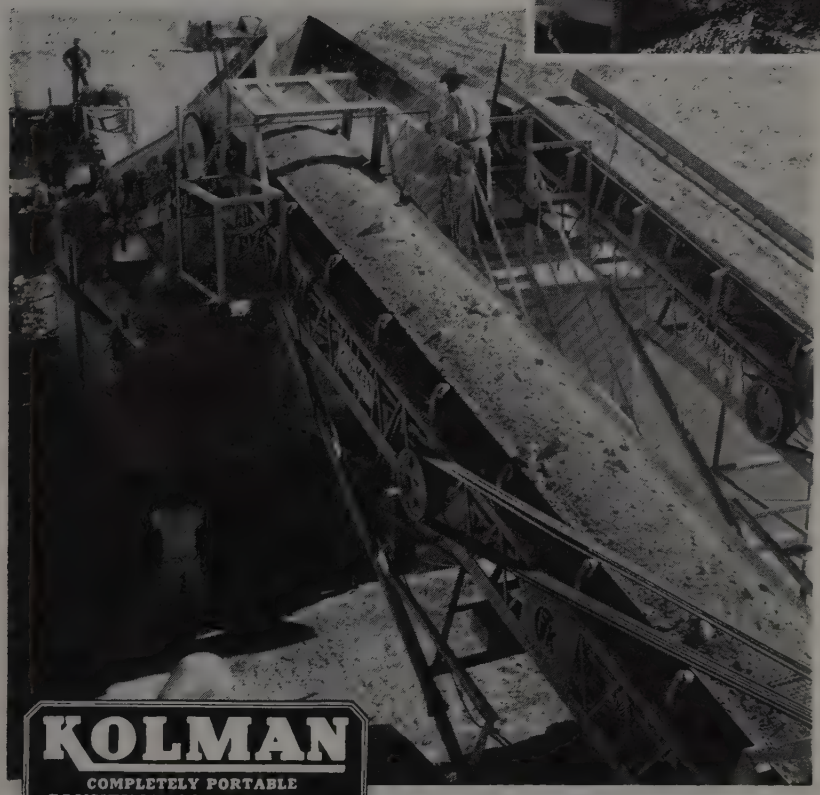
Rapids, Iowa, is announced by C. M. Basile, vice president of manufacturing and sales. N. V. "Norb" Chehak has been named sales manager in charge of all domestic and Canadian sales for the firm's line of crawler and rubber-tired shovel-cranes and related pipe-hammer equipment. D. F. "Dave" Van de Roovaart assumes the duties of assistant sales manager for the same territories.

Iowa Manufacturing Moves Man

Len Dvorak has been transferred from the factory at Cedar Rapids, Iowa, to the post of district representative for Iowa Manufacturing Co. in the Pacific Northwest.

Fredericksen & Kasler Lick Thin Margin on Freeway Job with Two KOLMANs

Dozers and scrapers charge the dump hopper for the twin KOLMANs.



As these two 60'x42" KOLMANs with 12'x60" screens set the pace, 25-ton trucks pull out from under the bunkers in 15 to 18 seconds.

Twin 60' x 42" KOLMANs Peak at 2000 tons per hour

Fredericksen & Kasler, California contractors, really sharpened their pencils to bid for a 29½-mile section of four-lane divided highway near Victorville, Calif., the longest contract the state of California has ever awarded. Their $5½ million bid left $950,000 "on the table" over their nearest competitor, and for awhile the margin appeared disastrous.

Only by coming up with imaginative methods to handle the astronomical quantities of material did Fredericksen & Kasler lick the job. There were 3½ million cubic yards of grading, over half a million tons of base course material production, and 250,000 tons of aggregate production for plant-mix paving.

Among their innovations was the use of two KOLMAN Model 101 Portable Conveyor-Screen Plants at the pit, placed side by side. By dumping each unit over its individual bunker, twin dumping points were developed for faster truck loading. KOLMAN feeders at the dump hopper were unprotected by manual gates. Everything from 8" rock on down was put through as fast as the system would take it — up to 2000 tons per hour!

Thus another contracting firm turned potential loss into profit by stepping up loading and screening production with KOLMANs, the original portable conveyor-screen plants.

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BUTTE, BILLINGS, GREAT FALLS and MISSOULA—Hall-Perry Machinery Co.

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. . . for more details, circle No. 62 on Reader Service Postcard

NEW EQUIPMENT

(Continued from page 104)

Pioneer develops new jaw crusher

A jaw crusher in the 20x36-in. size has been developed and placed on the market by **Pioneer Engineering**, Division of **Poor & Co.** Termed the 2036, this new crusher is the overhead eccentric type which means that the moving jaw is suspended from a shaft which also serves as the pitman. This eliminates double toggles, extra shafts and cuts down on overall crusher weight. The crusher has a longer jaw than former models for improved angle of nip to reduce "belching." It is hydraulically adjusted for setting to produce materials down to 2½ or 3-in. minus and has a rated capacity under average crushing of 190 to 200 tons an hour of 6-in. minus product. Rated capacity is 95 to 100 tons an hour of 3-in. minus product under similar crushing conditions. The base is all welded steel double-wall construction, on which the bearings are saddle mounted to prevent weave and wobble. Bearings are self-aligning spherical roller type.
. . . Circle No. 175

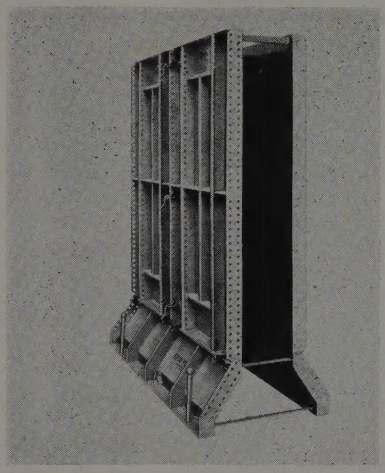
Self-propelled paving bridge

Designed to keep pace with faster moving paving trains in use today, the new self-propelled Power Traction Bridge developed by **The Cleveland Formgrader Co.** of Avon, Ohio, travels at a speed of 2½ ft. per min. The Power Traction Bridge is an all-around piece of equipment for finishing and belting, for use as a cross-over and for carrying tools, water and equipment. Powered by a 2¾-hp., 4-cycle engine, the bridge has a simple reversing transmission which is operated by a single control. One of the features of the power bridge is its ability to operate without attention once it has been put in gear.
. . . Circle No. 176

DESIGNED for its Model L 6-ton crane, *Little Giant Crane & Shovel, Inc.*, has announced a new Model 400 carrier. The new carrier is engineered by Little Giant from GMC banjo type axles, 6 x 6 military-type chassis. The carrier is announced as the lowest priced unit on the market for 6 to 8-ton cranes.
. . . Circle No. 177

Combined footing-wall form

To permit the pouring of footings and foundation walls at



the same time a new type of steel form has been designed and announced by **Economy Forms Corp.** The forms are designed to be used with the regular EFCO form equipment as pictured. The procedure saves time in building operations by eliminating the need for the usual time to elapse between the pouring of footings and walls. Important savings are also made in labor and in the time of form erection.

. . . Circle No. 178

Base spreader for tractors

A base spreader which can be attached in minutes to Caterpillar D8, D7, or D6 tractors has been announced by **John G. Ulrich Co.,** and identified as the U-100. Push fork arms slip onto the trunnions and are secured by a single bolt on each side. The blade of the dozer serves as the strikeoff and is attached to the spreader box by wing-nut clamps. The spreader adapts quickly to any width of dozer blade. The unit spreads accurately in lifts from 1 to 20 in. in depth. Widths of spread can be varied from 8 to 16 ft.

Four bolts on each cross beam permit quick knockdown for shipping, with the widest section only 4 ft. John Ulrich products will be sold and serviced exclusively by Caterpillar dealers.

. . . Circle No. 179

Meeting legal load limits

To carry maximum legal loads in areas where a 49,000-lb. gross weight is allowed on a 3-axle truck **Four Wheel Drive Auto Co.** has introduced a mixer truck with an extra-heavy front axle. The new C6-547 has a 54,000-lb. gross rating with an 18,000-lb. front axle and rear tandem axles rated at 32,000 lb.

To provide extra flotation of the heavy front axle load for off-highway use, the two front wheels are equipped with 14.00 x 20 tires. Both conventional and tilt-cab are available and the truck is equipped with a 212-hp gasoline engine.

. . . Circle No. 180

UNIT PRICES

Selected abstracts for Western projects

HIGHWAY—10.4 mi. of grading and surfacing

Montana—Lewis and Clark County—State. Naranche & Konda has received a $1,058,369 contract for 10.4 mi. grading, aggregate surfacing, plant mix surfacing, seal coating, and drainage.

(1)	Naranche & Konda	$1,058,369
(2)	S. Birch Inc. & S. Birch & Sons Construction Co.	1,107,010
	Robertson & Cave, Inc.	1,108,726
	Northwestern Engineering Co.	1,115,694

		(1)	(2)
Lump sum	Clearing and grubbing	$5,000.00	$1,300.00
800,102 cu. yd.	Unclassified excavation	.57	.60
3,540 cu. yd.	Culvert excavation	3.00	2.00
76,816 mi. yd.	OH unclassified excavation	.20	.18
1,600 unit	Rolling embankment	7.00	10.00
893 unit	Rolling aggr.-surf. course	8.00	8.00
94 unit	Rolling seal coat	12.00	8.00
12,602 M gal.	Watering embankment	1.50	2.00
4,251 M gal.	Watering surf. course	2.50	3.50
70 hr.	Watering cover aggregate	10.00	7.00
191,004 ton	Selected BB course (3 in. Cr.)	1.10	1.25
21,532 ton	Ty. "A" Cr. top surf., ¾ in.	1.45	2.50
2,339 ton	Cover material 3/8 in.	6.50	5.00
1,581.78 ton	150-200 PA cement	34.00	28.00
270.07 ton	MC-1 cutback asphalt	45.00	40.00
224,62 ton	RS-2 emuls. asphalt	45.00	40.00
28,777 ton	PMB surface, Ty. II ¾ in.	3.40	3.50
Lump sum	Rem. exist. structures	3,000.00	1,500.00
392 lin. ft.	Relay pipe culverts	3.00	4.00
861 cu. yd.	Aggregate backfill	5.00	2.50
144 lin. ft.	48 in. CMEP culverts, 8-gage	40.00	28.00
134 lin. ft.	60 in. CMP culverts	50.00	32.00
138 lin. ft.	72 in. struc., PEP culverts, 10-gage	70.00	55.00
174 lin. ft.	90 in. SPEP culverts, 10-gage	80.00	67.00
744 lin. ft.	18 in. RCP culverts	8.00	6.00
1,146 lin. ft.	24 in. RCP culverts	10.00	10.00
72 lin. ft.	30 in. RCP culverts	15.00	13.00
408 lin. ft.	36 in. RCP culverts	20.00	17.00
268 lin. ft.	48 in. RCP culverts	35.00	28.00
86 lin. ft.	60 in. RCP culverts	50.00	42.00
74 lin. ft.	73.5 in. S x 45 in. R RCA culverts	50.00	44.00
2 ea.	Project markers	25.00	25.00
55 ea.	Station markers	10.00	10.00
120 ea.	Right of way monuments	8.00	7.00

DAM—Prineville Dam, Oregon

Oregon—Crook County—Bureau of Reclamation. Keystone & Associates submitted a low bid of $2,614,943 for construction of Prineville Dam on the Crooked River, an earthfill dam, near Prineville.

(1)	Keystone & Associates	$2,614,943
(2)	Engineers Rentals & Rogers	2,991,446
	Peter Kiewit Sons' Co.	3,066,497
	Wayne Const., Inc.	3,068,320

		(1)	(2)
Lump sum	Diversion, care of river during constr., removal of water from foundations	$28,000.00	$130,000.00
47,000 cu. yd.	Excavation, com., in open cut, for spillway and outlet wks.	1.37	.54
137,000 cu. yd.	Excavation, rock, in open cut, for spillway and outlet wks.	1.50	1.68
60,000 cu. yd.	Excavation, com., for dam embankment foundation, first 80,000 cu. yd.	1.50	1.10
60,000 cu. yd.	Excavation, com., for dam embankment foundation, over 60,000 cu. yd.	1.50	1.10
6,800 cu. yd.	Excavation, all classes, in outlet-works tunnel, adit, and access shaft	32.00	41.00
165,000 lb.	Furnish., placing permanent structural-steel supports	.01	.01
700 lin. ft.	Furnish., installing tunnel roof support bolts	3.00	2.50
3,500 lb.	Furnish., installing chain-link woven-wire fabric for tunnel roof support bolts	.40	.50
55,000 cu. yd.	Excavation, strip. borrow pits	.30	.23
275,000 cu. yd.	Excavation, com., in bor. area A, sep., transp. to dam embankmt. first 275,000 cu. yd.	1.00	.62
275,000 cu. yd.	Excavation, com., in bor. area A, sep., transp. to dam embnkmt., over 275,000 cu. yd.	.60	.60
275,000 cu. yd.	Excavation, com., in bor. area B, sep., transp. to dam embankmt. first 275,000 cu. yd.	.75	.65
275,000 cu. yd.	Excavation, com., in bor. area B, sep., transp. to dam embnkmt., over 275,000 cu. yd.	.32	.62

5,500 cu. yd.	Pervious backfill	1.50	3.00
375 cu. yd.	Bedding for riprap	3.00	3.00
1,200 cu. yd.	Riprap	4.50	3.00
870,000 cu. yd.	Earthfill in dam embankment, zone 1	.16	.17
7,500 cu. yd.	Specially compacted earth fill.	2.25	2.70
78,000 cu. yd.	Placing sand, gravel, cobble, boulder fill in dam embankment, zone 2	.13	.34
160,000 cu. yd.	Cobble, boulder fill in dam embankment, zone 3	.13	.11
168,000 cu. yd.	Placing rock-fill material in dam embankment, zone 4, from sources other than rock sources	.32	.55
122,000 cu. yd.	Procuring rock-fill matrl. from rock sources, plac. in rock fill in dam embkmt., zone 4	.75	1.20
3,300 lin. ft.	Drilling grout holes in stage bet. depths of 0 ft.-30 ft.	3.00	5.00
220 lin. ft.	Drilling grout holes in stage bet. depths of 30 ft.-60 ft.	4.50	5.50
870 lb.	Furnish., placing pipe and fittings for grouting	1.00	1.50
160 hook-ups	Hook-up to grout holes and connections	11.00	20.00
3,500 cu. ft.	Pressure grouting	3.80	3.00
55 lin. ft.	Furnishing and placing metal seals, type M2	6.00	6.50
70 lin. ft.	Furnish. 8-in. diam. perforated asbestos-bonded corr.-metal pipe and construct. drains	5.00	11.00
220 lin. ft.	Furnish. 4-in. diam. perforated sewer pipe and const. drains with open joints	1.25	3.30
820 lin. ft.	Furnish. 6-in. diam. perforated sewer pipe and const. drains with open joints	1.50	3.30
850 lin. ft.	Furnish. 8-in. diam. perforated sewer pipe and const. drains with open joints	2.00	4.40
70 lin. ft.	Furnish. 10-in. dia. perforated sewer pipe and const. drains with open joints	2.50	6.50
110 lin. ft.	Furnish. 12-in. dia. perforated sewer pipe and const. drains with open joints	4.50	11.00
140 lin. ft.	Furnish., laying 8-in. diameter sewer pipe with calk. joints	1.60	3.30
50 lin. ft.	Furnishing, laying 12-in. dia. sewer pipe with calk. joints	3.25	6.60
70 lin. ft.	Furnishing, laying 24-in. dia. sewer pipe with calk. joints	10.50	16.00
600 lin. ft.	Drilling drainage holes	3.00	7.00
6,300 lin. ft.	Drilling holes for anchor bars and grouting bars in place	2.50	2.00
15,000 bbl.	Furnishing, handling cement	7.50	7.25
1,250,000 lb.	Furnish., plac. reinforce. bars	.15	.16
20 cu. yd.	Concrete in backfill	30.00	40.00
515 cu. yd.	Conc. in spill. inlet chan. walls	30.00	56.00
175 cu. yd.	Conc. in spill. inlet chan. lin'g	30.00	61.00
5,100 cu. yd.	Conc. in spillway crest structure, chute, stilling basin	37.08	51.00
22 cu. yd.	Concrete in spillway bridge	70.00	130.00
450 cu. yd.	Concrete in outlet-works intake structure, first stage	63.00	65.00
2,100 cu. yd.	Concrete in outlet-works tunnel lining	55.00	70.00
250 cu. yd.	Concrete in outlet-works adit lining and access shaft lin'g	90.00	93.00
235 cu. yd.	Concrete in outlet-works gate chamber, first stage	52.00	81.00
26 cu. yd.	Concrete in outlet-works shaft house	100.00	170.00
290 cu. yd.	Concrete in outlet-works and spillway, second stage	65.00	55.00
330 lin. ft.	Furnishing and placing rubber waterstop, type A	4.50	6.00
610 lin. ft.	Furnishing and placing metal seals, type N2	4.50	4.00
950 lin. ft.	Furnishing and placing metal waterstops	7.00	5.00
420 sq. ft.	Furnishing and applying corkboard insulation	1.00	7.00
210 sq. ft.	Furnishing, placing roofing	.50	2.00
42 sq. ft.	Furnishing, placing industrial-type steel swinging doors	12.00	25.00
23 points	Const. surf. settlement points.	20.00	20.00
Lump sum	Installing high-pressure gates, hoists and hangers	9,500.00	17,500.00
Lump sum	Furnishing and installing gate hanger anchors	350.00	400.00
Lump sum	Inst. control equip., piping for high-pressure gates	3,800.00	5,000.00
Lump sum	Furnish., inst. air-inlet piping on high-pressure gates	3,500.00	1,500.00
Lump sum	Inst. reservoir level gage, piping, and copper tubing	3,500.00	3,000.00
Lump sum	Furnish., install. ventilat. system and air-inlet piping	10,000.00	10,000.00
Lump sum	Inst. two position indicators for high-pressure gates	500.00	1,200.00
Lump sum	Furnish., installing trashracks	9,000.00	13,500.00
12,000 lb.	Installing metalwork	.18	.25
550 lin. ft.	Furnishing and erecting chain-link fence	4.00	6.00
550 lin. ft.	Furnish., install. elec. metal conduit ¾ in. or less in dia.	1.30	1.50
20 lin. ft.	Furnish., install elec. metal conduit 1 in. in diameter	2.00	3.00
30 lin. ft.	Furnish., install. elec. metal conduit 1½ in. in diameter	3.00	4.00
85 lb.	Furnish., install insulated electrical conductors	3.00	3.00
50 lb.	Furnish., install. grounding system materials	3.00	5.00
39 devices	Furnish., install. wir'g devices	10.00	25.00

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