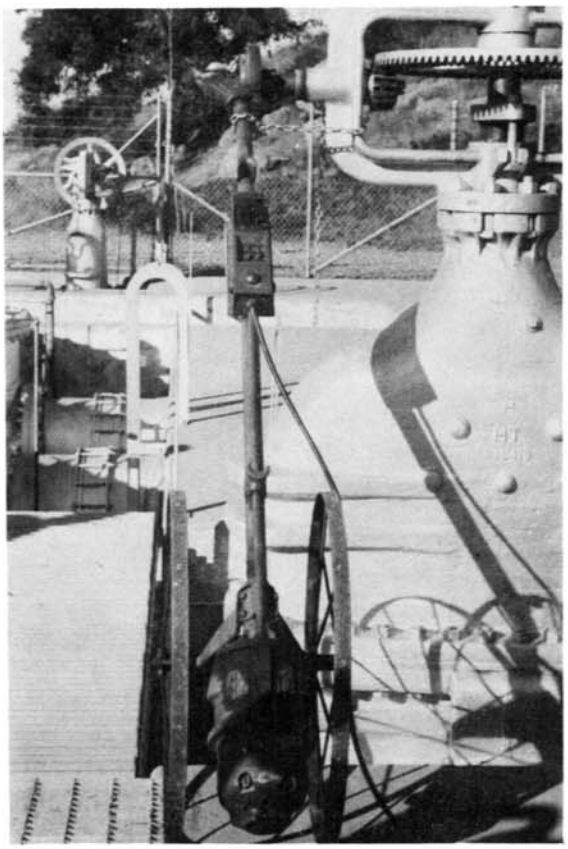
Department of the Interior
Bureau of Reclamation

OPERATION AND MAINTENANCE EQUIPMENT AND PROCEDURES

RELEASE NO. 30

October, November and December 1959



CONTENTS

Cover - Pipe threader operates large valves on the South Coast Conduit, Cachuma Project, California.

OPERATION AND MAINTENANCE

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INTRODUCTION

This bulletin, published quarterly, is circulated for the benefit of irrigation project operation and maintenance people. Its principal purpose is to serve as a medium of exchanging operation and maintenance information. It is hoped that the labor-saving devices or less costly equipment developed by the resourceful water users will be a step toward commercial development of equipment for use on irrigation projects in a continued effort to reduce costs and increase operating efficiency.

To assure proper recognition of those individuals whose suggestions are published in this and subsequent bulletins, the suggestion number as well as the person's name is given. All Bureau offices are reminded to notify their Suggestions Awards Committee when a suggestion is adopted.

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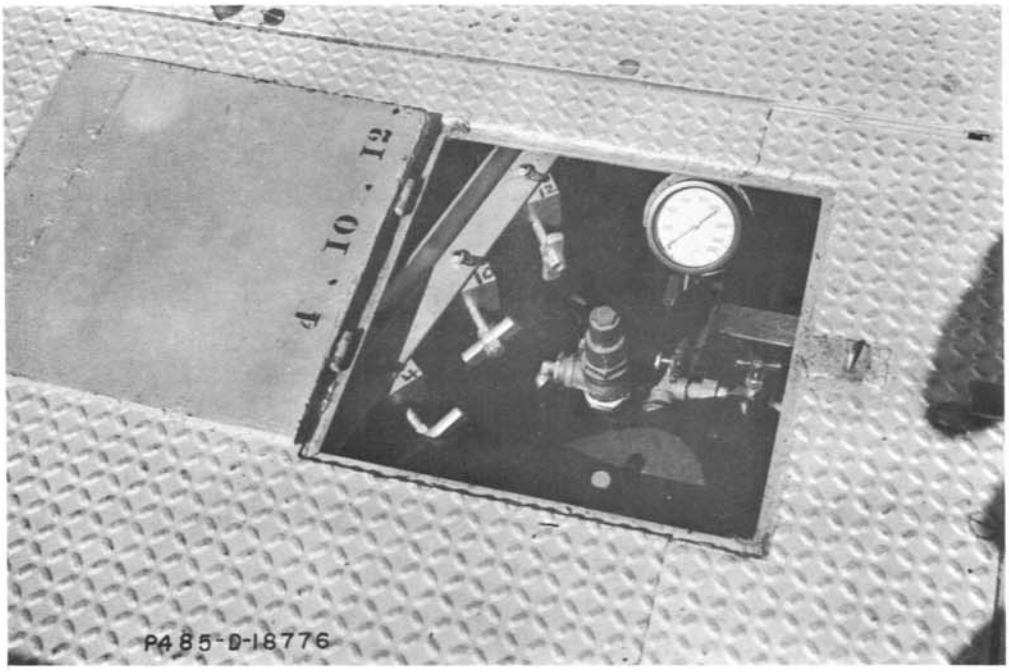
Division of Irrigation Operations
Commissioner's Office
Denver, Colorado

EXTENSIONS SIMPLIFY VALVE OPERATION
(Suggestion R2-59-126)

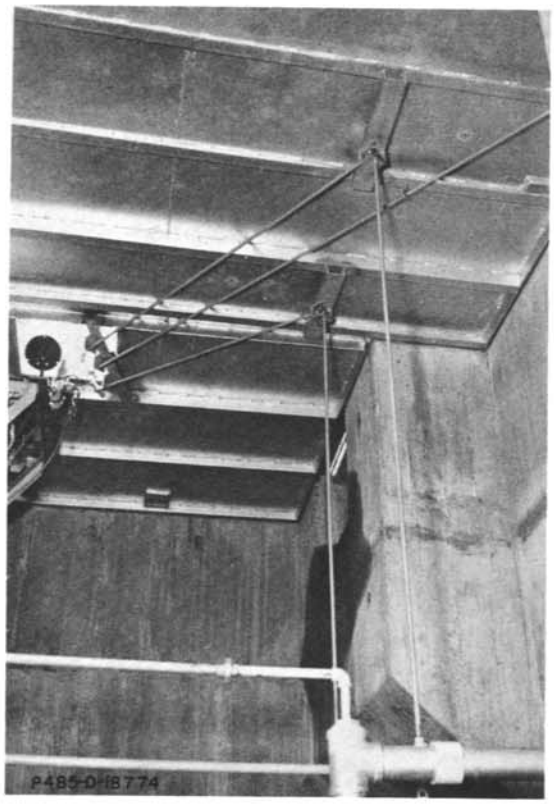
The original mechanism for closing each of the three fixed wheel gates at Folsom Dam in an emergency was installed on the dam under a hinged deck place cover over the gate operating chamber. In using this original equipment, it was necessary to first climb down a ladder to the operating floor level of the chamber. This defeated the purpose of the emergency mechanism installed.

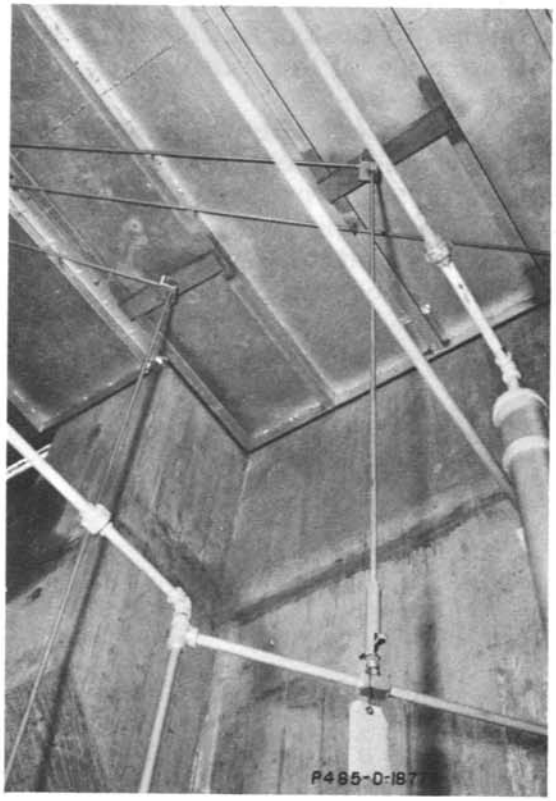
Cecil Brown and James Cox of the Folsom Operations Field Branch, Central Valley Project, designed and installed extensions which provided greater convenience and safety in the operation of the fixed wheel control valves. The extension provided for control of the valves from the same location as the closing mechanism as shown in the photograph below and consists of steel rods, angle gears and a slotted sleeve. The latter slips over the valve to be remotely controlled.



The handles marked, 4, 10 and 12 shown immediately under the deck plate in the above photograph are connected with and operate the valves of corresponding numbers in the gate chamber. The arrangement and method of mounting the control handles, extension rods and angle gears directly above the originally installed control valves are shown in the photograph at left on the following page. In the photograph at right on the following page additional detail of the angle gear mounting is shown, as well as the notched sleeve attached to the end of the extension rods, which slips over the originally installed valve.

The very neat arrangement presents a pleasing appearance, is functional and does not obstruct movement within the gate operating chamber. The housing for the angle gears was constructed of steel channel and this in turn was welded to the channel under the steel deck plate.





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REVERSE CURRENT PROTECTION IN BATTERY CHARGING
(Suggestion R2-59-203)

A silicon diode semi-conductor was recently installed in the station battery motor-generator power supply at Folsom Powerplant at the suggestion of Gene W. Buffum, Folsom Operations Field Branch, Central Valley Project, California, to prevent reverse current and minimize generator, battery, and contactor damage. Vibration had made it difficult to properly and reliably set a plunger-type voltage relay which had been provided to automatically disconnect the generator on low voltage; and damage to the d-c contactor switch had resulted under certain conditions.

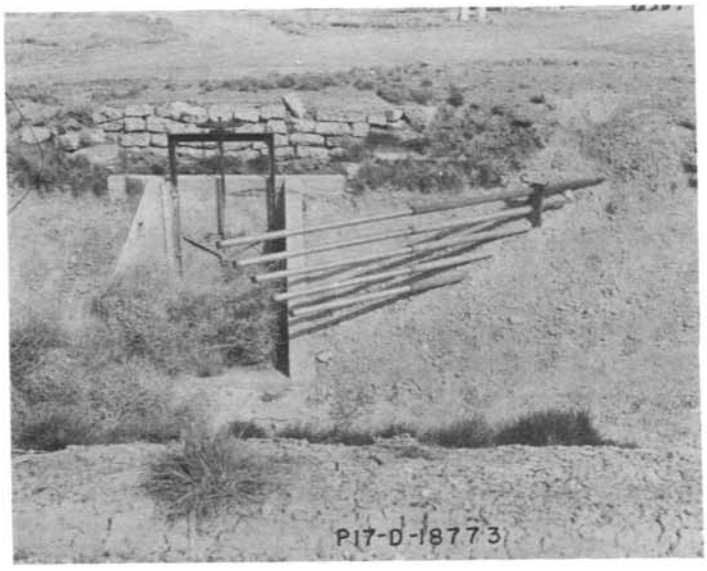
The total installation cost was approximately $10--considerably under the cost of a reverse current relay. Tests have

shown very satisfactory results. No annual maintenance is anticipated as no moving parts are involved.

* * * * *

PIPE WEED DEFLECTOR

The weed deflector shown in the photographs below was constructed at the request of and in accordance with plans prepared by Mr. Donald T. Mutch, Watermaster, West Branch of the North Side Irrigation Field Division, Minidoka Project, Idaho. The deflector is quite successful in keeping weeds and other floating debris from entering the farm turnouts.



The deflector is constructed of pipe throughout. Two large diameter pipes embedded in concrete in the side slopes of the canal serve as supports for the five horizontal pipe components shown. The large vertical pipes are drilled to accomodate the larger horizontal pipe which is welded to the vertical support for added structural rigidity.

The smaller horizontal pipe components are of such diameter that they fit into the larger horizontal pipe. The smaller pipe must be of such length that it can be telescoped outwardly into the canal as required to provide for adjustment and the best possible setting at a

given location for deflecting the weeds and other trash from the turnout inlet structure.

* * * * *

REPAIR OF ERODED CANAL LINING AND STRUCTURES

Winter operation of a power canal on the Strawberry Valley Project in north-central Utah over a period of about 50 years resulted in complete deterioration of a band of concrete lining located at about the winter water operating level. The deterioration, as shown in the photograph below and on the following pages, was so severe in some reaches of the canal that the lining had been completely eroded.

Repaired with unreinforced pneumatically applied portland cement mortar in 1950 and 1956, a recent examination of the lining discloses repairs are holding up exceptionally well, with no apparent deterioration of any kind. The present condition of the lining is shown in photographs on page 7.

This article, prepared by the staff of the Spanish Fork Project Office of the Bureau of Reclamation, Spanish Fork, Utah, presents the problem faced by the Strawberry Water User's Association after a survey in the spring of 1950 indicated that it would be necessary to repair the deteriorated concrete in the canal and tunnel linings as well as that in the diversion dam, and structures at the head of the power penstock.

The Strawberry Valley Project, completed in 1916, was the first project to be constructed by the Bureau of Reclamation in the

State of Utah. Project features include the Strawberry Reservoir with an active storage capacity of 270,000 acre-feet on the Strawberry River, a 3-3/4 mile long transmountain diversion tunnel, a hydroelectric plant, and over 80 miles of concrete lined canals and laterals.

The Strawberry Valley Project is distinctive in two respects: It provided for the first large-scale diversion of water from the Colorado River drainage basin to the Great Salt Lake Basin, and was one of the first projects in the history of the Bureau of Reclamation to develop hydroelectric energy. Electric power from the hydroelectric plant constructed was transmitted 25 miles easterly to the Strawberry Tunnel and Dam for construction use. Since construction of the project energy from the plant has been sold in the south portion of Utah County.

For winter operation of the powerplant, the Spanish Fork River flows are diverted through the power canal. The Canal has a capacity of 500 second-feet, and has open lined and unlined sections, cut and cover sections, and two tunnel sections of 800 feet and 749 feet in length.

The water surface elevation in portions of the canal fluctuates up to about three feet daily during winter operations in the process of providing additional storage in the canal for power peaking purposes. This fluctuating water surface coupled with the frost action contributed materially to deterioration of a band of concrete side slope lining of the canal, which averaged about three feet in width. The remainder of the lining, however, was in reasonably good operating condition and did not warrant repair or replacement.

The deteriorated lining, which in some instances as shown below, had been completely eroded, reduced the carrying capacity of the canal and it was evident that repair or replacement of this eroded and deteriorated band was necessary. After a study of methods of making the repairs to the lining and the deteriorated concrete in other structures, the water users entered into a contract with an experienced contractor for the application of the shotcrete as well as the related work.

Under terms of the contract the contractor furnished all materials, prepared the surfaces including the removal of deteriorated concrete, placed the shotcrete, cleaned up and removed all waste materials resulting from the operation. However, in the filling of large pockets, such as those shown in the photograph at left, rock and broken concrete were furnished by the water users to fill the voids.

Specifications provided that the portland cement mortar mix consist of one part portland cement to four parts of sand for canal lining repair. For work in the tunnels, the sand content was increased to four and one-half parts. It was required that the sand be washed, and that it be durable and evenly graded from fine to coarse particles. It was also required that the moisture content of the sand prior to mixing with the cement be maintained at between three and five percent.

In the fall of 1950, repairs were made on the diversion dam, concrete structures at the head of the penstock, the tunnel sections and the most critical sections of the canal. A total of 9,530 square feet of lining was placed in the canal at a cost of $1.18 per square foot; 4,770 square feet of tunnel lining was replaced at a cost of $2.06 per square foot; and 1,570 square feet of surface on the diversion dam and intake structures were repaired at a cost of $2.70 per square foot.

The balance of the canal lining was repaired in 1956, when the same contractor was engaged to place 14,350 square feet of deteriorated concrete lining at a cost of $1.10 per square foot.

The experience of the Strawberry Water Users Association indicates that the mortar lining can be used in making various types of repairs at a minimum of cost and with very good results.

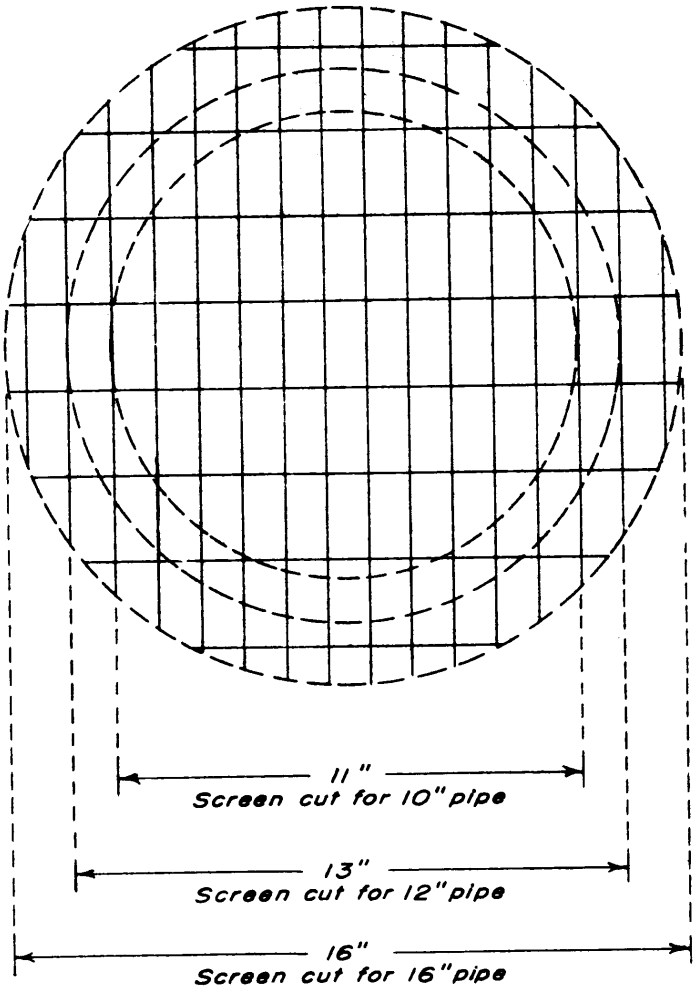
The condition of the unreinforced pneumatically-applied portland cement mortar repairs of the canal lining and the approach to one of the tunnels is shown in the photographs below. The photographs were taken in the fall of 1958.

* * * * *

DRAIN OUTLET RODENT CONTROL SCREEN

A wire screen is being used on the outlet end of closed drains on Riverton Project, Wyoming, to prevent access to the drain line by rodents. As shown below, the screen is constructed of standard 1- by 2-inch, 14 gage, electric welded wire fencing material and is pushed into the end of the corrugated metal pipe drain outlets. The screen has been very useful and satisfactory, and its publication in the bulletin was at the suggestion of D. B. Woltersdorf, Chief, Regional Drainage Branch, Billings, Montana.

Standard Fence Wire 1"X2" 14 ga. Electric Welded



Scale 3" = 1'-0"

Push screen in end of corrugated metal pipe drain outlets.

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CLOGGING OF PUMP BEARING COOLING WATER LINES
(Suggestion R1-56-157)

The original design of the pump bearing cooling water lines for volute pumps on the Roza Division of the Yakima Project in Washington, resulted in frequent and sometimes severe clogging of the lines with silt and debris. Originally the bearing cooling water came from the discharge side of the pump, through a globe valve, an elbow, the bearing cooling housing, another elbow, and finally to the suction side of the pump. All piping was 1/4-inch in size.

In the original design, there was much clogging of the bearing cooling water lines at the globe valve and the elbows. If an attempt was made to remove the lines for cleaning, the pump usually lost its prime and had to be shut down and restarted. In the past it was not unusual for at least two lines a week to become clogged with as many as four stoppages a day being not uncommon. The difficulty has been alleviated by a suggestion by Floyd M. Schmidt, Pumping Plant Mechanic on the Roza Irrigation Field Division, Yakima Project, located at Sunnyside, Washington.

At Mr. Schmidt's suggestion, the bearing cooling water on practically all of the Roza Division pumps is now taken from the discharge side of the pump and passed through a gate valve, a pipe tee, the bearing cooling housing, another pipe tee, and a second gate valve to the suction side. (A diagram of the revised cooling system is shown on the facing page).

There is considerable less clogging in the line, the gate valves and the tees. If the line does clog, the gate valve on the suction side of the pump can be closed, the plugs removed from the pipe tees, and the foreign material blown or rodded out. The clearing of the line in this manner requires very few minutes and the pump need not be shutdown.

The suggestion not only saves considerable time, but less "down time" means steadier water deliveries and better irrigation service.

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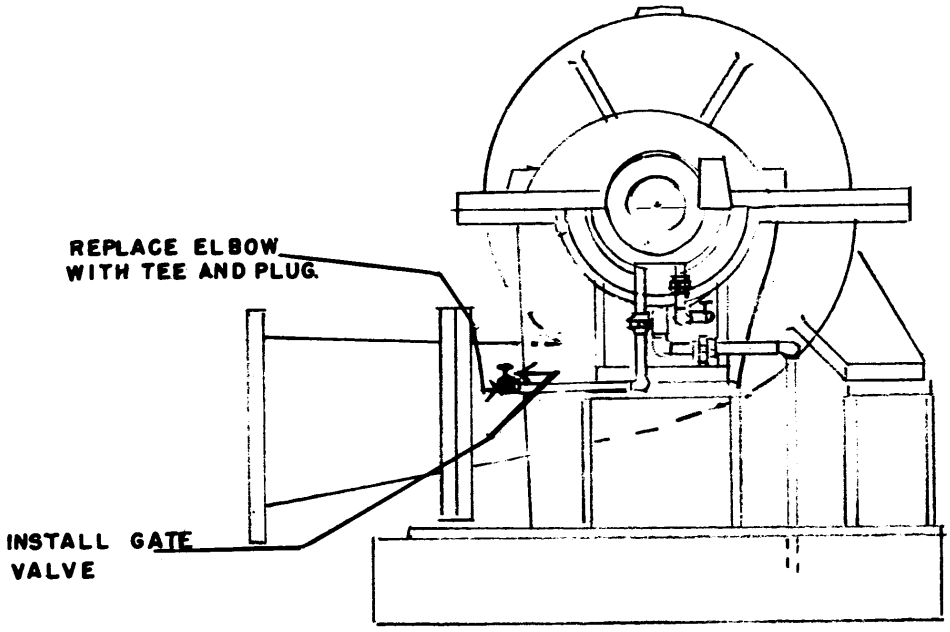
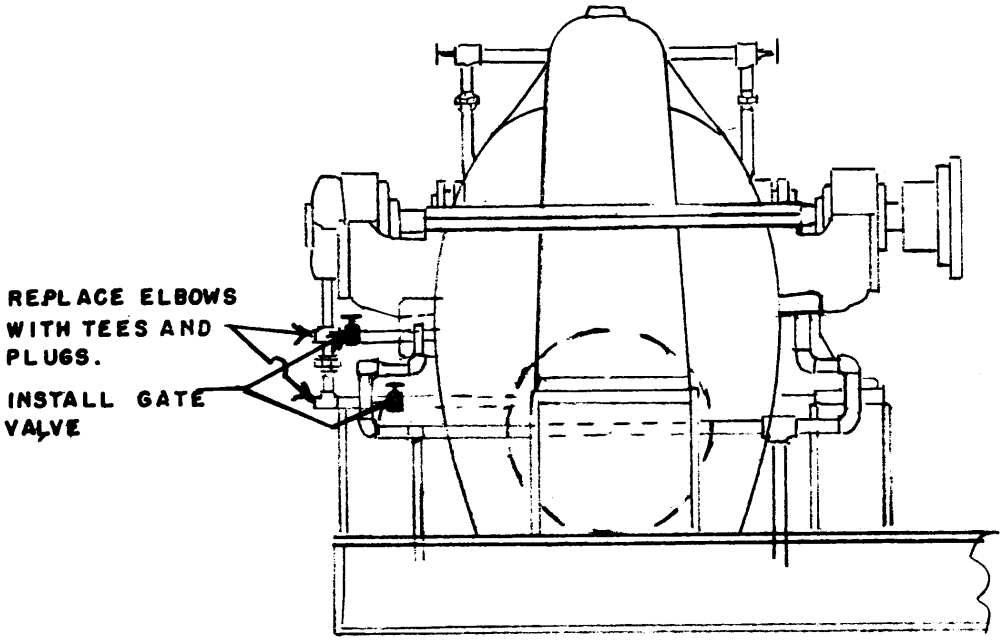




REVISED BEARING COOLING PIPING
VOLUTE PUMPS
YAKIMA PROJECT-ROZA DIVISION

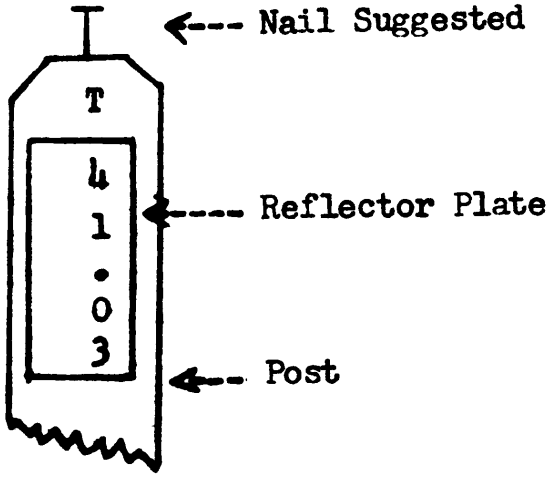
RI-56-157

PREVENTING MILE POST DEFACEMENT BY BIRDS
(Suggestion R2-59-7)

The farm turnout headgates along the Delta-Mendota Canal, Central Valley Project, California, are identified for operating purposes by posts of sawed timber, painted white, and bearing on two or more sides, stenciled numbers, in black, showing the mileage from the Tracy Pumping Plant. Recently, luminous reflector plates, also bearing the mileage number, were installed on the upstream faces of the posts to aid in locating and identifying the headgates by ditchriders working at night.

The mileage posts provide ideal perches for small birds and are soon defiled by them, which not only makes the posts unsightly, but defeats the purpose of the posts by rendering the stenciled numbers illegible. Because of this, the posts must be repainted often. The bird droppings were also damaging the luminous paint on the reflector plates, and if not protected the plates would have soon needed to be replaced.

The posts are shaped at the top by a bevel cut on all four sides leaving only a small flat place on top of the posts where a bird could perch, as shown in the sketch below. It was the suggestion of H. L. Craig, Irrigation Operator, Tracy Operations Field Branch, Tracy, California, that a 16 or 20 penny box nail be driven into the top of each mileage post, leaving two or three inches of the nail exposed.



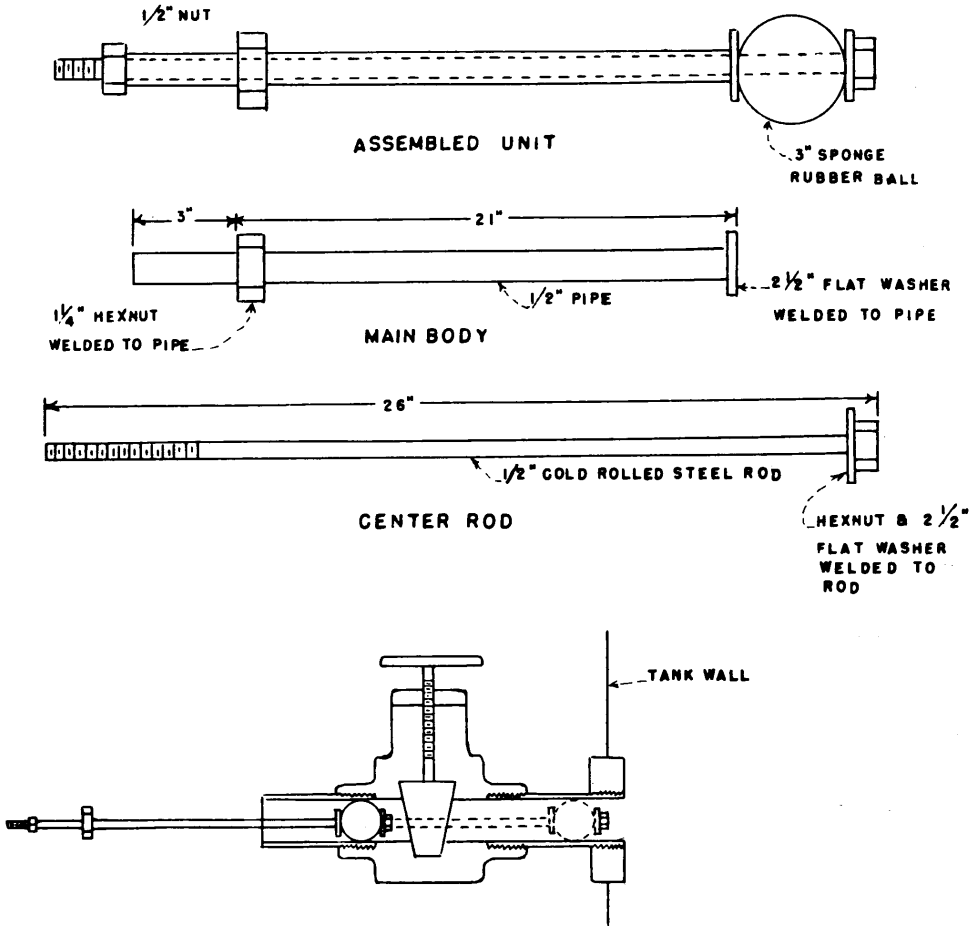
The protruding nail makes it impossible for a bird to come to rest on the post. The nail is also inconspicious and in no way interferes with men or equipment working on the canal. The cost is negligible.

The suggestion has been tried and has eliminated the bird problem. It is to be adopted for all mile post markers along the canal.

* * * * *

AN OIL STOPPER
(Suggestion R1-59-219)

An idea of Mark E. Spanogle, Head of the Maintenance Section of the Palisades Field Branch, Palisades Project, Idaho, provides for removal of cracked and leaking oil valves on transformers without lengthy service interruptions. Time and labor is cut from days to minutes by not having to drain and filter the oil and the cost of the tool used is less than $10.00. The "Oil Stopper" as the device has been labeled by Mr. Spanogle, for changing valves on electrical units in service, is shown in the sketch below.



The tool was first used to remove a badly cracked and leaking 3" gate valve on a substation transformer in 1957. In 1959 it was used on another substation transformer and proved very successful both times. The "Oil Stopper", as shown above is made of 1/2-inch pipe, 1/2-inch cold rolled steel, several different size nuts and a 3-inch sponge rubber ball. The latter can be purchased at any dime or variety store. The size may be altered to fit the job by purchasing a

different size ball and changing the size washers used in compressing the ball.

In using the Oil Stopper to change a flanged gate valve, a 3- to 6-inch pipe nipple should be added to the outside flange. The ball can be placed in the nipple and expanded by holding the main body hexagonal nut with one wrench and tightening the center rod with another. After the first seal is made the gate valve may be opened to the full opened position, the center rod loosened until the ball can be forced through the valve opening into the welded nipple in the tank.

Care should be taken not to go beyond the opening into the tank, or the ball will have to be withdrawn back into the nipple. This may be avoided by making a stop in the field and controlling the travel of the ball. Measure the distance from the first sealing position to the second position. Cut a wood stop that will fit between the valve flange and the 1-1/4-inch nut on the main body. After the second seal is complete and the ball compressed tight enough so that it can not be moved outwardly by pulling on the main body, the damaged valve may be removed.

The new valve can then be installed and the ball released and withdrawn in the reverse manner described for placing the ball into position. Again care must be taken not to pull the ball completely out of the outside nipple. This too may be avoided with some type of mechanical stop.

* * * * *

POWER CROSSCUT SAW GUARD

Even when not in operation, power crosscut saws make very dangerous weapons. Not only that, it isn't too difficult to damage the chain teeth or the steel extension plate on which the chain rides. Jack C. Raftery, Assistant Chief Ranger, Crater Lake National Park, uses a simple cover to prevent personal injury from these saws and at the same time provides a degree of protection for the saw itself.

The protective cover, described in Grist, a publication issued by the National Conference on State Parks in cooperation with the National Park Service, U. S. Department of the Interior, consists of a piece of discarded 1-1/2-inch cotton jacketed rubber lined fire hose long enough to go around the exposed chain. Mr. Raftery slits the hose its entire length along one of the creases and then, in dead center of its length, he cuts a V-notch. The notch will permit a custom fit at the outer end of the blade. The guard is held in a wrap-around position with two rubber bands cut from a discarded inner tube.

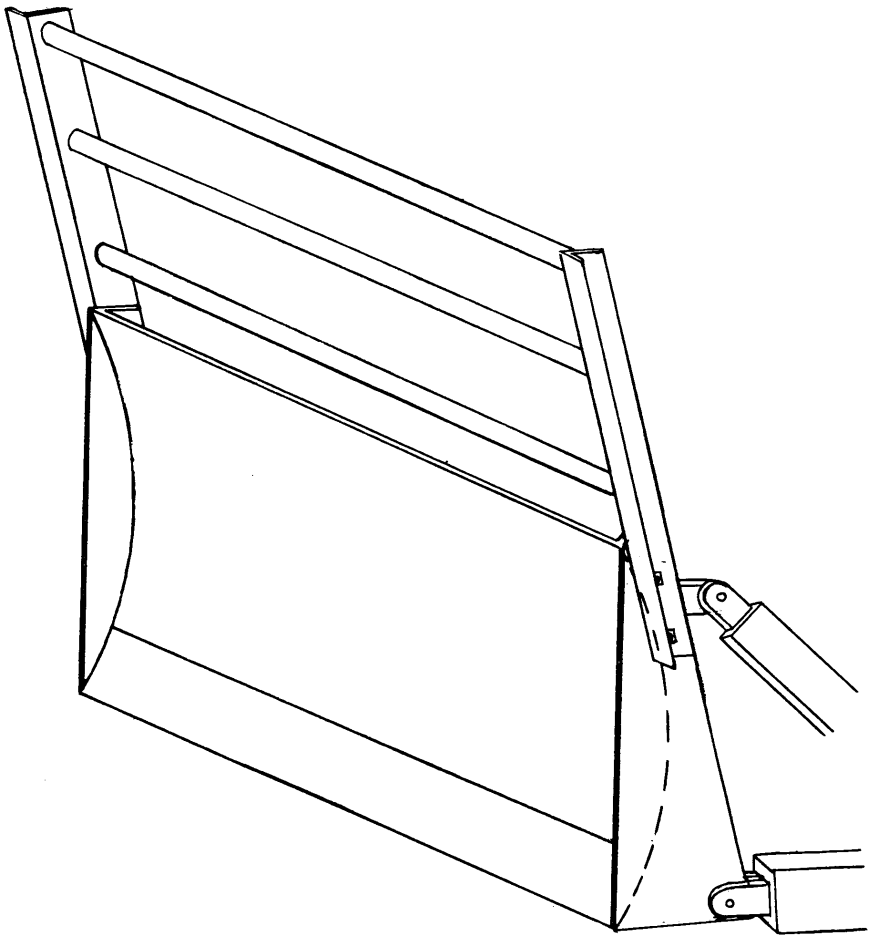
For the 2-man type of power saw, a similar cover can be provided, except two lengths of hose long enough to cover the exposed teeth, both top and bottom, are used. There is no need to go around the outer handle. This cover also can be held in place by inner tube rubber bands.

* * * * *

PUSH RAKE FOR DRY WEEDS
(Suggestion R1-58-182)

In the winter and early spring, tumble weeds create quite a maintenance problem on the Columbia Basin Project, Washington. The weeds which have blown into canals, accumulate around and under bridges and other structures. Removal of the weeds by burning in place is hazardous. Equally hazardous is an accidental fire which can easily start in the accumulated mass. If the weeds are to be burned, they must be moved a safe distance from the structures.

A push rake was designed and constructed by Gustav E. Becker and Joseph E. Gabardi, of the Royal Field Branch of the Irrigation Division, which permitted clearing and moving the accumulated weeds a safe distance from the structures at approximately 10 percent of the cost of hand work.



A prefabricated rack, as shown above, was bolted to the top of a dozer blade by overlapping the vertical posts of the rack to the outside edge of the dozer blade. The rack consists of 5/16- by 3- by

3-inch angle iron vertical posts and cross pieces of 1-1/4-inch nominal size, standard iron pipe, spaced 12-inches apart. The height of the dozer blade is doubled by adding the rack, and this is important in working the areas of limited vertical clearance, such as under bridges. However, the rack is easily removed by one man in a few minutes.

It was also found that for close work, the breather stack of the tractor may have to be lowered. It was found that with the blade raised six inches above the ground the overall height of the rack should be such that it would be the same as that of the breather, the exhaust or that necessary to provide clearance for the operator when seated in the tractor.

* * * * *

DOORS RATTLE? USE SILICONES

(Reprinted from the BuDocks Technical Digest, No. 96, June 1959. Publication of the Department of the Navy, Bureau of Yards and Docks; further reproduction is prohibited.)

Annoying rattles and squeaks can often be eliminated from automobile doors by applying a silicone base rubber lubricant to the weather stripping. The sponge type rubber used to seal the interior of vehicles from the weather also serves to absorb and cushion shocks caused by movement of the doors when the vehicle is in motion. If this rubber is permitted to become brittle and hard, it loses its effectiveness as a cushioning agent and as a result, noises and shocks are heard and felt throughout the vehicle.

The Transportation and Equipment Management Division of the Bureau of Yards and Docks, Department of the Navy, recommends seasonal applications of silicone base rubber lubricants as part of scheduled preventative maintenance services. Periodic treatments will keep the rubber in a soft, pliable condition and will prevent rubber-on-metal squeaks and rattles, reduce wear on the weather stripping and will preserve the rubber against weathering.

Rubber lubricants with silicone contents ranging from 1/2 of 1 percent to 88 percent depending upon the particular brand are available for local purchase at automobile dealers and jobbers. They are packaged in various sizes and cans, including the pressurized type spray cans.

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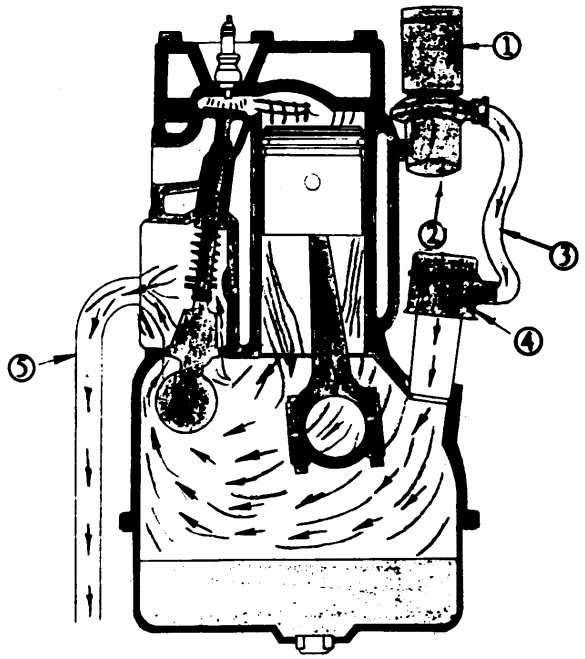
EXTENDING ENGINE LIFE IN COLD CLIMATES

(Reprinted from the BuDocks Technical Digest, No. 96, June 1959. Publication of the Department of the Navy, Bureau of Yards and Docks; further reproduction is prohibited.)

As a result of observations made during a tour of duty in Alaska, Mr. D. R. Bennett, former member of a Naval Staff, submitted a Beneficial Suggestion intended to prolong the life of engines operated in cold climates.

Mr. Bennett discovered that on installations, such as Elmendorf Air Force Base, Naval Station Adak, and Naval Base Kodiak, it was frequently necessary to overhaul engines of sedans and pickups after 15,000 and 20,000 miles of use. A preventative maintenance program, which included oil and filter element changes at prescribed intervals, was in effect at these bases. The frequent overhaul and replacement of engines was attributed to the formation of sludge and corrosion caused by the presence of acid products of combustion which blow by the rings and condense in the crankcase. These acid vapors, along with water vapor from the combustion process, condense and form aqueous acid solutions that are highly corrosive to pistons, rings and cylinder walls.

INSTALLATION OF POSITIVE CRANKASE VENTILATION

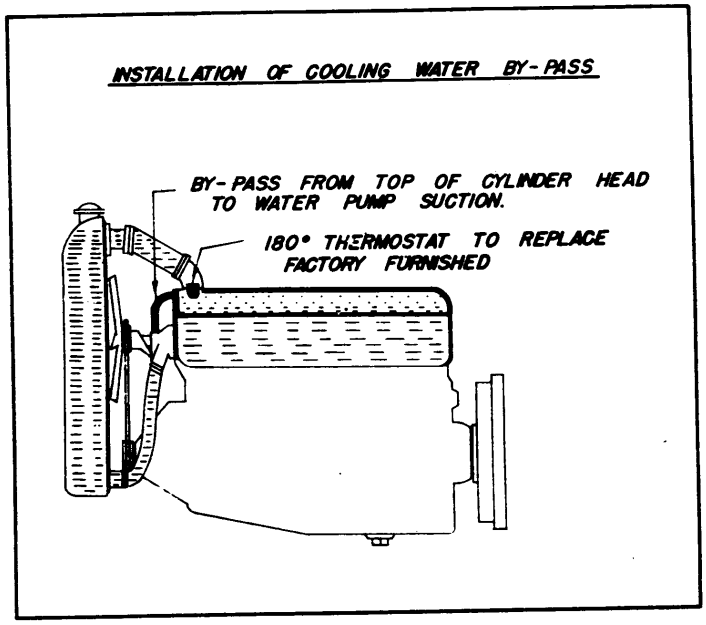


① *MOTOR DRIVEN VENTILATION*
② *D. C. MOTOR*
③ *CONNECTING TUBE*
④ *SPECIAL OILFILTER CAP*
⑤ *ROAD DRAFT TUBE (CRANKASE VENT. PIPE.)*

In addition, these blow-by products also form resins, gums and sludges. When an engine is operating for extended periods at fairly good speeds, the entire engine, including

the cooling system, heats up to a point where these vapors cannot condense. In addition, the rapid forward motion of the vehicle aspirates these vapors from the crankcase road draft tube, causing fresh air to be sucked into the crankcase through the breather tube to further purge it. Conditions are at their worst with a cold engine running at a slow speed, the exact situation found at Naval Base Kodiak and other cold climate facilities. These acids and water soon neutralize the alkaline agents found in all detergent oils, including the 9000 series Navy lube oils.

Mr. Bennett's suggested method involves two changes neither of which is expensive. The first change is in the installation of a positive crankcase ventilator. This consists of a small 6 or 12 volt DC motor-driven fan which pushes a small volume of fresh air into the crankcase via the oil filler pipe, as shown in the sketch on the previous page. From the crankcase it is vented out through the road draft tube taking with it the accumulated blow-by vapors which would ordinarily condense in the crankcase and on the cylinder walls. Such a ventilator is commercially available at a cost of approximately $12.00 wholesale and it can be installed for approximately $3.00.



The second change is the installation of a 180 degree F thermostat to replace the standard 140 degree F or 160 degree F equipment thermostat. In addition, a 3/8- or 1/2-inch by-pass tube from the top of the block to the bottom cooling water connection should also be installed. A small volume of water will then, by-pass the radiator, retaining its heat and tend to overcome the excessive cooling which takes place during warm up periods. The 180 degree F thermostat will remain closed for a longer period than the 140 or 160 degree F thermostat preventing any flow through the radiator until the water surrounding the cylinder head reaches a temperature of at least 180 degrees F. In the meantime, as the water approaches this temperature, a portion of it is recirculated to the lower part of the block, thus helping to even up the temperature of the entire mass. This eliminates the cold lower cylinder wall surfaces and reduces internal condensation to a minimum. This change could be accomplished for a cost of about $7.00 a vehicle.

Mr. Bennett emphasizes that this suggestion is not supposed to be a "cure-all" for all types of engine wear problems. It would have extremely limited results if applied indiscriminately to military installations in temperate climates. However, when utilized at cold weather bases, it is estimated that a direct cost saving of about $75.00 per vehicle would result, with another result being fewer vehicles on the deadline. This latter point has become increasingly more important with a reduction in the number of vehicles available at each station.

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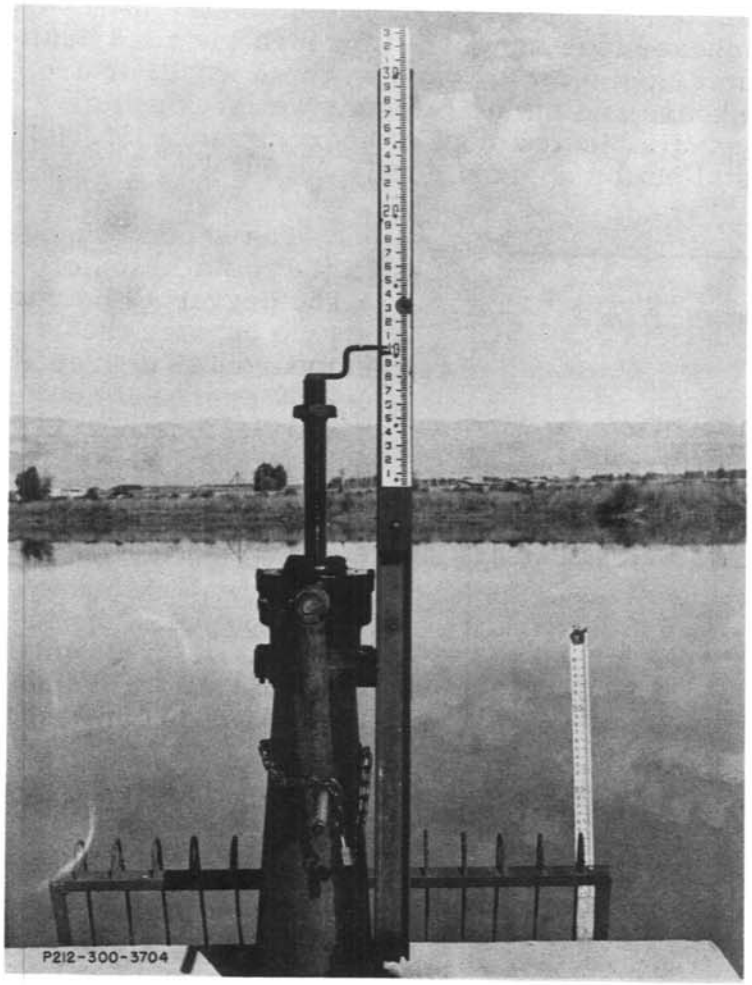
GATE POSITION INDICATOR



Something a little different in a gate position indicator is that shown at left. The indicator is being used on an outlet gate to control releases from a regulating reservoir on the Coachella Canal, a part of the All-American Canal System of the Boulder Canyon Project, California.

The indicator consists of a standard type enamel gage mounted on an upright support and a pointer. The pointer is made of a small steel rod which has been spot welded to the top of the gate stem.

The position indicator was designed and installed by the Coachella Valley County Water District, with headquarters at Coachella, California. The District operates the Coachella Distribution System and a part of the Coachella Canal, constructed by the Bureau of Reclamation.

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MAKING METER COMPARISON TESTS UNDER PRESSURE
(Suggestions R2-59-24 and R2-59-26)

During the irrigation season it is necessary to make Sparling Meter comparison tests on turnouts from the Delta-Mendota Canal of the Central Valley Project, California. These tests must frequently be made during the time the discharge line is in use for long periods of time. With check valves installed in the discharge lines to keep the lines filled, it is impractical, if not impossible, to drain the lines. Thus, they remain under pressure.

Making a test required that a hole be drilled and tapped in the discharge line and that valves be installed for the installation of a pitot tube. Also, it is necessary that the internal diameter of the discharge line be accurately known. To drill and tap the line and determine accurately the internal diameter of the pipe while it is under pressure, James D. Clapp, Engineering Aid of the project's Tracy Operations Fields Branch, made two suggestions that make the meter comparison test possible.

Both suggestions are illustrated in the sketches on the following pages. The first suggestion, Sketch 1, illustrates the method of drilling and tapping the discharge line. A piece of 3/4-inch steel plate is machined to correctly fit the outside radius of the pipe, and is drilled and threaded for a 1-inch corporation stop. If the discharge line is of steel pipe, the steel plate is field welded to the pipe. If the discharge line is of concrete, the steel plate is securely strapped to the pipe.

With the steel plate in position, a 1-inch corporation stop is screwed into the plate, then, with the adapter screwed onto the corporation stop, the discharge lines can be drilled by opening the corporation stop. After the hole has been drilled, the drill can be withdrawn. The corporation stop can then be closed without taking the line out of service and keep the water confined to the discharge line.

Sketch 2 illustrates the instrument devised to measure the interior diameter of the pipe. The device consists essentially of a measuring rod and a cap through which the rod fits and which can be tightly fastened to the corporation stop. The construction of the instrument is apparent from the sketch. All parts were fabricated from brass materials.

The suggestions have been used frequently on the Delta-Mendota Canal and have proved to be very useful as well as successful for the purpose for which designed.

Further information concerning the suggested devices can be obtained by writing the Regional Director, U. S. Bureau of Reclamation, Sacramento, California.

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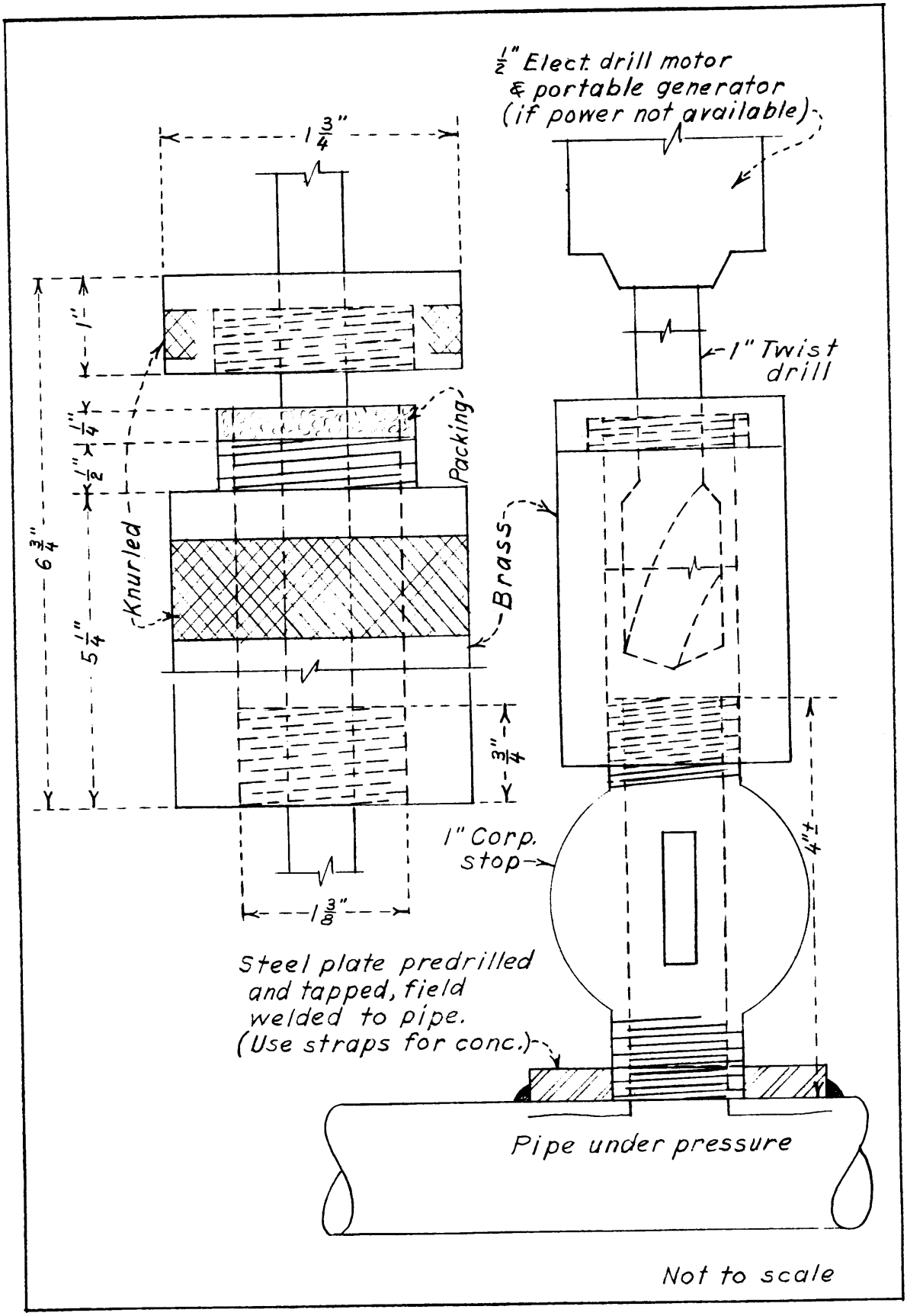
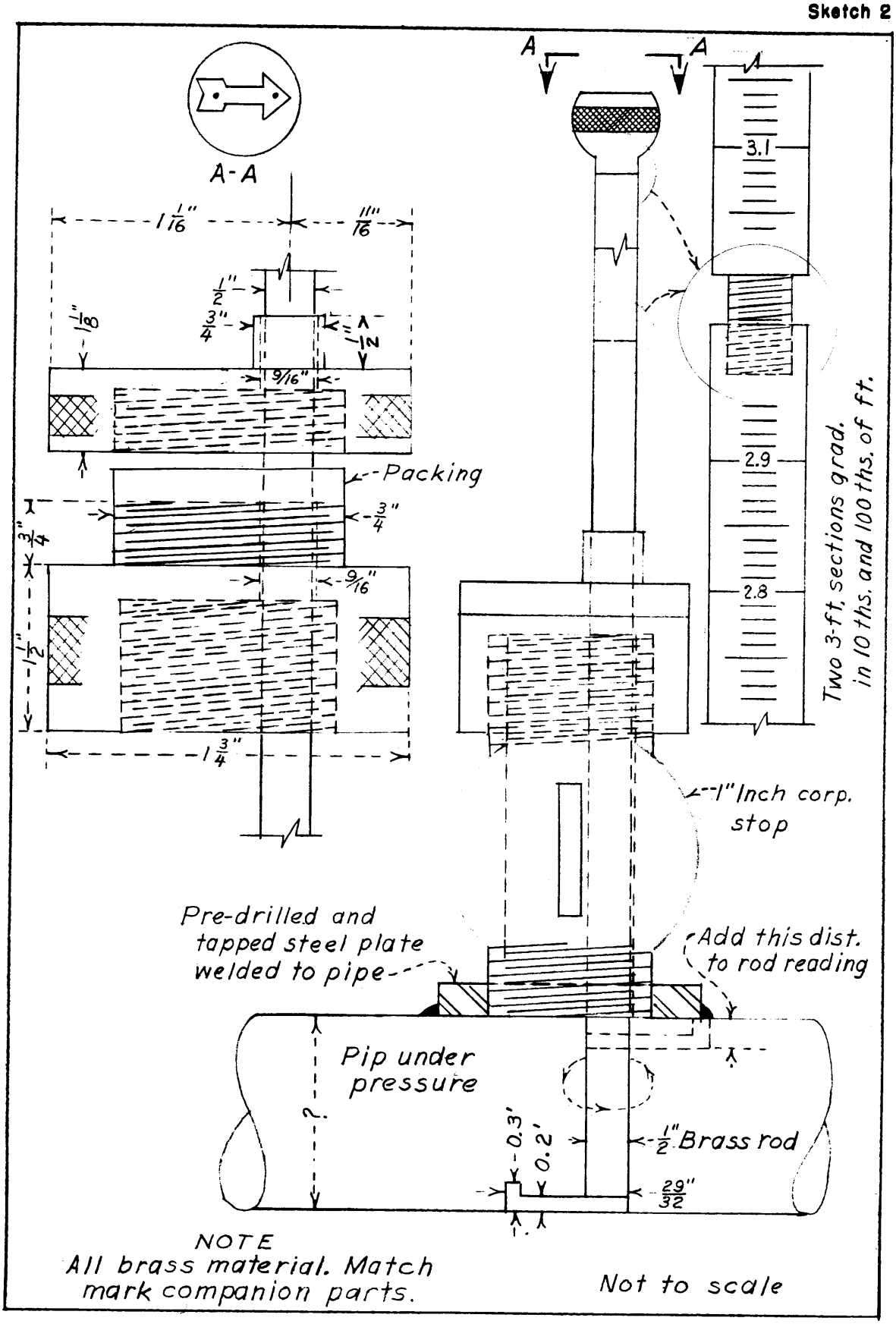


Sketch 1 - meter comparison tests under pressure.



Sketch 2 - meter comparison tests under pressure.

PIPE THREADER OPERATES LARGE VALVES

A pipe threading machine has been modified and is being utilized for operating large valves on the South Coast Conduit of the Cachuma Project, California. As shown in the photograph below, the machine is used particularly at control stations by the Cachuma Operation and Maintenance Board, which operates and maintains the works constructed by the Bureau of Reclamation.

The threading machine is powered by a 1/2-horsepower, universal electric motor. The project advises that the machine has been very useful and calls attention to the fact that similar portable power drives are obtainable from several manufacturers.

Many manufacturers include power drives of the type needed in several sizes. One is equipped with a 1/2-horsepower universal reversible motor to operate from any 115 volt or 230 volt source as desired. Another includes an adjustable safety device with settings permitting the chuck to slip at various overloads. Another light-weight unit with a net weight of 33 pounds is available commercially for use with either a 1/2-horsepower universal drive electric motor or with an air motor.

For further information, write the Cachuma Operation and Maintenance Board, Santa Barbara, California, or the Regional Director, U. S. Bureau of Reclamation, Sacramento, California.

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