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Department of the Interior
Bureau of Reclamation

OPERATION AND MAINTENANCE EQUIPMENT AND PROCEDURES

RELEASE NO. 47

January, February and March 1964

CONTENTS

Cover Sheet. Photograph shows a surplus dozer blade cut down and mounted at an angle on a dozer so that the width of the blade is the same width as the dozer tracks. This equipment has adequate power and yet is small enough to work in laterals of 5- and 6-foot bottom widths. P222-D-41681NA

OPERATION AND MAINTENANCE
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JANUARY, FEBRUARY AND MARCH 1964

INTRODUCTION

The Operation and Maintenance Equipment and Procedures bulletin is published quarterly, 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 and procedures 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.

This issue includes an article on controlling silt accumulations and pondweeds, page 1, and an article on the control of common cattails in channels, page 10. An article from WESTERN CONSTRUCTION is reprinted on page 19 with the permission of the Editor. The article is entitled, "Pulling Pistons With a New Tool."

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

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Division of Irrigation Operations
Office of Chief Engineer
Denver, Colorado

CONTROLLING SILT ACCUMULATIONS AND PONDWEEDS
(Suggestion R1CB-61-67)

Many laterals in the Quincy Watermaster Section, of the Columbia Basin Project, Washington, are required to carry their maximum capacity in making required deliveries, and water must be rationed to farms during the peak period of the irrigation season. Appreciable water loss from seepage in some of the laterals is a contributing problem in lateral capacity but pondweed growth is most rapid and also must be controlled since it accumulates silt and further restricts capacity.

Silt accumulations in the moss growth starts erosion of the channel around such accumulations. This is especially true in contour laterals where pondweed growth accumulates silt on the inside of curves and causes erosion on the outside.

Photo No. 1

Photo No. 2

Photographs No. 1, 2, 3 and 4 illustrate the conditions described during the 1960 irrigation season.

The silt accumulations have to be removed or broken up from the pondweed so it can be washed out at the beginning of each irrigation season. This is usually done by mobile excavating equipment with as little bank disturbance as possible. In the fall of 1960 the possibility of breaking up the silt accumulation and the established pondweed root system without removing the silt was discussed. The advantages of this were: Disturbing the moss roots would hold back regrowth the next season; spreading out the silt would make it possible for the silt to be carried along in moving water and result in some silting to diminish lateral losses; and would eliminate spreading, grass seeding and weed growth control of removed spoil material. It would also provide for the desired capacity.

A suggestion by Fred Kuhnly concerns the use of a cut-down dozer blade on a small dozer to break up silt accumulations and pondweed root systems. This is not an entirely new approach in maintenance of this type of lateral, but equipment to accomplish the work had to be developed. Track equipment with adequate power and yet small enough to work in laterals of 5- and 6-foot bottom widths was needed. A tractor with the necessary power and traction had to be used but the dozer

Photo No. 3

Photo No. 4

Photo No. 5

blades on this size tractor are 9.5 feet in length. The long blade could not be used in the bottom of a 6-foot lateral, and on the side slopes it removed grass above the waterline and dug into the bottom of the channel.

A surplus dozer blade was cut down and mounted at an angle on a dozer so that the width of the blade was the same width as the dozer tracks. Photographs No. 5, 6 and on the front cover show the machine in operation.

Photographs No. 8, 9 and 10 on the following page show the finished job.

Photo No. 6

Savings from this suggestion will result from less cleaning cost as well as benefits from silting for seepage control, pondweed control, and cost of disposing, seeding, and weed control on excavated material.

One man with the tractor and cut-down

Photo No. 8

Photo No. 9

Photo No. 10

blade cleaned 29 miles of lateral in 9 days for a field cost of $500. By comparison, an excavator was usually used for this type of work requiring an operator and oiler. The estimated time for cleaning of this 29 miles of lateral with the excavator was 20 days. Based on present equipment costs and wage scales this method would have cost $2,200. The saving in cleaning cost was $1,700. In addition, it was estimated that the extra cost involved during cleaning to spread the spoiled piles of silt plus seed and extra weed spraying was $200.

A reduction in the amount of aromatic solvent necessary for pondweed control results from more thorough smoothing out of small silt bars. The value of this and the benefits of the silt moving through the laterals for seepage control are side benefits and difficult to evaluate. The effectiveness of this machine and results of the work have proven its value in the Columbia Basin area, and it is planned to expand the program in coming nonirrigation seasons.

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WATER ELEVATION MEASURING DEVICE
(Suggestion R1CB-61-36)

The process of adjusting the flow of water from the relift pumps in Block 89 of the Columbia Basin Project was frequently a tiring and time-consuming process. The quick acting butterfly valves in the bypass pipe could not be calibrated for a predetermined flow per turn of the control handle. The ditchrider would make a trial setting at the pump, then walk to the discharge box to check the flow, then back to the pump for further adjustments. Four or five round trips were not unusual. It was very desirable to provide some means whereby the ditchrider could determine the elevation of the water in the discharge box while he was still at the pump. Several mechanical methods were contrived, but none were successful.

A simple electrical system was finally worked out by Assistant Irrigation Manager, Joe Kirk, and Watermaster, Joe Woolf. Electrical Engineer, Phillip Joray, furnished the electrical assistance. This system consisted of an ammeter, a 6-volt battery and an electric wire from the pump to the discharge box. The principle involved is that when one terminal of the ammeter is connected to the battery and the other terminal of each of the ammeter and the battery is connected to the ground, the ammeter will register an electrical current flow. This principle was used by permanently grounding one of the battery terminals and connecting the other terminal through the ammeter to the wire running to the pump discharge box, see Photograph No. 1 below. At the discharge box, the wire was suspended in the discharge box with its end exactly at the desired water elevation. When the water is at, or above, the desired elevation both terminals of the battery are grounded, and the ammeter registers a current flow. The ammeter will, within limits, register increased current flow as the end of the wire is submerged in the water.

Photo No. 1

There was obviously no point in having an ammeter and a battery at each pump plant. A wooden box about 3" x 3" x 5" was constructed to house the battery and hold the ammeter. The ammeter was installed in one side of the box so that the dial would be easy to read. One end of a double conductor electric wire was connected to the battery and ammeter, and the other end connected to a standard two-prong male electric plug. Each ditchrider therefore, required only

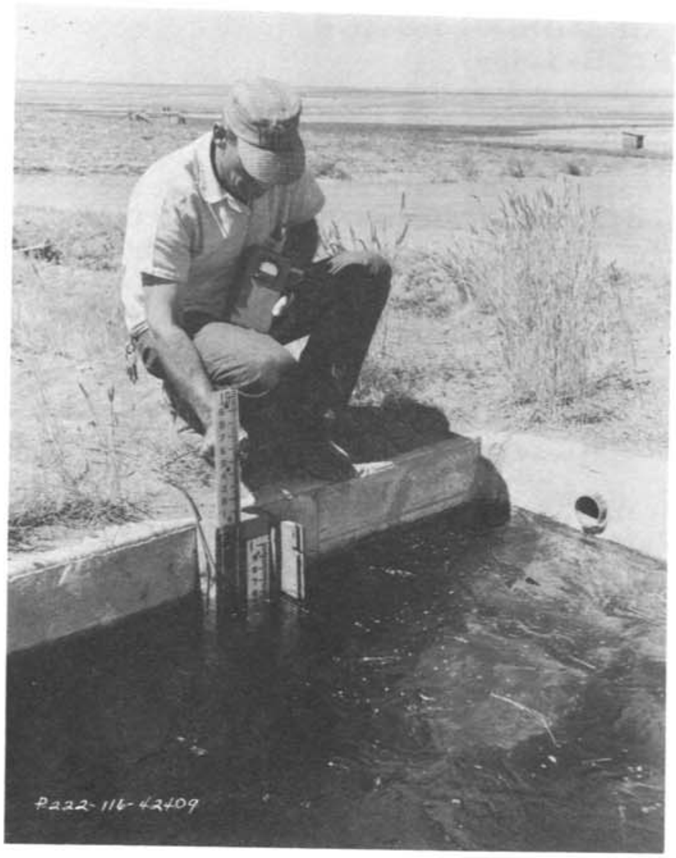

Photo No. 2

one ammeter for any number of pumping plants.

A standard female electric cord connector was permanently installed near the control valves at a point convenient for plugging in the ammeter. One terminal of the connector was grounded to the discharge pipe or the plant grounding system. The other terminal was connected to the wire to the discharge box. It was found that a 1/8-inch bronze welding rod made a better contactor at the discharge box than the copper wire. The wire from the pump, shown in Photograph No. 2, was connected to a definite length of welding rod. A weir gage was mounted on a board attached to the inside of the discharge box. The zero end of the weir gage was set the exact length of the contactor above the top of the discharge box weir. The contactor was then mounted on the weir gage board so that when the top of the contactor was set on the desired weir gage setting the bottom of the contactor would be at the elevation required to give the desired flow of water.

In the operation of this device the ditchrider goes first to the discharge box and sets the contactor at an elevation or weir gage reading to give the desired flow. He then goes to the pumping plant and plugs in his ammeter. The ammeter will show a full current flow if he is going to decrease the water. It will show no current flow if he is going to increase the water. For a decrease of water he adjusts the valve until the ammeter shows a zero. For an increase of water, he adjusts the valves until the ammeter shows contact between the water and the contactor. In those cases where the discharge box does not have a weir outlet, the weir gage must be set to some other reference elevation. Whether or not the rider will go to the discharge box after he has made his water adjustment probably will depend on the distance from the pump to the discharge box and the operator's faith in his ammeter.

Turbulence, waves or surges in the discharge box may cause trouble in reading the water elevation in the box. In some cases it may be necessary to shield the contactor or use a stilling well. Generally, however, the ditchrider will learn to accurately determine the water elevation in the discharge box from the action of the ammeter needle.

Materials used for this system were a D. C. Milliameter, a 6-volt electric lantern battery, No. 29 neoprene covered electric wire, brazing rod and standard electric cord connectors. The electric wire was ordered for this installation. The other materials were used because they were available. The ammeter was procured from the Project radio repairman. Other makes or types of ammeters would work equally as well if they were sufficiently sensitive for the low voltage used. A more sensitive ammeter might require a resistance coil to prevent damage to the ammeter when it is connected to a submerged contactor. Neoprene covered wire was used as the wire from the pump to the discharge box was buried.

Photo No. 3

Photograph No. 3 shows a general view of Lateral W20F24 pumps and discharge. The discharge box is right of the power pole in the upper left of the picture. Each of the 15 HP pumps can deliver 6-1/2 cfs at the 13.4-foot lift.

The cost of the ammeter assembly is minor. A good ammeter can be obtained for less than \$5.00. The battery and electrical plugs should cost less than a dollar. The cost of the box is insignificant. The cost of the wire will obviously depend on the number of plants and the distance from the plant to the discharge box. The installation can be made by the ditchrider or regular maintenance men.

If additional information is desired, please write to the Project Manager, Bureau of Reclamation, Post Office Box 815, Division Avenue and C Street NW., Ephrata, Washington.

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SAFETY SCREENS

Safety screens of different types and constructed of various materials have been used on Bureau irrigation canals as safety nets upstream from underground pipes, siphons, tunnels, etc. The Regional Engineer, Bureau of Reclamation, Billings, Montana, has called our attention to safety screens being installed on the Riverton Project, Wyoming. Also furnished, in addition to a drawing of the screens, was the method of screen assembly and a list of materials required for the screens.

Assembly Procedure

With reference to the drawing on the following page, 10-foot lengths of conduit are used for horizontal legs of the frame, and three pieces of conduit are cut 2 feet long for vertical legs. Fabrication is started by threading 10-foot pieces of conduit through vertical bars of the wire mesh. When the center of the section is reached, insert the conduit into tees on the assembled center member.

Make up end sections using 5/8-inch mild steel rod cut in 6-inch lengths and bent to 90° angle. The protruding rod from each vertical leg is then inserted into the horizontal members. The wire mesh is then pulled tight and wrapped around end legs.

The screens are attached to cables stretched across the canal using three cable clamps for each panel. The panels can be made up in varying widths and lengths.

Material Required

Conduit, thin walled 3/4 inch, 26 ft at 10 cents/ft	= $2.60
Corners, 5/8-inch mild rod, 2 ft at .075 cents/ft	= .15
Wire Mesh, 26-inch high, 6-inch spacing, 11 ft at .055 cents/ft	= .60
Galvanized tees, 3/4 inch, 2 at .30 cents/each	= .60
	$3.95
Labor Cost - 2 man hours at $2.00/hr	= 4.00
Total cost	$7.95

Assembled weight - 15-1/2 lbs

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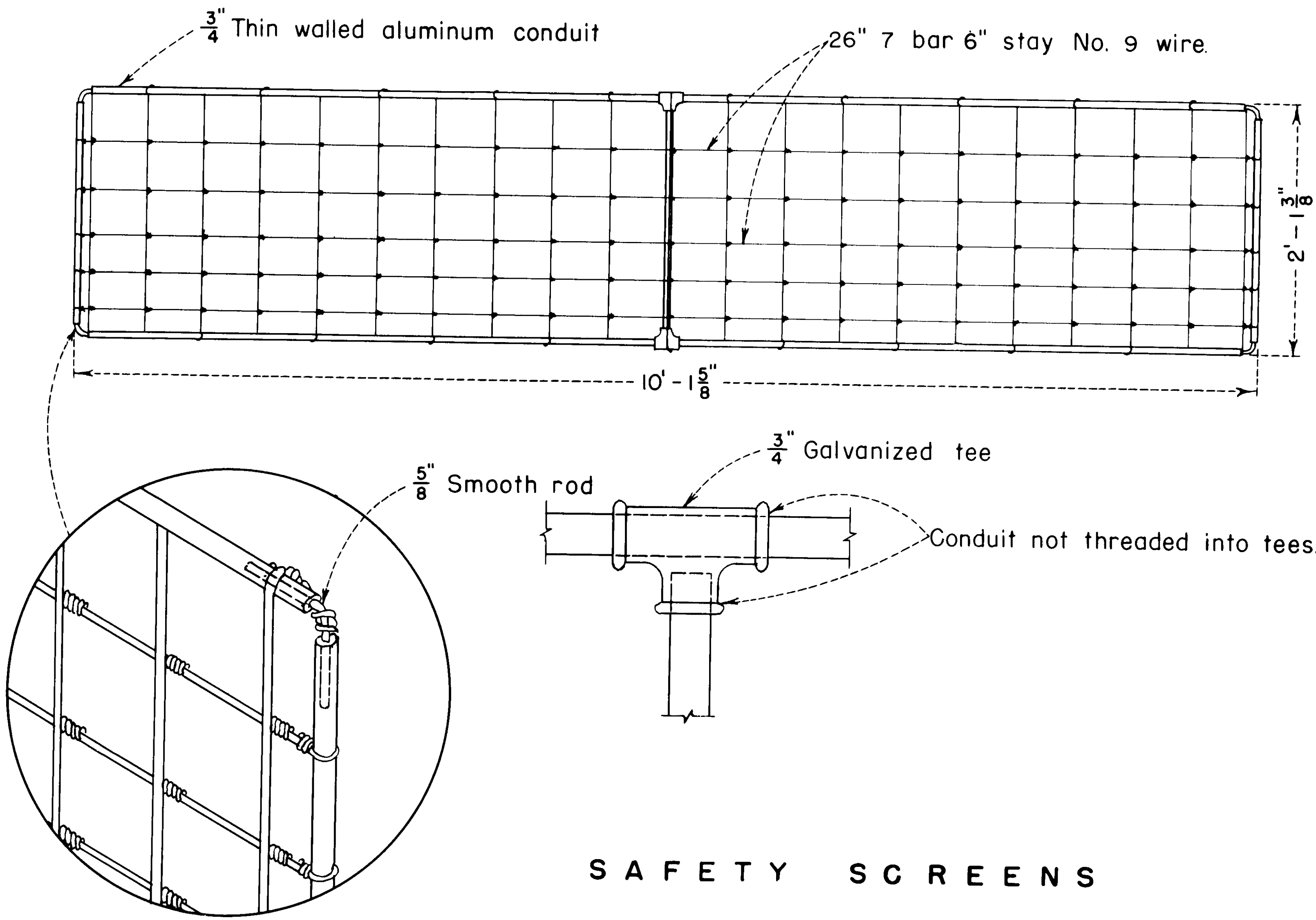

SAFETY SCREENS

CONTROL OF COMMON CATTAILS IN CHANNELS

A recently-issued bulletin by the Agricultural Research Service, United States Department of Agriculture summarizes "Studies on the Control of the Common Cattail in Drainage Channels and Ditches." For your general information the summary and conclusions of this Technical Bulletin No. 1286 are given below:

SUMMARY AND CONCLUSIONS

"Common cattail is widespread in aquatic environments throughout the United States and many other parts of the world and is an economically important weed in drainage and irrigation canals, farm ponds, reservoirs, marshes, and the margins of lakes.

"Life history studies of common cattail were made in Utah in 1949 and 1950 and in Montana from 1958 to 1960. Control studies were conducted in Washington, Utah, Idaho, Montana, and Wyoming from 1947 to 1960.

"In Montana the achene-like fruit of common cattail germinated and the seedling developed either submersed in water or on wet soil. A single seedling grown in a culture tank produced as many as 98 non-flowering shoots 2 to 48 inches tall and 104 crown buds in the first season.

"The shoots of older cattail developed slowly from crown buds in early spring, elongated rapidly in late spring, and reached the flowering stage by early summer in Utah and Montana. Pistillate spikes matured by late summer. The spikes contained an average of more than 200,000 seeds. New crown buds began to develop in midsummer after pollination and produced vegetative shoots during the remainder of the growing season. Numerous new crown buds developed at the end of the growing season.

"In Utah the level of carbohydrates in cattail roots and rhizomes was relatively high in early spring but decreased rapidly during vigorous growth in late spring. The seasonal low was reached when the shoots began to flower in early July. Thereafter, the trend was rapidly upward throughout the growing season, except for a brief period in late August coincident with the rapid development of new shoots.

"Severance of shoots below the water surface two or three times in one growing season during preheading or early heading stages reduced the stand of cattail 95 to 99 percent in Montana and Utah, respectively.

"Twenty-eight herbicidal formulations were tested alone or in combination for control of common cattail in Washington. Many of these formulations and several additional herbicides were tested also in the other four States. The most effective and economical herbicides at all locations were esters of 2,4-D in oil-water emulsions, amitrole, and the sodium salt of dalapon.

"Optimum rates of the esters of 2, 4-D in oil-water emulsions were 4 to 8 pounds of acid equivalent per acre. In Utah experiments, the emulsions generally were less effective when the amine salts of 2, 4-D were substituted for the esters. Neither ester nor amine formulations of 2, 4-D were effective on cattail when applied in water alone or with a commercial wetting agent. The addition of AMS or sodium salt of TCA at 20 pounds or more per acre increased the effectiveness of amine and sodium salts of 2, 4-D. However, these mixtures generally were inferior to esters of 2, 4-D plus diesel oil at 2.5 to 5 percent by volume of spray and emulsifier.

"Optimum volumes of 2, 4-D-diesel oil-water emulsions varied directly with the density and height of cattail growth and averaged about 240 gallons per acre for cattail in the boot to early flowering stage. The emulsions were much less effective in spray volumes of 80 gallons per acre.

"Two applications of 2, 4-D per season, the first at a preflowering or early flowering stage and the second on regrowth in late summer or early fall before frost, were necessary for satisfactory control and reduction in stand of cattail. Single applications, especially at post-bloom stages, were ineffective at all locations.

"The optimum rates of amitrole were 8 to 12 pounds per acre. The addition of wetting agents or diesel oil increased the effectiveness of initial applications of amitrole in Washington but not in Wyoming. After re-treatments, the importance of the additives was less obvious.

"The optimum rate of sodium salt of dalapon was 20 pounds per acre. The effectiveness of this herbicide was increased considerably by the addition of diesel oil and emulsifier or of a suitable wetting agent. The sodium salt of dalapon was more effective than an ester of dalapon in Washington.

"Limited tests showed no advantage in mixing amitrole and sodium salt of dalapon or either of these herbicides with 2, 4-D.

"Amitrole and sodium salt of dalapon were most effective when applied at a late stage of growth from August 5 to September 5 in Washington. In Wyoming the optimum dates were about August 1 for sodium salt of dalapon and September 1 for amitrole. Single applications of either herbicide at a preflowering or early flowering stage were much less effective in Washington, Wyoming, and Montana.

"Amitrole and sodium salt of dalapon were as effective in 40 gallons of water or oil-water emulsion per acre as in greater volumes of 80, 160, or 320 gallons.

"Erbon was effective on cattail in Montana. The optimum rate of erbon was 40 pounds per acre.

"Ammonium and sodium salts of TCA and various soil sterilant herbicides were only partially effective at several locations.

"Repeated applications of aromatic oils showed some promise of controlling cattail in Utah. Single applications of oils gave only temporary control in Idaho and Washington.

"No single chemical application or mechanical treatment eliminated common cattail. However, one application of amitrole, erbon, or sodium salt of dalapon, two applications of 2,4-D-diesel oil-water emulsion, two cuttings below the water level, or three sprayings with aromatic oil per season greatly reduced the stand the first year and frequently eliminated or nearly eliminated cattail in 2 or 3 years. The cattail not standing in water was more persistent than cattail standing in water, except when treated with aromatic oil. Repeated spraying with this oil was equally effective in either case."

If additional information or if a copy of Technical Bulletin No. 1286 is desired, please write to the Agricultural Research Service, United States Department of Agriculture at Logan, Utah; Laramie, Wyoming; Prosser, Washington; Huntley, Montana; or Meridian, Idaho.

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CUT-OFF WALLS FOR CHECK STRUCTURES
(Suggestion R5RG-61-22)

Considerable difficulty is being encountered on the Ysleta Division of the Rio Grande Project in Texas, in constructing the cut-off walls for lateral check structures 4-feet deep, where wet excavation is necessary or where a sandy subgrade makes it difficult to maintain a vertical sided trench for the cut-off walls. The narrow 8-inch trenches for the cut-off wall were originally excavated by hand methods until a narrow trenching bucket was built to operate as a backhoe attachment. Using either method a considerable amount of overexcavation occurs and inasmuch as this cannot be backfilled, it is necessary to fill the overexcavated volume with concrete at approximately $15 per cubic yard. It is difficult to place the reinforcing steel in these narrow trenches without causing additional overbreak of the excavation, necessitating the removal of the steel and excavating again in some instances. Six-inch-high steel forms are set on the edge of the excavated trench and in the case of an overbreak, it is necessary to suspend these forms over the edge of the excavation. This is difficult to do and maintain good alignment.

Mr. Woodrow D. Roquemore, Ysleta Irrigation Field Branch, suggested that these cut-off walls be precast, each upstream and downstream cut-off wall to be made in two sections cut in half along the centerline of the structure with a ship-lapped joint that could be bolted together or encased in concrete when the floor slab is placed. These walls are cast flat with the reinforcing steel extending straight above the top of the cut-off wall, so that it can be bent in either direction depending on whether the wall is to be used upstream or downstream. If the walls are precast the thickness of the wall can be reduced from 8 inches to 4 inches, thus effecting a saving of one half of the concrete volume. The narrow trenching bucket and the backhoe can still be used to excavate for the cut-off walls and inasmuch as one half of the heaviest cut-off wall will weigh slightly in excess of 2,500 pounds the backhoe also can be used as a crane to set the precast pieces. The backfill around the cut-off walls can be compacted with pneumatic tampers to a density greater than the density of the original materials.

The suggestion has been put into use whenever circumstances require it. A set of cut-off walls is precast for each size of check structure and stored in the material warehousing area. When a check structure excavation is encountered that is wet and has a tendency to slough, causing overexcavation that would have to be filled with concrete, the crew picks up a set of precast cut-off walls from the stock. These are used on the structure and the precasting yard crew makes up another set to maintain the stock on hand.

In approximately 80 percent of the cases the sidewalls of the excavation for the cut-off walls will stand vertically. The reinforcing steel and forms are set and the concrete for the entire structure is placed monolithically. If the work can be accomplished in this manner we believe it is cheaper and makes a better structure to build the check in one concrete placement. However, when wet excavation for the cut-off walls is encountered, we can use the precast concrete cut-off walls and greatly expedite the work.

* * * * *

EROSION STUDIES OF PIPE LINING MATERIALS

The Paint Laboratory of the Chemical Engineering Branch, Office of Chief Engineer, Denver, Colorado, has recently released a report on the continuing research of the Bureau of Reclamation in the field of protective coatings for steel pipe. These latest tests were conducted under situations which simulate conditions found in siphon pipes or sheet metal flumes subject to erosion by abrasive material in the water.

These tests were used to evaluate the erosion resistance of epoxy mortars, epoxy coal-tar paints, some of the newer synthetic resin materials, and sand-filled conventional paints. Other tests were made to determine the erosive effect on unlined steel pipe and asbestos-cement pipe. The resistivity of these materials to erosion is compared to that of coal-tar enamel.

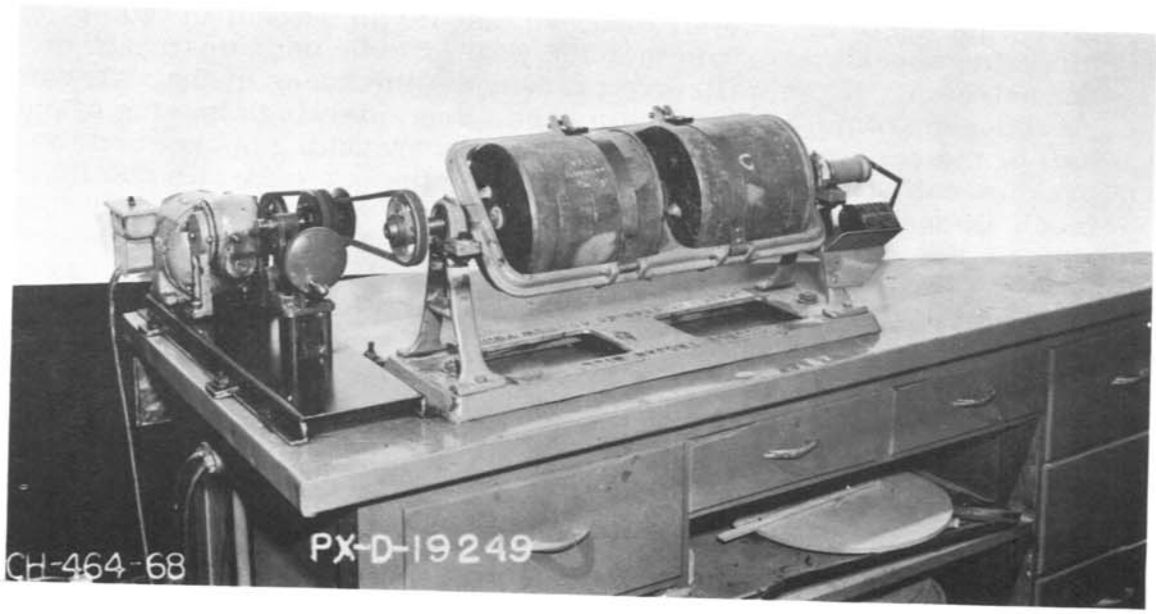

Figure 1

Test Procedures

The tests were conducted by coating the interior surface of 8-inch-diameter, 8-inch-long steel pipe sections with each of the materials being tested. They were applied to a thickness recommended by the manufacturer or by Bureau standards, whichever applied.

Figure 1 shows the testing apparatus in operation. Each coating was subjected to the same erosive action. The entire test operation is given in the table below:

Run No.	Velocity		Duration		Erosive charge
	rpm	fps	Days	Revolutions	
1	33	1.1	14	660,000	Sand
2	33	1.1	14	660,000	Sand
3	95	3.4	5	660,000	Sand
4	33	1.1	14	660,000	Gravel

Figures 2A, 2B, 2C, and 2D on the next page are "before and after" series of two of the more common coating materials.

Fig. 2A. Pipe "YY" before testing. Three coats of coal-tar paint, CA-50, second coat reinforced with ASTM C-190 Ottawa sand.

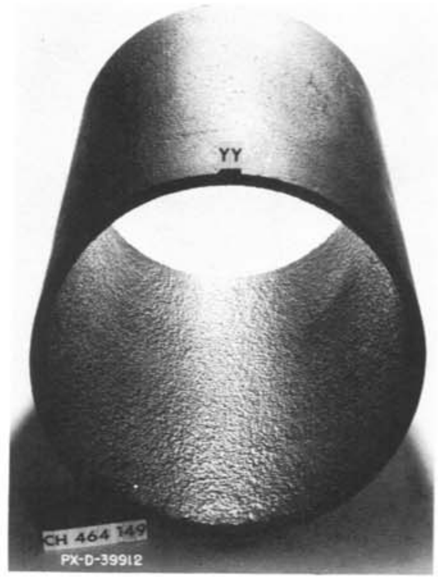

Fig. 2B. Pipe "YY" after testing. The only visible damage is the removal of the CA-50 from the tops of sand grains. View shows condition after four runs.

Fig. 2C. Pipe "ZZ" before testing. Lining consists of four coats of red-lead priming paint, TT-P-86a, Type IV, second coat reinforced with No. 20-30 mesh Ottawa sand (ASTM C-190).

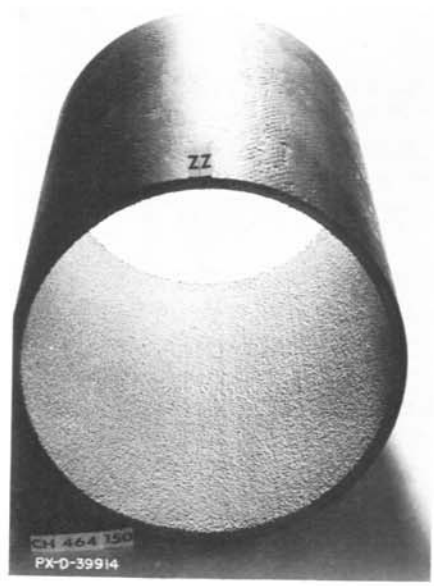

Fig. 2D. Pipe "ZZ" after testing. The main effect after four runs is the removal of paint from the tops of the sand grains.

Figure 3

The sand charges consisted of 3 pounds of sand plus 2,000 c.c. of water. The gravel charge was made up of 3 pounds of No. 4 aggregate plus 2,000 c.c. of water. The charge occupied about one-third of the pipe section volume. Figure 3 shows a typical section with the erosive charges used.

The materials tested were divided into categories according to the degree of erosion developed. Those materials that lost less than 5 percent of their weight or thickness per run were rated "good," those between 5 to 20 percent were rated "moderate," and those losing 20 percent or more per run were classed as having "low" erosion resistance. Any material partly worn through to the steel after one or two runs is classified as "poor." Following is a list of commonly used protective coatings and their classification:

Good

1. Epoxy-resin coal-tar mortars.

2. Epoxy-resin mortars.

3. Three-coat epoxy-resin paint (second coat sand filled).

4. Coal-tar paint, CA-50, three coats (second coat sand filled).

5. Red-lead priming paint, TT-P-86a, Type IV, two coats (second coat sand filled), plus two coats of phenolic-resin base aluminum paint.

6. Epoxy-resin modified coal-tar paint, three coats, (second coat sand filled).

7. Red-lead priming paint, TT-P-86a, Type IV, four coats (second coat sand filled).

8. Polyester resin reinforced with chopped glass fibers.

Moderate

1. Hot-applied polyvinyl chloride--polyvinyl acetate copolymer.

2. Epoxy-resin modified coal-tar paint, one coat system.

Low

1. Hot-applied epoxy resin.

2. Epoxy-resin modified coal-tar paint.

These tests were established to give results that would show the relative resistance of the protective coatings to abrasion. No attempt has been made to relate quantitatively the test results to the rate of erosion which occurs under field conditions. Because many other factors other than erosion affect a field application, recommendations will not be made on these results alone.

Results of the tests on materials with a sand-filled coat demonstrate a marked improvement over the same materials without a sand-filled coat. Table 2 shows these comparisons. See table on following page.

Each of these materials was also compared to coal-tar enamel which is generally considered to have very good resistance to sand and silt erosion. The results of these comparisons are shown in Table 3 on page 19.

The unlined steel showed very good resistance to erosion. However, erosion alone is not the most serious threat to steel pipe. Under some field conditions, corrosion can be expected to penetrate the pipe wall much more rapidly than erosion. For this reason, it is necessary to maintain a coating protection on the steel surface.

Conclusions

In addition to the rating of protective coatings given earlier, the Paint Laboratory found that sandfilling dramatically improved the erosion resistance of many paint materials. C190 Ottawa sand was used as the filler, being sprinkled liberally on the freshly applied paint surface. The improvement in erosion resistance of these easily applied materials is quite encouraging.

TABLE 2

Comparison of Performance of Sand-filled Linings Vs. Unfilled Linings

Material	Unfilled lining				C109 sand-filled lining				Loss ratio filled to unfilled linings
	Pipe No.	Loss per run: Weight percent	Loss per run: Thickness percent	Rating	Pipe No.	Loss per run: Weight percent	Loss per run: Thickness percent	Rating	
TT-P-86a, Type IV, 4 coats	C	29.1	50.0	Poor	ZZ	3.1	2.4	Good	0.07
CA-50, 3 coats	E	16.4	22.3	Low	YY	1.5	1.8	Good	0.09
Epoxy-coal tar paint 3 coats	M	16.4	22.0	Low	BBB	4.7	4.7	Good	0.24
Epoxy-resin-paint	F	20.1	23.0	Poor	GGG	1.0	2.0	Good	0.07
Vinyl-resin-paint, VR-3	S	16.4	33.9	Poor	AA	0.9	1.8	Good	0.05

TABLE 3

Material	Ratio of the average percent loss per run of a lining material to that of unsanded coal-tar enamel
TT-P-86a, Type IV, 4 coats*	0.71
CA-50, 3 coats*	0.40
Epoxy-coal-tar paint, 3 coats*	1.15
Epoxy-resin paint*	0.37
Vinyl-resin paint, VR-3	0.33
Epoxy-resin coal-tar mortars	0.12-0.195
Epoxy-resin mortars	0.28-0.43
Polyester resin reinforced with glass fiber	1.01
Unlined steel	0.024
Cement-asbestos pipe (no lining)	0.12

*Indicates sand-filled coating material.

The gravel charges were found to be approximately seven times as destructive as the sand charges. On this basis it is believed that silt would have no adverse effect on the better linings.

Copies of Chemical Engineering Laboratory Report No. P-93 are available and can be obtained by writing the Chief Engineer, Bureau of Reclamation, Denver Federal Center, Denver, Colorado 80225, Attention: Code 290.

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PULLING PISTONS WITH A NEW TOOL

(Reprinted from the September 1963 issue of WESTERN CONSTRUCTION with the permission of the Editor)

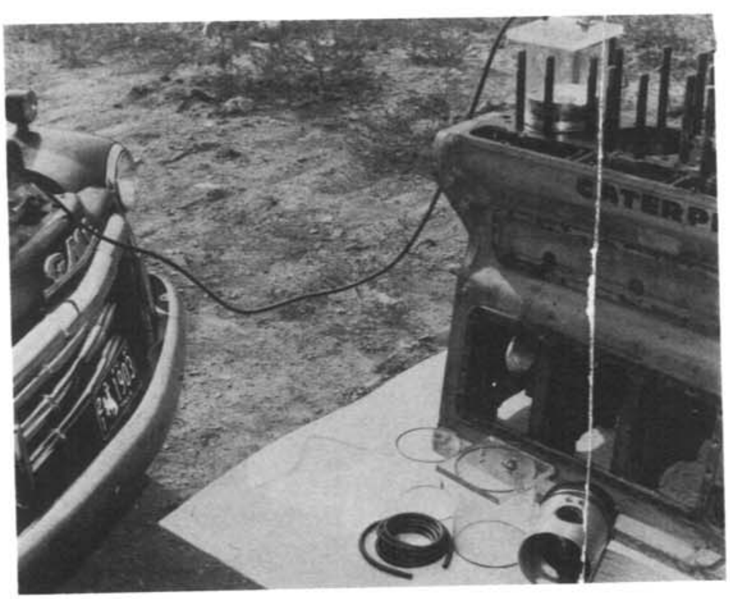
THE PROBLEM of raising a piston and connecting rod assembly up through the cylinder of an internal combustion engine is a common and annoying problem for mechanics. This is particularly true if the serviceman goes through the crankcase side plate ports of the engine to disconnect the connecting rod bearing cap.

Weight of the assembly and the drag of the piston rings make the removal impossible by hand and the serviceman usually resorts to prying the assembly up with a bar, placing a small jack in the engine crankcase, or inserting a wooden block between the connecting rod and crankshaft journal which will lift the assembly when the engine is rotated. By using any one of these make-shift methods the piston can be forced up through the cylinder to a point where the rings will expand and hold the piston until it can be removed by hand. However, these methods are difficult and frequently result in accidents that can damage one or more of the engine parts.

On the larger sizes of diesel engines there is a means provided for this operation, usually an eyebolt screwed into the top of the piston. Why not develop a tool to carry out this same operation on the medium size engines?

This was the problem attacked by two maintenance specialists in Wyoming, who developed a tool and procedure for carrying out this operation.

The tool and method is extremely simple, but the use of a vacuum as the pulling power is very unusual. Basically the tool consists of a plastic cylinder of the proper diameter with rubber seals at top and bottom. On top of this cylinder is placed a square plastic cap with two openings. One is attached to the suction source and the other is a valve to control the amount of vacuum and the resulting pull. Operation is as simple as the parts of the tools themselves. Place the lower end of the transparent cylinder in the proper location over the piston in the engine, being sure to seat the neoprene ring seal. The cap is then placed over the upper end using a similar ring seal. With the valve open the hose is attached to the vacuum source (engine intake or small vacuum pump) and the power started with the valve open. This intake valve is then closed slowly to develop the vacuum until the piston is raised past the first ring. Control of the raising is simple and easy. The freeing of the rings from the cylinder breaks the vacuum seal, and the expansion of the ring or rings hold the piston up until it can be removed by hand.



Photograph at left shows tool in position with piston raised and the tube to the engine providing the source of vacuum.

In addition to this basic purpose, the tool can be used with equal success for two other operations in connection with piston maintenance. By controlling the vacuum, the serviceman can hold the piston in any desired position while working on the lower end of the connecting rod. Or, it can be used to assist in the installing of a piston and rod assembly.

To do this the piston is forced gently down through the ring compressor to the position where the top ring has just entered the cylinder. Normally, it will hold the piston in this position. The tool can be placed over the piston as before but with the control valve closed. When the assembly is lowered by pulling on the connecting rod, the tool will act as a snubber, restricting downward movement so that the assembly will not fall free, and the rod can be guided onto the crankshaft bearing.

As to a source for the necessary vacuum, from 18 to 20 in. of mercury and sufficient capacity to overcome any leakage past the piston rings can be secured from the inlet manifold of a car or small truck. Of course, the capacity requirements of the vacuum system are in direct proportion to the condition of the piston rings. In using such an engine source, it is usually best to increase the idling speed about 100 rpm. to increase the volume.

As a word of caution, with the tool in pulling position and the vacuum applied, the operator must use care in handling the connecting rod and keep his hands out of a position where they would be caught as the piston is raised. The lifting capacity of the tool on a 6-1/4-in. bore piston is nearly 250 lb. with 18 in. of vacuum.

A patent is pending on the tool. Present production has been primarily for users of tractor engines. For further information write to Chief Engineer, Bureau of Reclamation, Denver Federal Center, Denver, Colorado 80225, Attention: Code 410.

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PORTABLE POWER

Two new portable generators have recently appeared on the market. Each of these generators is designed to supply both alternating-current and direct-current power.

One of these generators is designed to replace the standard automobile generator. Under normal operation it supplies 12 volts direct current; but by flipping a switch mounted on the dashboard; it is converted to a 110-volt alternating-current generator. This generator produces 2,300 watts at 110 volts. The generator is only slightly larger than the standard automotive generator and can be installed in any car or truck without alterations. The generator and control panel will cost approximately $200.

Figure 1

The other generator is a portable, gasoline-powered unit. A 3/4-horsepower 2-cycle gasoline engine turns this generator at 6,300 rpm. The unit is very compact, it occupies less than 0.4 of a cubic foot of space and weighs only 12 pounds.

However, this generator produces 300 watts at 115 volts alternating current. It produces a standard 12 volts direct current; but with the addition of a converter; the generator will produce 400 watts of 115 volts direct current.

The entire unit plus converter will cost approximately $110.

Figure 1 above is a view of the portable generator.

Figure 2 below shows the standard-type generator that can be mounted in a vehicle.

These generators could be the solution to many difficult maintenance problems such as: The operation of power tools for on-the-spot repairs in remote areas, providing emergency lighting systems, recharging batteries, and supplying power for posthole drilling.

Figure 2

Further information on the generators can be obtained by writing the Chief Engineer, Bureau of Reclamation, Denver Federal Center, Denver, Colorado 80225, Attention: Code 410.

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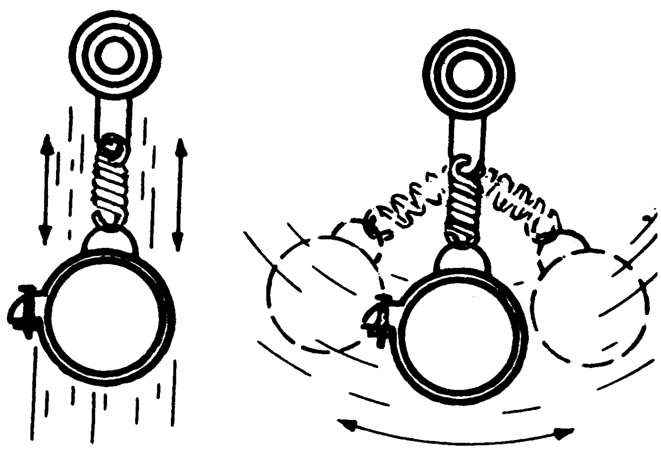
AVOID BROKEN TAILPIPE BRACKETS

(Reprinted by permission of GRIST, November/December 1961 issue, a publication by the National Conference on State Parks, Washington, D.C.)

Up at Waterloo Recreation Area, Michigan, they have no more trouble with broken tailpipe brackets on trucks and autos since James Hein replaced them with springs.



A rigid clamp around the tailpipe holds the bottom end of a helical cot spring; the top loop of the spring fastens into a hole drilled in the end of a short piece of steel bar bolted to the chassis.

"There's plenty of 'give' when the going gets rough," says Jim. "Tailpipe don't break off now as they once did with the rigid brackets."

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GPO 839-362