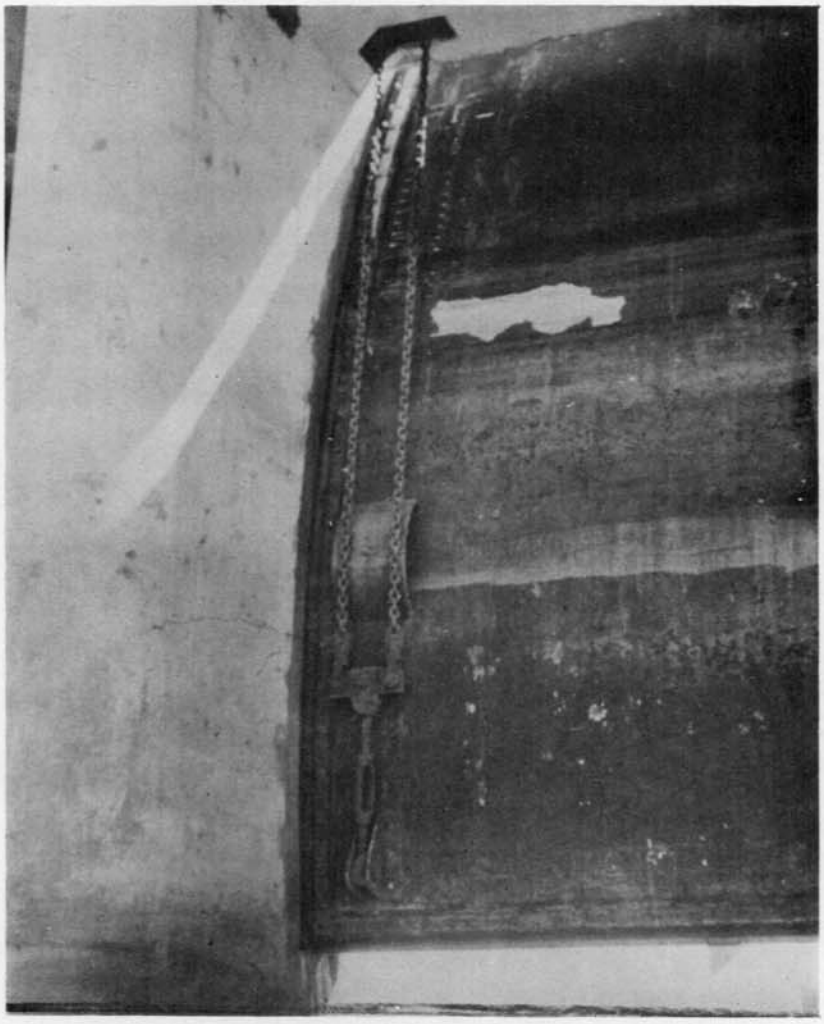
Department of the Interior
Bureau of Reclamation

OPERATION AND MAINTENANCE EQUIPMENT AND PROCEDURES

RELEASE NO. 19

January, February and March 1957



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OPERATION AND MAINTENANCE

EQUIPMENT AND PROCEDURES

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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. Reference to a trade name does not constitute the endorsement of a particular product, and omission of any commercially available item does not imply discrimination against any manufacturer. 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 continued effort to reduce costs and increase operating efficiency.

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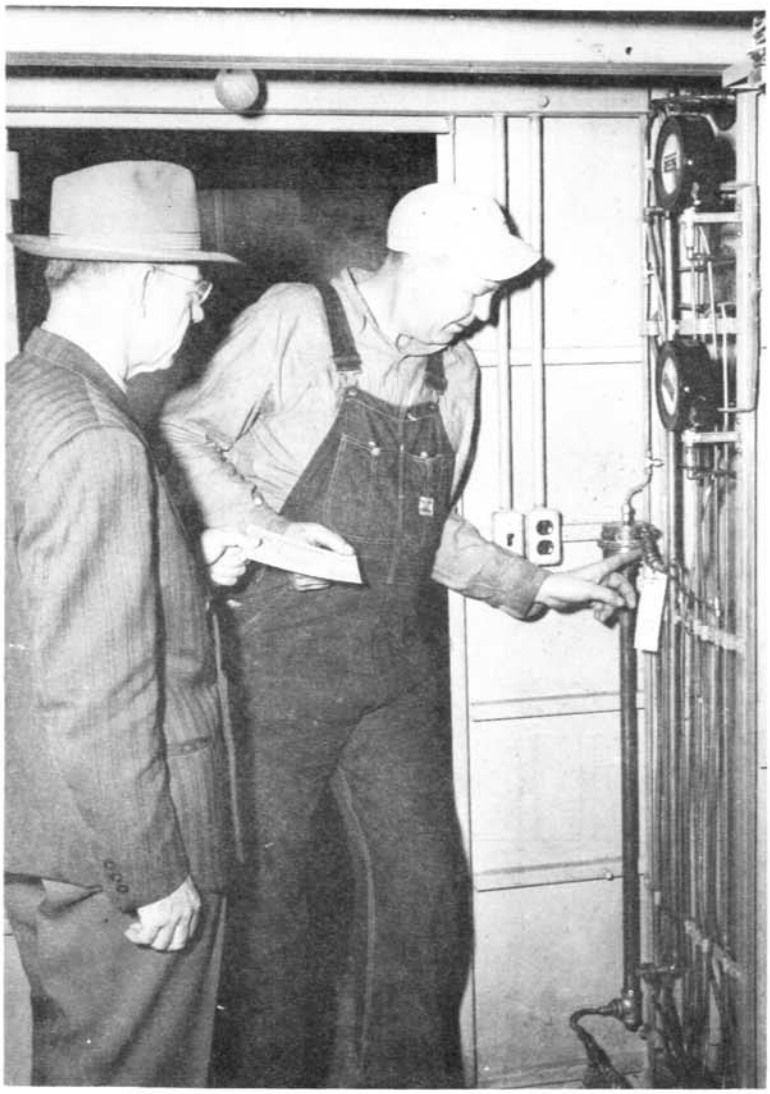
Division of Irrigation Operations

Commissioner's Office
Denver, Colorado.

NO MORE PLUGGED CONTROL PIPING

In the photograph below, Arthur C. Birdzell of the Tracy Operations Field Branch, Central Valley Project, California, is receiving an award for the development of the device he is pointing to for preventing the plugging of gages and mercoid control piping by silt.



The device consists of a diaphragm box to which is attached a "mud-leg." The diaphragm box keeps the silt out of the gage piping and still insures the proper pressure on the top gages and mercoid switches. The "mud-leg" (pipe attached to the diaphragm) is added to facilitate removal of silt trapped by the diaphragm and permits draining of the piezometer piping.

Construction:

The arrangement of the piezometer piping is shown on the schematic diagram on the following page. Tubing above the diaphragm box is filled with any suitable liquid to transmit the pressure to the gages. The water in the piezometers can not pass the diaphragm, hence can not enter the gage piping and cause a stoppage.

The inexpensive equipment and material required can be installed on any similar controls. For further details on the construction of the device and to obtain information concerning the diaphragm box, write the Regional Director, U. S. Bureau of Reclamation, Sacramento, California.

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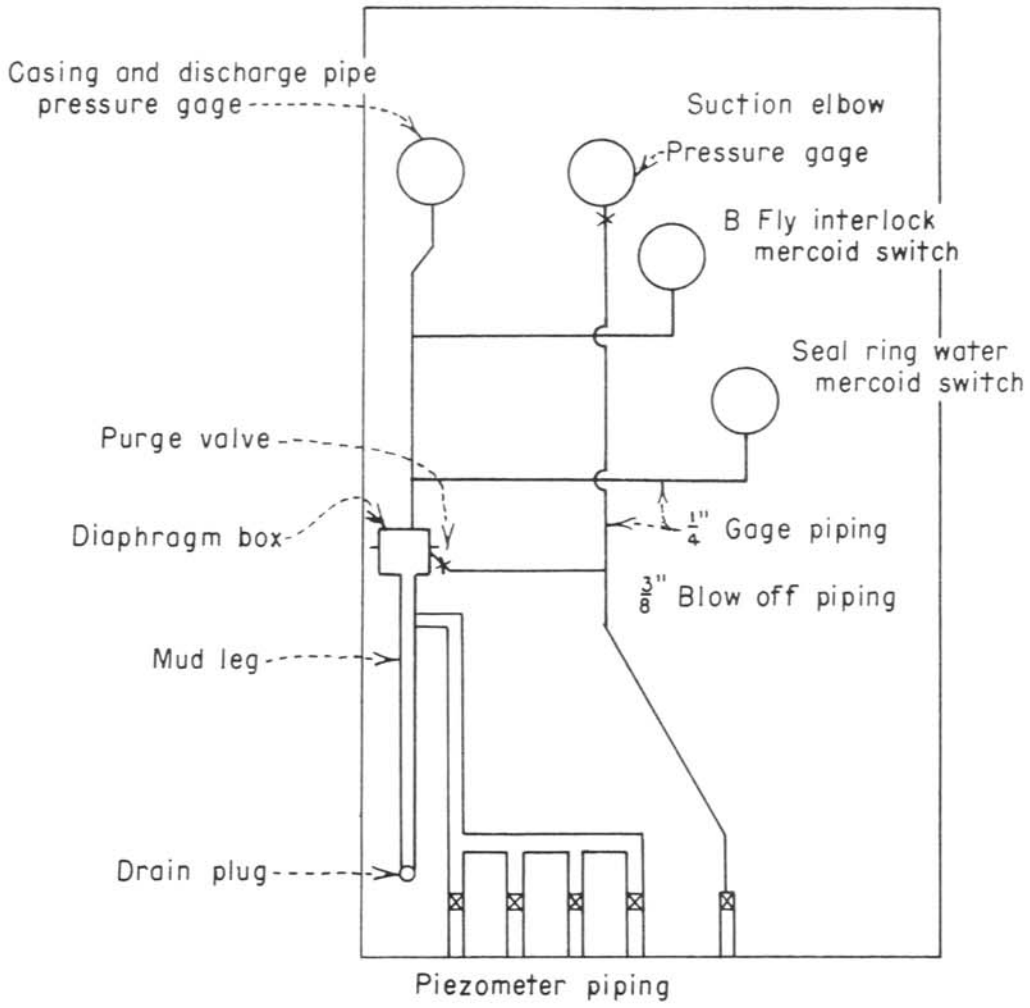


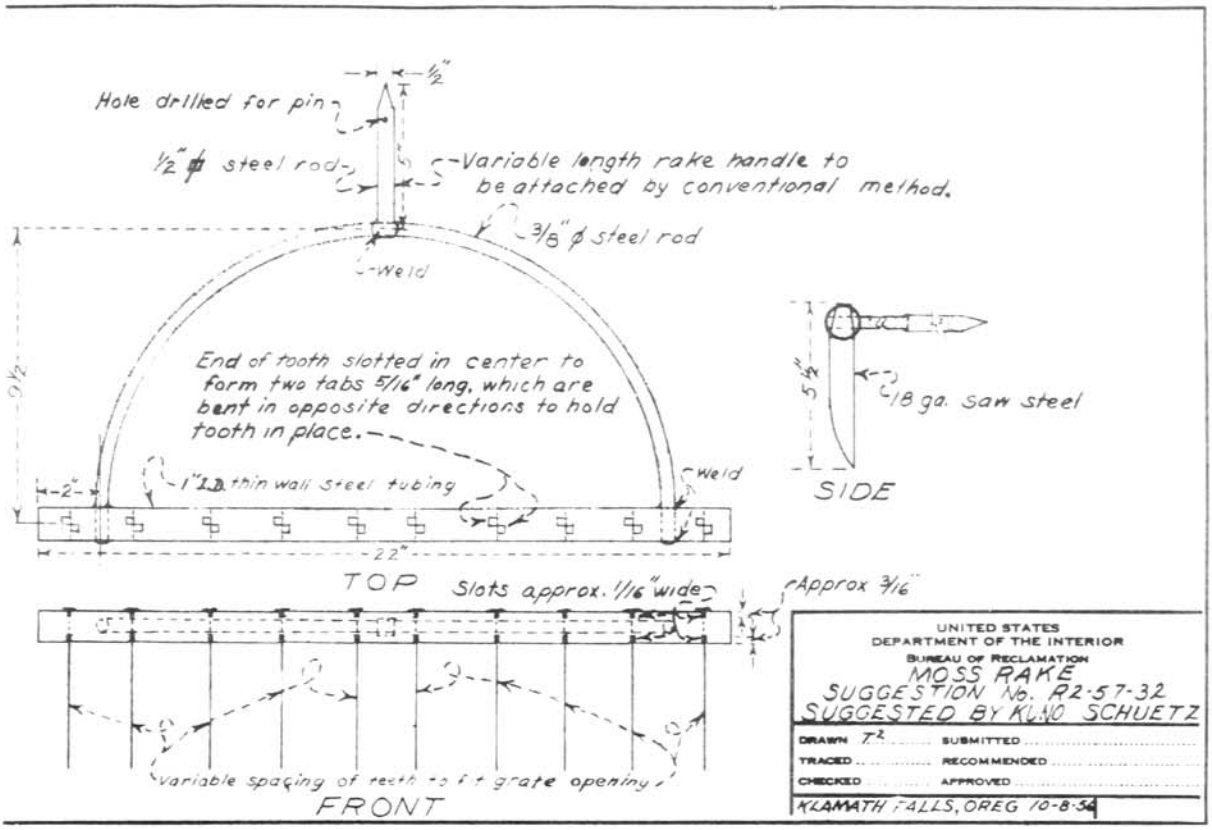
DIAPHRAGM BOX AND MUD LEG

MOSS RAKE

The removal of moss from the trashracks of the Klamath Falls Pumping Plants on the Klamath Project, Oregon, is quite a task, as it is on most projects where the moss problems are severe. Project Employee Kuno E. Schuetz devised the rake shown in the photograph below to simplify the task. In the photograph Mr. Schuetz is holding one of the tines of the new rake in his right hand and the old type rake used in the operation in his left hand.

Construction:

As shown in the drawing below, the new rake has tines spaced to match the spacing of the grate bars of the trashrack. The tines of the rake have been designed of such length to avoid their "hanging-up" on the cross members of the grates. The tines made of saw steel are durable and can be easily removed and replaced if they become broken and bent.



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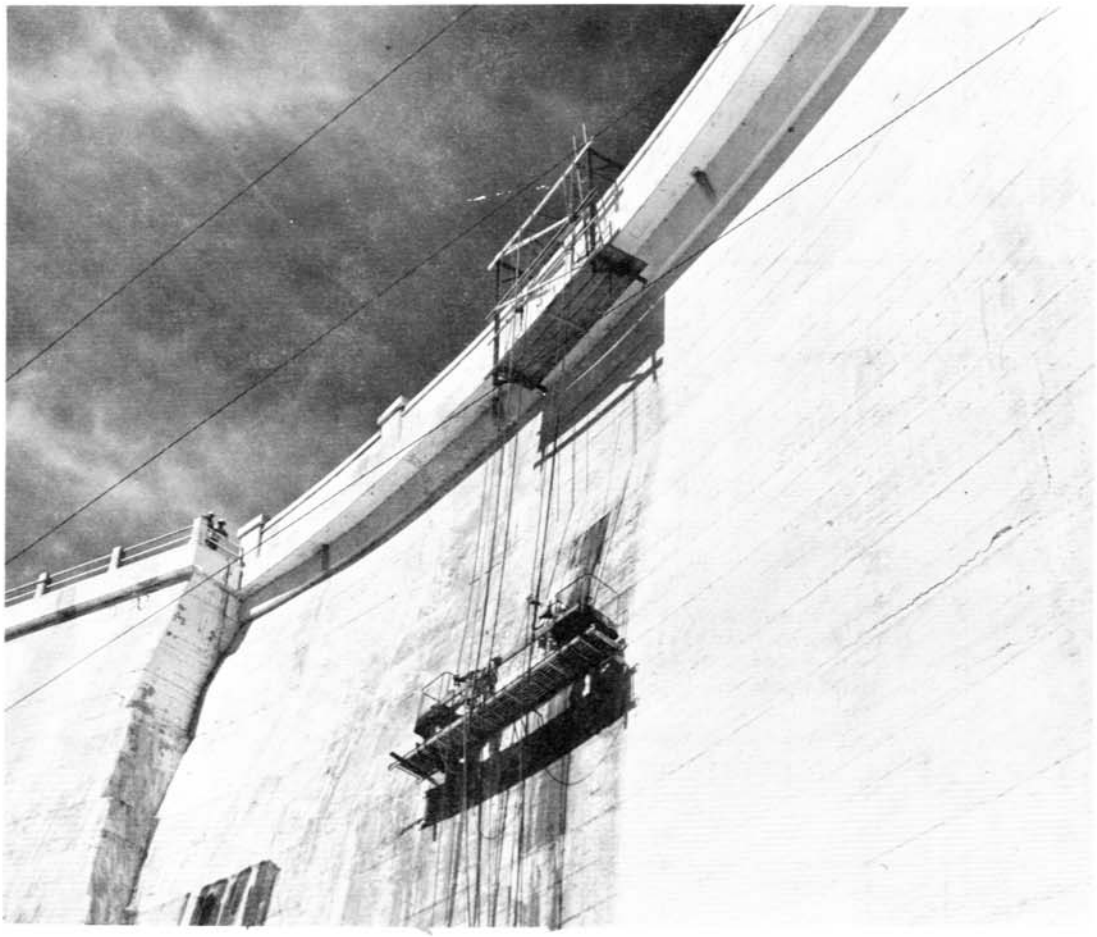
NOVEL PAINT RIG

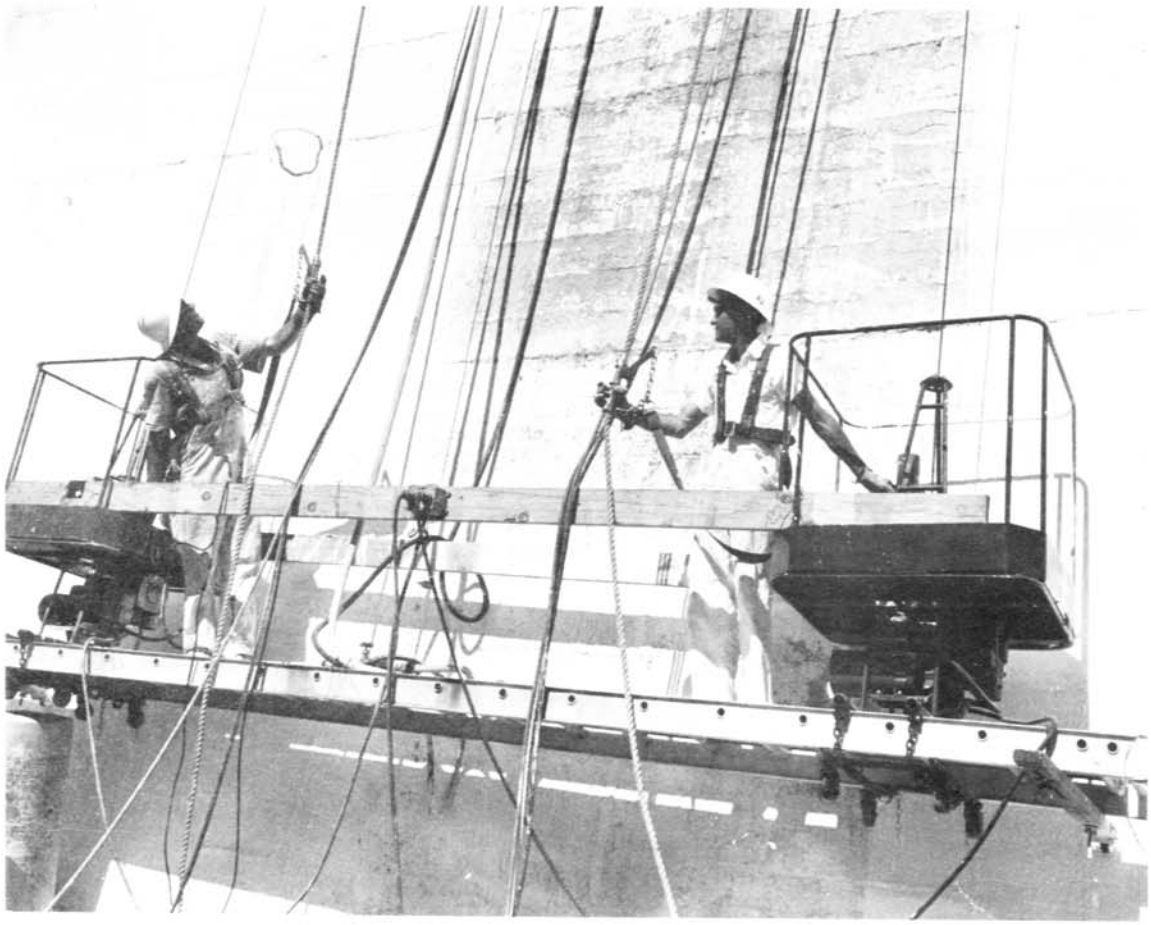
Stewart Mountain Dam, 41 miles northeast of Phoenix, Arizona, on the Salt River, was constructed by the Salt River Valley Water Users Association in 1930, with some supplemental work performed by the Bureau of Reclamation in 1936-39. The dam is one of seven storage reservoirs on the Salt River Project which has been operated by the Salt River Valley Water Users Association since 1917. Periodically the Association repaints the downstream face of the dam, which impounds 69,765 acre feet of water in Saguaro Lake, to reflect heat and diminish temperatures within the mass of the variable radius concrete arch structure and gravity abutments.

Last painted in 1949, the downstream face was again painted during the summer of 1956. To reduce hazards and to increase the efficiency of the painting operation, the united efforts of the Project Civil Engineering, Construction and Maintenance Departments and the painters were combined in development of the scaffolding shown below.



The painting rig was designed by Clarence Whalin, Supervisor of Civil Engineering and assembled by Al Martin of Construction and Maintenance and his crew. The repainting job was accomplished in approximately

three weeks. The deck portion of the assembled rig at the top of the photograph on the preceding page was provided with castors so that it could be moved manually across the top of the dam. Made with a framework of steel and decking and other accoutrements of wood, the upper deck is 14 feet long and 10 feet wide and provides means of access to the movable scaffolding over the 15-foot overhanging roadway and parapet at the top of the dam.



The movable scaffold, as shown above, has an aluminum base 14 feet long and 3 feet wide. It is raised and lowered by cables and one three-quarter horsepower motor at each end of the scaffolding. Two painters were employed on the platform at a time and were able to maneuver the scaffold as necessary.

As a matter of interest, approximately 550 gallons of vinyl paint was used to cover the face of the dam. Prior to applying the paint, the workers washed the face of the dam with jets of air and water at a pressure of 90-pounds per square inch. The paint was applied pneumatically moving from top to bottom in 14-foot wide panels. The pressure on the paint spraying equipment was maintained at a pressure of 40 pounds per square inch at the top of the dam and gradually reduced to 20 pounds per square

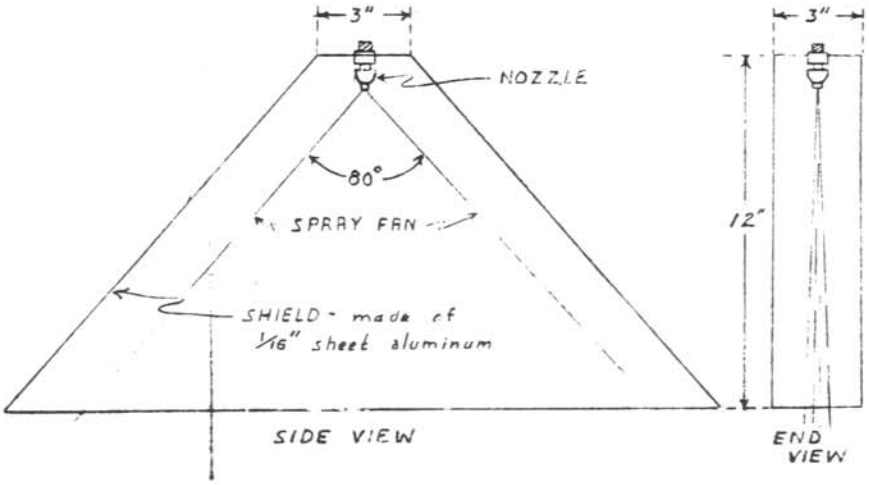
inch near the base of the dam. For further information concerning the design, construction and use of the rig, which could be adapted to other similar maintenance work, write the Salt River Power District, P.O. Box 1980, Phoenix, Arizona.

* * * * *

HAND SPRAY SHIELD

The light-weight shield for use on a hand-boom when spraying various weed control materials, shown in the photograph and sketch below, was fabricated by Tom Hines, Tracy, California, for use on the Contra Costa Canal, Central Valley Project.

The shield reduces the drift of weed control materials by excluding the wind from part of the spray fan. It is particularly adapted for use in spraying weed oils under over-hanging branches of shrubs and trees. The shield effectively prevents the branches from being sprayed by the drifting weed control material.



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TRANSMISSION JACK

Gordon Sewell and Roy Garner, of the Central Valley Project, Lindsay, California, built the movable platform on caster wheels shown below, which in combination with a regular 3-ton floor jack, made it into a transmission jack. After Roy lost six weeks work from an injury using a regular floor jack as a transmission jack, which they didn't have, he and Gordon Sewell put their heads together and developed the converted jack which will move forwards, backwards, sideways or at any angle and handle all types of car and truck transmissions.

For further details on the jack, contact the Regional Director, Bureau of Reclamation, Sacramento, California.

* * * * *

KILLING CRAYFISH IN LATERALS

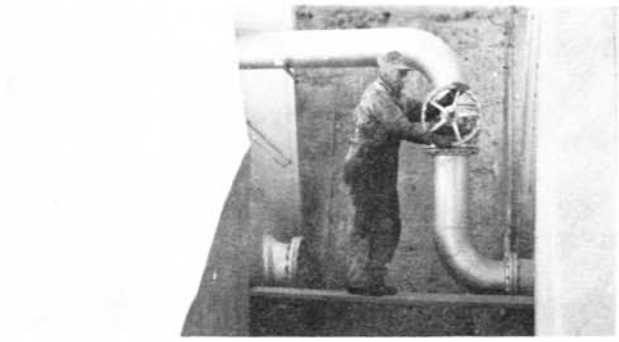
Some of our projects, troubled with crayfish digging holes in the canal and lateral banks, follow the practice of killing the crayfish with aromatic solvents, normally used in the control of water weeds. The amount of water flowing in the canal or lateral is reduced to the point at which it barely covers the bottom. The aromatic solvent is then added. A concentration of solvent about equal to that ordinarily used in treating water weeds should accomplish the job.

The best time for treatment of crayfish seems to be the summer months, rather than in the fall, as the crayfish seem to burrow into the canal bottom as the weather and water cools. Consequently, late in the season, the crayfish are out of reach of the solvent.

* * * * *

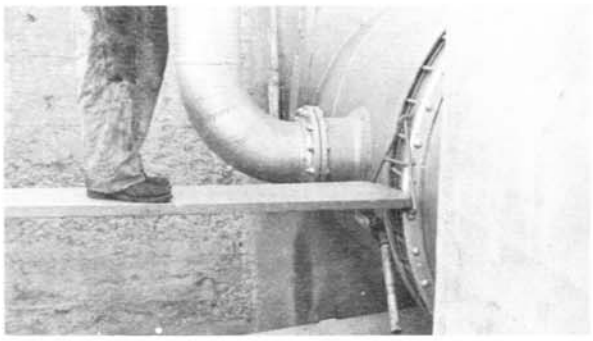
PORTABLE PLATFORM

Designed in Region 5 of the Bureau of Reclamation for the particular job of servicing penstock valves the portable platform shown in the photographs on this page and in the drawing on the following page may be used to advantage in other similar locations. It is safe and substantial.



1. View of portable platform hung between No. 1 and No. 2 penstocks. Mechanic is in position to operate the bypass valve.

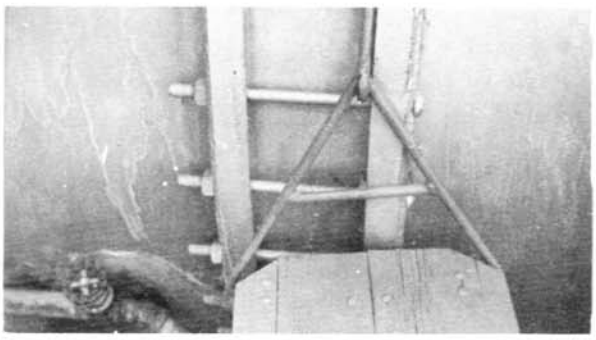
Hung between the two penstocks, as shown in the upper photograph, the portable platform provides easy access for the mechanic in repairing or operating a bypass valve.



2. View of the right end of portable platform hung on No. 1 penstock expansion joint. View shows relation of man, platform and penstock.

In the middle photograph, the right end of the portable platform is shown hung on the penstock expansion joint.

A closer view of the right end of the platform and details of the hanger are shown in the lower photograph. Note that the middle bar in the triangular shaped hanger has two fingers that fit over the right ring of the expansion joint to prevent the platform from swaying.



3. A close-up view of the right end of the portable platform. Note the middle bar in the triangle has two fingers that fit over the right ring of the expansion joint to prevent the platform from swaying.

Construction:

Details of the platform and hangers are given in the drawing on the next page. The platform is of timber construction, 16 inches wide and 7' 4" in length.

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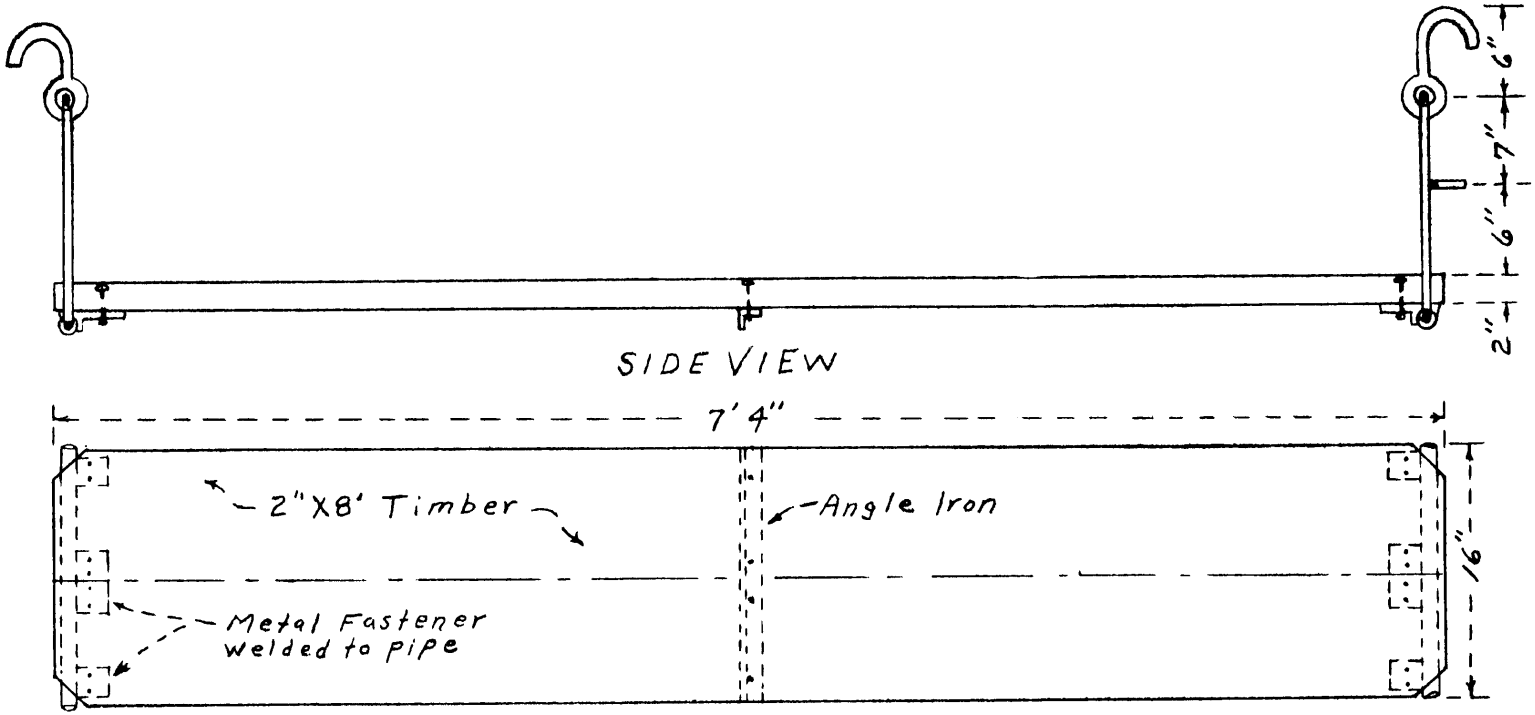
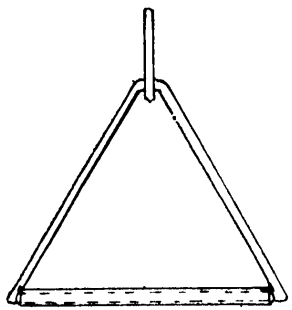


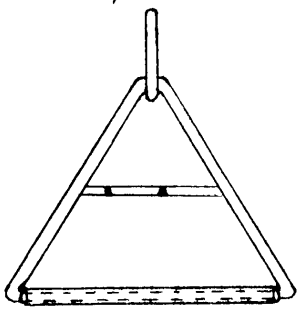
SIDE VIEW

PLAN

Scale 1" = 1'



LEFT SIDE HANGER



RIGHT SIDE HANGER

UNITED STATES
DEPARTMENT OF THE INTERIOR
BUREAU OF RECLAMATION

PORTABLE PLATFORM
For servicing Penstock Valves

DRAWN A.L.J.	SUBMITTED
TRACED	RECOMMENDED
CHECKED	APPROVED

AQUATIC WEED CONTROL

In the January 1957 meeting of the Four States Irrigation Council, composed of irrigationists in the States of Nebraska, Kansas, Colorado, and Wyoming, Robert B. Balcom, Weed Control Specialist of the Bureau of Reclamation, reported upon aquatic weed control studies that have been and are being made under the joint efforts of the Department of Agriculture's Research Service and the Bureau of Reclamation. So that you may be informed of the progress made, parts of Mr. Balcom's report are being presented.

"Operators of irrigation projects know the necessity for controlling waterweeds in irrigation systems, and many methods of control have been devised. Some have grown out of sheer necessity to do something to get the water through to the water-users. Many of these, of course, are only temporary means and have to be repeated several times a year.

"Before chemicals began to play an important part in controlling weeds it was natural to look to mechanical methods for solving this problem. Dragging heavy chains, discing the bottom and sides, and as a last resort, draglines have been, and often are still, used to clear the channels. No doubt you are all familiar with these methods.

"A few years ago the Bureau of Reclamation recognized the need for more effective and economical means of controlling weeds, including waterweeds, and study of the problem was initiated. Also a cooperative plan of research was formulated with the Department of Agriculture which has aided in the development of more effective means of controlling waterweeds. These investigations included the use of chemicals.

"One of the earliest and still used methods for controlling algae, a low form of plant which propagates from spores, is the use of copper sulphate. This is usually applied by hanging in the canal, sacks filled with crystals of this chemical, sometimes called blue vitriol. The dosage depends on the quality and temperature of the water and the kinds of algae present but usually 0.5 to 1.0 ppm is used in still water and 10 to 12 ppm is applied for 30 minutes in canals.

"More recently other chemicals such as the rosin amines have been used with good success on certain species of algae.

"The first chemical formulation found to be effective on higher type submersed waterweeds, like the pondweed, was a chlorinated hydrocarbon manufactured and sold by an eastern firm. This was considered to be too expensive for the larger scale treatments. A Department of Agriculture plant physiologist and Bureau of Reclamation chemists working together here in the Denver laboratory discovered the effectiveness of the material now most widely used for controlling submersed waterweeds. This is known as aromatic solvent and from a very small beginning its use, in the 17 states where Federal reclamation projects are located, increased to over 300,000 gallons in 1956. It is estimated that 365,000 gallons will be used in 1957 and by 1960 over 460,000 gallons of aromatic solvents will be used.

"The material is applied under the water through nozzles at a rate, depending on conditions, from 5 to 10 gallons per cubic foot per second of water flow. More detailed information on this is found in USDA Circular No. 971, entitled 'The Use of Aromatic Solvents for Control of Submersed Aquatic Weeds in Irrigation Channels. '

"For many years the cattail problem was one of the most difficult to solve, but thanks to the new herbicide 2, 4-D and the persistence of Mr. F. L. Timmons of the Agricultural Research Service a method was developed which has proved quite effective. Each acre of plants is sprayed with a solution prepared by mixing 4 to 6 pounds of 2, 4-D as a low volatile ester with 200 gallons of water and 10 gallons of diesel oil plus 1 quart of emulsifier. The first application is made in the spring when the cattail heads are just starting to form. The regrowth should be sprayed again just before frost. One or two spot treatments may have to be made the following year to clean up the infestation. Every precaution should be taken to prevent the spray drifting to sensitive crops.

"Tests underway to determine the effects of some of the newer herbicides on cattails look promising and as time and funds permit other formulations will be tested and additional, much needed, research work will be initiated.

"A herbicide known as Dalapon appears to be as effective as 2, 4-D when used at the rate of 15 to 20 pounds per acre in 100 to 200 gallons of water containing 5 gallons of diesel oil and 1 pint of emulsifier.

"Amino triazole at 8 to 10 pounds per acre of cattail plants in 100 to 200 gallons of water and 5 gallons of diesel oil is almost as effective.

"Both of these herbicides are considerably more expensive than 2, 4-D but may be useful on canals near crops sensitive to 2, 4-D, especially cotton, grapes, and tomatoes. Also beans and sugar beets are more sensitive than some other crops.

"The amount of research for the control of land weeds and the number of workers in this field have increased many fold in the past few years. The combined efforts of Federal Agencies, State Colleges, and commercial firms have resulted in excellent progress toward solving land weed problems. It is only natural that these problems have received more attention because they are common to every state and locality.

"Less attention has been given to waterweed problems because they are limited to specific locations or areas. However, we have some encouraging news to report in this regard. The cooperative research program which was discontinued for a while due to lack of funds has been renewed recently between the Agricultural Research Service of the Department of Agriculture and the Bureau of Reclamation. The new accelerated program promises to result in the development of more effective and economical methods of aquatic weed control. The research team consists of two Department of Agriculture Plant Physiologists and two Bureau of Reclamation Chemists.

"In addition to the laboratory work here in Denver the Agricultural Research Service has four field stations which do some field testing in aquatic weed control. The Agricultural Research Service is adding five new research specialists on aquatic weed control at field stations. Of these, two will be working on irrigation weed problems.

"Since less work has been done on developing better waterweed control methods and, therefore, there is less to report to you in this regard, we thought you would be interested in this brief resume of the problems involved and the research which has been conducted. Real progress in solving a problem is made only when the people like yourselves, who are vitally interested and affected by that problem, realize its full magnitude and the need for further study and research.

"Organizations like yours can do much toward a more complete mastery of the waterweed problem by your understanding of its importance, your backing of the research program, your encouragement of the research workers and through advising the Denver office on the problems which still need to be solved."

* * * * *

DITCHER HITCH

The Roza Division of the Yakima Project has developed the wire rope hitch shown in the photograph below. The hitch was developed to prevent the front wheels of the ditcher from flipping up on end when the going gets rough.

The Briscoe ditcher is pulled with a tractor on each bank. One of the hooks shown in the foreground is attached to each tractor. The rope from each hook passes through guides on the front axle and is fastened to the front end of the plow. In addition to controlling the position of the front wheels, the hitch takes the pull strain off the machineframe and applies it directly to the plow.

* * * * *

GATE HOIST WIRE ROPE PERFORMANCE

Recently the Bureau of Reclamation made a study of the performance of various types of wire rope used on gate hoists in an effort to determine the types giving best service under different conditions. From data supplied and comments received the matter of serviceability of wire rope is a very real problem on most operating projects. Frequent inspection of the cable by dam tenders, ditchriders, or other operating officials should be emphasized.

A study of the information provided leads to the conclusion that with the vastly differing conditions of exposure to which gate hoist ropes are subjected, the exposure conditions should be considered carefully when we choose wire rope to serve in a specific location. On some projects where the water is not corrosive, plain steel ropes have given very good service, although most agree that the service life is improved if protective coatings are maintained on the ropes. In certain areas, also, galvanized wire ropes are favored and have given up to 28 years of service on the Yakima Project, Washington, and 26 years of service on the Sun River Project, Montana, with the rope still in good condition. The water on these projects is not corrosive.

In other places where the water is corrosive, stainless steel seems to be the only satisfactory type of rope to use. The information provided shows that under severe conditions the additional cost of the stainless steel rope is fully justified. The Imperial Irrigation District in California, served by the All-American Canal with water from the Colorado River, reports that stainless steel ropes show no signs of deterioration after 10 years. The Gila Project, which also receives its water supply from the Colorado River, reports that some of the plain steel ropes originally installed on the project did not last six months. Of the several projects reporting use of stainless steel ropes, only one stated that trouble had been experienced due to galling or seizing of the wires making up the rope.

By way of preventing corrosion of ropes by the water, some projects as shown on the cover of this issue of the Bulletin use link chains or suspender rods for the submerged portions of the hoist lines. The chains or rods are connected to the ropes above the water's surface.

A majority of the projects reported that some type of protective coating was used to retard corrosion of wire ropes, and that the use of these coatings is worthwhile, although opinion in this regard was not unanimous. Two projects made favorable mention of plastic coated ropes which have recently become available. Only the submerged portion of the rope was coated and, since the coating is relatively soft, it would probably be damaged if it was wound up on the average hoist drum. The protective coatings used are: NO-OX-ID, CA-50, Texaco Crater LePro, Tnemec and Ensign 383 compounds, water pump grease and coal tar and red lead paints. Cleaning of the rope and soaking it in diesel oil was also recommended by one project.

Most of the operating projects agreed in comparing flexible versus stiff rope that the stiffer rope last longer. The opinions in this regard were not unanimous, however, and some qualifications should be stated. Where corrosion is the principal factor limiting the life of a rope, the stiff rope (6x19) with larger individual wires, will loose metal through corrosion at a slower rate than the more flexible (6x37) ropes. However, where corrosion is not the predominant factor and the rope will be subject to frequent bending and flexing, the 6x37 rope may give better results. The size of the rope compared to the drum and sheave sizes should also be considered along with the corrosion condition and frequency of operations when choosing between the stiffer (6x19) and more flexible (6x37) ropes.

While the information obtained did not indicate that there is one outstanding kind of rope that should be used under all conditions, it does show that there are varying degrees of exposure to be considered in selecting the type of rope to be used. Under non-corrosive water, it would be hard to economically justify the use of stainless steel rope; while in strongly corrosive water, stainless steel is the most economical. The widespread use of galvanized ropes, and their successful performance under the right conditions was quite interesting to note.

For information purposes, an abstract of questionnaires received from the projects in the 17 Western States is given in the tables on the following pages, as a guide to wire rope users. Also a study on the Central Valley Project, California, of various types of ropes and rope protective materials is appended to the abstract.

One project reported an experience in socketing ropes with lead instead of zinc, which is the preferred material. It was reported that the lead set up a galvanic action which caused rapid deterioration of the rope since the lead was less active chemically than the steel. With the zinc, this action is reversed and the steel is protected. There have been reports of several instances of ropes failing or pulling from their sockets when lead was used for socketing. This electrolytic action was called to the attention of readers in a recent issue of the Bulletin, but it cannot be emphasized too strongly, therefore, that only clean zinc should be used for this purpose and the various steps in the socketing process should be carried out in accordance with the instructions given in any reliable wire rope handbook. These handbooks can be obtained from any of the leading wire rope manufacturers. In addition to instructions for proper socketing, the handbooks contain a great deal of information of value to individuals working with wire rope. One such suggestion from one manufacturer concerns the best method of storing wire rope outdoors. It is reprinted here for your information.

In Wire Rope Talks, Robert M Kilian, Chief Engineer of Leschen Wire Rope Division, H. K. Porter Company, Inc., presents practical hints on the use and care of wire rope. In discussing the subject of storing wire rope outdoors, it is pointed out that when equipment is to be left outdoors in an unused condition, especially during the winter months, the wire rope being unused should be carefully protected. Several months of inclement weather can corrode wire rope so badly that it suffers a very large reduction

in breaking strength, and thus is of little use when it is put back into service again. Rust also tends to bind the wires together so they are not free to move back and forth and adjust themselves to operation around sheaves under a load.

Wire rope that has been removed from service and is to be stored for future use should first be cleaned thoroughly by means of a wire brush, compressed air, or superheated steam. It should then be well lubricated, first with a penetrating lubricant that will coat all the wires of all the strands, internally as well as externally, and then with an external protector that seals in the other lubricant and repels the penetration of moisture and fumes. The rope should then be wound on a reel and not coiled loosely on the floor or on the ground.

If the rope to be stored is new and on its original shipping reel it is a good idea to cover the outer layer of rope on the reel with heavy protective lubricant. A generous application will tend to protect the entire length.

Following this treatment it is advisable to cover the rope on the reel with waterproof or tar paper, sealed at the flange with protective lubricant. If a number of reels are to be stored at one concentrated spot it is an excellent idea to cover the entire group with a tarpaulin.

The storage area selected should be as clean and dry and as well protected from the weather as possible. It should be free from acid fumes and other corrosive agents because such fumes can cause embrittlement of the surface of the wires. Reels should not rest directly on the ground; they should be placed on wood or metal supports.

When the wire rope is put back into service any excess lubricant can be wiped off with some waste as the equipment is run very slowly. It is much better to wipe the rope than to clean it with a solvent, because the solvent would have a tendency to work into the rope and leach out the internal lubrication. It is true that the lubricant will pick up some dirt, but this will cause far less damage than would the solvent.

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Bureau of Reclamation
Division of Irrigation Operations
Denver, Colorado
October 5, 1956

ABSTRACT OF WIRE ROPE PERFORMANCE QUESTIONNAIRES

Region	Project	No. of gates using wire rope	Kind of rope being used	Other kinds which have been used	Kind that gave best service	Such rope will last about how long?	Is your project water corrosive?	What failures other than from corrosion?	Protective coatings used	Was service life increased by coatings?	Do stiff, or flexible, ropes last longer?	Have your stainless ropes galled or seized in service?	Compare galvanized rope service with plain steel rope service	Remarks
1	Boise Project, Payette Division	14	6 x 19, plow steel, wire rope center	None		Some ropes in service since construction in 1940	No	None	None		Do not think Tiller (flexible) rope should be used	Have not used stainless steel rope		Some rope gets painted along with the gate and we try to give all rope annual inspection. We are installing safety pins (stops) on radial gates where breakage or shooting of ropes would cause gate closure and subsequent canal break.
	Cascade Project Boise Payette Division	2	Galvanized, wire rope center	None	Experience with galvanized only	Not known	Yes	None	NO-OX-ID	Yes, 3 or 4 times	No test	No experience with stainless steel ropes	See remarks	Galvanized will last at least three times as long as plow steel cable under the same conditions. Experience is based on 27 years at Owyhee Dam and 2 years at Cascade Dam.
	North Unit, Deschutes Project	7	6-plow steel round 1-3" x 3/8" galv. flat woven	None	No noticeable difference	Not over 5 years to be safe	No	None	Yes	Very difficult to judge	No test		Very little improvement if any	To date there seems to be no type of cable that will remain rust free for a very long period of being submerged in water.
	Frenchtown Project	1	Plow steel	Numerous			No	See remarks	None				No better	The rope passed over an angle iron and would rust out at that spot. The lower portion of the rope was replaced with 5/8-inch chain which keeps the rope almost entirely out of the water and the chain is short enough so it does not wrap on the reel. We have had no trouble in the last 3 years which was about the life of a rope.
	Minidoka Project: American Falls Res. District No. 2	8	3/4" galvanized 6 x 19 straight lay	Plow steel	Galvanized		No	None	None		No test			Galvanized rope lasts about three times longer than steel rope.
	Minidoka Project: American Falls Division	15	Imp. plow steel galvanized 1 3/4" 6 x 37 hemp center	None		20 years estimated	No	None	Yes	Doubtful when corrosion resistant rope is used	No test		See remarks	Would not consider using any but corrosion resistant (galvanized) rope. Ropes are inspected every year and gates are operated several times during year for regulation and maintenance examination. Ropes were installed new in December 1942 and are sound.
	Minidoka Project: Jackson Lake Reservoir	20	Imp. plow steel galvanized 5/8" 6 x 37 hemp center round	Same cable excepting not galvanized	Galvanized	20 years estimated	No	None	Yes	Not when non-corrosive ropes were used	No test		About 3 times more life in service	Gates are operated during spill season and inspected once each year. Ropes were changed March 1941 and are sound as of October 1955.
	Minidoka Project: Minidoka Dam	5	Imp. plow steel, bronzed, 5/8" 6 x 19 hemp center round	None during past 15 years	Imp. plow steel galvanized 6 x 19	20 years estimated	No	None in last 15 years	Yes	See remarks	Excellent service with both		See remarks	Doubt that protective coatings pay when corrosion resistant ropes are used. Galvanizing is worth more than the difference in original cost by several times. Gates are operated during the flood and irrigation season and rope observed several times during each year and examined annually.
	Owyhee Project, North Board of Control	6	Plow steel 6 x 19 IWRC round	Same, galvanized	About the same	5 years, replaced regardless	Yes	None	Yes	Looks better			Galvanized no better	Wire ropes are replaced every 5 years regardless of condition as cost is small compared to trouble if failure occurred in the middle of the irrigation season. Wire rope is coated with CTP-3 each spring when the gates are painted.
	Twin Falls Canal Company	41	Generally 6 x 19	Drilling cable and galvanized	Not much difference	10 to 14 years	Yes	None	None		No preference		Galvanized lasts some longer	
	Yakima Project, Kittitas Division	17	Galvanized, hemp center	None		Ours have lasted 25 years	No	Recently 2 strands of cable broke	None		No test	No experience	That is all we have used.	I consider service of our galvanized ropes to be excellent. Breaking of cable caused by gate binding on one side causing excessive strain. Only galvanized rope has been used.
	Yakima Project, Roza Division	13	Galvanized flat woven and round plow steel with hemp and wire rope centers	None	Round plow steel where drum is designed for round rope	Possibly 7 or 8 years	Very little	None	Annual painting	See remarks	Believe flexible better	No experience	See remarks	Round cable possibly resists corrosion better than flat but cannot replace flat cable installation without changing drum. If painted every year life is probably doubled.
	Yakima Project, Lake Kachess	1	Flat galvanized	None		Been in use 23 years, still in good shape	Some	None	None		Prefer flexible	No experience	Only galvanized flat braided used	
	Yakima Project, Lake Cle Elum	5	3/8" x 5" flat woven	None		In use since 1933 and has given no trouble	No		None					These cables have given very satisfactory service.
	Yakima Project, Lake Easton	2	5/8" round, galvanized with hemp center	None	But one kind used	In use since 1928	No	None	Coated with red lead	Do not know	No test	No experience	See remarks	Only galvanized cable used, no basis for comparison. The rope in use was installed when the dam was built. At last inspection in 1956 it was still in fair condition.

Bureau of Reclamation
Division of Irrigation Operations
Denver, Colorado
October 5, 1956

ABSTRACT OF WIRE ROPE PERFORMANCE QUESTIONNAIRES (Continued)

Region	Project	No. of gates using wire rope	Kind of rope being used	Other kinds which have been used	Kind that gave best service	Such rope will last about how long?	Is your project water corrosive?	What failures other than from corrosion?	Protective coatings used	Was service life increased by coatings?	Do stiff, or flexible, ropes last longer?	Have your stainless ropes galled or seized in service?	Compare galvanized rope service with plain steel rope service	Remarks
2	Central Valley Project, Friant Unit	18	6 x 19 and 6 x 37, plow steel, hemp center also galvanized	None	Hard to say. Believe 6 x 19 Imp. plow steel galvanized best	Treated with NO-OX-ID it should last 8 to 10 years	No	None	Coating of NO-OX-ID cable dressing maintained continuously	Believed to increase life at least 1/4 to 1/3	Believe stiffer ropes last longer	None used	See remarks	Treated cable and galvanized treated, as far as we know, last a longer comparable time. The point of corrosion or failure has been at socket where point of flexing is rigid. We believe cables should be inspected annually and treated as needed. The frequency of changing depends upon accessibility for inspection and upon strategic location or seriousness of results should one break.
	Central Valley Project, Orange Cove Unit	21 gates (62 ropes)	6 x 37 plow steel, hemp center, round, galvanized on one structure	None	Galvanized looks best	Over 2 years but don't know	No	None	CA-50 and Lepro compound	Think so but have no comparison	6 x 37 used, no other for comparison	None used	See remarks	Galvanized ropes have been in use only two seasons and cannot be compared with plow steel which lasted four seasons. Many of the plow steel ropes used on top seal gates and are not submerged do not show corrosion, wear, or rust after six seasons. All plow steel rope that is intermittently submerged shows rust after two or three seasons.
	Central Valley Project, Lindsay Unit	21	6 x 19 and 6 x 37 plow steel galvanized	6 x 37 plow steel hemp core, not galvanized	Galvanized has been in service only two seasons	Do not know yet	No	None	Crater Compound No. 50	Cannot tell yet but estimate 50 percent more	Not enough experience to judge	None used	Not enough experience for comparison	The original installations of wire ropes on the concerned structures were made in 1950. Four years later one rope failed due, it was thought, to weakening by acid used in socketing. A year later all of the original ropes which were 6 x 19 plow steel, ungalvanized, were replaced with 6 x 19 or 6 x 37 galvanized plow steel ropes, except on two structures where the original ropes are still in service.
	Central Valley Project, Delano Unit	16	6 x 37 plow steel, hemp center and 6 x 19 galvanized	None, see remarks	Too early to tell	Do not know yet	No	None	Crater Compound No. 2, Rustoleum and Tnemec	Yes, 50 percent more estimated	No stiff rope used before this year	None used	Not enough experience for comparison	We are of the opinion that socketing hastens corrosive action, as its appearance shows first at this location and is much heavier. Replacements this year of plow steel ropes were made with 6 x 19 galvanized rope.
	Central Valley Project, Tracy Divisi	74	6 x 37 Imp. plow steel 3/4" to 1-3/4" dia. also stainless (see remarks)	See remarks	Looks like stainless steel but still in experimental stage	Do not know yet	Yes, extremely corrosive	Yes, failure at the socket, probably improper socketing	LePro wire rope dressing and Ensign 383 dressing	Very little if any	Have not tried any stiff ropes as yet	Stainless used only short time. No such trouble	See remarks	We plan on experimenting with a galvanized 1/2" 6 x 37 cable coated with Pacoat (similar to a plastic coating) and a galvanized cable same size and type but uncoated or untreated. The Cross Channel gate cables are under water of a much better quality than the Delta-Mendota Canal, therefore seem to be holding up much better.
	American River Project, Nimbus Dam	18	1-1/4" 6 x 19 plow steel	None		New installation	No	None	Texaco Crater compound heavily applied, hot	This is a new installation	No experience	None used	No galvanized rope used	This is a new job and has had no sustained experience with wire rope.
	Klamath Project, Tule Lake Division	25	Plow steel 6 x 19 IWRC also 6 x 19 hemp center has been used	Tiller rope, 1/2" dia. has been experimented with	6 x 19 IWRC	Without treatment, 1 to 2 years	Very much so	None of record	Some ropes treated with CA-50, some removed and treated with diesel oil	Yes, up to 5 times life of untreated rope	No	None used	No galvanized rope used	Water is very corrosive. Ropes are switched end for end after 1 year's service to make them serve 2 years. Untreated ropes are soon destroyed by corrosion. Spraying the rope with liquid plastic was tried one year, this did some good. Another method tried was removing ropes at the end of the season and submerging them in diesel oil. This method has been quite successful as ropes so treated have been in service 5 years and show very little deterioration. Recently ropes have been treated with CA-50 but it is too early to judge the performance. We prefer IWRC (independent wire rope core) ropes since the hemp center may be damaged when being leaded into sockets thus removing the center support from the outside strands and weakening the socket connection.
3	Yuma Project, Valley Division	7	Plow steel and galvanized	None	Galvanized	2 or 3 years	Yes	None	We have used crater compound	See remarks	The flexible ropes seem to last longer		See remarks	The service life of the rope was doubled or more depending on how often it could be dried out and treated. Without treating either, the galvanized lasts about twice as long as the ungalvanized rope.
	Gila Project, Wellton-Mohawk and Yuma Mesa Divisions, and Yuma Project, Reservation Division	75	Stainless steel 6 x 19	6 x 37 hemp center and wire rope center, also some flat cable	6 x 19 stainless steel	We have never replaced one	Yes, very	None	None used		The stiffer ropes last longer	No	We have never used galvanized rope	Most of the radial gate type structures built on this project used 6 x 37 wire rope with the cables fastened into the sockets with lead. These two metals set up a galvanic action that erodes the fine wires of the 6 x 37 cable. For the last 4 years the maintenance division has been replacing broken cables with stainless steel 6 x 19 wire rope and socketing the cable ends with zinc which reverses the galvanic action and prolongs the life of the cable. All of the steel cables that have been replaced in this manner are still in use. Some of the 6 x 37 cable that was installed new in the Wellton-Mohawk Division of the Gila Project did not last 6 months.

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Division of Irrigation Operations
Denver, Colorado
October 5, 1956

ABSTRACT OF WIRE ROPE PERFORMANCE QUESTIONNAIRES (Continued)

Region	Project	No. of gates using wire rope	Kind of rope being used	Other kinds which have been used	Kind that gave best service	Such rope will last about how long?	Is your project water corrosive?	What failures other than from corrosion?	Protective coatings used	Was service life increased by coatings?	Do stiff, or flexible ropes last longer?	Have your stainless ropes galled or seized in service?	Compare galvanized rope service with plain steel rope service	Remarks
	All-American Canal Project, Coachella Division	35	Round plow steel with plastic cover and wire rope center. Stainless round with wire rope center and stainless flat	Plow steel flat and round	Stainless. The round plow steel with plastic cover has been in use only a few months	Stainless has been in use for 6 years. Plow steel lasted 3 years	Yes. Ph=8 but it is well aerated and somewhat salty	None	Only the plastic cover	In use only a short time	No test	Stainless steel ropes do rust but at a slower rate. Galling or seizing has not given trouble	None used	
	Imperial Irrigation District	182	Stainless steel 6 x 19 and 6 x 37 wire rope center, flat and round as required	Galvanized and plow steel	Stainless steel	Unknown, cable in service over 10 years	Yes, Colorado River water	None	Yes	No	Stiffer ropes last longer	No troubles have occurred with stainless steel ropes used	Galvanized rope fails in 3 to 5 years when submerged	Stainless steel rope has proven most satisfactory for use in this area. It shows no signs of deteriorating after 10 years of service.
	Salt River Project	46	3/8" hemp center (Wickwire)			2 years average	Yes	Breaking at flexure point, about 2 feet above the bottom	None					We are now placing a 3-foot to 4-foot piece of chain from the bottom of gate to end of cable. No accurate information is available since it has been a normal operational service to replace worn cables. We will, in the future, maintain a service record.
5	W. C. Austin Project except Altus Dam	3	6 x 19 hemp center	Stainless steel rope at heading of West Canal	6 x 19 hemp center	2 to 4 years without protection	Yes	None	None			Yes		Cables at the West Canal heading were changed in 1948, 1950, and 1954. Cables originally installed in 1946. Stainless steel rope was used from 1948 to 1950. The other installations were 6 x 19 hemp center. Cables at the wasteway just below Altus Dam were changed in 1949, 1952, and 1954. Stainless steel rope has not been used at the wasteway.
	W. C. Austin Project, Altus Dam	9	6 x 37 hemp center	Stainless steel	6 x 37 hemp center	About 10 years with proper protection	Yes	None	Yes, see remarks	Yes, twice as long life as without protection	No test	See remarks		New cables were put on gates in 1951. The cables of eight of the nine gates were protected by covering the part below the water line with air hose and filling the space between cable and hose with Texas Company Crater No. 2 grease. The cables now in use have not been submerged much due to low water surface of the past few years. Stainless steel ropes were tried. They had no longer life than the 6 x 37 hemp center. There was some galling and seizing.
	Fort Sumner Project	2	6 x 37 improved plow steel, fibre core, uncoated	None		Ropes lasted less than two irrigation seasons below water line. See remarks	Yes	None	None					Chains attached to ropes and used below water line. Original ropes installed in spring of 1951 used above water line and are still in good condition. Chains do not wind on hoisting drums. Chains have not deteriorated materially.
	Tucumcari Project	11	6 x 19 improved plow steel, hemp center	None		3 to 5 years	Yes	None	CA-50 Compound	Not a great deal but some, 1 to 2 years				That part of rope exposed to water corrodes and breaks. Rope does not roll evenly on hoist drum, throwing more weight on one cable. We have installed 3/8-inch BB chain on bottom of all gates to keep as much cable out of water as possible. Chain was installed on some gates before 1955 irrigation season, coated with CA-50, and no damage due to corrosion is evident at present time.
	Rio Grande Project, Las Cruces Division	40	6 x 37 lang lay, plow steel, hemp center	Small amount of galvanized and plow steel with wire centers	Plow steel lang lay	10 to 30 years	Yes	None	Coal tar paints Only	Probably not	Stiff ropes may last longer in some instances if they are not run over small pulleys	None used	Galvanized no better than plain	The smaller wire rope with hemp center is more flexible and satisfactory with smaller pulleys. Turnbuckles with "shanks" or a 1-inch by 1-inch bar is recommended from bottom of gates to above the water with eyes for attaching the cable above water, thus eliminating the use of cable below water.
	Rio Grande Project, Ysleta Branch Division	39	6 x 19 right lay, plow steel, hemp center and stainless steel	6 x 37 galvanized tried for 1 year without success	Stainless and plow steel	2 to 3 years depending on submergence	Yes	None	None		Stiffer ropes last longer	No	1 year only compared to 2 years for plow steel	Our stainless steel rope has been in use only 2 years but shows no wear or rust. It looks better now than anything we have ever used. The service life of ropes depends upon their location. Some cables are submerged more than others. Our 6 x 37 galvanized rope lasted only 1 year but galvanizing no doubt caused the failure and not size of wires in rope.

Bureau of Reclamation
Division of Irrigation Operations
Denver, Colorado
October 5, 1956

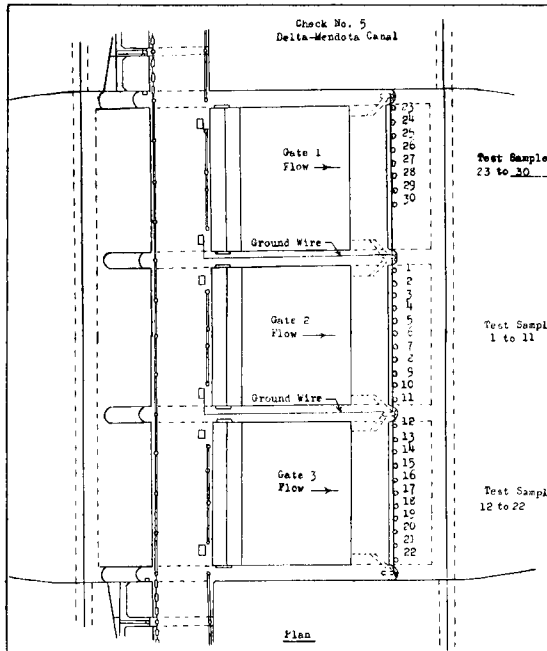
ABSTRACT OF WIRE ROPE PERFORMANCE QUESTIONNAIRES (Continued)

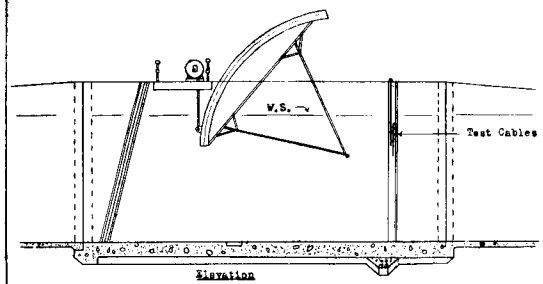
Region	Project	No. of gates using wire rope	Kind of rope being used	Other kinds which have been used	Kind that gave best service	Such rope will last about how long?	Is your project water corrosive?	What failures other than from corrosion?	Protective coatings used	Was service life increased by coatings?	Do stiff, or flexible ropes last longer?	Have your stainless ropes galled or seized in service?	Compare galvanized rope service with plain steel rope service	Remarks
	International Boundary and Water Commission, American Dam		5/8" hemp center 6 x 19 right lay			1-1/2 years when exposed to the water		None reported	See remarks	Yes				Steel chains have been placed on the lower end of the hoist lines to keep the ropes out of the water but the chains scrape the paint off of the gate faces. Early in 1953 an experimental installation was made of plastic covered wire rope furnished by Pacific Wire Rope Company. After 3 years of service it still looks like new. The plastic is not wound onto the drum.
6	Missouri River Basin Project Angostura Unit	9	6 x 37 plow steel	None		Unknown	No	None	A rust preventive was used on all ropes	Yes, these ropes have been in service 6 years	Don't know	None used	No galvanized rope used	Angostura Dam has been in service only 6 years and to date we have had very little experience with wire rope corrosion.
	Riverton Project Third Division	11	Plow steel	None		Average 4 years	No	None	None		Only flexible ropes have been used	None used	No galvanized rope used	Rope on three radial gates at Fivemile Siphon appear to be stainless steel (may be galvanized). They were installed when structure was constructed in 1948 and are in excellent condition.
	Sun River Project, Greenfields Division	3	Round, 6 x 19 wire rope center, galvanized	None	Galvanized ropes are very satisfactory	This has been in service 26 years. Still good	No	Failed at clevis by flexing from vibration	Rust preventive compounds have been used	Don't think so	No test	None used	Galvanized rope is the best used	
	Shoshone Project Heart Mountain Division	10	Imp. plow steel 6 x 37 rust resistant	Unknown	Undetermined at this time	At least 3 to 5 years	No	None	Rust preventive compounds	Probably doubled	No test	No stainless rope used	No galvanized rope used	Considering using stainless rope on Shoshone Siphon where rope is subject to being wet and dry as well as being buried in sealing dirt during winter. The life of usual wire rope on this gate is short.
7	Colorado-Big Thompson Project	23	Stainless steel of various stranding, dependent on the size of the hoisting drum	Original installation was plow steel with hemp or steel cores. See remarks	Stainless steel	Used only one year to date but are in perfect condition	No, but several of the originally installed plow steel ropes failed by corrosion	None	Various kinds of rust-preventive compounds and waterproof greases	Yes, where plow steel ropes are used. Coatings not need on stainless. Life doubled at least on plow steel	Stiff ropes last longer	No	None used	Stainless steel ropes have been in service only 1 year but they show no signs of corrosion or other weaknesses. Many years of satisfactory service are therefore anticipated. Two gates on the system are operated and maintained by the water users and plow steel cables are still being used. These will have to be replaced in the next 4 or 5 years regardless of the amount of rust-preventive compounds used. The originally installed plow steel ropes showed considerable corrosion after 5 years of use and several broke about 8 years after installation. Replacements were made with stainless steel ropes.
	Kansas River Project, Bostwick Division	24	6 x 19 improved plow steel, wire rope center	None, the project is new					Yes	Appear to help	No test			The project is new. The oldest structures are less than 5 years old. Hence, the cables have not had to be replaced nor have the cables shown excessive corrosion. The cables have been coated with rust-preventive compounds.
	Kansas River Project, Frenchman-Cambridge Division		Plow steel, galvanized, wire rope center	None	Galvanized	5 years on the Meeker Canal	No	Pulled them in two	CA-50 compound	Yes, about 2 years longer than those not treated	No preference	None used	See remarks	The size of gates, how much they silt in, the weight of the lift required, must all be considered in the life of wire rope. Heavy strains and corrosion tend to break wire rope. The galvanized rope on the Meeker Canal has lasted approximately 3 years longer than plow steel rope but they are smaller gates.
	Mirage Flats Project	4	Steel rope originally installed	None	This steel satisfactory	Has been in service about 10 years without deterioration		None	See remarks	Yes, don't know how much				The steel rope originally installed on the gates is still in use. Each fall for the last 5 years (known record) all corrosion was cleaned off and a coat of water pump grease applied which seals the water out. This has been very satisfactory as no deterioration is noted.
	Sutherland Project, Platte Valley P.P. and I.D.	31	6 x 19 and 6 x 37 plow steel galvanized, hemp center; Also 6 x 19 stainless hemp center	None	Stainless steel	Indefinitely	Mildly alkaline	None	None		Stiffer ropes last longer	See remarks	See remarks	Galvanized wire rope gives only a relatively short increase in life, 3 or 4 years, over bare rope in our water. Therefore we have gone to stainless steel but have had only about 5 years' experience with it. We have had no trouble with galling or seizing of stainless rope.
	Central Nebraska P.P and I.D., Gothenburg and Holdredge Divisions	36	6 x 19 plow steel, 6 x 37 galvanized steel, hemp center, 6 x 19 plow steel wire rope center	None	We hope the galvanized		To some exent	None	Most ropes are factory coated		Flex ropes are better	Have not used any stainless	See remarks	Have not used galvanized rope long enough to make comparison. Most of our rope breakage is caused from excessive wear due to ice conditions and contact with some portion of the gate structure itself.
	Kendrick Project	6	Wire rope 6 x 19 1/2" dia. regular lay; fibre core	3/8" dia. wire rope with hemp center	Stainless steel	30 years or more	Yes	None	CA-50 and asphalt	Yes, 3 years	Stiffer ropes last longer	No	Better service	Recommend purchase of stainless steel ropes for radial gates. The Kendrick Project is replacing all of the 3/8-inch cable as failure occurs with 6 x 19, 1/2-inch dia. regular lay, galvanized with fibre core. Federal Specification RR-R-571a Type XVIII (Paragraphs E-12g and E-15).
	North Platte-Gering-Fort Laramie Division	1	7/16" hemp center	None		Changed every 2 years	Yes	None	None					Since there was only one gate it was found that changing cable every other year is the easiest method of keeping the gate in working condition.

Bureau of Reclamation
Division of Irrigation Operations
Denver, Colorado
October 31, 1956

ABSTRACT OF WIRE ROPE PERFORMANCE QUESTIONNAIRES (Supplement to Abstract dated October 5, 1956)

Region	Project	No. of gates using wire rope	Kind of rope being used	Other kinds which have been used	Kind that gave best service	Such rope will last about how long?	Is your project water corrosive?	What failures other than from corrosion?	Protective coatings used	Was service life increased by coatings?	Do stiff, or flexible, ropes last longer?	Have your stainless ropes galled or seized in service?	Compare galvinized rope service with plain steel rope service	Remarks
4	Provo River Deer Creek Dam	2	Galvanized flat rope with solid steel bar on lower end	5/16"x3" galv. cast steel, flat rope, 4x7	Combination in service only 5 months	Galvanized rope lasted 14 years	Yes	None	Painted with red lead and aluminum paints	Not appreciably	Insufficient experience to know the facts	No stainless rope used	Only galvanized used	After the galvanized wire ropes had corroded and the two ropes on one spillway gate had broken about 5 feet above the bottom of the gate, all four ropes on the two gates were cut off at the level of the gate tops and connected to the bottom of the gate by 3/4"x1/2" solid steel straps. This allows raising the gates to their full opening but keeps the rope out of the water.
	Moon Lake	7	Galvanized 6x37, hemp center and stainless 6x19 wire rope center round	None	Stainless is recent replacement of galvanized	Galvanized rope lasted 12 years	No	Vandals raised the gate until the rope broke.	None		No facts	No	Have used only galvanized ropes except stainless for a short time	Galvanized has given satisfactory service.
	Eden	4	Imp. plow steel 6x19 round	None		About 3 seasons	Yes, resistivity 2,000 to 4,500 ohms	None	Painted with gates on original installation	No	Not known	No stainless used	No galvanized used	We are going to replace the ropes presently in use on two canal structures before next season as they are badly eroded. We propose to use galvanized rope of the same size.
	Truckee Storage	2	Plow steel, galvanized, flat	None	No comparison	Original ropes failed after 18 years	No	None	Yes	Yes		No	Galvanized rope far superior to other steel ropes	
	Newlands	3	Flat rope on Derby Dam gate, other gates have galvanized round rope.	None	No comparison	No data on round rope. See Remarks	Slightly	None	Yes, on new ropes	No adequate trial period	No experience	No	No experience on gates.	Ropes at Derby Dam are not under water at any time and are in good shape after 28 years of service. Believe that stiff ropes last longer. Log boom experience indicates that galvanized ropes last twice as long as plain steel.
	Humboldt	5	Plow steel, galvanized, round	None	No comparison	Changed after 15 years, fraying at socket	Yes	None	Not original ropes, replacements have been coated.	Yes, possibly 5 years	No experience	None used	Galvanized rope gives considerably more service	Replacement cables were installed according to the original specifications.
	Pine River	None, see Remarks	See Remarks				Very little		See Remarks	See Remarks				The flat galvanized cables have been coated with rust-preventive compound and have not been replaced since installation in 1941. These ropes are in excellent condition. The radial gates are operated by heavy sprocket-type chains and flat galvanized cables support the automatic gate control floats. The chains are well oiled and show no sign of wear or corrosion. All motors and other hoist equipment are protected from the elements and are in good operating condition.
	Newton	1	Galvanized, round	None	No information	No information	No	None	None		No information	No information	No data	Original ropes are installed on spillway gate hoist. Have served 10 years.
	Hyrum	3	3/4" round, plow steel, galvanized	None	No comparison		No	None	None	No data	No information	No information	No data	Original ropes installed on spillway gate hoists. Have served about 20 years.





DELTA-MENDOTA CANAL

WIRE ROPE CORROSION TESTS - EFFECT OF PROTECTIVE COATINGS

Condition on 12/14/54*	Sample No.	
		Support line covered with rust - Install left to right in Bay 2 Check 5
C	1	9/16" wire rope "ship towline" 6x24 extra heavy galvanized. Covered with rust at top end and near bindings, less at lower end probably wore off.
B	2	9/16" wire rope "ship towline" 6x24 extra heavy galvanized treated with "Lepro" Bureau dressing. Dressing gave some protection, rust near top.
E	3	9/16" wire rope "Salt Drilling Line" Treatolite lubricated. Covered with rust.
B	4	9/16" wire rope electrogalvanized 6x37 Improved Plow steel.
F	5	5/16" wire rope regular. Rusted at clip and broken off.
F	6	5/16" wire rope regular with "Lepro" Bureau dressing. Rusted at clip and broken off.
E	7	5/8" wire rope regular.
D	8	5/8" wire rope regular with "Lepro" Bureau dressing.
A	9	1/2" wire rope galvanized coated with clear Vinyl - ends sealed (3M Cement). (Not desirable since wire rope is 3/16" smaller in diameter)
A	10	1/2" wire rope galvanized coated with white Vinyl - ends sealed (3M Cement). (Not desirable since wire rope is 3/16" smaller in diameter)
D-	11	5/8" wire rope Bureau type 6x19 with Shell Madison Lubriplate 130 AA Bureau dressing. Covered with rust.
		Support line covered with rust and broken in center - Install left to right in Bay 3 Check 5
D-	12	3/4" wire rope 6x37 Preformed. Almost completely covered with rust.
D	13	3/4" wire rope 6x37 with "Lepro" Bureau dressing. Not completely covered with rust.
C+	14	1/2" wire rope 6x19 galvanized "Lepro" covered fibre core. Rust near clamp and clip.
B-	15	1/2" wire rope 6x19 galvanized with Shell Madison Lubriplate 130 AA Bureau dressing. Dressing probably wiped off.
C+	16	5/8" wire rope 6x19 galvanized improved plow steel fibre core.
Missing	17	5/8" wire rope 6x19 galvanized improved plow steel fibre core with "Lepro" Bureau dressing.
Missing	18	3/4" wire rope 6x19 galvanized improved plow steel fibre core.
B+	19	3/4" wire rope 6x19 galvanized improved plow steel fibre core with "Lepro" Bureau dressing. Slight rusting.
E-	20	9/16" 6x37 wire rope Bureau regular - clean of foreign materials (probably with solvent). Place one coat primer and one coat #930. Time between coats 15 minutes. Material furnished by Pitt Paint Company. Bottom portion has some coating.
F+	21	9/16" 6x37 wire rope Bureau regular - leave without cleaning and proceed as in #20. Center fair. Top has broken strands.
E	22	9/16" 6x37 wire rope Bureau regular - clean as in #20 then apply two coats of each. Less than 50% coating left. Strands broken top and bottom ends.
		Support line covered with rust - Install left to right in Bay 1 Check 5
2	23	3/4" wire rope 6x37 galvanized with "Lepro" Bureau dressing. Minor rust spots. Grease gone from outer surface.
2	24	3/4" wire rope 6x37 galvanized,as is. Galv. has turned black. Rust in numerous pinpoint spots.
1	25	1/2" wire rope 6x19 Stainless, with Shell Madison Lubriplate 130 AA Bureau dressing. Dressing only in bottom twists. Stainless Steel O.K.
1	26	1/2" wire rope 6x19 Stainless, as is. (Scratched in taking out of water.) O.K. but has a slight film.
1	27	1/2" wire rope Monel F. Preformed 6x19, with Shell Madison Lubriplate 130 AA Bureau dressing. O.K.
1	28	1/2" wire rope Monel F. Preformed 6x19, as is. O.K., but has a gray film.
3	29	9/16" wire rope 6x19 Lang Lay Wire Rope Core. Covered with rust. Some signs of deterioration. Hole in clip.
3	30	9/16" wire rope Bureau regular 6x37 with Shell Madison Lubriplate 130 AA Bureau dressing. Almost covered with rust.

Condition	
A or 1	No deterioration
B or 2	Slight rusting
C	Appreciable rusting
D or 3	Badly rusted
E	Almost completely covered with rust
F	Failure of rope

*Note: Tests discontinued 12/15/54.

Rev 12/15/54 FGJ
Redwg 11/18/54 FGJ

UNITED STATES
DEPARTMENT OF THE INTERIOR
BUREAU OF RECLAMATION

Sta. 835/00.00 - Mile Post 29.21
Test Samples of Wire Rope - Check 5 - Gates 1, 2 and 3 - August 6, 1954, Installed 1 to 22
October 1, 1954, Installed 23 to 30

Drawn FGJ Submitted
Traced Recommended
Checked TAF Approved

Sacramento, Calif. | Aug. 11, 1954 | 214-D08-D061