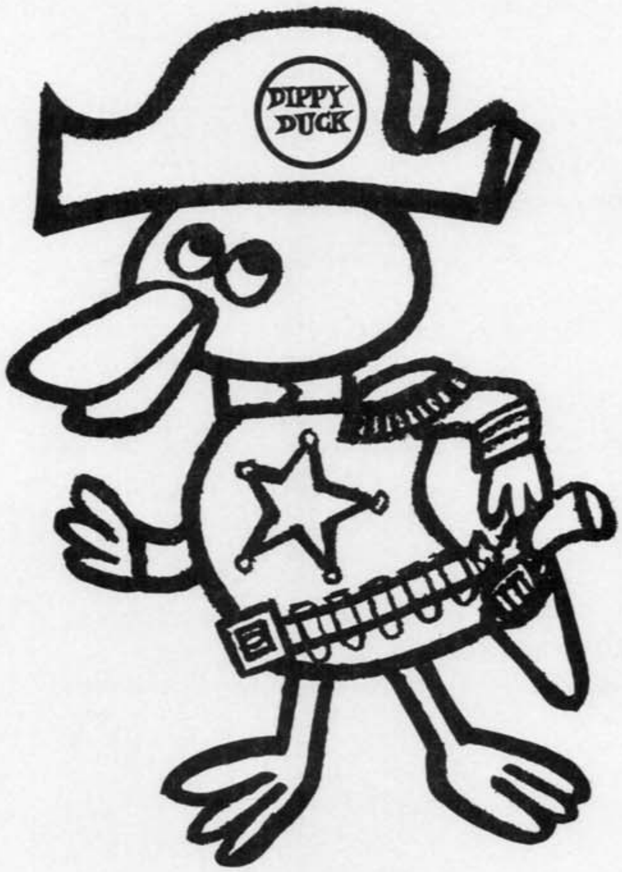
Department of the Interior, Bureau of Reclamation

IRRIGATION OPERATION AND MAINTENANCE

BULLETIN NO. 58

October, November, December 1966



In This Issue:

The Irrigation Operation and Maintenance bulletin is published quarterly, for the benefit of irrigation project people. Its principal purpose is to serve as a medium of exchanging operation and maintenance information. It is hoped that the reports herein concerning labor-saving devices and less costly equipment and procedures, developed by resourceful project people, will result in improved efficiency and reduced costs on the systems of those operators adapting these ideas to their needs.

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

We are in the process of reviewing our mailing list, in reference to this Bulletin. If the mailing card sent to you for this purpose has not been returned, please do so as soon as possible.

ON THE COVER:
Dippy Duck figure used by the Imperial Irrigation District, California, to promote their canal safety program for kindergarten and lower grade school children throughout the Imperial Valley.

IRRIGATION OPERATION AND MAINTENANCE
Bulletin No. 58

OCTOBER, NOVEMBER, AND DECEMBER 1966

INTRODUCTION

The first article in this issue of the Bulletin concerns a Canal Safety Program conceived and initiated last year by the Imperial Irrigation District, to carry a canal safety program to the kindergarten and lower grade school children throughout the Imperial Valley. The program has been so successful consideration is being given to strengthening and expanding it to cover all aspects of canal safety. Although this is the end of the irrigation season in many areas and the end of concentrated efforts toward water safety for this year, the ideas presented may help in planning for next year. A general description of the program starts on page 1.

Starting on page 6, is a description of a two- or three-stage water control device designed to maintain constant water levels within checks, reservoirs, over Parshall flumes or weirs or wherever a constant water level is required and is controlled by gages. Photographs and a sketch of the device are included.

Beginning on page 10 is an article written by Beata Gray giving the finer points for driving on ice and snow. Also, you will want to read the Thoughts on Management printed at the bottom of page 11.

A suggestion from Leroy F. Schaaf of the Rio Grande Project Office, for a fabricated tie-on moccasin, to eliminate the possibility of injury due to slipping while moving around in penstocks, can be found on page 12.

An article by R. J. Searle, Regional Safety Officer, Region 4, Salt Lake City, Utah, on fume poisoning from silver solder operations, can be found on pages 13 and 14. Also, recommended control procedures and precautions to prevent acute or chronic exposure to these fumes are given.

Recently published, revised, or new National Safety Council technical data sheets that are obtainable from the Council are listed on page 14.

Controlling the growth of vegetation in joints in concrete canal linings is a difficult maintenance problem on many projects. The way it is being done by the Fresno Field Division on the Central Valley Project in California, is described in an article beginning on page 15.

A device constructed for pulling posts that is being used by the National Park Service is described in a short article beginning on page 18.

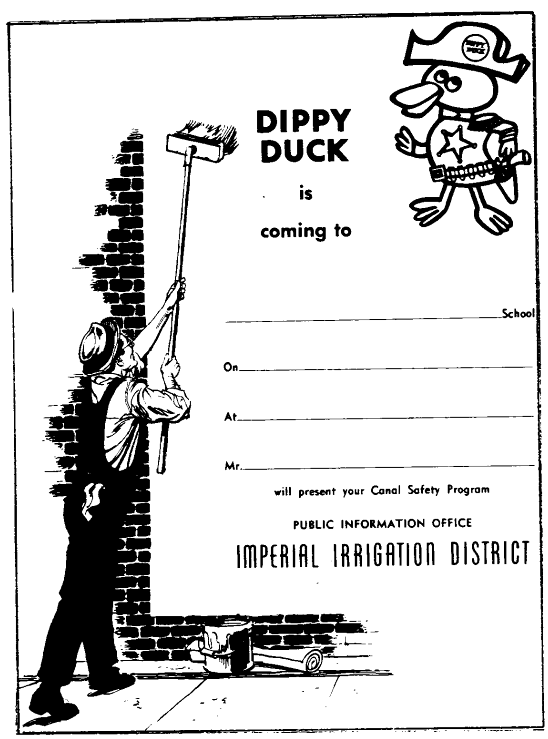
With automation becoming more popular on many irrigation systems, we are including some up-to-date information on the subject in the article prepared by Mr. P. R. Hanson, beginning on page 19. This article was prepared as a lecture for the 1966 Irrigation Operators' Workshop, in the Office of Chief Engineer, Denver, Colorado.

"DIPPY DUCK"--SAFETY PROGRAM

Water safety has again been emphasized this past summer, and at the quarterly meeting of the Imperial Dam Advisory Board in El Centro on June 20, 1966, public information officer William Stadler reported on Imperial Irrigation District's water safety program. This program was conceived and initiated in 1966. It carries the canal safety message to kindergarten and lower grade school children throughout the valley. The District believes it has been successful and is considering strengthening and expanding it to include all aspects of water safety.

A set of informational material is used in the campaign. The program is announced by the posting or the distribution of handbills, similar to that below, through the cooperation of school officials and others. An illustrated pamphlet designed to appeal to younger children also is distributed. The four pages of the pamphlet prepared for this past season are shown on the following pages. A 10-minute recorded message from Dippy Duck and a film strip accenting an oral message rounds out the program.

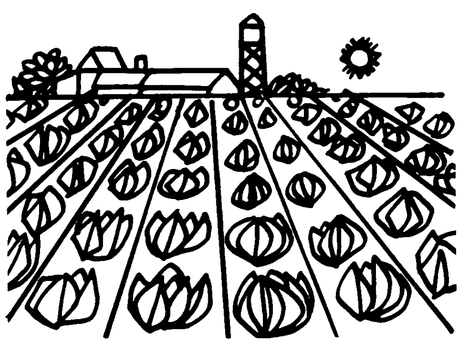
The Dippy Duck slogan has been cleared with the film industry in Hollywood and was reported as being the only remaining legally usable slogan involving a duck motif. The Imperial Irrigation District has no objection to others utilizing the motif and if additional information is desired in setting up a program of this kind, write the Regional Director, U.S. Bureau of Reclamation, Boulder City, Nevada.



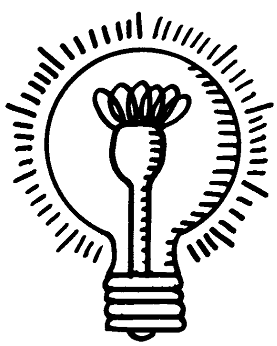
Don't go near the water in canals

(Stay out—Stay alive)

Water in Canals is . . . To Drink

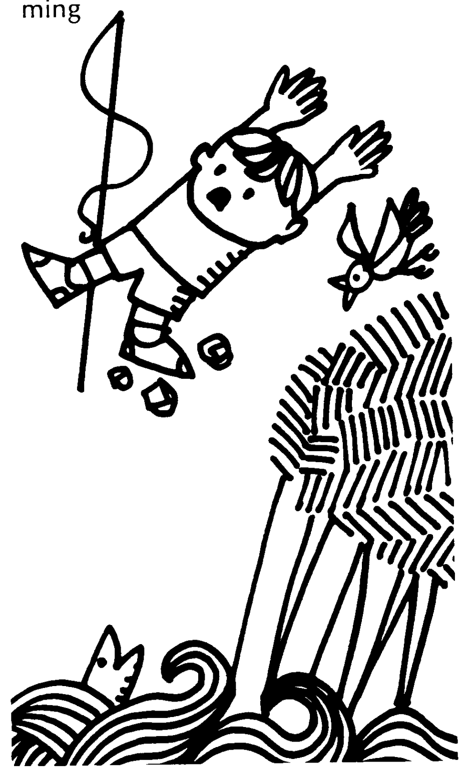


Water in Canals is . . . To Grow Crops



Water in Canals is . . . To Make Electricity

Water in Canals is . . . **Not** for Swimming



Water in Canals is . . . **Not** for Fishing or Playing

Canal banks may not hold you. Fast currents and mud or concrete bottoms make it hard to stand or walk.

IT IS STUPID, DANGEROUS AND AGAINST THE LAW TO SWIM OR PLAY NEAR CANALS

Tell your parents where you will be playing and *be there.*

Watch out for younger children near canals.

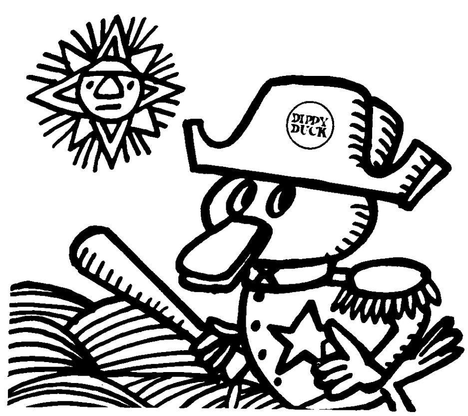
If you see children playing near canals, warn them then tell an adult. You may save Their lives.

Don't play games near a canal.

Don't walk on canal or ditch banks.

Don't play on bridges or gates where you could fall in the water.

Know how to swim and enjoy yourself in the nearest public pool, but never try to swim in a canal. It's dangerous and against the law.



IF SOMEONE FALLS IN A CANAL...KEEP CALM

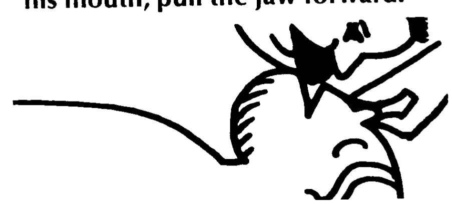
Don't jump in to help. ☛ Tell the person to...Swim with the current. Get close to the bank. Dig into the bank or hold on to the weeds. ☛ Try to find a stick, rope, wire, board to hold out to the person in the water. If you can't find one, use your belt, shirt or pants. ☛ Keep your own feet dry so you don't slip. Send someone for help but leave one person to help the one in the water. ☛ Try to stop passing cars or trucks by shouting or waving for help.

Remember, The Law Says You Can Be Punished by A Fine of Five Hundred Dollars ($500) and By Imprisonment For Six Months for Swimming In A Canal (Ordinance No. 269)

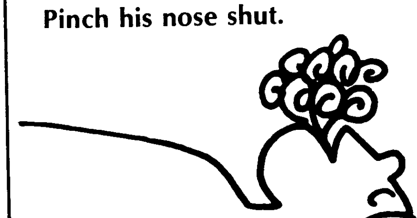
RESCUE BREATHING

Place the person on his back. Clear the throat. Tilt his head back.

Insert your thumb in the side of his mouth, pull the jaw forward.



Pinch his nose shut.



Take a deep breath and breathe it into his mouth until you see his chest rise, then let him exhale.

Keep breathing into his mouth until he starts to breathe by himself or until a doctor arrives.

IMPERIAL IRRIGATION DISTRICT

FLOAT-ACTUATED CAM CONTROLS AND CHANGES CANAL WATER LEVEL

The device described in this article for automatic control and the changing of the water level in canals was designed by William R. Turmon, of the Fresno Field Division, Fresno, California. This two- or three-stage control device is designed to maintain constant water levels within checks, reservoirs, over Parshall flumes or weirs or wherever a constant water level is required and is controlled by gates. All three stages are designed in parallel electrical circuits.

1. Microswitches, through float-activated cams.

2. Key transfer relays which select the operating stage according to the magnitude.

3. Direction of water-level change from check target.

The device is operationally different from the "Little Man" in that it allows three preset gate travel stages with respect to time. The interval times are "in-built" through the time clock drive motors. The pulse duration which energizes the gate hoist motor is adjustable, e.g., stage one produces a selected time pulse duration to the motor every 5 minutes.

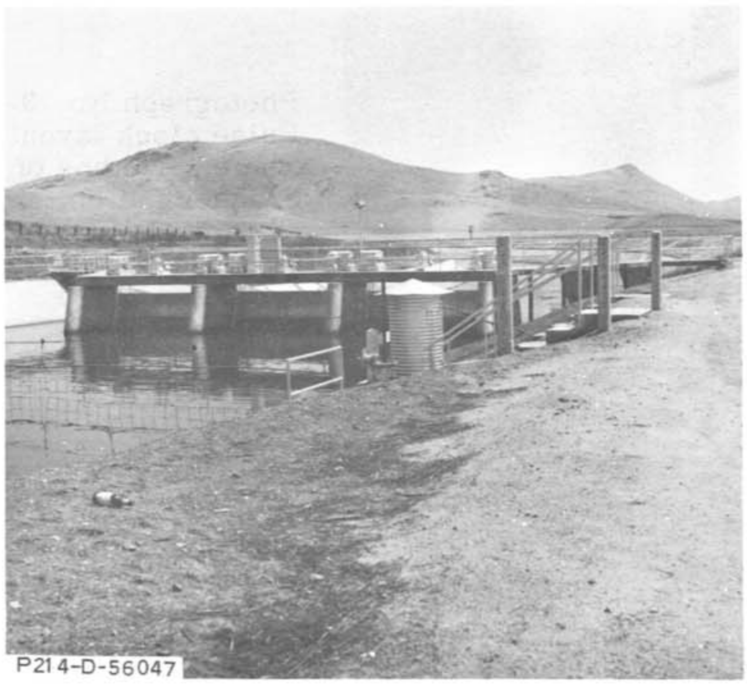
Photographs No. 1, 2, 3 and 4, are views of check and device as it is installed in one of the checks on the Friant Kern Canal. A sketch on page 9 presents more detail.

The float tape pulley and target drive motor are mounted directly to the main shaft. The floating cam shaft is locked to the main shaft through gearing from the motor pinion. This design arrangement allows a selected target shift to accompany normal operating conditions, i.e., a change of flow in the canal will override the device simultaneously while a new target shift is in process.

This device can also be used to dewater or lower the level of the check at the rate of 0.52 foot in 24 hours, as shown by the sketch of the "Float Actuated Cam and Level Change Device."

The device as it is now being used is set to operate the center gate of three 18-foot gates. During normal flow, the cams controlling stage one are set to call for gate operation if the water level changes $\pm$ .03 foot. The second stage will operate if the level changes $\pm$ .06 foot and the third stage operates when the level changes $\pm$ .09 foot from our target level. The clocks are set to raise or lower the gate .04 foot during a 5-minute cycle, .065 foot during a 2-minute cycle, and .13 foot during a 1-minute cycle. The third stage has seldom operated. When the rate of flow through the check is low it has been found that the most satisfactory operation is to eliminate the first stage. The second stage moves the gate .04 foot each 2 minutes and in the third stage the gate is moved .13 foot each minute. This two-stage operation gives us close control with more frequent gate operation. Similar devices may be built using different timing devices and clock setting to provide the type of control desired.

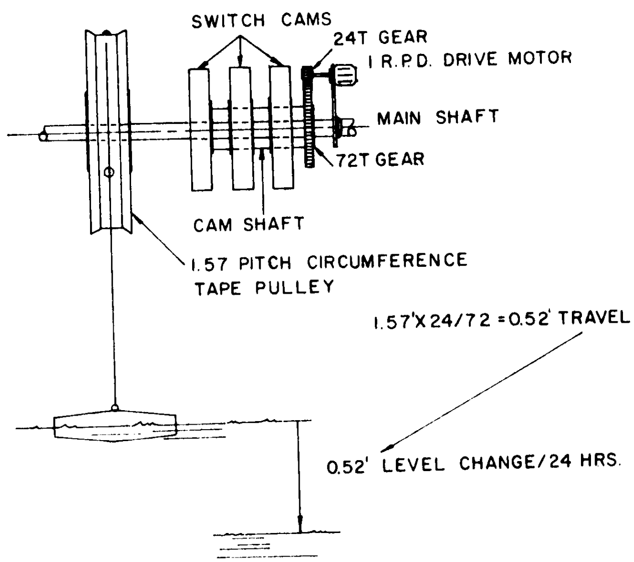
If further information is desired regarding this device, please write to: Chief, Fresno Field Division, Bureau of Reclamation, 2014 Tulare Street, Fresno California 93721.



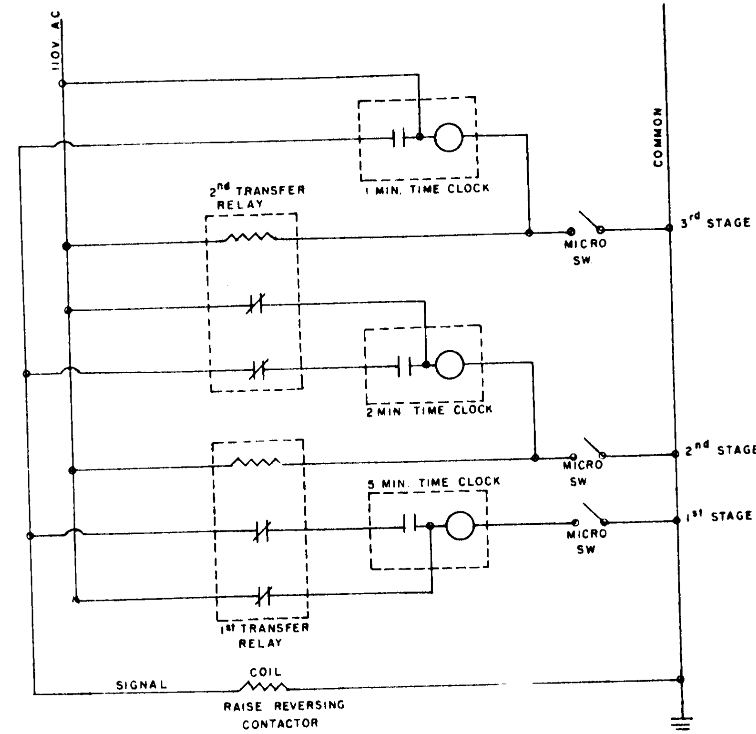
Photograph No. 1--Rocky Hill Check--Mile 79.25 Friant-Kern Canal

Photograph No. 2--Recorder Well--located immediately upstream on right bank. Note automatic gate control device.

FLOAT ACTUATED CAM & LEVEL CHANGE DEVICE



SCHEMATIC DESIGN OF 3 STAGE AUTOMATIC GATE CONTROL DEVICE, SHOWING INTERNAL WIRING OF RAISE CIRCUITRY. LOWER CIRCUITRY DIAGRAM SAME, BUT NOT SHOWN.



DRIVING ON ICE AND SNOW

By

Beata Gray[1/]

On Sunday night Jack's week-end host persuaded him to stay over and take the milk train the next morning. "Absolutely no trouble. We'll drive you to the station and you'll be back in plenty of time to get to work."

But during the night it began to rain. Not easy, wet rain. This was January and the rain froze as it fell. When Jack got up at 5:30, the countryside--and the roads--were covered with glare ice. Jack's host said, "I won't take the car out in this. But I'll call the cab. He's used to this kind of weather." But the local cab driver refused to come until the sand trucks had gone through. Jack was frantic. When Dave said, "Don't worry. We'll get Joe Gibson up the mountain. I've seen him out in all kinds of weather."

Joe turned up 15 minutes later in a jalopy tied together with baling wire. And off they went. It was astonishing. Joe handled that piece of junk as though it were alive--and it responded. Not another car was moving, but there were several in the ditches and skid marks all over. When they got to the station, Jack said, "how did you do it?" And Joe answered, "Well, you just gotta know how. You gotta drive differently under different conditions. But the most important thing is, you can't force it. You can't drive against the car and what it wants to do."

This is sort of like a cook describing a recipe--"A dollop of this and some of that." It gives you a general idea, but not much information to go on. The best background is experience, but getting the experience can be a nightmare. However, there are some points it's handy to know about driving in the winter.

STEERING. Don't oversteer. If you have power steering, be very careful not to react too quickly--you can lose control. But with any kind of steering equipment, all turns should be anticipated and the wheels turned gently.

SKIDDING. Anticipate skid traps. Don't pour on the gas on slippery patches. Don't brake if possible; reduce power. But if you do go into a skid, steer in the direction of the skid, not against it. Remember that ice at 30° is twice as slippery as at 0°. Even if the pavement is clear, remember that when the road is overhung by trees, ice lasts longer. As it does on bridges.

1/Reprinted by permission of the editor from an article appearing in Supervisory Management, February 1966 issue.

BRAKES. Never jam on your brakes. Start to pump your brakes long before it's necessary to stop or slow down. You will lessen the chances of going into a skid, and it will be easier to steer.

GEARS. If you have a stick shift, start your car in second gear. It will give you better traction. Too much power may only cause your wheels to spin. Don't gun your motor.

OTHER CARS. Keep a greater distance than normal between you and cars you are following. If the car ahead of you goes into a skid you have a better chance of not skidding in the same place. Keep a sharp eye on approaching cars, particularly on turns. You may have to do some intricate driving to avoid them if they lose control.

LIGHTS. If it is snowing or sleeting, drive--even in the daytime--with your headlights on low beam. Your parking lights will be useless.

TIRE EQUIPMENT. The National Safety Council urges drivers to use reinforced tire chains on glare ice and snow.

CAR EQUIPMENT. Be sure your brakes are evenly adjusted, with unworn linings. Uneven brakes can throw you into a skid even when you're careful. Be sure your car is properly aligned and the wheels balanced. If you do a great deal of driving on open highways, carry a shovel (army trench shovels are good), a pail of sand or a traction mat, tow chains or ropes, windshield scrapers or defrosters that plug into your lighter.

Your windshield wipers should be adjusted, with proper tension, clean blades; the muffler and tailpipe should be free of leaks; your lights in proper working order.

* * * * *

THOUGHTS ON MANAGEMENT

A leader is a man of unquestioned integrity, morally and mentally. He holds his personal honor in all things above all things. He is also honest mentally. He does not delude himself in appraising other men or his own situation. Facts are facts, and are so interpreted, and not made to appear in a rosy light to prevent him from facing the headaches which the hard cold truth imposes.

It is extremely important to ask two questions about a man being considered for a position of leadership:

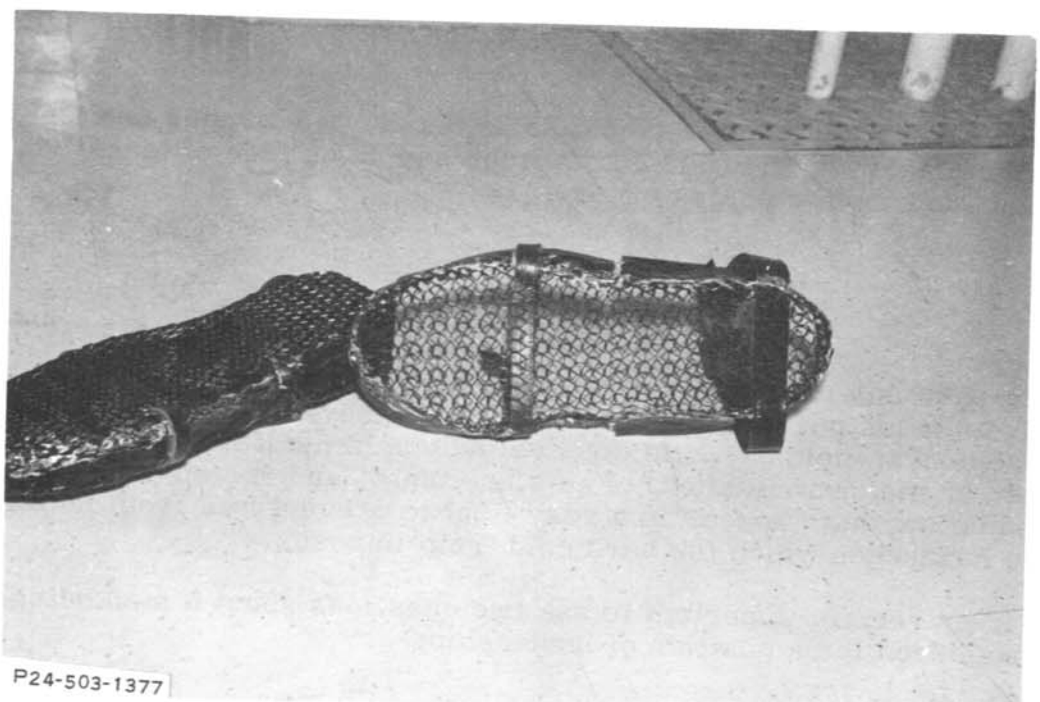
First, will he grow up, or swell up, with his new power and authority?
Second, will he broaden out, or flatten out under his new responsibilities?

MOCCASINS HELP IN PENSTOCKS
(Suggestion R5RG-66s-1)

Mr. Leroy F. Schaaf of the Rio Grande Project Office, reports that in the project's preventive maintenance program it is important to periodically check the penstocks and scroll cases in a powerplant. These inspections are accomplished by various personnel. While in the penstocks moving around is very hazardous due to the wet floor, particularly if entry is made soon after the penstock is draining. There is always a wet slick residual left on the surface of the scroll case, that creates an unsafe condition underfoot. Precautions have to be taken when performing these inspections because of the possibility of injury.

A loose tie-on moccasin, fabricated to prevent slipping, was suggested by Mr. Schaaf. The moccasins are made of metal lath and plastic strips as shown in the photograph below. The type of material used makes the moccasins inexpensive to fabricate. Canvas, web belting or some other material could be used for the sole. The moccasin should be made large enough so it can be slipped on over regular safety shoes.

Care should be taken in the use of the moccasins to avoid damaging painted metal surface.



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TWO WORKERS SUCCUMB TO FUME POISONING FROM SILVER SOLDER OPERATIONS

Two cases of fatal poisoning, one in Utah and one in California, neither involving Reclamation employees, were traced to improper use of silver solder containing cadmium. A second non-fatal incident was also discovered in California.

Investigation of silver solder being used by industry revealed some with a 90 percent cadmium content, with the average being from 12 to 16 percent. This solder, when overheated in soldering operations, produces cadmium fume concentrations far above the recommended atmospheric concentration (8 hours) of 0.1 milligram of cadmium oxide fume per cubic meter of air, and in many cases without proper ventilation, produces chronic or acute exposures.

The main problem encountered is that not all silver solder contains cadmium, but many types containing cadmium have no label or have a loose small tag which reads, "contains cadmium - admits dangerous fumes if over-heated."

The seriousness of this problem can be seen from the American Industrial Hygiene Association's Hygiene Guide Series on cadmium which rates the severity of the cadmium hazard as:

> High for both acute and chronic exposures. Single exposure to cadmium fumes can cause severe lung irritation, which may be fatal. Most acute intoxications have been caused by inhalation of cadmium fumes at concentrations which did not produce warning symptoms of irritation. Continued exposure to lower levels of cadmium in air has resulted in chronic poisoning characterized by irreversible lung injury (emphysema) with abnormal lung function and urinary excretion of a specific low molecular weight protein which may be associated with evidence of kidney dysfunction. Clinical evidence of the cumulative effects of cadmium may appear after exposure has terminated and the disease tends to be progressive.

Recommended control procedures and precautions to prevent acute or chronic exposures are as follows:

a. Check all silver solder now being used to determine cadmium content. If solder does contain cadmium, determine if a solder of lower cadmium content or if one devoid of cadmium can be substituted.

b. If solder containing cadmium is required, it must be properly tagged as to the cadmium content and the hazard involved.

c. All employees using the cadmium solder should be properly indoctrinated as to the hazards.

d. Adequate ventilation for soldering operations should be provided where possible and personal respiratory protective equipment, approved for protection against metal fumes or dust, can be used for temporary or supplemental control.

e. All employees having repeated exposures to cadmium dust or fumes should have preplacement and periodic medical evaluation.

--R. J. Searle, Regional Safety Officer
Region 4, U.S. Bureau of Reclamation,
Salt Lake City, Utah

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NATIONAL SAFETY COUNCIL DATA SHEETS

The National Safety Council has recently published revised or new technical data sheets on the subjects listed below. Copies of these data sheets (by numbers shown in parentheses) may be obtained from the National Safety Council, 425 North Michigan Avenue, Chicago, Illinois 60611.

Chlorine (207 Revised)
Tick Bites (228 Revised)
Power-Actuated Hand Tools (236 Revised)
Motor Trucks for Mines, Quarries and Construction (330 Revised)
Power Lawn Mowers (464 Revised)
Arsenic and its Inorganic Compounds (499 Revised)
Drilling in Open Pit Mines (573)
Projected Still Pictures (574)
Cutting and Clearing Vegetation (575)
Hauler-Loaders (576)
Sewer Pipe Cleaning (577)
Selenium and its Compounds (578)
Applications of Electric Plug and Receptacle Configurations (579)
Asphalt Roofing Manufacture (582)

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Whoever is out of patience is out of
possession of his soul. Men must not
turn bees, and kill themselves in
stinging others.

* * * * *

CONTROL OF VEGETATION IN DUMMY JOINTS1/

Grasses and broadleaved weeds germinate and grow in soil which has been deposited in the dummy joints of concrete canal linings, as shown in Photograph No. 1 below. This vegetation is unsightly and difficult to deal with. Various approaches to its control have been considered in the past. On the large Friant-Kern Canal in Region 2, high rates of monuron and other soil sterilants sprayed into the joints have failed to give satisfactory control, possibly because rains wash the treated soil out and new soil is deposited. Foliar sprays of weed oil, dalapon plus 2,4-D, and paraquat will kill the vegetation growing in the joints, but the dead plants are left, making this approach unsatisfactory from an aesthetic standpoint.

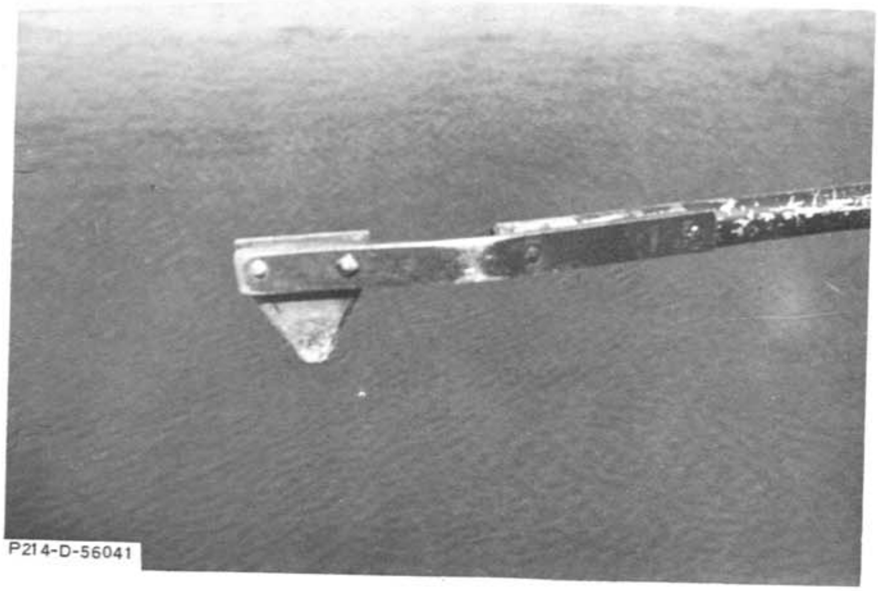
Photograph No. 1

Experience on the Friant-Kern and Delta-Mendota Canals in Region 2, has shown that the weeds will grow where very little soil is deposited in the joints and that they are best removed manually with a cutting tool attached to a long handle. This method has been used for several years. Utilizing this approach, only those joints in which weeds are actually growing need be considered.

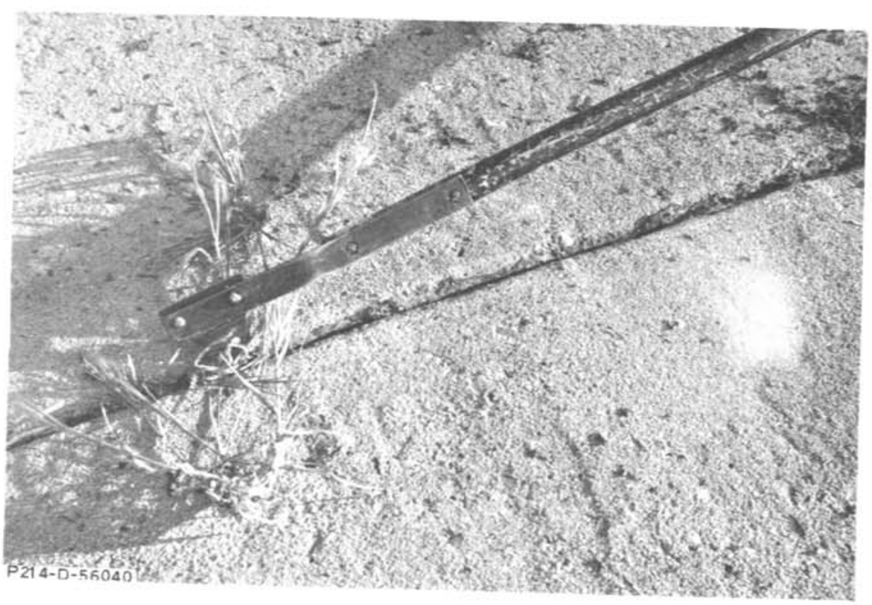
Prior to 1956, diamond shaped hoes, which could be obtained at the hardware store, were used to remove unwanted vegetation; however

1/Prepared by the Fresno Field Division, especially for this publication and printed with permission of the Regional Director, Sacramento, California.

it was soon found that where many weeds were encountered the soft steel hoes wore out rapidly and had to be discarded. In 1956, Mr. Owen J. Sterns of the Friant Section, Fresno Field Division, suggested bolting a serrated mower sickle section to an aluminum pipe handle. The hard steel sickle section lasted considerably longer, and was easily replaced when worn beyond usefulness. This tool is shown in Photographs No. 2 and No. 3.



Photograph No. 2



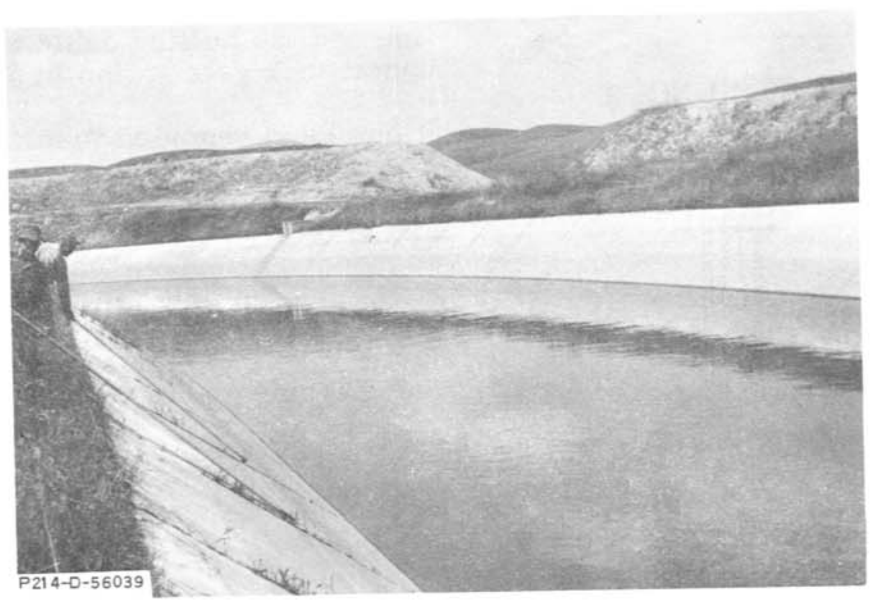
Photograph No. 3


Photograph No. 4

Photograph No. 4, at left, shows a modification of the original tool. It is equally effective. The modification has the disadvantage of being bulkier.

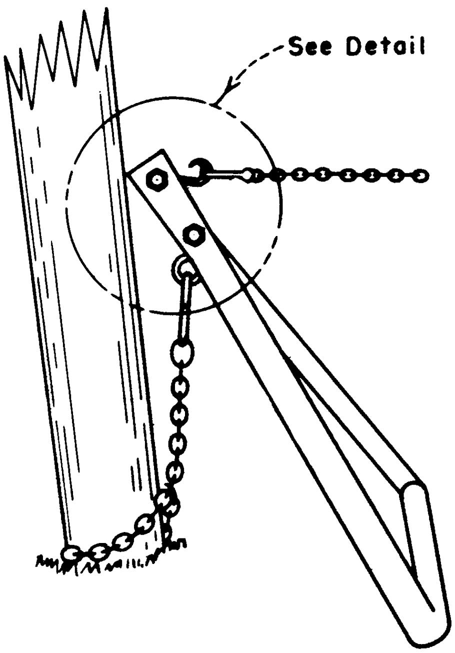
The joints can be cleaned during the growing season when the canals and reservoirs are normally in use. Photograph No. 5 below, shows the tool being used to clean joints in the lining on the Friant-Kern Canal. These tools have been used for ten years to cut grass from the joints, with little noticeable damage to the filler in the joints, or to the concrete.

This tool, or modifications of it, is recommended for cleaning vegetation from joints between concrete panels of canal and/or reservoir linings.

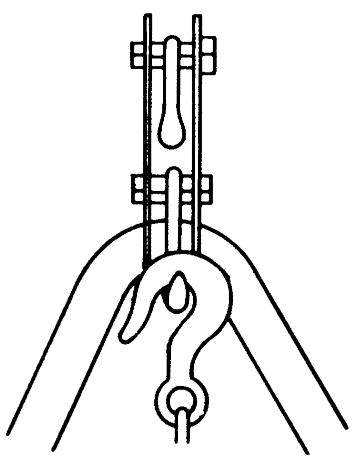

Photograph No. 5

POST PULLING WITH AN "A"-FRAME1/

If you're looking for some way to pull those posts, particularly if they are located where you can't get equipment in, look no further. Your problem has been solved by Mr. Joseph Hebda, Prince William Forest Park, National Capitol Region, National Park Service.



SKETCH NO. 1



DETAIL

This easy to fabricate post puller consists of a length of 2-1/2 inch water pipe bent at two points to form an equilateral triangle 3 feet long to the side, and two hooks mounted one above the other by bolts between two pieces of flat steel extending upward from the apex, as shown in the sketch and detail at left. The upward pulling power results from a pull on one hook rocking the frame from one angle over to another.

The hooks face in opposite directions, the lower one facing the post to be lifted while the other faces the truck or winch. A snatch chain or cable from the lower hook around the post near the ground line and the pulling cable to the upper hook gets action in a hurry.

It has been reported that this easily made, inexpensive rig has already saved considerable time and money on one job of removing abandoned telephone poles without damaging the poles in any way. It has proven so effective that a heavier A-frame of channel iron is now being fabricated to do bigger jobs.

1/Reprinted from an article in Plowback, Issue No. 1, dated May 1963

ELECTRONIC CONTROL OF IRRIGATION SYSTEMS[1]

By

P. R. Hanson

Initially we should briefly analyze why we are interested in electronic control of irrigation systems. Obviously because there may be a remote possibility that some electronic equipment or system may be available that could be used in your area for improving your operations. In order to improve your operations it is necessary for you to have an "awareness" of the potential of automation. It is also essential to have an "awareness" of the potential of automation in order to have a progressive efficient water district.

As for the benefits that may be derived from the electronic control of irrigation systems, the primary benefit desired is cost reduction and in this case reduced operating cost. With labor and wage rates on the rise, your operating costs measured in dollars per acre-foot are also on the rise, unless you can offset this with labor saving automatic or electronic control equipment.

Studies made by the Bureau of Reclamation for operating costs in power operations determined it was necessary to utilize electronic control equipment to achieve labor savings because of the increase in wage rates. A comparison of wage rates using a base of 100 percent for the year 1945 indicated that in 1950 the wage rate was 200 percent of the base. In 1958 it was 300 percent and on January 1, it was 390 percent. These studies showed that one man - an operator - on the payroll represents an amount of $800,000 for a repayment period of 50 years at 3 percent interest. One position manned around the clock for 24 hours a day, with 3 shifts, 7 days a week, requires essentially 5 men on the payroll because of vacation, holidays, etc. Therefore, this position costs approximately $4 million in repayment ability. This is a measure of the savings which can be realized with automatic or remote control equipment.

In evaluating costs of electronic control systems, it is necessary to anaylze the systems in terms of present worth or capitalized costs. For example, if one man is costing $5,000 a year and consideration is being given to an operation for 25 years, the present worth or capitalized cost of manual operation is $87,000; so if you can install facilities which will perform this function for $20,000, the savings is $67,000 less maintenance costs.

The other benefit is a more efficient operation. Although this is indirectly related to cost, it is concerned with the immediate area of reducing the amount of wasted water, a constant surveillance of

1/This article was reprinted from the Irrigation Operators' Workshop Lecture Notes, 1966, Division of Irrigation Operations, Office of Chief Engineer, Bureau of Reclamation, Denver Federal Center, Denver, Colorado.

your system with an immediate alarm of any abnormal condition, and instant control of remote diversion gates or facilities. For example, if we have a telemetering alarm system for a diversion structure in a canal and a jam causes a rising forebay water level, an alarm is transmitted immediately indicating a high forebay water level. Upon receipt of the alarm, a man can be dispatched to the structure immediately, thereby eliminating or reducing the amount of wasted water, potential breaks in the canal, etc. Without this alarm reporting feature or constant surveillance you would not be aware of any abnormal condition until a ditch rider drove by and noticed it visually.

The terminology, automation, constitutes an extremely broad area. To be more specific, we should define a few of the more common words associated with automation as related to irrigation systems. First, is automatic control. This is a control scheme that performs all functions by itself automatically without supervision. Second, is remote control or supervisory control. This is a means where an operator at one location can perform control functions at a remote location with remote control equipment and a communications channel. The operator performs his desired functions with pushbuttons or key switches on a control console.

A term frequently used is telemetering. It provides a means for metering from a distance or a remote location by transmitting it to a local station and indicating or recording the quantity measured. A remote control system consists of the remote control equipment and a communication channel. The communication channel can be a microwave system, a radio system or an open-wire telephone line. All remote control equipment will operate on any of these different types of communication channels. Costs of communication channels vary greatly. A microwave communication channel is the most expensive and requires a great density of channels before it can be justified. VHF (very high frequency) and UHF (ultra high frequency) radio channels are relatively economical and the costs for leased open-wire telephone lines vary from $1 to $4 per month per mile.

On page 25 and 26 are some pictures illustrating the various types of electronic equipment presently in use for automation of irrigation systems.

Figure 1, page 25, shows a selective, on-call radio reporting stream gage. It consists of a transistorized VHF mobile radio unit, a nickel-cadmium battery, a propane-operating engine generator set, a transistorized digital decoder and accessories. It is installed at Taylors Ferry, California, near Blythe, California, on the Colorado River and was developed by R. Bellis of Boulder City, Nevada.

In controlling the flow of the lower Colorado River, we have a treaty requirement with Mexico and are required to make a daily flow commitment into Mexico. This is accomplished in part by releases from

Parker Dam located on the Colorado River approximately 150 miles upstream from the Mexican boundary. Between Parker Dam and the Mexican border we have three of these radio stream gages which assist us to meet our daily delivery requirement to Mexico.

By utilizing the existing VHF radio river control radio network, means to provide an on-call stream gage report at the Bureau's Regional Office in Boulder City, Nevada, have been accomplished with this equipment. As there is no ac or primary power available at the stream gage site, it is necessary to operate the radio from a direct-current battery. With the use of an ampere-hour meter to measure the discharge rate of the battery, after approximately 4 days of operation the engine generator will automatically start and recharge the nickel-cadmium battery. A water level device is used for determining the water elevation with a conventional float and perforated metal tape. At anytime one desires to know the water elevation in the Colorado River at the Taylors Ferry site, he can dial three digits on the conventional telephone dial at the Regional Office in Boulder City and this will be transmitted over the VHF radio network and received at the Taylors Ferry site. The stream gage radio will then transmit the water elevation in hundredths of a foot. He may also dial three digits to start the engine generator set and monitor the channel to determine if it is running. Another number may be dialed to stop the engine generator set. I have witnessed all of these functions performed from the Regional Office in Boulder City.

Subsequently, another stream gage radio reporting unit was installed at the Adobe Ruins site downstream from Blythe, California. Again it was required to operate the radio from a battery since no primary power was available. In this installation, a thermal-electric generator was used instead of an engine generator set. This thermal-electric generator produces a direct current from a flame which in turn charges the battery. Two 50-pound bottles of propane shown (Figure 2, page 25) are installed at this site. One 50-pound bottle of propane lasts for approximately 1-1/2 months to maintain the present charging rate required for the battery. When one bottle of propane becomes empty an automatic valve switches to the other propane bottle and, therefore, the two tanks furnish a 3-month supply. In addition, another unit has been installed at Yuma. As primary power is available at this site auxiliary generators are not required.

By dialing three digits at Boulder City, you can select any of the three stream gages and the water elevation will be transmitted from that location immediately. Audio tones are used for transmission and a series of tones is counted to determine elevation. These gages are normally interrogated three times daily. They have been installed for over 3 years and are providing good service.

A similar radio reporting stream gage was developed by K. McMurray, of Casper, Wyoming, and was incorporated in their operations

2 years ago. One is installed on the North Platte River below Sinclair, Wyoming; one on the Medicine Bow River above Seminoe; one on the Sweet Water River; and one near Glendo, Wyoming. The only difference in these devices from the Arizona installation is that these utilize a tone control for selecting the desired gaging station instead of a dial code system.

The Littleman control is widely used on the Central Valley and Columbia Basin Projects for controlling the main canals. This is an automatic device developed by project personnel for maintaining a constant water level, usually above checks. It consists of floats controlling microswitches and timing clocks and is a relatively trouble-free, simple device. Some installations use probe contacts in place of float controls. Characteristic of automatic gate control devices is a tendency to hunt. Hunting is overcontrolling in both directions and the gate continually moves. With the addition of timeclocks on these devices, this hunting tendency has been eliminated. A desired forebay water elevation is set and the Littleman control device opens or closes the canal gates to maintain this water level. The Central Valley Project has had 10 years of extremely successful operation with these devices, and they are relatively inexpensive.

Three pumping plants on the Wellton-Mohawk Project are being controlled with remote control equipment located in the water users headquarters some 10 miles distant. Figure 3, page 26 is a view of the control panels in the office headquarters. The system has been in operation for approximately 10 years and has also proved to be very successful. The communication channel between the office headquarters and the pumping plants is a leased telephone line.

A recent remote control system has been installed on the Salt River Project in Arizona. It is solid state digital equipment manufactured in Phoenix, Arizona. The remote control equipment controls a principal bifurcation of their canal system. It is located approximately 20 miles from the main dispatching office in Phoenix. At the bifurcation there are two gates which are controlled. There are three telemetered water levels; one below each gate and one for the forebay. Gate height positions are also telemetered. The communication channel between the diversion structure and the dispatching office is a VHF radio channel. Gate positions and water level elevations are displayed as a visual digit quantity on the control console shown (Figure 4, page 26). To obtain these readings, the pushbuttons are depressed to command receipt of desired information. Gate control is initiated by depressing either a gate-lower or gate-raise pushbutton, and then requesting the telemeter position for the position of the particular gate. Water level is transmitted in hundredths of a foot. An alarm is transmitted in case of exceedingly high forebay water level as a result of debris plugging the gates, floodwater, or other causes. The approximate cost of this type of equipment, with the same number of control and telemetering functions, is approximately $10,000 per terminal. The transistorized VHF radio equipment cost is approximately $700 per terminal. This diversion structure is now operated by the central dispatcher and provides an efficient operation allowing instantaneous change of flows from the bifurcation. Previously, a resident operator was required 24 hours a day at this structure.

At Coachella, California, one of the latest remote control systems has been installed for the Coachella Valley County Water District. The Coachella Valley County Water District is approximately 150 miles from Imperial Dam, which is a diversion structure on the Colorado River for the All-American Canal and the Coachella Branch. The waterflow is entirely by gravity 38 miles down the All-American Canal to Drop 1, a diversion structure for the Coachella Canal, which is 123 miles long. Imperial Irrigation District has the operation, maintenance, and water control from Imperial Dam to Mile Post 49.3 in Coachella; the Coachella Valley District is responsible for the last 74 miles.

The remote control begins at Mile Post 49.3, where a digital-type system is installed. The remaining 14 canal and 6 distribution system locations use the analog-type system. If water delivered to the District is accurately measured, the remaining problem is maintaining constant water surface elevation upstream of the check gate. The remote control accomplished at each of the 21 locations varies from 3 to 28 functions. The functions consist of telemetering water levels, high level alarms, and power fail alarms, controlling check gates and lateral gates and start and stop of pumps.

The service area is 100,000 acres with an all-underground pipe system of 485 miles of 12- to 84-inch-inside-diameter pipe with a delivery of 3 cfs per 40 acres.

Remote control panels are located at the headquarters office. The contractor supplied and installed all remote control and communications equipment, and also installed all electrical equipment; that is, motors, gear boxes, conduits, wiring electrical control panels, and made the connection between the remote control equipment and the electrical equipment. There was electrical power at only three locations; therefore, powerline extensions were necessary. The three methods of communications used--VHF radio, microwave, and leased telephone lines--were determined by a cost comparison.

The telemetering equipment located in the field is pedestal mounted in bulletproof metal cabinets. Concrete block buildings, 14-foot by 11-foot by 8-foot, were constructed at three locations to house communications, telemetering, and electrical equipment.

The justification of expenditures of funds requested to install this equipment was water conservation and improved water delivery services to the users. The District delivered to the farms through meters in the excess of 90 percent of all the water received at Mile Post 49.3. Approximately 7 percent is lost due to seepage in the 37 miles of unlined canal and evaporation in 75 miles; approximately 3 percent is handling losses. Deliveries to the farms this past 5 years have been in excess of 320,000 acre-feet per year.

In conclusion, the benefits that may be derived from automation of irrigation systems are reduced operating cost and a more efficient operation. Development of reliable remote control equipment has progressed so rapidly that dependable systems are now available.

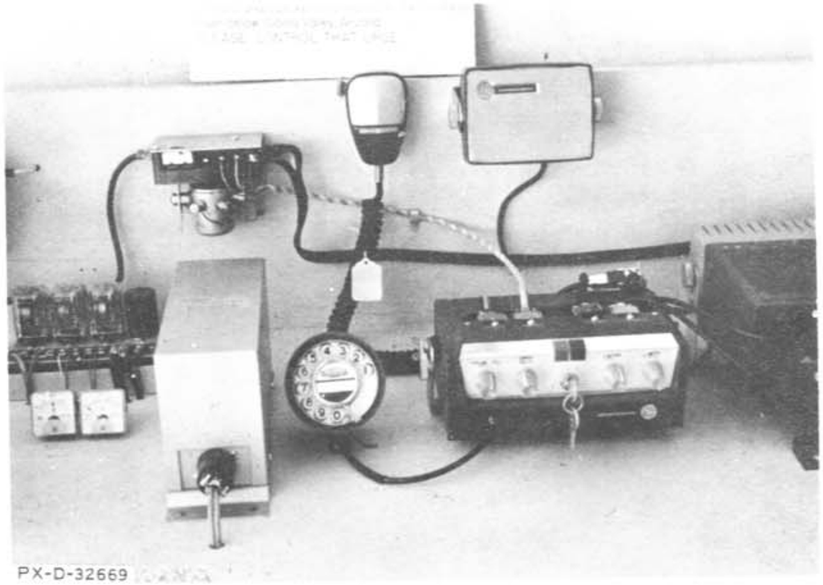


Figure 1

Selective, on-call, transistorized VHF radio reporting stream gage at Taylor's Ferry.

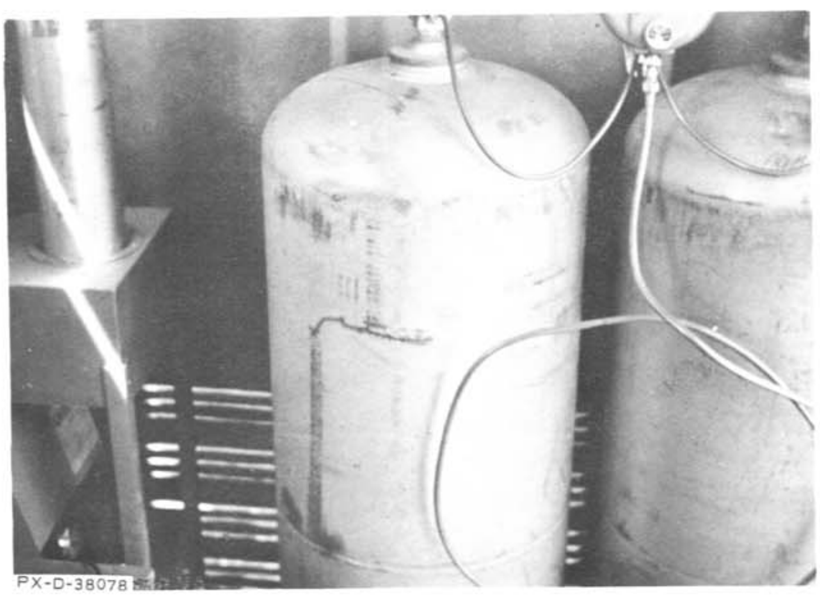


Figure 2

Thermo-electric generator for the on-call radio reporting stream gage at Adobe Ruins, Arizona.

Figure 3

Control panels for the remote control of the Wellton-Mohawk Pumping Plants No. 1, 2, and 3. These controls are located in the district headquarters at Wellton, Arizona.

Figure 4

Control console unit for the Salt River Project supervisory control unit.

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