Department of the Interior, Bureau of Reclamation

IRRIGATION OPERATION AND MAINTENANCE

Bulletin No. 59

January, February, March 1967

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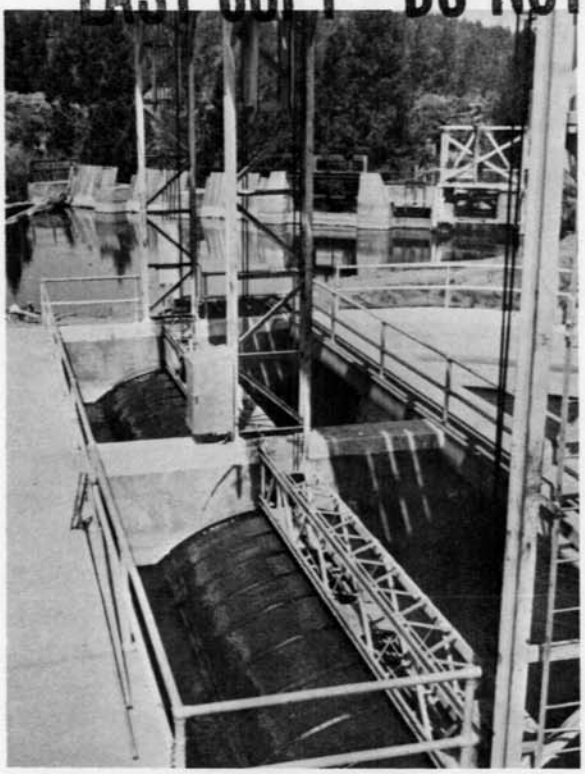

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The Irrigation Operation and Maintenance Bulletin is published quarterly, for the benefit of irrigation project people. Its principal purpose is to serve as a medium of exchanging operation and maintenance information. It is hoped that the reports herein concerning labor saving devices and less costly equipment and procedures, developed by resourceful project people, will result in improved efficiency and reduced costs of the systems for 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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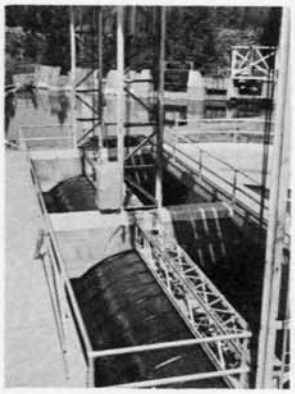
Division of Irrigation Operations
Office of Chief Engineer
Denver, Colorado



COVER PHOTOGRAPH:
This photograph shows the fish-screens at the Main Canal Headworks, North Unit Irrigation District, Deschutes Project, Oregon. P112-D-56949

IRRIGATION OPERATION AND MAINTENANCE
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INTRODUCTION

An automatic greasing mechanism for fishscreens installed at the Main Canal Headworks, North Unit Irrigation District, Deschutes Project, Oregon, is described in the first article. It is believed that this installation has eliminated expensive bushing failures and other costly repairs experienced in the past.

How to fit hard hats correctly is the subject of an article starting on page 4. An improperly fitted or incorrectly worn hard hat is contrary to all the safety provisions that are designed into it. This article also discusses adjustments that should be made and how to make them correctly, so that the wearer is given maximum protection.

This article "Well Development Solution Ingredients form a Spontaneously Explosive Mixture," starting on page 6, was prepared especially for this publication by Mr. Thomas P. Ahrens, a Geologist in the Office of Chief Engineer, Bureau of Reclamation, Denver, Colorado. It was prompted as a means of preventing serious accidents similar to one that occurred in the rehabilitation of a well in Idaho.

A brief summary of the annual Irrigation Operators' Workshop held November 14-18, 1966, in the Office of Chief Engineer, can be found on pages 8 and 9.

A suggestion by Mr. Fay Dunlap of the Rio Grande Project, El Paso, Texas, beginning on page 10, describes and shows improvements made on a core wall machine by equipping it with a revised concrete hopper attachment to allow for placing concrete behind the chain corewall cutter.

On page 12 is a suggestion by Mr. Cecil Wethered of the Columbia Basin Project Office, Ephrata, Washington, for improving screen service and cleaning screens on spray rigs.

The General Services Administration Safety requirements for 1967 model automobiles appears on page 13, and several short articles on safety will be found on pages 7 and 13.

Beginning on page 14, Mr. Richard A. Oakley of the Central Utah Project Office, Provo, Utah, explains the benefits of a suggestion submitted by him for a specially designed storage shelf to carry extra work clothing in the back of a Carryall or Suburban-type truck.

As explained in a short article on page 17, better performance can be maintained when the relays on Supervisory Control Equipment is kept dust free.

AUTOMATIC GREASING EQUIPMENT FOR FISHSCREENS

Mr. Roger S. Norland, Secretary-Manager of the North Unit Irrigation District, which operates the Bureau of Reclamation constructed Deschutes Project in central Oregon, reports that for many years the District had experienced frequent failure of the bushings on the rotating fishscreens, shown on the cover of this issue of the Bulletin, that are located at the head of the projects main canal. Replacement of the bushings was expensive and at times resulted in an interruption of water delivery because of the restrictions imposed for the protection of the fish, which made operation of the canal without the screens in operation impossible.

It was obvious that a great part of the bearing failure was due to the lack of frequent servicing, particularly greasing at night. Located 45 miles from headquarters, such servicing was only possible at considerable expense by travel from headquarters or by someone in constant attendance at the headworks. This prompted inquiry into an automatic greasing device. The result was the assembly of equipment and its installation so that a measured quantity of grease would be supplied to the screen bearings periodically and eliminate the need for a man to grease them every few hours.

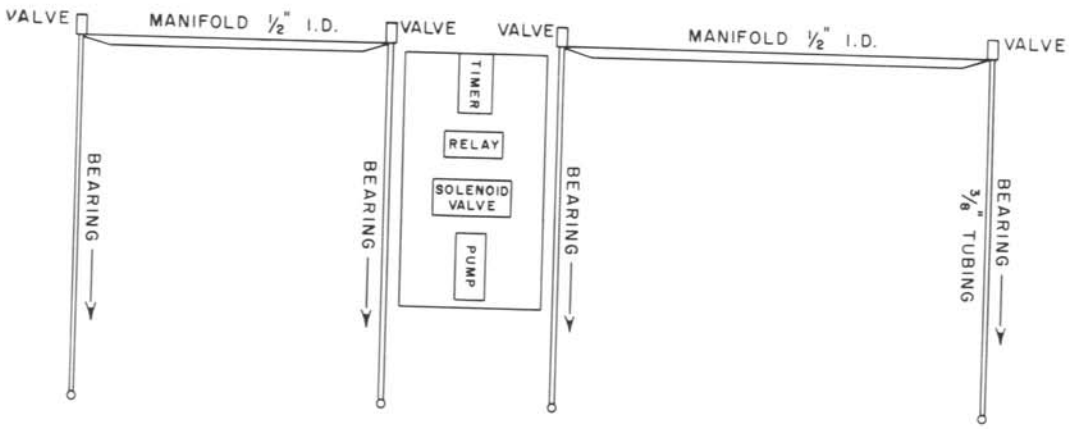
A list of commercially available components purchased for the installation, in addition to pipe, high-pressure hose and necessary fittings, is given below:

Photograph No. 1

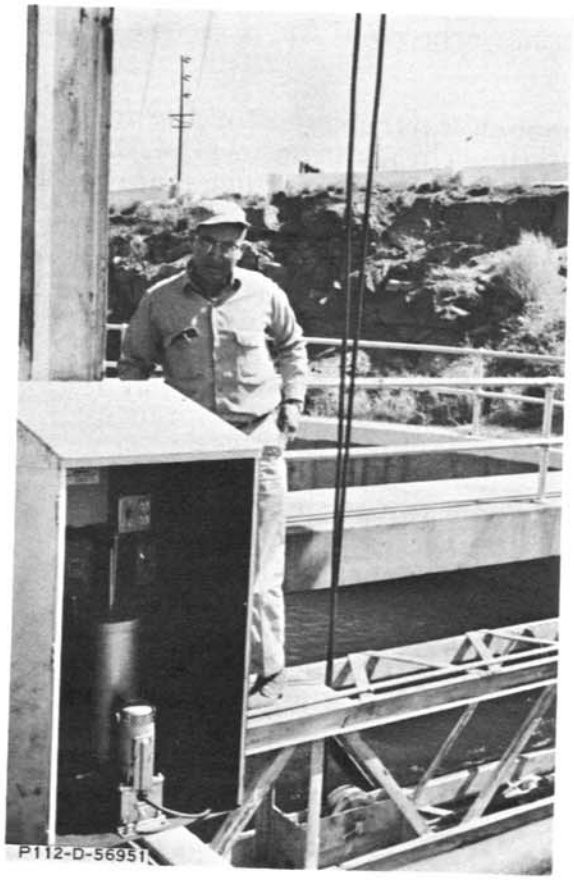
- 1 - Electric grease pump
- 1 - Solenoid pressure admitting valve
- 1 - Electric relay
- 1 - Electric timer
- 4 - Accumatic valves

Except for some electrical wiring, the installation was made by Mr. Gene McClure, the District's shop foreman. A view of the principal components is shown in Photograph No. 1 at left and No. 2 on the following page. Shown are the timer, relay, solenoid valve, pump and pressure pump reservoir.

In operation, the grease pump maintains a constant pressure to the pressure admitting valve. The timer controls, through the relay, both the time and duration



Schematic Diagram of Automatic Greasing System



Photograph No. 2

of the opening and closing of this valve. Upon opening of the valve, the 1/2-inch manifolds, shown in the diagram above, are charged with grease. This in turn charges the four accumatic valves, two of which are shown in Photographs No. 3 and 4, on opposite page. When the pump pressure is attained the self-regulated grease pump shuts off, the preset duration time of the timer closing the admitting valve, and this in turn vents the manifold pressure back to the pressure pump reservoir.

The charged accumatic valves, which are spring loaded, force 0.050 cubic inches of grease to each of four bushings. This sequence occurs once each hour inserting a total of 4.7 cubic inches of grease for the four bushings each 24-hour period.

Mr. Norland advises also that counting devices are being purchased so that there will be visual proof of the number of times the screens are serviced with grease each 24 hour period. He states further that it is probably too soon to

HARD HATS:
they're no good unless they fit

by
Robert W. Bowers1/

When does a safety hat give little or no protection?

Answer: When it is not properly adjusted--the intent is there, but not the benefits.

Unless every hat in your head safety program is properly fitted, you cannot enjoy maximum safety and the cooperation and enthusiasm of those wearing the hats. Incorrect adjustment of the hat shell and the shock-absorbing suspension reduces the amount of shock absorption protection. Worse, if the hat is not adjusted for maximum comfort and convenience, it may not be worn at all.

Basically, the right fit involves making five adjustments to suit the individual wearer and the conditions of the job. These five adjustments are: Suspension depth, headband size, headband tilt, concentricity and stability.

Suspension Depth

The main suspension of any safety hat controls how far the wearer's head fits into the hat shell. Thus, of course, it also controls the amount of clearance between the hat shell and the wearer's head. This clearance governs the ability of the hat to do its job--providing space for the deformation of the shell and the stretching of the suspension under impact, yet avoiding direct contact with the wearer's head. Minimum safety requires at least 1-1/4-inches clearance space. A hat with a narrower depth adjustment endangers the wearer. Always make sure that safety hats in your department have the minimum safe clearance at any adjustment.

Along with maintaining safe clearance, the safety depth adjustment must provide comfort. For some workers, a deep suspension fit feels more snug and stable; it is generally desirable where wind or other conditions threaten hat stability. Other workers prefer a more shallow fit when temperatures are high or simply because of the shape of the wearer's head. Therefore, the suspension section must be adjustable to the desired depth--within the limit of safe clearance.

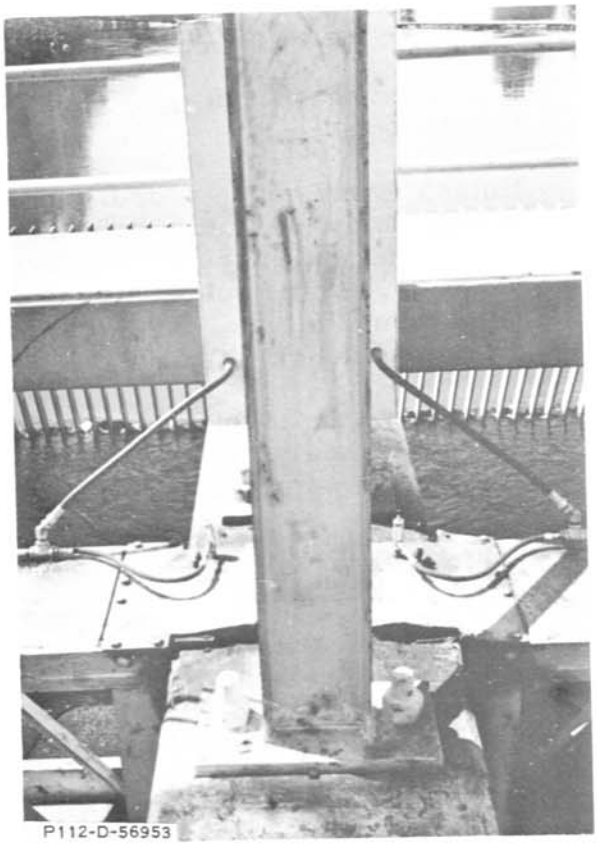
Headband Size

Probably the most obvious adjustment in a safety hat is the headband adjustment. Although simple to make, it is often incorrectly made, causing

1/Reprinted by permission of the editor from an article appearing in Safety Maintenance (Vol. 131, No. 4), 1966, as condensed in Supervisory Management, August 1966.

know the results of the installation, but so far the District is convinced that had this arrangement been in operation in the past, it would have eliminated many of the bushing failures, as well as costly repairs caused by bushing failure.

Photograph No. 3



Photograph No. 4

If further information is desired in regard to the equipment used or methods of installation of the automatic greasing system, you may write to Mr. Roger S. Norland, Secretary-Manager, North Unit Irrigation District, Deschutes Project, Madras, Oregon; or to the Chief Engineer, U.S. Bureau of Reclamation, Denver Federal Center, Denver, Colorado 80225.

* * * * *

A township, as used by the U.S. public land survey is a piece of land six miles square. The term is believed to come from the New England township which usually contained 36 square miles. The Yankees apparently arrived at this dimension because a walk of more than three miles to church, school and the seat of local government was considered an undue inconvenience. A distance of less than three miles would not contain enough population to justify local government.

Denver Post, Oct. 23, 1966

undue pressure on the wearer's head, and consequent headaches and skin discomforts. Remember a safety-hat headband is intended only to position the hat properly on the wearer's head and not to keep the hat on under all working positions or conditions. It should be snug, not tight. Neither is the adjustment of the headband a "one and forever done" job. For example, it should vary with the amount of hair on a wearer's head or the temperature.

Headband Tilt

A properly designed headband can also provide a very important safety and comfort adjustment. A flat headband that bears low on the forehead is uncomfortable because this is a sensitive facial area. But tilting a safety hat back on the head for more comfort lessens protection because it reduces head-to-shell clearance and exposes a greater facial area. To overcome this problem, the headband should adjust for tilting to a higher position on the forehead, without changing the best shell-suspension positioning. Another advantage of the headband tilt feature is that it usually gives better hat stability. It also provides for easy replacement of a worn out headband.

Concentricity

Most safety hats and caps are designed to fit the majority of industrial workers' head sizes and shapes. For others, a good fit requires special provisions--for example, to adjust for askew concentricity. Concentricity is the proper lateral positioning of the hat headband within the shell. When, for example, the back of a headband is tightened to fit a very small head, there is too little head-to-shell clearance at the front and too much head-to-shell clearance at the back. The effect on safety or shock absorption is not serious, but it does create an uncomfortable, unbalanced distribution of the hat weight on the wearer's head. It also looks unattractive--an important factor since the over-all appearance of safety headwear greatly effects the employee's willingness to wear it. It is simple to correct an uncentered headband when there is built-in provision for it. But this is not a common provision and it is not often used even when it is available.

Stability

Many industrial jobs have special conditions: unusual working positions, high wind, or extreme activity. Such conditions frequently lead to loss or disuse of safety hats. A simple, but somewhat annoying, solution is a chin strap. A better solution is a nape strap. This is simply a strap attached to each side of the safety hat, and extending around the lower back of the wearer's head. Adjustable for each individual, it is remarkably effective in securing the hat and it eliminates the need for a chin strap.

Getting a hat on every subordinate who needs one is only half the safety battle. The right fit is the key to maximum safety and comfort.

* * * * *

WELL DEVELOPMENT SOLUTION INGREDIENTS FORM A SPONTANEOUSLY EXPLOSIVE MIXTURE

by Mr. Thomas P. Ahrens1/

When developing new or rehabilitated water wells, chemical solutions to sterilize the well and to improve and facilitate the development are introduced into the well prior to surging and agitation with a surge block, jetting tool, or other procedures. A commonly used formula consists of 16 pounds of sodium hexametaphosphate, 15 pounds of sodium carbonate, 1 to 3 pounds of a surfactant or wetting agent, 1-1/2 pounds of 70 percent available calcium hypochlorite, and 100 gallons of water. The ingredients are usually dry powders, granules, or flakes.

Batches of half the above formula are usually mixed in a 55-gallon drum by dissolving the chemicals one at a time in the water. Sufficient batches are mixed to displace the water in the well. The addition of the separate dry chemicals to the water or solution in the drums is a safe and convenient procedure when working with small volumes of materials. However, the consequences can be serious if the chemicals are mixed dry prior to being dissolved in the water.

Recently during the rehabilitation of some large diameter deep wells in Idaho the volume of solution required for each well was in excess of 1,000 gallons. The contractor decided to use a cone jet mud mixer and small recirculating centrifugal pump attached to a 1,200-gallon steel tank to dissolve the dry chemicals and mix large batches of the solution. A dry flake type of surfactant with a hydrocarbon base, was used. Printed on the hypochlorite drum were warnings about contacting hypochlorite with hydrocarbons or other flammable materials. The significance of the warnings with respect to the surfactant used and hypochlorite apparently did not register with the contractor's men.

The calcium hexometaphosphate and sodium carbonate had been put through the cone mixer. By error the last shovelfull was rock salt rather than sodium carbonate. The rock salt blocked the jet and then bridged in the cone. The bridging was not noticed at the time. The driller then shoveled about 10 pounds of the surfactant into the hopper and on top of that 15 pounds of calcium hypochlorite. On checking he saw the results of the bridge and turned away from the hopper for a rod with which to break up the bridge. An instant later there was a violent explosion in the hopper. The inverted cone configuration of the hopper caused all the force to be directed upward. The driller fortunately received only a slight first degree burn on his side, singed hair, and a thorough scare. Molten hypochlorite was spread over a radius of 30 feet and started a number of small fires, which were quickly extinguished.

1/Mr. Thomas P. Ahrens, Geologist, Office of Chief Engineer, Bureau of Reclamation, Denver Federal Center, Denver, Colorado.

The procedure was immediately changed to provide a specific order of addition of the chemicals: Surfactant first, then sodium hexametaphosphate, sodium carbonate, and calcium hypochlorite last. No further difficulty was encountered during the balance of the contract. This experience indicates that well specifications should provide for the order and method of mixing chemicals when they are used.

* * * * *

A CONSTRUCTIVE SUGGESTION

A constructive suggestion is one that gives a "YES" answer to one or more of the following questions:

1. Will it simplify? Operations - Forms - Methods
2. Will it eliminate? Waste - Accident hazards - Nonessential routines
3. Will it improve? Service - Working conditions - Procedures
4. Will it establish a new practice? That is better - That is safer - That is more efficient
5. Will it provide a solution? That is understandable - That is practicable - That is timely

If you have a suggestion in one of the above categories that has helped in the operation or maintenance of your irrigation system, send it along. Others will be glad to hear about it.

* * * * *

The following list of items for your car or Pick-up truck's glove compartment is a composite of suggestions from safety counselors (including the American Automobile Association and the National Safety Council). They are all mighty handy to have along:

1. Plug-in emergency light
2. Spare fuses
3. Window scraper (for winter)
4. Clean cloth (for windshield)
5. Work gloves
6. Small first-aid kit
7. Car owner's manual and Service policy
8. Insurance and road service forms
9. Notebook and pencil or pen
10. A litter bag

* * * * *

IRRIGATION OPERATORS' WORKSHOP

The 1966 workshop for irrigation operation and maintenance personnel, that has now become an annual meeting because of the interest shown by those operating our irrigation projects, was held in the Office of Chief Engineer at the Denver Federal Center, Denver, Colorado, during the week of November 14 through 18, 1966. It was the sixth annual Workshop and was attended by 123 irrigation district officials, engineers and educators from 16 western states and 3 foreign countries. In addition to participants from Pakistan, Turkey, and Mexico, the Bureau of Indian Affairs, Bureau of Land Management, the University of California, Kansas State University, Arizona State University, Utah State University, Texas A&M College and North Dakota State University, were represented.

Self-improvement of project personnel who are directly responsible for the technical details of operating and maintaining their irrigation systems is the object of the workshop, arranged and conducted by the Division of Irrigation Operations of the Office of Chief Engineer.

There are no charges made for attendance at the workshop except for the purchase of certain reference materials and tickets for the dinner meetings. However, food, lodging, transportation, and other expenses are the responsibility of the individuals attending.

Instructors, or more precisely, group leaders include both Bureau and irrigation district personnel. They are well qualified in their respective fields and are in charge of the Workshop sessions. All participants are provided with bound sets of lecture notes covering the basic subject matter. These lecture notes are mailed out before the Workshop begins. The group leader, presents a brief summary of the material to be covered, and the remaining time is spent in discussion and exchange of information by all participants.

There are five sessions each day of the 5-day period. Certain subjects of general interest are covered in general assemblies. Another general assembly is devoted to a question and answer period with experts from the field and the Office of Chief Engineer participating as a panel.

The participation in certain courses that are felt to be basic to all types of irrigation systems are required for everyone. These courses are selected in accordance with requests received from previous workshop participants.

A choice of some optional courses of study is offered. The subjects that were presented this year are listed on the following page.

Required Courses	Optional Courses
Canal Lining and Soil Sealants	Drainage
Concrete Practices	Weed Control
Equipment Management	Earth Construction Practices
Operation & Maintenance Safety	Protection of Surfaces
Project Management	Pipe Systems Maintenance
Report of Atmospheric Research & Watershed Management	Ground Water and Wells
Water Management	Pump Maintenance
Water Conservation	Electronic Control of Irrigation Systems
Water Measurement	Electrical Maintenance
Rehabilitation of Distribution Systems	

* * * * *

KING OF BABYLON IRRIGATION CODE

This is the irrigation code of Hammurabi, King of Babylon, 1900 B.C.

If anyone is too lazy to keep his dikes in order and fails to do so, and if a breach is made in his dike and the fields have been flooded with water, the man in whose dike the breach was opened shall replace the grain which he has destroyed.

If he is not able to replace the grain he and his property shall be sold, and the people whose grain the water carried off shall share the proceeds.

If anyone opens his irrigation canals to let in water, but is careless and the water floods the field of his neighbor, he shall measure out grain to the latter in proportion to the yield of the neighboring field.

"I have made the canal of Hammurabi, a blessing for the people of Shumer and Accad. I have made water flow in the dry channels and have given an unfailing supply to the people. I have changed desert plains into well-watered land. I have given them fertility and plenty, and made them the abode of happiness" ..... so sayeth Hammurabi, King of Babylon.

* * * * *

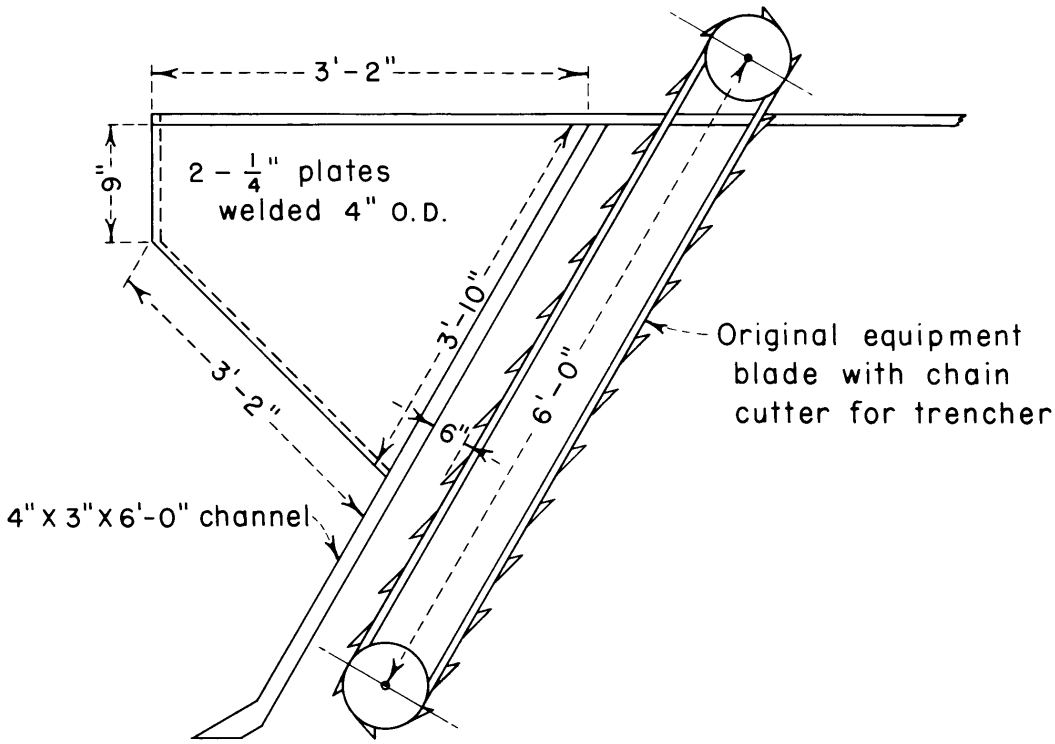
CONCRETE HOPPER ATTACHMENT FOR CORE WALL MACHINE
(Suggestion R5RG63-1)

This suggestion for a revised concrete hopper attachment as shown in the photograph below and diagram on the following page illustrates a core wall machine to allow placing of concrete behind a chain core wall cutter. It was developed by Mr. Fay Dunlap, of the Rio Grande Project, El Paso, Texas, and has greatly speeded up operations by eliminating bank caving of sandy soil. The main change in procedure from previous methods used has been the use of a separate hopper for placing the concrete instead of one immediately behind the cutter. By experience, the field forces have found that most banks will stand up with vertical sides for a short period of time, allowing the concrete to be placed further behind the cutter.

P23-D-56947

The main advantages of this suggestion are as follows: (1) The cutter can continue digging without waiting on concrete trucks. (2) Whenever an obstacle is encountered that requires raising the cutter, it can be readily raised because the concrete is not against the shield. (3) There is less drag on the sides and the trencher can excavate faster. Reducing the size of the shield also facilitates raising the cutter when necessary.

In ordinary banks the sides will stand until the concrete is placed, however, by using the revised hopper attachment the operators can observe if there is any caving of the sides. In case of caving, as in very sandy banks, the concrete can be placed immediately behind the cutter, as was previously being done. The reduced size of the shield, however, makes less drag than before even when this must be done.



REVISED CONCRETE HOPPER ATTACHMENT
FOR CORE-WALL MACHINE

Revised Concrete Hopper Attachment
for Core-wall Machine

CLEANING SCREENS FOR SPRAYING SYSTEMS FILTER ON SPRAY RIGS
(Suggestion R1CB-64-31)

Mr. Cecil Wethered of the Columbia Basin Project Office, Ephrata, Washington, believes that 30-mesh screens should be used on spray rigs rather than the 50 and 100 mesh now being used to eliminate foreign material from spray lines and nozzles.

It was discovered by experience that the finer mesh always thought essential in the past, was not necessary. The procedure as outlined by Mr. Wethered will save down time, loss of screens because of the fine mesh material and also do a much better job of spraying because the spray jets do not plug with foreign matter.

It was also suggested that:

a. Screens be replaced periodically for good results.

b. Extra screens should be made of Monel metal or stainless steel.

c. There should be five extra screens for each spray rig equipped with these filters.

d. The used screens should be cleaned, then put in an acid bath to clean out foreign material. Then they should be re-packaged for further use.

e. This same type filter be installed on all truck-mounted rigs.

f. Safety precautions should be taken when cleaning these screens, because of the acid solution being used.

This cleaning should be done in a safe place away from other working areas. Goggles or face shield should be used, along with rubber gloves or gauntlets and a rubber apron should be worn to protect clothing.

Mr. Wethered also informs us that the procedure as outlined in (e) above is used with Jet Engine fuel systems before each flight to safeguard the fuel lines from foreign matter.

* * * * *

GSA SAFETY REQUIREMENTS FOR 1967 MODEL AUTOMOBILES1/

The General Services Administration is an automobile buyer in a big way. GSA purchases cars for the Federal Government, which maintains a 36,000-car fleet.

The 1967 models, which GSA ordered recently, must have these safety devices as standard equipment:

1. Padded dash and sun visors.
2. Recessed instruments and controls on the instrument panel.
3. Impact-absorbing steering wheel and steering column.
4. Safety door latches and hinges.
5. Anchorage for seat belt assemblies.
6. Anchorage of seats.
7. Dual-brake system.
8. Standard gear quadrant (P-R-N-D-L).
9. Safety glass.
10. Glare-reduction surfaces on the instrument panel and windshield wipers.
11. Tires that meet Federal specifications (no overloading at curb weight or GVW rating) and safety rims.
12. Exhaust emission control system.
13. Constant speed (at least two speeds) windshield wipers and washers.
14. Standard bumper heights.
15. Four-way signal flasher.
16. Backup lights.
17. Outside rearview mirror.

Some of the items on the GSA list have been standard on autos for the last several years. Others are offered as optional accessories. Still others will require innovations on most models on the market.

The GSA hope is to encourage auto manufacturers to offer these safety devices as standard equipment, rather than as accessories, if at all. The size of the GSA fleet, combined with the influence of the Federal Government in setting an example for the public, puts teeth in the GSA objective.

* * * * *

WHY FASTEN YOUR SEAT BELT?

The American College of Neurosurgeons reports that of the 33,000 people dying from head injuries suffered in traffic accidents in the United States last year, 16,000 would very likely have survived had they been wearing seat belts.

1/This article was reprinted from the Reclamation Safety News, Second Quarter 1966, Bureau of Reclamation, Denver Federal Center, Denver, Colorado.

CLOTHING SHELF FOR CARRYALL OR SUBURBAN TYPE TRUCKS
(Suggestion No. R4CU-66S-3)

A Carryall or Suburban type truck when loaded with instruments and field survey equipment, does not have much space left for storing coats and extra work clothing. As a rule this extra clothing is piled on top of equipment behind the rear seat of the truck, this of course blocks vision through the rear window, creating a serious safety hazard.

Mr. Richard A. Oakley, of the Central Utah Project Office, Provo, Utah, suggested a shelf be installed behind the rear seat and above the rear window of the truck. Clothing stored on this shelf, is accessible from within the truck, and also through the rear door opening. This leaves a clear view for the driver through the rear vision mirror, as shown in Photograph No. 1 below.

Photograph No. 1

The field survey crews working out of the Central Utah Project Office, now using this shelf as suggested by Mr. Oakley find it very useful, and are pleased with the results. Photographs No. 2 and 3, on the following page shows a view of the shelf from the rear of the truck, and the sketch on page 18, includes a list of materials used in the installation.

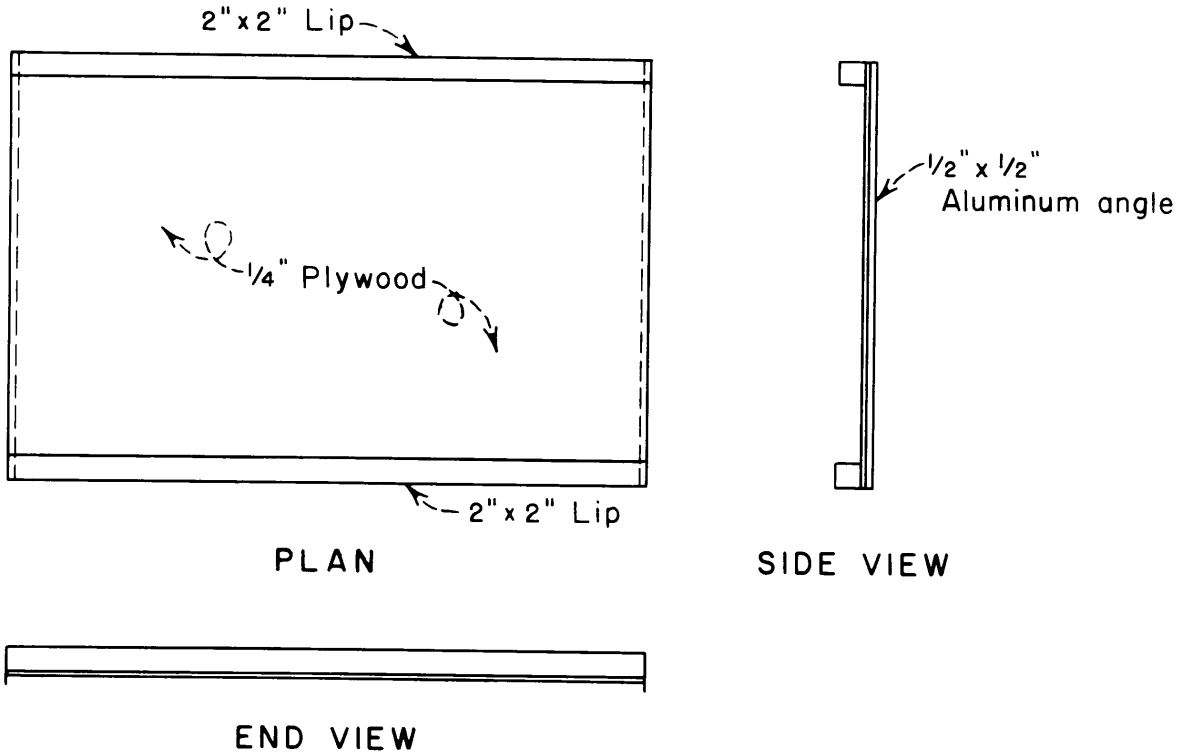
Instructions for the installation of the shelf are as follows:

Using small 1/2" x 1/2" aluminum angles fastened on each end of 1/4" plywood, shelf is set above windows with angles behind the window moldings.

A 2' x 2' wood brace is fastened to the forward and one to the rear edge of the plywood sheet to provide support and a lip to keep clothing from sliding off the shelf.

Photograph No. 2

Photograph No. 3



LIST OF MATERIALS

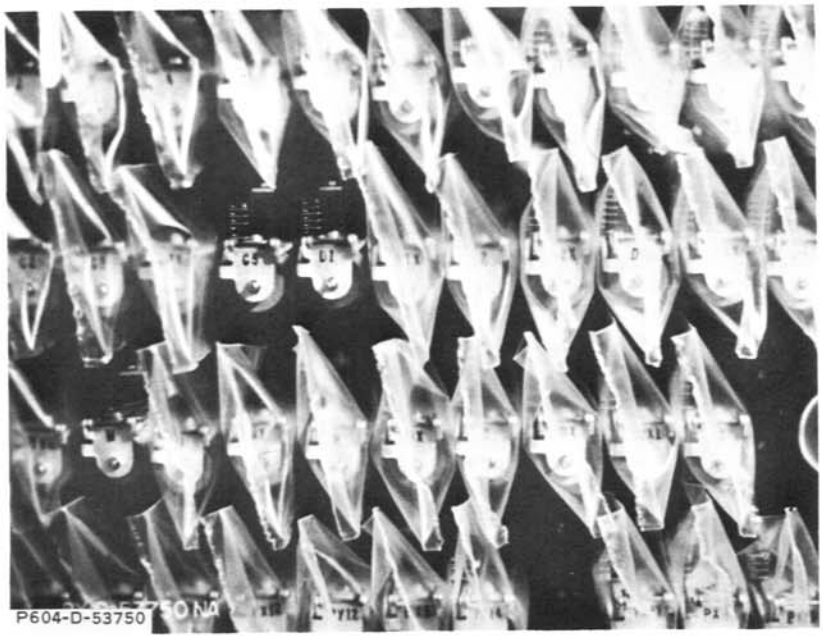
1-Piece of plywood - 3 1/2' x 4 1/2' ±
2-Pieces - 2"x 2"
2-1/2" x 1/2" x 3' ± Aluminum angle
Screws as needed
Construct to fit individual vehicle

Diagram

SUPERVISORY CONTROL EQUIPMENT
DUST FREE RELAYS1/

Devils Lake Substation is 1 of the 11 substations that is supervisory controlled from the Jamestown Dispatching Office. At this station, the supervisory control equipment is over 10 years old, and the relays are of the single-contact type. It was found that better performance was obtained from this equipment if these relays could be kept dust free.

By inserting each relay into a plastic bag and sealing it with heat, as shown in the photograph below, it has been possible to eliminate dust from the contacts on these relays. This has improved the reliability of this particular equipment.



Several improvements have been made in newer types of supervisory control equipment. One of these improvements was the conversion from single-contact relays to two-contact or multiple-contact relays. However, if dust is a problem with relays the suggestion is worth considering.

1/This article was reprinted from a Power O. & M. Report of a field review of communication equipment maintenance, May 11, 1966.

THREE-WHEELED CART FOR INSPECTING IN PLACE PIPE
(Suggestion No. R2-66S-86)

The joint efforts of Mr. Donald C. Anderson, and Mr. Arlan W. Tift, both from the Red Bluff Construction Office, Central Valley Project, Bureau of Reclamation, Red Bluff, California, has resulted in the design of an ingenious three-wheeled cart to facilitate the inspection of distribution system pipe.

Photograph No. 1

This self-propelled inspection "mole," as it is called by it's designers, is constructed of readily available materials and has resulted in substantial savings in the time required to inspect in place pipe. It has also eliminated the skinned hands and knees, not to mention the bruised elbows, backaches, sore muscles and torn clothing that usually accompany this type of work.

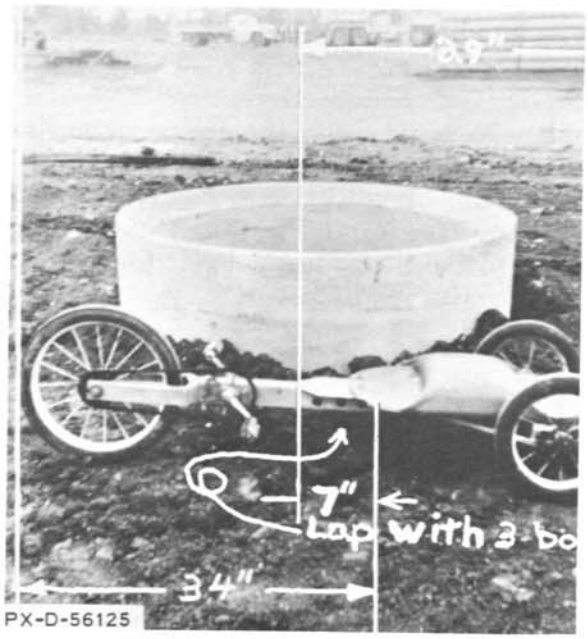
This machine will operate in a 24-inch and over diameter pipe, it can negotiate 90° bends and you can also reverse direction when necessary. The simple design of this machine makes it very easy to operate. The photographs on the left and also on the following page show the various operating positions: Photograph No. 1, shows a man operating the machine from a sitting position; Photograph No. 2, shows the same machine being operated from a kneeling position; and Photograph No. 3, shows the operator in a prone position.

Photograph No. 2

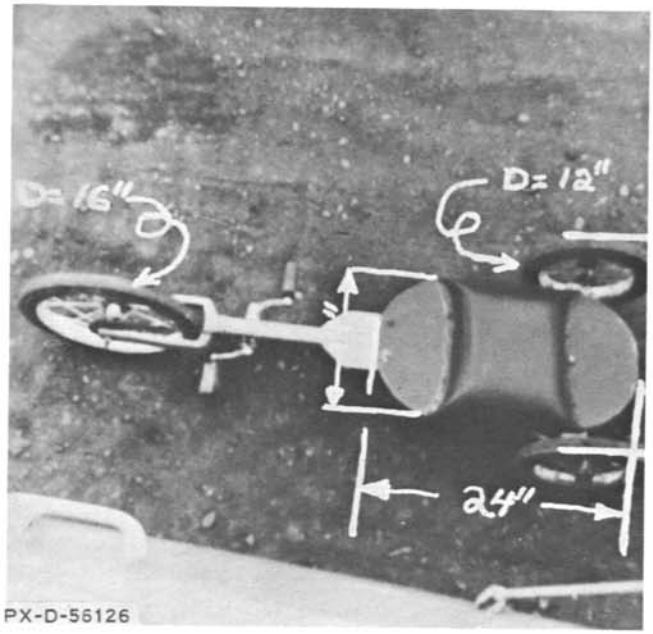
Photographs No. 4 and 5, on page 20, are views of the machine showing its general design and overall dimensions. Construction details are given in the sketch on page 21. The capitol outlay for material required to fabricate this machine was less than $10.

Those operators who have used the inspection "mole," state that its use certainly beats crawling through a rough and dirty pipe on your hands and knees. If additional details are desired they can be obtained from the Regional Project-Development Engineer, Region 2, Bureau of Reclamation, Post Office Box 15011, Sacramento, California 95813.

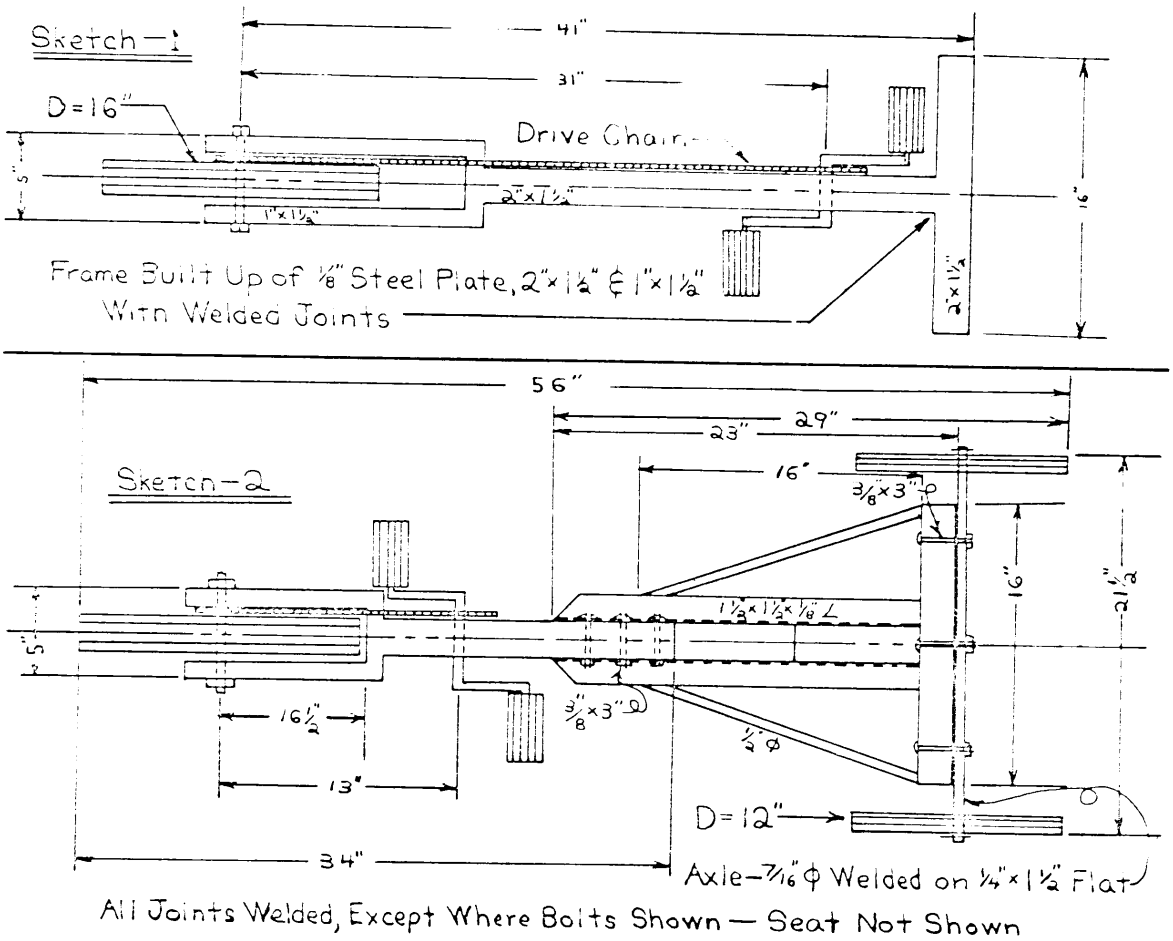
Photograph No. 3



Photograph No. 4



Photograph No. 5


Sketch—1
41"
31"
D=16"
Drive Chain
5"
2"×1½"
1"×1½"
16"
2"×1½"
Frame Built Up of ⅛" Steel Plate, 2"×1½" & 1"×1½"
With Welded Joints
56"
29"
23"
16"
Sketch—2
⅜"×3"
16"
21½"
1½×1½×⅛" ∠
5"
16½"
⅜"×3"
½" φ
13"
D=12"
34"
Axle—7/16" φ Welded on ¼"×1½" Flat
All Joints Welded, Except Where Bolts Shown — Seat Not Shown

* * * * *

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