United States Department of the Interior, Bureau of Reclamation

IRRIGATION OPERATION AND MAINTENANCE

BULLETIN NO. 67

January, February, March 1969

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 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 80225

COVER PHOTOGRAPH:

This is a view of anhydrous ammonia being introduced into a Lateral through a vent pipe in an attempt to seal cracks in concrete pipe.
Photo P413-D-63299

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INTRODUCTION

An article starting on page 1, describes a method for sealing narrow cracks in concrete pipelines by the addition of anhydrous ammonia and other materials to irrigation waters. Ammonia will produce a hard calcium carbonate precipitate in a water having the proper physiochemical characteristics. The precipitate then deposits in the cracks in the pipe and seals the leaks.

On page 12 is an article reprinted from Contractors and Engineers Magazine describing one contractor's idea to prevent material buildup inside a tractor-shovel bucket when sticky adobe clay is being excavated.

A suggestion starting on page 13, describes a vandal-resistant manhole cover that is preventing loss and prohibiting entry to galleries in a dam on the San Angelo Project, Texas.

The results of an automobile safety check program can be found on page 16, and, on page 18, you will find short articles on automobile seatbelts and studded winter tires.

How to make water meters run longer is told in this human interest story on page 17, reprinted from the Wenatchee (Washington) Daily World.

"Hinged Metal Repair Sleeve for Concrete Pipe," is the title of an article on page 19. The idea was developed on the Hammond Project, New Mexico, for emergency repair of leaks in large diameter pipe from the inside.

A method of sealing submerged gates and valves with sawdust by using an air gun was suggested by the Project Superintendent, Canyon Ferry Project, Helena, Montana. The gun and method are described beginning on page 22.

Two workable ideas can be found in an article on page 24 for modifying a dredger. The Las Cruces Irrigation Field Branch, New Mexico, suggests its modifications can probably be applied to any chain-driven machine that is exposed to mud and water.

GUIDELINES
FOR
SEALING CONCRETE PIPELINES WITH ANHYDROUS AMMONIA1/

Introduction

Several years ago, after using anyhdrous ammonia (NH_3) in solution with irrigation water to fertilize crops on his lands, a farmer in the Chowchilla Irrigation District of California discovered that leaks in concrete pipelines through which the water had flowed had suddenly stopped.

This apparent miracle led to experimentation by the irrigation district, then to scientific investigation by the University of California at Davis, under a contract grant financed by the Lower Cost Canal Lining Program of the Bureau of Reclamation. Practicality of the anhydrous ammonia sealing method was thus verified and suggestions for its appropriate use developed.

The story of the miracle has already been partially told in an earlier Irrigation Operation and Maintenance Bulletin2/. The present article, based largely on the published University of California findings, included in the Research Report (ChE-79) discusses recommended techniques for pipeline sealing by this new method.

In general, the process consists of adding anhydrous ammonia to water flowing through a pipeline. Reaction of the fertilizer with calcium and bicarbonate ions in the water forms calcium carbonate which flows into and is deposited in the cracks thus forming a seal.

The treatment process when properly conducted will seal ring cracks, longitudinal splits, and fractures between the pipeline and its control structure in both monolithic and precast concrete pipelines including small-diameter farm distribution systems. In cases where cracks are so large as to require repeated treatment, however, this method may prove too costly.

General Guidelines

Sealing of leaky concrete pipelines by treating irrigation waters with anhydrous ammonia is possible if certain requirements are met. These are:

1/Adapted by Engineers J. V. Walker and W. R. Morrison, Office of Chief Engineer, Denver Colorado, from Division of Research Report ChE-79, "Field Technique for Sealing Leaky Concrete Pipelines with Ammoniated Irrigation Waters," Messrs. Tanji, Doneen, Kubes, Simmons, OCCS Program, 1968. Available at $0.75 a copy by writing Chief Engineer, Bureau of Reclamation, Code 841, Denver Federal Center, Denver, Colorado 80225.
2/H. V. Eastman, Secretary-Manager, Chowchilla Water District, "Miracles Do Happen," Irrigation Operation and Maintenance Bulletin No. 52.

1. Suitable water composition for calcium carbonate precipitation.

2. Proper flow rate of water to provide sufficient time for precipitated calcium carbonate to enter and fill the cracks in the pipeline.

3. Proper selection of injection rates for anhydrous ammonia and other chemical additives when needed.

4. Control and monitoring of the treatment process.

5. Safety measures.

Suitability of Water for Treatment

For calcium carbonates to precipitate, the water must meet specific chemical requirements. It must contain 50 to 100 ppm (parts per million) calcium; and 150 to 300 ppm or more bicarbonate. For maximum utilization of these chemicals the ratio of calcium to bicarbonate should be 3:1. Also, the magnesium to calcium ratio on a ppm basis should be less than 0.6; otherwise, the tendency for calcium carbonate to precipitate is reduced. A chemical analysis of the water is suggested to determine the calcium, bicarbonate, and magnesium content before making plans to treat a pipeline.

If the chemical analysis shows the water to be low in calcium content, calcium chloride ($CaCl_2$) or gypsum ($CaSO_4 \cdot 2H_2O$) can be added to raise the calcium level. For waters low in bicarbonate, commerical grade sodium bicarbonate ($NaHCO_3$), more commonly known as baking soda, can be added to the water to increase the bicarbonate content.

Chemical Reactions

The chemical reactions for calcium carbonate precipitation are as follows:

1. $$\underset{\substack{\text{(ammonia)}\\ \text{(gas)}}}{NH_3} + \underset{\text{(water)}}{H_2O} \longrightarrow \underset{\substack{\text{(ammonium)}\\ \text{(hydroxide)}}}{NH_4OH}$$

2. $$\underset{\substack{\text{(ammonium)}\\ \text{(hydroxide)}}}{2NH_4OH} + \underset{\substack{\text{(calcium)}\\ \text{(bicarbonate)}}}{Ca(HCO_3)_2} \longrightarrow$$

$$\underset{\substack{\text{(ammonium)}\\ \text{(carbonate)}}}{(NH_4)_2CO_3} + \underset{\substack{\text{(calcium)}\\ \text{(carbonate)}}}{CaCO_3\downarrow \underline{1/}} + \underset{\text{(water)}}{2H_2O}$$

1/Precipitates out of solution. Insoluble in water.

Adjusting Waterflow Rate

In the chemical sealing of concrete pipelines, the rate of waterflow should be adjusted to obtain adequate precipitation time in the pipeline being treated.

The rate of flow for treatment of a pipeline depends upon several factors:

1. Diameter of pipe.

2. Length of pipe to be treated.

3. The length of time precipitation will take place.

Precipitation will usually occur over a period of 4 to 10 hours, although at times it may continue for several hours more. It is suggested that for purposes of calculation a precipitation time of 8 hours be used.

In the case of a long pipeline, it will be necessary to either (a) treat the line by sections or (b) adjust the rate of flow so that the treated water will pass through cracked reaches within the recommended 8-hour period. For example, if precipitation does stop at the end of 8 hours, in the case of a pipeline through which water requires 20 hours to flow, the lower end will obviously not receive treatment for the last 12 hours unless adaptation is made.

Since the chemistry of calcium carbonate is very complex, and the rate of precipitation can not be readily predicted, the precipitation time is only an estimate. Also, calcium carbonate may continue to precipitate beyond the length of pipe to be treated. For this reason, it is suggested that the treated water be allowed to continue flowing downstream to obtain as much benefit as possible before disposing of it. It must also be kept in mind that it may precipitate on valves or other equipment where it can be harmful.

Table 1 on page 10, has been prepared as an aid in selecting the rate of flow in a full pipeline for various diameters and flow units.

Material Requirements

Injection rate for anhydrous ammonia. - For most treatment operations, the application of 100 ppm of anhydrous ammonia is sufficient to precipitate calcium carbonate. At this concentration, nearly all of the active components in the water will be acted upon to form calcium carbonate. Also, the rate of crystallization will be favorable for sealing action. For these reasons, it is recommended that the starting injection rate of NH_3 be 100 ppm. Photograph 1 at top of next page shows a gage on an NH_3 tank calibrated to release the required amount of anhydrous ammonia.

Photograph 1 - P413-D-63300

The injection rates of anhydrous ammonia in pounds per hour for various flows are given in Table 2, page 11.

Requirements for calcium and bicarbonate. - As stated previously, the water to be treated should have at least 50 ppm of calcium, 150 ppm of bicarbonate, and a magnesium to calcium ratio of 0.6 or less. Many natural waters do not contain an adequate amount of these constituents and, therefore, chemical additives must be placed in the water to be treated.

The injection rates for calcium chloride or gypsum and sodium bicarbonate are listed in Table 3, page 11. Note that the amount listed will increase the calcium and bicarbonate concentration by 10 ppm.

The quantities listed in Table 3 are based on the purity usually available for these chemicals, 80 perecnt for calcium chloride, 93 percent for calcium sulfate, and 100 percent for sodium bicarbonate. If a material of different purity is used, the injection rates should be changed by a factor found by dividing the Table 3 listed purity by the actual purity of material used. (Listed purity ÷ actual purity).

For example, if sodium bicarbonate ($NaHCO_3$) is 90 percent pure, then the rate given in Table 3 would be increased by a factor of 1.11 (100 ÷90) and if calcium chloride ($CaCl_2$) is 90 percent pure, then the rate would be decreased by a factor of 0.89 (80 ÷90).

The choice between using calcium chloride or gypsum will depend on cost, application equipment, and available mixing time in the system. The solubility of gypsum is about 100 pounds per 6,000 gallons of water while calcium chloride readily goes into solution and thus may be easier to use.

Preparation of Materials

Calcium chloride, gypsum, or sodium bicarbonate are usually injected into water as a liquid solution or as a partly dissolved slurry depending upon the solubility of the salt. The solutions or slurries are generally prepared by adding 50 or 100 pounds of the additive to 100 gallons of water and mixing thoroughly in tanks equipped with agitators. A more dilute solution or slurry may be used for lower rates of injection.

Calcium chloride is generally available in granular form, while sodium bicarbonate is available in powder form. Gypsum, a salt of lower solubility, is better used in the powder form rather than granules because the powder form is less likely to clog the injection equipment. O&M Bulletin No. 28 describes various types of equipment for adding gypsum to irrigation water.

Calcium and bicarbonate solutions or slurries should be prepared individually and never together because calcium carbonate can precipitate from such a mixture in the mixing tank.

Introduction of Materials

Anhydrous ammonia, calcium, and bicarbonate salts may be introduced into canals or ditches, air vents, control boxes, or any other open structures. The delivery end of the injection line should be positioned where flow is somewhat turbulent so that adequate mixing will take place.

Anhydrous ammonia is usually introduced at the head end of the pipeline to be treated, or slightly upstream from the pipe entrance. If

Photograph 2 - P413-D-63301

the water is to be enriched with calcium or bicarbonate salts, the injection sites must be located upstream from the site of anhydrous ammonia injection. It is necessary that the materials be completely dissolved and mixed in the flowing water before reaching the anhydrous ammonia injection site. When both calcium and bicarbonate additives are required for effective precipitation, the materials are introduced as calcium, sodium bicarbonate, and anhydrous ammonia in that order.

Photograph 2 on the preceding page, shows sodium bicarbonate being introduced into a lateral at a turnout structure, while in the background NH_3 is being introduced into the same lateral through a pipe vent.

Selection of Length of Time for Treatment

The length of application time and extent of treatment will depend upon several factors such as size of cracks, chemical action, cost of material and application, etc. After the results of a trial run have been observed over a period of several days, guidelines can be established for local conditions.

Experience, so far, has indicated that 24 to 96 hours is the usual length of time for most treatments, depending on the severity of leakages.

In some instances the drying up of ponded water from leaks will be an indicator of success in sealing cracks.

Special Conditions of Treatment

If possible the pressure in the pipelines being treated should be increased so that the flow of the treated water will be from the pipeline, through the cracks, to the surrounding area. This may be accomplished by increasing the water level in system to near ground level at an open turnout.

Control and Monitoring of Treatment

Essentials of successful treatment include:

1. Adjusting injection rates of the anhydrous ammonia, calcium, and bicarbonate. - Milkiness in ammoniated waters is a sign of spontaneous precipitation necessitating a decrease in anhydrous ammonia injection rates. Hard precipitates of calcium carbonate are formed at a slow rate and are not readily scraped off coated surfaces.

2. Monitoring the pH[1] of the water. - Under most conditions, calcium carbonate begins to precipitate from waters in very small

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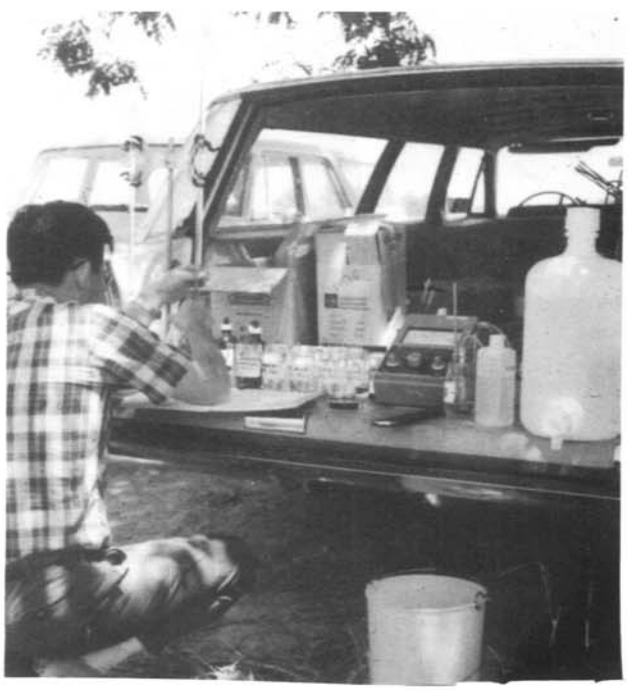
1/pH is a measure of alkalinity or acidity of a solution. A pH of 7 is neutral, over 7 is alkaline, under 7 is acidic.

amount at a pH of 8.4 (the level of pH at which the carbonate ion exists in solution). Water should be treated with anhydrous ammonia until the pH ranges from 9.0 to 9.8 for clear water and 9.5 for ordinary canal water. Because suspended materials such as silt, clay, algae, and other impurities in canal water tend to trigger spontaneous precipitation of calcium carbonate, the pH must be kept below 9.6. When the pH rises above 9.6 in surface waters the injection rate of anhydrous ammonia must be reduced. The pH can be measured with pH (Hydrion) paper, which is readily available. The paper should be wet sufficiently long for full color development and compared with standard color-pH chart provided with the pH paper. Paper covering the pH range of 8.2 to 9.8 is recommended.

3. Sampling and chemical analysis of treatment water. - Periodic sampling from stations downstream from the anhydrous ammonia injection site and on-site chemical analysis for calcium and other constituents provide the rate of precipitation and may suggest adjustment in calculated injection rates to attain optimum chemical conditions. Procedures for on-site chemical analysis are described in detail in ChE-79. (See footnote on page 1). Photograph 3 below, shows water being checked on site for calcium and magnesium content. However, this procedure is not always necessary.

4. Experience. - It is suggested before embarking on major treatments that operators undertake small-scale tests to gain experience and to observe the formation and effect of the calcium carbonate.



Photograph 3 - P413-D-63302

Safety Measures

Safety measures should be observed in any treatments attempted:

1. Caution is necessary in the handling of ammonia gas since it is highly irritating to the eyes and mucous membranes and can cause death or permanent injury after very short exposure to small quantities.

2. Caution is required in the disposal of ammonia-treated water to insure that it does not enter potable water supply systems.

3. Care must be exercised when disposing of ammonia-treated water on croplands. Careful selection of crops that can withstand high concentrations of ammonia is required. Since this will probably vary for each locality, it is advisable to check with water users. A 4-inch application of water treated with 100 ppm of anhydrous ammonia is equivalent to putting on 74 pounds of nitrogen per acre. Thus, the amount of nitrogen applied can be adjusted by the amount of water in an irrigation.

4. Ammoniated water should not be disposed of in waterways or ponds supporting fish and other wildlife unless adequate dilution is made in the receiving water.

5. Ammonia, even in trace amounts, is extremely corrosive to copper alloys often used in hydraulic machinery, heat exchanges, piping, etc.

<u>Summary</u>

The following are the steps to be taken in treating a pipeline:

1. Determine size and length of pipeline.

2. Have water analyzed for calcium, bicarbonate and magnesium and also determine pH.

3. Select flow to travel through reach of pipeline in 8 hours.

4. Plan to use 100 ppm of anhydrous ammonia and determine amount needed.

5. Calculate amount of additive to place in water for:

    a. 50-ppm calcium (minimum)

    b. 150-ppm bicarbonate ions (minimum)

    c. $\frac{\text{Magnesium}}{\text{Calcium}}$ ratio of $\frac{6}{10}$ or less

6. Select injection sites.

7. Select approximate length of time of treatment (usually 24 to 96 hours).

8. Monitor injection process.

9. Provide means for disposing of treated water.

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Example of Pipeline Treatment

This example follows the steps outlined in the summary.

1. The length of the pipeline has been determined to be 4,000 feet and diameter 18 inches. Because there is no intermediate structure in the pipeline, it is necessary to treat the line in one length. The length of time for treatment selected will be 24 hours.

2. Chemical analysis of the water indicates it naturally contains:

   20 ppm of calcium

   100 ppm of bicarbonate

   18 ppm of magnesium

   Note that the calcium content is deficient by 30 ppm, the bicarbonate content is deficient by 50 ppm, and the $\frac{\text{Magnesium}}{\text{Calcium}}$ ratio = $\frac{18}{20}$, or 0.9, which is too high.

3. Determine rate of flow of water to travel through the 4,000 feet of pipeline in 8 hours. From Table 1, the average velocity for 100 gpm in an 18-inch pipe is 456 ft/hr. Therefore, it would normally require 8.8 hours (4,000 ft/456 ft/hr) for water to reach Station 4,000 feet, using precipitation time of 8 hours, then discharge rate must be increased 1.1 times (8.8 hrs/8 hrs) or 110 gpm.

4. From Table 2 calculate the amount of anhydrous ammonia to be used for a flow rate of 110 gpm. The amount of anhydrous ammonia would be 5.5 pounds per hour (1.1 x 5) for an injection rate of 100 ppm.

5. Table 3 is used to calculate the amount of calcium and bicarbonate to be added to the water. From Table 3 the calcium chloride needed would be 1.8 pounds per hour for 10 ppm per 100 gpm; therefore, for adding 30 ppm for 110 ppm, the amount would be 5.9 pounds per hour (3 x 1.8 x 1.1).

   Also, from Table 3 the sodium bicarbonate needed would be 0.7 pound per hour for 10 ppm per 100 gpm; therefore, for adding 50 ppm the amount would be 3.9 pounds per hour (5 x 0.7 x 1.1).

   Checking the $\frac{\text{Magnesium}}{\text{Calcium}}$ ratio after adding calcium:

   $\frac{\text{Magnesium}}{\text{Calcium}}$ ratio = $\frac{18}{50}$ or 0.36 (which is well below 0.6)

Approximate material costs are as follows:

Anhydrous ammonia	$0.07 per pound
Sodium bicarbonate	7.50 per 100 pounds
Gypsum or calcium sulfate	1.00 per 100 pounds1/
Calcium chloride	6.00 per 100 pounds

These costs will vary in different localities. Of course, the quantities used are never as exact as calculated and if gypsum is used in place of calcium chloride, the cost is usually lower.

The estimated material cost for the 24-hour treatment described in the example above would be:

Anhydrous ammonia	$0.07 x 5.5 x 24 =	$ 9.20
Calcium chloride	0.06 x 5.9 x 24 =	8.50
Sodium bicarbonate	0.075 x 3.85 x 24 =	6.90
	Total	$24.60

TABLE 1

Average Velocity of Water for Different Pipe Diameters and Flow Rates

Pipe diameter	Waterflow Rates	
	100 gpm	1 cfs
Inches	Average velocity in feet per hour	
8	2,310	10,320
10	1,470	6,610
12	1,022	4,587
18	456	2,046
24	255	1,146
30	164	735
36	114	510
42	83	374
48	64	286

1/This cost can be as high as $8.00 per 100 pounds depending on purity and refining of gypsum used.

TABLE 2

Pounds of Anhydrous Ammonia Required Per Hour To Add 100 ppm for Different Waterflow Rates

Flow rate, gpm	100	200	300	400	500	600	700	800
Anhydrous ammonia, pounds per hour	5	10	15	20	25	30	35	40
Flow rate, cfs	0.25	0.5	0.75	1.0	1.5	2.0	2.5	3.0
Anhydrous ammonia, pounds per hour	6	11	17	22	34	45	56	68

TABLE 3

Pounds of Chemical Additives Required Per Hour To Increase the Concentration of Calcium and Bicarbonate by 10 ppm for Different Waterflow Rates

Flow rate, gpm	100	200	300	400	500	600	700	800
Calcium chloride $CaCl_2$, 80% purity	1.8	3.5	5.2	7.0	8.7	10.4	12.2	13.9
Gypsum Calcium sulfate $CaSO_4$, 93% purity	2.4	4.7	7.0	9.3	11.7	14.0	16.3	18.7
Sodium bicarbonate $NaHCO_3$, 100% purity	0.7	1.4	2.1	2.8	3.5	4.1	4.8	5.5

Flow rate, cfs	0.25	0.5	0.75	1.0	1.5	2.0	2.5	3.0
Calcium chloride $CaCl_2$, 80% purity	2.0	3.9	5.9	7.8	11.7	15.6	19.5	23.4
Calcium sulfate $CaSO_4$, 93% purity	2.6	5.3	7.9	10.5	15.7	20.9	26.7	31.4
Sodium bicarbonate $NaHCO_3$, 100% purity	0.8	1.6	2.3	3.1	4.7	6.2	7.8	9.3

* * * * *

LOOP OF CHAIN CLEANS TRACTOR-SHOVEL BUCKET1/

A loop of chain, fastened inside the bucket of a big tractor shovel, helps clean out sticky clay material as it loads trucks on a freeway grading project in San Diego, California. The grading contractor is using the tractor shovel and a spread of bottom-dump truck trailers to excavate and haul 3.5 million cubic yards of excess material from one large cut.

This tractor has a shovel with a 10-yard bucket and excavates a wide range of materials, among them a sticky adobe clay found in the upper portions of the excavation. The material began building up in the bucket until the machine had to be stopped periodically while workmen cleaned out the accumulated adobe by hand.

Working with the factory representatives, the contractor came up with the idea of hanging a piece of chain loosely inside the bucket, see photograph above. Workmen welded a pair of heavy steel eyes inside the bucket and opposite each other, then hung a length of heavy chain between them. The chain has enough slack to allow it to swing freely when the load is dumped, keeping the bucket clean - and requiring no maintenance.

1/This article reprinted by special permission from the editor of Contractors and Engineers Magazine, issue dated September 1968.

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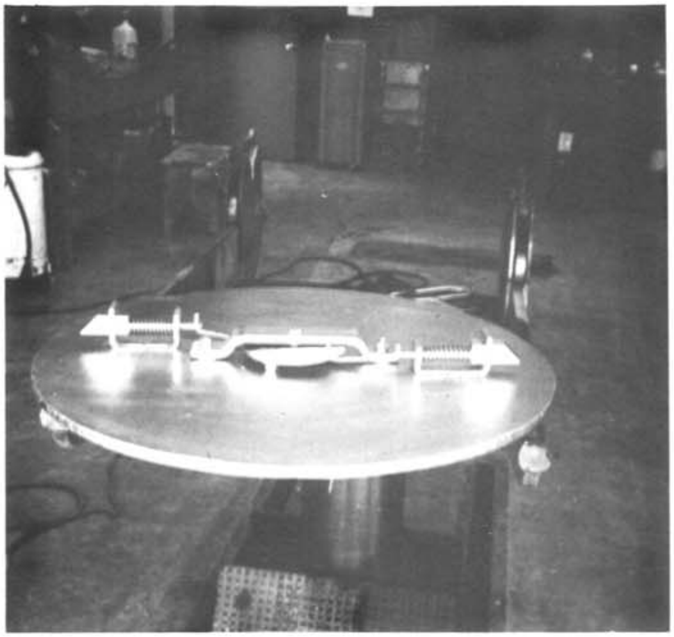
VANDAL-RESISTANT MANHOLE COVER
(Suggestion R5-68S-3)

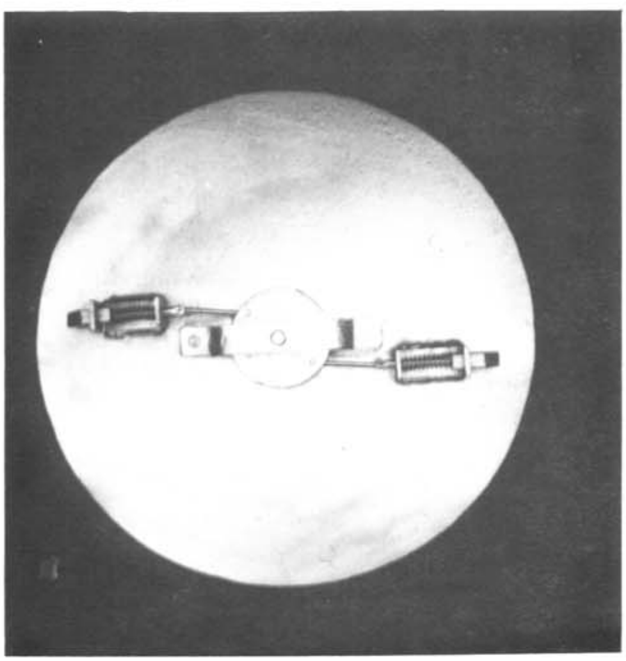
Mr. W. D. Nelson and Mr. H. E. Stanley of the Water and Land Operations Office, San Angelo Project, Veribest, Texas, combined their talents and came up with this very inventive idea for a vandal-resistant manhole cover. Besides the replacement cost of covers lost or stolen, it is essential that trespassers be prohibited from entering the spillway gallery at Twin Buttes Dam and possibly damaging ladders, gates, or gratings; or harming themselves by falling in the unlighted passageway.



Photograph 1 - P825-D-63304

This cover was fabricated in the headquarters shop after several covers with conventional fasteners, including padlocks, had been stolen or thrown into the spillway.

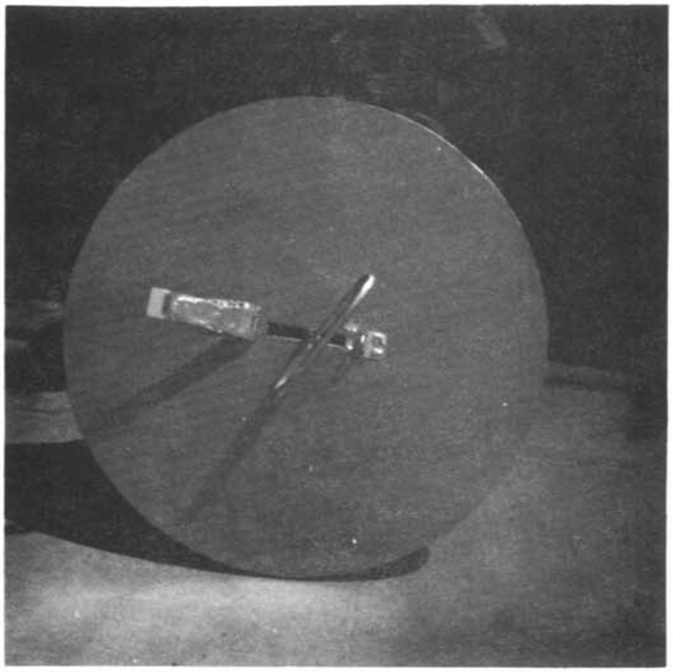
The device is relatively economical to fabricate utilizing plate steel and two heavy-duty barn-door-type latches. Photograph 1 at upper left shows the cover locking assembly, and Photograph 2 at left shows positioning of the cover locking latches.



Photograph 2 - P825-D-63305

A T-key inserted in a slot and rotated about 90° releases the latches and serves as the lifting handle. Photograph 3 on next page shows the top of the cover with the combination lifting handle-key in the unlocking position.

Extra protection is provided by a flap over the key slot secured by a padlock. Photograph 4, also on the next page, shows the cover and

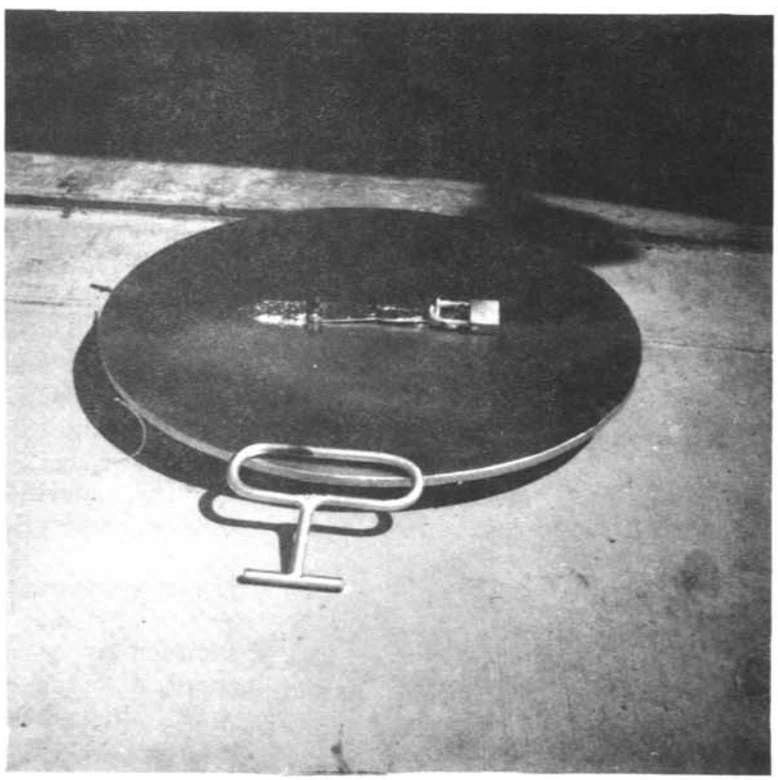


lifting key with key slot covered by the locked hasp. A sketch of the cover and locking assembly can be found on page 15.

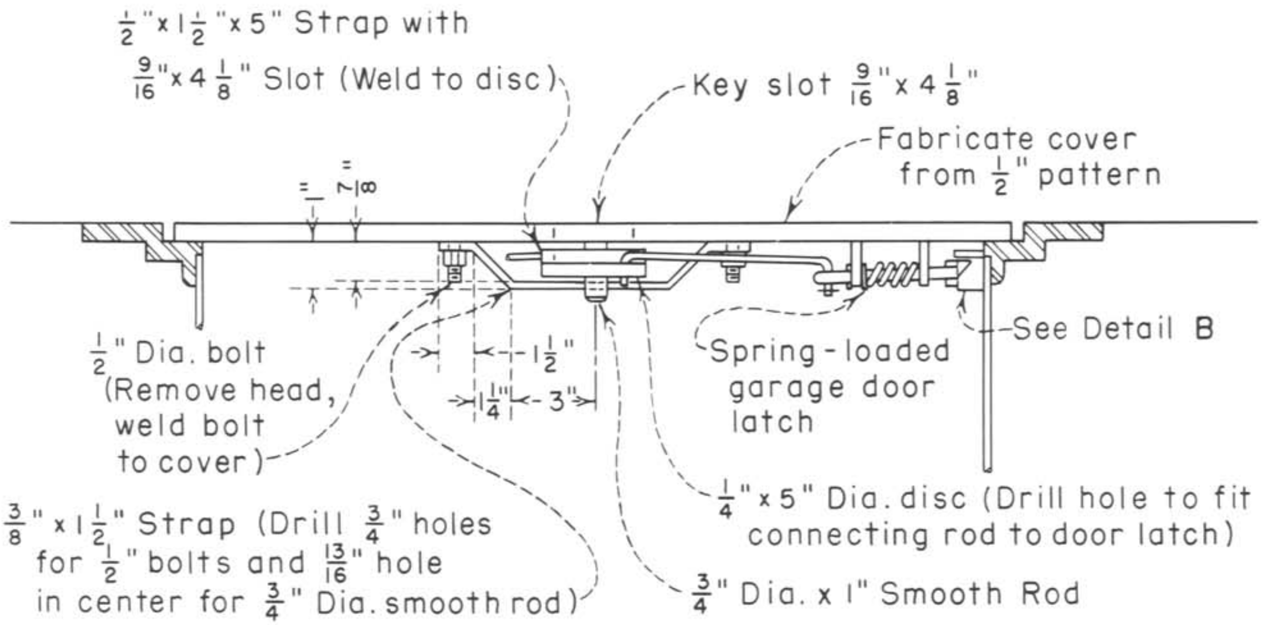
Vandals have attempted entry and did succeed on one occasion to break the hasp from the cover but were unable to remove the cover to gain entry.

If further information is desired regarding this suggestion, please write to the Regional Director, Bureau of Reclamation, Post Office Box 1609, Amarillo, Texas 79105.

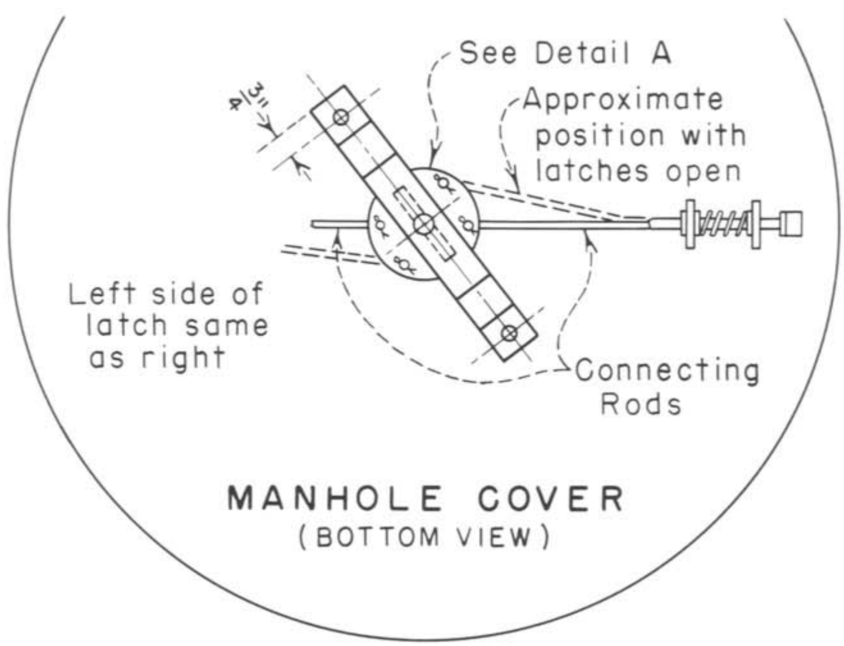
Photograph 3 - P825-D-63306



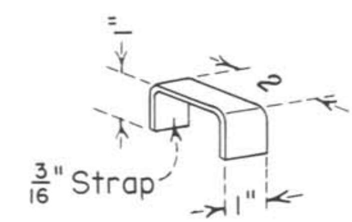
Photograph 4 - P825-D-63307



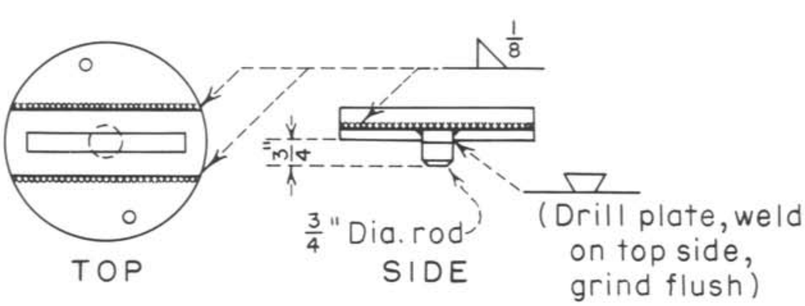
MANHOLE COVER LATCH
(NO SCALE)



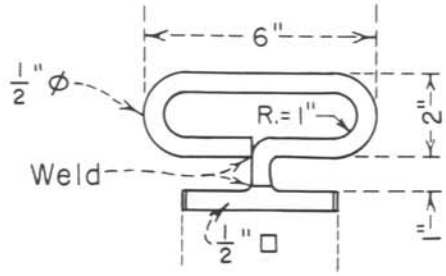
MANHOLE COVER
(BOTTOM VIEW)



DETAIL B
LATCH BOX
(2 REQ'D)
(FIELD WELD TO MANHOLE FRAME)



DETAIL A



KEY AND
LIFTING HAND

AUTOMOBILE SAFETY CHECK RESULTS

Faulty rear lights, headlights and stop lights again ranked one-two-three as the leading causes for rejection of the more than 350,000 cars and trucks failing the 20th annual National Vehicle Safety Check. Turn signals, brakes and tires followed in that order.

Over 4,700 local community groups and government agencies participated in the voluntary program during 1967, chiefly in states not requiring official motor vehicle inspection. Detailed results received from approximately one-third of these individual safety checks were compiled by the Auto Industries Highway Safety Committee, annual sponsors with a leading magazine in cooperation with the Association of State and Provincial Safety Coordinators.

Other safety-related items covered in the bumper-to-bumper checks included the exhaust system, windshield wipers and washers, horn, steering, all glass and mirrors. In the vehicles rejected, a total of 437,771 items were reported "in unsafe driving condition" due to maintenance neglect. The top offenders, rear lights, were noted 88,432 times.

The chairman of the Auto Industries Highway Safety Committee and vice president of marketing for a prominent automobile manufacturing company, says "A burned-out taillight is a minor matter and easily fixed, if it's known about. But the motorist driving a dark road at night minus a taillight could be in for a serious, even fatal, accident. The same is true of any other unsafe driving condition of which the motorist is unaware. This is why our committee for many years has advocated periodic inspection required of all vehicles, and why we are gratified that the National Highway Safety Bureau has included required inspection in its new standards for state highway safety programs."

During 1966-1967, 11 states passed laws requiring periodic inspection of all motor vehicles, bringing the total of inspection states to 31 and the District of Columbia. Other states have such legislation in progress. However, some programs will not become operative until 1969.

Traffic Safety

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MAKING METERS RUN LONGER1/

Fine silt of the Columbia River and heavy irrigation combine to wear out water meters on the Greater Wenatchee Project.

The abrasive, a flour-fine glacial silt from the Canadian Rockies, gets into the bearings and gear-wheels of the district's 500-odd meters. Routinely the meter condition is checked about every 3 years. Heavy water use, however, spins the meter parts faster and they cut out more rapidly, sometimes in the second season.

When this happens the patrolman, taking one of his five-times-a-season readings finds the meter has jammed and stopped, or else its little plastic water wheel is spinning gaily along without affecting the speedometer-like window on top.

The worn drive mechanism is pulled out, a spare installed, and the broken-down unit goes back to the district shop. There Mr. Coy Clark, East Unit irrigation operator, repairs it.

Mr. Clark noticed that the most troublesome part of the meter was a little worm gear - hardly as big as a walnut. The grip and friction between the ridges of the worm and the teeth of a pinion gear would cut away one face of the worm gear spiral thread.

Looking at the assembly Mr. Clark noticed that the other face of the thread was still in factory condition. He turned it end for end so that the good face became the operating surface and - behold! - he had a combination that ran as if new.

This and other handikinks won Mr. Clark a Bureau of Reclamation citation and a raise in pay last season. Mr. Boyd Walter, project engineer, said that Clark's tinkering has saved the district perhaps $1,200 and is being suggested to other districts.

Coy Clark has been with the irrigation project since 1962. He was with the predecessor United Water Company for 15 years before that. All this time he has been concerned with getting water to the people who need it and with watching how they use it after they get it.

Up to this point Mr. Clark says that there hasn't been much need for meters on the East Unit. The pumping capacity has been adequate for demand. Landowners are charged for and entitled to a basic three acre-feet per season. Many get along nicely on this amount.

The East Unit soil is light and not very deep with a porous stratum beneath. So you can put on any amount of water you want. After the

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1/Reprinted from the Wenatchee Daily World, with special permission from the editor.

soil is full, the excess just keeps on going down. So many use another foot of supplemental water, which takes a different rate. Some even use excess water, up to twice the basic amount.

When the other 25 percent of the district is developed, the meters will show their real value, Clark said. The system was designed to furnish 4 acre-feet to the project. When all the land is in use clear out into marginal areas, there won't be as much cushion in the pumping capacity. Deliveries and use will have to be smoothed out to give everyone his share. The meters will be needed then to make sure this happens.

The district force gets a foretaste of this condition now, sometimes, when field men tell orchardists that next week is time to apply a certain spray. They shut down their sprinklers in unison to get their spraying done, then start irrigating again with dramatic results on the telemetering equipment in the district office. Then that powdered quartz in the water starts rubbing metal off the steel gears of Clark's meters again.

* * * * *

SAFETY BELT STILL TOP LIFESAVER

Speaking at the site of the National Safety Council's Winter Driving Tests at Stevens Point, Donald Huelke, Professor of anatomy at the University of Michigan, said that instead of demanding more safety features in cars, the public should make use of the features already available. Stating that the safety belt still is the key to saving lives, he said that in his recent studies of 139 fatal accidents, 40 percent of the 177 persons killed would have been saved had they been wearing lap belts. Another 13 percent would have been saved if shoulder belts had also been used. "We could save the lives of one-half of the people killed in crashes in the United States if everyone wore seat and shoulder belts," he said.

* * * * *

<u>Hit the Brakes!</u> How good are winter tires with metal studs? Under some conditions - icy roads at zero degrees or dry roads at any temperature - they aren't significantly better than ordinary tires, Cornell University scientists have found. But under right conditions - icy pavements at around 32° - stopping distances are cut by 30 percent.

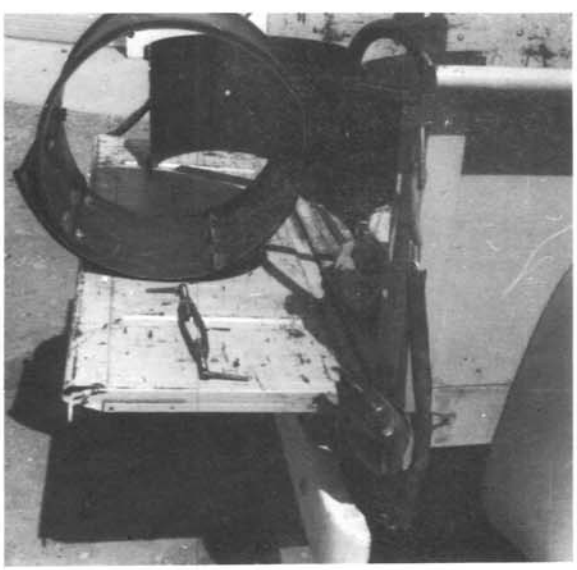
* * * * *

HINGED METAL REPAIR SLEEVE
FOR CONCRETE PIPE
(Suggestion R4-68S-7)

Repair of leaks in pipelines are generally more accessible and easier to make from the outside of the pipe. However, there are locations along pipelines such as under roadways or under structures, in areas of high ground water, etc., and where it is not practical or economical to repair the leak from the outside. In such cases it would be desirable to make the repair from inside of the pipe. Mr. Herbert L. Davis, of the Hammond Project, New Mexico, has developed a method of repairing pipe leaks from inside the pipe, that has proven to be very successful in a number of emergency repair jobs on the project's 21-inch pipe line.

Photograph 1 - P343-D-63308

The repairing of these circular cracks in the West Highline pump discharge line (21-inch-diameter concrete pipe), Hammond Project, New Mexico, was accomplished by the use of hinged metal sleeves placed inside the pipe. As the method of repair has effectively prevented leaking from the cracks for an entire irrigation season, (about 7 months of operation), it may satisfy a similar need on other projects, particularly, where only the inside of the pipe is accessible for repair, and/or when emergency type repairs are required. An overall sketch of the hinged metal sleeve is shown on page 21.



Photograph 2 - P343-D-63309

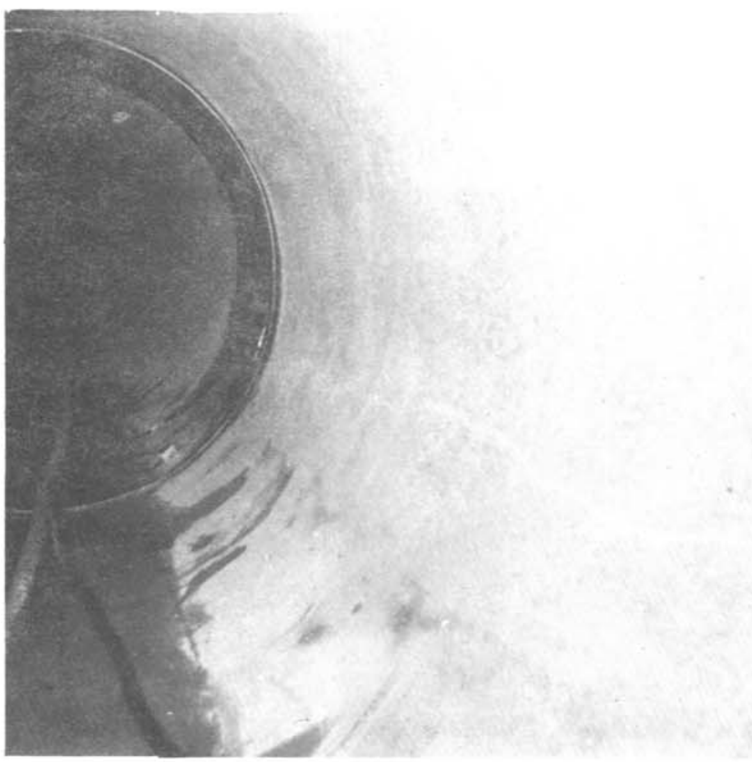
Photograph 1, upper left, shows the hinged metal sleeve fabricated from 12-gage sheet metal. Note the removable turnbuckle which is used to expand sleeve into full open position. A half section of a second sleeve, standing in

a vertical position, is visible in the background, also note the 1/2- by 1-inch rubber gaskets at top and bottom. A locking key can also be seen projecting beyond the edge of the sleeve near the center of the turnbuckle.

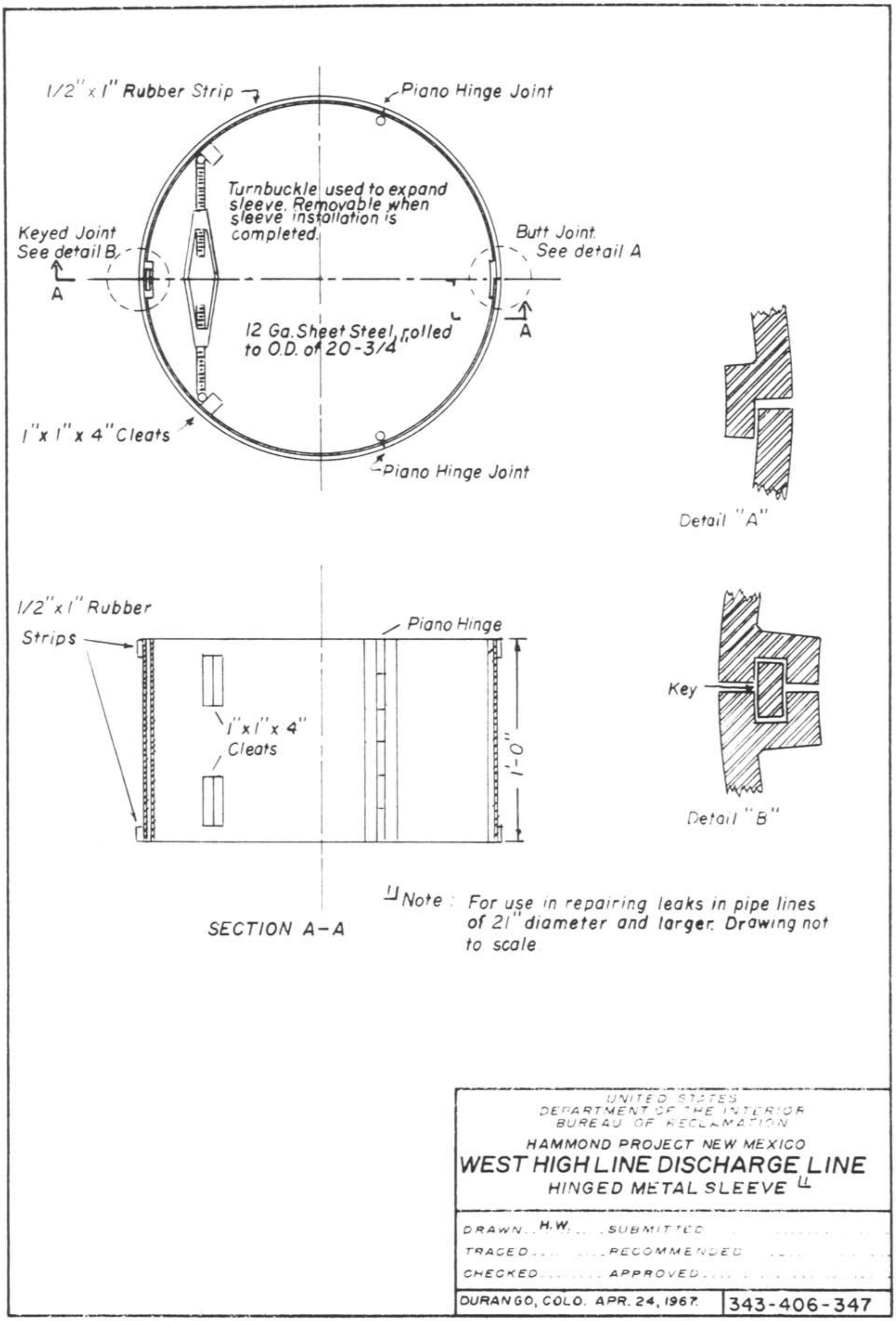
Photograph 2, on the preceding page, shows sleeve in a partially collapsed position. Photograph 3, at left, shows the two halves in a fully collapsed position. Piano hinges are used near the center of each half section. Photograph 4 below shows the hinged metal sleeve installed inside a 21-inch-diameter concrete pipe.

Photograph 3 - P343-D-63310

For more information regarding this suggestion, you may write to the Regional Director, Bureau of Reclamation, Post Office Box 11568, Salt Lake City, Utah 84111.



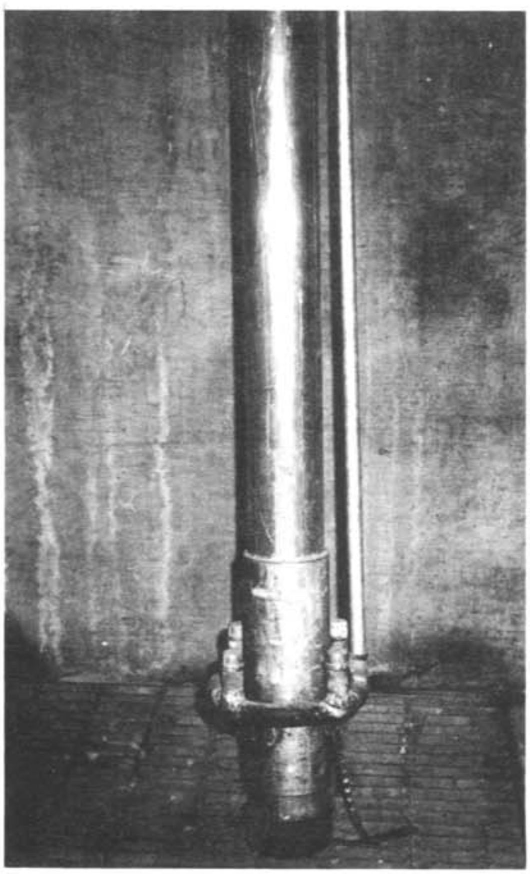
Photograph 4 - P343-D-63311


1/2" x 1" Rubber Strip
Piano Hinge Joint
Turnbuckle used to expand sleeve. Removable when sleeve installation is completed.
Keyed Joint
See detail B
Butt Joint.
See detail A
A
A
12 Ga. Sheet Steel, rolled to O.D. of 20-3/4"
1" x 1" x 4" Cleats
Piano Hinge Joint
Detail "A"
1/2" x 1" Rubber
Strips
Piano Hinge
1" x 1" x 4"
Cleats
1'-0"
Key
Detail "B"
SECTION A-A
Note: For use in repairing leaks in pipe lines of 21" diameter and larger. Drawing not to scale
UNITED STATES
DEPARTMENT OF THE INTERIOR
BUREAU OF RECLAMATION
HAMMOND PROJECT NEW MEXICO
WEST HIGH LINE DISCHARGE LINE
HINGED METAL SLEEVE
DRAWN H.W. SUBMITTED
TRACED RECOMMENDED
CHECKED APPROVED
DURANGO, COLO. APR. 24, 1967.
343-406-347

SEALING SUBMERGED GATES AND VALVES
(Suggestion No. R6-68S-58)

This device for sealing submerged gates and valves was suggested by Gilbert D. Davis, Project Superintendent, Canyon Ferry Project, Helena, Montana, and built under his direction and guidance. The idea works, and is used to obtain a final tight seal each time the emergency gates at a dam are closed.

The Sawdust gun device, in the photograph below consists of a 4-inch pipe about 6 feet long, capped at the top end and fitted with a hose connection for compressed air. The lower end is fitted with a cap held in place by friction clips so it can be blown off by air pressure. The cap is chained to the gun body for safekeeping. Just above the cap is a 1/2-inch circular pipe manifold fitting around the 4-inch pipe. There are four nipples welded into the manifold, pointing upward. Each nipple is capped and each cap has a 1/8-inch hole drilled in it. The manifold is connected to a verticle pipe fastened to the side and extending to the top of the gun. This pipe is also connected to an air hose.



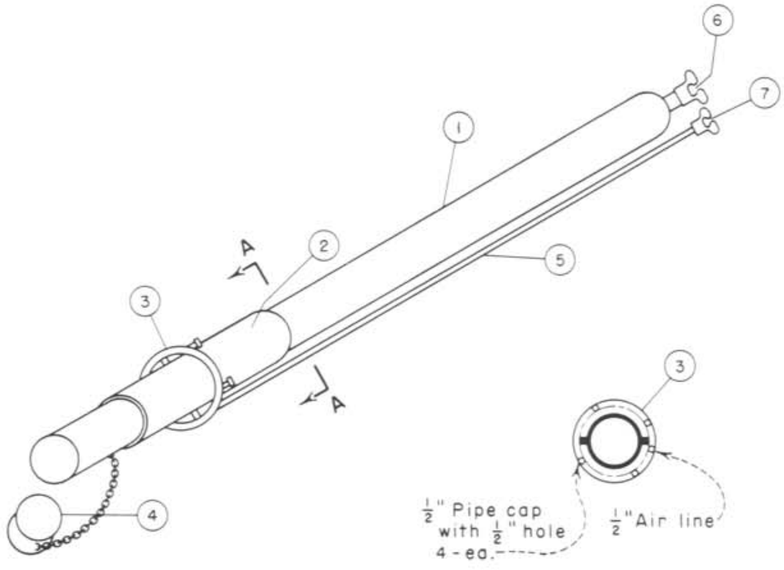
Operation of Gun

A sketch and a parts list for the gun will be found on the following page. Two air hose connections, Parts 6 and 7, on the sketch are used to lower the gun to the water surface. Air is turned into the manifold and the gun is lowered cap first into the water, just ahead of the gate. Air from the four jets helps pull the gun down to the desired elevation and when gun is in position, a small amount of air through the jets help to hold the gun in position. Air is also turned into the coupling (Part 6 in the sketch) through the main tube, dislodging the cap and ejecting sawdust into the water. This device can be quickly returned to the surface by discharging air through the main tube while the holddown jets are shut off.

Advantages of Sawdust Gun

The diffused sawdust above the gate is drawn into cracks or

1. 4" O.D. Aluminum sprinkler pipe 6" long.
2. 4" I.D. Steel pipe 12 $\frac{1}{2}$" long for weight.
3. Circular air manifold ($\frac{3}{4}$" pipe) with 4 - jets.
4. Cap with spring friction clips.
5. $\frac{1}{2}$" pipe airline to circular manifold.
6. Twist lock air coupling to $\frac{3}{4}$" pipe.
7. Twist lock air coupling to $\frac{1}{2}$" pipe.



SECTION A-A

holes where leakage is occuring and plugs these areas. As the sawdust swells, it seals more tightly.

This piece of equipment was developed in an effort to eliminate the use of cinders or abrasive-type materials that were being used as a sealant. As sawdust is not abrasive, it can be safely used to seal equipment headgates or stoplogs. Only the amount of sawdust required to make the seal will remain below the surface. This is an advantage over some other heavier and abrasive-type materials that have been used in considerable quantities to effect a seal, as a great deal of this is floated into shaft packings and machined areas causing damage.

The sawdust gun is light and can be used easily by one man at any location where an air supply or portable compressor is available. Any sawmill produces sawdust that is an ideal mixture of fine and coarse materials. In one typical test, the sawdust gun reduced an estimated flow of 40 to 50 gallons per minute from a 12- by 22-foot fixed wheel gate, to a mere trickle. This was done using only two tubes of sawdust. Considering the size of this gate and the fact that it was 90 to 100 feet below the water surface, this gun proved to be a very real effective maintenance tool.

If additional information is desired regarding this suggestion, please write to: Regional Director, Bureau of Reclamation, Region 6, Post Office Box 2553, Billings, Montana 59103.

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DREDGER MODIFICATION
(Suggestion No. R5RG-67-12)

Here are two very practical ideas that were presented by Mr. Sherman C. Scyrkels, of the Las Cruces Irrigation Field Branch, Region 5, Las Cruces, New Mexico, to eliminate excessive wear to various parts of a dredger. While these dredges are not widely used now, this idea may be of interest to those still having them in service and could have some practical application wherever chain drives are used on machinery subject to excessive wear in mud and water.

Photograph 1 - P23-D-63312

In the normal operation of the dredger it was discovered that a considerable amount of wear was caused by the buckets and chains dragging over the bottom standard crossarm and wearing the bottom trip of the buckets and also the crossarm. To alleviate this problem a spacer, or a piece of 4-inch channel steel was installed to the support of the top bucket roller. This raised the bearings and shaft so that the bucket roller carried the buckets over the bottom crossarm without touching it, thereby eliminating wear on both the crossarm and the bucket bottom trips. See Photograph 1 at left.

Photograph 2 - P23-D-63313

Mr. Scyrkels also found that the chain carrying the buckets became worn so that it caused wear to the arm of the hydraulic ram of the bucket boom to such a degree as to require replacements at 6-month intervals.

In order to eliminate this excessive wear, idler rollers were devised and installed, one on either side of the crossarm at the end of the boom. The rollers were supported by triangular standards fabricated from angle iron scraps. Discarded tractor crawler rollers were used and the bearings supplied with pressure grease fittings, as shown in Photograph 2.

GPO 849-424