Department of the Interior
Bureau of Reclamation

OPERATION AND MAINTENANCE EQUIPMENT AND PROCEDURES

RELEASE NO. 45

July, August and September 1963

CONTENTS

Cover Sheet. A reach of 2-inch-thick, slip-formed, portland cement concrete lining placed by the Arch-Hurley Conservancy District on the Tucumcari Project, New Mexico, as a part of a lateral rehabilitation and betterment program.

OPERATION AND MAINTENANCE EQUIPMENT AND PROCEDURES
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INTRODUCTION

The Operation and Maintenance Equipment and Procedures bulletin is published quarterly, for the benefit of irrigation project operation and maintenance people. Its principal purpose is to serve as a medium of exchanging operation and maintenance information. It is hoped that the labor-saving devices or less costly equipment and procedures developed by the resourceful water users will be a step toward commercial development of equipment for use on irrigation projects in a continued effort to reduce costs and increase operating efficiency.

This issue, Release No. 45, includes a supplementary report on the use of cathodic protection to protect submerged metalwork, page 1; an article on the rehabilitation of laterals on the Tucumcari Project, New Mexico, by lining with slip-formed, portland cement concrete, page 10; some helpful hints on mechanical maintenance; and several ideas of the National Park Service that appear to have adaptability to irrigation operation and maintenance work.

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

CATHODIC PROTECTION--A SUPPLEMENTARY REPORT
All-American Canal System
Boulder Canyon Project

Release No. 28 of the Operation and Maintenance Equipment and Procedures bulletin, for April, May, and June 1959, presented the article "Cathodic Protection of Submerged Metalwork," by L. R. McGlocklin, General Superintendent of the All-American Canal Section, and C. H. Youngstrom, Senior Electrical Engineer, Planning and Power Department, of the Imperial Irrigation District. The article described the cathodic methods being used by the Imperial Irrigation District in southeastern California to protect submerged metalwork in this large irrigation project constructed by the Bureau of Reclamation, but now operated by the district.

There has been great interest in the cathodic protection of metalwork on our irrigation projects, as there has been elsewhere. In Irrigation Operators' Workshop discussions held in the Chief Engineer's Office in Denver in the late fall of 1962, we were fortunate in being brought up-to-date on the performance of the cathodic protection systems employed on the All-American Canal System by Mr. O. L. Fudge, Manager of the Imperial Irrigation District's Water Department.

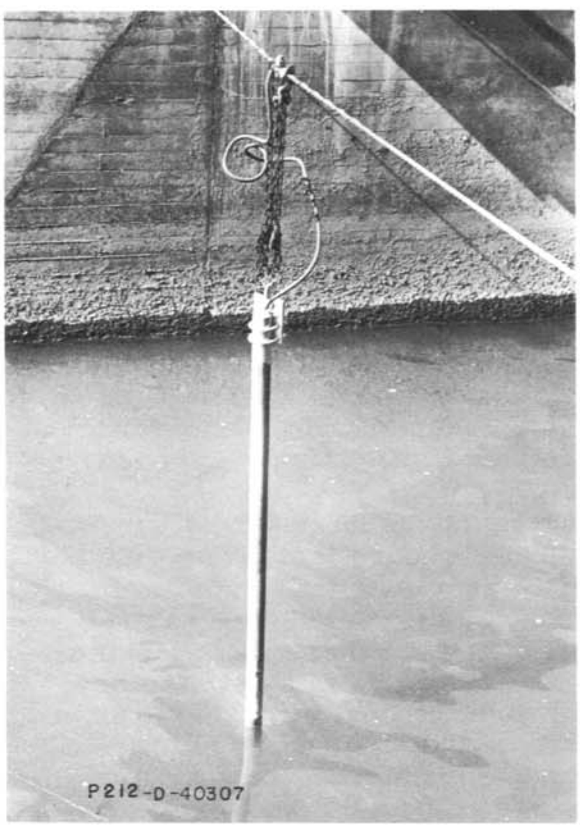


Photo No. 1

The protection of submerged metal against corrosion or electrolytic deterioration continues to be a major maintenance item on the canal system and the coating of metal surfaces to insulate them from the water continues to be a widely used method of accomplishing the needed protection. Cathodic protection, however, has been successful and over the last few years some problems have been corrected.

Type of Anode

The previous article in Release No. 28 mentioned the experimentation with various materials as anodes. A high-silicon, cast iron anode that was found to have a very low rate of dissipation has been adopted by the Imperial Irrigation District and now is being installed as replacement becomes necessary. Photograph No. 1 at left shows one of

Photo No. 2

the anodes of this type with an adjustable chain suspension, where it is being used to protect a bypass gate in the All-American Canal headworks. The detail of the connections and method of suspension are shown. The anodes are 2 inches in diameter, 60 inches long, and weigh about 48 pounds. Their cost continues to be about $19 per anode, and greater mechanical strength and longer life have contributed to their selection over other materials for use on the All-American Canal System.

Desilting Works

As mentioned in the previous release, the desilting works for the All-American Canal are composed of three large basins, with each basin divided in half by an influent channel. The south half of one of the dewatered basins is shown in Photograph No. 2. Also shown are the clarifiers and the anodes and supporting line of the cathodic protection system. In addition, there are numerous underground sludge lines, waterlines and metal conduits. The desilting equipment was exposed to the weather for about 9 years before being put into service. The equipment was submerged for about 3 years before experimentation with cathodic protection was begun.

The 72 clarifiers installed in the desilting basins have a total submerged steel surface area of about 200,000 square feet. The original coating on the desilting basin clarifiers was a coal-tar enamel. In 1952 the coating was judged to be in fair condition with bond to the steel also fair. Extensive cracks were noted but there was no extensive corrosion. The metal surfaces continue to be in a satisfactory condition with cathodic protection, although the cost of protection for the year 1961 was less than $2,000, including about $500 for power. This amounts to about 1 cent per square foot per year for the metalwork being protected. As pointed out in the previous article, the estimated cost of sandblasting and recoating this complicated machinery would be approximately $300,000.

Also as previously reported, numerous failures had occurred in the sludge lines, waterlines, and metal conduits under the desilting basins. Electrolysis was determined to be the prime cause of trouble and, as a result, the protective cathodic system was expanded to include anodes buried in the basin floor. There now have been no additional failures in the underground piping for the past 5-1/2 years.

New River Siphon

Some changes have been made in the cathodic protection system of the New River Siphon, which consists of two steel barrels, each 15 feet 6 inches in diameter with an overall length of 476 feet. Water flowing through the siphon has a velocity of about 7 feet per second.

Two types of anodes and systems originally were used to protect the siphon barrels. The anodes in the right or west barrel is magnesium and depends on galvanic action between the magnesium of the anode and the steel barrel for cathodic protection.

Regulation of the current is provided by an external resister. New sections of magnesium rods are spliced in as required. About 34 pounds of new magnesium rod are required per year. At 96 cents per pound, the cost for rod replacement is about $33.

The protection of the left or east barrel originally consisted of an impressed current system and a 7/8-inch-diameter steel rod anode, with current provided by a rectifier. This anode lasted from 1951 to 1959, when it was replaced by a commercial type series of high-silicon, cast iron anodes, 2 inches in diameter and 9 inches in length, strung horizontally at 4-foot centers, Photograph No. 3.

Photo No. 3

Photograph No. 4, on the following page, is a detail view of one of the anodes secured to the steel cable catenary which has been enclosed in a plastic tube. The cost of the new installation, exclusive of steel catenary cable and cable supports which were

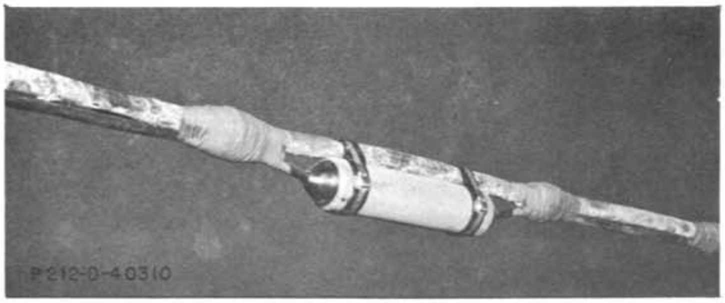


Photo No. 4

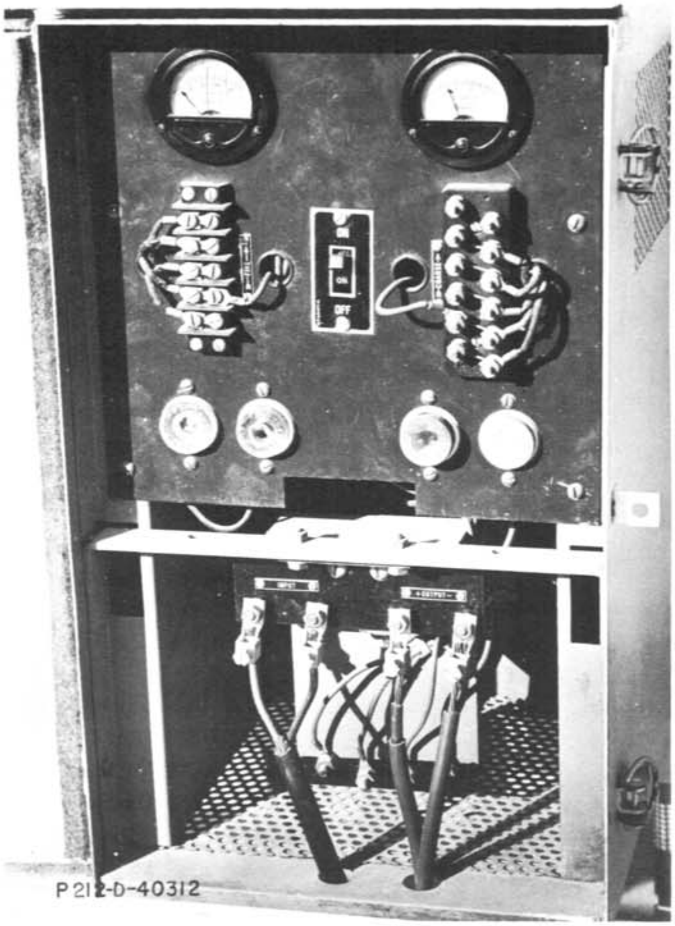
not replaced, was $1,116 for labor and $896 for parts. The total cost of $2,012 amounts to an investment of about 11 cents per square foot of area to be protected. The annual cost for current is negligible, amounting to about $2.45 for 98 kwh of power, or the equivalent of burning a 60-watt light bulb 4 or 5 hours per day for 1 year. Subsequent annual inspections have shown the dissipation rate of the high-silicon, cast iron, anodes to be practically nil.

District experience continues to show that the protection afforded the siphon barrels by either the impressed current system with cast iron anodes or the galvanic system with magnesium anodes is equal and sufficient. A typical view of the excellent protection afforded is shown in Photograph No. 5. However, because of the lower maintenance cost and longer life expectancy of the cast iron anode, and considering that the initial cost for material and installation were nearly the same for both barrels, the District believes the cast iron anode system will prove to be the most economical.

Photo No. 5

Inspections

As mentioned in the previous article, a typical impressed current cathodic protection system employs a disc-type or plate-type rectifier for converting the usually available alternating current to direct current. The rectifier unit, Photograph No. 6 contains a transformer to reduce the input voltage to 20 volts or less. Tap-changing links or rheostats to adjust the voltage are provided, as well as fuses or circuit breakers to protect the equipment from overload. In addition, the rectifier unit contains a voltmeter and an ammeter for convenient routine inspection by maintenance personnel and a record card has been provided for noting readings and condition of the system each month.



Additional Installations

Since publication of the previous article, the District installed in 1960, a cathodic protection system for three major check structures on the East Highline Canal, providing anodes both upstream and downstream from the radial gates. A typical installation is shown in Photographs No. 7 and 8 on the following page. These structures have a total of 17 radial gates about 12 feet wide by 10 feet high. The total cost including materials, labor, transportation and miscellaneous was $2,452 or $144 per gate.

The electric current consumed for each of these check structures is at the rate of about 11 watts at 5.5 volts and 2.0 amperes. Assuming 50 percent efficiency, this would be at the rate of 22 watts for a total of 193 kwh per year. Assuming a cost of 1.8 cents per kwh, the annual power cost for a six-gate structure would be only $3.37 or 58 cents per gate.

Trouble with Chlorine Gas

Chlorine gas is generated by the positive current flowing from an anode. The District has learned that a wrapping or covering on an impressed current anode tends to trap the chlorine gas, which is highly corrosive to the anode.

The first experience was with the cast iron anodes buried horizontally in the desilting basin floor. In an attempt to provide a waterproof connection, the lead wire connection and head of the anodes were taped in the normal manner and wrapped with linen covered by a bitumastic compound. Early failures lead to the discovery of the deterioration caused by the entrapment of chlorine gas. Excavated sand had been used to backfill the anodes in the original installation; however, this too, tended to retard the dissipation of chlorine gas. The condition was corrected by encasing

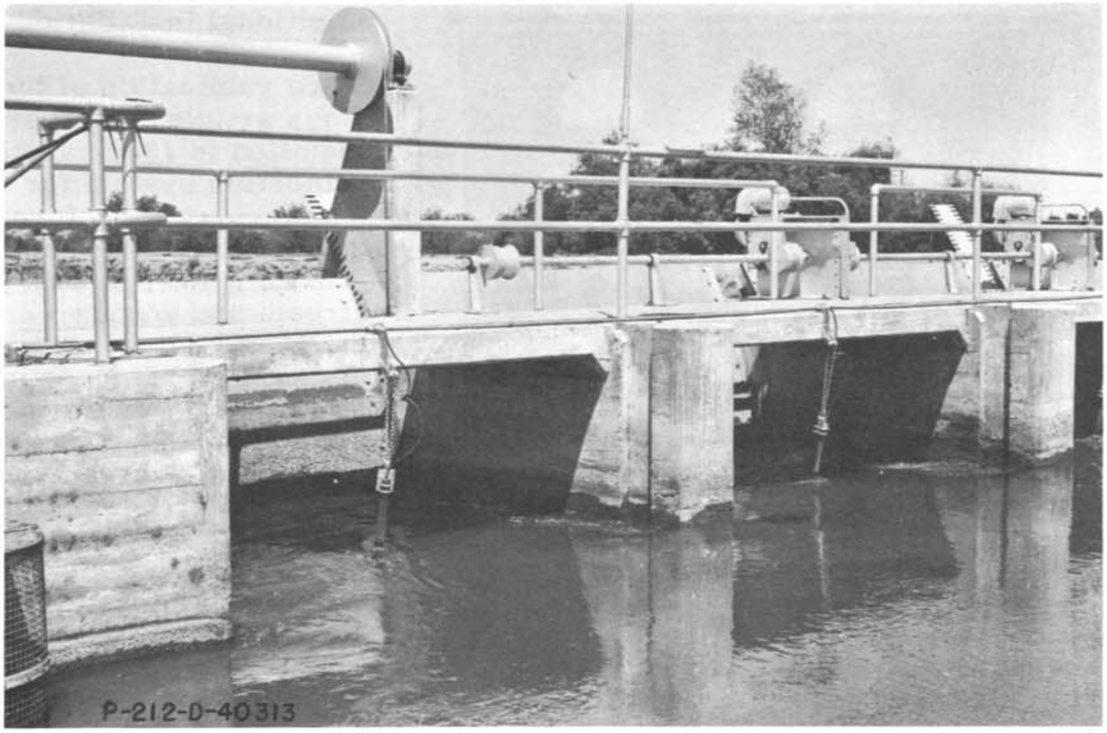


Photo No. 7

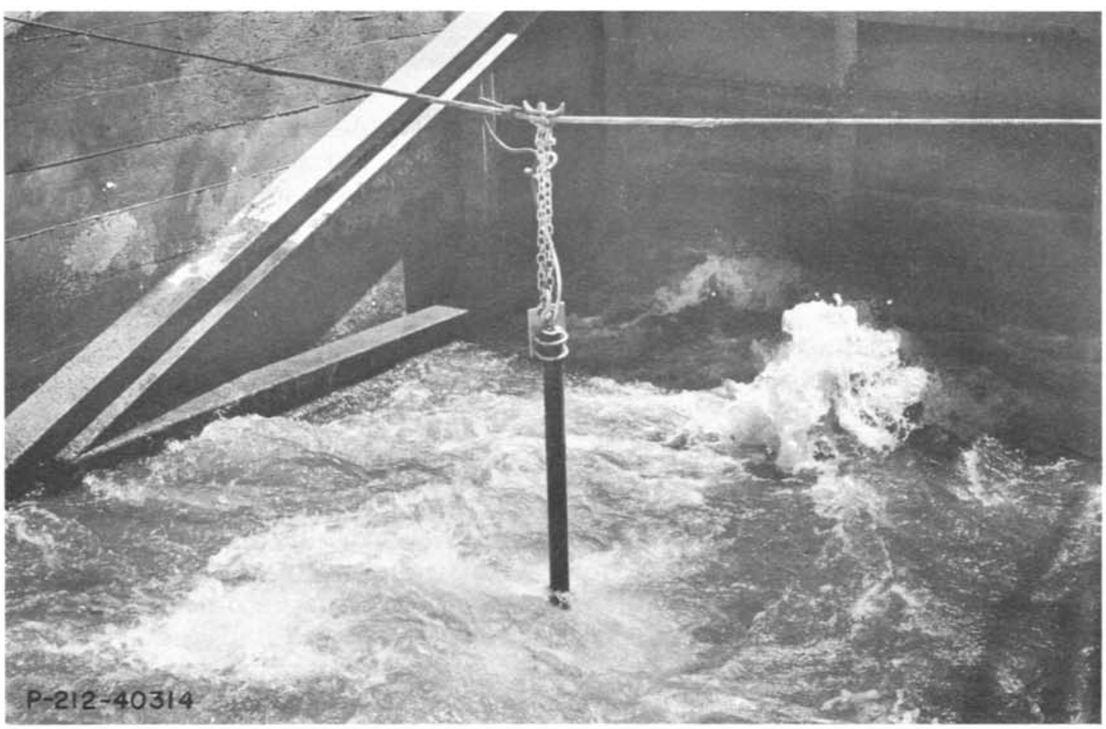


Photo No. 8

the lead wire connection in epoxy resin using a plastic tube mold; and by providing a coke breeze backfill for the entire anode and its connection.

The second experience was in the new high-silicon, cast iron anode system for the left barrel of New River Siphon. In this instance, the individual anodes had been secured to the plastic-covered catenary cable by wrappings of tape at each end and by a stainless steel clamp. Subsequent inspection revealed the failure of a number of these clamps caused by chlorine gas entrapment.

Effects of Cathodic Protection on Reinforcing Steel in Concrete

It has been noted in determining the correct protective current for various structures that the amount of reinforced concrete in a given structure has a noticeable effect on the final current requirement. With this in mind, tests are being conducted at the South Alamo turnout on the All-American Canal for the purpose of determining the effects of cathodic protection currents on embedded reinforcing steel in concrete. These tests were initiated in January 1961.

Two types of tests are being conducted as follows:

1. To determine if protective current will cause damage to an ungrounded bar of reinforcing steel in concrete.

2. To determine if protective current will cause deterioration of the bond between concrete and reinforcing steel.

After 18 months, a test cylinder receiving an average of 66 milliamperes per square foot was removed and broken open. In this time no corrosion was noted on the ungrounded bar and no visible deterioration of concrete bond to steel was evident on the bar under protection. The tests on the remaining cylinders will be continued.

Conclusions

We appreciate the efforts of L. R. McGlocklin, C. H. Youngstrom, and O. L. Fudge of the Imperial Irrigation District for the excellent summaries of the experience with cathodic protection of submerged metalwork. The protection being afforded such metalwork undoubtedly has decreased metal maintenance. We shall follow the further field experience and studies with interest and will prevail upon them to provide us with additional information.

If further detail is desired, address correspondence to Mr. Robert F. Carter, General Manager, Imperial Irrigation District, El Centro, California.

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TEN CENTS, THIRTY MINUTES--A SIGN!

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

If your park shop has on hand some standard road signs but needs some special lettering, one of the standard units may be easily converted into a clear, professional-looking special version if you use the method worked out by Phillip R. Iversen of Grand Canyon National Park. The picture shows a comparison--"Winding Road" is a standard sign purchased as such; "School Zone" is a special, prepared on the back of a "Winding Road" sign by the Iversen system.

To follow Phil's method, all you need is some paint thinner or similar nonoily liquid, a roll of black plastic electrical tape, a single-edge razor blade, some clear lacquer or plastic spray, a T-square or drafting triangle, and a pencil.

First, clean with paint thinner the reverse side of a standard sign, selected for the color and size you need. Then make light parallel lines, their distance apart corresponding to the letter height you want. Block in the letters in pencil. (Phil says you can skip this step as you gain experience.) Next, lay the edge of the square or triangle along the outer vertical edge of the first letter to serve as a guide as you apply a strip of tape a little longer than the side of the letter. Place the entire cutting edge of the razor blade firmly where you want the tape to end, then use a slight sawing motion to cut it straight and clean, removing the excess tape. If the letter has horizontal lines, as in E, F, or L, start the horizontal at the outer edge of your vertical piece, leaving no gap.

To get the effect of roundness on such letters as S and O, cut the corners of the squared tape on a diagonal, with the blade.

Unless the sign is to be used for only a few days, coat it with lacquer or plastic spray. If it is to be installed on a post which would leave the standard side visible, cover that side with plywood.

Such a sign takes 10 cents worth of materials (not including the standard sign used as background) and 30 minutes or less of your time. When it has served its purpose, it can be restored to the original condition simply by stripping off the tape.

One important advantage to this method of temporary sign making is that the end product looks professional.

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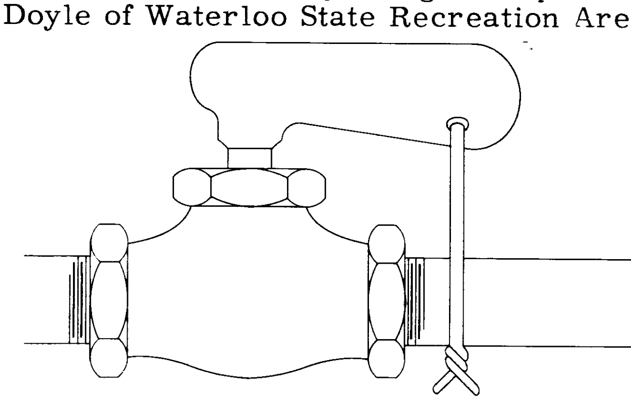
SAFETY LOCK FOR FUEL LINE VALVES

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

It will soon be time to light up space heaters, gas and oil burners, and other types of fuel-fed heating devices. Many are thermostatically controlled through pilot flames and the continuous burning of the pilot is essential to safety and efficiency. Tampering with fuel line valves, often unintentional, might cause the shutting-off of the pilot flame. This can be eliminated by using a simple idea submitted by Ranger Doyle of Waterloo State Recreation Area, Michigan.



As the drawing shows, you simply drill a 1/8-inch hole through the valve handle, put a wire through the hole, tie it around the pipe or tubing, twist and cut off the loose ends. The valve, open when the handle parallels the fuel line, is held in this position and cannot be moved accidentally to the closed position.

* * * * *

TUCUMCARI PROJECT CONCRETE LATERAL LINING PROGRAM

The Tucumcari Irrigation Project, with 41,411 acres of irrigable land, is located in Quay County in East Central New Mexico. The project was constructed by the Bureau of Reclamation and is operated by the Arch-Hurley Conservancy District. Mr. Sanford Caudill is manager for the District. In March 1961, the District undertook rehabilitation of project facilities, which will include drainage and lateral lining where seepage problems on the project lands exist. The lateral lining work is being accomplished in the off-irrigation season and for this reason work will proceed for several years. The work is presently being accomplished as a part of a Rehabilitation and Betterment Program with the Bureau of Reclamation. The District, however, plans to continue the work with their own funds until the facilities are rehabilitated in all portions of the project.

Photo No. 1

Photo No. 2

In the larger laterals, 10-mil thick polyvinyl chloride plastic is being used as a buried membrane-type lining, following construction practices described in Release No. 40, page 15, of our earlier Operation and Maintenance Equipment and Procedures bulletin. However, it is project policy to place 2-inch thick, slip-formed, portland cement concrete lining with a bottom width of 2 feet in laterals with a capacity of 60 cfs or less. A recently completed section of this slip-formed, concrete lining is shown on the cover page.

The concrete lining operation consists of first filling the existing lateral with compacted earth. The lateral water prism is then excavated by a ditcher purchased for the work by the Conservancy District. The commercially available ditcher is operated to close excavation tolerances so far as line and grade are concerned by utilizing an indicator arm riding along a taut wire cable set on steel grade stakes, Photographs No. 1 and 2. The finished excavation provides a lateral having a 24-inch bottom, 1-1/2:1 side slopes, and a 42-inch depth. The subgrade prepared for lining is shown in Photograph No. 3. The subgrade guided slip-form used in the placement of the concrete and remodeled for the work by the Conservancy District is shown in the background.

Concrete is supplied to the slip-form by transit-mix trucks having a capacity of 4 cubic yards and also purchased for the lining operation by the Conservancy District, Photograph No. 4. The truck-mounted mixers are charged from the Conservancy District's portable batching plant, Photograph No. 6, and the slip form is a standard type commercially available, but remodeled by the District to better fit conditions on the project.

Modification of the slip-form has consisted of installing the reversible direction screw conveyor shown in Photograph No. 6, the spading equipment shown in Photograph No. 7 on each side of the concrete hopper to distribute and consolidate the fresh concrete at the end of the

Photo No. 3

Photo No. 4

Photo No. 5

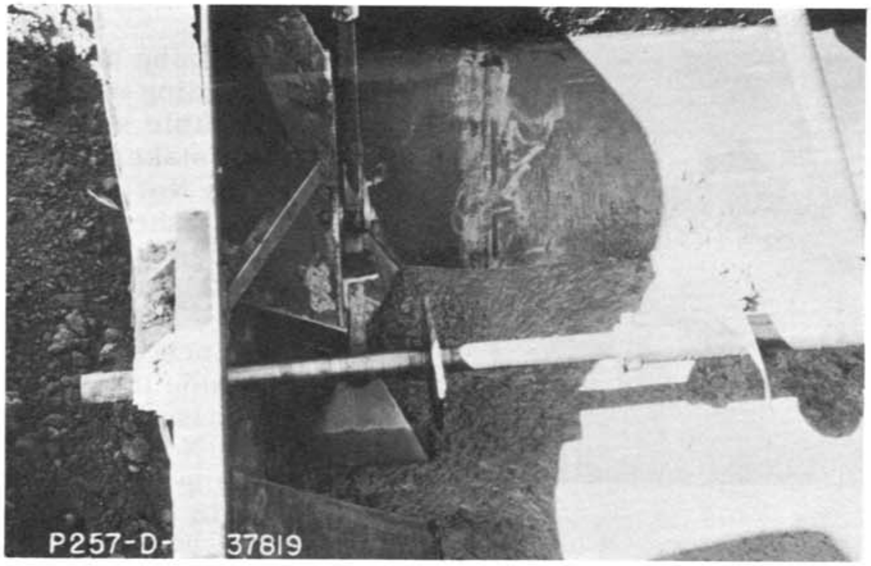


Photo No. 6

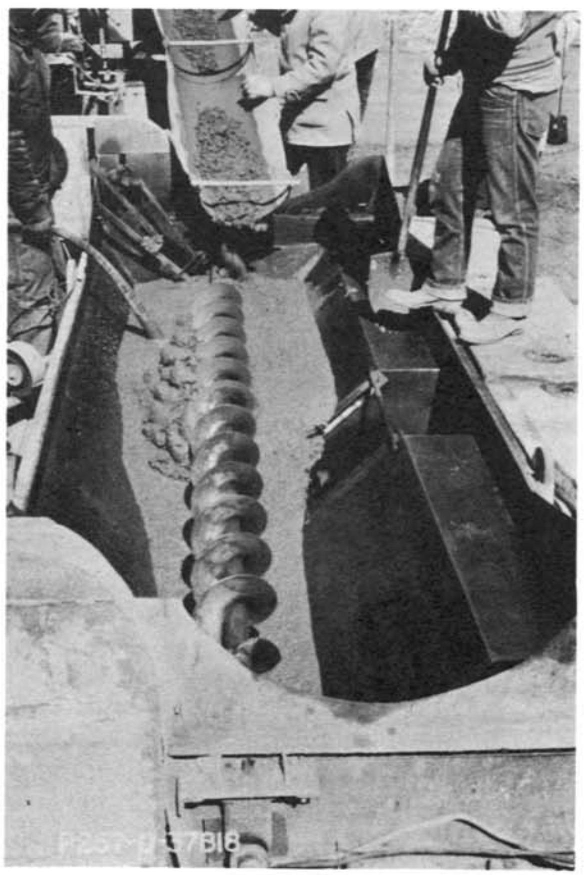


Photo No. 7

Photo No. 8

hopper in a satisfactory manner to provide a good top edge for the lining, and a concentric electric vibrator on the bottom and back end of the hopper, which also results in a more consolidated and uniform bottom lining. Weight has been added to the rear of the slip-form to provide additional stability and keep the slip-form from floating.

Photo No. 9

Four electric motors are used to power the screw conveyor, the spading equipment, and the electric vibrator on the bottom of the hopper. Current for operation of this equipment is supplied from a portable motor generator set, shown in Photograph No. 8, mounted on the rear of the slip-form. Additional independent generating units operate the immersion-type vibrators that are used to move the fresh concrete and keep it more uniformly distributed in the slip-form hopper, although the screw conveyor does an excellent job in this respect. A view of the hopper filled with fresh concrete is shown in Photograph No. 9.

The constructed lining appears to have very good line and grade and workmanship is very good. A template used to cut dummy joints in the fresh lining is shown in Photograph No. 10, and one of the as yet unfilled joints is shown in Photograph No. 11. These joints will be filled with mastic after they have been cleaned.

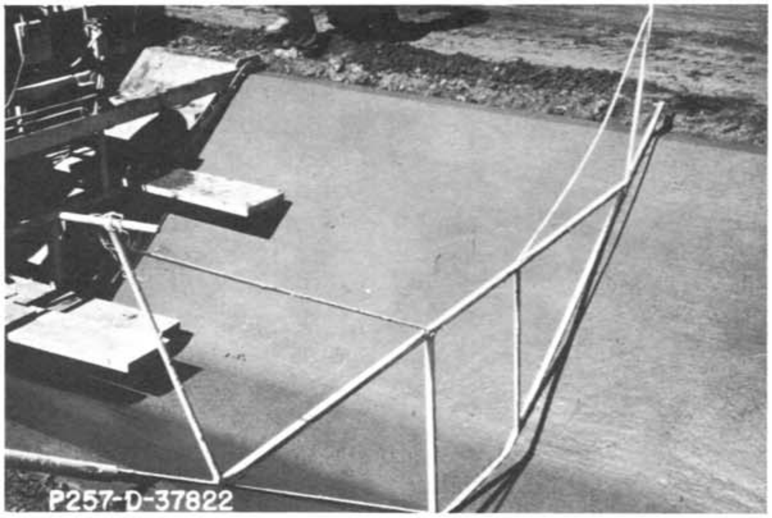


Photo No. 10

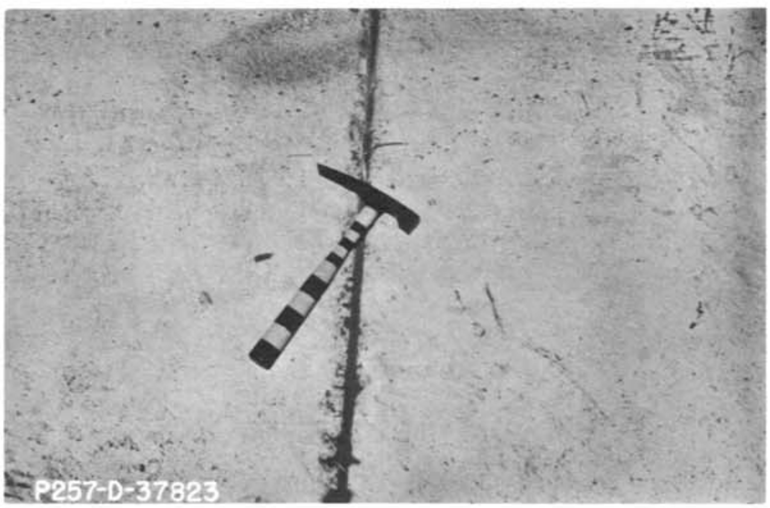


Photo No. 11

Finishers are easily able to keep up with the placement operations, and it was reported that approximately 800 to 1,000 linear feet of lining are being placed per day at a cost estimated between $2 and $2.50 per square yard for the 2-inch-thick lining.

Pigmented curing compound is spray-applied to the exposed surfaces of the concrete lining following finishing operations. Protection of the fresh concrete from freezing during winter months is provided by covering the lined section with polyethylene plastic film supported at intervals by timber planks spanning the section and anchored along each side by sandbags. Heating is provided by oil flare pots spaced at 20- to 30-foot intervals along the bottom of the lateral beneath the supported plastic cover.

A portion of the equipment used in the construction of the lining has been obtained by the Arch-Hurley Conservancy District on a lease purchase arrangement. The ditcher reportedly was purchased at a cost of $27,000. The transit mixers were purchased secondhand from transit-mix concrete companies who have but little use for the 4-cubic yard capacity mixers, preferring larger equipment in their normal operations. However, the smaller size mixers are ideally suited to the work on the Tucumcari Project.

Approximately 27,000 square yards of 2-inch-thick unreinforced portland cement concrete lining had been placed by the spring of

1963. With its own equipment now available, the District plans to continue the lining program, placing as much as possible during the non-irrigation season. The present program is one of taking care of the more serious seepage problems where adjacent lands are being damaged by water from unlined laterals.

Further information on the lining program can be obtained by writing Mr. Sanford Caudill, Manager, Arch-Hurley Conservancy District, Tucumcari, New Mexico.

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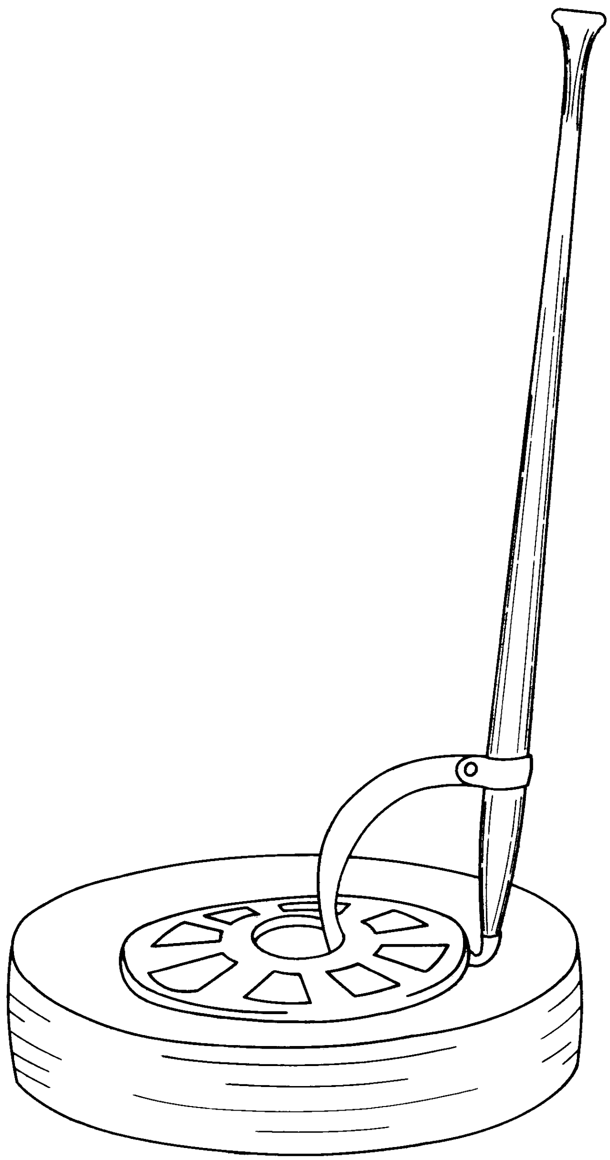

CANT HOOK BECOMES
A BEAD BREAKER

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

If you keep a cant hook on hand for moving logs, you have on hand an ideal tool for breaking the bead of a tire away from the rim. It works almost as well as one of those fancy bead-breakers bought by service stations.

Someone at Bald Mountain Recreation Area in Michigan discovered this new use for cant hooks and let GRIST know about it.

* * * * *

MASTER MECHANIC

(Reprinted from the July 1961 issue of WESTERN CONSTRUCTION with the permission of the Editor)

Significant reductions in maintenance costs are resulting from use of regular laboratory analysis of lube oil for big equipment fleets. A firm in California discussed the techniques of laboratory control of maintenance operations and the reasons for these maintenance department cost savings during a talk before the Los Angeles chapter of EMSA.

It was pointed out that in the past, engines and equipment operated until they broke down. Then, with the introduction of wide scale preventive maintenance programs, overhaul programing oftentimes became too conservative. Engines were being overhauled more frequently than necessary.

But with a laboratory's ability to detect engine conditions and plot trends, maintenance can be adjusted to the needs of individual engines. The savings payoff comes in the form of:

1. Reduction in equipment failures caused by unpredicted wear in the engine or hydraulic system.

2. Safe extension of oil and filter changes over longer periods.

3. Selecting oil and air filters best suited for different operating conditions and their use over longer periods of time.

4. Component replacement and repairs before their failure leads to major breakdown.

5. Maintenance can be programed safely, keeping key equipment on the job longer, leveling of manpower needs in the maintenance department.

Lube oil analysis, according to a member of the company, is practical with any hydraulic system, internal combustion engine, transmission or differential. It is being used by most large oil companies, railroads and engine companies.

Using samples taken by the maintenance department of the firms serviced, the California firm performs direct reading spectrometer analyses and physical tests of lubricating oil for controlled maintenance. The spectrometer measures the amount of trace elements in the oil--elements indicating component wear that show up in chemical solution and are measured in parts per million. The remainder of the oil is analyzed for viscosity, flash point, fuel and water dilution, acid, content, sludge and other physical properties.

Keeping logs of these tests, trained technicians detect early signs of ring, bearing and valve wear. They reportedly can pinpoint with great accuracy signs of pending trouble by watching increasing signs of wear of certain engine parts through elements showing up in the laboratory analysis.

Quickly reporting its findings to the maintenance department, the company advises remedial action and keeps a record of the laboratory history of each engine being sampled.

In removing the guesswork from equipment maintenance procedures, the company reports that big equipment operations are not only reducing the number of major breakdowns through laboratory control, but are keeping equipment on the job longer. They report that a conservative cost analysis shows that every dollar spent for this service saves $10 in maintenance costs.

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HOW TO MAINTAIN HYDRAULIC SYSTEMS

(Reprinted from the September 1961 issue of WESTERN CONSTRUCTION with the permission of the Editor)

It can probably not be said enough nor heard by enough people that trouble-free operation of any hydraulic system depends on clean oil. Almost all hydraulic components depend upon the hydraulic fluid itself for their lubrication. Hydraulic systems on construction equipment are particularly vulnerable to becoming contaminated due to the atmosphere in which they operate. Heavy dust and temperature changes which cause water to condense in the systems are the primary cause of contamination and subsequent failure through abrasive wear of internal parts and packing of the hydraulic components.

Manufacturers of hydraulic components take many steps to eliminate contamination of the units at the time of shipment, equipment manufacturers take many precautions in the design and assembly of the hydraulic system on the vehicle, but in too many cases the proper precautions for the elimination of contamination in the system end when the equipment is put into use by the contractor. Most well designed hydraulic systems utilize strainers in the inlet line to the pump and an in-line filter at some other point in the hydraulic system. Many hydraulic systems in construction equipment utilize a circuit which requires that the oil reservoir breathes to the atmosphere. The breather is usually fitted with a filter to screen out dust and dirt particles as the air enters when the oil level is lowered by the operation of the circuit. Some circuits eliminate this source of contamination by a slight pressurization of the reservoir by compressed air. It is important to know where your oil strainers and filters are located on the machine and to instigate a program for periodic cleaning or replacement of the filter elements.

Another source for contamination in a hydraulic circuit is any leak which may occur. All leaks or seepages of oil not only waste hydraulic fluid but also provide a source for entry of dirt. Seals and wipers around piston rods and hydraulic motor shafts should be kept in good condition and replaced when necessary for these areas also provide for the entry of dirt, water, and air.

A Suggested Program

No set rule can be established which will govern every situation for the periodic preventive maintenance functions to be performed on a mobile equipment hydraulic circuit because of the varying conditions under which such equipment operates. Many contractors spray vast quantities of water to reduce dust while in other areas this is not possible or practical. A good minimum set of rules for preventive maintenance to follow would be:

1. A complete change of hydraulic fluid and replacement with new fluid annually during the normal idle time of the equipment. A breakdown of equipment while in operation is always extremely costly.

2. Immediate reporting or repair of any oil leak when noticed.

3. A program established for the replacement of filter, cartridges, strainers and air breather assemblies on a schedule which is proportionate to the air contamination in which the equipment is operating. As a maximum, this period should be no longer than 1,000 hours and as mentioned previously, the minimum as local conditions dictate. Oil filter elements should be inspected weekly.

4. Check oil level weekly.

5. Report and/or correct any strange noises coming from the pump.

Most of us change the oil in our automobile engines at every 2,000 or 3,000 miles and periodically change our engine oil filter, but how often is the hydraulic power steering oil changed or even the oil level inspected? The oil in the hydraulic system may eventually break down through heat generation in the system even though there were the unlikely situation of no contamination in the system. When a hydraulic oil breaks down through heat, it forms varnish and resinous substances on the moving parts of the hydraulic components causing them to malfunction by sticking, if not locking completely. When we complicate this by the addition of abrasive dust and dirt wearing away the fine finishes and seals of valves, plus the rusting of springs and finished surfaces by small particles of water carried in the oil, it should be readily understood why the maintenance of clean oil is an essential to a trouble-free hydraulic system.

When servicing is required on a hydraulic system and a component must be replaced, it should be done under the most ideal conditions possible, preferably in a maintenance garage. When a hydraulic system is disassembled, or even one line removed, the interior of the system is exposed to contamination and all possible precautions must be taken to eliminate the introduction of dirt, pipe joint compound, or any other material foreign to the system.

A Horrible Example

An interesting incident which occurred some years ago concerned an equipment operator who was complaining bitterly about the hydraulics on his equipment. The pumps on the system would not last more than 2 weeks to a month, his valves seemed to stick too often, and oil was added quite often because of some leaks in the system. Upon making a visit to this equipment user, we discovered a situation which I thought could never happen in this age of enlightenment. It was true--his pumps were wearing out at an extremely rapid rate and his valves were sticking but it was not the fault of the pump or valve design or application, for the equipment manufacturer had installed an efficient system. This equipment user did have a few leaks and, as a result, the reservoir oil level went down. Rather than repairing the leaks developed on the system and having proper maintenance performed periodically, the user added oil to the reservoir. He did not add hydraulic oil, however, for this seemed like a great extravagance. On the contrary, crank case oil which was drained from the equipment's engines was added.

Further, since the inlet strainers in the reservoir seemed to be continually clogging up and causing strange noises in the pump, these were left off. Perhaps it is not necessary to finish this story but after the hydraulic systems were drained and flushed with clean hydraulic oil, all components of the system disassembled and cleaned and the filter elements replaced, the system filled with clean and proper hydraulic fluid, and the preventive maintenance performed on the system, the equipment user once again received good hydraulic operation and normal pump life.

Significant Trends

It is important to remember that a hydraulic power transmission system requires as much consideration as the other power transmission systems of your vehicles. Hydraulic power transmission is one of the most versatile yet devised and hydraulics, even in its high degree of development currently, is an infant compared to the giant we expect of it in the future.

As the art of hydraulics progresses today and advances in the future, the basic principles will not change, but we can expect some distinct changes in the components used. Many trends are apparent today which indicate the future complexion of hydraulics on mobile construction equipment.

One significant trend is the use of higher pressures on mobile equipment. The great majority of hydraulic systems on machine tool applications operate at, or below 1,000 psi, and in contrast to this, mobile equipment hydraulic systems currently operate in the majority of cases, in the range of 1,500 to 2,000 psi. Pumps capable of operating at higher pressures, in the range of 3,000 to 4,000 psi, are being used in increasing numbers. A majority of these units are specially designed high pressure gear pumps or piston type pumps.

The amount of power transmitted by the hydraulic system is directly proportional to the pressure and to the volume (gpm) of oil pumped, therefore the power transmitted by a hydraulic circuit can be increased by increasing one or the other, or both. In many cases it is being found advantageous to increase the pressure since with this approach the size of the hydraulic lines, valves, cylinders and in some cases, the pump can be reduced. While cost savings cannot always be realized by going to high pressures, usually the cost of the hydraulic system is comparable to a low-pressure system while the additional benefits of space and weight saving are realized.

Another significant trend in mobile equipment hydraulics is a progression from the relatively simple pump, manual control valve, cylinder circuit for power transmission to more complex semi-automatic or automatic circuits. These automatic circuits generally employ a control circuit to actuate or operate the power circuit. The control circuit can be pneumatic, hydraulic or electric and could be referred to as the "brains" while the power circuit is the "muscle" for doing the work. No, hydraulic service men in the future will not need to be doctors, but apparently some training in more complicated hydraulic circuits and electrical systems and components will be necessary.

Another significant current trend is the use of hydraulics as a means of propelling vehicles. For a number of years many small vehicles have been provided with a traction drive through the use of hydraulic motors but currently larger vehicles are progressing towards, or using, hydraulics in the vehicle propulsion system. Some earth-moving equipment is currently using hydraulic motors as booster drives which supply the extra tractive effort only when it is required, the vehicle being equipped with its normal transmission and final drive system from the engine.

Automatic push-button controlled hydraulic systems are now being used where a standard sequence of events must take place such as in a refuse collecting truck. In this system, when the refuse hopper is full, the operator merely pushes a button, the hopper raises, dumps into the main body of the truck, the refuse is compacted, the compacting cylinder returns to normal position and the hopper is lowered and tipped to its normal position, whereupon the system remains idle until the operator again pushes the button.

Many manufacturers of construction equipment would like to eliminate, if possible, the bulky and costly torque converters and transmissions, final drives, rear axles and differentials if possible through the use of a primary hydrostatic drive. Such a system would generally consist of the vehicle engine driving a high-efficiency hydraulic pump converting the mechanical energy of the engine into hydraulic energy. This hydraulic energy would then be piped to hydraulic motors at the wheels or track sprockets. With such a system there would be no mechanical connection between the engine and the wheels. With the necessary control valves it is conceivable that each wheel could be operated independently when necessary.

As progress continues in hydraulics we are sure that the day is not too far off where primary hydrostatic drive units will predominate as a method of vehicle propulsion.

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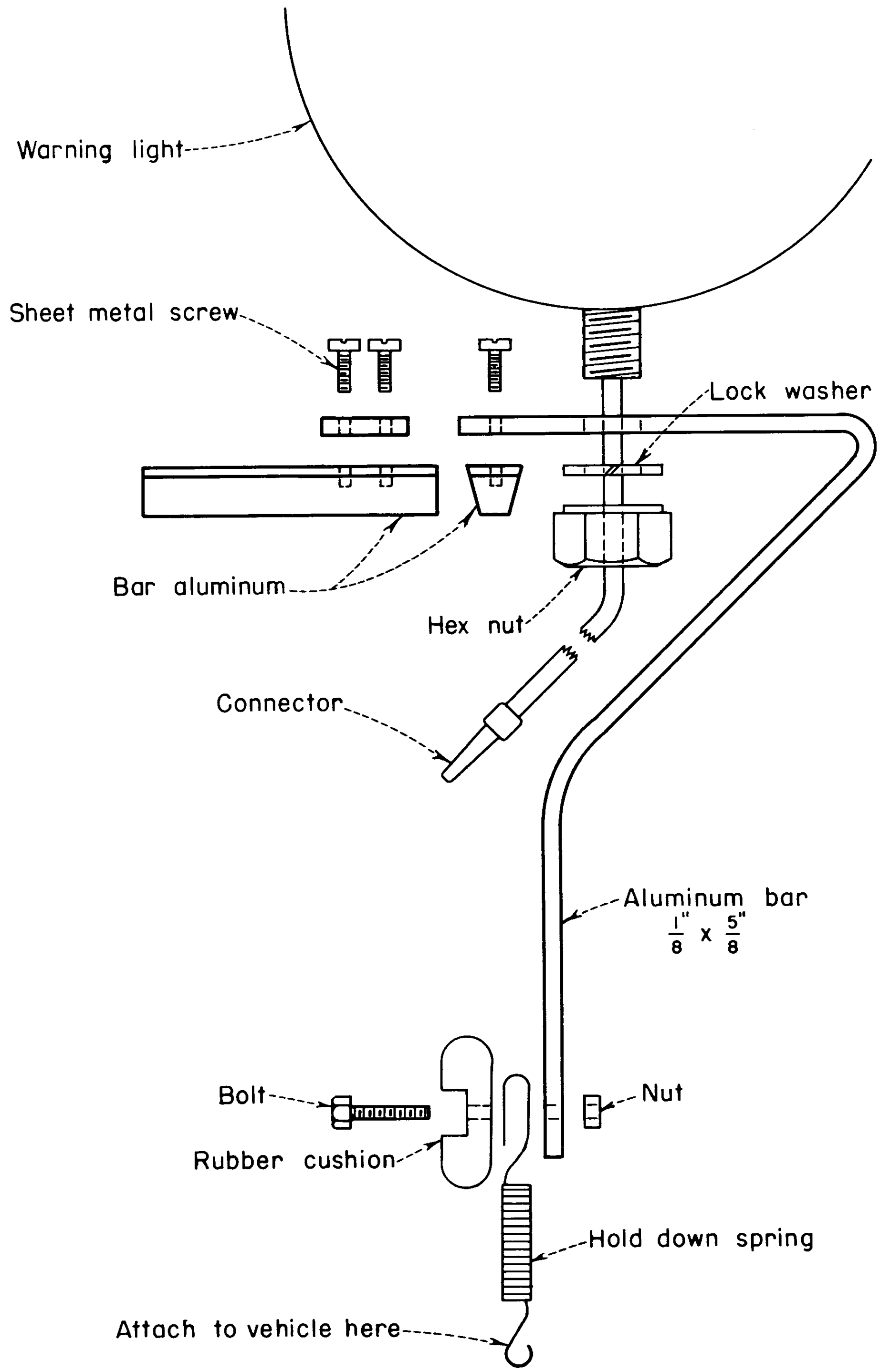
REMOVABLE CAR WARNING LIGHTS

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

Those flashing red warning lights on a park car are mighty important when the car is in patrol service, but what about the times when the car is on other duty and the lights look out of place? Wayne B. Cone, Chief; Park Ranger of Badlands National Monument, South Dakota, did some thinking about this problem and came up with a practical solution--an easily removable bracket which will hold a flashing light in place solidly while needed, but which can be taken down in a few minutes.

A drawing of the removable car warning light assembly is shown in a drawing on the following page. With several sets of the brackets, simple wiring, and the necessary small holes in the door posts of the cars or trucks, a number of vehicles can be set to go into emergency or patrol service with flashing lights, or to convert to service without such lights.



REMOVABLE CAR WARNING LIGHTS

Materials for the first pair of removable lights cost only $13.46, including brackets, warning lights and the flasher circuit. The person making up a set of lights should be careful to make the bar aluminum, which sets into the car gutter, fit tightly to prevent movement of the bracket. A sheet metal screw can be placed in the bottom of the gutter to prevent any possibility of movement in the bracket. The holddown spring should be firm enough to hold tightly.

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