

United States Department of the Interior, Bureau of Reclamation

IRRIGATION OPERATION AND MAINTENANCE

BULLETIN NO. 66

October, November, December 1968



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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 80225



COVER PHOTOGRAPH:
Composite picture showing
various activities in the
performance of day-to-day
duties for good maintenance
on irrigation projects.
Photo PX-D-62122.

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INTRODUCTION

Four basic objectives are realized by good maintenance, as pointed out starting on page 1. The importance of good maintenance were included in remarks made by Mr. Hollis Sanford, at the first water users conference held in Region 2, at Sacramento, California, prior to his retirement from the Bureau in March 1968, as Chief, Division of Irrigation Operations, Office of Chief Engineer, Denver, Colorado.

A suggestion on page 6, for a fiberglass gate opening indicator, points out the advantages of fiberglass over metal when used for this purpose.

Several individual articles on safety can be found in this issue: One on page 7 lists the most recent issues of the National Safety Council data sheets. The article on page 9 describes an accident resulting from flying steel fragments and suggests means of prevention, and the article on page 16 is entitled "What You Should Know About Studded Tires." Some seat belt facts are given on page 19, and how to help someone in case of a heart attack is discussed on page 24.

Located on page 8 is a suggestion submitted by two enterprising employees of the Cabrillo and Channel Islands National Monument for an inexpensive mooring buoy.

Starting on page 10, is an article entitled "Painting to Beat the Heat." The article discusses what can be done with paint when heating of machinery occurs, and the cooling effect various paints have for changing the movement of heat to or from machinery.

Two separate suggestions submitted by Bureau personnel can be found on pages 14 and 15. The first one recommends hour meters be put on all sump pumps to determine the amount of leakage at a dam, and the second idea is for an improved method of anchoring toe rock for rock riprap.

The summary on page 20 of a report entitled "Buried Asphalt Membrane Canal Lining," presents the Bureau's findings and use of buried hot-applied asphaltic membrane lining for control of water seepage from canals and shallow reservoirs, and briefly describes the construction methods.

Beginning on page 22 is a simple solution for reducing fluctuations of automatic overflow siphons. The suggested device, now in use, is both inexpensive and very easy to install.

This issue of the Bulletin contains two suggestions from GRIST, a publication of the National Conference on State Parks, that could be useful to irrigation project operation and maintenance personnel. One concerns an attachment to a forklift as shown on page 25, and, on page 26, is a heavy duty tow bar and fair lead to be fastened on the stern of a boat.

IMPORTANCE OF GOOD MAINTENANCE
by Hollis Sanford¹/

We in Denver have been reviewing the reports on your programs with interest and satisfaction because we find that the quality of maintenance of irrigation works in this area is unexcelled by that of any other irrigated area in the West. You can be justly proud because this means without doubt that it is unexcelled by any other area in the world. Eric Hoffer, the shirt-sleeved philosopher from the San Francisco waterfront, made this statement, "If the President had picked me to predict which country (in post-war Europe) would recover first, I would say 'Bring me the records of maintenance. The nation with the best maintenance will recover first. Maintenance is something very, very specially Western. If I were to go into a warehouse let's say, and see that the broom has a special nail, I would say 'This is the nail of immortality.' "

Not long ago, a group of irrigation managers in the Northwest attempted to define the phrase "good maintenance." They concluded that good maintenance achieves the following major objectives:

1. Timely and Reliable Service to all Water Users

In discussing this point, they emphasized the importance of uniform service. One of them pointed out that every mile of lateral or pipeline, every structure, and every pumping plant is an additional hazard to the man at the end of the lateral. The aim of a good manager, they concluded, is to reduce these hazards and to assure that last man timely and reliable service.

2. Low Operation and Maintenance Costs on a Long-range Basis

The group recognized that this is a broad objective and they broadened it even more by adding the phrase "on a long-range basis." In doing so they were saying that the deferment of needed maintenance usually increases the cost. Next year the work will probably cost more and, in the meantime, the threat of unreliable service has increased. There seems to be no basis for assuming that farmers will be more prosperous sometime in the future. Consequently, it was agreed that there is no justification for deferring needed maintenance.

¹/Report from the First Regional Water Users Conference 1968, Region 2, Bureau of Reclamation, by Mr. Hollis Sanford (retired). Formerly Chief, Division of Irrigation Operations, Office of Chief Engineer, Denver, Colorado.

3. Safe Conditions for the Workers on the System and the Public

All agreed that this is an important objective and that if it is not pursued aggressively it can result in increased costs and unsatisfactory service. A good safety program pays.

4. A Sense of Pride

Initially this "pride factor" was not included in the definition, but as the discussions progressed, there was a growing feeling that it is a most important objective. Every individual in an organization must have pride in his work if he is to contribute to the primary objectives of adequate and efficient service to the water users. The group of managers concluded that pride is reflected in the neat, orderly, well-managed appearance of everything in the district program including the office, the equipment, and the distribution system itself. They felt that an irrigation district has a service to perform that is perhaps more important to the welfare of the community than any other service function. They felt that O&M without pride is like a mother without love for her children.

You have a right to be proud. The cost of labor, equipment and supplies has been going up every year. In fact, in the past 17 years the price paid for labor, equipment, and supplies has more than doubled. In the same period, your O&M charges to the water users have gone up only half that amount. This means that you have utilized your labor, your equipment, and your supplies more efficiently each year. Despite this good showing, irrigation operation and maintenance costs have increased an average of 3 percent each year for the past 17 years. We can assume that the labor, equipment, and supply costs will continue to increase at the rate of about 6 percent a year. The challenge you face is to keep the actual O&M cost to the farmer from increasing faster than 2 or 3 percent a year.

Recently an irrigation district in another region reported that it faced serious problems. In the past 17 years its wages had increased 37 percent. Apparently they were not aware that wages in general have increased much more than 37 percent in 17 years. They have been operating in the red for a number of years and have used up \$100,000 they once had in reserve. They are now faced with a major increase in annual O&M charges and borrowing money to make major system improvements to reduce their O&M burdens. The reluctance on the part of the manager and the board of this district to raise charges in the past is understandable. We all appreciate the seriousness of the cost-price squeeze that farmers face today, but management does not make the farmers' circumstances any rosier by curtailing O&M or failing to raise charges when the cost of service actually goes up. A typical farm in the Central Valley Project in California has an overall annual operating cost of about \$300 an acre. The district O&M costs for this typical farm

could be about \$6 an acre or 2 percent of the total farm operating cost. When management defers an increase in O&M costs or defers necessary maintenance to avoid increasing the farm costs a fraction of a percent, they are doing a disservice to the farmer because eventually these costs must be paid and sometimes at a higher rate and at an even more unfavorable time.

Let us go back and discuss the things management can do to keep these ever-increasing costs as low as possible. You will, of course, keep in touch with industry and be alert to the possibilities of more efficient equipment, chemicals, and other materials. You will find, however, that almost two-thirds of your costs are in labor. In labor you will find the big possibilities for savings. Savings in labor must come from increased efficiency which reduces the number of personnel.

In the discussions I mentioned earlier the group of managers concluded that the "pride factor" is the most important element in labor management. They mentioned the following four specific phases of project management that have an important bearing on pride: appearance, the assignment of responsibilities, long-range programing and training. Much of the discussion revolved around appearance. They felt that the headquarters should be neat, clean, and efficient looking and so should the employees in the office. They felt that the appearance of headquarters reflects the efficiency of the district program in every phase. An efficient looking headquarters can be pointed to with pride by both the employees and the community itself. They felt that the equipment used by the district should be painted in a uniform color scheme and kept clean. The employees should be well equipped with safety devices such as hardhats, safety shoes, first aid kits, and fire extinguishers. There was a strong feeling that the attitude of the employees will be improved by these actions on the part of management showing pride and attention to details.

Major importance was attached to the assignment of specific responsibilities to each employee. Each ditchrider should be made responsible for all features on his beat that have not been specifically assigned to other maintenance employees. They should also be made responsible for the appearance and condition of the equipment and supplies they use. It was the consensus of the group that maintenance records should be kept for all important structures and features in the system. These records should be kept by the employee who has been assigned responsibility for that structure or feature. For example, a steel pipeline that is protected on the inside by coal-tar enamel should be examined periodically. The date of each examination, the name of the examiner, and a few terse comments should be kept on a card file in the office. Such a record would be used not only as a reminder of when such examinations are due but would also be useful whenever there is a change in employees or responsibility assignments. A more complete card system of maintenance records should be kept for such features as pumping plants. Irrigation Operation and Maintenance Bulletin No. 60 presents

a complete system for keeping such maintenance records. Similar but less detailed records should be kept for closed drains, siphons, large gates, control works, major buildings, and other important structures. These responsibility assignments should be periodically checked by management. Employees' suggestions for improvements should be solicited, carefully evaluated, and promptly adopted where practicable to do so. Good work should be commended, and need for improvements should be noted. In fact, it was the conclusion of this discussion group that every irrigation district should initiate some form of an incentive awards system in which efficiency and good appearance are both recognized.

In addition to the routine regular operation and maintenance program, the group concluded that the manager and the board should develop a long-range program for the accomplishment of major system improvements and replacements. Some of these will involve considerable capital expenditure and must be planned a number of years ahead. Some of them may reduce O&M costs significantly, and it is important that they be studied carefully to weigh the costs against the benefits. Such a program should be developed for at least 5 years in advance. It should be adjusted and refined as the time for the work draws near, and adequate financing should be arranged. The discussion group emphasized the importance of training. The process of learning is continuous, and it should start at the top. The directors on an irrigation district board should go to meetings like this. They should call on their state educational institutions for classes, lectures and bulletins through which both new and old directors can get a better understanding of the functions of a board and the way it should manage the business of the district. Similar training programs should be developed for the manager and his principal assistants, and they should be allowed to visit other irrigation districts to get new ideas and to discuss mutual problems with other managers. Some form of training should be available to all employees of the district. If this cannot be carried out through the help of an outside agency, there should be an in-house training program. The district's training program should have as its objectives, first, improved efficiency in the operation and maintenance program; and second, the development of employees who can fill higher level positions.

Attention to these four elements of management; namely appearance, assignment of responsibility, long-range programing, and training will all improve the "pride factor" in any district organization. In the discussions which were mentioned earlier, the group of managers generally agreed that while wages are an important element in developing good morale, they are by no means the only factor. They cited cases where their best employees were those who had been satisfied with gradual increases in a modest income. This satisfaction stems from a knowledge of the importance of their service to the community and from a strong feeling of loyalty and pride in the organization.

You managers of irrigation systems have been backward in telling the public and the water users in the district about the importance of your services. The functions you carry out are more important to the community than that of any other utility organization. You are more important than the power company. Your work is more important than the job done by the telephone company. The delivery of water to the farms is essential to the economy of that community and to the nation as a whole. Many of the directors on irrigation district boards and managers have performed services requiring many hours of personal time. Your employees have made similar sacrifices and have performed services beyond the call of duty. Such dedicated employees should be rewarded and the community should be informed of their loyalty. For example, in its advertisements the telephone company talks about the lineman working in a blizzard or the pretty operator with her feet in the floodwater. Similar efforts are made by the electrical utility companies to impress the public with the importance of their service by recognizing the individual effort of their field employees. An irrigation district has a better story to tell than any of these service organizations. It should be told to the public on every opportunity. It should be told to the water users themselves. It will help to develop a sense of pride, and it will help to make the community appreciate the organization that performs this essential community service.

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HIGHLY SENSITIVE TESTING DEVICE

An elephant's foot may be mighty sensitive, but not as sensitive as a 10,000-pound research tool designed and built by the Bureau of Reclamation's Engineering and Research Center at Denver, Colorado.

This ponderous unit will enable engineers to detect movements as slight as one ten-thousandth of an inch deep inside a rock wall when pressure is applied.

The new device is a radial jacking test unit which may be employed at the sites of proposed dams to determine if the surrounding rock structure can support the extreme pressure generated by the dam and the water it impounds.

Department of the Interior
News Release, dated February 23, 1967

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FIBERGLAS GATE OPENING INDICATOR (Suggestion R7-68S-40)

A very successful gate opening indicator for a radial gate on a water control structure was suggested by Mr. Edward Hlavinka, of the Kansas River Projects Office, McCook, Nebraska. This most economical and long lasting indicator is made from white fibreglas, 1/16 inch thick and 3 inches wide. A standard staff gage is seldom suitably graduated for use as an indicator on a radial gate, and custom gages are costly and are not readily obtainable to fit gates of different size and radius. Therefore, they must be fabricated by project personnel.

Metal indicators were first used and they lasted only three years. Experiments then with plexiglass indicated that this material would not be usable where direct sunlight is a factor, because of its expansion and contraction. Accordingly, fibreglas was tested. The fibreglas indicator shown in the photo below has been in use for three seasons and is still in good condition.



P60-D-62112

The fibreglas is inexpensive when purchased in sheets and can be cut in 3 inch strips with a regular bench saw. It is then sanded on one side to roughen it so the paint will adhere to its surface. After the computed radial gate scale in feet and tenths of feet are drawn on the sanded side, the numbers and marks are painted on with a black epoxy paint. This is a special paint for fibreglas. Then the indicator is fastened to the support frame on top of the gate and to the face of the gate with 3/16-inch stainless steel or brass bolts.

Where the bottom portion of the gate opening indicator is submersed in water, the fibreglas will not rust or corrode. Crustations that form on the portion of the indicator that is submersed in water can easily be cleaned off at the end of each season.

There are several gate opening indicators of this design in use on the Kansas River Project. The deterioration of the metal gages has been a problem throughout the years. Fiberglas staffs are being installed as replacements for the metal staffs as needed.

The initial cost of a gate opening indicator staff is very nearly the same for light weight flexible metal or fiberglas. Cost of replacement per staff gage installed on a gate including re-zeroing of gage is \$28.00 for metal and \$25.00 for fiberglas, including material and labor. The saving of the fiberglas over a metal staff is mainly through the elimination of frequent replacement by the longer life of the fiberglas.

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NATIONAL SAFETY COUNCIL DATA SHEETS

The National Safety Council has recently published new or revised technical data sheets on the subjects listed below. Copies of these data sheets (by the numbers shown in parentheses) may be obtained from the National Safety Council, 425 No. Michigan Avenue, Chicago, Illinois 60611.

Hydrogen Sulfide (284 Revised)

Gear-Hobbing Machines (362 Revised)

Metal-Working Milling Machines (364 Revised)

Chlorates (371 Revised)

Air-Powered Hand Tools (392 Revised)

Off-the-Job Safety (601)

Inspection and Maintenance of Mechanical Power Presses (603)

Safety Nets for Construction Projects (608)

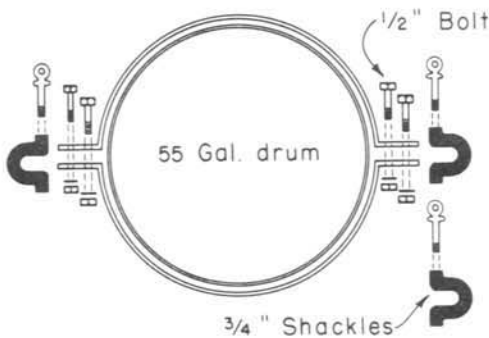
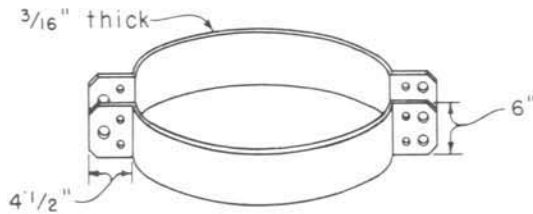
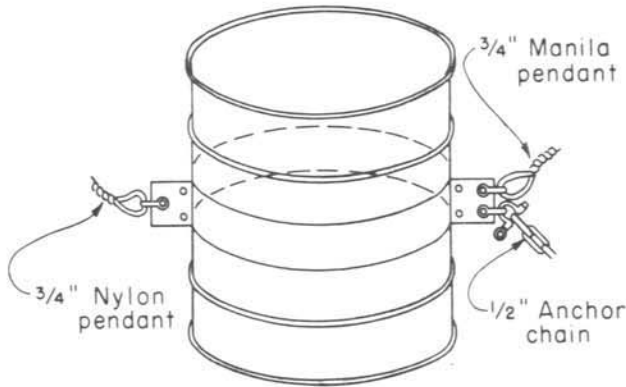
Cloth Shearing Machines (609)

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INEXPENSIVE MOORING BUOY

(Reprinted by permission of GRIST, May/June 1968 issue, a publication published by the National Conference on State Parks, Washington, D.C.)

Upon learning that a commercial buoy of sufficient size to which they could moor their patrol boat would cost more than \$200.00, Chief Ranger Robert White and Park Ranger James Martin of Cabrillo & Channel Islands National Monuments searched for a less expensive solution. When they came up with it, the cost was just \$16.00.



Bob and Jim designed a collar to fit around a 55 gallon drum as shown in the sketch at left and had it made and galvanized in a local welding shop. Made of 3/16" black iron, the collar is strong, light, and simple. It can be assembled by one man, and is easily transported in a small boat. The drum buoy can easily be changed if it becomes corroded or otherwise damaged. It is desirable to make the buoy unsinkable even if punctured, it can be filled with self-expanding polyurethane for about \$25.00.

Note the two pendants leading from the collar. Since the patrol boat is moored in an exposed ocean cove, the security of a second, longer pendant, is felt to be well worth the small additional cost. In one instance the second pendant saved the boat when a stainless steel pendant parted.

For their 25 ft. launch, Jim and Bob use a 720 lb. railroad car wheel, 3/4" and 1/2" chain attached to the buoy, and 3/4" nylon pendants.

* * * * *

FLYING PARTICLES

Activity

Government mechanic and helper repairing track on crawler-type tractor.

Accident Situation and Occurrence

Two employees were replacing a track on a crawler-type tractor. In the process of replacing the master track pin, a piece of flying steel became lodged in the mechanic's left leg below the knee. The injury resulted in 4 days' lost time.

Cause Determination and Prevention

The mechanic was driving the pin in place with a 12-pound hard steel hammer. This accident possibly could have been avoided by proper planning that included:

1. Cleaning the pin and track links with emory cloth.
2. Providing means by which the links could be expanded by heat.
3. Using a softer hammer to drift the pin. In addition to heating the links with a torch, most mechanics cool the pin with dry ice, or other means, allowing it to shrink and move freely through the enlarged links.

Reclamation Safety News - 1967

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NEW LABORATORY RESEARCH AIDS DRAINAGE STUDIES

Hydraulic research engineers of the Bureau of Reclamation's Engineering and Research Center at Denver, Colorado, have constructed a 60-foot-long tilting flume in their laboratory to study drainage from sloping irrigated land. They are using the flume to determine the most effective and economical spacing for installing agricultural drains on a variety of slopes--a major consideration in the development of irrigated agriculture. The flume is filled with fine sand and has a recharge system. The recharge system sprinkles water on the sand surface and simulates the application of irrigation water applied to the land.

* * * * *

PAINTING TO BEAT THE HEAT^{1/}

Painting to change the movement of heat to or from machinery often comes to mind when heating problems occur.

The three ways heat is moved are: convection - the transfer of heat by movement of gases or liquids; conduction - the transfer of heat by actual contact or through a material; and radiation - the transfer of heat by waves through the atmosphere from the hot body to the cooler body.

In actual practice it is very difficult to change convection and conduction by painting, but something can be done about radiation.

Outdoor Instrument and Circuit Breaker Cabinets

Outdoor cabinets containing instruments and equipment which generate little internal heat (such as circuit breakers) are often painted for protection from the heat of the sun. The photograph below shows a typical small pumping plant. Note the outdoor cabinets in the background containing the instruments and equipment.



P586-D-62110

^{1/}From Power O. and M. Bulletin No. 14, "Painting of Transformers and Circuit Breakers," Division of Power Operations, Office of Chief Engineer, Revised May 1967.

Dark colors absorb the most heat from sun radiation and white absorbs the least. Contrary to a widespread impression, aluminum paint absorbs more heat than white. A table of coefficients of absorption of solar radiation is as follows:

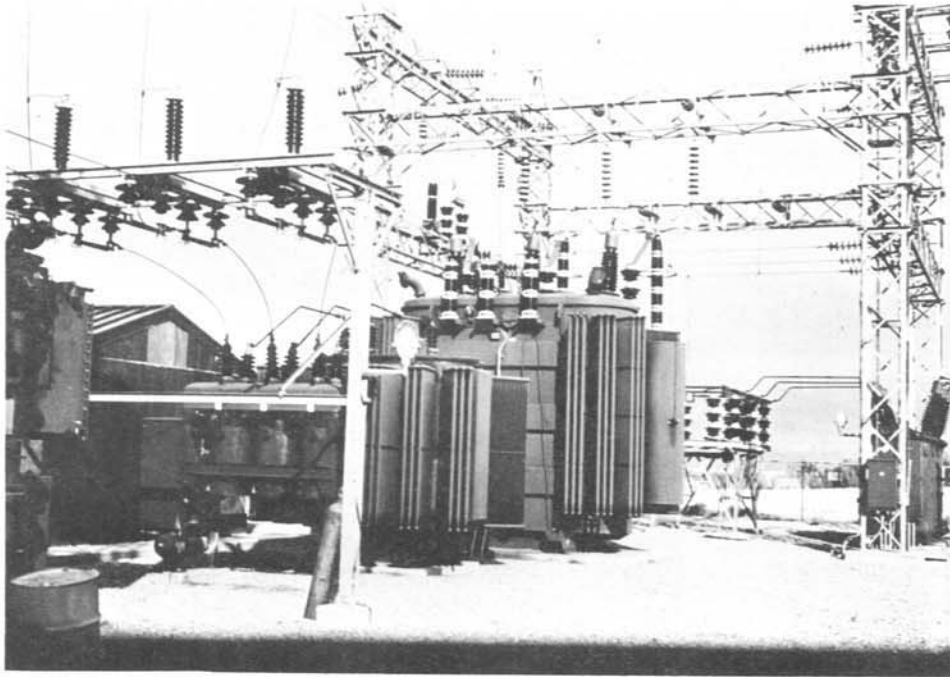
White	0.25
Aluminum	0.35
Gray	0.75
Black	0.97

Therefore, for minimum absorption of heat from the sun an outdoor cabinet should be painted white or possibly some other light color.

Indoor cabinets can be painted any color.

Transformers

Like cabinets installed outdoors, transformers can also absorb heat from the sun. In addition, transformers themselves generate and transmit heat by convection, conduction, and radiation. The photograph below is of a typical substation showing the transformers in the foreground.



P285-D-61979

Radiation

When transformers are located in the sun, both the absorption of solar heat and radiation of the transformer heat must be considered. Unfortunately,

the colors that give the best radiation of transformer heat will permit the highest absorption of heat from the direct rays of the sun.

Heat loss from a body by radiation can be computed by formula which indicates that a light colored transformer will dissipate less heat than a black one. In the formula the coefficient for aluminum paint is 0.55; for mat black paint 0.95; and for practically any other paint 0.90 to 0.95. An aluminum painted transformer will therefore dissipate by radiation approximately one-third less heat than a transformer painted some other color.

It has been found that when transformers are exposed to the sun a light colored transformer will usually operate one to two degrees Centigrade (3° F) cooler than one painted black.

The amount of heat absorbed by transformers will depend on these coefficients but will also depend on other conditions such as shape, size, area exposed to the direct rays of the sun, and the time of such exposure. As these conditions vary widely, the best indication of the effects of paint on transformers located in the sun can be obtained from field tests.

Tests made by a power company at Dallas, Texas, on identical transformers with equal loads and located in the sun showed a maximum oil temperature of 40° C for black painted transformers and 39° C for the aluminum painted ones.

Similar tests by a power company in California showed a maximum oil temperature of 29.5° C for black and 27.0° C for light gray.

At Pittsfield, Massachusetts, similar tests were run over a 24-hour period. During the day the maximum oil temperatures were 52° C for black, 49° C for aluminum, and 48° C for white. At night the maximum temperatures were 41° C for aluminum and 39° C for black and white.

In all the test reports available, the light colored transformers ran cooler than black transformers when exposed to the sun. The difference in temperature was small, averaging between one and two degrees. In cases where transformers are operating near the limit of their safe temperature during exposure to the sun, this slight decrease in temperature might be important. The daytime temperature decrease would be, to a certain extent, counteracted by an increase in temperature at night.

In general, the total effect of the type and color of the paint is too small to justify any repainting for its effect on temperature alone. When painting is necessary it should be done on the basis of the appearance and durability.

Self-cooled transformers exposed to the sun should be painted light colors only where operating temperatures are critical. Other colors are preferable from an appearance standpoint and should fit into a color scheme.

Conduction

In a transformer the heat passes from the electrical conductors and core iron through the insulation, oil, the steel case, and the paint coating. The thickness of the paint will usually add only an infinitesimal amount to either the length of the heat path or the combined thermal resistivity of the material through which the heat must pass. Paint (of any type or color) will therefore have a negligible effect on heat loss by conduction, when the paint is thinly coated.

The effect of film thickness in a recent test by a leading paint manufacturer was determined by applying multiple coats of metallic lead-suboxide black and non-metallic white to a test specimen. It was discovered that film thickness has an appreciable effect on heat transfer for both types of paint, with a marked decrease in rate when the film is 10 mils or more in thickness.

Convection

Heat loss by convection depends on the shape and size of the transformer and the temperature and rate of movement of the cooling medium. Convection is not affected by painting the exterior.

Transformers Indoors

As there is no reflection of the sun's rays to be considered with transformers located indoors, the type and color of paint will affect only the heat loss by radiation. A transformer painted a light color would be expected to operate at a higher temperature than one painted black or any other color due to the low emissivity factor of light paint.

Considering temperature alone, the best color for indoor self-cooled transformers is dull black. However, gray, green, or almost any other color will increase the temperature such a small amount that the paint can be selected on the basis of appearance or the color scheme in the plant.

Electric Motors

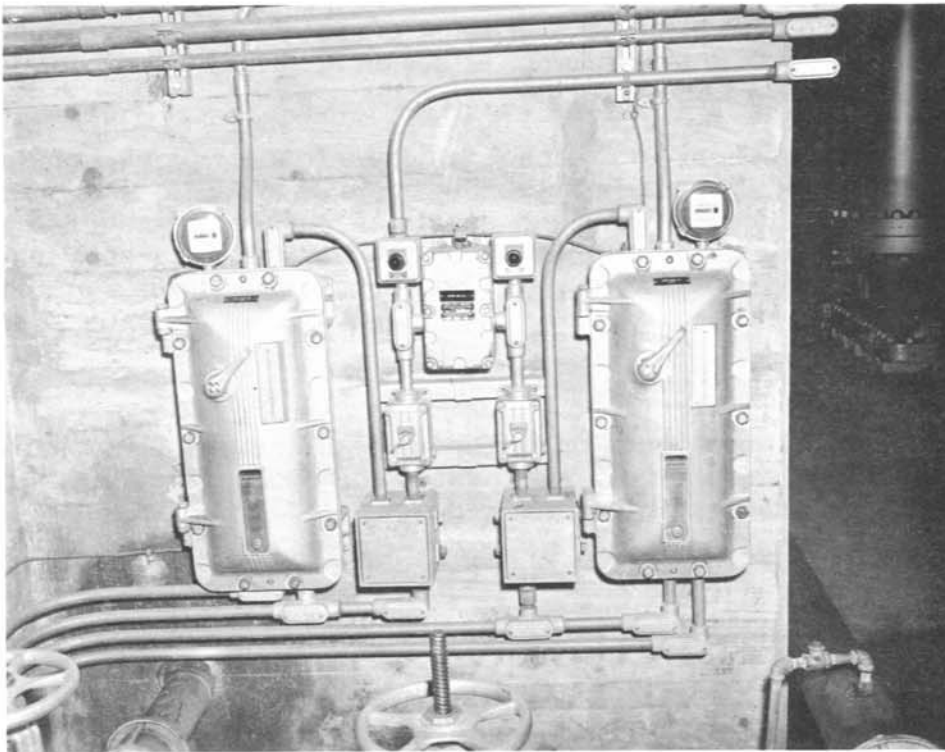
Heat from motors is mostly dissipated by convection so little is gained in painting them a specific different color.

In direct sunlight absorption of heat from the sun may increase motor temperature somewhat. The comments concerning color of paint for transformers would also apply to motors.

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HOUR METERS ON SUMP PUMPS (Suggestion R2-67S-25)

A suggestion by Mr. Gerald W. Jensen, of the Central Valley Project, Folsom Field Division, Folsom, California, has recommended that hour meters be installed on all sump pumps at Folsom Dam. The installation of such meters is to determine the amount of leakage at the dam. These hour meters with the pump controls are shown in the photograph below. The meters are located on top of the circuit breaker boxes.



P485-D-62109

The hour meters are wired so that they operate only when the pumps are running, recording the minutes and hours of operation, and by knowing the capacity of the pumps in gallons per minute the amount of leakage at the dam can be determined.

For the past several years hour meters have been installed as standard equipment on Bureau pump installations. Not only are they a good indicator of the water pumped but are almost essential in determining the hours of operation for maintenance purposes, and the meters are inexpensive and simple to install.

* * * * *

ANCHORING TOE ROCK FOR ROCK RIPRAP
(Suggestion R1-66S-47)

An improved method of anchoring toe rock for rock riprap, was devised by Woodrow W. Bryars, of the Minidoka Project Office, Burley, Idaho. This idea was proven very successful on the right abutment to the stilling basin at Palisades Dam, which was constantly sloughing away.

Mr. Bryars suggests using 1-1/4-inch galvanized cable to make a chain of rock so that one could not move unless the whole chain of rocks moved. This was accomplished by drilling the toe rocks after they were placed, and inserting anchor bars. These anchor bars are threaded, to securely hold a 6-inch cast steel eye. Through these eyes a cable is passed and anchored on both ends, as shown in the photograph below. For added stability, every few feet along this chain of rocks, a cable anchors the lateral cable and to a large dead man deep in the rockfill.



P17-D-62104

For additional information write the Project Superintendent, Minidoka Project, Bureau of Reclamation, Box 549, Burley, Idaho 83318.

* * * * *

WHAT YOU SHOULD KNOW ABOUT STUDED TIRES

by Harris E. Dark¹/

Studded tires are here to stay for the foreseeable future, at least in the snow states.

A studded tire is a regular highway or snow tire that has had several dozen metal shafts imbedded in its tread. The studs when new are about half an inch long and have heads approximately the size and shape of a thumbtack. They are all-metal, having a head and jacket of stainless steel or aluminum and a core (like the lead in a pencil) of tungsten carbide, an extremely hard metal that can scratch a diamond.

Typically, about six dozen studs are installed in a tire, though this will vary somewhat according to tire size and tread design. Holes a small fraction of an inch in diameter are first drilled in the tire's tread rubber--less than a half inch deep, not enough to penetrate to the cloth carcass. (Most tires have molded-in holes, made at the time the tread is formed.) The studs are installed by means of a special gun that "shoots" them headfirst into the holes where they are firmly held by their flanged heads.

The cost of studs is about 10 cents each, installed; the average studded tire costs \$7 to \$9 more than the same tire without studs.

The purpose of studs is to give the tire greater traction on ice and hard-packed snow, the places where driving is the most dangerous. On ice and packed snow, studs have proved to be tremendously effective. Though they can't provide as much ice-gripping traction as tire chains, studs have several important advantages over chains:

1. They are less expensive, per tire, than top-quality reinforced chains.
2. They last many times longer.
3. They can be driven at much higher speeds with safety.
4. They don't have to be put on and taken off; they can be used for the entire winter season.
5. They are vibration-free and virtually noiseless.
6. They can be installed on the car's front as well as rear wheels, while chains should be put on the rear wheels only. Thus, studs provide much more assistance in steering than chains, which help mainly with starting, stopping and tailwag.

¹/Reprinted from an article appearing in the December 1967 issue of TRAFFIC SAFETY, by special permission of the editor.

Success in Europe

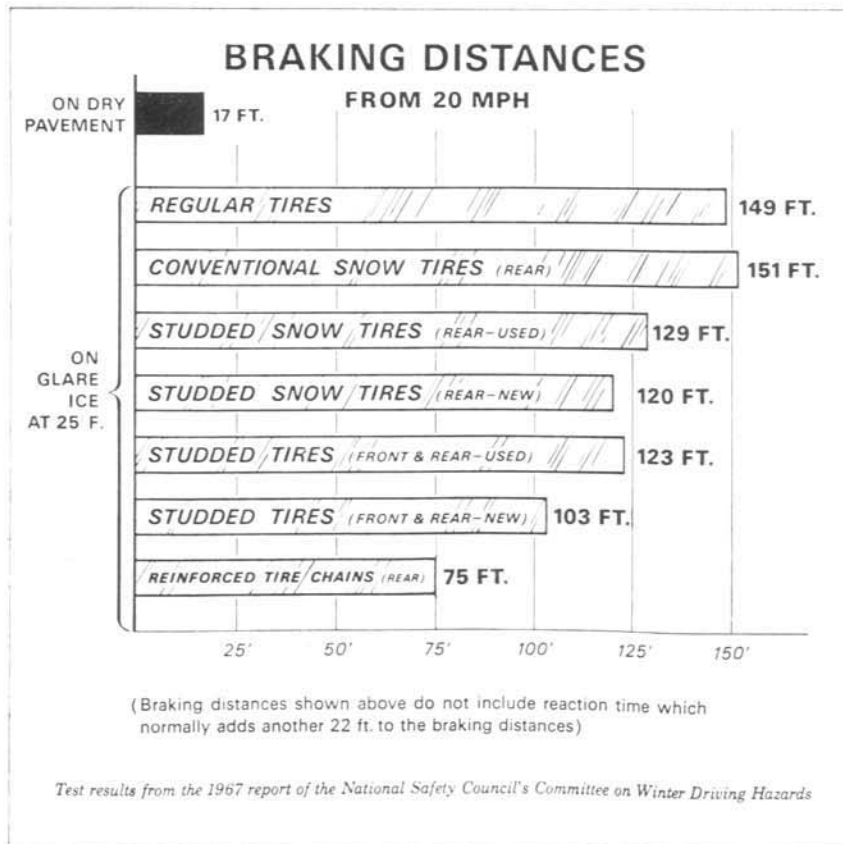
Studded tires were first used extensively in the Scandinavian countries six years ago. They were an immediate success and quickly spread to the other European snow countries. By the winter of 1963-64 they had been introduced into Canada and the United States.

Along with the growing popularity of studs in the United States, however, a bitter debate arose regarding their potential for damaging pavement. Just how injurious they are is yet to be determined. In the meantime--often over the objections of state highway departments--the use of studs finally has been permitted in all snow states, except Virginia. In many cases, this is a wait-and-see action pending further assessment of highway damage.

Right now, the public's primary interest is whether studs are worth the money. Are they an adequate substitute for chains and will you need them enough to warrant the investment in them? On the first point--the ability of studs to provide grip on ice surfaces--little question. In repeated tests conducted by the National Safety Council's Committee on Winter Driving Hazards, cars equipped with four studded tires had a 31 per cent better braking ability on glare ice than cars with regular tires. When brakes were slammed on at 20 m.p.h., cars without studs would skid an average of 149 feet before coming to a halt on the ice. But the

same car with four studded tires could be stopped in only 103 feet. Obviously, in an emergency situation this could make the difference between a serious accident and no collision at all.

How does this compare with the glare-ice performance of snow tires? Studded snow tires, rear wheels only? Chains on the rear tires only? A set of reinforced chains on just the rear wheels of a car will shorten the glare-ice stopping distance by a full 50 per cent, while studded snow tires make an improvement of 19 per cent.



And unstudded snow tires, while helpful in mud and snow, are actually worse on ice than regular highway tires.

Although studded tires are only second-best to chains in stopping ability, the fact that you can keep them on your car throughout the snow season means they're more likely to be there when you need them. Chains cannot be driven long on bare pavement (only about 100 miles), so they must be repeatedly put on and taken off. Studded tires, once installed, give constant protection--even against the unexpected patches of ice and frost you're likely to encounter between the periods of snowy driving.

In addition to greatly improving the stopping ability of tires, studs provide a dramatic increase in the glare-ice traction of the car's powered wheels. The committee's tests indicate that snow tires with studs are 121 per cent better at gripping the ice and preventing wheelspin, compared to the same tires without studs. This not only means that studded tires can help keep you from getting stuck, but they can also prevent a deadly side skid that might otherwise throw you into the path of another car if you stepped on the gas too hard.

Improved cornering ability on ice is another plus feature of studs. Their grip on the ice greatly enhances your car's steering dependability and at the same time reduces the danger of wheel lockup when you apply the brakes. Wheels must roll in order to steer; the instant they lock and skid, your car is out of control.

In its latest report on test results, the winter tests committee has concluded that the average effective life of tire studs is about equal to the life of the tires themselves. Since bare pavement is harder on studs than driving on ice and snow, you can greatly prolong the life of your studded tires by removing them each spring. In fact, because of highway damage potential, you are required to make the switch in most states. Check your local regulations on this point.

When you buy studded tires, be sure they have at least 72 studs, if they are average-size 14-inch tires. This will give the tire's footprint six or more studs. The committee feels that at least six studs per tire should be in contact with the ice at all times to provide adequate protection. Gyp dealers in many areas have been selling tires with as few as 40 studs installed in their treads. Such tires would be almost totally ineffective as ice grippers.

When you first use a set of brand-new studded tires, you'll notice the rather loud buzzing sound made by the studs as they strike the pavement. The sound diminishes somewhat, however, as the sharp edges of the protruding tips of the studs are worn. At the same time, just during the first 500 miles or so, there's a slight loss of ice-gripping ability for the same reason. It's a good idea to keep this in mind--if you test brand-new studded tires on ice, remember that some of their effectiveness will have vanished by the next time you need them on ice. This initially fast wear rate diminishes quickly and remains stable throughout the remaining life of the studs.

And, finally, remember that high-speed driving is hard on both studs and tires, particularly if the pavement is bare. You can greatly prolong their life by holding down to moderate speeds as much as possible.

* * * * *

SEAT BELT FACTS

1. Two-thirds of the drivers involved in fatal accidents live within 25 miles of the crash. Even a short trip to the grocery store can be dangerous. Wear seat belts whenever and wherever you go.
2. Actual crash condition tests prove your chances of being killed are five times greater if you are thrown out of your car.
3. "The seat belt, properly used, pulls down and back across the pelvis and hips, not across the abdomen. Even a woman in the last months of pregnancy may safely wear them."
(American Medical Association Journal).
4. A seat belt meeting acceptable standards can be purchased for as little as \$4.95....about the cost of a steak dinner. What is your life worth?
5. If your car catches fire or goes under water in an accident, a seat belt will hold you in place and lessen your chances of being knocked unconscious. The seat belt can be released in a second with the flip of a finger.
6. Seat belts should be worn for comfort as well as for safety. They help you maintain good posture and reduce fatigue. They keep you behind the wheel when emergencies occur and help to prevent accidents.
7. A seat belt restrains you. It lessens the impact of the blow. BUT, it is never a substitute for careful driving.
8. Smart drivers do everthing they can to keep themselves and their passengers alive and comfortable. How's your seat belt I.Q. ?

Reclamation Safety News
Second Quarter 1967

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REPORT--BURIED ASPHALT MEMBRANE CANAL LINING^{1/}

A water resources technical publication, Buried Asphalt Membrane Canal Lining, is now available. This report, documents 20 years of laboratory and field experience in the Bureau of Reclamation's use of buried hot-applied asphaltic membrane lining for control of water seepage from canals and shallow reservoirs. The first lining of this kind was installed in 1947 on the Klamath Project in California. Since then, more than 8 million square yards (6.7 million square meters) of buried asphalt membrane lining have been placed at more than 100 sites in the western United States. A specially processed catalytically-blown-type asphalt is used.

Beginning in 1962, samples from linings in service from 1 to 14 years from canal and lateral installations on 9 Bureau projects, have been evaluated in the Bureau's Denver laboratories for comparison of ductility, consistency, and temperature susceptibility with the original material. Included in the report are laboratory test results obtained from the samples, field observations which support laboratory findings, on-the-job photographs of typical installations, description of laboratory testing apparatus, and an aging index of tested asphalt membrane. The index is used to measure the relative change in the physical properties of the membrane due to field or laboratory aging.

This report also describes briefly the construction methods and techniques for lining canals, and gives specification requirements for the asphalt material.

Report Summary

Analyses of test results and visual observations on membrane samples after 14 years of service did not reveal serious deficiencies in the asphalt membrane canal lining. Of the 112 field samples evaluated from 20 canal installations, more than 80 percent demonstrated satisfactory membrane resistance to field aging. In most cases, phosphorus pentoxide catalytically-blown asphalt cement had greater resistance to aging when used as a buried membrane than other types of asphalt.

The membranes in poor condition were a consequence of accelerated aging, caused primarily by these faulty construction practices:

- a. Nonuniform thickness in membrane.
- b. Large rocks or clods in the membrane, indicating improper sub-grade preparation.

^{1/}This report published as Research Report No. 12, "Buried Asphalt Membrane Canal Lining" is for sale by the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402, or the Chief Engineer, Bureau of Reclamation, Attention: 841, Denver Federal Center, Denver, Colorado 80225, at 35 cents a copy.

- c. Sand, gravel, and silt mixed in the membrane caused by excessive spray bar pressures or use of the spray bar too close to the subgrade, or both.
- d. Accumulation of excessive silt, sand and gravel on the membrane before the second pass of spray application was completed, resulting in two thin membranes separated by a layer of soil.

Other conditions causing a poor membrane were:

- a. Water entrapped in the membrane interior, producing a "lifeless" condition.
- b. Physical damage to the membrane after loss of protective cover.

The investigation indicated that thickness is one of the more important factors contributing to the life of asphalt membrane. A minimum of 0.20 inch (0.51 cm.) is required before long-time service can be expected.

Changes in physical properties of the membrane, as measured by the aging index, show that approximately 90 percent of asphalt aging occurs during the first 6 years of service. After 6 years the rate of change is much slower.

For a majority of the membranes evaluated, the change in physical properties did not materially affect the ability to provide a flexible, water-tight lining.

The aging index was calculated for both the "as received" and for the melted membrane. Original material has an aging index of 100. In general, an aging index of 60 and above for the "as received" material and 50 and above for the melted indicated a fair to good membrane. Membranes with indexes below these numbers were generally classified as fair to poor.

Test results indicate some correlation between the laboratory 14-day aging at 140° F (60° C) test and field aging. Material with a higher 14-day aging index may have greater resistance to field aging. However, a number of unknown factors such as climatic conditions, type of soil, and location in canal influence field aging.

If hot-applied asphalt membrane is installed in accordance with current Bureau specifications, and the cover properly maintained, adequate seepage control should be provided for many years beyond the 14-year service age studied in this investigation.

The watertightness of a properly installed asphalt membrane lining is evidenced by a field-performed seepage test (ponding method) in an 11-year-old canal where the seepage rate was only 0.80 cubic ft. per square ft. per day. Ponding tests prior to installation of the asphalt membrane lining indicated a seepage rate of 9.96 cubic ft. per square ft. per day.

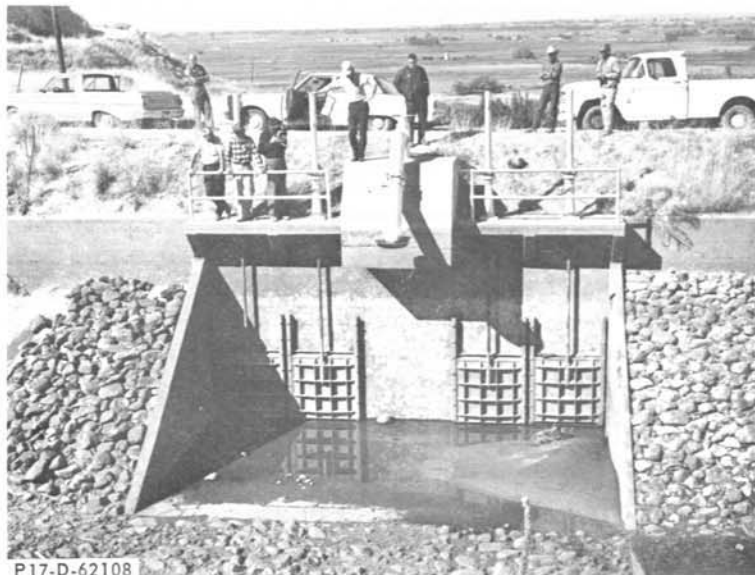
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A SIMPLE SOLUTION FOR REDUCING FLUCTUATIONS OF AUTOMATIC OVERFLOW SIPHONS

An inexpensive method has been found for controlling excessive fluctuations in canal water surface levels when automatic overflow siphons go into operation. This ingenious idea was originally conceived by Mr. Clifford Sutton, Pump Station Foreman, of the Burley Irrigation District, Burley, Idaho, to overcome a regulating problem at the "F" Wasteway structure in the District's Main Canal upstream from its First Lift Pump Station.

Siphons have been installed on a number of projects at wasteway structures to dispose of excess flows, particularly at locations where heavy storm runoff or where pumping plant outages occur. Once started in operation, an automatic overflow siphon frequently lowers the water surface elevation as much as a foot before the siphon breaks suction and stops operating. This situation has made it undesirable to use these siphons for operating regulation, because extreme variations cause undue fluctuations in downstream deliveries.

To solve this problem Mr. Sutton, installed a round metal pan on the siphon breaker vent pipe. Photograph No. 1 below, shows how the pan was installed at the Tunnel No. 2 wasteway of the Black Canyon Main Canal, near Emmett, Idaho. Note siphon overflow section with 10-inch pipe air vent.



Photograph No. 1

Previous to installation of this pan the intermittent operation of the overflow siphon caused serious variation in downstream water surface elevation. Since its installation water surface elevations have not varied over

.03 foot when the overflow siphon goes into action. A clear view of the metal pan and air vent pipe is shown in Photograph No. 2.



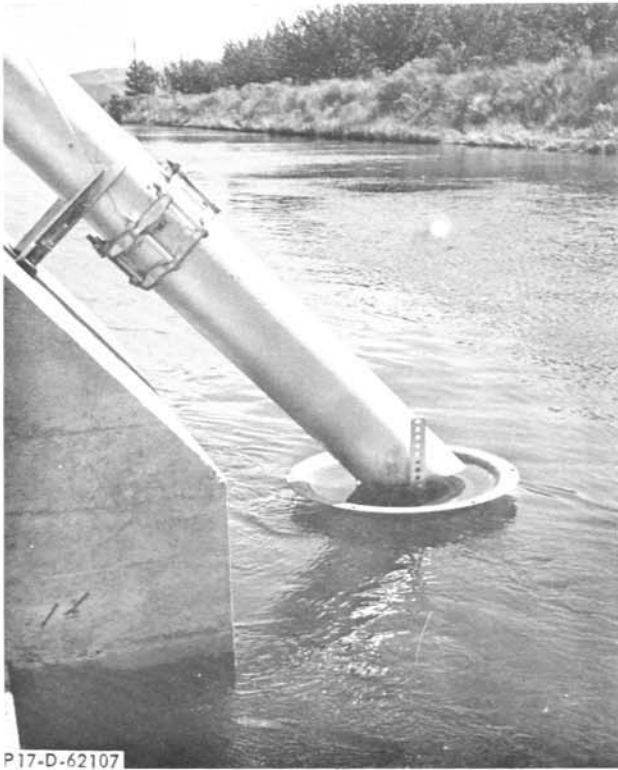
Photograph No. 2



Photograph No. 3

The water surface is normally carried 0.2 foot above the overflow siphon crest. Both the top of the pan and the bottom of the air vent pipe are set at normal water surface elevation. As shown in Photograph No. 3, the pan can be adjusted if necessary. Thus, a small amount of water spills over the overflow crest at all times but the siphon does not go into action until the pan fills and seals off the air vent pipe. As soon as the water surface is lowered to the top of the pan, the pan is sucked dry and the siphon action is broken.

The pan used in this case is actually an old tractor wheel. Photograph No. 4 on the next page, shows the metal pan on the bottom of 10-inch air vent pipe. The water surface is



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about 0.2 foot below its normal elevation.

At this location, this device is successful in holding the water surface to a maximum variation of .03-foot during peaking periods.

If additional information is desired regarding this device, please write to the Project Superintendent, Minidoka Project, Bureau of Reclamation, P. O. Box 549, Burley, Idaho 83318.

Photograph No. 4

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HOW TO HELP IN CASE OF HEART ATTACK

Call the doctor at once.

Help the patient take the position that is most comfortable for him.

(This will probably be halfway between lying and sitting. He usually cannot breathe comfortably if he lies flat.)

Do not attempt to carry or lift the patient without the doctor's supervision.

Loosen tight clothing such as belts and collars.

See that the patient does not become chilled, but do not induce sweating with too many blankets.

Do not give the patient anything to drink without the doctor's advice.

--American Heart Association
44 E. 23rd St., New York City

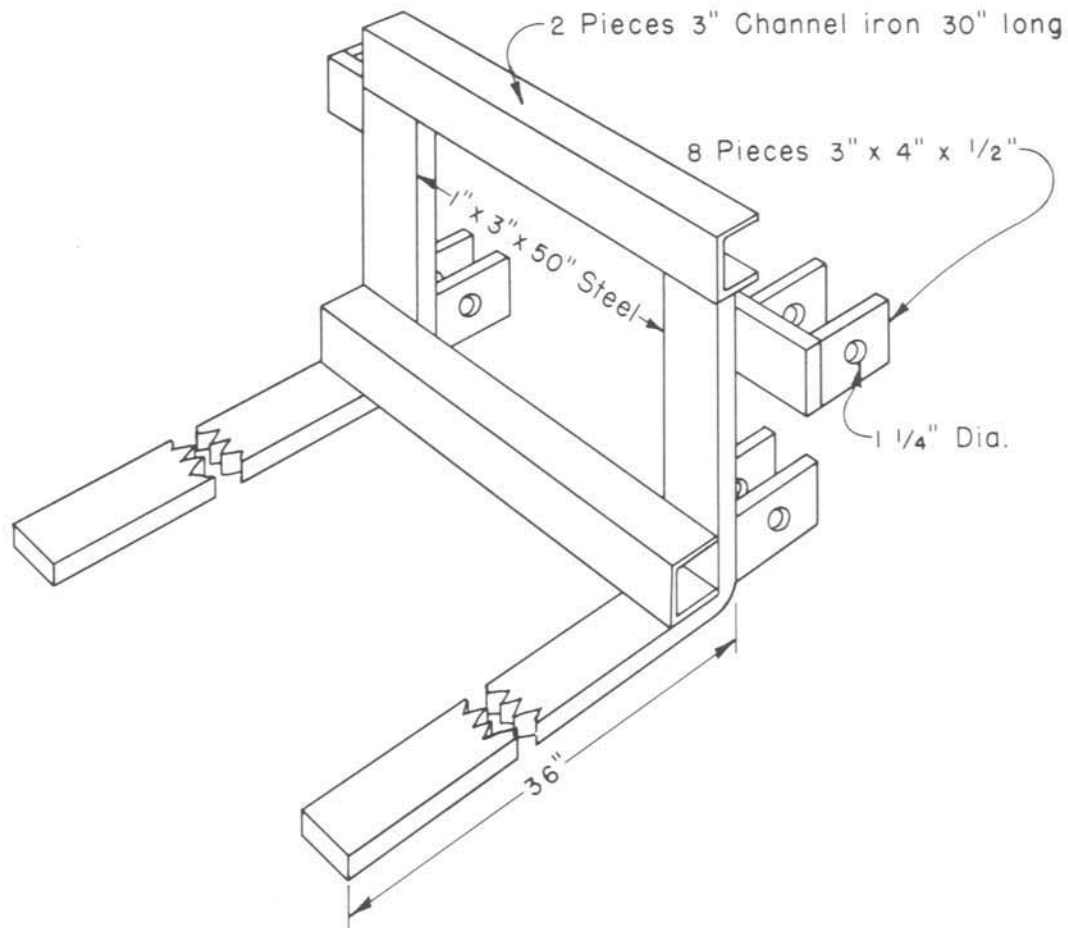
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FORKLIFT ATTACHMENT FOR FRONT END LOADER

(Reprinted by permission of GRIST, May/June 1968 issue, a publication by the National Conference on State Parks, Washington, D.C.)

When there were 100 pre-fab concrete tables to assemble at Joshua Tree National Monument, Maintenceman James B. Johnson thought they needed some mechanical help for the heavy job.

For a \$36.80 outlay in material and labor, Jim designed and constructed the forklift (shown in the sketch) for a front end loader. It can be interchanged with the bucket in about 30 minutes.



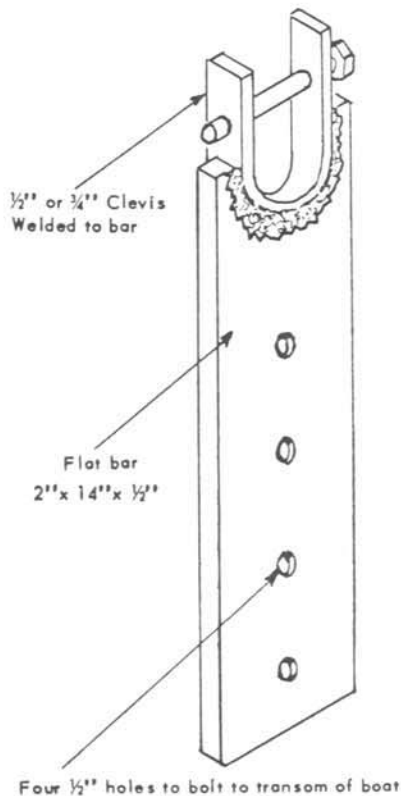
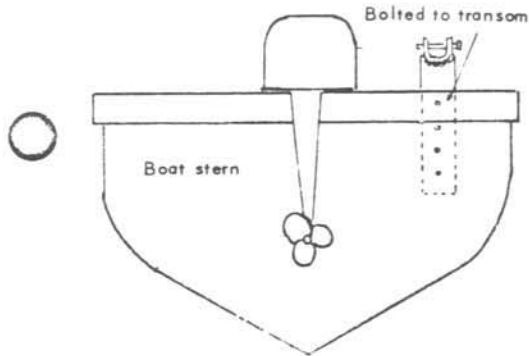
Heavy concrete table tops, end sections, and seats were handled and assembled by two men more safely than by hand, using four men. Table assembly time was cut by about 30 percent.

Although the specific job for which the attachment was designed is not one likely to occur frequently on an irrigation project, there are times when such a device could materially reduce manual labor and probably save considerable time.

* * * * *

HEAVY-DUTY TOW BAR & FAIR LEAD^{1/}

The Senior Park Manager at Cherry Creek Recreation Area, near Denver, Colorado, has come up with an idea for a heavy-duty tow bar and fair lead for use on his patrol boat or work barge, see sketches below:



Mr. Ed Fahey's suggestion consists of a clevis or shackle welded to the end of a flat bar 2" x 14" x $\frac{1}{2}$ " which is bolted to the transom of the boat high enough to keep away from the boat cables. To use as a tow bar, just drop the rope over the bar. To use as a fair lead, take out the pin and you're ready to go.

Material for the bar need not be heavier than specified with no fear of bending. The clevis can be any size to serve your needs.

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^{1/}Reprinted by permission of GRIST, July/August 1968, a publication printed by the National Conference on State Parks, Washington, D.C.