PAINTING TO BEAT THE HEAT1/

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:

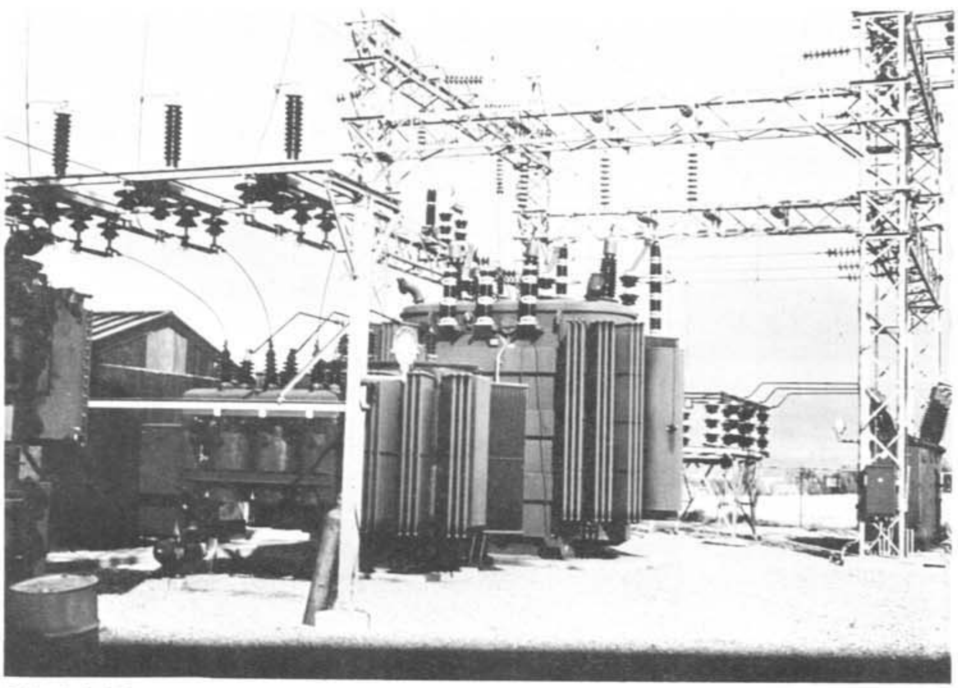
White	0.25
Aluminum	0.35
Gray	0.75
Black	0.97

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

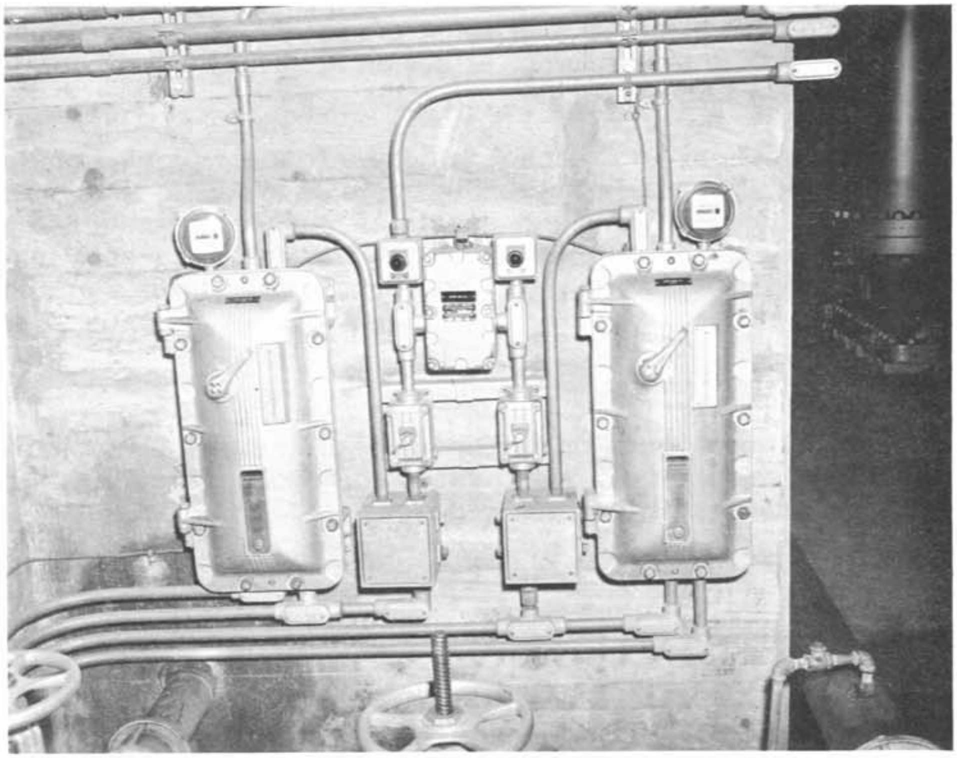
Heat from motors is mostly dissipated by convection so little is gained in painting them a specific different color.

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.

* * * * *

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 STUDDED 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.

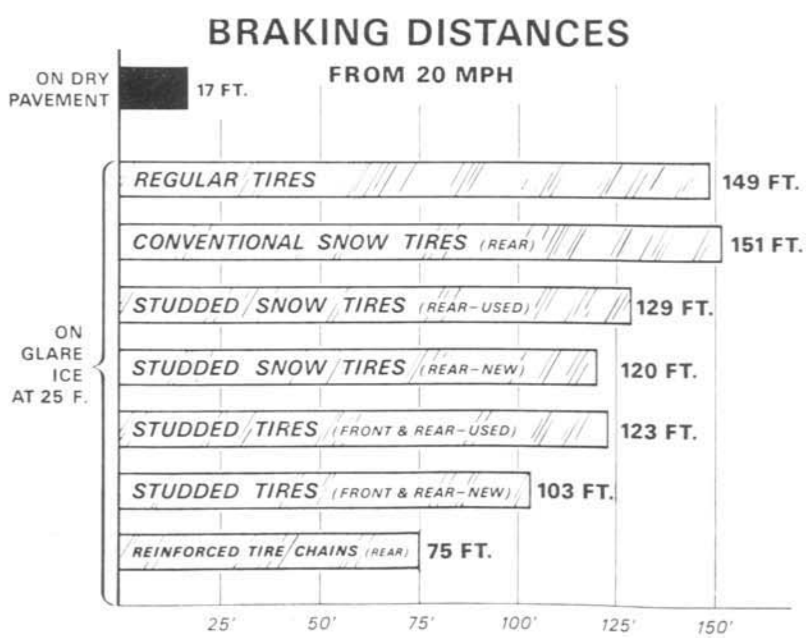
1/Reprinted from an article appearing in the December 1967 issue of TRAFFIC SAFETY, by special permission of the editor.

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.



(Braking distances shown above do not include reaction time which normally adds another 22 ft. to the braking distances)

Test results from the 1967 report of the National Safety Council's Committee on Winter Driving Hazards

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 lease 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 LINING1/

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 subgrade 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 seperated 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, watertight 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.

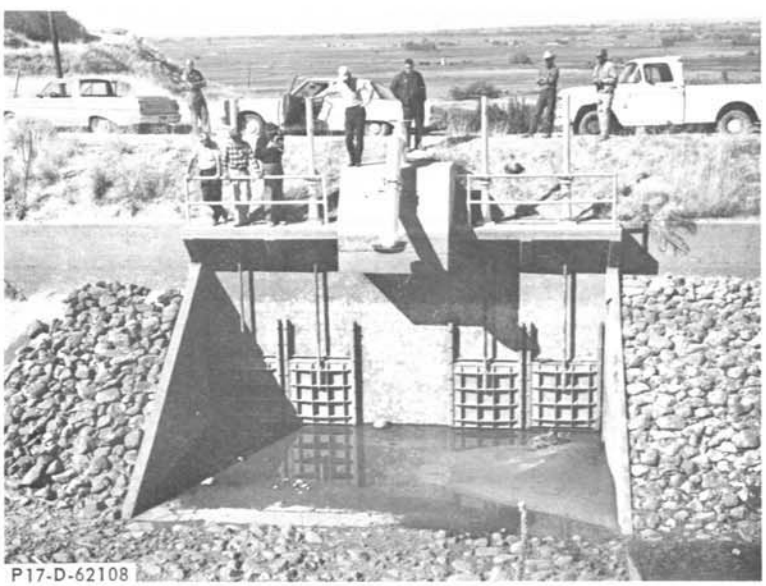
* * * * *

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

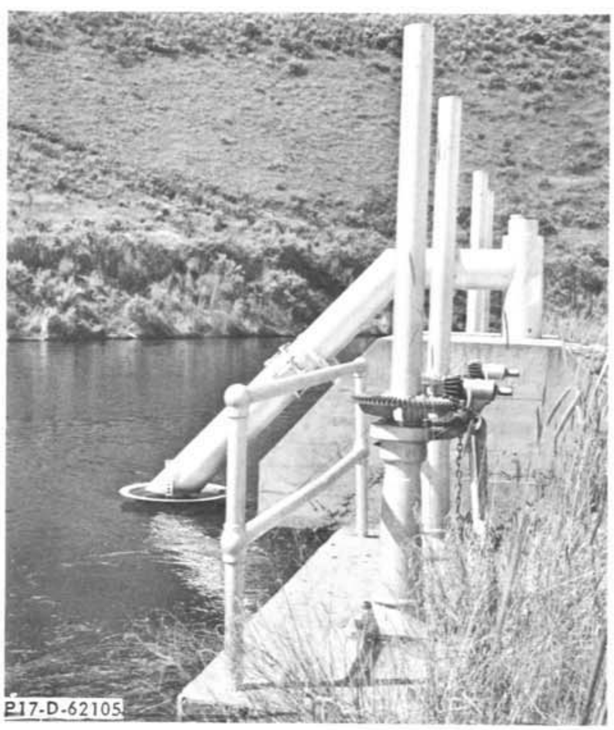
Previous to installation of this pan the intermittent operation of the overflow siphon caused serious variation in downstream water surface elevation. Since its installation water surface elevations have not varied over

.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.

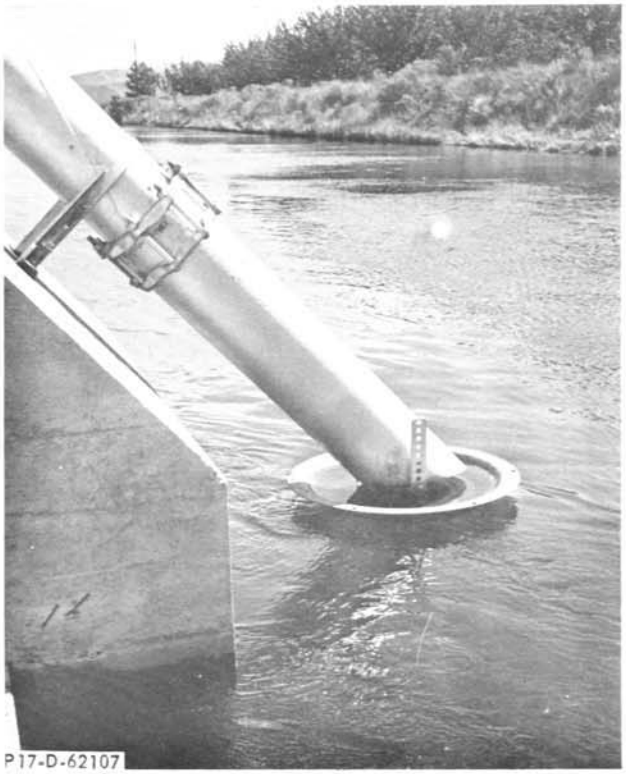
Photograph No. 2

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



Photograph No. 3



Photograph No. 4

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.

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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

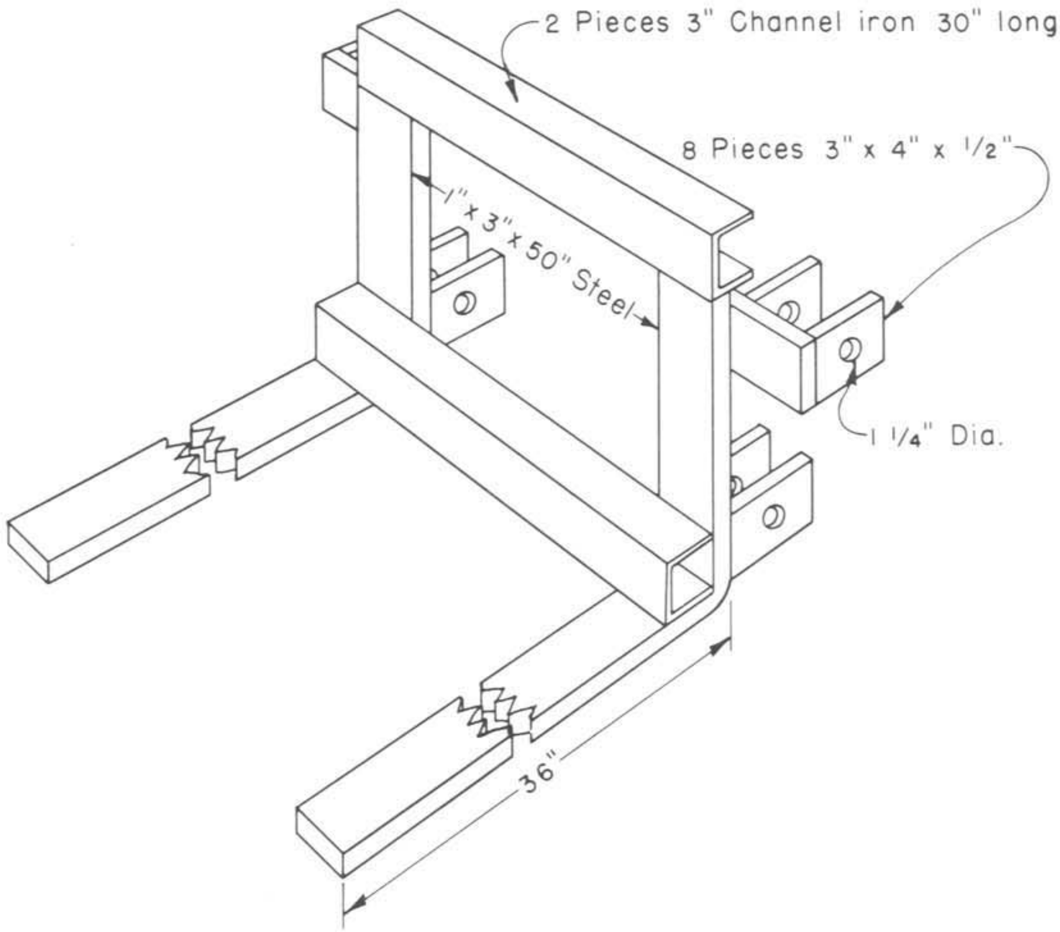
* * * * *

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, Maintenanceman 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.



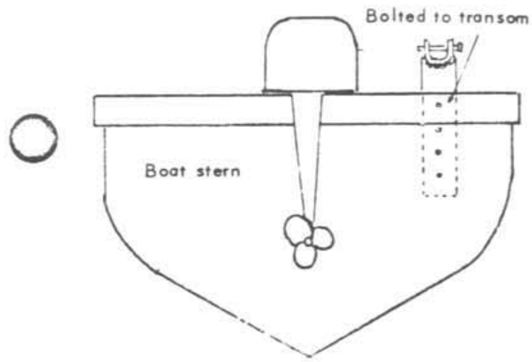
Heavy concrete table tops, end sections, and seats were handled and assembled by two men more safely than by hand, using four men. Table assembly time was cut by about 30 percent.

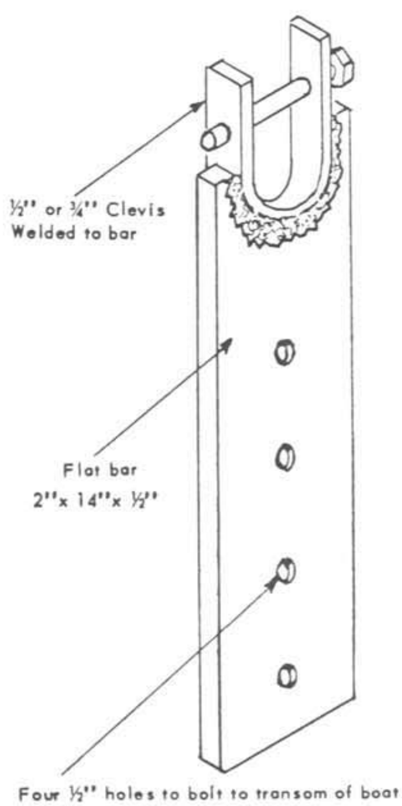
Although the specific job for which the attachment was designed is not one likely to occur frequently on an irrigation project, there are times when such a device could materially reduce manual labor and probably save considerable time.

* * * * *

HEAVY-DUTY TOW BAR & FAIR LEAD1/

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 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.

GPO 846-531