

Department of the Interior, Bureau of Reclamation

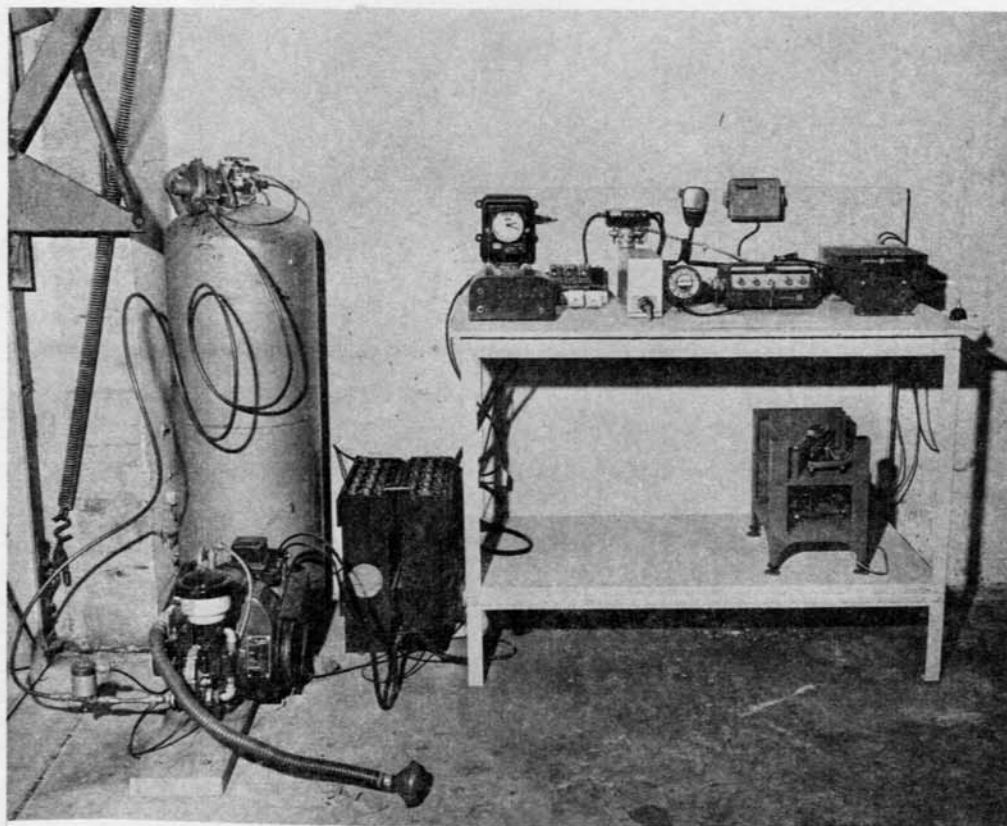
IRRIGATION OPERATION AND MAINTENANCE

BULLETIN NO. 53

July, August, September 1965

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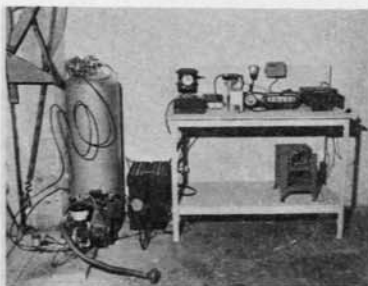
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The Irrigation Operation and Maintenance bulletin is published quarterly, for the benefit of irrigation project people. Its principal purpose is to serve as a medium of exchanging operation and maintenance information. It is hoped that the reports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



Taylor-Ferry on-call radio reporting
gage equipment assembled for test.
Cover Photo No. P45-300-4340-2

IRRIGATION OPERATION AND MAINTENANCE
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INTRODUCTION

The use of on-call radio reporting gages by the Bureau of Reclamation as an important aid in the operation of the Lower Colorado River and the type of equipment used in some of the more remote areas are described in an article beginning on page 1 prepared by R. E. Bellis and J. I. Sanders of the Bureau's Region 3 staff in Boulder City, Nevada.

An evaluation of buried asphalt membrane linings developed by and installed on Bureau constructed projects over the past 14 to 16 years is the subject of an article beginning on page 8 on the use of this lower cost canal lining material. In addition to field performance the results of laboratory tests on field specimens of the membranes are discussed in the summarization of a laboratory report prepared by the Bureau's Division of Research.

Several pieces of equipment designed and constructed by project operation and maintenance personnel also are included in this issue of the bulletin. These are: a device for driving rod-type electrical ground and steel fenceposts, page 15; the use of a portable 3-hp gasoline engine to power a hoist on a movable crane to expedite the removal, disassembly, reassembly and reinstallation of 80-cfs pumps and their 300-hp electric motors, page 17; a large, but lightweight bucket for cleaning smaller laterals and drains with a hydraulically operated tractor-mounted backhoe, page 19; a simple device for removal of packing from pipe and penstock expansion joints, page 21; and on page 22, a plexiglass shield to protect the operator of rotary weed mowing equipment.

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RADIO REPORTING RIVER GAGES AID WATER SCHEDULING ON LOWER COLORADO

By R. E. Bellis and J. I. Sanders

On-call radio reporting gages are helping the Bureau of Reclamation operate the Lower Colorado River for maximum conservation and utilization of water. The Bureau, through its Region 3 Lower Colorado River Control Office, is responsible for the operation of the Lower Colorado River from Lees Ferry to the Mexican Boundary. Operation of the river must be in accordance with the Colorado River Compact, Boulder Canyon Project Act, Mexican Treaty, all water delivery contracts, and the Supreme Court Decree of March 9, 1964. Drought cycles along with rapidly increased demand on the water supply of the Colorado River have called for concentrated efforts by the Bureau for water conservation. One of the methods used to conserve water was to improve the accuracy of delivery by better river routing procedures. Among other things, this called for improved reporting of river flows at different locations (gaging stations) along the river. One of the steps taken to accomplish this has been the development of improved methods of radio reporting of river stages from the gages.

The drought cycle on the Colorado River during the period 1953 to 1956 emphasized the need for an improvement in our reporting procedures on river flow as it progressed from storage reservoirs to points of diversion. About five days are required to deliver stored water from Lake Mead to Imperial Dam, the last major diversion point for irrigation use in the United States. Another five to seven days are required for flow diverted at Imperial Dam to reach the Coachella Valley farmers at the end of the Coachella canal. The last storage reservoir on the Colorado River at which some reregulation of storage can be accomplished is in Lake Havasu, the reservoir formed by Parker Dam near Parker, Arizona. Water released at this point is either diverted to users along the river or lost to the Gulf of California.

In 1954, the first move was made to obtain telemetering equipment for installation at Colorado River gages to report water stages to the scheduling offices by radio. Soon thereafter a telemeter was installed at the Colorado River gaging station below Cibola Valley, Arizona, which is located about 24 hours' water travel time above Imperial Dam. This gage reported on an FM river control radio system to the Imperial Dam Office and the Boulder City River Control Office. It reported by clock program every 6 hours and was used for several years for advance information on flow that could be expected to arrive at Imperial Dam 24 hours later. This allowed a 24-hour reduction in the time required to make changes of releases of stored water at Parker Dam to meet downstream requirements. During the drought years, this was particularly important because only water for downstream requirements was being released from storage.

In 1960, the need became apparent for additional flow information to be reported by radio. The existing radio equipment was replaced with transistorized on-call equipment and two additional on-call radio reporting systems were installed; one at the Taylor Ferry gage several miles upstream from the Cibola gage, and another below Yuma, Arizona. Several views of the physical facilities at the sites are shown in Figures 1 through 5.

Figure 1 below is a view of the river stage recording gage at Taylor's Ferry. Figure 2 also is a view of the Taylor Ferry installation showing



Figure 1



Figure 2

ing the radio building, and the small enclosure outside the building which protects the butane tanks supplying fuel to the butane burning engine which drives the generator to supply power to the radio unit as discussed later.

Figure 3 on the following page is a view of the radio building and antenna at the Adobe Ruin's river stage recording gage of the Cibola Field Division.

Figure 4, also on the following page, shows the river stage recording gage at the Adobe Ruin's.

Figure 5, on page 4, is a view of the Yuma gaging station of the California side of the Colorado River, downstream from Yuma, Arizona. Commercial power as discussed below made this installation a more conventional type.

Power Supply

Commercial power is not available at the Taylor Ferry and Cibola gage sites. With the advent of the transistorized FM radio receiver and remote control tone equipment, it was feasible to design an on-call reporting system with storage-battery power supply and propane-fueled chargers. The receiver and



Figure 3



Figure 4



Figure 5

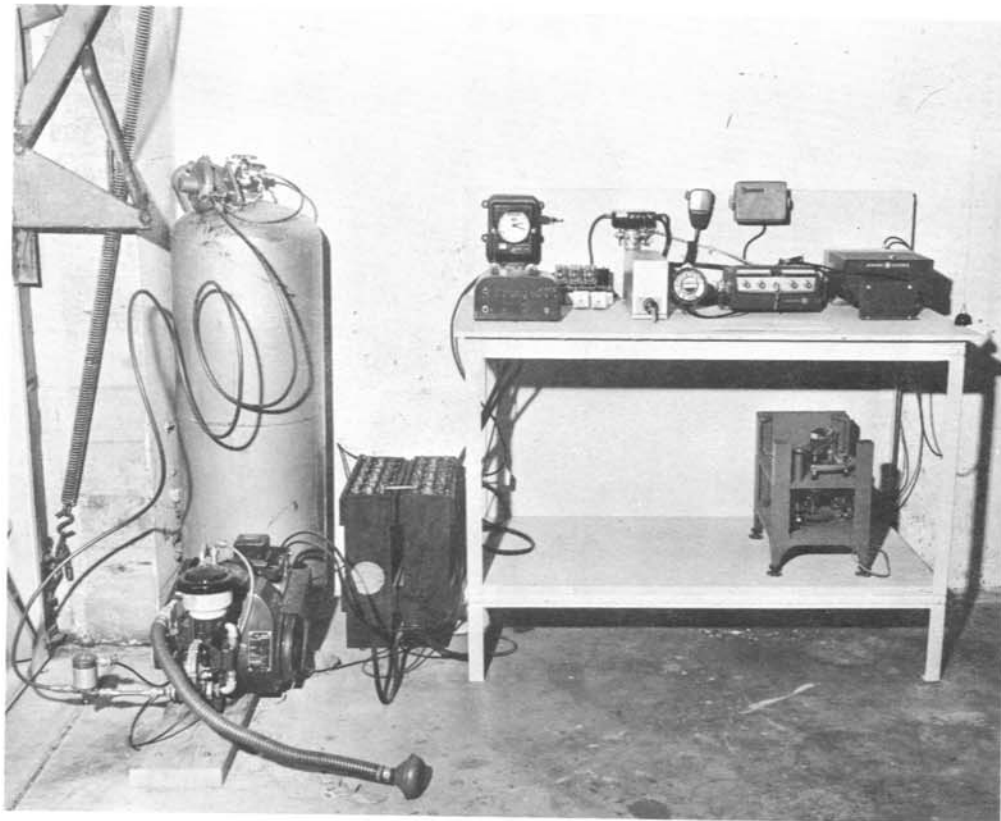


Figure 6

decoder consume such a small amount of power that they can be energized on standby 24 hours a day and the battery can be maintained with a trickle charge of a few hundred milliamps. Thus, the gage will respond to selective call at any desired time.

The Taylor Ferry on-call radio reporting gage was developed first. At that time, the gas-fueled thermoelectric generator, which has been developed as a static low-power source of electrical energy, was not commercially available. The cost of a suitable solar cell was about equal to the total cost of all of the other equipment needed for one installation. Thus, a small one-cylinder propane-fueled engine generator set with automatic starting control was used. The equipment for the Taylor Ferry installation is shown on the cover and in Figure 6 on the preceding page.

In the Taylor Ferry installation, a contact-making ampere-hour meter registers battery drain. When a predetermined number of ampere-hours have been used, the starting circuit is set up. The next time the gage is called, the engine starts and runs until the battery is charged. A small pulse voltage from the engine magneto points is used to modulate the transmitter. The background clicking noise heard on the radio signifies that the engine is running but does not over-shadow the tone coded water level report.

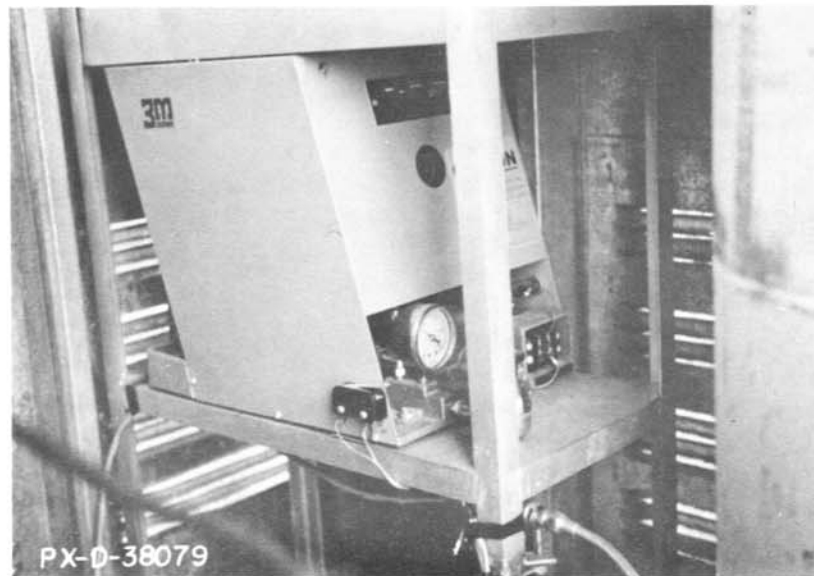


Figure 7

The second on-call gage at Cibola was designed with a thermoelectric generator consisting of a thermopile (series of thermocouples, a gas burner, cooling fins for the cold junction, and a transistorized converter and rectifier. A view of a thermal electric generator as installed is shown in Figure 7. It produces up to one ampere of direct current for charging a nickel-cadmium battery, has no moving parts,

is simple, trouble- and maintenance-free, and holds almost constant battery voltage.

Radio System

Each gage is equipped with a 12-volt, 30-watt, transistorized, FM, mobile radio, as shown in Figure 6 and on the cover page. These radios work into existing river control voice radio network repeaters. Vacuum tubes are used in the final stages of the transmitter. To keep the battery drain low, the transmitter tubes are heated only during reporting. A twenty-second time delay between the call and the report allows the tubes to warm up. This undesirable time lag can be eliminated now through the use of new all-transistorized radio or quick heat transmit tubes, without increasing battery drain.

Remote Control Signaling

Two commonly used systems are available for selective radio call. The single or double tone system employs audio frequency tones sent out by the calling station. A resonant decoder in the receiver responds to the appropriate tone or combination of two tones to close a set of relay contacts. The two-tone system affords a good degree of security against false operation from noise or voice frequencies.

The digital tone code system uses an audio tone which is pulsed or interrupted by a telephone selector. The decoder is available with five function contacts, each of which can be closed separately by dialing appropriate numbers. This system has a high degree of inherent security against false operation and affords a simple means of sending more than one control signal to the gage, as described herein. All electrical transistorized digital decoders are now available.

Water Level Encoder

All three of the gages described use drum-type float-operated encoders with which most persons engaged in water measurement and control are familiar. A roller actuated micro-switch scans three stagger-ridged drums on command. The resultant pulses are counted in groups to decode the water surface elevation in feet, tenths, and hundredths.

These encoders scan the switch closures which normally would pulse an audio oscillator to modulate the radio transmitter. However, since transistorized radio power supplies contain an audio frequency oscillator, it is only necessary to apply positive battery voltage to the ungrounded microphone terminal, through a relay operated by the scan switch, to produce a good quality audio tone from the transmitter. This simple technique was discovered accidentally and precludes the need for a separate audio oscillator.

Monitoring and Alarm System

Since the gages are completely automatic and are called around the clock, they have been designed with features to alert the calling station if certain abnormal conditions develop. As mentioned above, the engine-generator set at Taylor Ferry starts and stops automatically as required and can be monitored while running by listening for the ignition pulses on the radio. If, for any reason, the engine fails to stop when it should, it may be stopped on command by dialing an appropriate number. Conversely, it may be started by dialing an appropriate number in case it fails to start automatically. If the thermoelectric generator at Cibola fails for any reason, a steady tone is received in lieu of the water level report when the gage is called. By dialing a different number, the water level report can be obtained. A technician is then notified. Failure of power or battery charger at the Yuma gage results in this same response. If, for any reason, the transmitter is not cut off automatically, a time-delay relay locks it out after two minutes. This relay may be reset by dialing an appropriate number.

Future Planning

These gages are a valuable aid in scheduling water on the Lower Colorado River, however, more flow data is needed and this type of gage has limited application due to its slow response and method of encoding. It would not be practicable for a large number of frequently called stations on a voice-shared radio network. A high-speed programmed telemetering and recording system is being considered. Such a system could call in and record data from several locations in the time required to interrogate one of the existing gages.

The fast-moving development of data collection, transmission, and logging systems opens the way for improvement of water scheduling and control techniques. The increasing shortage of water, with resultant demands for better utilization and control emphasizes the need for such improvement.

Assistance

For further information, please write the Regional Director, Attention: Code 3-600, Bureau of Reclamation, P. O. Box 427, Boulder City, Nevada 89005; or Chief Engineer, Code 400, Bureau of Reclamation, Building 53, Denver Federal Center, Denver, Colorado 80225.

* * * * *

EVALUATING BURIED, HOT-APPLIED ASPHALT MEMBRANE LININGS

One present disadvantage of any buried membrane-type lining is the uncertainty of the life of the membrane material as compared with the hard-surface-type linings such as those composed of portland cement concrete and mortar. Some bentonite membranes have been in service 25 years, the first linings of this type being installed in 1940. Buried, hot-applied and prefabricated asphalt membranes have only been in service from 14 to 16 years, plastics 10 years, and synthetic rubber only 4 years. Most of the Bureau of Reclamation experience has been with the hot-applied asphalt membranes and some 8 million square yards of this type of lining have now been installed. However, there is reason to believe that plastic and synthetic rubber sheeting will prove equally as efficient and effective. All should provide some of the tightest linings developed to date.

Field observations indicate that buried asphalt membrane linings, generally, have performed very satisfactorily over periods up to 16 years. Most project operators are well satisfied with the performance of the linings and would install or are installing more of this type of lining, except in smaller canals and laterals where mechanical cleaning without damage to the membrane is a problem. From the field observations it appears that the life of the membrane lining that is adequately protected and maintained will be primarily dependent upon the life of the membrane and recent laboratory tests of the hot-applied asphalt membranes constructed of catalytically blown asphalt cements indicate that little change in the membranes characteristics has occurred since their application.

Field Observations

Very few reaches of buried asphalt membrane linings have failed. Some have been damaged. The damage has been the result of: (1) placement of the lining on unstable side slopes, (2) inadequate protection of the membrane, (3) weed growth in cover material, (4) surface runoff, (5) type of subgrade materials, (6) cleaning operations, (7) scouring of cover material on the outside of curves and subsequent exposure of the membrane, (8) overtopping of the lining by operating, laterals primarily, at greater than designed normal water depth, and (9) membrane rupture or puncture. Rupture from hydrostatic pressure under the lining has occurred, but once relieved the rupture apparently does not become more serious.

The maintenance of buried asphalt membranes has consisted essentially of providing a better quality cover material or adding to such cover; removing silt and debris from channels; removing silt and grass berms at the water line in channels; repairing membrane damage due to erosion of the cover because of channel velocity or surface water flowing down the side slopes; improving the subgrade material before replacement of punctured or ruptured membrane; and providing surface water inlets into the channels. Several views of some of the lined reaches are shown in Figures 1 through 7 on the following pages.



Figure 1



Figure 2



Figure 3

Figure 1 shows the Casper Main Canal, on the Kendrick Project. This is a reach lined with a buried asphalt membrane in 1954 that is providing excellent seepage control and has required no maintenance.

Figure 2 shows Lateral R4-S on the Shoshone Project. This reach was lined with a buried asphalt membrane in 1953.

Figure 3 is a view of the Main lateral of the Angostura Unit of the Missouri River Basin Project; the lateral was lined with a buried asphalt membrane in 1952, and is effectively controlling seepage and has required no maintenance although the membrane has slipped and folded at the top of the slope.

Figure 4 on the following page, shows the Casper Main Canal. Very stable gravel protective covers are used in some buried asphalt membrane lining installations.



Figure 4



Figure 5



Figure 6
10



Figure 7

Figure 5 on the preceding page is a view of the Shirley Canal. The surface runoff has damaged buried asphalt membrane lining on the side slope.

Figure 6 also on the preceding page, shows the Glendive Canal on the Buffalo Rapids Project. Membrane damage shown is attributed to scour and erosion on the outside of the curve and in part to cleaning with a dragline and sloper. Some membrane slippage also is apparent.

Figure 7 above is a view of the Main Canal, Angostura Unit, Missouri River Basin Project. Grouted rock over buried asphalt membrane lining serves as a satisfactory surface water inlet.

Laboratory Evaluation of Asphalt Membrane Aging

One of the early research activities of the Bureau's Bituminous Laboratory was the development of the buried asphalt membrane lining.

Through cooperation with industry, much laboratory and field testing was conducted to determine the best asphalt material available and construction techniques for producing a durable watertight lining. As a result, the catalytically blown asphalt cement used today was developed. This asphalt cement is prepared by catalytically blowing asphaltic materials obtained from crude oil to produce a special asphalt having a very low temperature susceptibility, a high degree of toughness, resistance to tearing or breaking, and an indicated high durability.

Since the first installation of the hot-applied buried asphalt membrane type of lining in 1947 on the Klamath Project in California, very little data have been reported relative to the effects of field aging upon the physical characteristics of the catalytically blown asphalt used in this type

of construction. Under the Bureau's Lower Cost Canal Lining Program, an extensive testing program was started in 1962 consisting of visual observations and physical testing of asphaltic membrane linings having service records of up to 12 years. The purpose of this program was to obtain information relative to the effects of field aging.

The laboratory report summarizes the test results on 65 samples from 15 different canal or lateral installations on 9 Bureau projects.

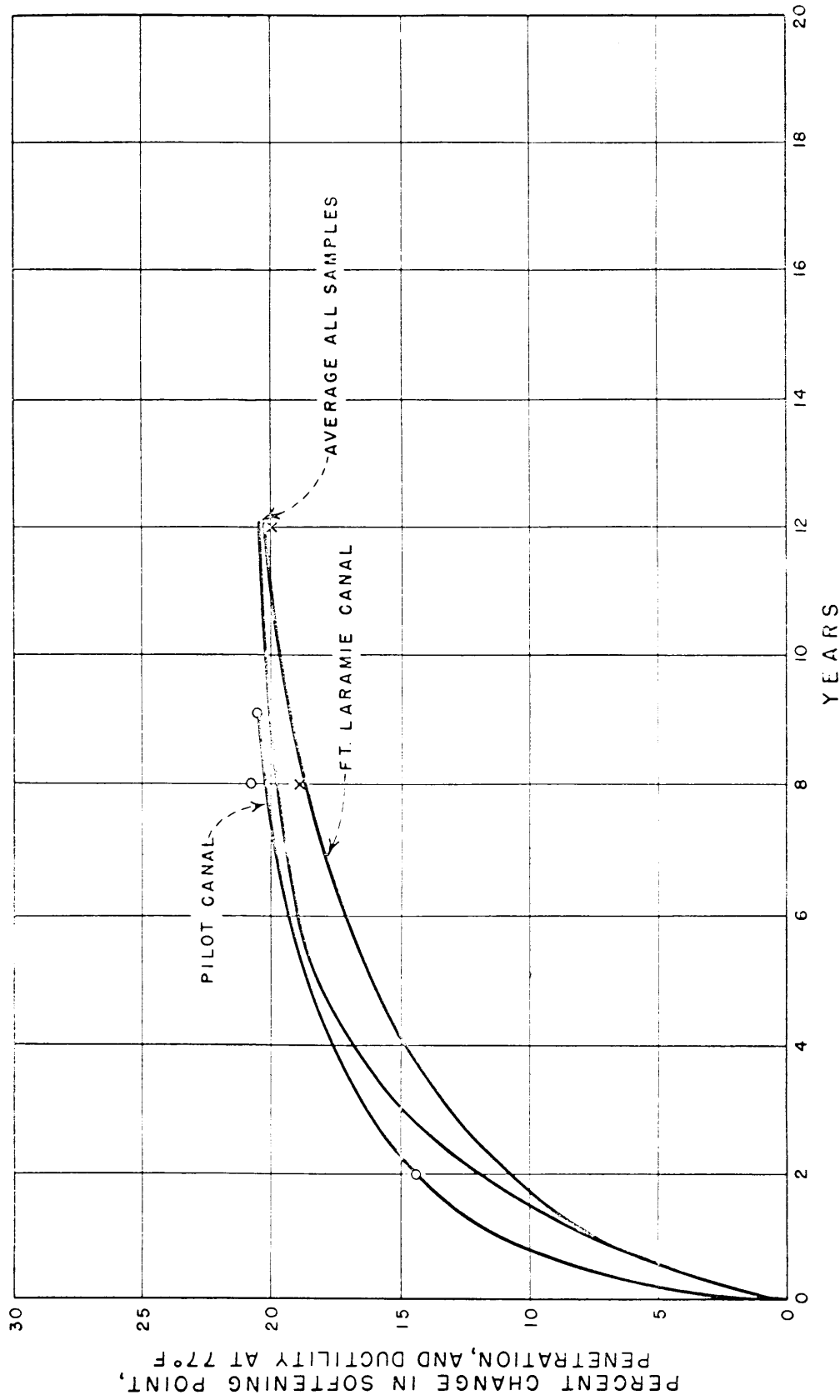
On the average, 8-year field aging results in a reduction of 20 percent in penetration, 30 percent in ductility, and an increase of 5 percent in softening point. As evidenced by service performance and visual examination, this change in physical properties of the asphalt membranes did not materially affect their ability to provide a flexible, watertight lining.

Based on change in physical properties as determined by softening point, penetration, and ductility testing, it is indicated that approximately 90 percent of the aging of the asphalt membranes studied occurred during the first 4 years of service. The change due to aging decreased sharply after about 8 years' service, as shown in Figure 8 on the following page.

The results of visual observations and physical testing indicated that one of the more important factors contributing to life of the asphalt membrane is thickness. A minimum thickness of 0.20 inch, approximately 1.12 gallons per square yard, is required before longtime service can be expected. (Bureau specifications now require a minimum of 1.25 gallons per square yard.) A study of the reported field observations and analysis of test results completed on membrane samples after up to 12 years' service did not reveal any information that would signify serious deficiencies of the asphalt membrane lining.

Based on the comparison of the test results of 65 field membrane samples, most of which represent the oldest installations, with the test results from the original asphalt cement at the time of application, 88 percent have demonstrated satisfactory resistance to field aging, with only 12 percent in a fair to poor condition. The membranes in poor condition resulted from accelerated aging due to construction deficiencies such as holidays, incorporated subgrade material, and nonuniformity in thickness.

The watertightness of asphalt membrane lining is evidenced by a field-performed seepage test (ponding method) in an 11-year-old lateral installation where the seepage rate was determined to be only 0.08 cfd (cubic foot per square foot per day). Ponding tests made in 1950 in the same general area, prior to the installation of the asphalt membrane lining indicated a seepage rate of 9.96 cfd.



AVERAGE AGING OF BURIED ASPHALT MEMBRANE CANAL LININGS
 TESTS CONDUCTED UPON SAMPLES IN "AS RECEIVED" CONDITION.

FIGURE 8

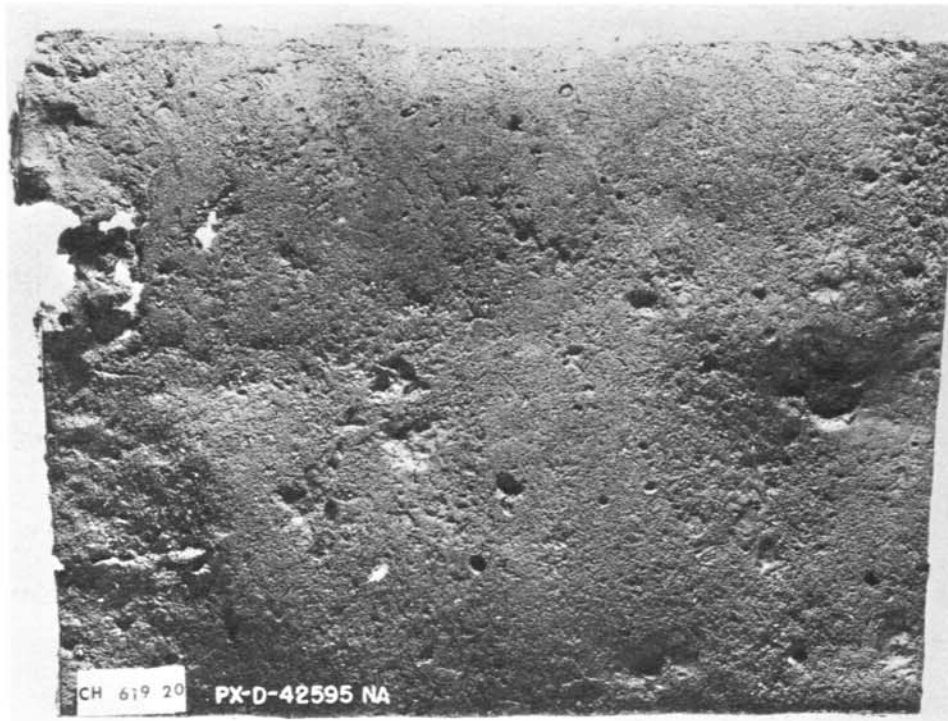


Figure 9

Deficiencies noted in a number of membrane samples are as follows:

- (a) Nonuniform thickness of membrane.
- (b) Large rocks or clods contained in the membrane indicating improper subgrade preparation, Figure 9, above.
- (c) Sand, gravel, and silt mixed in the membrane as a result of use of 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. This results in two thin membranes separated by a layer of soil, as shown in Figure 10 on the following page.

Examination of the membrane samples gave evidence that better construction control through more rigid inspection can be expected to produce a higher quality membrane significantly reducing deficiencies.

The laboratory studies summarized in this article are contained in Report No. B-34, prepared by F. H. Geier, of the Bituminous Laboratory



Figure 10

Section of the Chemical Engineering Branch, Division of Research, Office of Chief Engineer. Copies of the report can be obtained by writing the Chief Engineer, Bureau of Reclamation, Denver Federal Center, Denver, Colorado 80225.

* * * * *

STEEL ROD OR POST DRIVER (Suggestion R6-65S-37)

Earl J. Foster, Jr., a lineman with the Watertown Field Unit of the Bureau of Reclamation, Watertown, South Dakota, suggests that the driver shown in the sketch on the following page, designed for driving rod-type electrical grounds can also be made a little larger for driving fence posts for electrical grounds or fencing jobs. By the numbers: (1) is made of 3-inch-diameter solid steel stock; (2) is extra strong steel pipe; and (3) is a stop collar welded to the top end of the standard weight "holding" pipe (4) with minimum inside diameter of 1 inch for use with the rod-type ground and larger for fenceposts; (5) is the stop plate welded to the lower end of the driver pipe with the hole in the plate large enough to allow free movement of the driver and small

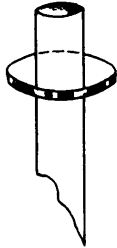
SAFETY SUGGESTION FOR IMPROVED FENCE GROUND DRIVER

This driver is designed for the rod type ground (part No. 71.11) Can also be made on a little larger scale for the fence post type ground (part No. 71.10)

1. 3" Solid stock.
2. Extra strong pipe.
3. Stop collar. (See Note 1.)
4. Standard weight pipe minimum inside diameter 1.
5. Stop plate. (See Note 2.)
6. Two 1/2" set screws.
7. Ground rod.

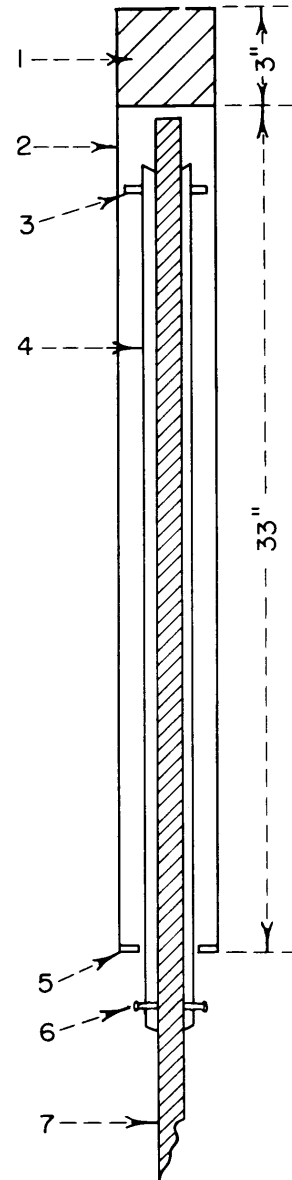
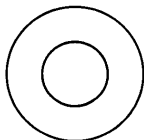
Note 1.

Stop collar welded near top end of hold pipe. Small enough to allow free movement of driver and large enough not to pass through stop plate hole.



Note 2.

Stop plate welded on lower end of driver. Hole made large enough to allow free movement of driver and small enough so stop collar will not pass through.



enough so that the stop collar (3) will not pass through it; (6) designates two 1/2-inch set screws with locking nuts, holes for which are drilled and tapped in the inner or "holding" pipe; and (7) is the ground rod or post.

The driver is placed over rod with the rod extending an inch or two beyond the upper end of the inner or "holding" pipe as shown in the diagram and the set screws and locking nuts are tightened. The outer or driving pipe is raised and lowered in a hammering motion on the head of the ground rod and cannot be raised above or off the head of the ground rod until set screws are loosened, this eliminates the possibility of accidentally getting the hand between the driver and the ground rod.

All the hammering force of the driver is applied directly to the rod whereas with some drivers the force strikes an anvil base which rests on the rod end, and continual hammering creates some play between the anvil and the rod, causing some bounce, thereby losing some of the driving force. All movement of many drivers is above the rod whereas the suggested driver extends 32 inches down from the top of the rod, thereby doing away with some of the height hazard which is involved in operating some drivers.

* * * * *

NOVEL AND PORTABLE POWER UNIT

Personnel of the Buford-Trenton Irrigation District devised a unique method for handling their large pumps as described below:

The Buford-Trenton Irrigation District is a 7,800-acre project supplied by three 80-cfs capacity pumps powered with 300-hp electric motors.

The Project was constructed during World War II when materials were critical and substitution for the more desirable materials and items of equipment was necessary. Consequently, besides constructing the pumping plant of timber, substitution had to be made as to the type of overhead crane installed. This consisted of a chain hoist, hand-operated movable crane. This type of equipment required two 2-man teams (heavyweight men) 24 man-days to remove, disassemble, reassemble and reset the three units.

Upon investigating the possibility of motorizing the crane, an estimate of \$1540 was made by the supplier of the crane for converting it to electrical operation. The District thought this too costly.

Further search by the Manager produced a 3-hp air-cooled gasoline engine equipped with a gear reduction transmission with a hand-operated clutch at a cost of \$138. A suitable chain sheave cost an



Photograph No. 1

additional \$7.50. To make this motor movable, it was mounted on a small wagon which cost \$11.50. The work which formerly required 24 man-days is now accomplished in less than 8 man-days for an investment of only \$157.00. The motor is also used to operate a concrete mixer, weed sprayer and water pump as needed.

Photograph No. 1 above shows the unit mounted in a wagon.

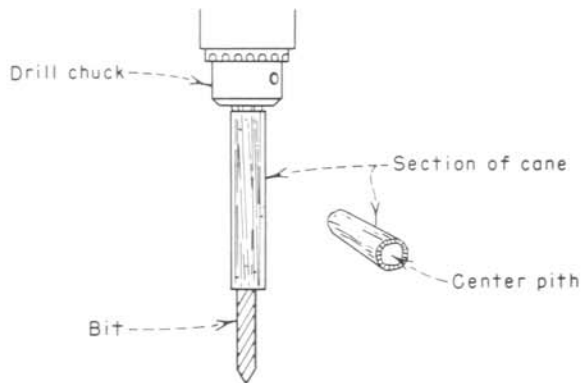
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HOW TO DRILL UNIFORM HOLES

(Reprinted by permission of GRIST, November/December 1963 issue, a publication by the National Conference on State Parks, Washington, D.C.)

That friendly writer of many useful suggestions, Donald M. Black, Naturalist with the Natchez Trace Parkway, says that in woodworking he often finds it necessary to drill several holes "just so deep." Usually he has made a gauge or guide by cutting a piece of dowel rod to a length which will prevent the drill bit from going deeper than desired. He has made a hole down through the dowel, then slipped it over his drill bit.

Although the dowel method is a good one, Don says that sometimes "woodgrain and human weakness" cause the bit to drift a little while making the hole through the middle, so that the thing comes out with a slight slant or drift. Last summer he found a naturalist's answer to the problem--he went across the road and picked up some dead cane which had a tapering diameter with holes right down the middle. All he does now is to cut a piece of cane of the length needed, hold it



with a pair of pliers while he forces the turning drill down through the hollow core, and he's in business. If cane doesn't grow in your park, he suggests you get an old bamboo fishing pole. One pole will supply depth gauges for a long time.

Incidentally, we sometimes use an old spool from the wife's sewing basket to make a drill depth gauge.

The sketch at left describes the assembly of the drill and gives directions for making one.

* * * * *

LARGE BUCKET--SMALL BACKHOE

Mr. Harold Sexton, Secretary-Manager of the Rogue River Valley Irrigation District, Medford, Oregon, informs us, that over a year ago a 6-foot-long bucket was designed for use on their hydraulically operated backhoe for cleaning canals and laterals. The first bucket was a complete success and the photographs below and on the following page are views of the District's latest model--a 7-foot-long bucket.



PX-D-50655 NA

The photographs show the new blade (bucket) rehabilitating a small lateral. The lateral runs through varied soil conditions, as well as numerous fenced areas, which makes use of conventional ditches only partially successful. Note the oversize pad used on the stabilizer to prevent tipping of the tractor. This is necessary with the use of the large blades.

Twice last year, due to local conditions, a large amount of silt and mud partially filled two

Photograph No. 1



Photograph No. 2



Photograph No. 3

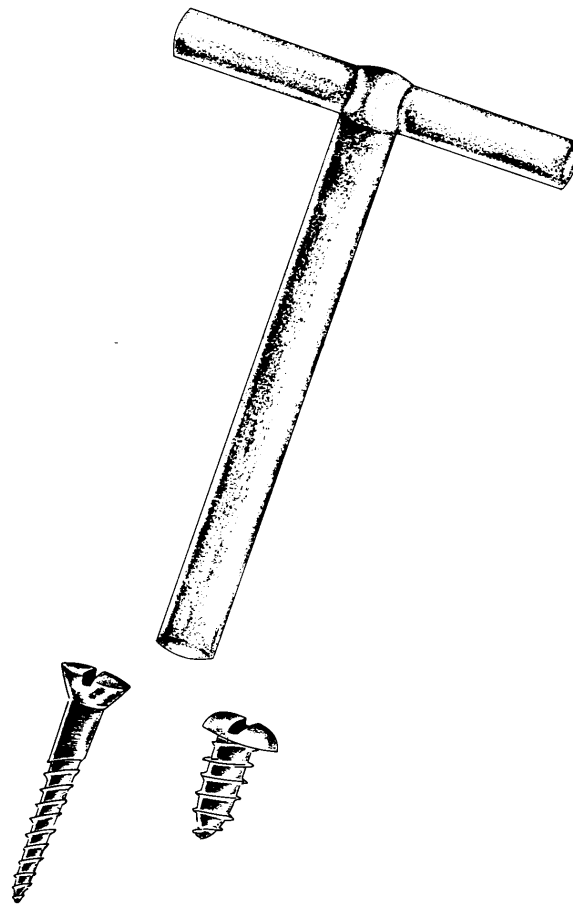
different sections of a 25- to 40-cfs canal. It was necessary to remove this material with water in the canal. The District found the original 6-foot blade excellent for work.

* * * * *

REMOVAL OF PACKING IN EXPANSION JOINTS (Suggestion R1-64-30)

This suggestion was submitted by Raymond J. Michels, Plant Mechanic, Region 1. He states that in replacing the 1-inch packing in the expansion joints of penstock and outlet tubes, it was found that a corkscrew type of packing puller would straighten out and would not pull out the packing. By welding a self-tapping metal or wood screw to a quarter-inch rod, as shown in the sketch below, the job was done very well, and although some of the packing came out exceptionally hard, there was no damage to material, and it could be used again.

The screw should be butt welded to the end of the quarter-inch rod, using a slight excess of acetylene when there is a gas weld.



PACKING PULLER

FIGURE 6.

* * * * *

ROTARY MOWER TRACTOR SAFETY SHIELD (Suggestion R5R6-65S-4)

An operator of necessity must be able to frequently observe, for correct operation, a mower being towed behind a tractor when cutting weeds on canal banks and roadways. With rotary mowers, such as those used advantageously on the Rio Grande Project in New Mexico and Texas, Figure 1, the operator also of necessity must be protected from objects thrown by the mower blades. Drop chain and wire-screen-type guards have not proved to be sufficiently effective in stopping all small objects thrown by the mower. A more positive plexiglass shield was suggested by Alfred L. Hulbert, an employee of the Ysleta Irrigation Field Branch, and Chairman of the Ysleta Branch Safety Council on the Bureau's Rio Grande Project.

Figure 1 below and Figures 2 and 3 on the following page are views of the 3/16-inch by 4-foot by 4-foot plexiglass shield installed behind the tractor operator to prevent him from being struck by objects thrown from the mower blades.

Figure 4 on page 24 is a sketch of the shield.

With the plexiglass shield the operator may observe the mower in complete safety at any and all times. The shield should be braced to the tractor because of heavy vibration caused by the mower blades, however, metal braces can be easily adapted to any make or model tractor. Also a special coating applied to the plexiglass will prevent excess dust accumulation on the plexiglass caused by static electricity. The plexiglass shield should be edged with light angle iron for extra strength and rigidity.

If additional information is desired, please write to the Project Manager, Bureau of Reclamation, 211 U.S. Courthouse, El Paso, Texas 79901.



Figure 1



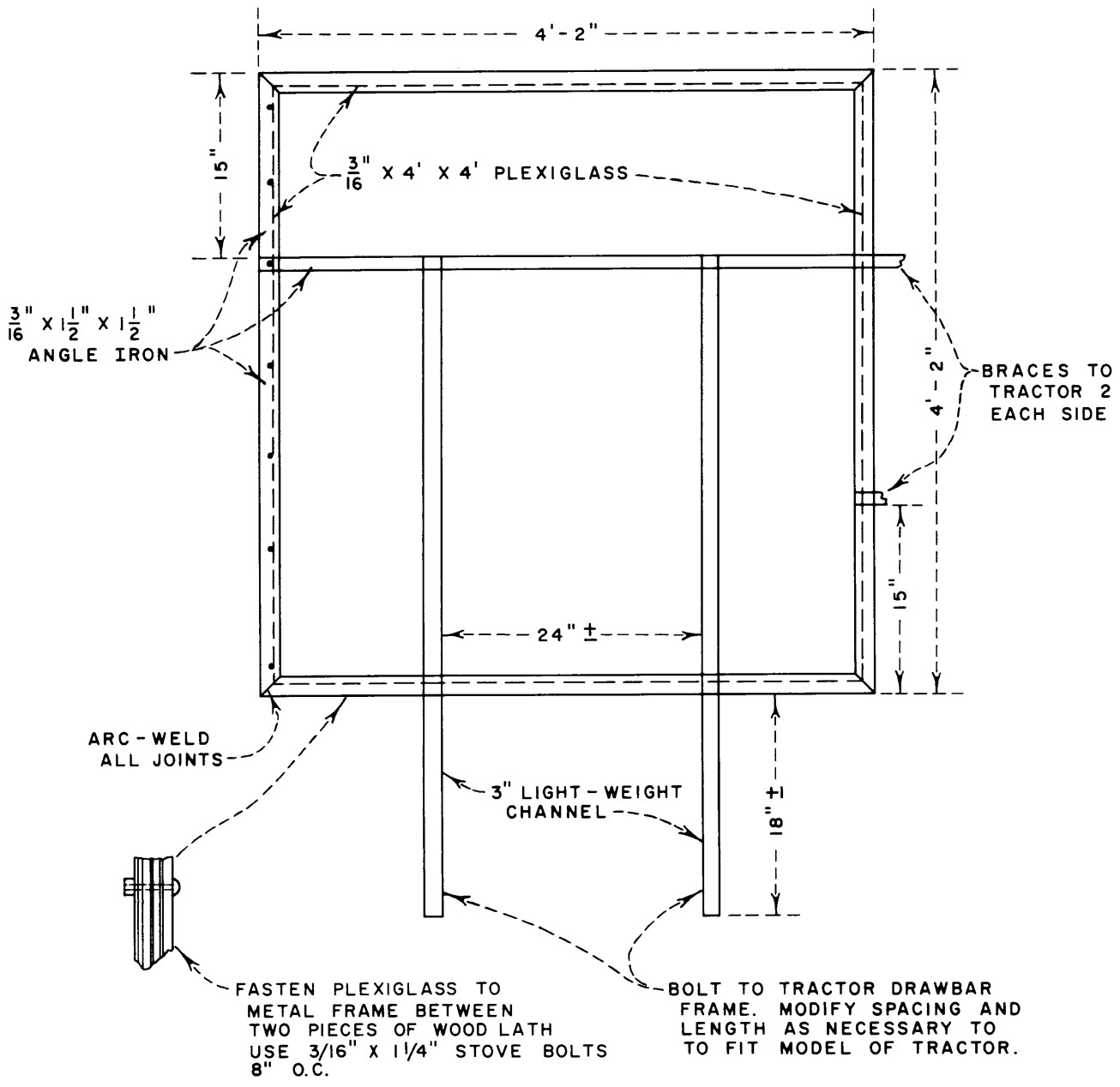
Figure 2



Figure 3

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PLEXIGLASS SHIELD FOR MOWER TRACTOR



BACK VIEW

Figure 4