Department of the Interior, Bureau of Reclamation

IRRIGATION OPERATION AND MAINTENANCE

BULLETIN NO. 51

January, February, March 1965

In This Issue:

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

The cover depicts a machine in operation in the Mercedes Division, Lower Rio Grande River Project, Texas, cleaning moss and silt out of a concrete-lined lateral having a 3-foot bottom width and a depth of 3-feet, 3-inches.

IRRIGATION OPERATION AND MAINTENANCE
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JANUARY, FEBRUARY, MARCH 1965

INTRODUCTION

Beginning on page 1, there is described a machine for cleaning concrete-lined laterals which is in use in the Lower Rio Grande Valley, Texas; on page 3 is an article from the same project discussing the maintenance of roadways on lateral banks.

"How to Understand Horsepower Ratings," beginning on page 4, has been reprinted with the special permission of the Editor of Western Construction.

On page 11 there is an article on safety nets for canals and laterals and also a drawing on page 13 describing installation of the nets.

Of special interest to some projects, will be the article on the Control of Pocket Gophers which begins on page 16. This article is reprinted by permission of the Fish and Wildlife Service, U.S. Department of the Interior. Improvement of methods of controlling pocket gophers has long been needed by farmers, ranchers, and others engaged in agriculture. A new approach, one using a machine called a "burrow-builder" has been developed. This equipment attached to a tractor, constructs artificial gopher runways at controlled depths below the surface of the ground and mechanically places bait in the runways. Tests in Colorado have shown the high potential this approach and equipment have in controlling both the plains pocket gopher and the mountain pocket gopher. The method and machine may also have application in the control of other rodents.

The final article on pages 25 and 26 concerns a suggestion for the prevention of damage to cattle guard wings by traffic crossing the guard.

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CLEANING CONCRETE LINED LATERALS

Mercedes Irrigation District No. 9 comprises 68,000 acres of irrigable land located in Hidalgo and Cameron Counties in the Lower Rio Grande Valley of Texas. Climate of the area is semitropical and the average annual rainfall in the District is 24 inches. Temperatures range from an extreme high of 110° to an extreme low of 16°, with a mean value of 74°. Normally there are 362 days above freezing during the year.

Under a $10,800,000 repayment contract executed on July 18, 1958, the Bureau of Reclamation is completely rehabilitating the District distribution system. Existing earth and deteriorated lined canals are replaced with either new concrete lined sections or concrete pipelines with round, rubber gasket joints. In addition to reducing seepage losses, the rehabilitation work facilitates weed control, an unusually difficult problem in this warm, humid climate.

Laterals with design capacities that can be contained in concrete pipe ranging in size from 15 to 42 inches in diameter are constructed as buried pipelines by District forces with pipe furnished by the Bureau of Reclamation. The 30-inch and smaller-size pipe is a heavy-wall, unreinforced, pressure-pipe manufactured locally. The 36- and 42-inch pipes are reinforced, and the smaller sizes are reinforced where heads exceed 20 feet. The District has constructed about 138 miles of an estimated final project total of 238 miles of pipeline. Rate of progress is currently about 40 miles per year using one crew working six days a week.

Cost of concrete pipe averages less than $17,000 per mile for all sizes, and ranges from about $8,000 to $52,000 per mile. District Manager W. D. Parish estimates District costs for labor, gates and other materials at about $5,000 per mile.

Farmers in the District are particularly pleased with the new pipelines which furnish better service, eliminate the old weed infested open ditches, and return many acres of unneeded right-of-way to the farmer for production of valuable crops.

Laterals with design capacities too large for concrete pipelines were constructed by contract with an open section and slip-form lined with 2.5-inch thick unreinforced concrete. All of the concrete lining construction is now complete and 55 miles of concrete lined laterals were constructed in the District between September 1960 and October 1963. Concrete lined laterals have bottom widths of 3 or 5 feet and range in depth from 2.5 to 6 feet. Average overall construction costs for the lined laterals is less than $65,000 per mile.

The Board of Directors of the Mercedes District retained responsibility for operation and maintenance of project works both during and after construction. District Manager W. D. Parish discovered soon after placing the new concrete lined laterals in service that the clear water and semitropical climate were very favorable for aquatic growth in the new laterals.

This growth is especially bad where earth accumulated in the lined laterals from newly constructed embankments and in reaches of lateral above checks where velocity of flow is often reduced. In several instances, the growth clogged almost the entire lateral section. Ditch riders complained that they were unable to deliver sufficient quantities of water to meet delivery requirements.

Irrigation in the Mercedes District is on a year around basis for citrus, vegetables, cotton, grain, and pasture. It is difficult to find periods of limited irrigation when the laterals can be taken out of service for cleaning, and the District found hand cleaning was too time consuming and expensive.

Mr. Parish noted that several manufacturers build machines that possibly could be used to clean the new concrete lined laterals at a much faster rate than by hand labor. After investigation, the District purchased in April 1964 for $20,375, a track-mounted hydraulically-actuated excavator. The wrist-like action where the 5-foot wide bucket is attached to the boom and the sensitive hydraulic controls permit fast efficient cleaning of the concrete lined lateral sections.

Original plans were to take laterals out of service for quick machine cleaning. An unexpected bonus developed that was highly pleasing to the District management, when it was found the machine satisfactorily and efficiently removes aquatic growth and accumulated silt without taking the laterals out of service. This is very fortunate as it is difficult to schedule interruption of service in laterals because of the year around irrigation requirement.

The photograph on the front cover shows the machine in operation in the Mercedes District with lateral flowing at less than one-half design capacity. Total depth of the 3-foot bottom width lateral section at this point is 3 feet and 3 inches. It is estimated the machine cleans about 4,000 lineal feet of lined lateral per 8-hour shift at an operating cost of about $20 to $25 per mile, not including depreciation or ownership expense.

Mr. Parish anticipates many other District operation and maintenance uses for the machine such as loading materials, excavation for repair work, and cleaning of drains, particularly near structures. Further information can be furnished upon request by the Division of Irrigation Operations, Mail Code D-400, Bureau of Reclamation, Building 53, Denver Federal Center, Denver, Colorado 80225.

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MAINTENANCE OF ROADWAYS ON LATERAL BANKS

The Bureau of Reclamation recently constructed under five construction contracts, 23 miles of new concrete lined laterals to replace earth and deteriorated lined laterals in the La Feria Irrigation District, located in Cameron County in the Lower Rio Grande Valley of Texas.

Design width of lateral banks for use as roadways on both sides of the newly lined canals was only 8 feet minimum. Although this width is less than desirable, insufficient borrow material on existing rights-of-way and extremely high cost of additional rights-of-way over valuable crop lands prevented design of additional bank width. Fortunately, unanticipated optional use of drain bank spoil available within relatively long haul distances and use of large conventional grading equipment by construction contractors, resulted in more than the required 1 foot of earth freeboard above the concrete lining and in finished bank widths of about 10 feet in most instances.

However, La Feria District ditchriders and maintenance personnel found it difficult to maneuver cars,and trucks around some of the sharp curves in the newly lined laterals with roadways built to design width of 8 feet. It is also difficult to use conventional large grading equipment for minor repairs to the roadways and embankments.

Manager R. T. Hensley of the La Feria District solved this problem by attaching a 5-foot grader blade to a rubber-tired farm-type tractor to maintain the surface of the curved roadways and to widen banks constructed with more than the design freeboard of 1 foot. See photograph at left. The tractor is also very useful in making minor repairs quickly to the lateral roadways and embankments at miscellaneous locations, where settlement or erosion may occur after heavy rains on the newly constructed lateral banks.

Cost of the tractor purchased in October 1958 was $2, 310, and the blade cost $300. Although the tractor is available for lateral roadway repairs, it is used primarily with a mower attachment to mow weeds on lateral banks.

Further information concerning the tractor and blade can be obtained from the Division of Irrigation Operations, Code D-400, Building 53, Denver Federal Center, Bureau of Reclamation, Denver, Colorado 80225.

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HOW TO UNDERSTAND HORSEPOWER RATINGS

(Reprinted from the August 1964 issue of Western Construction with the permission of the Editor)

Do construction men really understand the horsepower ratings in their vehicles? Rating systems for wheel loaders, track loaders, wheel tractors, off-highway trucks, motor graders, track-type tractors and tractor-scrapers vary greatly among manufacturers of diesel equipment.

While horsepower can be readily defined with precision as an expression of rate of work output, it's hard to be sure of what a vehicle's working horsepower is on the basis of the advertised rating. Basically there are two types of vehicle horsepower ratings, one based on performance and the other on capacity.

Performance horsepower ratings report the actual work output of the engine as applied to the vehicle. Capacity horsepower ratings are generally described as maximum and tell the potential of the basic engine. Although both are actual ratings, they give the engine output under entirely different conditions. Thus they are not comparable and comparisons may be misleading.

As different definitions of horsepower are used, it is apparent that a more complete understanding of ratings is needed. If owners know the basic factors involved in determining horsepower, it can assist in the understanding of horsepower ratings.

The four factors involved in engine horsepower ratings are:

Sea level correction,
Rating speed on RPM,
Accessory load, and
Load duration

How do these affect horsepower ratings?

A sea level correction allows for the theoretical affect on engine rating caused by differences in ambient temperatures and barometric pressures. The air density where an engine is rated varies between manufacturers, because of differences in location. By correcting ratings to sea level standard conditions, a basis for comparison is provided. The ratings, however, show only potential outputs under the specified conditions.

Rating speed, or rpm., indicates the engine speed at which the horsepower rating is produced. It is not necessarily the same RPM at which the engine is set for use in a particular vehicle. This difference occurs when the same engine is used in various types of vehicles. While it might have the same capacity rating in all uses, the engine's actual output and rpm. will be set to correspond with the power needed for a particular unit.

Accessory load defines how the engine is equipped for a given rating. Accessories (fan, generator and air compressor) are power users and a higher rating can be obtained by excluding them in rating calculations. A maximum capacity rating normally is achieved in part by excluding accessories. The fan is the largest power consumer, taking as much as 30 hp. from an engine in a 40 yd. /struck wheel tractor-scraper.

Load duration specifies how long the engine must hold the load to establish the horsepower rating. Extreme output can be taken from an engine only for a short duration. A maximum rating generally states the load is held for a period of 5 min. A flywheel rating is based on unlimited vehicle operation as long as it is used for the purpose for which it is designed.

When these factors are understood and properly defined, it is easier to know what the various rating systems mean.

Throughout the industry, six general rating descriptions are used:

(1) Maximum: the bare engine, sea level correction, extra rpm. and 5 min. of load (extra rpm, means beyond what is applied in the vehicle).

(2) Maximum: bare engine, sea level correction, applied vehicle rpm. and 5 min. load.

(3) Maximum: bare engine, sea level and temperature correction, vehicle rpm. and engine's rated load.

(4) Flywheel: without fan only, sea level correction, vehicle RPM, and vehicle load (vehicle service load conditions).

(5) Flywheel: with accessories, sea level correction, vehicle rpm. and vehicle load.

(6) Flywheel: with accessories, factory conditions, vehicle rpm. and vehicle load.

The practices of principal manufacturers of construction machinery vary widely. Thus arises the problem for some customers of trying to compare unlike horsepowers when preparing to apply machinery to various jobs.

To illustrate the effect of these rating definitions, it is best to take as an example an engine set at 100 hp. and defining this horsepower as flywheel with accessories, or number 6, as indicated above. This particular engine corrected to sea level standard conditions (29.92 in Hg and 60 deg. F.), which is the flywheel definition, number 5, could bring the horsepower rating as defined to 104.

Moving to flywheel definition, number 4, and removing the fan only, could raise the horsepower rating to 114. The next area, number 3, is a maximum or capacity type rating. The bare engine is corrected to sea level at engine manufacturer's rated load and could result in horsepower rating of 120. The next maximum rating, number 2, has a short duration load but at the vehicle operating speed that provides a possible 135-hp. rating. The ultimate of capacity ratings, number 1, might reach as high as 150. Thus, the same engine with a flywheel horsepower output of 100, as indicated in number 6, could, by these various definitions, have as high as 150 hp. maximum for rating purposes.

In another phase of understanding horsepower ratings, it is obvious the intended use of vehicles and normal application conditions can allow different flywheel horsepower settings for essentially the same engine and still provide equal service life.

How is it best to provide realistic horsepower ratings? It has become apparent so far that the best starting points for understanding are recognizing that maximum horsepower ratings reflect capacity, or capability, and that flywheel ratings indicate the actual output performance.

Flywheel horsepower output of the engine is set by the manufacturer to provide good service life in a vehicle. Thus, no limitations are made on the operation of the vehicle as long as it is used for the purpose it was designed and built. It becomes the manufacturer's responsibility to set the engine output to match intended usage of the machine without working limitations and still give good service life.

Owners recognizing that there are differences in horsepower ratings will buy construction vehicles with a better understanding of what the machines can do on the job.

* * * * *

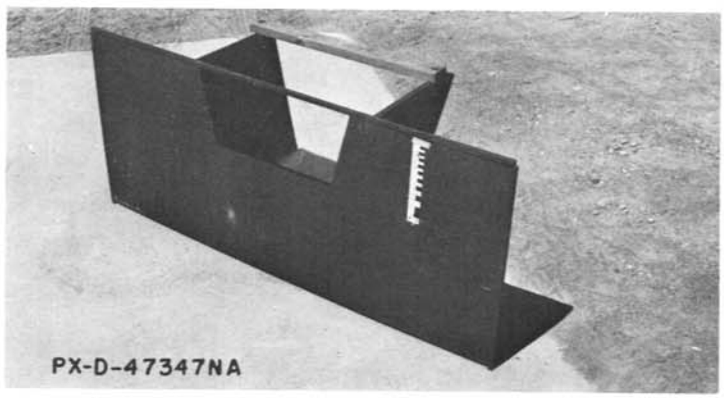
PORTABLE WEIRS

Mr. John V. Walker of the Regional Irrigation Division of the Bureau of Reclamation, Boise, Idaho, has suggested the three photographs on the next page be included in the bulletin for the benefit of those who have a need for portable weirs.

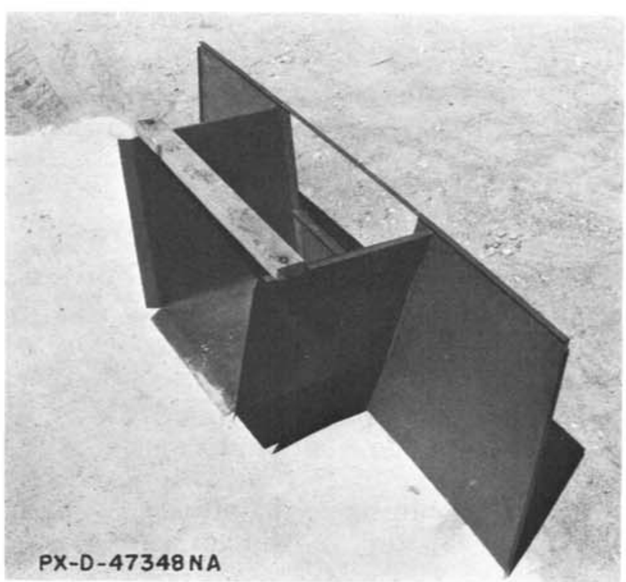
PX-D-47346NA

The portable weir shown in the photograph at left, with canvas attached, can be dropped into a farmer's ditch to serve as a check and weir. The top rod spans the ditch from bank to bank and supports the weir in a vertical position while the canvas acts as a portable canvas dam.

The two photographs below show a weir fabricated by the North Side Canal Company at Jerome, Idaho, and can be used to check farm deliveries or serve as a measuring device until a permanent installation is made.



PX-D-47347NA



PX-D-47348NA

"HOOKAROON"

Another device observed by Mr. John V. Walker, Bureau of Reclamation, Division of Irrigation, Boise, Idaho, in his travels about the Pacific Northwest projects constructed by the Bureau (see Portable Weirs, page 6) is the "Hookaroon" used to remove check boards. This tool, shown in use in the photograph at left, is used extensively by the lumber industry and can be located in any good hardware catalog.

Mr. Walt Hoffbuhr, Manager, of the Talent Irrigation District, Rogue River Basin Project, Oregon, uses these tools to very good advantage. A light duty type is recommended for the service required by Mr. Hoffbuhr.

* * * * *

LIGHTNING ARRESTORS FOR FENCES
(Suggestion R7-65-2)

In some areas the loss of livestock caused by lightning striking a wire fence is not at all unusual. Severe electrical storms arise in the Ainsworth, Nebraska, area, where extensive livestock on range grass grazing across boundary fences necessitates a safety device for their protection. Also government personnel opening and closing metal gates while engaged in operation and maintenance of facilities are also vulnerable to lightning exposure. In addition to the hazardous condition that can be created by lightning, there are overhead numerous transverse crossings of power transmission lines to be considered. Line breakage that occurs during high winds or from coatings of ice, can cause a high voltage charge to be transmitted throughout the fence lines and into the gate positions along the main fence lines.

Mr. Robert D. Fitch, Safety Officer, of the Niobrara-Lower Platte Projects Office, Ainsworth, Nebraska, has drawn a sketch of an electrical charge grounding arrangement that can be used along right-of-way fencing adjacent to main canals, laterals, and on reservation boundary lines. Where problems exist similar to those cited in the Ainsworth, Nebraska, area, the suggestion may be very worthwhile.

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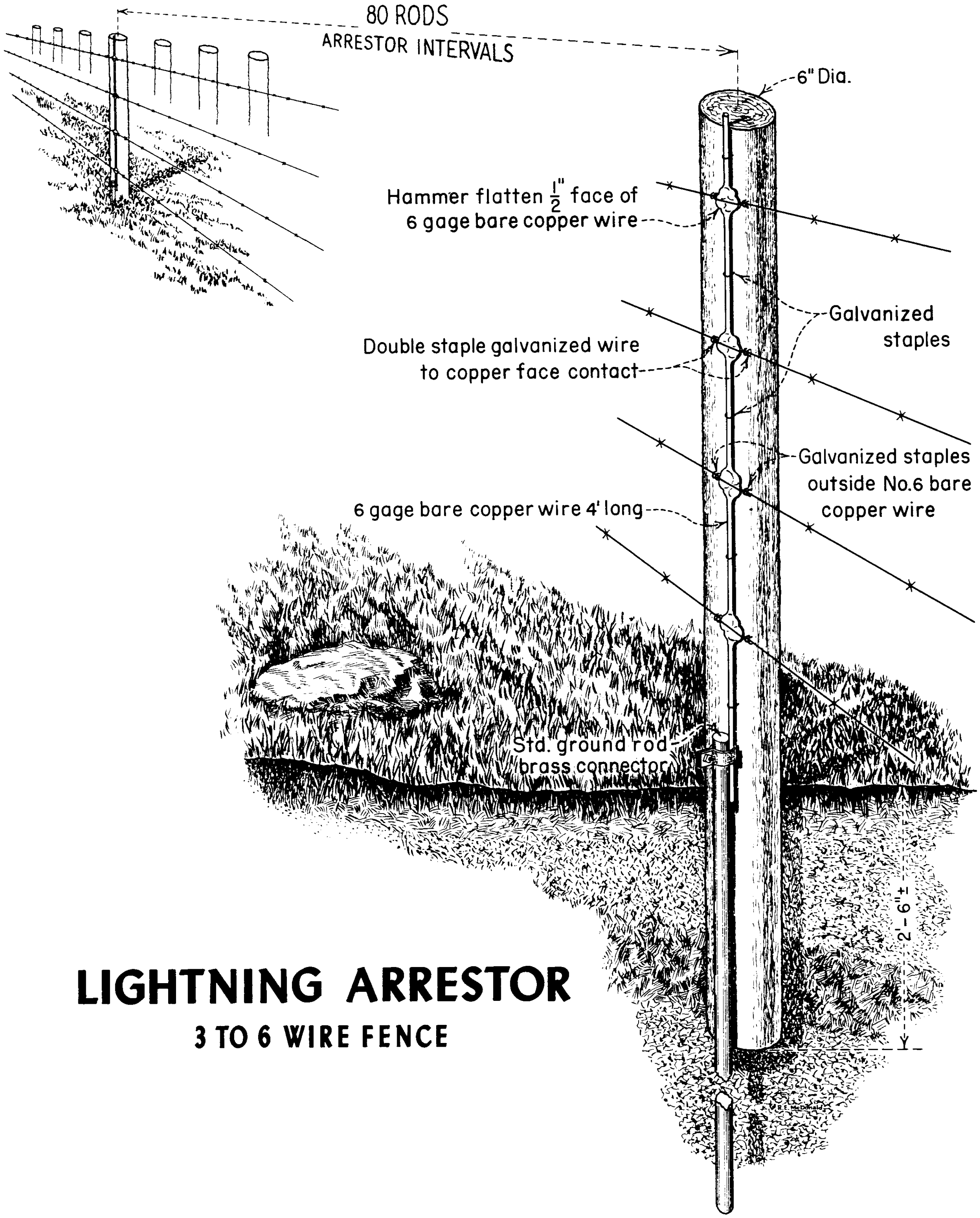

LIGHTNING ARRESTOR

3 TO 6 WIRE FENCE

SELF CLEANING WEEDRACK

By
Eldon L. Johns
Columbia Basin Project, Washington

"Build a better mouse trap and the world will beat a path to your door," the maxim goes. In this case perhaps it could well be edited to read, build a better weedrack and O&M personnel will beat a path to your desk. Although possibly not the ultimate, a new and better type of weedrack has been developed on the Columbia Basin Project that is simple to construct, requires less material to build, and by using existing chutes or inclined drops, it is particularly well suited to combing out large weeds such as Russian Thistle or Mustard which are common to the Project area. Several views of typical racks are shown in Figures Nos. 1, 2 and 3.

Figure 1

Constructed of one to one and a half inch diameter pipe or square tubing, the rack has a flat metal plate at the upstream end and an operating platform at the downstream end, where weeds are collected and burned. The operating platform is made up of landing mats supported by laterally positioned pipes. The upstream flat plate has a dual purpose. It smooths the flow of water through the rack and prevents the water from splashing over the structure walls. The plate also prevents weeds hanging upon the upstream end of the pipes forming the rack. Whenever possible the plate and rack are positioned to take advantage of any changes in the slope of the structure to minimize the obstruction to the flow of water.

The real value of this weedrack, of course, lies in its self-cleaning action. Since the rack does not require constant attention to keep the weeds from impeding the water's flow, the weeds are easily removed

Figure 2

Figure 3

from or destroyed on the landing mat platform, and a great deal of time and labor are saved by not having to pick heavy clumps of weeds from the teeth of the rack. Also, and at least equally important, there is much less chance of this type of weedrack becoming choked with weeds and flooding a lateral.

In operation since 1956, this type of rack, where applicable, appears to be a real winner for racking up the weeds.

* * * * *

CANAL AND LATERAL SAFETY NET
(Suggestion R9-64-9)

The present safety nets which are installed in canals and laterals, as shown on Drawing No. 325-D-136, page 13, are designed with panel sections presumably to permit the passage around or under the individual panels of tumbleweeds and other floating debris which would normally lodge on a 6" x 6" wire screen. However, William Maxey, Jr., of the Division of Irrigation and Land Use, Washington, D.C., has observed that the panels, which were placed on the Steinaker Service Canal, Vernal Unit, and on the Florida Canal, Florida Project, were so heavy that they could not be moved enough by the force of the water-soaked weeds backed up in the canal above the net to allow the debris to get around or under the individual panels. The principal factor involved in this excessive weight seemed to be the 3" x 1/4" steel bars which were bolted along the bottom and top of the panel.

A restriction of passage for debris down a canal or lateral can be dangerous in that any appreciable amount of such material lodged at a safety net will cause a partial dam in the water course and a corresponding rise in the water surface elevation which very possibly could overtop the canal bank. A great many tumbleweeds blow into canals and laterals during the windstorms, and it would be advantageous from a maintenance cost standpoint, as well as safety, if such floating debris could be passed on down the watercourse and flushed out a wasteway. This danger from windstorms is accentuated at night when ditchriders normally are not on duty.

Mr. Maxey suggests that the design of the individual panels be modified in the following way to facilitate the passage of debris past the structure. The position of the vertical suspension chains or cables which support the individual panels should be moved in towards the center of the panels so that considerably less torque pressure would be required to turn the panel sideways and permit a mass of weeds to slip past the side of the safety net and float on down the watercourse. In addition the overall weight of the individual panels should be decreased as much as 60-75 percent, if possible, by narrowing the width and by installing small and lighter weight steel bars on the top and bottom of the panels. That much decrease in weight would greatly facilitate the passage of weeds and other debris around, as well as under the panels, and yet the net normally would hang in a position where a person floating down the watercourse could reach it.

It also would appear that the safety nets could be shorter and still be effective, particularly in the shallower canals. For example, in a canal with water depth of 5 feet, the bottom of the net should not have to be closer than 2.5-3.0 feet from the bottom of the canal. A canal with normal water depth of 5 feet usually is operated at a depth of 2.5-3.0 feet for only very short periods of time, principally during the priming period in early spring, and a human being in the water could still reach the net if it extended down to the top of the water surface.

It is believed the suggested changes in design could assist materially in making safety nets self-cleaning, thus greatly reducing the present maintenance cost of manually pulling debris from above a net with a weed hook. They also will reduce the possibility of a break in a canal caused by a weed jam backing up the water and overtopping the bank. While the monetary saving in maintenance cost would be appreciable, the safety and stability of canals and laterals is much more important, as a single break in a large canal could very easily result in thousands of dollars in repair and damage costs.

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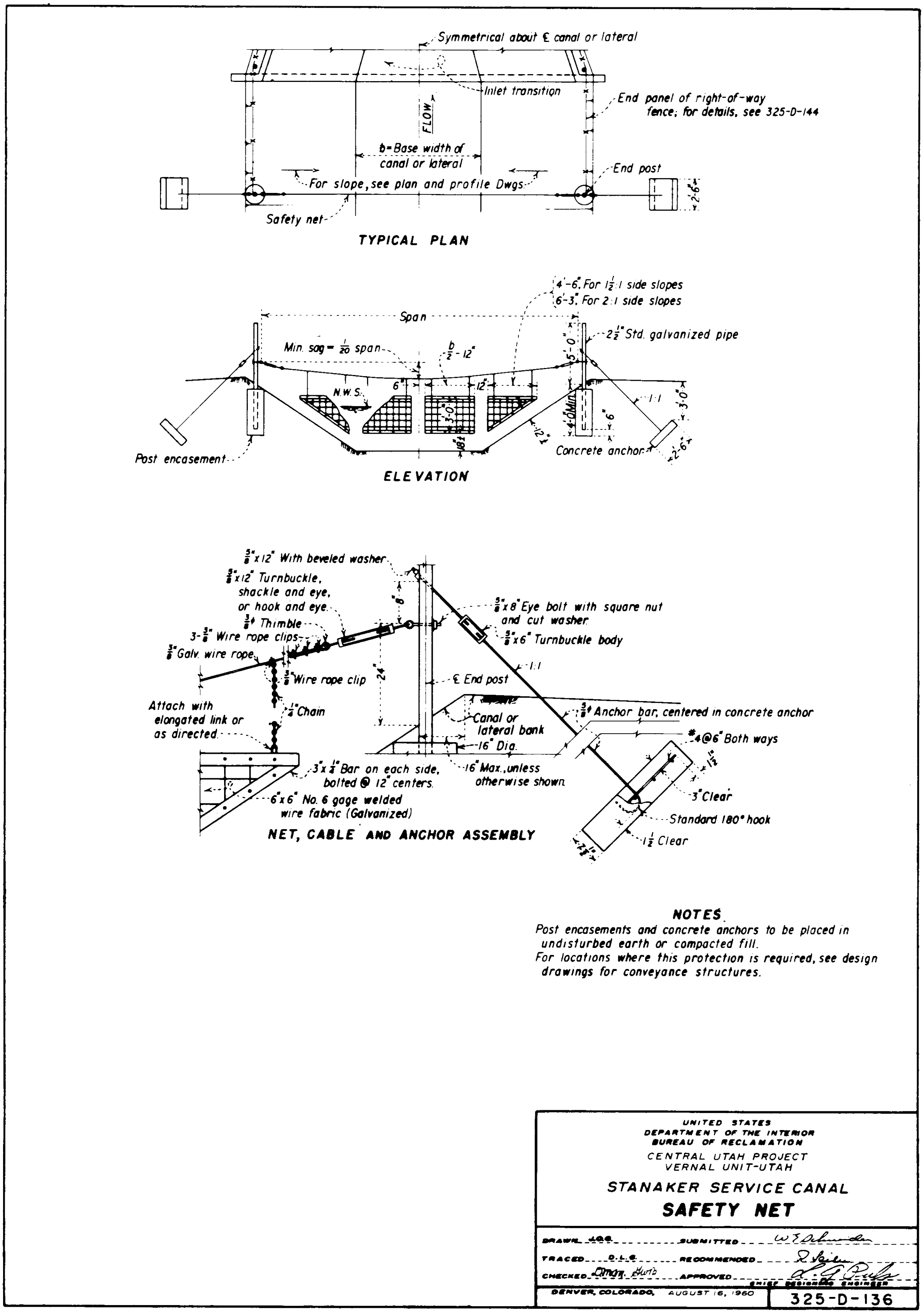
Symmetrical about ℄ canal or lateral
Inlet transition
End panel of right-of-way fence; for details, see 325-D-144
FLOW
b = Base width of canal or lateral
End post
For slope, see plan and profile Dwgs.
2'-6"
Safety net
TYPICAL PLAN
4'-6" For 1½:1 side slopes
6'-3" For 2:1 side slopes
Span
2½" Std. galvanized pipe
Min. sag = 1/20 span
b/2 - 12"
5'-0"
N.W.S.
6"
12"
3'-0"
1:1
3'-0"
4'-0" Min.
1'-6"
Post encasement
12"
18"
Concrete anchor
2'-6"
ELEVATION
5/8" x 12" With beveled washer
5/8" x 12" Turnbuckle, shackle and eye, or hook and eye
5/8" Thimble
3-5/8" Wire rope clips
5/8" Galv. wire rope
5/8" x 8" Eye bolt with square nut and cut washer
5/8" x 6" Turnbuckle body
8"
24"
5/8" Wire rope clip
℄ End post
1:1
Attach with elongated link or as directed
1/4" Chain
Canal or lateral bank
5/8" Anchor bar, centered in concrete anchor
#4 @ 6" Both ways
16" Dia.
16" Max., unless otherwise shown
3" x 1/4" Bar on each side, bolted @ 12" centers
6" x 6" No. 6 gage welded wire fabric (Galvanized)
3" Clear
Standard 180° hook
1½ Clear
NET, CABLE AND ANCHOR ASSEMBLY
NOTES
Post encasements and concrete anchors to be placed in undisturbed earth or compacted fill.
For locations where this protection is required, see design drawings for conveyance structures.
UNITED STATES
DEPARTMENT OF THE INTERIOR
BUREAU OF RECLAMATION
CENTRAL UTAH PROJECT
VERNAL UNIT-UTAH
STANAKER SERVICE CANAL
SAFETY NET
DRAWN
SUBMITTED
TRACED D.L.G.
RECOMMENDED
CHECKED
APPROVED
CHIEF DESIGNING ENGINEER
DENVER, COLORADO, AUGUST 16, 1960
325-D-136

PREVENTING ALGAE ATTACHMENT TO IRRIGATION STRUCTURES

Laboratory Report No. WC-14, under date of April 24, 1964, prepared by the Water Conservation Branch of the Division of Research, Office of Chief Engineer, Bureau of Reclamation, Denver, Colorado, is a progress report of 1963 field evaluations on antifouling materials for algae prevention. The investigations summarized in the report are part of the aquatic weed control field research program being conducted by the Bureau of Reclamation, in cooperation with the Crops Research Division, ARS, USDA. The field study of antifouling materials is made possible primarily by the further cooperation of the Northern Colorado Water Conservancy District of Northeastern Colorado and the Bureau's Region 7 in canals constructed by the Bureau on the Colorado-Big Thompson Project; however, other cooperative field tests in irrigation canals of Regions 1, 3, and 7 are also included.

Earlier studies of materials that would reduce the tendency of algae to adhere to concrete irrigation structures have been published in previous issues of the Irrigation Operation and Maintenance bulletin. The two more recent issues that contained a discussion of the research program were Releases Nos. 37 and 40, to which referral is made for a more complete discussion of the research program.

Results to Date

The study now in its fifth year reports briefly that of 38 paint materials, some special coating applications and several algaecidal concrete additives, certain vinyl-based, high cuprous oxide content-type paints continue to show the best results on the basis of both algae inhibition and durability after 4 and 5 years of exposure; a coating of metallic copper applied as a molten spray to a concrete panel has continued to give good algae prevention during 3 years of exposure; and various algaecidal materials incorporated into and on the surface of concrete panels did not show any degree of algae inhibition.

Continuing Studies

Three views typical of the method of field evaluation are shown in Figures 1, 2, and 3. The first is a view of the concrete lined St. Vrain Supply Canal, looking upstream with some of the painted sections on the right side.

Figure 2 shows a VR-3 coating containing 20 percent tributyl tin oxide and is relatively free of algal growth following the third season of exposure, as compared with the adjacent unpainted concrete lining.

Figure 3 is a vinyl resin cuprous oxide paint that exhibits good algae prevention following five seasons of exposure.

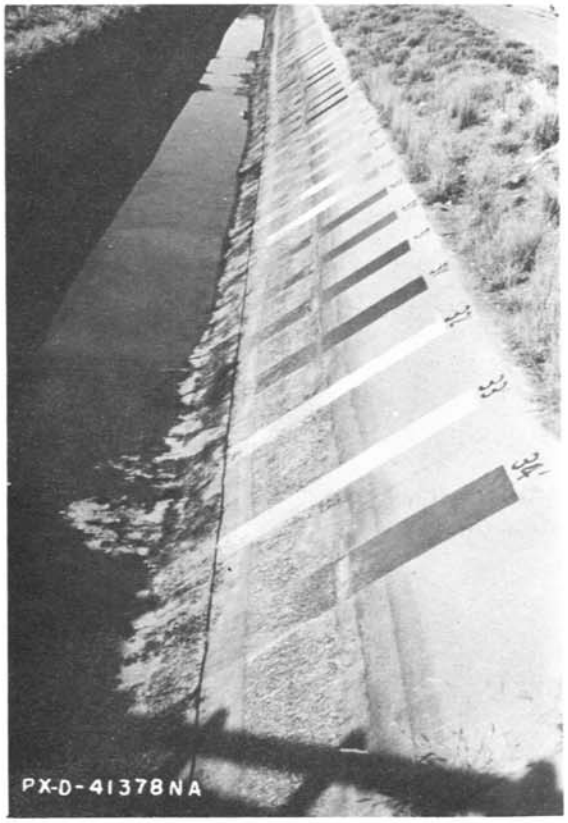

Figure 1

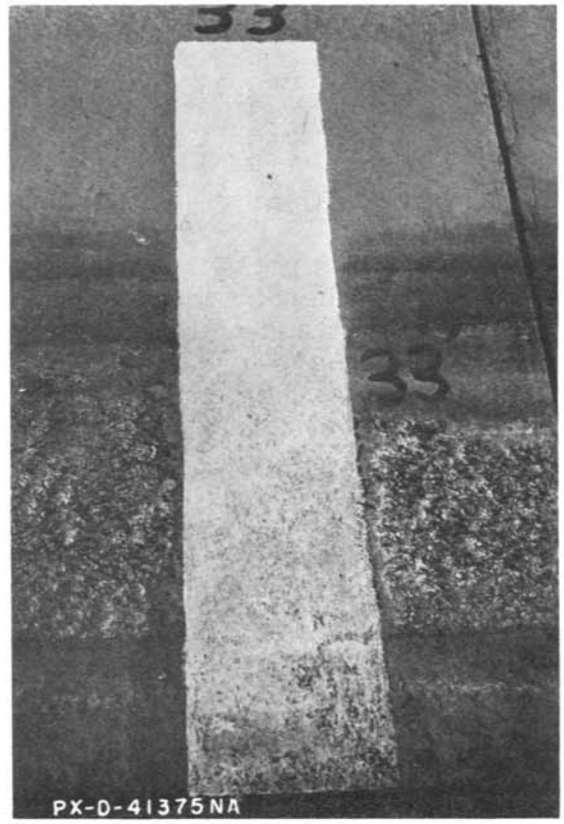

Figure 2

Figure 3

The studies described will be continued and it is intended, as new materials and proprietary products are developed or marketed, that additional tests be initiated. The results of the tests will be used in recommending materials suitable for use on irrigation systems, and elsewhere as needed, to inhibit the growth of algae and other self-attaching organisms.

Copies of Report WC-14 can be obtained for $1.25 by writing Publications and Film Management Unit, Code D-841, Office of Chief Engineer, Bureau of Reclamation, Denver Federal Center, Denver, Colorado.

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THE BURROW-BUILDER AND ITS USE FOR CONTROL OF POCKET GOPHERS*

Introduction

Previous pocket gopher control techniques have required hard manual labor whereby the operator generally has had to probe for underground runways and place bait, all by hand. The "burrow-builder" offers a mechanized method by which the operator constructs and baits an artificial gopher runway in one operation. This method allows the gopher to find the control agent.

The purpose of this report is to describe the "burrow-builder", how it operates, the results that have been obtained so far in tests, and to list other possible applications.

Construction

The "burrow-builder", Figures 1 and 2 on the following page, is made up of three basic pieces of machinery: (1) A tool carrier bar with one 24-inch subsoiler shank, less chisel and boot, equipped with an 18-inch coulter disc and frame; (2) one seed corn can with standard bottoms, and one large whole center drop plate equipped with one #5-302 press wheel drive assembly, less press wheel; and (3) two wheel assemblies, including axles, spacers, cup, and two 4" x 8" tires and tubes.

Torpedo

The torpedo, which is 2-1/2 inches in diameter and 20 inches long, forms the burrow and facilitates the placement of the bait. It is made of hard steel and is attached to the bottom of the subsoiler shank; the front end is solid and hard-surfaced to resist wear. The torpedo is sloped at a 60-degree angle to give it "bite" and to hold the machine in the ground. Its cylinder has a hole through the midsection where the feeder tube connects, and is open on the posterior underside to provide an outlet for the bait.

Bait-Feeding Mechanism

A seed corn can is mounted on the rear of the subsoiler, and a two-wheel assembly is fastened to the can by means of metal supports and a chain drive. The wheel assembly is mounted over the rear of the torpedo in a position to pack the soil over the cylinder and serves

*Reprinted from Special Scientific Report--Wildlife No. 47; Department of the Interior, Fish and Wildlife Service, Washington, D.C., January 1960; by A. Lorin Ward, Branch of Wildlife Research, Denver, Colorado, and Dr. Richard M. Hansen, Colorado State University, Fort Collins, Colorado.

Figure 1--Burrow-builder

Figure 2--Burrow-builder in operation

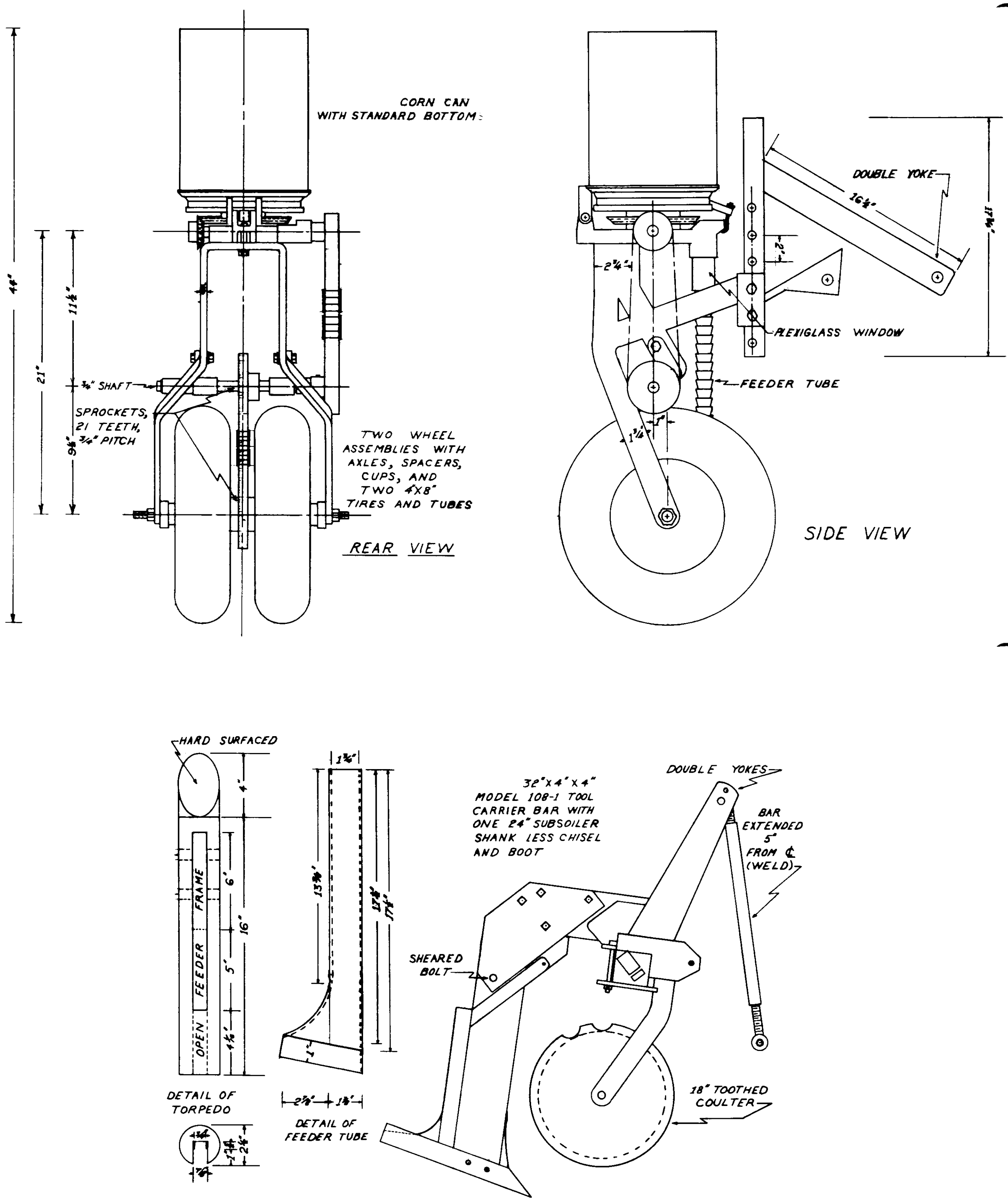

Figure 3--Parts of the burrow-builder

as a drive for the feeding mechanism. The seed can is connected by a flexible hose to a built-on feeder tube on the back of the subsoiler shank. A small plexiglass section is inserted at the base of the can to enable the operator to check on bait feeding. By changing the position of the two bolts that hold the feeder mechanism to the subsoiler, the depth the torpedo penetrates in the ground can be regulated from 4 to 16 inches. The flexible tube connecting the can to the tube on the back of the subsoiler shank will lengthen or shorten to permit a continuous flow of bait as the depth of the torpedo is changed.

Costs

The cost of the constructed "burrow-builder" was $469.94 but this could be reduced to approximately $450.00 if a number of machines were to be made.

Operation

The "burrow-builder" is designed to construct an artificial burrow and bait it with poison baits in one operation. For effective use in pocket gopher control, a number of adjustments must be made. The depth of gopher runways first must be determined by measuring existing burrows, and the machine then must be set at the desired depth. A few short trial runs should be made and the top link adjusted so that the machine rides the ground with the wheels barely packing the soil. If the "bite" of the torpedo is too great, the wheels start dragging dirt; if the "bite" is too little, the torpedo will not stay in the ground.

The condition of the soil has to be such that a good burrow can be made. This usually means that there is enough moisture in the soil to make it firm into a pack when squeezed in the hand.

Pocket gophers inhabit areas from sea level to the tops of our highest western mountains, and are found in both agricultural and rangelands. The "burrow-builder" can be used for control of gophers in any area where soil conditions and the physical aspect of the land make it possible to drive over the area with a tractor and construct a good artificial burrow.

In order to make a good burrow it is necessary that the soil is moist. In the arid West this condition can usually be found in the spring or fall of the year.

The effectiveness of the "burrow-builder" is dependent upon the gophers finding the artificially-constructed runway and using it long enough to find the poisoned bait. In order to make this possible, the artificial burrows are constructed at a depth so as to intercept the greatest number of natural gopher tunnels, Figure 4. This will vary with soil conditions and the species of gopher being controlled. The distance between artificial burrows across an area is determined by density of gophers and the species involved, Figure 5.

Figure 4--Artificial burrow intercepting natural pocket gopher burrow

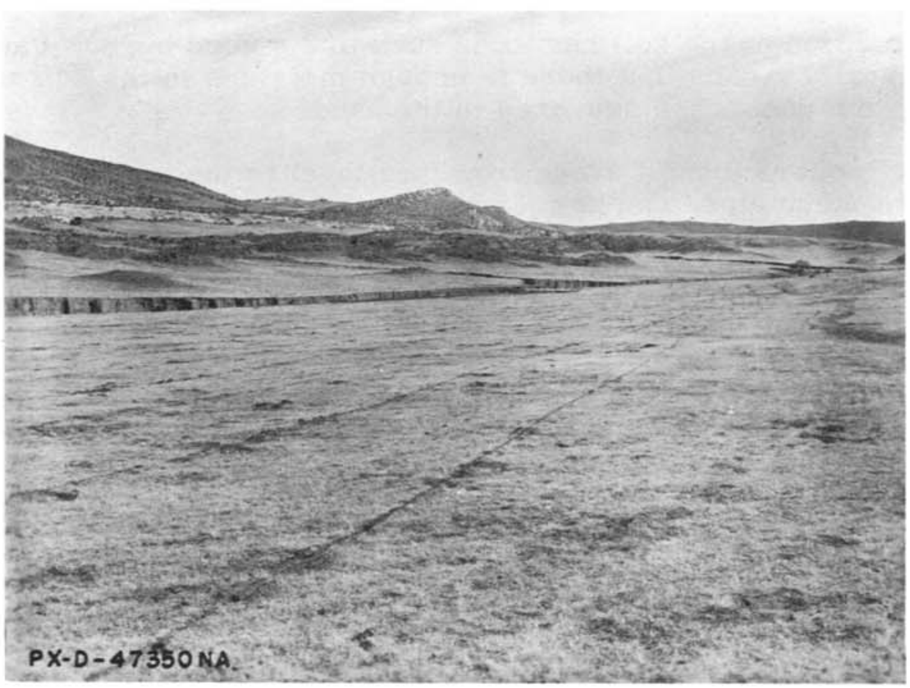

Figure 5--Field near Livermore, Colorado, after treatment with burrow-builder, showing surface disturbance

What Has Been Done

The machine has been field-tested against the plains pocket gopher (Geomys bursarius) in alfalfa fields in Weld County, Colorado. All tests were conducted in the spring of 1959 when the sandy-loam soil was moist. Gopher populations were estimated to be 10 to 15 animals per acre. A good artificial burrow was constructed at a depth of 9 inches, and the interval between these burrows across the field was 25 to 30 feet. Between 3 and 4 pounds of bait were used on each acre and the average treatment time was 10 minutes. At this rate, one man could treat approximately 50 acres per day at a cost of $1.50 per acre (80 cents for bait, 30 cents for labor, and 40 cents for rental of tractor). Under these conditions 90 to 100 percent control was obtained.

Baits used in these tests were formulations of Compound 1080 and milo maize, and strychnine and milo maize with the addition of a small quantity of Erigeron extract to increase acceptance. Recommended baits for use in the "burrow-builder" may be obtained by contacting district offices of the Branch of Predator and Rodent Control.

Soil conditions in the mountains of Colorado during the summer of 1959 generally were too dry for efficient use of the "burrow-builder", so tests involving the mountain pocket gopher (Thomomys talpoides), Figure 6, were carried out in October in mixed alfalfa-grass hayfields

Figure 6--Thomomys talpoides

in Larimer County. The soil, moistened by recent rains, was a sandy-clay-loam type with some rocks. Gopher populations were estimated to be 10 to 15 per acre. A good artificial burrow was constructed at a depth of 6 inches, and the interval between these burrows across the field was 20 to 25 feet. About three pounds of bait were used on each acre. Under these conditions 85 to 100 percent control was obtained.

Baits used in the tests on mountain gophers were formulations of Compound 1080 and whole oats. The whole oats were found to be more acceptable to these gophers in laboratory tests.

There were no accidental or secondary poisonings in any of the test areas even though baits were exposed within 100 yards of farm dwellings. Dogs were frequently observed in the baited areas. Crop damaged due to the operation was negligible, and no objections from the landowners were registered.

Possible Applications

Other possible uses of the "burrow-builder" would be in controlling other rodents. Such rodents as kangaroo rats, grasshopper mice, ground squirrels, meadow mice, and deer mice have been found dead in the artificially constructed burrows; however, the machine has not been tested against these animals.

It is also likely that fresh-cut, root-type baits, such as carrots, could be used in the machine. Carrots diced to 3/8-inch have passed through the feeding mechanism without plugging. Work is being done to perfect this procedure.

For Assistance

For further information, please contact the authors of this article: A. Lorin Ward, Biologist, Branch of Wildlife Research, Bureau of Sport Fisheries and Wildlife, Denver Federal Center, Building 45, Denver, Colorado; or Dr. Richard M. Hansen, Biologist, Forestry and Range Management Section, Colorado State University, Fort Collins, Colorado.

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SPRAYING WEEDS IN INACCESSIBLE AREAS
(Suggestion R7-65S-15)

Maintenance forces of the South Platte River Projects Office, Loveland, Colorado, found it difficult to control weeds from the single operation and maintenance roadway located on the downhill side of canals in their area. It was particularly difficult to reach weeds on the far side of the canal, although the truck-mounted spray rig used for the work was equipped with adjustable booms that can cover a 26-foot wide swath. To expedite the work Messrs. Herman Krening and Albert Kramer of the Irrigation and General Maintenance Division, suggested a hand-spray gun with hose and reel be purchased and assembled on the truck to make it possible to reach the weeds across the canal and also those in areas not accessible to the truck. Since

the spraying is done in rattlesnake-infested areas, and water of high velocity is flowing in the canal, it was found necessary to modify the equipment to support the hose leading to the spray gun to accomplish the work in an efficient and safe manner. This required considerable adaptation.

A folding boom to support the hose that could be quickly assembled and disassembled and still be attached to the spray rig in a manner that would be permissible for transportation on the highway was devised and constructed. The boom, 25 feet 7 inches long with a total weight of only 80 pounds that folds up to form a compact unit 7 feet long is shown in the photograph above in use along the Charles Hansen Feeder Canal of the Colorado-Big Thompson Project. A reel-mounted hose expedites any changes needed in hose length. Distances up to 75 feet from the truck can be covered with this device, and the hose is supported in such a manner as to prevent it from dragging on the ground or in the water.

Another view of the spray rig and boom that was constructed in the Project's Loveland Irrigation maintenance shop is shown in the photograph on the next page. The boom was constructed in three sections and folds along the vehicle bed when not in use. The sections are tapered. The first section is made of 1-inch angle iron, 1/4" thick, and the second and third sections are made of 1/8-inch by 1-inch angle iron. The final section of boom consists of a 1-inch oak dowl 4-1/2 feet in length. The boom is used with 125 feet of 1/2-inch I.D. high pressure hose.

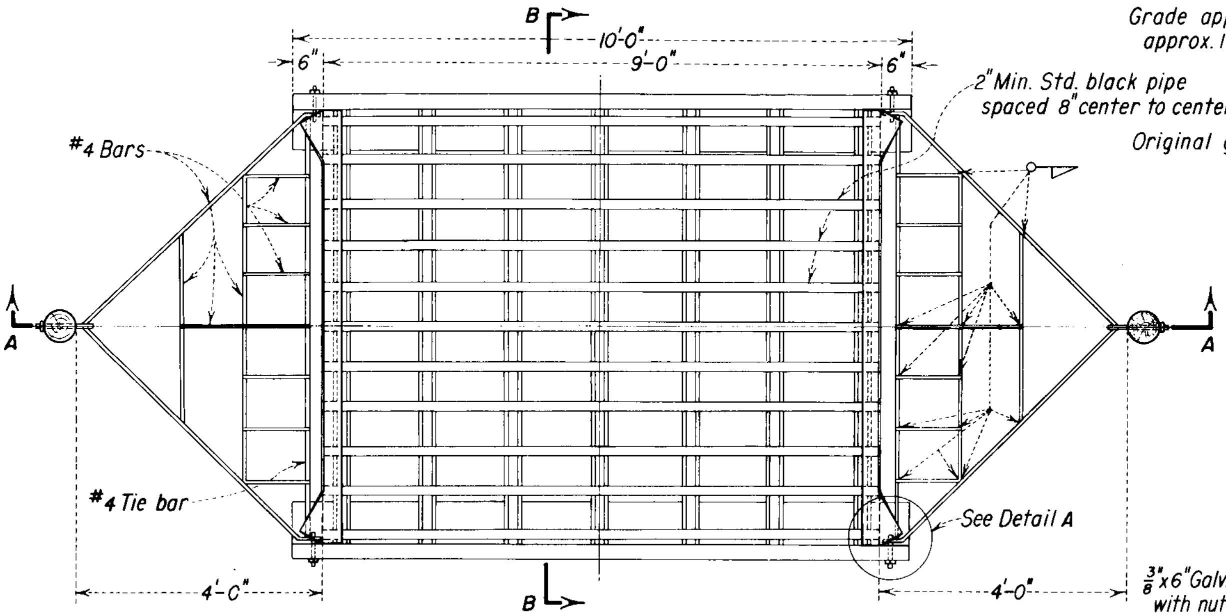
With the devised equipment, the operator using the hand spray has greater balance and more freedom to maneuver. This makes it possible to spray weeds for longer periods of time without tiring and with greater safety and efficiency. Another view of the sprayer in action is shown below.

CURB ANGLES FOR CATTLE GUARD
(Suggestion R7-64-87)

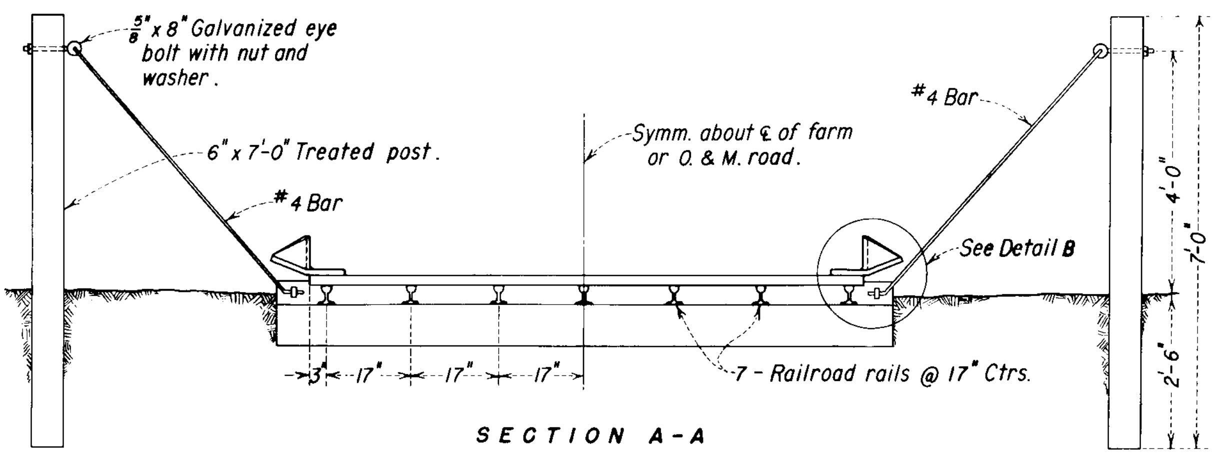
Mr. Claude E. Murphy, Construction Inspector, Farwell Unit, Middle Loup Division, Missouri River Basin Project, Nebraska, noted that it was costing considerable money to straighten and replace cattle guard wings that were damaged by traffic slipping off the cattle guards. His suggestion to reduce the hazard to farm and project vehicles as well as prevent damage to the guard wings is shown on the sketch on the following page, and has been adopted for use in the preparation of future specifications to be prepared in the Office of Chief Engineer.

The suggestion entails the use of two 3- by 3- by 1/4-inch steel angles welded on the cattleguard and located on each side of the traveled surface with the steel angles horizontal legs extending toward the centerline of the roadway. The vertical legs are lined up with the ends of the bars, rails or pipes forming the roadway portion of the guard with the legs bent outward at each approach end so that they become horizontal in a distance of approximately 8 inches. This presents a sloping surface to the wheel of a vehicle that might be at the edge of the guard when entering or crossing the cattleguard.

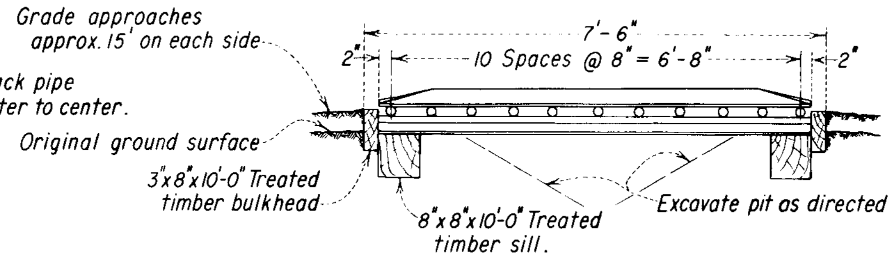
* * * * *



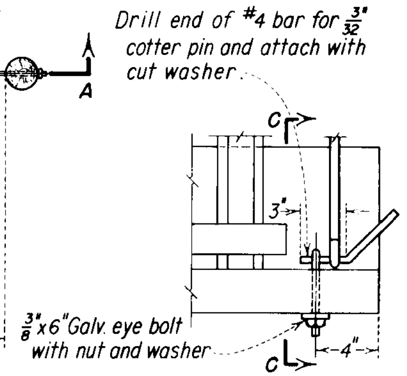
PLAN



SECTION A-A

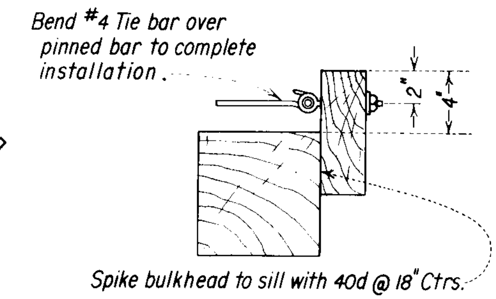


SECTION B-B

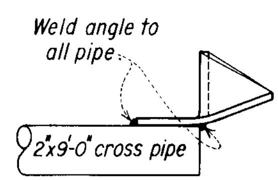


DETAIL A

WITHOUT FLARED CURB ANGLE



SECTION C-C



DETAIL B

NOTES

Cattle guards to be designed for A.A.S.H.O. H-5 loading.
Structurally sound used metal pipe and railroad rails may be substituted for new material.
Weld 2" black iron pipe to railroad rails at all contact points.
Do not fasten rail stringers to sills.

FLARED CURB ANGLE FOR CATTLE GUARDS

GPO 848-376