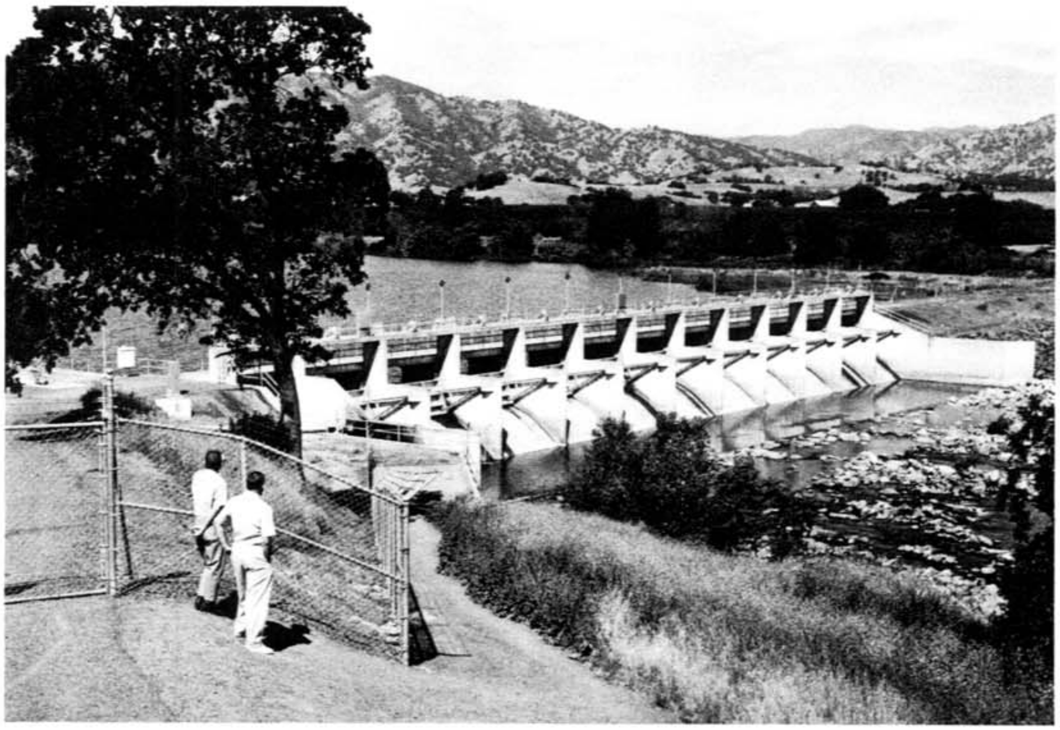
WATER OPERATION AND MAINTENANCE

BULLETIN NO. 104

JUNE 1978



IN THIS ISSUE

UNITED STATES DEPARTMENT OF THE INTERIOR
Bureau of Reclamation

The Water Operation and Maintenance Bulletin is published quarterly for the benefit of those operating water supply systems. Its principal purpose is to serve as a medium of exchanging operation and maintenance information. It is hoped that the reports herein concerning laborsaving devices and less costly equipment and procedures will result in improved efficiency and reduced costs of the systems for those operators adapting these ideas to their needs.

To assure proper recognition of those individuals whose suggestions are published in the bulletins, the suggestion number as well as the person's name is given. All Bureau offices are reminded to notify their Suggestions Award Committee when a suggestion is adopted.

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Division of Operation
and Maintenance Technical Services
Engineering and Research Center
Denver, Colorado 80225

Putah Diversion Dam, Solano Project, California. Located 9.7 km (6 mi) downstream from Monticello Dam, the Putah Diversion Dam diverts a portion of the regulated flow of water released from Lake Berryessa into the Putah South Canal for conveyance to the project service area. This structure also was completed in 1957 and impounds attractive Lake Solano which provides opportunities for aquatic sports.

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INTRODUCTION

Is it a pong or ping! Locating voids behind concrete linings seems impossible, but the Instrumentation Branch has developed a device that has proven quite successful in detecting voids as described on page 1.

The advantages of using a reservoir as an anode bed in high-resistivity terrain for pipeline protection against corrosion is discussed beginning on page 3.

The article beginning on page 6 describes the installation of a tailgate quick release device developed by the Fresno Operations Branch to quickly and safely remove rocks wedged in the tailgates of their dump trucks.

Pages 11 through 13 show two unique installations of welding equipment on pickup trucks or cars.

Beginning on page 15 is an article "Ongoing Changes to the Algae Cleaning Pump." The article describes modifications to the pump and its bags to enable use of the pulverized weed as mulch on land side slopes.

Two short articles on precautionary measures entitled "Handling Pesticide Spills Requires Care" and "Gasoline Storage Tips Merit Review" appear on page 18.

PONG PING[1]

Almost everyone has tried to determine the location of a stud in the wall by tapping the wall and listening to the sound (pongs and pings). Some people are fairly adept at this, but others are horrified when they discover that what they thought was a pong was really a ping and they have drilled a hole, not into a stud, but right through their wall.

This same basic technique is often used for larger structures such as concrete linings. Usually, the "tap" is a hard blow, or some large, heavy object is dragged through the area. The objective, in this case, isn't just trying to drive a secure nail on which to hang a picture, but trying to locate voids behind the lining, discovery of which may be highly important in terms of structural safety and cost. However, the chance of success is usually the same: about 50-50.

To improve the probability of locating a void behind concrete linings, an electronic nondestructive device has been successfully designed, built, and tested by the Instrumentation Branch at Reclamation's Engineering and Research Center. Although still in the experimental stage, this void detector shows much promise and has worked accurately in its initial tests.

It all started when project personnel at Shoshone Canyon conduit in Wyoming became concerned that voids had developed behind the concrete lining. Some random drill holes were made in the lining, and one large void was located. This resulted in field forces asking the E&R Center for ideas which would help locate other voids.

One idea suggested by the Instrumentation Branch was to apply a sudden force to the lining and to measure the energy available in the lining at various points located at equal distances from the point where the force was applied. It was believed that if a solid foundation existed, much of the energy would be transferred to the foundation, but if a void existed below the foundation, a considerable amount of energy would remain in the concrete.

Preliminary tests at the E&R Center proved this idea had merit, and a prototype was designed and constructed by Manuel Gutierrez, computer equipment analyst in the Instrumentation Branch.

The prototype device consists of three accelerometers at equal distances from the point where the sudden force is applied. It also has signal conditioning and displays necessary to read the energy which remained in the concrete (amplitude and duration of the vibration). This device is mounted on small wheels so it can be readily moved throughout the conduit.

Field tests were conducted at Shoshone Canyon during the fall of 1976, and 12 areas with expected voids were located. The voids were outlined, and drilling verified the voids existed. Recent tests on Currant Creek pipeline in Utah and Stone Corral Creek siphon in California have also proven successful in locating separations at reinforcing steel layers in the conduit.

Even though successful and operational, the void detector is considered to be in the experimental stage and development is continuing.

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[1] Written by P. "F" Enger, Chief, Instrumentation Branch, Division of Research, Bureau of Reclamation, Engineering and Research Center.

Figure 1.–The prototype electronic void detector is demonstrated by Manuel Guiterrez. Although still in the experimental stage, the device has been successfully tested.

Additional information on the void detector may be obtained by calling P. "F" Enger, (303) 234-3680.

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PIPELINE CATHODIC PROTECTION IN A RESISTIVE TERRAIN[2]

by Lindsay M. Applegate

Soil in the vicinity of Paradise, California, is volcanic, rocky, and has a resistivity from 12 000 to 100 000 Ω·cm. The Paradise Irrigation District (PID) has a 1050-mm (42-in) steel main traversing a distance of 3.2 km (2 mi) from the Magalia Dam and Reservoir to a wye at the main distribution feed point. Although laid in this highly resistive soil, the main passes through some moist canyon areas where leaks from corrosion have occurred. Corrosion pits and leaks can develop at points where coatings have been damaged and where variations in aeration, moisture, and soil structure in contact with the steel produce differences in surface potential.

Figure 2.–Leak in the 1050-mm (42-in) pipeline, resulting from corrosion in a damaged coating.

Cathodic protection was tried some 15 years ago but the attempt was defeated by the soil resistivity. A second effort was made in 1975 near the wye junction, in a strip of ground sufficient in width and length to accommodate an anode bed 90-m (300-ft) long. The bed was built, consisting of twenty-nine 75 x 1500-mm (3 x 60-in) graphite anodes, each placed in a hole 2.8 m (9 ft) deep and 400 mm (16 in) in diameter and coke breeze backfilled.

Preliminary measurements indicating 12 000 Ω·cm showed this to be the best site available with respect to low resistivity. A rectifier placed at the wye was able to deliver 7 A at 60 V d.c. with this large anode bed. Evidently there is hardpan about 6 m (20 ft) below the surface, so that the effective anode-bed resistivity approaches 100 000 Ω·cm. The 7 A at the wye developed more than 1 V pipe-to-test electrode but provided no effect at a distance of 400 m (1/4 mi) along the 1050-mm (42-inch) main.

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[2] Reprinted by special permission of Editor, from January 1978 issue of *Public Works*.

Anode beds in the soil were consequently deemed hopeless, but the engineer had another idea. The PID water containing 50 to 70 mg/L dissolved solids has a resistivity of 10 000 Ω·cm. Although this is a higher resistivity than is found in most soils and bodies of water, the Magalia Reservoir looked like a potential anode bed for the area. Measurements in the water at the edges of the reservoir and of the mud under the water showed resistivities of 10 000 Ω·cm.

The PID furnished some short lengths of 100 and 150-mm (4 and 6-in) pipe to which had been welded 13-mm (1/2-in) bolts for cable connections. The pipes were carried by PID crew members out into the reservoir and submerged along the edge at 3- to 6-m (10- to 20-ft) intervals. A No. 6 AWG insulated copper wire had been bolted to each anode

The wire-to-pipe connection was coated with tar to prevent the cutting of the anode wire by electrolysis before the steel had been dissolved. The several anode leads were joined at a convenient shore location and connected to a single wire leading to a 30-V, 15-A, d-c rectifier at the chlorinating station about 300 m (1000 ft) distant. This single anode line was laid in a 0.3-m (1-ft) deep trench as far as possible. Part of the route was difficult. The cable had to cross a gravel road along the crest of the dam, pass under a new road bridge and down the face of the dam over a very rocky course with sharp turns. One paved road in front of the dam was crossed in a trench where some abandoned telephone poles provided support to the chlorinator house at the side of the 1050-mm (42-inch) pipeline.

Results

When the system was activated in November 1976 using a rectifier at 28 V and 5.5 A, a reading was taken on an air valve on the 1050-mm (42-in) line near the point where it enters the dam. It measured 0.6 V from pipe to a copper/copper sulfate electrode on the backfill over the edge of the pipe. This voltage increased slowly for several months. In September 1977, 10 months later, it was 1 V. The readings along the line ranged from 0.9 to 1.4 V.

Full cathodic protection is indicated when the voltage under these circumstances reaches 0.85. It must be measured with a voltmeter having a resistance of 20 000 ohms per volt or more, connected with its positive terminal to a copper/copper sulfate electrode and its negative terminal connected to the pipe. The 0.85-V criterion is based on the algebraic differences in the electromotive series potentials involved. That of copper in a saturated copper sulfate solution is +0.32 V and that of iron in water, –0.53 V. Thus, $+0.32 - (-0.53) = 0.85$ V. Desirable margins of potential are provided by readings of 0.9 to 2 V. Coal tar enamel pipe coatings are secure in cathodic protection at much higher voltages, 20 V at least. Asphalt coatings which absorb water are good for less, but still several volts.

The advantages of using a reservoir as an anode bed in high-resistivity terrain are enormous. Any attempt to protect this pipeline with additional anodes in the soil would have failed and been excessively expensive. The size of the anode bed is important and that reservoir simplifies anode placement. Graphite rods, scrap steel pipe, structural iron or steel or even cast iron engine blocks with bolts welded on for connections, will serve as effective anodes. The anodes should be placed along the shore at about 6-m (20-ft) intervals. Where the anode wire is submerged in water, it should be insulated and the connections should be covered with tar. Leads should be concealed by burial to discourage thieves and vandals. The construction of a reservoir anode bed is simple enough for ordinary utility work crews to undertake. However, at least one crew member should be familiar with cathodic protection principles in order to give instructions. This was done at PID with complete satisfaction.

Figure 3.–Anodes placed along the reservoir shore were connected by a single buried cable to the 30-V rectifier.

The manager of the Paradise Irrigation District is Phil Kelly. Bill Harvey, a PID foreman, assisted the engineer in measuring resistivity and in planning the entire layout. Randy Bane and Jim Schindler laid the anode cable and selected the routing from the reservoir to the rectifier.

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TAILGATE QUICK RELEASE[3]

A quick and easy way of releasing the tailgate spreader chains on dump trucks was developed by Lloyd Gammel of the Fresno Operations Branch, Central Valley Project, California. The Fresno Operations Branch was continually having work delays and personnel injuries while trying to dislodge rocks stuck in the tailgates of their dump trucks during spreading operations until the tailgate quick release was installed.

The Fresno Operations Branch does a great deal of road work that includes the placing of road material that has been obtained from spoil piles or borrow areas. This material is dispersed on the roadbed by adjusting dump truck tailgates to an opening that will give the desired distribution of the material. To maintain the tailgate at the required opening, spreader chains that attach to the frame of the truck are inserted into slots on the tailgate, (see fig. 4). The material being dispersed usually has large rocks and boulders in it that will not pass between the tailgate and the truck bed. Invariably these large rocks and boulders get wedged between the tailgate and truck bed, making the tension on the spreader chains so great that they could not be released with the "old style" slot and chain arrangement. Because the dump truck tailgates are very heavy and large rocks become wedged between the tailgate and the truck bed, it required driving the truck and vibrating the rock loose or prying the rock with a bar. There have been occasions when the truck operators got their fingers crushed while trying to release rocks from between the tailgate and the truck bed.

With the installation of the tailgate quick release, there is now a quick and safe way of removing rocks that have become stuck between the tailgate and the truck bed.

The mechanism consists of spreader chains with slotted pins welded to their ends. The pins are inserted into holes through the frame of the truck so that hinged hooks slide through the slots in the pins thus preventing them from pulling out. When a rock gets stuck in the tailgate and the tension on the chains is so great that the rock cannot be dislodged, the hooks can be made to release the chains from the truck. The hooks are operated by a handle at the front of the truck bed via linkage under the bed.

Figure 5 and the accompanying photographs show the mechanism and some of the critical dimensions used on one of the Fresno Operations Branch trucks. All material is cold rolled mild steel and is either welded or pinned with bolts that have double nuts on their ends to prevent them from coming loose. The linkage connected to the handle was installed so that it snaps the handle up after the linkage rotates past its horizontal position. Another area of special importance is to make sure that the linkage connected to the hook has enough clearance to operate over its full range.

The cost of developing and installing the *first* tailgate quick release came to $1,473.70 (four employees for 5 days and materials). The weight of the steel used came to approximately 126 pounds.

It was estimated that it would take two employees 3 days to fabricate (cut, dress, and paint) and install the tailgate quick release. Because some vehicles have different tailgate arrangements, the cost for materials, time of fabrication, and installation can be variable.

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[3] Written especially for this publication by the Fresno Operations Branch, Central Valley Project, California.

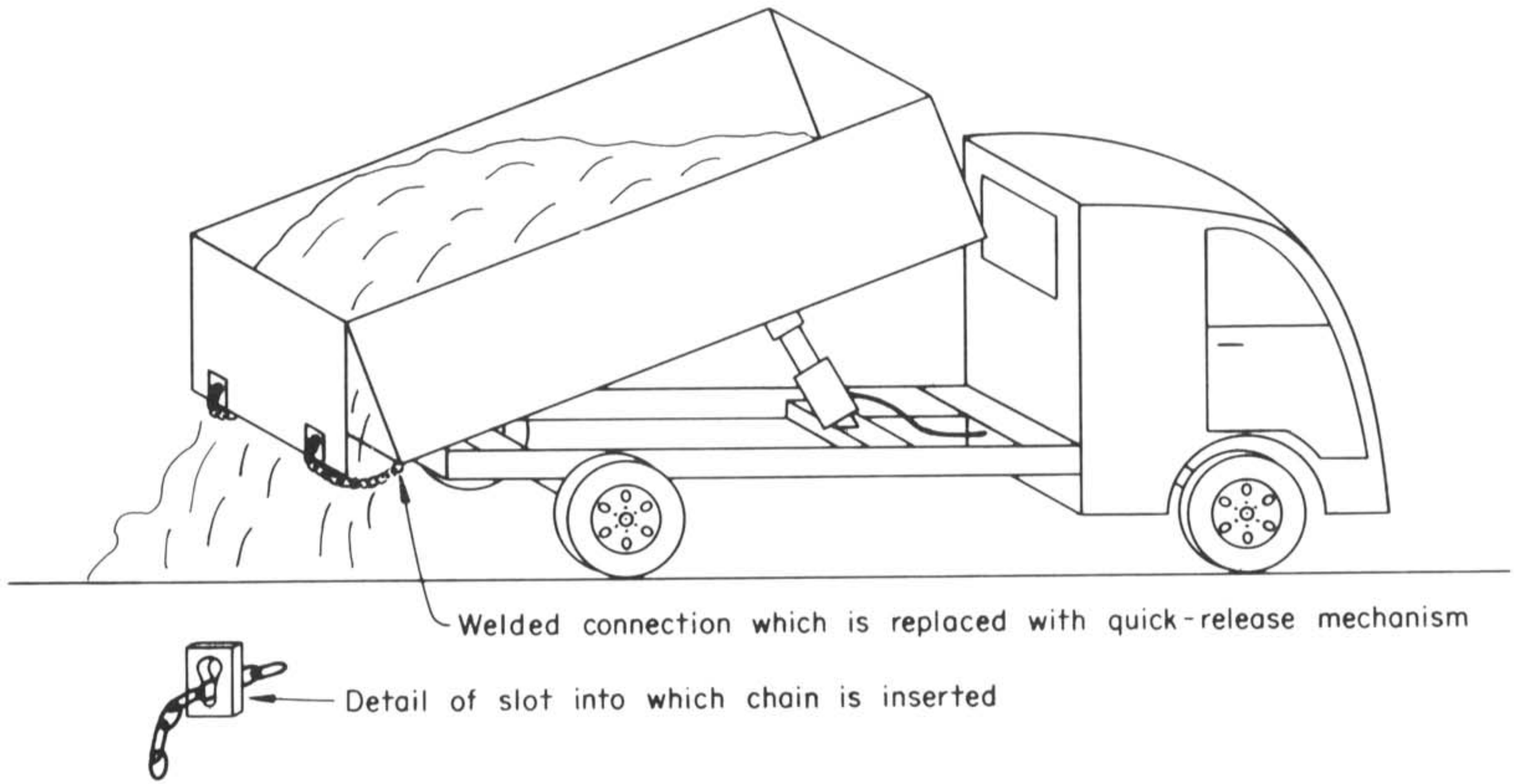
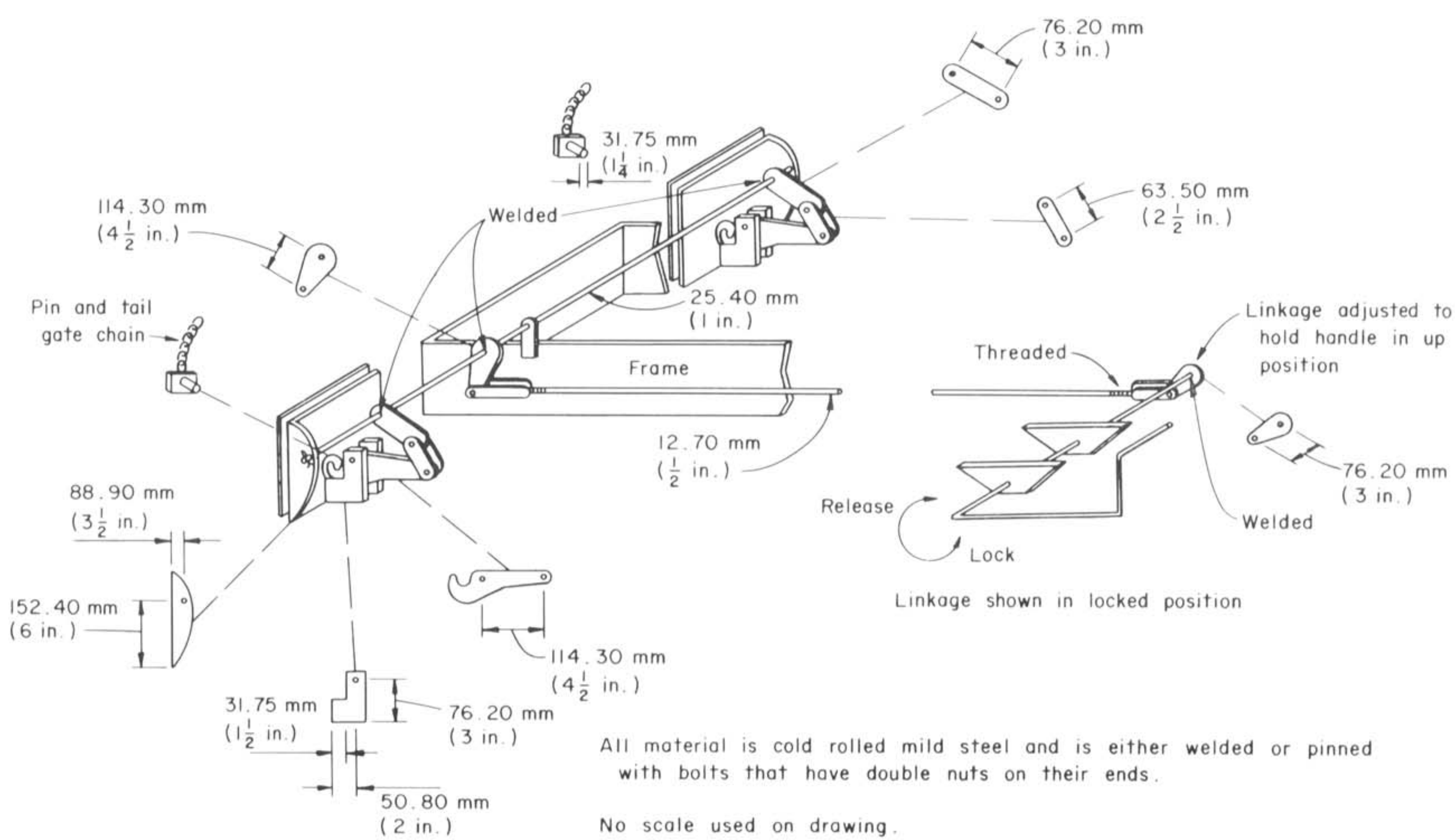


Figure 4.–Truck and spreader chains.



All material is cold rolled mild steel and is either welded or pinned with bolts that have double nuts on their ends.

No scale used on drawing.

Figure 5.–Tail gate quick release mechanism.

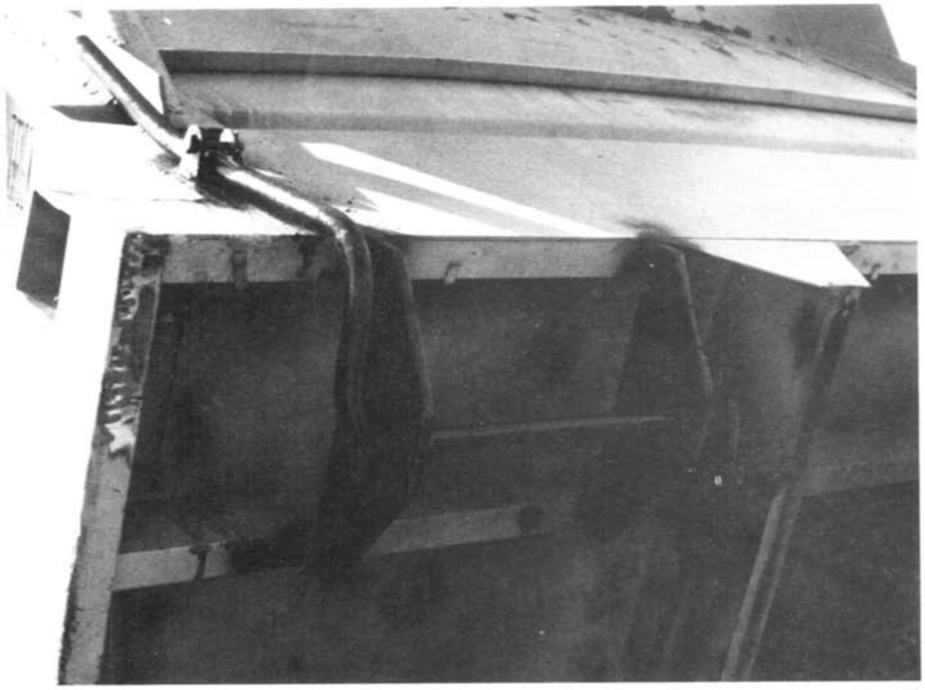


Figure 6.–Handle and linkage leading to rear of truck. Note the handle safety latch.

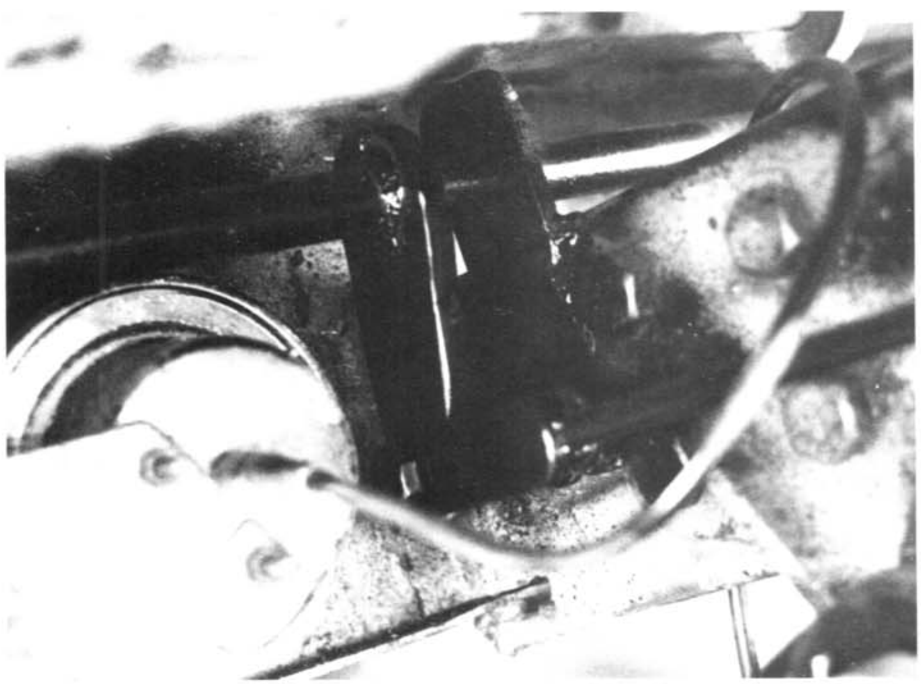


Figure 7.–Linkage in rear of truck.

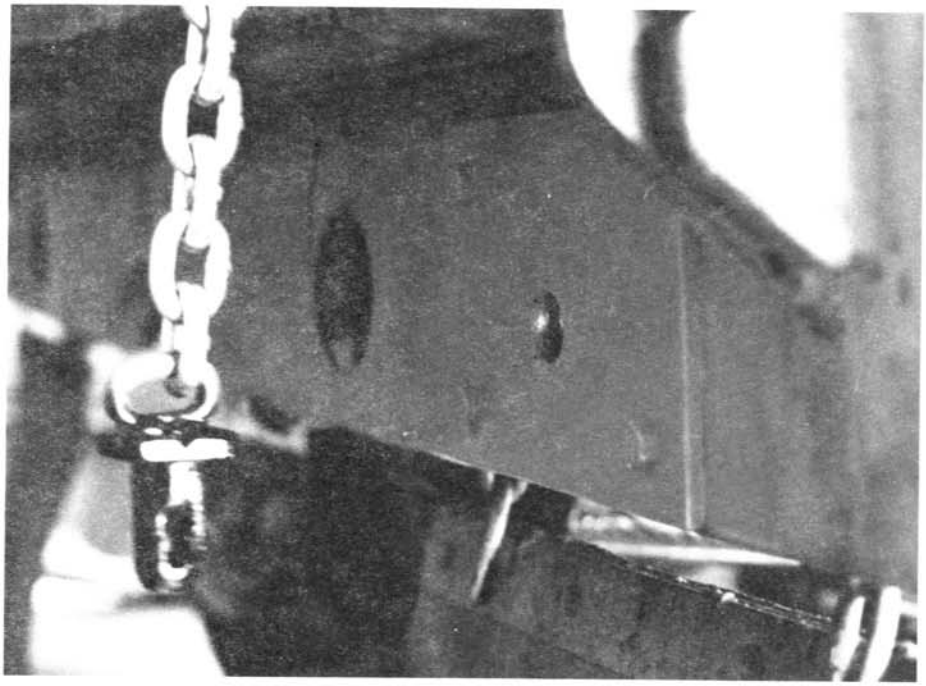


Figure 8.–Spreader chain and pin.

PICKUP TRUCK WELDER

The Solano Irrigation District in California recognizes the need for having their maintenance crews properly equipped to handle field maintenance as efficiently as possible. A recent example of this is the mobile welding unit assembled by district personnel, and is illustrated in the photographs submitted by Mr. Gordon Johnston.

The mobile unit consists of a 3/4-ton pickup truck modified by district personnel to carry all welding equipment and accessories. The pickup truck was purchased without the rear box, which permitted district personnel to fabricate a chassis-mounted bed to meet their needs. The truck bed is made of sturdy steel construction and equipped with compartments to house a fire extinguisher, hoses, welding rods, and spare pieces of metal, while the doors hold the hoses and cables from the oxygen and acetylene tanks and welding torch. The truck also has been equipped with a reinforced rear bumper to accommodate a trailer or drag.

Figure 9.–Oxygen and acetylene system and side view of welder.

The welding equipment consists of an oxygen and acetylene system and an engine-driven generator arc welding unit permanently mounted on the truck bed. The built-in a-c generator unit can also serve as a power source to operate lights and other maintenance tools and serves as an emergency power source.

The cost for the welding equipment and materials for fabricating the truck box amounted to approximately $2,500.

Figure 10.–Back view of arc welder and compartment with fire extinguisher.

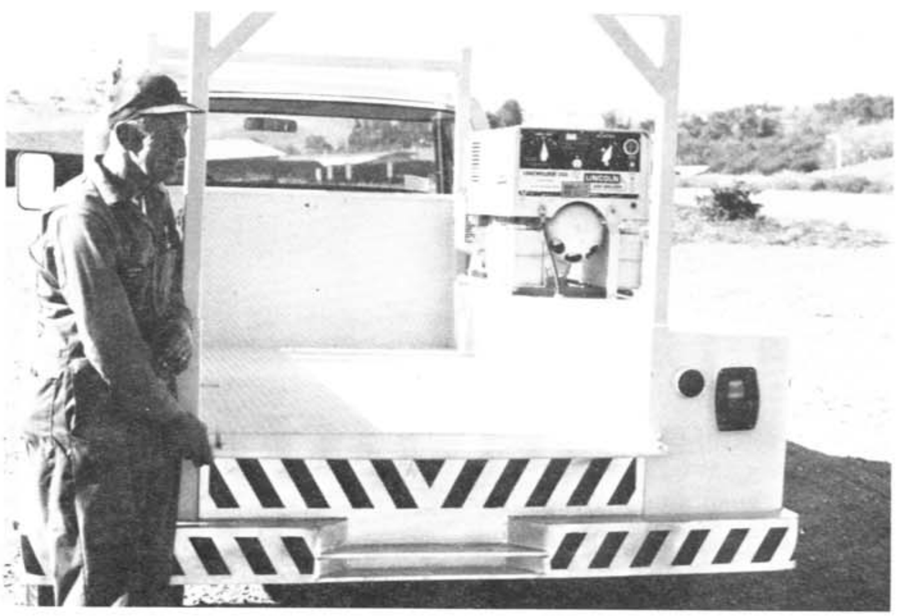


Figure 11.–View of reinforced bumper.

Arc Welder Fits Under Car Hood[4]

Believe it or not a welding machine can now be placed under the hood of your pickup truck or car. This is a real "honest to goodness" welder that can do heavy duty arc and heliarc welding. The new welder adds only 11.8 kg (26 lbs) weight to the vehicle and it employs a totally new welding principle.

The welder works on the principle of using high frequency instead of amperage to heat the metal. With a conventional arc welder, it requires bigger cables and a bigger machine to produce the amperes to heat thick metals.

The PC-130 welder does not sound like a regular arc welder. When the electrode strikes the arc, a high frequency sound can be heard. The small unit can use all types of both a-c and d-c welding rods in sizes up through 3.9 mm (5/32 in). Joe Douglass, factory representative for Resco (manufacturer of the welder), explained that a conventional arc welder is like a 135-kg (300-lb) football player blasting himself down the field at 6.8 m/s (15 mi/h). The welder is like a 9-kg (20-lb) football player whizzing down the field at 90 m/s (200 m/h). The high frequency does the heating.

The welding machine consists of two components, a special alternator and an electronic unit which produces the high frequency pulsating d-c output. When set at its midrange of 65 V (65 volts), it can do the same work as a conventional machine set at 165 A (165 amperes).

The welder was tested for 7 years before it was put on the market. It is the first welder to use the principle of regenerative feedback. This principle enables you to get more current out of the alternator. Instead of using the truck's regular alternator, a special alternator, which is designed to work with the unit, is installed.

Tungsten Inert Gas (TIG) welding and arc are easy to do with this unit. It is easier to hold an arc with the new welder, because the rod can be held closer to the metal. With a TIG torch attachment, you can weld aluminum, stainless steel, copper, and brass. This is welding, *not* brazing. The high frequency needed for TIG welding is built into the welder. With a conventional welder, you have to buy an expensive high frequency unit for TIG welding.

TIG welding with the PC-130 was quite easy. Never having used a TIG torch before, it was possible to lay a decent bead after the fourth try. The TIG welding attachment will come in handy for mending irrigation pipes.

To control the heat while welding, rev up the truck's engine. One thing some people would be concerned about is the possibility of overheating the truck. The pickup truck was running for over an hour and we were welding some heavy metal. It was over 38 °C (100 °F) outside and there was no overheating problems. Another thing which prevents overheating is that the truck or car hood has to be kept open while you are using the welder.

The welder is also equipped with an outlet so you can run power tools and charge batteries. Any power tool with a universal wound motor can be used. The unit can also be used to power resistive loads such as branding irons, coffee pots, and incandescent lights. It cannot be used to power radios or other electronic items.

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[4] Reprinted by special permission of the Editor, *Arizona Farmer-Ranchman*.

This unit stays on the car at all times. To weld, just plug in the leads.

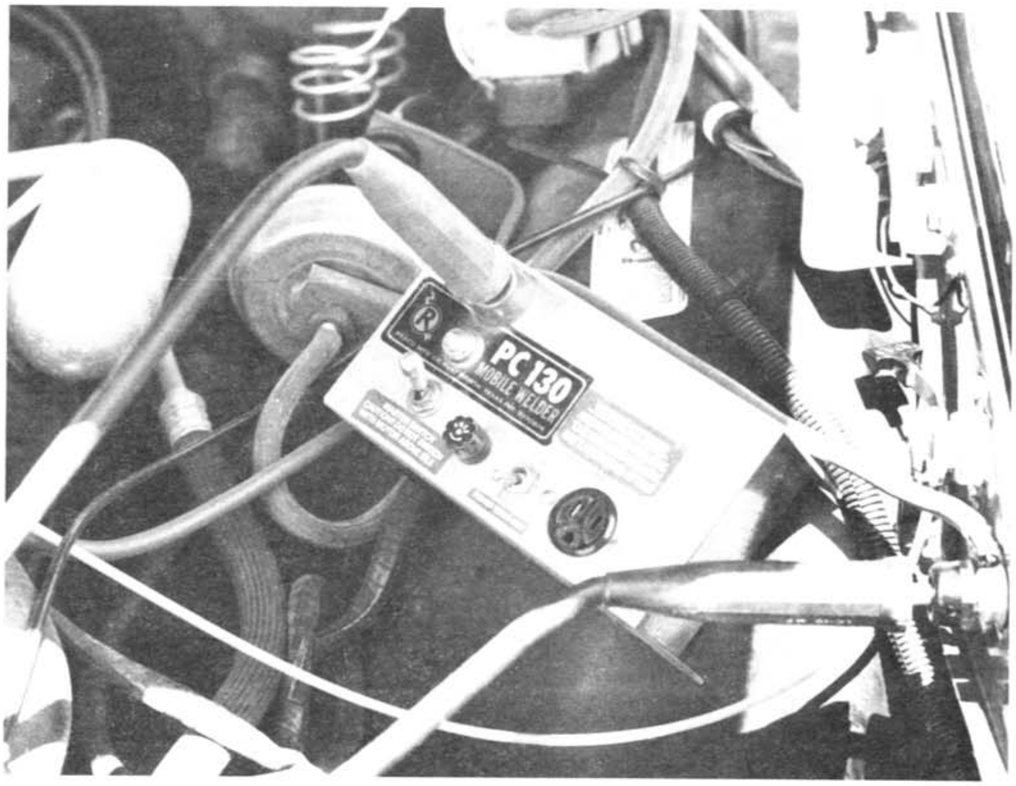

Figure 12.–PC-130 welder.

Additional information on the PC-130 welder may be obtained from Resco Manufacturing Company, 6544 Baker Blvd, Fort Worth, TX.

ONGOING CHANGES TO THE ALGAE CLEANING PUMP[5]

Few things that are genuinely used remain unchanged. This is particularly true if the item is custom-made to start with. A past issue of the California Department of Water Resources Technical Bulletin No. 24 and the Water O&M Bulletin No. 98 carried a description of a specialized pump used to clean the aqueduct turnout trashracks. This pump was referred to as a "vacuum cleaner" because of its ability to suck up, pulverize, and discharge large quantities of weeds. The maintenance cleaning job was vastly simplified as a result. Weeds were so reduced it did not constitute a clogging danger for pumps or sprinkler systems. However, later experience indicated that the finely ground weed was a rich nutrient for all sorts of growing processes. The conclusion: The weed had to be caught and removed.

Originally, the pump had one discharge tube, located on top. By securing one bag to this tube, the weight distribution would cause the pump to turn over. The logical solution was to modify this into a manifold of two discharge pipes. Cecil Owens suggested the modification, and Audrey Adams fabricated it; both are at the Coalinga O&M Subcenter, San Luis Field Division, California Department of Water Resources. This configuration is shown in figure 13.

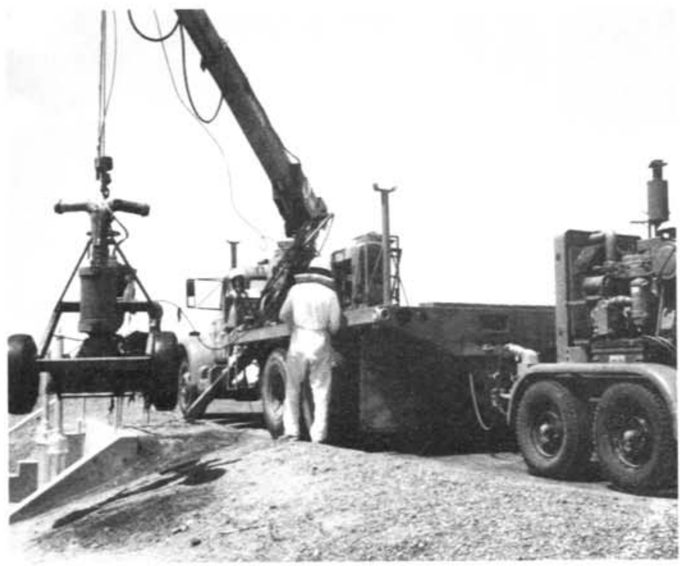

Figure 13.–The algae cleaning pump.

The first suggestion was for sacks to be secured over each discharge nozzle to collect the debris. Figure 14 shows the pump after operation with two catching bags.

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[5] Reprinted by special permission of the Editor from Technical Bulletin No. 35, California Department of Water Resources.

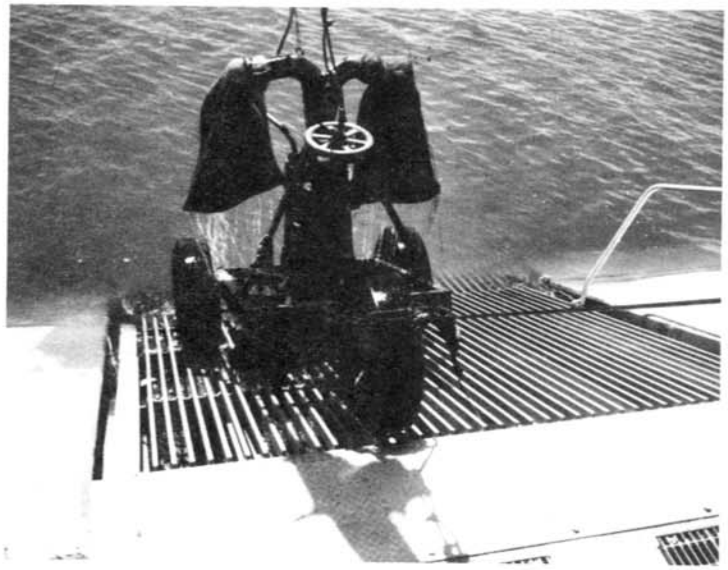

Figure 14.–The algae cleaning pump after operation.

Description

Various kinds of bags were used. The most successful type was a loosely-woven bag of jute or some similar material. It held the weed but allowed the water to flow back. In too short a time, however, these bags would wear out, or because of the weight of the material and water pressure, the bags would blow out. The bags also had to be changed four or five times at each turnout location, at no more than one-fourth capacity. The used bags would have to be picked up later for disposal. The need was for a more durable, free-flowing bag. With some thought and pencil work, Cecil Owens and Don Davis designed a pair of "baskets" as catchers. Again Audrey Adams did the production work, fabricating the baskets out of metal angle and 6.35-mm (1/4-in) expanded metal screen welded into rectangular shape. These baskets were fitted to the pump as shown in figures 15 and 16.

Each pump discharge pipe is fed into one of the catch baskets. When full, the baskets can be emptied by raising a hinged cover over the lower half and dumping the mulched weeds out. The covers are held in place with snap fasteners through metal loops. Figure 16 shows this feature plainly. With the new catch baskets, the pump operates much longer between cleanings. The baskets only have to be dumped once every five or six turnouts. Figure 17 shows a typical load.

The material (which is biodegradable) is dumped over the land side slopes, away from turnout locations. This keeps the work area cleaner, free from flies, and safer. The baskets also eliminate the double work of picking up and disposing of old weeds left in bags. The time saving is substantial.

* * * * *

For any additional information, please telephone or write Cecil Owens or Don Davis, Coalinga O&M Subcenter, San Luis Field Division (209-884-2405) or Randy Klippel, Administrative Office, San Luis O&M Center, California Department of Water Resources.

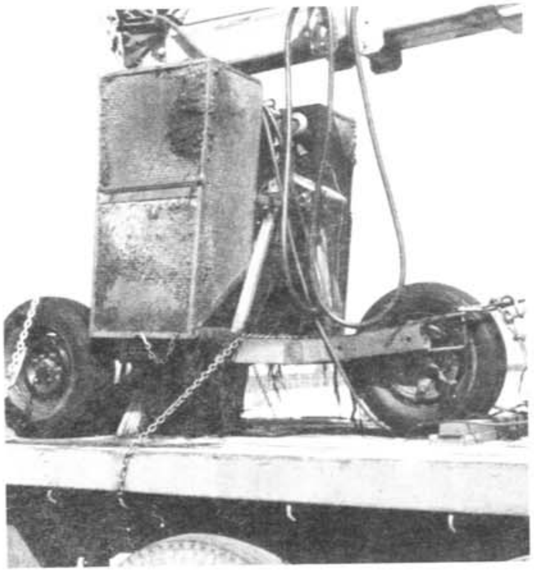

Figure 15

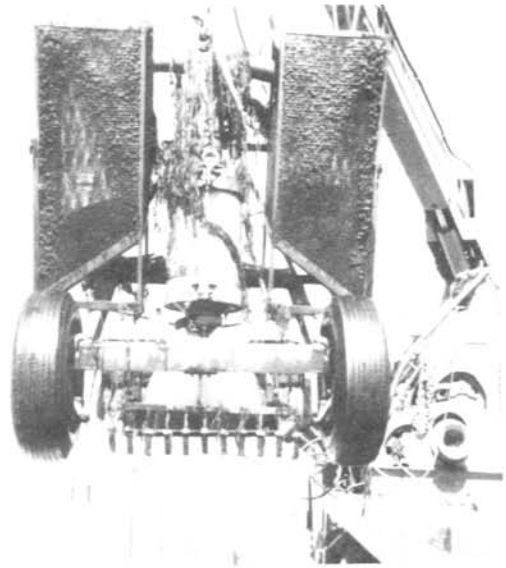

Figure 16

Figure 17

HANDLING PESTICIDE SPILLS REQUIRES CARE[6]

Here are some helpful hints in handling potentially dangerous pesticide spills.

If minor spills occur, it is recommended that the area be roped off and people kept away. Pesticides should be washed off immediately if spilled on anyone. Consult the pesticide label for correct first aid measures.

A spill should be confined and possibly soaked with an absorbent material such as sawdust, clay, or sand. Then it can be disposed of according to pesticide label regulations.

For major chemical spills, follow the same precautions in addition to acquiring more help. It is recommended that the manufacturer be called plus CHEMTREX (a toll free number), 800-424-9300.

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GASOLINE STORAGE TIPS MERIT REVIEW[7]

Safe storage of gasoline is a matter of knowing the proper steps as well as remembering to carry them out.

Just one electrical spark, lighted cigarette or a pilot light on an appliance is all it takes to ignite vapors from gasoline stored in a room or vehicle.

Use only a tight container or safety can designed for gasoline storage. Never use a glass jug, discarded bleach bottle, or other makeshift container.

Store gasoline in a well ventilated area, located so it can't accidently be tipped over or spilled.

Never store gasoline in the basement or a room which has a furnace or water heater.

Never carry extra gasoline in the car trunk or the back of an enclosed truck. The vapor buildup from the gasoline in such enclosed areas, even when approved safety cans are used, creates the danger of explosion.

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[6] [7] Reprinted by special permission of Editor from *Nebraska Farmer* dated November 1977.

GPO 846 - 493

The purpose of this Bulletin is to serve as a medium of exchanging operation and maintenance information. Its success depends upon your help in obtaining and submitting new and useful O&M ideas.

Advertise your district's or project's resourcefulness by having an article published in the bulletin! So let us hear from you soon.

Prospective material should be submitted through your Bureau of Reclamation Regional office.