

Fig. 41



Fig. 42

Cattle guards made of rubber strips, Figures 41 and 42, extend across certain paved county roads on the same project. No pit is required. The guards may be moved rapidly to another location. Objects trailing from a vehicle have snapped one of the bands occasionally.

All cattle guards have been eliminated and wire gates substituted on some of our projects because of restricted funds.

Many believe that serious consideration might well be given to the use of bump gates in lieu of cattle guards. A gate of this type will serve both to provide for passage of equipment too wide for a cattle guard and provide a means of keeping stock from straying, without delaying the ditch riders.

#### Spraying Equipment for Land Weeds

Spraying equipment for use in the control of land weeds may be of the mounted-motorized type or it may be easily portable small units, depending upon the job to be done, access to the area where the problem exists, and the condition and needs encountered on the individual project. Large motorized equipment may be of the single or multiple purpose types, with a selection of booms, means of controlling the booms, and accessories that may be needed in a given situation.

The decision for obtaining single purpose or multipurpose equipment is based on the expected requirements for each purpose.

A sprayer will be acquired for a single purpose if there is sufficient need for that one kind of performance. Single purpose units may be designed to get a job efficiently utilizing labor, equipment and materials to the best advantage, provided there is a sufficient quantity of one kind of work to be done during the lifetime of the equipment. Often other uses will be found for the sprayer, should the sprayer be available during a part of the season.

### Spray Rigs

A multipurpose unit may fulfill several needs, where the quantity of work of one kind is insufficient to support a single purpose sprayer. For example, if a project could afford only one weed sprayer, that sprayer would probably be capable of a wide range of pressures, and could be changed rapidly to spray with a boom, with a gun, to apply sterilants, aquatic herbicides, to fight fires, to transfer liquids from tank to tank, to apply residual insecticides, dust control chemicals, and to perform other project work where there is a need for the application of liquids under pressure.

The disadvantages of a multipurpose sprayer are that it will do none of the jobs as well, it may be more cumbersome, it may require more changeover time, and the operating charge will be higher than that of single purpose equipment. With the excellent availability of small portable power supplies, a few single purpose units may be feasible even for a very small irrigation system.

Multipurpose sprayers have been used for:

- Fire fighting, especially grass fires
- Cleaning insulators on electrical installations
- Applying residual insecticides to pump houses
- Mosquito control
- Emergency dewatering
- Preliminary phases of asphalt membrane lining applications
- Applications of concrete curing
- Emergency grouting behind concrete lining
- Applying aquatic herbicides
- Applying dust control chemicals
- Operation of remote hydraulic motors such as in pipeline cleaning
- Weed burning
- Transfer of liquids from tank to tank
- Water pressure for gunite
- Cleaning silt from cracks in concrete lining
- Cleaning piezometer rings on venturi meters

Several of the factors that should be considered in the design and construction of a good quality weed spraying rig are shown in the diagram, Figure 43, which illustrates the functions that are required by such a rig.

The factors essential to the satisfactory performance of a spray rig were embodied in the waterway weed sprayer designed for spraying large and small ditchbanks under irrigation system conditions on the Columbia Basin Project, Washington. The assembled unit was the result of suggestions and tests by more than 25 employees. Credit for many of the basic principles should go also to contributors to the O&M Equipment and Procedures releases, to numerous contributors from other projects, and from commercial concerns. The final design, however, was a cooperative effort of sprayer operators, shop men, and their supervisors. Functioning and component parts were such that:

1. The sprayer is simple to construct, operate, maintain, and repair, with parts being standard items or simply constructed.
2. Effective operation is flexible enough to cover rough terrain, long steep slopes, or sandy or wet sites at low or high speed, low or high gallonages, and very low to moderate spray pressures.
3. Refilling is done from the ditch on either side of the vehicle in 8 minutes or less. Line strainer and large nozzle prevent frequent nozzle cleaning.
4. Sufficient herbicide concentrates are carried to spray 1 day (up to 150 acres). Concentrates are measured and fed directly into spray tank without handling. Two major concentrates may be carried separately in the piggy-back tank.
5. Mechanical agitation is adequate for water-oil emulsion and suspended solid types of herbicides. The propellor is small and is driven directly from the single cylinder gasoline engine.
6. The single-stage centrifugal pump cost less than \$60. The 10-gallon priming tank permits use of all the material in the spray tank before refilling.
7. The hydraulic system operates at low pressure, less than 300 pounds per square inch. Cylinders on the jointed booms are light weight types. Automobile convertible top cylinders can be used.
8. Spray hose is nylon reinforced vinyl plastic garden hose and the 3/4-inch inside diameter size weighs less than 3/8-inch high-pressure spray hose. It has several times less friction loss, costs 25 percent as much and is resistant to oils and herbicides. This hose may be obtained in standard lengths or in bulk. Neoprene hose washers are used.

9. Nozzles are one-piece type with an orifice large enough to pass debris which is not retained on the 50 mesh line strainer. Thus, no nozzle strainers are required. Nozzles seldom need cleaning.
10. The sprayer tank has a capacity of 380 gallons, may be placed parallel or at right angles to the truck frame axis and may be mounted separately or as a unit with the power supply system. The tank or whole unit may be demounted by removing "U" bolts and lifting from the truck.
11. The boom system covers a 50-foot swath. It is bolted to the truck frame in place of the front bumper.
12. The hydraulic and spray controls are mounted in banks which may be placed where the operators have the greatest visibility. Spray controls are poppet type (pushbutton) in manifolds which contain three boom unit valves and one master valve. Cost of this valve manifold is less than that of most 90° gate or ball valves as single units.
13. Operation is designed for two men; one as truck driver, the other at the sprayer controls. Where visibility and road conditions permit, the controls can be placed so that the driver can also operate the sprayer.
14. Wherever possible, hose is used instead of pipe to carry fluid. Less vibration damage occurs and maintenance and repair is less expensive.
15. Containers for records, maps, tools, and parts for maintenance and field repairs protect these items from damage by spray.
16. A small anemometer (cost \$5.00) is kept on the sprayer for checking wind velocity and direction.
17. The sprayer is designed in compartments or systems. As better or less expensive components become available, they may be employed. If original parts cannot be obtained, they may be replaced with other brands. The problems of parts availability and obsolescence are reduced.

Details of the design and construction of the waterway weed sprayer may be obtained from Project Manager, Columbia Basin Project, Ephrata, Washington.

The commercially available multipurpose spray rig, shown in Figure 44, is used by Bureau forces on the Friant-Kern, Madera, and Delta-Mendota Canals, Central Valley Project, California.

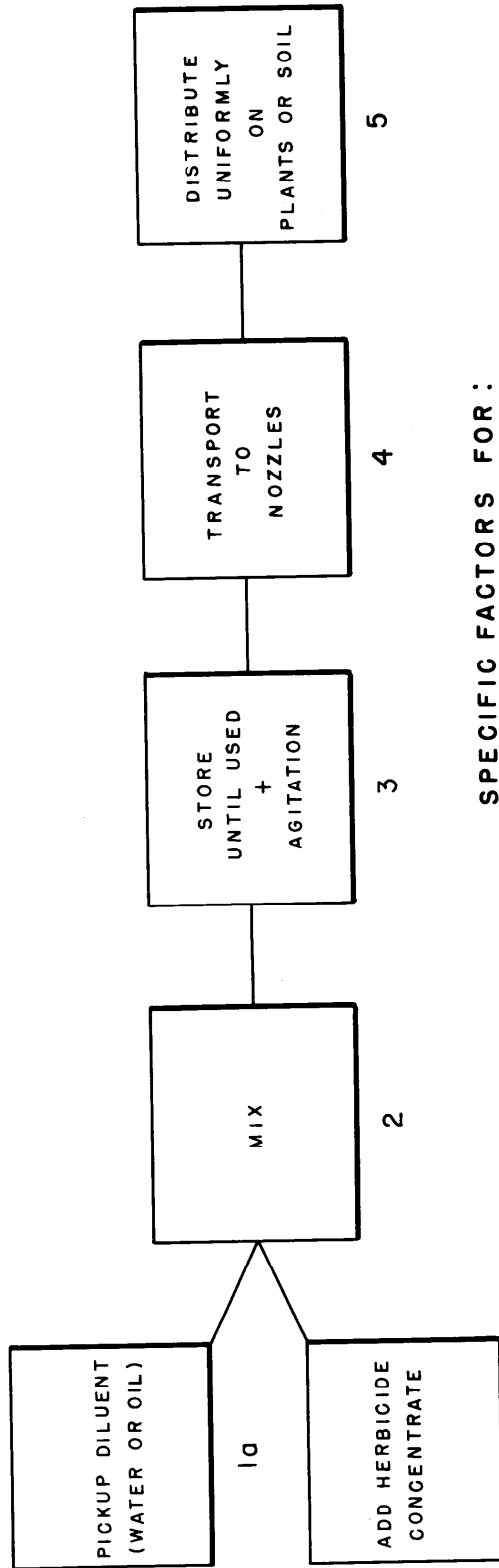


Fig. 43

**SPECIFIC FACTORS FOR :**

- 1a - Refill Rate, Priming Pump, Straining, Valving, Suction Hose.
- 1b - Concentrate Storage, Metering, Transport to Spray Tank, Valving, Filling, Air Vent.
- 2 - Agitation, Foam Control, Wetting, Emulsification, Invert Problems.
- 3 - Tank (Size, Shape, Location), Gage, Cleaning, Scale, Air Vent.
- 4 - Friction Losses, Hose - Pipe, Valves, Gages, Strainers, Mechanical Activators, Booms - Joints.
- 5 - Spacing, Nozzles, Strainers, Calibration.

**GENERAL FACTORS**

- Corrosion
- Safety Covers
- Fire Prevention
- Weight
- Mounting

**DIAGRAM: FUNCTIONS OF A WEED SPRAY RIG**



Fig. 44

Basically the spray rig consists of a "V" bottom, 500-gallon tank made of a material resistant to the chemicals used in spraying weeds. It may be mounted on any standard 2-1/2-ton truck frame with minor alterations. A mechanically driven agitator, driven from the pump, insures adequate mixing of the various ingredients in the solution.

Pressure is supplied by a 40-gallon-per-minute, three-cylinder reciprocating pump. It is in turn gear driven by a gasoline engine.

In order to fill the tank, a portable-type 1-1/2-inch self-priming pump and two 15-foot lengths of neoprene lined 1-1/2-inch hose have been provided as shown in the illustration.

The two hose reels shown on top of the tank each contain 100 feet of 3/4-inch neoprene lined and covered 2,500-pounds-per-square-inch hose. These are used when it becomes necessary to hand spray or work in confined areas. When used in this manner, the hose is usually led down the side of the tank and out along the boom through the two sets of roller guides which are fastened to the upper side of the boom. High pressure orchard spray guns or hand wands can be used with the handling, depending on the nature and requirements of the respective operations.

The two 10-foot booms, as shown in Figure 45, are lowered and raised hydraulically by remote control from the rear platform, the hydraulic control pressure being supplied by a 2-gallon-per-minute pump. The booms are capable of being lowered from 35° below horizontal to a vertical position. This is an extremely desirable characteristic since it may be adjusted to the slope of the canal banks. This is a feature which is not generally available on most of the commercial weed sprayers, at the time of purchase.

The side booms are held in a horizontal spraying position simply by friction and swing back along the sides for traveling. In addition to the two side booms there is a 90-inch center spray manifold mounted under the operating platform which is in two sections, but controlled by a single valve. It may be operated with or without the side booms, but is not movable.

Mounted on the lower side of each boom are two 3/4-inch pipe manifolds, an inner and an outer, on which the spray nozzles are connected. The effective coverage of the booms is increased by the addition of off-center nozzles on the ends.

The pressure to the spray nozzles is controlled by a 0-800-pounds-per-square-inch pressure regulator. There is also a pressure regulator for the hand lines which will allow the booms and hand lines to be operated simultaneously at different pressures. Through the manipulation of the valves at the operating platform, either the outer or inner spray manifold may be used individually or both may be used simultaneously.

With the foregoing description in mind, numerous uses of the spray rig are apparent. To cite a particular, and one of the most important alternate uses, it was used in shotcrete operations for repairing of broken or cracked concrete lining on the Friant-Kern Canal. When a shotcrete machine, for the pneumatic application of the portland cement mortar first arrived on the job, it was necessary to maintain a continuous supply of compressed air and water under



Fig. 45

pressure. At first it was considered necessary to have a tank truck with water, a truck to pull the air compressor and also the shotcrete machine. This required several men

and pieces of equipment which was soon found to be unnecessary. An air-driven pump was furnished with the shotcrete machine to be used on a tank truck. However, this did not prove satisfactory as there was a shortage of air for this type of service. The use of the spray rig was proposed. Its use became two-fold in that it was a ready source for the continuous high pressure water supply required, and was also the prime mover for the air compressor shotcrete machine and sand trailer. The arrangement of equipment is shown in Figure 46, which was taken during lining repair operations.

Prior to application of the mortar, the cracks in the lining had to be thoroughly cleaned. In order to speed this process the spray rig was again put to use. A man with the hose was lowered down

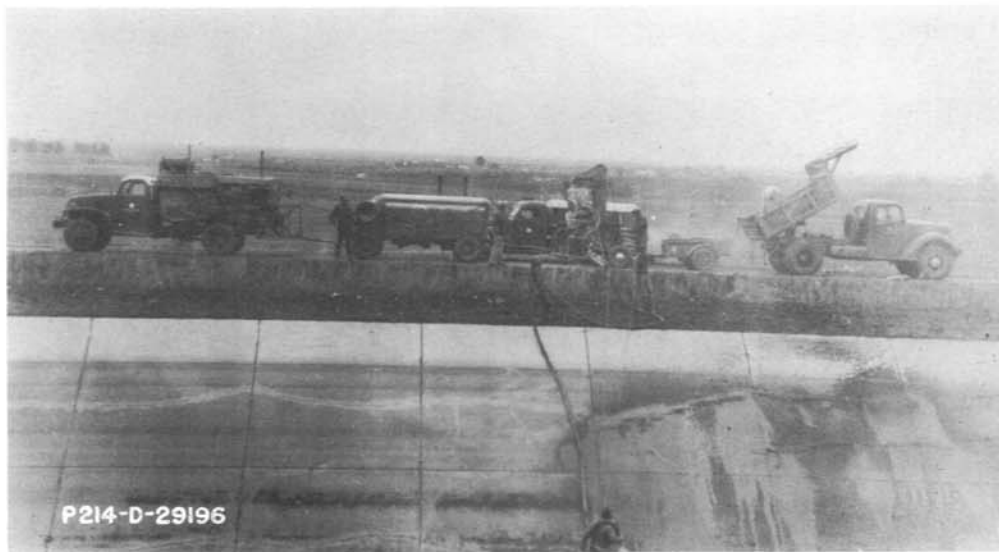


Fig. 46

the slope by a line. The water pressure was adjusted to 400 pounds per square inch which had been found to be the right pressure to easily jet the silt from between the cracks.

During a recent maintenance period, a contract was let for providing a catalytically blown asphalt membrane over a 400-foot section of concrete lining at Mile 79.85 on the Friant-Kern Canal. Bureau of Reclamation personnel were to apply an asphalt primer prior to the application, and apply a coat of asphalt base aluminum paint after the asphalt membrane had been applied. It was necessary, of course, to have the lining clean before applying the primer. Here again the sprayer played an important role. Not only was it used to water wash the lining, but was also used for spraying the primer and aluminum paint. This was done simply by filling the tank with the asphalt primer and applying it by the use of a hand wand. The 34,400-square foot area was completely covered in slightly less than 4 hours by



one man, with approximately 150 gallons of primer. Upon completion a few gallons of solvent were used to clean out the tank and hose. After the catalytically blown asphalt had been applied, the asphalt base aluminum paint was sprayed on in the same manner in the same amount of time.

Other lesser uses also have been made of the sprayer on the Central Valley Project. It became routine for the field offices to keep the truck filled with water over the weekends during the dry months, in the event a fire should occur.

During one irrigation season, pondweed became a serious problem in the Friant-Kern Canal. In order to make the proper herbicidal applications, it was necessary to treat the surface area of the water. This required applications from a boat. The materials were thoroughly mixed with the agitator and then applied, as shown in Figure 47. The boat was pulled by a pick-up, not shown, over a one-mile stretch of unlined canal.



Fig. 47

Another utilization of the rig's high pressure was in cleaning out piezometer rings in venturi meters. Hydrographers had previously used compressed air, but found that 125 to 150-pounds-per-square-inch water pressure was much more effective in cleaning out the accumulated silt. It was also found invaluable in cleaning out the structures for painting and maintenance work. The high pressure water jet was very effective in removing mud and debris from checks, bridges, and siphons. Also it has been converted into a weed-burning rig and for storing or transferring fuels from tank to tank. Along this line it might also be used for transporting fuel to a location where several pieces of heavy equipment are working.

The initial cost of a sprayer of this type may become small in comparison to the savings made in the number of man hours that would ordinarily be spent for these many and varied tasks.



Fig. 48

Several views of a multipurpose sprayer designed by the Tracy Division, Central Valley Project and used on the Delta-Mendota and other canals are shown in the Figures 48, 49, 50, and 51. Features include an electrically operated side boom, of light weight rigid construction extendable to 30 feet; a 400-gallon tank, exhaust priming for the one-stage centrifugal pump and mechanical swing back for the side boom. Also featured are hour meters on the truck and on the sprayer engine, and a truck engine tachometer calibrated in miles per hour for each forward gear used in spraying.

The top mounted reel, Figure 51, contains 100 feet or more of hose for spot spraying. The hose is available from either side of the truck. Agitation of spray material is accomplished by paddles on a shaft through the length of the tank near its bottom.

The spray rig is operated by two men. One man drives the 4-wheel drive, 1-1/2-ton rated capacity truck. The sprayer operator stands on a railed platform at the rear of the truck, where he can see the boom and the banks to be sprayed.



Fig. 49



Fig. 50

more than 400 gallons per acre. Rates of 1 to 20 gallons per acre are within the range of aircraft application. Ground spray rigs have a low range of approximately 5 to 35 gallons per acre. The high range then would include the 100- to 400-gallon rates.

This multi-purpose sprayer has been used for spraying weeds with boom and gun, to supply water pressure for gunite operator for cleaning cracks in concrete, to spray undercoat and paint in asphalt membrane installations.

Other multi-purpose sprayers may be developed to overcome a limitation. The oil or water used as the spray fluid carrier is an important limitation. Very large tanks, 1,000 gallons or more in capacity, become feasible only if water or other carrier is not readily available and a relatively high rate per acre is required. Large tanks may be utilized on areas which have good roads though the rate of application may be comparatively low. Where access to the area is no problem and the road will support the extra weight, it will be desirable to fill the tank only once per day.

Low and high rates are comparative terms. Rates of application may vary from 1 gallon to

Figure 52 is a view of a commercial sprayer. The large tank, the 4-wheel drive truck, the broad-fan nozzle, and side arm multi-nozzle booms are illustrated. In Figure 53, the absence of extendable booms and the large tank indicate use of the equipment largely from well improved roads or for spot treatment of weeds off these roads. Developed by the Yolo County Agricultural Commissioner, California, this spray rig is more nearly a single-purpose rig than the commercial sprayer shown in Figure 52.

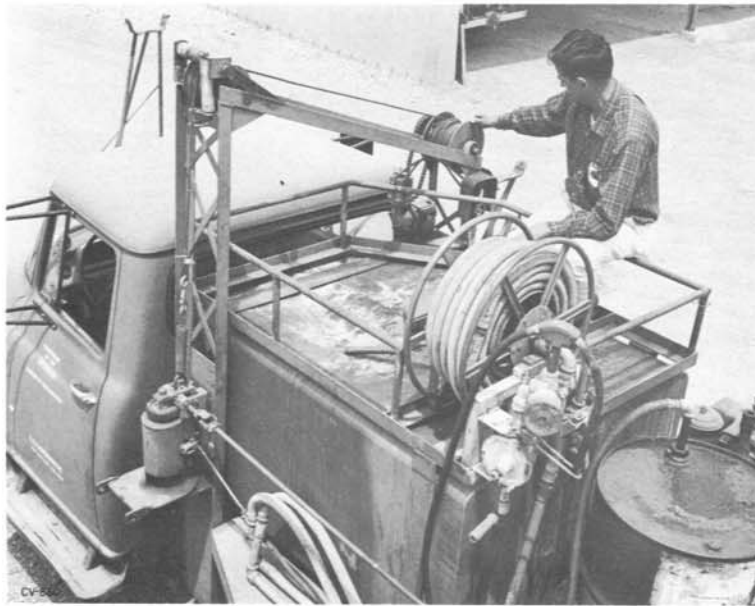


Fig. 51



Fig. 52



Fig. 53



Fig. 54

A multi-purpose spray rig developed for high volume spraying of roadside and ditchbank weed control is shown in Figures 54 and 55. Features of this rig include a 1,000-gallon tank, a hydraulic cylinder actuated side boom for spraying narrow strips on road sides and an overhead boom capable of supporting a man



Fig. 55

offside for spot spraying, Figure 55. Spraying may be done at a rate as high as 400 gallons per acre with a speed as great as 20 miles per hour.

A diagrammatic layout of a mobile weed sprayer is shown in Figure 56. This rig was constructed by O&M personnel, North Unit, Deschutes Project, Oregon, for use on a 4-wheel drive, 1-ton truck.

### Booms for Spray Rigs

Many types of booms are used on the spraying equipment utilized by the operators of irrigation systems. Also, several methods of controlling the booms have been used. Generally, the lighter constructed booms are mechanically operated, but even some of these are operated by electrical and hydraulic systems.

The spray rig shown in several illustrations below and in the drawing, Figure 65, was developed by the Kirwin Irrigation District. The District operates the irrigation system of the Kirwin Unit of the Missouri River Basin Project in Kansas. Boom construction is shown in detail in the drawing. The spray unit itself is powered by an auxiliary engine and is mounted on the rear of a truck. The innovation which the Kirwin Irrigation District has conceived is the control of the spray boom by electrical power rather than by mechanical or hydraulic methods. This is accomplished simply by the use of automotive starter motors which are powered by the truck's 6-volt electrical system.

The starter motors power winches, which through a system of cables, provide the desired control to the spray boom. Two starter motors are used on each power unit to accomplish forward and reverse movement of the winch drum. This is done simply by the fact that the starter motors have been reversed in position and, therefore, automatically rotate in opposite directions.

The operation of the complete rig is usually accomplished by two men; however, if necessary, it can be operated satisfactorily by the driver. The Kirwin Irrigation District is well satisfied with



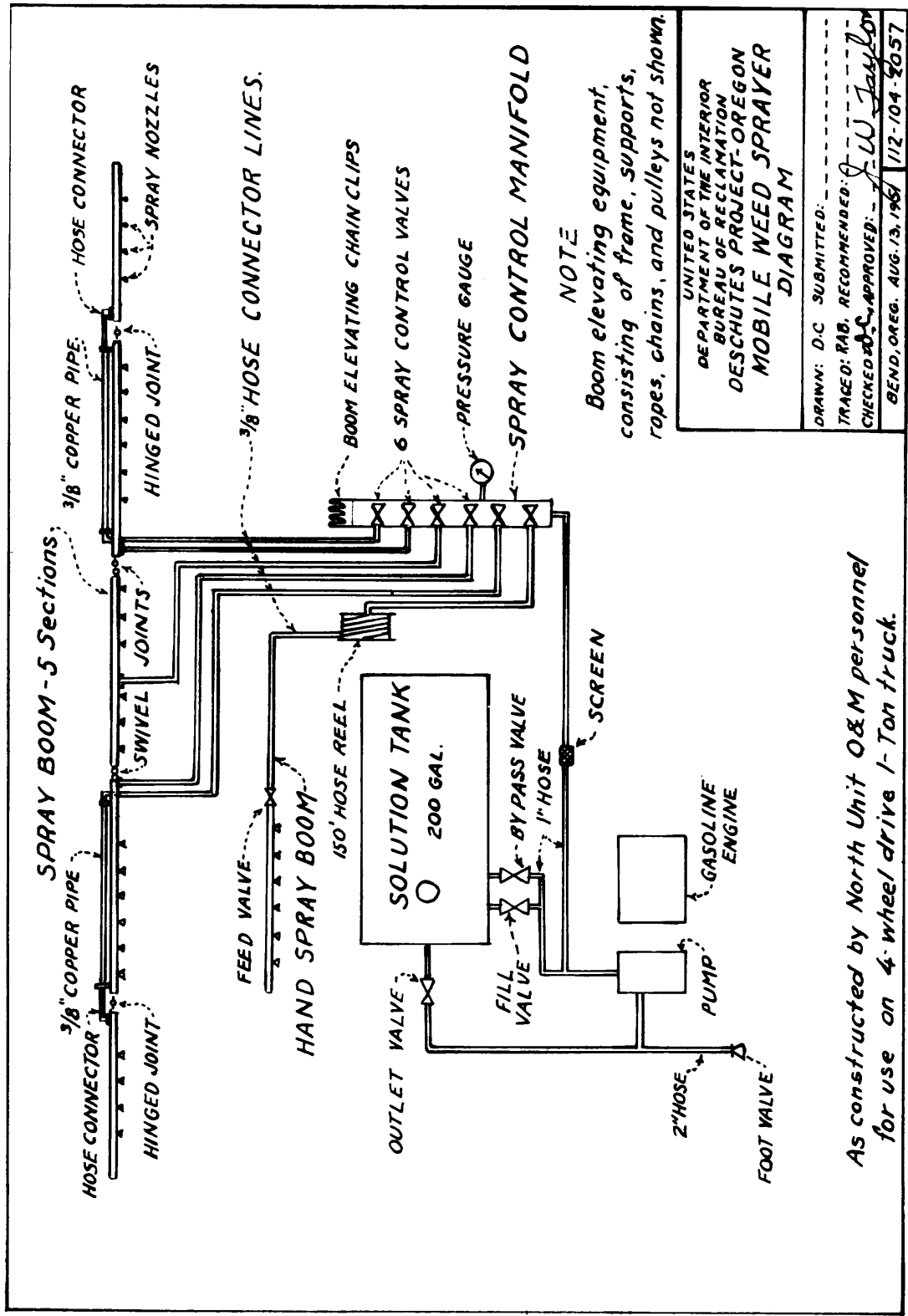


Fig. 56

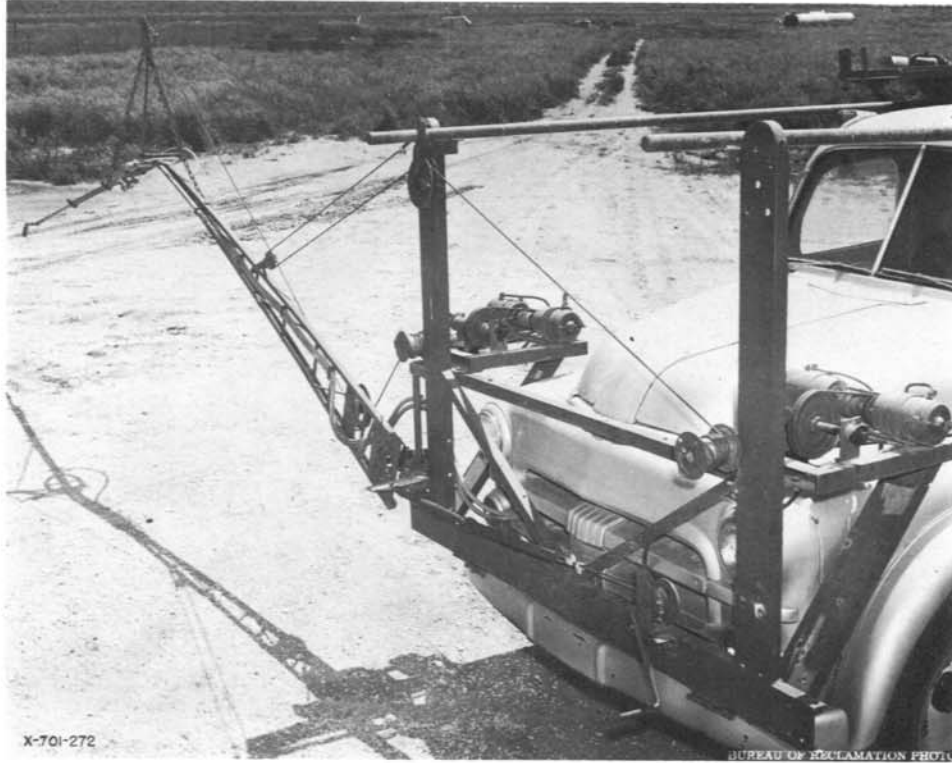


Fig. 57

the spray unit because of the ease of controlling the spray boom. It is simple, has a high degree of maneuverability and precise adjustments are possible.



Fig. 58

Figures 57, 58, and 59 show the boom and the method used in mounting it on the front of a truck.

Figure 57 is a general view of the front mounting with the boom in an extended position.

Figure 58 is a general view of the spray unit with the boom in a traveling position. Details of the front mounting assembly are shown in Figure 59.





Fig. 59



Fig. 60

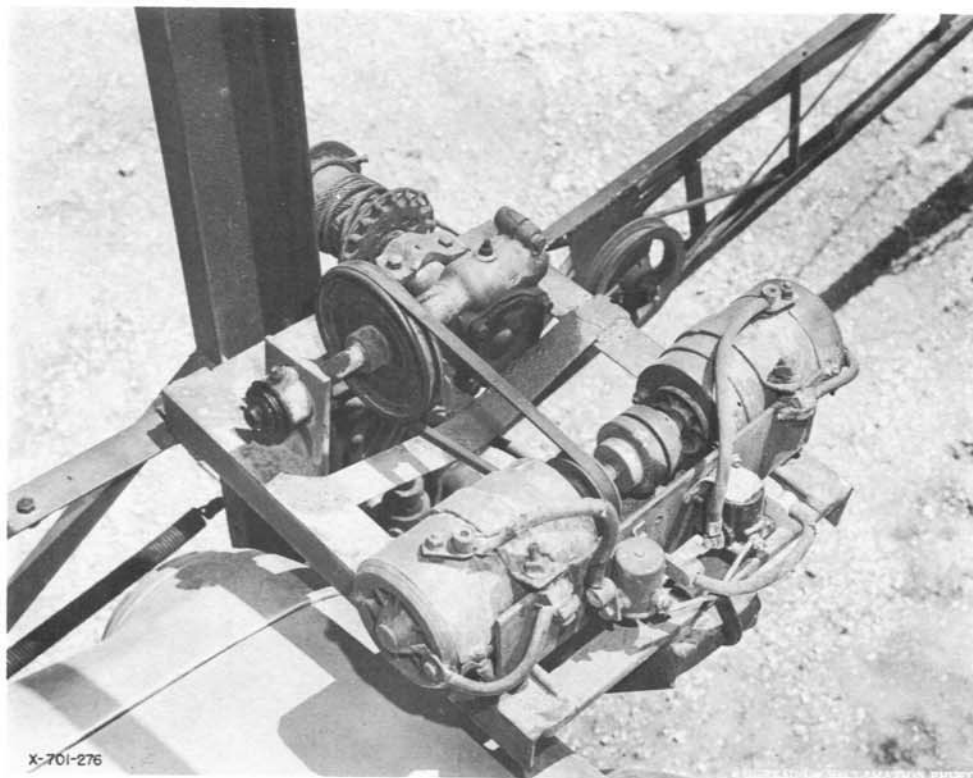


Fig. 61

Details of the boom pivot assembly are shown in Figure 60. The right side power unit is shown in Figure 61 with the two starter motors oppositely mounted.

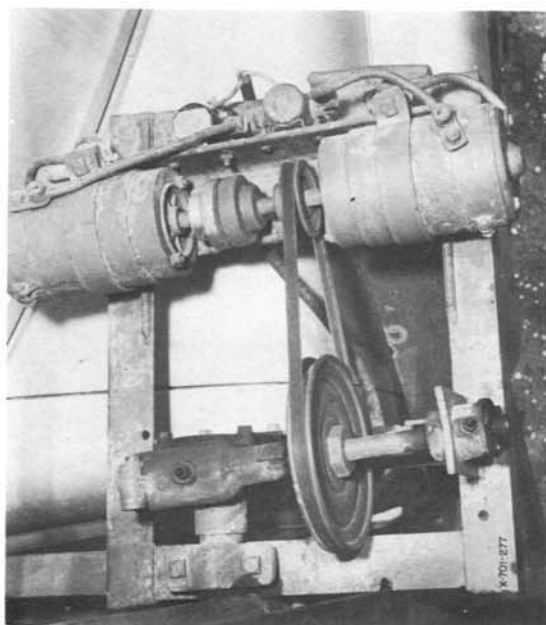


Fig. 62

The assembly of the left side power unit is shown in Figure 62.

In Figure 63, a detailed view of the boom joint from underneath shows the hose and nozzle arrangement.

Figure 64 is a view of the control panel mounted within the cab and on the dash of the truck. Shown is the selective valve control and pressure regulator on the right, and spray boom control unit with pushbutton switches on the left.

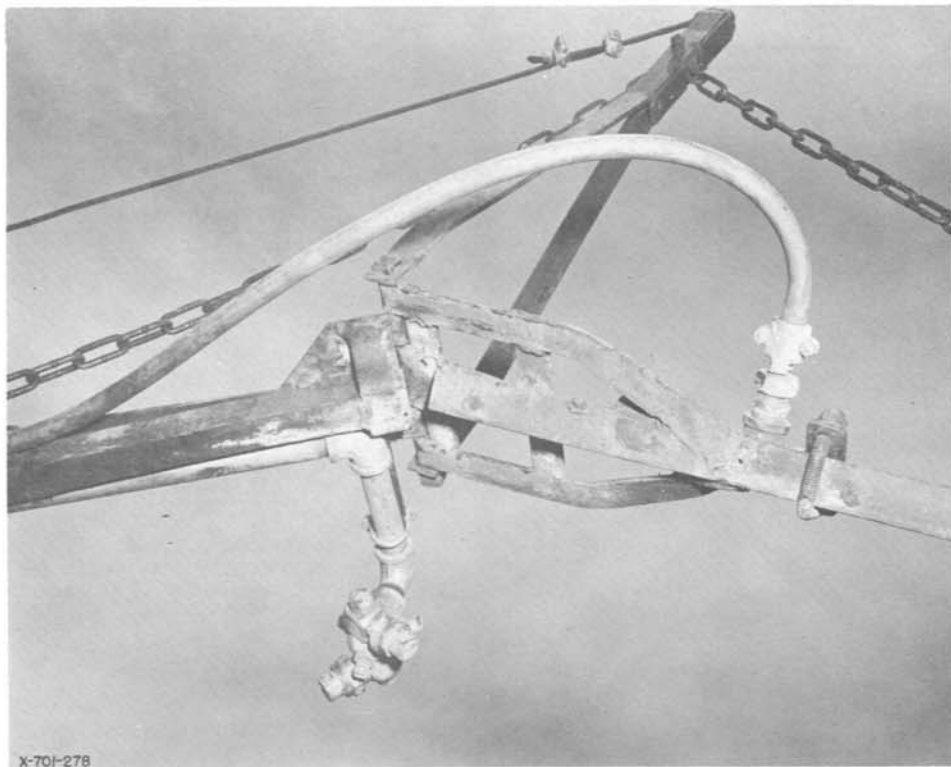


Fig. 63

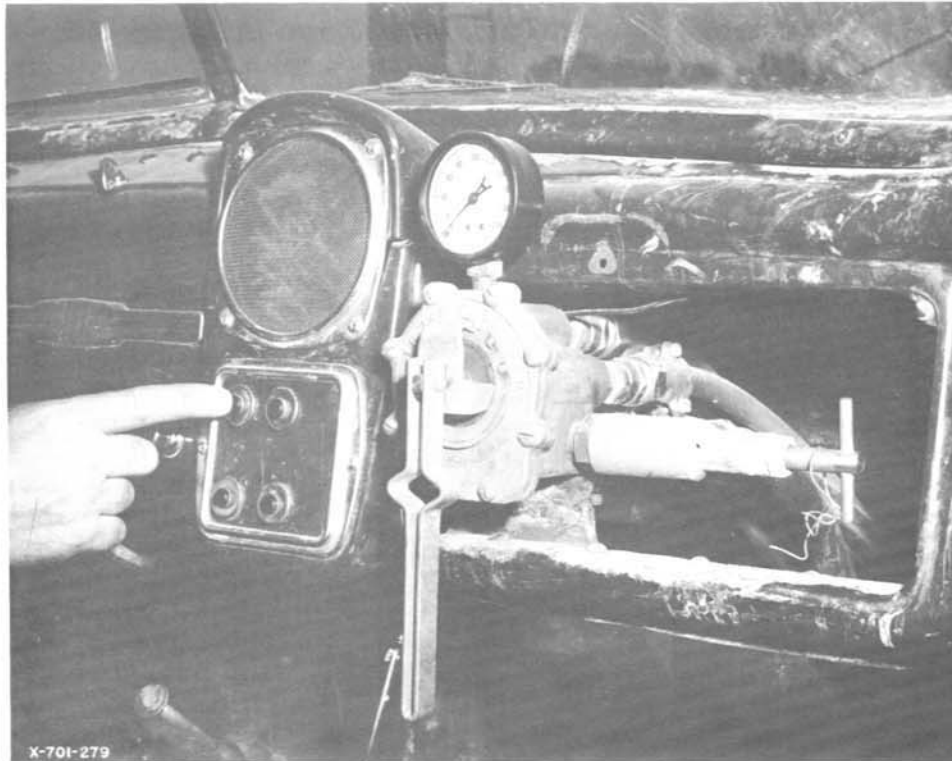


Fig. 64



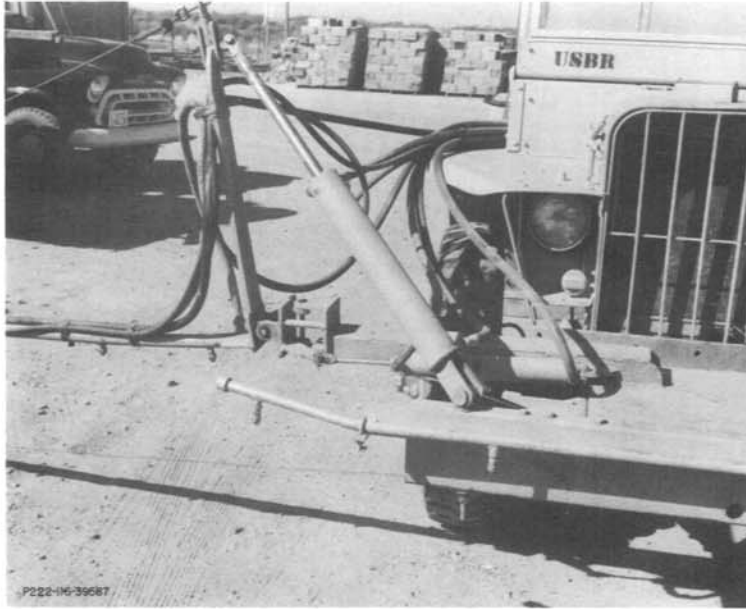


Fig. 66

members are made rigid to the spray pipe, and wire rope diagonal members are adjusted just tight enough to take up slack. The double acting hydraulic cylinder is fixed to the first boom section permitting the movement of the outer boom section by extension and retraction of the piston rod.

The hydraulic spray boom shown in Figure 67 is unique and simple in construction. It allows for one-man operation of both the spray boom and the vehicle. The operator has full control of the spray boom at all times as the control panel is located within easy reach of the driver's seat and, when operating, the spraying nozzles are visible. Operation of the boom and spray bar is accomplished by pressure developed by the spray unit. That is the hydraulic system of the equipment is merged with the spraying system thereby eliminating the necessity of two independent pressure units. Pressure is developed with any liquid or chemical solution, but use of corrosive herbicides is not recommended.

This hydraulic spray boom was designed and constructed by personnel on the Tucumcari Project, Tucumcari, New Mexico.

The spray pump develops a pressure of 800 pounds per square inch, which is adequate to operate the hydraulic cylinders at the same time fluid is being discharged through the spray nozzles. The nozzles are spaced 17 inches on center along the spray bar. Using these nozzles the sprayer will apply from 10 to 200 gallons of fluid per mile depending upon rate of travel and operating pressure.

Details of the weed sprayer and its component parts are shown in Figure 65.

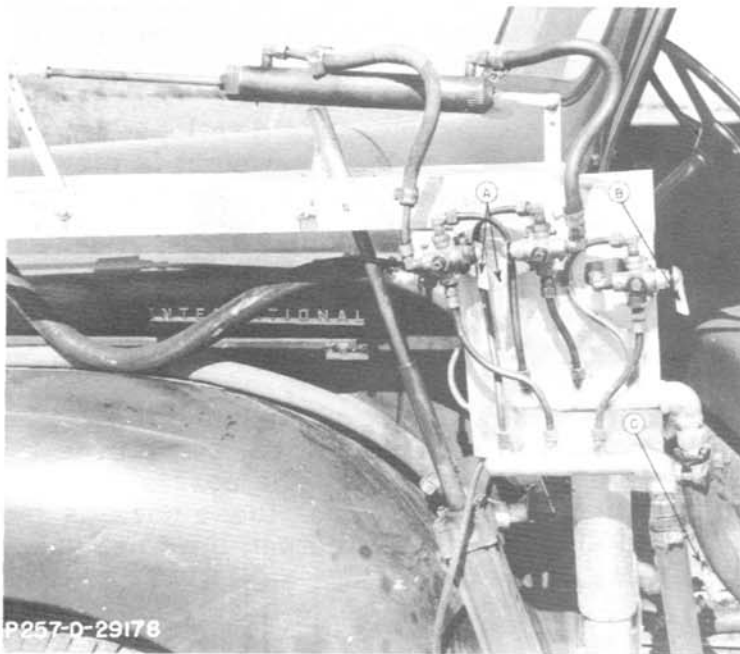
Details of a hydraulically-operated 20-foot side boom which utilizes two hydraulic cylinders are shown in Figure 66. The diagonal cylinder provides for vertical movement and the horizontal cylinder for swinging the boom back along the side of the truck.

Each of the two 10-foot boom sections is constructed so that the horizontal members are the pipes carrying spray fluid; the vertical mem-



Fig. 67

The operator controls the boom and spray bar by manipulation of the valves on the control panel. The boom and spray bar can be adjusted to either a horizontal or below horizontal position which permits spraying regardless of ground contour or slope of the ditch bank or levee.



With reference to the illustration and drawing, Figures 68 and 69, a double action hydraulic cylinder activates the spray bar and is controlled by valve "A." By placing the control handle in "up" position, the spray bar is raised. Valve "B" operates the single-action hydraulic cylinder. When the control handle is at "up" position, the spray boom is raised

Fig. 68

