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FLUID FERTILIZER APPLICATION EQUIPMENT

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Anhydrous Ammonia

Anhydrous ammonia is usually metered by one of two methods. In one method a variable orifice meter is used. Figure 1 is a sketch of a typical orifice meter which has a calibrated plunger that moves in an orifice plate. A V-type groove is machined into the plunger so that as the plunger moves out from the orifice plate a larger opening is exposed between the orifice and the groove. Constant pressure is maintained on the orifice plate by means of a diaphragm and spring device. This diaphragm makes it possible to maintain on the orifice plate a constant pressure that is not affected by changes of pressure in the applicator tank or by back pressure from the anhydrous ammonia application knives. Liquid from the orifice meter is directed by means of tubes to application knives which are usually shaped in the form of curved swords and which inject the ammonia to depths from 6 to 12 inches beneath the surface of the soil. After the ammonia has been injected, two paddle-shaped blades on the applicator cover the groove in the soil made by the knives. This type of metering system is dependent upon the speed of the tractor, and if the application rate is to be uniform, a constant tractor speed must be maintained.

One manufacturer fabricates a variable orifice meter which has a governor device attached to the diaphragm. He reports that this orifice is not dependent upon tractor speed, that as this speed is varied the governor device varies the spring tension on the diaphragm, and the result is a compensation in the ammonia flow proportional to the change in tractor speed.

Figure 2 is a sketch of another type of metering device used to control the flow of liquid anhydrous ammonia to the applicator knives. It is a piston-type metering pump. Ground-driven through a system of sprokets, it has a double-acting variable stroke piston. The application rate is varied by varying the strokes of the piston. Incoming ammonia from the applicator tank is cooled in a heat exchanger which consists of pipes within a pipe. Liquid from the heat exchanger enters the piston through the inlet port. The cylinder in which the piston moves is divided into two compartments in each of which is an inlet and a discharge valve. One section of the cylinder discharges while the other is filling. Therefore, there is a delivery stroke for each stroke of the piston. As the piston moves to the left, the righthand section of the cylinder fills. The inlet valve opens, and liquid ammonia flows from the liquid header into this section of the cylinder. The movement of the piston to the left causes the lefthand side of the cylinder to discharge through the outlet valve which in this instance is open. Liquid discharged from the outlet valve expands and passes through the vapor side of the heat exchanger.

This cool vapor cools the incoming liquid from the applicator tank and insures that liquid ammonia is delivered to the header. As the stroke changes to the right the inlet valve closes, and this section of the cylinder discharges into the outlet header. As the stroke continues to the right, the inlet valve in the lefthand section of the cylinder opens, and the inlet valve closes. Liquid ammonia is then drawn into the lefthand section of the cylinder. By the moving of the piston back and forth in the cylinder a constant metered flow of ammonia to the applicator knives is accomplished.

Broadcasting Nonpressure Solutions

Figure 3 is a sketch of a truck for the broadcasting of nonpressure fluid fertilizers. This truck has a single flooding-type nozzle. Pressure on the nozzle is maintained by the pressure in the applicator tank. Air enters the applicator tank through a sparger mounted inside and near the bottom of the tank. This sparger agitates suspension-type fluid fertilizers. It is not necessary for clear liquids. Application rates are varied as the pressure in the applicator tank and the speed of the truck are varied or as the height of the nozzle from the ground is raised or lowered.

Figure 4 is a sketch of another type of broadcast application truck for fluid fertilizers. This truck varies the pressure on the nozzles by varying the amount of liquid recirculated to the applicator tank. Liquid is pumped to the nozzles and recirculated by a centrifugal pump. This truck utilizes multinozzles. Tests at TVA indicate that a more nearly uniform rate of application can be obtained by the use of a single flooding nozzle than by the use of multinozzles. These tests indicate that when multinozzles are used it is difficult to control the overlapping of application by the individual nozzles. When overlapping occurs, the rate of application is not uniform. Flooding nozzles are designed to give a uniform rate from a single nozzle.

Figure 5 is a sketch of a slinger-type applicator that has recently been developed by an equipment manufacturer for the application of suspensions. This sketch is a cut-away of this type of equipment. An agitator in the shape of a sweeping baffle agitates the liquid in the tank of the applicator. The slinger mechanism is designed so that as it rotates it causes the material to be pumped from the tank of the applicator. This applicator has been tested with various types of suspensions and has been found satisfactory for applying even those that are the most difficult to handle.

Row and Preplant Application of Nonpressure Solutions

Most liquids that are applied in the row are applied by some kind of gravity-flow system such as that shown in Figure 6. This type of applicator has an airtight tank with a vent pipe. With this arrangement a constant pressure is maintained at the orifice plate independently of the height of the liquid in the tank. The metering head is composed of an orifice disk and holding device. The orifice disk usually has six graduated holes. The rate of liquid being metered is controlled by the speed of the tractor and the size of the hole in the orifice plate. Many farmers have found that instead of purchasing prefabricated equipment of this type

they can convert a 55-gallon drum to a constant head metering system. Figure 7 is a sketch of a drum that has been converted to a metering system of this type. The breather pipe is usually installed in the filling hole of the pump. It is important that the drum be airtight so that a constant pressure can be maintained on the orifice plate. The orifice assembly is usually fabricated from a standard machine pipe union and has a flat disk-type orifice plate. The union must be opened and the orifice plate changed each time the application rate is to be changed to a degree where it cannot be varied with tractor speed.

Positive Displacement Pumps

Figure 8 is a sketch of a typical piston-type metering pump for liquid fertilizers. Details of the operation of this pump are similar to those of the anhydrous ammonia metering pump that was previously described, but this pump for liquid fertilizers does not require a heat exchanger. Liquids that have a slight vapor pressure, such as aqua ammonia, also have been satisfactorily applied with pumps of this type.

Figure 9 is a sketch of a squeeze pump that is used for the row application of liquid fertilizers. As liquid is squeezed from the rubber tubes of this pump, more liquid is drawn into them from the applicator tank. The quantity of liquid delivered by the pump is varied by changes in the speed of the rollers as they pass over the tubes, and this speed is varied by the varying of the ground-driven sprockets of the drive to the pump.

Figure 10 is a sketch of an internal gear pump which is another type of positive displacement pump that is used to apply liquids, either in the row or for broadcasting. This pump consists of a gear which revolves inside another gear. The motion of the gears provides for positive pumping of the liquid from the applicator tank to the application knives. The pump is usually ground-driven, and the quantity of liquid delivered to the application knives is dependent upon the shaft speed of the internal gears in the pump.

Another pump of this type is a roller-impeller pump. Figure 11 is a cut-away sketch of a pump of this type. As the roller-impeller passes over the eccentric housing, it draws liquid from the applicator tank and delivers it to the application knives. The quantity of liquid delivered by the pump is dependent upon the shaft speed of the roller impellers. These shafts can be either ground-driven or driven by a power take off.

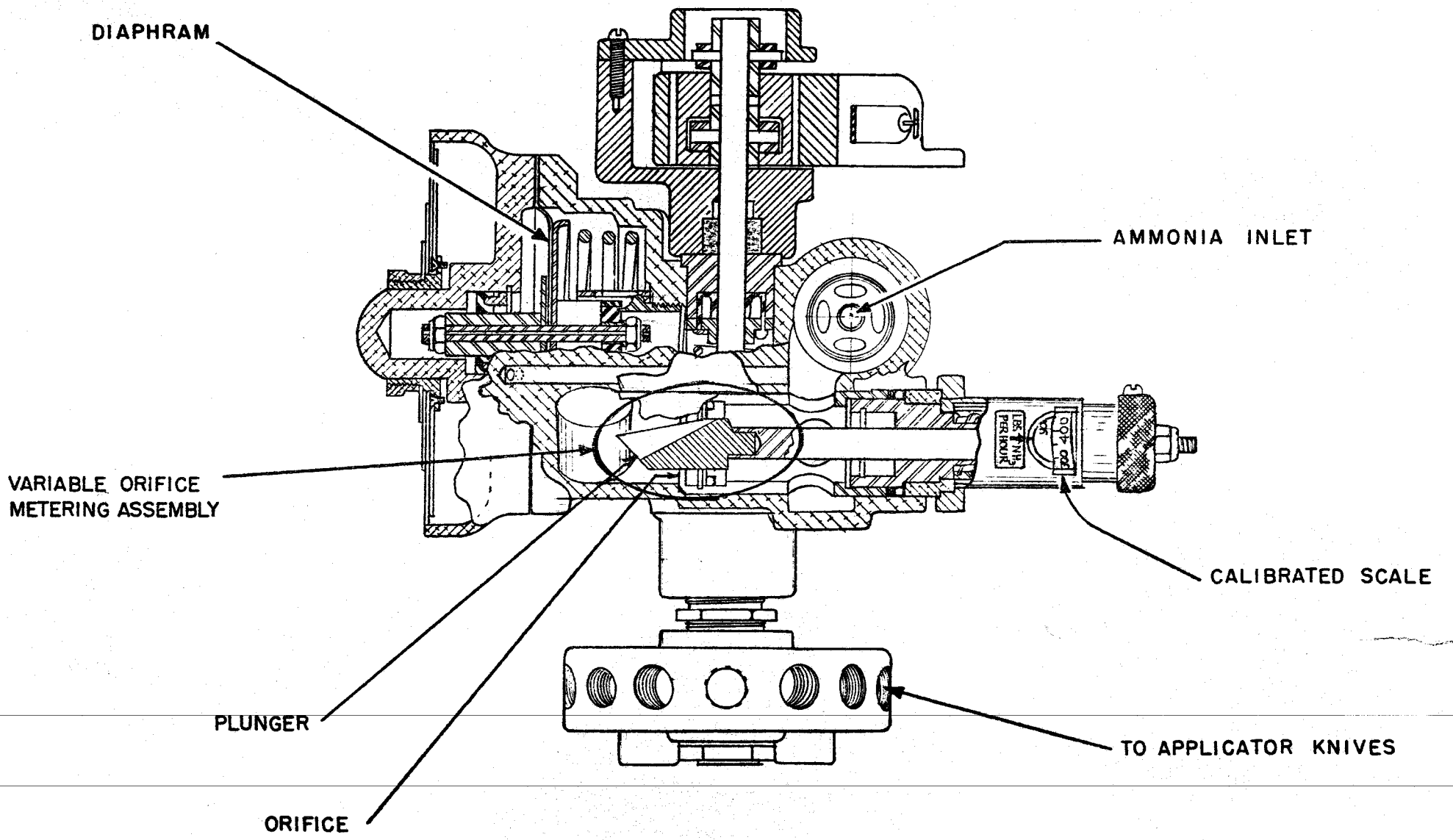


FIGURE 1

VARIABLE ORIFICE METER FOR ANHYDROUS AMMONIA

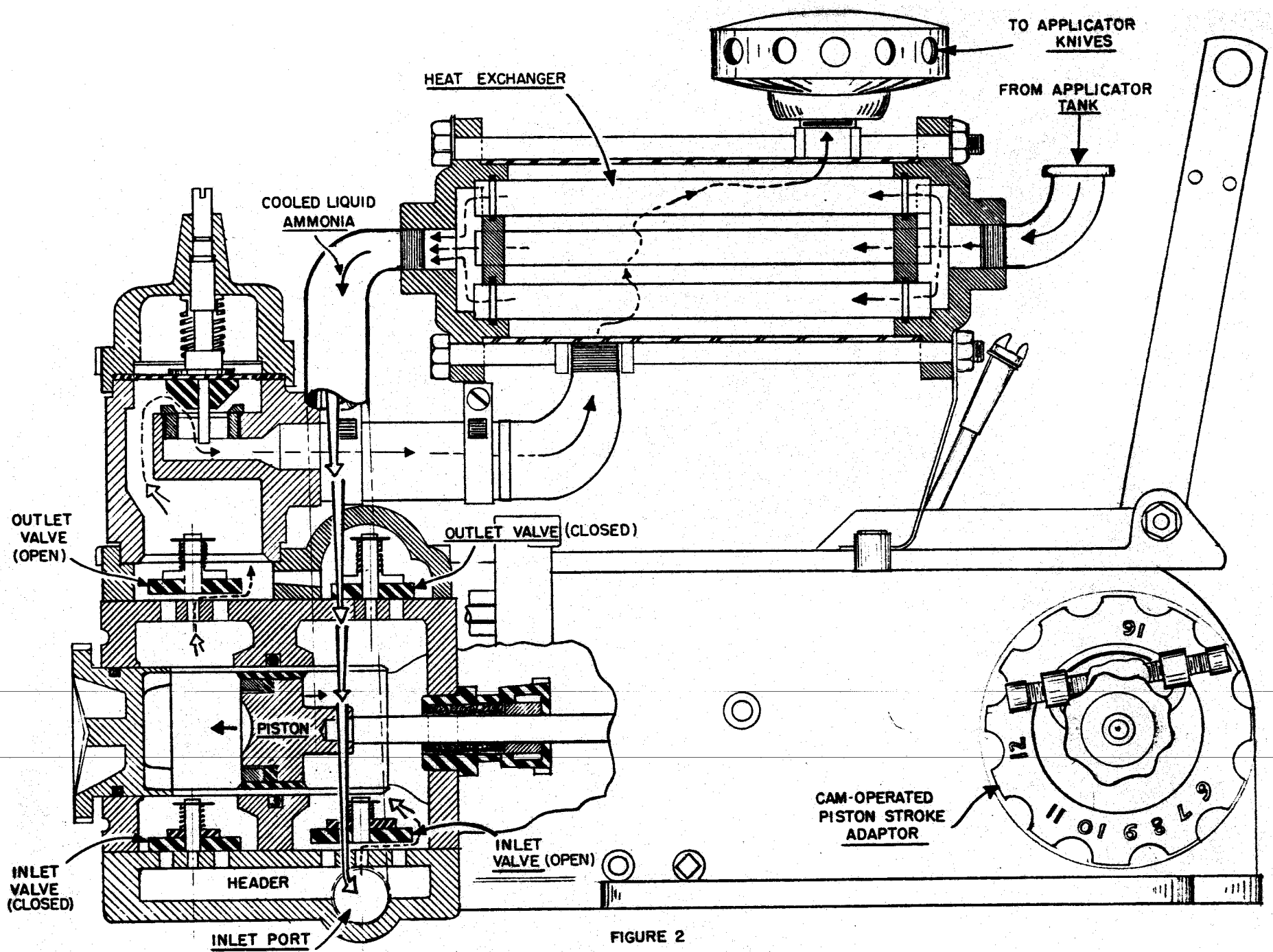


FIGURE 2

ANHYDROUS AMMONIA METERING PUMP

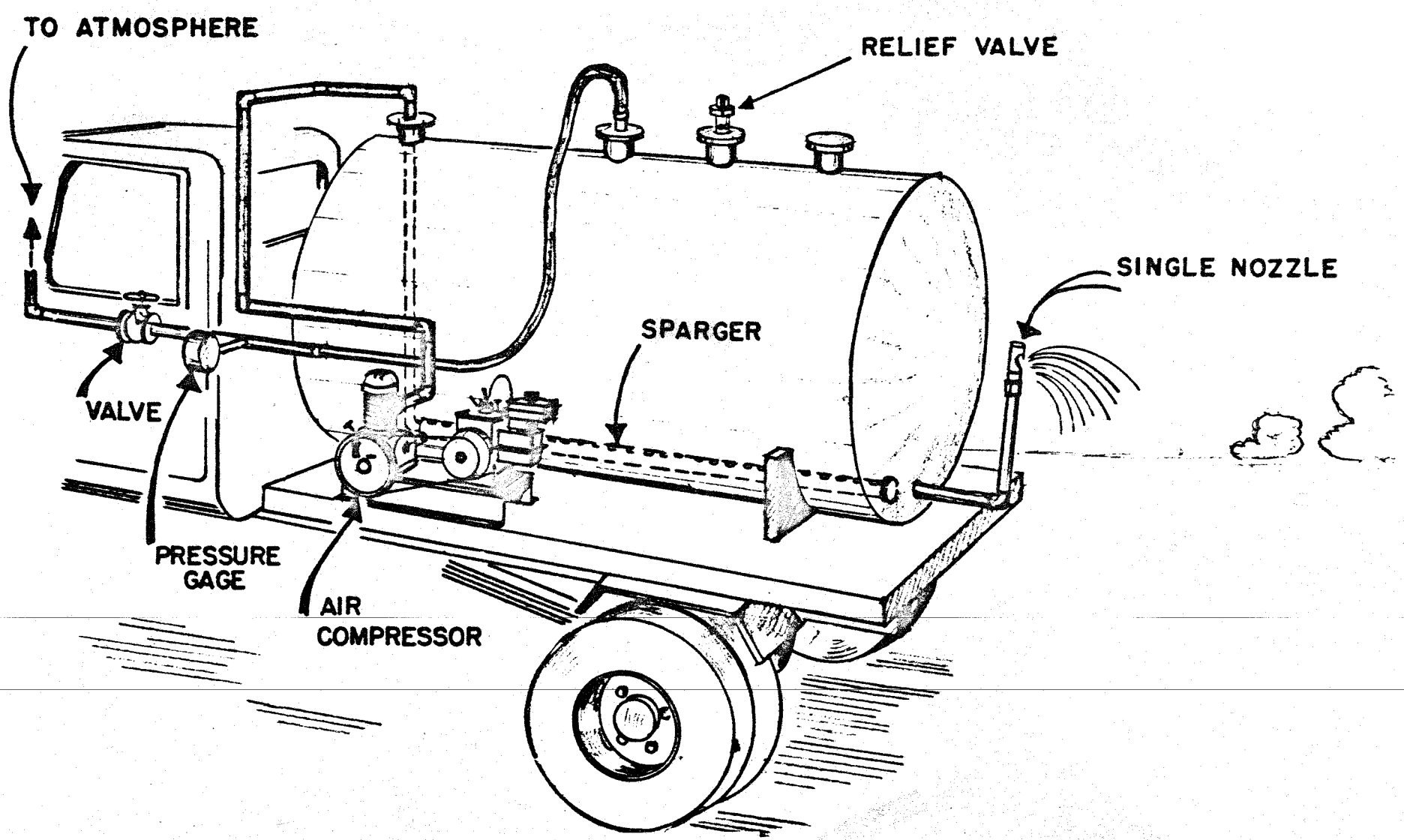


FIG. 3
BROADCAST APPLICATION TRUCK
FOR FLUID FERTILIZERS THAT UTILIZES AIR COMPRESSOR

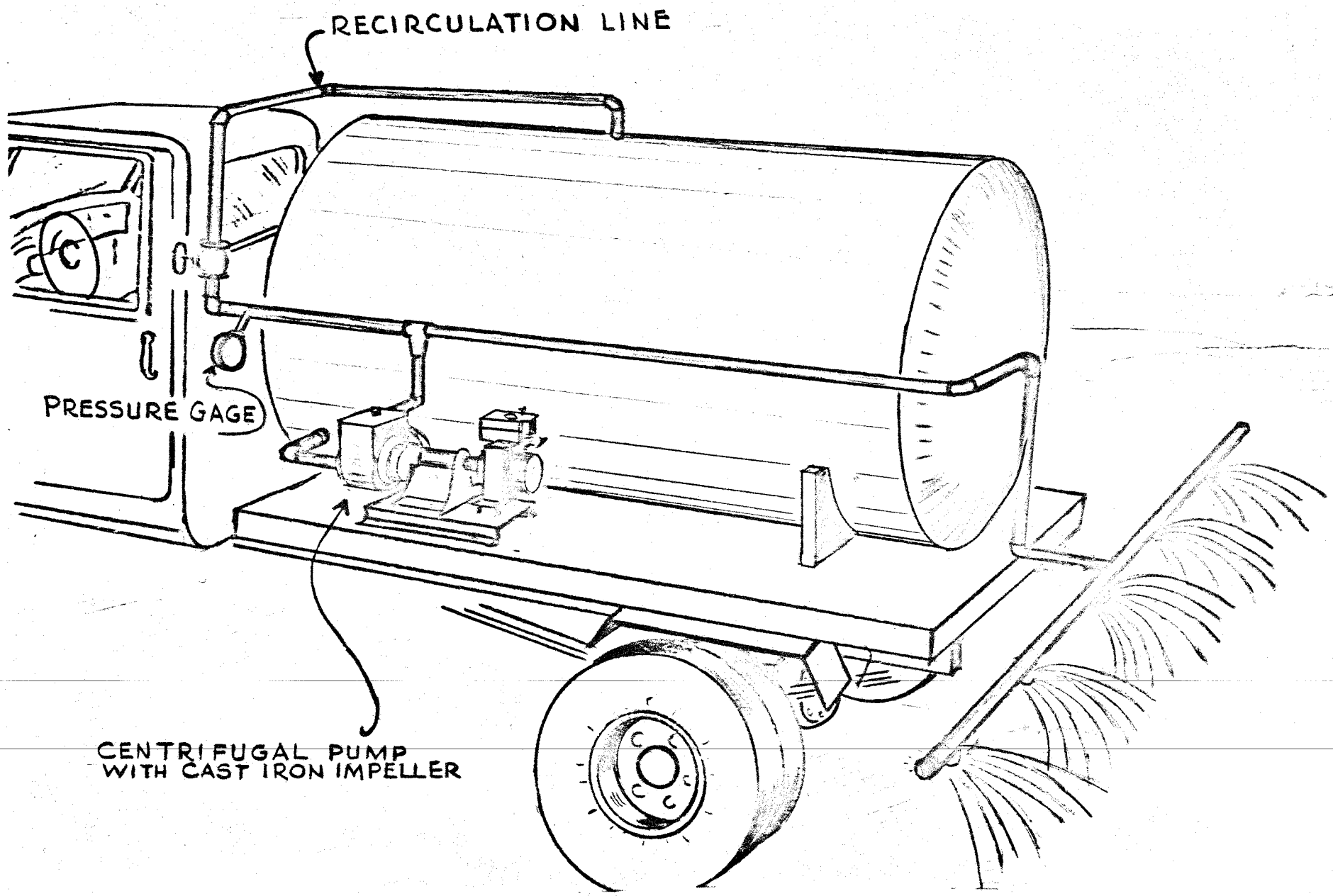


FIGURE 4
BROADCAST APPLICATION TRUCK
FOR FLUID FERTILIZERS THAT USES PUMP & NOZZLES

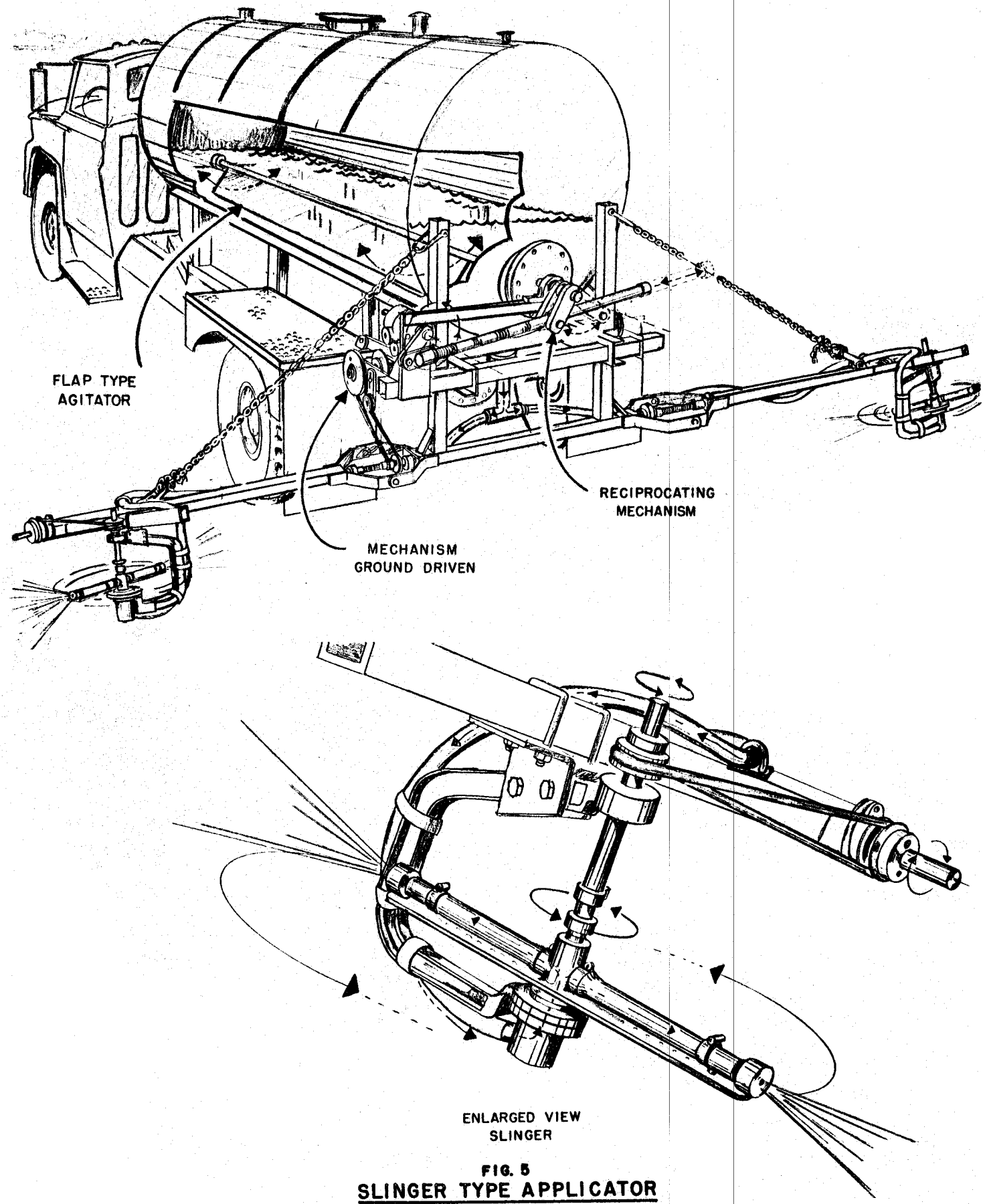


FIG. 5
SLINGER TYPE APPLICATOR

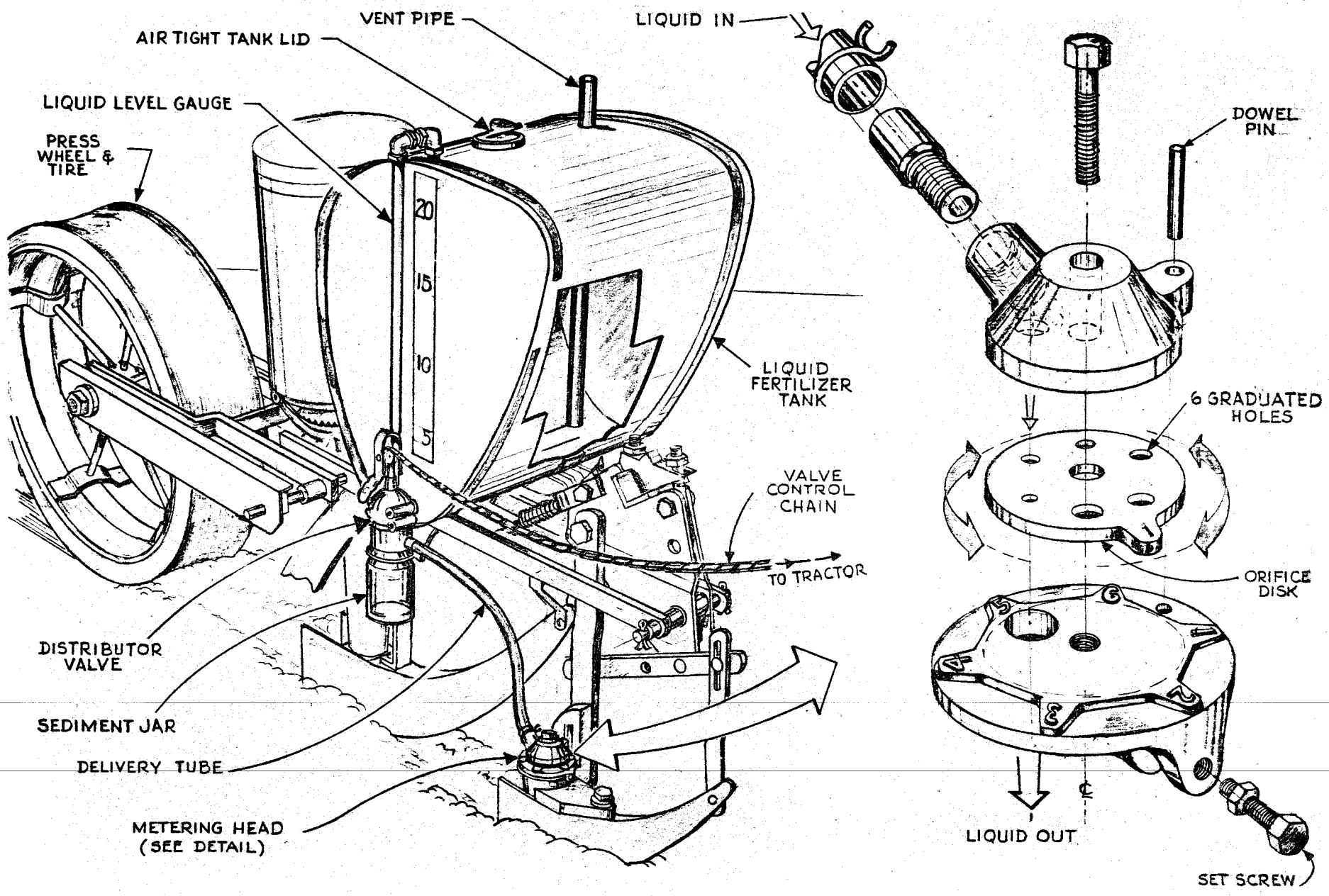
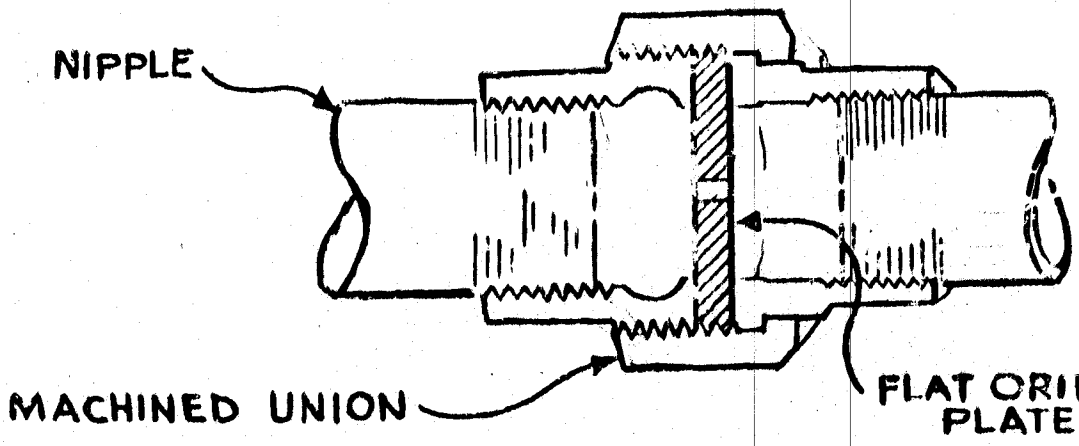


FIGURE 6

LIQUID APPLICATOR WITH CONSTANT-HEAD TANK AND ORIFICE PLATES



DETAIL A

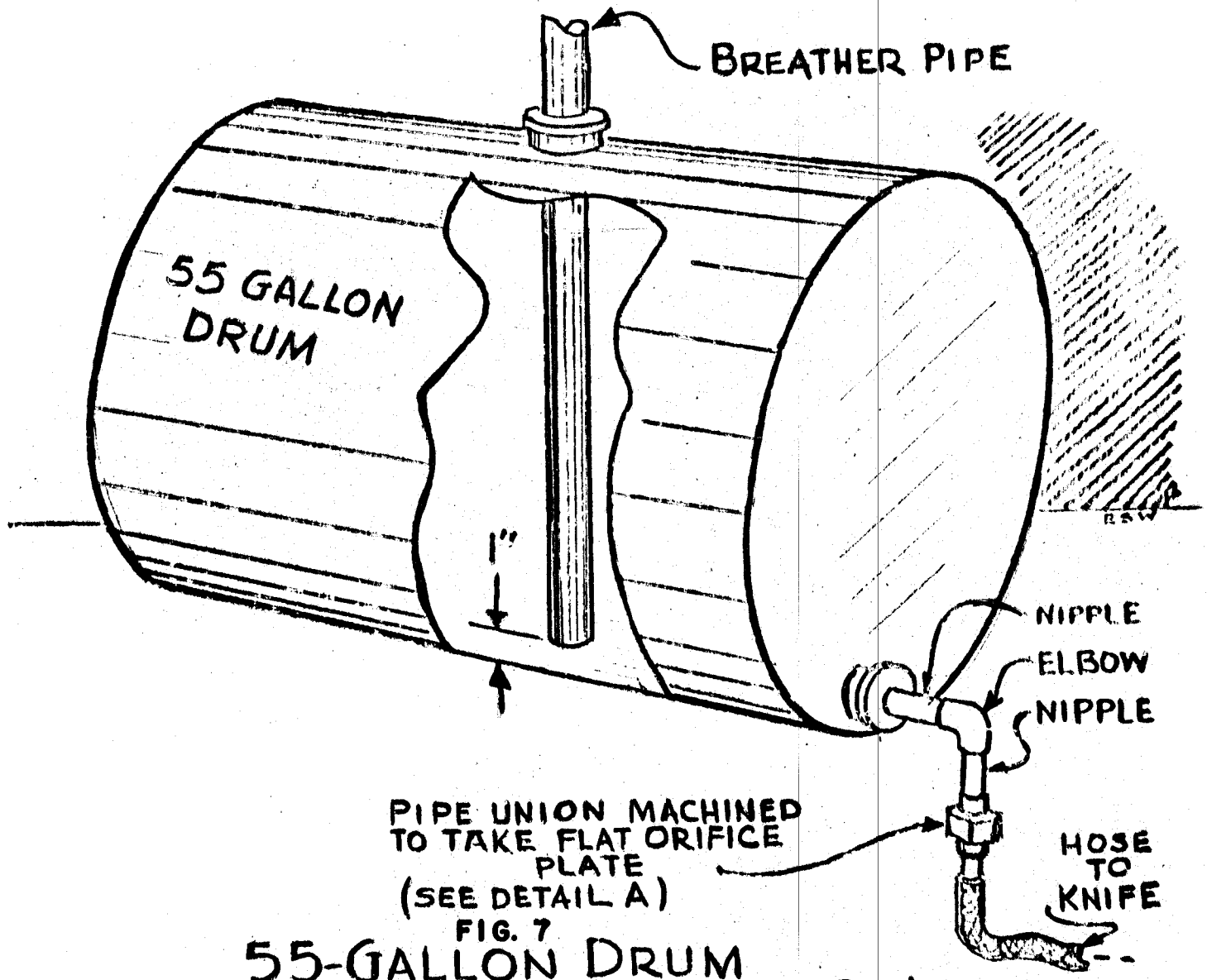


FIG. 7

55-GALLON DRUM EQUIPPED FOR ROW APPLICATION OF LIQUIDS

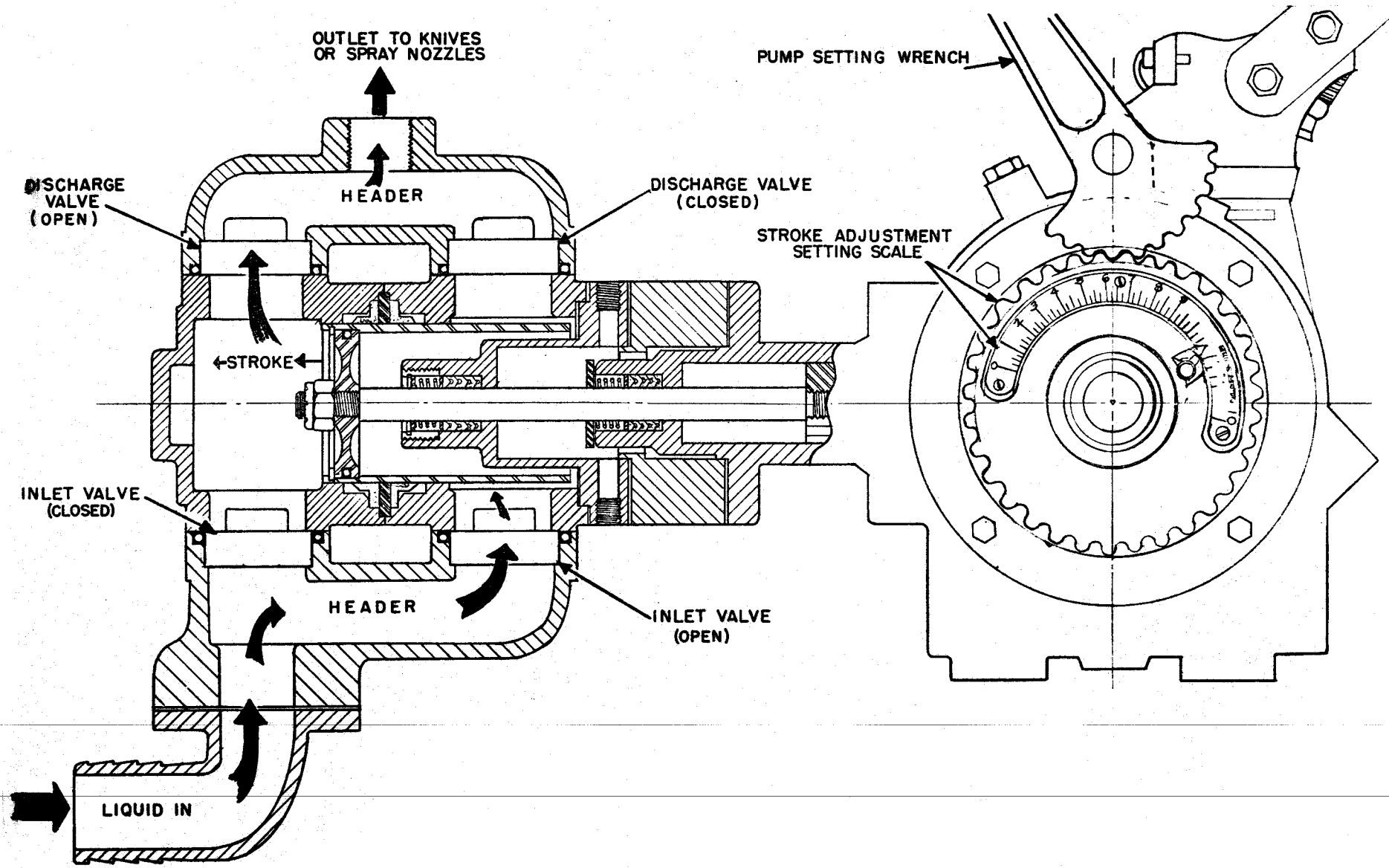


FIGURE 8

LIQUID FERTILIZER-PISTON TYPE METERING PUMP

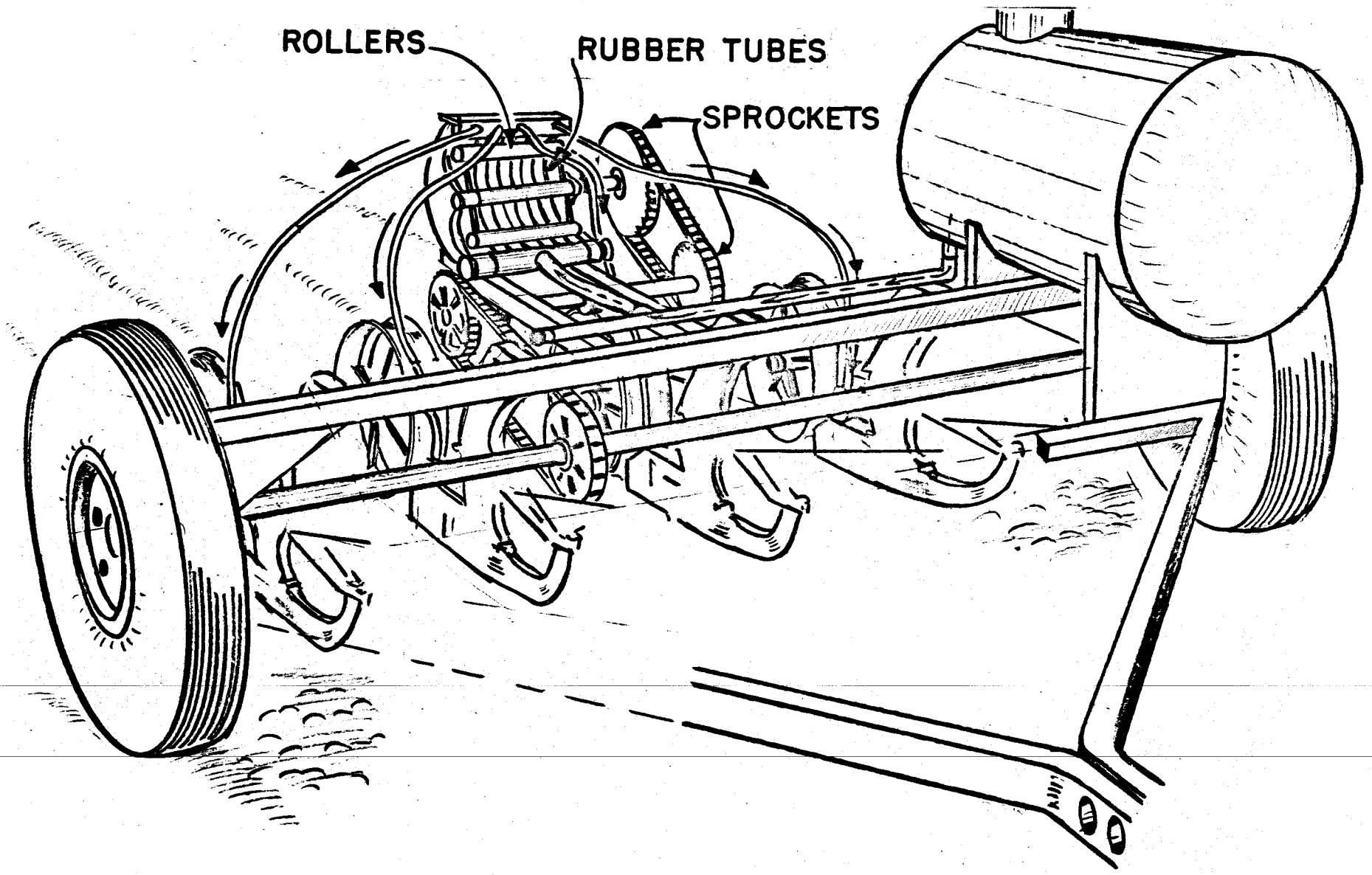


FIGURE 9

SQUEEZE PUMP FOR ROW APPLICATION

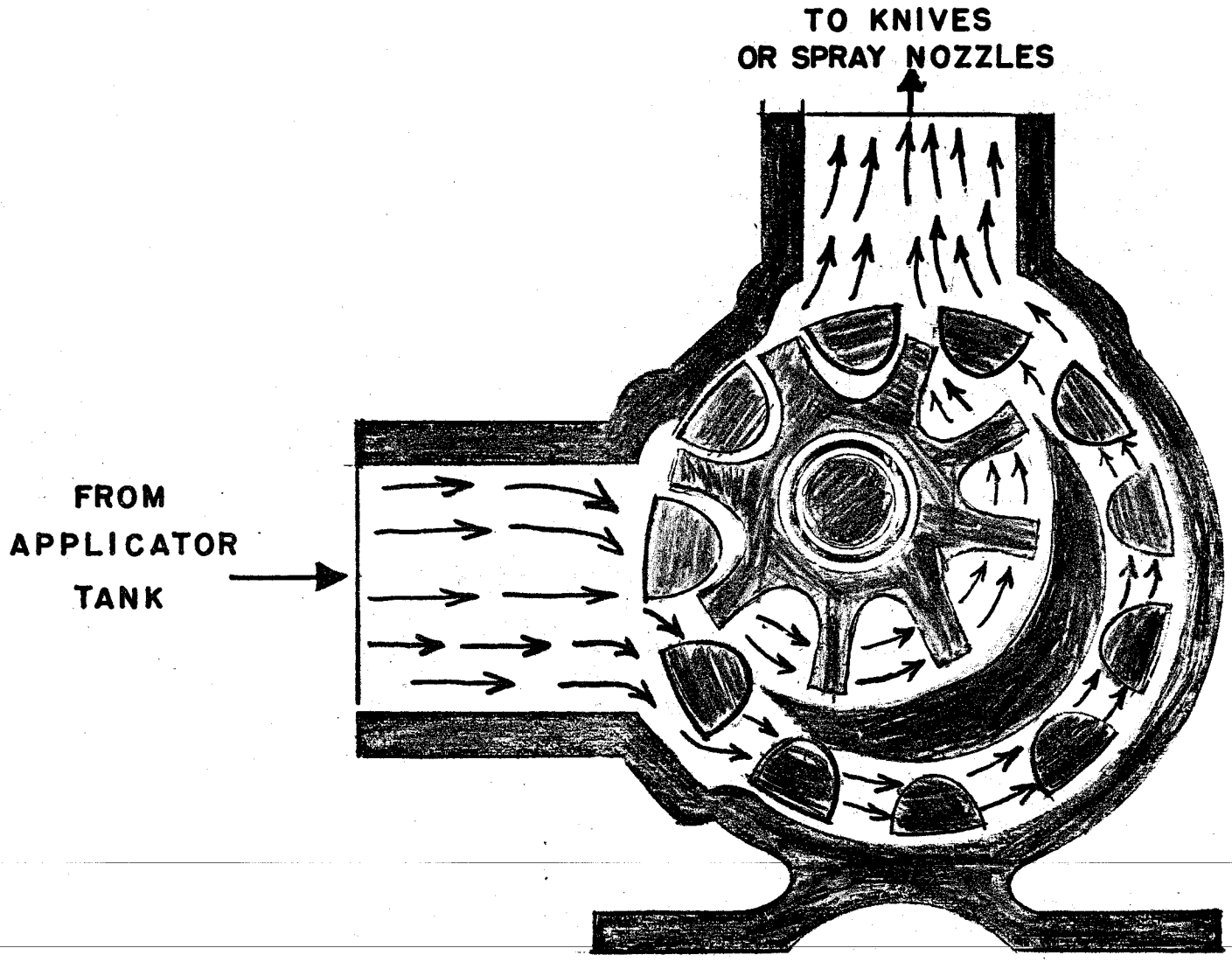


FIGURE 10

INTERNAL IDLE GEAR PUMP

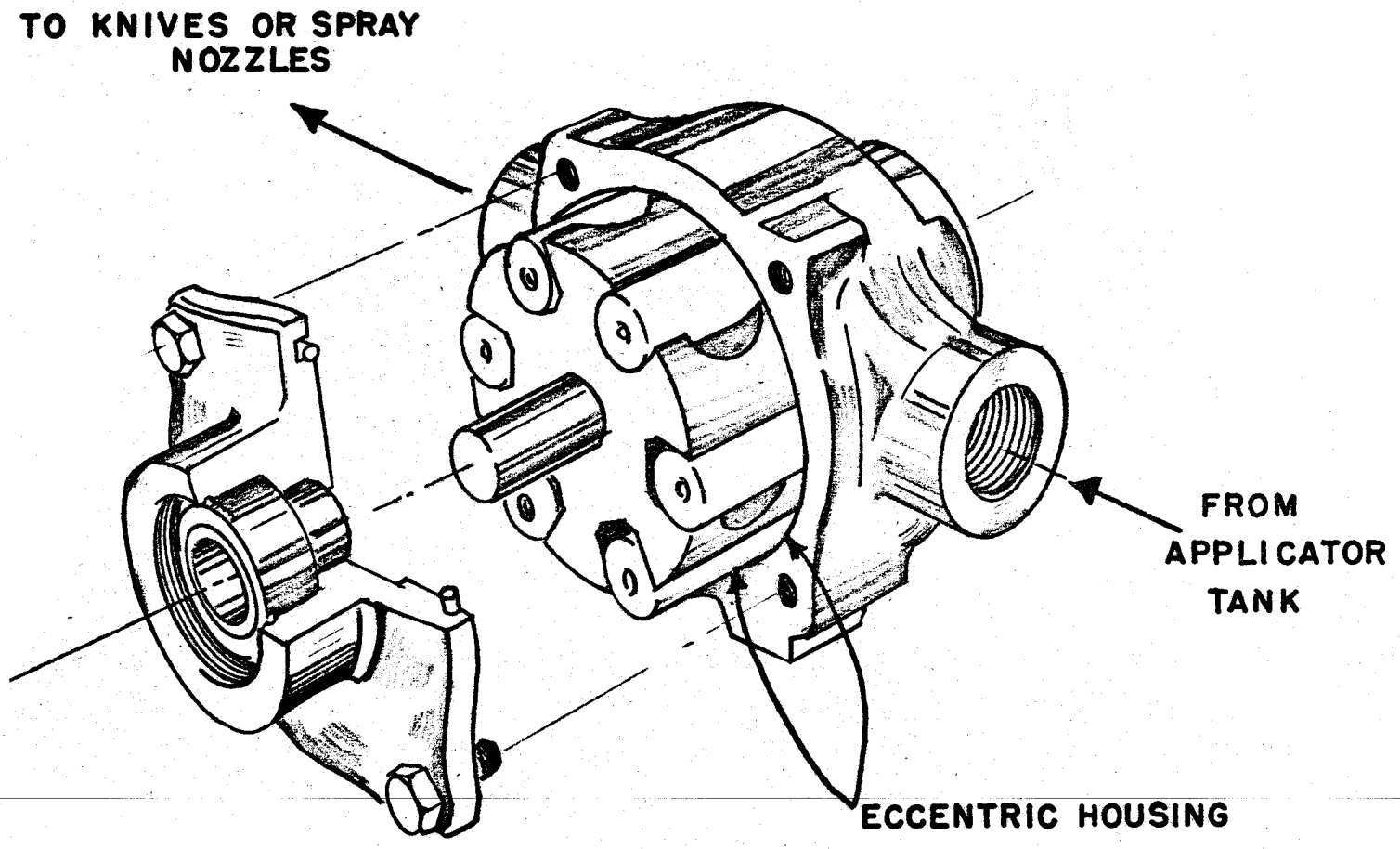


FIGURE II

ROLLER IMPELLER PUMP