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WHAT'S AHEAD FOR APPLICATION PRACTICES?

22p.

For Presentation at the
TVA Fertilizer Conference
St. Louis, Missouri
August 18-19, 1982

→ Situation-82 Oct. 82
p. 71-78

by

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WHAT'S AHEAD FOR APPLICATION PRACTICES?

Application of the 51 million tons of fertilizers sold each year in the U.S. is probably the most underrated step and yet one of the most important steps in the fertilizer production and marketing system. Statistics from TVA and other sources show the following distribution among fertilizer materials applied (1):

	% of Total Nutrients
Anhydrous ammonia	19.7
Granular or solids	63.7[a]
Fluids	16.6[b]

a. Includes homogeneous mixtures, granular bulk blends, and direct application of solid fertilizers.
b. Includes nitrogen solution fluid mixtures.

Anhydrous Ammonia

Little change is expected to occur in the methods used for application of ammonia. However, dual application of ammonia and mixtures (solid or fluids) is becoming popular because of the savings in combining two applications into one application. Also there are some indications that dual application of ammonia with 10-34-0 ammonium polyphosphate solution may have some agronomic advantages (2). There is a trend to more dual application of ammonia with granular homogeneous mixtures such as the 6-24-24 or 10-30-5-7S-2Zn grades. Farmers report that the new granular materials remain mixed and are easy to uniformly apply.

Figure 1 shows a new pneumatic-type applicator for applying granular mixtures and anhydrous ammonia. Solid material is conveyed to the application knife by air pressure. Materials are conveyed to the air stream by a conventional volumetric belt feeder. The granular mixtures do not disintegrate in the pneumatic system and most farmers are pleased with this equipment.

Figure 2 shows equipment for dually applying fluid mixtures with ammonia. The typical applicator has one tank for ammonia and another for the fluid mixture. Suspensions are the mixtures most frequently used; a typical grade is 7-21-21. Ammonia is added through a conventional tube mounted behind the knife; suspension is applied through a tube inserted in a pipe mounted on the back of the ammonia tube as shown in figure 3. At first, some suspension froze in the application tube because of the negative heat of expansion of ammonia being injected into the soil. This problem was solved by separating the two tubes and inserting the suspension tube through and out of its pipe so that it forms a tail following the knife as shown in figure 4.

Custom application of ammonia is not popular and probably will not become so because of the high cost of application equipment and the difficulty of ammonia injection and deep placement. Also incomplete sealing may allow ammonia to be lost during its placement in the soil.

Some companies convert anhydrous ammonia to liquid aqua ammonia which can be applied rapidly with reasonably priced applicators and nurse trucks. Figure 5 is a photograph of a high flotation applicator equipped to apply aqua ammonia. The company that owns this applicator uses two used gasoline tankers (20-ton capacity) to transport aqua ammonia from the converter to the applicator. Although aqua ammonia contains only about one-fourth as much nitrogen as anhydrous ammonia, transportation costs are not greatly different because of the short hauls normally involved and the fact that cost of transportation and application equipment is substantially less for aqua ammonia. A given acreage can be applied with aqua ammonia in one-third of the time required to inject anhydrous ammonia. Aqua ammonia is also less hazardous than anhydrous ammonia. Since aqua ammonia applied in this way is the second most economical source of nitrogen, this type of application should increase in the future.

Granular or Solids

About 64 percent of all plant nutrients in the U.S. is applied as solids. Probably the most popular way to apply solid fertilizers is by custom application (usually by a dealer) using a high flotation applicator as shown in figure 6. This applicator has a delivered cost of about $100,000 and is usually tended by two truck-type tenders. The tenders can be unloaded by augers or by dumping 5-ton batches as shown in figure 7. Tenders cost about $30,000 each.

Based on these investments, the estimated minimum acreage and tonnage which must be applied to financially break-even at various application charges were calculated and plotted in figure 8 (3). With an application charge of $3 per acre, the applicator must service 16,000 acres (3200 tons) to break-even. These costs do not include management and overhead. When these are considered, it is not unreasonable to consider that the applicator must handle 20,000 acres at the $3 per acre charge and 10,000 acres at the $6 per acre charge.

Two major costs are depreciation and interest charges. Since there is no indication of substantially lower interest rates in the near future, high application costs will probably prevail during the next few seasons. Companies that cannot justify these costs may want to consider the new pull-type applicator which farmers can rent. This would pass on the savings in application cost to the farmers, many of whom are short of cash and may be willing to assume more responsibility for fertilizer application. Some farmers may want to apply solids dually with other materials such as nitrogen solution or ammonia to help keep application cost down.

Other companies want to cover more acres at higher rates of speed. This demand has caused development of newer high speed applicators such as the Lor-Al pneumatic applicator shown in figure 9. This applicator uses a vertical auger to supply granular materials to an air chamber. Air is used to convey the granules to several outlets of a boom about 60 feet in length. Other new pneumatic applicators of this type give application results comparable and sometimes superior to results from conventional spinner-type applicators.

Tests by TVA and others have shown that the conventional spinner-type applicator can be adjusted to provide uniform application of solid fertilizer if there is suitable overlap between passes. However, the volumetric belt feeders used to feed the spinning disk are inaccurate. Calibration results show volumetric belt feeders vary as much as 40 percent from the preset application rate. Other data show that auger-type conveyors have better accuracies than the belt feeders. TVA and others are studying the use of these and other more accurate feeders.

Costs can be lowered in two other ways. Many dealers use floater applicators for applying limestone, seed and either solid or fluid fertilizer. This multiple use lowers overall cost of applying all materials. Also, application of granular fertilizer-pesticide mixtures is increasing (4). This saves one pass of an applicator across the field. Since good results in weed control and crop response have been reported by farmers that have used these types of mixtures (5) this practice is expected to gain in popularity.

Use of solid homogeneous NPK mixtures as a starter fertilizer is becoming more popular. Grades such as 10-30-5-2Zn, 8-25-8, 8-32-8-6S-2Zn-0.1Mn-2Mg and others are made by a TVA melt granulation process which results in a hard, well-shaped, completely homogeneous product. Practically all of the P_2O_5 in the product is monoammonium phosphate (pH 4.0) which agronomists believe is an excellent source of P_2O_5 (6). Some think it is superior to diammonium phosphate (DAP) for row application, which partially explains the increased interest of farmers for products of this type. Some of these new starter-type fertilizers contain 7 to 8 percent polyphosphate. The homogeneous mixtures are unlike granular blends because they do not tend to separate into individual particles of DAP and urea during row application. Although DAP and urea can cause some germination damage when applied with or close to the seed (7), the homogeneous mixtures have not caused these problems. Their use is expected to increase.

Fluids

Fluid mixed fertilizers and nitrogen solutions are the most rapidly growing segments of the fertilizer industry. About 17 percent of plant nutrients are applied in this form and continued growth is expected. These are the main reasons dealers are interested in fluids:

1. Ease of handling.
2. Uniformity of application.
3. Accuracy of measuring materials as they are applied.
4. Advantage of being able to add and mix pesticides in the applicator.
5. High speed overall operation.

The most popular way to apply fluids is by high flotation equipment similar to that used to apply granular fertilizers except that the applicator is equipped with a fertilizer tank and applicator. Figure 10 shows a photograph of such an applicator equipped for fluid fertilizer and one of two nurse trucks required to transport fluid to the applicator.

Since total investment cost is about the same as for the solid applicator (total $160,000), the curve shown in figure 8 also applies. Some companies find it more convenient and more economical to use smaller pull-type applicators such as the one shown in figure 11. This applicator has a relatively large single nozzle. Some dealers in the Southeast find this is excellent equipment for applying seed with suspension fertilizer to reduce application costs. Both grass and wheat seed have been successfully applied this way without adversely affecting yield. In the Southeast we expect this practice to gain in popularity.

The practice of adding fluids to irrigation systems continues to grow. Although it does save most of the cost of applying fertilizer, usually only nitrogen solutions are applied. Nitrogen applied several times during the growing season, which is possible with irrigation systems, enhances nitrogen use efficiency. Problems have occurred with application of ammonium phosphate solutions through some irrigation systems because of the reaction of phosphate with calcium and magnesium in the water which forms sludges that plug the system. Newer fertilizers are being developed that will circumvent this problem. Many producers of high value cash crops have found that using chemically pure phosphoric acid or ammonium phosphate solution in drip irrigation units is very convenient.

Other companies have saved application cost by applying fluid fertilizer during such tillage operations as disking and plowing. Some agronomists report agronomic advantages to the dual application of ammonia and ammonium phosphate solutions on wheat (8) (9). The same results have been reported for other sources of nitrogen and phosphate. Dual application of anhydrous ammonia with fluid mixtures should also help decrease application costs.

Minimum Tillage

A discussion of fertilizer application concepts would not be complete without mention of minimum tillage. Generally, in all minimum tillage systems, planting is accomplished without the use of moldboard type plows to prepare a seed bed. Some farmers disk before seeding; others use a chisel plow once or twice across the field and then disk to smooth the seed bed. In most systems seed, pesticides and fertilizer are applied at the same time.

In recent years many researchers have had successful results with 100 percent no-till operation. The farmer applies the fertilizer, pesticide, and seed at the same time and in the stubble from the previous crop. Some agronomists report better yields with no-till at high nitrogen rates than with conventional tillage (separate plowing, fertilizer and application, disking and separate planting) (10). Some report that with no-till operations there is essentially no erosion of the soil (11). Others believe it may be a way to preserve moisture in dry regions of the U.S. There also should be savings in energy required to till, apply fertilizer, apply pesticide, and plant a crop. Because of these advantages, no-till is expected to spread from the eastern seaboard and mid-south states, where it is in common widespread use, to other parts of the country. In Maryland, for example, 51 percent of the corn crop is no-till planted. Exact details of how and where to use no-till planting are lacking but will be supplied as universities continue to work on improvements of the practice.

Strip Application

In the past 30 years there have been many types of band application such as sidedressing, injection as a starter fertilizer, etc. However, in 1977 and recently Dr. Stanley Barber of Purdue University and others reported some promising results for strip application. This type of application is somewhere between broadcasting and banding of fertilizers. A strip application for a corn crop is made by applying a strip (3 inches wide) on the soil surface with 28 inches between the center lines of each strip. This spacing is used because a corn crop is usually planted with a row width of 28 inches. This strip is applied and then the surface is usually plowed or disked. Agronomic results appear to be promising both in the application of phosphate and potash. Equipment has been developed for this strip application. A typical applicator is shown in the photograph of figure 12. The applicator is equipped with a boom and fluid fertilizer is applied as solid streams through orifice type nozzles or application tubes which extend from the boom. There are other types of applicators for the strip application of both solid and fluid fertilizers.

The "jury is still out" concerning specific advantages for strip application; however, the initial agronomic results indicate that in all instances the yields are the same or better than when the fertilizer is broadcasted or banded. Therefore, it is expected that many farmers will specify this type of application to insure the highest possible yield.

Summary

Fertilizer application is now a far more precise operation than in the past. Yet, much work remains to be done in lowering the cost of application, improving delivery systems to the farm, developing more efficient application systems, improving uniformity of application, improving metering equipment on applicators, and developing new low cost fertilizers that work well in new efficient application systems.

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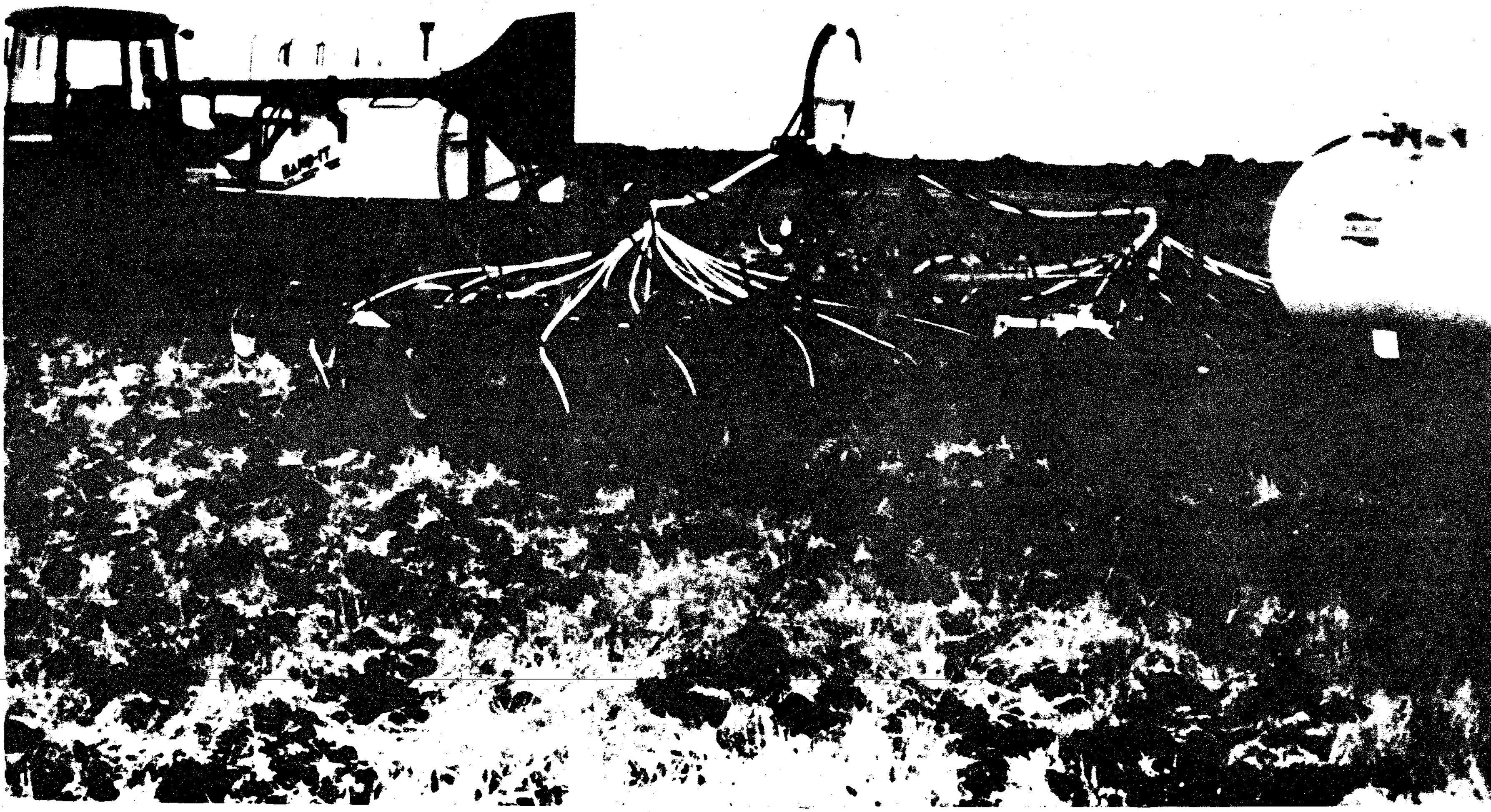

FIGURE I
PNEUMATIC TYPE APPLICATOR FOR GRANULAR MIXTURES AND ANHYDROUS AMMONIA

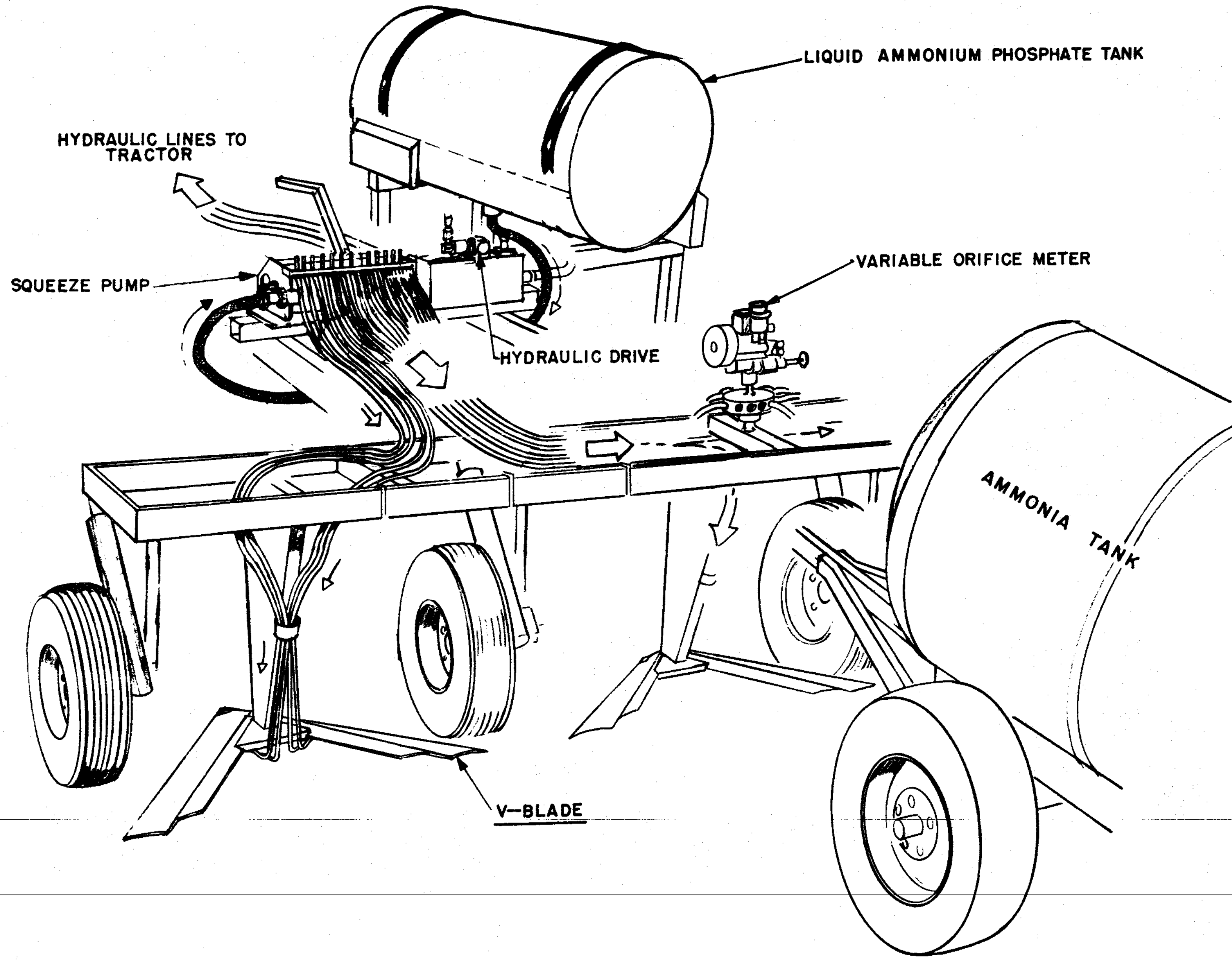

FIGURE 2
DUAL APPLICATOR FOR AMMONIA AND LIQUID PHOSPHATE ON V-BLADE TILLAGE IMPLEMENT

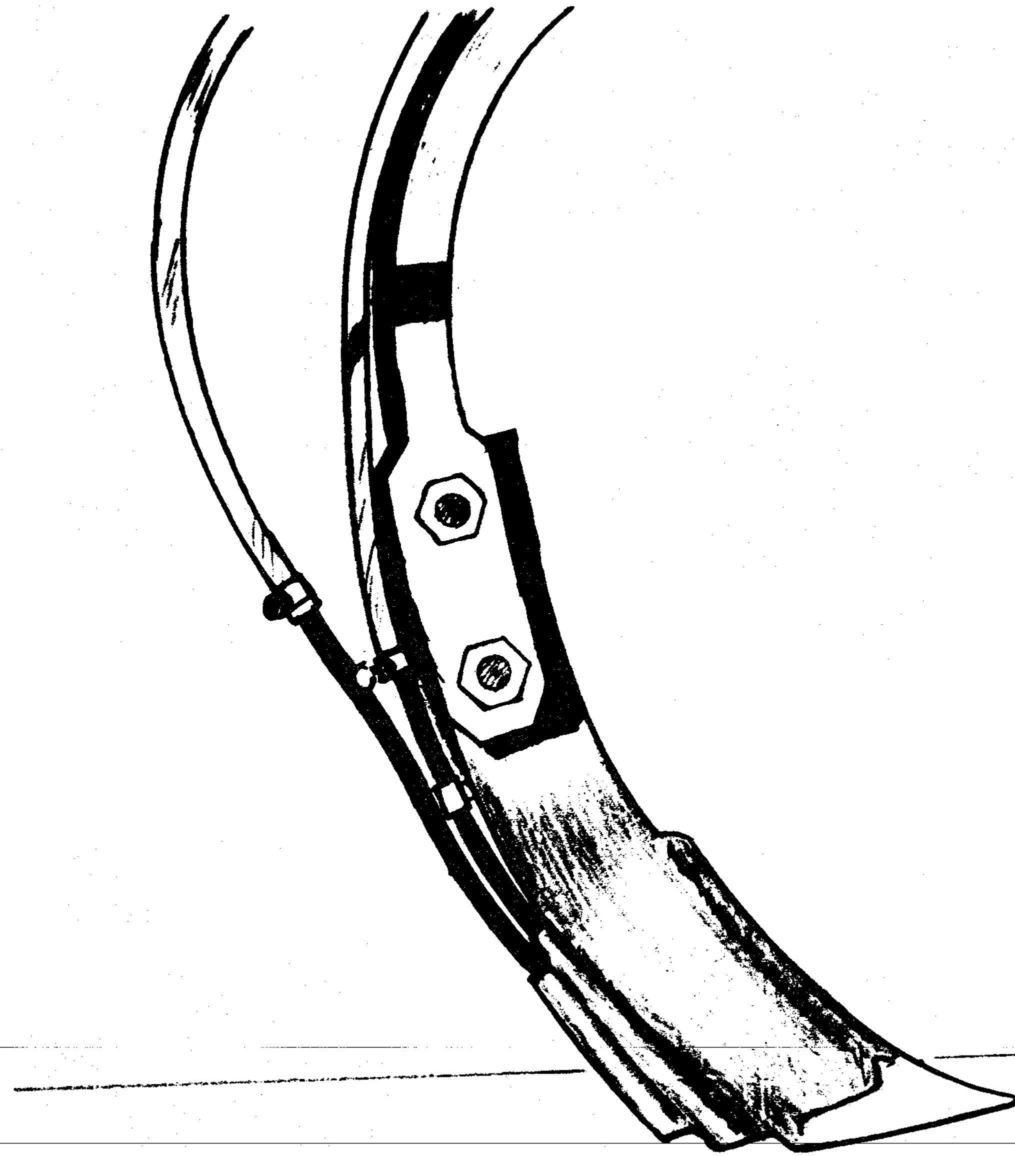

FIGURE 3
CONVENTIONAL DUAL APPLICATION KNIFE

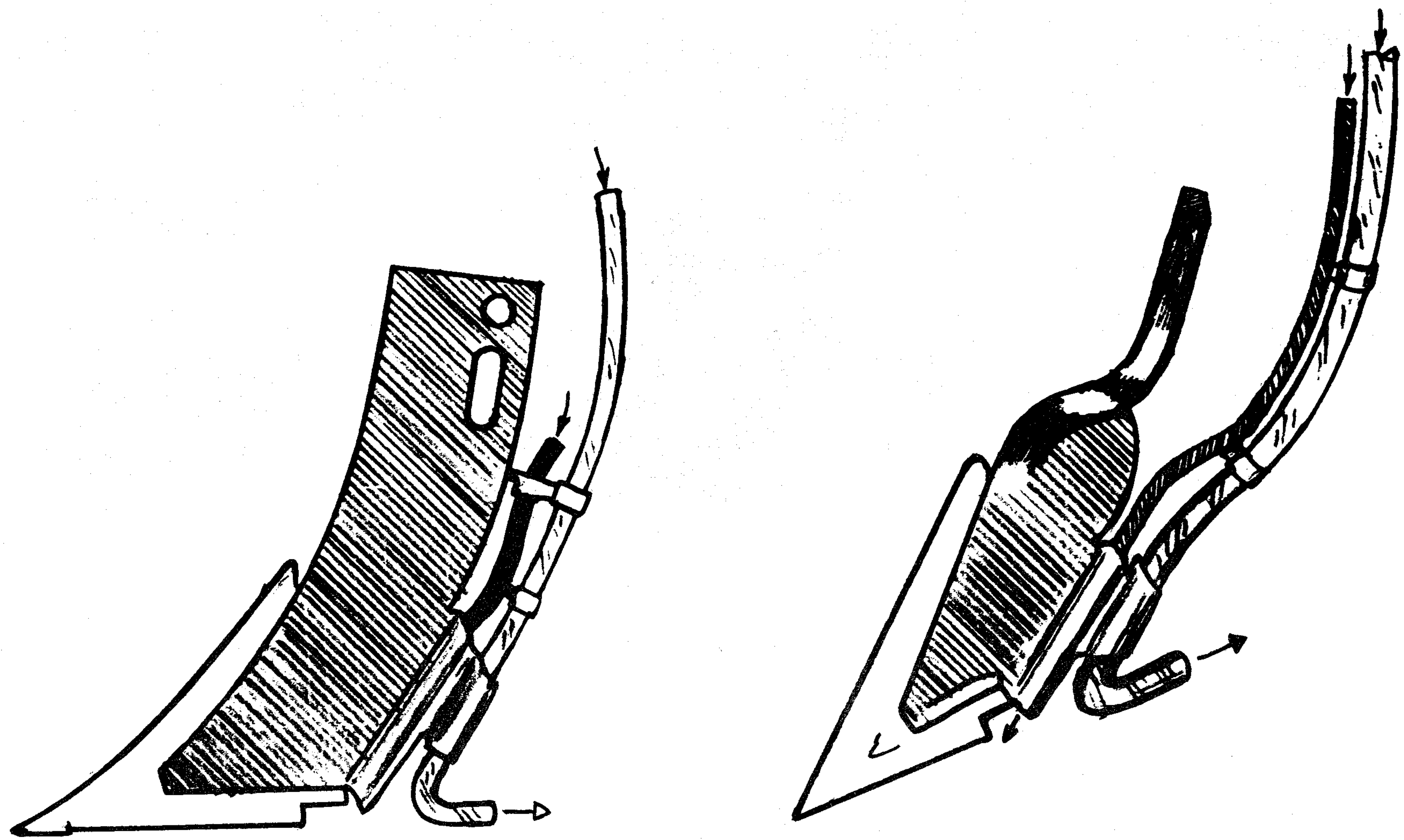

FIGURE 4

AMMONIA KNIVES EQUIPPED FOR DUAL APPLICATION

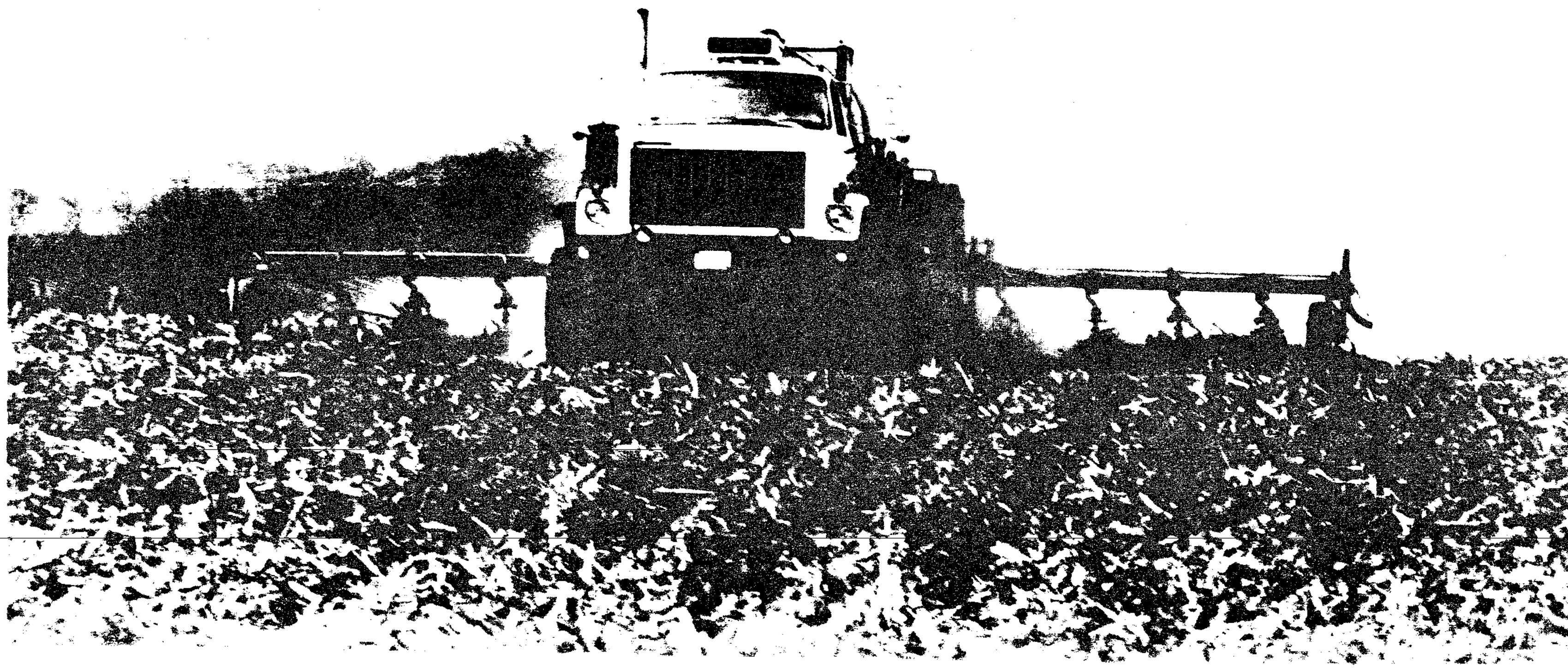

FIGURE 5

HIGH SPEED HIGH CAPACITY AQUA AMMONIA APPLICATOR

FIGURE 6

HIGH FLOTATION APPLICATOR FOR APPLICATION OF SOLID FERTILIZERS

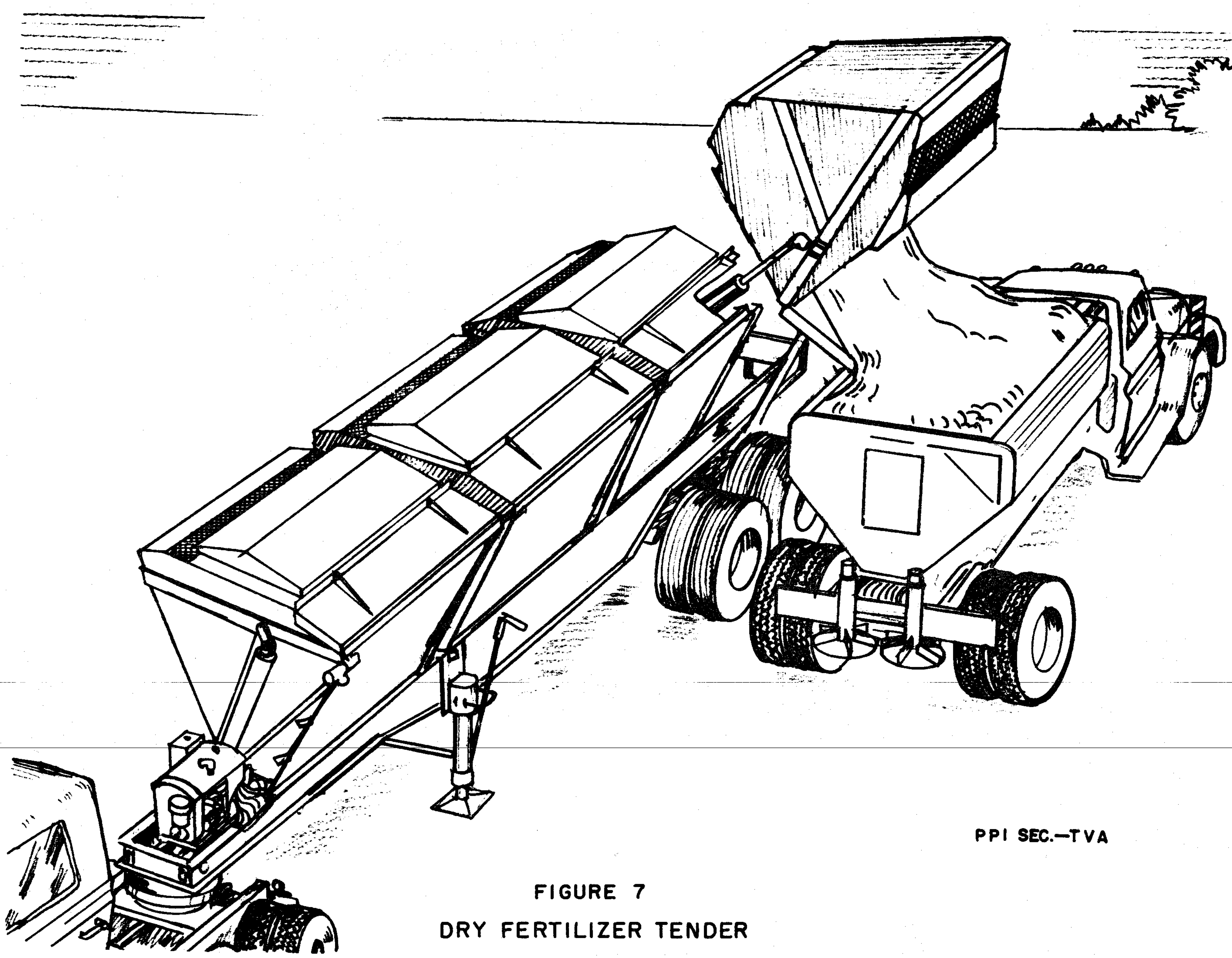

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FIGURE 7

DRY FERTILIZER TENDER

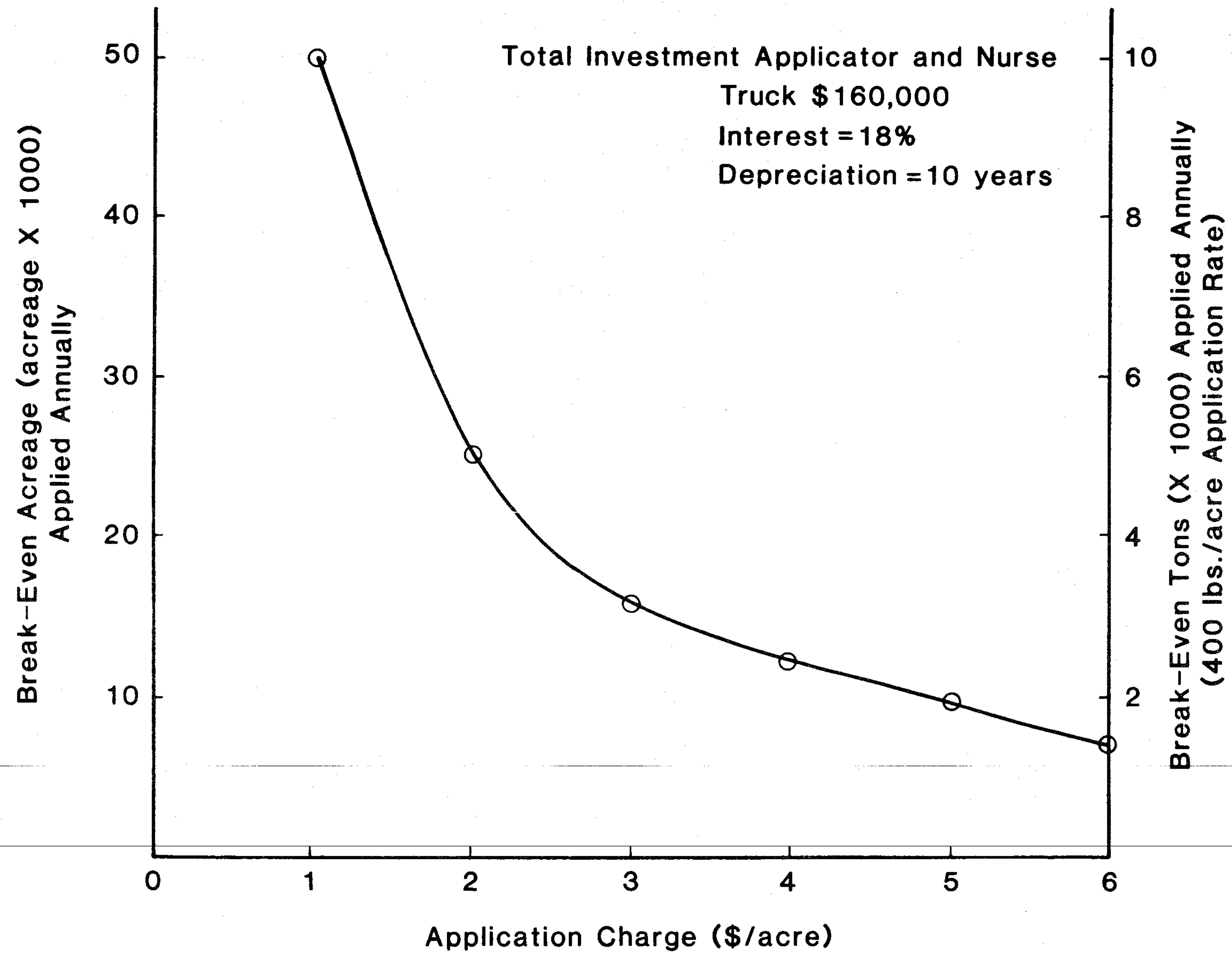

FIGURE 8. BREAK-EVEN APPLICATOR USE
VS.
APPLICATION CHARGE ($ ACRE)

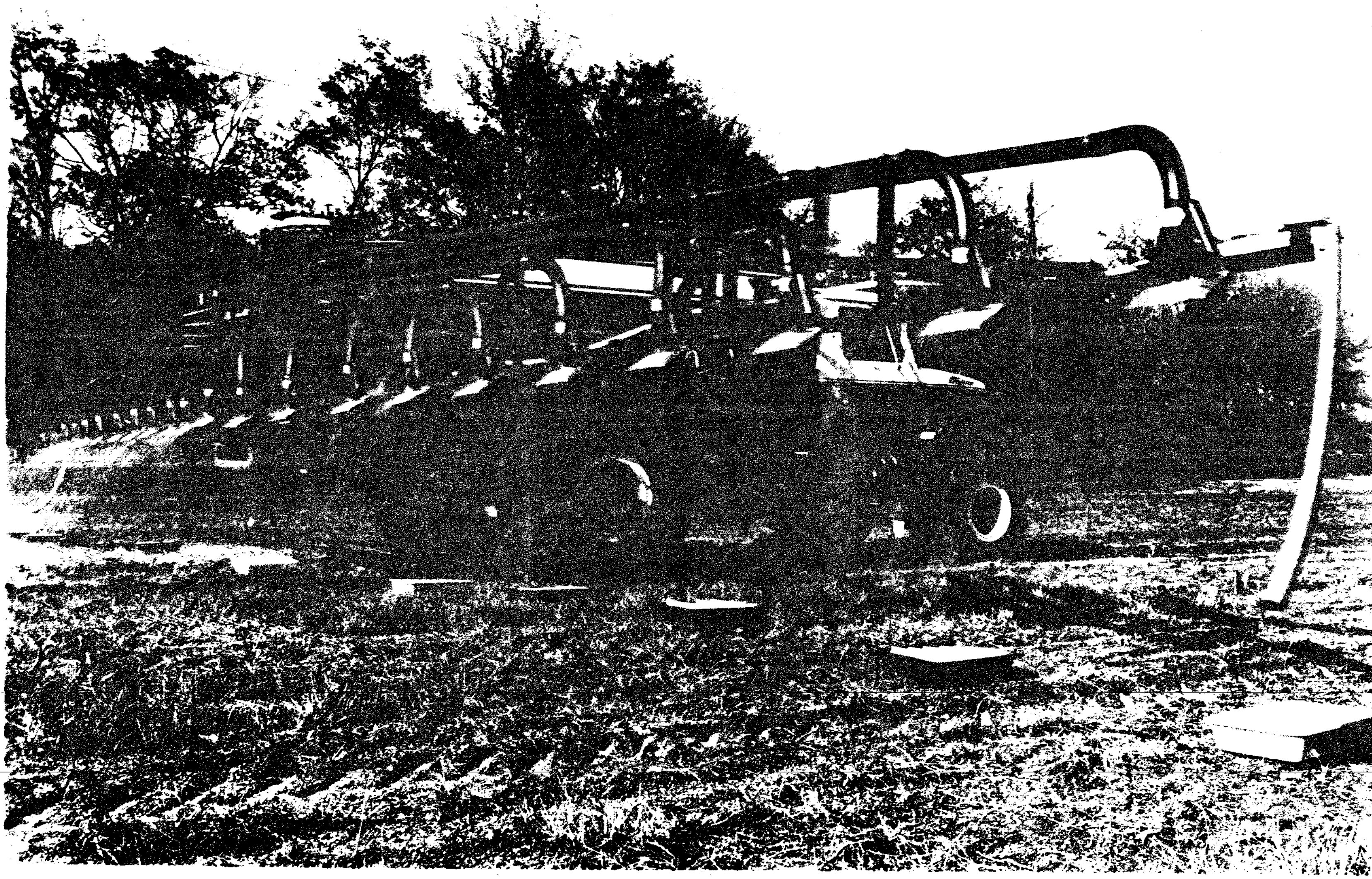

FIGURE 9

LOR-AL PNEUMATIC APPLICATOR

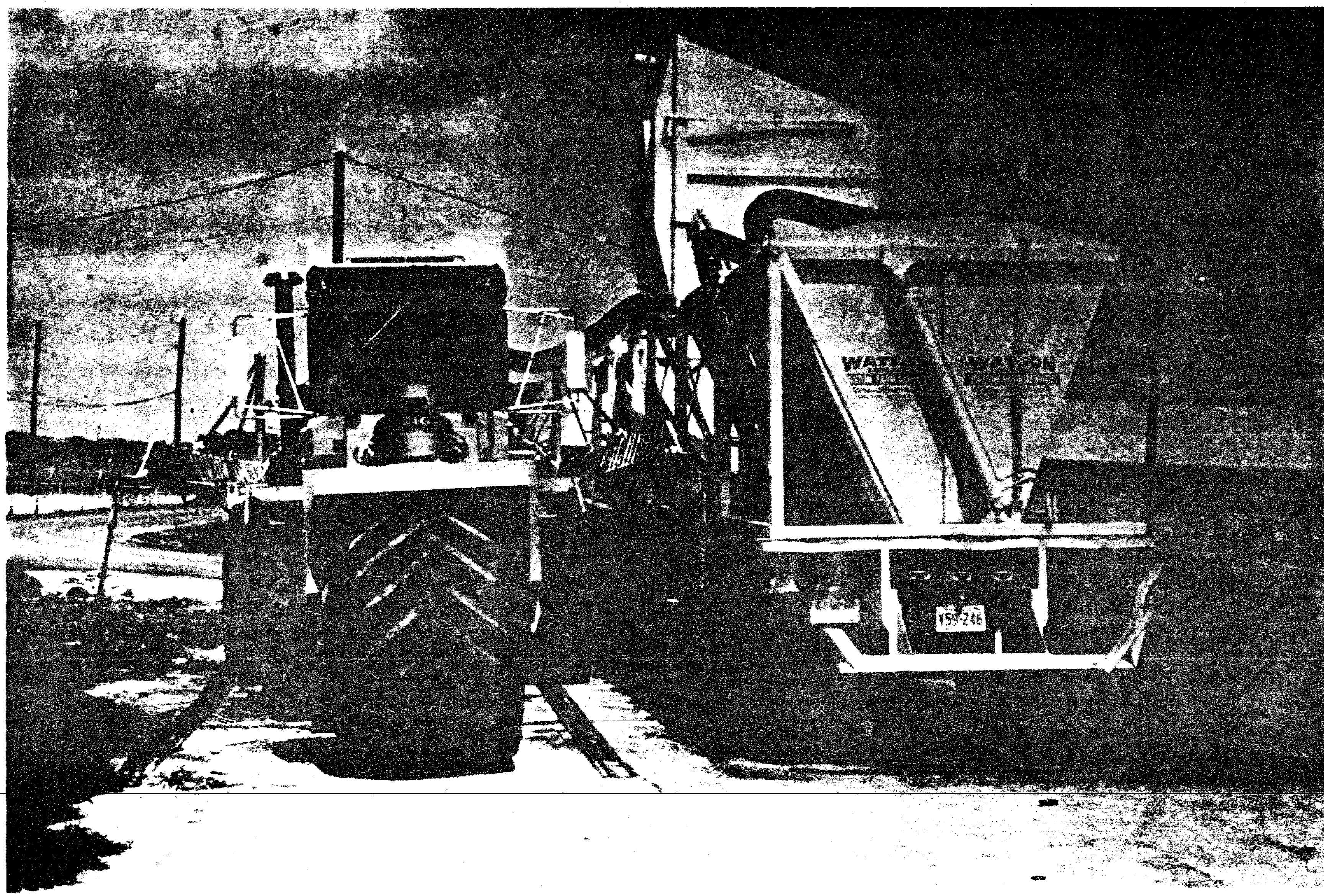

FIGURE 10

FLOATER EQUIPPED FOR FLUID FERTILIZER

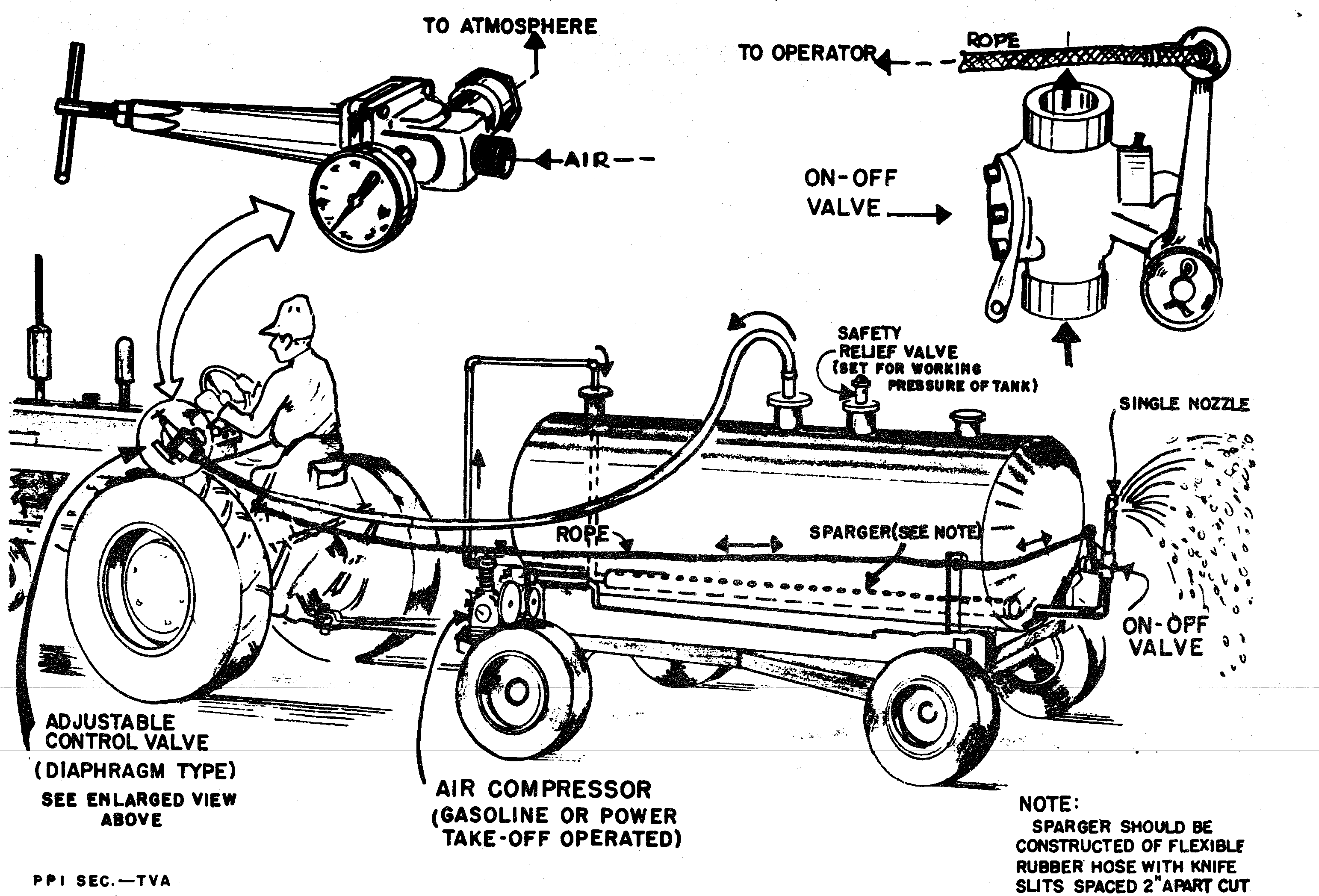

FIGURE 11

AIR PRESSURE PULL APPLICATOR

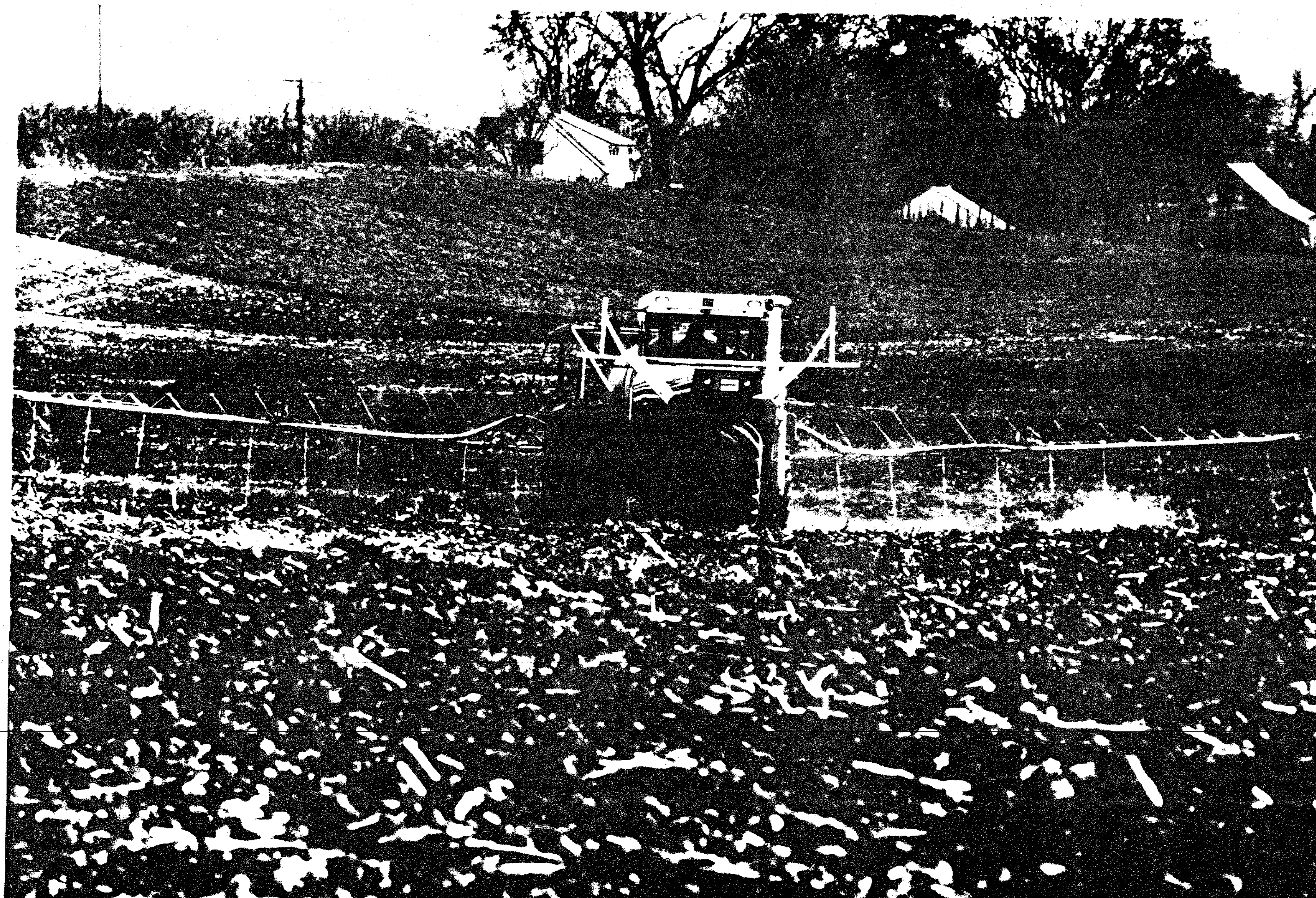

FIGURE 12

STRIP APPLICATOR