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THE ROLE OF THE ENGINEER IN PROVIDING TECHNICAL INFORMATION

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Presented at the Second International Training Course

May 19, 1966

Within the past few years the fertilizer industry in the United States has improved, causing a need for more technical assistance in introducing the newly developed products and processes. About 20 years ago little or no engineering assistance was required in the marketing of various forms of fertilizer. The marketing path then was mostly the production of byproduct materials such as solid ammonium sulfate from coke-oven gas, bone meal for phosphate, fish meal for nitrogen, P_2O_5 , and K_2O , with very little consideration for economics. Low-analysis materials were mined or manufactured with minor changes and sold. For example, mined sodium nitrate was one of the major sources of nitrogen used in this country, and normal superphosphate was one of the major sources of P_2O_5 produced from sulfuric acid and phosphate rock.

Approximately 15 years ago the fertilizer industry in this country began to change from an entirely byproduct industry to a partial chemical industry and began the production of intermediates--nitrogen solution, normal superphosphate, concentrated superphosphate, triple superphosphate, calcium metaphosphate, superphosphoric acid, sulfuric acid, and anhydrous ammonia. The use of intermediates made it necessary to supply technical information to the consumers. Many of these materials were used in the production of granular products. It was necessary for the field engineering personnel to provide information concerning the design of an ammoniator-granulator and associated equipment, to recommend formulations containing these intermediates, to recommend procedures for the drying and cooling of the granular products, and to make recommendations for the storage and handling of the finished products.

Engineers assisted in the development of newer products. They conducted demonstrations of the production of run-of-pile triple superphosphate in simplified equipment, such as the cone mixer, and the production of granular triple superphosphate. They assisted with the use of intermediates in the pulverized-mix plants and furnished plant operators information to improve their operation so that these producers could compete with companies having more up-to-date facilities. These technical services were instrumental in the development of granulation in the United States. Because of these services

granulation became an important factor in the production and the marketing of fertilizers.

Cost studies by technical personnel indicated that the use of fertilizers of higher analyses in the United States would lower the cost of transportation and application and would help lower the cost of plant nutrients to the farmer. The field engineering personnel was instrumental in developing formulations for these high-analysis grades.

During the last decade the demand for numerous grades of fertilizer has increased because of the wider use of soil testing. Because of the numerous grades produced a granulation plant of medium size became impractical. A small dry-mix plant was developed that could economically mix small quantities of numerous grades. This process is commonly referred to in the United States as bulk blending.

Bulk blending is the dry mixing of several solid materials to various nitrogen, P_2O_5 , and K_2O ratios. Engineering field service personnel was instrumental in developing various types of mixing equipment for the bulk blending plant. Several types of mixers have been used. The rotary batch mixer is the most widely accepted. Another is the gravity-flow mixer which consists of several mixing cones. The gravity flow of the materials is utilized to effect the mixing of the raw materials.

Figure 1 is a sketch of another type of gravity-flow mixer which was developed by engineering service personnel. This is the gravity-flow mixing tower. TVA constructed a small model of this tower, and several manufacturers of bulk blends have used it as a guide in constructing a large-scale tower. The producers consider the tower to be satisfactory, and they are constructing additional blending towers. Analyses of the mixtures from the large-scale tower indicate that when granular raw materials are used the tower has a mixing efficiency comparable to that of a rotary mixer. Engineering field personnel has conducted numerous demonstrations with this tower, supplied detailed construction blue-prints, and assisted in its operation.

TVA field personnel, in cooperation with the engineering staff of a university, is now conducting segregation studies to determine the degree of segregation that occurs in various types of bulk blending plants and where it occurs. Previous tests have shown that segregation during blending causes spotty growth in the field. Although these studies indicate that spotty growth does not affect yield, there has been a great deal of complaint by the farmer concerning such growth, and some of us doubt that segregation under some conditions will not cause a reduction in yield. To help minimize segregation of the dry materials, blenders several years ago started using multinutrient materials such as diammonium phosphate 30-10-0 and 25-25-0. At that time some of our field engineering personnel who had been working with the various granulation plants devised a method of producing diammonium phosphate with the TVA ammoniator-granulator and a preneutralizer. The diammonium phosphate was needed for blending, and it could be produced by this economical process.

Engineering economic studies indicate that the use of multinutrients in blending is more economical than the use of intermediates in granulation plants. As the agricultural business continued to become more sophisticated, the need for

micronutrients became apparent in certain areas of this country. Research engineers developed methods of sticking micronutrients to the individual particles of bulk blends with oil, water, or a fertilizer solution as a binding agent. For the past year engineering field personnel has conducted several demonstrations of these procedures in commercial bulk blending plants.

The need for the uniform application of micronutrients has become apparent in the last few years. Agronomists indicate that in many instances the micronutrients should be added uniformly in the row near the time of planting. It is easy to apply micronutrients uniformly in the row by incorporating them into liquid fertilizers. Therefore, because of the ease and uniformity of applying, liquid fertilizers for row application have gained in popularity.

Field engineers have assisted in developing new marketing systems for liquid fertilizers. Several years ago all liquid fertilizer was produced by neutralizing phosphoric acid with anhydrous ammonia and adding a supplemental form of nitrogen such as urea-ammonium nitrate. In the past 5 years engineering service personnel has developed the liquid cold-mix plant in which liquid mixtures are produced by the cold mixing of a base solution such as 11-37-0 with potash and a straight nitrogen solution such as ammonium nitrate solution. Field engineers have conducted plant demonstrations of the use of these base solutions in liquid cold-mix plants. They have supplied information for the design of the plants. Recently commercial companies have started the production of superphosphoric acid, and TVA has shipped this material to various fertilizer manufacturers. Field engineering personnel has designed and assisted in the initial operation of plants for the continuous production of 10-34-0 and 11-37-0 base solutions.

Solubility relationships will permit only limited amounts of micronutrients to be dissolved in liquid fertilizers without radically changing the characteristics of the liquids. Agronomic data indicated that larger quantities of micronutrients were needed than could be dissolved; therefore, liquid suspension fertilizers were developed. When a suspension is used, a sufficient amount of a micronutrient can be added to the base suspension, and the micronutrient can be uniformly applied to the soil. By producing liquid suspensions it is possible to produce also high-analysis liquid grades. The plant-nutrient contents of these liquids are comparable to the plant-nutrient contents of solid fertilizers. Field engineers have conducted demonstrations of the production and application of suspension fertilizers, and they have helped to design mixing and application equipment for suspension mixtures.

Figure 2 is a sketch of a typical liquid cold-mix plant. In this plant raw materials such as 12-40-0, urea-ammonium nitrate, and potash are mixed to produce high-analysis grades such as 7-21-21, 15-15-15, and 10-20-20. Engineering service personnel has designed and assisted in the construction of this type of plant.

Figure 3 is a sketch of a typical truck for broadcasting liquid fertilizers. Engineering field service personnel has assisted in the design of this type of application equipment. We have had numerous other new products, such as anhydrous ammonia with sulfur. Engineering field service personnel has had

considerable difficulty in developing equipment for the application of this solution; however, we think that we have developed the proper type of equipment for the application of this liquid.

Engineering technical service became necessary for the use of every new development. For this reason most companies in the United States have a technical service group that provides technical services to the consumers of their fertilizer products. Each technical service group consists of engineers, agronomists, and economists. In TVA we have a process and product improvement group that corresponds to the engineering technical service group of commercial companies.

For TVA program purposes the continental United States is divided into four sections, Northeast, Northwest, Southeast, and Southwest. An engineer works primarily in one of these sections. We have other engineers who work here at Muscle Shoals in developing application equipment and making engineering and economic studies. These engineers work with field representatives in each state in this country. These field representatives are usually agronomists or economists, and each is a local contact man for the states in which he works. The engineers and the field representatives work with personnel in the industry, and by providing a new product they help the industry to develop a new process by which it can be produced. These field research programs include not only manufacturing programs but also demonstrations. After a product has been manufactured, field demonstrations are made to show the use of the product on various field crops. These agronomic demonstrations are conducted under the auspices of the local state colleges. TVA field representatives supply technical assistance with the demonstrations.

When a new product is developed in our research and development laboratories, the engineers of the Process and Product Improvement Section obtain quantities of the material and make limited application studies here at Muscle Shoals or, in some instances, on a limited basis with the industry close to our plant. For example, most of our initial work with liquid suspensions was conducted with small fertilizer companies within a 200-mile radius of our plant at Muscle Shoals. Our research division works out the procedures for the use of new products. After we have developed application equipment and procedures for using the products, the products are introduced to other states in this country.

Recently we have received from companies in foreign countries many inquiries concerning our commercial plant work, and in many instances we have supplied technical information to foreign visitors concerning the manufacture, transportation, and application of various types of fertilizers. It is anticipated that in the future we will probably be expected to do some foreign technical service work similar to that which we have accomplished in this country or process and supply technical assistance.

I realize that many types of marketing systems that I have discussed would have little or no use in your countries; however, I am sure that if the engineering service personnel is familiar with your problem they can assist in devising means whereby the difficulty of obtaining, producing, transporting, distribution, and applying fertilizers can be surmounted.

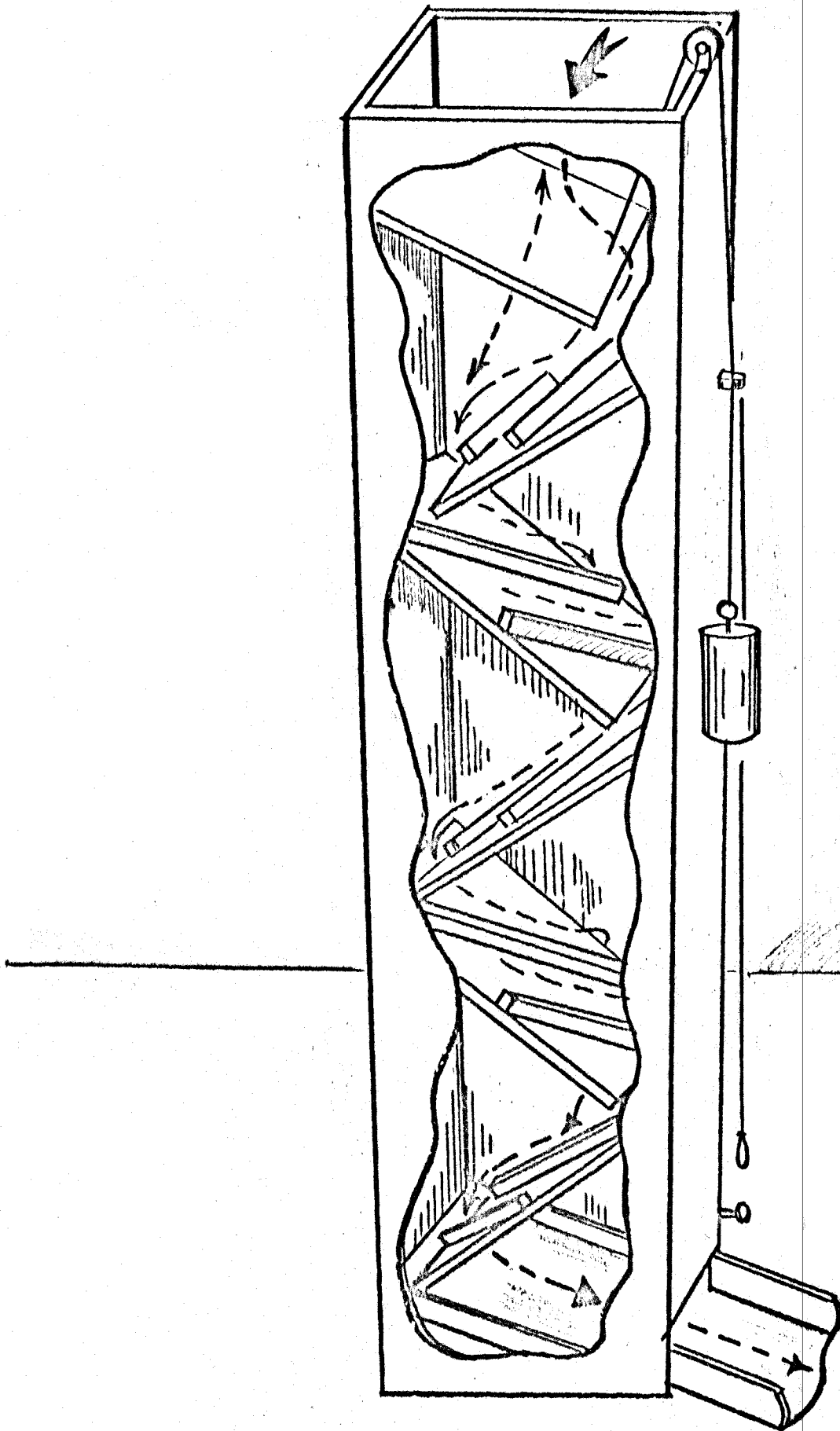


FIG. I
GRAVITY MIXING TOWER

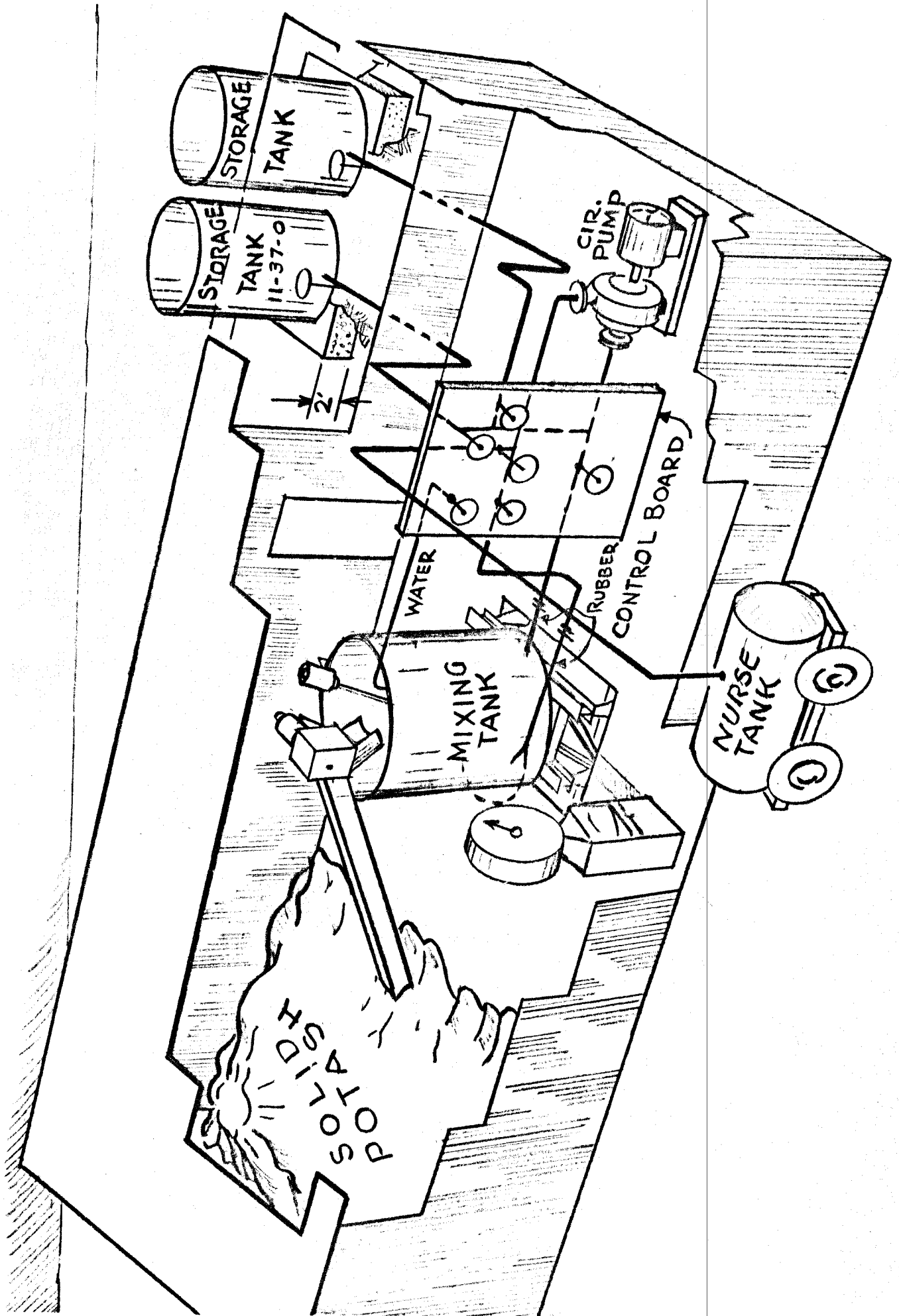


FIG. 2
LIQUID COLD BLENDING PLANT

RECIRCULATION LINE

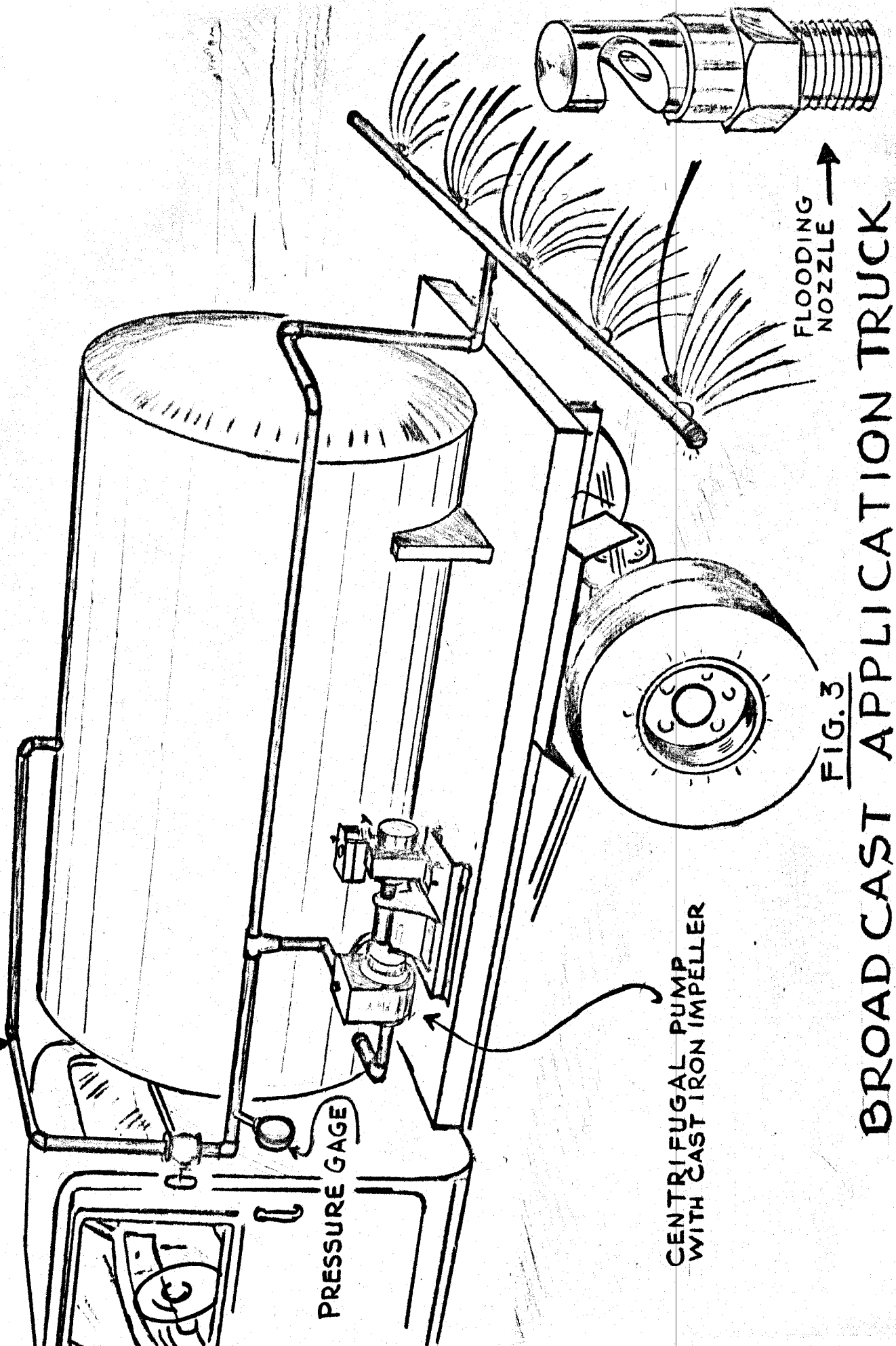
PRESSURE GAGE

CENTRIFUGAL PUMP
WITH CAST IRON IMPELLER

FLOODING
NOZZLE →

FIG. 3

**BROADCAST APPLICATION TRUCK
FOR SUSPENSIONS**



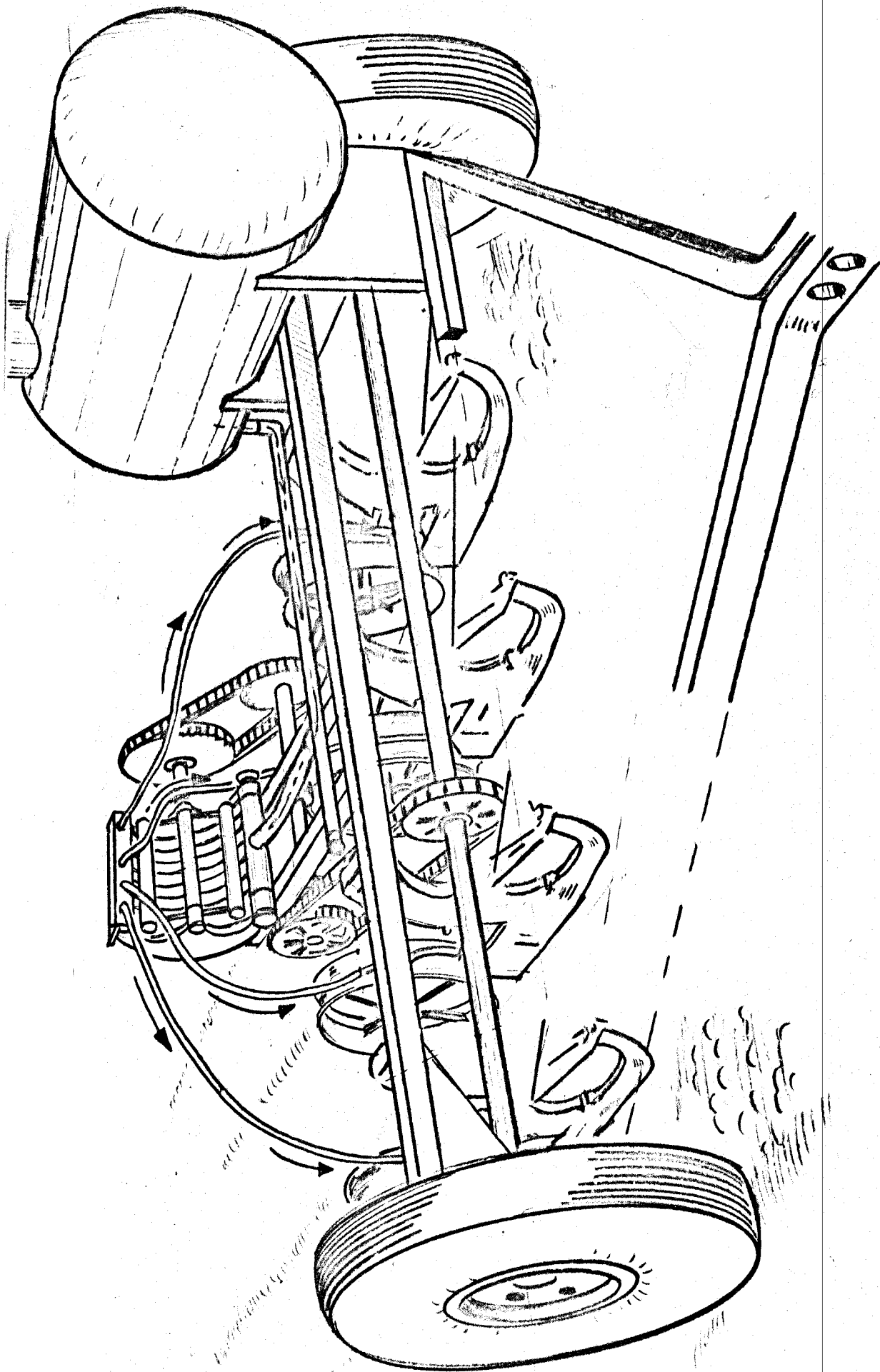


FIG. 4
PLANTER ATTACHMENT
FOR SUSPENSIONS