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D00687

United Nations Industrial Development Organization

UNIDO
Distr.
LIMITED
ID/WG.40/5
16 June 1969
ORIGINAL: ENGLISH

Expert Group Meeting on Agricultural
Machinery Industry in Developing Countries

Vienna, 18 - 22 August 1969

AGRICULTURAL MACHINERY INDUSTRY IN DEVELOPING COUNTRIES - MANUFACTURING PROSSIBILITIES OF PLANT PROTECTION EQUIPMENTS 1/

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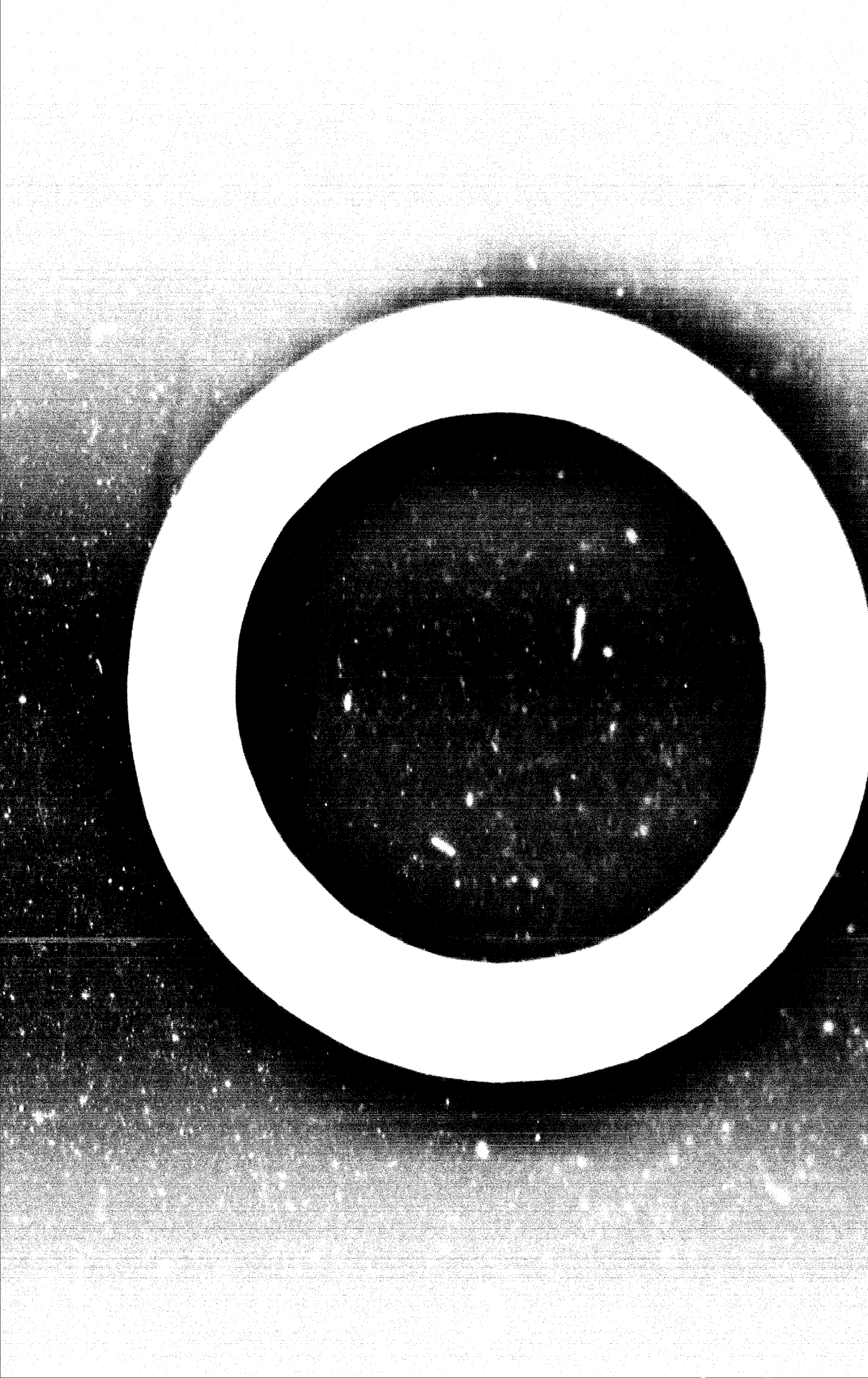
id. 69-3156



INTRODUCTION

The control and destination of plant pests is a continual problem: first of all the pest has to be identified on the evidence of the damage it causes and then the proper means must be found to destroy it systematically while causing as little demage to the plants themselves as possible. The problem is rore acute still in the case of plantations in tropical countries, where these plantations sometimes stretch over very large areas. For most of the year the warm and damp climate with its heat and heavy rain creates ideaé conditions for insect and other type of pests to develop and multiply.

The present paper has the purpose to point at the possibilities of proõucing agricultural machines, particularly tnose for plant protection in the developing countries.

In the first chapter the types of the machines for plant protection are treated and in the third one their basic constructional units and production characteristics, as well as some ideas on the basis of which the production will be organized and promoted in the countries under discussion. We briefly [illegible] the way it is necessary to use machines for plant protection and where it would be [illegible] produce them.

The purpose of our paper is not directed to make detailed concrete suggestions for the above mentioned countries. Such proposals could be made only after thoroughful survey and investigation.

I. WHY AND WHERE IS NECESSARY TO PRODUCE MACHINES FOR PLANT PROTECTION

World food supply situation

During the last 80 years, the population of the world has been doubled and nowadays it numbers more than 3 billions According to careful estimates this number will be nearly doubled again by the year of 2000, when it will reach the total number of 5.5-5.8 billions inhabitants.

The food supply situation has been investigated by the FAO. According to this survey, one third of the population on the world, round 1 billion persons, consume the established necessary daily food value of 3000 calories per head. The second one, third of the population can get only 2000 caloric value of food a day, i.e. they are undernourished. At least one billion people, first of all in Africa and Asia, consume about 1000 calories of food value a day and so they continually starve.

The annual increase of the World population is about 60 millions. For nourishing them 24 million tons additional food is needed in a value of about 4 billion dollars. Considering the actual level of production, an increase of about 120 million hectare cropland would be required. Such a large scale increase of agricultural land is from several reasons impossible and therefore the only possibility is to raise the production, to increase the yields, particuéarly by plant protection and ferjilization /1/.

Damage in agriculture

Many investigations have been done to measure the damages due to the parasites, fungi and weeds in the world. According to the data collected, all the damages caused by the insects, fungi and weeds signify 40 - 50 per cent of the total products produced in the agriculture. The field crops and the agricultural fruits with great yield

are more sensible to the parasites and diseases and considering the greater [illegible] of their yield [illegible] the [illegible] of the damages suffered by them [illegible] greater. The agricultural [illegible] by weeds. The [illegible] to 15 [illegible] per cent [illegible] since [illegible] and [illegible] and fungal diseases, as well as [illegible] the harvest, increase the damages.

In [illegible] was caused by the weeds in the United States.

The [illegible] insects is about [illegible] per cent and nearly the same damage are caused by the fungi.

Conforming to the statements of the French [illegible] /3/, the plant diseases, the weed and the insects destroy a quantity of [illegible] human nourishment [illegible] annual value of [illegible] billion dollars [illegible]. The following table gives an idea of the distribution of [illegible] damage caused by insects and diseases [illegible]

Table 1 The damage of yield, per cent

	Insects	Plant diseases	Weeds	Total	Yield part remaining for human consumption
North and Central America	9,4	11,3	8.0	28.7	71.3
South America	10.0	15.2	7.8	33.0	67.0
Europe	5.1	13.1	6.8	25.0	75.0
Africa	13.0	12.9	15.7	41.6	58.4
Asia	20.7	11.3	11.3	43.3	56.7
Oceania	7.0	12.6	8.3	27.9	72.1
Soviet Union and China	10.5	9.1	10.1	29.7	70.3
Average	12.3	11.8	9.7	33.8	66.2

The greatest damage occurs in the developing countries, where significant progresses could be obtained by relatively less expensive investments using the methods of up-to-date plant protection and intensive agricultural production.

[illegible] of crops in [illegible]

In order to indicate the necessity where and for which plants would it be most reasonable to use plant protection means we give the numbers of economically important parasites for information purposes.

Table 2 Number of pests of crops

Coffee	51	Maize	31	Pineapple	14
Cocoa	40	Sorghum	13	Date palm	3
Tea	40	Rice	81	Banana	20
Cola-nut	17	Sugar-cane	69	Mango	36
		Beans	14	Citrus	70
		Cassava	15		
		Sweet-potato	18		

The above mentioned plants are produced generally in the countries of Africa, South America and Asia, on large areas. In consequence of the tendency towards monocultures on continuously increasing areas the damages caused in crops increase from year to year. The natural enemies of the pests usually fail at such development and therefore the control is to be solved first of all in tropical countries, where the development of the agriculture is directed to introduce monocultures on large areas.

Methods for pest control

Several methods are used by the plant protection, the most importants of which can be mechanized.

The agrotechnical plant protection with the corresponding soil cultivation methods denotes circumstances advantageous to the crops and disadvantegeous to the parasites. These machines are introduced not for plant protection purposes and according to their characteristics they cannot be considered as plant protection equipments.

From the point of view of the plant protection the plant selection is of great importance, with regard to the selective production of species resistant to the diseases. In this domain the problems of the mechanization in the plant protection concern first of all the seed-cleaning and seed-dressing. The seed-dressing equipmentsare typical plant protection machines.

One of the method of the plant protection isXthe biological control The biological protection controls the adverseries of the parasites, reinforcing and maintaining the biological equilibrium.

It has no significant mechanization problems.

Mechanical control. It is generally envisaged to control the parasites by physical means. From the point of view of the mechanization, this protection method cannot be neglected. The insect-collecting equipments, the trenching machines preventing the migration of the parasites, the tree-trunk cleaning tools, etc. can be used with good results in many cases. There are many possibilities which can be exploited in the future in this domain.

Chemical control.It is the most efficient plant protection method. In order to prevent or directly remove the menacing damages it can be used with the best result nearly against every insects and diseases. As its disadvantage isto be mentioned that, especially in the last time, the applied chemicals have controlled also some parasites insects. This harmful phenomenon is very unsignificant in comparison to

the advantages of this protection method and there is a possibility to eliminate it.

More than 9o per cent of the equipments used to plant protection purposes signifies the executive means of the properly called chemicae control. In consequence, very often only the equipments of the chemical control are mentioned in the literature as plant protection machines.

The effectiveness of the chemical control has been determined by several statistical methods with the result of quadruple compensation, that is on an average, the monetary unit spent for chemical plant protection ws reinbursed by an additional yield in a value of 4 monetary units. However, the question may not be treated only from economic point of view. The plant protection providing th food supply for millions of starving people is to be increased also in that case, when it is not more favourable to the economical optimum. Furthermore, the insects and the fungoid diseases, the so-called quarantine insects, etc., e.g. the potato beetles, rats, malaria mosquitos, milaew, etc., are to be controlled in any case, according to the sense of the international treaties, as well as the epidemically spreading insects, locusts, mites, etc., menacing not only the yield of the year, but the distroyment of the total vegetation of the region, are to be eliminated.

Classification of the plant protection machines

The machines and equipments are to be distinguished, first of all according to the plant protection methods.

Machines of the mechanical control can be included the insect-collecting equipments, the trenching machines for insect-collection, the equipments and tools for tree-trunk cleaning, the flame-throwers, the soil fumigators, etc. It is

characteristic for all these equipments that they control the insects mechanically without chemicals.

Machines and equipments of the chemical control solve the tasks of the plant protection using chemicals. To the machines of the properly called chemical plant protection can be included the spraying, the soil-injecting, the dusting and the seed-dressing equipments. They are used practically to the execution of the protection in 8o-9o per cent.

Considering the task of the total weedcontrol, they are not used directly for plant protection, but their constraction and application are nearly identical to those of the sprayers. Total weedcontrol is used generally to clean the roads, railways and dikes.

Our paper deals further only with the properly called plant protection machines and equipments, mentioning also some particular methods for mechanization in relation with the plant protection.

The further classification of the machines for chemical control can be carried out on the basis of the properties of the applied chemicals, as well as according to the working methods of the machines.

The spraying equipmentsprovide the uniform spreading of the liquid material in form of droplets. As the spreading, the uniform distribution and the covering of the plants expressed in the percentage of the surface are determined first all by the droplet size, and the droplet size depends upon the working principle, it is reasonable to classify the spraying equipments according to the producing methods of particle.

1. Hydraulic drop-forming spray equipments disintegrate the material in droplets without using air and disperse them onto the surface of the plants.

2. The spraying equipments working with compressed air blast use the air to atomise the liquid and to transfer the droplets. The air blast is produced by the constructural units of the machines.
3. If the air blast has the primary task to atomise the spray liquid, the equipments are atomisers.
4. Spraying equipments with combined drop-making and drop-spreading by compressed air are named such equipments wich only diminish the drop-size and distribute the drop by air blast.
5. The mist blowers work with smaller drops than all the other spraying equipments. They atomise the spraying material in liquid state producing mistlike droplets. If the mistblower is based only on mechanical principle and the droplet-size is determined by air pressure and air speed, these method can be called mist blowing /aerosol/ method. In the case of thermal fog blowing the spraying material is evaporated by heat and the fog is formed by the steam precipitation /warm aerosol/.

The dusting machines are used to spread products in form of powder. Every duster operates on the principle of air blast. In order to increase the adhesive effect of the powder, the powder is mixed by water. This method is called wet or moistened dusting.

The seed-dressing machines are envisaged to protect the seeds to be sown or planted against fungoid infection. If the processing medium is used on the seed surface in liquid state, the procedure is named liquid dressing. The machines and equipments using processing mediums in form of powder are named powder dressing equipments. If the machines carry out the sprinkling and the powder dressing method pro-

cessing in the same time, the method is called liquid dressing with powder or spinning dusting dressing.

The machines are classified according to the type of power source driving the plant protection machines can be classified as follows:

- manual operation
- petrol engine driven
- P.T.O. driven
- electrically driven machines

According to the working method, the plant protection machines can be classified as follows:

- manual operation of moved
- horse traction
- tractor trailed
- tractor mounted, and
- vehicle mounted machines for plant protection.

II. [illegible]

/Description of the principal machine types for plant protection

A. [illegible] hand-operated spraying and dusting equipments

The pest control in the orchard tree plantations, parks, vineyards as well as in special type flower gardens, greenhouses etc. can be generally solved using small equipments. The up-to-date low capacity machines and equipments are useful means for plant protection. Recently, even the hand-operated spray machines are produced in the most up-to-date quality with the general tendency of using plastic parts and increasing the performance. The use of plastics is advantageous to minimize the weight and the increasing of the spread performance promotes the output.

The following types of hand-operated sprayers are known:

1. Hand-operated sprayers

They are used first of all in flower gardens, greenhouses. Their output is low, but the quality of work is good. The weight of the sprayers is not more than 3-4 kg., and the spraying performance signifies some cubic centimetres spraying liquid. Two basic types of the above sprayers are known potentially:

- Hydraulic hand-operated sprayers /Fig.1./

In the simplest type a liquid pump with a metal cylinder is used with 1.5-3.0 cm diameter and in a length of 200-400 mm. In the cylinder there is a pump sealed by leather or rubber, operated by pump-handle. At the end of the cylinder nozzle is attached. At the filling, the piston is drawn out from liquid sucked in through the nozzle hole. Pushing forward the piston, the valve is closed and the liquid cannot flow out but through the nozzle /Fig.2/. The hand-operated air pump is suitable to form smaller droplets and to be used in continual operation. Over the spraying liquid there is compressed air of 2-5 atm pressure which is pumped by hand-operated air pump.

- Pneumatic hand-operated sprayers /Fig.3/.

In consequence of the hand-operated air pump, the compressed air in the cylinder flows towards the emission hole /under the pressure of some tenth of atmospheres/. The air which is flowing out with relative great speed absorbs the liquid through the tube placed in ringhtangle before the emission hole and takes with in small distribution. The liquid containers are generally made in cylindric form, placed under the emission hole in vertical or horizontal position. The usual volume of the containers is 1-12 lit. The diameter of the pneumatic pump cylinder is 20-50 mm., the stroke of the leather piston with muffle is 150-300 mm.

2. Knapsack sprayers

The hand-operated knapsack sprayers can be divided in two large groups. In operation, the sprayers with liquid pumps are to be continually hand-operated, while the sprayers with air pumps and batteries are not. The total weight of the sprayers is generally 2o-25 kg. The most important characteristic of the knapsack sprayers is the liquid pressure. The droplet-size of the sprayers performance of 0,5-2 litre/min can be achieved. As the effective pressure depends first of all upon the construction of the sprayer, which is known in four generally used types, the sprayer types are classified as follows:

- Low-pressure, diaphragm pump-operated sprayers /Fig.4/

The construction of this type is the simplest, its weight and price are small. As to the operational principle of the sprayer, it works with low-pressure liquid pump. The diaphragm pump mounted on the bottom of the sprayer and operated by the swinging movement of a hand-lever attached to a bent axle. The liquid pumping based on the principle of the volume changes is provided by the diaphragm bending and defirmation. The pressure maximum is given by the stability of the rubber diaphragm. A maximum pressure of 2-3 atm can be reached. In consequence of the low pressure, the droplet-size large and the coverage small. This sprayer type is known everywhere as Vermorel product, because this French factory produced the first sprayers in this type. The diameter of the rubber diaphragm ranges from 5o to 15o mm, while the effective displacement is 1o-5o cu.cm. The most important data of some low-pressure sprayers are summarized in Table 3.

Table 3 Sprayers with diaphragm pumps

Production and type	Own weight	Tank capacity /litres/	Effective medium pressure atm
System Vermorel /Hungarian/	8	10	2,0
Holder Metzinger /West-German/	7	15	3,5
Morava M-1 /Yougoslav/	7,5	12	3,5
Vermorel Eclair /French/	6	15	3,0
Platz I. /West-German/	7	15	3,5

- Medium pressure, liquid pump-operated sprayers /Fig.5/

The operating principle of the sprayer is in agreement with that of the sprayers with diaphragm pump. Essential is the difference due to the liquid pumping carried out by a piston pump. The piston can be sealed in several solution. Earlier nearly exclusively leather sealing was used, while recently pneumatic sealing is very often used. The effective pressure is 4-6 atm and so the drop size is suitable and the coverage provided by the nozzle is as large as 0,8 m. The hand lever is generally conducted over the shoulder of the operator and the vertical pulling lever can be operated in a comfortable position.

Table 4 **Knapsack sprayers operated by piston-type liquid pumps**

Production and type	Weight /kg/	Liquid tank capacity /litres/	Medium pressure /atm./
Universal Arbor /Hungarian/	8,5	18	7
Pomosa Rebenspritz /East-German/	9,0	18	4
Morava M-2 /Yugoslav/	6,8	14	4
Holder Fortuna I /West-German/	7,5	16	5,5
Kyoritsu MSS /Japanese/	6,5	16	4
Platz Frankonia /West-German/	8,9	18	5,5

The sprayers indicated in the Table 4 can be operated with a performance of 0.5-0.7 lit/min, and can be used both in vineyards and in orchards.

- Air compressor-operated knapsack sprayers /Fig 6/

During the operation of the sprayers no manual control is necessary, the operators work is limited and only to control the spray liquid jet. Filling is always possible using the air compressor build in the sprayer. As the air compressor, built in the sprayer must be always carried, the effective liquid tank capacity cannot be larger than 10-16 litres. The sprayers with air compressors are always produced with pressure-tight cylindric tanks. After having filled in the liquid using the manual air compressor, a pressure 5-10 atm can be provided over the liquid, depending upon the sprayer type. The sprayers tank can be mouted with safety valve and manometer. In operation, no continual pumping is

needed to the sprayer work, only the additional pressure regulation is to be carried out from time to time and so the operator can draw full attention to the control of the spraying tube.

This sprayer type can be well used in orchards, too, when a 1,5-3 m long metal or bamboo lance can be attached to the flexible tube. Table 5 includes the informative data about the sprayers with air compressor s. In the up-to-date sprayers the diametres of the air compressor cylinders are 2o-4o mm, while the stroke of the piston with muffle is 3oo-4oo mm.

Table 5 Air compressor operated knapsack sprayers

Production and types	Weight /kg/	Liquid tank capacity /litres/	Maximum pressure /atm/
Harmat /Hungarian/ I.	10	10	6
II.	11	14	6
Pomosa Rückenspritz /East-German/ 112	9,5	14	6
113	8,0	10	6
Kyoritsu MSA /Japanese/	6,3	11,5	7
Platz Herba /West-German/	6,0	12	5
Holder California I /West-German/	10.0	12	5
Metalurgia /Bulgarian/	12,5	19	4,5

- Pneumatic sprayer with air-storage tanks /Fig.7/

To this type of sprayers simple, pressure-tight cylindric tanks are used which can be filled by separate filler.

This knapsack tanks are furnished only with valves and in consequence their weight is smaller and the carrying of the sprayer is not tireing even with 20 litres liquid filled in. The knapsack tank must be filled with air till 3 atm pressure. After that the liquid is pumped into the sprayer, while the air is compressed and after having finished the filling, the pressure reaches a value of 10 atm. During spraying, the spray liquid is pressed out by an elastic air cushion through the pressing tube. The hand-operated filling pump used to the machine can stisfy during the operation of 3-6 sprayers depending upon the work conditions. The filling pump has diaphragm piston system. Recently, engine--driven fillers are used, too. The two-stroke air-cooled petrol engine with 125-250 cu.cm can drive a piston pump by decelerator, or in the case of switching over, a piston compressor.

3. Dusting machines and equipments

The use of the dusting machines and equipments with small performance is similar to that of the spraying equipments and knapsack sprayers. Besides the dusters carried in hands and knapsack dusters, there are known dusters carried in the front. All these models can be operated by hand. The classification can be done here also according to the construction of the equipments.

- Hand-operated dusters /Fig.8, 9/

The application of the hand-operated dusters are similar to those of the hand-operated sprayers. The tank volume is made for 1.5 kg powder. Their coverage is about 1 m, the powder quantity to be thrown out by a double stroke is 1-2 grams. The air current for the powder spreading is

provided by bellows composed by leather bellows and a closing plate. The closing plate can be moved by hand, too.

- Knapsack duster with swinging blade /Fig. 10/

The greatest air volume is provided by this type of dusters. The container of the duster fits well to the back of the operator. The container is divided in two parts. If the hand lever is moved upwards, the swinging blade will start to the left. The right side volume of container increases and air flows through the right upper sucking valve behind the blade. In the same time the air pressure increases before the blade and air flows through the left bottom valve to the delivery pressure tube. Inversely, the processes are exchanged on the two sides of the blade. The usual volume of the powder receiver includes 6-8 cu.dm, and 10-20 g powder is thrown out by one stroke.

- Fan-operated duster carried in the front /Figs. 11, 12/

The duster is carried by the operator on bearing straps in the front of his body. The air current needed for the powder throwing is provided by the fan. The fan is operated by hand lever, using accelerating gear. The effective revolution number is 60 r.p.m. on the crank arm, and about 500-700 r.p.m. on the fan, while the power demand is about 0.1 HP. The mixing blade mounted in the receiver has the same revolution as the hand lever. The uniform rating is provided by the bristle brush feeder, while the powder is supplied to the feeder by a pulley.

4. Hand-operated wheelbarrow-type equipments

The dimensions and outputs of the kanpsack equipments are limited by the maximum load capacity of the operator, but the continual load can be prevented of the machines are mounted by runners.

- **Wheelbarrow-type hand-operated equipments with piston pumps** /Figs. 13,14/

Such equipments are generally operated by two persons. The intermittent operation of the equipment is provided by one of the operators who operates the piston pump in standing position. The second operator generally carries out the spraying by the lance. Some manufacturers have introduced equipments with air compressors or tanks on hand-operated wheelbarrows. The operating principle is like to that of the knapsack equipments, only the container capacity is much greater. The spraying can be executed in a distance of 10-30 metres from the one position, depending upon the length of the flexible rubber tube attached to the spraying gun. The spraying liquid tank capacity is 50 litres, and the piston pump pressure is 10 atm. The performance of these equipments exceeds that of the knapsack machines, and their structure is simple and safe in operation. The continuous rating necessary to the operation is about 0.1 HP. The medium effective pressure is 4-5 atm. The top limit of the total weight is about 160 kg. The spraying output can be 2-6 litres/min, that of the medium type equipments.

- **Impeller-driver wheelbarrow dusters** /Fig. 15/

Easily operated equipment with relatively simple construction. The fan and the powder feeder are driven by the axle of the pneumatic runners, using an accelerating gear. The horizontal dust pipe provides 3 m dusting length to the equipment. It is suitable to dusting smaller plots, parks, lawns, the adjustable maximum portion is 2.5 gramm/sq.m The usual volume of the powder container is 10-30 cu.dm.,

the total weight is 25-30 kg.

B. Engine-driven, hand-operated equipments

This group includes the engine-driven knapsack equipments, the wheelbarrow and stretcher-type machines. These equipments generally provide intermediate output. They are used first of all in vineyards and orchards.

1. Engine-driven knapsack equipments (Fig. 16,17)

This set of engine-driven atomizers suitable to spraying and dusting with transitory output between the low volume and medium volume methods is generally wide-sprpad. For the moment the weight of these equipments, on account of the driving engine, exceeds that of the knapsack equipments. At the present, the performance of the engines with a weight of 4-6 kg and a displacement of 30-150 cu.cm is 0.5-3 HP. The runner of the small-sized radial fan providing 0.02-0.05 atm pressure is fixed directly on the axis of the driving engine. The air volume generated by the fan, cools the engine and simultaneously provides the air current needed to the spraying and dusting. The readjustment of machine from spraying to dusting position is relatively simple. The powder feeding equipments are generally operated with high revolution. The usual speed of the engine is between 2500-5000 r.p.m. The characteristics of these equipments are included in Table 6.

2. Engine-driven sprayers with piston pumps

This type is suitable to intermittent operation as well as to continuous operation and operation with spraying gun. It is generally used in vineyards. Some types are manufactured to operation with field spraying frame. The equipment can be operated by one person. The equipments are driven by two-stroke air-cooled petrol engines for operating one

of two cylindric piston pumps by decelerating gear through gear of [illegible] it drive, [illegible] limit of the engine performance is 1.4 HP, the tank capacity is 60-[illegible] lities, the total weight is [illegible] [illegible] piston pumps have a maximum [illegible] of [illegible] atm, [illegible] spraying output is [illegible] [illegible] data of the [illegible] wheelbarrow engine sprayers at [illegible]

Table 1 [illegible] characteristics of the engine-driven sprayer equipments

Type	Engine data for [illegible]		Application possibilities			
	displacement cm^3	[illegible] rev/min	[illegible]	[illegible]	[illegible]	flame thrower
Gutbrod ATP (West-German)	[illegible]	-	•	•	-	-
Blake-Fletcher [illegible] Mamba (English)	75	-	•	•	•	-
[illegible] (West-German)	75	-	•	•	-	-
[illegible] (Dutch)	26	7000	•	•	•	-
Kyoritsu mist blower (Japanese)	30	5000	•	•	-	-
Le Fontan (French)	66	-	•	•	mist blower	
Platz [illegible] (West-German)	-	-	•	•	-	-

3. Engine-driven wheelbarrow sprayers with compressors (Fig. 18,19)

Unique used structural unit in the machine is the piston compressor, driven by internal combustion engine. The pressure of the compressor is conducted into the spray liquid tank, and therefore no pump is needed.

The pressure ranges from 6 to 8 atm, and the air drying output of the piston compressor is 12 cu.m/h. The compressor is driven by a 1.5 hp two-stroke engine, except the use in greenhouses and [illegible] cultivated areas, when electric engine is mounted in the equipment. It has a weight of some 80 kg, while its spray liquid tank capacity includes 90 litres.

Table 7 Hand-operated wheelbarrow equipments with engine-driven piston pumps

Type and manufacture	Engine performance (hp)	Weight (kg)	Spray liquid tank capacity (litres)	Pressure (atm)	Max. spraying output (lit/min)
Holder [illegible] /West-German/	2	80	100	0-30	16
Jos.[illegible] Swoboda /Austrian/	1.8	65	100	0-30	10
Grube [illegible] /West-German/	1.0	70	100	0-20	7.5
Castaing [illegible] /French/	2.0	90	100	0-30	12.0
Kyoritsu [illegible] /Japanese/	3.5	85	80	28-35	27.0

4. Engine-driven wheelbarrow and stretcher-type dusters and sprayers with fans (Figs. 20,21)

This type is suitable first of all to provide dusting, but it is possible to use it with corresponding fittings to carry out wet dusting and atomizing spraying, too. The built-in engines have a performance of 2-3 hp, the top limit of the total weight of wheelbarrow equipments

must not exceed 1[illegible] kg. The stretcher equipments, carried by two workers, are operated with a total weight of maximum 60 kg. The pressure of the radial fans is 200-300 w.g. mm, the air feeding output supplies 1500-2000 cu.m/h. According to the principle advantage of these equipments the air flow of the fan in continuous rotation provides a coverage of 360°, as well as it covers the plant leaves. The equipments are driven by two-stroke air-cooled petrol engines. The fan unit of the single-seat powder sprayer are driven directly by the axis of the engine. It has a speed of 3000 r.p.m. The equipments can be used with good results for dusting and wet dusting in vineyards, as well as for plant protection processes in sparsely planted orchards. It can be used both in stretcher and wheelbarrow models, as the task requires it.

c. Horse-drawn sprayers and dusters

Horse-drawn equipments are generally used in limited number in the large-scale agriculture. The output of such equipments corresponds only to the small estate conditions for spraying and dusting. However the use of these equipments is necessary to the plant protection to be executed in scattered orchards, plantations in not easy passable landscape, as well as to especially activities on areas impassable for tractors, where the small estates are in dominating number. The horse-drawn field spraying machines are generally used, as well as hanging spraying guns in orchards and dusting equipments in the fields.

1. Impeller-driven horse-drawn field sprayers /Figs. 22,23,24/

The equipments have simple and safe design, their operation does not require skilled labour. Nearly every type is operated with piston pump and hydraulic droplet-form-

ing field spraying frame. The traction force of the horse provides both the travel and the drive of the units of machine. The equipments have a total weight of 100-400 kg, the total power demand is 0.2-0.5 HP. The equipments work with low or medium volume methods.

2. Horse-drawn dusters without engine /Fig.25/

The equipments can be used to carry out field dusting by air current, field dusting pipes, or orchard dusting by hand-guns, and often both operations. Every tape is fitted by radial fan working with an effective speed of 1000-2500 r.p.m. The fan is generally driven by two-stage gear from the impeleer, but sometimes by three-stage gear. The first stage is usually driven by chain, while to the higher stages is used both gear and chain drive. Auger-type powder feeders are designed to the equipments.

3. Engine-driven horse-drawn equipments /Figs. 26,27/

- Engine-driven horse-drawn equipments with piston pumps

They are generally designed to carry out field spraying by spraying pipes an orchard spraying by parying guns with lance. The piston pumps are operated by built-in two-stroke air-cooled engines, generally through decelerating gears. The spraying output of the piston pumps provides 15-40 litres/min, while the pressure often exceeds the 30 amt value. In most cases, two-cylindric piston pumps are used, but two or three cylindric types occur, too. /Fig.28/.

- Engine-drawn horse-drawn equipments with fans

Besides the fan, centrifugal pump, or sometimes powder feeder, or both can be used as constructional units. The equipments are designed to spraying or dusting with atomisation orchards or rarely, for atomising spraying or dusting fields.

D. Tractor-driven spraying and dusting equipments used in fields and orchards

By the introduction of multi-purpose tractors and the increase of the power demand, this operating method has generally spread on the areas of large-scale mechanization. A part of the spraying and mist blowing equipments working with pulverzation in orchards, can be drawn both by horse and tractor. As these equipments can be drawn by horse, too, they are generally operated by built-in engine. Some equipment types has been manufactured with removable engines, in order to operate them by P.T.O., but the dismantling is not very reasonable, because in most cases, the detached engines generally cannot be used for other purposes. /Fig. 29/

The other group of the tractor-drawn equipments operated by built-in engine, excells by the extraordinary great output. The so-called automatic orchard sprayers with "giant" output are manufactured in such execution. The top limit of the performance of tractors suitable to plant protection purposes is 40-50 HP /heavy multi-purpose tractors with pneumatic wheels/. The built-in engines have a performance of 20-80 HP. The total weight of them generally exceeds 1500 kg, and the spray liquid tank volume is over to 1000 litre. /Fig.30/.

The predominant part of the recently produced plant protection machines for large-scale estates are de-

signed to tractor-traction and P.T.O. In comparison with the drive by a separate engine, the equipments with P.T.O. have the great advantage of the significantly lower price due to the absent engine and the elimination of the breakdowns due to the operation of a separate engine. /Fig.31/.

The tractor mounted macyine are driven by P.T.O. too. One of the special characteristics of the mounted machines signifies that they have no wheels, but sometimes castors are used. The elimination of the chassis makes the machines more simple and less expensive. The top limit of the effective volume of the spray liquid tanks is about 300-400 litre and their total weight does not exceed 500 kg. The power demand of the construcitonal units is 5-20 HP /Figs. 32,33/.

The constructural parts, the spraying frames, etc. of some mounted macyine types are built in the tractor, in consequence of which the diminishing tractor stability must be prevented using tractor-drawn tanks furnished by wheels. This machine type is named semi-mounted machine /Fig. 34/.

The machine types built on the tractor must be distinguished from the tractor mounted types. The tractor mounted equipments are characterized by the complete closed unit and the possibility to simply mount it to the rear of the tractor. We can speak about built-in machines, when the structural units are not built in blocks and some detail groups are to be mounted separately on the tractor. Tractor mounted machines on normal chassis can be used first of all in low field crops and orchards.

Machines mounted on straddle type high-clearance tractors are used in vineyards and high row-crops /Fig.37/.

There are machines driven by horticultrual tractors, belonging to the plant protection equipments of the multi-purpose "manual" tractors. These equipments are designed for use in "semi mounted" execution. The structural

units requiring drive, /e.g. piston pump/ are mounted on tractors, while the spray liquid tank are drawn. There are types to be operated completeley mounted on the tractor /Fig. 38/.

Tables 8 and 9 give a summary of the generally used machin types.

Table 8 Hydraulic droplet-forming field sprayers

Type and manufacture	Traction	Drive	Max. spraying output /lit/min/	Liquid pressure	Spraying length /m/	Spray liquid tank capacity /litres/	Total weigh /kg/
Almann 100 G 45 Holder AS 25 /West-German/	mounted	P.T.O.	120	6	14.4	378	-
Z 50	"	"	50	50	8.7	250	-
Platz 75/90 /west-German/	tractor drawn	"	90	60	10.0	900	40
Jessering TS /Austrian/	mounted	"	30	30	8.5	300	-
Holder Z 6 F /west-German/	tractor drawn	"	75	60	10.0	600	370
S 281 /East-German/	"	"	66	40	12.0	900	620
O-SS-6 /USSR/	built-in	"	30	25	7.6	700	260

Table 9 Hydraulic pre-atomiser-type automatic air current operated orchard spraying equipments

Type and manufacture	Traction	Drive	Max. spraying output /lit/min/	Spray liquid tank capacity /litre/
S 050/1 /East-German/	tractor	P.T.O.	54	900
OVM /USSR/	"	built-in eng.	82	2000
OVM 1 /USSR/	"	P.T.O.	80	1200
Platz Ax 710/900 /West-German/	"	"	90	900
Kyoritsu SS1-A /Japanese/	"	built-in engine	150	1100
Drake Fletcher Penetrator 3 /English/	"	P.T.O.	60	900

E. Multi-purpose high-volume sprayers and dusters

The multi-purpose equipments are suitable to carry out both spraying and dusting, at least in two different areas, generally in fields and orchards. In multi-crops estates /fields and orchards/ they can totally satisfy the mechanization requirements and at the same time, they can be well used in special field or fruit-growing farms. These tractor-drawn and P.T.O. shaft-driven machines have at least the power demand of a 25 HP multi-purpose tractor with about 600 kg weight, and the spray liquid tank of about 600 litres equipped with mixer. The tanks are fitted with intake and outflow strainers.

F. Mist-blowers

- Cold mist-blowing

The mist-blowing is generally characterized by the fact that the droplet-size is smaller than 50 micron. In the literature the mist droplets are named aerosols, too, but this denomination is generally used in an improper manner. In physical and chemical sence, the liquid or solid particles with a diameter between 0.1 - 10 micron in air suspension, are named aerosol. The gravity speed of such particles in the air has a value of some mm/min. The aerosol, in the real sense of the word, can be used, in the agriculture on account of the drift danger, only in calm weather. In consequence, the droplet-size in increased upwards by the machines originally providing aerosol. In the case of mist-blowing, using some litre solution 80-90 per cent coverage of the plant surface can be provided and the water demand of the plant protection processes is diminished to minimum or it is totally eliminated. Cold mist-

blowing is used, when the mist is produced by pulverzation, without using heat, i.e. the solution does not evaporate. The generally used cold mist-blowers /cold aerosol generators/ provide the droplets with a diameter of 15-40 micron exclusively by pulverzation and the amount of liquid required per sq.metres can be reduced /20-25 litres/10.000 sq.m/ Cold mist can be produced by several methods.

- Atomization by high-pressure air /Fig. 39/

The operation scheme of the machine type can be seen in the Fig.39. The structural units of machine: 1. pressure-tight tank, 2. piston compressor, 3. nozzles, are designed like to paint spreading guns, the solution generally meets the air stream with a high speed, around the flowing out apertures. 4. fan, needed to the transfer and distribution of the droplets, made with minimum air transmission performance.

- Thermal fog

The thermal fog apparatus works with highly concentrated chemical substance deluted in organic solvents or oil products /e.g. gasoil/. The oil evaporatives when mixing with the equipment-heated air. The mist-droplet size, /produced by thermal method/ belongs effectively to the aerosol range /0.1-10 micron/. Two machine types are generally used to produce thermal mist blowing.

- Low volume hand-operated thermal mistblower vibrating valve

- High volume thermal mistblowers.

Constructural units used to the equipments: 1. fuel tank, 2. tank of chemicals, 3. petrol nozzle, 4. chemical atomizer, /gasoil atomiser/, 5. air nozzle /in some cases radial fan with 0,06-0.1 atm pressure/, 6. ignition apparatus /ignition magnet and spark plug/. The small-size droplets of the mist-

provide good coverage, while the great spreading output gives high productivity. /Fig.40/

- Hand-operated thermal mistblowers

Mistblowing can be wele carried out with the same equipment in orchard, field, wood, vineyard, as well as in closed rooms. It is especially true in the case of hand-operated equipments, because no vehicle is needed to the travel and the equipment can be operated everywhere. The weight of the equipment does not exceed 16-18 kg and so, it can be operated by one person who carries it in hand. The constructural units are: 1. fuel tank, 2. tank for chemicals, 3. petrol atomizer, gasoil atomizer, 5. spark plug, 6. vibrating valve, 7. handoperated airpump. The voltage demand to produce the sparks on the poles of the spark plug is 10-15000 V. The intermittent high tension circuit is provided by a transformer aggregated with the vibrating interrupter /booster coil/. The transformer is to be attached to a high volume accumulator or 3-4 pcs. flashlight batteries. Though the constriction of the equipment is simple, its operation requires skilled labour and great practice. Starting is complicated and the used vibrating valve has short endureance. In the recent years, the equipments have been much developed and their employment has been well spread. 6-8 types of the hand-operated equipments are generally used also in international relations. There are no significant structural differences among the machines. Their dimensions and outputs are generally the same, but their operational safety and endurance are different /Table 10/.

Table 10 Hand-operated thermal mistblower

Type and manufacture	Max.spreading output /lit/min/	Weight /kg/	Fuel consumption /lit/min./	Chemical tank capacity	Fuel tank capacity /litres/
RAG I. /Chechoslovak/	0.5	14.5	1.2	4.5	1.5
LIFFLAN RZI /Yugoslav/	0.5	14.0	0.8	5.0	1.8
Pulsopyl /Polish/	0.5	11.5	1.1	4.0	1.5
Swingfog /West-German/	0.5	11.3	1.0	4.5	1.3

G. Seed dressing

The purpose of the seed dressing concern the protection of the seeds to be sown or planted, against the fungoid infection. Recently, combined dressing agents have been introduced to protect the seeds or cloves against the insects and rodents in the soil. The seed dressing is used to provide the healthy plod and to increase the yield. According to its effect, the seed-dressing has the following purposes:

- seed-dressing with fungicid effect,
- seed-dressing with bactericid effect,
- seed-dressing with insecticid effect,
- seed-dressing with rodenticid effect,
- frost-protecting seed-dressing,
- seed-dressing against chemical and climatical effect,
- stimulating seed-dressing with nutritive and fertilizing effect,

Table 11 shows some characteristics of the generally used seed-dressing machines.

Table 11 Seed-dressing machines

Type	seed-dressing method: wet-dressing with sprinkling	panogen dressing /vapour/	dry dressing /powder	Semi-purpose equipment	Multi-purpose equipment
Panogen "A" /Swedish/		+			
Betoxin M 10 /Swedish/		+			
Mist-O-Matic /West-German, English/		+			
Plantector /English/		+	+		+
Superior /USA/	+		+		+
PC 100-F/1 /Hungarian/	+		+		+
Panogen "D" /Swedish/		+		+	
Mobitox /Hungarian/	+		+		+

- Sprinkling method of seed-dressing

The most up-to-date liquid method of seed-dressing. The sprinkling process of the seed protection is carried out exclusively by equipments with continual working method. This system cannot be done without using equipments. The continually working seed-mixer is always in movement and every seed goss several times through the spreading cone of the nozzle providing fine droplets. Using 10-40 lit/ton dressing solution, the surface of the seeds get perfectly covered by the liquid.

the superfluous solution quantity is not accumulated on the seeds and consequence, the most difficult process of the wet dressing, the drying is eliminated. The droplet-forming of the dressing liquid can be carried out by nozzles /Fig. 41/

- Seed-dressing with powder

The powder-type dre-sing mediums carry out the fungicid procession not during the dressing period. After sowing, the processing material adhered to the surface of the seed will be solved under the effect of the soil moisture providing the desinfective process /Fig.42/.

- Wetted powder-type seed dressing

The wetted powder-type dressing can be carried out by equipments designed both for sprinkling and powdering methods of seed-dresssing. In these cases, the liquid and the powder feeders are to be operated in the same time. The most significant disadvantages of the seed-dressing by powder can be eliminated by wetting method. The powder adhesion can be multiplied by the smallest quality of solution /Fig.43/.

III. HOW TO MANUFACTURE

/The principal structural members of the enumerated plant protection equipments and their manufacturing possibilities/

The medium and high volume equipments for plant protection are more or less composed from identical constructional parts. Equipments for different purposes and operative systems can be suitably assembled from some generally used constructional dements.

A. Spraying liquid tank and mixer

In every spraying equipment, tanks are designed in different types and from different materials and with different volumes to store spraying liquid. An important accessory of the tank is the mixer. The spraying liquid tank are divided in two groups: 1. tanks under atmospheric pressure. Their task is the storage. As they do not work under the stressing effect of the internal overpressure, they can be designed in light execution. 2. Tanks submitted to overpressure. They are generally used to some types of the knapsack equipments and mist-blowers. Over the spray solution the air has 3-10 atm execution. In every case, they have cylindric form, resisting the best to the internal pressure. They are made from copper or from any copper-alloys. Recently glass fibre polyester is used in a large scale.

1. Mixers

The mixers used to prevent the sediment of the chemicals can be divided in three groups:

- Mechanical mixer. It is hand-operated unit used in smaller equipments in intermittent manner /Fig.44/
- Hydraulic mixer. Made for the equipments of plant protection in the large scale estates, the control of the spraying performance is often carried out by reconducting a part of the solution forwarded by the pump. The solution quantity reconducted into the tank, provokes a turbulent movement, mixing the spraying solution /Fig.45/.
- Pneumatic mixer. A rarely used method.

2. Strainers.

To prevent clogging in the nozzles, the spraying equipments are designed to use several type of strainers. The strainers are generally made from metal thread sieve texture, but recently perforated plastic plates are used, too, to eliminate the corrosive effect. The strainers are classified according to their place in the construction and in consequence we can speak about charging built in the pressure pipe and single strainers mounted in the nozzle

3. Recharging unit

During the operation period, the recharging of the tank is an often repented process. If the charging time can be shortened, the additional times will be significally diminished. too. when it is not necessery to use special wäer forwarding or stocking facilities serving the operation of t equipment, the automatic recharger of the tanks is used. The charging can be carried out by gravity tank syster, centrifugal pump and injector.

B. Pumps

In spraying equipments the pressure needed to dispersing and droplet-forming is generally provided by pumps. Many systems of pumps are used, but in the practice the pisto and centrifugal pump types are well known.

1. Centrifugal pump

The centrifugal pumps belong to the range of the rotating pumps, forwarding relatively significant liquid quantity by low pressure. Its construction can be seen in Fig. 47. The principal details are as follows: 1. the scroll case, manufactured nearly always in cas form, made generally from copper alloys and cast iron. 2. Runners, equipped with

blades, the most suitable material of wich is bronze. In the equipments for plant protection, pumps with radial transfer are exclusively used. 3. Runner shaft. It is generally made from stainless steel, and supported in bearing only on one end, where the driving V-belt pulley is mounted. 4. Sealing case, in which the runner shaft rotates. The centrifugal pumps having one runner are made with 60-250 mm OD runner, and they are operated with 1000-4000 r.p.m. to provide 2-6 atm pressure. To obtain higher pressure or sometimes to increase the effect, multi-stage pumps are used. The capacity of the centrifugal pumps used to high volume plant protection equipments provides 100-400 litres/min to recharge the tank.

2. Pistion pump

In the up-to-date plant protection equipments 2 or 3 cylinder piston pumps are generally used. The piston pumps working with 200-500 r.p.m. deliver 20-100 litres/min liquid. Their weight is about 15-70 kg. Their usual high pressure limit doeas not exceed 20-60 atm. To operate hyuraulic droplet-forming equipments, in consequence of the longer pressure time, piston pumps are nearly always used.

3. Special pumps

In some special plant protection equipments pumps differing from the piston and centrifugal types are used. Gear type pumps are used to the cold mist-blowers, wich are suitable first of all to deliver oil emulsion and solution. Operating with 500-1200 r.p.m., 30 atm maximum pressure can be provided to the normal processing fineess. Depending upon the dimensions, their delivery capacity can be 5-25 litres/min /Fig.48/.

C. Constructural parts of air generation

Air blast is used by atomizing sprayers and dusters to form droplets, to forward them, or to dispers powder. Air blast can be produced only in case of pressure difference. The value of the necessary pressure and air volume is determined by the system, construction and output of the equipment. To fulfill the demands, several type of constructions are to deliver air.

1. Blowers

Their operating principle is similar to that of the centrifugal pumps. The pressure is not more than tenth of atm, while the delivered air volume can reach the vaéue of 100,000 cu.m/h. The air flow can be either radial or axial. Smaller air delivery can be reached by radial flow blowers, than by axial ones. With a pressure of 0.03-0.1 atm, 500-6000 cu.m/h air volume can be generally delivered in the case of plant protection equipments. They have a speed of 2000-5000 r.p.m. and their runners have an OD of 300-900 mm. The blower blades are usually manufactured in hollow execution, using steel plates in streamline form. /Fig.49/. The axial blowers /Fig.50/ are characterized by the high air volume delivery and the low pressure. A speed of 2500-5000 r.p.m. and 500-1500 mm OD runners are used. Using 15-160 w.g. mm pressure, the air delivery output provides 20,000 - 100,000 cum/h.

2. Medium volume air blower

The medium volume air blowers are used with 0.1-1 atm pressure and 100-800 cu.m/h normal air delivery capacity. Smallsize droplets can be produced by such structural members. In the high volume mist-blowers nearly always Root-type fans are used in the air blowers /Fig.51/.

3. Piston compressor

High pressure air can be provided only by such compressors. The value of the pressure available in one stage is 2-10 atm. Their operational principle is similar to that of the piston pumps. In equipments for plant protection, in most cases one-cylinder compressor are used.

D. Powder feeders and powder tanks

Powder tanks are designed to store dusting materials. With them are built together the fedders designed to uniform powder delivery. They have a usual volume of 20-100 cu.dm. Depending on the feeding system, their form can be made in horizontal cylinder, vertical truncated cone or pyramid shape, diminishing from the top to the bottom. From the many differnet feeding systems, four types are used to the up-to-date equipments: 1. bruchfeeder. It is used to the low volume knapsack and front equipments. 2. grooved feeder. 3. screw feeder with paddle-wheel. This system proved to be the best to the equipments for plant protection in large-scale estates. The powder is delivered with uniform speed by the right-and left-hand augers fitted to the shaft turning on the bottom of the tank, to the middle where the material is thrown by the paddle-wheel to the flowing out aperture /Fig.52/. The dispersing capacity has the top limit of 5-8 kg.

E. Nozzles

They are designed to disperse liquid, granular and powder-like chemicals. The liquid spraying and processing chemicals are delivered by nozzles to the products or plants to be protected.

1. Hydraulic droplet-forming nozzles and mechanisms

In the practice many types of nozzles are spread, but in our paper only the generally used types are treated. They are: 1. circulating nozzle, 2. nozzle with dispersing screw /Fig. 53/, 3. nozzle with tantential intake, 4. nozzle with cross aperture /Fig.54 /, nozzle with pumping plate /Fig. 55/.

2. Atomizing nozzles /Figs.56,57/

3. Dispersing mechanisms for dusting machines

The accessories and the dispersing mechanism, used to the equipments atomizing and high pressure droplet-forming, spraying air blasting methods can be used to dusting, too.

4. Mist-blowing nozzles

Two types of typical nozzles for medium pressure cold mist-blowers are shown in Figs. 58, 59. The nozzle shown in Fig. 59 is operated by high pressure air, with a structure similar to that of the painting guns. Droplet-sizes of 20-40 micron diametres can be reached by both nozzles.

F. Transmissions

Depending upon the traction and driving, the concection and drive of the constructural units are solved, using several types of details and power sorce in the equipments for plant protection. P.T.O. shaft driving is almost exclusively used in tractor -trailed and driven equipments. The P.T.O. shafts have generally a revolution of 15 r.p.m. 540 r.p.m. speed is not suitable to drive the constructural units. The powder feeder, the axle of the hydraulic agitator and the piston pump usually require lower revolution, while

the blower and the centrifugal pump demand higher speed. The revolution provided by the P.T.O. shaft is to be therefore diminished for some constructural units and increased for other ones. In consequence, the decelerating gears to be solved generally by chain drive and almost exclusively by using roller chains, while the accelerating transmissions are to be solved by gear-drives with 1:2, to 1:4 ratio.

G. Carriage and chassis

With the exception of the plant protection equipments built in the tractor, the constructural units are generally mounted on chassis. The chassis forms a closed frame. In most cases the frame is manufactured from rolled steal, pipe or plate. The principal advantege of the pipe frame signifies the simple production possibility, the relatively light weight and the stability. The pipes have 30-60 mm ID, 3-6 mm wall-thickness. In most cases seamless pipes are used in welded structure. Rolled steel chassis can be assembled by welding, screwing and riveting. Especially is advantageous to manufature chassis from rolled steel for mounted equipments. Recently cold-formed sheet-frames are used with good results. Their Production in large series is economic.

CONCLUSION

On the basis of the present paper can be ascertained, why it would be necessary to manufacture plant protection equipments in the developing countries and can be outlined in general, which constructions and complexity degree could be expected for these countries. We have emphasized, which details for constructural units could be used in the most types. In consequence, conclusions can be made as follows:

Depending upon the technological level and technical standard of the countries, the production of such machines could be introduced in three stages:

1. On the basis of the know-how, obtained from abroad and the imported total detail quantity, assembling of the equipments in existing or established eracting plants.

2. On the basis of the know-how, obtained from abroad and imported principal constructural units of the machines, as well as other simple parts produced by the home industry, execujion of the assembling processes in the particular country.

3. On the basis of the know-how, obtained from abroad, manufacturing every part and constructural unit, as well as their assembling to complete plant protection equipments in the factories of the particular country.

In order to execute the above mentioned tasks, detailed surveys are to be carried out in the interested countries, examining the following:

- which machine or machines are needed in the particular country among the types enumerated in the presen paper /FAO/WHO problem/

- how many machines are required in a year;
- has the coutry manufacturing capacity and in which structure?
- Is the manufacturing capacity available in the country, suitable to produce the principal constructural units reqfired to the plant protection equipments enumerated in the present paper and which are the parts to be produced.
- Has the country manufacturing plants suitable to assembling work and what capacity and level can latters provide.
- Is there a possibility in order to diminish the establishing costs of transport ways and production costs, to co-operate with several neighbour coutries and to execute

the detail production and assembling in a concentrated manner. It would be very economic in order to increase the series production.

- Has the country raw material sources and in which measure. Where can the basic materials, necessary to the detail production, obtained from.
- How is the manufacturing or assembling industry perhaps available in the coutry, endowed by experts. The education of ski-led labour for the manufacturing industry /I.L.O. problem/.
- Has the particular country intention to produce plant protection equipments besides the own requirements to export purposes.
- Which developed countries are ready to hand over know-how to the developing countries and under which conditions?

We suggest that a group of selected experts of the UNIDO carries out surveys according to the above mentioned points of view and on this basis, this group has to prepare detailed suggestions in order to introduce the assembly and manufacture of plant protection and other agricultural machines in the developing coutries.

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F I G U R E S

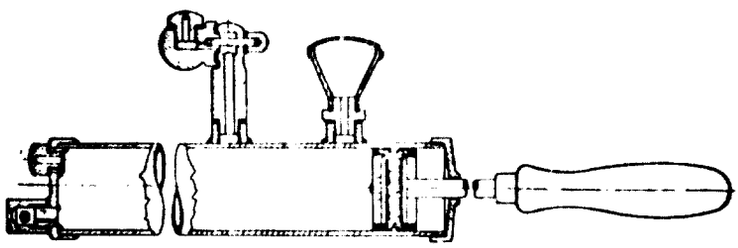
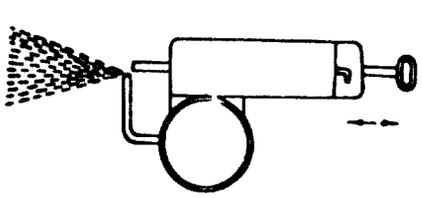


Fig. 1

Fig. 2



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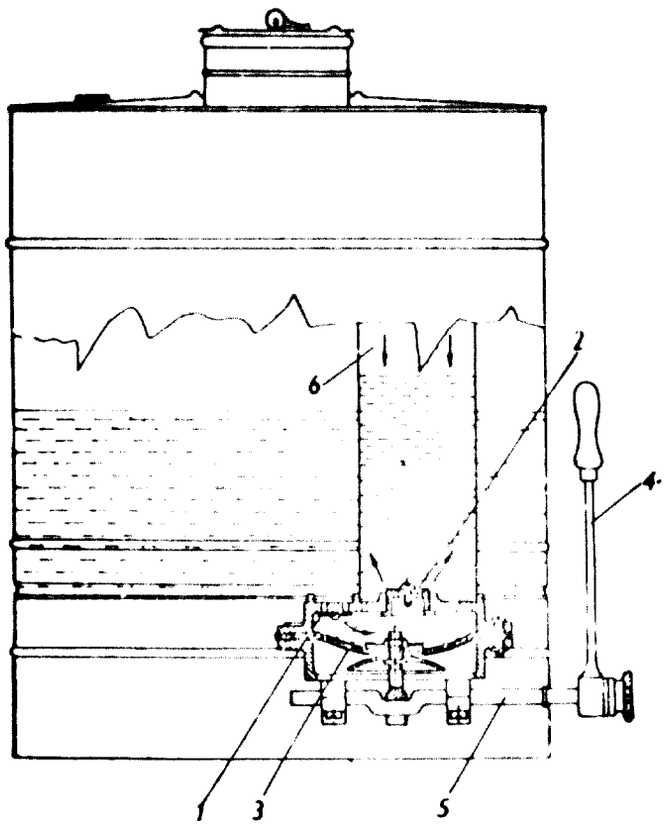

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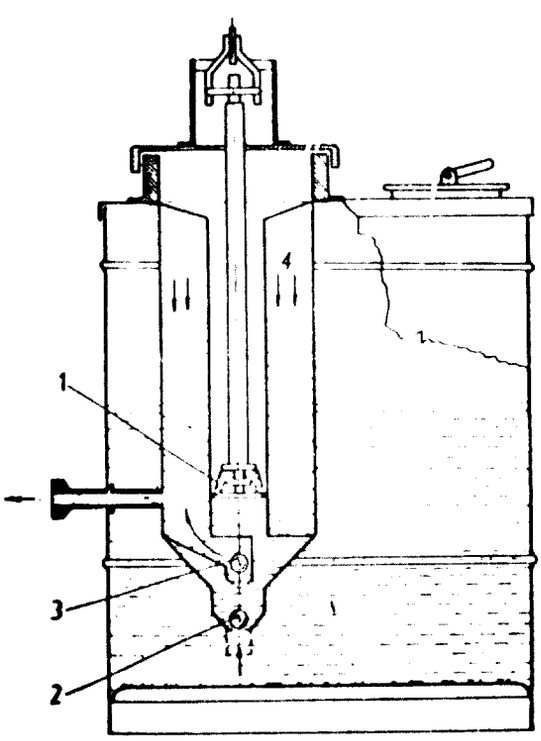
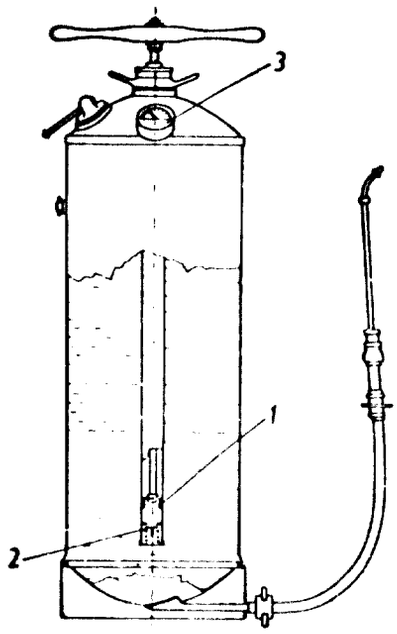


Fig. 5



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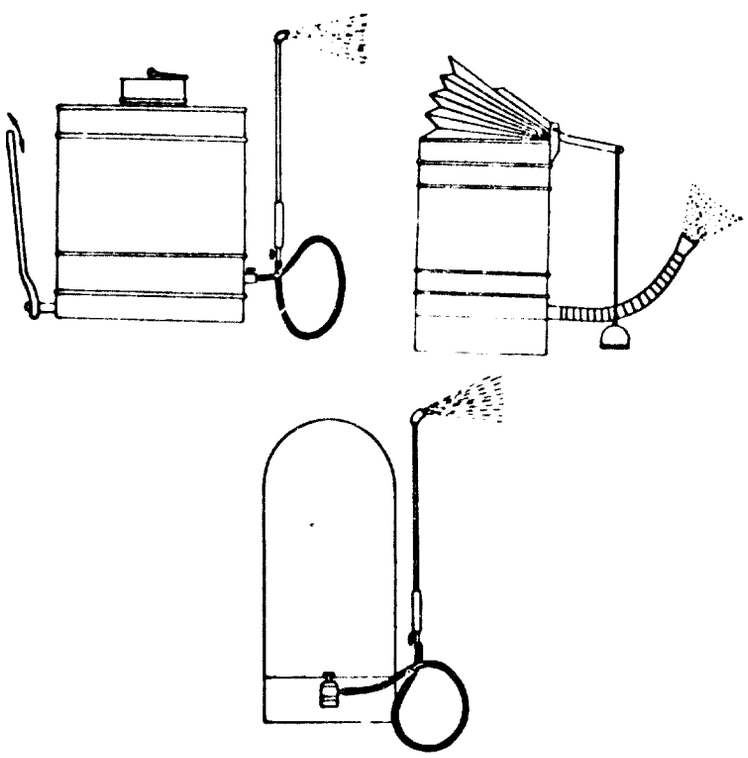


Fig. 9

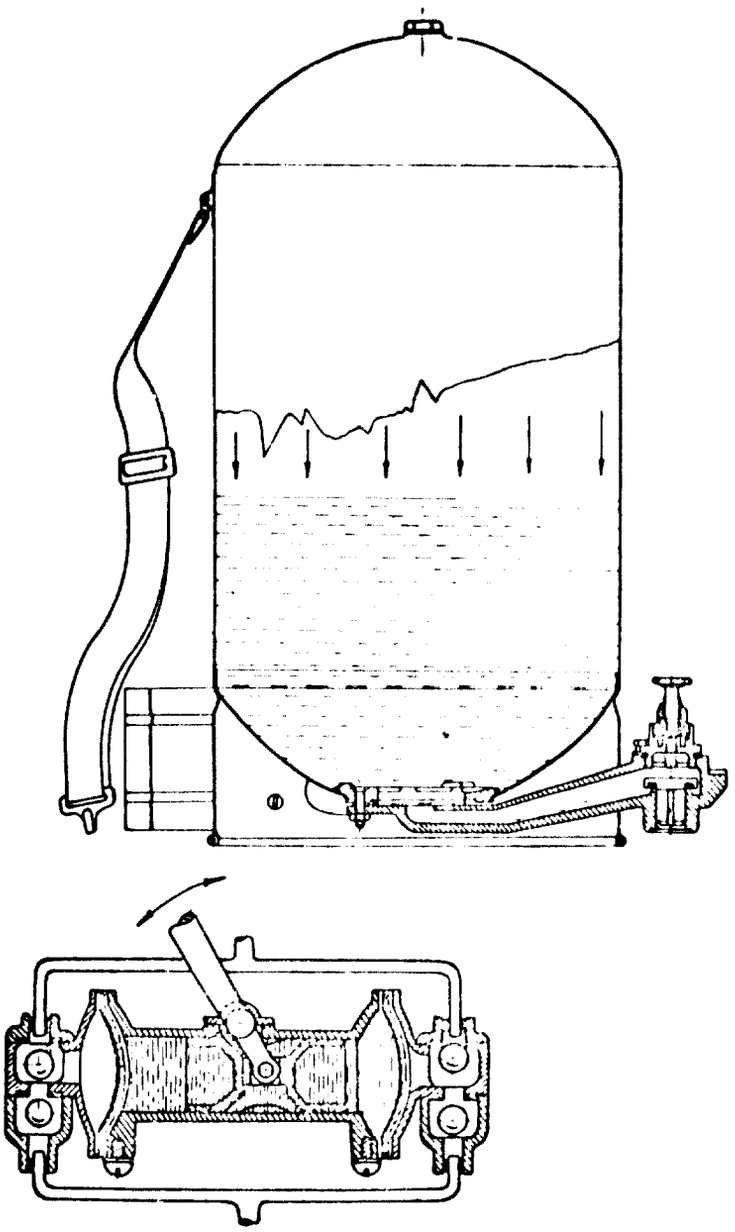


Fig. 7

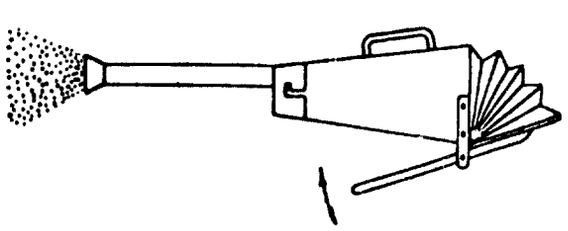


Fig. 8

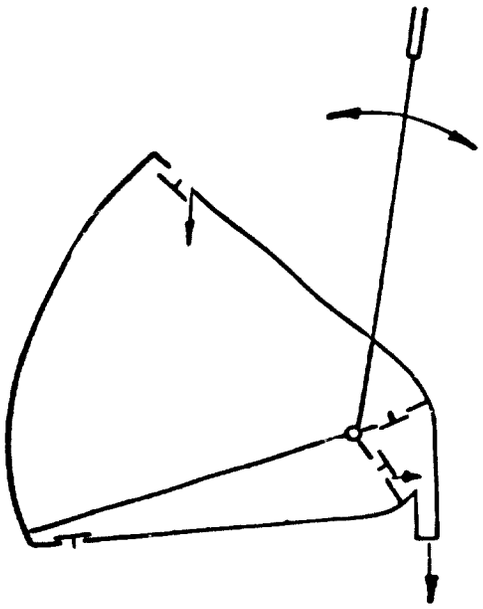
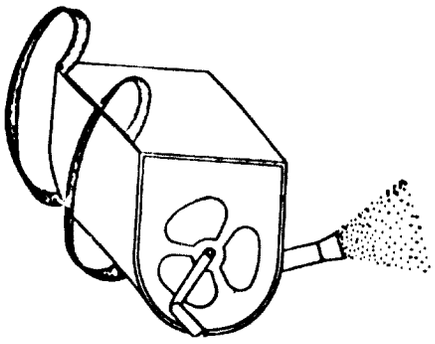


Fig. 10



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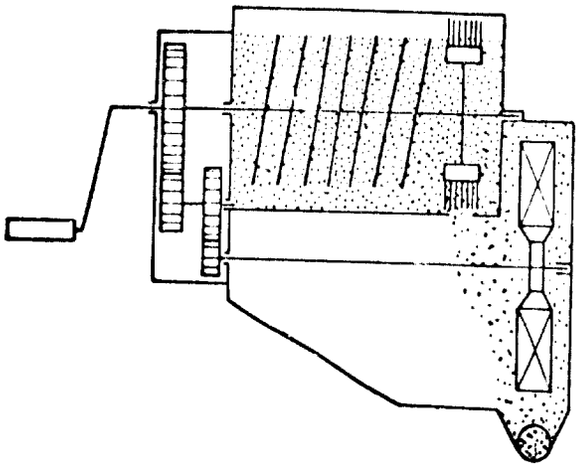

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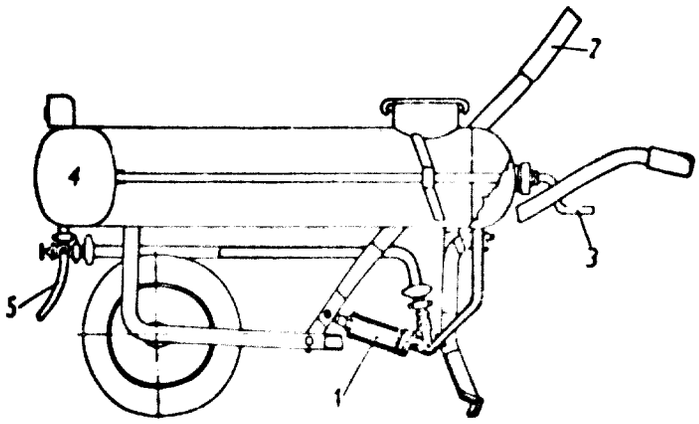

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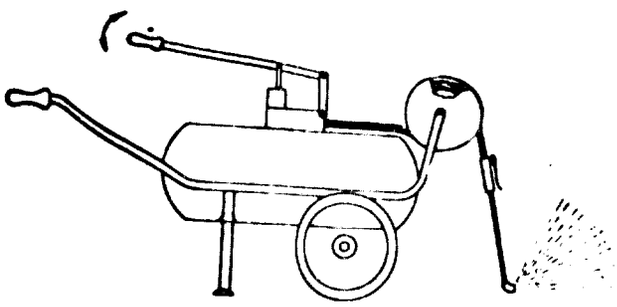

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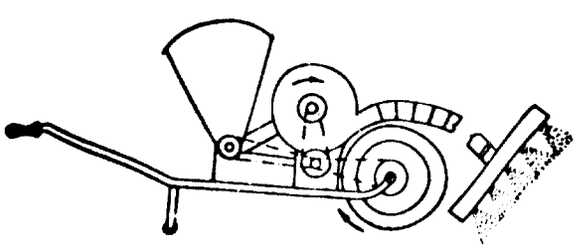

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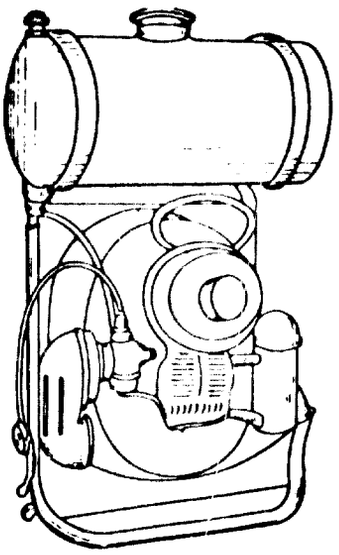

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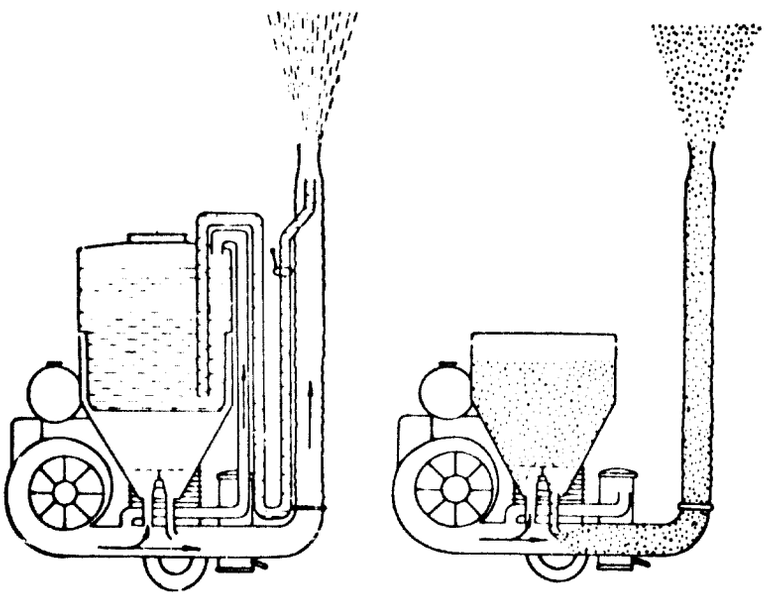

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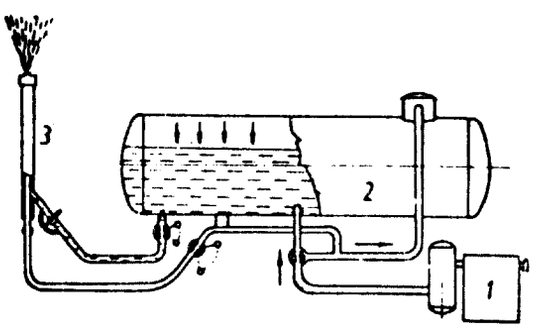

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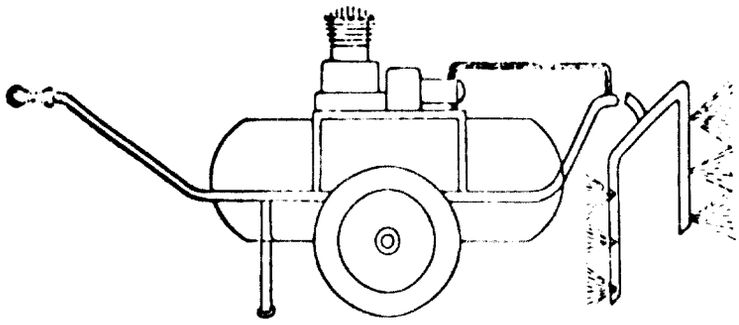

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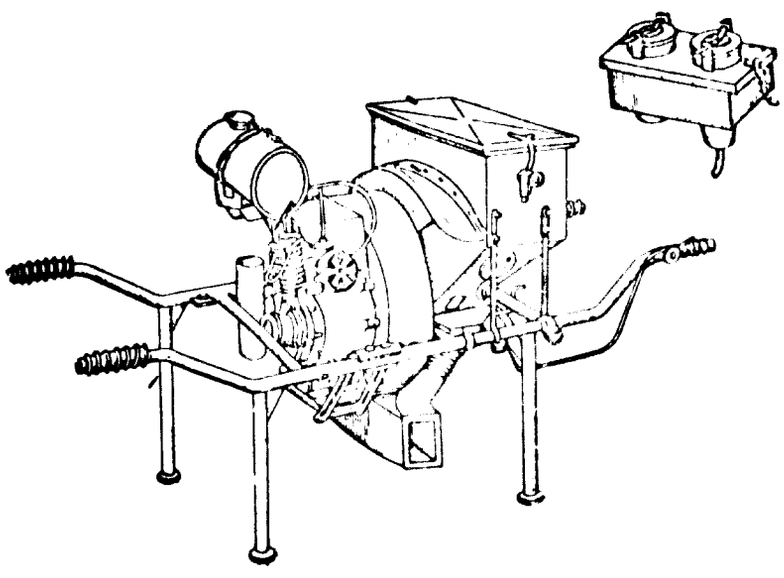
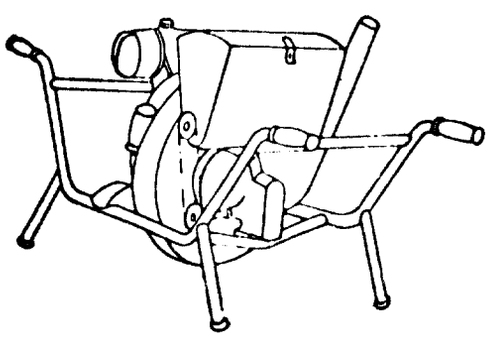


Fig. 2o



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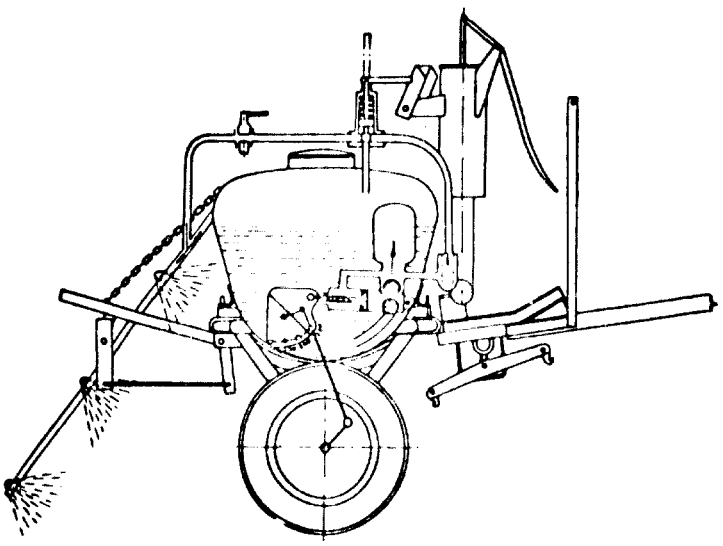

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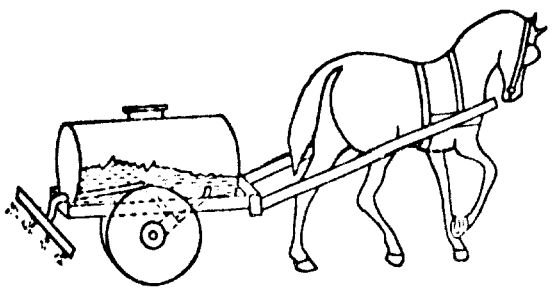

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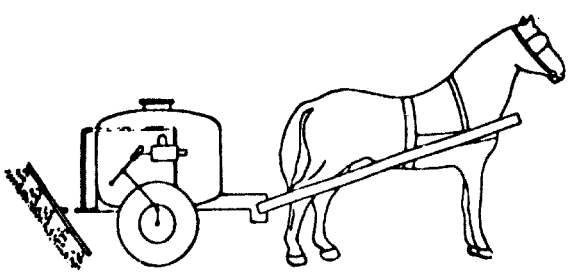

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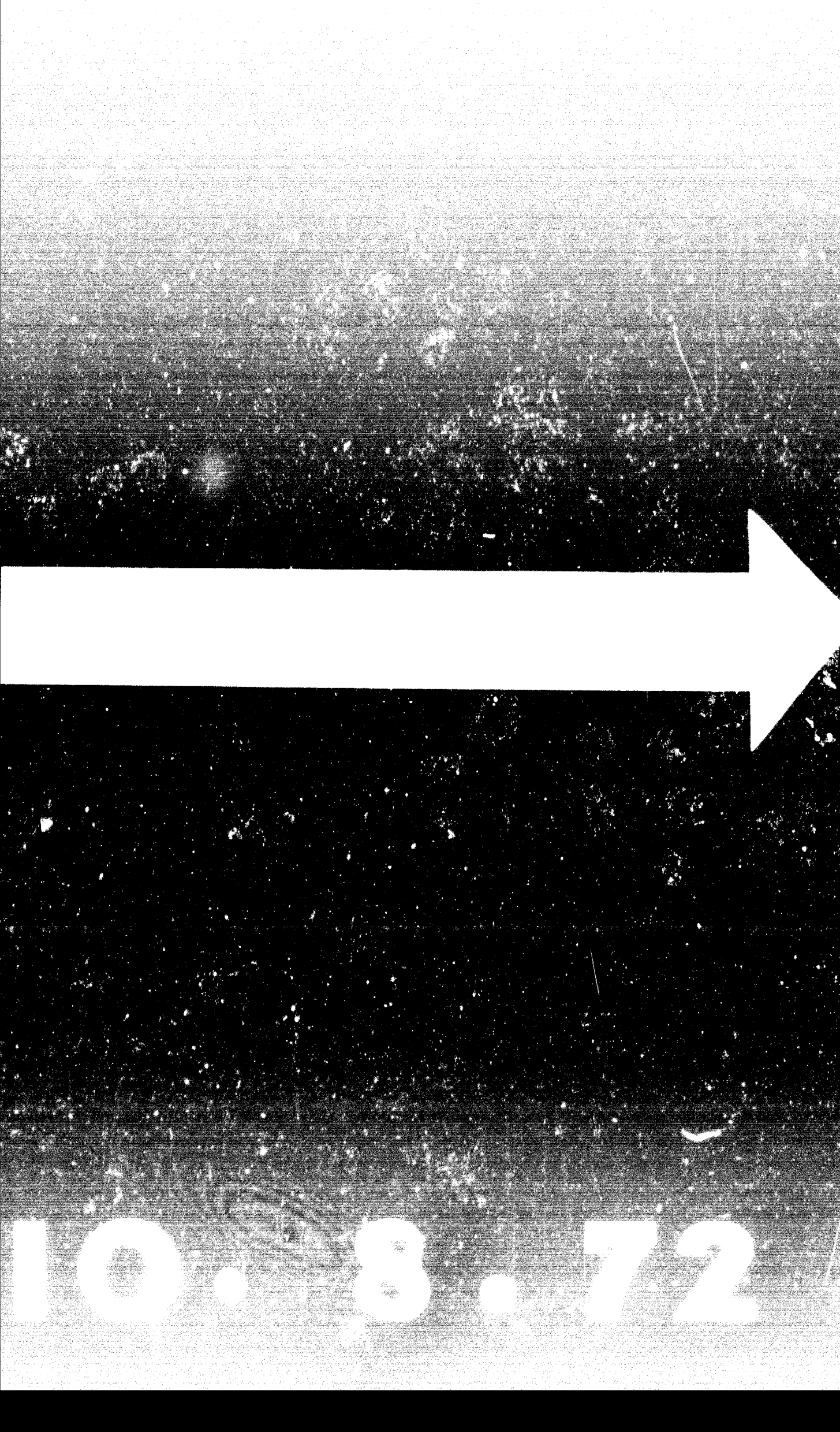
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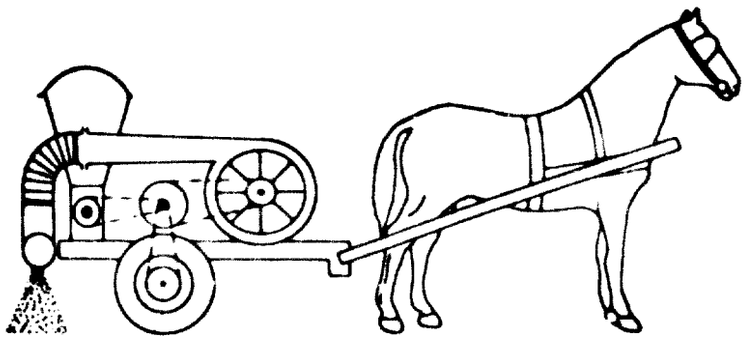

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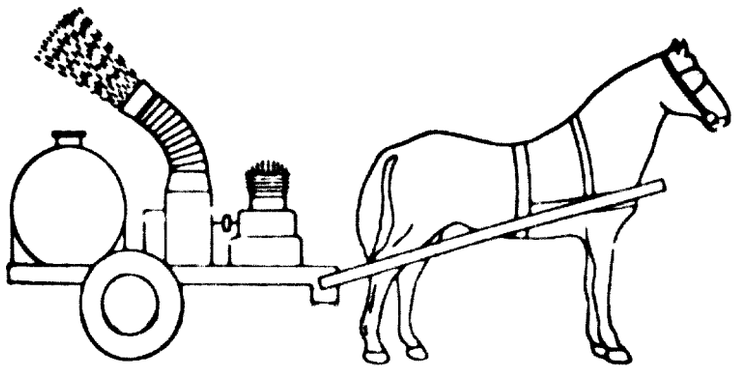

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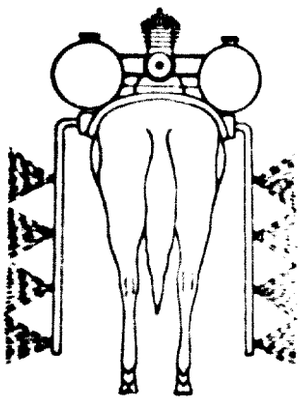

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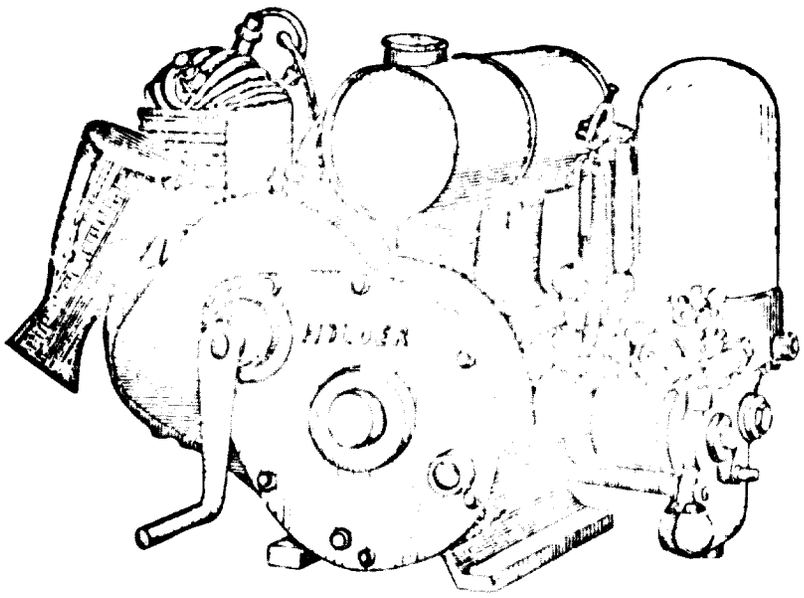

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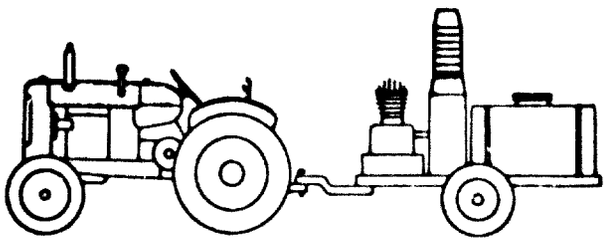

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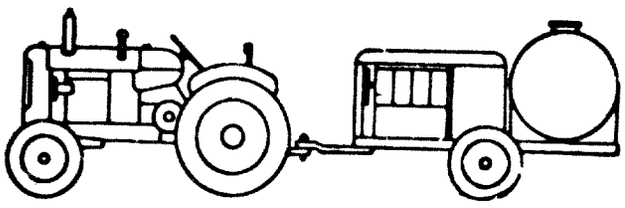

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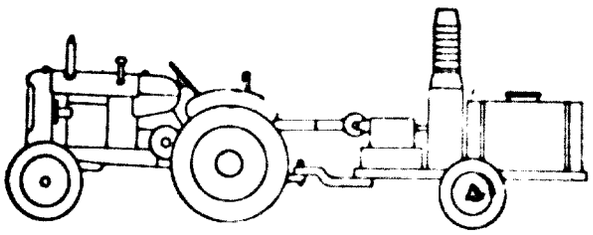

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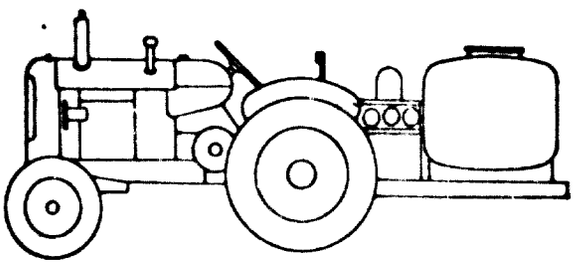

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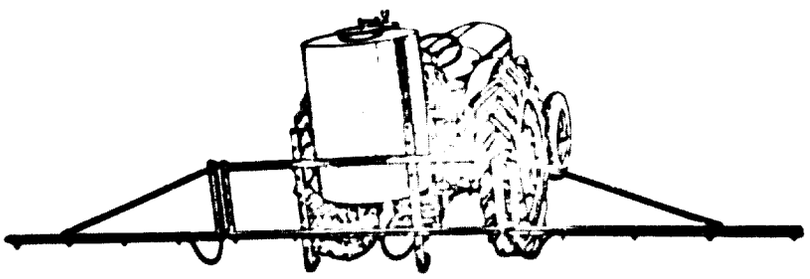

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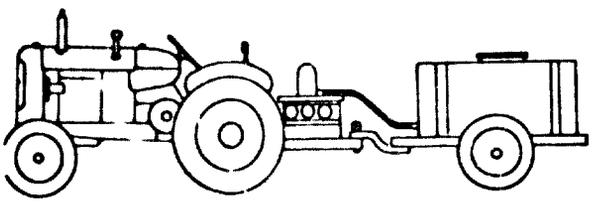

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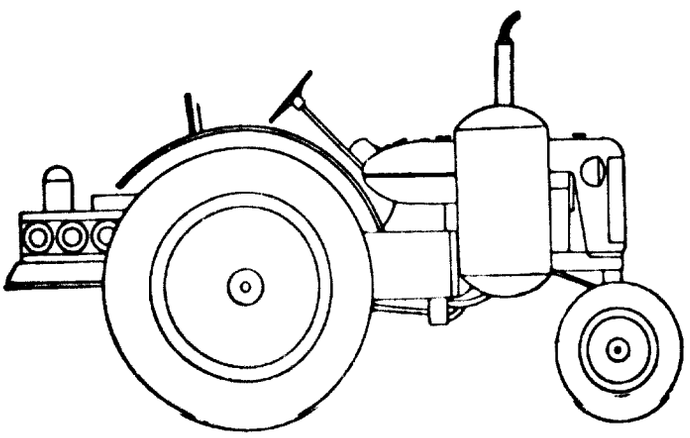

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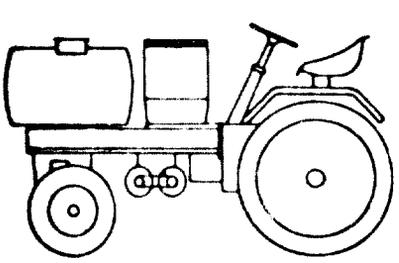

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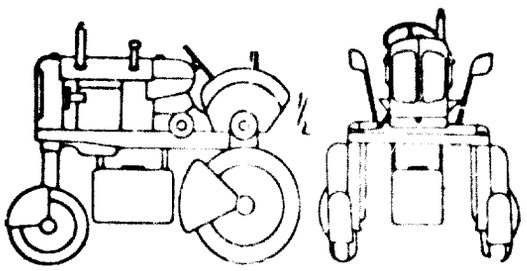

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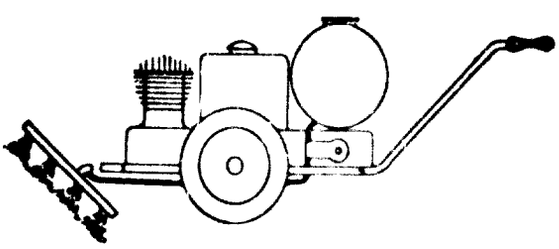

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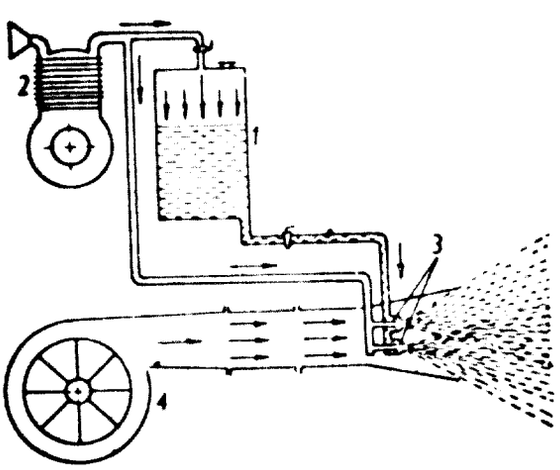

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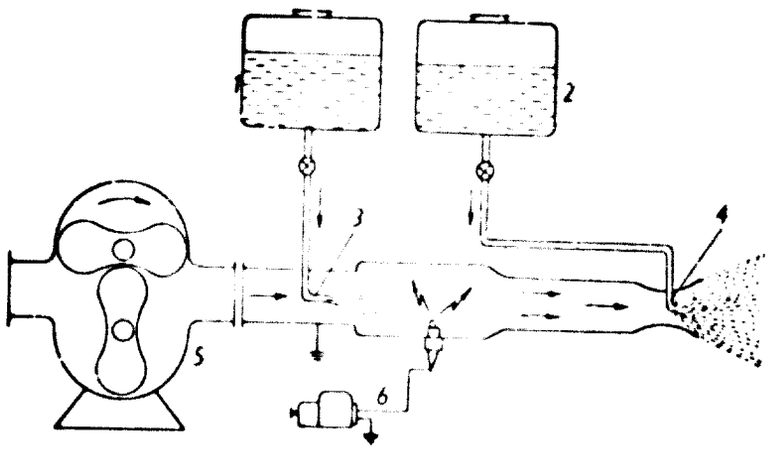

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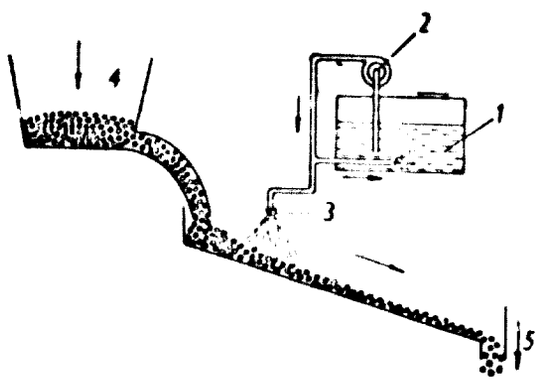

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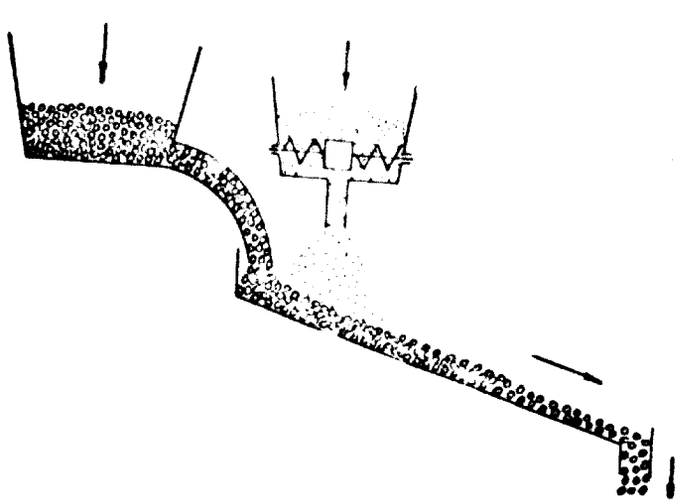

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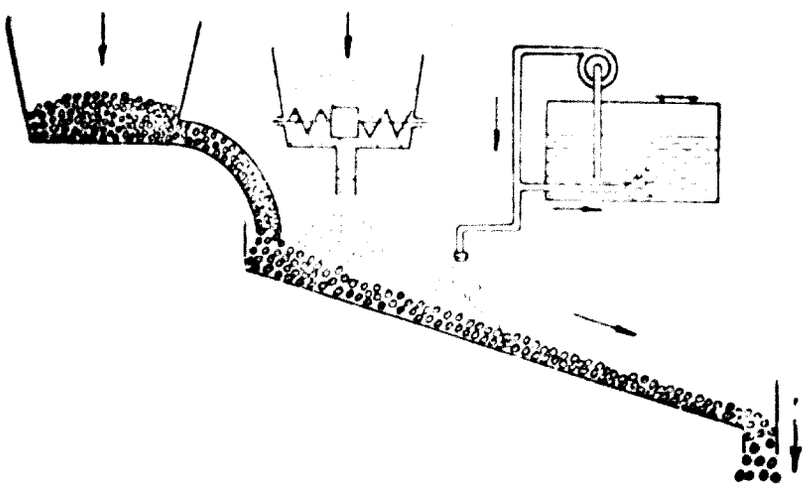

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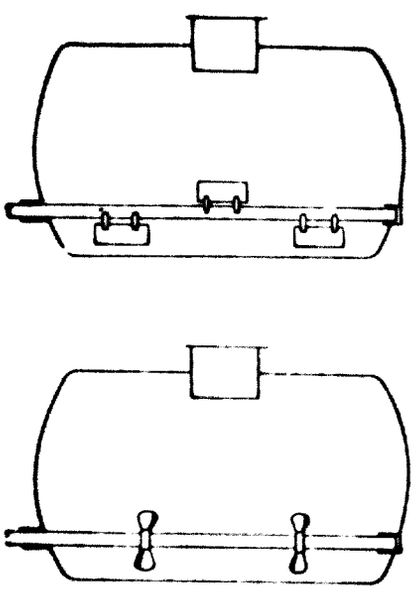

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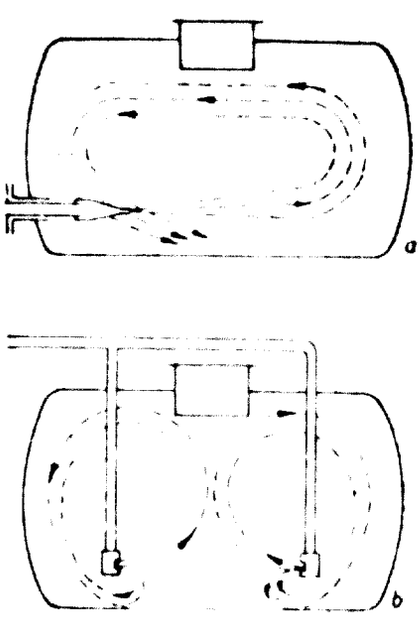

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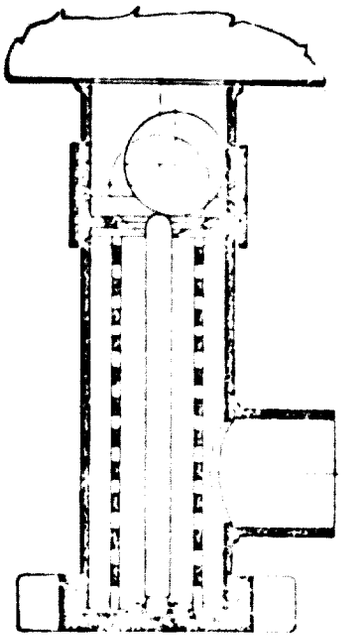

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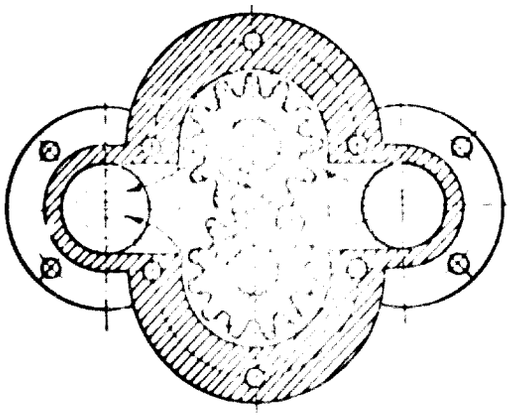

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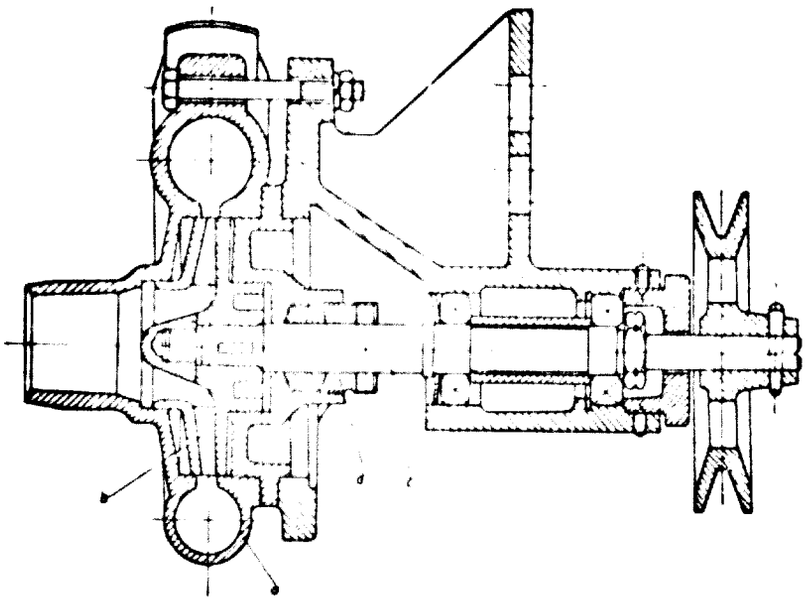

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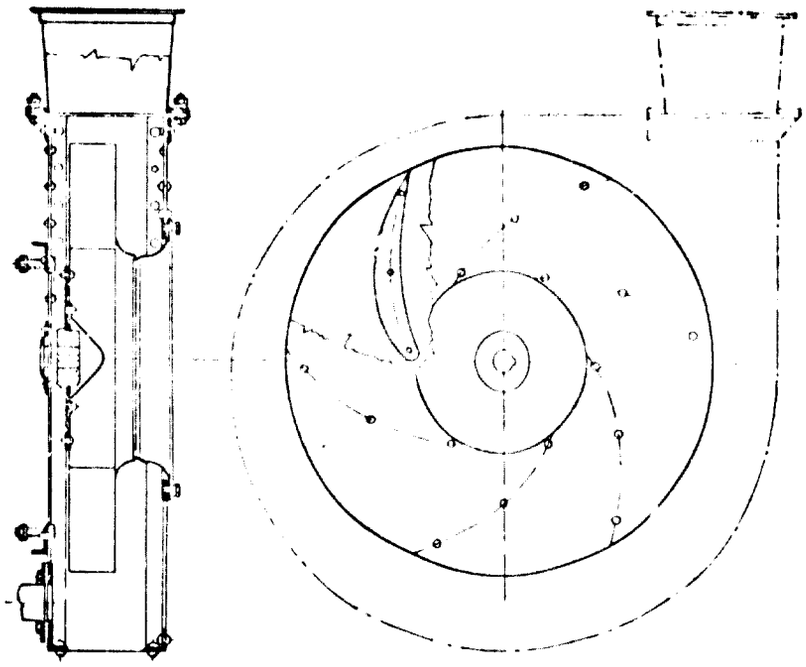

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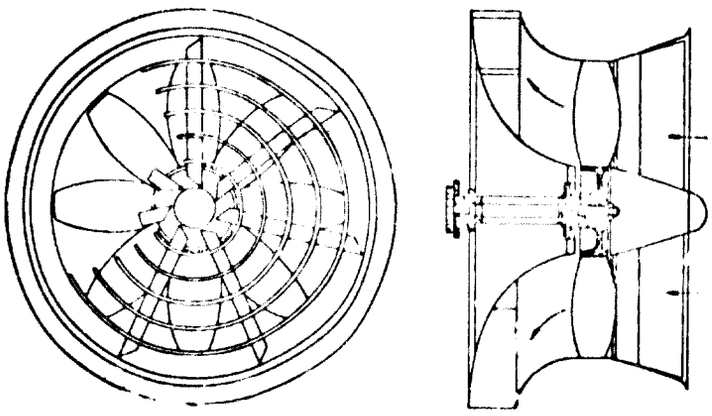

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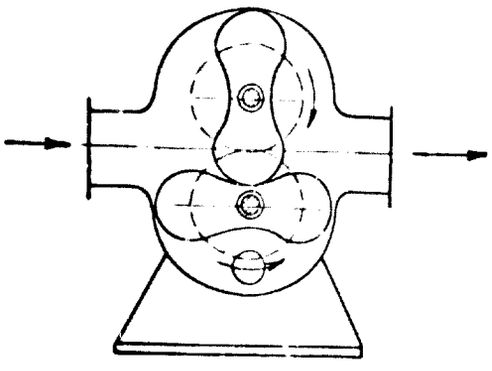

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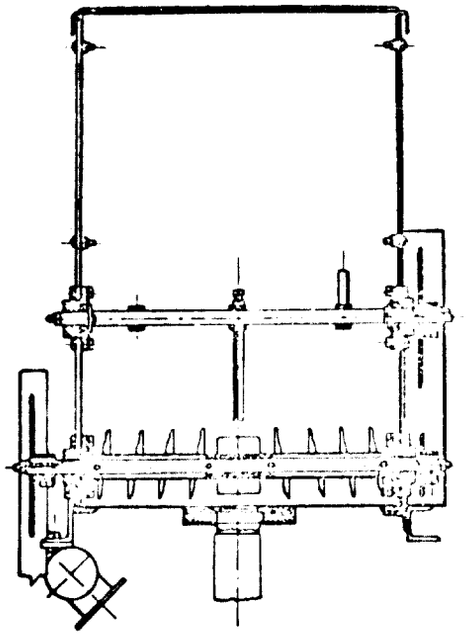

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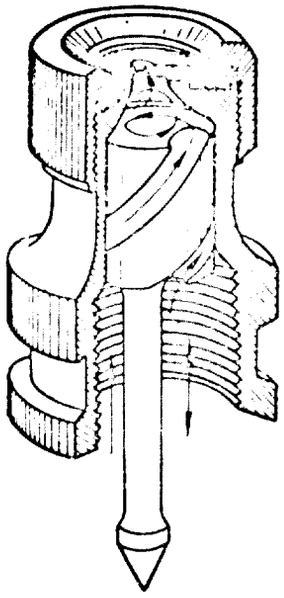

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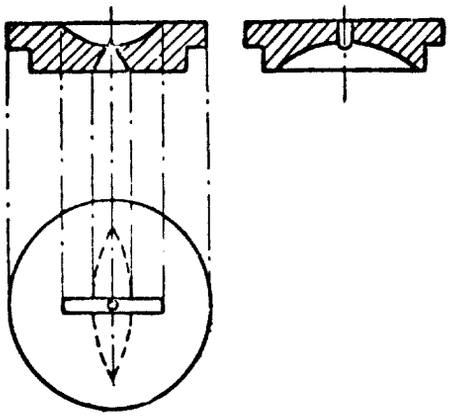

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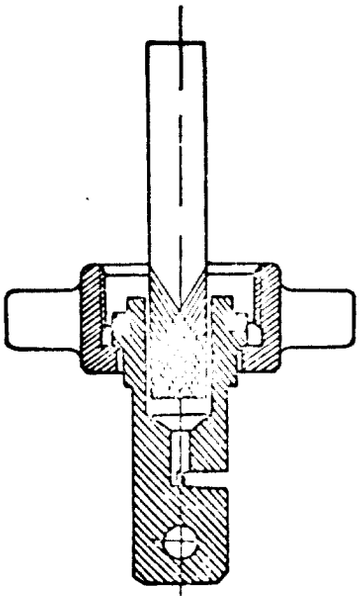

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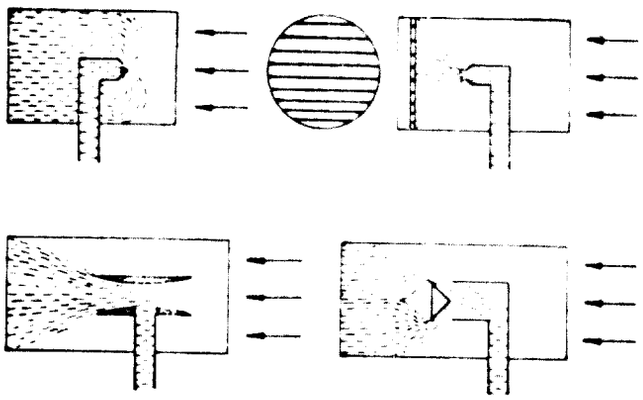

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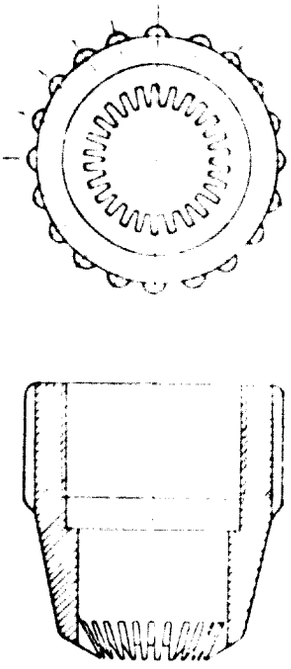

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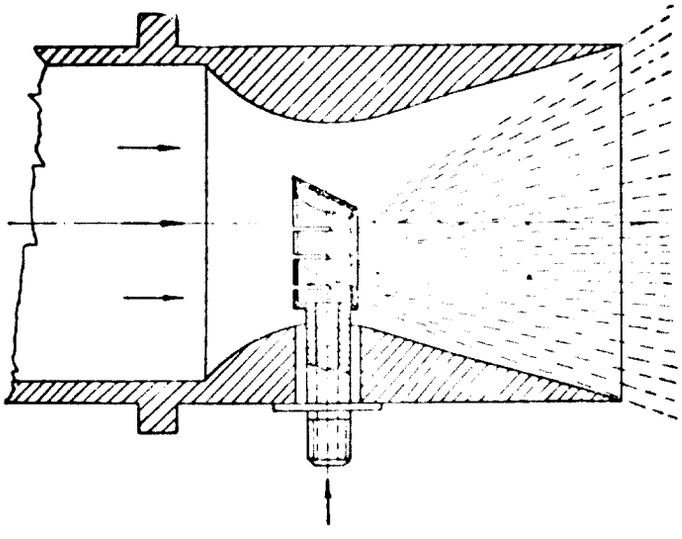

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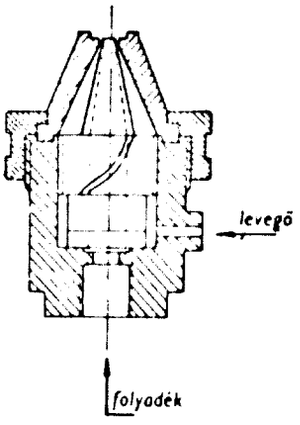

Fig. 59


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