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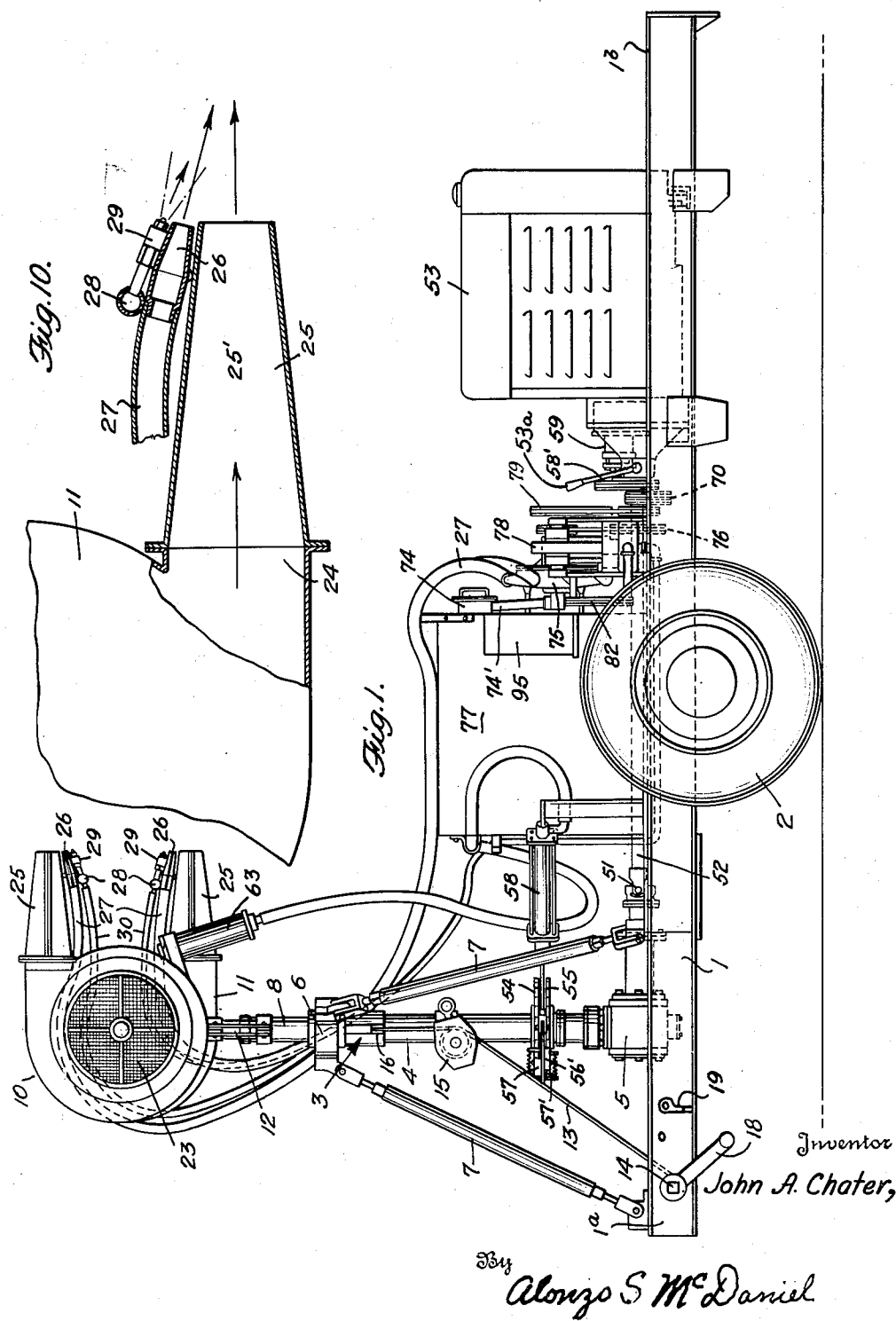
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2,608,792

MOISTENED DUST SPRAYING MACHINE

Filed Sept. 9, 1949

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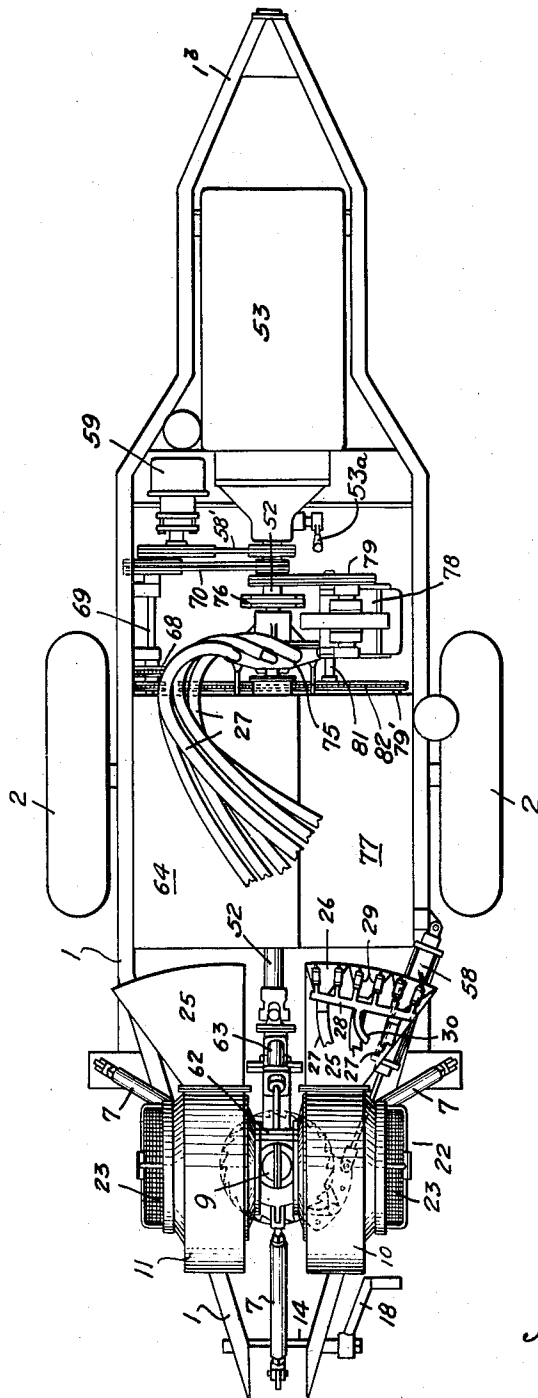
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Fig. 2.



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Fig. 3.

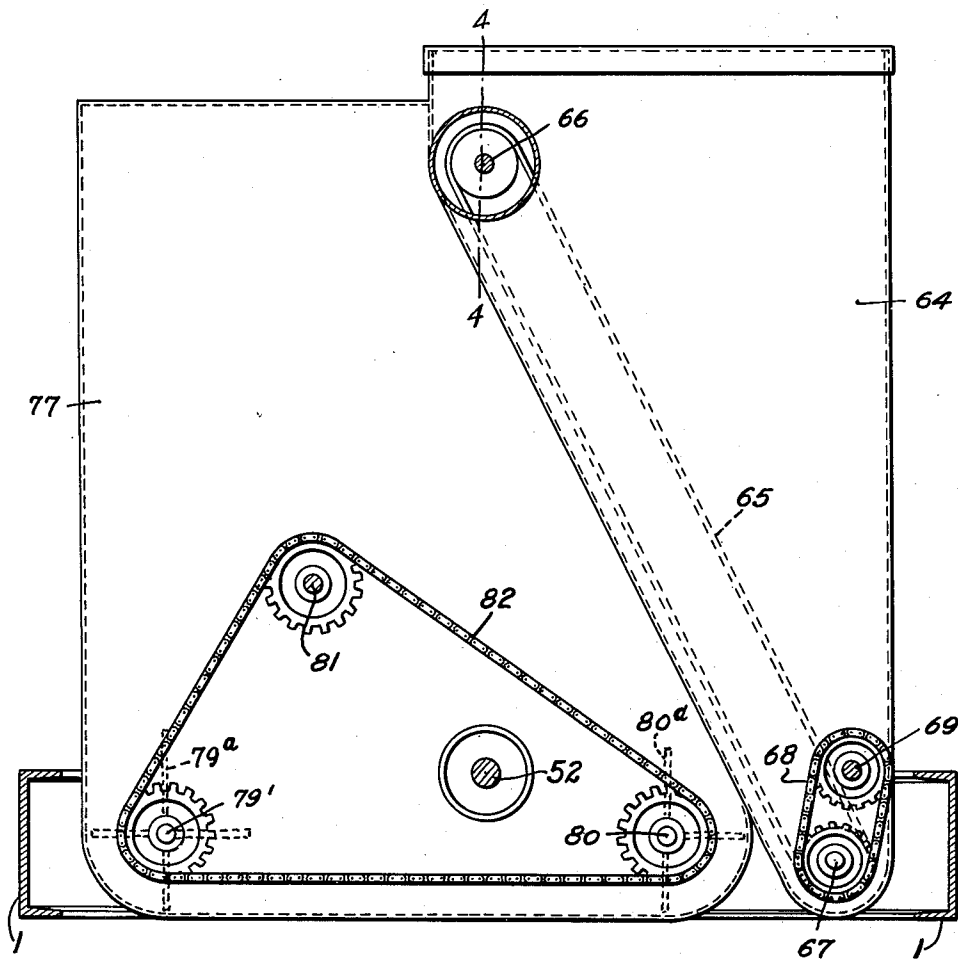
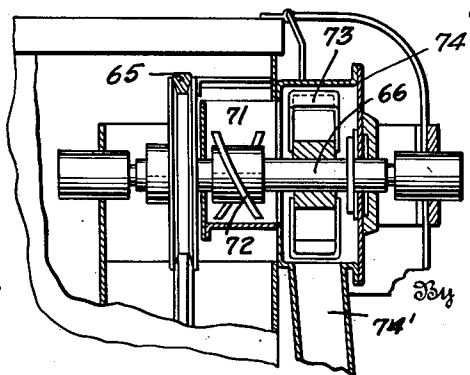


Fig. 4.

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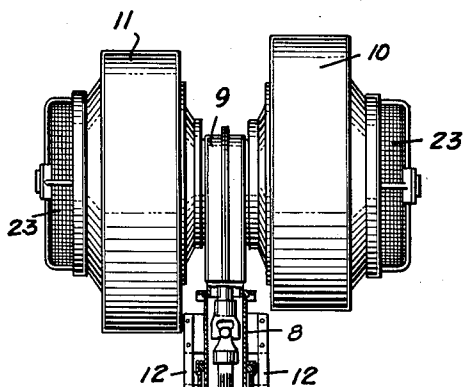


Fig. 5.

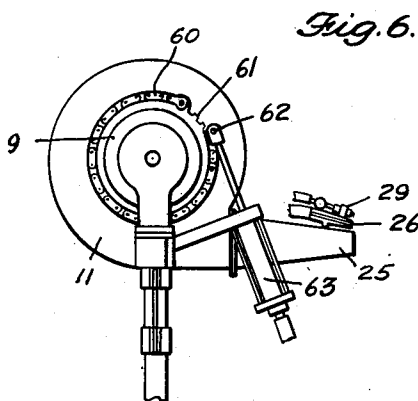


Fig. 6.

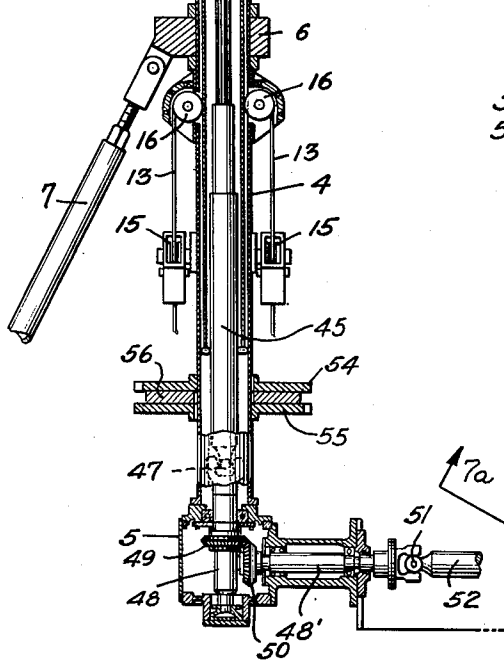
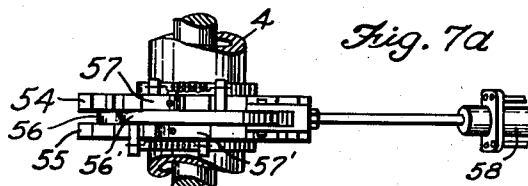


Fig. 7a

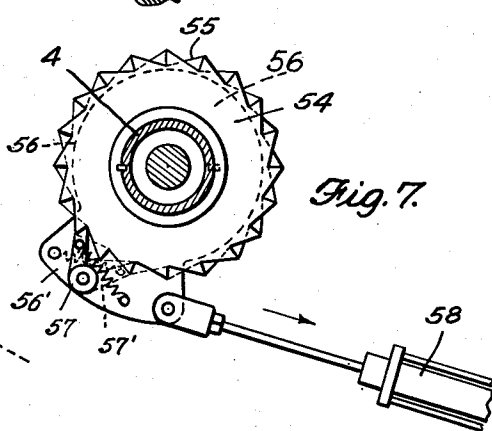


Fig. 7.

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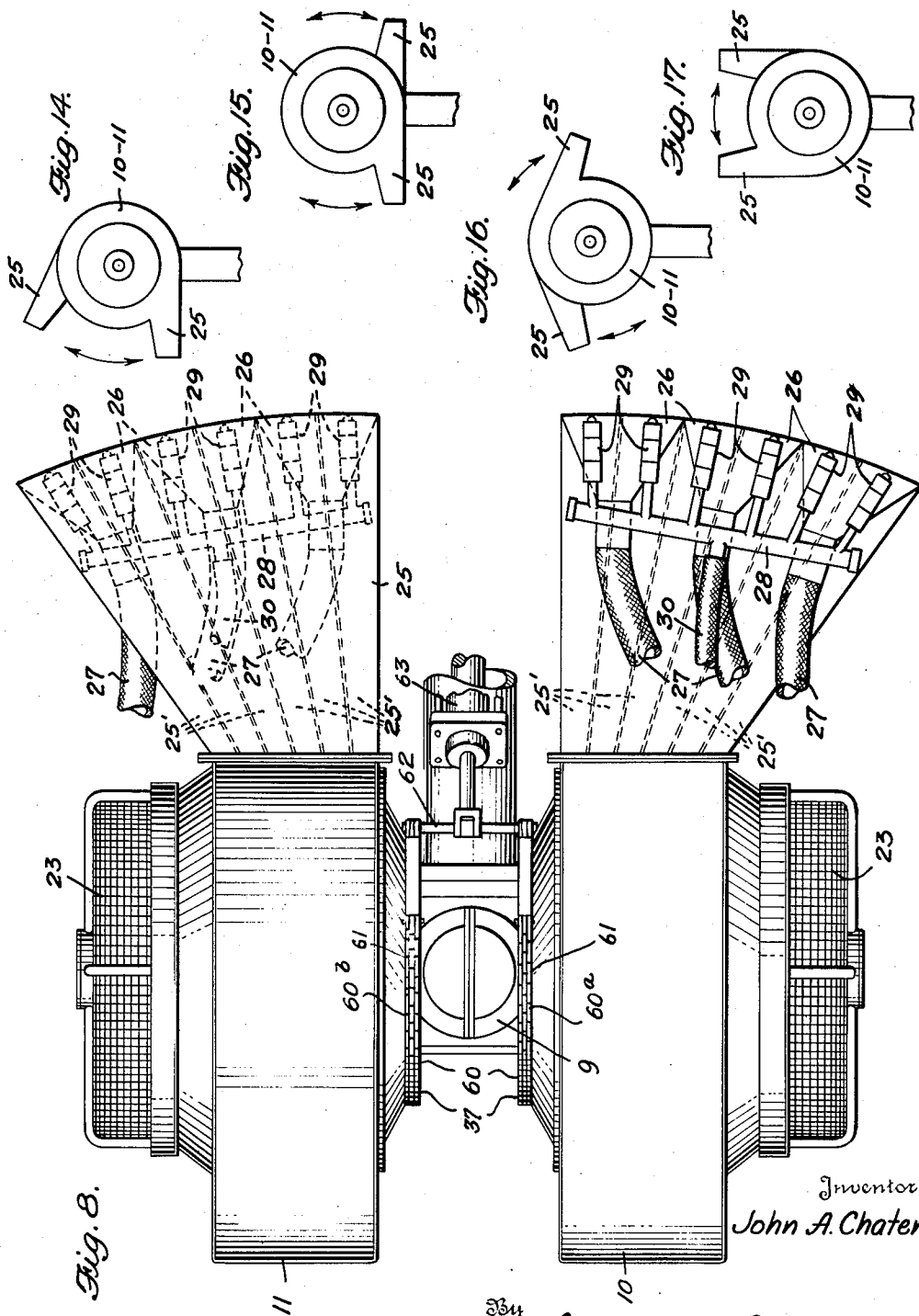
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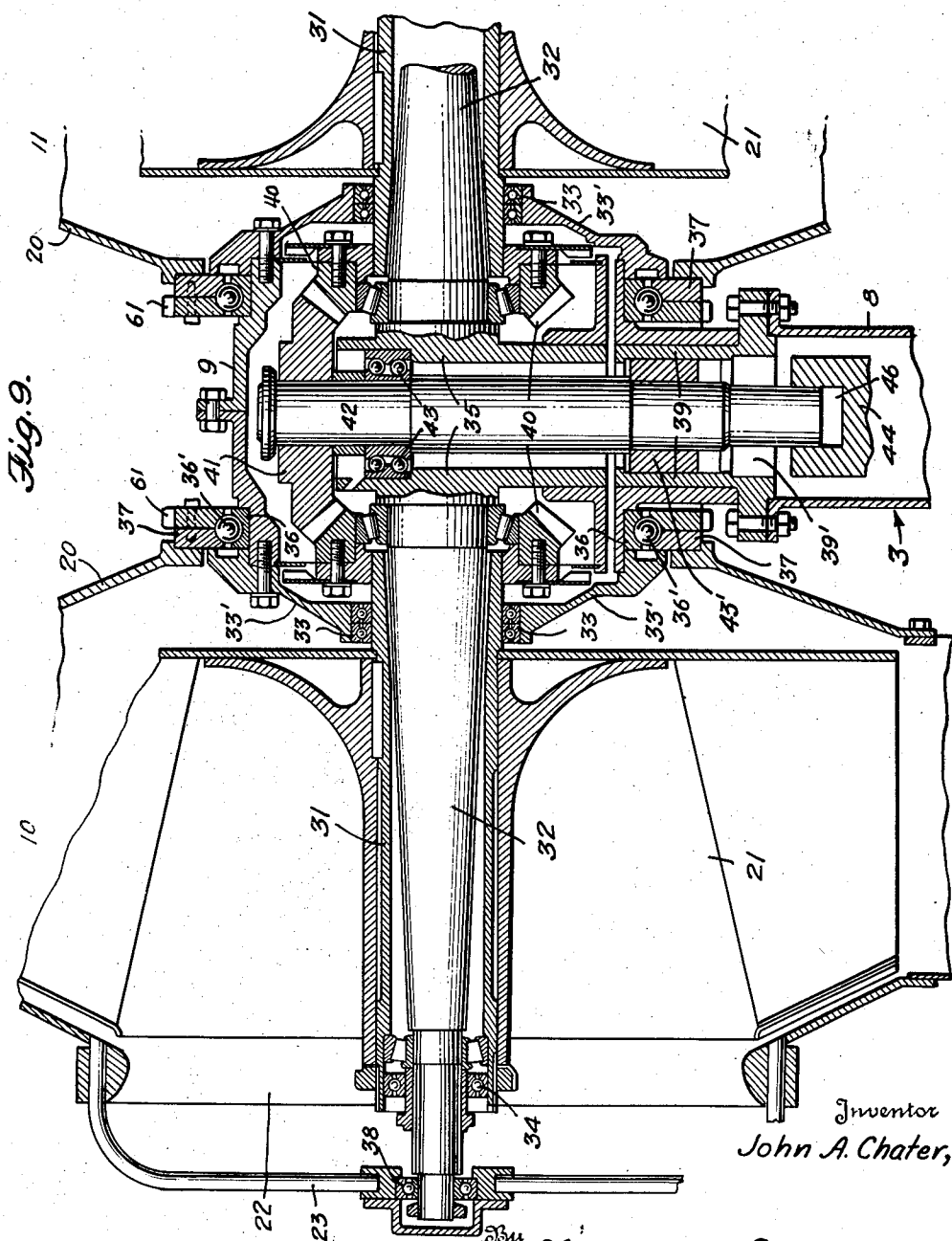
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MOISTENED DUST SPRAYING MACHINE

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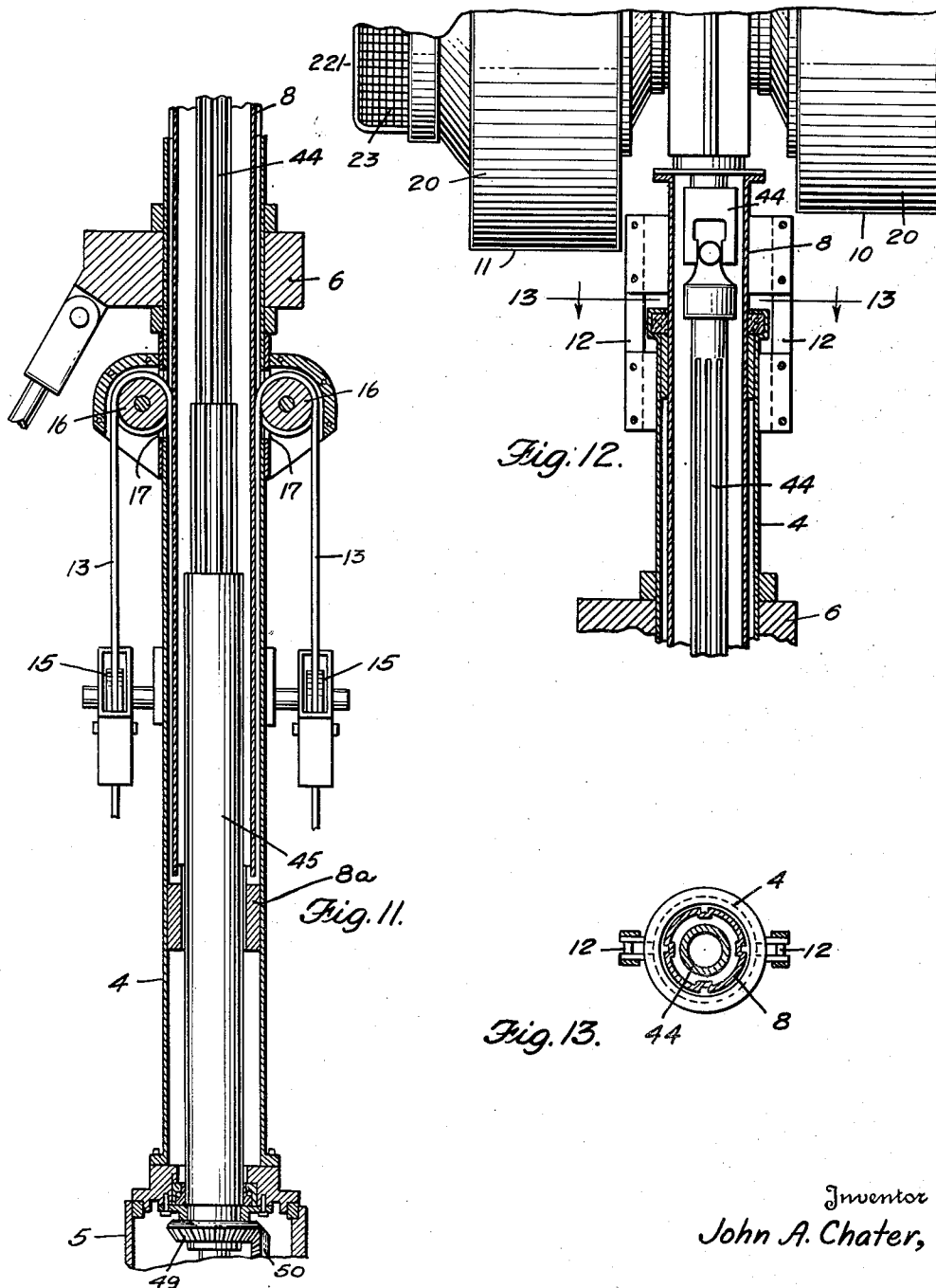


Fig. 12.

Fig. 13.

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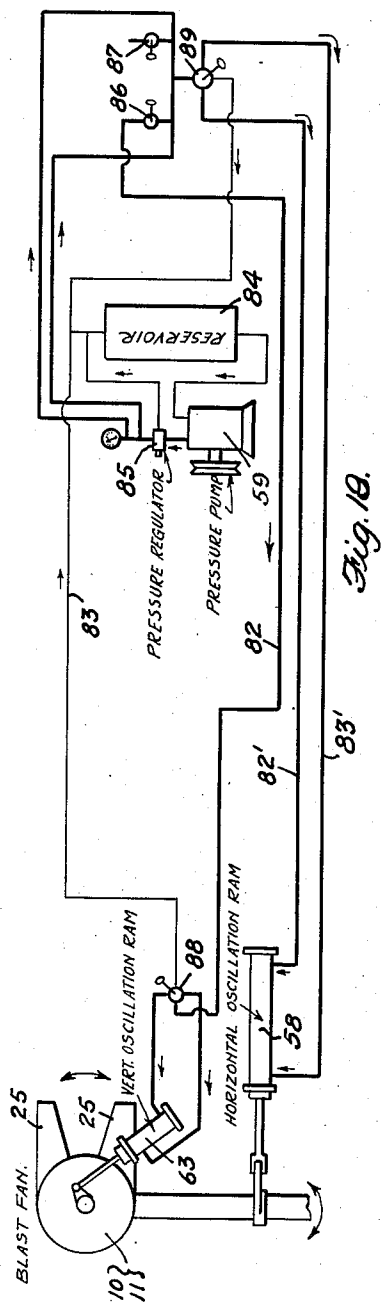
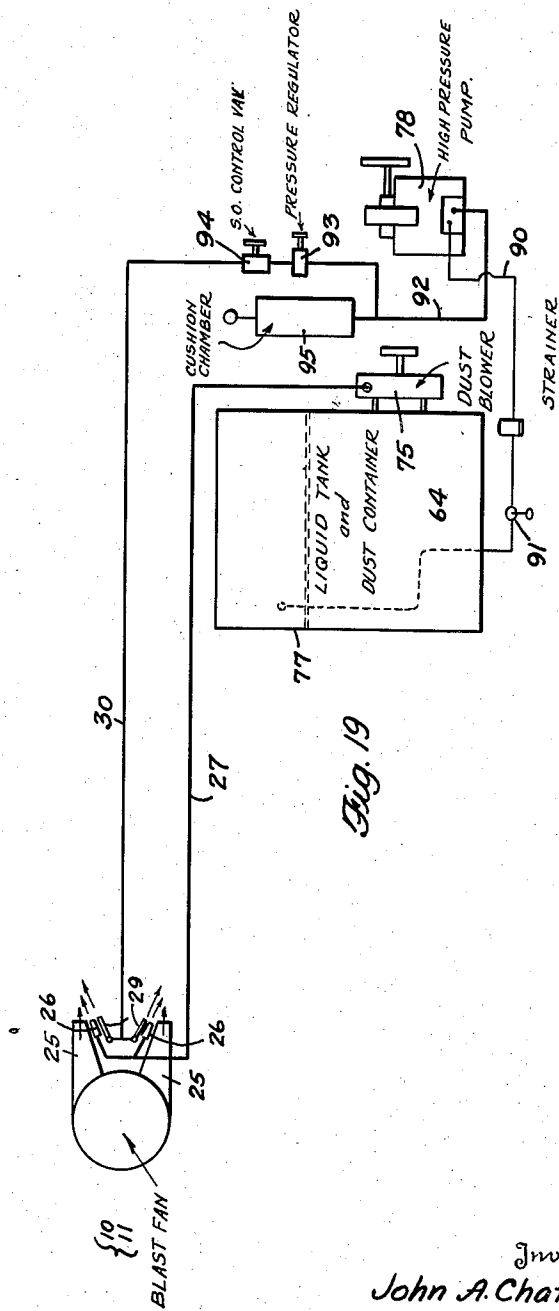
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## UNITED STATES PATENT OFFICE

2,608,792

## MOISTENED DUST SPRAYING MACHINE

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Application September 9, 1949, Serial No. 114,877

2 Claims. (Cl. 43-148)

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This invention relates to a method of and apparatus for producing a remedial, insecticidal or toxic spray and projecting the same into contact with growing vegetation, such as trees, plants or flowers, for the treatment of disease affecting or destruction of insects preying on the growing vegetation. More particularly the invention is directed to a novel and improved method and apparatus of that character in which a toxic agent combined with an inert material in dust form is mixed with a carrier stream of air whereby it is conveyed to and deposited on the plants.

It has heretofore been a practice to project a toxic dust or toxic liquid spray under high pressure directly against the plants or to mix the dust or spray liquid with an air carrier stream of large volume but high pressure whereby the dust or liquid is deposited on the plants. For reasons well known to those versed in the art these methods are wasteful or open to certain objections and are less effective than a method of treatment using dust as an active medium if the dust is wetted to prevent its undue dissipation in the air and cause it to adhere to the plants. The use of a wetted dust produced by introducing liquid into a carrier stream of air, with which the dust has been previously mixed, has been suggested, but this is open to the objection that the dust is dispersed to such an extent before being wetted that a proper mixture of dust and liquid for the production of a wetted dust for conveyance and adherence to the plants cannot be obtained.

One object of my invention is to provide a method and apparatus whereby these objections are overcome, and whereby dust in a suitably concentrated form may be wetted to a proper extent and the wetted dust then mixed with an air carrier stream for conveyance to the plants to be treated.

Another object of my invention is to provide a method and apparatus whereby streams of the dust, wetting liquid and carrier air may be brought together at a common aspirating and/or mixing point in such manner that a stream of atomized liquid will be caused to enter and commingle with a concentrated dust stream and to be forced or drawn therewith into the carrier air stream, whereby the dust will be wetted to a desired degree and dispersed in the air stream and conveyed in a properly wetted and dispersed state for distribution to and over the plants.

Still another object of my invention is to provide means for supplying the dust, liquid and air in proper volume and at proper pressures to discharge nozzles constructed and arranged in a

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novel manner to produce a composite spray of the character described.

Still another object of my invention is to provide a spray head for mixing the spray ingredients and projecting a plurality of commingled spray streams toward the vegetation to be treated.

Still another object of my invention is to provide a spray head which may be adjusted to different working elevations and oscillated horizontally or vertically to distribute the spray to different portions of the plants.

Still another object of my invention is to provide an oscillatory spray head which may be axially adjusted to different positions to discharge the spray at either side of the machine and at different angles or elevations to spray large or small trees or other vegetation.

Still another object of the invention is to provide a double spray head arrangement wherein each spray head embodies a centrifugal air blast fan for producing a carrier blast, which fans carry the spray nozzles and are mounted so that the fan runners are driven from a common central drive shaft by oppositely projecting driven shafts about which the heads may be horizontally oscillated for the purpose described, the arrangement and mounting of the heads being such that the heads may be adjusted to different working positions at the same or different sides of the machine to spread or vary the spray pattern as described, and the arrangement further being such that in operation the heads will eliminate gyroscopic forces so that they may operate at a high elevation without causing undue strain on their support.

With these and other objects in view, which will appear as the nature of the invention is more fully disclosed, the invention consists of the novel method and steps of the method, and of the novel features of construction, combination and arrangement of parts, hereinafter more fully described and claimed, and as shown in the accompanying drawings, in which:

Fig. 1 is a view in side elevation of a spraying apparatus embodying the invention, parts being omitted for sake of clarity or as not essential to the invention;

Fig. 2 is a top plan view of the same with parts broken away to more fully show other parts of the apparatus;

Fig. 3 is a view in elevation of the dust and liquid hoppers showing the means for driving the agitators in the hoppers and the dust elevator and feed fan;

Fig. 4 is a section on line 4-4 of Fig. 3 through

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the upper part of the dust hopper showing the upper portion of the dust conveyor, the dust agitator, the dust feeder and the chute leading to the dust blower;

Fig. 5 is a vertical section through the mast showing the spray heads in rear elevation;

Fig. 6 is a view looking toward the inner side of one of the spray heads and showing the ram and associated means for vertically oscillating the spray heads and permitting adjustment thereof;

Fig. 7 is a horizontal section through the mast showing the ram and associated means for horizontally oscillating the spray heads;

Fig. 7a is a fragmentary side view of the mast viewed in the direction of the arrows 7a—7a in Figure 7;

Fig. 8 is a top plan view on an enlarged scale showing the spray heads disposed to project spray in one direction laterally of the machine and illustrating the arrangement of the outlet ends of the dust and liquid supply tubes and the dust, liquid and air discharge nozzles;

Fig. 9 is a vertical sectional view through the gear box at the upper end of the mast, showing the gearing for operating the spray head fan runners and the mode of mounting the fan casings for adjustments and oscillating actions;

Fig. 10 is a fragmentary view on an enlarged scale of one of the spray head fan casings, showing in section the air discharge nozzle thereof and showing the arrangement of coating dust and liquid discharge nozzles relative thereto for producing the spray streams to be mixed;

Fig. 11 is a vertical sectional view through the lower portion of the mast and parts therein below the gear on an enlarged scale, certain parts being omitted;

Fig. 12 is a vertical sectional view through the upper portion of the mast on an enlarged scale;

Fig. 13 is a detail transverse section on line 13—13 of Fig. 12;

Figs. 14, 15, 16 and 17 are diagrammatic views showing different working positions to which the spray heads may be shifted;

Fig. 18 is a diagrammatic view showing the working parts and flow lines of the hydraulic ram mechanism for oscillating the spray heads;

Fig. 19 is a diagrammatic view showing the working parts and flow lines of the means for supplying dust and liquid to the dust and liquid nozzles of the spray heads for injection into the carrier air stream.

In carrying my invention into practice I provide a truck or trailer comprising a platform 1 supported at a point between its center and one end 1a on wheels 2 and adapted to be coupled at its opposite end 1b to a motor tractor or other draft means whereby it may be supported at that end and transported from place to place and moved along a field in which the vegetation to be treated is located.

Mounted upon the platform at or adjacent to its first-named end is a hollow telescopic mast 3 including an outer section 4 journaled at its lower end on or rotatably connected to a gear box 5, which is suitably fixed to the frame of the platform 1, and journaled at a suitably elevated point in a bearing bracket 6, secured to the frame of the platform by struts 7, whereby the mast is stably supported in position but may be oscillated about its vertical axis. Mounted to rotate with and slidably adjustable in the outer mast section 4 is an inner mast section 8 which carries at its upper end a gear casing 9 on which are

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mounted a pair of spray heads 10 and 11, which are similar in construction to each other and are hereinafter more fully and particularly described.

The mast section 8 may be adjusted in the mast section 4 to adapt the spray heads to be raised and lowered to different elevations or working positions for spraying tall or short trees or plants or spraying downward on the plants, and a clamp 12 is provided to clamp the mast section 8 in adjusted position to the mast section 4. This clamp may consist of fixed and removable sections bolted together and adapted when united to hold the mast section 8 in any position to which it may be adjusted. In order to raise and lower the section 8 and the parts carried thereby, which are more or less weighty, a raising and lowering device is provided in the form of a winch comprising cables 13 fixed at one end to a transverse shaft 14 on the platform frame and thence passing upward in engagement with a lower set of guide pulleys 15 on the mast section 4 and thence over an upper set of guide pulleys 16 on the mast section 4 and through slots 17 in said outermost section 4 to the interior thereof and depending therefrom and secured at their other ends to the bottom 8a of the mast section 8. On the shaft 14 is a hand crank 18 whereby the shaft 14 may be rotated to wind or unwind the cables, when the clamp 12 is released, to raise the mast section 8 or allow it to be lowered in a controlled manner by gravity. A holder 19 may be provided in the platform frame with which the crank handle may be engaged to hold the shaft 14 from rotation to temporarily maintain the mast section 8 in an adjusted position while the clamp 12 is being fastened or released. Any other means for holding the winch stationary may, however, be used, and any other suitable means in place of the winch may be employed to raise and lower the adjustable mast section.

The spray heads 10 and 11 are arranged in axial alignment opposite each other and at diametrically opposite sides of the mast center. Each consists of a centrifugal fan casing 20 and a runner 21, the casing having at its outer side an air inlet 22 guarded by a screen 23 and being provided at a point in its periphery with an outlet 24 from which extends a sector shaped, fan-shaped or outwardly flaring shallow nozzle 25 partitioned to provide a plurality of channels 25' arranged side by side to discharge streams of air over a comparatively wide area. These streams of air, supplied in large volume, but at low pressure, are combined on ejection to serve as a carrier stream for conveying the wetted dust in the form of a spray of dust and liquid to the plants to be treated. Supported by the air discharge nozzle on each fan casing is a transverse series of dust discharge nozzles 26, connected to flexible dust supply pipes 27, and also supported by the air discharge nozzle of each fan casing are headers 28 each carrying a transverse series of liquid discharge nozzles 29, which headers are connected to flexible liquid supply pipes 30. The nozzles 25, 26 and 29 are so arranged that their tips lie in close proximity, with each dust discharge nozzle 26 disposed between the air discharge nozzle 25 and a liquid discharge nozzle 29, and with the nozzles 26 and 29 disposed at an angle to the nozzle 25. This angular disposition is or may be such as shown particularly in Fig. 10, that the atomized streams of liquid issuing from the nozzles 29 will be projected toward, across and through the more or less concentrated streams of dust issuing from the nozzles 26 and pass there-

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with into the large volume stream of air issuing from the nozzle 25, whereby the dust particles will be mixed with particles of the liquid and wetted before they are dispersed to any material degree and at their time of mergence into the air stream. The effect of this action is that none of the dust will be blown away and lost and that the dust particles will be mixed with liquid before they are unduly dispersed by and in the current of air, and the wetted dust particles will be uniformly mixed with and more or less uniformly dispersed throughout the current of air. As a result, a mixture of a desired volume and consistency of the active agent or agents will be produced which is adapted to be conveyed by the carrier air stream toward and deposited on the plants so as to adhere to the plants to subject the same in a most highly efficient manner for treatment of disease or destruction of insect life, thus avoiding the objections named with respect to prior methods of producing and employing a treatment spray in which dust is used as an ingredient.

The dust employed may be an inert dust (a non-chemical dust or a non-toxic dust) mixed with a powdered toxic agent, or it may be a chemical or insecticidal dust mixed with a toxic agent, or a chemical or toxic dust may be used in connection with an insecticide wetting solution acting in conjunction with the dust to produce a treatment spray of a proper kind and potency. The liquid employed may be a solution of water and a wetting agent, or such a solution containing also a toxic agent, or it may consist of a simple toxic solution or plain water. In the present instance it may be assumed that the liquid consists of a solution of water and a wetting agent. I do not, however, limit myself in these particulars or to the particular angles at which the dust and wetting liquid streams are projected for a commingling action with each other and with the air stream so long as the defined method of delivering dust and liquid in the described condition to the carrier air stream is preserved.

While a single spray head may be used in a small capacity machine, I preferably employ a pair of spray heads because of their wider range of usefulness and because of certain other advantages which are obtained. As before stated, each of these spray heads is of centrifugal fan type and comprises a casing 20 and a runner 21 therein which are arranged about a horizontal, hollow runner drive shaft 31, the shafts 31 of the two spray heads being arranged about stationary shafts or supporting arms 32, and the shafts 31 being journaled at their inner ends in bearings 33 interposed between the shafts 31 and the side walls 33' of the casing 9 and at their outer ends in bearings 34 interposed between the shafts 31 and the outer ends of the shafts 32, which ends of the shafts 32 project outward beyond the outer ends of the shafts 31. The shafts or arms 32 are fixed at their inner ends to a bearing sleeve 35 disposed vertically in the casing and the shafts 31 and 32 are arranged at right angles to the sleeve and concentric with each other at opposite sides of said sleeve 35 and at equal distances beyond the axial center of the mast. Bearing rings 36 mounted on the casing 9 and carrying anti-friction bearings 36' engaged by supporting rings 37 on the fan casings form supports for the inner sides of the fan casings which are supported at their outer ends by bearings 38 carried by the screens 23 on the extended outer ends of the shafts or arms 32, whereby the fan casings are

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mounted to permit them to be axially adjusted and vertically oscillated in a manner hereinafter described. The sleeve 35 is disposed in the casing 9 above a spray head carrier sleeve 39 suitably secured within the bottom of the casing 9 and detachably coupled by a bearing and coupling member 39' to the upper end of the mast section 8, whereby the spray head section as a whole is supported and is adapted to be vertically adjusted by raising and lowering the mast section 8, as hereinbefore described.

The gearing which drives the fan runners 21 comprises bevel gears 40 on the inner ends of the shafts 31 which mesh with a bevel gear 41 arranged therewith in the casing 9. Gear 41 is mounted upon the upper end of a shaft 42 disposed in the sleeve 35 and member 39 and journaled at its upper end in a bearing 43 in the sleeve 35 and adjacent its lower end in a bearing 43' in the member 39 and extending at its lower end below the sleeve 39 and into the upper end of the mast section 8. Within the mast is arranged a telescopic transmission shaft comprising an upper shaft section 44 which is fitted to slide within and feathered to rotate with a hollow lower shaft section 45. The shaft section 44 has a step bearing 46 at its upper end receiving the lower end of the shaft 42, while the shaft section 45 is coupled at its lower end, as at 47, to a short shaft 48 in the gear box 5, whereby the telescopic shaft and the runner drive shafts are adapted to be driven to operate the fan runners. The telescopic shaft section 44 is adapted to slide with the mast section 8 in its vertical adjustments so that in any position to which the spray heads may be raised and lowered the fan runners may be driven. Journaled in the gear box 5 is a short horizontal shaft 48' which is connected to the shaft section 48 by bevel gears 49, 50 and coupled, as at 51, to the forward end of a main driving shaft 52 suitably driven from the shaft of a motor 53 mounted upon the rear portion of the platform 1. Any suitable controlling means may be provided to throw the shaft 52 into and out of action and to control the operation of the motor and the driven speed of the fan runners.

The means for horizontally oscillating the spray heads may be of any suitable type but as shown comprises a pair of ratchet disks 54, 55 fixed to the mast section 4 above and below a spacing disk 56 journaled for free rotative movement upon the lower mast section 4, the ratchet disks having ratchet teeth facing in opposite directions. Disk 56 has an ear or projection 56' carrying pivoted, spring controlled pawls 57, 57' to engage the teeth of the respective ratchet disks to rotate the disks and the mast to which they are affixed in opposite directions in an obvious manner. To the ear 56' is connected the piston rod of a hydraulic ram 58 arranged in a liquid supply circuit including a pressure pump 59, driven through a transmission 58' from the main drive shaft, 52 according to the position of a manual control lever 53a. Through the operation of said pump the pawls are actuated to alternately engage the ratchet disks to oscillate the mast and there-through the spray heads to direct the spray horizontally through a given arc over the plants to be treated. To change the rotative adjustment of the mast, one or the other of the pawls may be raised out of engagement with its ratchet disk while reciprocally moving the piston rod of the ram 58.

The means for vertically oscillating the spray heads may also be of any suitable type but as

shown comprises a sprocket link belt, band or strap connection 60 embracing the periphery of the casing 9 and embodying a pair of sprocket chains 60a, 60b detachably secured at one end to the sprocket rings 37 and engaging sprocket teeth 61 on the rings and having their opposite or free ends detachably connected to a rod 62 coupled to the piston rod of a hydraulic ram 63 supported by the casing 9 or otherwise at the top of the mast. The ram is arranged in a hydraulic supply circuit connected with the pump 59 and normally holds the fan casings against rotation in a position in which the nozzles 25, 26, 29 and other weighting parts carried thereby are disposed in their normal working position as regards their level of projection from the fan casing. In one direction of motion the ram operates to rotate the fan casings so as to swing the nozzles upwardly. In its opposite direction of motion the ram operates to rotate the fan casings so as to swing the nozzles downwardly, or to allow the parts to return to normal position by gravity. By this means the spray heads may be oscillated vertically to spray up and down within a given radius when this manner of spraying is required. The free ends of the chains may be detached from the rod 62 and the other ends of the chains detached from the sprocket rings 37 to allow relative rotative adjustments of the fan casings to dispose their nozzles in varying working positions in which they may be held by refastening the ends of the chains to the rod and to the sprocket rings 37.

The fan casings are normally held to dispose their nozzles in a desired working position or positions by the belt or band 60, but are rotatably adjustable about their axes to dispose the nozzles in different positions to project the spray upward, downward or in either direction laterally of the machine. Figs. 14, 15, 16 and 17, for example, show some of these adjustments. In Fig. 14 the fan casings are shown as arranged to project the spray at different high and low levels beyond one side of the machine. Fig. 15 shows the fan casings adjusted to project the spray at a low level beyond opposite sides of the machine. Fig. 16 shows the fan casing adjusted to project the spray at a high level beyond opposite sides of the machine. Fig. 17 shows the fan casing adjusted to project the spray vertically upward in parallel streams. It is to be understood from these illustrations that the two sprayers may be adjusted in the same or different directions to the same or different degrees so that they may both discharge upwardly or downwardly, or discharge at the same or different sides of the machine, at the same or different levels, the advantages of which for the performance of various spraying operations will be readily understood. These adjustments may be effected by releasing the link belt 60 which holds the fan casings stationary, then turning one or the other, or both, of the fan casings to the desired position or positions of adjustment, and then refastening the ends of the belt members to hold the fan casings in their new relative positions of adjustment.

It will be noted that by the mounting of the fans and their runners on the same center line and with the runners revolving about a common axis and on opposite sides of a conveyor drive shaft, all gyroscopic actions and reaction forces will be balanced out, allowing mounting of the spray heads in a high position on a mast without causing undue strain on the mast or its

supports. This arrangement also allows spraying to be done at a higher level than usual and adjustment of the fan casings in the manner described to vary the spray pattern to wide degrees.

The means for supplying the dust in concentrated form to the dust nozzles 25 comprises a dust containing tank or hopper 54 mounted on the platform 1 and having an endless conveyor or elevator 65 therein passing around pulleys on shafts 66 and 67, shaft 67 being driven by gearing 68 from a shaft 69 driven by gearing 70 from the main drive shaft. This conveyor picks up the dust from the hopper and conveys the same to a primary feed box 71 containing an agitator or stirrer 72 which breaks up any lumps and reduces the dust to a uniformly fine state. The agitator is mounted on the shaft 66 on which is also mounted an even-feed fan 73 operating in a secondary feed box or casing 74 communicating with the feed box 71 and into which the dust is fed and drawn by the action of the agitator and the feed fan. From the feeder fan casing the dust passes through a duct 74' to a blower 75 driven by gearing 76 from the main drive shaft. The blower casing is provided with a plurality of peripheral outlets with which the inlet ends of the pipes 27 are connected, which pipes lead therefrom to the nozzles 26. The fan blows the dust through these pipes and the dust issues from the nozzles 26 in the form of concentrated dust streams.

The means for supplying liquid to the liquid atomizing nozzles comprises a tank 77 to contain water or other suitable liquid or solution as hereinbefore described. This tank communicates with a pressure pump 78 driven by gearing 79 from the main shaft and with the outlet of which connect the pipes 30 leading to the manifold pipes to which the liquid spray nozzles 29 are connected, whereby the liquid at the desired pressure is supplied to said nozzles. Mounted upon the tank are shafts 79', 80, 81 carrying sprocket gears about which are trained a drive chain 82. On the shafts 79', 80 within the tank are mounted agitators 79a, 80a of suitable type. Shaft 81 receives its motion from the pump 78 whereby when the pump is in operation the agitators will also be operated.

Figs. 18 and 19 show diagrammatically but in greater detail the parts of the hydraulic ram driving and liquid nozzle supply systems. As shown in Fig. 18, the rams are arranged in a hydraulic circuit including sets of feed and return lines 82, 83, 82', 83', a liquid reservoir 84, a pressure regulator 85, and valves 86, 87, 88 and 89 suitably arranged to control the supply of liquid to the rams. As shown in Fig. 19 the pump 78 is connected by an intake pipe 90, containing a control valve 91, with the tank 77, and by a discharge pipe 92, containing a pressure regulator 93, a control valve 94, and a cushion chamber 95, with the liquid supply pipes 30 leading to the nozzles 29.

From the foregoing description, taken in connection with the drawings, the method of forming and projecting the spray, and the construction and mode of operation of the apparatus embodying my invention, will be readily understood without a further and extended description, and it will be seen that my method of producing and projecting the spray overcomes the specified objections to previous wetted dust spray methods and secures the advantages hereinbefore set forth. Also it will be seen that

my invention provides an apparatus whereby direct or sweep spraying at different levels and in one direction or in different directions simultaneously may be performed to deposit the spray in an optimum condition and in a most efficient manner on the plants.

It will, of course, be understood that the steps of the method, and construction and arrangement of the parts of the apparatus, may be varied within the scope of the appended claims without departing from the spirit or sacrificing any of the advantages of the invention.

#### I claim:

1. A plant spraying apparatus comprising a spray-head having means for projecting into the atmosphere for admixture an air carrier stream, liquid spray streams, and concentrated dust streams, said means embodying a fan having a comparatively wide, shallow-depth discharge nozzle for producing and projecting an air carrier stream of large volume at low pressure, a plurality of liquid spray nozzles arranged longitudinally of and side by side transversely of the air discharge nozzle, a plurality of similarly arranged dust nozzles disposed between said liquid spray nozzles and the shallow-depth discharge nozzles, the nozzles being arranged axially to discharge their streams in the same general direction, the spray nozzles being positioned closely adjacent the dust nozzles and directed at relative angles such as to cause mergence of the streams and to cause an inter-mixture of the spray and dust streams at or just prior to their mergence with the air stream, means for supplying liquid under pressure to the liquid spray nozzles, and means for supplying streams of dust in a substantially concentrated state to the dust nozzles.

2. A plant spraying apparatus comprising a spray-head having means for projecting into the atmosphere for admixture an air carrier

stream, liquid spray streams, and concentrated dust streams, said means embodying a fan having a comparatively wide and shallow discharge nozzle for producing and projecting an air carrier stream of large volume at low pressure, a plurality of liquid discharge nozzles extending longitudinally of the air discharge nozzle adjacent its outlet, a plurality of similarly arranged dust discharge nozzles located between the liquid discharge nozzle and the shallow-depth discharge nozzle, said liquid and shallow-depth discharge nozzles being arranged at such angles relative to each other and to the dust nozzle as to cause mergence of the streams and mixture of the spray streams with the dust streams at or just prior to their mergence with the air stream, means for supplying liquid under pressure to the liquid spray nozzles, and means for supplying streams of dust in substantially concentrated form to the dust nozzles.

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