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Brown

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[54] **ACCESSORY ATTACHMENT FOR A VEHICLE USED FOR FLUID SPRAYING OF VEGETATION**

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[51] **Int. Cl.**..... **B05b 15/02;** B05b 17/02; B05b 1/30

[58] **Field of Search** 239/104, 119, 159, 164, 239/171, 176, 392, 395, 443, 446, 448, 449, 551, 562, 570–572, 578, 583, 586

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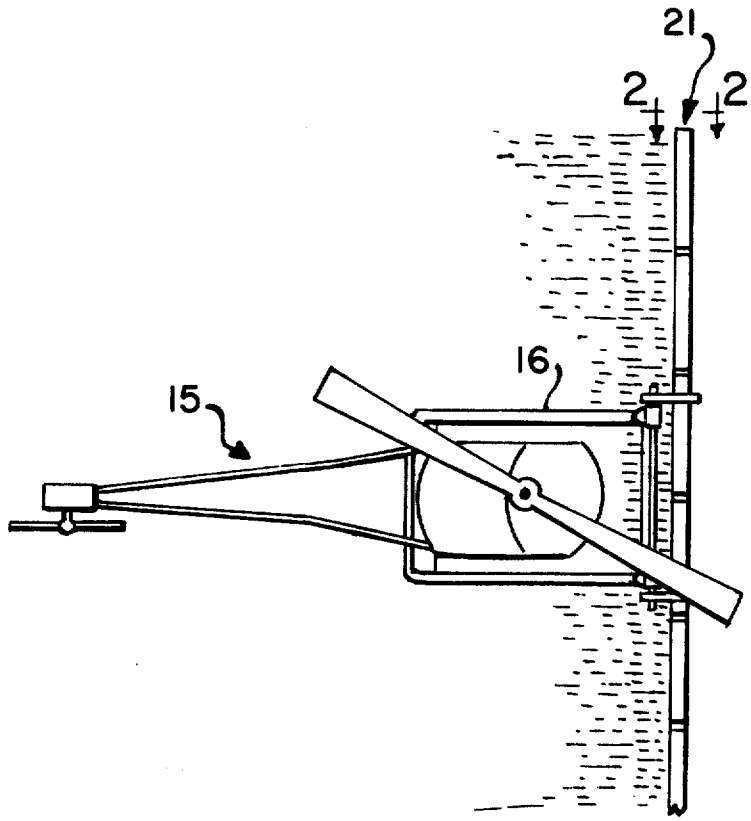
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Attorney, Agent, or Firm—Howard T. Jeandron

[57] **ABSTRACT**

This invention involves a fluid sprayer in the form of an elongated boom for attachment to an airplane, helicopter, or fast moving ground vehicle, that will dispense a spray in cohesive droplets at low pressure from a plurality of nozzles in laminar formation along the trailing flight edge and further in which the boom is divided into a plurality of sections each side of center with means to activate two central sections and further activate more sections either side for enlarging the spraying pattern and means to not only cut-off the flow of fluid spray at an exact point in flight but in addition to drawback fluid from the distribution in each nozzle after the fluid flow is stopped to provide a hydrostatic seal and prevent leakage of the fluid.

4 Claims, 14 Drawing Figures



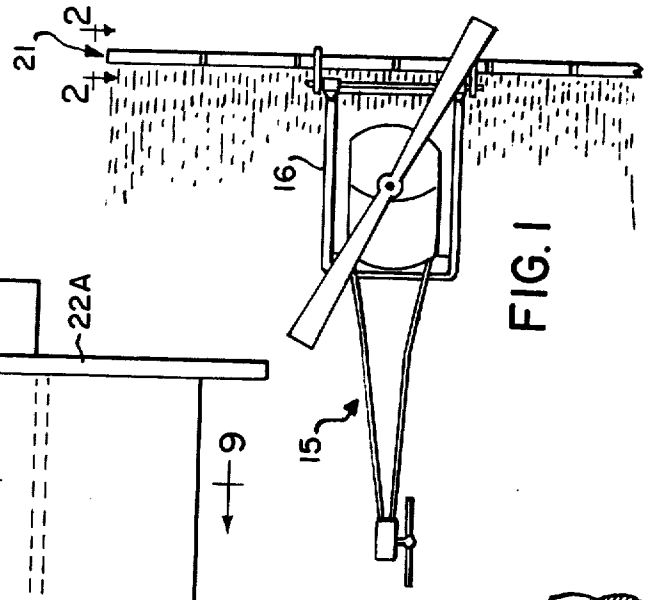


FIG. 1

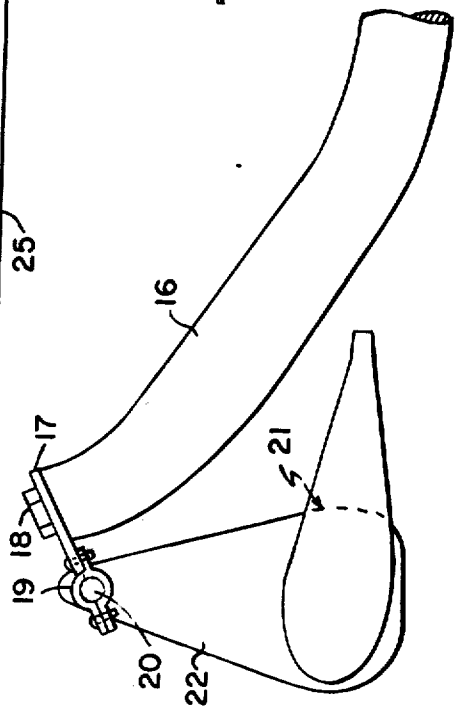
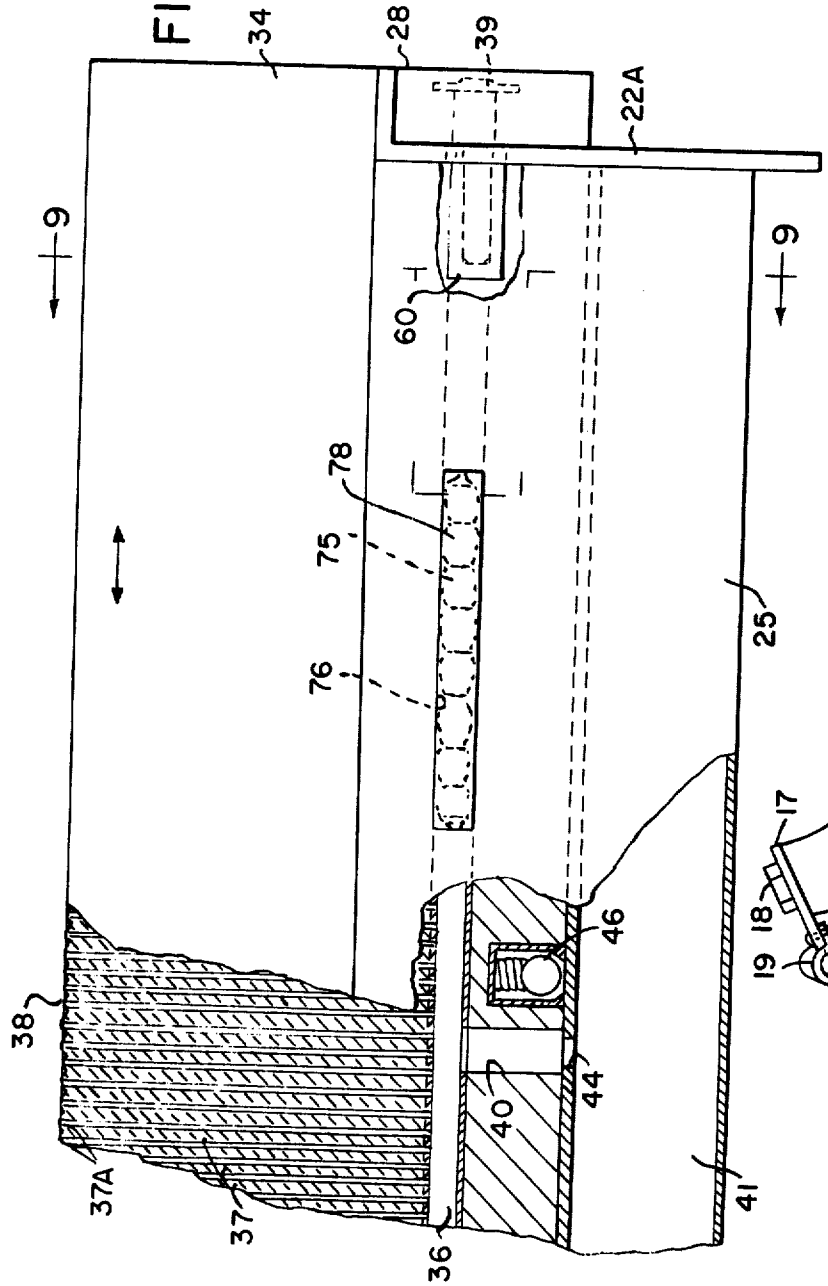


FIG. 2

FIG. 6



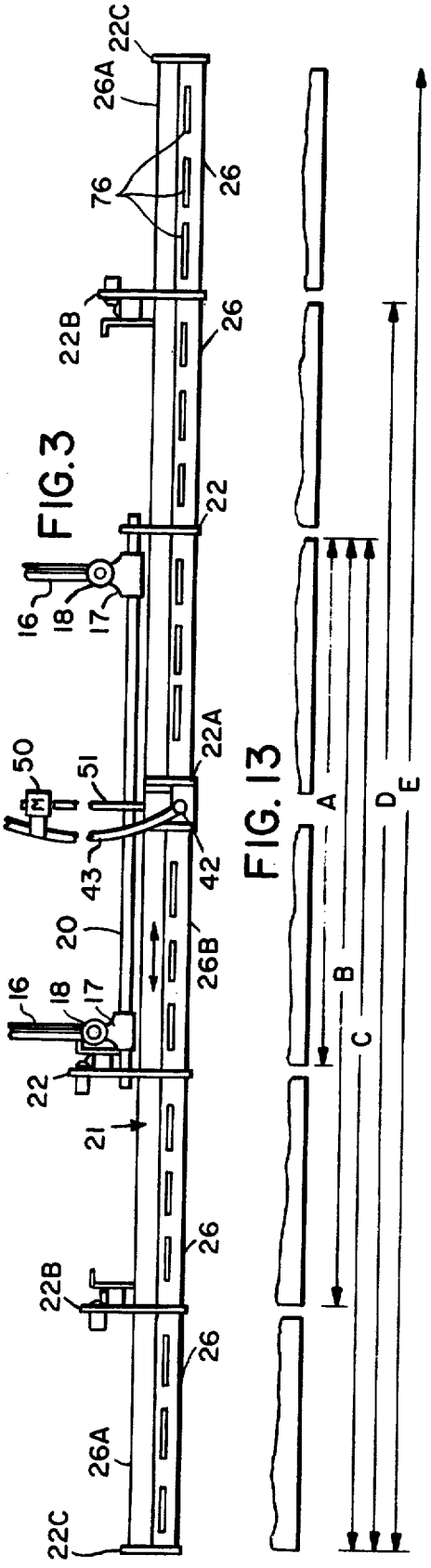


FIG. 3

FIG. 13

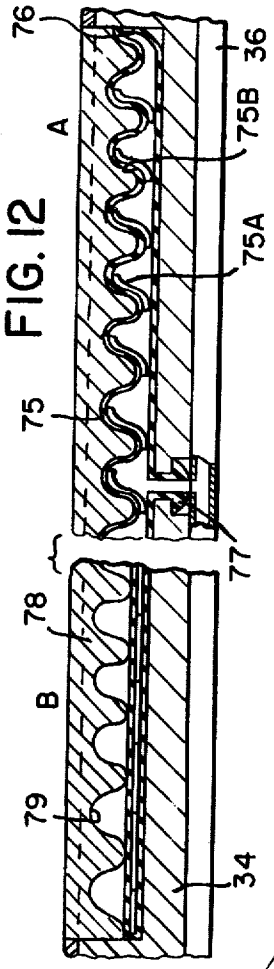


FIG. 12

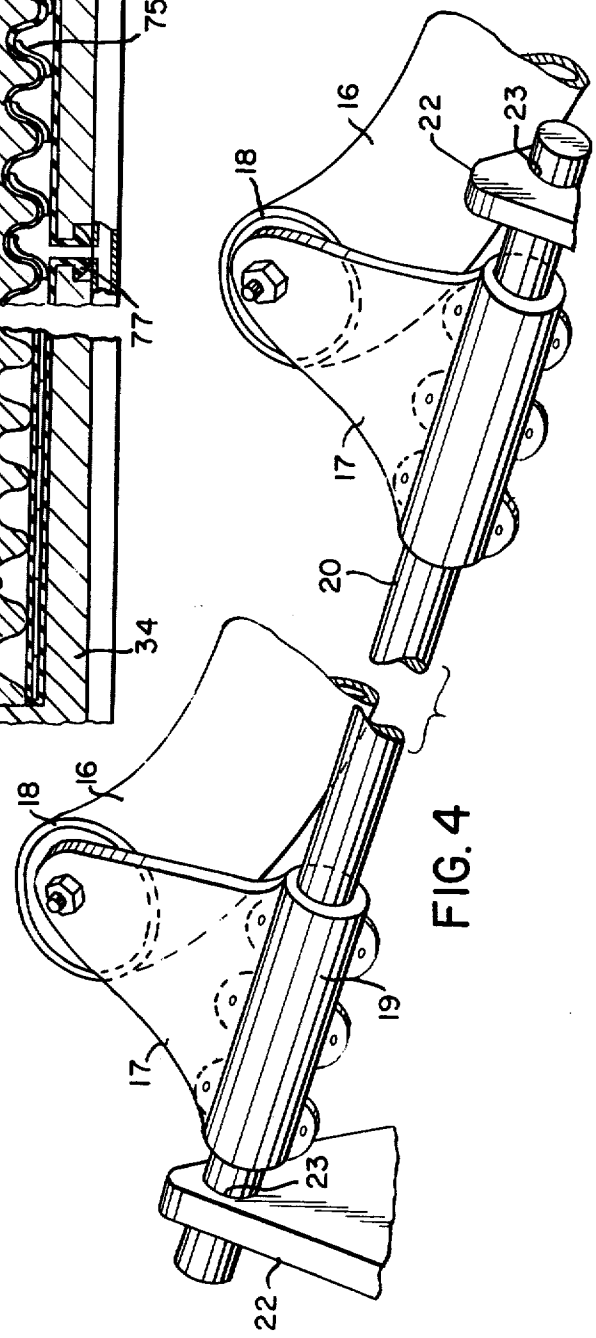


FIG. 4

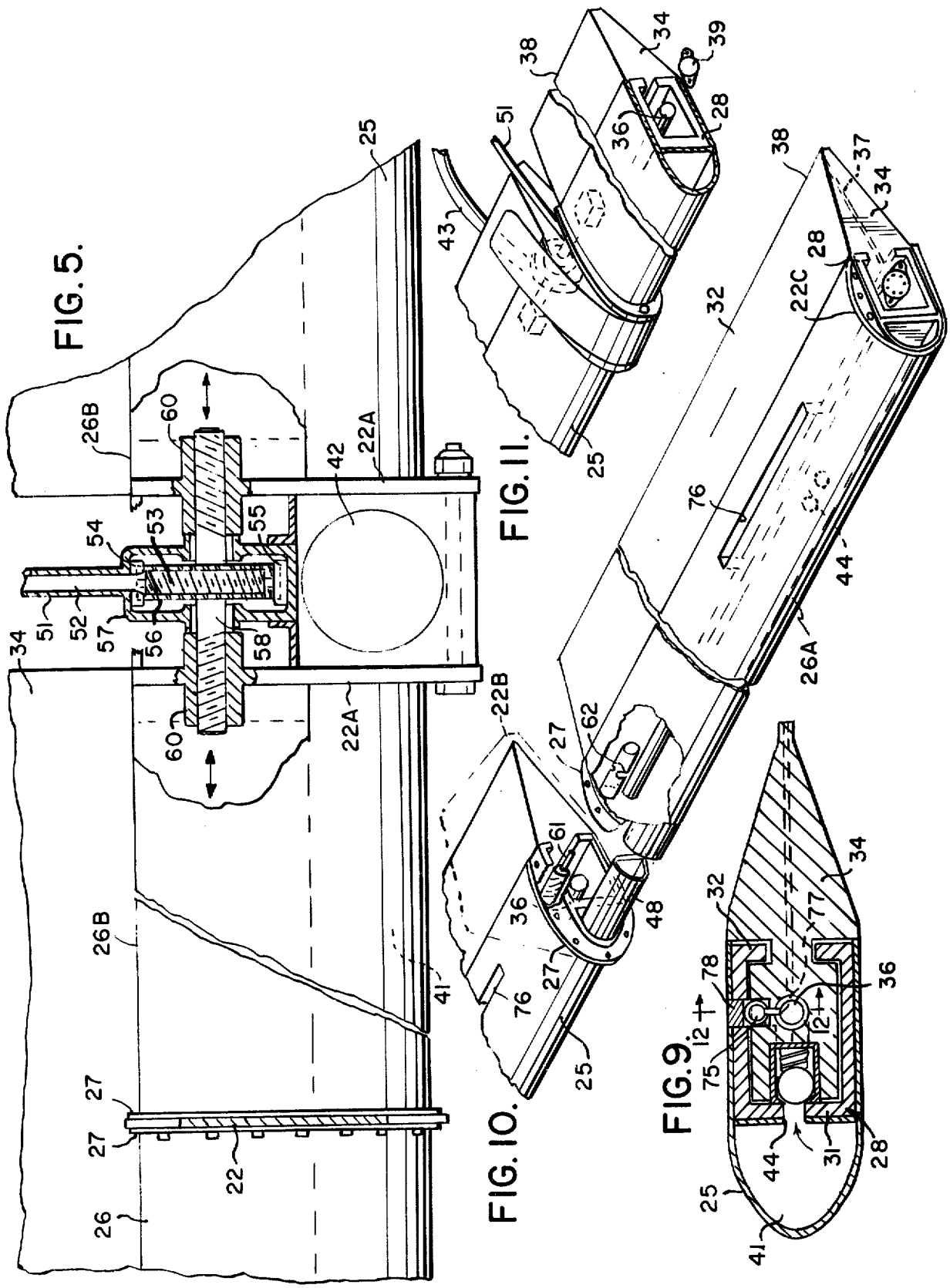

FIG. 5.
FIG. 11.
FIG. 10.
FIG. 9.

FIG. 7

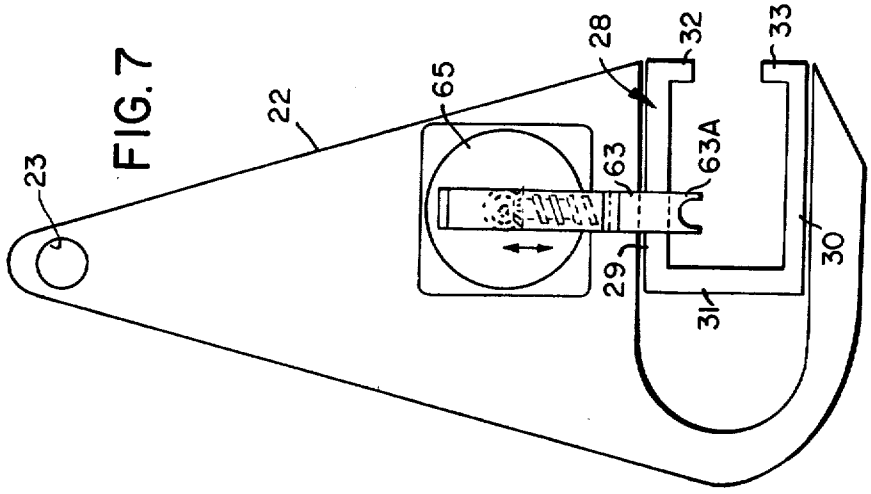


FIG. 8

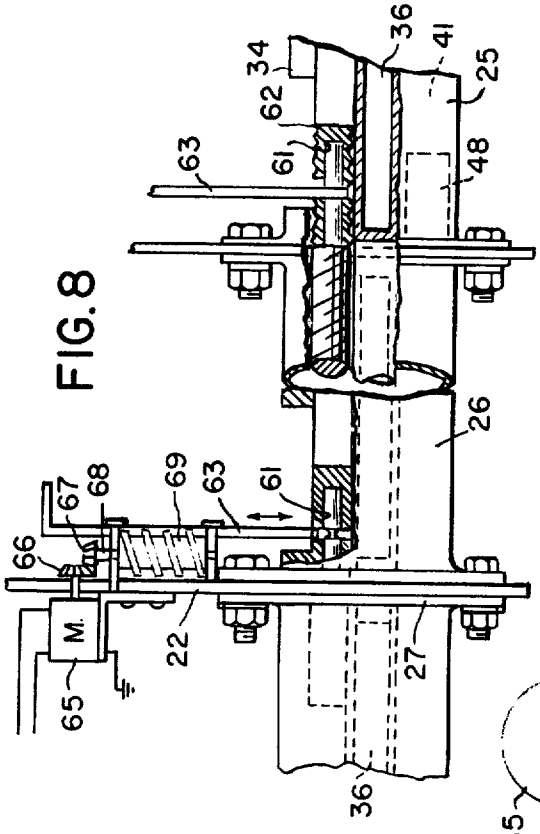
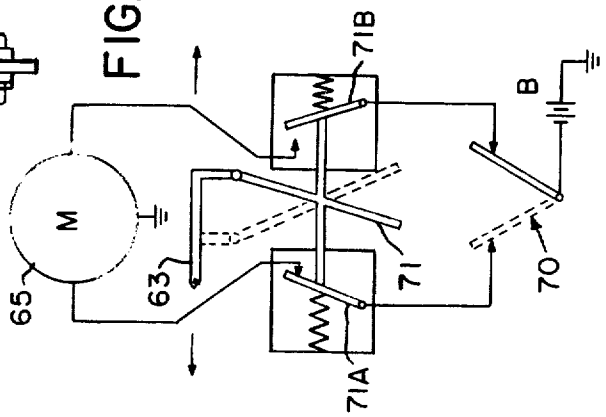


FIG. 14



ACCESSORY ATTACHMENT FOR A VEHICLE USED FOR FLUID SPRAYING OF VEGETATION

This invention relates to a fluid sprayer commonly used in spraying vegetation with fluid such as a herbicide to eliminate or regulate plants and more particularly a sprayer in the form of an airfoil for aerial spraying and having control limitations to provide a positive shut-off without overrunning, or dripping past the spray pattern and control to reduce or enlarge the width of the spray pattern.

In the application of systemic herbicides, a few drops on the wrong plants are sufficient to kill that plant, therefore any spraying operation must be carefully and exactly applied and controlled. The problem is also increased during spraying by uncertain winds or drafts that tend to displace or modify the intended placement of the herbicide droplets.

To provide the utmost in spray control there are several factors, (1) there must be substantially uniform droplets, (2) the spray jets or tubes must be placed in laminar formations, so that each tube is emitting to provide a sheet or layer of spray that is identical over the whole pattern, (3) the cut-off of the fluid or herbicide must not only be positive at a given point in flight but there must be a means of preventing any leakage or dripping beyond the intended cut-off point, and (4) the width of spray pattern should be controllable so that all or a portion of the spray boom may be utilized.

In all spraying operations from a plane or helicopter it is to be noted that the spray nozzles are being moved in a direction (forward) which is opposite to the direction of spray (backward) this has the effect of holding or laying the sprayed droplets in the horizontal plane just long enough to allow them to settle downward without changing the form of the intended spray by maintaining uniform droplets.

Accordingly, it is an object of this invention to provide a sprayer for fluids used in aerial spraying that will produce a generally uniform size droplet.

A still further object of this invention is to provide an aerial sprayer having an airfoil configuration that is easily attached to the plane or helicopter for a spraying operation.

A further object of this invention is to provide a sprayer having a plurality of jets in laminar formation to produce an even distribution of droplets in a fluid sheet-like cover as they settle down over the intended target.

A still further object of this invention is to provide a means for all jet tubes that will reverse the fluid flow at the nozzle when the flow is shutoff so that any drip that could occur normally would actually be drawn back by suction created within the tube.

A still further object of this invention is to provide a sprayer having a sectionalized spraying boom with means to activate two or more sections to control the width of the spray pattern.

Further objects of this invention may become obvious by reference to the accompanying detailed description and the drawings which include:

FIG. 1 is a top plan view of a helicopter with a spraying boom attached to the skids for support.

FIG. 2 is a side view (slightly enlarged) of the spraying boom, taken on line 2—2 of FIG. 1.

FIG. 3 is a plan view of the spraying boom, illustrating the sectionalized construction and the supporting connections to the helicopter skids.

FIG. 4 is an enlarged perspective view of the means of supporting the boom at its central section as it is attached to the helicopter skids.

FIG. 5 is an enlarged plan view of the central portion of the boom, with the operating elements shown in partial cross section.

FIG. 6 is a plan view of a portion of the boom, slightly enlarged and partially cut away to show the relationship of its elements.

FIG. 7 is an enlarged side view of one of the boom hanging supports.

FIG. 8 is a cut away view of the boom showing the locking pins and their operating mechanism.

FIG. 9 is a cross sectional view of the boom taken on line 9—9 of FIG. 6,

FIG. 10 is a perspective view of a portion of the boom with two sections in a separated relationship.

FIG. 11 is a perspective view of the central portion of the boom.

FIG. 12 is a cross sectional view taken on line 12—12 of FIG. 9.

FIG. 13 is a diagrammatic view of the division of spray patterns, and

FIG. 14 is a schematic wiring diagram of the wing supported motors.

Referring to the drawings it is apparent that in FIG. 1 there is illustrated one type of vehicle upon which the spraying device may be mounted, in this example there is a helicopter 15 having a pair of landing skids 16. The skids 16 are turned upward at their forward end as shown in FIGS. 2 & 4. A pair of supporting brackets 17 are affixed to the center of a plug 18, the plugs 18 being inserted in the ends of the skid tubes 16. The brackets 17 at their opposite ends are formed as two piece clamps 19. The clamps 19 are afixed around a supporting tube or pipe 20. To hang the spraying boom 21 (FIGS. 2 & 3) from tube 20 there are provided a pair of flat plates 22 (FIG. 7) some what triangular in space with an aperture 23 through which the tube 20 may pass. The plates 22 are mounted at either side of the skids on tube 20 just past the brackets 17 in a hanging position. Two plates 22A are also mounted between the two inner sections of the boom 21 and two end plates 22C seal the ends of the boom. With the supporting structure described the boom 21 to be supported is comprised of an outer, front rigid section 25 that extend the entire length of the boom as shown in FIG. 5. This front section is comprised of six sections 26A and 26B (FIG. 3). The two end sections 26A are afixed on one side by the matching shoulder portions 27 (FIG. 10) to the plate 22B FIG. 3. The inner sections 26B are provided with shoulder portions 27 at either end, these shoulders abut plates 22 and are all fastened in a rigid structure as shown in FIG. 1 and 3. The frame 28 (FIG. 7 & 9) is a continuous section running the entire length of the boom 21. The frame 28 in cross section is a three sided form, upper section 29, lower section 30, end section 31, with the two ends 32 and 33 turned inward. Frame 28 has the open rear section so that the movable rear sections 34 may be keyed within the frame 28 as shown in FIGS. 6, 9, 10 & 11, thus each rigid section 26 has a movable section 34 keyed therein.

A circular aperture with a stainless steel pipe 36 (FIG. 6) runs through each section 26 and a plurality

of tubes 37 laid in laminar formation are connected to tube 36 at one end and extend to the nozzles 37 A and wing edge 38 FIG. 6. The tube 36 is closed or sealed at each end with a cover plate 39 (FIG. 6). Also connected to each tube 36 is a port 40 that extends to the front face of Section 34 FIG. 6. The front section 25 forms a hollow chamber 41, the chamber 41 is connected to the inlet 42 (FIG. 5) and the inlet 42 is in turn connected by a tubing 43 to a valve and supply tank (not shown) FIG. 3. The chamber 41 has a plurality of ports 44 (FIGS. 6, 9 & 10). These ports will align with ports 40 of sections 34, when the movable section 34 is pulled into an operative position for spraying, however, when the sections 34 are moved outward away from center there is a poppet valve 46 for each port so that in the out position the poppet valve will close port 44. Chamber 41 is interconnected between the bolted sections by a tubular extension 48 (FIG. 10) that mates with a socket or tubular aperture in the mating section, thus preventing any leakage between sections. Referring to FIG. 5 there is illustrated the drive mechanism to slide sections 34 outward from center or inward toward center, to thus move them into a connected spraying position of a disconnected or shut-off of the spray. In FIG. 5 and FIG. 3 there is shown a motor 50 and drive 51. The drive 51 has a rotatable center 52 and at its end there is attached a worm 53. The worm 53 is mounted between two bearings 54 and 55 to retain the worm in engagement with a worm gear 56, all enclosed in a housing 57. The worm gear 56 is supported on and affixed to a shaft 58. The shaft 58 extends through the housing 57 on either side, and the extended shaft is formed or affixed to a worm thread or gear on either side, each side being opposite in the direction of thread. The shaft 58 extends through the fixed supporting plates 22A and is threaded into portion 60 of the movable sections 34, this control structure being anchored or fixed.

The sections 26B (FIG. 5) either side of center are connected to this central section so that the inlet 42 is connected to the chamber 41. The movable sections 34 on either side of plates 22A have a worm or socket 60 (FIG. 5), so that each one is threaded onto each end of the shafts 58. The relationship or connecting drive being so that rotation clockwise of the driven center shaft 52 will produce a counter clockwise rotation of gear 56. The counter clockwise rotation of gear 56 will be similarly produced by shaft 58 to which it is attached. The sockets 60 that are attached to the movable sections 34 will be moved outward from center thus moving the sections 34 outward in their keyed alignment with the front section. The degree of movement necessary is illustrated in FIG. 6, moving the poppet valve 46 outward to close port 44. This movement outward of the portions 34 of the sections 26B is not only the means of closing or retaining closed all of the poppet valves 46 but is also the manner in which any number of sections 26 may be combined to increase the width of the spray pattern. The minimum spray pattern is when only the two center sections 26B are activated. Thus by reversing motor 50 every element of the drive train is reversed and the two center portions 34 of the sections 26B will be drawn inward and as illustrated in FIG. 6 the poppet valves will be moved away from ports 44 and port 40 will align with port 44. Thus with the spray fluid (under pressure) supplied from a tank on the vehicle (not shown) through the supply line 43, through port 42 into the chamber 41, the fluid will pass through ports 44 and port 40 and the tube in passage 36 to all tubes 37 to be sprayed outward at the wing edge 38. To increase the width of the spray pattern, referring to FIG. 13, A is the pattern of spraying with just the two center sections 26B. B is the extended pattern when an additional section 26 is added. To add a section to be activated, the control drive must again move sections 26B outward. When in the extended position, referring to FIG. 8, the moveable portion 34 of the boom (FIG. 5) abuts with the section 34 of the next section 26 and one section has a male pin 61 that extends outward and fits into a female socket 62 as shown in FIG. 8. To retain this connection there is provided a motor driven locking member 63 that may be driven downward to fit into grooves in the male member 61 to lock it with female member 62, thus locking the sections 34 together so that when the motor 50 is activated to draw portions 34 of the sections 26B toward center an additional joined section 26 will also be drawn inward and three sections will be pulled into an active position for spraying according to the spray pattern B of FIG. 13. Referring back to FIG. 8 it is apparent that each of the two outer plates 22B must be provided with the same means shown in FIG. 8 so that additional sections 26 may be added to the center sections to produce the spray patterns, C. D & E (FIG. 13). The plates 22 & 22B (FIG. 3) are provided with a reversible motor 65 (FIG. 8) when activated it will through pinion gear 66 drive pinion gear 67 and shaft 68, shaft 68 having a worm gear 69 that engages a plate 63 that has worm gear grooves of apertures (FIG. 7) to mesh with the teeth of the worm gear. Thus with the rotative drive of the motor the plate 63 will have a contained movement up and down. The plate 63 is both the driven element and at its lower end 63A the locking member for pin 61 (FIG. 8). Plate 63 is held in a slidable relationship by brackets from Plate 22. Plate 63 is also grounded and provided with a stop switch to limit its movement up or down. Thus with Section 26 abutting as shown in FIG. 8 with a circuit as shown in FIG. 14 the motor 65 may be controlled and by closing switch 70 to the left a circuit is closed from battery B through limit switch 71 to the motor 65. The motor driving the plate 63 downward until is reaches engagement with pin 61 and by means of limit switch 71, 71A will be opened and power is cut and the motor stops. To release plate 63 from pin 61 the switch 70 must be closed on the right, this completes a circuit from battery through switch 70 and through the now closed switch 71B to operate the motor in a reverse direction until the limit switch 71 is opened by the movement of plate 63 to open contact 71B and the switch is ready for its next cycle of operation.

When portions 34 of the section 26B and the added portion 34 of the section 26 are pulled inward they are all opened to the flow of spray fluid. When the spraying in this pattern is completed the portion 34 of the sections 26 and 26B may again be moved outward and shut off the flow of fluid to the spray tubes. As already described the sections 26 may then be changed in their relationship to provide any of the spray patterns shown in FIG. 13, each additional section added in the same fashion and released in the same manner.

Referring to FIGS. 6, 10 and 12, there are additional improvements added to prevent any leakage of the spray from the tubes 37 after there is a closing of ports

44 with valves 46. To accomplish this there are normally expanded plastic flexible tubes 75, the tubes 75 being inserted in cut out portions of each section 26 and each tube sealed at each end. Referring to FIG. 10 it is to be noted that there are a plurality of long narrow apertures 76 cut in the upper face of section 25. These apertures or slits are directly over the passage or tube 36 and the flexible tube 75 is laid in above this passage as shown in FIGS. 9 & 12, and there is a connecting rubber nipple 77 that is forced through an aperture in tube 36 to project into tube 36. Thus, fluid under system pressure can pass from chamber 41 through port 44, through port 40 into passage 36 and through the tubes 37, but cannot pass through the nipples 77 into the tube 75 because the tube is compressed as in FIG. 12 at B. This is in spray position, when the sections that are used to spray are in the retracted position with valves 46 (FIG. 6) retracted. When the spray flow is to be stopped the sections 34 are moved outward (FIG. 6) since the front section 25 does not move but does support the upper inserts 78, the tube 75 (carried by section 34 (FIG. 9) will be moved under the corrugated face 79 (FIG. 12A) thus releasing the flexible tube 75, and allowing it to expand and thus the fluid is drawn back into tubes 37. When section 34 (FIG. 6) is moved toward center, the portions retaining tube 75 will move to a position as shown in the A portion of FIG. 12, the tube 75 will in this position expand as it had been deformed or compressed in B position. The tubes 75 are assisted in their expansion by inserting springleafs 75 in each expansion area of tubes 75B and so formed that unless compressed they will tend to expand into the area as shown, this occurs only at the top side as the lower side of the tube 75 is afixed to the bottom of the cut out apertures 76 so that the tube will always move with the movement of portion 34 (extended or retracted). The flexible tubes 75, that is, the combined 3 tubes in each boom section 26 have a capacity of about 50% of the space utilized within the area of tube 36. To simplify the function of the tubes 75 we may assume them to be the rubber bulb on a medicine dropper and the space 36 and tubes 37 as the nipple end of the dropper. When the rubber bulb (tubes 75) is compressed (as the tube is in section B, FIG. 12) the valve 46 is moved to allow port 40 to be open system pressure is activated and the fluid flows through 44 and 40 into tubes 36 and passes to the tubes 37 for spraying and it is acting upon all the tubes 37, it is to be noted that when tube 75 is compressed the fluid expelled through nipple 77 will flow along with the system fluid flow through tube 36. Thus like a medicine dropper the fluid in the dropper is ejected when the bulb is pressed, when the bulb is released the fluid in the tubes is drawn back, and similarly when valve 46 covers port 44, the tube 75 is expanding and with negative pressure the expanded tube draws fluid back in tube 36 and tubes 37 and there is no leakage therefrom.

However, when section 34 is moved inward to open port 44 to passage 40, then fluid under pressure flows through and at the same time the tube 75 is moved under section 78 (FIG. 12B) thus compressing tubes 75 (as shown in this portion of FIG. 12) and allowing the fluid to flow through nipple 77, out of tube 75 to tubes 37 to be ejected therefrom in a spray. This negative pressure chamber around tube 75 is accomplished by the sliding action of the tube 75 against the surface 79, it allows compression in one position and expansion in the other position. The tube compresses to no area in one position to allow the fluid to pass and be sprayed under fluid pressure. The tube in the other position with the help of springs expands and creates a cavity (at this time the fluid spray pressure is also cut off) thus the negative pressure is created and atmospheric pressure on the outside of the spray tubes and the draw back capacity of the low pressure chamber will produce a draw back of any leakage remaining in the tubes 37, also the capacity of the negative pressure chambers is the exact capacity of the outlet orifices within the undivided nozzles.

Thus it is apparent that whenever the spraying of fluid droplets is shut off, by turning off the fluid pressure flow, there is a complete reversal of the fluid direction, that is the fluid that remains in the tubes 37 will be drawn back and thus there will not be any leakage of the fluid beyond the turn off point of travel of the vehicle 15.

It is therefore apparent that a number of present problems in the spraying of vegetation by a moving vehicle is readily solved. The spraying pattern (width) is controllable from a minimum width to a maximum, as desired. The ability to discharge a substantially even curtain of droplets over any area is more or less common practice, due to the direction of flight (or movement) being forward and the ejecting of droplet spray backward. The rate of discharge of fluid droplets and the forward speed of the vehicle are easily controlled. The problem of overrun in spraying is eliminated by the very exact means of cut-off of the ejected spray droplets and the control of all spray tubes to not only be cut off from a pressure flow but have a complete reversal due to the creation of a negative pressure chamber that effects every spray tube to draw the fluid back and thus prevent any leakage.

It is also to be noted that the spray boom is in fact as accessory that is quickly and easily attached to a plane, a helicopter or a land vehicle and a fluid supply from the vehicle under pressure connected to the spray boom. The controls are also of the simplest form with only switches to provide complete control.

What is claimed is:

1. In an apparatus connectable to a vehicle for spraying a fluid, the combination of:

a. an elongated boom having central supports for attachment to the vehicle and the boom having a rigid hollow strong front section that extends the full length of the beem with a plurality of keyed in shorter movable spraying sections in alignment and rearwardly of the front section, said front section carrying the fluid to be sprayed, said keyed in movable sections interconnectable in alignment and provided with valve means that is opened by the connecting movement of each section,

b. a fluid tube with a valve connected between the vehicle and the elongated boom to carry the fluid to be sprayed under pressure from the boom,

c. said movable spraying sections provided with a plurality of spray tubes laid in laminar formation and each movable section provided with inlet ports that are movable to an alignment position with the ports of the front section for spraying and movable out of alignment to stop spraying.

2. A combination as defined in claim 1 including a plurality of compressable and expandable flexible elements inserted in each of the movable sections of the

boom that are mounted within or connected with the fluid spray passage with means to compress the flexible elements during the spraying operation and means to release and allow these elements to expand when the fluid pressure spray is stopped to in turn create a negative pressure and cause the remaining fluid in said spray tubes to be drawn back and prevent leakage.

3. An accessory sprayer to be supported and carried in a particular position on a movable vehicle in which the vehicle carries the fluid to be sprayed and is connected to the sprayer by tubing to supply same during a spraying operation and in which the sprayer is in the form of an elongated boom that is centrally supported and carried cross wise to the direction of movement of the vehicle and in which the boom is provided with a plurality of compressible and expandable flexible elements inserted in said boom with means to compress the flexible elements during spraying operations and means to expand said flexible elements after stopping the fluid spray and produce a negative pressure to in turn draw back the remaining fluid in said boom and prevent leakage.

4. An accessory sprayer to be supported and carried in a particular position on a movable vehicle in which the vehicle carries the fluid to be sprayed and is connected to the sprayer by tubing to supply same during a spraying operation and in which the sprayer is in the form of an elongated boom that is centrally supported and carried cross wise to the direction of movement of the vehicle and in which the boom is provided with a plurality of spraying sections which include motor controlled movable locking means on said boom for locking and unlocking each movable section into engagement or disengagement with an adjoining section of said boom for spraying operations.

* * * * *