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 [73] Assignee **Snorkel Fire Equipment Company**

3,074,649	1/1963	Atkinson	239/587 X
2,729,295	1/1956	Edwards	169/25
2,834,416	5/1958	Becker	169/25
2,984,422	5/1961	Vogt et al.	169/25 X
3,010,519	11/1961	Gillespie	169/25
3,106,247	10/1963	Lacks et al.	169/25
3,346,052	10/1967	Moore et al.	169/25

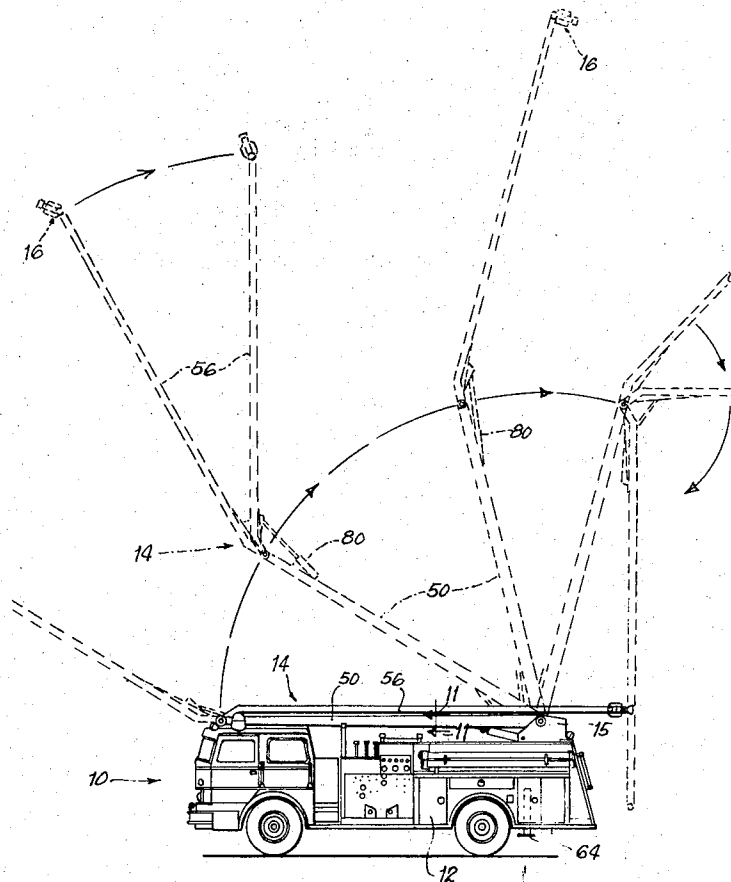
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[54] **REMOTELY CONTROLLABLE FIRE FIGHTING APPARATUS**
 12 Claims, 16 Drawing Figs.

[52] U.S. Cl. 169/24,
 169/25, 239/587
 [51] Int. Cl. A62c 27/00
 [50] Field of Search 239/160,
 166, 587; 169/24, 25

[56] **References Cited**
UNITED STATES PATENTS
 2,834,416 5/1958 Becker 239/587 X

ABSTRACT: A remotely controllable, boom-supported water delivery monitor and nozzle assembly particularly adapted for fire-fighting apparatus, and having independently operable nozzle sweep and vertical travel functions, and remotely controllable flow rate adjustment and spray pattern adjustment, all hydraulically operable from a remote control panel.



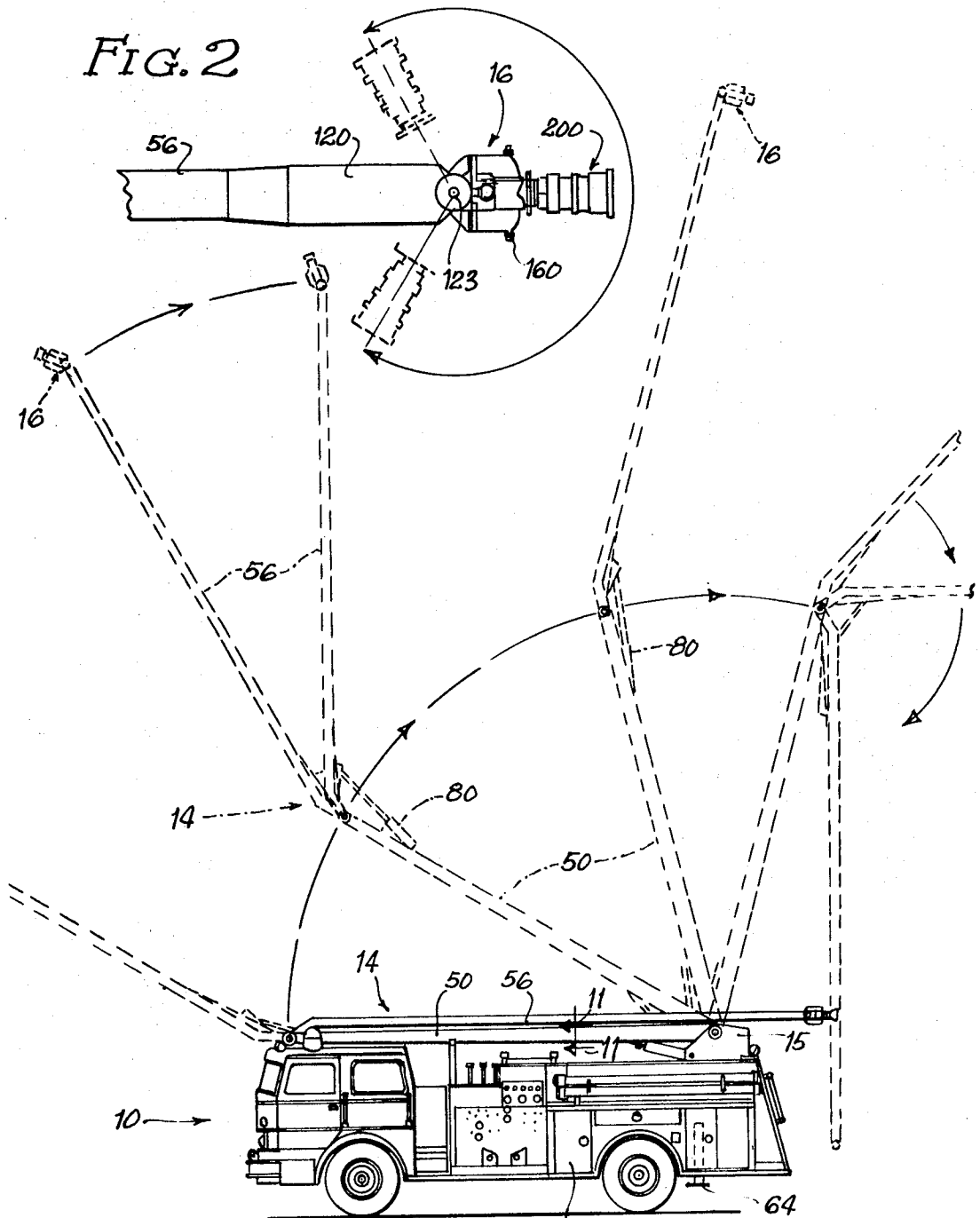
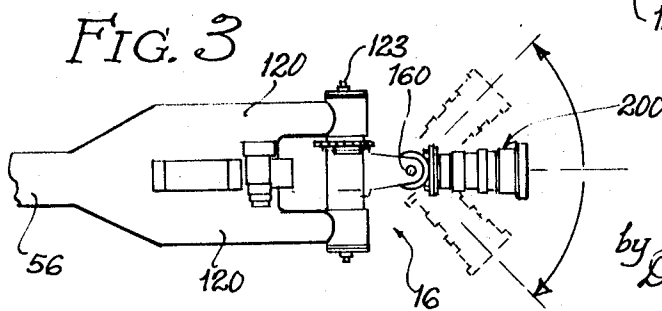
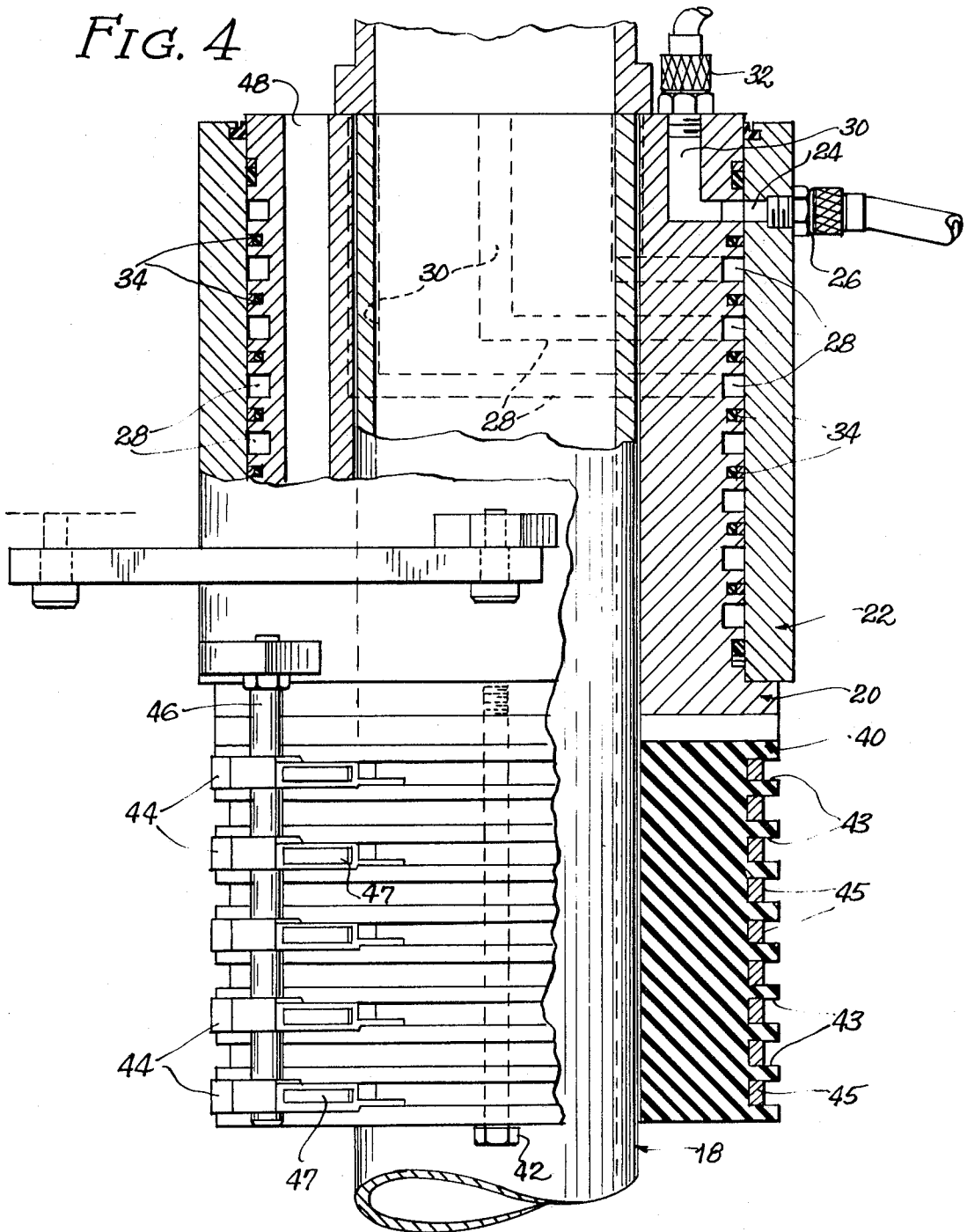


FIG. 1

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FIG. 4



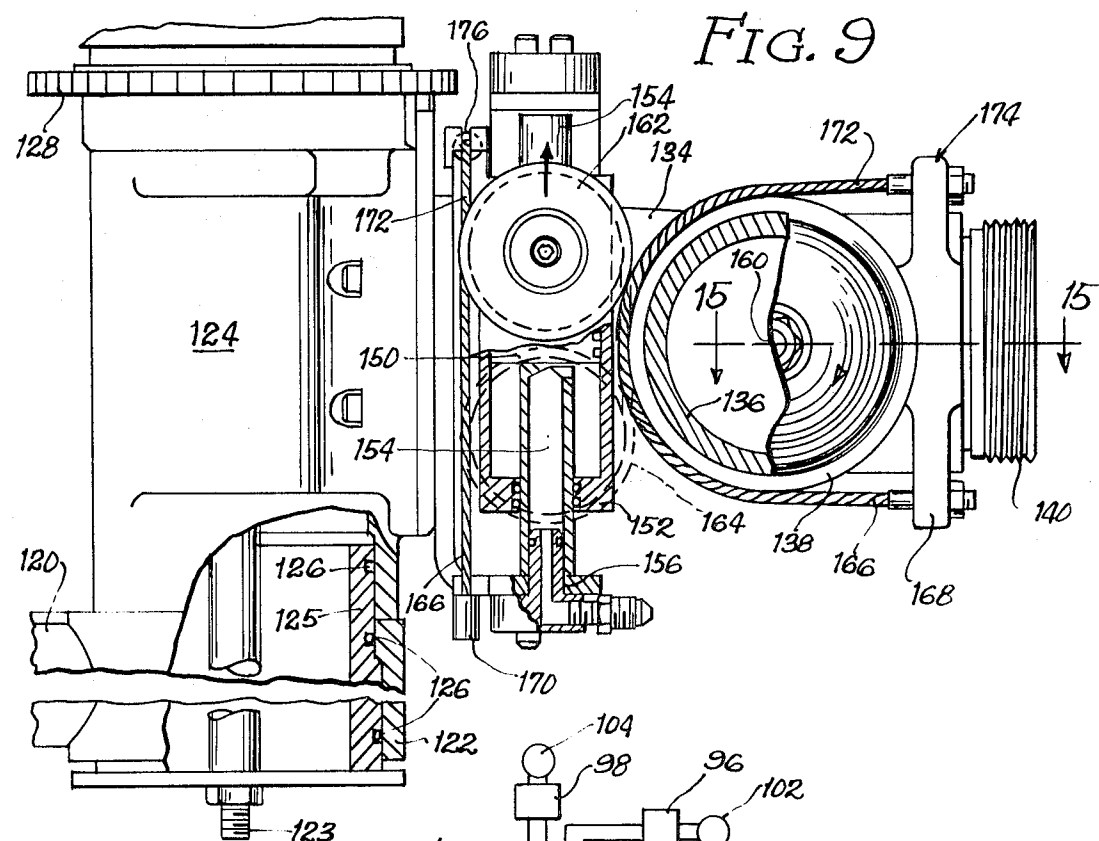
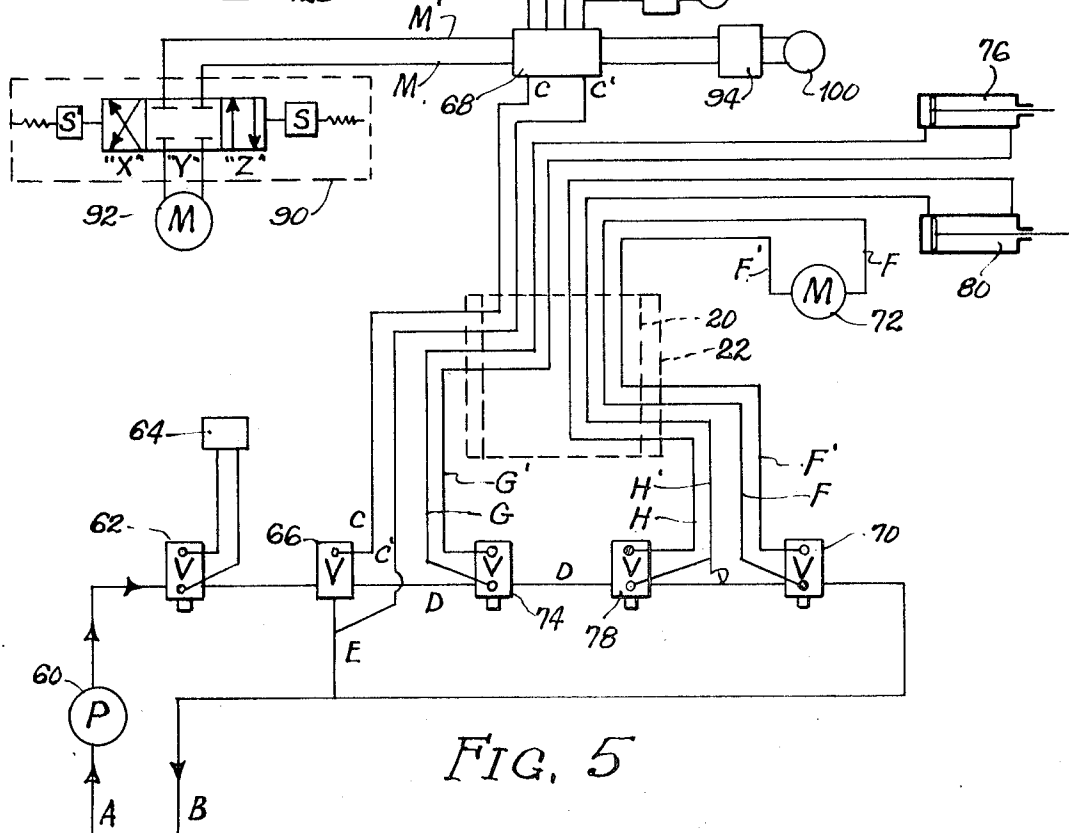


FIG. 6

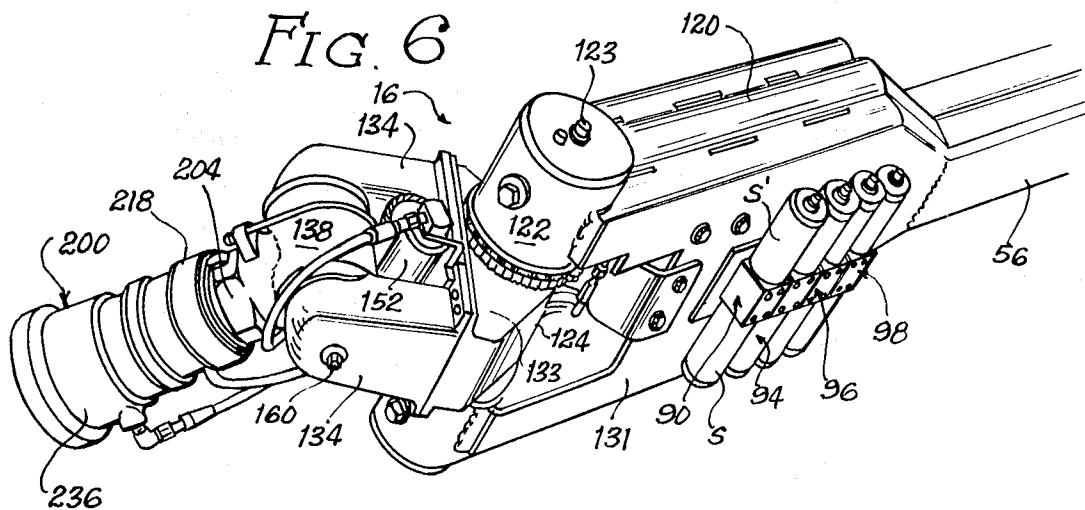


FIG. 7

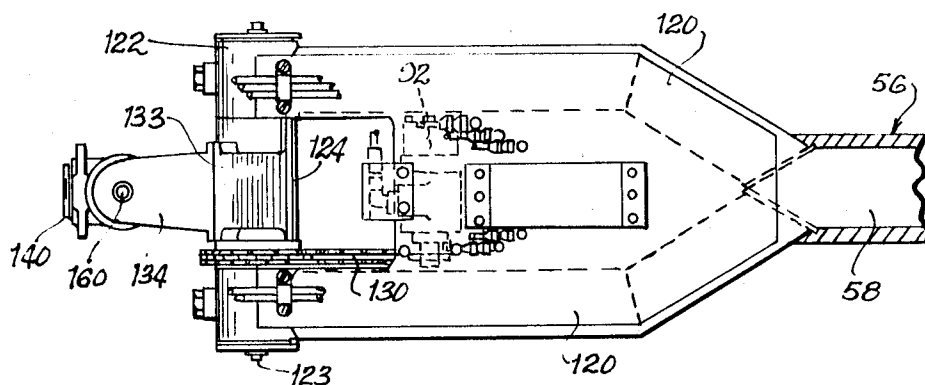


FIG. 8

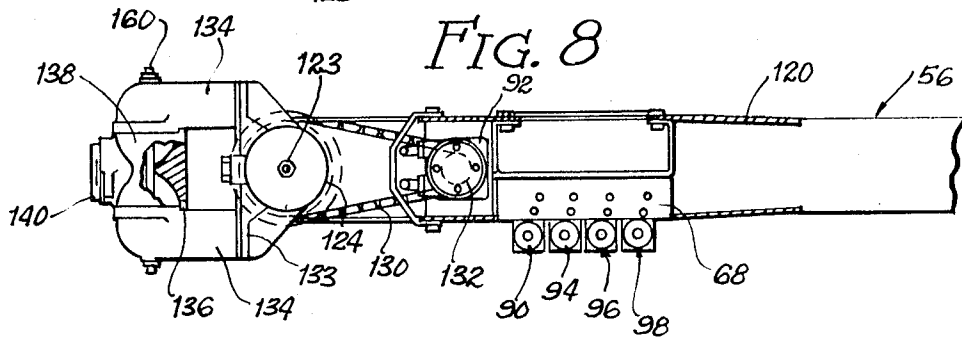


FIG. 10

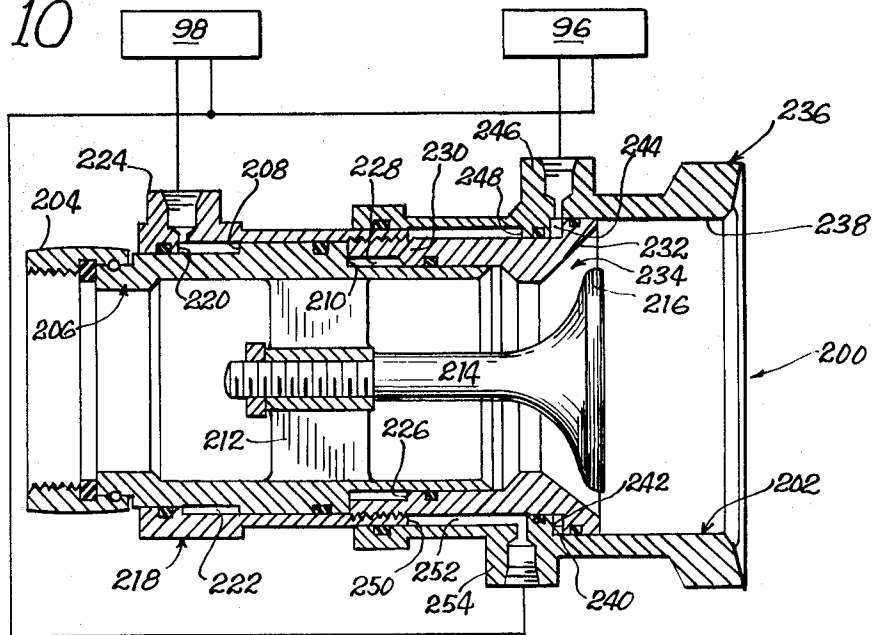


FIG. 15

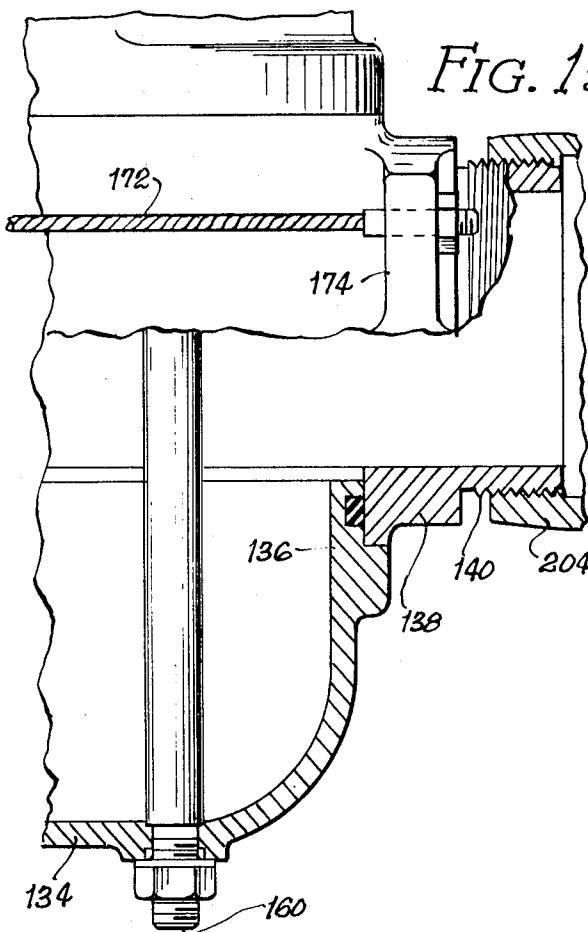


FIG. 16

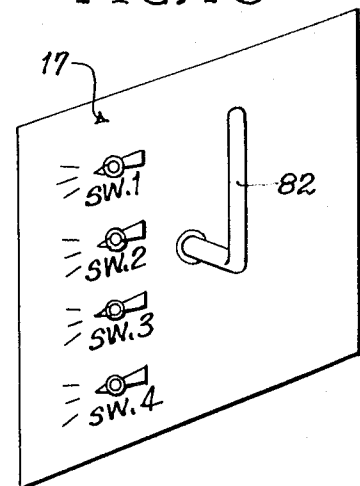


FIG. 11

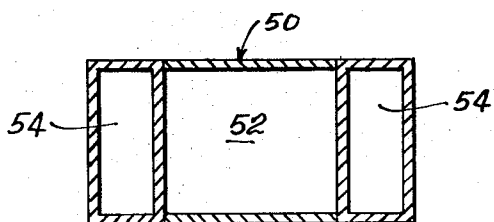


FIG. 12

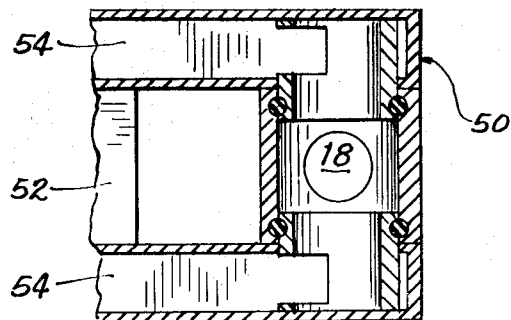


FIG. 13

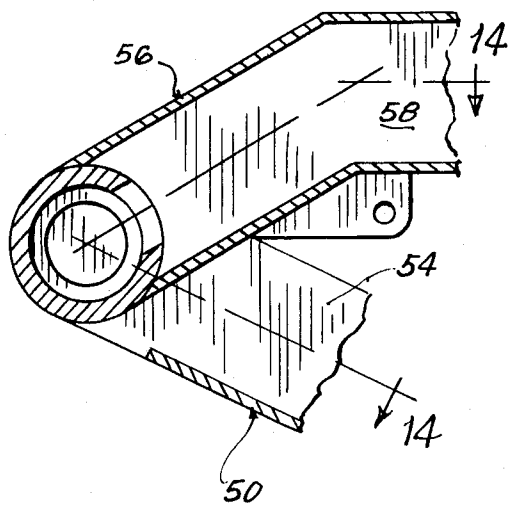
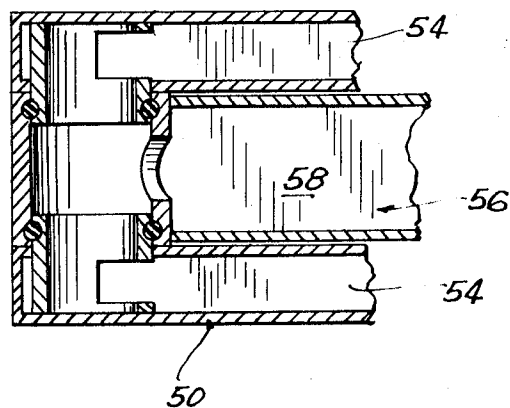


FIG. 14



REMOTELY CONTROLLABLE FIRE FIGHTING APPARATUS

This invention relates to improvements in fire-fighting equipment and, more particularly, to a pumper truck having a boom-supported, remotely controlled water delivery nozzle assembly which is adapted to provide a variety of modes of movement for the nozzle assembly.

Although shiftable booms have been used in the past with fire-fighting apparatus for supporting water delivery nozzles, until introduction of a fire-fighting apparatus of the character illustrated in U.S. Pat. No. 3,346,052, such a boom generally has required a basket or platform at the upper end thereof to support a fireman who, in turn, must control a water delivery nozzle, either hand-held or secured to the basket so as to direct a water stream issuing from the nozzle onto a fire. The range of operating positions of a boom of that type was limited because the fireman in the basket had to remain a discrete distance from a fire to avoid being overcome by heat. Therefore, the nozzle on such booms could not be moved within a minimum distance from the fire for fear of imperiling the fireman. Thus, for those and other reasons, it was desirable to eliminate the need for a fireman manning the nozzle at the upper end of the boom. That was accomplished in accordance with the disclosure of the aforementioned patent.

The present invention is directed to an improved boom-supported, remotely controlled water delivery nozzle assembly which is attachable to a fire-fighting truck for extending its fire-fighting capabilities, for overcoming the problems associated with the above-mentioned conventional boom-operated fire-fighting equipment and for improving upon the operation of the apparatus as described in the aforementioned patent. To this end, the invention includes a boom construction which is rotatably mounted on a fire-fighting truck for movement on a turntable about a generally vertical axis, and a water delivery monitor and nozzle assembly mounted for movement in a variety of modes on the upper end of the boom. The nozzle assembly is controlled remotely from the truck, whereby the boom and the monitor and nozzle assembly may be simultaneously and selectively shifted into their respective operating positions from a single remote control station on the truck.

The improved boom and nozzle construction of this invention is constructed to provide a water delivery passage therethrough which provides constant communication between a source of pressurized water, as a water pump on the truck, and the nozzle assembly at the upper end of the boom so that changes in operative positions of the boom and nozzle assembly will not interrupt the flow of water to the nozzle such as might occur if a flexible hose or the like were used between the pump and the nozzle. Not only can the boom supported nozzle assembly of this invention be mounted on new or existing truck units, but it also can be transferred from one truck to another without substantial modification to either, and without impairing any of the pumping or hose storage capabilities thereof. Thus, a truck utilizing the teachings of the present invention is highly versatile and is considerably more effective in fighting fires than pumper trucks of conventional design.

One of the features of this invention is the provision of a shiftable boom and remotely controlled improved nozzle assembly wherein the boom and nozzle assembly may be simultaneously or selectively operated to minimize the time required to move the nozzle into any one of a number of fire-fighting dispositions with respect to an associated truck.

Of special significance in the monitor and nozzle assembly is the isolation of the side-to-side sweep and vertical travel functions. Thus, the nozzle discharge orifice is adapted to travel in a vertical plane and the nozzle discharge orifice is adapted to travel in a side-to-side direction, each independently of the other mode of travel, unlike the construction specifically illustrated in the aforementioned patent. Thus, regardless of the position of the boom and regardless of the elevation of the

discharge orifice, independent sweep within the design limits of the nozzle assembly is provided.

In addition to independent remote operation of the sweep and vertical travel functions, the monitor and nozzle assembly provides a nozzle construction which is remotely operated to provide variation in flow discharge rate and variation in spray pattern, each independently of the other. Thus the monitor and nozzle assembly has four independent remotely controlled functions providing a highly versatile fire-fighting construction.

Preferably the functions are each hydraulically operated, as by hydraulic motor means, each of which motors, as stated, is operable remotely and from a single station on the pumper truck. Although certain related functions are illustrated as electrically operated in the aforementioned patent, it has been determined that the use of hydraulic motors substantially and significantly improves upon the operation of the unit. Among other things, the hydraulic motors are simpler and less expensive to make, provide greater power at higher efficiency and have substantially increased service life, all as compared to electric motors which require a high amperage source.

More particularly, the invention herein comprises fire-fighting apparatus which is adapted to be mounted on a motorized vehicle which supports an elongate supply conduit having a pair of ends, to the remote end of which is mounted a monitor and nozzle assembly, that assembly and the conduit being in continuous fluid flow communication. Preferably the conduit is an elongate boom which may be an articulated boom or a telescopic boom. The monitor and nozzle assembly includes a monitor member pivotally connected to the boom end for oscillation about a first axis, transverse to the axis of the boom, a nozzle support member mounted on said monitor member for oscillation about a second axis, the first axis lying in a plane which is normal to said second axis, and a nozzle connected to said nozzle support member, the nozzle having a discharge orifice projecting away from said first axis and which is in continuous fluid flow communication with the boom. The monitor and nozzle assembly therefore provides independent vertical travel and sweep. Desirably, the monitor and nozzle support members are driven by remotely controlled hydraulic motor means, the first axis is a substantially horizontal axis spaced from the second axis, and the nozzle is remotely controllable for variation of flow rate and spray pattern. This construction is notably useful in conjunction with a sectionalized boom which is mounted for pivotal movement of the sections and for rotation about a vertical axis on the motorized vehicle.

These and other advantages and features of this invention will become apparent from the following description and drawings, of which:

FIG. 1 is a side elevational view of a pumper truck with the boom-supported, remote-controlled delivery nozzle assembly of this invention, the boom being shown in a stored disposition and being shown in phantom in a variety of operable positions;

FIG. 2 is a side elevation of a nozzle and monitor assembly of this invention, showing in phantom the range of movement thereof about a horizontal axis;

FIG. 3 is a plan view of a nozzle and monitor assembly of this invention showing in phantom the range of movement thereof about an axis lying in a vertical plane;

FIG. 4 is an enlarged sectional view of the centerpost and manifold construction mounted on the pumper truck of FIG. 1;

FIG. 5 is a hydraulic circuit diagram;

FIG. 6 is a perspective view of the nozzle and monitor assembly of FIG. 1;

FIG. 7 is a plan view of a portion of the nozzle and monitor assembly of FIG. 6;

FIG. 8 is a side elevational view partially in section of a portion of the nozzle and monitor assembly of FIG. 6;

FIG. 9 is an enlarged partial sectional view of a portion of the nozzle and monitor assembly of FIG. 6;

FIG. 10 is a longitudinal sectional view of a portion of the nozzle assembly of FIG. 6;

FIG. 11 is a cross-sectional view through the lower boom section taken substantially along line 11-11 of FIG. 1;

FIG. 12 is a cross-sectional view through the pivot connecting the lower boom section to the water delivery pipe;

FIG. 13 is a vertical sectional view taken through the pivotal connection of the boom sections of FIG. 1;

FIG. 14 is a cross-sectional view taken substantially along the line 14-14 of FIG. 13;

FIG. 15 is a view, partially in section, taken substantially along line 15-15 of FIG. 9; and

FIG. 16 is a schematic view of a control panel at the rear of the truck.

Fire-fighting apparatus 10 comprises a truck, such as a pumper truck 12 of conventional design and construction having a chassis frame, a self-contained water tank and a storage rack for lengths of hose. A water pump (not shown) is carried by pumper truck 12 and is adapted to be operably coupled with a source of water, such as a fire hydrant or the like, to increase the pressure of the water delivered by pumper truck 12. Suitable valves and gauges are associated with the pump to control and indicate the water pressure thereof.

An elongate supply conduit comprising a sectionalized boom 14 is secured to a suitable turntable structure 15 mounted on the frame of the truck for rotation about a generally vertical axis. A water delivery monitor and nozzle assembly 16 is mounted on the remote end of boom 14 and is adapted to be controlled remotely from a control panel 17 on the truck. Boom 14 is tubular to define a fluid passage and is connected with a water delivery pipe 18 coupled with the pump of pumper truck 12 so that water is delivered therethrough to monitor and nozzle assembly 16 at a flow rate and pressure determined by the operating characteristics of the pump and pump controls.

The turntable may be like that described in U.S. Pat. No. 3,346,052. In the embodiment here illustrated, the turntable rotates with the vertical water delivery pipe 18 which serves as the axis of rotation for the turntable and the associated sectionalized boom 14.

As will become apparent, there are several modes of movement of boom 14 and a number of functions performable by the monitor and nozzle assembly 16. Because the turntable and the turntable supported boom 14 are adapted to rotate 360° continuously, a manifold and centerpost construction concentric with water delivery pipe 18 is provided through which power sources between the manifold and centerpost and the boom are continuously connected. In the embodiment here illustrated, the centerpost 20 is rotatable with the turntable 15 and water pipe 18, whereas manifold 22 is stationarily mounted on truck 12. Water pipe 18 is coupled with a swivel connection to a vertical supply conduit section on the truck below the centerpost.

Manifold 22 is a cylindrical annulus defining a plurality of entry ports 24 staggered and spaced about its circumference. One such port 24 is illustrated in FIG. 4 where a connector 26 for a hose leading to a source of hydraulic fluid is illustrated. Each such port, of which there are eight, is positioned to mate with an annular groove 28 completely circumscribing the surface of a cylindrical annulus, centerpost 20. Sectional representations of each such groove are illustrated in FIG. 4. Each of those grooves communicates with a complementary entry port 24 and each groove terminates inwardly of the outer surface of centerpost 20 in a circumferentially spaced upwardly extending vertical channel 30. Each channel 30 is provided at its end with a takeoff connector 32 for secureance to a hydraulic hose. Each of the eight flow paths thus formed through centerpost 20 and manifold 22 and between connectors 26 and 32 is continuously connected during rotation of the turntable assembly, i.e., rotation of the centerpost with respect to the manifold, but is isolated from each adjacent flow path by a pair of hydraulic seals 34 spaced between each of the pairs of associated entry ports 24 and grooves 28 as is clearly illustrated in FIG. 4. Desirably the seals are Teflon seals with O-ring backups.

In addition to the eight isolated fluid paths provided by the complementary manifold and centerpost construction, a plurality of continuously connected electrical paths are provided for purposes to be described. For that purpose, a collector ring 40 of electrically nonconducting material is secured as by bolts 42 to the lower face of centerpost 20. Ring 40 defines nine annular grooves 43 in its outer periphery, each seating an electrically conducting annular strip 45. Strips 45 are coupled to respective contactors, carried by contact arms 44 which are in turn carried by an electrically nonconducting post 46 secured to manifold 22. Thus, when centerpost 20 rotates so do the strips 45 which contact the post supported contactors 47 continuously. Contactors 47 are, of course, electrically isolated from each other. They are adapted to provide electrical signals to operate control switches as will be described. A vertical bore 48 is provided in centerpost 20 to receive electrical wiring connected to strips 45 which wiring then runs up boom 14 to the monitor and nozzle assembly 16. Thus, the contactors and strips are in constant communication in any position of movement of the turntable, the wiring connected to the strips serving to operate controllers at the top of the boom while being controlled from the control panel 17 on the truck.

Thus, it is seen that the centerpost 20 rotates with water pipe 18 and within manifold 22, the centerpost 20 and water pipe 18 rotating with the turntable 15. The vertical water pipe 18 is connected through a conventional pipe swivel to a pipe portion below the centerpost, hence providing continuous fluid flow communication between the pumper truck 12 and the turntable supported boom. Similarly, the boom and nozzle assembly is continuously connected with the eight entry ports 24 via grooves 28 and channels 30 in all positions of the turntable and through continuous 360° rotation thereof. The same is true of the electric supply which is continuous through wire fed contacts 47, through strips 45 and through wires leading upwardly through bore 48.

Boom 14 may be of any one of a number of different configurations. In this case, as illustrated in the aforementioned patent, articulated boom 14 consists of a lower section 50 having a hollow central portion 52 and a pair of hollow side portions 54 adapted to provide fluid or water passages through section 50 (FIG. 11). The central portion 52 houses the hoses an wiring. As shown in FIG. 12 the lower end of section 50 is connected through a swivel to pipe 18 for rotation about a generally horizontal axis. This then provides the journal means permitting boom 14 to be raised and lowered with respect to the turntable 15 as well as providing flow channels between pipe 18 and hollow side portions 54.

The interconnection between lower boom section 50 and upper boom section 56 is illustrated in FIGS. 13 and 14 and is described in the aforementioned patent. Section 56 is tubular and provided with a pipe section 58 at the normally lowermost end thereof, pipe section 58 having an opening for placing it in fluid communication with hollow side portions 54 through an assemblage like that shown in FIG. 14. Hence, upper boom section 56 is pivotally and swingably connected to lower boom section 50 for movement about a horizontal axis and is in constant fluid communication therewith. A separate channel, not illustrated, houses the hydraulic fluid hoses and wiring up to the remote end where the nozzle and monitor assembly is located.

Boom 14 may be formed from any suitable lightweight material so as to minimize the weight load required to be supported by pumper truck 12. To this end, boom 14 may be formed of a synthetic resin material having electrically nonconducting properties and reinforced with fiber glass or the like to provide structural integrity therefor or, where weight is not critical, the parts may be constructed of steel or the like.

The monitor and nozzle assembly 16 of this invention is positioned at the remote end of upper boom section 56 and is in constant flow communication with pipe section 58 in a manner which will be described, thereby to provide fluid flow through the discharge orifice of the nozzle. The nozzle assembly has a plurality of functions and modes of operation to

spray water selectively in a virtually infinite number of directions, and from straight stream to fog. To understand these modes of operation and functions, it will be helpful now to refer to FIG. 5 which is a schematic hydraulic circuit diagram. As there seen, a truck mounted hydraulic fluid pump 60 provides a high pressure source of suitably filtered hydraulic fluid taken from a reservoir through line A. Line B returns hydraulic fluid to the reservoir. Line A passes to a stabilizer valve 62 to supply hydraulic outriggers or stabilizers 64 which are extensible to ground level and which are retractible to the position shown in FIG. 1 to stabilize the pumper truck when the boom 14 is in extended position. Line A further provides supply fluid for other hydraulic prime movers and motors.

A second valve so fed is a control valve 66. This valve desirably provides fluid to line C such as at a constant pressure of 500 p.s.i. and to line D at 4 g.p.m. at a maximum of 3,000 p.s.i., the excess fluid being ported to line E to return. Lines C and C' are continuous, respectively, through entry ports 24 in manifold 22, and through grooves 28 and vertical channels 30 in centerpost 20. Line C terminates in a common manifold 68 which serves to provide hydraulic supply and return fluid for all of the nozzle assembly functions to be described at 500 p.s.i. Return for the common manifold 68 fluid is provided via return line C' to return line E.

Valve 66 also, as stated, provides hydraulic fluid to line D desirably at 4 g.p.m. This line feeds three valves which respectively serve to operate a pair of hydraulic cylinders for boom 14 and a hydraulic turntable motor. These three valves are assembled so that they are operable by a single control handle 82 at the control panel 17 conjointly or separately, and in opposite directions.

One of these valves, turntable valve 70 serves to feed a hydraulic motor 72 through lines F, F'. Supply pressure provided to one or the other of these lines will result in rotation of the turntable in one direction or the other. Lines F, F' lead through the manifold entry ports and are taken off through the centerpost channels 30 to provide pressurized fluid in the appropriate line for the direction of rotation desired.

Lower cylinder valve 74 selectively feeds lines G, G' with fluid from line D to operate a two-way lower boom piston and cylinder assembly 76 to move the lower boom section 50 between the storage position and the various operating positions illustrated in FIG. 1. Lower cylinder assembly 76 is pivotally connected to each of the turntable and the lower boom section 50. To raise lower boom section 50, one of the lines G, G' is ported to supply and the other to return. To lower section 50, the lines G, G' are reversed. Lines G, G' enter and leave the manifold and centerpost in the same manner described respecting lines C, C' and F, F'. Similarly, upper cylinder valve 78 serves to supply lines H, H' which feed and exhaust upper boom cylinder and piston assembly 80, which assembly is pivotally secured to each boom section, to pivot upper boom section 56 to a wide variety of relative positions, for example as illustrated in phantom in FIG. 1. As stated, it is preferable that a single control lever or handle 82 be connected through a suitable mechanical linkage to each of the valves 70, 74, 78 whereby operation of all three spool valves separately or conjointly is possible. Through the lever 82 any one of the spools of the three valves may be selectively shifted to control either singly or in any combination the three hydraulic functions of boom sections 50, 56 and the turntable 15.

As seen in FIG. 5, the manifold 68 provides four pairs of supply and exhaust lines, all fed by line C and all exhausted by line C'. Each pair of lines serves to provide hydraulic power for one of the four nozzle assembly functions. Each such pair supplies a hydraulic prime mover or motor through a four-way, three-position valve operated by a pair of oppositely acting solenoids for activating the operating spools of the valve. One such four-way, three-position valve and solenoid assembly is illustrated in FIG. 5 as valve assembly 90.

The three positions of the valve assembly 90 are referred to by the letters "X," "Y" and "Z" and as can be seen in FIG. 5,

valve assembly 90 is supplied with hydraulic fluid at 500 p.s.i. through line M, line M' being a return line.

To operate hydraulic motor 92, the solenoids S, S' associated with valve assembly 90 are energized, alternately to select either the "X" or "Z" position, the "Y" position being a neutral, inoperative position. When the assembly 90 is in the "X" position, fluid under pressure is admitted to motor 92 to drive it in one direction. When assembly 90 is in the "Z" position, fluid is admitted to the motor to drive it in the opposite direction. The selection of the "X" and "Z" positions is provided by the solenoids, S, S' which are controlled by a three-position electric switch SW1 on the remote control panel 17, which switch has positions corresponding to the "X," "Y" and "Z" positions of the valve. Power to operate the solenoids is provided via pairs of the conductors connected to the strips 45 in grooves 43 which run up to the solenoids.

The particular valve assembly 90 illustrated is adapted to operate hydraulic motor 92. Three other four-way three-position valve assemblies 94, 96 and 98 operate three other prime movers 100, 102, 104, respectively, similarly via switches SW2, SW3 and SW4, for purposes to be described.

Now referring to FIGS. 6, 7 and 8, upper boom section 56 terminates in a yoke which comprises a pair of hollow arms 120, each defining a tubular conduit in flow communication with the pipe section 58 of boom section 56, so that the water supplied through the boom section 56 splits into two streams which, as viewed in FIGS. 6 and 7, move to the left through arms 120. Arms 120 terminate forwardly in a swivel connection including an integral external tubular section 122 and an internal tubular member 125, which are oriented along a horizontal axis 123, i.e., an axis parallel to the earth's surface. A monitor member including a tubular sleeve 124 is mounted for rotation about that axis on tubular member 125 and adjacent tubular section 122 and is sealed to tubular member 125 as by a plurality of sealing gaskets such as O-rings 126.

Tubular sleeve 124 mounts a sprocket 128 which is adapted to be driven by a continuous loop or drive chain 130. Drive chain 130 also travels around a drive sprocket 132 which is driven by hydraulic motor 92 which is suitably mounted on a framework 131 secured to arms 120. Motor 92, as stated, is supplied with drive fluid via the manifold and centerpost construction through the previously described four-way three-position valve assembly 90. When the motor and sleeve 124 are to be driven, one of the associated solenoids S, S' is actuated by the three-position switch SW1 which is connected to two contactors 47 via two conductors. One of the conductors and contactors serves to operate one of the solenoids S, S' and the other conductor and contactor serve to operate the other solenoid. One side of each of the solenoids S, S' is always grounded. When a solenoid S, S' is actuated, fluid is then supplied through lines M, M'. When the power is cut to that solenoid a spring associated with it returns it to the closed position closing off the hydraulic fluid supply to the valve 90 and returning it to the "Y" or neutral position, thus maintaining the driven tubular sleeve 124 in a desired position. When the sleeve 124 and motor 92 are to be driven oppositely, the other of the solenoids S, S' is activated to provide fluid for lines M, M'.

This then provides vertical travel for the nozzle and monitor assembly about a horizontal axis. With respect to the end of boom section 56, as seen in FIG. 2, the nozzle assembly is capable of approximately 240° of vertical travel about a horizontal axis transverse to the boom section 56 and regardless of the position and disposition of the boom sections 50, 56.

As stated previously, one pair of hoses (lines C, C') feed the manifold 68. The manifold 68 is operatively connected to each of the four 4-way three-position valves to selectively provide pairs of pressure and exhaust lines for each of the motors 92, 100, 102, 104 through the respectively associated valves. It will be observed that the framework 131 supported by arms 120 mounts the valves 90, 94, 96, 98.

Returning now to tubular sleeve 124, it will be observed that the sleeve opens into a further yoke assembly or nozzle support monitor comprising a "Y" 133 secured to a pair of monitor arms 134. Water passing through arms 120 is directed inwardly toward the center of tubular section 122 and is then directed by internal porting and baffling into monitor arms 134 and toward the forward end of monitor arms 134, thence inwardly toward the center of the monitor whereat a tubular monitor section 136 is provided. Tubular monitor section 136 mounts a tubular monitor sleeve 138 which is sealed to, but is in flow communication with, monitor section 136. Monitor section 136 is ported to direct the two flow streams toward each other and forwardly through a threaded nipple 140. In the manner described, water is brought forward through the boom assembly, through the arms 120, through monitor arms 134 and to the threaded nipple 40, and is in constant flow communication with the nozzle discharge orifice.

The axis of rotation of the tubular sleeve 124, which mounts the monitor arms 134, as stated is horizontal. The axis of rotation 160 of the tubular monitor sleeve 138 lies in a plane which is normal to horizontal axis 123 and which axis is not coincident with the axis of boom section 56. It is clear that each of the axes 123, 160 lies in a plane which is normal to the other axis and neither of which is coincident with the boom section 56 axis, unlike the construction illustrated in the aforementioned patent. This disposition of the monitor axis 160 provides for side-to-side sweep for the nozzle itself regardless of the disposition of the boom sections and regardless of the position of the monitor arms 134.

Referring now to FIGS. 6 and 7, tubular sleeve 124, is connected to the monitor arms 134. Arms 134 support a prime mover 100 for providing horizontal sweep. This prime mover comprises a fixedly mounted position 150 and a floating double-acting cylinder 152 sealed at the piston by O-rings. Piston 150 includes a pair of feed rods 154 which project outwardly therefrom and through opposite endwalls of the cylinder whereat they are suitably sealed (see FIG. 9). The feed rods are sealingly secured at their outer ends to feed connections 156 and to a mounting frame secured to the monitor arms 134. Fluid is provided to the cylinder 152 via the feed connections 156, through feed rods 154 and through apertures in the feed rods internally of cylinder 152 on opposite sides of the cylinder. This prime mover 100 is hydraulically actuated through one of the four-way, three-position valve assemblies previously described, i.e., assembly 94, operated by a switch SW2. It will be clear that the four-way, three-position valve, when cylinder 152 is to be moved downwardly (as viewed in FIG. 9) will supply fluid to the cylinder chamber below piston 150 and exhaust from above. When the cylinder is to be moved upwardly, the reverse takes place.

The movement of the cylinder 152 is translated into rotary or oscillatory movement about the axis 160 (see FIG. 9) by a sheave and cable assembly. Cylinder 152 mounts a pair of sheaves 162, 164 which are rotatably journaled thereon. A first cable 166 is secured at its forward end to monitor sleeve 138 by a bracket and connector assembly 168. Cable 166 is partially wrapped around sleeve 138, is trained around sheave 162 and is secured by a connector 170 to the framework mounting prime mover 100. The other cable 172 is similarly mounted to an oppositely positioned bracket and connector assembly 174, is partially wrapped around sleeve 138, is trained around sheave 164 and is connected by a connector 176 to the framework. The cables are tautly secured and act oppositely to drive the sleeve 138 (hence the connected nozzle) for side-to-side sweep about axis 160. Thus, for example, when the cylinder is driven upwardly (as viewed in FIG. 9) and as indicated by the vertical arrow, it will pull cable 166 which will drive sleeve 138 in a clockwise direction as shown by the arrow indication. Opposite linear movement of the cylinder will result in opposite or counterclockwise motion of sleeve 138 to elevate the discharge orifice of associated nozzle.

Thus, it is seen that hydraulic prime movers 92 and 100, as illustrated by FIG. 2 and 3 respectively, operate to provide for the nozzle vertical travel of up to about 240° about a horizontal axis and independent horizontal sweep of about 90° about an axis lying in a plane normal to the horizontal axis. This permits a wide range of adjustability in operation which is independent of movement of the boom sections and turntable and which, with them provides a virtually infinite range of adjustability. It provides a substantial improvement over the construction of the aforementioned patent wherein side-to-side sweep required conjoint operation of a pair of electric prime movers unless one of them happened to be in a single particular position, a very rare occurrence.

A preferred nozzle assembly to be used with this construction is illustrated in FIG. 10 and is adapted to be sealingly screwed to nipple 140. This nozzle has two functions or modes of operation, one being the function of adjusting volumetric flow rate and the other the function of adjusting the flow pattern continuously between straight stream and fog. Each function is controlled by a drive means or prime mover operate through a dual solenoid, four-way, three-position valve assembly of the type illustrated and described previously and as shown schematically in FIG. 10. As will appear, these nozzle functions are operable from remote locations, such as the control panel, by switches SW3 and SW4, and require no manual mechanical adjustment to vary flow pattern and require no springs or the like for biasing any of the nozzle elements in one direction or the other.

The nozzle assembly 200 provides a discharge orifice 202 which is in fluid flow communication with said boom fluid passage. Assembly 200 includes a first tubular member 206 that extends forwardly from connector 204 which in turn is secured to nipple 140. Member 206 is provided with rearwardly facing annular shoulder 208 on the outer surface thereof, adjacent the rearward end of the member. Member 206 is also provided with a forwardly facing shoulder 210 on the outer surface thereof, forwardly of shoulder 208. A spider structure 212 extends inwardly from the inner surface of member 206 intermediate the ends thereof, and the spider structure terminates centrally in means for fixedly securing a valve stem 214 forwardly thereof and mounting a diametrically enlarged valve member 216 to provide a par of a fluid flow control means, as will hereafter appear.

The nozzle assembly includes a second tubular member 218 that is mounted for axial sliding movement relative to member 206. It may be formed of two separate sections, fixedly secured to each other as by threading.

The inner surface of member 218 is provided with a forwardly facing shoulder 220 adjacent the rearward end thereof, with the shoulder 220 being positioned in opposed axially spaced relationship with respect to the shoulder 208 on member 206 to define an annular chamber 222 therebetween. A bored boss 224 is provided to establish communication between a source of fluid under pressure and the chamber 222 whereby member 218 may be moved rearwardly relative to member 206 to increase the volumetric flow rate discharged by the nozzle.

The inner surface of member 218 is further provided with a shoulder 226 which is in opposed relationship with respect to the shoulder 210. An annular chamber 228 is provided between shoulder 210 and shoulder 226. One or more bores 230 extend through the sidewall of member 218 to establish communication between chamber 228 and a source of fluid under pressure to move member 218 forwardly with respect to member 206 to decrease the volumetric flow rate discharged by the nozzle.

The forward end of member 218 includes a flared portion 232 which extends forwardly and outwardly to cooperate with valve member 216 to provide a discharge orifice or annular passage means 234 for controlling the volumetric flow of fluid through the nozzle.

In the rearwardmost position of member 218 flow is at its maximum and in the forwardmost position flow rate is at its

minimum or at shut off if desired. Assuming a generally constant pressure of about 80 p.s.i., a minimum flow rate may be 300 g.p.m. and a maximum flow rate may be 1,000 g.p.m.

The nozzle assembly 200 further includes a third tubular member 236 that is telescopically mounted upon member 218 for movement axially thereon. Member 236 includes a generally cylindrically shaped inner bore 238 and adjacent discharge orifice 202 that cooperates with the flared surface 232 and with valve member 216 to control the pattern of fluid spray emerging from the nozzle orifice. Member 236 is counter-bored to provide a forwardly facing shoulder 240 on the inner surface thereof. Shoulder 240 cooperates with a rearwardly facing shoulder 242 on member 218 to define an annular chamber 244 therebetween. A bored boss 246 extends laterally outwardly from member 236 to establish communication between a source of fluid under pressure and chamber 244 for moving member 236 rearwardly with respect to member 218 to increase the angle of spray emerging from the nozzle, as to a wide-angle fog.

The inner surface of member 236 rearwardly of shoulder 240 is positioned in sliding engagement with the outer surface of member 218, and provides a rearwardly facing shoulder 248 that is spaced from a shoulder 250 defined by member 218 to define an annular chamber 252 therebetween. A bored boss 254 extending through the sidewall of member 236 establishes communication between a source of fluid under pressure and chamber 252. When fluid under pressure is admitted into chamber 252, member 236 is moved forwardly relative to member 218 to decrease the angle of flow emerging from the nozzle. In the forwardmost position of member 236, a substantially straight stream emerges from the nozzle.

The means for controlling the admission of fluid into chambers 222, 228, 224, and 252 includes a pair of solenoid-actuated four-way, three-position valve assemblies 96 and 98, the solenoids having springs biasing the operating spools of the valves toward the center or neutral position. The chambers 252 and 244 constitute prime mover 102 and the chambers 228 and 222 constitute prime mover 104. It will be observed that chambers 228 and 252 are both in fluid communication through a common line with bored boss 254, chamber 228 through bores 230. However, one or the other will act selectively depending upon which cooperative exhaust line is opened by the valve in question, unless of course both are opened for operation of both functions of the nozzle. Of course, as will be apparent from FIG. 10, suitable seals, such as O-rings, are provided in recessed portions of nozzle members so that the chambers are fluid tight.

In operation, pumper truck 12 is positioned sufficiently close to the fire to permit the use of the remote controlled assembly described herein. The operator then positions himself at the control panel 17 (FIG. 16) and then is in a position to operate the assembly.

The boom sections may be elevated with respect to each other and with respect to the turntable, via control handle 82. Control handle 82 in one of its modes of movement also permits continuous 360° rotation of the turntable, in either direction. The lower boom may desirably be moved through an arc of about 105° relative to the turntable from its position of rest, and the upper boom through an arc of about 150° relative to the adjoining end of lower boom section.

The nozzle and monitor assembly 16 is remotely operated by the three-position solenoid-activating switches SW1, SW2, SW3, SW4 at the control panel 17. One of these, switch SW1 operates the solenoids S, S' for the hydraulic motor 92 which controls the vertical disposition of the nozzle end with respect to the end of the boom section 56 and within the range of movement illustrated in FIG. 2. A second of these switches SW2 operates the solenoids for the valve assembly 94 for the floating cylinder 152 for side-to-side sweep of the nozzle end with respect to the end of the boom, and within the range illustrated by FIG. 3. The other two switches SW3 and SW4 control the pairs of solenoids operating valve assemblies 96 and 98 which control the flow pattern and flow rate, respectively,

of the nozzle assembly 200. At all times suitable pressure is maintained in water delivery pipe 18 to supply water through the conduits and connections described at a suitable pressure to the discharge end of the nozzle assembly.

It will be understood that where the terms fluid and water are used herein, they contemplate flowable materials such as water, foams, foam formers, water with additives and the like.

Although only certain embodiments of this invention have been described, it is clear that modifications apparent to those skilled in the art may be made within the spirit and scope of this invention.

What we claim is:

1. In a fire-fighting apparatus: a support; an elongate boom having a pair of ends; one of said ends being mounted on said support for movement with respect to said support; the other of said ends pivotally mounting a monitor and nozzle assembly; means associated with said boom for defining a fluid passage extending from said one end to said other end, said fluid passage being in flow communication with said monitor and nozzle assembly; said monitor and nozzle assembly comprising a monitor member pivotally connected to said other end for oscillation about a first axis, said first axis being transverse to said other end of said elongate boom, a nozzle support member pivotally mounted on said monitor member for oscillation about a second axis, said first axis lying in a plane which is normal to said second axis, a nozzle connected to said nozzle support member, said nozzle having a discharge orifice projecting away from said first axis and which is in continuous fluid flow communication with said fluid passage, said first axis always being substantially parallel to the earth's surface, first motor means for oscillatably driving said monitor member about said first axis, second motor means for oscillatably driving said nozzle support member about said second axis, and control means for controlling said first and second motor means.

2. In the fire-fighting apparatus of claim 1 wherein said axes are spaced apart.

3. In the fire-fighting apparatus of claim 1 wherein said other boom end defines a yoke and said monitor member is positioned for oscillation between the arms of said yoke about said first axis.

4. In the fire-fighting apparatus of claim 1 wherein said monitor member defines a yoke and said nozzle support member is mounted for oscillation between the legs of said yoke about said second axis.

5. In a fire-fighting apparatus comprising: a vehicle having a frame; an articulated, self-supporting boom having a pair of tubular boom sections and tubular pivot means swingably mounted one section on the other section and placing said sections in fluid communication with each other, the sections thereby providing fluid delivery means in the boom; means mounting the boom on the frame of said vehicle for movement of both of said sections with respect thereto; and means coupled with said boom for moving the boom relative to said vehicle frame, said fluid delivery means being coupled with a source of fluid under pressure for receiving a stream of said fluid therefrom; the improvement comprising: a nozzle and monitor assembly for receiving said stream of fluid from said boom, said assembly comprising a monitor member pivotally connected to said boom for oscillation about a first axis with respect to said boom, a nozzle support member pivotally connected to said monitor member for oscillation about a second axis which lies in a plane normal to said first axis, said first axis extending in a direction substantially parallel to the earth's surface, and a nozzle connected to said nozzle support member, said nozzle providing a nozzle discharge orifice, remotely actuatable first motor means for oscillatably driving said monitor member, second remotely actuatable motor means for oscillatably driving said nozzle support member, said first and second motor means being independently and remotely actuatable from a control station on said vehicle frame to provide independent vertical travel of said nozzle discharge orifice about said first axis and independent sweep of said nozzle discharge orifice about said other axis.

6. In the fire-fighting apparatus of claim 11, in which each of said first and second remotely actuatable motor means are fluid operated motor means, and in which said boom mounting means comprises a turntable mounted for rotation on said vehicle frame, a centerpost, said centerpost being corotatable with said turntable, a manifold, said manifold being secured to said vehicle frame, said centerpost and said manifold being in continuous fluid flow communication to provide continuous hydraulic fluid flow from said vehicle frame to valve means for said first and second motor means.

7. In a remotely controllable nozzle assembly, support means for said nozzle assembly, said support means being accurately movable in a vertical plane, an elongate supply conduit in flow communication with said nozzle assembly, said nozzle assembly comprising a monitor member pivotally connected to said support means for oscillation about a first horizontal axis, a nozzle support member pivotally connected to said monitor member for oscillation about a second axis which lies in a plane normal to said first axis, and a nozzle connected to said nozzle support member and providing a nozzle discharge orifice, first remotely actuatable motor means for oscillatably driving said monitor member, second remotely actuatable motor means for oscillatably driving said nozzle support member, said first and second motor means being independently and remotely actuatable to provide independent vertical travel of said nozzle discharge orifice about said first axis and independent sweep of said nozzle discharge orifice about said other axis, whereby the range of sweep is the same regardless of the position in which said monitor member is oscillatably disposed about its horizontal axis.

8. In the remotely controllable nozzle assembly of claim 7, wherein said first remotely actuatable motor means is a fluid motor and drives a continuous loop means for oscillating said monitor member.

9. In the remotely controllable nozzle assembly of claim 7, wherein said second remotely actuatable motor means comprises a double-acting fluid cylinder construction, and sheave and cable means for oscillating said nozzle support member.

10. In a fire-fighting apparatus: a support; an elongate boom having a pair of ends; one of said ends being mounted on said support for movement with respect to said support; the other of said ends pivotally mounting a monitor and nozzle assembly; means associated with said boom for defining a fluid passage extending from said one end to said other end, said fluid passage being in flow communication with said monitor and nozzle assembly; said monitor and nozzle assembly comprising a monitor member pivotally connected to said other end for oscillation about a first axis, said first axis being transverse to said other end of said elongate boom, a nozzle support member pivotally mounted on said monitor member for oscillation about a second axis, said first axis lying in a plane which is normal to said second axis, a nozzle connected to said nozzle support member, said nozzle having a discharge orifice projecting away from said first axis and which is in continuous fluid flow communication with said fluid passage, said first axis always being substantially parallel to the earth's surface, a

first remotely controlled hydraulic motor means for oscillating said monitor member about said first axis, a second remotely controlled hydraulic motor means for oscillating said nozzle support member about said second axis, and first control means on said support for remotely controlling said first and second motor means.

11. In a fire-fighting apparatus: a support; an elongate boom having a pair of ends; one of said ends being mounted on said support for movement with respect to said support; the other of said ends pivotally mounting a monitor and nozzle assembly; means associated with said boom for defining a fluid passage extending from said one end to said other end, said fluid passage being in flow communication with said monitor and nozzle assembly; said monitor and nozzle assembly comprising a monitor member pivotally connected to said other end for oscillation about a first axis, said first axis being transverse to said other end of said elongate boom, a nozzle support member pivotally mounted on said monitor member for oscillation about a second axis, said first axis lying in a plane which is normal to said second axis, a nozzle connected to said nozzle support member, said nozzle having a discharge orifice projecting away from said first axis and which is in continuous fluid flow communication with said fluid passage, said first axis always being substantially parallel to the earth's surface, and wherein said elongate boom is an articulated boom having at least two sections foldable and unfoldable with respect to each, a first of said sections being pivotally mounted on a rotary turntable on said support, a second of said sections being pivotally mounted on said first section, the axes of said pivots lying generally parallel to said first axis.

12. In a remotely controllable nozzle assembly, support means for said nozzle assembly, said support means being accurately movable in a vertical plane, an elongate supply conduit in flow communication with said nozzle assembly, said nozzle assembly comprising a monitor member pivotally connected to said support means for oscillation about a first horizontal axis, a nozzle support member pivotally connected to said monitor member for oscillation about a second axis which lies in a plane normal to said first axis, and a nozzle connected to said nozzle support member and providing a nozzle discharge orifice, first remotely actuatable motor means for oscillating said monitor member, second remotely actuatable motor means for oscillating said nozzle support member, said first and second motor means being independently and remotely actuatable to provide independent vertical travel of said nozzle discharge orifice about said first axis and independent sweep of said nozzle discharge orifice about said other axis, and wherein said elongate supply conduit is a boom, said boom being articulated and having at least two sections foldable and unfoldable with respect to each other, said support means comprising one end of said boom, a first of said boom sections being pivotally mounted on a rotary turntable, a second of said sections being pivotally mounted on said first section, the axes of the said boom section pivots lying generally parallel to said first axis.

UNITED STATES PATENT OFFICE
CERTIFICATE OF CORRECTION

Patent No. 3,599,722 Dated August 17, 1969

Inventor(s) Kenneth H. Davidson and Carrol V. Morris

It is certified that error appears in the above-identified patent and that said Letters Patent are hereby corrected as shown below:

Col. 4, line 43, "an" should be -- and --;
Col. 8, line 43 "par" should be -- part --;
Col. 9, line 34, "224" should be -- 2⁴4 --;
Col. 10 (Claim 5), line 50, "mounted" should be
-- mounting --;
Col. 11 (Claim 6), line 1, "11" should be -- 5 --;
Col. 11 (Claim 7, lines 12 and 13 "accurately" should
be -- arcuately --;
Col. 12, (Claim 12), line 34, "aid" should be -- said --

Signed and sealed this 29th day of February 1972.

(SEAL)

Attest:

EDWARD M. FLETCHER, JR.
Attesting Officer

ROBERT GOTTSCHALK
Commissioner of Patents