Sept. 11, 1951 E. D. BALLARD 2,567,176

FIRE FIGHTING NOZZLE

Filed March 31, 1948 7 Sheets-Sheet 1

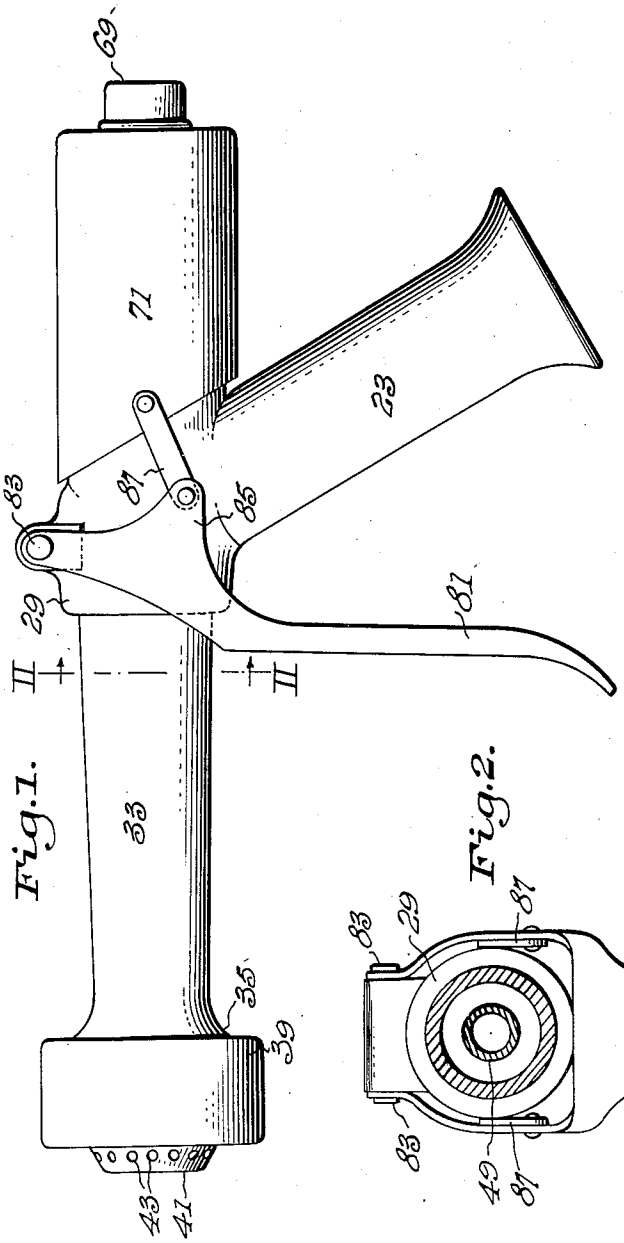

Fig. 1.

Fig. 2.

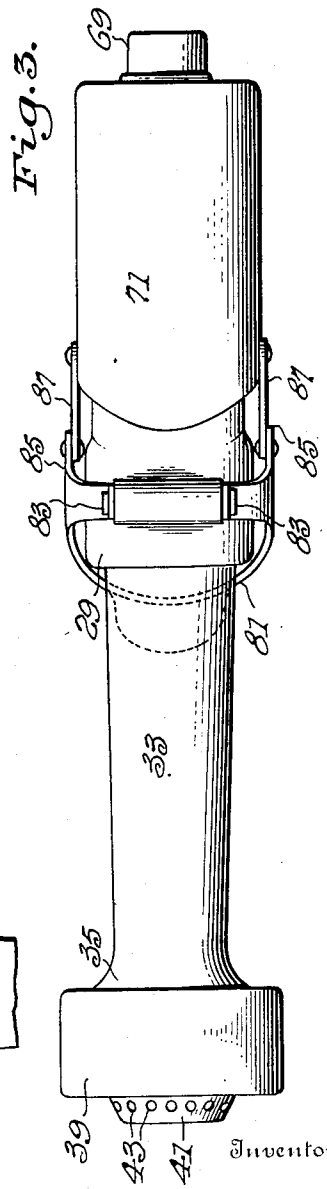

Fig. 3.

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FIRE FIGHTING NOZZLE

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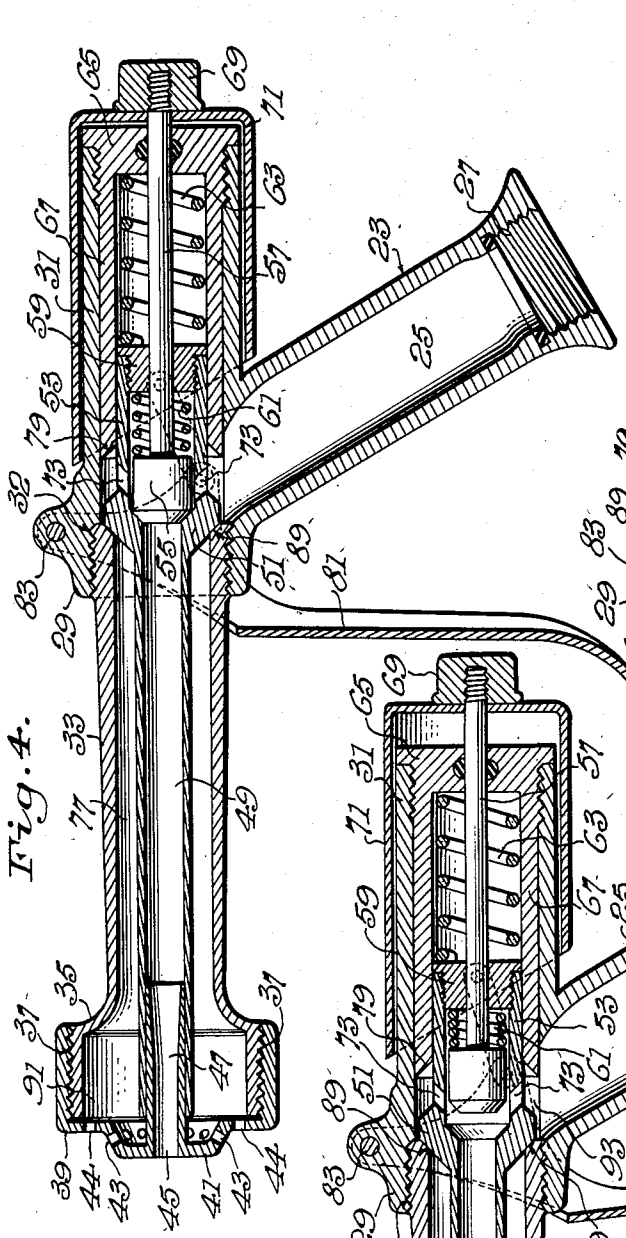

Fig. 4.

Fig. 5.

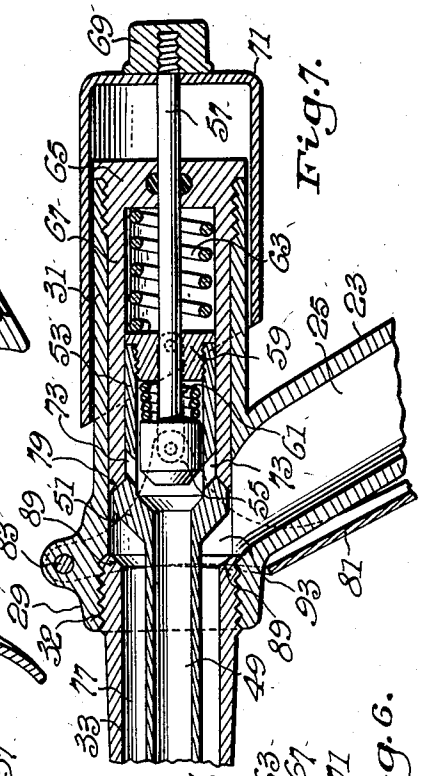

Fig. 7.

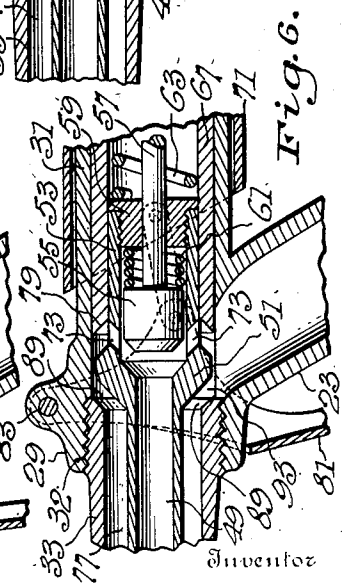

Fig. 6.

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FIRE FIGHTING NOZZLE

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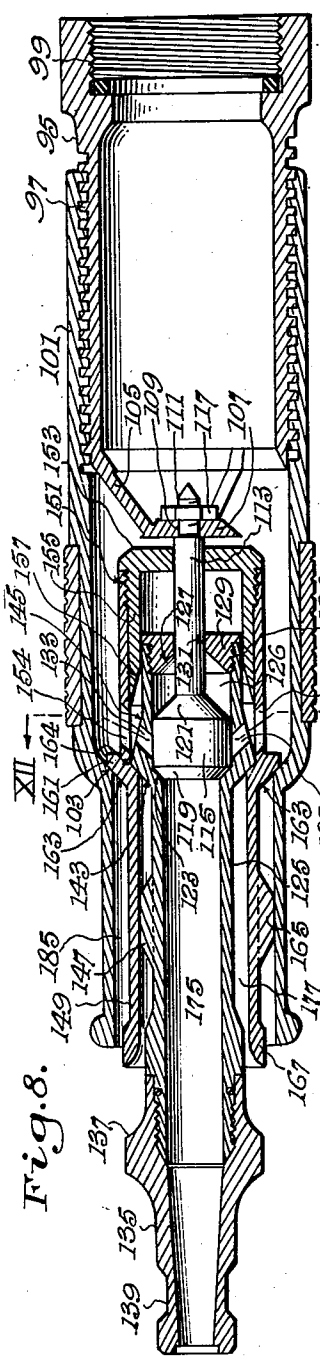

Fig. 8.

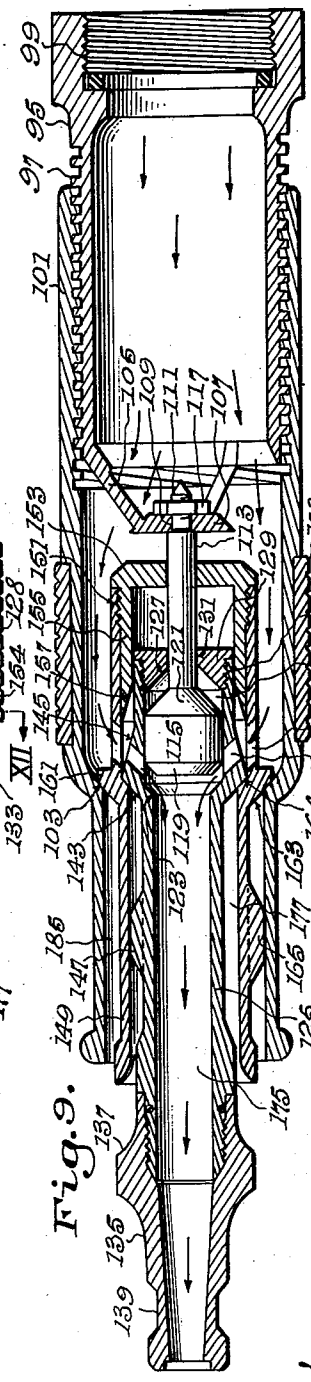

Fig. 9.

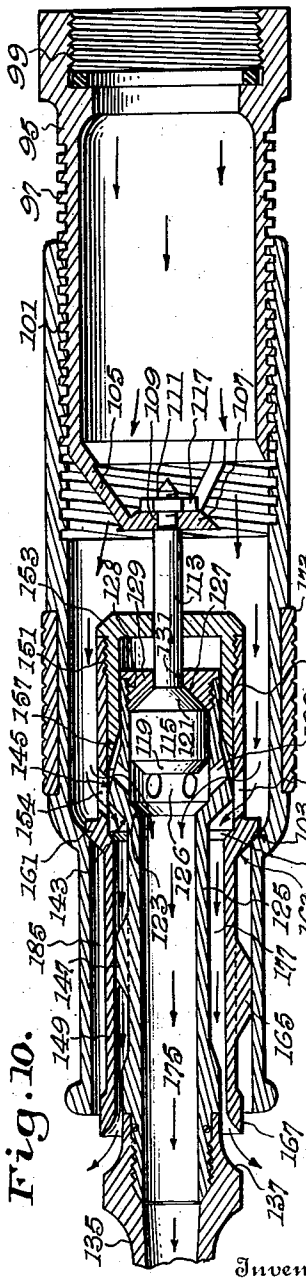

Fig. 10.

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FIRE FIGHTING NOZZLE

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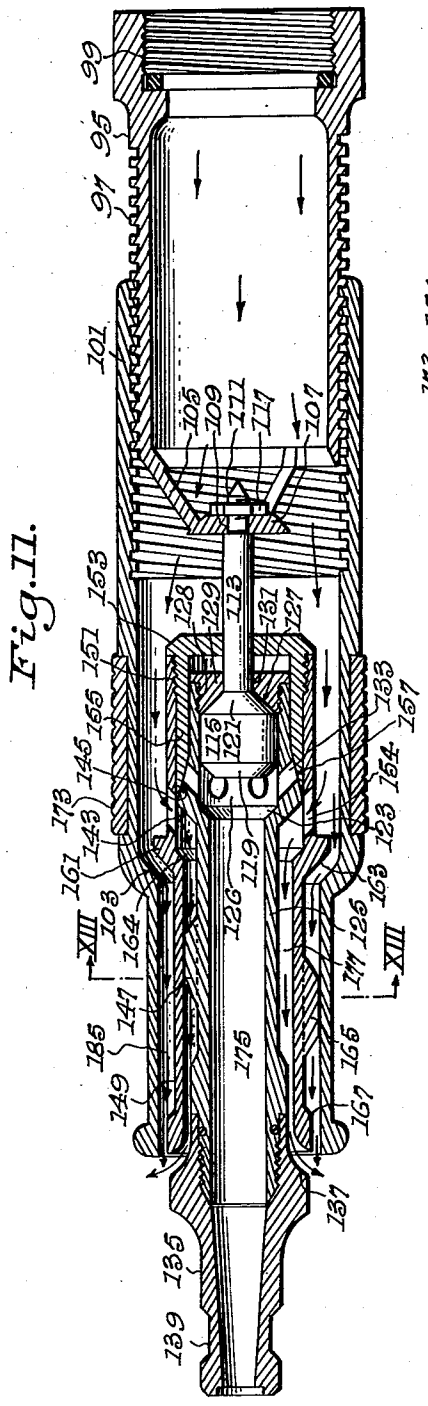

Fig. 11.

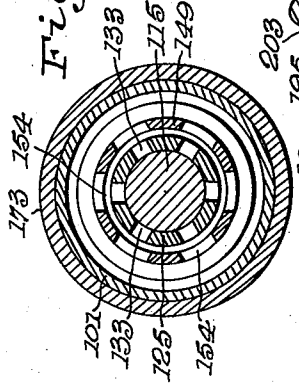

Fig. 12.

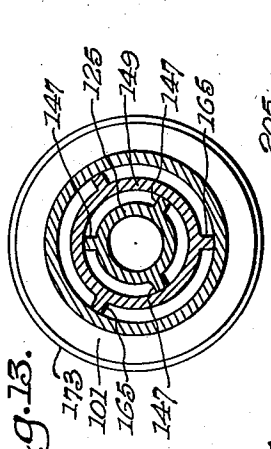

Fig. 13.

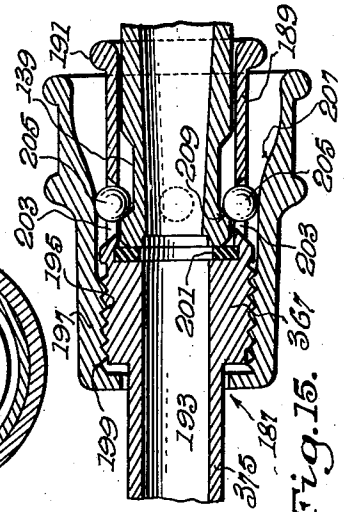

Fig. 15.

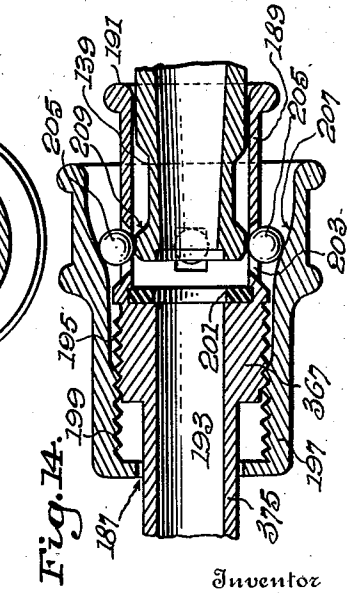

Fig. 14.

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FIRE FIGHTING NOZZLE

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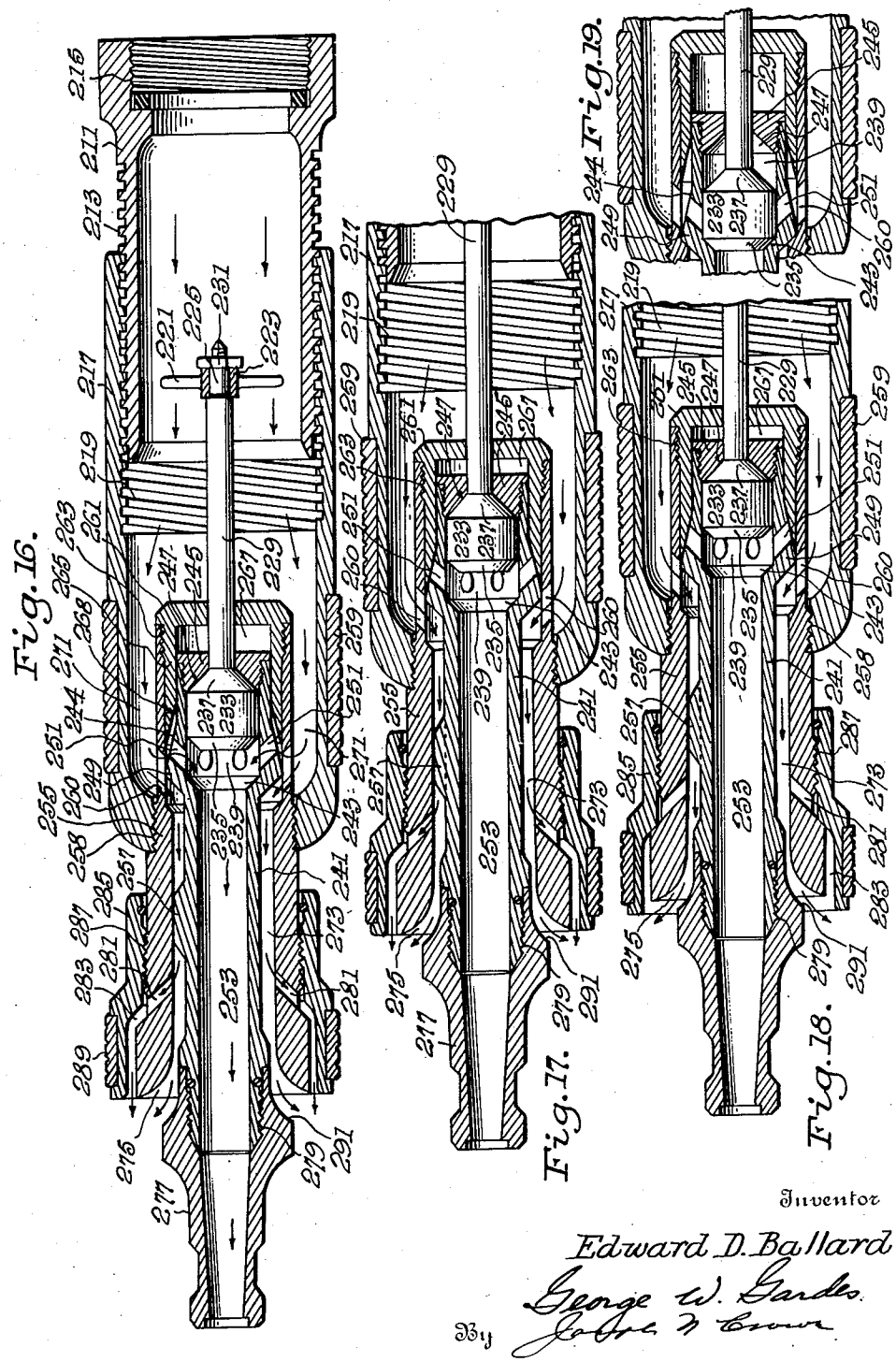

Fig. 16.

Fig. 17.

Fig. 18.

Fig. 19.

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Sept. 11, 1951 E. D. BALLARD 2,567,176

FIRE FIGHTING NOZZLE

Filed March 31, 1948 7 Sheets-Sheet 6

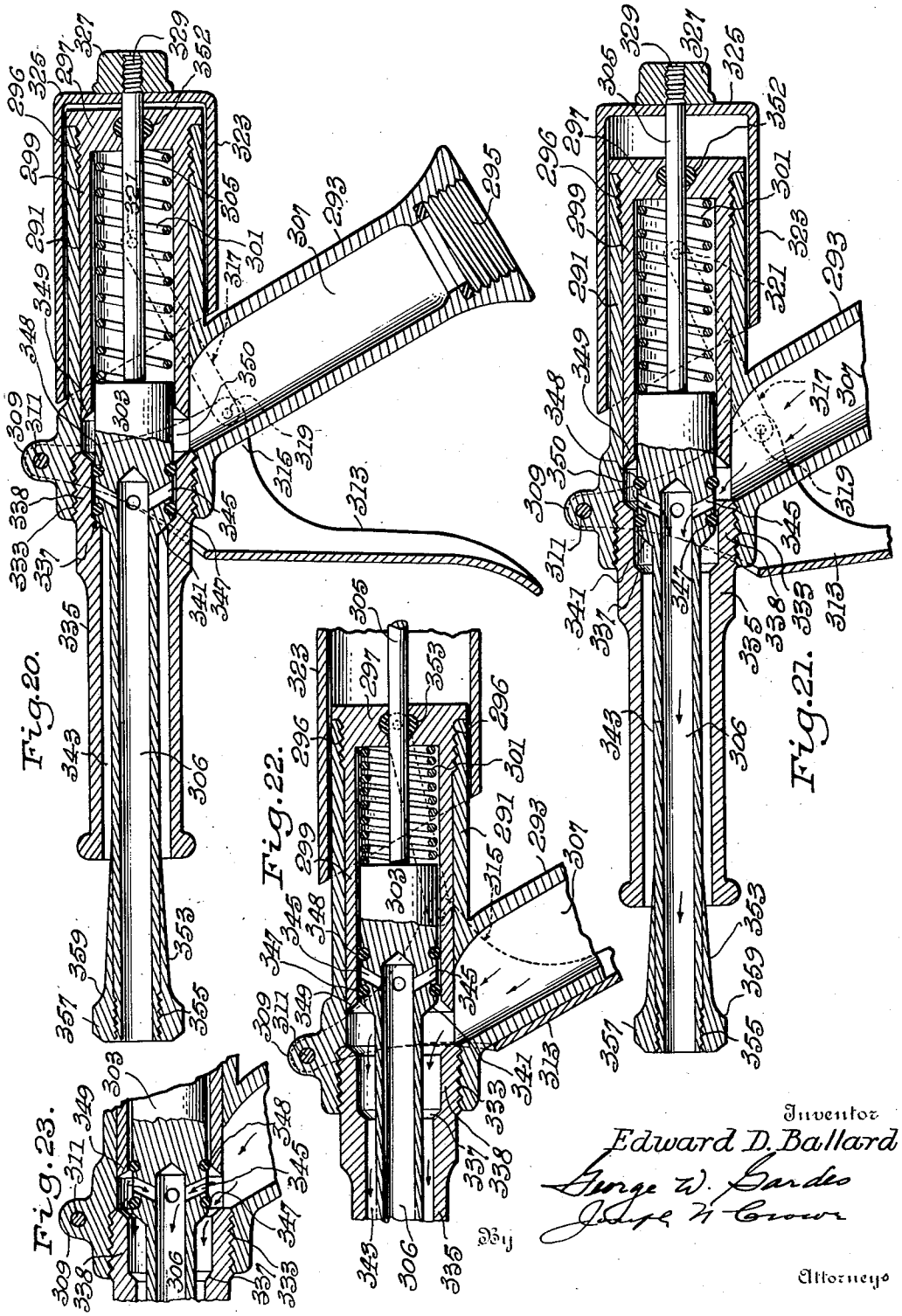

Fig. 20.

Fig. 21.

Fig. 22.

Fig. 23.

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FIRE FIGHTING NOZZLE

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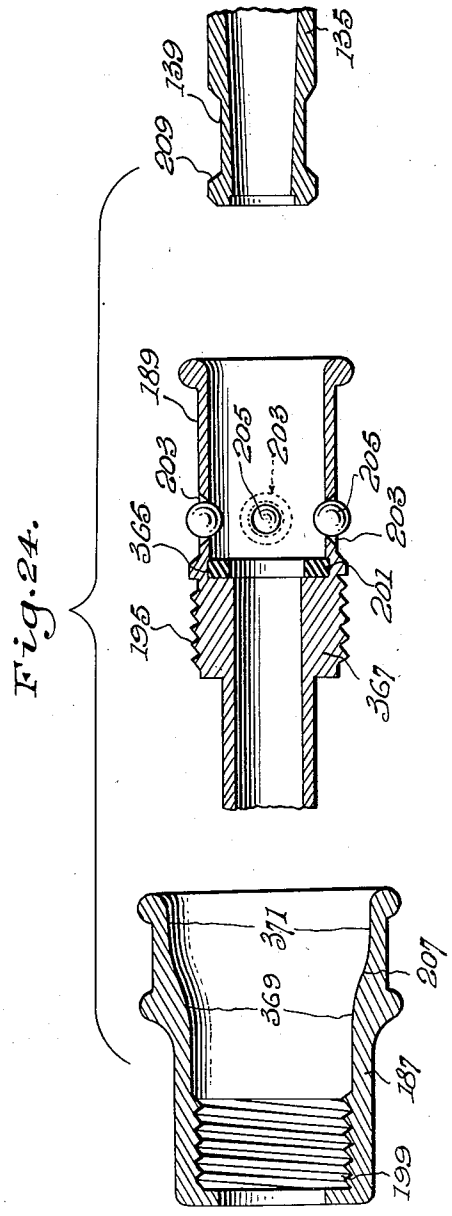

Fig. 24.

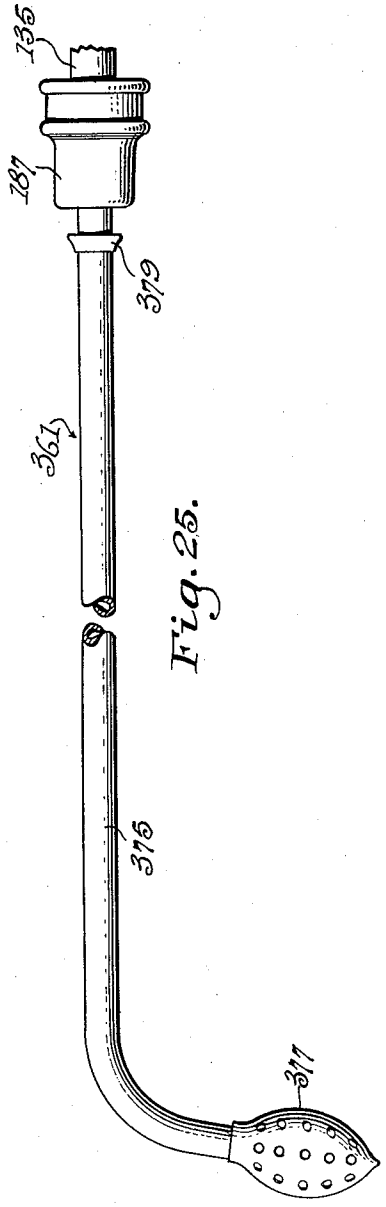

Fig. 25.

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Patented Sept. 11, 1951 2,567,176

UNITED STATES PATENT OFFICE

2,567,176

FIRE FIGHTING NOZZLE

Edward D. Ballard, Orlando, Fla.

Application March 31, 1948, Serial No. 18,123

28 Claims. (Cl. 299—141)

(Granted under the act of March 3, 1883, as amended April 30, 1928; 370 O. G. 757)

1

This invention relates generally to nozzles adapted for discharging fluid in the form of streams or fog, and more particularly to nozzles which may be actuated to four positions for shutting off flow of the fluid through the nozzles, producing a solid stream of the fluid, a combination of solid stream and fog, and a fog or mist thereof.

One of the objects of the invention is to provide nozzles adapted to selectively or simultaneously discharge a solid stream or mist as desired.

Another object of the invention is to provide nozzles having a single control which will function in any position for discharging solid streams of fluid or a fog or mist thereof selectively, with the quality and range of the streams being varied to any reasonable degree without stream distortion.

Another object of the invention is to provide nozzles adapted to produce a solid stream of fire-extinguishing fluid and simultaneously produce a heat-absorbing water curtain around the solid stream for the protection of the operator of the nozzles, with the quantity of water or other liquid in the curtain adapted to be varied in any reasonable amount without affecting the solid stream in the center.

Another object of the invention is to provide nozzles adapted to produce a solid stream of liquid and a hollow cone of such liquid, forming a curtain, and which may be actuated to shut off the solid stream without cutting off the hollow cone water curtain.

Another object of the invention is to provide nozzles adapted to produce a cylindrical hollow liquid stream which may be discharged simultaneously with, and impinging upon, a hollow cone stream in a continuous uniform circle, thus producing a solid pattern of fog, with the rate of application, area covered, and range of the solid pattern fog produced, adapted to be varied by increasing or decreasing the rate of discharge of the hollow cylinder stream impinging against the hollow-cone stream.

Another object of the invention is to provide a nozzle which is adapted to produce a protective liquid curtain around the base of an applicator simultaneously with discharge of fluid through the applicator, whereby fires caused by inflammable liquid may be fought.

Another object of the invention is to provide a nozzle adapted to discharge a plurality of separate streams simultaneously, with the fluid supply to each stream being adequate and the quality of each stream being unaffected by virtue of the flow of the other streams.

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Another object of the invention is to provide a nozzle of substantially simple, durable, and inexpensive construction and which is not liable to get out of order.

With the above and other objects and advantages in view the invention consists of certain features of construction and operation of parts, which will hereinafter be described and shown on the accompanying drawings in which:

Fig. 1 is a side elevation of one form of the improved nozzle;

Fig. 2 is a cross-sectional view taken on line II—II of Fig. 1;

Fig. 3 is a top plan view thereof;

Fig. 4 is a longitudinal sectional view of the nozzle in closed position;

Fig. 5 is a fragmentary sectional view showing the nozzle in partly open position for discharging a continuous stream of water, or other fluid, in the form of a solid stream;

Fig. 6 is a fragmentary sectional view showing the nozzle in position for discharging a solid stream of fluid and fog simultaneously;

Fig. 7 is a fragmentary sectional view showing the nozzle in position for shutting off the flow of the solid stream of fluid, leaving only the fog;

Fig. 8 is a longitudinal sectional view of a modified form of another of the improved nozzle showing it in closed position;

Fig. 9 is a longitudinal sectional view of the modified form of nozzle in partly open position for discharging fluid in the form of a straight stream;

Fig. 10 is a longitudinal sectional view thereof showing the nozzle being operated to discharge a liquid curtain completely surrounding the straight stream;

Fig. 11 is a longitudinal sectional view thereof showing the nozzle having been operated to shut off the flow of the solid stream leaving only the fog;

Fig. 12 is a cross-sectional view taken on line XII—XII of Fig. 8;

Fig. 13 is a cross-sectional view taken on line XIII—XIII of Fig. 11;

Fig. 14 is a fragmentary detail longitudinal sectional view of a portion of a nozzle tip with an applicator being applied thereto;

Fig. 15 is a fragmentary detail longitudinal sectional view thereof, with the applicator in operative position on the nozzle tip;

Fig. 16 is a longitudinal sectional view of another modified form of nozzle, showing the valve

parts in operative position to produce a combined solid stream and a heat protecting water-cone curtain surrounding the solid stream;

Fig. 17 is a fragmentary longitudinal sectional view of the modification of Fig. 16, the view showing the valve parts operated to produce two hollow streams, impinging to produce a spray;

Fig. 18 is a fragmentary longitudinal sectional view of the nozzle of Fig. 16, the view showing the valve parts in position to discharge a hollow stream only from the nozzle;

Fig. 19 is a fragmentary sectional elevation of the modification of Fig. 16, showing the valve parts in complete cut-off position;

Fig. 20 is a longitudinal sectional elevation of a still further modified form of nozzle somewhat similar to the form of construction illustrated in Figs. 1 to 7, inclusive; the parts being in cut-off position;

Fig. 21 is a view of the modification of Fig. 20, with the valve parts in position to discharge only a solid stream from the nozzle;

Fig. 22 is a view of the modification of Fig. 20, the view showing the parts in position for discharging only a hollow stream from the nozzle;

Fig. 23 is a fragmentary view of the modification of Fig. 20 showing the valve parts in an intermediate position for discharging a combined solid stream and hollow stream from the nozzle;

Fig. 24 is a fragmentary longitudinal sectional view showing, in expanded relation, the mounting means for the applicator attachment shown fragmentarily in Figs. 14 and 15;

Fig. 25 is a side elevation of the applicator.

Referring more particularly to the drawings, and first to the embodiment of the invention shown in Figs. 1 through 7, it will be seen that a handle or stock **23**, which is hollow as shown at **25** and which has an internally threaded open end **27**, is provided with a bushing portion **29** which is extended into a tubular housing portion **31**, as will be described in greater detail hereinafter.

This bushing portion **29** is threaded internally as indicated at **32** for receiving a threaded end of a barrel **33**, the other end of which is enlarged as shown at **35**, and threaded as indicated at **37** for receiving a cap **39**. This cap is a casting having an outlet tip **41** thereon, a series of small annularly spaced, angularly diverging holes **43** being provided around a central discharge orifice **45** having an inwardly projecting tubular extension **47**, and corresponding holes **44** being provided in the cap **39** extending parallel to the axis of the nozzle.

The tubular extension **47** snugly fits into tubular slide valve means including a discharge tubular stem **49** that is provided with an enlarged valve flange **51** and terminates rearwardly in a hollow valve head **53** in which is mounted a movable control piston head **55** carried by a piston rod **57** that extends through a closure plug **59** which completes the hollow head **53** of the slide valve, it being threadedly mounted in the end of valve head **53** and closes the end thereof. A relatively light spring **61** is interposed between the control piston head **55** and the plug **59** and a heavy spring **63** is interposed between the space located between the plug **59** and the relatively heavy end **65** of a cylindrical lining **67** which is threadedly secured to the housing **31**. The spring **63** is substantially heavier and stronger than is the spring **61**. The piston rod **57** is threadedly mounted in a cap **69** on a cylindrical sleeve **71** which slidably encloses the housing **31**. The valve head **53** is provided with liquid passage ports **73**, and the

inner end of the barrel **33**, and the adjacent end of lining **67** are oppositely tapered to form liquid cut-off valve seats for the oppositely tapered valve surfaces of the valve flange **51**, that engagement of the valve flange with the correspondingly tapered valve seat **89** on the inner end of the barrel serves to cut off the flow of liquid into the annular space **77** between the tube **49** and barrel **33**, so that liquid will not pass to the fogging or misting openings **43** but will pass only through the interior liquid passage in the tubular valve stem **49** of the slide valve and through the central orifice **45** as a solid stream, while seating of the valve flange **51** against the tapered end **79** of the lining **67** closes the ports **73** and cuts off flow of liquid through the orifice **45**, it being apparent from the foregoing that the hollow valve head **53** and the tubular valve stem **49**, that is integral therewith, form a slide valve assembly as referred to above, the valve flange **51** shifting in the space between valve seat **89** on the inner, or posterior, end of the barrel **33** and the valve seat **79** on the anterior end of the lining **67**, responsively to full retraction of the piston head **55** against the closure **59** of the valve head **53**, and further simultaneous retraction of the control piston head **55** and the said slide valve assembly until the posterior valve surface on the valve flange **51** engages the said valve seat **79** responsively to actuation of trigger **81**. As will be seen from the drawings, the valve flange **51** maintains the tubular valve stem spaced concentrically relative to the enclosing barrel **33**, for forming liquid passage **77** around the tubular slide valve stem **49** between this valve stem **49** and the barrel **33**. The liquid passage extending within the valve stem **49** and the liquid passage **77** therearound are approximately coextensive with the valve stem **49**.

The trigger **81** has a bifurcated end that passes over the bushing **29** and is pivotally secured as indicated at **83**. Each side of the trigger mounting has a projection **85** to which is secured a link **87**, each of the links being secured in turn to the sleeve **71** for actuating the sleeve, as will be apparent from Figs. 1, 2 and 3.

Fig. 4 shows the parts in inoperative position, that is, when no liquid will pass through the nozzle. In order to pass liquid, the threaded end **27** of the stock **23** is connected to a source of liquid, not shown, and the trigger **81** is pressed while stock **23** is gripped tightly.

Manual pressure on the trigger **81** moves sleeve **71** rearwardly pulling piston rod **57** and the control piston head **55** backwardly against spring **61**. This uncovers ports **73** and allows the liquid to flow therethrough into the liquid passage in the tubular valve stem **49** and out through orifice **45** in a solid stream. The passage **77** around the valve stem **49** is still cut off because of the seating of the anterior valve surface of the valve flange **51** against the beveled end valve seat **89** of the barrel **33**. The position of the ports for effecting discharge of the liquid as a solid stream only from the nozzle is shown in Fig. 5.

Further retraction of the trigger **81** compresses spring **61** still further into its extremely compressed condition. This produces a sliding retraction of the slide valve assembly including valve stem **49** relative to the barrel **33** until the anterior valve surface of the valve flange **51** unseats from the end seat **89** of the barrel **33** permitting liquid to flow into the space **77** around the tubular valve stem **49**, this liquid passing into the enlarged end chamber **91**, which reduces its

velocity before it passes out through the misting apertures 43 and 44. The liquid also is being discharged under these conditions as a solid stream from orifice 45. This position of the parts is shown in Fig. 6.

Still further retraction of trigger 81 now causes the control piston head 55, rod 57, valve head 53 and tubular valve stem 49 of the slide valve means to move in unison against the action of the relatively heavy spring 63 to compress this spring between closure plug 59 and end 65 of housing 67. This brings ports 73 into position where they are closed by lining 67, the flow of liquid into the tubular valve stem 49 thereby being cut off while passage 77 is maintained in communication with hollow interior 25 of the stock 23 through passage 93, so that liquid passes, under such conditions, only to the apertures 43 and 44, which are of small diameter and deliver small streams of liquid therefrom. Because of the inclination of the apertures 43 an expanding cone of liquid is discharged therefrom, composed of these fine streams of liquid, which impinge against the parallel streams issuing from the ports 44 to produce a curtain of fine spray or mist between a fire fighter and a fire being treated with the extinguishing liquid from the nozzle.

In the modified form of the nozzle construction shown in Figs. 8 through 13, the trigger actuating means of the form of construction of Figs. 1 through 7 is replaced by a manually operated rotary actuating means.

In this form of the construction there is provided a stock 95, which is threaded exteriorly at 97 with a thread of a wide pitch for receiving the actuating instrumentalities, and is threaded internally at 99 to receive a hose, not shown. The stock 95 has threadedly mounted on threads 97 a barrel 101, the rear end portion of which is of substantially larger diameter than the discharge end, there being formed a tapered shoulder 103 at the junction between the small and large diameter portions, the posterior surface of which shoulder forms a cut-off valve seat as will be explained more fully hereinafter. The stock 95 is a mounting for a rigidly mounted spider 105, that is provided with a centrally disposed plate 107 having a central hole 109 therethrough, through which hole passes a threaded extension 111 of a fixedly mounted piston rod 113, having a control piston head 115 thereon, which will be referred to in greater detail hereinafter. A nut 117, threaded on the end or extension 111 of the rod 113, holds the control piston head 115 rigidly in proper position.

This control piston head 115 is substantially cylindrical in cross section, having a tapered portion 119 on its forward surface, and another and oppositely tapered portion 121 on its rear surface.

The control head 115 is stationarily positioned, when the construction is assembled, in an assembly of cooperating but independently actuating slide valve instrumentalities or means comprising a plurality of independently slidable valve constituents defining concentrically arranged, spaced apart slide valves, the inner one of which is a tubular slide valve, indicated at 125, the rear end of which defines a hollow valve head 126 which houses the central piston head 115 with a predetermined space lengthwise of the valve head to permit the desired movement of the slide valve 125 relative to the control piston head 115, as will be pointed out in greater detail hereinafter.

The forward end of the valve head 126 is defined by an internal anterior seat 123 that is

tapered correspondingly to the tapered portion 119 of control head 115, and defines a seat therefor when the slide valve 125 is in retracted position, as will be pointed out hereinafter. The valve head 126 of the slide valve 125 is closed by a closure plug 129 threaded therein as indicated at 128, and which has a tapered rear seat 127 of a shape corresponding to the rear tapered portion 121 of control piston head 115 to form a seat for the control piston head when the slide valve 125 is in forward position. The piston rod 113 passes through an opening 131 centrally disposed in closure plug 129 for this purpose.

The slide valve 125 is provided with a plurality of spaced ports 133 that are arranged around the forward part of the valve head 126 just behind the seat 123. These ports 133 are adapted to be closed by engagement with the control piston head 115 when the slide valve 125 is in retracted position, and are moved out of engagement with the control head when the slide valve 125 is in extended position.

The slide valve 125 is threaded at its outer end for receiving a nozzle tip 135, the nozzle tip 135 being provided with a shoulder 137 adjacent to its juncture with slide valve 125. The tip 135 also is provided adjacent to its discharge with a flat-bottomed groove 139, the sides of which slope as shown. This groove is adapted to receive an applicator attachment, shown more particularly in Figs. 14 and 15, as will be described in greater detail hereinafter.

The slide valve 125 is formed adjacent to the ports 133 with a valve flange provided with anterior and posterior tapered surfaces 143 and 145, which form cut-off valves, as will be described hereinafter, and is also provided, respectively, with centering and guiding webs 147 which are spaced circumferentially around the slide valve on the outside thereof, which webs concentrically space the slide valve 125 in a second or enclosing slide valve 149.

This second slide valve 149 is threaded interiorly adjacent to its inner hollow end as indicated at 151 for receiving the end closure 153 for the valve head 155. This valve head 155 forms a lining for the outer slide valve 149 and extends around the valve head portion of the inner slide valve 125 and in sliding engagement therewith for enabling independent movement therebetween. The valve head 155 has its end tapered as indicated at 157, this taper corresponding to the slope of posterior valve surface 145 on the slide valve 125, so that engagement of the posterior valve surface 145 with the tapered end 157 on valve head 155 closes the ports 133, as shown in Fig. 11.

The outer slide valve 149 is provided with a plurality of spaced ports 154 which correspond to ports 133 of the inner slide valve and in advance of these ports. The slide valve 149 is provided with an annular valve flange 161 which has an anterior valve surface 163, the posterior side of the collar 161 having a tapered valve seat 164 therein, the slope of which corresponds to the slope of the valve surface 143 on the inner slide valve 125, thereby forming a seat for the anterior valve surface 143 of the slide valve 125. The outer slide valve 149 is provided with circumferentially spaced ribs 165 for guiding and spacing the slide valve 149 concentrically in the barrel 101, which barrel forms a rotary operative means for the aforesaid slide valve assembly. The slide valve 149 is provided with an end flange 167, the purpose of which will be pointed out hereinafter,

as the said barrel is advanced and retracted on the threads 97 by corresponding manual rotation of the operating sleeve 173, the sleeve 173 and barrel 101 operating together.

As has been mentioned above, barrel 101 is mounted on the large pitch threads 97 on stock 95. The discharge end of the barrel is of smaller diameter than the remainder thereof, thereby forming the shoulder 103 at the juncture between the small and large diameter portions of the barrel. The inner surface of this shoulder has a taper corresponding to the taper of surface 163 of valve flange 161 so as to form a seat therefor. The barrel 101 also is provided with the manually rotating sleeve 173 for rotating the barrel, as has been mentioned above, for enabling ready rotation of the barrel.

In operation, reference may be had also to Figs. 8 through 11. In Fig. 8, the nozzle is shown in completely closed position, the ports 133 being closed by the seating of tapered portion 119 of the stationary control piston head 115, in the forward seat 123, on the posterior surface of the valve flange on the head of the inner slide valve the ports 154 being closed against liquid passage by the seating of the anterior valve 143 on the anterior surface of the valve flange on the head of the inner slide valve in seat 164 in the posterior surface of the valve flange 161 on the outer valve head. Also, the anterior valve 163 of the valve flange 161 is held seated against the inner surface of barrel shoulder 103 which, as has been stated above, forms the seat for the valve 163 on the said valve flange 161. Liquid under pressure fills the barrel to the shoulder 103, but is sealed against further passage by the seating of the valve 163 of the valve flange 161 against the posterior valve seat in shoulder 103, this seating preventing flow of liquid through liquid passage 185 that is anterior of the valve seat shoulder 103. Also, passage of liquid through ports 154 into passage 177 is prevented by the seating of tapered valve 143 in seat 164 in the valve flange 161, and passage of liquid through ports 133 into passage 175 extending through the tubular valve stem of the inner slide valve is prevented by the closing of these ports through the seating of tapered portion 119 of control piston head 115 in anterior seat 123 in the valve head of the inner slide valve 125. All engaging surfaces are made liquid-tight by any suitable means as will be well understood.

The operation of this embodiment of the invention will be understood from the following considerations, reference being had to Figs. 8 through 11 in sequence, comparative reference being made to the embodiment of the invention shown in Figs. 1 through 7. Whereas in the embodiment of Figs. 1 through 7, the slide valve means is a single slide valve consisting of the hollow valve head 53 and the tubular valve stem 49 integral therewith and having a liquid passage extending interiorly axially therethrough and having an exterior liquid passage 77 exteriorly enclosing the tubular valve stem 49, the slide valve means of the embodiment of the invention shown in Figs. 8 through 11 consists of concentrically disposed constituents made up of a plurality of slide valves, namely the inner slide valve 125 and the outer slide valve 149, each of which is composed of a hollow valve head and a tubular valve stem integral therewith and communicating with the interior of the valve head. It will be noted further that the slide valve means of the embodiment of Figs. 1 through 7 are controlled

by a control piston head 55 that is mounted in the hollow valve head 53 and initially is movable from the front of the valve head to the rear thereof responsively to manual actuation of the actuating trigger 81, this movement initially causing no movement of the slide valve means but uncovering the ports 73 which communicate to the interior of the valve head from the interior 25 of the stock 23 for supplying liquid into the liquid passage inside of the valve stem 49, further retraction of the piston head 55 by further actuation of the trigger unseating the valve 51 from the seat 89 in the barrel, which opens passage 77 between the valve stem 49 and the barrel 53. This valve seat 89 corresponds to the valve seat 103 in the barrel 101 of the embodiment of Figs. 8 through 11, and the outer slide valve component 149 of slide valve means of this embodiment corresponds to the slide valve means 53, 49 of Figs. 1 through 7. The valve 163 on the outer slide valve 149 corresponds to the valve 51 of the embodiment of Figs. 1 through 7, liquid passage 185 enclosing the outer valve 149, corresponding to the liquid passage 77 enclosing the slide valve means of Figs. 1 through 7.

It has been noted above that the slide valve means of the embodiment of Figs. 8 through 11 comprise a plurality of independently actuable slide valve components, which are concentrically disposed relative to each other and to the barrel 101. Similar to the embodiment shown in Figs. 1 through 7, there is a control piston employed in the embodiment of Figs. 8 through 11, this piston comprising the control piston head 115 and the piston rod 113, the control head 115 being mounted in the hollow valve head of the inner valve 125, this valve head communicating with liquid passage 175 extending through the tubular valve stem of the inner valve 125. However, unlike the control piston of the embodiment of Figs. 1 through 7, the control piston of the embodiment of Figs. 8 through 11 is a stationary piston, the piston rod 113 being rigidly connected to the stock 95 by the spider 105.

The slide valve means of the embodiment of Figs. 8 through 11 also includes the outer slide valve 149, as has been noted above, this outer valve having a hollow valve head and a tubular valve stem communicating therewith and defining the liquid passage 177 which corresponds to the liquid passage in the tubular valve stem 49 of the embodiment of Figs. 1 through 7.

This liquid passage 177 encloses the tubular valve stem of the inner valve of the slide valve means of Figs. 8 through 11 and is exterior of the said stem, as is apparent from the drawings.

When the embodiment of Figs. 8 through 11 is inoperative, as illustrated in Fig. 8, the parts are in the position shown with the anterior seats 123 of the inner valve head seating against the complementarily tapered anterior end 119 of the control piston head 115, with the anterior valve 143 of the valve flange on the inner slide valve head seated in posterior seat 164 of the valve flange of the outer valve, and with the anterior valve 163 seating against the barrel seat 103. All ports and passages are closed against liquid flow.

In the first stage of the operation as shown in Fig. 9, the barrel 101 is manually rotated by operating grip member 173 on the barrel 101, the manual operating grip 173 corresponding in the function to the operating trigger 81 of the embodiment of Figs. 1 through 7. Initial rotation of the barrel 101 moves with it the slide valve means positioned in it, pressure of liquid in the

stock 95 maintaining valves 143 and 163 in their respective seats thereby maintaining closed both of the liquid passages 177 and 185, the forward movement of the slide valve means, however, unseating the anterior seat in the inner valve head from the control piston head so as to move ports 133 and 154, which are still in register, forwardly with respect to the control piston head 155, thereby permitting liquid to flow through the passage 175 in the inner tubular valve stem, the liquid projecting therefrom as a solid stream.

Further rotation of the barrel as indicated in Fig. 10, next unseats valve 143, communicating liquid passage 177 in the outer tubular valve stem with the liquid in the stock, ports 133 remaining open and valve 163 still being seated on the barrel seat 103, liquid now passing through the passage 175 and also through passage 177, the discharge being a combined solid and a hollow stream. During this second movement, the inner valve head has moved forwardly relative to the control piston head 115 until the posterior surface thereof seats in the posterior seat 127 in the posterior end of the inner valve head, the inner valve thereby being restrained against further forward movement, the parts now occupying the positions shown in Fig. 10.

Still further forward rotation of the barrel 101 as shown in Fig. 11, causes the valve 163 to unseat from the barrel seat 103. At the same time, however, the outer valve head has advanced forwardly along the restrained inner valve until the cut-off seat 157 in the outer valve head seats against the posterior valve 145 on the inner valve head, so that ports 133 leading into the inner valve head are closed, and liquid passes through both passages 177 and 185 issuing therefrom as hollow impinging streams, which are converted into a fine spray by the impingement thereof.

It will be understood in connection with the embodiment shown in Figs. 8 through 11, that surface 131 between the closure plug 129 for the inner valve head, and the piston rod 113 is not sealed, so that there is no entrapment of liquid in space 126 behind the piston head 115, and the same holds true with respect to the bearing surface between the piston rod and the end closure 153 for the outer valve head, so that liquid in the space between the ends of the inner and outer valve heads can escape around the piston rod 113 into the liquid supply in the stock.

It will be observed that the orifice of the outer valve member is outwardly flaring corresponding to the shoulder 137 on tip 135, which arrangement causes the liquid passing therefrom to diverge into a thin spreading cone. Also the liquid issuing from passage 185 is discharged as a thin hollow cylinder which impinges against the thin spreading cone discharged from passage 177 and is broken up into a finely divided spray of uniform density. The spray produced by the impinging streams serves to shield firefighters from heat and at the same time provides an efficient form of extinguishing liquid for certain types of fires.

When the nozzle is in closed position, as illustrated in Fig. 8, an applicator attachment 187 may be applied to the nozzle, as is indicated in Figs. 14 and 15. This applicator attachment includes a cylindrically shaped, tubular connector 189, with its rear end 191 of sufficient inside diameter to receive the nozzle tip. The forward or front end 193 of the applicator is of sufficient inside diameter to carry the required water flow. The connector 189 of the applicator is threaded, as indicated at 195, to receive a hollow, cylindrical sleeve 197, which is substantially cup-shaped and internally threaded as indicated at 199 for meshing with threads 195 for adjusting the nut relatively to the applicator stock 189. The stock 189 is recessed for the reception of a resilient washer 201, and a plurality of spaced, tapered holes 203 are formed around the circumference thereof, with a ball 205 provided in each of the holes 203. The holes 203 are tapered with their least diameter inwardly so that the balls 205 will not drop through the holes, the least diameter of the holes being less than the diameter of the balls, while permitting the balls to extend into the groove 139 on the nozzle tip.

The locking sleeve 197 is tapered inwardly as indicated at 207 such an amount that, when the nut is screwed forwardly on the stock 189, the balls 205 can ride clear of the bottom of the holes 203, but cannot fall out of the stock; and as the sleeve 197 is advanced on the stock, the tapered shoulder 207 therein presses the balls 205 back into the holes 203 and over the tapered shoulder 209 of the nozzle end and into the groove 139, whereby the nozzle end is secured against the gasket 201 and locked in such engagement. However, the applicator attachment is free to rotate relatively to the nozzle and it may be attached to the nozzle tip in any position with respect to the bend in the applicator pipe.

The modification shown in Figs. 16, 17, 18 and 19 is similar to the precedingly-described embodiment in its operation.

In Fig. 16 the stock 211 is threaded externally at 213 and is threaded interiorly at 215 to provide a hose connection. Mounted on the stock 211 is the barrel 217, which is threaded internally at 219 to mesh with the threads 213 on the stock. The stock 211 is cylindrical and hollow, and has mounted on the interior thereof a spider 221 that has a bushing 223 thereon, which receives the reduced portion 225 of the stationary piston rod 229. The stationary piston rod 229 is mounted in place by a nut 231 threaded on the end of the reduced portion 225 and tightly engages the bushing, thus locking the rod 229 in position.

The stationary piston rod 229 terminates in a control piston head 233 having a tapered portion 235 on its forward surface and another similar tapered portion 237 on its rear surface. The control piston head 233 is positioned in a slide valve head 239 in the rear of an inner tubular slide valve 241. The valve head 239 is tapered at its forward end as indicated at 243 in conformity with the taper of the forward tapered portion 235 on the control piston 233 to form a seat therefor. The rear of the valve head 239 is closed by a plug 245 that is threadedly mounted in the inner end of the valve head 239, and has its inner surface 247 tapered correspondingly to tapered rear portion 237 on control piston head 233 and forms a rear seat therefor. The closure plug 245 has a hole through it for passage of piston rod 229.

The forward wall of the valve head 239 is expanded outwardly as indicated at 244 to an annular valve flange 249, behind which valve flange is a plurality of spaced ports 251 which serve as inlet ports for the tubular passage 253 in the slide valve 241.

Concentrically enclosing the inner slide valve 241 is a second or rotary outer slide valve 255 which is held in concentrically spaced relation

with the inner slide valve 241 by spacing and guiding ribs 257 on the inner slide valve 241 which engage the inner wall of the outer slide valve 255. The outer slide valve 255 is threadedly connected to the barrel 217 as indicated at 258 so that rotation of the barrel 217 on threads 213 by actuation thereof by means of a handgrip 259 thereon will cause a corresponding and simultaneous turning of the outer slide valve 255, with advancement or retraction thereof relative to the inner slide valve 241 in an amount corresponding to the pitch of the threads 213 on stock 211, and in accordance with the direction of rotation of the actuating member 259.

The outer slide valve 255 has circumferentially spaced ports 260 therein, and the valve head is closed by a closure or plug 261, which is connected threadedly, as indicated at 263, with the slide valve 255, the plug 261 having a hole therethrough for passage of the rod 229. The closure plug 261 defines a space 267 with reference to the closure plug 245 of the inner slide valve 241, this plug 245 and the valve head 239 of inner slide valve 241 being positioned on the valve head portion of the outer slide valve 255.

The closure plug 261 is cup shaped with its side 265 extending sufficiently far into the outer slide valve head so that the end 268 thereof can engage the valve flange 244 of the inner slide valve 249 so as to close the ports 251 when the barrel 217 has been rotated sufficiently far to bring the open end 268 of the side 265 into closing engagement with the ports 251, and to clear the ports 260 from the shoulder 249 of the inner slide valve 241.

It will be observed that the barrel 217 is substantially larger in diameter than is the above-described slide valve assembly, the end of the barrel tapering inwardly to the threads 258 thereby providing a liquid passage 271 around the slide valve assembly. The inner slide valve 241 and the outer slide valve 255 define between them the annular liquid passage 273, the discharge end of which expands outwardly, as indicated at 275, to produce a diverging discharge for this liquid. A nozzle tip 277 is shown as threadedly mounted at 279 on the end of the valve 241.

As is shown in this embodiment, spaced ducts 281 communicate with liquid passage 273, these ducts communicating with discharge 283 in the auxiliary actuating member 285, threadedly mounted at 287 on the periphery of the outer valve 255, the auxiliary actuating member being turnable on threads 287 under action of a turning force applied to grip member 289. Liquid issuing from the discharge 283 is in the form of a thin hollow cylindrical stream directed in a direction parallel to the longitudinal axis of the nozzle structure. Rotation of the auxiliary actuating member 285 will close the discharge 283, as indicated in Fig. 18, or will open this discharge as shown in Fig. 17.

The stream of liquid from the discharge 283 is met by the diverging cone of liquid produced by liquid issuing from passage 273 impinging against shoulder 291 on the nozzle tip 277, the effect of all of which is to produce a protective spray curtain as before, except that the spray is more finely divided than that obtained by the precedingly-described modification. The auxiliary actuating member 285 provides a convenient means for interrupting flow of liquid through ducts 281. Except for these spaced ducts 281 and the second, or auxiliary, control 285 therefor, the construction and operation of this embodiment is similar to that shown in Figs. 8 through 11.

The modification shown in Figs. 20 through 23 inclusive is an embodiment generally similar to that shown in Figs. 1 through 7, with the exception that the slide valve 49 and control piston head 55 of Figs. 1 through 7 are made unitary in the modification of Figs. 20 through 23.

In Figs. 20 through 23, the tubular housing portion 291 is provided with a tubular grip or stock 293 which is internally threaded at its end, indicated at 295, for the reception of a hose, not shown, for supplying fire extinguishing liquid to the nozzle construction. The housing portion 291 is cylindrical in shape, and is hollow, and has an internally threaded end 296 for the reception of a closure plug 297 which has a tubular extension 299, which extension forms a lining for the stock 291 and a housing for spring 301. The spring 301 is compressed between the connecting head 303 of the slide valve and the closure 297 through which slide valve stem 305 extends, as will be referred to more particularly hereinafter. The tubular stock 293 forms a liquid reservoir 307 which is continuously filled with liquid. The housing portion 291 is provided with an upstanding boss or lug 309 which forms a mounting for pin 311 for the valve actuating means, which include an actuating trigger 313, upon which pin the trigger pivots. An extension 315 on the trigger forms a mounting to which one end of a link 317 is connected pivotally, as is indicated at 319. Link 317 is connected at its other end 321 to the hollow cylindrical sleeve 323 which encloses the tubular housing portion 291 and is freely movable relatively thereto. The trigger 313, the mounting therefor on the tubular housing portion 291, and the link-actuating means for the sleeve, together with the stock and sleeve elements, are similar to the construction of the modification shown in Figs. 1 through 7.

On the closed end 325 of the slidable cylindrical sleeve 323, there is mounted a boss or internally threaded nut 327 which receives the threaded end 329 of a valve-actuating rod 305, which is connected to the valve head 303.

The forward end of the tubular housing portion 291 is threaded, as is indicated at 333, for the reception of a barrel 335 through which the hollow valve stem 306 projects. The valve head 303 fits into a seat 337 in the externally threaded end 338 of the barrel 335, the seat tapering to correspond to taper 341 of the valve head 303, which taper is located at the juncture of the valve head 303 with tubular valve stem 306, and forms a seat for the valve head 303 that cuts off flow of liquid through passage 343 between the tubular valve stem 306 and the barrel 335.

The valve head 303 is provided with a plurality of intake ports 345, which are spaced around the valve head and communicate with the tubular valve stem 306 as shown on the drawings. On each side of the ports 345, there are mounted in the valve head resilient gasket rings 347, 348. The barrel 335 terminates short of the end 349 of the lining 299, thereby defining a liquid receiving space 350 which receives liquid from the liquid passage 307 and is filled continuously with such liquid.

As the trigger 313 is compressed, sleeve 323 is moved backwardly relative to the tubular housing portion 291, which movement of the sleeve pulls backwardly along with it the valve rod 305 and the valve head 303, against the coil spring 301 for compressing the spring. The valve rod passes

through registering openings in the closure member 297 and in the end 325 of the sleeve 323. Packing seals 352 are shown as being provided around the valve rod 305.

As the valve head 303 is retracted into the end chamber enclosed in the lining 299 in the tubular housing portion 291, the tubular valve stem 306 is retracted into the barrel 335. When the ports 345 thus are brought into communication with the reservoir 350, as shown in Fig. 21, with the sealing rings 347 still in sealing position, the liquid will pass from passage 307 and reservoir 350 into the tubular valve stem 306, and exits therefrom as a solid stream. When the valve head 303 is pulled still further, the ports 345 are in communication with reservoir 350 while also the passage 343 is opened to this reservoir. Still further retraction of the valve head 303 closes the ports 345 on the lining 299 so that the tubular valve stem 306 is sealed off, but passage 343 is in communication with the chamber 350 so that the liquid will pass through this passage.

A diverging sleeve 353 is mounted suitably on the exterior of the valve stem 306, by the threads 355, and it carries at its end a shoulder 357 having a tapering side 359, against which the hollow stream of liquid emerging from the passage 343 impinges, and becomes broken up into a mist.

In Fig. 23, the valve parts are shown in intermediate position, where liquid flows both as a solid stream from the tubular valve stem 306 and as a mist or spray discharged from passage 343.

When the actuating trigger 313 is released, the spring 301 returns the slide valve until the valve head 303 seats against seat 337, thus completely cutting off the flow of liquid through the barrel.

Reference now may be had to Figs. 24 and 25, which show the details of the applicator and attaching means for connecting the applicator to the nozzle, reference in this connection also being made to Figs. 14 and 15.

The connection of the applicator attachment 361 is made by means of the cylindrical, tubular connector 189, the forward end of which is threaded as indicated at 195 for attachment of the locking sleeve 197. The tubular connector 189 is provided with the holes 203 in which the metal balls 205 are placed. These balls 205 fit into the holes 203 so that, although the balls 205 extend into the inside tubular space of this connector, they cannot go completely through the holes which receive them. That is to say, the balls 205 are slightly larger in diameter than the minimum diameter of the countersunk holes 203. The connector 189 is provided with a gasket 201 which abuts against a shoulder 365 in the threaded portion 367 that carries the male threads 195. The locking sleeve 197 is hollow, cylindrical in shape, but slightly tapered inside, as is indicated at 369 and 371, and is provided with female threads 199 which mesh with the male threads 195 on the connector.

In assembling the attachment, the metal balls 205 are placed in the countersunk holes 203. The sleeve 197 is slipped over the connector and threads 195 and 199 are engaged. At this position, the metal balls 205 are free to move up and down in the countersunk holes 203, but they cannot be lost out, since there is insufficient clearance between the outside of the connector and the inside of the sleeve, and since the minimum diameter of the countersunk holes 203 is less than the diameter of the metal balls 205. Furthermore, at this point the assembled attachment can be slipped over the nozzle tip (see Fig. 14),

since the inside diameter 371 is such that the balls 205 can be pushed outwardly to completely unobstruct the nozzle tip as it enters the connector.

Then as the sleeve is screwed further onto the connector in the direction of the nozzle tip, the convergingly tapered cam surface 207 of the sleeve engages the balls 205 and depresses the balls in their countersunk holes until they extend into the annular groove 139 in the nozzle tip and against the tapered cam surface 207, forcing the nozzle tip tightly against the gasket 201 to prevent leakage. The applicator pipe 375 of the applicator attachment 361 is carried by the connector, and is provided with a suitably perforated head 377 which is adapted for application of water, foam, and loaded streams to hard-to-reach fires in attics, walls, or other difficultly-accessible locations, the pipe 375 being bent to facilitate this application. The applicator or adaptor unit is replaceable readily with other units of similar construction but of different lengths, for example, six, eight, ten or twelve feet, depending on conditions of use. It will be noted that a stop 379 is provided on the applicator pipe 375 to prevent accidental displacement of the sleeve 197 from the connector 189, thereby preventing possible loss of the balls 205, which balls actually serve as the locking means for securing the applicator to the nozzle. The sleeve 197 is slipped over the applicator pipe 375 prior to the bending thereof and attachment of the spray head 377, and also prior to application of the stop means 379, which means may be welded or secured otherwise to the pipe 375. The spray head 377 may be made removable from the pipe 375.

What is claimed is:

1. A nozzle adapted to direct fire extinguishing liquid of controlled consistency to burning material, which comprises, in combination, a hollow stock, means for supplying liquid to the stock, a hollow elongated barrel carried by the stock, tubular slide valve means positioned in the barrel in spaced relation thereto and defining with the barrel an annular liquid passage enclosing the tubular slide valve means, liquid intake means for admitting liquid from the stock into the tubular slide valve means, the stock being maintained continuously filled with liquid, the annular passage being also communicable with the stock for receiving liquid therefrom, valve cut-off means carried by the barrel cooperating with the tubular slide valve means, control means for the liquid-intake means for the tubular slide valve means, and a single actuating means for selectively actuating the tubular slide valve means for controlling admission of liquid into the said tubular slide valve means for production of a solid stream of liquid therefrom, into the tubular slide valve means and the annular passage, selectively, the annular passage ejecting the liquid as a hollow stream, whereby a solid stream, a spray, or a combined solid stream and hollow stream, selectively, may be supplied by the nozzle, and also the liquid supply to the slide valve means and annular passage may be cut off, as desired.

2. A nozzle adapted to direct fire extinguishing liquid of controlled consistency to a mass of flaming combustible material which comprises, in combination, a hollow stock, means for supplying liquid to the stock, a hollow elongated tubular barrel carried by the stock, tubular slide valve means positioned in the barrel in spaced relation thereto and defining with the barrel, an annular liquid passage enclosing the tubular slide valve

means, liquid intake means for admitting liquid from the stock into the tubular slide valve means, the stock being continuously filled with liquid, the annular passage being also communicable with the stock for receiving liquid therefrom, valve cut-off means carried by the barrel cooperating with the slide valve means, control means for the liquid-intake means operatively associated with the tubular slide valve means for controlling admission of liquid to the tubular slide valve means responsively to predetermined movement of the tubular slide valve means, a single actuating means for selectively actuating the tubular slide valve means for controlling admission of liquid into the tubular slide valve means for production of a solid stream of liquid therefrom, and into the annular passage for obtaining a hollow stream therefrom, and operatively associated with the barrel for converting the hollow liquid stream from the annular passage into a spray, the actuating means for the tubular slide valve means enabling selectively obtaining a solid stream only of the liquid, a combined solid stream and spray, and a spray only, the actuating means also enabling a complete shut-off of liquid from the tubular slide valve means and annular passage.

3. A nozzle adapted to direct fire extinguishing liquid of controlled consistency to a mass of flaming combustible material, which comprises, in combination, a hollow stock, means for supplying liquid to the stock for maintaining the stock continuously filled with liquid, a tubular barrel carried by the stock, tubular slide valve instrumentalities mounted in the barrel, the said instrumentalities including hollow valve head means and elongated tubular valve stem means communicating with the valve head means and defining liquid passage means through the stem means, means for mounting the slide valve instrumentalities in the barrel in spaced relation therewith to define a liquid passage around the stem, liquid intake means communicating with the liquid in the stock for passing liquid therefrom into the valve instrumentalities, control means for controlling admission of liquid to the intake means, valve seat means carried by the barrel adapted to be engaged predeterminedly by the valve head means of the slide valve instrumentalities for interrupting flow of liquid to the passage around the valve stem means from the stock, and a single actuating mechanism for the slide valve instrumentalities for actuating the slide valve instrumentalities through a predetermined distance to produce a solid stream from the slide valve instrumentalities, a hollow stream from the passage around the slide valve instrumentalities, and a combination of these streams, selectively.

4. A nozzle adapted to direct fire extinguishing liquid of controlled consistency to a mass of flaming combustibles, which comprises, in combination, a hollow stock, means for maintaining the stock continuously filled with liquid, a tubular barrel mounted on the stock, tubular slide valve means mounted in the barrel, the said slide valve means including a hollow valve head and an elongated tubular valve stem communicating with the valve head and defining a liquid passage through the stem, means for mounting the slide valve means in the barrel in spaced relation therewith to define a liquid passage around the stem communicable with the liquid in the stock, liquid intake means communicating with the liquid in the stock for passing liquid therefrom into the tubular slide valve means, control means for controlling admission of liquid to the intake means, means in the barrel cooperating with the slide valve means responsively to movement of the slide valve for controlling admission of liquid to the liquid passage around the slide valve means, and a single actuating means for the slide valve means instrumentalities for moving the said slide valve means through predetermined distances in an opening direction relative to the control means and the cooperating means in the barrel to produce a predetermined character of liquid discharge from the nozzle, predetermined movement of the slide valve means by the actuating means therefor through one distance opening the liquid intake means for the slide valve means to admit liquid from the stock into the tubular valve stem for discharging the liquid in a solid stream, while maintaining the passage around the valve stem closed to liquid passage therethrough, movement of the slide valve means through another distance opening the passage around the slide valve means to the liquid in the stock for discharging liquid as a hollow stream from the tubular slide valve means, movement of the slide valve means through still another distance closing the intake means for the slide valve means while maintaining the passage around the slide valve means open for cutting off the solid stream while continuing the hollow stream, actuation of the actuating means for the slide valve means in full closing direction closing both the slide valve means and passage therearound to liquid flow, thereby cutting off all liquid discharge from the nozzle.

5. A nozzle adapted to direct fire extinguishing liquid of controlled consistency to a mass of flaming combustibles, which comprises, in combination, a hollow stock, means for maintaining the stock continuously filled with liquid, a tubular barrel mounted on the stock, tubular slide valve means mounted in the barrel, the said means including a hollow valve head and an elongated tubular valve stem communicating with the valve head and defining a liquid passage through the stem, means for mounting the slide valve means within the barrel in spaced relation with the said barrel to define a liquid passage around the tubular slide valve means communicable with the liquid in the stock, liquid intake means communicating with the liquid in the stock for passing liquid therefrom into the tubular slide valve means, control means for controlling admission of liquid to the intake means, means in the barrel cooperating with the slide valve means responsively to movement of the slide valve means for controlling admission of liquid to the liquid passage between the slide valve means and the barrel, and a single actuating means for the slide valve means coacting with the control means for moving the slide valve means through predetermined distances in an opening direction relative to the control means to produce a predetermined character of liquid discharge from the nozzle, movement of the slide valve means by the actuating instrumentalities therefor through one distance opening the liquid intake means for the slide valve means to admit liquid from the stock into the tubular valve stem for discharging the liquid in a solid stream while maintaining the passage around the valve stem closed to liquid passage therethrough, movement of the slide valve means through another distance opening the passage around the slide valve means, and actuation of the actuating instrumentalities for

the slide valve in full closing direction closing both the slide valve and passage therearound to liquid flow, thereby cutting off all liquid discharge from the nozzle.

6. A nozzle adapted to direct fire extinguishing liquid of controlled consistency to a mass of flaming combustibles, which comprises, in combination, a hollow stock, means for maintaining the stock continuously filled with liquid, a tubular barrel mounted on the stock, tubular slide valve means mounted in the barrel, the said means including a hollow valve head and an elongated tubular valve stem communicating with the valve head and defining a liquid passage through the stem, means for mounting the slide valve means within the barrel in spaced relation therewith to define a liquid passage between the stem slide valve means and the barrel communicable with the liquid in the stock, liquid intake means communicating with the liquid in the stock for passing liquid therefrom into the tubular slide valve means, control means for controlling admission of liquid to the intake means, means in the barrel cooperating with the slide valve means responsively to movement of the slide valve means for controlling admission of liquid to the liquid passage between the slide valve means and the barrel, a single actuating means for the slide valve means cooperating with the control means for moving the slide valve means through predetermined distances in an opening direction relative to the control means to produce a predetermined character of liquid discharge from the nozzle, movement of the slide valve by the actuating instrumentalities therefor through one distance opening the liquid intake means for the slide valve to admit liquid from the stock into the tubular slide valve means for discharging the liquid in a solid stream while maintaining the passage surrounding the slide valve means closed to liquid passage therethrough, movement of the slide valve means through another distance opening the passage around the slide valve means, and operation of the actuating instrumentalities for the slide valve means in full closing direction closing both the slide valve means and the passage therearound to liquid flow for cutting off all liquid discharge from the nozzle, and means on the valve stem for disseminating the liquid discharged from the passage around the tubular valve into a spray.

7. A nozzle adapted to direct fire extinguishing liquid of controlled consistency to a mass of flaming combustibles, which comprises, in combination, a hollow stock, means for maintaining the stock continuously filled with liquid, a tubular barrel mounted on the stock, tubular slide valve means mounted in the barrel, the said means including a hollow valve head and an elongated tubular valve stem communicating with the valve head and defining a liquid passage through the stem, means for mounting the slide valve means within the barrel in spaced relation therewith to define a liquid passage around the slide valve means communicable with the liquid in the stock, liquid intake means communicating with the stock for passing liquid therefrom into the tubular slide valve means, means in the barrel cooperating with the slide valve means responsively to predetermined movement of the barrel for controlling admission of liquid to the liquid passage between the slide valve means and the barrel, means positioned in the slide valve means for restraining the slide valve means relative to forward movement of the barrel for a predetermined distance to bring the intake means into communication with the liquid in the stock for discharging liquid in a solid stream from the tubular valve stem, the liquid passage around the slide valve means remaining closed, further forward movement of the barrel relative to the slide valve means opening the liquid passage for discharging liquid therefrom in a hollow stream, while still discharging a solid stream of liquid from the tubular valve stem, and control means within the slide valve means for shutting off the intake means to the said slide valve means responsively to still further forward movement of the barrel relative to the slide valve means while the liquid passage around the slide valve means remains open thereby continuing to discharge only the hollow stream.

8. A nozzle adapted to direct fire extinguishing liquid of controlled consistency to a mass of flaming combustibles, which comprises, in combination, a hollow stock, means for supplying liquid to the stock, a tubular barrel mounted on the stock, tubular slide valve means mounted in the barrel, the said slide valve means including a hollow valve head and an elongated tubular valve stem communicating with the valve head and defining a liquid passage through the stem, means for mounting the slide valve means within the barrel in spaced relation therewith to define a liquid passage around the stem communicable with the liquid in the stock, the said stock including a liquid supply chamber for the valve means, liquid intake means adapted to communicate with the liquid in the said chamber responsively to predetermined movement of the slide valve means for passing liquid from the chamber into the tubular valve stem, a valve seat in the barrel cooperating with the slide valve means for controlling flow of liquid into the liquid passage around the said stem, mechanism for actuating the slide valve means, instrumentalities connecting the actuating mechanism to the slide valve means, whereby upon a predetermined movement of the actuating mechanism, the intake means for the slide valve means openly communicate with the liquid supply chamber in the stock for ejecting liquid from the chamber through the tubular valve stem as a solid stream, control means in the slide valve means controlling the liquid intake means for controlling flow of liquid through the tubular valve stem responsively to further predetermined actuation of the actuating mechanism while the liquid passage around the valve stem is brought into communication with the liquid in the liquid supply chamber for discharging liquid through the said passage as a hollow stream, and means operably associated with the barrel for disintegrating the hollow stream into a spray.

9. A nozzle adapted to direct fire extinguishing liquid of controlled consistency to a mass of flaming combustibles which comprises, in combination, a hollow stock, means for supplying liquid to the stock, a tubular barrel mounted on the stock, tubular slide valve means mounted in the barrel, the said slide valve means including a hollow valve head and an elongated tubular valve stem communicating with the valve head and defining a liquid passage through the stem, means for mounting the slide valve means within the barrel in spaced relation therewith to define a liquid passage around the stem communicable with the liquid in the stock, the said stock including a liquid supply chamber for the valve means, liquid intake means adapted to communi-

cate with the liquid in the said chamber responsively to predetermined movement of the slide valve means for passing liquid from the chamber into the tubular valve stem, a control piston for controlling admission of liquid to the valve head, means normally urging the valve head into closing position for the liquid intake means, a valve seat in the barrel for the valve head, mechanism including a trigger for actuating the valve responsively to retraction of the trigger, movement of the trigger through one predetermined distance actuating the control portion for opening the liquid intake means to the slide valve to permit liquid to flow through the tubular slide valve stem and to issue therefrom as a solid stream while the valve head is still seated on the seat in the barrel, further movement of the trigger through another predetermined distance opening the liquid passage around the said valve stem while maintaining the said inlet means open, thereby producing a combined solid stream and a hollow stream, cut-off means in the stock for the inlet means, further movement of the trigger through a still further predetermined distance engaging the inlet means with the cut-off means, thereby closing the inlet means while maintaining open the liquid passage around the valve stem, thereby producing only a hollow stream, and means carried by the slide valve stem for disintegrating the hollow stream into a spray.

10. A nozzle adapted to direct fire extinguishing liquid of controlled consistency to a mass of flaming combustibles, which comprises, in combination, a hollow stock, means for supplying liquid to the stock, a tubular barrel mounted on the stock, tubular slide valve means mounted in the barrel, the said slide valve means including a hollow valve head and an elongated tubular valve stem communicating with the valve head and defining a liquid passage through the stem, means for mounting the slide valve means within the barrel in spaced relation therewith to define a liquid passage around the stem, the said stock including a liquid supply chamber for the valve means, liquid intake means adapted to communicate with the liquid in the said chamber responsively to predetermined movement of the slide valve means for passing liquid from the chamber into the tubular valve stem, a piston for actuating the slide valve, a valve seat in the barrel adapted to receive and to seat the valve head, yieldable means mounted rearwardly of the valve head normally urging the valve head against the seat and the piston in closing position for the inlet means, a valve closure lining defining a space adapted to secure the valve head and piston responsively to retraction thereof, actuating instrumentalities for the slide valve including a trigger and mechanism connecting the trigger to the piston for retracting the piston and slide valve into the said space against tension of the yieldable means responsively to retraction of the trigger, movement of the trigger through a predetermined distance shifting the piston to open the inlet means for enabling discharge of liquid from the tubular valve stem in a solid stream while maintaining closed the liquid passage around the valve stem, actuation of the trigger through a further predetermined distance opening the said liquid passage while maintaining the inlet means also open, thereby producing a combined solid stream and a hollow stream, still further actuation of the trigger through a third predetermined distance closing the inlet means while allowing the said fluid passage to remain open, thereby allowing only a hollow stream to be discharged from the nozzle.

11. A nozzle adapted to direct fire extinguishing liquid of controlled consistency to a mass of flaming combustibles, which comprises, in combination, a hollow stock, means for supplying liquid to the stock, the said stock defining a reservoir for the liquid, a tubular barrel mounted on the stock for longitudinal adjustment relative to the stock, a plurality of concentrically disposed tubular slide valve means mounted in the barrel in spaced-apart relation to define liquid passages between the concentrically disposed slide valve means and between the said slide valve means and the barrel, there being an inner slide valve means and an outer slide valve means, each of the slide valve means being tubular and having a valve head and a tubular valve stem communicating with the valve head, an end closure for each valve head, the head of the inner sliding valve having oppositely disposed seats, a fixed piston in the head of the inner sliding valve, inlet means for the slide valve means for admitting liquid from the stock to the interior of the slide valve means responsively to predetermined movement of the slide valve means as the barrel is moved forwardly, an interior valve seat in the barrel, a valve flange on the outer slide valve means adapted to engage the seat in the barrel, a valve seat in the head of the outer slide valve means, a valve flange on the head of the inner slide valve means adapted to seat against the valve seat in the head of the outer slide valve member, the said slide valve means being independently movable relative to each other for controlling the said inlet means for the liquid, fixed closure means for the inlet means positioned in the valve head of the inner slide valve member, and means for rigidly supporting the closure means from the stock, the inner and outer slide valve means moving in unison with the barrel during opening movement of the barrel with the valve flange on the head of the outer slide valve means seating against the valve seat in the barrel, and the valve flange on the head of the inner slide valve means seating against the valve seat in the head of the outer slide valve means until movement of the slide valve means with the barrel uncovers the inlet means, whereupon liquid entering the inner slide valve means is projected therethrough as a solid stream while maintaining the liquid passages closed, further opening movement of the barrel also opening the liquid passage between the inner and outer slide valve means while retaining closed the liquid passage between the outer slide valve means and the barrel, thereby discharging a solid stream of liquid from the inner slide valve means and the barrel and a hollow stream of liquid from the passage between the inner and outer slide valve means, still further opening movement of the barrel seating the piston in the head of the outer slide valve means against the valve flange on the head of the inner slide valve means thereby closing the liquid inlet means to the inner slide valve means and the passage between the inner and outer slide valve means, while unseating the valve flange on the outer slide valve means from the seat in the barrel, thereby causing liquid to flow through the passage between the outer slide valve member and the barrel and to be discharged as a hollow stream, and means on the inner valve member for dissipating the hollow stream into a spray.

12. A nozzle adapted to direct fire extinguishing liquid of controlled consistency to a mass of flaming combustibles, which comprises, in combination, a hollow stock, means for supplying liquid under pressure to the stock, the said stock defining a reservoir for the liquid, barrel means mounted on the stock for longitudinal adjustment relative to the stock, a plurality of tubular slide valves mounted in the barrel means in concentrically spaced relation whereby there is an inner slide valve and an outer slide valve, each of the slide valves including a hollow valve head and a tubular valve stem communicating with the valve head, there being a liquid passage between each of the slide valves and between the outer slide valve and the barrel means, cooperating valve and valve-seat elements on the slide valves and in the barrel means adapted to close the liquid passages to ingress of liquid from the stock, liquid intake ports opening into the head of the inner slide valve and adapted to supply, when open, liquid from the stock to the tubular valve stem for delivery therefrom as a solid stream, closure means for the ports mounted in the head of the inner slide valve, means for rigidly mounting the closure means, whereby opening adjustment of the barrel means causes an initial movement of the slide valve means in unison with the barrel means through pressure of the liquid against the valve elements maintaining these elements seated against the valve-seat elements until the inner slide valve shifts to seat the closure means against the end of the head of the inner slide valve, thereby uncovering the liquid intake ports for admitting liquid into the inner slide valve, further opening movement of the barrel opening the passage between the slide valves while maintaining the valve elements on the outer slide valve seated against the valve-seat element in the barrel means, further opening movement of the barrel means causing unseating of the valve element on the inner slide valve from the valve seat on the outer slide valve, thereby opening the liquid passage between the slide valves, thereby producing a solid stream in combination with a hollow stream, still further opening movement of the barrel seating valve means in the outer slide valve against the valve element on the inner valve head, thereby closing the inlet ports of the inner slide valve element and opening the passage between the outer slide valve and the barrel means to produce a finely divided mist from the nozzle.

13. A nozzle adapted to direct fire extinguishing liquid of controlled consistency to a mass of flaming combustibles, which comprises, in combination, a hollow stock, means for supplying liquid under pressure to the stock, the said stock defining a reservoir for the liquid, barrel means mounted on the stock for longitudinal adjustment relative to the stock, valve instrumentalities mounted in the barrel communicable with the liquid in the stock, and a single actuating means enabling sequential operation of the valve instrumentalities for discharging liquid from the stock through the barrel means first as a solid stream, secondly as a solid stream and a protective curtain, and thirdly as a mist or fog.

14. A nozzle adapted to direct fire extinguishing liquid of controlled consistency to a mass of flaming combustibles, which comprises, in combination, a hollow stock, means for supplying liquid under pressure to the stock, the said stock defining a reservoir for the liquid, barrel means mounted on the stock, tubular slide valve instrumentalities in the barrel means and spaced therefrom, there being a liquid passage extending through each of the valve instrumentalities and a single operating means for the slide valve instrumentalities for sequentially bringing the slide valve instrumentalities and liquid passages in communication with the liquid in the stock for effecting selective discharge of the liquid through the slide valve instrumentalities and liquid passages for producing, selectively, a solid stream, a solid stream and a liquid curtain in advance of the nozzle, and a liquid curtain only.

15. A nozzle adapted to direct fire extinguishing liquid of controlled consistency to a mass of flaming combustibles, which comprises, in combination, a hollow stock, means for supplying liquid under pressure to the stock, the said stock defining a reservoir for the liquid, barrel means mounted on the stock, tubular slide valve instrumentalities in the barrel means and spaced therefrom, there being a liquid passage in the barrel means and through each of the valve instrumentalities, a single operating means for the slide valve instrumentalities for sequentially bringing the slide valve instrumentalities and liquid passage in communication with the liquid in the stock for effecting selective discharge of the liquid through the slide valve instrumentalities and liquid passages responsively to predetermined actuations of the single operating means for producing, selectively, a solid stream discharge and a combined solid stream and a hollow stream discharge from the nozzle, and means operative responsively to further predetermined actuation of the operating mechanism for discontinuing the solid stream discharge, thereby producing only a hollow liquid discharge from the nozzle.

16. A nozzle adapted to direct fire extinguishing liquid of controlled consistency to a mass of flaming combustibles, which comprises, in combination, a hollow stock, means for supplying liquid under pressure to the stock, the said stock defining a reservoir for the liquid, barrel means mounted on the stock, tubular slide valve instrumentalities in the barrel means and spaced therefrom, there being a fluid passage in the barrel means around the valve instrumentalities, a single operating means for the slide valve instrumentalities for sequentially bringing the slide valve and liquid passage in communication with the liquid in the stock for effecting selective discharge of the liquid through the slide valve and liquid passage responsively to predetermined actuations of the operating mechanism for producing, selectively, a solid stream discharged through the slide valve instrumentalities, and a combined solid stream and hollow stream discharged from the nozzle, means operable responsively to further predetermined actuation of the single operating means for discontinuing the solid stream discharge, thereby producing only a hollow stream discharge from the liquid passage, and means acting on the hollow stream for converting the hollow stream into a finely divided spray.

17. A fire fighting nozzle adapted to direct fire extinguishing liquid of controlled consistency to a mass of flaming combustibles, which comprises, in combination, a hollow stock adapted to receive and retain a supply of fire extinguishing liquid, a tubular barrel threadedly mounted on the stock for rotation relative thereto for advancement and retraction relative to the stock, a valve assembly positioned in the barrel com-

prising an inner slide valve and an outer slide valve mounted on the inner valve, means fixedly mounting the valve assembly within the barrel and concentrically spaced therefrom, thereby forming a liquid passage extending through the barrel from the stock to an open discharge end of the barrel, the said liquid passage being defined between the barrel and the slide valve assembly, an annular valve seat in the barrel extending into the said liquid passage, each of the valves comprising a hollow valve head and a tubular valve stem, the said valves being provided with ports communicating with liquid in the stock and with the interior of the valve heads for supplying liquid to the interior of the valves, a valve flange on each of the valves, the valve flange on the outer valve including an anterior valve portion adapted to seat on the valve seat in the barrel for interrupting the liquid passage between the barrel and the outer valve and a posterior valve seat for seating the valve flange on the inner valve, each of the valves having a tubular valve stem extending through the open discharge end of the barrel, the valve head of the inner valve being nested in the valve head of the outer valve, the outer valve head including a valve portion adapted to close the ports in the inner valve head, ports in the inner valve head, means concentrically spacing the inner tubular valve stem in the outer tubular valve stem, and a fixed piston in the valve head of the inner valve for restraining forward movement of the valve assembly for more than a fixed distance, and for controlling the ports communicating with the interior of the valve head of the inner valve, liquid pressure from the stock maintaining all valves in closed positions against their respective seats until forward movement of the barrel relative to the stock moves the valve assembly relative to the fixed piston until the inner valve moves the length of the valve head and the piston is seated against the anterior end of the inner valve, thereby uncovering the ports leading into the inner valve head for projecting a solid liquid stream from the tubular stem of the inner valve liquid pressure maintaining the valve flange of the inner valve seated against the valve flange of the outer valve, liquid pressure also maintaining the valve flange on the outer valve seated against the annular valve seat in the barrel, further advance of the nozzle causing the valve flange on the inner valve to separate from the valve seat on the valve flange of the outer valve by retention of the inner valve against further forward movement by the said piston, liquid flowing both through the tubular valve stem of the inner valve and the liquid passage between the two tubular valve stems, thereby discharging liquid from the barrel as a combined solid stream and a hollow stream, still further forward movement of the nozzle engaging the posterior end of the inner valve head, thereby restraining the outer valve against further forward movement, the ports in the inner valve head being closed by the outer valve head while contact between the valve flange on the outer valve and the valve seat in the barrel is broken, thereby causing liquid to be projected simultaneously through and around the outer valve as concentric hollow streams.

18. A fire fighting nozzle for directing fire extinguishing liquid of controlled consistency onto a fire, which comprises a fixedly mounted hollow stock for receiving and retaining a supply of fire extinguishing liquid, a barrel threadedly mounted on the stock, means on the barrel for rotating said barrel to advance and retract it relative to the stock, the said barrel having an open discharge end, a slide valve assembly positioned in the barrel, means in the barrel and stock for rigidly mounting the said valve assembly concentrically relative to the barrel for defining a liquid passage between the barrel and the valve assembly extending through the barrel from the stock to the discharge end of the barrel, an annular valve seat in the barrel, the said valve assembly comprising an outer tubular valve and an inner tubular valve, each of the valves having a valve head and a tubular valve stem extending from the head to an open discharge end, the inner valve head being nested in the outer valve head, the inner and outer tubular valve stems being spaced concentrically relative to one another, there being a liquid passage through each of the stems and around the inner valve stem, a valve collar on the outer tubular slide valve adjacent to the head thereof defining a valve on its anterior side adapted to seat against the annular valve seat in the barrel for closing the liquid passage in the barrel, the said valve collar defining a valve seat on its posterior surface, a second valve collar on the inner valve head defining a valve on its anterior surface adapted to seat against the said valve seat in the outer valve head, ports extending through the valve heads of the outer and inner slide valves and adapted to flowing liquid from the stock into the said slide valve heads, the outer slide valve head having a port closing portion thereon, the valve head of the inner valve stem having a closed rear end spaced from the similarly closed rear end of the outer valve head, and a fixed piston in the inner valve head adapted to seat anteriorly and posteriorly thereof corresponding to advancing and retracting movements of the slide valve assembly, the piston closing the ports in the inner valve head when seated anteriorly in the head and opening the ports when seated posteriorly therein, the inner valve being slidable relative to the outer valve and both valves being slidable relative to the barrel, movements of the slide valve assembly being controlled by rotary movements of the barrel, means fixedly mounting the said piston in the valve assembly mounting means, and means on the tubular slide valve stems for maintaining the said stems in the said concentric relation, whereby a forward rotary movement of the barrel moves the entire valve assembly forwardly with the barrel relative to the said piston thereby opening the ports through the valve heads into the inner tubular valve for supplying liquid under pressure from the stock into the said inner tubular valve, pressure of the said liquid meanwhile seating the valve flange on the outer slidable valve against the valve seat in the barrel and the valve flange of the inner valve against the valve seat in the head of the outer valve, the liquid being projected as a solid stream only from the inner valve, further forward movement of the barrel unseating the inner valve flange from the valve seat in the outer valve head responsively to restraint of the inner valve by engagement of the fixed piston against the rear end thereof while the liquid pressure still seats the valve flange on the outer valve against the annular valve seat in the barrel, thereby projecting liquid as a combined solid stream from the inner valve and a hollow stream from the passage between the inner and outer

valve stem, still further forward movement of the barrel finally unseating the valve flange on the outer supply valve from the seat in the barrel responsively to further restraint of the inner valve member, while the valve head of the outer valve member is moved relative to the valve head of the inner valve member to close the ports leading to the inner valve member by the port-closing portion thereof, thereby closing flow of liquid into the inner valve member while opening the liquid passage between the outer valve member and the barrel, the liquid passage between the inner and outer tubular valve stems being maintained open, and means carried by the valve members adjacent to the discharge end of the barrel for intermingling streams of liquid projected from the passages between the barrel and the outer valve member and between the outer and inner valve members.

19. A nozzle for directing a selected type of stream of fire-extinguishing liquid onto a fire, which comprises in combination, a barrel, tubular slide valve means positioned in the barrel, a liquid passage extending longitudinally through the slide valve means, a second liquid passage around the slide valve means, means for selectively passing flow of liquid from a supply thereof through the slide valve only, and both through the slide valve and around the slide valve, and a single manual operating means for the slide valve for effecting the selected flow of liquid relative to the said slide valve.

20. A nozzle for directing a selected type of stream of fire-extinguishing liquid onto a fire, which comprises, in combination a barrel, tubular slide valve means positioned in the barrel, a liquid passage extending longitudinally through the slide valve means, a second passage exterior of the slide valve means and approximately coextensive therewith, means for selectively passing flow of liquid from a supply thereof through the slide valve means only, and through the slide valve means and around the slide valve means simultaneously, and a single manual operating means for the slide valve means for adjusting the slide valve means relatively to the barrel for effecting the selected flow of liquid relative to the said slide valve means.

21. A nozzle for directing a selected type of stream of fire-extinguishing liquid onto a fire, which comprises, in combination, a barrel, tubular slide valve means positioned in the barrel, means for passing liquid from a supply thereof through the slide valve means and around the slide valve means, cooperating valve means carried by the barrel and by the slide valve means for passing liquid through the slide valve means only, around the slide valve means, and both around the slide valve means and through the slide valve means, selectively, and a single manual operating means for the slide valve means for selectively positioning the slide valve means relative to the barrel for effecting the selected flow of liquid relative to the said slide valve means.

22. A nozzle for directing a selected type of stream of fire-extinguishing liquid onto a fire, which comprises in combination, a barrel, tubular slide valve means positioned in the barrel, means for passing liquid from a supply thereof through the slide valve means and around the slide valve means, and a single control means for effecting selective and relative amounts of displacement between the barrel and the slide valve means for positioning the barrel and the slide valve means relative to each other for effecting a selected path of flow of liquid relative to the slide valve means.

23. A nozzle for directing a selected type of stream of fire-extinguishing liquid onto a fire, which comprises, in combination, a barrel, tubular slide valve means positioned in the barrel and including a plurality of concentrically disposed individual valve components slidable relative to each other and to the barrel, means coextensive with the said valve components for passing liquid from a supply thereof through each of the said valve components and around the said components, cooperating valve means carried by the barrel and by the tubular slide valve means for directing passage of liquid through selected valve components and around each of the said components, and a single operating means mounted on the barrel for effecting selected displacements between the barrel and the slide valve means and between the individual valve components for effecting selected flow of liquid relative to the said valve components.

24. A nozzle for directing a selected type of stream of fire-extinguishing liquid onto a fire, which comprises, in combination, a barrel, tubular slide valve means positioned in the barrel, means for passing liquid from a supply thereof through the slide valve means and around the slide valve means, and a trigger actuating means for effecting selected displacement between the barrel and the slide valve means for positioning the slide valve means in the barrel for effecting selected flow of liquid relative to the slide valve means.

25. A nozzle for directing a selected type of stream of fire-extinguishing liquid onto a fire, which comprises a barrel, tubular slide valve means positioned in the barrel for relative displacement therewith, means coextensive with the slide valve means for passing liquid from a supply thereof through and around the slide valve means, and trigger actuating means for the slide valve means for retracting and advancing the slide valve means relative to the barrel in selected amounts for effecting selected flow of liquid relative to the slide valve means.

26. A nozzle for directing a selected type of stream of fire-extinguishing liquid onto a fire, which comprises a barrel, tubular slide valve means positioned in the barrel for relative displacement therewith, means coextensive with the slide valve means for passing liquid from a supply thereof through and around the slide valve means, cooperating valve means carried by the barrel and by the slide valve means for directing passage of liquid relative to the slide valve means, a piston for actuating the slide valve means, the piston being actuable first independently of the slide valve means and then together with the slide valve means for controlling admission of liquid into and around the slide valve means respectively, a first movement of the piston admitting liquids into the slide valve means only, a second movement of the piston admitting liquid both into and around the slide valve means only, a third movement of the piston, which actuates the slide valve therewith, closing admission of liquid to the slide valve and passing liquid around the slide valve only, and trigger actuating means for the piston for effecting, selectively, the aforesaid movements of the piston.

27. A nozzle for directing a selected type of stream of fire-extinguishing liquid onto a fire, which comprises a barrel, tubular slide valve

means positioned in the barrel for relative displacement therewith, means coextensive with the slide valve means for passing liquid from a supply thereof through and around the slide valve means, cooperating means carried by the barrel and by the slide valve means for directing passage of liquid relative to the slide valve means, the piston being actuable first independently of the slide valve means and then together with the slide valve means respectively, a first movement of the piston admitting liquid into the slide valve means only, a second movement of the piston admitting liquid both into and around the slide valve means only, a third movement of the piston, which actuates the slide valve therewith, closing admission of liquid into the slide valve means and passing liquid around the slide valve only, trigger actuating means for effecting, selectively, the aforesaid movements of the piston, and means for returning the piston and slide valve means to completely closing position responsively to release of the trigger actuating means.

28. A nozzle for directing a selected type of stream of fire-extinguishing liquid onto a fire, which comprises a barrel, a tubular slide valve piston positioned in the barrel for relative displacement therewith, means coextensive with the slide valve piston for passing liquid from a supply thereof through and around the slide valve piston, cooperating means in the barrel and on the slide valve piston for directing passage of liquid relative to the slide valve piston, the said

slide valve piston being actuated first for admitting liquid into the slide valve piston only, a second movement of the piston admitting liquid both into and around the slide valve piston, a third movement of the slide valve piston closing admission of liquid into the said slide valve piston and passing liquid therearound only, and trigger actuating means for effecting, selectively, the aforesaid movements of the slide valve piston.

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