

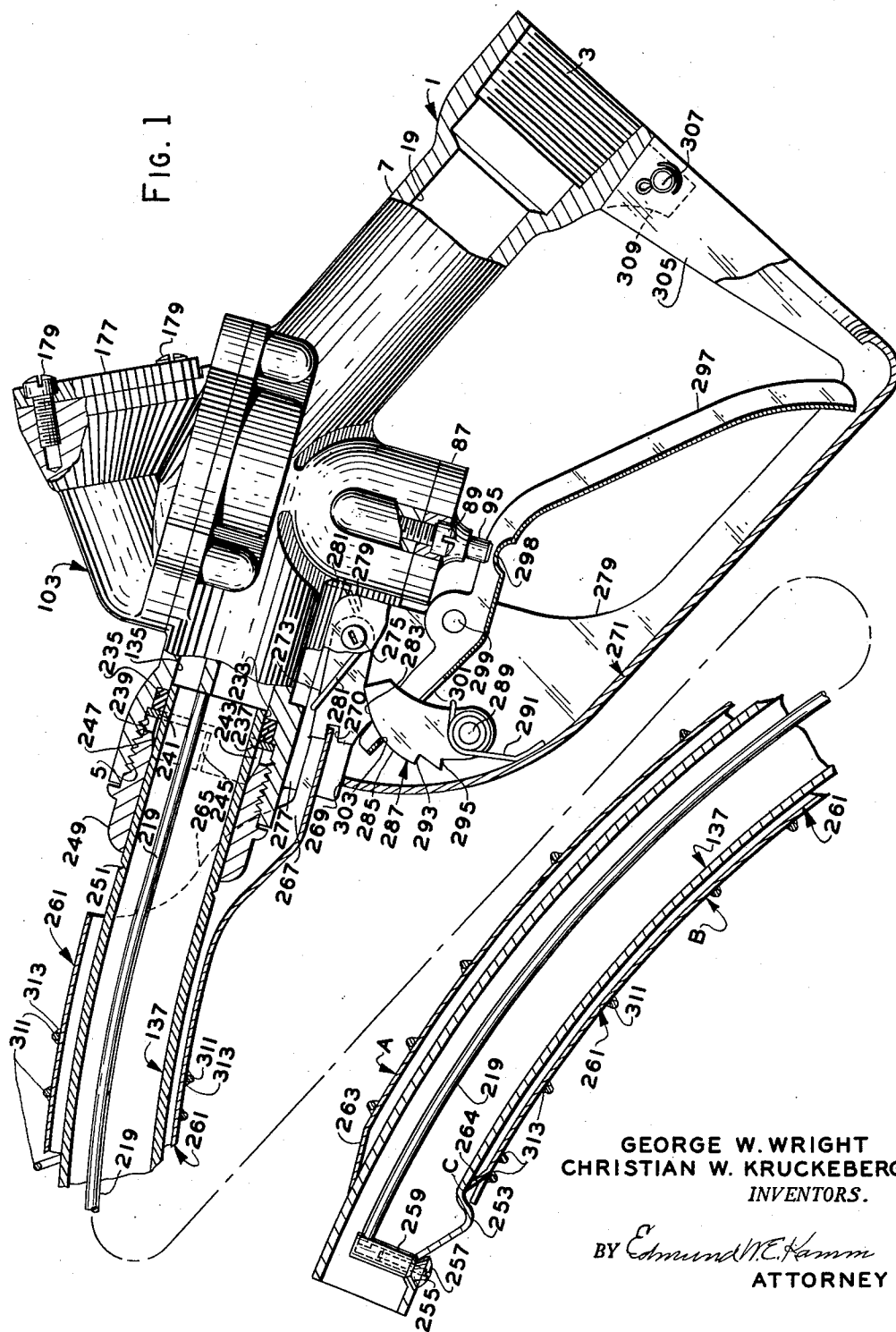
Dec. 12, 1961

G. W. WRIGHT ET AL
AUTOMATIC SHUTOFF NOZZLE

3,012,592

Filed Jan. 9, 1958

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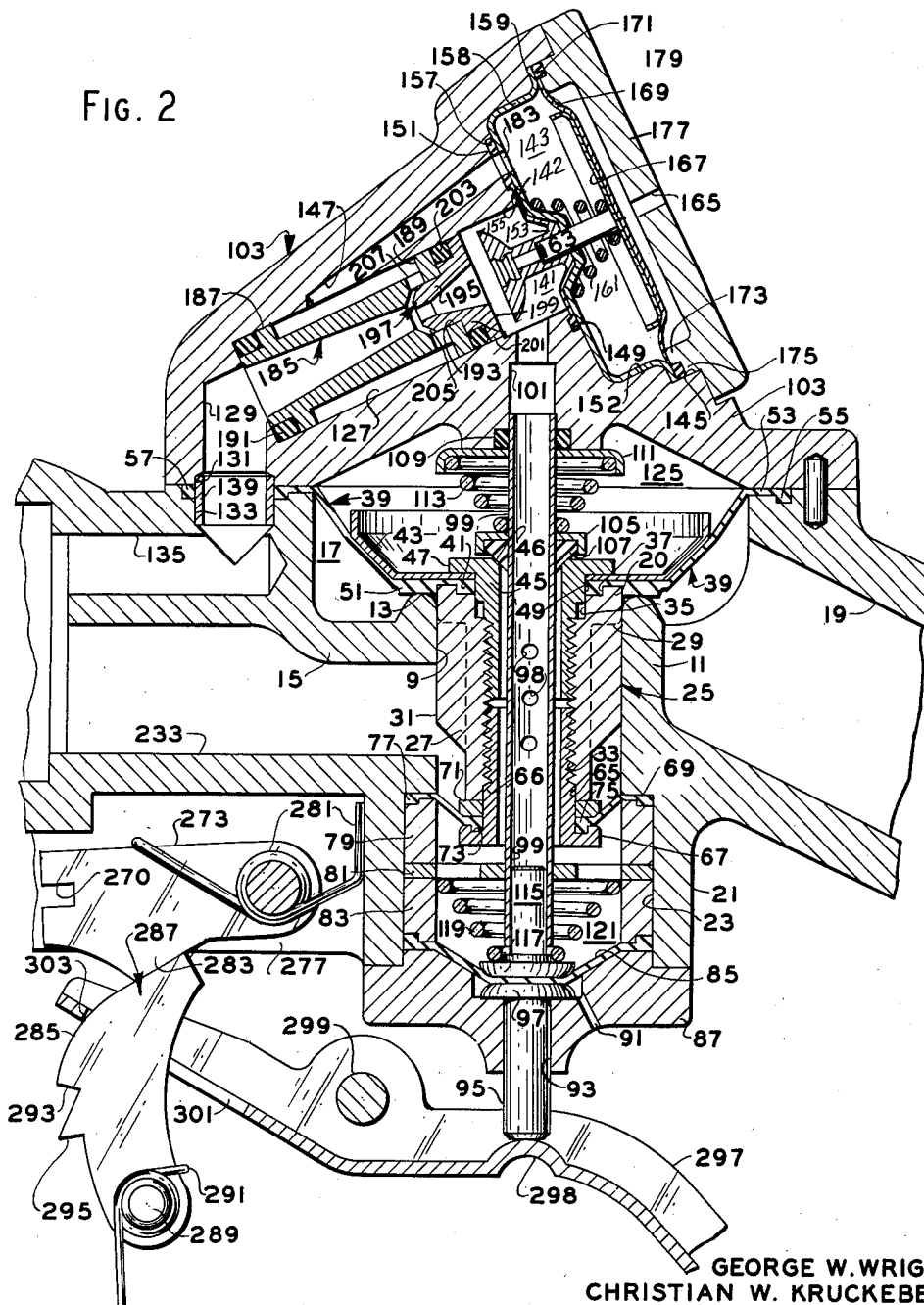
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FIG. 2



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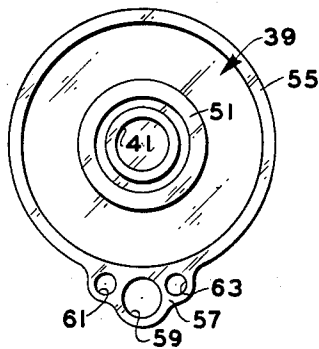


FIG. 3

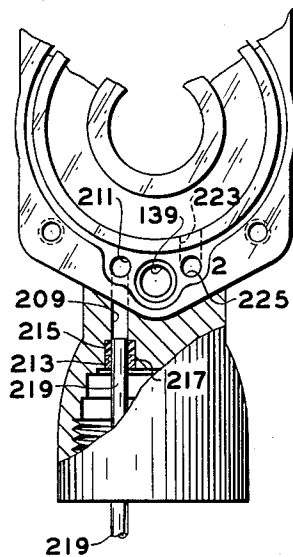


FIG. 4

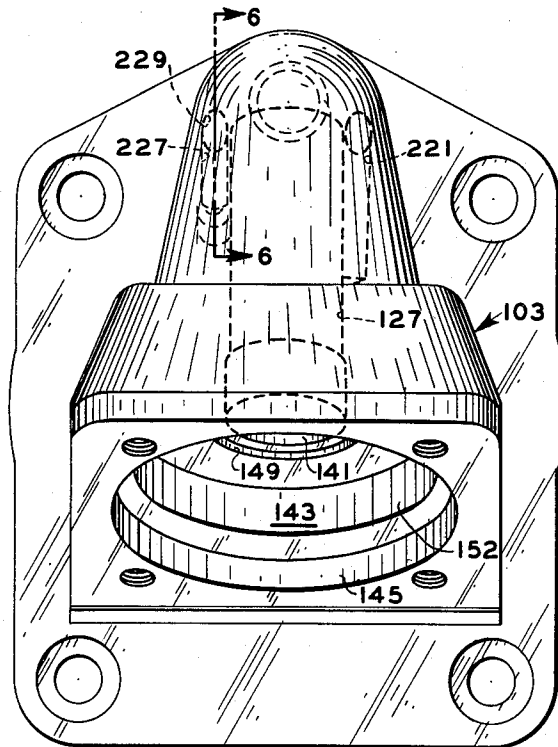


FIG. 5

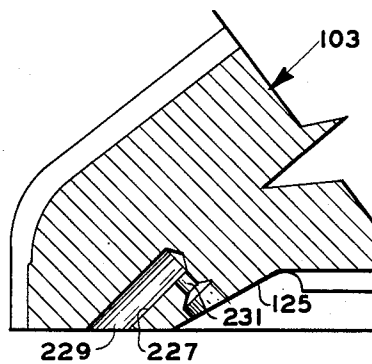


FIG. 6

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3,012,592

AUTOMATIC SHUTOFF NOZZLE

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Filed Jan. 9, 1958, Ser. No. 707,973
23 Claims. (Cl. 141—208)

The invention relates to automatic shutoff nozzles of the type which may be used on the end of a delivery hose through which liquid is dispensed under pressure. One common use of such nozzles is on fuel dispensers which are found in the usual automobile filling station.

The invention comprises such a nozzle in which the opening of the control valve is initiated manually but is effected by an hydraulic mechanism. The closing of the control valve may be initiated manually, by the rise of the liquid level in the liquid receiving container to a level at which it immerses the tip of the nozzle spout, by the removal, accidental or otherwise, of the nozzle from the container or by breakage of the nozzle spout resulting from the application of unusual stresses to it. The closure of the control valve is, in any such case, effected by the hydraulic mechanism.

The hydraulic mechanism also reduces the physical force required to open or throttle the valve and is smooth in its operation. It eliminates "chattering" of the control valve when the latter is throttled, as in topping off a container. It also responds quickly to changes in the liquid pressure or to surges, so as to prevent "bucking" of the nozzle which might dislodge it from the fill pipe of the tank.

These and other advantages will become apparent from a study of the specification and the drawings which are attached hereto, made a part hereof and in which:

FIGURE 1 is a side elevation of the nozzle with parts in section to show the spout and latching mechanism.

FIGURE 2 is a sectional view taken on the central, axial plane of the nozzle of FIGURE 1, showing the main, pilot and vacuum valves and their operating mechanisms.

FIGURE 3 is a bottom view of the main valve diaphragms.

FIGURE 4 is a top plan view of a portion of the nozzle body, partly in section, showing the various ports and passageways.

FIGURE 5 is a top plan view of the cap, showing the vacuum chamber, venturi chamber and certain passageways.

FIGURE 6 is sectional view taken substantially on the line 6—6 of FIGURE 5, showing the restricted diaphragm pressure balancing passageway.

CONTROL AND PILOT VALVE MECHANISM

Referring to FIGURES 1 and 2, numeral 1 represents a nozzle body which has internally threaded inlet and outlet openings 3 and 5 at either end, and a hand grip portion 7. The openings communicate through a valve port 9 which is defined by boss 11 and valve seat 13 which are a part of transverse wall 15 of the body.

The body defines a chamber 17, above the valve seat, which opens to the exterior of the body and which communicates with inlet 3 through the inlet conduit 19. The body is also provided with a downwardly extending boss 21 which has an internal bore 23 which is somewhat larger in internal diameter than, but in coaxial alignment with the valve port.

A valve mechanism indicated generally by 25 is provided to open and close the port and comprises a tubular guide or stem member 27 having an annular flange 20 at its upper end and a number of radial guide vanes 31 running axially downwardly from the flange. The flange and

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vanes are guided for reciprocation by the walls of the port.

The stem 27 is internally threaded at 33 (FIG. 2) while the flange is internally bored at 35 and counterbored at 37.

A valve actuating or main diaphragm 39 which is cupped, has a central opening defined by an annular seal bead 41 which is seated in the counterbore 37. A follower 43 which is formed with the same general contour as the cupped portion of the diaphragm, rests therein and is drawn down to compress the seal bead, by a hollow clamp screw 45. The screw has an internal valve seat 46, a top, radial flange 47 which bears on the follower, a cylindrical surface 49, which fits the opening in the diaphragm and the bore 35, and a threaded lower end which screws into the threads 33. When the screw is drawn down, the seal bead 35 is compressed axially and expanded radially to seal the joint between the screw and stem against the passage of liquid.

The diaphragm (FIGS. 2 and 3) has a second, flat, annular, downward projection 51 which is preferably substantially rectangular in cross section and is spaced radially outwardly from the seal bead. The projection serves as the valve which opens and closes on seat 13 to control the flow through the main valve port 9.

The diaphragm is also formed with a peripheral flange 53 which terminates in an outer seal bead 55. This flange has a laterally extending ear or tab 57 which is of the same thickness as the bead and which is provided with three perforations 59, 61 and 63 (FIG. 3) for the purposes described below.

Referring to FIGURE 2, the lower end of stem 27 is counterbored at 65 to receive cylindrical portion 66 of a second clamp screw 67 which is passed through the central opening of a diaphragm seal 69 and a washer 71 which is disposed between the end of the stem and the diaphragm.

The clamp screw is screwed into the threads 33 and the screw head, which has an axially directed groove 73 to receive the central annular seal bead 75 of the diaphragm, compresses the bead when the screw is tightened. The diaphragm 69 is cupped and has an axially downwardly facing seal bead 77 at its periphery which fits in the bore 23 of boss 21. It is mounted in the boss by a hollow bushing 79, a perforated spring seat and guide 81, a lower bushing 83, a lower diaphragm seal 85 and a cap 87 which is held in place on the end of boss 21 by screws 89 (FIG. 1). The diaphragm 85 is imperforate and has an upwardly extending seal bead at its periphery. The beads of diaphragms 69 and 85 are received in annular recesses in the upper and lower ends of bushings 79 and 83 respectively, and are compressed thereby and by the cap so as to seal the bore 23.

Cap 87 is ported at 91 to atmosphere and has a central guide passage 93 through which the pilot valve actuating plunger 95 extends. The plunger has a button or head 97 which is disposed between the cap and diaphragm 85.

A tubular pilot valve stem 99 which has a number of radial ports 98 disposed intermediate its ends, is slidably mounted in guide 81 and in a passage 101 in the cap 103. The stem has a downwardly cupped member 105 fixed to it between its upper end and ports 98. A pilot valve 107 is mounted on said stem and the lower side of member 105 and is adapted to close on the seat 46 on upper screw 45.

The passage 101 is counterbored to receive an O-ring seal 109 which also receives the upper end of pilot valve stem 99. The O-ring is compressed by a spring seat 111 to seal the joint. A conical, helical spring 113 is confined between the seat 111 and member 105.

A valve lifter 115 has a button or head 117 which lies

on the inside of diaphragm 85, opposite the button 97, and has a plunger which is slidable in the hollow stem 99. A conical helical spring 119 is confined between the guide 81 and head 117 to urge the plunger in a direction to withdraw it from the stem.

The hollow stem 99 has a smaller external diameter than the internal diameter of the screws 45 and 67 so that liquid may pass down through the space between the stem and screws, through ports 98 and passage 101 to the chamber 141 in the cap, when the pilot valve 107 is open.

AUTOMATIC SHUTOFF MECHANISM

(FIGS. 1 and 2)

The cap 103 is mounted on the body 1 by means of suitable screws and serves to compress the seal bead 55 and tab 57 of the diaphragm 39 against the body, to establish the seals therebetween. The cap defines, with the diaphragm, a chamber 125 above the diaphragm.

A cylindrical bore 127 is defined by the cap, which communicates at its lower end with a downwardly directed passage 129 which terminates in a counterbore 131. The body is provided with a corresponding bore 133 which communicates with an axially directed passage 135 which opens within the spout 137 (FIG. 1). A collar 139 is received in 131 and 133 and passes through the opening 59 (FIG. 3) in the ear of the diaphragm 39 which seals the joint between the body, cap and collar.

The bore 127 is provided at its upper end with a first counterbore 142 which defines a chamber 141, a second counterbore 152 and a third counterbore 145. A passage 147 is drilled at an angle from the bottom of 152 so as to intersect the bore 127 between the midportion and the lower end thereof.

The bottom wall of 152 is provided with an annular groove 149 having a widened portion or recess 151 which extends out over the passage 147. The groove and recess are adapted to receive the seal head and tab 157 of a diaphragm 153 which is preferably formed integrally and centrally with a vacuum valve 155 which extends into chamber 141.

A cup 158 is inserted in counterbore 152 and has a peripheral radial flange 159 which seats in counterbore 145. The cup has a port 183 which aligns with passage 147 and a port in the diaphragm tab. It is also formed with a central boss 161 which extends away from chamber 141 and which is centrally perforated to serve as a guide for the valve stem 163 which is preferably molded as an insert with valve 155.

A follower 167 is mounted on the end of the stem opposite valve 155 and bears against the underside of a vacuum diaphragm 169, the peripheral bead 171 of which rests on cup flange 159 and is clamped in sealing relation therewith and with the counterbore 145 by the flanges 173 and 175 of a cover 177. The cover is held in place by screws 179 and has a vent port 165. The pressure exerted by screws 179 also causes cup 158 to compress the bead and tab of diaphragm 153 into sealing relation with the groove and recess 149, 151.

The boss 161 serves as a seat for a spring 181 which bears on the follower 167 to hold valve 155 normally open.

The cup 158 and diaphragm 169 define a vacuum chamber 143 for a purpose to be described.

A venturi tube 185 is provided with two, axially spaced, radial flanges 187 and 189, which fit in the bore 127. Flange 187 is spaced a short distance from the discharge end of the tube and an O-ring 191 is disposed around the end of the tube so that it will be compressed radially between the bore and tube to seal the joint and is held between the flange 187 and the end of the bore when the tube is inserted in the bore.

The venturi tube has the inlet end bored at 193 concentrically with the throat, to receive and center the boss

195 of the jet tube 197. Shoulders 199 and 201 on the jet tube define, with flange 189 of the venturi tube, an annular recess in which is received another O-ring 203. Shoulder 199 engages flange 189 to hold the discharge end of the jet tube spaced axially from the throat of the venturi tube so that a chamber 205 is formed therebetween which communicates through radial ports 207 and the space between the venturi tube and bore 127, with the passage 147. The inlet end of the jet tube communicates with chamber 141 and flow from the chamber of the tube is controlled by the valve 155.

Referring to FIGURE 4, the nozzle body defines a longitudinal channel 209 which bends upwardly and terminates in a port 211 which is in alignment with the opening 63 of diaphragm 39. The other end of this channel is counterbored at 213 to receive an O-ring gasket 215 and a collar 217 which is fixed to the sensing tube 219. The latter tube enters the channel and is held therein partly by the friction of the gasket.

As will be seen from FIGURE 5, the cap defines a channel 221 which communicates at its lower end with the opening 63 in the diaphragm and at its other end with the bore 127, between the flanges 187 and 189 described above.

Another curved channel 223 (FIG. 4) which communicates at one end with the chamber 17 of the body and terminates in a port 225 which communicates with the opening 61 in the ear on diaphragm 39. The cap 103 has a passage 227 (FIGS. 5 and 6) which has one end 229 in alignment with the opening 61 in the diaphragm ear and the other end opening into chamber 125 of the cap. A restriction 231 is formed in this passage as shown in FIGURE 6, for a purpose described below.

SPOUT AND LATCHING MECHANISM

Referring to FIGURE 1, the outlet of the nozzle body 1 is provided with a bore 233 which slidably receives the inlet end of spout 137 and is also formed with a counterbore 235 which receives an O-ring gasket 237 which is fitted on the end of the spout. A second counterbore 239 is formed adjacent 235 and a tube clamp, which comprises a radial flange 241 which enters counterbore 239 to hold the gasket in place and a cylindrical member 243 which has a number of axial slits 245 extending its full length to the flange, fits closely on the end of the spout. The free end of the cylindrical member is tapered and is received in a mating taper 247 in the nut 249 which is externally threaded to enter the threaded bore 5 of the nozzle body.

The entry of the inlet end of the spout into bore 233 is limited by the end of the wall which defines the passage 135.

The spout is preferably provided with a circumferential V-groove 251, outside of the clamp nut 249, to form a weakened section which will determine the line on which the spout will break off should it be subjected to undue stress.

The discharge end of the spout is curved downwardly and the bottom side thereof is formed with a protuberance or nub 253 at a point spaced slightly from the end of the spout. A conical indentation 255 is also formed in said wall, between the end of the spout and the nub and is centrally perforated to receive a hollow screw 257.

The sensing tube 219 extends from the body toward the outlet of the spout and is curved to conform with the curvature thereof. It terminates in a tubular header 259 which is transversely affixed to the tube at one end and which receives the hollow screw in the other end to hold the sensing tube in its proper position in the spout.

A tubular or sleeve lever 261 which is curved to conform substantially with the curvature of the spout, is fitted over the spout and terminates adjacent the nub 253. This end of the lever converges toward the spout at 263 to prevent the lever from sliding downwardly beyond the nub 253 and is provided with a bent-in projec-

tion 264 which engages the spout at "C" to serve as a fulcrum for the lever.

The opposite end of the lever is cut away at 265 and formed into an arm 267 of upwardly open, U-shaped cross section, which extends through a notch 269 in the trigger guard 271. It engages a notch 270 in an arm or lever 273 which is pivotally mounted on a screw 275 which is inserted through parallel, spaced, depending lugs 277 formed on the nozzle body and between which the arm 273 is inserted.

The trigger guard has a pair of spaced side plates 279 which are held in place on the exterior of the lugs or walls 277 by the above mentioned screw 275.

A spring 281 mounted on the screw 275 between one of the walls 277 and arm 273 and has one end bearing on the upper edge of arm 273 and the other end on boss 21 so as to urge the arm 273 in a counterclockwise direction (FIG. 1).

The arm 273 has a projection 283 which bears on a curved edge 285 of a toothed pawl 287 which is pivotally mounted on a cross pin 289 which is held in and extends transversely between the guard side plates 279. A spring 291 is mounted on the pin and has one end bearing on the pawl and the other end on the guard so that it urges the pawl in a counterclockwise direction (FIG. 1). At least 2 teeth 293, 295 are formed on the edge of the pawl below the curved portion.

A valve trigger lever 297 is pivotally mounted on a pin 299 which extends transversely between and is held in the guard side plates 279. The trigger has a U-shaped, upwardly open cross-section and the web portion thereof is slotted at 301 to receive the end of the pawl 287. The spring 291 urges the curved portion and the teeth of the pawl into engagement with the web portion of the trigger at 303. An upwardly extending projection 298 is formed on the web portion of the trigger for contact with the lower end of the valve actuating plunger 95 as the trigger is rotated counterclockwise about pin 299 (FIG. 1).

The trigger guard has its flange portions 305 supported by a pin 307 on a lug 309 which depends from the inlet end of the body 1.

A wire 311 is preferably coiled helically about the tubular lever 261 for the major portion of its length and is soldered or otherwise fixed to the lever at a number of points such as 313 along the lever, preferably at the bottom and top thereof.

OPERATION

Liquid under pressure is supplied to the inlet 3 of the nozzle body which is screwed on the dispensing hose coupling (not shown).

The spout 137 and tubular lever 261 are inserted into the fill opening of a fuel tank or other container.

The converging end portion of the tubular lever which fits the spout rather closely and the inclined forward portion of the nub 253 facilitate such insertion by guiding it past any projecting edges which define the fill opening.

The wire 311 will catch on such edges when the nozzle is released and resists accidental displacement of the nozzle from such opening.

When the nozzle has been inserted in a fill opening, the lever will engage the fill pipe or other receptacle mouth at at least two points such as A and B on the top and bottom of the lever. Such contact will limit the clockwise rotation of the lever. The weight of the nozzle will shift the spout downwardly (clockwise FIG. 1) relative to the lever. The result is a rotation of the spout clockwise (FIG. 1) about the point C as a fulcrum which will cause the arm 267 of the lever to rotate arm 273 clockwise (FIG. 1) against its spring 281 to free the projection 283 of the arm from the curved surface of pawl 287. As a result, the pawl spring 291 rotates the pawl 287 counterclockwise so that the curved edge 285 will ride on the edge 303 of the trigger. As the latter is rotated counterclockwise, one of the teeth 293, 295 will engage said

edge 303 to hold the trigger in a corresponding rotated position.

Usually two teeth are provided. Tooth 293 will hold the trigger in a medium flow position and tooth 295 will hold it in a fast flow position.

Should the nozzle spout be withdrawn from the fill opening either deliberately or accidentally without the trigger being manually held, spring 281 will shift arm 273 to its initial (FIG. 1) position, the tubular lever following with it, and projection 283 will force the latch pawl 287 clockwise to disengage the active tooth from the trigger latch portion 303. The trigger will then be rotated clockwise to its initial position by spring 119.

Should an unusual bending moment be applied to the tubular lever and nozzle spout in any direction, as would be the case when a car is driven away before the spout has been removed from the fill pipe, the spout will break at the groove 251 and the broken end of the spout and the tubular lever will be carried away from the nozzle body. This again frees arm 273 which then will be rotated by its spring 281 to unlatch the trigger for closing movement. Since the lower end of sensing tube 219 is fastened by screw 259 to broken end of the spout which is carried away, the upper end of the tube will be pulled out of the gasket 215 and counterbore 213 and the tube will be carried away by the broken end of the spout.

Should it be desired to top off a tank, the spout and lever will normally be withdrawn from the opening until only the tip remains therein so that the operator may observe the rise of liquid in the fill pipe. In such case too, the tubular lever is freed from any substantial forces which would hold arm 273 in its clockwise position. Its spring 281 returns the arm 273 so as to release the latch pawl from the trigger. The operator will usually then manipulate the trigger to secure a small flow of liquid and will stop the flow entirely when the level in the fill pipe attains the desired level, by releasing the trigger.

As the trigger is rotated counterclockwise (FIG. 1), it will lift the plunger 95, head 97 (FIG. 2), diaphragm 85 and head 117 against the action of spring 119 until the lower end of valve stem 99 is picked up by the button 117, whereupon the stem will be moved upwardly to lift the pilot valve 107 from its seat 46. This will bleed liquid from the chamber 125 above the diaphragm 39, which liquid will pass down between the stem 99 and the interior bores of nuts 45, 67 inwardly through ports 98, up the interior of the pilot valve stem, through the passage 101 in the cap to the chamber 141. Since spring 181 normally holds valve 155 open, the liquid will flow from this chamber through the jet tube 197, chamber 205, the venturi 185, channel 129, collar 139, channel 135 to the nozzle spout 137 and into the receptacle. Since these passages are connected to atmospheric pressure through the spout, it is obvious that the pressure in chamber 125 will be reduced if the flow of liquid from the chamber by the route described exceeds the flow of liquid to the chamber 125 from chamber 17 through channel 223 (FIG. 4), port 225, opening 61 of the diaphragm tab, port 229 (FIG. 6), channel 227 and the restricted orifice 231. The latter element serves to limit the flow to chamber 125 by the path just described.

It will be noted from FIGURE 2 that the area of the main diaphragm 39 which is exposed to inlet pressure in chamber 17 is somewhat less than the area of the diaphragm exposed to the pressure in chamber 125. Accordingly, when either the pilot valve 107 or the vacuum valve 155 is closed and the pressures on the opposite sides of the diaphragm are balanced, there will be a definite force acting on the diaphragm which urges the main valve 51 toward its seat and which will hold it on the seat.

When the pilot valve is opened (with the vacuum valve open) the pressure in chamber 125 will tend to decrease and the rate of decrease will depend upon the difference in the rates of flow of liquid from the chamber

125 through the venturi and to the chamber 125 through the orifice 231. When the pilot valve is opened to a certain extent, the pressure in chamber 125 will reach a value at which the forces acting in opposition on the diaphragm are balanced. Further opening of the pilot valve produces a force acting in a valve opening direction so that the diaphragm will move and open the main valve. However, this motion of the diaphragm moves the pilot valve port toward the pilot valve to throttle the flow from the chamber 125 which in turn causes the pressure in this chamber to increase thereby decreasing the valve opening force. The diaphragm will obviously stop when this force reaches zero so that the diaphragm and main valve reach an equilibrium condition with the main valve open. Also the amount by which the main valve opens will be determined by the amount by which the pilot valve has moved beyond the position necessary to balance the forces on the diaphragm.

Conversely, assuming that the diaphragm is in a valve open, equilibrium condition, and the pilot valve is moved to throttle its port, the pressure in chamber 125 will rise. This creates a force on the diaphragm in a direction to close the main valve and the diaphragm moves in that direction. However, such motion also automatically opens the pilot valve port wider, because the port moves with the diaphragm, away from the pilot valve and increases the flow from chamber 125. The valve closing force is therefore diminished and when it reaches zero, the diaphragm and main valve will reach and stop in a new equilibrium position. Other conditions remaining the same, the amount of movement of the main valve will correspond to the amount which the pilot valve was moved from any equilibrium condition and the direction of movement will also correspond to that of the pilot valve movement.

Thus, once the forces acting on the diaphragm have been brought into balance, the main valve will "follow" the movements of the pilot valve both in direction and magnitude. Further, since the inflow of liquid to chamber 125 is restricted while the outflow therefrom is comparatively unrestricted, the acceleration of the main valve will correspond generally with the acceleration applied to the pilot valve. Thus if the pilot valve is moved quickly to any new position the flow from the chamber will be quickly regulated correspondingly and the force applied to the diaphragm will be correspondingly large so that the diaphragm will also be rapidly accelerated in the "following" direction. The closing operation of the main valve will obviously be obtained whether the flow out of chamber 125 be stopped by the pilot valve or by the vacuum valve 155.

The operation of the vacuum valve will now be described. Since the liquid from chamber 125 is directed through the jet tube and venturi 197, 185 as described above, this flow will tend to create a vacuum in the chamber 205 between the nozzle and the venturi. This vacuum is satisfied by air inducted through the hollow screw 257 in the nozzle tip, the header 259, sensing tube 219, channel 209 in the body (FIG. 4), port 211, port 63 of the diaphragm tab, channel 221 (FIG. 5), the space between bore 127 of the cap (FIG. 2) and the venturi tube and ports 207.

The vacuum in chamber 205 will accordingly be of low magnitude if not entirely dissipated through the channels described. However, when the level of liquid in the container rises high enough to cover the opening in hollow screw 257, the vacuum cannot be readily satisfied due to the resistance to the flow of liquid presented by these channels and the vacuum will attain a greater magnitude. It will be applied through channel 147 (FIG. 2) in the cap to chamber 143 with the result that the vacuum diaphragm 169 will be drawn into the chamber. The diaphragm moves the follower 167, stem 163 and vacuum valve 155 in a direction to close the inlet to the jet tube 197. When this occurs, the pressure in the chambers 141

and 125 and their connecting channels comes practically instantaneously into balance with the pressure in chamber 17 due to the connection of the chambers 17 and 125 through said orifice 231. This creates a force on the diaphragm acting in a direction to close the main valve and to maintain the main valve closed. The unbalanced force results from the fact that the entire area above the diaphragm is exposed to inlet pressure while the area below the diaphragm is exposed partly to inlet pressure and partly to outlet pressure (within the area defined by seat 13).

Since the trigger 297 remains latched in its initial position, the vacuum valve 155 remains closed and the pilot valve remains open. No further delivery can be made until the nozzle is withdrawn from the fill opening. This releases the latch pawl 287 as described above and the trigger, plunger 95 and associated parts including the pilot valve will be moved to their initial positions by the springs 119 and 113. As this occurs, the diaphragm 85 also moves down relieving the pressure in chamber 121 and, by way of ports 98, valve stem 99 and passage 101, also relieves the pressure in chamber 141 so that the vacuum valve 155 may be opened by spring 181 which acts on diaphragm follower 167. When this valve has opened, the trigger may again be operated to start flow again at any desired rate. Should the trigger and pilot valve be held out of their initial positions for any reason, the valve 155 will not open because it is locked in the closed position by line pressure.

If it is desired to top off the tank, the operator will usually actuate the trigger after the nozzle spout has been pulled out of the fill pipe until only the tip remains in it and will manipulate the trigger to start and stop the flow as he may desire to top off the tank. If he wishes to fill a different tank he may fully insert the nozzle and latch the trigger in the desired position in the manner described above.

He may also, if he wishes, simply hold the nozzle out of engagement with the fill pipe but with the spout extending thereinto and manipulate the trigger to secure the desired flow. In such case, if the liquid rises to a level at which it covers the hollow screw 257, the main valve will again be closed automatically by the vacuum mechanism in the manner described above.

It is obvious that the structure described will permit the opening of the pilot valve 107 to a certain degree without effecting any operation of the main valve. This follows from the fact that the area of the diaphragm 39 and bushing 47 which are exposed to the pressure in chamber 125 is substantially greater than the area of the diaphragm and valve which is exposed to the pressure in chamber 17. Thus, liquid may be drawn from chamber 125 through valve 107 in a stream sufficient to reduce the pressure in chamber 125 below that in chamber 17 without opening the main valve. The size of the stream which can be withdrawn, and therefore the degree of opening of the pilot valve without opening the main valve, is controlled by the size of the orifice 231 (FIG. 6).

It is therefore inherently possible, with the structure shown and described, to fill a tank or to top off a tank at a relatively slow rate without opening the main valve. Nevertheless, since the stream from valve 107 flows through the nozzle 195, a vacuum will be created by the flow in chambers 127 and 143, so that when the sensing tube becomes immersed in liquid, the valve 155 will close to terminate the flow in the same manner as described above.

It will thus be seen that the device may be operated in a fully automatic manner without the attention of the operator, may be operated entirely manually or may be operated semiautomatically as last described.

The apparatus has several important advantages over the usual automatic nozzles. The first advantage lies in the fact that the vacuum creating stream is not the main discharge but a stream which by-passes the main valve.

Therefore there are no additional restrictions placed in the path of the main flow and the maximum delivery through the nozzle is markedly greater than that which can be attained from a nozzle in which the venturi is interposed in the main stream. Further, the rate of flow through the vacuum creating means is not reduced when the main valve is throttled as it is in the usual types of nozzles during semiautomatic operation. In fact, in the instant device, the rate of flow of the control stream is increased under such conditions because the jet tube is supplied with liquid under greater pressure when the main valve is throttled. Thus the magnitude of the vacuum which is created is increased and insures proper closure of the main valve when the sensing tube becomes immersed whereas when the venturi mechanism carries the main stream, the flow to it is reduced when the main valve is throttled and the vacuum created is of much less magnitude than when the main valve is wide open.

Accordingly, the nozzle described herein produces positive automatic closure of the main valve at extremely low rates of flow through the main valve.

The main valve, being operated by hydraulic pressure, imposes no burden on the trigger. The pilot valve which is actuated by the trigger and which is opened against line pressure is of small area and can be very easily opened. Thus the pilot valve can be opened readily to any degree and held or further moved, in either direction, without noticeable effort and the desired flow can be quickly attained. This is practically impossible in a nozzle which requires the main valve to be opened manually against full line pressure because great manual pressure has to be exerted on the trigger and when the main valve starts from its seat the trigger pressure required to open it further, drops suddenly. The operator cannot suddenly reduce the squeeze he has applied to the trigger and as a result, the main valve usually pops wide open, whether or not the operator wants it to do so. The delivery is thus initiated with a spurt of liquid which may result in spillage of the liquid. Similarly, when it is desired to throttle the usual nozzle to a small flow, the pressures on the valve usually snap it shut and it becomes very difficult to maintain a small flow without exerting considerable conscious effort.

Further, since the main valve in this case follows the setting of the pilot valve and the forces on the main valve adjust to equilibrium very quickly after the pilot valve is moved, the main valve can be throttled to even very small flows of substantially less than 1 g.p.m. without chattering.

This is again because of the fact that the flow is controlled by a small valve rather than by the main valve as in the usual nozzle. In the latter case the operator has to try to adjust the main valve against rapidly changing forces of large magnitude and such adjustment is practically, physically impossible at very low flows.

Another advantage of the valve mechanism disclosed herein is that a sudden increase in pressure at the nozzle inlet during automatic operation does not create any substantial forces at the nozzle which will cause it to jump and possibly become displaced from the fill opening as is the case with existing nozzles.

A number of dispensers are commonly connected in a system so as to be supplied by a single large pump and the closure of the nozzle of one dispenser will cause a marked increase of the pressure and flow at another nozzle which is also dispensing liquid from the system. Since the main valve disclosed herein depends for its operation upon a predetermined unbalance of pressures on the valve operating diaphragm and since it automatically adjusts to maintain such predetermined unbalance, a sudden increase in pressure will not produce a sudden and substantial increase in the delivery from the nozzle because the main valve automatically and immediately moves to prevent such increased flow and there is no material change in the reactive force from the stream leaving the nozzle which might tend to dislodge the nozzle from the fill open-

ing. The effects of other impact pressures in the lines are similarly minimized or eliminated.

Also when the main valve is automatically closed, such closure occurs smoothly and uniformly because the diaphragm 69 displaces liquid from chamber 121, through the space between stem 99 and the bores of the nuts 45, 67 into chamber 125 as the main valve closes. This action produces a damping action to cushion the closure of the valve. The usual automatic nozzle valve closes with great impact since it is latched open against the pressure of a stiff spring which is suddenly unlatched and which causes the valve to slam shut. Such impact action often dislodges the nozzle from the fill pipe and results in spillage of liquid and damage to the nozzle.

The number and weight of the parts which must be accelerated and decelerated when the main valve closes have been minimized and the forces produced by such motions have therefore also been minimized and reduce the chance that the nozzle will be dislodged upon closure. The trigger and pilot valve mechanisms, for example, do not move during automatic or semiautomatic closure. Also no springs operate in a sudden manner.

There are no strong springs and no latching mechanisms which must move in frictional engagement under the load of such springs in order to trip the valve. Consequently there are no parts which are subjected to severe wear as in the case of existing nozzles.

It is obvious that various changes may be made in the form, structure and arrangement of parts of the specific embodiments of the invention disclosed herein for purposes of illustration, without departing from the spirit of the invention. Accordingly, applicants do not desire to be limited to such specific embodiments but desire protection falling fairly within the scope of the appended claims.

We claim:

1. In a dispensing nozzle, means defining an inlet, an outlet and a valve port therebetween, a main valve mounted for movement to open and close said port, a double acting fluid motor having opposed first and second pressure chambers and means movable in response to the difference in pressures in said chambers and connected to actuate said main valve, means connecting said first chamber in communication with said inlet, a restricted channel connecting said chambers and a passage connecting said second chamber with said outlet, said passage having a greater flow carrying capacity than said channel, said motor being constructed so as to close said main valve when the pressures in said chambers attain a predetermined minimum differential in the valve opening direction and to open said valve when said minimum differential is exceeded, a normally closed valve means for controlling the flow through said passage to thereby control the pressure in said second chamber, manually operable means settable to select the rate of delivery from said nozzle, means connecting said manually operable means to actuate said valve means, an additional, normally open valve in said passage, liquid level sensing means connected to be energized by the flow of liquid through said passage and means controlled by said sensing means to close said additional valve.

2. In a dispensing nozzle, means defining an inlet, an outlet and a valve port therebetween, a main valve mounted for movement to open and close said port, a double acting fluid motor having opposed first and second pressure chambers and means movable in response to the difference in pressures in said chambers and connected to actuate said main valve, said movable means forming a part of each of said chambers, means connecting said first chamber in communication with said inlet, a restricted channel connecting said chambers and a passage, including a control port in said movable means, connecting said second chamber with said outlet, said passage and port having a greater flow carrying capacity than said channel, said motor being constructed so as to close said

main valve when the pressures in said chambers attain a predetermined minimum differential in the valve opening direction and to open said valve when said minimum differential is exceeded, a normally closed pilot valve mounted for movement relative to said control port to start, stop and vary the flow through said passage to thereby control the pressure in said second chamber, manually operable means setttable to select the rate of delivery from said nozzle and means connecting said manually operable means to actuate said pilot valve, said pilot valve being disposed with respect to said central part so that as said movable means moves to open and close the main valve, it will respectively move said control port toward and away from said pilot valve so as to stabilize said main valve in a position corresponding to the setting of said manually operable means.

3. The structure defined by claim 2 which includes an additional normally open valve in said passage, liquid level sensing means and means controlled by said sensing means to close said additional valve.

4. In a dispensing nozzle, means defining an inlet, an outlet, a valve port therebetween, a main valve mounted for movement to open and close said port, a double acting fluid motor having opposed first and second pressure chambers and means movable in response to the difference in pressures in said chambers and connected to actuate said main valve, means connecting said first chamber in communication with said inlet, a restricted channel connecting said chambers and a passage connecting said second chamber with said outlet, said passage having a greater flow carrying capacity than said channel, said motor being constructed so as to close said main valve when the pressures in said chambers attain a predetermined minimum differential in the valve opening direction and to open said valve when said minimum differential is exceeded, a normally closed valve means for controlling the flow through said passage to thereby control the pressure in said second chamber, manually operable means setttable to different positions to select the rate of delivery from said nozzle, means connecting said manually operable means to actuate said valve means, a spout connected to said outlet, latching means having effective and ineffective positions and adapted, in said effective position, to hold said manually operable means in a set position, latch control means, including an element extending along said spout, having a normal position with respect thereto and adapted to be displaced from said normal position by contact with a receiving container and by the weight of the nozzle, means connecting said control means to move said latching means to ineffective position when said element occupies its normal position and means for moving said latch means to effective position when said element is displaced from said normal position.

5. In a dispensing nozzle, means defining an inlet, an outlet, a valve port therebetween and a spout connected to said outlet, a main valve mounted for movement to open and close said port, a double acting fluid motor having opposed first and second pressure chambers and means movable in response to the difference in pressures in said chambers and connected to actuate said main valve, means connecting said first chamber in communication with said inlet, a restricted channel connecting said chambers and a passage connecting said second chamber with said outlet, said passage having a greater flow carrying capacity than said channel, said motor being constructed so as to close said main valve when the pressures in said chambers attain a predetermined minimum differential in the valve opening direction and to open said valve when said minimum differential is exceeded, a normally closed valve means for controlling the flow through said passage to thereby control the pressure in said second chamber, manually operable means setttable to select the rate of delivery from said nozzle, means connecting said manually operable means to actuate said valve means, latch means for holding said

manually operable means in a set position, an eductor connected in said passage and having a vacuum chamber, an additional normally open valve mounted for movement to open and close said passage upstream of said eductor, a sensing tube connecting at one end to said vacuum chamber and vented adjacent the discharge end of said spout, and vacuum responsive means communicating with said vacuum chamber and connected to close said additional valve upon immersion of the vented end of said sensing means.

6. The structure defined by claim 5 wherein said vacuum responsive means comprises a fluid motor connected to close said additional valve and yieldable means for urging said additional valve open.

7. In a dispensing nozzle, means defining an inlet, an outlet, a valve port therebetween and a spout connected to said outlet and having a discharge end, a main valve mounted for movement to open and close said port, a double acting fluid motor having opposed first and second pressure chambers and means movable in response to the difference in pressures in said chambers and connected to actuate said main valve, means connecting said first chamber in communication with said inlet, a restricted channel connecting said chambers and a passage connecting said second chamber with said outlet, said passage having a greater flow carrying capacity than said channel, said motor being constructed so as to close said main valve when the pressures in said chambers attain a predetermined minimum differential in the valve opening direction and to open said valve when said minimum differential is exceeded, said passage including a jet tube, a venturi tube and a vacuum chamber therebetween, a pilot valve normally closing said passage upstream of said jet tube, manually operable means for actuating said pilot valve, an additional, normally open valve mounted for movement to open and close said passage upstream of said jet tube, a sensing tube having one end opening exteriorly of said spout adjacent the discharge end thereof and the other end connected in communication with said vacuum chamber, a second fluid motor connected to actuate said additional valve and communicating with said vacuum chamber, said second motor being operable in response to a vacuum of predetermined magnitude in said chamber resulting from immersion of said sensing tube, to close said additional valve.

8. In a dispensing nozzle, means defining an inlet, an outlet, a valve port therebetween and a spout connected to said outlet and having a discharge end, a main valve mounted for movement to open and close said port, a double acting fluid motor having opposed first and second pressure chambers and means movable in response to the difference in pressures in said chambers and connected to actuate said main valve, means connecting said first chamber in communication with said inlet, a restricted channel connecting said chambers and a passage connecting said second chamber with said outlet, said passage having a greater flow carrying capacity than said channel, said motor being constructed so as to close said main valve when the pressures in said chambers attain a predetermined minimum differential in the valve opening direction and to open said valve when said minimum differential is exceeded, said passage including a jet tube, a venturi tube and a vacuum chamber therebetween, a pilot valve normally closing said passage between said first chamber and said jet tube, manually operable means for actuating said pilot valve and setttable to select the rate of delivery from said nozzle, latch means for holding said manually operable means set with the pilot valve open, an additional normally open valve mounted for movement to open and close said passage between said first chamber and said jet tube, a sensing tube having one end opening exteriorly of said spout adjacent the discharge end thereof and the other end connected in communication with said vacuum chamber, a second fluid motor connected in communication with said vacuum chamber

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and connected to actuate said additional valve, said second motor being operable in response to a vacuum of predetermined magnitude in said chamber resulting from immersion of said sensing tube, to close said additional valve, means for disabling said latching means and means responsive to the closure of said pilot valve for reopening the additional valve.

9. The structure defined by claim 8 wherein said means responsive to the closure of said pilot valve includes an expandible chamber communicating with said passage and means for expanding said chamber after said pilot valve is closed.

10. The structure defined by claim 4 wherein said element comprises a sleeve lever disposed around said spout, having fulcrum means resting on said spout and constructed so as to pivot relative to said spout, said connecting means being operable, under the control of said lever to move said latching means to said ineffective position.

11. A dispensing nozzle comprising a body, a spout, valve means in said body for controlling the flow of liquid through said nozzle, a fulcrum mounted on said nozzle in fixed relation thereto, and a valve actuator mounted on said fulcrum for movement between a valve closed and a valve open position, means operable by said actuator to close and open said valve means in response to such movement, a latch mounted on said nozzle for movement to and from an effective position with respect to said actuator in which it engages and holds said actuator in a valve open position, latch control means for moving said latch to and from said effective position, said latch control means including a lever, means for mounting said lever on said nozzle so as to extend along said spout, to enter and engage a fill pipe substantially simultaneously with said spout and for movement relative to said spout, to and from a normal position with respect to the spout in which position said valve actuator is unlatched, means for urging said lever toward its normal position, said lever being moved from its normal position by the weight of the nozzle, when said lever and spout rest in a fill pipe, said latch control means being disposed for operative engagement with said latch to free said latch to move to its effective position as said lever moves from its normal position and to move said latch from its effective position when the lever is moved to its normal position.

12. The structure defined by claim 11 which includes liquid level responsive means for closing said valve means while said actuator is latched in its valve open position.

13. The structure defined by claim 11 wherein said lever comprises a tube loosely disposed telescopically over said spout and a fulcrum on said tube disposed to engage said spout adjacent the free end thereof.

14. A dispensing nozzle comprising a body, a spout, valve means in said body for controlling the flow of liquid through said nozzle and a valve actuator mounted for movement between valve closed and a valve open position, a latch mounted on said nozzle for movement to and from an effective position in which it holds said actuator in a valve open position, latch control means for moving said latch to and from said effective position and normally urging it from said position, a lever mounted on the spout so as to extend along said spout to enter and engage a fill pipe substantially simultaneously with said spout, said lever being also mounted for movement relative to said spout, from a normal position with respect to the spout by the weight of the nozzle, when said lever and spout rest in a fill pipe, means for separably connecting said lever to actuate said latch control means, said latch control means being operable by said lever to move said latch to its effective position when said lever moves from its normal position and to move said latch from its effective position when the lever is moved to its normal position, said spout defining a circumferential groove between the body and the mounting for said lever so that said spout and lever will be carried away when

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the spout is fractured along said groove, to separate said separable connection and free said latch control means to render said latch ineffective.

15. In a liquid dispensing nozzle, an inlet and an outlet connected by a valve port, a main valve for regulating the flow of the liquid through said port, means for opening and closing said main valve, a liquid conduit connecting said inlet and outlet, said conduit by-passing said main valve to provide a flow through the nozzle irrespective of the closure of the main valve, a normally open valve in said conduit, means, including liquid level sensing means connected to be energized by liquid flowing in said conduit for producing an effect when said sensing means is immersed in a level of liquid dispensed from said nozzle and means responsive to said effect for closing said normally open valve.

16. In a liquid dispensing nozzle, an inlet and an outlet connected by a valve port, a main valve for regulating the flow of liquid through said port, means for opening and closing said main valve, a liquid conduit connecting said inlet and outlet, said conduit by-passing said main valve to provide a flow through the nozzle irrespective of the closure of the main valve, a normally open valve in said conduit, a vacuum producing device associated with said conduit and adapted to be energized by the flow therethrough, a vent channel having an inlet port disposed exteriorly of said outlet but closely adjacent thereto, means connecting said channel with said device so as to decrease the vacuum produced thereby when said inlet port is open and to permit an increase of said vacuum when said inlet port is closed by liquid, and means connected for response to said increased vacuum to close said normally open valve.

17. The structure defined by claim 16 wherein said normally open valve is disposed so as to be held closed by the pressure of liquid in said conduit, said nozzle including means, controlled by said main valve opening and closing means, for relieving the pressure in said conduit to free said normally open valve to open.

18. In a liquid dispensing nozzle, an inlet and an outlet connected by a valve port, a main valve for regulating the flow of liquid through said port, means for opening and closing said main valve, a liquid conduit connecting said inlet and outlet, said conduit by-passing said main valve to provide a flow through said nozzle irrespective of the closure of the main valve, a normally open valve in said conduit, a chamber adjacent said conduit, a vacuum producing device connected to evacuate said chamber, said device communicating with said conduit so as to be energized by the flow of liquid through said conduit, a vent channel having an inlet port outside of but closely adjacent to said nozzle outlet and having its outlet connected with said chamber so as to decrease the vacuum in said chamber when said inlet port is open and to permit an increase in said vacuum when said port is closed by liquid, and means connected to said chamber and responsive to said increased vacuum to close said normally open valve.

19. The structure defined by claim 18 wherein said normally open valve is disposed upstream of said device and said chamber so as to prevent the discharge of liquid therethrough when said valve is closed.

20. The structure defined by claim 18 wherein said vacuum producing device comprises a venturi tube which is mounted in the stream of liquid flowing through said conduit.

21. An automatic dispensing nozzle having a main liquid passage, a main valve normally closing said passage, a control passage for conducting control flow independently of the opening of said main valve, manually operable means for opening said control passage, hydraulic control means for opening said main valve in response to flow in said control passage, suction-producing means actuated by flow in said control passage, an air passage having an air inlet positioned to be blocked by

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dispensed liquid for terminating a dispensing operation, said air passage being connected to admit air to said suction-producing means for at least partially satisfying the suction thereof, and suction-responsive means for closing said control passage in response to increased suction resulting from the blocking of said air inlet by dispensed liquid, whereby said control passage is closed in response to blocking of said air inlet regardless of the condition of said main valve, and said main valve, when open, is closed in response to the closure of said control passage.

22. An automatic dispensing nozzle as set forth in claim 21 in which said hydraulic control means comprises a pressure chamber in which pressure acts to close said main valve, and said manually operable means is in the flow-path between said pressure chamber and said suction-producing means.

23. An automatic dispensing nozzle according to claim 21, in which said manually operable means comprises a control valve controlling flow through said control passage and having seat and closure elements, one of said elements being movable with said main valve and the

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other being movable with respect thereto, the relationship being such that opening movements of the main valve tend to close the control valve whereby the control valve has a servo relationship with said main valve.

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