July 25, 1967 R. S. ESTABROOKS 3,332,581

APPARATUS FOR DISPENSING ADHESIVE

Filed March 15, 1965 5 Sheets-Sheet 1

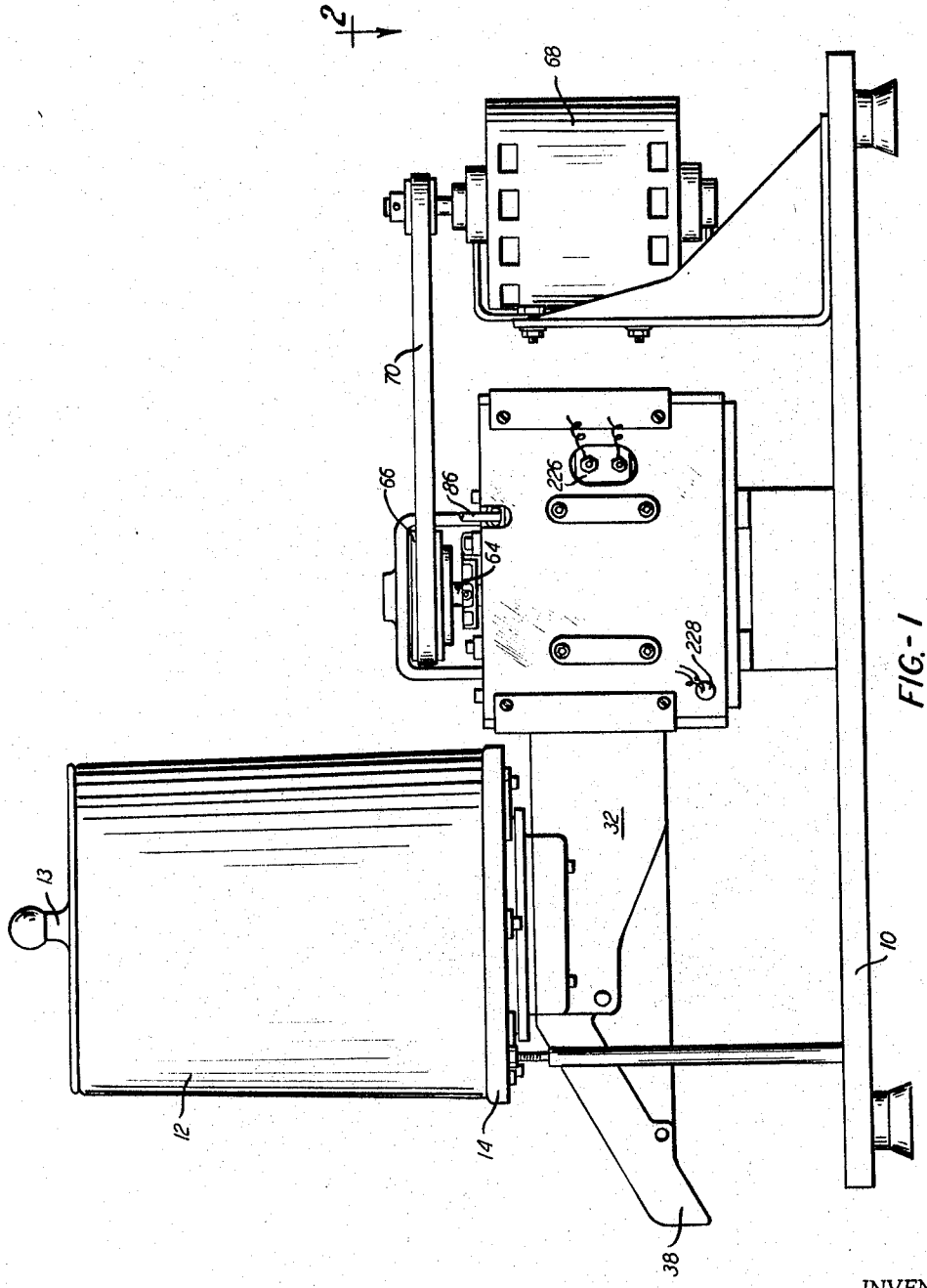


FIG. 1

INVENTOR

Roger S. Estabrooks

BY Albert Gordon

ATTORNEY

July 25, 1967 R. S. ESTABROOKS 3,332,581

APPARATUS FOR DISPENSING ADHESIVE

Filed March 15, 1965 5 Sheets-Sheet 2

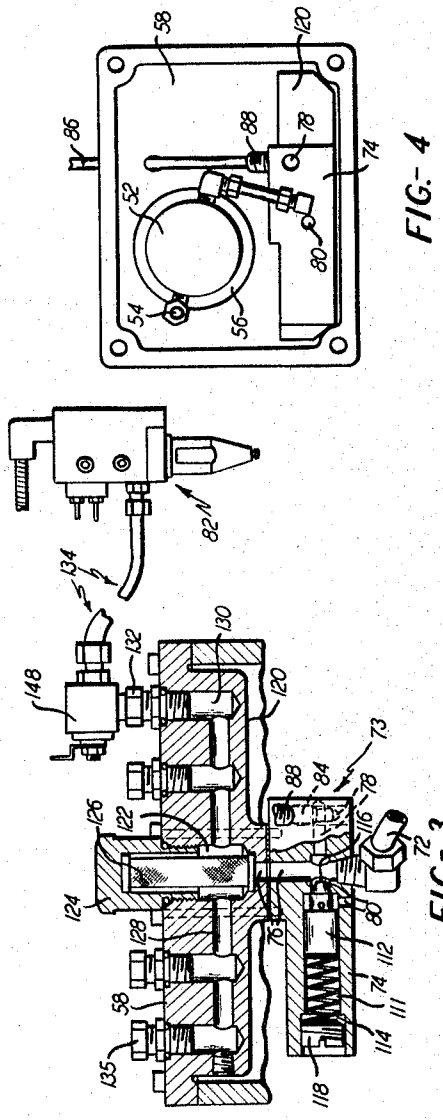


FIG. 3

FIG. 4

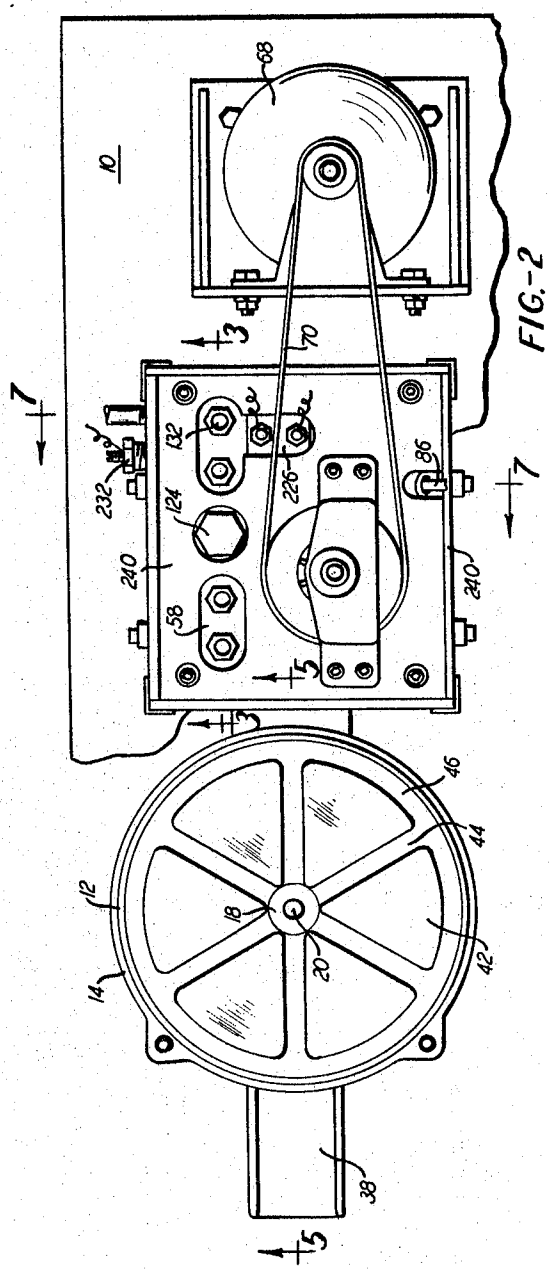


FIG. 2

APPARATUS FOR DISPENSING ADHESIVE

Filed March 15, 1965 5 Sheets-Sheet 3

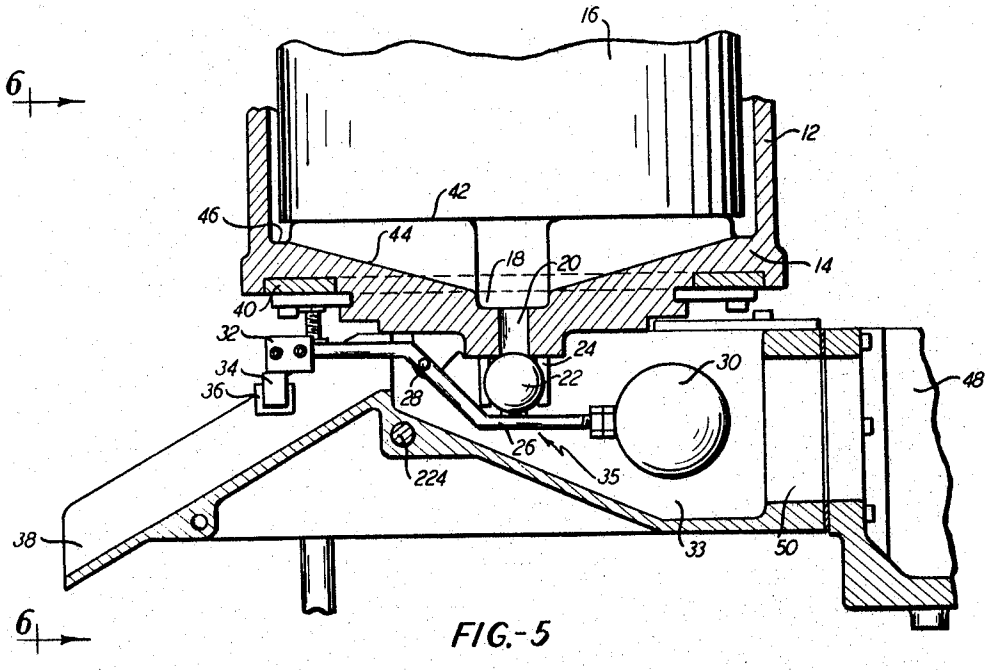


FIG.-5

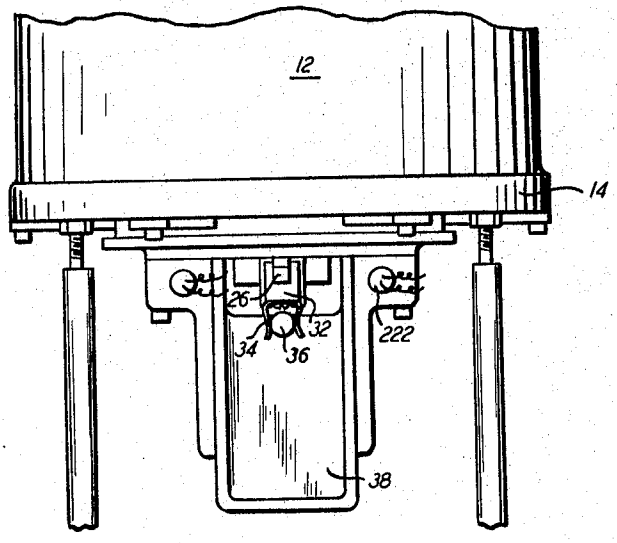


FIG.-6

July 25, 1967 R. S. ESTABROOKS 3,332,581

APPARATUS FOR DISPENSING ADHESIVE

Filed March 15, 1965 5 Sheets-Sheet 4

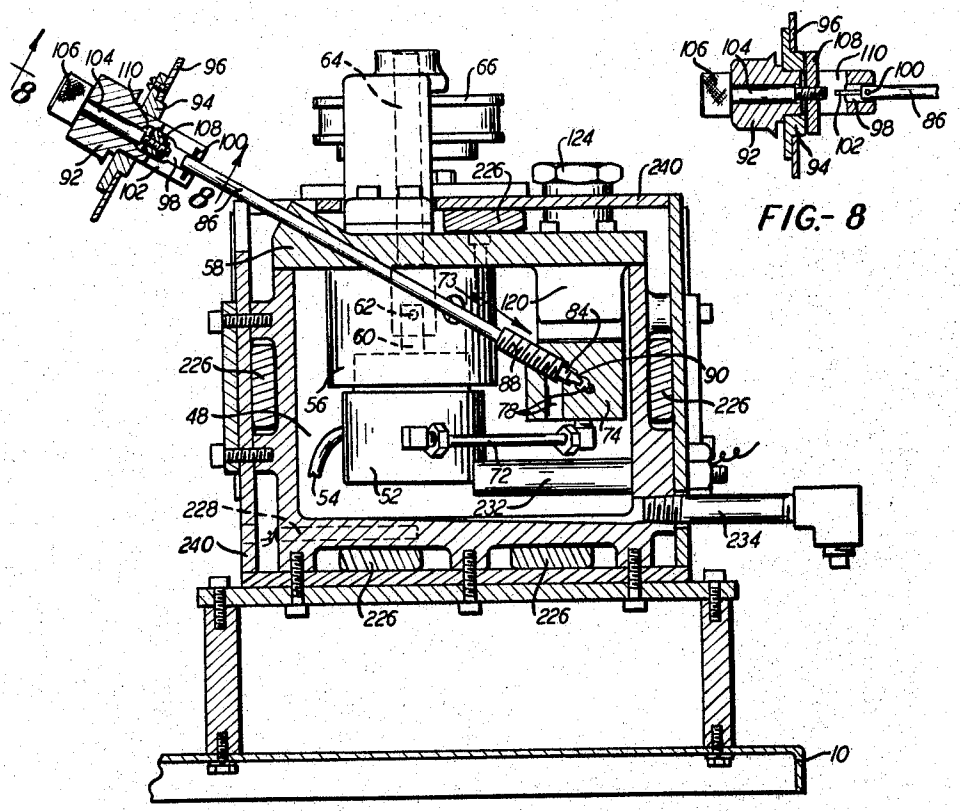


FIG.-7

FIG.-8

July 25, 1967 R. S. ESTABROOKS 3,332,581

APPARATUS FOR DISPENSING ADHESIVE

Filed March 15, 1965 5 Sheets-Sheet 5

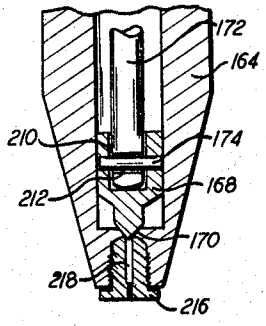


FIG.-12

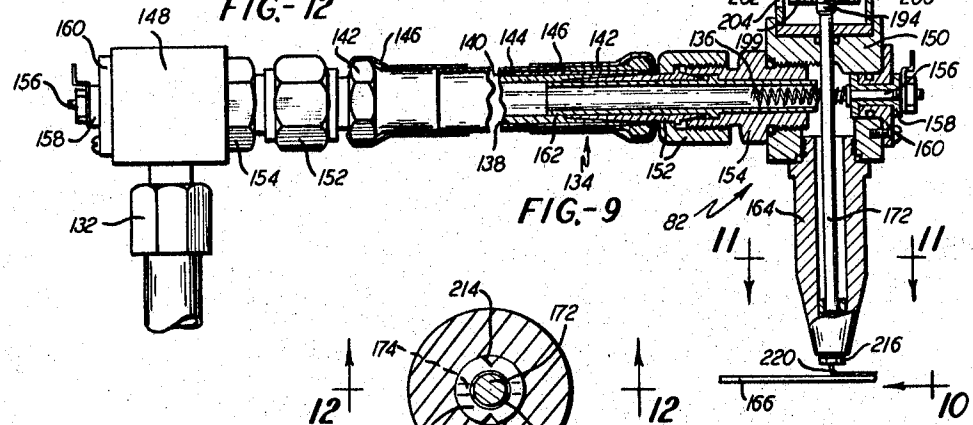


FIG.-9

FIG.-11

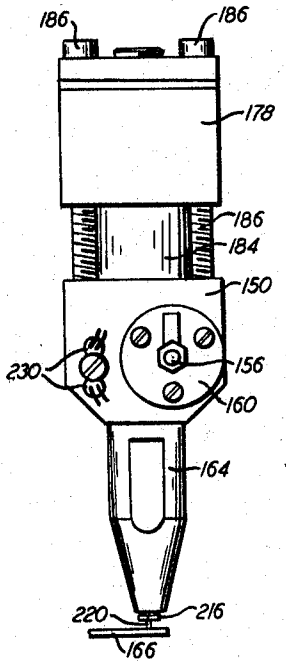


FIG.-10

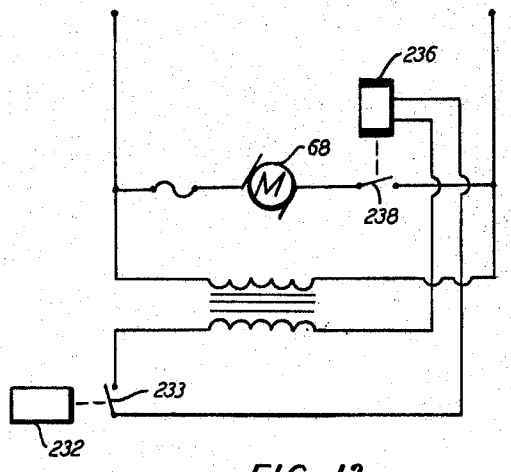


FIG.-13

United States Patent Office 3,332,581 Patented July 25, 1967

3,332,581

APPARATUS FOR DISPENSING ADHESIVE

Roger S. Estabrooks, North Quincy, Mass., assignor to International Shoe Machine Corporation, Boston, Mass., a corporation of Massachusetts

Filed Mar. 15, 1965, Ser. No. 439,661
21 Claims. (Cl. 222—181)

This invention relates to apparatus for periodically dispensing fluid to a workpiece as the need for such fluid arises. It is particularly adapted for use with a fluid which is handled at high pressures and temperatures, such as a thermoplastic adhesive.

Among the objects of this invention are:

To provide an improved method and apparatus for efficiently melting solid thermoplastic adhesive and thus render it fluid so as to be adaptable for use in a fluid dispensing system;

To provide an improved apparatus for dispensing fluid material at a constant rate;

To provide an improved apparatus for periodically dispensing a fluid in precise and equal amounts;

To provide an apparatus for dispensing fluid material in response to a signal, the time lag between the signal and the dispensing of the fluid being minimal;

To provide an improved valve apparatus having features of continually accurate seating;

To provide a fluid dispensing apparatus which is compact and portable;

and to provide an improved knob for mechanically controlling the position of a member.

Other object and advantages of the present invention will become apparent from the following description.

In the operation of this apparatus, the solid thermoplastic adhesive is loaded into a melting tank where a heating element at the base of the tank causes the adhesive to liquify. Once in a liquid state, the adhesive gravitates through an orifice in the base of the melting tank to a chamber located below the melting tank. The chamber houses a float valve the function of which is to obstruct the orifice in the base of the melting tank when the fluid in the chamber reaches a predetermined level, thereby terminating flow from the melting tank to the chamber. Abutting the float chamber is a second chamber, hereinafter referred to as the sump, with a passageway between them so as to allow the adhesive to flow from the float chamber to the sump. Housed within the sump is a continuously operating gear pump, the inlet of which is immersed in the adhesive, thereby drawing in the adhesive forcing it through the pump outlet and into a pressure regulating device. The pressure regulator consists of a primary conduit, leading from the pump outlet to a dispensing gun where the adhesive is dispensed, and two subsidiary conduits, each one being in communication with the primary condut so as to divert and receive a portion of the flow of adhesive in the primary conduit. Each of the subsidiary conduits directs the adhesive flowing therein back to the sump. An obstruction is situated within one of the subsidiary conduits and means are provided for varying the degree of obstruction.

The amount of static pressure present in the primary and subsidiary conduits can thus be varied by increasing or decreasing the degree of obstruction in said subsidiary conduit. The other subsidiary conduit contains a pressure relief valve which is normally closed thereby preventing flow back to the sump, and is designed to open when a predetermined maximum static pressure in the conduits is attained. Means are provided for varying the amount of static pressure necessary to open the pressure relief valve. The portion of adhesive flowing in the primary conduit and not diverted back to the sump then passes through a filter before entering a distribution manifold.

The dispensing gun is connected to the distribution manifold by means of a flexible hose so that the adhesive may be dispensed at any point within reach of the hose.

Incorporated in the dispensing gun is a valve, the function of which is to block or unblock the orifice in the tip of the nozzle, thereby controlling the flow of adhesive to the workpiece. The valve is so constructed as to form a perfect seal with the valve seat, thereby minimizing drip, leakage and wear. Means are provided for actuating the valve and a device for sensing the need for adhesive controls the valve actuating means. Heating elements are situated at various locations throughout the apparatus for the purpose of maintaining the adhesive at a temperature level sufficient to prevent its solidification. Heat sensing elements are similarly disposed throughout the apparatus for the purpose of controlling the operation of the heating elements and thereby preventing overheating of the adhesive.

The invention will now be described in greater detail with reference to the accompanying drawings wherein:

FIG. 1 is a side elevation of the apparatus;

FIG. 2 is a plan view of the apparatus taken on the line 2—2 of FIG. 1 with the melting tank lid omitted;

FIG. 3 is a partially sectional view taken on the line 3—3 of FIG. 2;

FIG. 4 is a plan view of the underside of the sump cover as viewed from the bottom of the sump;

FIG. 5 is a partially sectional view taken on the line 5—5 of FIG. 2;

FIG. 6 is a fragmentary elevation as seen from the left side of FIG. 1;

FIG. 7 is a partially sectional view taken along the line 7—7 of FIG. 2;

FIG. 8 is a partially sectional view taken along the line 8—8 of FIG. 7;

FIG. 9 is a partially sectional view of the dispensing and hose, shown in relatively large scale;

FIG. 10 is a side elevation of the dispensing gun as indicated by the line 10—10 of FIG. 9;

FIG. 11 is a sectional view of the nozzle and valve assembly taken along the line 11—11 of FIG. 9;

FIG. 12 is a fragmentary sectional view of the nozzle and valve assembly taken along the line 12—12 of FIG. 11; and

FIG. 13 is a diagram of the electrical circuitry in the motor safety control circuit.

Referring to the drawings (FIG. 1), the entire apparatus is mounted on a platform 10, thereby facilitating portability. A melting tank 12, formed of aluminum or other heat conductive material, has a base 14 upon which the solid thermoplastic adhesive 16 rests as indicated in FIG. 5. The tank 12 may be provided with a cover 13. Centrally located in the base 14 is an orifice 18 which leads into another concentric orifice 20 of a smaller diameter, the bottom of the smaller orifice forming a valve seat which accommodates a ball-check valve 22. The ball is restricted to substantially vertical motion by four pins 24 which are mounted on the underside of the base and lie on the circumference of a circle which is concentric with the orifice in the base. The vertical motion of the ball is accomplished by means of a float arm 26 upon which the ball freely rests, said float arm being pivotally mounted with a float 30 being attached to one extremity of the float arm and a counterweight 32 being slidably connected to the other extremity. The bottom of the ball 22 rests on the float arm at a point in between the float arm pivot 28 and the float 30. A float chamber 33, located underneath the melting tank base 14, houses the float valve mechanism 35 and receives the molten adhesive as it flows through the orifices 18, 20 and past the ball-check valve 22. As the level of adhesive raises within the float chamber, the float 30 will similarly rise, caus-

ing the float arm 26 to swing about the float arm pivot 28, thereby imparting an upward movement to the ball-check valve 22. This motion will terminate when the level of adhesive is such that ball-check valve 22 is in contact with valve seat at the bottom of the smaller orifice 20 and the adhesive is unable to flow into the float chamber 33. As the level of the adhesive in the float chamber decreases a downward movement of the float arm 26 and ball-check valve 22 will occur, thereby allowing adhesive to gravitate from the melting tank 12 into the float chamber. The level of adhesive at which the ball-check valve 22 will obstruct the orifice 20 may be varied by means of the slidably mounted counterweight 32 located at the extremity of the float arm 26. Shifting of the counterweight towards the float arm pivot 28 will decrease the buoyancy of the flot 30 thereby causing it to be more submerged in the adhesive, the effect being that the adhesive will have to rise to a higher level in order for the ball-check valve 22 to fully obstruct the orifice 20. The same result may be obtained by maintaining the counterweight in a fixed position while varying its size. A decrease in the size of the counterweight would have the same effect as sliding a counterweight of fixed size inwardly towards the float arm pivot 28. The present apparatus utilizes both of these methods in that the slidably mounted counterweight 32 has fixed to it a clip 34 for the purpose of retaining an additional weight 36. An overflow spout 38 is provided in one of the walls of the float chamber so as to limit the maximum allowable level of adhesive in the float chamber.

Heat is supplied to the melting tank by means of an annular electric heating element 40 embedded in the melting tank base 14.

The upper surface 42 of the melting tank base upon which the solid adhesive rests is flat with the exception of a plurality of radial troughs 44 which are inclined downwardly from the periphery of the melting tank base to the center of the melting tank base where the troughs terminate in the larger orifice 18. There is also an annular trough 46 at the periphery of the melting tank base which is in communication with the radial troughs 44.

These troughs serve a dual purpose in that they facilitate the gravitation of the molten adhesive to and through the orifices 18, 20 and that they cause a more rapid rate of melting of the solid adhesive due to the increased surface area of the melting tank base.

Abutting the float chamber 33 is a sump 48 with a passageway 50 between them so as to allow the molten adhesive to flow unaided from the float chamber into the sump. Thus, the level of adhesive in the sump cannot be greater than the level of adhesive in the float chamber.

A continuously operating gear pump 52 (FIG. 7) is located within the pump with its inlet port 54 being near the bottom of the sump so as to insure its being immersed in the molten adhesive at all times. The pump is rigidly suspended from a hollow, cylindrical pump mount 56 which in turn is rigidly suspended from the sump cover 58. The pump shaft 60 extends vertically upward into the hollow pump mount where a joint 62 is made between the pump shaft 60 and an extension shaft 64. A pulley 66 is fixed to the extension shaft and an electric motor 68 (FIG. 1) or other rotary driving means is connected to the pulley by a chain or belt 70.

The molten adhesive is pumped to the pump outlet conduit 72 which directs the flow into the pressure regulating device 73. Said device (FIG. 3) consists of a pressure regulating block 74 in which is fabricated a primary conduit 76 and two subsidiary conduits 78, 80 each of the subsidiary conduits being in communication with the primary conduit so as to divert and receive a portion of the flow of molten adhesive from the primary conduit. Both of the subsidiary conduits return the adhesive to the sump 48 whereas the primary conduit directs the adhesive towards the dispensing gun 82.

The first subsidiary conduit 78 consists of a pair of passages, located askew, and interconnected by tapered orifice 90 (FIG. 7) which acts as a seat for a needle valve 84, the purpose of said needle valve being to obstruct the flow of adhesive in the first subsidiary conduit 78 thereby controlling the pressure and the flow rate in said subsidiary conduit. This, in turn, affects the pressure and flow rate of the adhesive in the primary conduit 76. A decrease in the degree of obstruction which the needle valve presents to the orifice 90 in the first subsidiary conduit causes a greater rate of flow of adhesive through said subsidiary conduit which in turn causes both the pressure and the flow rate in the primary conduit 76 to decrease. The converse is true, in that an increase in the degree of obstruction of the orifice 90 results in an increase in the pressure and flow rate of the adhesive in the primary conduit 76. Variation of the degree of obstruction which the needle valve 84 presents to the orifice 90 is accomplished by means of a rotatable pressure control rod 86, the tip of which forms the needle valve 84 itself. The pressure control rod extends from the exterior of the sump 48, through the sump cover 58 and into the interior of the sump where a threaded portion 88 of the pressure control rod engages a tapped hole in the pressure regulating block 74. The location of the tapped hole is such that the longitudinal axis of the pressure control rod 86 and the central axis of the orifice 90 coincide, thereby insuring that the tip of the pressure control rod which forms the needle valve 84 and the portion of the orifice 90 which forms the valve seat, will be in alignment.

In operation, as the pressure control rod 86 is rotated, an axial motion is simultaneously imparted to the control rod by reason of its threaded engagement with the pressure regulating block 74, thereby increasing or decreasing the degree of obstruction which the needle valve 84 presents to the orifice 90, depending on the direction of rotation of the pressure control rod.

Rotation of the pressure control rod 86 is facilitated by a regulating knob 92 (FIGS. 7, 8) having a head portion and a shank portion, the head portion being of a greater diameter than the shank portion. The periphery of the head portion may be knurled to aid in the manual gripping of the knob. The regulating knob 92 is mounted in a support bushing 94 so that the shank portion is free to rotate within said support bushing. The support bushing 94 is rigidly mounted to a control panel 96. A centrally located internal bore 98 extends through the entire length of the regulating knob. The portion of said internal bore which is located in the shank portion of the regulating knob accommodates in a loose fit, the outer extremity of the pressure control rod 86, thereby allowing axial movement of said rod within said bore. Rotary motion is transmitted from the regulating knob 92 to the pressure control rod 86 by means of a pin 100 secured to the outer extremity of the pressure control rod and extending diametrally into a longitudinal slot 102 cut along the diameter of the shank portion of the regulating knob.

Once the setting of the pressure control rod 86 has been fixed it becomes desirable to maintain this setting and with this end in view a locking mechanism is made an integral part of the regulating knob 92. The portion of the internal bore 98 which is located in the head portion of the regulating knob accommodates, in a loose fit, a locking shaft 104, the outer extremity of which is rigidly attached to a lock shaft knob 106, with the inner extremity extending into the shank portion of the regulating knob and threads being formed at said inner extremity. A rectangular locking bar 108 is slidably mounted in an oval shaped slot 110 located in the shank portion of the regulating knob, the longitudinal axis of said locking bar being perpendicular to the longitudinal axis of said regulating knob, with the ends of said locking bar protruding beyond the periphery of the shank por-

tion of the regulating knob 92. A tapped hole is centrally positioned in the locking bar and thereby engages the threaded portion of the locking shaft 104 so that as the locking shaft is rotated on axial motion is imparted to the locking bar, thereby drawing the protruding ends of the locking bar against the rigidly fastened support bushing 94 and preventing rotary motion of the regulating knob.

Obstructing the second subsidiary conduit 80 (FIG. 3) is a spring-biased plunger 112 slidably contained in an internal bore 111. A helical compression spring 114 contained in said internal bore maintains the plunger in a position which fully obstructs the second subsidiary conduit. A reactor surface 116 of the plunger is in communication with the adhesive so that the plunger will retract from its obstructing position when the force on the reactor surface exceeds force exerted by the spring 114. The force needed to compress the spring may be varied by means of a plug 118 which is threaded to engage complementary threads in the internal bore 111. Thus, the mechanism acts as a relief valve, the purpose of which is to limit the maximum pressure within the system, thereby preventing leakage or rupture at locations throughout the apparatus subject to relatively large stresses.

The pressure regulating block 74 is rigidly mounted to the underside of a distribution manifold 120, said manifold being an integral part of the sump cover 58. A continuation of the primary conduit 76 is located in the underside of the distribution manifold. Directly above and in communication with the primary conduit is a relatively large diameter bore 122, hereinafter referred to as the filter chamber, which extends vertically upward from the termination of the primary conduit through the outer surface of the sump cover 58. A cup-shaped filter cap 124 is mounted in an inverted position on the sump cover above and concentric with the filter chamber, thereby enclosing said chamber. Situated within the filter chamber 122 and concentric with it and the primary conduit is a hollow, cylindrical filter 126, the upper end of which abuts the ceiling of the interior of the filter cap 124 and the lower end of which abuts the bottom of the filter chamber so that the adhesive will flow from the primary conduit 76 to the interior of the filter 126. The filter cap 124 is mounted on the sump cover by threaded engagement therewith, thereby allowing compression of the filter 126 between said filter cap and the bottom of the filter chamber so as to insure a tight seal at its ends. The filter is easily accessible for cleaning or replacement purposes.

The portion of adhesive that is not returned to the sump via the subsidiary conduits 78, 80 and hence remains in the primary conduit 76 flows into the interior of the filter 126, passes through the filter to the filter chamber 122 wherefrom it enters a distribution conduit 128. The distribution conduit is essentially an internal bore running longitudinally within the distribution manifold 120 and intersecting the filter chamber 122 so as to receive the flow of adhesive from said filter chamber. A plurality of passages 130 extend vertically from the distribution conduit 128 through the upper surface of the sump cover at which point fittings 132 connect each of said passages to a flexible heated hose 134 which directs the adhesive to the applicator nozzle 82. Hoses may be connected to as many fittings as are available, the remaining unconnected fittings being closed by plugs 135.

Referring to FIG. 9 the flexible heated hose 134 is composed of three concentric layers of tubing, with a helical electric heating element 136 located within and extending throughout the length of the hose so that the adhesive in the hose is in direct contact with the heating element. The innermost tube 138 conducts the adhesive and is in direct contact with it. It is important that this tube be of a composition having high electrical insulative qualities, high resistance to corrosion, flexibility and strength so that it may withstand the high pressures of the adhesive which it conducts. It is also desirable that the tube 138 be heat insulative as the adhesive flowing within it is generally at a very high temperature. It has been found that the material commonly known as "Teflon" is suitable for these purposes. The intermediate tube 140 is a stainless steel braid, the main function of which is to add strength to and protect the tube 138. A number of such braided Teflon hoses complete with fittings 142 are available commercially. Although Teflon has some heat insulative qualities the temperature of the adhesive is generally so high that the hose becomes extremely hot and for this reason an outer tube 144 of fiberglass insulation is provided. Such fiberglass tubes are also available commercially. To prevent the ends of the fiberglass tube 144 from becoming frayed they are covered by shrink tubing 146. As shown in FIG. 9 the shrink tubing covers both the end of the fiberglass tube 144 and the fitting 142.

The ends of the hose 134 are connected to hollow anchor blocks 148, 150 by means of fittings 152, 154. The coiled electric heater 136 extends beyond the end of the hose and its fittings and is secured at its ends to electrically conductive anchor studs 156 which in turn are indirectly fastened to the anchor blocks. Each anchor stud is surrounded by an electrically insulative (Teflon) bushing 158 which in turn is contained within a sealing bushing 160. The sealing bushing 160 is fastened directly to the anchor block 150 and serves the dual function of holding the anchor stud in place as well as preventing leakage of adhesive. The heater element 136, anchor stud 156, insulating bushing 158, and sealing bushing 160 are so arranged as to have a common central axis. By extending the heating coil beyond the end of the hose and its connective fittings, and fixing it to anchor block 150, the difficulties encountered by anchoring the heating element to the hose or its fittings itself are avoided in that a better seal is obtained and the heating element is more readily accessible for removal or replacement if such need should arise. A relatively short electrically insulative (Teflon) sleeve 162 is located within the innermost tube 138 so as to enclose the heating element 136 and thereby insulate it from making electrical contact with the fittings 152, 154.

In addition to its function of securing the heating element 136, the anchor block 150 is an integral part of the dispensing gun 82. A nozzle 164 having a passage therein is threaded to the underside of the anchor block 150 so that the passage in the nozzle is in communication with the hollow of the anchor block, which in turn is in communication with the passageway of the heated hose 134, thereby allowing molten adhesive to flow under pressure from the heated hose, through the anchor block 150 and into the nozzle 164 where it is dispensed to a workpiece 166. Slidably mounted for vertical motion within the nozzle passage is a self-centering valve member 168 (FIGS. 11, 12) which cooperates with a valve seat 170 formed at the interior of the outlet end of the nozzle 164 so that discharge of the adhesive is allowed or prevented, depending on the position of the valve member 168. The construction and functioning of the self-centering valve member will be later described in greater detail.

Vertical motion of the valve member is accomplished by means of a valve stem 172 to which the valve member is connected by a pin 174, said valve stem being centrally located within the nozzle passage. The uppermost end of the valve stem is rigidly secured to a piston 176 slidably mounted within an air cylinder 178 so that the vertical motion of the piston will be transmitted to valve member 168. An aperture is provided in the air cylinder base 180 so that the valve stem may pass and reciprocate therethrough. An air cylinder cap 182 is located at the top of the air cylinder and may be removed for access to the interior of the air cylinder. The anchor

block 150 and air cylinder 178 are aligned by means of a hollow cylindrical spacer 184 interposed between them. The spacer also acts as a means of insulating the air cylinder 178 from the heat radiated by the anchor block. It is preferable to fabricate the spacer from a material having relatively low heat conductivity such as stainless steel. The outside diameter of the spacer is made small enough so that bolts 186 (FIG. 10) may be passed through the air cylinder cap 182, air cylinder 178 and threaded into the anchor block 150 without interfering with said spacer, thereby fastening and rigidifying the various components of the dispensing gun with respect to each other.

Compressed air is communicated to air cylinder chambers 188, 190 from a suitable source by means of passages 192 formed in the wall of the air cylinder 178. A device not shown (microswitch, photoelectric cell, etc.) for sensing the need for application of adhesive to a workpiece 166 controls the actuation of a valve (not shown) disposed between the source of air pressure and the air cylinder 178, which admits the air into either of the air cylinder chambers 188, 190, thereby actuating the piston 176, the vertical motion of which is transmitted to the valve member 168 by means of the valve stem 172. When the compressed air is in air cylinder chamber 190 the valve member 168 will be unseated and adhesive will be continuously dispensed until the compressed air is directed to air cylinder chamber 188 whereupon the valve member 168 will be seated and the flow of adhesive will stop.

Some of the uses in which this apparatus may be employed may require that the seating of the valve member 168 be instantaneous. To decrease the time required to bring the valve member from a dispensing to a non-dispensing position, means for shortening the stroke of the valve stem are provided. A threaded portion 194 of the valve stem 172 that is contained within the hollow spacer 184 engages a tapped hole, centrally located in the base of a cup-shaped limiting stop 196, similarly contained within the hollow spacer, so that the upper end of the limiting stop is directly below the lower surface of the air cylinder base 180, with a clearance separating them. The amount of this clearance determines the stroke of the valve stem 172 which may be varied by rotating the valve stem with respect to the limiting stop 196. This is facilitated by means of a screwdriver slot 198 cut in the upper surface of the piston 176 whereby the piston and valve stem may be rotated while the limiting stop 196 is held in a fixed position. A flange 199 is provided at the base of the limiting stop, the upper surface of the flange defining a shoulder. A recess 200 is provided at the periphery of the flange 199 so that an instrument may be inserted into said recess for the purpose of maintaining the limiting stop in a fixed position while the piston 176 and valve stem 172 are being rotated. A set screw 202 is also provided in the flange 199 to lock the limiting stop to the valve stem once their relative position has been determined. Access to the recess 200 and set screw 202 is provided by means of an opening 204 in the hollow spacer 184. Access to the screwdriver slot 198 is provided by means of a removable plug 206 in the air cylinder cap 182. In addition to the shortening of the stroke of the valve stem 172, rapid seating of the valve member 168 is further aided by means of a coil spring 208 which circumscribes the upper portion of the limiting stop 196 while being compressed between the lower surface of the air cylinder base 180 and the shoulder at the base of the limiting stop. The spring 208 imparts a downward motion to the valve stem 172 and thus aids the downward motion imparted to the valve stem by the introduction of compressed air into air cylinder chamber 188.

To prevent improper seating of valve member 168 at valve seat 170 due to possible misalignment of the valve stem 172, the valve member is attached to the valve stem so as to allow a limited amount of universal movement (FIGS. 11, 12). A bore 210 is centrally located in the upper portion and along the longitudinal axis of the valve member 168 so as to accommodate the lower end of the valve stem 172, the diameter of said bore being greater than the diameter of said valve stem. It is desirable that the bottom of the bore 210 be flat. Another bore 212 is located along the diameter of the valve stem so as to accommodate the pin 174, the ends of which are rigidly fastened to the valve member 168. The bore 212 in the valve stem is of a greater diameter than that of the pin 174 and is of such size as to allow the lower tip of the valve stem to be in contact with the bottom of the bore 210 in the valve member without the pin 174 making contact with the valve stem. Thus when the valve stem has downward motion said motion will be transmitted to the valve member solely by means of the contact between the lower tip of the valve stem and the flat bottom of the bore 210. There being no rigid connection between the valve stem and the valve member, the valve stem may slide or pivot freely at its point of contact with the bottom of the bore 210 in the valve member 168. The lower tip of the valve stem is rounded to facilitate such sliding or pivoting. Thus, the misalignment of the valve stem has no effect on the alignment of the valve member. The alignment of valve member 168 with the valve seat 170 is accomplished solely by means of its contact with the wall of the passage in the nozzle 164. To allow the adhesive to flow between the periphery of the valve member and the wall of the passage in the nozzle, vertical grooves 214 are formed in the valve member at its periphery.

A removable plug 216 having a discharge orifice 218 is located at the tip of the nozzle and may be interchanged with similar plugs having discharge orifices of a different diameter, thereby allowing variance in the size of the bead 220 dispensed.

The flow rate of adhesive thus may be varied by means of the pressure regulating device 73 and/or substitution of plugs 216 with different sized discharge orifices. Once the flow rate has been determined and so fixed it is mainained at that level by means of the continuously operating gear pump which subjects the adhesive to a constant pressure. When there is no flow through the nozzle and the apparatus is not dispensing, the pump continues to operate, recirculating the adhesive within the apparatus by means of the pressure regulating device 73.

The viscosity of the adhesive is of major importance in determining the flow rate. Should the temperature of the adhesive be allowed to vary, to any great extent the viscosity will similarly vary with the result that the flow rate will be uncertain. To insure a relatively constant viscosity and flow rate, the temperature of the adhesive is maintained at a constant level by means of electric heating elements strategically located throughout the apparatus. The heating elements are actuated by heat sensing elements similarly located. In addition to the annular heater 40 and the heating coil 136, a pair of heating elements 222 (FIG. 6) are located in the casting of the float chamber 33. A heat sensing element 224 (FIG. 5) is also located in said casting and controls the operation of heating elements 222 and annular heater 40. Electric heating elements 226 (FIG. 7) are fastened to the outer surface of the casting of the sump 48 and are actuated by a heat sensing element 228 (FIG. 1) located within said casting. A pair of heaters 230 are located in the anchor block 150 of the dispensing gun (FIG. 10). These heaters are not controlled by any heat sensing elements and are in continuous operation.

As a safety precaution, a temperature sensing element 232 (FIG. 7) is located within the sump 48 so as to be in direct contact with the adhesive, and is electrically integrated (FIG. 13) into the motor circuit so that the motor 68 will not operate until the temperature of the adhesive has reached a level wherein it is molten. When element 232 is heated to a predetermined level, a switch

233 is closed which in turn energizes a relay 236 to close another switch 238. The switch is connected in series with the motor 68 thereby precluding operation of the motor 68 when the switch 238 is open. A drain pipe 234 (FIG. 7) may also be provided for cleaning the sump.

In view of the relatively high temperatures at which the apparatus is operated it is advisable to provide insulation 240 at points of patricularly high temperature, such as surrounding the sump.

When there is no workpiece 166 presented to the apparatus this condition will be sensed by a suitable device (microswitch, photoelectric cell, etc.) and compressed air will be directed (through valve means responsive to said microswitch or photoelectric cell) to air cylinder chamber 188, thereby forcing the valve member 168 downwardly against the valve seat 170 so as to be in a non-dispensing position as shown in FIG. 12. While the apparatus is in a non-dispensing position the pump 52 continues to operate so that the full flow from the pump outlet conduit 72 is recirculated to the sump 48 by means of the subsidiary conduits 78, 80 in the pressure regulating block 74. The adhesive in the hose 134 and dispensing gun 82, being in communication with the adhesive in the primary conduit 76, is thus subjected to the same pressure as the adhesive in said primary conduit and will immediately begin to flow onto the workpiece 166 when the valve member 168 has retracted from the valve seat 170 and is thus in a dispensing position.

When a workpiece is presented to the apparatus, its presence is similarly sensed with the result that compressed air is introduced into the air cylinder chamber 190, thereby causing the valve member 168 to unseat, so that the apparatus will be in a dispensing position. When the apparatus is dispensing, the flow of adhesive from the pump outlet conduit 72 is divided between the primary conduit 76 which leads to the dispensing gun 82 and the subsidiary conduits 78, 80 which lead back to the sump 48. The proportion in which the flow of adhesive will so divide is dependent on the amount of obstruction presented to the first subsidiary conduit 76 by the needle valve 84 and the size of the discharge orifice 218 in the removable plug 216.

It should be understood that the present disclosure is for the purpose of illustration only and that this invention includes all modifications and equivalents which fall within the scope of the appended claims.

I claim:

1. A dispensing gun for use in a fluid dispensing system in which there is a source of fluid under pressure comprising:

an anchor block having a hollow interior, said hollow being in communication with said source of fluid pressure;

a nozzle having an inlet end, an outlet end and a passage interconnecting said inlet and outlet ends, said nozzle being affixed at its inlet end to one end of said anchor block, said inlet end being in communication with the hollow of said anchor block thereby allowing fluid to flow from its source into said anchor block and through said nozzle passage;

a valve stem, coaxially located within said nozzle passage and protruding through the other end of said anchor block;

an air cylinder rigidly mounted in relation to said anchor block, said air cylinder having a base in which an aperture is centrally located for slidable accommodation of that end of said valve stem protruding through said anchor block whereby said valve stem may enter said air cylinder;

a piston, slidably contained within said air cylinder thereby dividing the interior of said air cylinder into a pair of expansible air chambers, said piston being rigidly attached to said valve stem whereby the motion of said piston will be transmitted to said valve stem;

means for introducing compressed air into said air chamber thereby activating said piston;

valve means located within said nozzle passage and in operative engagement with said valve stem whereby the motion of said valve stem may be transmitted to said valve means thereby causing said valve means to be in an open or closed position;

a hollow spacer interposed between said air cylinder base and said anchor block, and enclosing a portion of said valve stem;

a cup-shaped limiting stop located within said spacer and having a cylindrical sidewall, a base having a tapped hole centrally located therein and a peripheral shoulder located at the lower portion of said limiting stop, said shoulder being of a greater diameter than that of said sidewall, said base being in threaded engagement with that portion of said valve stem enclosed by said spacer, the uppermost end of said limiting stop defining a plane normal to the longitudinal axis of said valve system and parallel to the plane of the lower surface of the air cylinder base, whereby upward movement of said valve stem will terminate when the uppermost end of said limiting stop abuts the lower surface of said air cylinder, the amount of said upward movement being determined by the clearance between the uppermost end of said limiting stop and the lower surface of said air cylinder base, said clearance being adjustable by rotation of said limiting stop about said valve stem;

means for locking said limiting stop and said valve stem in a fixed position relative to each other;

and a helical compression spring encircling said limiting stop, the lower end of said spring abutting the shoulder of said limiting stop and the upper end of said spring abutting the lower surface of said air cylinder base, whereby a downward force will act upon said limiting stop and valve stem, thereby increasing the speed with which said valve member will change from an open to a closed position.

2. An apparatus as recited in claim 1 wherein said valve means comprises:

a valve seat located within said nozzle passage;

a valve member slidably mounted within and guided by said nozzle passage and having its lower end conforming to the shape of said valve seat, said valve member having a first blind bore centrally located at its upper end;

communicative means between the portion of said nozzle passage above said valve member and the portion of said nozzle passage below said valve member whereby fluid contained in said upper portion under pressure may flow from said upper portion to said lower portion and thus be dispensed upon the opening of the valve;

a pin rigidly secured to the upper end of said valve member, said pin diametrally traversing said first bore;

said valve stem having a second bore located at its lower end, said lower end being accommodated by the first bore in the upper end of said valve member and secured thereto by means of mating cooperation of said pin and the second bore in said valve stem,

said first bore being of a greater diameter than that of said valve stem and said second bore being of a greater diameter than that of said pin so that a limited amount of universal movement may exist between said valve stem and said valve member,

the diameter of said second bore being of such a size that the lower tip of said valve stem may be in contact with the bottom of said first bore in the upper end of said valve member without said pin being in contact with said valve stem, the point of contact being the sole point of contact between said valve stem and said valve member, thereby allowing said

valve stem to pivot and slide about said point of contact,

whereby misalignment of said valve stem will have no effect upon the alignment of said valve member with said valve seat, said valve member being guided into alignment solely by means of the wall of said nozzle passage.

3. A valve apparatus comprising:

a nozzle having a passage therein;

a valve seat formed within said passage;

a valve member slidably mounted within and guided by said nozzle passage and having its lower end conforming to the shape of said valve seat, a first blind bore centrally located at its upper end, and at least one groove formed at its periphery so that said groove in conjunction with the wall of said nozzle passage defines a passage leading from the upper end of said valve member to the lower end thereof, thereby allowing fluid to flow from the upper end of the nozzle passage, through the passage defined by said groove and said wall and into a position where it will be dispensed upon opening of the valve;

a pin rigidly mounted to the upper end of the valve member, said pin diametrally traversing the first bore;

a valve stem located within the nozzle passage and having a second bore diametrally located at its lower end, said lower end being accommodated by the first bore in the upper end of the valve member and secured thereto by means of mating cooperation of the pin and said second bore in the valve stem;

the first bore being of a greater diameter than that of the valve stem and the second bore being of a greater diameter than that of the pin so that a limited amount of universal movement may exist between the valve stem and the valve member;

the diameter of the second bore being of such a size that the lower tip of the valve stem may be in contact with the bottom of the first bore in the upper end of the valve member without the pin being in contact with the valve stem, said point of contact being the sole point of contact between the valve stem and the valve member thereby allowing the valve stem to pivot and slide about said point of contact;

whereby misalignment of the valve stem will have no effect upon the alignment of the valve member with the valve seat, said valve member being guided into alignment solely by means of the wall of the nozzle passage.

4. An apparatus as recited in claim 3 wherein:

the bottom of the first bore located in the upper end of the valve member is flat and the lower tip of the valve stem which is in contact with the bottom of said first bore is convex thereby minimizing the area of contact between the valve stem and the valve member and facilitating pivoting and sliding of the valve stem with respect to the valve member.

5. A valve apparatus comprising:

a nozzle having a passage therein;

a valve seat formed within said passage;

a valve member slidably mounted within and guided by said nozzle passage and having its lower end conforming to the shape of said valve seat and a first blind bore centrally located at its upper end;

a pin rigidly mounted to the upper end of the valve member, said pin diametrally traversing the first bore;

a valve stem located within the nozzle passage and having a second bore diametrally located at its lower end, said lower end being accommodated by the first bore in the upper end of the valve member and secured thereto by means of mating cooperation of the pin and said second bore in the valve stem;

the diameter of the first bore being greater than that of the valve stem and the diameter of the second bore being greater than that of the pin so that a limited amount of universal movement may exist between the valve stem and the valve member;

the diameter of the second bore being of such a size that the lower tip of the valve stem may be in contact with the bottom of the first blind bore in the upper end of the valve member without the pin being in contact with the valve stem, said point of contact being the sole point of contact between the valve stem and the valve member, thereby allowing the valve stem to pivot and slide about said point of contact;

whereby misalignment of the valve stem will have no effect upon the alignment of the valve member with the valve seat, said valve member being guided into alignment by means of the wall of the nozzle passage;

means for the introduction of fluid into the nozzle passage so that it may flow therethrough and thus be dispensed when the valve is in an open position.

6. An apparatus as recited in claim 5 wherein:

the bottom of the first bore located in the upper end of the valve member is flat and the lower tip of the valve stem which is in contact with the bottom of said first bore is convex, thereby minimizing the area of contact between the valve stem and the valve member and facilitating pivoting and sliding of the valve stem with respect to the valve member.

7. A valve apparatus comprising:

a nozzle having a passage therein;

a valve seat formed within the lower end of said passage;

a valve member slidably mounted within and guided by the wall of said nozzle passage and having its lower end conforming to the shape of said valve seat and a first blind bore centrally located at its upper end;

communcative means between the portion of the nozzle passage above the valve member and the portion of the nozzle passage below the valve member whereby fluid contained in said upper portion under pressure may flow from said upper portion to said lower portion and thus be dispensed upon the opening of the valve;

a pin rigidly mounted to the upper end of the valve member, said pin diametrally traversing the first bore;

a valve stem located within the nozzle passage and having a second bore diametrally located at its lower end, said lower end being in a mating relationship with the first bore in the upper end of the valve member and secured thereto by means of mating cooperation of the pin and said second bore in the valve stem;

the diameter of the first bore being greater than that of the valve stem and the diameter of the second bore being greater than that of the pin so that a limited amount of universal movement will be permitted between the valve stem and the valve member;

the diameter of the second bore being of such a size that the lower tip of the valve stem may be in contact with the bottom of the first blind in the upper end of the valve member without the pin being in contact with the valve stem, said point of contact being the sole point of contact between the valve stem and the valve member, thereby allowing the valve stem to pivot and slide about said point of contact;

whereby misalignment of the valve stem will have no effect upon the alignment of the valve member with the valve seat, said valve member being guided into alignment by means of the wall of the nozzle passage.

8. An apparatus as recited in claim 7 wherein:

the bottom of the first bore located in the upper end of the valve member is flat and

the lower tip of the valve stem which is in contact

with the bottom of said first bore is convex, thereby minimizing the area of contact between the valve stem and the valve member and facilitating pivoting and sliding of the valve stem with respect to the valve member.

9. A dispensing gun for use in a fluid-dispensing system in which there is a source of fluid under pressure comprising:

an anchor block having a hollow interior, said hollow being in communication with said source of fluid under pressure;

a nozzle having an inlet end, an outlet end and a passage interconnecting said inlet and outlet end, said nozzle being affixed at its inlet end to one end of said anchor block, said inlet end being in communication with the hollow of said anchor block thereby allowing fluid to flow from its source into said anchor block and through said nozzle passage;

a valve stem coaxially located within said nozzle passage and protruding through the other end of said anchor block; means for imparting to said valve stem motion toward and away from said outlet end, said means being in engagement with that portion of said valve stem protruding through said anchor block;

a valve seat located within said nozzle passage;

a valve member slidably mounted within and guided by said nozzle passage and having its lower end conforming to the shape of said valve seat, said valve member having a first blind bore centrally located at its upper end;

communicative means between the portion of said nozzle passage above said valve member and the portion of said nozzle passage below said valve member whereby fluid contained in said upper portion under pressure may flow from said upper portion to said lower portion and thus be dispensed upon the opening of the valve;

a pin rigidly secured to the upper end of said valve member, said pin diametrally traversing said first bore,

said valve stem having a second bore located at its lower end;

said lower end being accommodated by the first bore and the upper end of said valve member and secured thereto by means of mating cooperation of said pin and the second bore in said valve stem,

said first bore being of a greater diameter than that of said valve stem and said second bore being of a greater diameter than that of said pin so that a limited amount of universal movement my exist between said valve stem and said valve member;

the diameter of said second bore being of such a size that the lower tip of said valve stem may be in contact with the bottom of said first bore in the upper end of said valve member without said pin being in contact with said valve stem, the point of contact being the sole point of contact between said valve stem and said valve member, thereby allowing said valve stem to pivot and slide about said point of contact, whereby misalignment of said valve stem will have no effect upon the alignment of said valve member with said valve seat, said valve member being guided into alignment solely by means of said nozzle passage.

10. An apparatus as recited in claim 9 further comprising:

a limiting stop threadably engaged with the portion of said valve stem protruding through and beyond said anchor block;

abutting means rigidly mounted with respect to said anchor block and located above said limiting stop, said abutting means being so constructed and arranged that upward movement of said valve stem will terminate when the uppermost end of said limiting stop abuts the lowermost end of said abutting means, the amount of said upward movement being determined by the clearance between the uppermost end of said limiting stop and the lowermost end of said abutting means, said clearance being adjustable by rotation of said limiting stop about said valve stem; and

means for locking said limiting stop and said valve stem in a fixed position relative to each other.

11. A dispensing gun for use in a fluid dispensing system in which there is a source of fluid under pressure comprising:

an anchor block having a hollow interior, said hollow being in communication with said source of fluid under pressure;

a nozzle having an inlet end, an outlet end and a passage interconnecting said inlet and said outlet ends, said nozzle being affixed at its inlet end to one end of said anchor block, said inlet end being in communication with the hollow of said anchor block thereby allowing fluid to flow from its source into said anchor block and through said nozzle passage;

a valve stem coaxially located within said nozzle passage and protruding through the other end of said anchor block;

means for imparting to said valve stem motion toward and away from said outlet end, said means being in engagement with that portion of said valve stem protruding through said anchor block;

means for varying the distance that said valve stem may be withdrawn from said outlet end;

a valve seat located within said nozzle passage;

a valve member slidably mounted within and guided by said nozzle passage and having its lower end conforming to the shape of said valve seat, said valve member having a first blind bore centrally located at its upper end;

communicative means between the portion of said nozzle passage above said valve member and the portion of said nozzle passage below said valve member whereby fluid contained in said upper portion under pressure may flow from said upper portion to said lower portion thus be dispensed upon the opening of the valve;

a pin rigidly secured to the upper end of said valve member, said pin diametrally traversing said first bore,

said valve stem having a second bore located at its lower end, said lower end being accommodated by the first bore in the upper end of said valve member and secured thereto by means of mating cooperation of said pin and the second bore in said valve stem,

said first bore being of a greater diameter than that of said valve stem and said second bore being of a greater diameter than that of said pin so that a limited amount of universal movement may exist between said valve stem and said valve member,

the diameter of said second bore being of such a size that the lower tip of said valve stem may be in contact with the bottom of said first bore in the upper end of said valve member without said pin being in contact with said valve stem, the point of contact being the sole point of contact between said valve stem and said valve member, thereby allowing said valve stem to pivot and slide about said point of contact, whereby misalignment of said valve stem will have no effect upon the alignment of said valve member with said valve seat, said valve member being guided into alignment solely by means of the wall of said nozzle passage.

12. An apparatus as recited in claim 11, wherein the means for varying the distance that said valve stem may be withdrawn from said outlet end comprises:

a limiting stop threadably engaged with the portion of said valve stem protruding through and beyond said anchor block; abutting means rigidly mounted with respect to said anchor block and located above said

limiting stop, said abutting means being so constructed and arranged that upward movement of said valve stem will terminate when the uppermost end of said limiting stop abuts the lowermost end of said abutting means, the amount of said upward movement being determined by the clearance between the uppermost end of said limting stop and the lowermost end of said abutting means, said clearance being adjustable by rotation of said limiting stop about said valve stem; and

means for locking said limiting stop and said valve stem in a fixed position relative to each other.

13. A dispensing gun for use in a fluid dispensing system in which there is a source of fluid under pressure comprising:

an anchor block having a hollow interior, said hollow being in communication with said source of fluid under pressure;

a nozzle having an inlet end, an outlet end and a passage interconnecting said inlet and outlet ends, said nozzle being affixed at its inlet end to one end of said anchor block, said inlet end being in communicaiton with the hollow of said anchor block thereby allowing fluid to flow from its source into said anchor block and through said nozzle passage;

a valve stem coaxially located within said nozzle passage and protruding through the other end of said anchor block;

an air cylinder rigidly mounted in relation to said anchor block said air cylinder having a base in which an aperture is centrally located for slidable acccommodation of that end of said valve stem protruding through said anchor block whereby said valve stem may enter said air cylinder;

a piston, slidably contained within said air cylinder thereby dividing the interior of said air cylinder into a pair of expansible air chambers, said piston being rigidly attached to said valve stem whereby the motion of said piston will be transferred to said valve stem;

means for introducing compressed air into said air chambers thereby activating said piston;

a valve seat located within said nozzle passage;

a valve member slidably mounted within and guided by said nozzle passage and having its lower end conforming to the shape of valve seat, said valve member having a first blind bore centrally located at its upper end;

communicative means between the portion of said nozzle passage above said valve member and the portion of said nozzle passage below said valve member whereby fluid contained in said upper portion under pressure may flow from said upper portion to said lower portion and thus be dispensed upon the opening of the valve;

a pin rigidly secured to the upper end of said valve member, said pin diametrally traversing said first bore,

said valve stem having a second bore located at its lower end, said lower end being accommodated by the first bore in the upper end of said valve member and secured thereto by means of mating cooperation of said pin in the second bore in said valve stem,

said first bore being of a greater diameter than that of said valve stem and said second bore being of a greater diameter than that of said pin so that a limited amount of universal movement may exist between said valve stem and said valve member, the diameter of said second bore being of such a size that the lower tip of said valve stem may be in contact with the bottom of said first bore in the upper end of said valve member without said pin being in contact with said valve stem, the point of contact being the sole point of contact between said valve stem and said valve member, thereby allowing said valve stem to pivot and slide about said point of contact,

whereby misalignment of said valve stem will have no effect upon the alignment of said valve member with said valve seat, said valve member being guided into alignment solely by means of the wall of said nozzle passage.

14. A dispensing gun for use in a fluid dispensing system in which there is a source of fluid under pressure comprising:

an anchor block having a hollow interior, said hollow being in communication with said source of fluid under pressure;

a nozzle having an inlet end, an outlet end, and a passage interconnecting said inlet and outlet ends, said nozzle being affixed at its inlet end to one end of said anchor block, said inlet end being in communication with the hollow of said anchor block thereby allowing fluid to flow from its source into said anchor block and through said nozzle passage;

a valve stem, coaxially located within said nozzle passage and protruding through the other end of said anchor block;

an air cylinder rigidly mounted in relation to said anchor block said air cylinder having a base in which an aperture is centrally located for slidable accommodation of that end of said valve stem protruding through said anchor block whereby said valve stem may enter said air cylinder;

a piston slidably contained within said air cylinder thereby dividing the interior of said air cylinder into a pair of expansible air chambers, said piston being rigidly attached to said valve stem whereby the motion of said piston will be transmitted to said valve stem;

means for introducing compressed air into said air chambers thereby activating said piston;

means for varying the distance that said valve stem may be withdrawn from said outlet end;

a valve seat located within said nozzle passage;

a valve member slidably mounted within and guided by said nozzle passage and having its lower end conforming to the shape of said valve seat, said valve member having a first blind bore centrally located at its upper end;

communicative means between the portion of said nozzle passage above said valve member and the portion of said nozzle passage below said valve member whereby fluid contained in said upper portion under pressure may flow from said upper portion to said lower portion and thus be dispensed upon the opening of the valve;

a pin rigidly secured to the upper end of said valve member said pin diametrally traversing said first bore,

said valve stem having a second bore located at its lower end, said lower end being accommodated by the first bore in the upper end of said valve member and secured thereto by means of mating cooperation of said pin and the second bore in said valve stem, said first bore being of a greater diameter than that of said valve stem and said second bore being of a greater diameter than that of said pin so that a limited amount of universal movement may exist between said valve stem and said valve member;

the diameter of said second bore being of such a size that the lower tip of said valve stem may be in contact with the bottom of said first bore in the upper end of said valve member without said pin being in contact with said valve stem, the point of contact between said valve stem and said valve member, thereby allowing said valve stem to pivot and slide above said point of contact whereby misalignment of said valve stem will have no effect upon the alignment of said valve member with said valve seat, said

valve member being guided into alignment solely by means of the wall of said nozzle passage.

15. A dispensing gun for use in a fluid dispensing system in which there is a source of fluid under pressure comprising:

an anchor block having a hollow interior, said hollow being in communication with said source of fluid under pressure;

a nozzle having an inlet end, an outlet end, and a passage interconnecting said inlet and outlet ends said nozzle being affixed at inlet end to one end of said anchor block, said inlet end being in communication with the hollow of said anchor block thereby allowing fluid to flow from its source into said anchor block through said nozzle passage;

a valve coaxially located within said nozzle passage and protruding through the other end of said anchor block;

an air cylinder rigidly mounted with relation to said anchor block, said air cylinder having a base in which an aperture is centrally located for slidable end of that end of said valve stem protruding through said anchor block whereby said valve stem may enter said air cylinder;

a piston slidably contained within said air cylinder thereby dividing the interior of said air cylinder into a pair of expansible air chambers, said piston being rigidly attached to said valve stem whereby the motion of said piston may be transmitted to said valve stem;

means for introducing compressed air into said air chambers thereby activating said piston;

a hollow spacer interposed between said air cylinder base and said anchor block and enclosing a portion of said valve stem;

a limiting stop, located within said hollow spacer and threadably engaged to that portion of said valve stem enclosed by said hollow spacer, the uppermost end of said limiting stop being located directly below the bottom surface of said air cylinder base, whereby upward movement of said valve stem will terminate when the uppermost end of said limiting stop abuts the bottom surface of said air cylinder base, the amount of said upward movement being determined by the clearance between the uppermost end of said limiting stop and the bottom surface of said air cylinder base, said clearance being adjustable by rotation of said limiting stop above said valve stem;

means for locking said limiting stop in said valve stem in a fixed position relative to each other; and

valve means located within said nozzle passage and in operative engagement with said valve stem whereby motion of said valve stem may be transmitted to said valve means thereby blocking or unblocking said nozzle passage.

16. An apparatus as recited in claim 15 wherein said valve means comprises:

a valve seat located within said nozzle passage;

a valve member slidably mounted within and guided by said nozzle passage and having its lower end conforming to the shape of said valve seat, said valve member having a first blind bore centrally located at its upper end;

communicative means between the portion of said nozzle passage above said valve member and the portion of said nozzle passage below said valve member whereby fluid contained in said upper portion under pressure may flow from said upper portion to said lower portion and thus be dispensed upon the opening of the valve;

a pin rigidly secured to the upper end of said valve member, said pin diametrally traversing said first bore,

said valve stem having a second bore located at its lower end, said lower end being accommodated by the first bore in the upper end of said valve member and secured thereto by means of mating cooperation of said pin and the second bore in said valve stem,

said first bore being of a greater diameter than that of said valve stem and said second bore being of a greater diameter than that of said pin so that a limited amount of universal movement may exist between said valve stem and said valve member,

the diameter of said second bore being of such a size that the lower tip of said valve stem may be in contact with bottom of said first bore in the upper end of said valve member without said end being in contact with said valve stem, the point of contact being the sole point of contact between said valve stem and said valve member thereby allowing said valve stem to pivot and slide above said point of contact whereby misalignment of said valve stem will have no effect upon the alignment of said valve member with said valve seat, said valve members being guided into alignment solely by means of the wall of said nozzle passage.

17. A dispensing gun for use in a fluid dispensing system in which there is a source of fluid under pressure comprising:

an anchor block having a hollow interior, said hollow being in communication with said source of fluid under pressure;

a nozzle having an inlet end, an outlet end and a passage interconnecting said inlet and outlet ends, said nozzle being affixed at its inlet end to one end of said anchor block, said inlet end being in communication with the hollow of said anchor block thereby allowing fluid to flow from its source into said anchor block through said nozzle passage;

a valve stem coaxially located within said nozzle passage and protruding through the other end of said anchor block;

an air cylinder, rigidly mounted in relation to said anchor block, said air cylinder having a base in which an aperture is centrally located for slidable accommodation of that end of said valve stem protruding through said anchor block whereby said valve stem may enter said air cylinder;

a piston slidably contained within said air cylinder thereby dividing the interior of said air cylinder into a pair of expansible air chambers, said piston being rigidly attached to said valve stem whereby the motion of said piston will be transmitted to said valve stem;

means for introducing compressed air into said air chambers thereby activating said piston;

a valve seat located within said nozzle passage;

a valve member slidably mounted within and guided by said nozzle passage and having its lower end conforming to the shape of said valve seat, said valve member having a first blind bore centrally located at its upper end;

communicative means between the portion of said nozzle passage of above said valve member and the portion of nozzle passage below said valve member whereby fluid contained in said upper portion under pressure may flow from said upper portion to said lower portion and thus be dispensed upon the opening of the valve;

a pin rigidly secured to the upper end of said valve member, said pin diametrally traversing said first bore;

said valve stem having a second bore located at its lower end, said lower end being accommodated by the first bore in the upper end of said valve member and secured thereto by means of mating cooperation of said pin and the second bore in the said valve stem;

said first bore being of a greater diameter than that of said valve stem and said second bore being of

a greater diameter than that of said pin so that a limited amount of universal movement may exist between said valve stem and said valve member;

the diameter of said second bore being of such a size that the lower tip of said valve stem may be in contact with the bottom of said first bore in the upper end of said valve member without said pin being in contact with said valve stem, the point of contact being the sole point of contact between said valve stem and said valve member, thereby allowing said valve stem to pivot and slide above said point of contact whereby misalignment of said valve stem will have no effect upon the alignment of said valve member with said valve seat, said valve member being guided into alignment solely by means of the wall of said nozzle passage: and

bias means so constructed and arranged as to urge said valve member into a blocking relation with said nozzle passage whereby said bias means may aid the action of said air cylinder and piston in causing said valve to convert from an unblocking to a blocking relation with said nozzle passage.

18. An apparatus as recited in claim **17** further comprising:

means for varying the distance which said valve stem may be withdrawn from said outlet end.

19. An apparatus as recited in claim **18** wherein the means for varying the distance which said valve stem may be withdrawn from said outlet end comprises:

a hollow spacer interposed between said air cylinder base and said anchor block and enclosing a portion of said valve stem;

a limiting stop located within said hollow spacer and threadably engaged so that portion of said valve stem enclosed by said hollow spacer, the uppermost end of said limiting stop being located directly below the bottom surface of said air cylinder base, whereby upward movement of said valve stem will terminate when the uppermost end of said limiting stop abuts the bottom surface of said air cylinder base, the amount of said upward movement being determined by the clearance between the uppermost end of said limiting stop and the bottom surface of said air cylinder base, said clearance being adjustable by rotation of said limiting stop about said valve stem; and

means for locking said limiting stop and said valve stem in a fixed position relative to each other.

20. An apparatus as recited in claim **19** wherein the valve means comprises:

a valve seat located with said nozzle passage;

a valve member slidably mounted within and guided by said nozzle passage and having its lower end conforming to the shape of said valve seat, said valve member having a first blind bore centrally located at its upper end;

communicative means between the portion of said nozzle passage above said valve member and the portion of said nozzle passage below said valve member whereby fluid contained in said upper portion under pressure may flow from said upper portion to said lower portion and thus be dispensed upon the opening of the valve;

a pin rigidly secured to the upper end of the said valve member, said pin diametrally traversing said first bore,

said valve stem having a second bore located at its lower end, said lower end being accommodated by the first bore in the upper end of said valve member and secured thereto by means of mating cooperation of said pin and the second bore in said valve stem,

said first bore being of a greater diameter than that of said valve stem and said second bore being of a greater diameter than that of said pin so that a limited amount of universal movement may exist between said valve stem and said valve member,

the diameter of said second bore being of such a size that the lower tip of said valve stem may be in contact with the bottom of said first bore and the upper end of said valve member without said pin being in contact with said valve stem, the point of contact being the sole point of contact between said valve stem and said valve member, thereby allowing said valve stem to pivot and slide about said point of contact, whereby misalignment of said valve stem will have no effect upon the alignment of said valve member with said valve seat, said valve member being guided into alignment solely by means of a wall of said nozzle passage.

21. A valve apparatus comprising:

a nozzle having a passage therein and an outlet orifice in communication with said passage;

a valve member contained within said nozzle passage for movement therein between a first position wherein said valve member is remote from said outlet orifice and a second position wherein said valve member is in obstructing relation with said outlet orifice;

means for guiding said valve member along said passage in a path that is in paralleling relationship to axis of said nozzle passage, said guide means being effective to so guide said valve member during the entire range of movement of said valve member between said first and second positions;

a valve stem located within said nozzle passage;

means providing a non-rigid connection between said valve member and said valve stem to effect said movement of said valve member and to as to permit a limited amount of motion between said valve member and valve stem;

drive means for effecting movement of said valve stem to move said valve member between said first and second positions; and

means enabling fluid material to flow through said orifice when said valve stem is in said first position.

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RAPHAEL M. LUPO, *Primary Examiner.*

UNITED STATES PATENT OFFICE

CERTIFICATE OF CORRECTION

Patent No. 3,332,581 July 25, 1967

Roger S. Estabrooks

It is hereby certified that error appears in the above numbered patent requiring correction and that the said Letters Patent should read as corrected below.

Column 12, line 61, for "blind" read -- bore --; column 17, line 16, for "valve" read -- valve stem --.

Signed and sealed this 9th day of July 1968.

(SEAL)
Attest:

Edward M. Fletcher, Jr.
Attesting Officer

EDWARD J. BRENNER
Commissioner of Patents