

[54] SEALANT APPLYING APPARATUS

[76] Inventor: **George F. Nordenholt**, 25 Dogwood Dr., Ft. Lauderdale, Fla. 07960

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[51] Int. Cl. **B05c 5/02**

[58] Field of Search **118/7, 8, 410, 411, 25; 222/334**

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Primary Examiner—John P. McIntosh

Attorney, Agent, or Firm—Watson, Cole, Grindle & Watson

[57] ABSTRACT

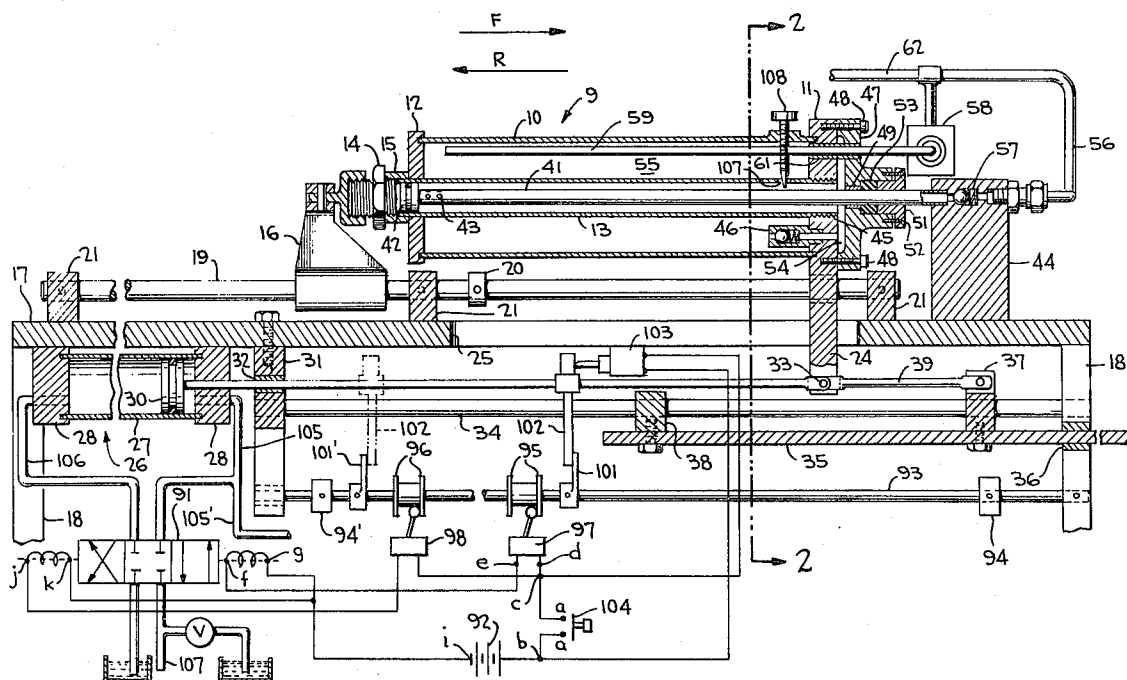
A sealant applying apparatus for delivering a ribbon or bead of the sealant at a uniform cross-section onto a workpiece, includes a metering pump for metering a controlled quantity of hydraulic fluid to a hydraulic fluid actuator which directly drives a feed cylinder of

equal size containing the sealant. The piston rod diameter and the inner diameter of the fluid actuator and the cylinder are the same. Hence, the volume of the hydraulic fluid delivered to the fluid actuator and the volume of sealant material delivered to the workpiece will be the same. Essentially, the volume of the hydraulic fluid delivered to the fluid actuator will maintain a constant ratio to the volume of sealant delivered to the workpiece. Thus, needle valve means are provided in the metering cylinder for controlling the amount of fluid metered therefrom.

The metering pump, having a hollow and fixed piston rod located therein, is designed for movement in a reverse and forward direction. Movement thereof in a reverse direction effects a pumping of the hydraulic fluid into the actuator, thereby expelling an equal volume of sealant from the feed cylinder, after which sealant from a pressurized supply means refills the feed cylinder and forces the hydraulic fluid back into a reservoir provided in the metering pump.

A power cylinder is provided for reciprocating the metering pump by means of hydraulic fluid delivered to such cylinder through a control valve with solenoids which, when energized, slide a valve spool to control the direction of hydraulic fluid to effect reciprocation. The control valve, being self-centering, shuts off all flow of hydraulic fluid for the power cylinder when its solenoids are not energized.

15 Claims, 7 Drawing Figures



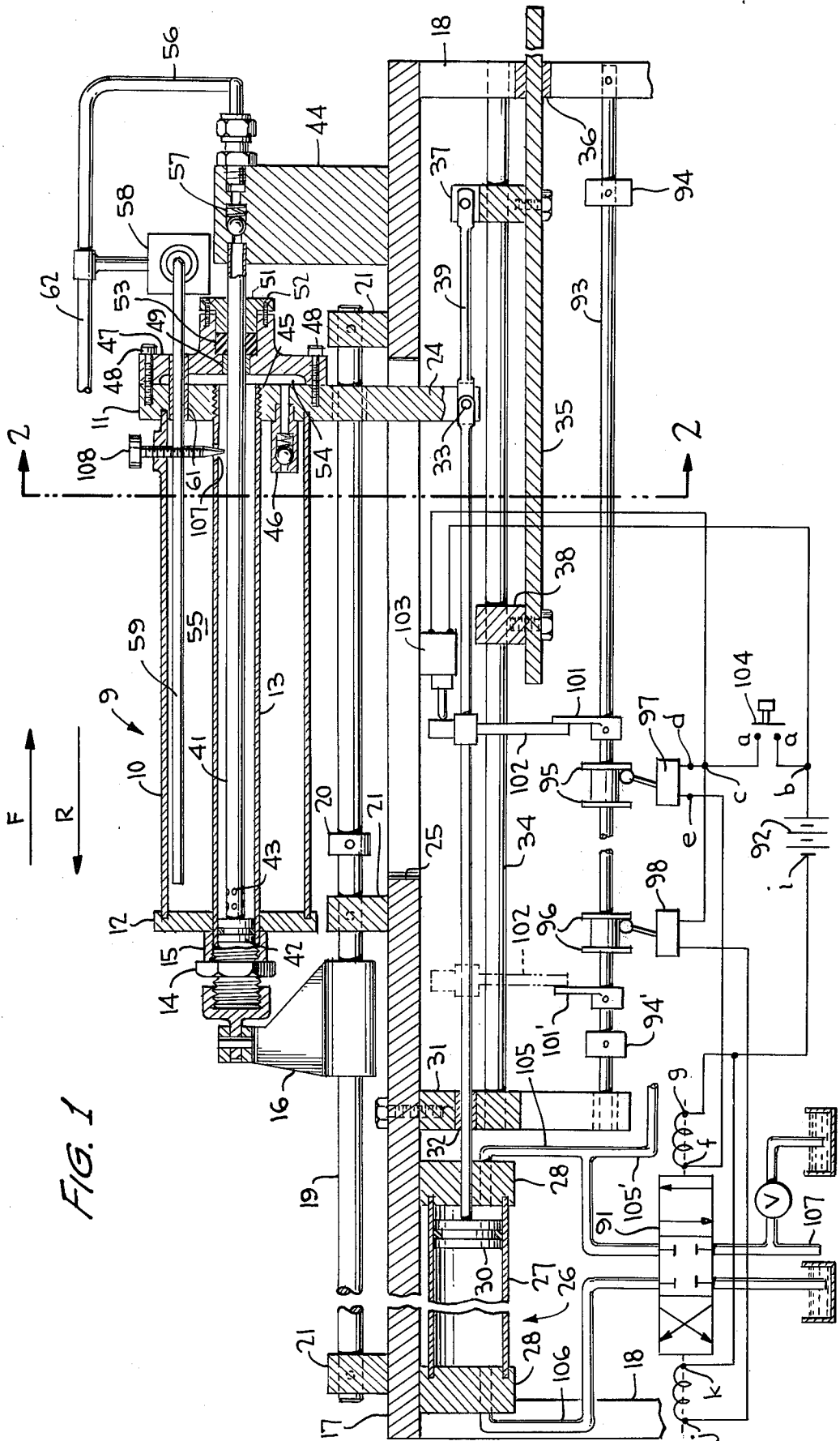


FIG. 1

FIG. 2

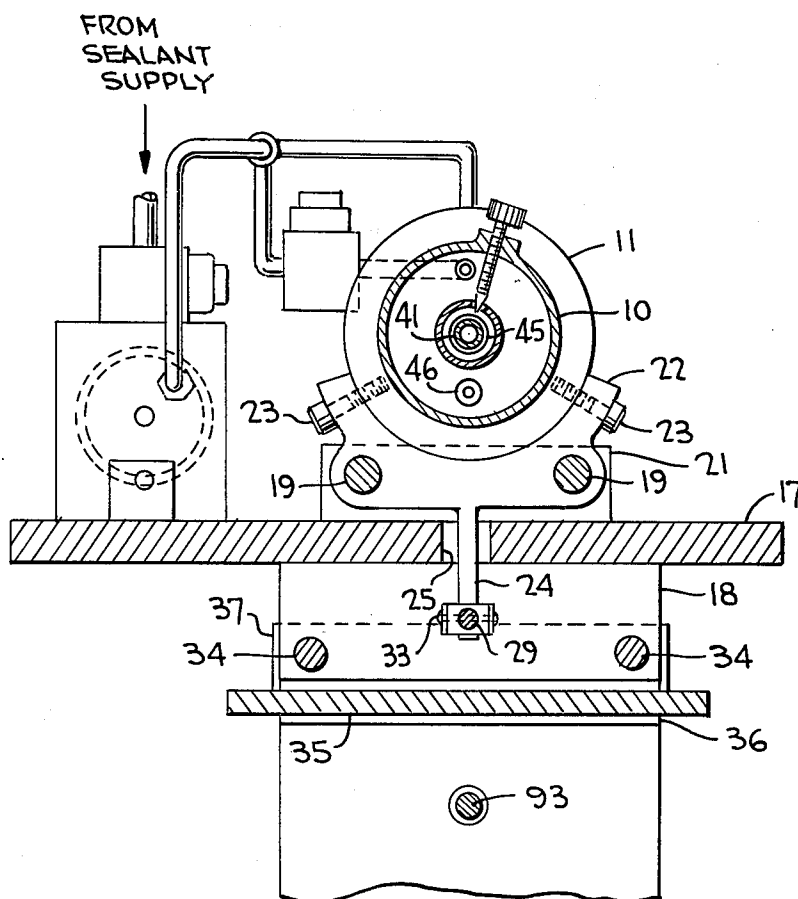


FIG. 4A

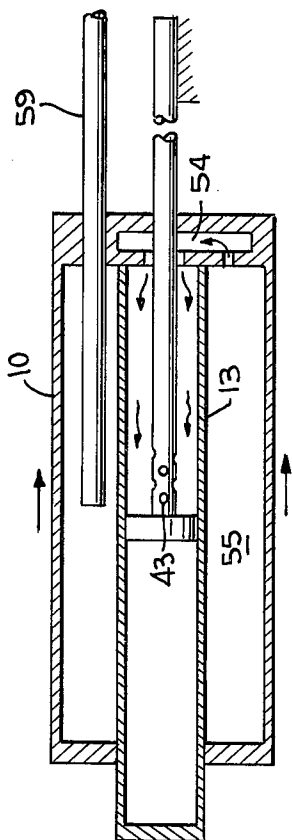


FIG. 4B

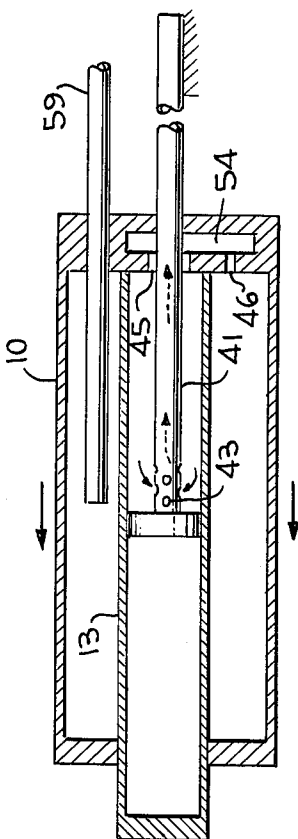


FIG. 4C

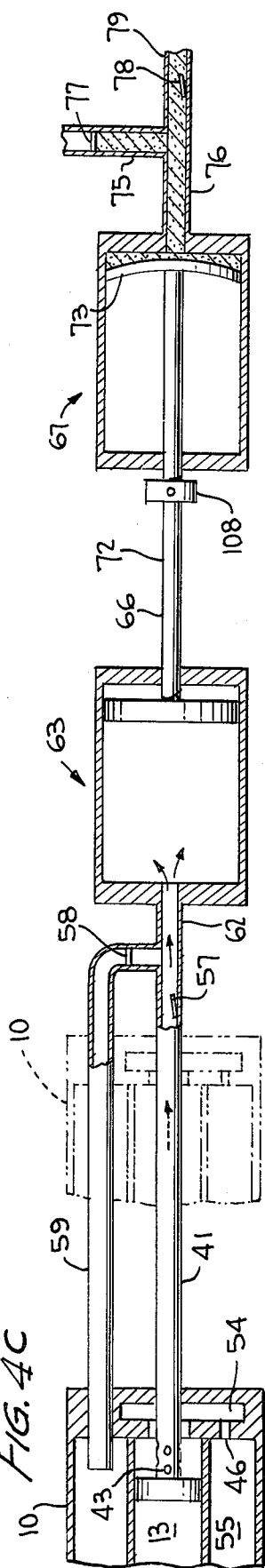
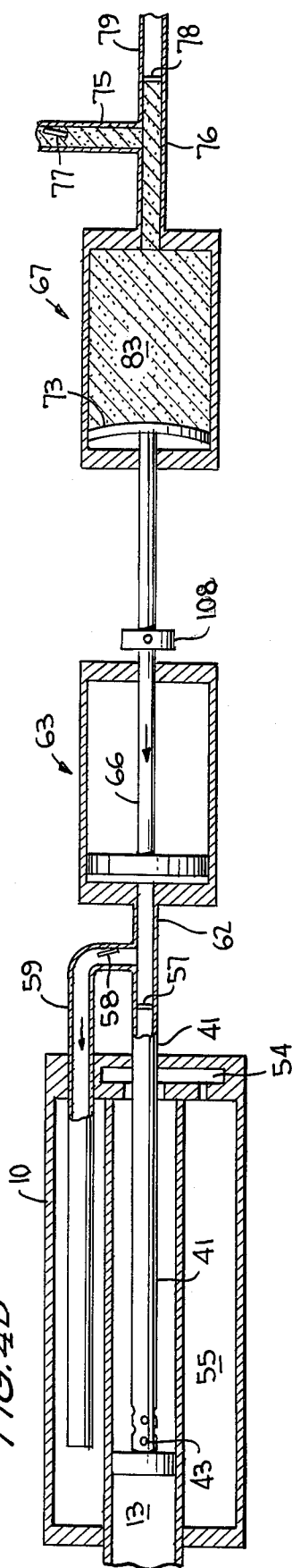


FIG. 4D



SEALANT APPLYING APPARATUS

This invention relates generally to an apparatus for applying a volume of sealant material onto a workpiece in an automatic and uniform manner, and more particularly relates to such an apparatus wherein the volume of sealant material delivered to the workpiece is equal to or constantly proportional to the volume of hydraulic fluid delivered to a fluid actuator thereof. Thus, a bead or ribbon of sealant material of uniform cross-section throughout its length is deposited. This is made possible since the volume of hydraulic fluid pumped into a fluid actuator (the piston rod of which also serves as the piston rod of the sealant feed cylinder, the cylinder of the actuator and that of the feeder being equal) and the volume of material fed to the workpiece are equal. This is a principal objective of the present invention.

Another object of this invention is to provide such an apparatus wherein the amount of hydraulic fluid delivered by the metering pump may be simply regulated by returning to a reservoir serving the metering pump during its pumping action, a controllable portion of the hydraulic fluid. This diminishes by such amount the volume of hydraulic fluid delivered to the actuator, and hence the bead of sealant material delivered to the workpiece will have a correspondingly smaller cross-section.

Another object of this invention is to provide such an apparatus wherein the metering pump is mounted for movement in a reverse and forward direction with respect to a fixed hollow piston rod and piston head located within the metering pump and having openings near the piston head so that, upon rearward movement of the cylinder, hydraulic fluid is pumped to the actuator.

A further object of the invention is to provide such an apparatus wherein manual switch means are provided for starting movement of the metering pump in a forward direction so as to draw the hydraulic fluid from the reservoir into the metering pump, such switch means being held closed long enough for a contactor holding the manual switch open to move enough to allow it to close its contact. A control circuit is thereby closed and remains closed until the return stroke in the forward direction is completed, and the contact with the pushbutton switch again holds the control circuit open. At the end of this cycle of operation, the feed cylinder will have delivered a measured volume of sealant for depositing onto the workpiece. When the cycle has been completed, the control circuit opens a passage from the sealant supply to the feed cylinder and thereby refills it, feeding into it the same volume of sealant as the feed cylinder has discharged onto the workpiece.

Other objects, advantages and novel features of the invention will become more apparent from the following detailed description of the invention when considered in conjunction with the accompanying drawings wherein:

FIG. 1 is a side elevational view showing in cross-section the reciprocating metering pump assembly and its hydraulic actuator as well as all connected elements and controls, in accordance with the invention;

FIG. 2 is a transverse sectional view of the metering pump assembly taken along line 2—2 of FIG. 1;

FIG. 3 is a side elevational view showing in cross-section the fluid actuator, the interconnected feed cylinder assembly and the control circuit related thereto; and

FIGS. 4A through 4D are schematic representations of the metering cylinder in the process of its forward direction of movement, in the process of its rearward direction of movement, at the end of its rearward movement, and at the end of its forward movement, respectively.

Turning now to the drawings wherein like reference characters refer to like and corresponding parts throughout the several views, the metering pump assembly 9 of the invention and its constituent parts are shown in FIG. 1 as comprising a reservoir cylinder 10 tightly secured to a forward end plate 11 as well as to a rearward end plate 12. A metering-pump cylinder 13, located centrally within cylinder 10, maintains the end plates tightly in place with its forward end threadedly engaged with plate 11 and its other end extending outwardly of plate 12.

Circular grooves at the inner surfaces of both end plates permit a snug fit with cylinder 10, and O-ring gaskets (not shown) are located within such grooves. An elastomeric spacer 15 fits over the projected end of cylinder 13 and bears against a leakproof seal (not shown) between cylinder 13 and plate 12. A nut 14 threadedly engages with the cylinder and bears against the spacer so that upon tightening thereof, plates 11 and 12 are pressed tightly against the ends of cylinder 10. A support member 16 is also threaded onto the rearward end of metering-pump cylinder 13.

A bedplate 17, having legs or end walls 18, is provided for supporting the metering-pump assembly. A pair of spaced, elongated guide rails 19, lying in the same plane, are mounted on the top surface of the bedplate and are spaced upwardly therefrom by means of spacers 21. Member 16 is mounted on the guide rails for sliding movement with respect thereto, bushings being provided (not shown) between member 16 and the guide rails to insure a smooth sliding motion. Also, the forward end of cylinder 10 is supported on guide rails 19 by means of a bracket member 22 (see FIG. 2) mounted on end plate 11 as by means of bolts 23 and engaging with rails 19 for sliding movement with respect thereto. Again, bushings or liners (not shown) are located between the guide rails and bracket 22 to insure a smooth sliding movement. The bracket is provided with a downward extension 24 which extends through an elongated slot 25 provided in the bedplate and extending parallel to guide rails 19 for at least a distance sufficient in each direction to permit bracket 22 to move the full length of the stroke it will be called upon to make.

A hydraulic actuator 26 is provided as the prime mover of cylinders 10 and 13 in a forward and reverse direction, the actuator including a cylinder 27 and end walls 28 which are mounted to the underside of bedplate 17. An elongated piston rod 29, having a piston head 30, extends outwardly of the actuator through its forward end wall and is guided within an opening provided in a support element 31 also mounted to the underside of the bedplate. A liner or bushing 32 is located between the piston rod and element 31 to insure a smooth sliding movement of the piston rod. The extension piece 24 of bracket 22 is connected with the piston rod as at 33 so that, upon actuation of the piston rod

in a forward and reverse direction in a manner to be hereinafter described, cylinder 10 and its end plates along with piston cylinder 13 will be likewise moved in a forward and reverse direction.

Another pair of guide rails 34 extend parallel to guide rails 19 and are located below the bedplate. The rearward ends of guide rails 34 are mounted in support element 31 and the forward ends thereof are mounted in the forward end wall 18 of the bedplate. A work table 35 for supporting the workpieces is located below guide rails 34 and extends in a forward direction through forward end plate 18. A liner 36 is located between the work table and this forward end wall to insure a smooth sliding movement of the work table in a forward and reverse direction. The work table is supported on guide rails 34 for sliding movement with respect thereto by means of support elements 37 and 38, liners or bushings (not shown) also being provided between these support elements and guide rails 34. A connecting rod 39 interconnects support element 37 with extension piece 24 of bracket 22 for transmitting movement of cylinders 10, 13 and piston rod 29 to the work table so that they all reciprocate in unison. Because the metering pump cylinder and the work table are operating in unison, the bead or ribbon of sealant deposited onto the workpiece will be of uniform cross-section throughout its length as will be hereinafter described.

A hollow piston rod 41 is located within cylinder 13 and, as shown in the position of the metering-pump cylinder in FIG. 1, the piston head 42 thereof lies in the vicinity of rearward end plate 12. Openings 43 are provided in the wall of the piston rod near the piston head end thereof, the forward end of the piston rod extending outwardly through forward end plate 11 and being fixedly mounted in a support member 44 which is securely fixed on the top surface of bedplate 17. Piston rod 41 extends through an oversized opening 45 provided in end plate 11, and a one-way check valve 46 is located in end plate 11. Also, a nose piece 47 is mounted on the outer surface of forward end plate 11 as by means of bolts 48, the hollow piston rod also extending outwardly through the nose piece as shown in FIG. 1.

A bushing or liner 49 is located between the nose piece and the hollow piston rod to insure a smooth sliding movement of the nose piece with respect thereto. A stuffing box gland 51 is also provided through which the hollow piston rod extends, fasteners 52 being provided for tightening the gland on the nose piece so as to compress an elastomeric stuffing material 53 to assure proper coaxial alignment of the hollow piston rod with respect to the metering-pump cylinder, and to further provide a tight seal between the nose piece and the hollow rod during sliding movement of the nose piece.

The rearward face of the nose piece has a dished-out portion defining a chamber 54 surrounding the hollow piston rod and communicating with both opening 45 and the opening of check valve 46. Also, it should be noted that the space between cylinder 10 and cylinder 13 serves as a reservoir 55. This reservoir communicates with the interior of cylinder 13 through check valve 46, chamber 54 and opening 45 for a purpose to be hereinafter described.

A hydraulic fluid conduit 56 is mounted on block 44 and communicates with hollow piston rod 41 through a one-way check valve 57 located in the block. A solenoid valve 58 is provided in conduit 56, and a hydraulic discharge line 59 extends from solenoid 58 and into reservoir 55 through nose piece 47 and forward end plate 11. A bushing 61 is located between members 11, 47 and line 59 to insure smooth sliding movement with respect thereto.

Referring to FIG. 3, it can be seen that a segment 62 of the hydraulic conduit extends between solenoid valve 58 and into another hydraulic actuator 63. This actuator is similar to hydraulic actuator 27 except that it has a single acting piston as shown in the drawing, although a double-acting piston may be used as well. Cylinder 64 of this actuator has end walls 65 which are securely mounted to the top surface of bedplate 17, a piston rod 66 located in the cylinder extending outwardly through forward end wall 65.

A feed cylinder assembly 67 is provided as having a cylinder 68 with its end walls 69 and 71 securely mounted on the top surface of bedplate 17. A plunger is provided in cylinder 68, its rod 66 extending outwardly through end wall 69, and being the same rod as that described for hydraulic actuator 63. The length and diameter of both cylinders 64 and 68 are the same, and a plunger head 73 is mounted on rod 66 within actuator 63 for expelling the sealant material from the feed cylinder as rod 66 is moved in a forward direction F to be hereinafter more fully described. Both the feed cylinder and hydraulic actuator 63 are vented through an opening 74 provided in end walls 65 and 69, and end wall 71 of the feed cylinder has ducts 75 and 76 respectively communicating with solenoid valves 77 and 78. A discharge spout 79 communicates with duct 76 through solenoid valve 78, the spout being directed to a workpiece 81 mounted on work table 35. Also, a supply tank 82 for the sealant material 83 is connected with duct 75 through solenoid valve 77. The tank is connected with a source of air under high pressure (not shown) through line 84.

In FIG. 1, an electric control circuit is shown for operating actuator 26 which effects movement of the metering-pump cylinder in both its forward and rearward directions. The control circuit includes a four-way solenoid valve 91 interconnected with a power source 92, the solenoid valve being arranged for porting hydraulic fluid into cylinder 27 of the actuator at opposite sides of piston head 30. A shaft 93 is mounted for shifting movement in forward end wall 18 and in support element 31, stop elements 94 and 94' being mounted on the shaft for limiting the extent of its shifting movement in forward and reverse directions. A pair of spaced contact elements 95 and 96 are also fixedly secured to shaft 93, these element pairs being respectively associated with toggle switches 97 and 98 each suitably mounted on some portion of the apparatus. Spaced contact plates 101 and 101' are also fixedly secured on shaft 93 to effect a shifting of the shaft when contacted by a contactor 102 fixedly mounted on piston rod 29 of hydraulic actuator 26. A push button switch 103 is mounted as, for example, to the underside of bedplate 17. The control circuit further includes a manually operable push button switch 104 for initiating movement of the metering cylinder in a forward direction F.

When cylinder 10 is in its rearwardmost position as shown in FIG. 4C, movement thereof will terminate in a manner to be more fully described hereinbelow. At such time, feed cylinder 67 will have been refilled with sealant material 83 from supply tank 82. During this re-

filling operation, the sealant material will have pressed against plunger head 73 to move rod 66 rearwardly, thereby expelling the hydraulic fluid from fluid actuator 63 back into reservoir 55 of the metering cylinder through hydraulic line 59. This will have completed one cycle of operation in delivering sealant material onto the workpieces.

In order to restart the apparatus, push button switch 104 is manually depressed to close the control circuit thereby completing the circuit from switch 98 through solenoid valve 91 and through source 92. The now energized solenoid 91 causes its valve spool to be moved to the right so as to direct hydraulic fluid under pressure from inlet 107 to hydraulic line 106 and into cylinder 27 thereby causing piston head 30 and its rod 29 to move to the right as shown in FIG. 4A in a forward direction F. Accordingly, the metering cylinder and all the parts connected therewith are moved in a forward direction along guide rails 19 by reason of the interconnection between extension piece 24 and piston rod 29. Movement of the metering cylinder to the right with respect to fixed piston rod 41 is the equivalent of the piston rod moving to the left in relation to a fixed cylinder 13. Accordingly, the volume of piston cylinder 13 increases thereby creating a vacuum with respect to the hydraulic fluid located within reservoir 55 and any fluid located in chamber 54. The hydraulic fluid is therefore sucked into the piston cylinder from chamber 54 through opening 45 and from reservoir 55 through one-way check valve 46, and further through chamber 54 and opening 45 as seen in FIG. 4A. Piston cylinder 13 therefore reaches its full capacity in the position shown in FIG. 1.

Referring to FIG. 3, solenoid valve 58 is of the normally-open type, i.e., it is open when its solenoid is not energized, and solenoid valve 77 is also of the normally-open type, although solenoid valve 78 is of the normally-closed type. Each of these valves is connected in parallel through the electric circuit as shown. An electric-pressure operated switch 87 is provided for controlling the on/off of the circuit and is connected to a conduit 105' shown in FIG. 1 as connected to a conduit 105 of solenoid control valve 91 which delivers high pressure hydraulic fluid to the forward face of piston head 30 to effect movement thereof in a rearward direction R. The electric control circuit of valves 58, 77 and 78 will be energized or de-energized as soon as solenoid control valve 91 commences to furnish high pressure hydraulic fluid to actuator 26. Upon rearward movement of piston 30, cylinders 10 and 13 are likewise moved to the left whereupon the hydraulic fluid within cylinder 13 is ported through openings 43 and out through the hollow piston rod 41 and through check valve 57 and conduit 56 and to hydraulic actuator 63 through conduits 62. In order to bypass valve 58, it must be closed by being energized. Pressure switch 87 must therefore be closed to energize valve 58. Switch 87 is closed by means of hydraulic pressure through conduit 105' during the commencement of rearward movement of cylinder head 30. With pressure switch 87 closed, solenoid valve 77 is closed and solenoid valve 78 is open.

When the pressurized hydraulic fluid is delivered to actuator 63 as aforescribed, its piston and rod 66 are caused to move to the right to thereby also move piston head 73 of feed cylinder 67 to the right. Now that valve 77 has energized, it is closed and solenoid valve 78 is

open since it too is energized. Sealant material is therefore delivered from feed cylinder 67 through conduit 76 and nozzle 79, and a metered amount thereof is deposited as a bead or ribbon 83a onto workpiece 81. The reciprocating worktable 35 moves at the same speed and in the same direction as cylinders 10 and 13. The speed of the workpiece relative to stationary nozzle 79 is therefore always in the same proportion to the volume rate of discharge from nozzle 79. Hence, the cross-sectional area of bead 83a deposited onto the workpiece will be constant throughout its length.

At the completion of the rearward stroke, contactor 102 is moved from its position shown in solid outline in FIG. 1 to that shown in phantom outline therein. In moving away from push button switch 103, the switch remains in a closed position. As contactor 102 reaches contact plate 101', it shifts shaft 93 to the left until contact plate 101' abuts against stop 94'. During such movement one of the contact elements 95 causes the toggle of switch 97 to be moved from a closed position shown in FIG. 1 to an open position. At the same time, one of the contact elements 96 causes the toggle of switch 98 to move from its normally open position shown in FIG. 1 to a closed position. Thus, the circuit to solenoid g goes to zero while the circuit to solenoid j-k becomes fully established. Spool valve 91 therefore shifts to the right to thereby connect lines 107 and 106 for directing high pressure hydraulic fluid into hydraulic actuator 26 to the left of piston head 30 thereby urging it in the forward direction F. At the same time, hydraulic fluid is discharged from the opposite end of piston head 26 through conduit 105 and into a reservoir as in the customary manner. Near the end of the forward stroke, after piston head 30 and its rod 29 have been shifted in a forward direction, contactor 102 contacts push button switch 103 thereby opening such switch. Thus, the entire circuit for controlling hydraulic actuator 26 goes dead. At the end of the forward stroke, sliding movement of the assembly ceases until the operator manually depresses push button 104 and maintains that button depressed so as to again commence the rearward stroke whereupon contactor 102 moves away from switch 103 to thereby again close the electric circuit.

During the return stroke in the rearward direction R, no hydraulic fluid under pressure is transmitted from conduit 105 to the pressure switch 87 since the hydraulic fluid passing through conduit 105 is at a discharge pressure from actuator 26. Hence, pressure switch 87 is open and all the solenoid valves 58, 77 and 79 are in their normal positions, i.e., the positions at which these solenoids are not energized. Valves 58 and 77 are therefore open and valve 78 is closed.

Pressurized sealant in supply tank 83 therefore flows unimpeded through solenoid valve 77 and conduits 75, 76, and flows into feed cylinder 67. Piston head 73 in cylinder 68 is accordingly moved to the left thereby moving piston rod 66 also to the left so as to discharge an equal volume of hydraulic fluid from hydraulic fluid actuator 63. There is no resistance to flow of that discharged fluid other than the resistance to flow through conduit 62 and the normally open solenoid valve 58 and conduit 59 which returns the hydraulic fluid to reservoir 55. Adjustable collar 108 mounted on rod 66 may be provided for limiting the travel of such rod.

Upon the completion of one cycle of operation beginning with a reverse stroke and ending with a forward

stroke, the apparatus comes to rest as aforescribed upon delivery of the sealant material onto the workpieces. The operator is now free to change the position of the workpiece or workpieces, replace one workpiece with another or make any other necessary adjustments. The succeeding cycle of operation cannot begin until the operator again depresses push button 104 so as to energize solenoid *g* of solenoid control valve 91 to thereby shift the spool of this valve to the left to interconnect conduits 107 and 105. Metering-pump cylinder 9 therefore again commences its movement to the left in the direction R. Contactor 102, during its movement to the left, allows push button switch 103 to close, after which the operator may release push button switch 104 for continuance of the rearward movement.

Although it is not essential that the speed of travel of the reciprocating work table 35 be the same as the speed of travel of cylinders 10 and 13, both must reverse their direction of travel at precisely the same time. It is however essential that the speed of linear travel of the work table and that of the metering-pump cylinder be in the same ratio at all times, so that the bead of sealant material to be deposited may be of the same cross section throughout its length.

Table 35 may be of some customary design other than that shown in the drawings. The apparatus herein disclosed has its work table and the drive means designed for depositing straight beads of sealant in a straight path. Beads in circular paths or other geometric paths may likewise be deposited by properly designing other table drives.

In summary, it can be seen that, at the commencement of operation, the metering-pump cylinder and all the parts connected thereto move to the left in the direction R. Since hollow piston rod 41 remains in a fixed position, when the metering-pump cylinder moves to the left, it is equivalent to piston head 42 and piston rod 41 moving to the right with cylinders 10 and 13 remaining stationary. Thus, the volume of space to the right of piston head 42 in the metering-pump cylinder decreases. From this space, which has been filled with hydraulic fluid drawn into it during the preceding stroke in an opposite direction, the hydraulic fluid must be discharged from cylinder 13 as its volume decreases.

During the forward stroke in the direction F as in FIG. 4A, cylinders 10 and 13 move to the right while hollow rod 41 remains stationary. This is the equivalent of cylinders 10 and 13 remaining stationary and rod 41 moving to the left relative thereto. A vacuum is therefore created within cylinder 13 relative to the hydraulic fluid in reservoir 55. Therefore, hydraulic fluid is drawn or suctioned in through check valve 46 and through spaces 45 and 54 thereby filling the space between rod 41 and the inner surface of cylinder 13. Upon reverse movement of cylinders 10 and 13 in the direction R as shown in FIG. 4B, this hydraulic fluid is forced into openings 43 and out through hollow piston rod 41 whereafter it flows through check valve 57 and through conduit 56 and then into conduit 62 toward hydraulic actuator 63. The solenoid operated valve 58 is closed during this portion of the cycle.

At the commencement of the operation of the apparatus as when cylinder 10 is in its rearwardmost position relative to hollow piston rod 41 as in FIG. 4C, the apparatus is restarted as the operator manually depresses switch 104. In such position, actuator 63 is filled with hydraulic fluid and feed cylinder 67 is emp-

tied of its sealant material. Cylinder 10 commences its forward movement to the right as shown in FIG. 5A thereby creating a vacuum within cylinder 13. Plunger 66 of actuator 63 is therefore moved outwardly to the right (see FIG. 4C) thereby causing head 73 of feed cylinder 67 to also move to the right thereby expelling the sealant material 83 through duct 76 and into spout 79 via open solenoid valve 78. During the rearward stroke of cylinder 10, and until it reaches its rearwardmost position of FIG. 4C, switch 87 is closed to effect an open condition for valve 78 and a closed condition for valves 58 and 77. However, at the complete end of this rearward stroke, shaft 93 is shifted leftward to cause a rightward shift of spool 91 and a consequent forward movement of piston head 30 as aforescribed. Switch 87 is therefore made to open via pressure lines 105 and 105'. With its circuit open, valves 58 and 77 are open and valve 78 is closed. Therefore, sealant material 83, being under pressure through pressure line 84, flows through normally open valve 77 and into feed cylinder 68 via duct 75. Solenoid valve 78, which is normally closed, remains closed now that the control circuit is open.

As the sealant material enters cylinder 68 of the feed cylinder assembly, it begins to push plunger head 73 in a rearward direction to the left thereby causing the hydraulic fluid to be dispelled from actuator 63 by means of plunger 66 and through lines 62 and 59 into reservoir 55 via open valve 58 at the time cylinder 10 is moving in a forward direction. At the end of this forward stroke, normally-open switch 103 is closed as it is contacted by plate 102. Continued movement of the apparatus therefore ceases until the operator again depresses button 104.

The metering cylinder is therefore moved from its position shown in FIG. 4C in solid outline to that shown in phantom outline therein so that fluid once again is sucked into piston cylinder 13 from chamber 54 and from reservoir 55 as shown in FIG. 4A. When the metering cylinder reaches its position of FIG. 1, it automatically begins its movement in a rearward direction as the hydraulic fluid is pumped through line 105 against the forward face of piston head 30 of actuator 27.

In FIG. 1 it can be seen that an opening 107 is located in the wall of cylinder 13. A needle valve 108 is mounted in cylinder 10 and extends into opening 107 for adjusting the size of this opening to thereby control the amount of hydraulic fluid flowing back into the reservoir 55 during the discharge stroke as shown in FIG. 4B. Thus, the volume of hydraulic fluid delivered to hydraulic actuator 63 is controlled in a simple manner. Feed cylinder 67 being of the same inner diameter and having a common piston rod 66 for both actuators 63 and this feed cylinder 67, the volume of sealant material delivered from cylinder 67 is equal to the volume of hydraulic fluid delivered to actuator 63.

It can be seen that the cycle of operation ceases when the metering-pump cylinder has discharged one load of hydraulic fluid into actuator 63, thereby discharging an equal volume of sealant material from feed cylinder 67, and the feed cylinder being replenished by the same volume of sealant material. To continue the operation until the feed cylinder is completely empty of sealant material would decrease the efficiency of operation since all other operations of the apparatus would have

to cease until the feed cylinder had received a full supply of sealant from tank 82.

Of course, each workpiece may be so arranged and the work table so designed as to deposit beads of a variety of cross-sectional shapes as well as any number of configurations such as circular, rectangular, triangular or other shapes, without departing from the scope of the invention. It is therefore to be understood that within the scope of the appended claims, the invention may be practiced otherwise than as, specifically described.

What is claimed is:

1. Apparatus for delivering a ribbon of sealant material onto a workpiece, comprising: a closed-ended reservoir cylinder mounted for forward and rearward axial movement; a coaxial piston-cylinder located within said reservoir cylinder dividing it into a fluid containing piston chamber and a fluid reserve chamber; a fixed hollow piston rod within said piston chamber having openings near its one end and said rod extending outwardly of the forward end of said reservoir cylinder; said chambers communicating with one another through a one-way valve means on said cylinder; a sealant-containing feed cylinder means interconnected with a pressurized sealant supply means; a first hydraulic actuator connected by means of its plunger to that of said feed cylinder means, said first actuator and said feed cylinder means having approximately the same volumetric capacity, and conduit means interconnecting said actuator with said fluid reserve chamber; whereby rearward movement of said reservoir cylinder pumps the fluid from said piston-cylinder and into said hydraulic actuator which causes the sealant to be discharged from the feed cylinder means, said sealant supply means refilling said feed cylinder means when needed and causing said fluid actuator to pump fluid into said reservoir, and whereby forward movement of said reservoir cylinder draws the fluid from said fluid reserve chamber and back into said piston-cylinder through said valve means.

2. The apparatus according to claim 1 wherein a second hydraulic actuator is provided for moving said reservoir cylinder rearwardly and forwardly, the piston rod of said second actuator being connected to said reservoir cylinder.

3. The apparatus according to claim 2 further comprising a workpiece support connected to said reservoir cylinder for forward and rearward movement therewith.

4. The apparatus according to claim 3 wherein a bedplate is provided having guide rods on which said reservoir cylinder is mounted for sliding movement in a forward and rearward direction, said second actuator being mounted on said bedplate, contact elements and switch means being provided on said bedplate and on said support for actuation of said switch means between an on and off position upon contact with said elements during sliding movement of said reservoir cylinder and said workpiece support, said switch means forming a part of an electric control circuit for said second actuator so that, upon actuation of said switch means, said reservoir cylinder is moved in a forward and reverse direction by said second actuator piston rod.

5. The apparatus according to claim 1 wherein the ends of said reservoir cylinder are closed by forward and rearward end walls secured thereto, said forward

end wall having an opening greater than the cross-sectional dimension of said piston rod, plate means mounted on said forward end wall and having a cavity communicating with said valve means and with said end wall opening, the fluid being drawn back into said piston-cylinder from both said fluid reserve chamber and said cavity through said end wall opening when said reservoir cylinder moves in a forward direction.

6. The apparatus according to claim 5 wherein a bedplate is provided having guide rods on which said reservoir cylinder is mounted for sliding movement in a forward and rearward direction, a support block on said bedplate to which said hollow piston rod is fixed, and said hollow piston rod extending through said plate means in sliding engagement therewith.

7. The apparatus according to claim 1 wherein contact switch means are provided for said first hydraulic actuator and said feed cylinder located in the path of movement of the connection between said plungers of first actuator means and said feed cylinder, solenoid valve means provided in both said conduit means and in said sealant supply means, said switch means and said solenoid valve means forming a part of an electric control circuit for opening and closing said solenoid valves to thereby switch the hydraulic fluid flow into said reservoir and to switch the sealant flow into said feed cylinder after said feed cylinder has delivered one discharge of sealant material, and to thereby switch the hydraulic fluid flow into said first hydraulic actuator and the sealant out of said feed cylinder and onto the workpiece after said feed cylinder is full.

8. The apparatus according to claim 1 further comprising a manually adjustable needle valve extending into engagement with a valve opening provided in said piston-cylinder, the size of said valve opening thereby being adjusted to control the flow of fluid from said piston-chamber into said fluid reserve chamber, whereby the volume of fluid through said hollow piston rod is controlled as well as the volume of sealant delivered to the workpiece by reason of the same volumetric capacity of said first actuator and said feed cylinder.

9. Apparatus for delivering a ribbon of sealant onto a workpiece, comprising: a reservoir cylinder having closed end walls and being mounted for movement in a forward and rearward direction; a piston-cylinder pump extending between said end walls, the space between said piston-cylinder and said reservoir cylinder defining a reservoir; a fixed hollow piston rod located within said piston-cylinder, one end of said piston rod extending outwardly of said reservoir cylinder through an oversized opening in one of said end walls, a piston head closing the other end of said piston-cylinder, and openings being provided in the wall of said piston rod near said other end; means mounted on the outer surface of said one wall defining a chamber therewith; a one-way check valve on said one wall interconnecting said reservoir with said chamber and normally permitting fluid flow toward said chamber; a hydraulic power cylinder; a sealant containing feed cylinder having an outlet thereon; plungers provided for each said power cylinder and said feed cylinder and being interconnected for movement together as a unit; a hydraulic fluid line interconnecting said one end of said hollow piston rod with said power cylinder and further communicating with said reservoir; and means for moving said reservoir cylinder relative to said hollow piston rod whereby, upon movement of said reservoir cylinder

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away from said one end of said hollow rod, the fluid within said piston-cylinder is forced through said hollow piston rod and said line to said power cylinder to thereby expel the sealant from said feed cylinder through its outlet; means for introducing sealant under pressure into said feed cylinder so that, when said feed cylinder has discharged sealant for one cycle of operation, the sealant introduced into said feed cylinder causes the hydraulic fluid to be forced back into said reservoir through said hydraulic line; and movement of said reservoir cylinder toward said one end of said hollow piston rod causes the fluid to re-enter said piston-cylinder from said reservoir and through said check valve, said chamber and said opening.

10. The apparatus according to claim 9 further comprising a hydraulic actuator having a plunger operatively interconnected with said reservoir cylinder for forward and rearward movement thereof.

11. The apparatus according to claim 10 wherein said hydraulic actuator is mounted on said bedplate, an electric control circuit provided for said hydraulic actuator including solenoid valve means for effecting movement of said actuator plunger in a forward and rearward direction, said circuit also including a pressure switch connected to said power cylinder for being opened and closed respectively during the rearward

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and forward directions of movement.

12. The apparatus according to claim 10 further including contact elements fixed on a shaft mounted for shifting movement parallel to said actuator plunger, spaced shift plates being fixed to said shaft at opposite ends of the travel of said actuator plunger, and a shift plate also being fixed on said actuator plunger for effecting shifting movement of said shaft as it contacts said respective shaft plates to effect automatic movement of said metering cylinder.

13. The apparatus according to claim 9 wherein guide means are provided for permitting sliding movement of said reservoir cylinder in a forward and rearward direction, said guide means including a bedplate and guide rails.

14. The apparatus according to claim 9 wherein a workpiece support is interconnected with said reservoir cylinder for sliding movement therewith.

15. The apparatus according to claim 9 further including an opening in said piston cylinder, and a needle valve provided for controlling the size of said opening to regulate flow of hydraulic fluid into said reservoir during rearward movement of said reservoir cylinder, thereby controlling the amount of sealant expelled from said feed cylinder.

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