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PNEUMATICALLY CONTROLLED APPLICATOR SYSTEM FOR ADHESIVE AND THE LIKE

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Fig. 1.

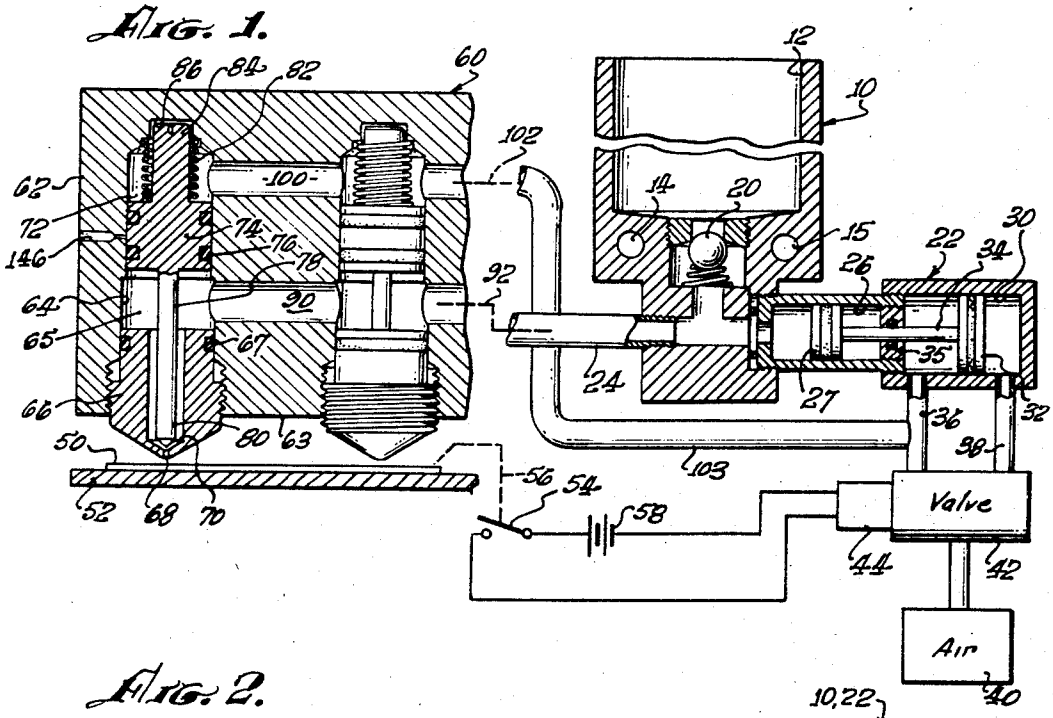
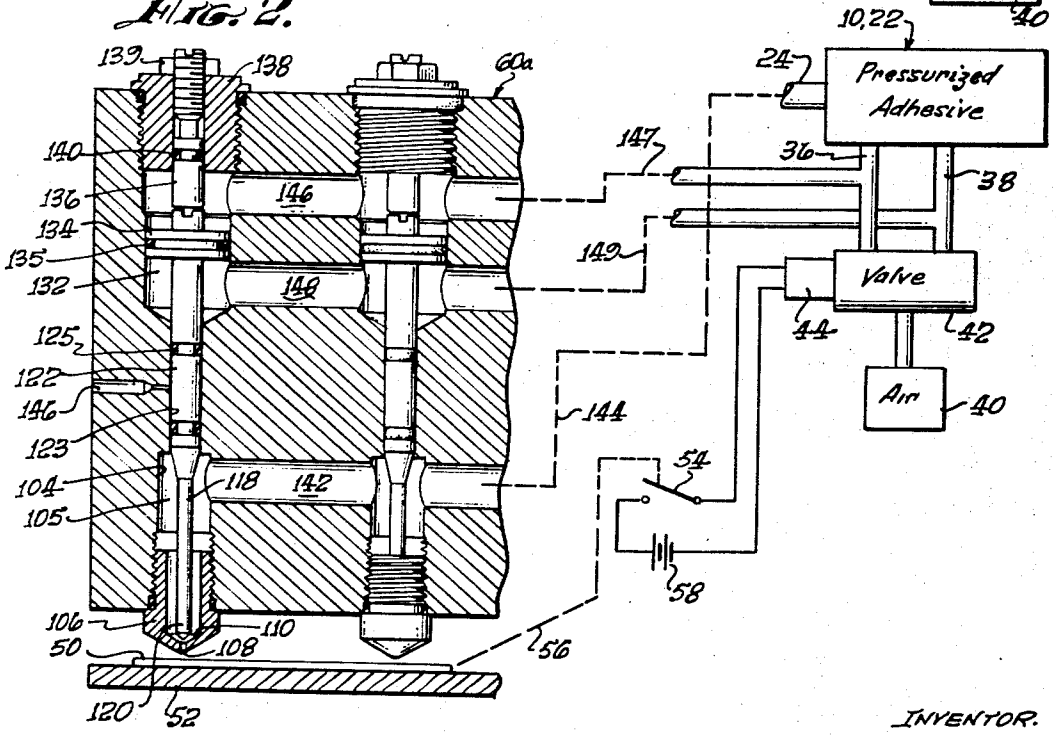



Fig. 2.




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# PNEUMATICALLY CONTROLLED APPLICATOR SYSTEM FOR ADHESIVE AND THE LIKE

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## ABSTRACT OF THE DISCLOSURE

Liquids such as hot melt adhesives are applied to a work surface through orifices connected in parallel and controlled by individual needle valves actuable in response to pneumatic signals. The same pneumatic signals control the valves and the pump mechanism by which the adhesive is intermittently pressurized.

This invention has to do generally with the application of a liquid material to a relatively moving work surface in a definite and controllable application pattern.

The invention is especially useful for applying hot melt adhesive to such work surfaces as the flaps of paperboard cartons or cases to effect sealing. The invention will be described with special reference to such systems, but without implying limitation to any particular type of liquid or work surface.

It has previously been suggested to control the application pattern of such liquids by intermittently pressurizing the fluid by means of a pump mechanism controlled by a pneumatic actuator. Systems are also known in which the fluid to be applied is mentioned under continuous pressure, and its supply to the applicator nozzles is controlled by intermittent actuation of valve mechanism at the applicator head.

One aspect of the present invention provides improved accuracy and reliability of the cutoff of fluid flow by combining intermittent pressurization with intermittent valve actuation, timing of the pump and valve controls being coordinated by making them both responsive to the same control signals.

A further aspect of the invention utilizes pneumatic signals for combined control of the type just described.

Another aspect of the invention employs individual shutoff valves for each nozzle orifice, each valve being located immediately adjacent the orifice outlet. With that arrangement particularly accurate and positive control is provided. Moreover, each valve can be separately adjusted, facilitating the selection of different patterns of application.

The invention also provides valve structures and valve operating mechanisms that are particularly well adapted for systems of the present type.

A full understanding of the invention and of its further objects and advantages will be had from the following description of illustrative manners in which it may be carried out. The particulars of that description, as of the accompanying drawings which form a part of it, are intended only as illustration and not as a limitation upon the scope of the invention, which is described in the appended claims.

In the drawings:

FIG. 1 is a schematic drawing representing an illustrative system in accordance with the invention, with fluid supply mechanism and part of an applicator head shown in section; and

FIG. 2 is a schematic drawing representing a modification.

Referring first particularly to FIGURE 1, the numeral 10 represents illustrative means for providing a continuous supply of hot melt adhesive or similar fluid. The container 12 has an open top through which solid adhesive can be added, and is heated by electrical elements represented schematically at 14. The temperature of the resulting liquid in tank 12 is preferably controlled, as by a thermostat 15 of conventional type.



Fluid from tank 12 is withdrawn through the check valve 20 by the pump mechanism 22, and is supplied under pressure through the supply conduit 24. Pump mechanism 22 typically comprises the pump cylinder 26 with pi ton 27, and the actuating cylinder 30 with pi ton 32. The two pistons 27 and 32 are positively coupled by the rod 34 which passes in sealed relation through the partition 35 between the two cylinders. Actuator piston 32 is driven in its reciprocating motion by admission of pressurized air to one end or the other of cylinder 30 via the respective control conduits 36 and 38. Control air is supplied to those conduits from the conventional source of compressed air indicated schematically at 40 via the solenoid controlled four-way valve 42. The solenoid mechanism indicated schematically at 44 maintains valve 42 normally in position to supply air to control conduit 36, and opens conduit 38 to the atmosphere. Electrical energization of the solenoid shifts the valve to supply control air to conduit 38 and to open conduit 36 to the atmosphere. Current for solenoid 44 is supplied intermittently in any suitable manner to produce the desired pattern of fluid application.

In the present illustrative system the work surface 50 represents typically a flap of a carton to be sealed, and is moved continuously by conventional mechanism, not explicitly shown, along the support 52. A control switch 54 is operated in response to presence of the work surface at support 52 by a mechanism indicated schematically by the dashed line 56. Switch closure completes an energizing circuit through solenoid 44 and a suitable power source, shown as the battery 58. Valve 42 is thereby shifted to pump operating position, admitting air to the right of actuator piston 32 and driving pump piston 27 to the left as seen in FIGURE 1. Fluid is thereby forced under pressure into conduit 24. Upon release of switch 54, valve 42 returns to normal position, causing pump piston 27 to be positively retracted, typically drawing fresh fluid from tank 12 via check valve 20.

The present invention is concerned more particularly with the applicator valve structure shown illustratively at 60. That structure comprises the block 62 with the working face 63 and with parallel valve bores 64 which open inwardly from face 63 and in which the applicator nozzles 66 are threaded. Each of the nozzles 66 has a small axial orifice 68 which opens outwardly from an annular conical valve seat 70. Valve bore 64 extends coaxially inwardly, forming the valve chamber 65 and the valve actuating chamber at 72, in which the valve actuating piston 74 is slidably contained, with suitable sealing means shown as the two axially spaced O-rings 76. An elongated spindle 78 projects axially from piston 74 and carries at its outer end the needle valve 80. The working surface of valve 80 is conically tapered to engage valve seat 70 in positively sealing relation in response to downward movement of piston 74. Seating of valve 80 on its conical seat 70 is facilitated by lateral flexure of the relatively slender spindle 78. Control piston 74 and valve 80 are yieldingly urged toward valve closing position by the coil spring 82, which acts between the upper end of the piston and block 62.

Upward movement of piston 74 is positively limited by contact of the coaxial boss 84 with the end of the valve bore at 86, that contact limiting the degree of opening of valve 80. The effective position of stop surface 86 with respect to the valve action is adjustable by screwing nozzle 66 in or out of block 62. The O-ring 67

typically exerts sufficient resistane to nozzle rotation to effectively lock that adjustment. Whereas such adjustment might be used for regulating the rate of delivery of fluid through orifice **68**, it is normally preferred to make the valve opening large compared to the cross section of the orifice. If it is desired to modify the rate of flow, the entire nozzle **66** can readily be removed and replaced with a nozzle having an orifice of the desired diameter. In practice the described stop adjustment is conveniently made by screwing in nozzle **66** until boss **84** engages stop surface **86**, and then unscrewing the nozzle through a predetermined angle.

A system of passages **90** is provided within block **62** interconnecting the valve bores **64** at points between their respective nozzles **66** and pistons **74**. Passages **90** are connected, as indicated by the dashed line **92**, to fluid conduit **24**, already described. Hence pressurized fluid from pump mechanism **22** is supplied in parallel to all of the valves **80** and their orifices **68**. Fluid in each valve chamber **65** also fills the lower portion of valve actuating chamber **72**, exerting upward force on the piston **74**.

The passage structure **100** interconnects the upper portions of actuator chambers **72** above pistons **74**. Passages **100** are connected, as indicated by the dashed line **102**, to the line **103** and control conduit **36**, already described, which supplies control air from control valve **42** to the left side of pump actuating piston **32**. That control air drives valve piston **74** down, as seen in FIG. 1, positively closing valve **80** during the periods when the fluid in passages **90** is relieved of pressure. When the fluid in valve chamber **65** is again pressurized by pump mechanism **22** air passages **100** are vented to atmosphere via control valve **42**. Hence valve **80** is opened by the fluid pressure on the lower side of piston **74**, applying adhesive to surface **50**.

If desired, the valve-piston element can be resiliently biased in either direction. As illustrated, the spring **82** supplements the action of control air in closing the valve, reducing the air pressure required for that purpose. Spring **82** also holds the valve positively closed when the apparatus is shut down with air pressure turned off. With suitable values of spring bias and air pressure, the adhesive pressure can be maintained continuously in chamber **65**, selective application being controlled entirely by the single pneumatic signal pulses applied to chamber **72** above the control piston. Also, with suitable spring bias, the system may be operated successfully without supplying pneumatic signals to passages **100**, those passages then forming a buffer chamber that permits piston movement without excessive pressure variation.

In the modified structure of FIG. 2 the mechanism **10** for providing hot melt adhesive and pump mechanism **22** for intermittently pressurizing that liquid are typically as described in connection with FIG. 1, and are indicated only schematically. Air supply **40**, control valve **42** and solenoid **44** and its control circuit are typically as already described.

The applicator block **60***a* of FIG. 2 is provided with parallel bores **104**, which extend coaxially through the entire thickness of the block. The forward portions of those bores form the valve chambers **105** with the nozzles **106** fixedly mounted in them, as by coaxial threads. Nozzles **106** are provided with the orifices **108** with the conical valve seats **110** immediately adjacent them. The needle valves **120** are mounted by means of the elongated spindles **118** on the valve plungers **122**, guided in the relatively small guide portions **123** of bores **104**, and sealed by the two O-rings **125**. Plungers **122** are directly coupled to the valve actuating pistons **134** which work in the cylinders **132** with sealing O-rings **135**. Inward movement of each entire piston and valve member is limited by the positive stop **136** which is adjustably threaded in a coaxial bore in the plug member **138**. Adjustment of the stop in plug **138** is locked by the nut **139**, and the stop member is sealed at **140**.



The liquid adhesive to be dispensed through orifice **108** is supplied to all the valve chambers **105** in parallel via the passage system **142**, which is connected to pump outlet conduit **24** as indicated at **144**. Control air is supplied selectively to each valve actuator chamber **132** on both sides of piston **134** via the respective passage systems **146** and **148**. Passage **146** on the inner side of piston **134** is connected via the tube indicated at **147** to control conduit **36**, essentially as in the structure of FIGURE 1. Passage **148** on the outer side of piston **134** is connected via the tube **149** to control conduit **38**. Control air is thus supplied under pressure from valve **42** to passage **148** during periods of adhesive pressurization.

Operation of the mechanism of FIG. 2 is generally similar to that of FIG. 1 except that the operation of each needle valve **120** is essentially independent of the fluid pressure in passage **142** and valve chamber **105**. Each valve is opened by the pressure of control air from passage **148** on the outer face of piston **134**, and is closed by pressure of control air from passage **146** on the inner face of piston **134**. Thus each valve is positively actuated in both directions in response to control air pressure from control valve **42**. Since that control air pressure also controls pump mechanism **22**, accurate synchronization of the pump and valve operations is reliably maintained. The mechanism is thus capable of providing extremely rapid and clean projection and cutoff of the liquid that is dispensed.

In accordance with a further aspect of the invention it has been found that under the severe service conditions presented by the relatively high temperature and pressure typically employed in adhesive applicators the live seals at **125** and **135** tend to give only limited service. I have found that the life of such O-ring seals can be greatly extended by mounting them in grooves whose axial dimension is appreciably less than that normally employed. Rather than providing axial clearance between the rings and the sides of the groove, I preferably reduce the normal groove dimension by from 15 to 30%. The O-ring is then appreciably flattened on its axial faces by the opposing sides of the groove. Under that condition, and with the relatively short valve stroke, typically only 0.010 to 0.030 inch, the O-ring is restrained against rolling and is merely laterally distorted by the valve movement. With the described O-ring channel dimensions satisfactory life of the live seals is obtained.

In order to provide prompt indication of deterioration of the fluid seals, I preferably provide an indicator orifice **146** leading from the exterior of applicator block into each valve containing bore **104** at a point between the two piston seals **76** in FIG. 1 and between the two plunger seals **125** in FIG. 2. If the outer one of those seals, which is exposed to the full fluid pressure, should start to fail, the resulting leak is made visible promptly by oozing of liquid from orifice **146**. That flow is sharply limited by the small orifice diameter, shown at its inner end.

The applicator structure of FIG. 2 has the particular advantage that it can be effectively employed either with intermittent pressurization of the dispensed liquid, as has been described, or with continuous pressurization of that liquid. For example, adhesive source **10** and pump **22** of FIG. 2 may be considered to represent any suitable means for supplying adhesive under continuous pressure to supply conduit **24**, being then isolated from both control conduits **36** and **38**. The latter conduits then supply pneumatic control signals from valve **42** only to the passages **146** and **148** of applicator block **60***a*. With that arrangement the applicator needle valves **120** are operated as already described, and selectively control the intermittent application of the continuously pressurized fluid.

I claim:

**1**. A system for selectively applying a fluid to a relatively moving work surface, comprising in combination structure forming a plurality of nozzle orifices mounted

adjacent the path of the work surface for projecting pressurized fluid thereon,

first conduit means communicating with all the orifices in parallel,

pump means for supplying a pressurized fluid to the conduit means intermittently in response to pneumatic control signals,

individual valves connected in series between the conduit means and the respective orifices,

a piston mechanism coupled to each of said valves for operating the same,

second conduit means for supplying said pneumatic signals to the piston mechanisms for controlling said valves to permit fluid flow to the respective orifices only during periods of said fluid pressurization,

and means for developing said pneumatic signals in controlled relation to the movement of the work surface.

**2.** A system as defined in claim **1**, and in which said pneumatic signals comprise on signals and off signals, the pump means acting to supply pressurized fluid in response to the pneumatic on signals and to relieve the fluid pressure in response to the pneumatic off signals,

and said second conduit means supply the off signals to said piston mechanisms in a direction tending to close the valves in response to the pneumatic off signals.

**3.** A system as defined in claim **2**, and in which

said piston mechanisms comprise a piston for each valve exposed on one side to the pneumatic off signals for closing the valves during periods of fluid pressure relief, and exposed on the other side to the fluid pressure in said first conduit means, for opening the valves during periods of said fluid pressurization.

**4.** A system as defined in claim **1**, and in which

said valves comprise generally annular valve seats surrounding the respective said orifices immediately inward thereof, and needle valves axially movable with respect to the valve seats and coupled to the respective piston mechanisms.

**5.** A system as defined in claim **4**, and in which

said piston mechanisms comprise structure forming cylinders coaxial with the respective orifices, pistons slidable in the cylinders and directly coupled to the respective needle valves, said second conduit means supplying pneumatic signals to the cylinders on at least one side of the pistons.

**6.** A system as defined in claim **5**, and in which

said second conduit means supply pneumatic pressure signals to the cylinders on the side of the pistons remote from the orifices only during fluid pressure relief,

the sides of the pistons toward the orifices being exposed to fluid pressure in the first conduit means.

**7.** A system as defined in claim **5**, and in which

said second conduit means supply pneumatic pressure signals to the cylinders on the side of the pistons toward the orifices during said fluid pressurization, and supply pneumatic pressure signals to the cylinders on the side of the pistons away from the orifices during fluid pressure relief.



**8.** A system for selectively applying a fluid to a relatively moving work surface, comprising in combination

structure forming a nozzle orifice mounted adjacent the path of the work surface for projecting pressurized fluid thereon,

pump means for intermittently supplying pressurized fluid to the nozzle orifice in response to a control signal,

a valve means connected in series between the pump means and the orifice, said valve means comprising

a valve actuating piston slidable in a cylinder coaxial with the orifice,

a needle valve adapted for closing the orifice and and directly coupled to the piston,

control conduit means communicating with at least one side of the piston,

and sealing means for isolating the control conduit means from the orifice,

and control means for supplying control air under pressure intermittently in controlled relation to the movement of the work surface both to the pump means as said control signal to supply pressurized fluid and to the control conduit means to operate the valve.

**9.** A system as defined in claim **8**, and in which

said control conduit means comprise valve opening conduit means communicating with the piston on the side toward said orifice and valve closing conduit means communicating with the piston on the side away from said orifice,

and said control means act to supply control air under pressure intermittently and simultaneously to the pump means as said control signal and to said valve opening conduit means to apply fluid to the work surface, and act to supply control air under pressure intermittently to said valve closing conduit means to terminate fluid application to the work surface, said air supply to the valve closing conduit means alternating with said air supply to the pump means and to the valve opening conduit means.


**References Cited**

UNITED STATES PATENTS

| | | | |
|---|---|---|---|
| 1,987,046 | 1/1935 | Bergner | 118—323 X |
| 2,804,764 | 9/1957 | Runton | 118—313 X |
| 3,081,947 | 3/1963 | Walter | 239—533 X |
| 3,152,923 | 10/1954 | Marshall et al. | 118—2 |
| 3,250,247 | 5/1966 | Beaman | 118—315 X |
| 3,286,689 | 11/1966 | Ziemba | 118—411 |
| 3,348,520 | 10/1967 | Lockwood | 118—411 X |



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