

Oct. 24, 1967

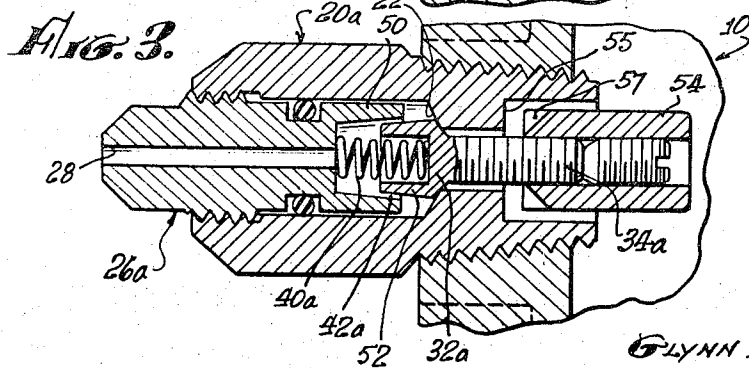
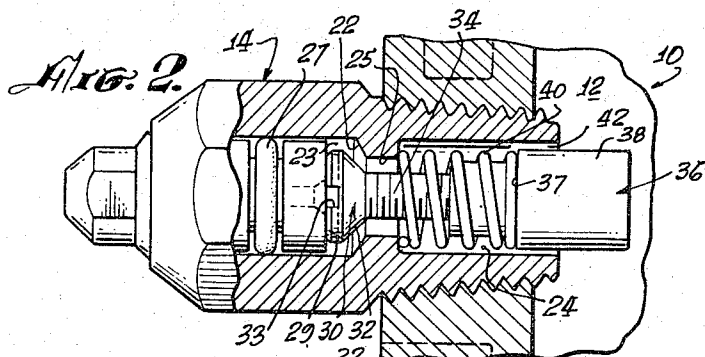
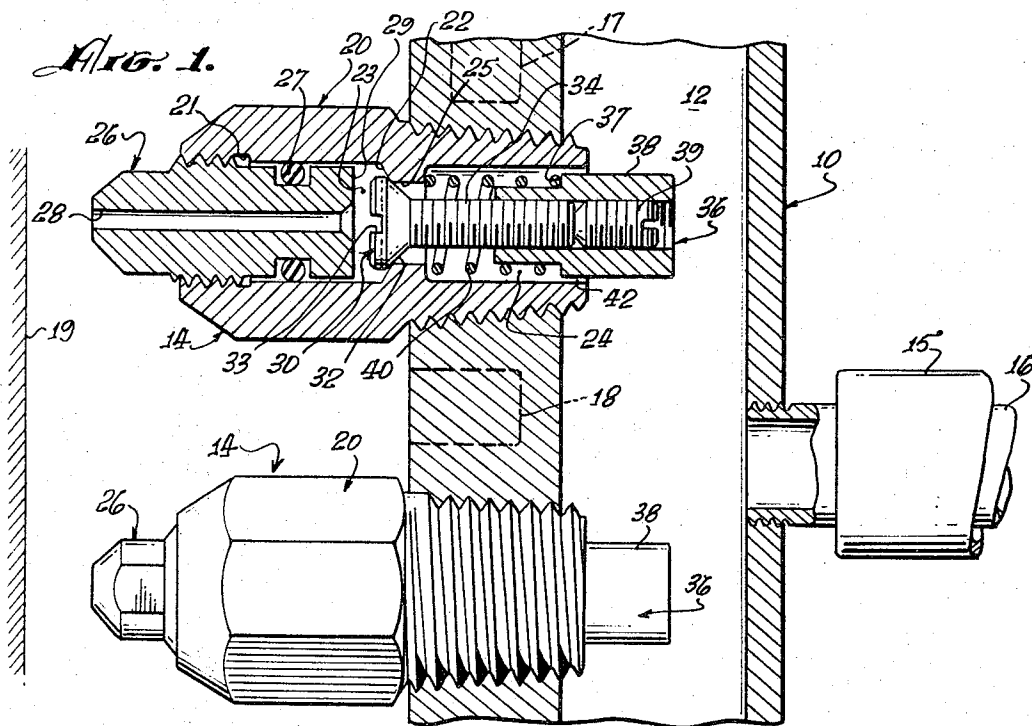
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3,348,520

APPLICATOR SYSTEM FOR HOT MELT ADHESIVE AND THE LIKE

Filed Sept. 16, 1965

2 Sheets-Sheet 1



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APPLICATOR SYSTEM FOR HOT MELT ADHESIVE AND THE LIKE

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2 Sheets-Sheet 2

Fig. 4.

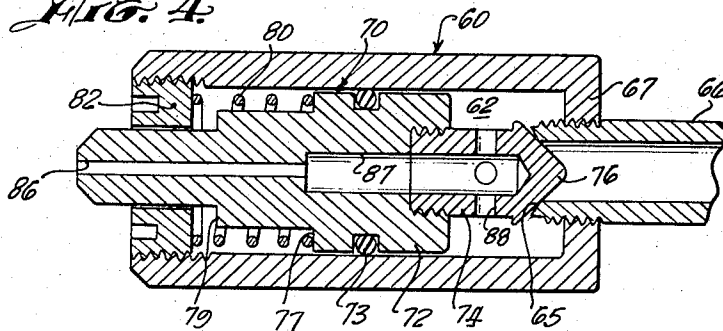
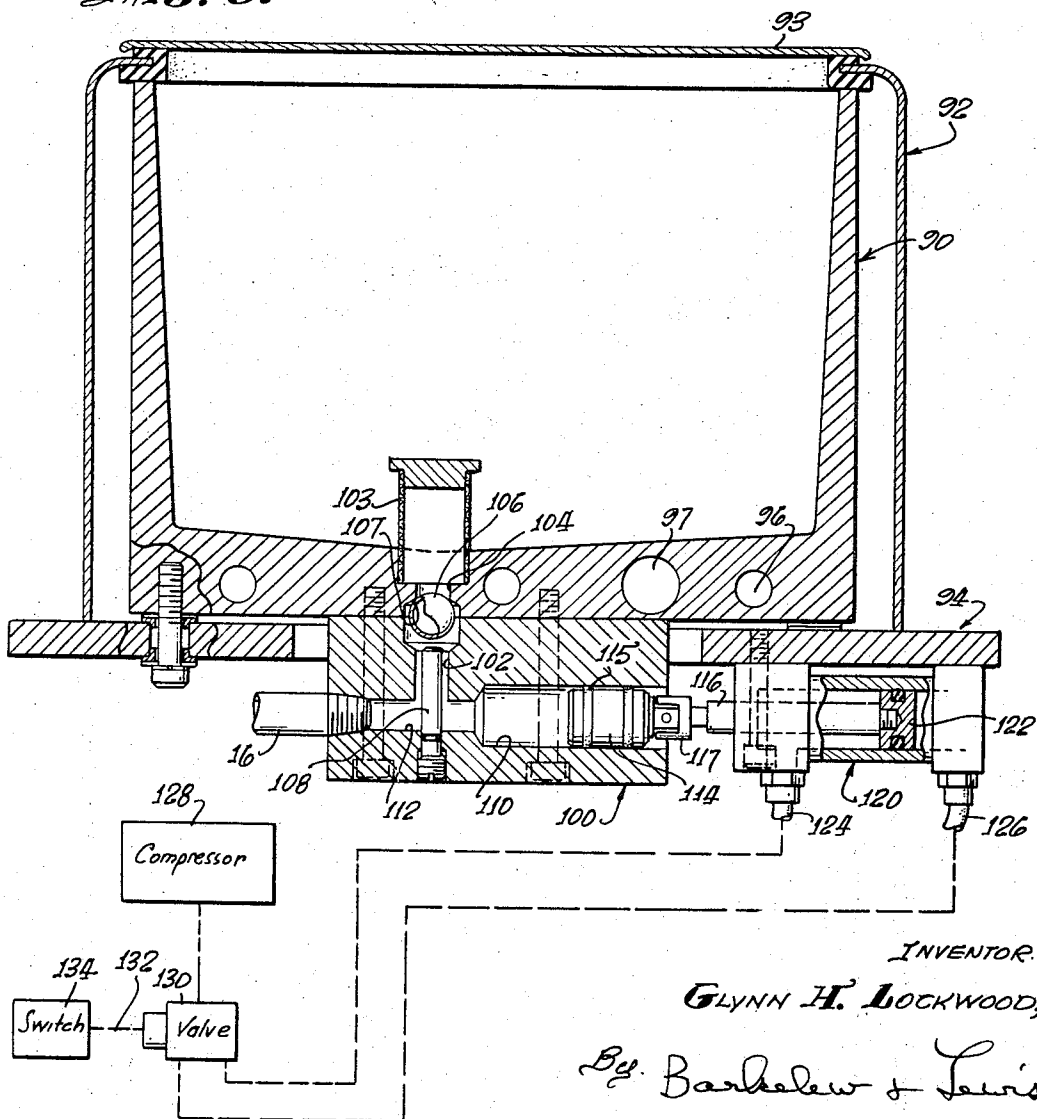


Fig. 5.



1

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APPLICATOR SYSTEM FOR HOT MELT ADHESIVE AND THE LIKE

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Filed Sept. 16, 1965, Ser. No. 487,699

8 Claims. (Cl. 118-2)

ABSTRACT OF THE DISCLOSURE

Particularly effective pressure-actuated valve structures are incorporated in nozzles for applying hot melt adhesive and the like to a moving work surface. The valves are operated simultaneously by pressure pulses developed in the adhesive by a piston pump intermittently driven under fluid control and receiving adhesive from a melt tank through a check valve. Improved operation is obtained by omission of any pump outlet valve, and by limiting the inlet flow to the pump to produce a controlled negative pressure during the suction stroke.

This invention has to do generally with systems for applying to a work surface a liquid material in a definite and controllable application pattern.

Certain aspects of the invention are especially useful in connection with systems 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.

For sealing such objects as cartons, hot melt adhesive is preferably applied in a definitely predetermined pattern that will insure proper sealing and at the same time avoid wasting adhesive. In some instances it is also desirable to obtain a seal of accurately limited strength to facilitate opening. The present invention permits particularly flexible, accurate and reliable control of the application pattern, which may include not only accurately placed dashes or stripes on the moving work surface but also short dots applied at high cycling rate.

The present invention utilizes an intermittently driven pump for pressurizing the fluid supplied to the applicator nozzles during those periods when fluid is to be applied to the work surface, and fluid application is terminated by terminating the pressure pulse produced by the pump.

One aspect of the invention provides a check valve closely adjacent each nozzle orifice. When several nozzles are supplied with fluid in parallel from a common pump and via a common conduit or header chamber, the check valve for each nozzle is preferably inserted between that nozzle and the conduit or header chamber. In a preferred arrangement, a header chamber is supplied with fluid from the pump via a single conduit, which may be branched for supply to other header chambers, and a plurality of nozzle orifices communicate via respective check valves with each header chamber. If the pump is located close to the header chamber no conduit is required. The pump is typically of reciprocating type, with the pressure cylinder preferably connected directly, that is, without any intervening valve structures, with the header chamber or chambers.

A further aspect of the invention involves pump structure that produces the desired supply pressure on the pressure stroke and produces a distinctly negative pressure in the header chamber or chambers on the suction stroke. Such subatmospheric pressure is obtainable by the combination of suitably restricted supply of fluid to the pump in combination with the described open communication

2

between the output side of the pump and the header chamber. With that arrangement relatively long conduits can be successfully used. Transmission of the negative pressure the entire length of the conduit directly to the check valve at each nozzle insures prompt and clean closure of the check valves, cutting off the fluid delivery sharply and preventing any tendency toward dripping from the nozzles.

A further aspect of the invention provides improved check valve structures which are remarkably prompt and reliable in operation, both in opening in response to an applied pulse of fluid pressure and in closing in response to sharply reduced or negative pressure. Such improved operation is attained by providing a control orifice of limited sectional area through which fluid flows when the valve is open, and applying the pressure drop developed by that orifice to a piston structure that is coupled to the valve. Whereas such structure utilizes an appreciable portion of the available fluid supply pressure in operation of the valve, the resulting speed and uniformity of the valve operation is highly desirable. That is particularly true when several nozzles are to be supplied through respective check valves from a common pressure source.

In addition to the improved operating characteristics described above, the systems of the present invention are unusually simple and economical to construct and install, and are remarkably versatile in the detailed design and operation that are obtainable.

A full understanding of the invention, and of its further objects and advantages, will be had from the following description of certain illustrative ways in which it may be carried out. The particulars of that description, and 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 defined in the appended claims.

In the drawings:

FIG. 1 is an elevation, partly in axial section, representing a portion of an illustrative nozzle block with valved nozzles in accordance with the invention;

FIG. 2 is an axial section corresponding to a portion of FIG. 1 and showing a nozzle valve in open position;

FIG. 3 is an axial section corresponding generally to FIG. 2 and showing a modification;

FIG. 4 is an axial section showing a further modification; and

FIG. 5 is a vertical section showing an illustrative intermittent pressurizing system in accordance with the invention.

Referring first to FIGS. 1 and 2, an elongated nozzle block is represented fragmentarily at 10, with header chamber 12 through which the fluid to be applied is distributed to the nozzles 14 for application to a work surface 19. Fluid is supplied to chamber 12 via the tube 16, which is typically at least somewhat flexible. If the liquid to be applied is a hot melt adhesive, for example, the entire block assembly is preferably maintained at elevated temperature, as by individual electric heating units indicated at 17 and controlled by one or more thermostatic switches 18. Conduit 16 is then preferably surrounded by a thermostated heating jacket, which may be of conventional type and is indicated only schematically at 15. The other end of conduit 16 is connected to a suitable intermittent source of pressurized fluid, such as that to be illustratively described. A wide variety of nozzle configurations may be employed. For example, block 10 may be of any required length, with a row of applicator nozzles 14 distributed as desired along the length of chamber 12. Or block 10 may extend appreciably in a direction perpendicular to the plane of FIG. 1, with nozzles 14 arranged as desired in a two-dimensional array.

Also, several blocks may be connected, as via branch conduits, to a single fluid supply conduit such as 16. Alternatively, a suitable pump mechanism for producing intermittently pressurized fluid may feed directly into chamber 12, without any distinct conduit structure.

Each nozzle shown illustratively in FIGS. 1 and 2 comprises a body 20 of generally cylindrical form with external threads at its rearward end for mounting it in sealed relation in a threaded bore in block 10. Body 20 has an axial through bore that is counterbored and threaded at its forward end at 21. An internal flange 25 forms a forwardly facing, generally conical valve seat 22 and divides the bore into a forward or nozzle chamber 23 and a rear or entrance chamber 24. The nozzle proper comprises a coaxially bored tip 26 mounted in chamber 23 for axial adjustment by means of the threads 21 and provided with sealing means shown as the O-ring 27. The axial nozzle orifice 28 in tip 26 produces a well defined jet of liquid that typically carries for an appreciable distance to the work surface, indicated at 19. The direction of that jet delivery may have any desired orientation with respect to gravity.

The valve element 30 comprises the valve head 32 with conical or spherical working face, and the valve stem 34 which extends upstream from the head and is threaded to carry the cylindrical piston member 36. A suitable spring is provided to yieldingly urge the valve element rearwardly to seat the valve. Such a spring is shown illustratively at 40 in chamber 24 acting between the rear face of flange 25 and a shoulder 37 on the piston member. Alternatively, the spring 40 may be of somewhat larger diameter positioned in header chamber 12 and acting between the extreme rearward face of body 20 and an external flange at the rear end of piston member 36. In either case, the force tending to close the valve is variable by adjustment of the piston member on threaded stem 34. That adjustment of the piston member is locked by means of the set screw 39, typically provided with an Allen head. The piston member includes a cylindrical body portion 38 to the rear of shoulder 37 which has a diameter nearly equal to that of entrance chamber 24, leaving an annular passage or control orifice 42 of small radial dimension. In closed position of the valve, piston body 38 protrudes rearwardly from the main housing bore, so that only its forward portion directly opposes the chamber wall. As the valve element moves forward to open the valve (FIG. 2), control orifice 42 is lengthened, increasing the resistance to fluid flow. The length of the control orifice, and hence its flow resistance, also varies with the axial position of piston member 36 on the valve stem. Forward movement of valve element 30 is limited by the rearward face of nozzle tip 26. Either that face or the opposing face of the valve element is channeled or otherwise formed as at 33 to provide ample fluid flow into the tip bore 28 despite that contact.

In operation of the described valve structure, the valve is normally in closed position of FIG. 1, with the fluid pressure in header chamber 12 below a positive threshold value determined by the adjustment of spring 40. To apply adhesive, the pressure supplied to the header is abruptly raised above that threshold. The force thereby developed on the valve element, acting as a piston, compresses spring 40 and opens the valve. The effective piston area for initial opening of the valve is essentially the area inside valve seat flange 25. Once the valve has opened, pressure on both sides of the valve head (FIG. 2) tends to be equalized by the relatively free flow through the valve (FIG. 2). With a conventional valve, that often leads to an equilibrium condition in which the valve-opening pressure is barely sufficient, or even insufficient, to hold the valve open, causing chatter or other malfunction of the valve.

In the present structure, on the other hand, once the valve is open it tends to remain stably in that condition. Flow through the resistance due to the small section

area of control orifice 42 produces an appreciable pressure drop that increases with flow through the valve. The fluid pressure in entrance chamber 24 is therefore appreciably less than the supply pressure in header chamber 12. That pressure difference acts on piston member 36, the effective area of which is typically large compared to the actual valve orifice, producing a forward force that tends to hold the valve open. Moreover, the viscous drag of the fluid flowing in control orifice 42 in contact with piston body 38 produces a further force tending to open the valve. Neither of those valve-opening forces is present to a significant extent in a conventional check valve in open position. Their effect in the present valve is to stabilize the valve in open position by a kind of positive feedback action.

Upon termination of the pressure pulse supplied to header chamber 12, the valves are all promptly closed by action of their return springs 40. If the header chamber is reduced at cutoff to a pressure less than atmospheric, as is preferred, a reverse pressure drop is established across control orifice 42, rendering the valve closing action more prompt and reliable. The valve structure thus tends to increase stability of operation both for opening and closing of the valve.

That stabilizing action greatly facilitates satisfactory operation of a plurality of valved nozzles supplied from the same header block, and is especially valuable for operating several such nozzles from the same supply line 16. When a pulse of fluid pressure is supplied to chamber 12 there is initially no flow out of the chamber, and the header pressure tends to rise to the full supply pressure. If that pressure exceeds the valve-opening threshold, all valves may be opened, at least momentarily. The resulting flow, however, reduces the header pressure appreciably, due to pressure drop in conduit 16. With check valves of conventional type, that reduction may well go below the threshold pressure, permitting some of the valves to close. The practical effect is usually erratic and unreliable valve operation, and correspondingly irregular delivery of fluid to the work surface. With the present valve structures, even if the pressure in header chamber 12 drops under steady flow conditions below the threshold needed initially to open the valves, that pressure is still ample to prevent valve closure due to the piston and viscous actions that have been described. It is therefore feasible to operate a plurality of nozzles from the same supply line even with a supply pressure that exceeds the valve-opening threshold by only a moderate excess.

That threshold is readily adjustable by shifting piston member 36 on the valve stem to vary the tension of spring 40. Moreover, such adjustment automatically varies the length of control orifice 42 correspondingly, making that passage longer as the spring tension is increased. Hence the stabilizing pressure drop that tends to hold the valve open increases automatically with the spring tension tending to close the valve. That combination of two coordinated results in a single adjustment operation is ordinarily highly convenient. If preferred, of course, separate adjustments can be provided for the two functions, as by forming spring shoulder 37 on a sleeve threaded on valve stem 34 and making piston body 38 threadably adjustable on external threads on that sleeve.

Ordinarily the rate of delivery of fluid from nozzle 14 is most conveniently adjustable by variation of the fluid supply pressure at the intermittent source, as will be described. However, further adjustment of the delivery rate is available by axial adjustment of tip 26. As that tip is screwed forward, valve element 30 is permitted to move farther forward in open position. With suitable dimensioning of the parts, the nozzle tip may be screwed home to lock the valve closed, providing convenient selection of the active nozzles for a desired pattern.

FIG. 3 represents in axial section a modification of the structure of FIGS. 1 and 2, whereby the control orifice 42a is located downstream of the valve itself and is

5

variable together with the spring force by adjustment of the nozzle tip 26a. The latter is threaded into the forward end of the main body bore, as in the previous form, but carries a rearwardly extending integral sleeve formation 50. The valve head 32a carries an integral forwardly extending sleeve formation 52 which is telescopically received within tip sleeve 50 with a small radial clearance. The two sleeves thus define a generally annular passage 42a of limited radial dimension. That passage corresponds generally in function to control orifice 42 of the previous embodiment. A spring 40a is received within sleeve 52 and acts between the valve element and the nozzle tip. Axial adjustment of that tip thus varies the spring tension and also varies the length of control orifice 56. As illustrated, that orifice is relatively short in closed position of the valve and increases in length with opening movement of the valve element. That movement is positively limited by the nut 54, which is threaded on the valve stem 34a and engages a rearwardly facing shoulder 55 on the valve body. Channels 57 are formed in the forward portion of the nut insuring essentially free fluid flow in fully open position of the valve. The modification of FIG. 3 thus provides adjustments that functionally correspond to those of the previous embodiment, but the functions of the tip adjustment and the valve stem nut adjustment are interchanged.

FIG. 3 further illustrates that the flow resistance in the control orifice can be made to vary with the position of the valve element by making the opposing walls of the orifice slightly conical, so that relative axial movement of the walls directly alters the radial spacing between them. In FIG. 3 such variation of radial dimension of control orifice 42a is combined with simultaneous variation of the effective length of the orifice. The same effect may be obtained in the modification of FIGS. 1 and 2 by making the opposing walls of control orifice 42 slightly conical. A variety of similar effects are obtainable by using different conical angles on the two walls, or by making one wall conical and the other right cylindrical. The term "conical" in this connection is intended to include functionally similar forms, which may include curves or step functions of varying radius rather than strictly conical surfaces.

The invention is further illustrated by the structure shown somewhat schematically in FIG. 4. The housing 60 encloses a cylindrical chamber 62 in which the valve element 70 is axially slidable. The annular valve seat 65 is formed on the end of tube 66, coaxially threaded into the inner end wall 67 of housing 60. That tube may connect the valve to a suitable source of intermittently pressurized fluid, either directly or via a header chamber or a preferably flexible conduit. Valve element 70 comprises a cylindrical body portion 72 and a valve portion 74. Body portion 72 preferably fits closely but freely in the valve chamber and is provided with a suitable seal, shown as the O-ring 73. At its inner end the valve element carries a valve formation 76, adapted to sealingly engage valve seat 65 in response to inward movement of the valve element. That engagement acts as a limit stop for such movement, which is yieldingly urged by the compression spring 80, acting between the shoulder 77 on the valve element and an internal collar 82, adjustably threaded in the end of housing 60. Collar 82 also functions as a positive stop, being engaged by the shoulder 79 on the valve element to limit outward movement of the later. Threaded adjustment of collar 82 permits coordinated variation of the degree of valve opening and the spring tension.

Fluid from chamber 62 enters the axial bore 87 in the valve element via the radial passages 88, and is then delivered through the axial nozzle orifice 86 of relatively small diameter. Orifice 86 not only acts as delivery nozzle, but during outward fluid flow develops a pressure drop that is effectively applied to the entire inner axial face of the valve element, tending to hold the valve open so long as an appreciable supply pressure is maintained in tube 66.

6

When the operating pressure pulse is terminated, the valve is returned to closed position by spring 80. If, as is preferred, the cutoff pressure in tube 66 is less than atmospheric, fluid tends to be drawn inward through nozzle orifice 86, and the pressure drop developed by that flow aids the closing movement of the valve. The present structure is similar to the previous forms in utilizing piston action to stabilize the valve operation, but differs in that the forward face of the piston structure is exposed to atmospheric pressure rather than to a fluid pressure upstream of the nozzle orifice. However, nozzle orifice 86 in the present structure may be considered to establish the pressure differential between substantially the whole supply pressure acting on the inner piston face within chamber 62 and atmospheric pressure acting on the outer piston face outside that chamber. As in the previous embodiments, the effective piston area is larger than the area of the valve orifice, the latter being approximately equal to the inside diameter of tube 66.

Pressurized fluid may be supplied intermittently to nozzle structures of the described type in many different ways. For example, a continuously operating pump may supply pressure to a switching valve that is operated by solenoid control or the like to connect the nozzles via a suitable conduit alternatively to the output and to the input sides of the fluid pump, thereby supplying either a relatively large supply pressure or a subatmospheric cutoff pressure to the nozzle structures.

FIG. 5 represents a preferred supply system in which a fluid pump of reciprocating type is actuated intermittently only when fluid application to the work surface is required. Following each such actuation, the pump is returned to rest position and is thereby recharged and ready for another actuation. In ordinary practice, the pump stroke capacity is abundantly adequate to maintain application for the longest continuous application periods that are required.

In FIG. 5 an open melt tank is represented at 90, with insulating housing 92 and removable cover 93, mounted in heat insulated relation on a supporting frame 94. Heaters are mounted in suitable bores 96 in the body of the tank, and are thermostatically controlled in known manner by a temperature probe in the bore 97. The tank accepts hot melt compositions in slab, pellet or chunk form, melting the material and raising it to the desired temperature for delivery through the filter screen 103 to the outlet opening 104 in the tank bottom. The pump block 100 is mounted in close heat conducting relation to the bottom of tank 90, with the inlet passage 102 to the pump communicating with tank outlet 104. An O-ring seal 105 is provided between the tank and the pump block. The passage 102, 104 is provided with a check valve, shown as the hollow ball 106 which normally floats in the fluid melt, engaging the downwardly facing valve seat 107 and preventing upward flow. Alternatively, a conventional solid ball may be used, spring-urged upward by a coil spring. Downward movement of ball 106 to open the valve is limited by the stop rod 108, which is threaded in sealed relation in the valve block and is accessible for adjustment from below. The light ball makes a valve spring unnecessary, and the valve then opens in absence of fluid, making the pump self priming. The low mass of the ball offers the further advantage of fast response to changes in direction of fluid flow.

The pump cylinder comprises a horizontal bore 110 in pump block 100, communicating at its inner end with pump inlet 102. Pump outlet 112 is typically coaxial with cylinder 110, though additional outlets may diverge in other directions in any desired number. Outlet 112 communicates directly and without any intervening valve structure with header chamber 12 of FIGS. 1 to 3, for example, either directly or via supply conduit 16, typically heated in known manner. The pump piston 114 slides in cylinder 110 with suitable seals 115. The piston is driven by the rod 116, preferably connected through a universal joint

indicated at 117. Rod 116 may be driven by any desired type of two-way actuator that responds with suitable speed and power to a control signal. Actuators of electrical, hydraulic and pneumatic types are well known. The present illustrative actuator will be described as pneumatic, but with simple modifications may be considered as hydraulic instead.

A double-acting air cylinder is represented at 120 with piston 122 and inlet conduits 124 and 126 at its inner and outer ends, respectively. Compressed air from a source such as a continuously operated compressor 128 is supplied to conduits 124 and 126 via the solenoid operated four-way valve indicated schematically at 130. That valve normally supplies air to conduit 124 and opens conduit 126 to the atmosphere, driving pump piston 114 outward in its cylinder, that is, to the right as seen in FIG. 5. A charge of fluid is thereby drawn into pump cylinder 110 from tank 90 via check valve 106. Energization of air valve 130, as by an electric pulse delivered over the line 132 from a suitable switch device 134, shifts the compressed air to conduit 126 and opens conduit 124 to the atmosphere, driving pump piston 114 inward and pressurizing the fluid melt in cylinder 110 and throughout supply conduit 16. Fluid flow back to tank 90 is prevented by check valve 106. When the system is employed for the illustrative purpose of sealing cartons, switch 134 is typically controlled in known manner by one or more mechanical feeler arms that engage the cartons as they pass the applicator nozzles. The fluid pressure during delivery pulses, and hence the rate of fluid delivery at each nozzle, is conveniently adjustable by variation of the air pressure supplied at 128. Actuator 120 is preferably also provided with adjustable limit stops, not explicitly shown, by which the length of the piston stroke during each actuation can be limited if desired. Further convenient control of the actuator operation is obtainable by utilizing at 130 a four-way control valve that has separate exhaust ports to atmosphere for exhaust from line 124 and from line 126, and providing a variable flow-limiting orifice in the exhaust from line 124. That orifice then controllably limits the rate of the fluid delivery stroke of pump 120 without affecting other aspects of the cycle.

It will be noted that in the present preferred system supply conduit 16 communicates directly and without any intervening valve structure whatever with the working face of pump piston 114. Hence the full pump pressure during the compressing stroke is delivered to that conduit; and, during the return stroke of the piston, conduit 16 is exposed to whatever sub-atmospheric pressure is produced in pump cylinder 110. The magnitude of that negative pressure is readily adjustable by varying the setting of stop pin 108 to control the extent to which check valve 106 is permitted to open. As that opening is decreased, for example, the rate of fluid supply to the pump during its return stroke is correspondingly decreased, producing a more negative pressure in conduit 16. The rate of piston return is correspondingly reduced, but it is found in practice that for most application patterns that are required the intervals between pattern elements allow ample piston return time even with considerable throttling at valve 106.

In general, the greater the magnitude of the negative pressure developed during the pump return stroke and transmitted to the nozzle header chamber or chambers, the more sharp and reliable is the closure of the check valves at the respective nozzles. When a plurality of nozzles with their respective check valves are operated from a single supply conduit, the described valve structure with piston assisted actuation greatly aids the uniformity and stability of operation of all nozzle valves.

I claim:

1. A system for applying to a work surface that is movable along a path a viscous hot melt adhesive in a controlled pattern of parallel line segments, said system comprising in combination

structure forming a hot melt tank open to atmospheric pressure and adapted to receive solid adhesive, means for controllably heating the tank structure to melt adhesive in the tank,

5 structure forming a pump cylinder thermally integrated with said tank structure, said cylinder containing an axially reciprocable pump piston and communicating with the tank interior via a check valve for admitting liquid adhesive to the cylinder during suction movement of the piston,

10 a piston actuator mechanically coupled to the piston to drive the piston in intermittent cycles of movement in response to control fluid pressure pulses supplied to the actuator, each piston cycle comprising a delivery stroke followed by a suction stroke,

15 structure forming a header chamber having a chamber wall with a plurality of mutually spaced through bores therein, said header structure being adapted to be mounted with said wall in spacedly opposed relation to said work surface path and with the bore spacing transverse of said path,

20 a conduit connecting the header chamber to the pump cylinder, said conduit being continuously open for flow of liquid adhesive therebetween in both directions,

25 a plurality of nozzle structures mounted in the respective through bores in said header chamber wall and forming respective nozzle orifices that communicate in parallel with the header chamber,

30 an individual normally closed valve for each nozzle orifice normally closing the communication between that orifice and the header chamber and actuable, in response to presence in the header chamber of fluid pressure exceeding a predetermined threshold value, to permit outward flow of adhesive from the header chamber to the orifice to apply a line segment of adhesive to the work surface,

and means for supplying to said actuator control fluid pressure pulses in timed relation to the work surface movement and of sufficient magnitude to make the adhesive pressure in the header chamber at least momentarily exceed said threshold value and thereby to open all the nozzle valves effectively simultaneously.

2. The combination defined in claim 1, and in which each said nozzle structure and valve comprise

a generally cylindrical body having a passage with a forwardly facing shoulder forming a valve seat, structure forming said nozzle orifice at the forward end of the passage and closely adjacent the valve seat,

a valve element axially movable in the passage and having a closure portion adapted to sealingly engage the valve seat by virtue of rearward movement of the valve element,

means yielding urging the valve element rearwardly to close the valve,

the valve element having a generally cylindrical portion that forms with the passage wall a generally annular and axially elongated control orifice of limited sectional area through which fluid flows in series with the valve when the valve is open, the sectional area of the control orifice throughout its axial length being so limited with relation to the nozzle orifice that such flow exerts an appreciable viscous drag on the valve element tending to hold the valve open.

3. The combination defined in claim 2, and in which said generally cylindrical portion of the valve element is axially adjustable relatively to the closure portion of the valve element to vary the effective length of the control orifice.

4. The combination defined in claim 2, and in which said means yielding urging valve closure include

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means adjustably movable to vary the yielding force exerted on the valve element,

movement of the last said means acting to vary the axial length of said control orifice in the same sense as said force variation.

5. The combination defined in claim 1, and in which each said nozzle structure and valve comprise

a generally cylindrical body having an axial through passage with a forwardly facing shoulder forming a valve seat,

a valve element axially movable in the passage in sealed relation therewith and having a portion adapted to sealingly engage the valve seat by virtue of rearward movement of the valve element,

structure forming said nozzle orifice at the forward end of said valve element in open communication with the passage between the valve seat and the valve element seal,

and means yielding urging the valve element rearwardly in the passage to close the valve.

6. The combination defined in claim 1, and including means for adjustably limiting the rate of flow through said communication between the tank and the pump cylinder when the check valve is open, to produce an adjustably variable subatmospheric pressure in the header chamber during the suction stroke of the pump piston.

7. A system for applying to a work surface that is movable along a path a viscous hot melt adhesive in a controlled pattern of parallel line segments, said system comprising in combination

structure forming a hot melt tank open to atmospheric pressure and adapted to receive solid adhesive,

means for controllably heating the tank structure to melt adhesive in the tank,

structure forming a pump cylinder containing an axially reciprocable pump piston and communicating with the tank interior via a check valve for admitting liquid adhesive to the cylinder during suction movement of the piston,

a piston actuator for driving the piston in intermittent cycles of movement in timed relation to the work surface movement, each piston cycle compris-

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ing a delivery stroke followed by a suction stroke, structure forming a plurality of dispensing nozzles mountable adjacent the work surface path and communicating in parallel with the pump cylinder,

an individual normally closed valve for each nozzle normally closing the communication between that nozzle and the cylinder and actuatable in response to adhesive pressure to permit outward flow of adhesive from the nozzle,

and means for adjustably limiting the rate of flow from the tank interior to the pump cylinder to produce an adjustably variable subatmospheric pressure in the cylinder during the suction stroke of the pump piston and thereby insure closure of said valves.

8. The combination defined in claim 7, and in which the last said means comprise structure adjustably limiting the degree of opening of said check valve.

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