HOT MELT ADHESIVE GUN

Inventor: Robert L. Ornsteen, Cape Nedick, Maine

Assignee: Ornsteen Chemicals and Textiles Co., Inc., Seabrook, N.H.

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Primary Examiner—Robert B. Reeves
Assistant Examiner—John P. Shannon
Attorney—Joseph Weingarten et al.

ABSTRACT

A hot melt gun for use with a cartridge of thermoplastic adhesive and in which a bead of melted adhesive is forced out of a gun nozzle by pneumatic action for efficient high volume bonding. The gun includes apparatus preventing blockage of the air supply line which can be caused by the backup of molten adhesive within the gun, while not detracting from overall gun performance.

8 Claims, 6 Drawing Figures
HOT MELT ADHESIVE GUN

FIELD OF THE INVENTION

This invention relates to adhesive dispensing apparatus and more particularly to a hot melt gun for the application of normally solid molten adhesive to a working surface.

BACKGROUND OF THE INVENTION

Hot melt guns are known wherein a thermoplastic adhesive is maintained in a molten state within the gun, and a bead of adhesive extruded through a nozzle for application to a work surface. In one well known form of hot melt gun, adhesive material is supplied to the gun in the form of a normally solid cartridge which is contained within a heated chamber and which is maintained therein in a molten or plastic state. The gun is operated by actuation of a trigger mechanism which allows the introduction of air of suitable operating pressure into the chamber to force molten adhesive forward through the gun nozzle. However, adhesive guns of the conventional construction have exhibited a major disadvantage which limits their overall utility. Molten adhesive within the chamber can flow into the air supply line and associated pneumatic apparatus, especially if the gun is disposed in an inclined position with the air supply line below the adhesive material. The air supply line and pneumatic apparatus can thereby become clogged resulting in impaired gun operation, which can be remedied only by disassembly and cleaning of the contaminated elements.

In an attempt to remedy the difficulties of adhesive backflow, glue guns have been designed heretofore employing a piston disposed within the adhesive chamber, and pneumatically driven along the length of the chamber to force melted adhesive through the gun nozzle during use. The piston and associated chamber must be machined to rather close tolerances to provide proper operation, thereby increasing the cost of such a gun structure. Moreover, the addition of the piston adds to the complexity of the gun structure. It is an object of this invention to provide an improved hot melt adhesive gun in which the problems of adhesive backflow are substantially eliminated without material increase in gun complexity or cost.

SUMMARY OF THE INVENTION

In accordance with the present invention, a hot melt adhesive gun is provided wherein the adhesive is isolated from the pneumatic elements of the gun structure such that the air supply line and associated pneumatic elements cannot become clogged during operation. Briefly, the gun includes a heated chamber in which a cartridge of normally solid thermoplastic adhesive is maintained in a molten or plastic state. Disposed within a rear surface of the chamber is a sealing plate which is pneumatically driven and which isolates the air supply line from the adhesive when the gun is de-energized. The air supply line is disposed behind the sealing plate and is provided with air or other gas or suitable operating pressure from a gas supply. Air is also supplied to an actuator coupled to the sealing plate and operative to cause forward movement of the plate to allow release of air into the adhesive chamber.

The gun is typically operative by a manually actuated trigger valve which permits the introduction of air to the gun from a compressed air supply. Upon actuation of the trigger, air is introduced into the chamber to force the melted adhesive forward through the nozzle for application to a work surface. Upon release of the trigger, the pressurized air within the cylinder is evacuated to the atmosphere to cause discontinuation of the flow of adhesive from the nozzle. The actuator is operative to remain energized until a predetermined lower pressure level is reached, at which time the actuator retracts causing the sealing plate to return to its rest position in sealing engagement over the air supply line. Melted adhesive which may flow rearwardly in the adhesive chamber cannot occlude the supply line, as the retracted sealing plate substantially prevents any flow of adhesive to this line. Any adhesive which may flow onto the sealing plate tends to be driven forward by the action of air introduced into the chamber when the gun is next actuated. As a result, the gun operates in a clean and extremely efficient manner as there is substantially no opportunity for the operating elements to become clogged by adhesive.

DESCRIPTION OF THE DRAWINGS

The invention will be more fully understood from the following detailed description taken in conjunction with the accompanying drawings, in which:

FIG. 1 is a pictorial view of a hot melt adhesive gun according to the invention;
FIG. 2 is an elevation view, partly in section, of the embodiment of FIG. 1;
FIG. 3 is a plan view of the inner surface of the sealing plate of the embodiment of FIG. 2; and
FIGS. 4 through 6 are partly cutaway sectional elevation views illustrating the pneumatic operation of the adhesive gun at various stages of its operating sequence.

DETAILED DESCRIPTION OF THE INVENTION

A hot melt adhesive gun embodying the invention is shown in typical implementation in FIG. 1. The gun includes a housing 10 having a heated chamber for maintaining a cartridge of thermoplastic adhesive in molten or plastic condition, a handle 12 having a trigger mechanism 14 mounted therein for manual actuation of the gun, a nozzle 16 through which a bead of melted adhesive is pneumatically driven for application to a work surface, and a pneumatic assembly 18 attached to the rear portion of housing 10. A cable 20 includes a gas supply line for connection of the gun to a source of air or other operating gas of suitable pressure, typically 40 psi, and electrical wiring for application of energy to an electric heater for maintaining the gun chamber at a temperature sufficient to maintain the adhesive in a molten or plastic state.

The gun is shown in more detail in FIG. 2 - 4 and includes a cylindrical chamber 22 formed in housing 10 and into which an adhesive cartridge is introduced. A rod shaped electric heater 24 is disposed in an opening provided in housing 10 below chamber 22 and is operative to generate sufficient heat to melt the thermoplastic adhesive and to maintain it in a liquid or plastic state within chamber 22. The heater is thermostatically controlled by an appropriate electrical energy source well known in the art. Typically heater 24 has a higher heat concentration at the forward end of the chamber to maintain adhesive in this region in sufficiently molten condition for extrusion out of nozzle 16. Heating of chamber 22 can be enhanced by use of radiating fins.
within the chamber and which can also serve to break up a plastic mass of adhesive which can be pushed against the fins by force of the compressed air in the chamber.

The pneumatic assembly 18 includes a mounting plate 26, removably attached to the housing 10, as shown, having an air supply connector 28 which is coupled to trigger mechanism 14 via a tube 30 by which pressurized air is supplied. A spring-loaded pneumatic actuator 32 is coupled via a fitting 50 to connector 28 by way of a tube 34 having a smaller bore than that of tube 30. A cylindrical sealing plate 36 is connected to a piston rod 38 of actuator 32 by means of a hub portion 40 secured to a threaded end of rod 38. The plate 36 in its rest position is disposed within a cylindrical recess 42 provided in mounting plate 26. The recess has a peripheral surface which flares outwardly toward chamber 22 to provide an annular aperture 44 of V-shaped cross section for introduction and evacuation of air into and out of the chamber, as will be explained.

The hub 40 is disposed within an opening 46 which includes a port communicating via passage 48 to fluid input connector 28. The actuator 32 includes a piston 52 connected to rod 38 and slideably disposed within a cylinder 53. A spring 54 is disposed within cylinder 53 between piston 52 and mounting fitting 56 and is biased to maintain piston 52 and associated plate 36 in its retracted position, which in the illustrated embodiment, is in the position shown in FIGS. 2 and 4. The actuator 32 is, per se, well known in the art and is operative to remain in a retracted position until a predetermined pressure, say 10 psi, in introduced via tube 34 into cylinder 53, at which time the piston 52 is forced, against the bias force of spring 54, into its extended position until the applied air pressure drops below the predetermined minimum pressure level needed to overcome the biasing force of spring 54, whereupon the piston 52 and associated plate 36 are caused to retract to the rest position.

The pneumatic assembly 18 is affixed to the rear surface of housing 10 such as by machine screws 58 attached to mounting flanges 60, and which cooperate with threaded handles 62 and flanges 64 to maintain mounting plate 26 in sealing relationship with the confronting surface of housing 10. An annular gasket 66 can be provided between the confronting surfaces of housing 10 and plate 26 to maintain proper sealing relationship.

In the retracted position depicted in FIGS. 2 and 4, plate 36 is in substantially sealing relationship within the associated recess 42 to prevent melted adhesive within chamber 22 from flowing behind plate 36 to block or occlude the air supply passage 48 or opening 46. Only slight forward movement of plate 36 is needed to permit air to be emitted via groove 44 into chamber 22 to provide rapid pressurization of the chamber and resulting flow of glue from nozzle 16. The nozzle includes a normally closed ball valve 68 which is maintained in closed position by action by a spring 70, and which, by the force of melted glue being extruded through passage 72, is caused to open to allow the flow of glue out of the nozzle and onto a work surface. The spring 70 compresses at a selected pressure which is intermediate the operating pressure within chamber 22 and the residual pressure therein after venting.

Upon actuation of trigger mechanism 14, the surge of air from passage 48 into opening 46 exerts an impulsive force on the rear surface of plate 36, causing its immediate outward displacement, as illustrated in FIG. 5, sufficient to provide an air path, as illustrated by the arrows 74, from operating 46 through the air channel provided between the confronting surfaces of plate 36 and plate 26, and thence via groove 44 into chamber 22 to commence the pressurization thereof. The groove 44 also serves as a nozzle to direct the pressurized air in an annular stream into the chamber such that any adhesive which may have collected in the groove and confronting surfaces of the chamber or plate 36 tend to be blown forward and away from the input air passages. Thus, any tendency of the adhesive to clog the air supply passages is substantially minimized by operation of the novel gun construction.

When the pressure in cylinder 53 exceeds the bias force of spring 54, piston 52 is caused to be forced forward to its fully extended position, as depicted in FIG. 6. With the sealing plate 36 fully extended, compressed air more rapidly enters chamber 22 to pressurize the chamber to its operating level and force the molten adhesive toward the front of the chamber and out through nozzle 16. If the adhesive in the back portion of the chamber is not fully melted, the unmelted portion of the adhesive cartridge can act as a piston under the force of the compressed air to aid in forcing the melted adhesive out through the nozzle. To aid in this piston effect, the adhesive cartridge in its normally solid state can be made with an outside diameter slightly smaller than the inside diameter of chamber 22 to provide a good sliding fit.

Upon release of trigger mechanism 14, the air supply tube 30 is coupled to a vent port 76 which is provided in the trigger valve and which provides a venting path for the pressurized air within chamber 22. The air path for evacuation is the same as the path for pressurization. More particularly, the air within chamber 22 is evacuated via groove 44 opening 46, passage 48, tube 30 and vent port 76. The air within cylinder 53 of actuator 32 is evacuated at a slower rate by reason of the smaller capacity and greater flow resistance of the tube 34 which is of smaller bore than the bore of tube 30 and passage 48. Thus, the actuator 32 remains energized and the piston 52 and sealing 36 remain in their full forward position for a predetermined time during which chamber 22 is evacuated to an intended lower pressure level. When the pressure in actuator 32 falls below its predetermined lower pressure limit, piston 52 is caused to retract by action of spring 54, causing plate 36 to seat within recess 42 and seal the air supply opening 46. The chamber 22 can be vented to substantially atmospheric pressure, or, alternatively, to some higher residual pressure which is below the pressure which is needed to open nozzle valve 68. This higher residual pressure may be useful in reducing the time needed to pressurize chamber 22 to its operating level. The provision of a tapered groove 44 cooperative with plate 36 permits the evacuation path to remain open until plate 36 fully seats within recess 42.

The nozzle valve 68 under the government of associated spring 70 is operative to open at a pressure higher than the pressure necessary to operate actuator 32. During gun operation, the nozzle valve will therefore open after actuator 32 extends sealing plate 36, and the nozzle valve will close before the actuator retracts the sealing plate to its seated or rest position. As a result, valve 68 closes quickly upon evacuation of air from
chamber 22 of discontinue the flow of adhesive and prevent dripping after gun deactuation. It is preferable to evacuate chamber 22 to a sufficiently low pressure level such that residual pressure within the chamber is insufficient to cause spraying or emission of adhesive from the back of the chamber when mounting plate 26 is removed for cleaning or recharging of the gun.

The time for evacuation of chamber 22 is determined by the bias force of actuator spring 54, the stroke of piston 52 and the size and configuration of groove 44 and associated air path defined by plates 26 and 36, opening 46 and passage 48, as well as the relative flow capacities of tubes 30 and 34. The evacuation time is usually a fraction of a second and is selected in a particular implementation to provide reduction of the air pressure in chamber 22 to an intended residual level.

It will be appreciated that the sequence of operations of the gun structure described hereinabove occurs within a fraction of a second and can be considered substantially instantaneous in terms of practical operation. Thus, upon depression of the trigger, glue immediately issues from nozzle 16, while glue flow immediately ceases upon release of the trigger.

While a preferred embodiment of the invention has been shown and described, it will be appreciated that various modifications and alternative implementations will now occur to those versed in the art. For example, rather than employing air supply tubes 30 and 34 of different bores to provide the different flow rates, tubes of equal bore can alternatively be used with a flow control valve in the path of tube 34 to adjust the flow therein. Accordingly, it is not intended to limit the invention by what has been particularly shown and described except as indicated in the appended claims.

What is claimed is:

1. A hot melt adhesive gun for use with a cartridge of normally solid thermoplastic adhesive, said gun comprising:
   a housing having a chamber adapted to contain a cartridge of normally solid thermoplastic adhesive;
   means for heating said chamber to a predetermined temperature to maintain said adhesive in a molten condition;
   nozzle means coupled to the forward end of said chamber and including a normally closed valve operable in response to a predetermined force of molten adhesive to permit the flow of adhesive from said nozzle means;
   trigger means adapted for coupling to a source of operating gas at predetermined operating pressure;
   means for venting said chamber to the atmosphere; and
   a pneumatic assembly including;
   a mounting plate sealingly attached to the rear end of said housing and confronting said chamber;
   a gas supply port disposed within said mounting plate and coupled to said trigger means;
   actuator means; and
   a sealing plate disposed in said mounting plate and connected to said actuator means and operative in a first position to isolate said gas supply port from said chamber and in a second position to provide a gas communication path between said chamber and said gas supply port.

2. A hot melt adhesive gun according to claim 1 wherein said actuator means includes a piston;

3. A hot melt adhesive gun according to claim 2 wherein said sealing plate is operative to be driven to a third position intermediate said first and second positions in response to the initial application of operating gas pressure through said gas supply port caused by actuation of said trigger means; said third position being operative to establish a gas communication path between said chamber and said gas supply port.

4. A hot melt adhesive gun according to claim 3 wherein said sealing plate in its first position is disposed within a recess provided in said mounting plate; said recess having a peripheral surface cooperative with a confronting surface of said sealing plate to define a groove which flares outwardly toward said chamber and which functions as an aperture upon the establishment of said gas communication path.

5. A hot melt adhesive gun according to claim 4, wherein said pneumatic assembly includes a first gas supply line provided in said mounting plate and terminating in said gas supply port; a second gas supply line in fluid communication between said first gas supply line and said actuator means;

6. A hot melt adhesive gun according to claim 5 wherein the stroke of said piston, the relative fluid flow capacities of said first and second gas supply lines, the retraction time of said sealing plate, and the configuration of said aperture are predetermined to provide evacuation of said chamber to a selected residual pressure upon release of said trigger means.

7. A hot melt adhesive gun according to claim 2 wherein said nozzle valve includes a spring means urging said nozzle valve into a normally closed position;

8. A hot melt adhesive gun according to claim 2 wherein said nozzle valve includes a spring means having a bias force operative to permit opening of said nozzle valve at a pressure level intermediate the operating pressure in said chamber and the residual pressure therein.

9. A hot melt adhesive gun according to claim 2 wherein said nozzle valve includes a spring means urging said nozzle valve into a normally closed position;

10. A hot melt adhesive gun according to claim 2 wherein said nozzle valve includes a spring means having a bias force greater than the bias force of said actuator spring means such that during evacuation of said chamber said nozzle valve closes before retraction of said actuator piston to its first position.