GLUE GUN CONSTRUCTION

Inventors: Carl E. Weller, Easton, Pa.; Alden J. Brassaw, Phillipsburg, N.J.

Assignee: Cooper Industries, Inc., Houston, Tex.

Filed: May 7, 1971

Appl. No.: 141,110

U.S. Cl. .......... 401/2, 401/180, 222/146 HE, 222/340

Int. Cl. ............... B05c 5/02, B67d 5/62

Field of Search.......... 222/146 R, 146 H, 222/146 HE, 386, 340, 163, 387, 325, 326, 327, 324; 401/1, 2, 259, 260, 180; 219/221, 227, 229, 230, 241, 421; 228/52, 53; 184/45

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Primary Examiner—Robert B. Reeves
Assistant Examiner—Francis J. Bartuska
Attorney—Mason, Fenwick & Lawrence

ABSTRACT

An electrically heated glue gun having an elongated tubular melt chamber for receiving a solid adhesive rod near one end thereof and having a convergently tapering portion at its other end, a nozzle coupled on the other end of the melt chamber having a bore defining a discharge orifice and a valve seat, a heating element for heating the adhesive in the melt chamber to a molten state, a plunger movable axially through the melt chamber for pressing the adhesive forwardly, a valve in the nozzle bore for normally closing against the valve seat and having a pin extending through the discharge orifice to be engaged by the work for opening the valve, and a spring mechanism to be releasibly coupled with the plunger to urge the plunger forwardly.

15 Claims, 11 Drawing Figures
INVENTORS
CARLE. WELLER &
ALDEN J. BRASSAW

ATTORNEYS
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GLUE GUN CONSTRUCTION

BACKGROUND AND OBJECTS OF THE INVENTION

The present invention relates in general to devices for dispensing hot melt adhesives, and more particularly to hand held devices having a heated melt chamber through which a hot melt thermoplastic adhesive is forced to melt and dispense the adhesive through a nozzle to a work surface. Such devices are now commonly referred to as glue guns.

Hot melt adhesives in the form of thermoplastics and the like have been found to be well suited for a wide variety of uses and have come into popular use. A number of hand held gun type dispensing devices for such hot melt adhesives have been developed, wherein the adhesive in a solid rod form is supplied to a heating passage way in which it is melted and extruded through a narrow opening onto the surface to be adhered. Various arrangements have been resorted to for applying force to the adhesive rod to move the molten adhesive through the discharge nozzle and apply it to the desired surface, such as by arranging the glue gun so that the thumb of the user can press against the exposed rear end of the adhesive rod to force it toward the discharge nozzle, or by use of rotating feed wheels, feed ratchets, or similar devices. Difficulties have been encountered in minimizing the expense of glue guns while providing satisfactory mechanical feed mechanisms for applying force urging the adhesive rod toward the discharge nozzle and in preventing leakage or drip from the nozzle during non-use. One type of glue gun which has been offered commercially employs a ratchet and trigger mechanism for advancing the adhesive rod and has a nozzle which must be rotated by a wrench to close or open a valve mechanism in the nozzle to control leakage or drip during non-use.

An object of the present invention is the provision of a glue gun or thermoplastic adhesive dispensing hand tool of novel construction which has a spring urged force mechanism for continuously urging the solid adhesive rod toward the forward or discharge end of the heating chamber and which provides a convenient arrangement for loading new charges of adhesive in rod form into the glue gun.

Another object of the present invention is the provision of a novel glue gun having a heating chamber and discharge nozzle into which an adhesive charge in rod form is urged, and including a valve mechanism which automatically closes to prevent leakage of glue from the discharge opening except when a portion of the valve mechanism which projects through the discharge opening in the nozzle is pressed against a surface on which glue is to be deposited.

Another object of the present invention is the provision of a novel glue dispensing hand tool as described in either of the two preceding paragraphs, including a plunger or piston mechanism for urging the charge of solid adhesive into the heating chamber and discharge nozzle, wherein the plunger mechanism can be easily removed for cleaning of the tool or for replacement of the plunger assembly.

Other objects, advantages and capabilities of the present invention will become apparent from the following detailed description, taken in conjunction with the accompanying drawings illustrating a preferred embodiment of the invention.

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BRIEF DESCRIPTION OF THE FIGURES

FIG. 1 is a perspective view of a glue gun or adhesive dispensing hand tool embodying the present invention;

FIG. 2 is a vertical section view of the glue gun, taken substantially along the center line of the tool;

FIG. 3 is a schematic diagram of the electrical heating circuit for the tool;

FIGS. 4 and 5 are vertical transverse section views through the glue gun, taken along the lines 4—4 and 5—5 of FIG. 2;

FIG. 6 is a fragmentary exploded perspective view illustrating the removable nozzle, the converging portion of the melt chamber, and the valve components of the glue gun;

FIG. 7 is a horizontal longitudinal section view, taken along the line 7—7 of FIG. 2;

FIG. 8 is a fragmentary longitudinal section view through the melt chamber and discharge nozzle portions of a modified embodiment;

FIG. 9 is a vertical section view taken along the line 9—9 of FIG. 8;

FIG. 10 is a fragmentary section view through the melt chamber and discharge nozzle portions of another modified embodiment; and

FIG. 11 is a vertical section view taken along the line 11—11 of FIG. 10.

DETAILED DESCRIPTION OF PREFERRED EMBODIMENTS

Referring to the drawings, wherein like reference characters designate corresponding parts throughout the several figures, the glue gun of the present invention is indicated generally by the reference character 12 and comprises a pistol-like housing 13 formed of mating housing halves 13A and 13B and including an upper body portion 14 and a pistol grip 15. Supported within the housing halves 13A and 13B in the upper region thereof is an elongated tubular melt chamber 16 having a cylindrical tubular portion 16A over the major part of its length and a converging truncated conical or tapered forward portion 16B at its forward end projecting forwardly from the gun housing 13 and terminating in an externally threaded annular end portion 16C surrounding a small diameter outlet opening 17. In the rear portion of the uniform diameter cylindrical barrel portion 16A is an upwardly facing loading opening 18 communicating with a loading well 19 defined by the housing halves 13A and 13B and opening through the top of the housing 13, through which a glue charge in solid form in the shape of a cylindrical rod or stick, indicated at 20 in FIG. 2, can be manually inserted into the uniform diameter barrel portions 16A of the melt chamber 16.

A discharge nozzle 21 is threaded onto the end portion 16C of the melt chamber 16, and has a bore 22 therethrough, having a smaller diameter outlet section 22A at the forwardmost end of the nozzle, and intermediate diameter middle section 22B, and a larger diameter internally threaded rear section 22C which threads onto the annular end portion 16C. A valve pin 23 has a smaller elongated cylindrical portion 23A within the bore portion 22 which projects forwardly from the nozzle, an enlarged valve portion 23B having a truncated conical surface confronting the annular transition wall between the bore portions 22A and 22B defining a valve seat, and having a shank portion 23C extending
rearwardly through the tapered portion 16B of the melt chamber and maintained in generally centered position within the outlet opening 17 by the triangular valve washer 24. Staked or otherwise formed outwardly protruding formations 23C on the shank portion 23C between the valve portion 23B and the valve washer 24 engage the valve washer when the valve pin 23 is forced rearwardly by pressing the projection 23A against the work surface to limit the extent of rearward axial movement of the valve pin 23 and thereby define its open limit position.

Projecting forwardly through the open rearmost end of the melt chamber 16 is a plunger 25 having a cylindrical teflon piston 26 at its forwardmost end whose outer diameter corresponds to the inner diameter of the uniform barrel portions 16A of the melt chamber, constrained by plunger washers 26A on a plunger rod 27 which is held in coaxial relation with the barrel portions 16A by a guide plate 28 fixed to the housing 13 and having a guide aperture through which the plunger rod extends. A plunger knob 27A is provided on the rearmost end of the plunger rod 27 at a location rearwardly and external of the housing 13.

A spring 30 supplies the force to expel hot glue from the nozzle 21. The spring 30 is located within a cylindrical spring tube 31 for guidance, positioned below and parallel to the axis of the plunger rod 27. The forwardmost end of the spring 30 is anchored, as indicated at 30A, to a post or anchoring formation on the housing 13, and the rearmost end of the spring 30 is anchored to a forwardly projecting cylindrical boss 32A on a manual spring pull device 32 having a finger hole 32B therein. The boss 32A is positioned within the rearmost end portion of the spring tube 31 and the spring tube is secured to it, for example, by the inwardly deformed indentation 31A. The forwardmost end of the spring tube is outwardly flared as indicated at 31B so that the circular outermost edge of the outwardly flared portion is slidably guided in the cylindrical cavity indicated at 33 defined by confronting portions of the housing halves 13A, 13B. The forwardmost end of the spring pull device 32 is inclined upwardly and forwardly to correspond to the inclination of the rearmost end of the upper body portion 14 of the housing 13, and has a forwardly opening cavity 32C therein sized to releasably receive the plunger knob 27A.

Surrounding the region of the barrel portion 16A of the melt chamber between the loading opening 18 and the tapered portion 16B is an electrical heating element 34 encompassed by a tubular metallic sleeve defining an element cover 35 for the heating element and also providing an elongated generally cylindrical thermostat well 35A along the bottom of the element cover to removable receive a cylindrical probe portion 36A of a thermostat switch 36. The heating element is formed of a wrap of mica sheeting, wrapped for example in spiral fashion about the barrel portion of the melt chamber 16, with a first winding layer of resistance wire such as nichrome wire, forming a 150 watt winding HW-1 between successive layers of the mica sheeting, and a second outer winding HW-2 forming a ballast winding, as hereinafter described with reference to the schematic electrical circuit. Nickel strips or similar thin conductor strips may also be provided between layers of the mica sheeting to make electrical connections with the windings as required.

In order to load the glue gun, the spring biased pull device 32 is pulled rearwardly against the force of the spring 30 until the cavity 32C therein is withdrawn from about the plunger knob 27A, and the pull device 32 is then rotated about the axis of the spring tube 31 so that the portion having the cavity 32C therein extends laterally from the axis of the boss portion 32A. The plunger rod 27 is then pulled rearwardly as far as it will go, withdrawing the piston 27 to a position just rearwardly of the loading opening 18, as determined by the limit stop screw 37, and a glue stick or rod 20 is inserted manually through the loading well 19 and opening 18 into the melt chamber 16. The plunger 25 is manually pushed forwardly to begin advancing the rod toward the nozzle, and the spring pull device 32 is then withdrawn to a point rearwardly of the plunger knob 27A and rotated upwardly to align the cavity 32C with the plunger knob 27A, and the pull device 32 is then allowed to be drawn forwardly by the spring 30 to receive the plunger knob 27A in the cavity 32C and exert a spring force on the plunger rod 27 forcing the plunger forwardly to advance the glue stick 20 as far as it will go toward the tapered portions 16B of the melt chamber 16. When the heating element 34 is energized as described hereinafter, to heat and melt the glue in the melt chamber 16, the spring force exerted on the plunger assembly 25 by the spring 30 forces the glue forwardly into the tapered chamber portions 16B and into the bore portion 22B of the nozzle 22, where a hydraulic pressure within the melt chamber is created and acts internally on the valve pin 23 to force the enlarged valve portion 23B against its seat formed by the transition wall between the nozzle bore sections 22A and 22B. When the forwardly projecting portion 23A of the valve pin is pressed against a surface on which glue is to be deposited, the enlarged valve portion 23B is moved rearwardly from its seat and glue is allowed to pass through and exit from the nozzle 22.

The glue gun is designed so that approximately one and one-half sticks of glue are required to fill that portion of the melt chamber 16 of an empty glue gun extending forwardly of the loading opening 18. The length of the stroke of the plunger 25 from the location disposing the piston 26 at the forwardmost end of the loading opening 18 to the forwardmost end of the stroke is such that when the tool is in use, a volume of glue equivalent to one stick is all that can be dispensed. Because of this, when the plunger reaches the forwardmost end of its stroke, the glue gun can be reloaded with another glue stick and immediately used again, since there is still melted glue in the forwardmost portion of the melt chamber.

It will be understood that internal pressure exerted by the glue against the enlarged valve portion 23B of the valve pin 23 normally keeps the valve closed. When the plunger piston 26 has moved to its forwardmost position, it could no longer generate pressure in the glue if the valve is in opened condition, and the valve pin 23 could then locate randomly, either open, nearly closed, or completely closed. To avoid this possible problem, provision has been made to insure positive closure of the valve when the plunger piston 26 reaches its forwardmost limit position. This is achieved by dimensioning the cylindrical extension or shank portion 23C of the valve pin extending rearwardly from the valve portion 23B so that the piston 26 comes into contact with the shank portion 23C and exerts spring force on it
shortly before the piston 26 reaches the forwardmost end of its travel. This force then holds the valve pin in closed position with the valve portion 23C against its seat until the glue gun is reloaded.

The thermostat switch or thermally actuated switch mechanism 36 having the probe portion extending into the lower well 35A of the element cover 35 is preferably of the type wherein the probe includes a ceramic sleeve which houses a thermally expandable metallic rod located coaxially within the sleeve and secured to or in abutment with the sleeve at the forwardmost end of the probe portion. The rod projects from the other end of the ceramic sleeve and engages a spring-like switch arm or similar switch member when the rod has expanded to a selected extent to open a pair of switch contacts which are normally closed until they are forced open by expansion of the rod.

A schematic diagram of the electrical circuit is illustrated in FIG. 3. It will be noted that in the preferred form of the circuit illustrated in FIG. 3, the first or principal heating element winding HW-1 is connected across the supply line through the closed thermostat 36 and causes a rapid heating of the melt chamber 16. In one practical example, the first heating element dissipates approximately 130 watts to effect rapid heating of the melt chamber. The thermostat is thermally coupled to the heating element HW-1 by being located in the well 35A immediately adjacent the heating element windings, and opens when the melt chamber temperature reaches approximately 350°F. After the thermostat switch 36 opens, the current must then flow through the heating element winding HW-1 and the second heating element windings HW-2 and the illuminating lamp IL. The illumination of the lamp IL indicates to the user that the tool is ready for use. The second or ballast heating element winding is designed so that the tool stabilizes at a temperature higher than the switching temperature of the thermostat switch 36 so that the thermostat switch stays open and the lamp IL stays lit. For example, the second heating element winding HW-2 may be of such value as to make the total current about 0.27 amperes, reducing the total wattage to about 31 watts, including the wattage dissipated by the lamp. The lamp IL functions both as an indicator to show that the melt chamber has been heated up to the proper temperature for operation and also as an illuminating work light.

The over-temperature protector OTP is thermally coupled to the heating elements and functions by melting at a selected over-temperature level to permanently open the supply circuit and cause the glue gun to no longer function until it has been repaired. If desired, the over-temperature protector could be located in series with the thermostat switch 36 in the line which bypasses the second winding HW-2 and the lamp IL, so that if the thermostat switch failed the over-temperature protector could open the thermostat circuit permanently. In such a case, the glue gun would be ON continuously when it was plugged into a power source, would take much longer to heat up, but would not overheat.

It will be observed that by the particular construction of the glue gun as hereinbefore described, wherein the plunger piston 26 is normally limited against withdrawal from the melt chamber by the screw 37, and the guide 28 is removably supported on the housing by the screw 28A, the plunger rod 27 and piston 26 can be easily removed for cleaning of the tool or to replace the plunger assembly. The operator merely draws the pull device 32 rearwardly to withdraw the socket 32C from the plunger knob 27A and rotates the pull device 32 through about 90° to a laterally extending position, and then removes the screws 28A and 37 to permit complete removal of the plunger assembly.

If desired, still further assurance that the valve portion 23B will close against its seat whenever the valve pin 23 is withdrawn from contact with the work may be attained by providing an extension spring 40 surrounding the shank portion 23C between the valve portion 23B and the valve washer 24 and bearing against these two elements, as illustrated in FIGS. 8 and 9. The extension spring 40 will therefore exert a resilient biasing force forwardly against the valve portion 23B of the valve pin 23 to urge the valve portion 23B to closing position engaging the valve seat and the nozzle and thereby coact with the hydraulic pressure of the melted glue in the forward portion of the melt chamber 16 which also exerts a valve closing force on the valve portion 23B of the valve pin whenever the inwardly displacing force exerted on the valve pin by engagement with the work is removed.

Yet another modification is illustrated in FIGS. 10 and 11, in which a valve guide and accelerator member 42 is provided in the tapered or converging portion 16B of the melt chamber. This valve guide and accelerator member 42 is an aluminum member having a cylindrical tubular core portion 43 to encircle and slidable receive the shank portion 23C of the valve pin 23 and having substantially right triangular or truncated triangular vane portions 44 radiating at 90° positions relative to each other from the core portion 43 with their outer edges in intimate contact with the inside surfaces of the taper portions 16B of the melt chamber 16. Thus the aluminum member 42 facilitates transfer of heat from the heating element 34 and walls of the melt chamber through the vane portions 44 to the glue in the converging or tapered portions 16B of the melt chamber. In the illustrated embodiment, the rearmost portion of the tubular core portion 43 has a slightly constricted neck defining an aperture which is sized to closely approximate the diameter of the shank portion 23C of the valve pin for slidable supporting the rearmost portions of the valve pin in centered position. Also, FIG. 10 illustrates another construction for providing a limit stop limiting the extent of inward movement of the valve pin 23. In the form shown in FIG. 10, instead of using the pinched formations 23C', a short length of steel tubing 45 surrounds the shank portion 23C of the valve pin immediately rearwardly of the valve portion 23B, its length being such that the piece of tubing 45 would engage the valve washer 24 when the valve pin has reached the selected inward limit position to prevent further inward movement of the valve pin. Similarly, a close wound spring having a total length corresponding to the length of the tube 45 may...
be employed instead of the tubing 45, to surround the shank portion 23C and have a total length so as to engage the valve washer 24 when the valve pin 23 has reached the selected inward limit position to prevent further inward movement of the valve pin.

What is claimed is:

1. A glue gun for dispensing hot melt adhesive onto a work surface, comprising a housing member, a tubular melt chamber having an elongated cylindrical portion for receiving forwardly adjacent a rearward end thereof a solid rod of thermoplastic adhesive, heating element means for heating the melt chamber and adhesive rod therein, a nozzle removably mounted on a forward end of said melt chamber having a bore therethrough defining an outlet orifice for discharge of molten adhesive and a valve seat therein, a movable valve member coactive with the valve seat and an actuator pin projecting through said orifice to engage the work surface and be moved thereby to displace the valve member from said valve seat, a plunger slidable in said melt chamber for reciprocative movement axially therein between rearward and forward limit positions within said cylindrical portion of said melt chamber, said cylindrical portion having a lateral loading opening forward of said rearward end thereof located between said rearward and forward limit positions for introduction of the adhesive rod into said cylindrical portion along a path extending radially of the axis of the cylindrical portion, and a forwardly spring urged movable abutment member located rearwardly of the plunger and guided for movement along said axis through advancing and retracting strokes, the abutment member being supported for lateral movement relative to said axis from spaced decoupled relation to the plunger to coupled relation therewith to resiliently urge the plunger forwardly when coupled therewith to urge the adhesive rod forwardly and cause molten adhesive to exert pressure on said valve member tending to close the latter against said valve seat.

2. A glue gun as defined in claim 1, wherein said valve member includes a stem portion projecting rearwardly to a position to be engaged by said plunger at its forward limit position and forced thereby to closed position against said valve seat.

3. A glue gun as defined in claim 1, including a coil spring which is expandable and contractable along a spring axis paralleling the axis of said melt chamber, means providing a stationary anchor for a forward end portion of said coil spring, and said movable abutment member being guided for advancing and retracting movement along said spring axis and supported for angular movement about said spring axis from a first position in abutting relation to said plunger to a second position laterally displaced therefrom.

4. A glue gun as defined in claim 3, wherein said plunger includes a piston movable within said melt chamber and a piston rod extending rearwardly therefrom to a position exposed rearwardly of the housing member, and said abutment member having a forwardly opening well therein for removably receiving the rearmost end portion of said piston rod.

5. A glue gun as defined in claim 3, wherein said housing includes a cylindrical guideway concentric with said spring axis and opening rearwardly of said housing, and said abutment member having a cylindrical tube projecting forwardly therefrom surrounding said coil spring and having cylindrical surface portions thereof guided by the surface of said guideway to maintain a selected attitude of the abutment member relative to said housing.

6. A glue gun as defined in claim 5, wherein said plunger includes a pistonmovable within said melt chamber and a piston rod extending rearwardly therefrom to a position exposed rearwardly of the housing member and said abutment member having a forwardly opening well therein for removably receiving the rearmost end portion of said piston rod.

7. A glue gun for dispensing hot melt adhesive onto a work surface, comprising a housing member, a tubular melt chamber having an elongated cylindrical portion for receiving adjacent a rearward end thereof a solid rod of thermoplastic adhesive, heating element means for heating the melt chamber and adhesive rod therein, a nozzle removably mounted on a forward end of said melt chamber having a bore therethrough defining an outlet orifice for discharge of molten adhesive and a valve seat therein, a movable valve member coactive with the valve seat and an actuator pin projecting through said orifice to engage the work surface and be moved thereby to displace the valve member from said valve seat, a plunger slidable in said melt chamber for reciprocative movement axially therein, spring means movable between coupled and decoupled relation with said plunger to resiliently urge the plunger forwardly when coupled therewith to urge the adhesive rod forwardly and cause molten adhesive to exert pressure on said valve member tending to close the latter against said valve seat, said spring means including a coil spring which is expandable and contractable along a spring axis paralleling the axis of said melt chamber, means providing a stationary anchor for a forward end portion of said coil spring, and a movable abutment member guided for advancing and retracting movement along said spring axis and supported for angular movement about said spring axis from a first position in abutting relation to said plunger to a second position laterally displaced therefrom.

8. A glue gun as defined in claim 7, wherein said plunger includes a piston movable within said melt chamber and a piston rod extending rearwardly therefrom to a position exposed rearwardly of the housing member, and said abutment member having a forwardly opening well therein for removably receiving the rearmost end portion of said piston rod.

9. A glue gun as defined in claim 7, wherein said housing includes a cylindrical guideway concentric with said spring axis and opening rearwardly of said housing, and said abutment member having a cylindrical tube projecting forwardly therefrom surrounding said coil spring and having cylindrical surface portions thereof guided by the surface of said guideway to maintain a selected attitude of the abutment member relative to said housing.

10. A glue gun as defined in claim 8, wherein said heating element means comprises a first heater winding of a selected wattage rating for producing rapid heating of adhesive in the melt chamber to molten condition when connected across a supply circuit, a first branch circuit including a thermostatic switch connected in series circuit relation with said first heater winding and a side of the supply circuit for connecting the first heater winding across the supply until a selected temperature is reached in the melt chamber, and a second branch circuit including a second heating element winding
forming a ballast winding and a lamp connected in series with said first heater winding and paralleling the first branch circuit to reduce current flow through the first heater winding when the thermostatic switch opens to a value causing the heating element means to stabilize at a temperature slightly above the switching temperature for the thermostatic switch and cause the lamp to become illuminated.

11. A glue gun for dispensing hot melt adhesive onto a work surface, comprising a housing member, a tubular melt chamber having an elongated cylindrical portion for receiving adjacent a rearward end thereof a solid rod of thermoplastic adhesive, heating element means for heating the melt chamber and adhesive rod therein, a nozzle removably mounted on a forward end of said melt chamber having a bore therethrough defining an outlet orifice for discharge of molten adhesive and a valve seat therein, a movable valve member coactive with the valve seat and an actuator pin projecting through said orifice to engage the work surface and be moved thereby to displace the valve member from said valve seat, a plunger slideable in said melt chamber for reciprocative movement axially therein, and a spring urged abutment member for driving the plunger movable parallel to said axis and transversely of said axis between coupled and decoupled relation with the plunger to resiliently urge the plunger forwardly when coupled therewith to exert such pressure on the adhesive in the melt chamber to cause the pressurized adhesive to force closed the valve member against said valve seat, said plunger being movable between rearward and forward limit positions, and said valve member including a stem portion projecting rearwardly to a position to be engaged by said plunger at the forward limit position of the plunger and forced thereby to closed position against said valve seat, said spring means including a coil spring which is expandable and contractable along a spring axis paralleling the axis of said melt chamber, means providing a stationary anchor for a forward end portion of said coil spring, and a movable abutment member guided for advancing and retracting movement along said spring axis and supported for angular movement about said spring axis from a first position in abutting relation to said plunger to a second position laterally displaced therefrom.

13. A glue gun as defined in claim 12, wherein said plunger includes a piston movable within said melt chamber and a piston rod extending rearwardly therefrom to a position exposed rearwardly of the housing member, and said abutment member having a forwardly opening well therein for removably receiving the rearmost end portion of said piston rod.

14. A glue gun as defined in claim 12, wherein said housing includes a cylindrical guideway concentric with said spring axis and opening rearwardly of said housing, and said abutment member having a cylindrical tube projecting forwardly therefrom surrounding said coil spring and having cylindrical surface portions thereof guided by the surface of said guideway to maintain a selected attitude of the abutment member relative to said housing.

15. A glue gun as defined in claim 12, wherein said heating element means comprises a first heater winding of a selected wattage rating for producing rapid heating of adhesive in the melt chamber to molten condition when connected across a supply circuit, a first branch circuit including a thermostatic switch connected in series circuit relation with said first heater winding and a side of the supply circuit for connecting the first heater winding across the supply until a selected temperature is reached in the melt chamber, and a second branch circuit including a second heating element winding forming a ballast winding and a lamp connected in series with said first heater winding and paralleling the first branch circuit to reduce current flow through the first heater winding when the thermostatic switch opens to a value causing the heating element means to stabilize at a temperature slightly above the switching temperature for the thermostatic switch and cause the lamp to become illuminated.