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Reighard et al.

[11] **3,811,601**

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[54] **MODULAR SOLENOID-OPERATED DISPENSER**

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[52] **U.S. Cl.** ..... **222/146 HE**, 222/181, 222/504

[51] **Int. Cl.** **B67d 5/62**

[58] **Field of Search** ..... 222/504, 146 HE, 181; 251/139

[56] **References Cited**

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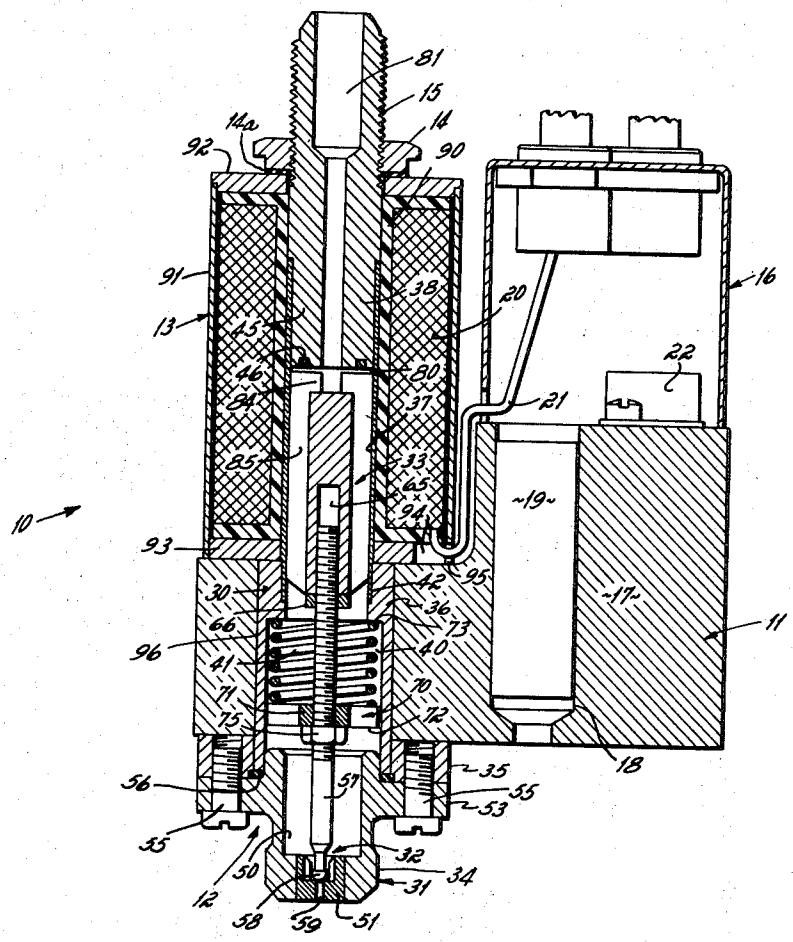
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Assistant Examiner—John P. Shannon
Attorney, Agent, or Firm—Wood, Herron and Evans

[57] **ABSTRACT**

A solenoid-operated dispenser for dispensing liquid materials. The dispenser comprises a heated service module which contains static parts, a gun module which contains all of the movable parts of the dispenser, and a solenoid coil module, all three modules of which are resiliently held in an assembled relationship by a single threaded nut.

8 Claims, 2 Drawing Figures



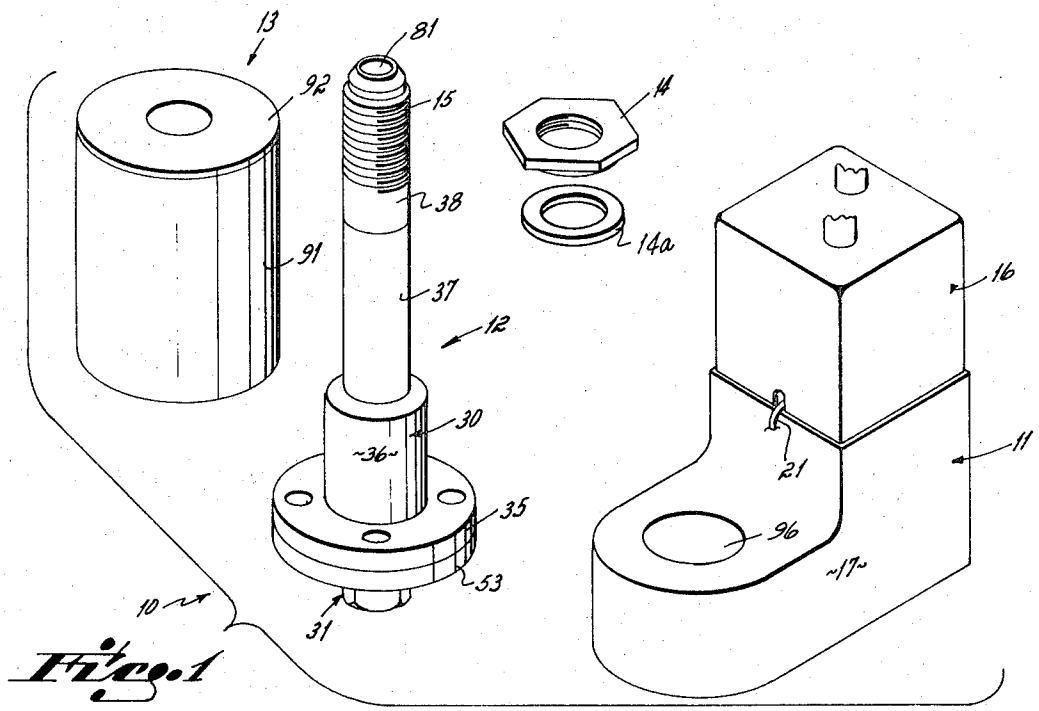

13
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14
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14a
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21
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96
53
17
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31

Fig. 1

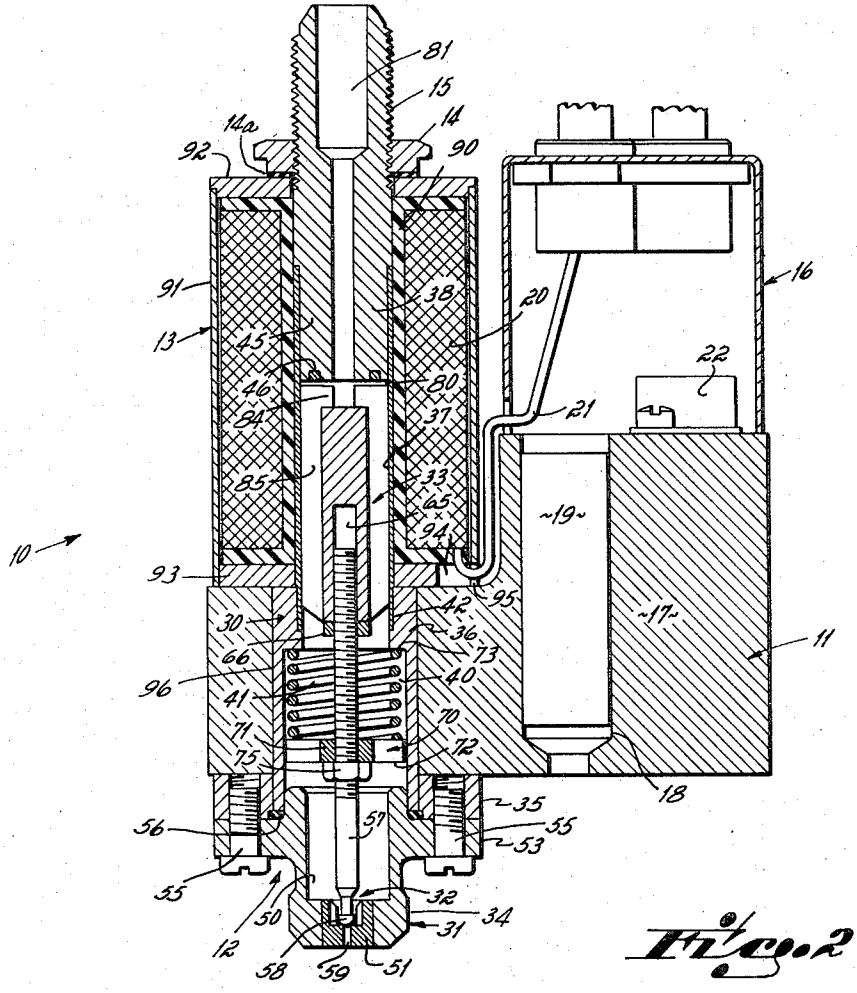

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Fig. 2

MODULAR SOLENOID-OPERATED DISPENSER

This invention relates to a dispenser or a gun for dispensing liquids in the form of beads, ribbons, or stripes in a desired pattern under high speed production conditions. More particularly, the invention relates to equipment for applying molten adhesives or so-called "hot melts" to substrates used in packaging, sealing or assembling a variety of products.

Liquid adhesives, or so-called "hot melts," are commonly used where there is a need for a very short setting time for the material to set up and bond together two parts of a package or two parts of an assembly. Typically, they are solid at room temperature and must be heated before they become molten so that they can be supplied to and dispensed from a gun. When heated to molten form, the materials change to a relatively viscous liquid which may be supplied to a dispensing gun at a relatively high pressure and then dispensed from the nozzle of the gun in the form of a continuous bead or ribbon or an intermittent deposit. The flow of material from the gun is controlled by a valve located internally of the gun adjacent the nozzle orifice.

A common production problem encountered with hot melt dispensing guns in high production facilities is that of interrupting the production facility for relatively long periods of time in order to clean the gun of hot melt material which has become lodged therein or to replace worn out parts. Generally, cleaning requires disconnection of the service lines, including the electrical service lines to the heater of the gun, disconnection of the liquid supply lines for supplying the molten material to the gun, and disconnection of the power lines for operating the gun. If the gun is a pneumatically operated gun, the power line is an air line to the gun; and if the gun is solenoid-operated, the power line is an electrical one. After disconnection of all lines, the gun generally must be broken apart in order to disconnect it from its mounting so as to enable a new or clean gun to replace it. All of this disconnection and disassembly is generally time consuming and expensive because of the resulting loss of a production facility on which the gun is one relatively small component.

In U.S. Pat. No. 3,570,725 issued Mar. 16, 1971, and assigned to the assignee of this application, there is disclosed a modular type of pneumatically operated gun in which the gun may be removed from a service module as a separate unit and replaced without any time-consuming disconnection of the service lines and disassembly of the gun. That modular gun has been well received in hot melt production facilities and has eliminated many of the problems set forth hereinabove. There is still, though, a need for a solenoid-operated modular gun to accomplish the same objectives and eliminate the time-consuming disassembly and reassembly problem normally associated with the cleaning and replacement of solenoid-operating hot melt dispensing guns in high speed production facilities.

It has therefore been one objective of this invention to provide a modular solenoid-operated dispensing system in which the gun portion of the dispenser may be easily and quickly replaced in the event that the gun portion needs to be cleaned or a component needs to be replaced.

Still another object of this invention has been to provide a solenoid-operated dispensing apparatus for dispensing hot melt or viscous liquids in which the solenoid coil of the gun may be easily and quickly replaced in the event that it fails while the remainder of the gun and system is fully operative.

The invention of this application which accomplishes these objectives comprises a three-module dispensing apparatus made from a service module, a gun module, and a solenoid module. All three modules are resiliently held in an assembled relation by a resilient washer and a single threaded connector. The service module houses all of the essentially static components of the dispenser and includes an electrical heater for heating the service module and subsequently transmitting heat through contacting surfaces to the gun module so that the molten material contained in the gun remains in the molten state. The gun module contains all the movable components of the dispensing apparatus and is generally tubular in configuration. Over this tubular gun module the solenoid coil module is mounted and is resiliently held in an assembled relation by a resilient washer and a single threaded connector which also holds the gun module mounted within an aperture of the service module.

The primary advantage of this modular construction of solenoid-operated dispenser is that it enables the solenoid module to be quickly replaced in the event that it fails or the gun module to be easily and quickly replaced in the event that it becomes clogged or breaks down because of excessively worn parts. After replacement of a worn or clogged gun with a new clean one, or replacement of a failed coil, the failed gun or solenoid coil may be torn down and rebuilt without interruption of a production facility upon which the gun or coil had previously been in use. This construction also has the advantage of facilitating repair and cleaning of the dispensing apparatus.

These and other objects and advantages of this invention will be more readily apparent from the following description of the drawings illustrating one preferred embodiment of the invention in which:

FIG. 1 is an exploded perspective view of a dispensing apparatus incorporating the invention of this application; and

FIG. 2 is a cross sectional view of the apparatus.

Referring to FIG. 1, it will be seen that the dispenser **10** of this application is assembled from three modules which are easily assembled and disassembled for purposes of cleaning or repairing the unit. Specifically, this dispenser **10** comprises a service module **11**, a gun module **12**, and a solenoid coil module **13**. These three modules are all resiliently held in an assembled relation by a resilient washer **14a** and a single nut **14** threaded over one end **15** of the gun module **12**, as is explained more fully hereinafter.

The service module **11** serves as a mounting block for the gun and solenoid coil modules as well as for an electrical control enclosure **16**. This service module **11** is generally fixedly mounted, by a means not shown, upon a slide block or some other fixed fastening located in a predetermined location relative to a substrate upon which molten liquid material is dispensed from the gun.

The service module is comprised of a stepped block **17** which has two vertical bores through it. One of these bores **18** is counterbored and is adapted to receive an electric heating element **19**. The other bore receives and supports the gun module **12**.

Electrical power to the coil **20** of the solenoid **13** is supplied via electrical leads **21** which are housed within the conventional electrical enclosure or so-called junction box **16.** This box is fixedly mounted upon the top of the service module block **17.** The enclosure within the box **16** also houses an electrical thermostat **22** which controls the flow of electric power to the heater **19** and consequently determines the temperature of the block **17.** Heat from the block **17** in turn is transmitted through the contacting surfaces of the service module block **17** and the gun module into molten material contained interiorly of the gun.

The gun module **12** comprises a cylinder assembly **30,** a nozzle assembly **31,** a valve **32** for controlling the flow of pressurized molten material from the nozzle **31,** and a valve plunger **33** for controlling actuation of the valve **32.**

The cylinder assembly is made from four components, all of which are brazed together to form a sealed and joined unit. These components comprise an annular flange **35,** a spring chamber sleeve **36,** a nonmagnetic plunger guide sleeve **37,** and a magnetic inlet fitting **38.** The spring chamber sleeve **36** has a through bore **40** which is counterbored at the lower end and provides a large open chamber for the reception of a valve control spring **41.** This bore **40** is also counterbored at its upper end, as indicated at **42,** so as to provide a seat for the lower end of the plunger guide sleeve **37.** At its upper end, the plunger guide sleeve **37** receives the lower end **45** of the molten material inlet fitting **38.** There is preferably a conventional copper shading ring **46** mounted within an annular recess machined from the lower end of the inlet fitting **38.** The upper end **15** of the inlet fitting is externally threaded for reception of a resilient washer **14***a* and the nut **14** which resiliently holds the three modules in an assembled relation, as is explained more fully hereinafter.

The nozzle assembly **31** of the dispensing gun is conventional and comprises a radially flanged gun seat through which there extends an axial bore **50.** This axial bore is counterbored so that the lower small diameter end section may receive and be brazed to a carbide valve seat **51.** The radial flange **53** of the nozzle gun seat is bolted to the flange **35** of the cylinder assembly by machine screws **55.** There is preferably a metal O-ring **56** located between the lower end of the cylinder assembly and the flange **53** of the nozzle gun seat to prevent leakage of molten material between the two.

The valve of the gun is formed by an axial needle **57,** the lower end of which terminates in a semispherical end **58** which seats over and closes an axial passage **59** of the valve seat **51.** This passage **59** is counterbored and fluted so that molten material may flow around the needle within the larger upper end section of the bore.

At its upper end, the needle **57** is externally threaded and is received within an internally threaded bore **65** of the plunger **33.** A lock nut **66** secures the needle in an axially adjusted position within the plunger.

Intermediate its ends, the needle supports a spring collar **70.** This collar has a central hub **71** threaded over the threaded section of the needle and four arms **72** which extend radially from this hub **71** and support the lower end of the compression spring **41.** At its upper end this spring rests against a shoulder **73** in the bore **40** of the spring chamber sleeve **36.** There is preferably a lock nut **75** threaded over the needle to lock the spring collar **70** in an adjusted position.

The plunger **33** is made from a magnetic stainless steel or other ferrous material so that it acts as the armature of the solenoid coil **20** within the cylinder. A gap **80** between the lower end of the inlet fitting **38** and the top surface of the plunger **33** permits the plunger to be moved upwardly by magnetic flux of the solenoid coil **20.** When the plunger is in its uppermost position, the valve **32** is open so that pressurized molten material contained within the valve chamber **50** may exit through the passage **59.**

In order for the molten material supplied to the gun via the inlet fitting **38** to flow through the axial passage **81** of the fitting **38** downwardly to the valve chamber **50,** there are four radial grooves **84** and four intersecting longitudinal grooves **85** machined from the surface of the plunger. The radial grooves **84** in the top surface of the plunger are axially aligned with and intersect the longitudinal grooves **85** in the peripheral surface of the plunger so that each groove forms a continuous flow path along the exterior of the plunger from the lower end of the passage **81** into the spring chamber **40** of the sleeve **36** and subsequently into the valve chamber **50** of the nozzle gun seat **34.**

The solenoid coil module **13** comprises a tubular spool **90** of Teflon or a similar dielectric material upon which the wire of the coil **20** is wound. The ends of this wire terminate in the leads **21** which extend into the electric enclosure **16.** A magnetic metal casing completely encloses the coil **20** and spool **90.** This casing comprises a steel sleeve **91** over which there is fitted a steel cap **92** and a lower flux retainer disc **93.** The disc **93** and the sleeve **91** both have a cutout recess **94, 95** on one side through which the leads **21** extend.

The lower retainer flux ring **93,** the sleeve **91,** and the cap **92** are all sealed and permanently joined together around the coil **20** so as to form a complete subassembly which may be assembled over the cylinder of the gun or removed therefrom as a complete unit. This module **13** is held in an assembled relation over the barrel of the gun module **12** by the nut **14** threaded over the end **15** of the fitting **38** and the resilient washer **14***a.* The purpose of the resilient washer **14***a* is to accommodate relative thermal deflections among the service module **11,** the gun module **12,** and the solenoid module **13.**

In operation, if the gun should become clogged or should fail for any reason, all that is required to remove it from the service module **11** so as to permit its replacement on the service module is to remove the nut **14** and resilient washer **14***a* from over the inlet fitting of the gun barrel. Upon removal of this nut and washer, the complete gun module **12** may be dropped downwardly through the bore **96.** The coil will automatically be removed from over the barrel as a consequence of this disassembly. Alternatively, if the coil should fail, all that is required to remove it is to remove this same nut **14** and resilient washer **14***a* and lift them from over the cylinder. In this way the solenoid coil module may be replaced or the gun module may be replaced with a minimum of lost production time. After the gun module or the solenoid module has been removed from the service module, it may be cleaned or disassembled while the production line upon which it had previously been operating continues to function.

It is to be noted that in addition to the removability of the solenoid module **13** and/or the gun module **12** by simply unthreading and removing the nut **14** from over the threaded section **15** of the gun inlet fitting **38**, the internal mechanism of the gun may be removed from the barrel while the nut **14** retains the solenoid and the gun barrel in an assembled relation on the service module **11**. This type of disassembly is sometimes desirable if the spring **41** should become broken or if the gun should become broken or clogged at the valve seat. In that event, all that is required is to remove the bolts **55** and drop the nozzle assembly **31** together with the needle **57**, the spring **41**, and the plunger **33**. Any one of these components may then be replaced or repaired and the unit reassembled with a minimal loss of production time.

It is also to be noted that when one gun replaces another, there is no alignment problem associated with properly locating the nozzle relative to the substrate upon which it is intended to dispense molten material. As a consequence of having the service module fixed relative to that substrate, the dispensing guns automatically become properly aligned when located in the service module.

While we have described only a single preferred embodiment of our invention, persons skilled in this art will appreciate changes and modifications which may be made without departing from the spirit of our invention. Therefore, we do not intend to be limited except by the scope of the following appended claims.

Having described our invention, we claim:

1. Apparatus for dispensing a liquid from a pressurized source comprising

a service module having essentially only static parts, said service module including a mounting block having a gun module contacting surface of substantial area, said mounting block being adapted to be secured to a support,

a readily removable gun module attachable to and mountable upon said service module mounting block, said gun module including essentially all of the movable parts of said dispensing apparatus, said gun module including a discharge nozzle and a valve for controlling flow of viscous liquid from said nozzle, said gun module further including a cylinder and a movable plunger mounted within said cylinder, said plunger being operatively connected to said valve so as to effect opening and closing of said valve upon actuation of said plunger, said gun module having a service module mounting block contacting surface of substantial area,

heater means contained within said service module for heating said service module mounting block, said service module mounting block being operable to transmit heat through said contacting surface into said gun module so as to heat liquid contained within said gun module, and

a solenoid coil module mounted over said cylinder of said gun module, said solenoid coil module including an electrical solenoid coil for controlling movement of said plunger within said cylinder,

said solenoid coil module being removable and replaceable on said dispensing apparatus without disassembly of said gun module and said gun module being removable and replaceable on said service module without disassembly of said gun module,

said solenoid coil module and said gun module being jointly secured to said service module mounting block by a single fastening element.

2. The dispensing apparatus of claim **1** in which said heating means is an electrical heater mounted within said service module mounting block, said service module further including a thermostat for controlling the flow of electrical power to said electrical heater.

3. The dispensing apparatus of claim **2** in which said service module mounting block has an aperture therein for the reception of said gun module, said gun module being mounted within said aperture, with at least a portion of said cylinder extending outwardly from said aperture, said solenoid coil module being mounted over said cylinder outwardly of said aperture.

4. The dispensing apparatus of claim **3** in which said solenoid coil module and said gun module are jointly secured to said service module mounting block by a single threaded element.

5. The dispensing apparatus of claim **1** in which said gun module further includes a liquid inlet fitting axially aligned with and secured to said cylinder, and liquid passage means extending from said inlet fitting through said plunger into a valve chamber located interiorly of said gun module.

6. Apparatus for dispensing a viscous liquid from a pressurized source comprising

a service block module having essentially only static parts, said service block module including a mounting block adapted to be secured to a support, heating means contained within said service module mounting block,

a readily removable gun module attachable to and mountable upon said service module mounting block, said gun module including essentially all of the movable parts of said dispensing apparatus, said gun module including a discharge nozzle, a valve for controlling flow of viscous liquid from said nozzle, and spring means for biasing said valve to a closed position, said gun module further including a cylinder and a movable plunger mounted within said cylinder, said plunger being operatively connected to said valve so as to effect opening and closing of said valve upon actuation of said plunger,

a solenoid coil module mounted over said cylinder of said gun module, said solenoid coil module including an electrical solenoid coil for controlling movement of said plunger within said cylinder, and

a single threaded connector for jointly securing said solenoid coil module and said gun module to said service module.

7. The dispensing apparatus of claim **6** in which said service module mounting block has an aperture therein for the reception of said gun module, said gun module being mounted within said aperture, with at least a portion of said cylinder extending outwardly from said aperture and said solenoid coil module being mounted over said cylinder outwardly of said aperture.

8. The dispensing apparatus of claim **7** in which said gun module further includes a liquid inlet fitting axially aligned with and secured to said cylinder, and liquid passage means extending from said inlet fitting through said plunger into a valve chamber located interiorly of said gun module.

* * * * *