Feb. 25, 1969 E. T. NORD ETAL 3,429,482

APPARATUS FOR DISPENSING BEADS OF VISCOUS LIQUIDS

Filed Sept. 15, 1967 Sheet 1 of 2

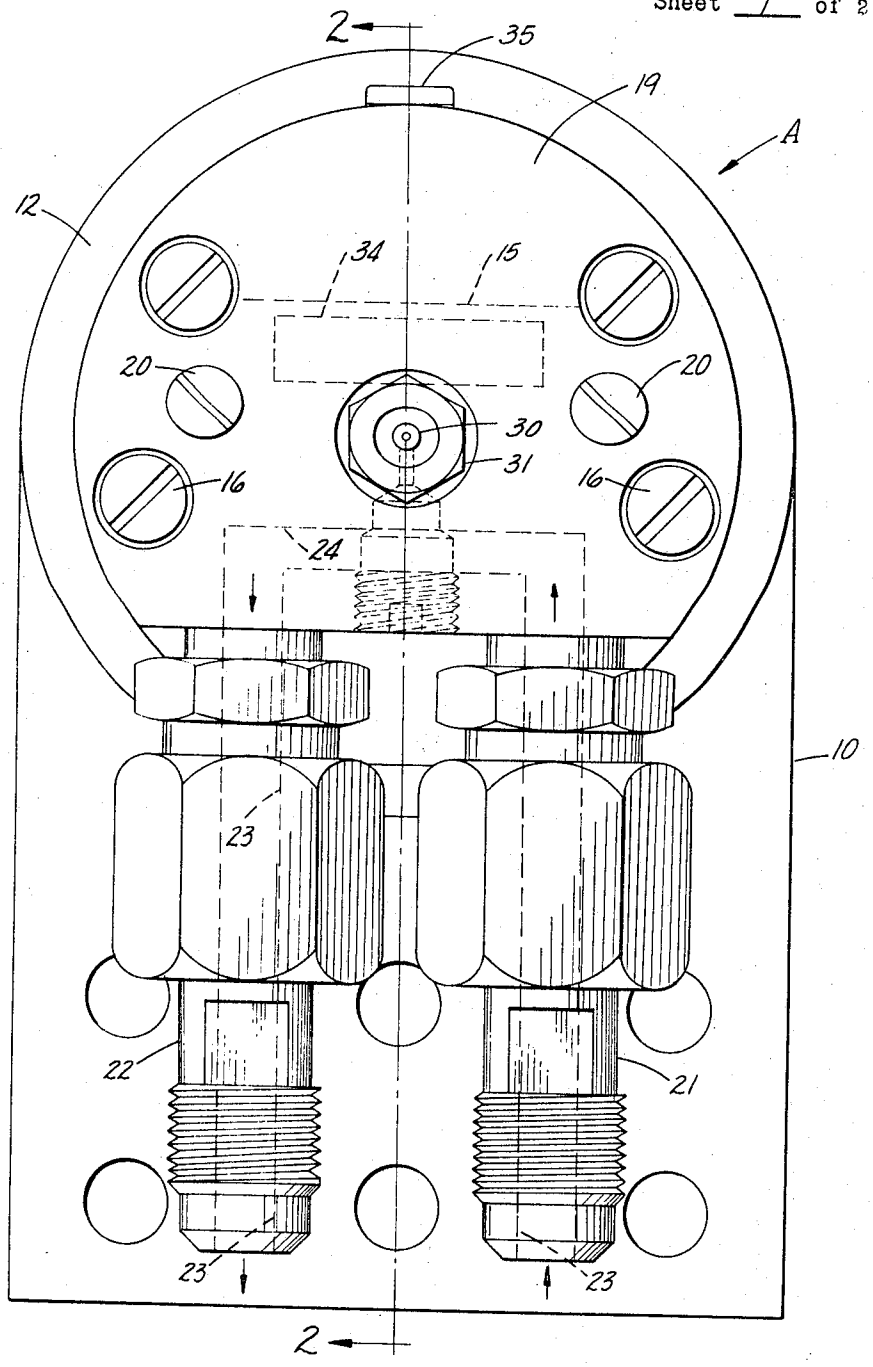


Fig. 1

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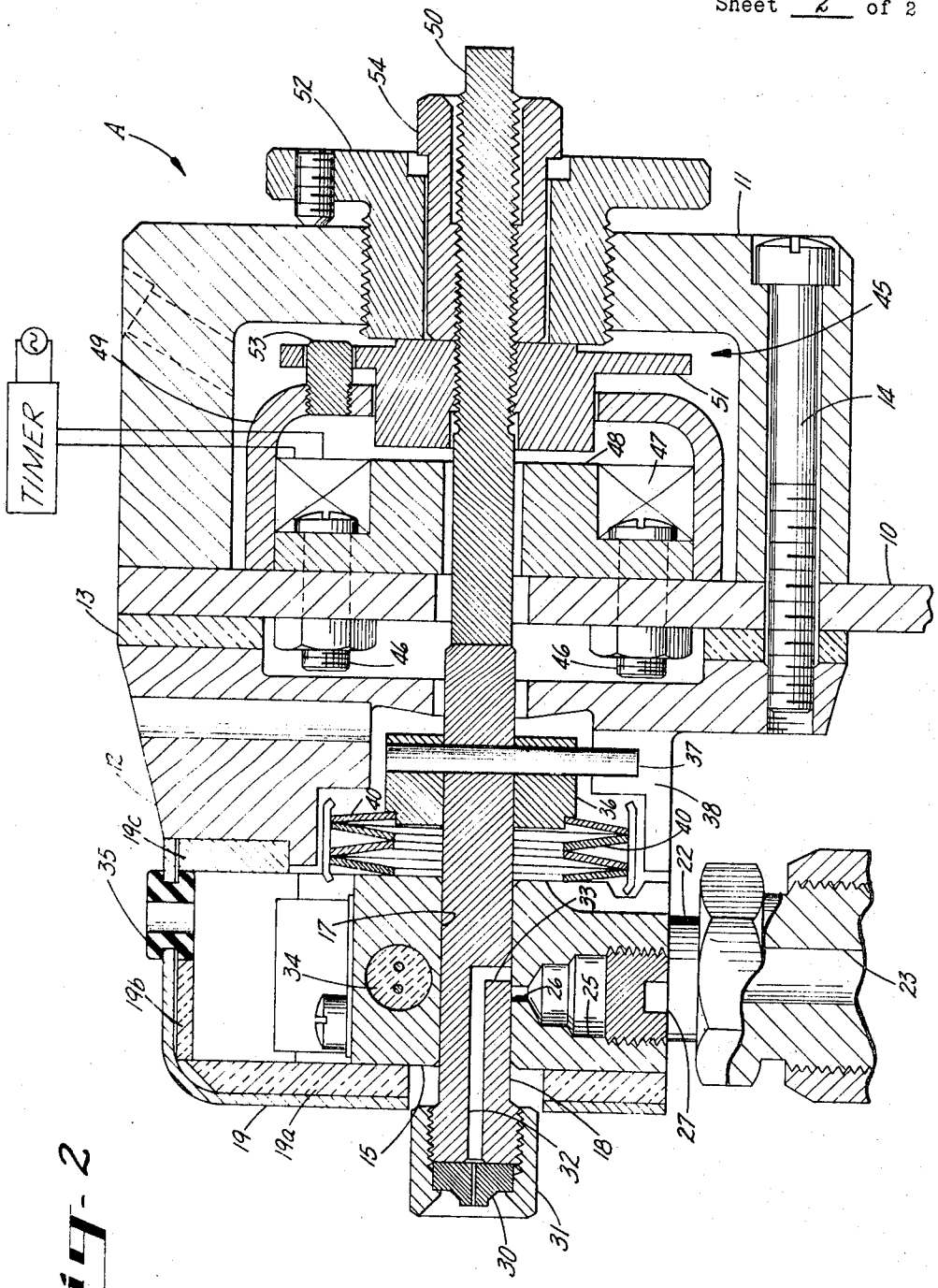


Fig. 2

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APPARATUS FOR DISPENSING BEADS OF VISCOUS LIQUIDS

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Int. Cl. B67d 5/62, 47/18; B05b 1/30

ABSTRACT OF THE DISCLOSURE

Apparatus for dispensing viscous liquids such as molten adhesives, either in a continuous bead or as spaced unitary deposits. The outflow of the viscous liquid is controlled by a valving arrangement including a reciprocating plunger which opens and closes a port located in the barrel in which the plunger slides and through which the liquid may flow into a passage extending through the plunger to a nozzle. When the port is closed the fluid pressure is cut off. The movement of the plunger in closing the port also retracts the nozzle from its liquid dispensing position and thus abruptly breaks the outwardly extending column of viscous liquid at the nozzle orifice.

Background of the invention

This invention relates to the application of viscous liquids to surfaces and especially to equipment used to apply beads, ribbons or small unitary deposits of the liquid in a desired pattern under high-speed production conditions. More particularly the invention relates to equipment for applying molten adhesives to various materials such as flat sheets or webs of paper or cardboard used in packaging and sealing a variety of products.

Liquid adhesives have many applications in the packaging art, particularly in connection with paper and cardboard type packaging materials. One particular type of liquid adhesive generally termed "hot-melt," is often preferred where there is a need for a very short "setting time," being the time interval between application of the adhesive and the completion of the bonding together of the parts being adhered or sealed.

Hot-melt adhesives are typically of the asphaltic or synthetic resin type and are generally in their solid state at room temperature. When heated to molten form however, they change in physical state to a relatively viscous liquid which may be pumped through the nozzle of an applicator tool or gun and applied to a surface in the form of a continuous bead or ribbon or as intermittent unitary deposits. Normally such adhesives are converted to a molten state in a heater and then circulated to applicator guns under pressure through heated lengths of flexible hose. The applicator gun is preferably heated also to assure that the adhesive remains in molten form until it leaves the nozzle of the gun.

In many high-speed packaging applications the molten adhesive is applied to moving sheet material such as a web of paper or flattened cardboard cartons. In other applications the adhesive is applied to filled containers prior to the sealing of flaps or an end closure.

It is often necessary to apply the adhesive in the form of intermittent unitary deposits along a narrow band so that ultimately a discontinuous seal is achieved. For example, certain packaging applications utilize this technique to form a closure which is more easily opened by a consumer.

Accordingly when these intermittent unitary deposits must be applied in closely spaced intervals on a rapidly moving web of sheet material, the applicator gun must operate extremely fast such as in excess of 20 cycles per

second. Such high-speed operation however presents certain problems particularly in view of the relatively high viscosity of the molten adhesive being applied.

For example it is difficult to separate or break the column of molten adhesive extending from the nozzle of the gun, between each separate deposit. Also the high viscosity of the molten adhesive tends to retard the movement of the valving mechanism which intermittently interrupts the flow of adhesive from the gun to form unitary closely spaced deposits. These difficulties have in the past seriously limited the speed of translation of the materials on which hot-melt adhesives have been applied.

The apparatus of the present invention, however, substantially reduces the difficulties indicated above and affords other features and advantages not obtainable from the prior art.

Summary of the invention

It is among the objects of the invention to apply a viscous liquid in the form of beads, ribbons or spaced unitary deposits to a rapidly translating surface.

Another object is to deposit at high speeds a molten adhesive in the form of beads, ribbons or small closely spaced unitary deposits on surfaces of sheet material to be adhered or sealed.

Still another object is to provide an apparatus for applying a molten adhesive to a surface of translating sheet material or other product, in the form of small closely spaced unitary deposits, which apparatus is capable of relatively high speed operation.

These objects and other are accomplished by an applicator gun construction including a housing having a barrel and entry and exit fittings for the supply circuit which circulates the viscous liquid. The supply circuit within the housing includes a conduit terminating at a port in the barrel. Located in the barrel is a plunger with a nozzle at one end and a passage therein communicating with the nozzle. Liquid enters the passage through a lateral port in the plunger which is movable between an extended position wherein the lateral port registers with the port in the barrel and a retracted position wherein the plunger closes the ports.

The plunger may be operated for example by a solenoid which when energized forces its armature forward to push the plunger to its extended position. Resilient means such as Belleville springs for example are used to rapidly return the plunger to its retracted position when the solenoid is deenergized after a desired time interval. Control means such as an electronic timer may be used to operate the solenoid so as to control both the frequency of the cycle and the duration of the time interval during which the solenoid is energized.

In the preferred embodiment, a heater is provided in the housing to maintain the adhesive in a molten state until after it leaves the nozzle of the gun.

Brief description of the drawings

FIGURE 1 is a front elevational view of an applicator gun for viscous liquids, embodying the invention; and

FIGURE 2 is a transverse sectional view taken on the line 2—2 of FIGURE 1.

Description of the preferred embodiment

Referring more particularly to the drawings there is shown an applicator gun A embodying the invention and adapted for use in connection with apparatus for heating and circulating a hot-melt type adhesive to be applied to a surface by the gun A. The gun A comprises a mounting plate 10 which has secured on opposite sides thereof a rear casing 11 and a forward casing 12, the forward casing 12 being spaced from the mounting plate 10 by means of an insulator 13. The casings 11 and 12 are connected

to the plate **10** and to one another by means of machine bolts **14**. A barrel block **15** is secured to the forward end of the casing **12** by machine bolts **16** (FIGURE 2), the block **15** defining a barrel **17** which receives a sliding plunger **18**. A cover **19**, secured to the barrel block **15** by machine bolts **20**, covers the forward end of the gun A and also serves to locate insulators **19***a*, **19***b* and **19***c* positioned therein.

Fastened to the bottom of the barrel block **15** are inlet and outlet fittings **21** and **22** respectively which are adapted to receive flexible heated hoses (not shown) from a hot-melt adhesive heating and circulating apparatus. The fittings **21** and **22** have central passages **23** which communicate with a passage **24** in the barrel block **15** as shown in dash lines in FIGURE 1. Accordingly the hot-melt adhesive is permitted to circulate through the barrel block **15** by means of the passage **24**. Located in the barrel block **15** intermediate the fittings **21** and **22** is a bore **25** which extends perpendicular to the barrel **17** and through the passage **24**. Located at the end of the bore **25** is a counterbore which extends into the barrel **17** and thus forms a port **26** in the barrel that communicates with the passage **24**. The outer end of the bore **25** is threaded and closed by a threaded plug **27**. This arrangement permits the hot-melt adhesive to enter a valving arrangement in the barrel which will be described in detail below.

The plunger **18** has a nozzle **30** secured at the outer end thereof by a threaded cap screw **31** (FIGURE 2). Located within the plunger **18** is an axial passage **32** communicating between the orifice of the nozzle **30** and a lateral port **33** located in the side of the plunger **18** at the end of a 90° bend in the passage **32**.

Referring to FIGURE 2 it will be seen that the port **26** is closed by the plunger **18** when the plunger is in the position shown. However, when the plunger **18** is moved forward or to the left as viewed in FIGURE 2 the port **26** registers with the lateral port **33** so that the hot-melt adhesive is forced through the passage **32** and out from the end of the nozzle **30**.

In order to maintain the adhesive in the passage **24** in its molten state until it leaves the nozzle orifice, a heating cartridge **34** is provided in a bore extending transversely through the barrel block **15**. The cartridge **34** is energized by electrical leads (not shown) extending through a grommet **35** located in the cover **19**.

Sleeve **36** is secured on the plunger **18** at the rearward end thereof by a pin **37**. The lower end of the pin **37** extends into a slot **38** formed at the bottom of the forward casing **12** to prevent turning of the plunger **18** during operation. Located between the sleeve **36** and the barrel block **15** are Belleville springs **40** which serve to bias the plunger **18** to its retracted position (FIGURE 2). The Belleville springs **40** have a relatively high spring modulus and thus provide a high acceleration during their expansion movement so that they are capable of returning the plunger **18** from its extended position (not shown) to its retracted position very rapidly.

The plunger **18** is moved to its forwardly extending position wherein the passage **32** is placed in communication with the port **26**, by means of a solenoid broadly indicated by the numeral **45**. The solenoid is mounted within the rear casing **11** to the mounting plate **10** by means of bolts **46**. The coil **47** is located on a plate **48** within a frame **49** and is connected to a suitable timing device (not shown) such as an electronic RC timer. According to one embodiment, a modified high voltage output (45 volts) electronic RC timer identified by the trade designation Amtron Model ABC–41514, manufactured and sold by Amtron Inc. of 14633 S. Waverly Ave., Midlothian, Ill., is used. This timer is adjustable to control both the frequency of the gun cycle and also the duration of the time interval in which the solenoid is energized and the plunger **18** moved to its extended position.

The armature rod **50** of the solenoid **45** extends through the mounting plate **10** and engages the inward end of the plunger **18**. A threaded sleeve **51** located on the armature rod **50** bears rearwardly due to the force of the Belleville springs **40** when the solenoid **45** is deenergized, against an adjusting plug **52** which is threaded into the rearward end of the rear housing **11** and which serves to limit the rearward movement of the armature rod **50**. When the solenoid **45** is energized, the sleeve **51** bears forwardly against the frame **49** of the solenoid **45**. In a typical situation, the sleeve **51** is adjusted to provide an armature rod movement of about .040 inch. A locater screw **53** is used to prevent rotation of the sleeve **51**. A lock nut **54** is threaded onto the end of the armature rod **50** and tightened against the sleeve **51**. This serves to lock the armature rod **50** in a predetermined position and permits fine adjustment of the relative positions of the ports **26** and **33**.

Operation

In the operation of the preferred embodiment shown and described herein, the applicator gun A is connected in a fluid circuit forming a part of a hot-melt adhesive heating and circulating system, and positioned with its nozzle adapted to apply the adhesive to a translating surface at a desired location. The timer is adjusted to provide the desired frequency of the gun cycles and to establish the duration of the time interval in which the solenoid is energized and the plunger **18** moved to its extended position. This time interval determines the size of the unitary deposits of adhesive which are dispensed from the gun.

The material, such as a web of paper or flattened cardboard container bodies, is then translated past the gun nozzle at a desired speed and the timer is actuated to begin the operation. The hot-melt adhesive circulating through the passage **24** from the inlet fitting **21** to the outlet fitting **22** is at a relatively high pressure as it passes the bore **25**.

Accordingly whenever the armature rod **50** moves the plunger **18** to its extended position which places the lateral port **33** in registration with the port **26** in the barrel **17**, the molten adhesive will be forced through the passage **32** and out through the orifice of the nozzle **30**. It will be seen that the hot-melt adhesive will fill the passage **32** at all times and in order to keep the adhesive in its moltent form, the heating cartridge **34** is energized to raise the temperature of the barrel housing **15** and plunger **18** to a suitable level such as around 350° F.

As long as the plunger **18** remains in its extended position, the hot-melt adhesive will flow from the orifice of the nozzle **30** and onto the translating surface. The duration of this time interval during which the solenoid is energized and the plunger moved to its extended position may be for example as short as 3 milliseconds. At about the same time the adhesive is deposited on the translating surface it cools to ambient air temperature and changes to its solid state.

When the solenoid **45** is deenergized by the timer, the Belleville springs **40** rapidly move the plunger **18** to its retracted position, moving at the same time, the armature rod **50** to the rearward limits of its travel as established by the threaded sleeve **51**. This rearward travel of the plunger **18** closes the ports **26** and **33** and thus shuts off the pressure acting upon the hot-melt adhesive within the passage **32**. The rapid rearward travel also very abruptly breaks the column of viscous liquid extending outwardly from the nozzle. This abrupt breaking is important in order to assure that the column of viscous liquid does not gradually taper to a thin filament or tail. The Belleville springs **40** provide the necessary high spring rate which abruptly separates the viscous liquid material in the nozzle orifice from the column of liquid extending from the nozzle **30**.

The operation of the gun continues in this fashion thus providing, depending upon the setting of the timer, a

band of small closely-spaced unitary deposits of solid adhesive on the translating surface. The preferred embodiment of the apparatus shown and described is capable of operation at speeds up to at least 40 cycles per second so that very high speeds of translation may be used for the material to which the adhesive is being applied.

Although only one embodiment of the invention is illustrated and described, it will be understood that variations and modifications may be made in the form and arrangement of the several parts and elements thereof without departing from the spirit of the invention. The invention therefore is not to be limited to the particular structures and mechanisms herein shown and described nor in any manner inconsistent with the extent to which the progress in the art has been advanced by the invention.

We claim:

1. Apparatus for dispensing viscous liquids comprising a housing defining a barrel, means for conducting liquid under high pressure to a port in said barrel, a plunger adapted for reciprocating travel in said barrel and defining a restricted nozzle at one end and a passage leading to said nozzle, said plunger also having a lateral port leading to said passage, said lateral port being movable to and from registration with said port in said barrel and power means for extending said plunger automatically through successive cycles, each extension including a registration of said ports for sufficient time for said high pressure means to force a column of liquid to protrude from the nozzle exit, and resilient means for retracting said nozzle with sufficient acceleration to attenuate and break the protruding column from said nozzle exit while simultaneously closing said ports.

2. Apparatus as defined in claim 1 wherein said means for extending said plunger comprises a solenoid having an armature adapted to move said plunger to an extended position wherein said ports are in registration when said solenoid is energized.

3. Apparatus as defined in claim 1 wherein said resilient means comprises Belleville springs.

4. Apparatus as defined in claim 2 wherein said solenoid is energized by a timer.

5. Apparatus as defined in claim 4 wherein said timer includes means for controlling the duration of the time interval in which said solenoid is energized and for controlling the frequency of said intervals.

6. Apparatus for dispensing a molten adhesive comprising a housing comprising a barrel, means for heating said adhesive to its molten state and for circulating said molten adhesive under pressure through said housing and to a port in said barrel, a plunger adapted for reciprocating travel in said barrel and defining a restricted nozzle at one end and a passage leading to said nozzle, said plunger also having a lateral port leading to said passage, said lateral port being movable to and from registration with said port in said barrel, a solenoid having an armature adapted to move said plunger to a forwardly extending position wherein said ports are in registration for sufficient time for said high pressure means to force a column of molten adhesive to protrude from the nozzle exit when said solenoid is energized and resilient means for returning said plunger to a retracted position when said solenoid is deenergized, with sufficient acceleration to attenuate and break the protruding column from said nozzle exit while simultaneously closing said ports.

References Cited

UNITED STATES PATENTS

1,103,752	7/1914	Fuegmann et al.	222—525 X
2,925,102	2/1960	Cummings et al.	222—504 X
3,146,913	9/1964	Nagai	222—525
3,187,949	6/1965	Mangel	222—504 X
3,351,240	11/1967	Gray	222—504 X

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