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PISTON ARRANGEMENT FOR DISPENSING PARTIALLY COMPRESSIBLE PLASTIC MATERIALS

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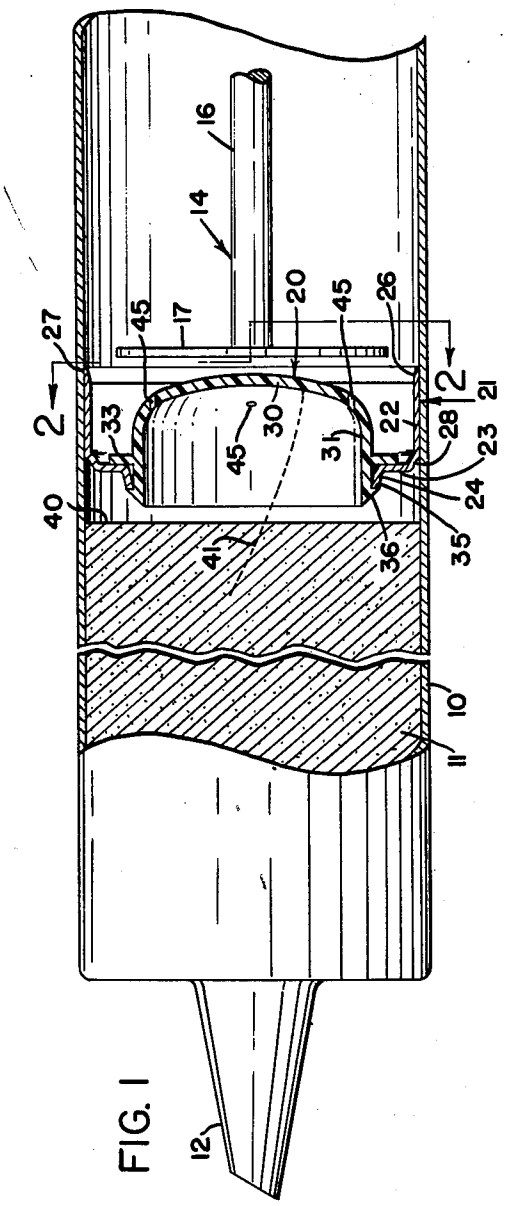

FIG. 1

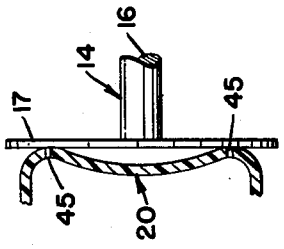

FIG. 3

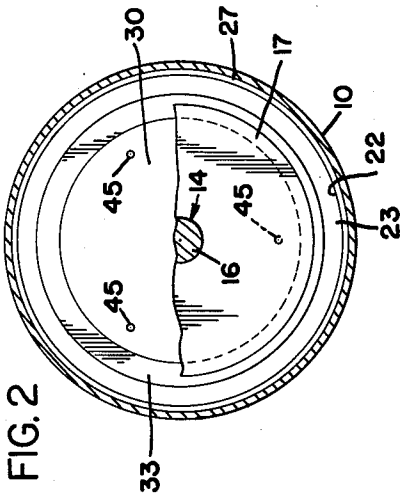

FIG. 2

INVENTORS.
ROBERT W. ANKNEY,
ALFRED A. HURSCHMAN &
ERIC S. WORMSER

BY Alfred C Body
ATTORNEY

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PISTON ARRANGEMENT FOR DISPENSING PARTIALLY COMPRESSIBLE PLASTIC MATERIALS

Eric S. Wormser, Shaker Heights, and Robert W. Ankney and Alfred A. Hurschman, Lakewood, Ohio, assignors, by direct and mesne assignments, to The Gibson-Homans Company, Cleveland, Ohio, a corporation of Ohio

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This invention pertains to the art of dispensing, and more particularly to a piston arrangement for dispensing partially compressible plastic materials.

The invention is particularly applicable to the dispensing of caulking materials from caulking guns, and will be described with particular reference thereto although it will be appreciated that the invention has broader applications.

Caulking material is ordinarily sold in an elongated, cylindrical tube having a nozzle at one end and a piston in the other end. A plunger forces this piston through the tube to force the caulking material out of the nozzle. The nozzle end is usually held against cracks or the like to be filled, and considerable hydraulic pressures are developed within the caulking material in the tube. When a caulking operation is finished, the nozzle is removed from the crack and the plunger is withdrawn from its engagement with the piston.

Caulking material usually has various amounts of air entrained therein during the mixing operation. This air is compressed during a dispensing operation. Immediately upon the release of the pressure on the material, this air commences to expand, the rate of expansion being restricted by the high viscosity of the caulking material. This expansion, however, causes the caulking material to ooze out of the nozzle for considerable periods of time after the end of each caulking operation. This oozing is not only messy and annoying to the operator, but is wasteful of caulking material.

Various means have been attempted in the past to prevent or alleviate this oozing problem. In one known arrangement, the head of the piston was formed from a thin sheet or film of flexible pliant material assembled with an outer metal ring so as to have a slack formed therein which slack would take up the expansion of the air in the caulking material. Such pistons, while extensively used, have not been entirely satisfactory. The thin sheet of material requires a complicated assembly operation with the other parts of the piston. It is difficult to obtain uniform degrees of slack in the material, and it is almost impossible to obtain a sufficient volume of slack to take up all of the air expansion of a full tube of caulking material. Thus, the problems of oozing still continued.

The present invention contemplates a piston arrangement for dispensing caulking materials and the like which overcomes all of the above-referred to difficulties, and others, and provides a piston arrangement which is simple in construction, inexpensive to manufacture, and effective in operation.

In accordance with the present invention, a piston is provided having a head of thin resilient, flexible material having in the normal unflexed condition a concave surface facing the material to be dispensed which head is adapted to be collapsed into engagement with the material by externally exerted pressures and will then be biased to spring back to its original shape upon the release of such pressures. Further in accordance with the invention, the amount of volume provided by the concavity will be in excess of the maximum air content of the material being dispensed.

Further, in accordance with the invention, the piston

is provided with one or a plurality of passages therethrough, each having a dimension such as to freely pass air therethrough, but either none or insignificant amounts of the material being dispensed. If a plurality of openings are provided, they should be widely spaced one from the other. Furthermore, such openings may be so located in the piston that as the head is collapsed, these openings will be at least in part closed.

Further in accordance with the invention, the piston is comprised of a head formed of a molded polyethylene material, or the equivalent, and a skirt of metal having an outer cylindrical portion adapted to engage the inner walls of the tube, and an inner axially extending portion defining an opening into which portions of the head extend and interlock therewith.

The principal object of the invention is the provision of a new and improved piston for the dispensing of partially compressible plastic materials which will prevent the oozing of such materials at the completion of a dispensing operation.

Another object of the invention is the provision of a new and improved piston having a flexible resilient head which is collapsed in the course of dispensing the plastic material and is biased to return to its original shape upon the release of the dispensing pressure to provide a space into which the material may expand.

Another object of the invention is the provision of a new and improved piston of the general type described having a head which is collapsible under dispensing pressures, and is biased to return to its original shape, and which has passages therethrough to permit the escape and return of air to the space under the piston.

Another object of the invention is the provision of a new and improved piston of the general type described comprised of a molded plastic head and a metallic skirt which are readily and economically assembled, and which may be then handled as a unit without danger of their becoming separated.

The invention may take physical form in certain parts and arrangements of parts a preferred embodiment of which will be described in detail in this specification, and illustrated in the accompanying drawing which is a part hereof wherein,

FIGURE 1 is a side cross-sectional view partly schematic of a caulking gun arrangement illustrating a preferred embodiment of the invention,

FIGURE 2 is a cross sectional view of FIGURE 1 taken approximately on the line 2—2 thereof, and

FIGURE 3 is a fragmentary view of FIGURE 1 showing the head of the piston in the collapsed or material dispensing position.

Referring now to the drawings wherein the showings are for the purposes of illustrating preferred embodiments of the invention only, and not for the purposes of limiting same, FIGURE 1 shows fragmentary portions of an elongated tube 10 filled with a plastic material 11 to be dispensed, and having at one end a tapered nozzle 12 through which the material 11 is to be dispensed, and at the other end, a piston arrangement constructed in accordance with the invention. A plunger 14 is axially movable along the length of the tube 10 to advance the piston axially therethrough and force the material 11 out of the nozzle 12.

The tube 10 may be of any desired material including paper, plastic, or metal; preferably it is formed of thin sheet metal either seamless or having a formed longitudinally extending seam.

The nozzle 12 may in a like manner be formed of any known or desired material. In preferred embodiments, it is formed of a molded semi-pliant plastic material

and may be fixed to the end of the tube **10** in any desired manner.

The plunger **14** is comprised generally of a plunger rod **16** having a flat head **17** of an outer diameter slightly less than the inner diameter of the tube **10** which is adapted to engage the piston, as will be described, and force it through the tube **10**.

The material to be dispensed **11** may also be as desired, but is normally a caulking material which, as known, generally has entrained therein approximately 8% by volume of air or other gaseous medium. The word "air" will be used hereinafter generically to to indicate any gaseous medium entrained in the material **11**.

The piston arrangement of the preferred embodiment includes a head portion **20** which extends generally transversely across the diameter of the tube **10**, and a skirt portion **21** which extends generally axially of the tube **10** and is in sealing engagement with the inner walls thereof.

The skirt portion **21** may be formed of any known rigid material, but in the preferred embodiment is stamped and drawn from a sheet of thin metallic material so as to have a skirt portion proper **22**, a radially inward extending flange **23**, and an axially extending flange **24** which flange **24** defines an axial opening in the skirt portion **21** which is covered over by the head portion **20**.

The skirt portion proper **22** terminates at its right end, as viewed in FIGURE 1, in a slight outwardly turning feather edge **26** which upon initial assembly of the piston with the tube **10** bears against the right hand end **27** of the tube **10** to assist in holding the piston in assembled relationship with the tube.

The opposite or left hand end of the skirt proper **22** has a slight radially inward offset **28** which facilitates the assembly of the piston in the right end of the tube **10**.

With this arrangement it is possible to have the skirt portion **22** snugly fit on the inside of the tube **10** to provide a good sealing action as the piston is advanced during the dispensing of caulking material.

The head portion **20** is the important part of the present invention, and includes a dome-shaped portion **30** with the concave surface thereof facing the material **11**. This dome-shape terminates in generally an axially extending flange **31** having an outer diameter such as to fit within the opening defined by the axial flange **24**. The outer surface of the portion **31** has a radially outwardly extending flange **33** which bears against the radial flange **23** of the skirt portion **21** and also has a short radially outwardly extending surface **35** spaced from the flange **33** a distance in relation to the axial length of the portion **24** as to engage the end of such portion and retain the head portion **20** in assembled relationship with the skirt portion **21**. As shown at **36**, the axial end of the portion **31** is beveled inwardly to facilitate and assist in the assembly of these two portions. In a like manner, the flange **24** has a slight inward taper to assist in this assembly operation.

The head portion **20** is, in accordance with the invention, formed of a flexible, resilient material and by flexible resilient is meant a material which can be readily flexed by a force in one direction but will have sufficient resiliency to restore itself to its original shape upon the removal of the deforming force. In this respect it may be said that the material is one which has a sufficiently high yield point on a modulus of elasticity curve that for the flexing which will occur in normal operation, the yield point of the material is never reached. Thus, the invention may be distinguished from the use of thin film-like materials which if once deformed will substantially remain in such deformed condition for long periods of time.

While possibly various materials will suffice for the construction of the domed portion **30**, a molded polyethylene plastic material is preferred and wall thicknesses of .024 and .018 inch for the portions **30** and **31** respectively have worked very satisfactorily in practice.

While the piston arrangement described so far has worked quite satisfactorily, even improved performance has resulted from the provision of air bleed passages through the piston head. Such passages may take a number of different forms, but in the preferred embodiment are comprised of one or a plurality of openings **45** in the domed portion **30**. These openings **45** extend axially and are preferably located adjacent the edge of the dome portion **30**, and more particularly close to the line of intersection of the curvature of the dome **30** and the axial flange **31**.

Any number of openings **45** may be employed, but three, as shown in FIGURE **2**, spaced 120° from each other, have been found to be adequate.

The purpose of so spacing the openings is to prevent the closure of all of such openings in the event that the tube **10** full of caulking material **11** is stored on its side for any period of time such that the caulking material would flow from its normal fill line, indicated at **40**, to a fill line indicated by the dashed lines **41**. In such event, if only one opening were provided, there would be a possibility that the caulking material would plug up the opening **45** below the fill line **41**. With the arrangement shown, however, this is prevented.

The openings **45** should have a diameter such that air can freely pass therethrough, but such that the caulking material cannot, at least in any appreciable amounts. Without limiting the invention, a diameter of .025 inch has been found to be entirely adequate and satisfactory.

The tube **10** is generally filled with caulking material **11** to the fill line **40**. Some means not shown are normally provided to prevent the exodus of the caulking material through the nozzle **12** prior to the first use. The head and skirt portions may be assembled prior to assembly with the tube **10**, or the skirt portion **21** may be assembled with the tube **10** and then the head portion **20** assembled therewith. In either event, the tapered surface **36** and the shoulder **35** act to hold the head and skirt portions in the assembled relationship shown.

In operation, the plunger **14** is advanced axially into engagement with the outer or right hand surface of the head portion **20**. The first action is that the domed portion **30** collapses and air moves outwardly through the openings **45**. As the domed portion **30** continues to collapse to the position shown in FIGURE 3, the openings **45** are in whole or part closed substantially, as is shown. When the pressure on the dome portion **30** exceeds the frictional force of the skirt **22** on the tube **10**, the piston moves axially down the tube **10** into engagement with the fill line **40**. The caulking material **11** with its entrained air is placed under compression with a sufficient force to force the material out of the nozzle **12**. Upon the completion of a caulking operation, the plunger **14** is pulled back from its engagement with the head **20**. Immediately the dome portion **30**, because of its inherent resiliency, springs back to the shape shown in FIGURE 1, the holes **45** acting to allow air to enter the space thus formed. Thereafter the compressed entrained air in the caulking material **11** can gradually expand the thick viscous caulking material into the space formed by the return of the domed portion **30** to its original shape.

As indicated, the caulking material normally has about 8% entrained air, and the total expansion of the caulking material which must be provided for is about 5% of the volume of caulking material remaining in the tube **10**. The dome portion **30** in the preferred embodiment has a total change of volume approximately 10% greater than the maximum possible volume change of the caulking material **11**.

Using the present invention, it is possible to accurately determine and to control in manufacturing operations the amount of air space which will be made available for the caulking material to expand into. Such volume is thus not subject to variations in assembly such as would exist with the use of thin sheet or film-like materials which are

assembled with a skirt member so as to have a substantial amount of slack.

Furthermore the flexible portion and the rigid skirt portion may be assembled without the need for special assembly jigs or special assembly techniques. It will be appreciated that insofar as the use of the dome portion 30 is concerned, the entire piston, including the skirt portion, may be made of a molded polyethylene material. However, to obtain the same rigidity of the skirt using polyethylene material, a very substantial volume in weight of polyethylene material would be required. As such material is quite expensive, it has been determined that the described preferred embodiment is the cheaper to manufacture.

The invention has been described with reference to preferred embodiments. Obviously, modifications and alterations will occur to others upon reading and understanding of this specification, and it is my intention to include all such modifications and alterations insofar as they come within the scope of the appended claims.

Having thus described our invention, we claim:

1. A piston for dispensing partially compressible plastic material from an elongated hollow tube, said piston comprising a rigid skirt having an annular outer skirt portion shaped and dimensioned to slidingly and sealingly engage the inside of said tube and having an inner axially extending flange connected integrally with said outer skirt portion and disposed radially inward therefrom and defining an axially extending opening, and a head formed of thin, flexible, resilient material extending transversely across said skirt, said head having an axially projecting annular mounting portion which is received in said axially extending opening in said flange, said mounting portion of the head at its free end having a radially outwardly projecting portion which projects radially outward across one end of said flange in engagement therewith and being deformable radially inwardly to pass slidably through said opening toward said one end of the flange when the head is being assembled on the skirt, said head presenting a radially outwardly projecting flange which engages said skirt at the opposite end of said flange thereon.

2. A piston for dispensing partially compressible plastic material from an elongated hollow tube, said piston comprising a rigid metal skirt having an annular, axially extending, outer skirt portion shaped and dimensioned to slidingly and sealingly engage the inside of said tube, said skirt at the forward end of said outer skirt portion having a radially inwardly extending flange connected integrally to said outer skirt portion, and a forwardly projecting, axially extending flange connected integrally to the radially inward end of said radially inwardly extending flange and defining an axially extending opening, and a head formed of thin, flexible, resilient material mounted on said skirt and extending transversely thereacross, said head having a forwardly projecting annular mounting portion which has an outer diameter substantially equal to the inner diameter of said axially extending flange on the skirt and which is received in said axially extending opening, said mounting portion of the head at its forward end tapering rearwardly and outwardly and defining a radially outwardly protruding segment which projects across the forward end of said axially extending flange on the skirt in engagement therewith, said tapering forward end of the mounting portion of the head being insertable into the rear end of said opening and being deformable radially inward therein to pass slidably forward through said opening when the head is being assembled on the skirt, said head presenting a radially outwardly projecting flange at the back end of said axially extending flange on the skirt which engages the skirt thereat to lock the head in place on the skirt.

3. The piston of claim 2 wherein said axially extending flange on the skirt tapers forwardly and inwardly from its rear end.

4. The piston of claim 2 wherein said skirt has a radially inwardly and forwardly offset portion between said outer skirt portion and said radially inwardly extending flange.

5. An anti-ooze caulking assembly comprising a caulking gun provided with an axially movable plunger and including means for incrementally advancing said plunger; and a cylindrical cartridge containing caulk and provided with a dispensing spout on one end and with a piston in the other end, said cartridge being held by said gun for axial movement of said plunger into engagement with said piston to move the piston axially in said cartridge to displace under pressure caulk therein through said dispensing spout, said piston including an outer metallic part that is radially rigid and is formed with an axially extending skirt which has a wedge shaped leading end portion to facilitate insertion of said piston into said cartridge body and an adjoining cylindrical skirt portion tightly fitted in said cartridge body, said leading end portion having a radially inwardly extending flange portion forming a central aperture through said outer metallic part; and an inner molded plastic part closing such aperture to the passage of caulk therethrough, said inner part being formed with a central portion convexly bowed toward said plunger, said central portion of said inner part axially corresponding to such aperture, said plunger being shaped initially to contact said central convexly bowed portion to deform the same toward said spout whereby, upon release of axial pressure on said plunger, the compressed caulk in said cartridge in expanding is effective readily to restore said central portion to its initial convexly bowed form rather than to ooze from said spout, said inner molded plastic part also including an outer circumferential more rigid portion; and locking means holding said metallic outer part and said inner molded plastic part against relative axial movement, said locking means including axially spaced radially overlapped surfaces on said inner and outer parts to form a unitary piston of said inner and outer parts.

6. In a dispenser for dispensing partially compressible plastic material including a hollow tube for holding the material and a plunger movable axially along the inside of the tube, a piston in the tube separate from the plunger and disposed between the plunger and the material to be dispensed, the piston having a relatively rigid peripheral portion slidable along the inside of said tube in sealing engagement therewith, said piston also having a relatively flexible portion radially within said relatively rigid peripheral portion, said piston, including said relatively flexible portion of said piston, being in containing relationship with said material to be dispensed and being movable by said plunger in pushing relationship with said material to be dispensed upon engagement of said piston by said plunger when said plunger is forced toward said material to be dispensed, with said relatively flexible portion of said piston being movable by said plunger from a condition of relatively great concavity with respect to said material to be dispensed to a condition of lesser concavity with respect to said material to be dispensed during the initial portion of said movement of said piston in said pushing relationship with said material to be dispensed, valving means within said piston and communicating from the one side of said piston facing said material to be dispensed to the other side of said piston for responsively and selectively passing air and shutting off the passage of material presented to said valving means from said one side of said piston, with said passing responsively occurring when air under compression is presented to said valving means and with said shutting off responsively occurring when said material to be dispensed is presented to said valving means, said valving means comprising passage means of a diameter to pass air but prevent the passage of said material to be dispensed.

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