June 18, 1963 J. J. CULLEN ETAL 3,094,254

NUTATING NOZZLE

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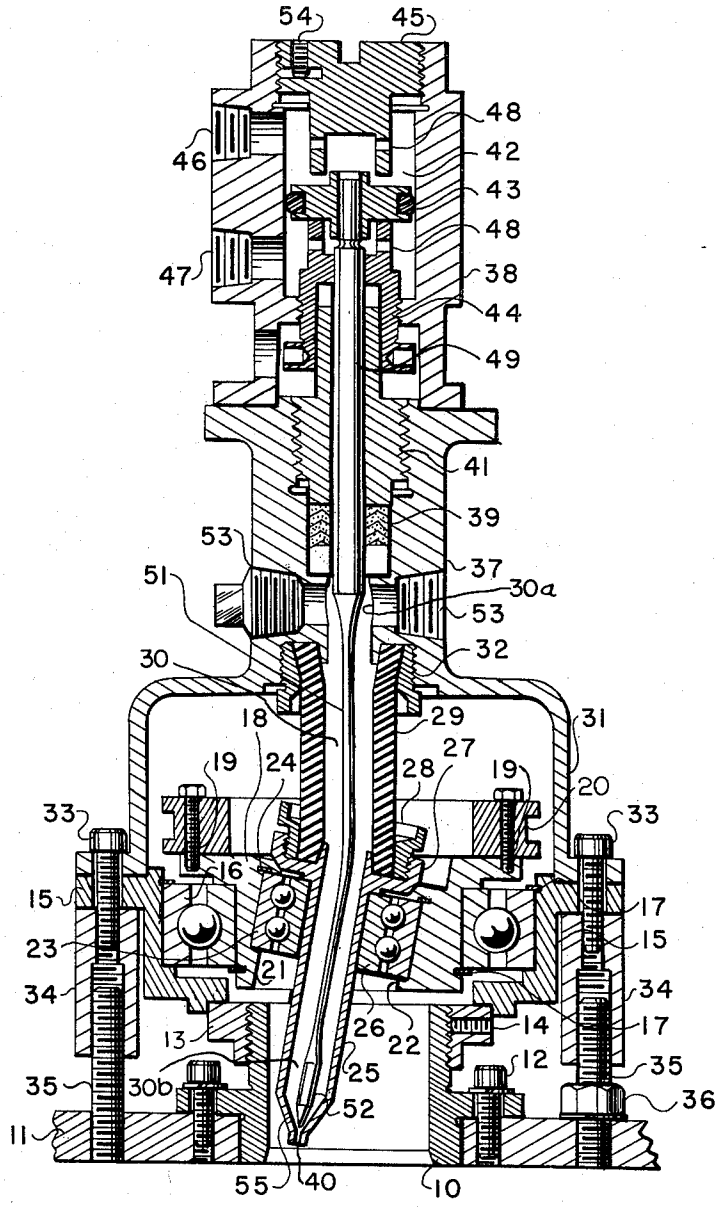


Fig. 1

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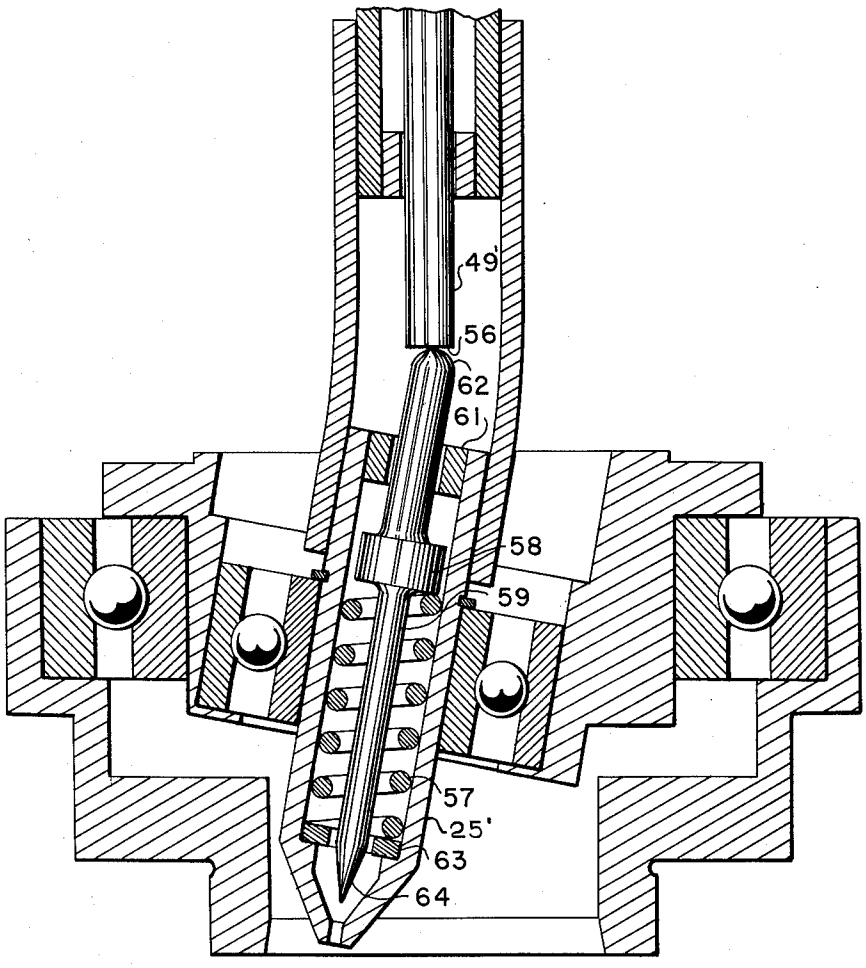


Fig. 2.

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NUTATING NOZZLE

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This invention relates to a nozzle adapted to apply gasket forming compositions to container closures and other metal parts and particularly adapted to place a ring or "lining" of such a composition in small closures such as bottle crowns or caps.

The function of a nozzle in applying a gasket forming composition to a metal part is to apply a uniform stripe of such a composition to the desired portion of the metal part. The composition is of such a nature that it can later be transformed, usually by heat, into a solid gasket. Normally a needle valve nozzle has been used for this purpose, since such a nozzle can provide a uniform flow of compound and can be adapted to provide a quick and positive control of the initiation and cessation of flow of compound so necessary if areas of overlap or underlap where the end of the gasket meets the beginning is to be avoided.

Such a nozzle consists of a tip which also serves as a valve seat, a compound receiving passage which terminates at the tip, a needle which passes through the passage, one end of which is adapted to cooperate with the valve seat in the nozzle tip, a valve actuating mechanism which cooperates with the other end of the needle, a conduit for supplying compound to the compound receiving passage and means for actuating the valve mechanism.

To apply the gasket forming composition at the proper place on the metal part, the nozzle tip and the metal part necessarily must move relative to each other. Normally this has been accomplished by moving the metal part in a predetermined path beneath a stationary nozzle. Since most such metal parts such as the ends for cans or caps for jars and bottles require a circular lining this most usually has been accomplished by placing the metal part on a rotating chuck and rotating the part beneath the nozzle. In some instances it is not convenient to rotate the part because of its size, shape or configuration. In such instances it has been proposed to move the nozzle instead of the part. In one such instance, it has been proposed that the entire nozzle assembly be moved, but this proposal has not proved to be very satisfactory because of the weight of the entire assembly and because of the difficulties of providing a flexible means of supplying the compound while maintaining a constant compound pressure at the nozzle tip and means for actuating the nozzle. More recently it has been proposed to maintain the majority of the assembly in a stationary position and to rotate a nozzle tip having an off-center outlet about the assembly. In connection with this proposal however, it has proved difficult to provide a satisfactory, completely fluid-tight, slip coupling to allow for the relative movement of the two parts of the nozzle assembly.

The nozzle of the present invention avoids these difficulties by providing a stationary valve actuating mechanism and compound supply port, a flexible compound receiving passage and a nozzle tip which can be moved in a predetermined path without rotating relative to the remainder of the nozzle.

In view of the fact that it is by far the most common use of such a nozzle, this specific description of the present invention will be set forth in terms of such a nozzle with a nozzle tip adapted to describe a circular path and thereby forming a circular gasket on a metal part. The details of

the invention will be better understood by the reference to the drawings in which:

FIGURE 1 shows a sectional elevation of the nozzle of this invention.

FIGURE 2 shows a sectional elevation of an alternate form of the nozzle of this invention.

The nozzle assembly rests on a base **10** which is rigidly mounted on a metal part transport device such as a conventional compound applying machine indicated at **11** by cap screws **12—12**. The upper portion of base **10** is threaded and is surrounded by a threaded collar **13**, which engages the threads of base **10**. This permits the collar **13** to be raised or lowered as the nature of the metal part demands. Collar **13** is locked in place by set screw **14**.

Bearing seat **15**, into which an annular ball bearing **16** is pressed, is supported by collar **13**. The inner and outer races of ball bearing **16** are retained by ring retainers **17**. Drive ring **18** is force fitted into the inner race of bearing **16**. Drive ring **18** may be provided with a drive gear, or more conveniently with a pulley **20** adapted to receive a timing belt. The drive gear or drive pulley is attached to the drive ring **18** by screws **19** which engage tapped bores in ring **18**. A driving motor (not shown) adapted to drive the drive gear or drive pulley through gear or belt means (not shown) may then be placed at some convenient remote location.

The drive ring **18** incorporates an angular bore **21**, the displacement of which form the vertical axis is a variable depending on the diameter of the closure to be lined. For example, the departure from the vertical axis is 10° if a common crown closure is to be lined. Bore **21** is shouldered at **22** to provide a stop for the outer race of radial ball bearing **23** which is pressed into the bore **21**. The race of bearing **23** is held by retainer **24**.

Bridge **31**, which forms a stationary support, is provided with the ports **53**, and a connecting, T-shaped fluid passage **30***a*. The bridge is fastened to bearing seat **15**, by the cap screws **33—33**. A hose **29**, is secured to the bridge **31**, by the jamb-nut **32**. Hose bore **30** communicates with the vertical leg of passage **30***a*. Nozzle-tip **25**, fits snugly into the inner race **26**, of bearing **23**, and is provided with an axial bore **30***b*, which terminates in a needle-valve seat **55**, formed adjacent the exit orifice **40**. The upper portion of nozzle-tip **25**, is connected to the lower end of the hose **29**, by the jamb-nut **28**, which is threaded into the enlarged upper portion **27**, of nozzle-tip **25**. Thus, as shown in FIG. 1, passage **30***a*, hose bore **30**, and passage **30***b*, together form a continuous path for fluid sealing compound which is delivered through a conduit connecting the port **53**, to an external pressurized source.

Proper height adjustment of the assembly is secured by the adjustable legs **34** screwed onto studs **35—35** which project from the working face of transport device **11**. To make the adjustment, after the collar **13** has been set (which determines the elevation of bearing seat **15**), the legs **34** are run up until they just touch the bearing seat **15**. Two check nuts **36** (only one of which is shown), lock the legs **34** after the adjustment is made.

Extension **37** forming a part of and rising above bridge **31** forms the base for the valve actuating mechanism **38** and also houses shaft packing **39** and packing follower **41**, which is threaded into the extension **37**.

The valve actuating mechanism **38** as shown comprises an air cylinder **42**, provided with a piston **43**, the travel of which is limited by adjustable stops **44** and **45** threaded into the actuating mechanism body. Air is admitted (or exhausted) both above and below the piston through the ports **46** and **47**. Air vents **48—48** in both stops prevent the trapping of air as the piston closes against each stop. Obviously, alternate valve actuating mechanisms may be employed.

Piston 43 is carried on piston rod 49. In the design as shown in FIGURE 1, the rod, its flexible extension 51 and the needle 52 are formed from a single piece of a fatigue resistant alloy, such as a beryllium-copper alloy. Experience has shown that this alloy will withstand the fatigue of bending extremely well and, even when the nozzle tip revolves at speeds up to 3600 r.p.m. for extended periods the needles give long, dependable service.

Alternatively since there is no rotary motion of needle 52 relative to extension 51 or rod 49, these three parts or any two of them may be formed of different materials and fastened together as by a threaded or a force fit. For example, it is preferable to form the tip of needle 52 of an abrasion resistant material such as a tungsten carbide.

Compound under an adjustable head pressure flows into the valve through one or the other of the ports 53. The other of ports 53 is provided to permit the recirculation of compound which is desirable in connection with heated compounds. If not so used the second port may be plugged. Operating adjustments are simple. After the collar 13, and the legs 34, have been adjusted, as described above, to raise or to lower the height of the nozzle tip 25, to suit the closure and to secure the "placement" of the lining compound which is desired, the volume of compound deposited on the closure is adjusted (1) by varying the head pressure on the compound entering port 53 and (2) by changing the lift of the needle by raising or lowering the stop 45, then locking the stop with screw 54. Shut-off is secured by adjusting the down stroke of piston 43 by adjusting the lower stop 44 to allow the needle to seat in conical seat 55.

In the version of valve actuating mechanism shown, valve opening is controlled by air which is supplied to the actuating mechanism by an electropneumatic valve mechanism which in turn is controlled by an electrical impulse supplied for example by a breaker switch which rides on an adjustable cam which in turn is geared to the metal part transport device so as to supply compound only when a part is in position to receive compound. Other valve actuating mechanisms may be used.

FIGURE 2 shows a modification of the nozzle which is used when no copper contamination of the compound can be tolerated. (For example, a very few parts per million of copper catalyze the oxidative degradation of natural rubber.)

All of the structure in the nozzle of FIGURE 2 remains the same as that of FIGURE 1 as previously described except that the piston rod 49', instead of continuing as a single piece of the needle, ends in a flat 56. Nozzle-tip 25' is bored to receive an opening spring 57 which pushes upwards against the shoulder 58 formed on the needle shaft 59. The upper end of shaft 59, after passing through a slotted guide portion 61 of nozzle-tip 25', terminates in a hemispherical head 62, which is urged by spring 57, into constant contact with the flat end 56 of piston rod 49'. Another slotted guide, 63 adjacent the needle point 64, keeps the needle in alignment. Consequently, this valve is opened by the spring and closed by the piston.

This version of the nozzle also has given dependable service while operating at the rapid opening and closing cycle necessary to apply compound to as many as 300 metal parts per minute and while revolving at 3600 r.p.m.

It will be understood that a non-circular motion may be imparted to nozzle tip 55 by a suitable mechanism replacing the ball bearings described such as by providing a cam and cam follower or by offseting the axis of motion from axis of rotation of the bearings.

We claim:

1. A nozzle for applying predetermined quantities of fluid gasket-forming material to container closures and like parts comprising the combination of a stationary support, a passage for fluid in said support, a valve actuating mechanism having a piston and a piston-rod mounted on and extending above the support, a flexible hose attached to and extending downwardly from the support having the bore of said hose maintained in communication with said passage, a nozzle-tip attached to the opposite end of the hose having a fluid passage communicating with said bore, a valve seat formed in the passage adjacent the lower end of the nozzle-tip, a valve needle positioned within said passage and said bore adapted to be reciprocated by the piston along a path angularly displaced from the axis of travel of the piston and piston-rod and co-operating with the valve seat to form a fluid seal, means to maintain the nozzle-tip angularly displaced from the vertical axis, and power-connected means to cause the nozzle-tip to move in a prescribed path.

2. A nozzle adapted for use in combination with container closure lining machinery having a nutating nozzle-tip, means to supply fluid lining compound to said tip, and valve means to control the flow of compound through said nozzle-tip, including means to secure the nutatory motion of said tip comprising a first named radial bearing having a fixed outer race and a rotatable inner race, means including a drive ring to rotate the inner race, a second named radial bearing having outer and inner races, having its outer race seated in the drive ring and having its axis angularly disposed to the vertical axis of the first named bearing, the said nozzle-tip being fitted through and supported by the inner race of said second named bearing whereby, when said inner race of said first named bearing is rotated, the end of said nozzle-tip describes a circular path.

3. A nozzle according to claim 1 wherein the piston-rod 49, the intermediate connecting portion 51 and the valve needle 52 are combined in a unitary structure formed of a fatigue-resistant alloy, and wherein the intermediate connecting portion 51 possesses a sufficiently smaller diameter than that of the piston-rod portion 49 and the needle portion 52 as to be bendable and permit the reciprocation of the needle and the consequent opening and closing of the valve in the nozzle-tip despite the nutatory motion of the nozzle-tip.

4. A lining machine nozzle having: an angularly disposed nozzle-tip arranged to sweep about the sealing area of a closure, a longitudinal bore terminating in a discharge orifice in said tip, a valve seat in the bore adjacent the orifice, a valve needle co-operating with said seat to close the bore, a valve actuating mechanism, and means to conduct fluid sealing compound to said bore, wherein the valve needle is formed in two parts, the first of which is attached to the valve actuating mechanism and the second of which is slidably supported by guides in the bore of said nozzle-tip and wherein the nozzle-tip is provided with a spring which normally urges the second part of the valve needle toward an open position and wherein the upper end of the second part terminates in a hemisphere which rests against the bottom of the said first part.

5. A nozzle for container closure compound applying machines comprising a base, a first radial bearing having an outer race attached to said base, an inner race, means associated with the inner race to rotate said race, a second radial bearing having inner and outer races supported by the said means and having its axis angularly disposed to the vertical axis of the first named bearing, a nozzle tip fitted through the inner race of the said second bearing, a valve needle cooperating with said tip and forming a needle valve, flexible conduit means to conduct compound to said tip and means to operate the valve.

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