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APPARATUS FOR EXTRUDING A LENGTH OF MATERIAL

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Fig. 1.

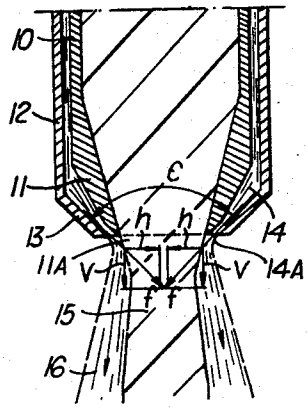


Fig. 2.

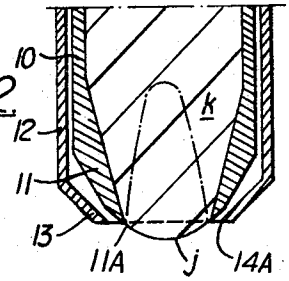


Fig. 3.

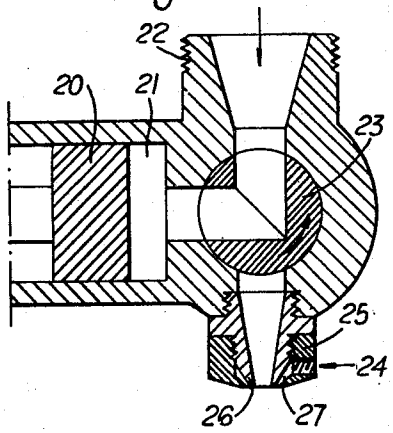
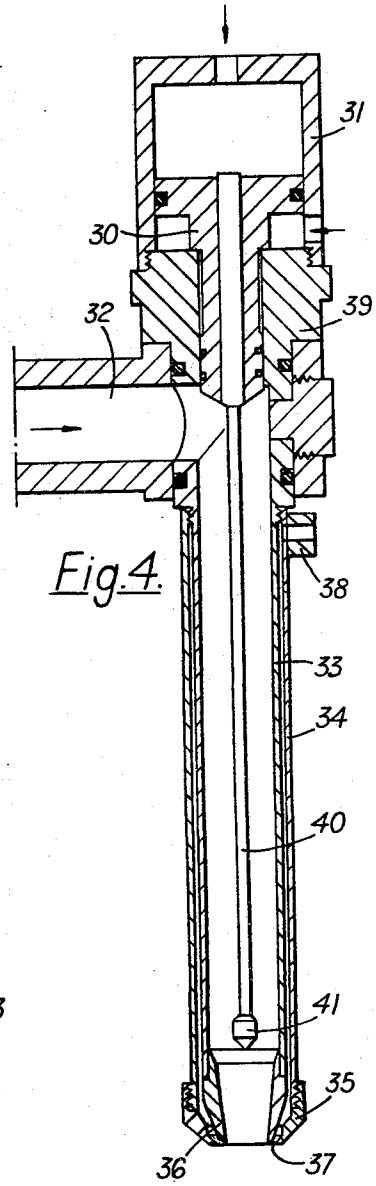


Fig. 4.



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APPARATUS FOR EXTRUDING A LENGTH OF MATERIAL

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U.S. Cl. 222—571 5 Claims

ABSTRACT OF THE DISCLOSURE

An extrusion apparatus for extruding a length of glutinous viscous material into a receptacle, in which a convergent conical stream of gas is used to cut the stream of extruded material after said length has been extruded. If desired, suction may be applied within the extrusion tube to assist in the cutting of the length.

The present invention relates to an apparatus for extruding a length of material, and may be used for extruding a length of glutinous and viscous material in order to pack it into a receptacle.

Known machines for filling receptacles at a high rate with a viscous or pasty product comprises a metering member, which may be a piston pump, with an injector nozzle thereon, and a distribution system which alternately places a storage tank containing the product in communication with the metering member and the metering member with the injector.

If the product to be packaged is of a relatively fluid nature, the injector is very often composed of a tube section whose outlet orifice is narrow in relation to the opening of the receptacles to be filled. The volume of product to be injected must be released at a sufficiently high speed to ensure filling without, for example, the formation of air pockets. If very viscous products are to be packaged, it is possible to use an injector which, by a relative plunging movement, commences the filling of the containers from the bottom and then rises as the products are injected. With this arrangement, the outlet orifice of the tube section must be wider than that employed with the injection of more fluid i.e. less viscous products. This difference arises because the machine must supply in a very short time larger forces for injecting a viscous product than are required for the same volume of a more fluid product, and the increase in the diameter of the tube section then decreases the stresses exerted on the machine.

However, regardless of the mode of injection employed, when a charge of material has been injected, a string of the material is left between the injector and the receptacle. Various devices have been proposed for cutting this string to prevent soiling of the edges of the injector and of the receptacle. Thus, the viscous stream of product extending from the end of the injector may be aspirated with the aid of the metering pump or of an auxiliary pump, or a jet of gas may be passed through an axial tube section concentric with that at which the product is injected, so as to break the string.

However, these systems are not always effective, especially when very glutinous products are being injected. It is true that the aspiration produces a narrowing of the viscous stream extending from the injector to the receptacle but this stream remains continuous and is not broken. Furthermore, with axial blowing, the presence of the product in front of, or even inside, the glowing pipe causes a rise of the pressure of the jet, until a wad of product

which is formed is violently ejected. This will result in splashing, and particles of the glutinous material rise along the external part of the injector and foul the upper edges of the receptacle.

According to the present invention, there is provided an extrusion apparatus for extruding a length of material, such apparatus comprising an extrusion tube having an extrusion orifice, and an outer tube surrounding said extrusion tube and defining with the outer surface of the extrusion tube, an annular chamber, in the form of a frustum of a cone, converging towards the axis of the extrusion tube downstream of said extrusion orifice, the angle at the apex of the cone being between 10° and 180°, injection means for injecting a charge of material through said tube, and means for connecting said chamber to a source of gas under pressure via a shut-off valve, synchronised with said injection, means, so that gas flows from said chamber only after a charge has been injected.

The angle at the apex of the cone is preferably between 40° and 140°. With this apparatus it is possible, at the end of each injection, to provide a convergent gas jet on the string of product joining the injector and the receptacle, and break this string. The apparatus may be associated with a suction system which acts simultaneously and produces a narrowing of the string of product in order to facilitate its breaking.

The tube section outside the extrusion tube, may be mounted on any type of injector. Since the annular chamber between the tube sections is never blocked by the product, and the viscous stream of material is broken outside the extrusion tube, the gas or stream can readily be adjusted to its lowest pressure value and its shortest duration, in order to avoid the danger of splashing due to gas turbulence at the top of the receptacle.

This is one of the main advantages of the apparatus of the present invention as compared with apparatus in in which a co-axial blowing is employed. In addition, the presence of a gas which may be inert, makes it possible to enclose in the receptacle a neutral atmosphere, which protects products which might be impaired by contact with the ambient air before final closure of the receptacle.

A further advantage afforded by having the gas jet in a convergent form, is that the product is more effectively heaped in the receptacle, which is necessary more particularly for thixotropic products which form in the receptacle, after the viscous stream of product has been broken, at the end of the injection, a substantially vertical tow which remains intact and is likely to soil the upper part of the receptacle at the time when it is closed.

In order that the present invention may be more readily understood, the following description is given, merely by way of example, reference being made to the accompanying drawings, in which:

FIGURE 1 is a fragmentary sectional view of the tip of the extrusion tube and outer tube of one embodiment of apparatus according to the invention:

FIGURE 2 is a view similar to FIGURE 1, illustrating the apparatus immediately after the stream of extruded product has been cut;

FIGURE 3 is a fragmentary section through one embodiment of apparatus incorporating the tip illustrated in FIGURES 1 and 2; and

FIGURE 4 is an axial section through a second embodiment of apparatus.

Referring now to FIGURE 1 there is illustrated an internal extrusion tube **10** provided with a frusto-conical end portion **11** and having a circular extrusion orifice **11A** at the lower end. Surrounding tube **10** is an outer tube **12**, also having a frusto-conical all **13** which defines with the outer surface of frusto-conical portion **11** of the tube **10**, a frusto-conical chamber **14** terminating in a lower con-

tinuous annular opening **14A**. The interior of the tube **10** may be connected to an injection device for injecting a charge of material into the tube **10**, this charge issuing through the extrusion orifice as a stream at **15**.

The annular space between the tubes **10** and **12** is connected to a source of gas, e.g. air, under pressure, and this gas may be ejected from the annular chamber **14** in a conically convergent stream. This stream will emit from the opening **14A** of the chamber at an angle θ, which is between 10° and 180° and is preferably between 40° and 140°. The stream issues in a direction *f* which is composed of a horizontal component *h* and a vertical component *v*.

When a charge of material has been injected through the tube **10**, the gas stream is started, and this serves to cut the stream of material **15**, and to provide an envelope **16** surrounding the stream. This envelope prevents the stream from splashing out sidewardly from the receptacle, and furthermore, keeps the end of the tubes **10** and **12** completely clean, which is particularly desirable when using the apparatus of the invention for packaging products which deteriorate in the ambient atmosphere. If such products are used, the gas stream will be of a gas which is inert to the products, e.g. one of the so-called inert gases.

The horizontal component *h* of the gas stream *f*, serves to cut the product after the charge has been ejected through the extrusion orifice, and the vertical component *v* assists in the drawing away of the rod-like charge which has just been extruded.

FIGURE 2 shows the lower surface *j* of the product after the string or stream of products has been cut by the gas stream.

Referring now to FIGURE 3, there is illustrated an apparatus incorporating an extrusion arrangement similar to that illustrated in FIGURES 1 and 3. The tube **26**, which corresponds to the tube **10** of FIGURES 1 and 2, is connectable, by rotation of valve **23**, to a cylinder **21** in which is slidable an injection piston **20**. The valve **23** is rotated to the position illustrated in FIGURE 3, so that the cylinder **21** may be placed in communication with a source of product to be injected via the connection **22**.

The outer tube **25** may be connected to a source of gas under pressure (not shown) via a shut-off valve (not shown).

In use of the apparatus of FIGURE 3, the valve **23** is moved to the position shown in the drawing, and the piston **20** is drawn to the left, thus introducing a charge of material into the cylinder **21**. The valve **23** is rotated in the direction indicated by the arrow, and the piston **20** moved back towards the right, thus injecting a charge of material through the tube **26**. When this charge has been completed, the valve (not shown), which is synchronised with the movement of piston **20**, opens and a stream of gas emanates from chamber **27** to cut the string of product.

In FIGURE 4, there is shown a similar apparatus in which a piston **30** is movable in a cylinder **31**, and the product to be injected may be drawn in through conduit **32**. Cylinder **31** is connected by means of block **39** and concentric tube **33**, **34** to an inner extrusion tube **36** and an outer surrounding tube **35** respectively. Tubes **35** and **36** define, at the lower extremity a frusto-conical chamber **37** directed towards the axis of the tubes **33**, **34**, **35** and **36**. The frustro-conical annular chamber **37** may be connected to a source of gas (not shown), via a connection **38**, and a shut-off valve may be positioned between connection **38** and the source of gas. Extending from the lower end of piston **30** is a rod **40** which carries at its lower end a head **41** which is positioned upstream of the outlet orifice of extrusion tube **36** when the piston **30** is in its lowermost position.

In operation of the above-described apparatus, the piston **30** is forced upwardly by pneumatic pressure from a source not shown, and a charge of material is introduced through conduit **32**. The source of gas is then connected to the upper end of cylinder **31** and the piston **30** is forced downwardly injecting a charge of material through tube **33** and extrusion tube **36** and out through the orifice in tube **36**. At the end of the stroke the piston **30** is returned to its upper position thus producing a suction effect at the extrusion orifice. Simultaneously, air is introduced through connection **38** and produces a conically converging gas stream surrounding the extrusion orifice. This serves to cut and pull apart the extruded stream from the quantity of product within tubes **33** and **26**. Owing to the suction effect produced by retraction of piston **30**, the product is drawn inwardly of the extrusion orifice in a manner similar to that indicated by the dotted portion *k* illustrated in FIGURE 2.

Any gas is suitable for blowing through the chamber **14**, **27**, **37**. Suitable gases are air, nitrogen, helium, argon and krypton. The products which may be packed with the apparatus of the invention may include, inter alia, gums, adhesives, pastes and glutinous greases, mastics, tacky resins, certain latexes, and composition capable of being vulcanised to form rubber in solution, or in the pure state. More particularly, the apparatus is very useful for packaging organopolysiloxane compositions vulcanisable to form elastomers at ambient temperature. The following examples, illustrate the packaging of products using the apparatus of the invention.

EXAMPLE 1

In cylindrical aluminium tubes (height 140 mm., diameter 35 mm.) was packed a stringy and sticky organopolysiloxane composition comprising by weight:

	Parts
Dihydoxylated dimethylpolysiloxane oil having a viscosity of 20,000 cst. at 25° C.	100
Silica of combustion	5
Diatomaceous silica	25
Methyltriacetoxysilane	3

The machine illustrated in FIGURE 3 was employed, the injector being composed of two concentric tube sections **25** and **26** which define between them an annular space of 0.5 mm. with an apex angle θ of 90°. The outlet orifice through which the product leaves the tube section **26** had a diameter of 3.5 mm. Nitrogen was introduced through connection under a pressure of 0.5 bar, the duration of the jet being 0.5 sec. per injection.

Under normal operating conditions, the machine filled 900 tubes per hour with 100 g. per tube. It was found that after operation for 8 hours, neither the injector nor the aluminium tubes were soiled by sticky product. On the other hand, when the tube section **25** was removed simply by unscrewing, or on simple interruption of the supply of blowing gas, it was found that both the tubes to be filled and the outside wall of the injector were soiled by splashing of the product to be packed, which would necessitate frequent cleaning, reduce the rate of filling of the tubes and impair their appearance.

EXAMPLE 2

A mastic which hardens in the air, comprising (by weight):

	Parts
Dihydroxylated dimethylpolysiloxane oil having a viscosity of 10,000 cst. at 25° C.	100
Liquid methylpolysiloxane resin of R/Si=1.77	16
Silica of combustion treated with octamethylcyclotetrasiloxane	22.2
Methyltriacetoxysilane	7.6

was packed in cylindrical aluminium tubes having the same dimensions as those employed in Example 1, with the machine illustrated in FIGURE 4.

The orifice through which the product left the short tube section **36** had a diameter of 8 mm. and the two tube sections **35** and **36** defined betwen them an annular

space **37** of 0.75 mm. in width with an apex angle θ of 90°. The internal and external diameters of the tube **33** were 18 and 20 mm. and those of the tube **34** were 24 and 28 mm. Nitrogen was introduced through connection **38** under a pressure of 0.6–0.7 bar for a period of 0.6 sec. per injection.

The machine was run at an operating rate of filling of 900 tubes per hour (100 g. of mastic per tube). After operation for 8 hours, it was found that the injector was free from any traces of mastic and that the tubes were perfectly clean.

On stopping the supply of blowing gas, or on drilling an axial blowing channel in the interior of the rod **40**, it was found that the advantages afforded by the apparatus of the invention immediately disappear and that the mastic formed streaks on the tubes and distributing plate, which necessitated careful cleaning and frequent stoppage.

EXAMPLE 3

Example 2 was repeated, but cylindrical pasteboard cartridges measuring 255 mm. in height and 45 mm. in diameter were filled at the same rate (350 g. of mastic), using the machine of FIGURE 4 with the internal and external diameters of the tube **33** measuring 29 and 32 mm. and those of the tube **34** measuring 35 and 40 mm., the annular space betwen the tube sections **35** and **36** being 1 mm., the apex angle θ being 90°, and the orifice through which the product leaves the tube section **36** being 10 mm.

The machine was operated for 8 hours, after which it was found that the packing was still clean. When the supply of blowing gas was stopped, or an axial blowing was employed, the disadvantages already mentioned in Example 2 immediately reappeared.

We claim:

1. An extrusion apparatus for extruding a length of material, such apparatus comprising:

(a) an extrusion tube defined in an extrusion orifice;

(b) an outer tube surrounding said extrusion tube and defining therewith an annular chamber in the form of a frustum of a cone, terminating in an external continuous annular opening surrounding said extrusion orifice, said cone converging towards the axis of the extrusion tube, the angle at the apex of the cone being above 10°;

(c) injection means for injecting a charge of material through said extrusion tube; and

(d) means for connecting said chamber to a source of gas under pressure via a shut-off valve synchronized with said injection means, whereby gas flows from said chamber through said opening only after a charge has been injected.

2. The extrusion apparatus defined in claim **1**, wherein the angle at the apex of the cone is between 40° and 140°.

3. The extrusion apparatus defined in claim **1**, and including means for produciny a suction in said extrusion tube when gas flows from said chamber.

4. The extrusion apparatus defined in claim **3**, wherein the injection means includes a cylinder connected to said extrusion tube; a double acting piston movable in said cylinder, whereby forward movement of said piston causes injection of a charge of material through said tube and retraction of said piston causes a suction in said extrusion tube.

5. The extrusion apparatus defined in claim **4**, wherein a rod is mounted on said piston; and a head is mounted on said rod within said extrusion tube at a position a short distance upstream of said extrusion orifice.

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