

[54] **METHOD OF DILATING A FLATTENED TUBE TO A DESIRED CROSS-SECTION AND DELIVERING A PRE-DETERMINED LENGTH OF DILATED TUBE**

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[58] Field of Search 425/289; 26/55 R, 26/55 C; 83/175, 176, 18, 20, 188, 276; 53/197, 291, 292

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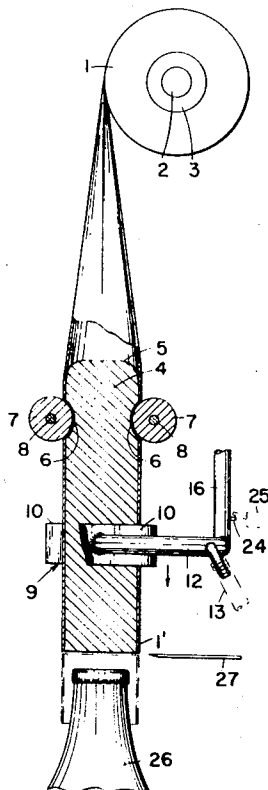
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ABSTRACT

The leading end of a film tube folded flat in the form of a roll is fitted over a guide element arranged to be movable in the axial direction thereby to cylindrically expand or distend the end portion, and then the external surface of this end portion is encircled by an annular hoop-like suction applying means arranged to be axially reciprocable at a constant stroke and so designed that it produces a suction force when it moves forward and that such force is eliminated when it moves back, thereby allowing the expanded tube end to project forwardly of the guide element portionwise at a constant rate.

4 Claims, 2 Drawing Figures



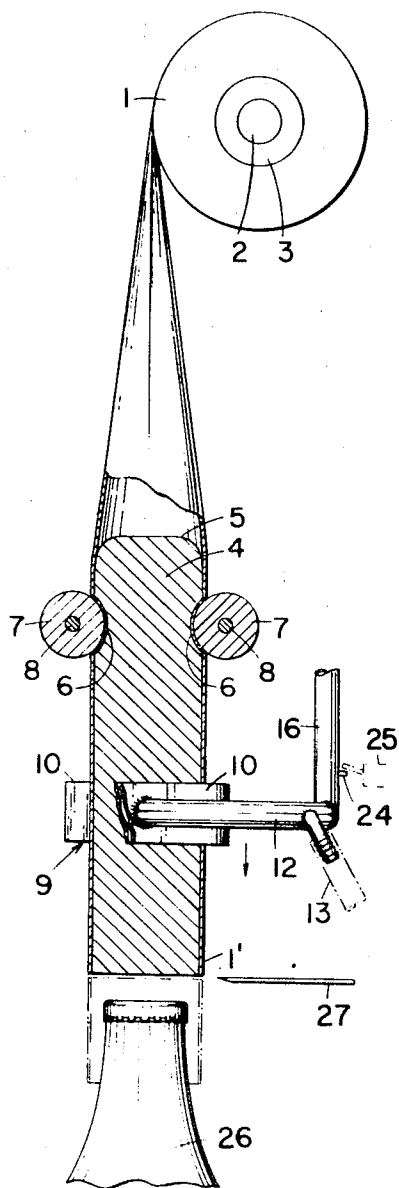


FIG. 1

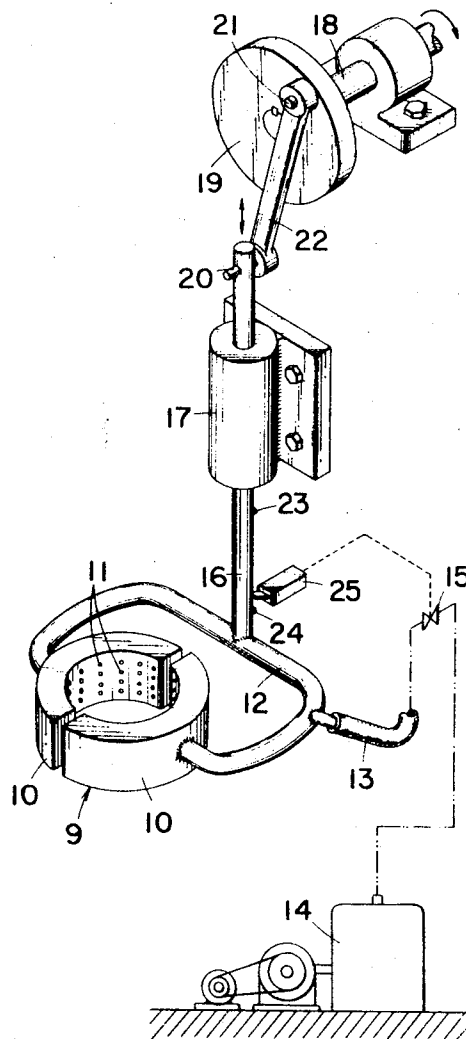


FIG. 2

METHOD OF DILATING A FLATTENED TUBE TO A DESIRED CROSS-SECTION AND DELIVERING A PRE-DETERMINED LENGTH OF DILATED TUBE

BACKGROUND OF THE INVENTION

This invention relates to a method of and an apparatus for expanding the leading end of a flattened tube and delivering predetermined lengths thereof, for example for facilitating the fitting of such lengths onto a bottle or can at a constant rate.

For forming a cap seal or the like from a tube of synthetic resin film which is wound on a reel in flattened form, by feeding the leading end of such tube and capping the mouth of a bottle or the like with tube portions cut from the end thereof, the following steps are required: drawing off the tube from the reel, expanding the end portion thereof to cylindrical form, and delivering it portionwise at a constant rate while maintaining the dilated configuration.

These steps are quite different in nature from one another and therefore involve difficulties in execution on an in-line system. Moreover the equipment necessary for performing the steps separately is very complicated.

The present invention has for its object to provide a method and apparatus which allows performance of some or all these steps in an appropriate manner in a single operation.

SUMMARY OF THE INVENTION

According to one aspect of the present invention, there is provided a method of expanding a flattened tube to a desired cross-section and delivering a predetermined length of expanded tube, comprising drawing the flat tube over a guide element, which expands the tube to the desired cross-section, applying suction to the exterior of the expanded tube from a suction applicator arranged to surround the tube with a slight clearance while causing the applicator to advance a predetermined distance to deliver a predetermined length of expanded tube, the cross-sectional configuration of the guide element being such as to allow a slight clearance between it and the expanded tube.

According to a second aspect of the present invention, there is provided an apparatus for expanding a flattened tube to a desired cross-section and delivering it stepwise at a constant rate, comprising a guide element of a cross-section configuration such as to impart the desired cross-section to the tube but to have a clearance fit therewithin and having a plurality of recesses in its external surface, holding members received in the recesses to retain the element in a fixed position, a suction applicator mounted around the guide element but arranged to clear the surface of the expanded tube, reciprocating means for reciprocating the suction applicator over the guide element with a constant stroke, and valve means to connect the suction applicator to a source of suction during the advance stroke of the applicator and to disconnect it from the source during its return stroke so that successive equal lengths of tube are delivered from the guide element.

In a preferred embodiment of the method according to the present invention, the leading end of an elongated film tube, which is folded flat or collapsed in the form of a strip and wound up on a reel, is led over a guide element having its largest diameter slightly smaller than the inner diameter which will be assumed

by the film tube when the latter is expanded to a perfectly cylindrical form and so mounted that it cannot move axially of the film tube, thereby to expand the leading end of the tube cylindrically. The cylindrically expanded portion of the film tube is then further advanced along the guide element with its external side encircled by an annular hoop-shaped suction applicator which is arranged to reciprocate in the axial direction of the tube and to exert a suction force when it moves forward and not to exert such a force when it returns. The applicator is so formed that its inner diameter is substantially the same as the outer diameter of the film tube when the latter is expanded into a perfect cylinder. The expanded end portion of the film tube is thus projected forwardly of the guide element portionwise at constant rate.

An embodiment of the present invention will now be described, by way of example, with reference to the accompanying drawings in which:

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a partially broken-away from elevation of an apparatus according to the present invention; and

FIG. 2 is a perspective view of the vacuum applicator shown in FIG. 1 and an associated reciprocating mechanism.

DETAILED DESCRIPTION OF THE INVENTION

FIG. 1 shows a long tube of synthetic resin film 1 which is folded flat or collapsed in the form of a strip and wound on a reel 3 rotatably supported on a horizontal shaft 2 mounted in a framework (not shown) of the apparatus. A guide element 4 is somewhat reduced in diameter at its upper end portion 5 and is so designed that it has a round cross-section with a diameter slightly smaller than the inner diameter of the tube 1 when the latter is caused to assume a perfectly circular cross-section. There are formed in the guide element 4, immediately below its upper end portion 5, a pair of opposed part-cylindrical recesses, 6 which each receive one of a pair of holding rollers 7, which have a radius slightly smaller than that of the arc of the recesses 6 and which are each pivotally supported on a horizontal shaft 8 provided in the framework. The rollers 7 are received in the respective recesses 6 in such a manner as to be slightly spaced therefrom, to hold the guide element 4 vertically as shown.

A suction applicator 9 includes a pair of semi-cylindrical elements 10 arranged, when assembled, to have an inner diameter substantially the same as the outer diameter of the film tube 1 when the latter assumes a perfectly circular cross-section. The applicator 9 is so designed that it can move vertically at a constant stroke and provides a suction during its descending stroke but not during its ascending stroke.

FIG. 2 shows the suction applicator 9 and its operating mechanism. It will be noted that numerous small holes or apertures 11 are provided around the inside of each of the semi-cylindrical elements 10 and that the elements 10 are connected with each other through a substantially U-shaped connecting pipe 12, with the latter also serving to hold the elements 10 in an annular relationship as shown in the drawing. The connecting pipe 12 is connected to a flexible conduit 13 leading to a vacuum tank 14 and which is provided with a magnetic valve 15.

Extending from a central part of the connecting pipe 12 is a vertical rod 16 which is slidably supported in a vertical sleeve 17 mounted on the framework of the apparatus. The upper end of the vertical rod 16 and the key point of a crank 19 integral with a horizontal shaft 18 rotatably supported by the framework in a suitable manner, are coupled through a connecting rod 22 and co-operating pins 20 and 21.

At selected parts of the vertical rod 16 are provided a pair of vertically aligned protuberances 23, 24, and an inversion retaining type limit switch 25 is provided at a selected part of the framework, with the limit switch 25 being connected to a source of electric current and to the magnetic valve 15. The arrangement is such that when the vertical rod 16 moves up to a predetermined position, the lower protuberance 24 will actuate the limit switch 25, and when the rod 16 moves down to another predetermined position, the upper protuberance 23 will actuate the limit switch 25, so as to open or close the magnetic valve 15, thereby causing the applicator 9 to suction during the downward stroke and not during the upward stroke.

In the operation of the apparatus the leading end of the film tube 1 wound on the reel 3 is drawn out therefrom, is then passed through the space between the holding rollers 7 and the guide element 4 and drawn around the remainder of the element 4 so as to be expanded. Thereafter, the external surface of the thus expanded portion of the film tube is subjected to suction so as to cause it to assume a perfectly circular cross-section, by the applicator 9 which is then at the elevated position; and thereafter the applicator 9 is lowered.

By this movement, the circularly expanded end portion 1' of the film tube 1 is projected downwardly a fixed distance from the guide element 4, so that if the top or neck portion of a bottle or the like 26 is positioned immediately below the guide element 4 as shown in FIG. 1, the projected end portion 1' of the film tube 1 will be fitted over the top portion of the bottle 26 as shown in chain dotted lines.

A rotary cutter 27 is then advanced in a suitable manner between the top of the bottle 26 and the bottom end of the guide element 4 to cut the end portion of the film tube 1, which has been fitted over the bottle 26, from the remainder of the tube.

Upon completion of this cutting operation, the applicator 9 is raised by the timed action of the crank 19 through the connecting rod 22 and the vertical rod 16. During this ascending stroke, no suction is applied. Consequently, the remaining portion of the film tube 1 remains stationary around the outer periphery of the guide element 4 but is again delivered a fixed length downwardly from the guide element 4 upon the next downward movement of the applicator 9.

It is to be noted that the guide element 4 is so designed that its largest diameter is slightly smaller than the inner diameter of the film tube 1 when it is expanded to a perfectly round cross-section. The expansion of the film tube 1 by the guide element 4 causes the external surface of the film tube 1 to be placed in a position close to the internal wall surface of the applicator 9. Thus, the suction action further expands the film tube 1 to a perfectly cylindrical form. Consequently, when the tube 1 is lowered with its outer surface drawn on to the inner face of the elements 10, the inner face of the tube 1 will not frictionally rub the out-

side of the guide element 4; also, during the ascent of the applicator 9, the inner surfaces of the elements 10 will not frictionally rub the outer face of the tube 1, thus allowing the tube 1 to be smoothly, lightly and positively drawn out portionwise at a constant rate.

It is preferred to constitute the suction applicator by a combination of the semi-cylindrical elements 10 as in the described embodiment or by a greater number of arcuate segments of smaller length, and these segments are preferably arranged so as to form a slight space between each adjoining segment, thus facilitating opening of the film tube by a suction action. However, the applicator 9 may be of continuous cylindrical configuration.

Although, in the described embodiment, the guide element 4 is held in a vertical position, it is also possible to orientate the guide element horizontally by suitably positioning the holding rollers 7, so as to allow horizontal feeding of the tube.

Also, in the described embodiment, a combination of the crank 19, the connecting rod 22 and the vertical rod 23 is used for effecting reciprocating motion of the vacuum applicator 9 at a constant stroke, but such operation can also be effected by employing a double-action type solenoid, a reversible motor, a hydraulic, pneumatic or vacuum-operated type reciprocating piston or the like.

Furthermore, for effecting a connection and disconnection between the applicator 9 and the suction source 14 in accordance with the reciprocation of the applicator 9, it is also possible to effect such opening and closing by mechanical, hydraulic, pneumatic or suction means associated with the movement of the applicator 9.

I claim:

1. An apparatus for expanding a flattened tube to a desired cross-section and delivering the flattened tube stepwise at a constant rate to a point of utilization, comprising a guide element of circular cross-section, the maximum diameter of the guide element being less than the internal diameter of the expanded tube to allow a clearance between the guide element and the tube, means cooperable with the guide element to hold the guide element in a fixed position, a suction applicator surrounding the guide element and tube thereon located below the holding means, means mounting said applicator for axial movement toward and away from the point of utilization, means operably connected to said applicator for imparting axial movement thereto, said applicator having a circular internal cross-section, the diameter of which is substantially the external diameter of the tube when the tube is expanded to circular form, a suction source, means providing communication between the suction applicator and the suction source, valve means provided for the communication means to connect and disconnect the applicator with the suction source, and valve control means operably related to the mounting means for the applicator and the valve means operative upon axial movement of the applicator towards the point of utilization to connect the applicator with the suction source whereby the applicator and expanded tube held thereby are delivered to the point of utilization and upon axial movement of the applicator away from the point of utilization to disconnect the applicator from the suction source.

2. The apparatus as claimed in claim 1 in which the applicator includes a plurality of arcuate segments having an inner space, apertures providing communication

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between the inner space and the inner periphery of the segments, first conduit means communicating with the inner space of each segment and maintaining the segments in circular form, second conduit means connected to the first conduit means, said first and second conduit means constituting said communication means between the applicator and the suction source, said mounting means including a fixed sleeve, and a rod connected to the first conduit means slidably positioned in said fixed sleeve, said valve control means including a pair of aligned axially spaced protuberances on said slidably positioned rod, and a limit switch lo-

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cated in the path of movement of said rod and actuable by the protuberances, and means connecting the limit switch to the valve means.

3. The apparatus as claimed in claim 2, in which the means for imparting axial movement to the applicator includes a driven crank, a connecting rod, and means connecting the connecting rod to the crank and rod connected to the first conduit means.

4. The apparatus as claimed in claim 3 including cutter means for severing the delivered length of tube.

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