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(54) APPARATUS FOR SEALING OPEN-TOPPED CONTAINERS

(71) We, SUMITOMO BAKELITE COMPANY LIMITED, a body corporate organised and existing under the laws of Japan of 2/2, 1-chome, Uchisaiwai-cho, Chiyoda-ku, Tokyo-to, Japan do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:–

This invention relates to an apparatus for sealing open-topped containers, and more particularly to an apparatus for sealing open-topped containers with a heat-shrinkable film comprising a horizontal conveyor for conveying the containers to be sealed, and an endless belt disposed above the conveyor with its lower run parallel to the conveyor and adapted to be driven in the same direction as the conveyor at a speed equal to the speed of the conveyor, such that during the sealing operation the film is held entirely below the lower run of the endless belt and is slightly pressed thereby against the top of a container to be sealed, and nozzles for applying hot air to the peripheral portion of the pressed sheet projecting from the periphery of the top of the container to shrink the peripheral portion and to thereby seal the top of the container with the sheet in the form of a cap.

With the sealing apparatus of this type, the container to be sealed and the sealing sheet thereon are conveyed as held against displacement between the lower run of the endless belt and the conveyor therebelow and parallel thereto, and the peripheral portion of the sealing sheet projecting from the periphery of the top of the container is exposed to hot air, with the sealing sheet held entirely below the holding belt. Thus, containers can be cap-sealed more effectively than by apparatus of other types. The apparatus can carry out the sealing operation continuously and automatically with high efficiency when incorporating means for automatically feeding containers to the conveyor and means for automatically cutting out sealing sheets from a continuous plastic film and automatically feeding the sheets to the tops of the containers.

An apparatus of such type for sealing the tops of containers is disclosed, for example, in the specification of U.S. Patent No. 3,508,380. According to the prior art disclosed, hot air is forced out upward against the container to be sealed from therebelow and is applied to the peripheral portion of the sealing sheet, so that part of the hot air impinging on the lower surface of the holding belt will flow upstream of the container conveyor along the lower belt surface, namely toward the sealing sheet feeding position, consequently exposing the sealing sheet to the hot air and shrinking the sheet before it is pressed against the top end of the container by the holding belt.

Another apparatus for sealing the tops of containers is disclosed, for example, in the specification of Australian Patent No. 225, 318 in which a sealing sheet is held by a horizontal endless belt to the top end of a container on a horizontal conveyor, such that hot air is applied to the sealing sheet in a horizontal direction transversely of the belt from hot air ducts arranged on the opposite sides of the lower run of the travelling belt. According to the latter prior art, the hot air will not impinge on the lower surface of the belt and be forced toward the sealing sheet feeding position, so that the sealing sheet is less likely to be exposed to the hot air than in the former prior art being pressed by the holding belt against the top end of the container. However, the hot air will flow toward the sheet feeding position due to spontaneous diffusion. Thus the sealing sheet is not always free from the problem of the undesired shrinkage. Further with the latter prior art, the sealing sheet is covered with the holding belt not entirely but partially, with the result that the uncovered portion of the sealing sheet covering the top end of the container will shrink on exposure to the hot air. Consequently, the sealing sheet

fails to effectively seal the top of the container in the form of a cap.

Further according to the two prior art references mentioned above, the holding belt tends to rise from the sealing sheet on the container during travel, permitting the hot air to flow into the resulting space between the sealing sheet and the holding belt and causing undesirable shrinkage of the sheet, or the holding belt tends to deviate sidewise, displacing the sealing sheet relative to the top of the container and leading to improper sealing.

Accordingly, the main object of this invention is to eliminate the drawbacks of the prior art and to provide an improved apparatus for sealing the tops of containers with a heat-shrinkable sealing material in the form of a cap, permitting every sealing sheet fed to the container to seal the container satisfactorily as desired.

In accordance with the present invention, we provide apparatus for sealing open-topped containers with a heat-shrinkable film, comprising a horizontal conveyor for conveying the containers to be sealed, an endless belt having a horizontal lower run disposed above the conveyor and parallel thereto and adapted to be driven in the same direction as the conveyor at a speed equal to the speed of the conveyor, the lower run of the endless belt being operative during the sealing operation to overlap and hold entirely therebelow a sealing sheet of heat-shrinkable film placed on an open-topped container on the conveyor and to slightly press the sheet against the top surface of the container to be sealed, the sheet being of sufficient size for the peripheral portion thereof to be shrinkable about the top of the container nozzle means extending along each of the opposite side edges of the lower run of the endless belt in opposed relation thereto, the outlet or outlets of each nozzle means being positioned at the same level as the lower surface of the lower run, means for heating air and supplying the hot air to the outlet or outlets of each nozzle means whereby, in operation of the apparatus, hot air is applied to the peripheral portion of the pressed sheet projecting from the periphery of the top of the container to shrink the peripheral portion and to thereby seal the top of the container with the sheet in the form of a cap, each nozzle means being adapted at least at the upstream end thereof (in relation to the direction of movement of the conveyor and the lower run) to direct the hot air in an oblique direction toward the respective side edge of the lower run of the endless belt in the direction of travel of the lower run, and a belt holder disposed at a fixed position for preventing the lower run of the endless belt from rising at least in the zone where hot air is supplied from the nozzle means, the belt holder being provided with plates extending downward therefrom close to the opposite side edges of the lower run of the endless belt and having lower ends positioned substantially at the same level as the lower surface of the lower run of the endless belt.

The hot air emitted from the nozzle outlets is effectively applied to the peripheral portion of the sealing sheet on the top end of the container on the conveyor. Moreover, since each nozzle means is adapted at least at the upstream end thereof to direct the hot air in an oblique direction toward the respective side edge of the lower run of the endless belt in the direction of travel of the lower run the problem of hot air flowing toward the sealing sheet feeding position is overcome. Thus the present invention has completely eliminated the objection that the sealing sheet would undesirably shrink on exposure to the hot air before being held by the belt against the top end of the container on the conveyor.

The belt holder acts to prevent the belt from rising off the sealing sheet on the container during its travel through the sealing zone, so that the sealing sheet can be held entirely below the lower run of the endless belt during the sealing operation, and hence the hot air cannot flow into a space between the belt portion and the sealing sheet and cause undesirable shrinkage of the sheet. The part of the lower run of the endless belt holding the sealing sheet to the top end of the container is so restrained by the plates of the belt holder as to travel straight, maintaining the sealing sheet in the original position relative to the top of the container. Moreover, since the lower ends of the plates are positioned substantially at the same level as the lower surface of the lower run of the endless belt portion, the hot air to be applied from the nozzle means to the sealing sheet will not be blocked by the plates or deflected but is forced against the sheet very efficiently.

This invention therefore has the advantage that every sheet fed onto the top of the container can be satisfactorily usable for sealing the top of the container in the form of a cap.

The apparatus of this invention is particularly useful in sealing the open tops of cups, cans, bottles, plastics containers and the like, containing foods, beverages such as soft drinks, juices or alcoholic beverages, drugs, cosmetics etc.

These and other features of this invention will hereinafter be described in detail with reference to the accompanying drawings, in which:

Figure 1 is a front view showing a preferred embodiment of the apparatus of this invention;

Figure 2 is a view in section taken along the line II-II in Figure 1;

Figure 3 is a plan view showing a conveyor included in the embodiment of Figure 1 and the part below the conveyor;

Figure 4 is a fragmentary front view on a larger scale of a conveyor chain portion of

the embodiment;

Figure 5 is a side elevation showing the conveyor chain portion shown in Figure 4;

Figure 6 is a view in vertical section showing a belt driving drum included in the embodiment;

Figure 7 is a perspective view on a larger scale of a suction box included in the embodiment;

Figure 8 is a front view on a larger scale of means shown in Figure 1 for cutting out sealing sheets;

Figure 9 is a side elevation, partly in vertical section, showing the means illustrated in Figure 8;

Figure 10 is a view on a larger scale showing an air applicator illustrated in Figure 9;

Figure 11 is a front view showing a modification of means for preparing sealing sheets from a continuous plastics film: and

Figure 12 is a front view showing another modification of the present apparatus.

Like parts are referred to by like reference numerals throughout the drawings.

Figures 1 to 10 shown an embodiment of this invention in which a biaxially oriented plastics film *f* is set on the apparatus and sealing sheets of predetermined shape and dimensions are cut out from the film to seal the open tops of containers.

The embodiment shown in Figures 1 to 10 includes a horizontal conveyor 1 for conveying the containers *a* to be sealed. The conveyor 1 is in the form of a chain conveyor provided with pairs of front and rear attachments 2 and 3 arranged at regular spacing and adapted for receiving and retaining the containers. Insofar as the pair of the attachments are adapted to receive and retain the container *a* in the space therebetween, the attachments need not be opposed to each other in the direction of travel of the conveyor but may be opposed transversely thereof. The pair of attachments may alternatively be in the form of a single tray.

The chain conveyor 1 is reeved around sprocket wheels 5 mounted on the opposite ends of and to be driven by a spindle 4 and sprocket wheels 7 mounted on the opposite ends of a shft 6. The spindle 4 and the shaft 6 are supported by arms 9 and 10 secured to the front and rear ends of a horizontal frame 8, by means of bearings 11 and 12. The horizontal frame 8 is provided with cross bars 13 and 14 secured thereto. The frame 8 is attached to the main frame 15 by the cross bars and level adjusting screws 16 and 17 vertically shiftable for adjustment. Accordingly, the conveyor 1 is vertically shiftable for adjustment by vertically shifting the horizontal frame 8. This permits the lower horizontal run 22*a* of a travelling endless belt 22 for sealing sheets to exert optimum pressure on the tops of containers *a* of varying heights.

The conveyor 1 is driven in the direction of the arrow A in Figure 1 by a motor 18 by way of transmission chains 19, 20, a drive sprocket wheel 21 on the spindle 4, the spindle 4 and the sprocket wheels 5.

The endless belt 22 is disposed above the conveyor 1 in parallel thereto, with its lower run 22*a* spaced from the conveyor 1 by such a distance that the run 22*a* will come into slightly pressing contact with the top surfaces of the containers *a* retained between the attachments 2 and 3 on the conveyor 1. The belt 22 is reeved around a drive drum 23, a roller 24 and a tension roller 25 mounted on the main frame 15. The drive drum 23 for the endless belt 22 is provided with a drive sprocket wheel 26 at one end of its shaft. The belt 22 is driven in the direction of the arrow B in Figure 1 at the same speed as the conveyor 1 by the motor 18 via the transmission chain 19, a shaft 27, transmission gears 28, 29, a shaft 30, transmission chains 33, 34 and the drive sprocket wheel 26.

The endless belt 22 is preferably formed with a large number of apertures 35 over its entire surface. When the sealing sheet is placed onto the upper run of the belt 22, the air between the sheet and the belt will escape through the apertures 35, permitting the sealing sheet to be retained on the belt 22 free of any displacement. Consequently, if the feeding position and timing for the sealing sheet relative to the belt 22 are properly predetermined, the sealing sheet can be fed to the top end of the container *a* accurately concentrically therewith. This can be achieved more effectively by applying slight suction to the apertures 35 over an area extending from the sheet feeding position to the peripheral surface of the drum 23. However, satisfactory results are attainable with the apertures 35 alone without using any suction. Usually, the sealing sheets are electrostatically charged during the manufacture of the elongated biaxially oriented plastic film from which they are prepared or when they are cut out from the film, so that they adhere to the belt 22. The means for applying suction to the belt 22 over the above mentioned area may comprise, for example, a suction box 37 disposed in a fixed position and having an upper wall plate 39 formed with openings 38 in corresponding relation to the apertures 35 (see Figure 7). The suction box 37 has a duct 40 in communication with a suitable suction source such as a vacuum pump (not shown). The suction to be applied to the belt over the peripheral surface of the drum 23 may be provided, for example, through a suitable number of grooves 36 formed in the peripheral surface of the drum 23 circumferentially thereof in corresponding relation to the apertures 35 and communicating with the interior space of the suction box 37. The groovs 36 can be maintained in communication with the interior space of the suction box 37 by suitable means, for example,

by forming an open end 37a in the box 37 in opposed relation to the drum 23, providing the side walls of the box with circular arc edges at the open end in conformity with the periphery of the drum and holding the circular edges in contact with the drum periphery.

Hot air nozzles 41 are opposed to and extend substantially along the opposite side edges of the lower run 22*a* of the belt 22. The nozzles are positioned at the same level as the lower surface of the lower run 22*a*. Although the nozzles 41 of the illustrated embodiment continuously extend along the opposite side edges of the lower run 22*a* of the belt, the continuous nozzle 41 may be replaced by a plurality of nozzles arranged close to each other and aligned along each side edge of the lower run 22*a* of the belt. The hot air nozzle 41 on each side of the lower run of the belt is provided with means by which the hot air to be forced out from at least the upstream end of its nozzle orifice 41*a* is directed in an oblique direction toward the respective side edge of the lower run 22*a* in the direction of advance of the run 22*a*. When a plurality of nozzles are used on each side of the belt, the orifices of some of the nozzles are provided with like means. In the illustrated embodiment, air guide plates 42 and 43 are used as the above-mentioned means. At the portion other then where the air guide plates 42 and 43 are disposed, the nozzle orifice 41*a* is preferably provided with a suitable number of plates 44 by which the hot air to be forced out from this portion will be directed toward the peripheral portion of the sealing sheet with improved effectiveness. Satisfactory results can be achieved when the latter plates 44 are disposed at right angles to the longitudinal direction of the belt 22, although they may be oriented in the same direction as the plates 42 and 43. Each of the nozzles 41 incorporates a heater 101 and communicates with the outlet 47*a* of a pressurized air source 47 such as an air compressor or blower. The outlet 47*a* is provided with a damper 102 which is turnable about a vertical axis extending across the outlet. The pressurized air can be supplied at an equal rate to the ducts 46, therefore to the nozzles 41 on the opposite sides, by adjusting the damper 102. Indicated at 103 is the handle of the damper 102.

A belt holder 45 extends over part of the lower run 22*a* of the belt 22 corresponding to a sealing zone, i.e. to a heating zone provided longitudinally of the belt 22 by the hot air forced out from the nozzle orifices 41a. The belt holder 45 has plates 48 extending downward therefrom and close to the opposite side edges of the lower run 22*a* (see Figure 2). The lower edges of the plates 48 are substantially at the same level as the lower surface or the lower run 22*a*.

Sealing sheet cutting-out means I is disposed at a specified position above the upper run of the belt 22 in proximity thereto. The means I schematically shown in Figure 1 is illustrated in greater detail in Figures 8 to 10.

The means I for cutting out sealing sheets comprises a substantially annular punch 49, a clamp 50 slidably fitting around the punch 49, a stationary clamp 51 disposed below and opposed to the clamp 50, and an air applicator 52 slidably fitting in the punch 49. The punch 49 cuts out sheets of sufficient size for the peripheral portions of the sealing sheets to be satisfactorily shrinkable about the tops of the containers. The lower clamp 51 has a lower edge 78 co-acting with the punch 49.

The punch 49 is formed at its lower end with a blade comprising a plurality of inverted V-shaped edges arranged along the entire circumference of the punch over an equal distance so as to cut out the sealing sheets effectively. Preferably, the blade is in the form of serrated teeth. When cutting out a sealing sheet from the film *f*, the blade will come into point contact with the film *f*, with a uniform force acting on the entire periphery of the punch 49, thus ensuring an effective cutting-out operation. The annular punch 49 is secured to the bottom of a plate 53 secured to the lower ends of columns 56 whose upper ends are secured to the lower end of a vertical shank 55. The shank 55 is secured to the lower end of the plunger 65 of an air cylinder or hydraulic cylinder 54 such as water pressure cylinder. The upper clamp 50 is secured to the lower ends of vertical rods 58 (only one rod shown in Figure 9 to simplify the drawing) slidably extending through holes 57 at the four corners of the plate 53. Each of the vertical rods 58 is fixedly provided at its intermediate portion with a collar 59 resting on the plate 53. Slide shoes 61 (only one shown in Figure 9) secured to the plate 53 by (not illustrated) means and slidable on columns 60 are mounted on the upper ends of the respective vertical rods 58. A coiled spring 62 is provided between the collar 59 and the slide shoe 61. The lower clamp 51 is secured to the lower ends of the columns 60 and is positioned close to the upper surface of the upper run of the belt 22. The air applicator 52 is mounted on the lower end of the plunger 64 of an air cylinder or a hydraulic cylinder 63 such as water pressure cylinder secured to the plate 53. The air applicator 52 has air supply ducts 67 in communication with its interior space 66 (see Figure 10) and with a source (not illustrated) for supplying air at room temperature. The sealing sheet cutting-out means I is further provided with rollers 68 and 69 for guiding the continuous film *f*. The rollers 68 and 69 are supported by a support 70 mounted on the columns 60 or some other suitable fixed member in such arrangement that the film *f* will be passed through the space between the upper clamp 50 and the lower clamp 51.

The apparatus shown in Figures 1 to 10 will operate in the following manner.

conveyor is usable for the containers in place of the conveyor of the type described above.

WHAT WE CLAIM IS:

1. Apparatus for sealing open-topped containers with a heat shrinkable film, comprising a horizontal conveyor for conveying the containers to be sealed, an endless belt having a horizontal lower run disposed above the conveyor and parallel thereto and adapted to be driven in the same direction as the conveyor at a speed equal to the speed of the conveyor, the lower run of the endless belt being operative during the sealing operation to overlap and hold entirely therebelow a sealing sheet of heat-shrinkable film placed on an open-topped container on the conveyor and to slightly press the sheet against the top surface of the container to be sealed, the sheet being of sufficient size for the peripheral portion thereof to be shrinkable about the top of the container, nozzle means extending along each of the opposite side edges of the lower run of the endless belt in opposed relation thereto, the outlet or outlets of each nozzle means being positioned at the same level as the lower surface of the lower run, means for heating air and supplying the hot air to the outlet or outlets of each nozzle means whereby, in operation of the apparatus, hot air is applied to the peripheral portion of the pressed sheet projecting from the periphery of the top of the container to shrink the peripheral portion and to thereby seal the top of the container with the sheet in the form of a cap, each nozzle means being adapted at least at the upstream end thereof in relation to the direction of movement of the conveyor and the lower run to direct the hot air in an oblique direction toward the respective side edge of the lower run of the endless belt in the direction of travel of the lower run, and a belt holder disposed at a fixed position for preventing the lower run of the endless belt from rising at least in the zone where hot air is supplied from the nozzle means, the belt holder being provided with plates extending downward therefrom close to the opposite side edges of the lower run of the endless belt and having lower ends positioned substantially at the same level as the lower surface of the lower run of the endless belt.

2. Apparatus as claimed in Claim 1, wherein each nozzle means comprises a single nozzle with its outlet extending continuously along the respective side edge of the lower run of the endless belt.

3. Apparatus as claimed in Claim 1, wherein each nozzle means comprises a plurality of nozzles arranged close to each other with their outlets aligned along the respective side edge of the lower run of the endless belt.

4. Apparatus as claimed in Claim 1, 2 or 3, further comprising means for applying heat to the portion of the sheet overlying the top of the container the heat applying means being disposed above the conveyor downstream of the lower run of the endless belt.

5. Apparatus as claimed in Claim 4, further comprising means for applying cold air over the top of the container, the cold air applying means being interposed between the downstream end of the lower run of the endless belt and the heat-applying means.

6. Apparatus as claimed in any one of the preceding claims, including means for intermittently feeding a continuous heat-shrinkable film to a position close to and above a portion of the upper run of the belt in parallel thereto, cutter means disposed above the upper run of the endless belt for cutting out the sealing sheet from the film, the cutter means including a movable punch and a stationery die member co-operative with the punch.

7. Apparatus as claimed in Claim 6, including clamp means for clamping the heat-shrinkable film along the portion thereof to be cut out, the clamp means including a vertically movable upper member and a stationery lower member for clamping the film therebetween while the sealing sheet is being cut out.

8. Apparatus as claimed in Claim 6 or 7 further comprising means for forcing the sealing sheet downward away from the cutter means.

9. Apparatus as claimed in any one of Claims 6 to 8, further comprising attachments for retaining the containers on the conveyor at regular spacing, the cutter means being operative at a time interval corresponding to the spacing distance between the containers on the conveyor.

10. Apparatus as claimed in any one of the preceding claims, wherein the belt is formed with apertures over its entire surface.

11. Apparatus as claimed in Claim 10 further comprising means for applying suction to the belt apertures to suck the sealing sheet, the apertures being provided over an area extending from the position where the sealing sheet is fed to the belt to a position immediately adjacent the position where the sealing sheet on the belt meets the container on the conveyor.

12. Apparatus for sealing open-topped containers, substantially as hereinbefore described with reference to Figures 1 to 10 of the accompanying drawings.

13. Apparatus for sealing open-topped containers, substantially as hereinbefore described with reference to Figures 1 to 10 when modified by Figure 11 of the accompanying drawings.

14. Apparatus for sealing open-topped containers, substantially as hereinbefore described with reference to Figures 1 to 10 when modified by Figure 12 of the accomapnying drawings.

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1582216 COMPLETE SPECIFICATION

9 SHEETS *This drawing is a reproduction of the Original on a reduced scale*

Sheet 1

FIG. 1

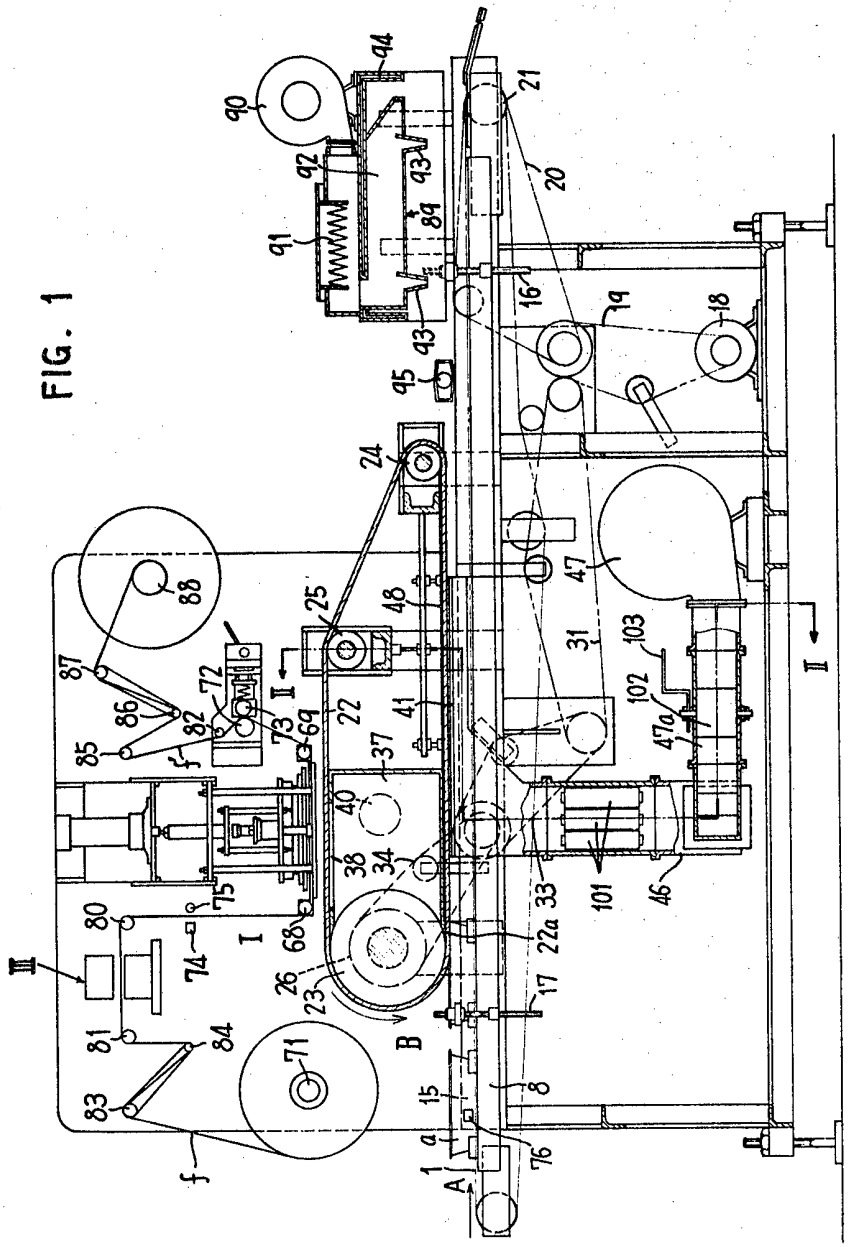

FIG. 2

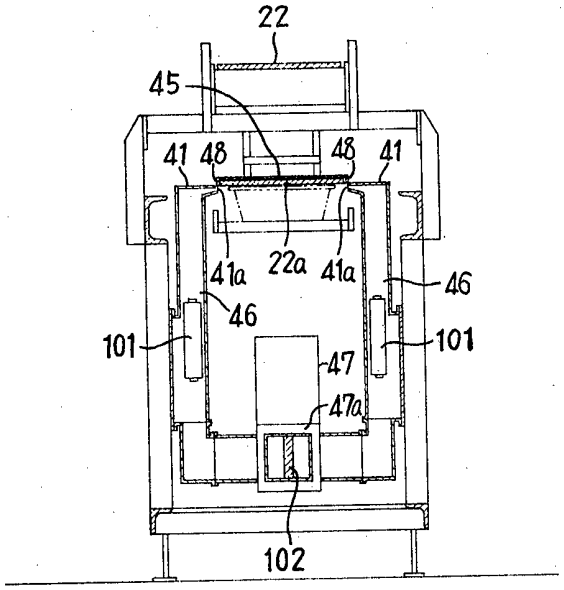

FIG. 3

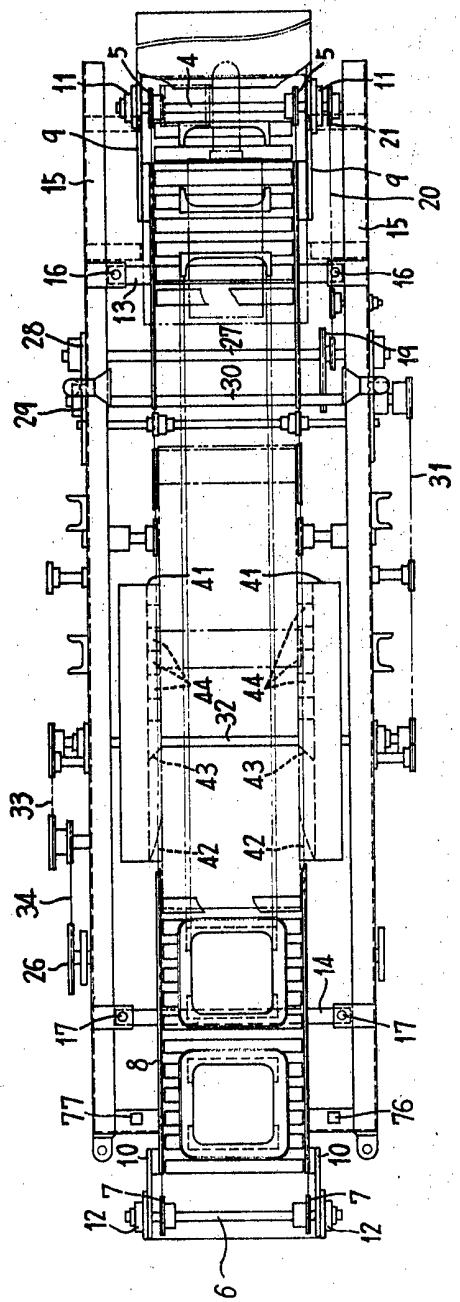
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FIG. 4

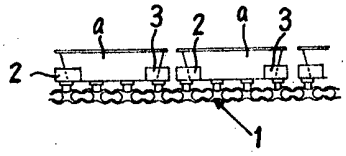


FIG. 5

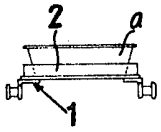
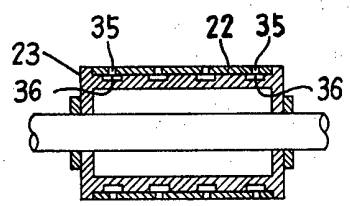


FIG. 6



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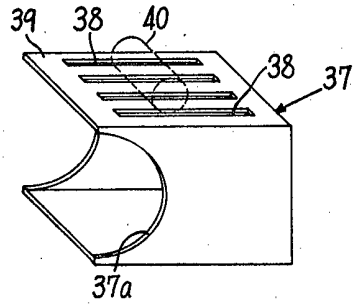

FIG. 8

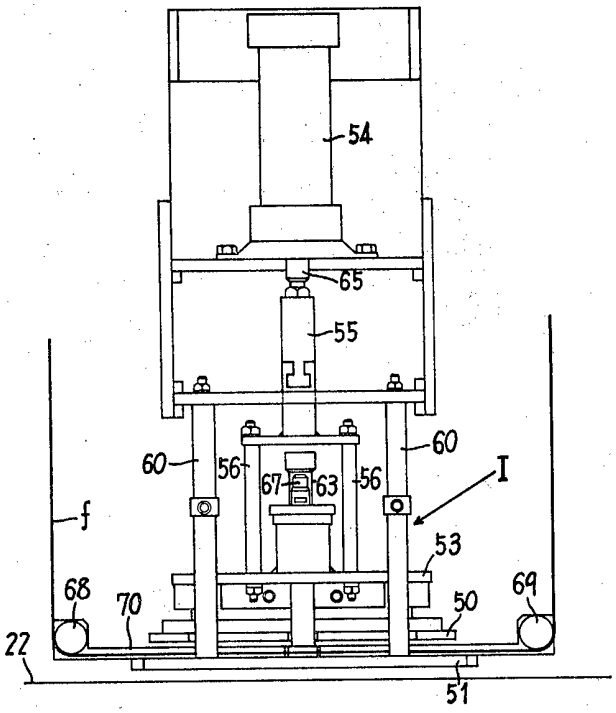

FIG. 9

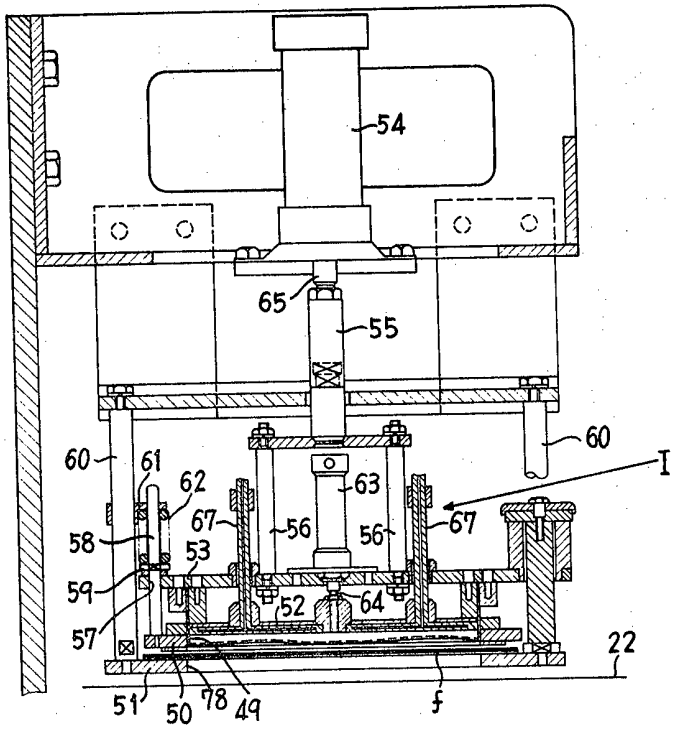

FIG. 10

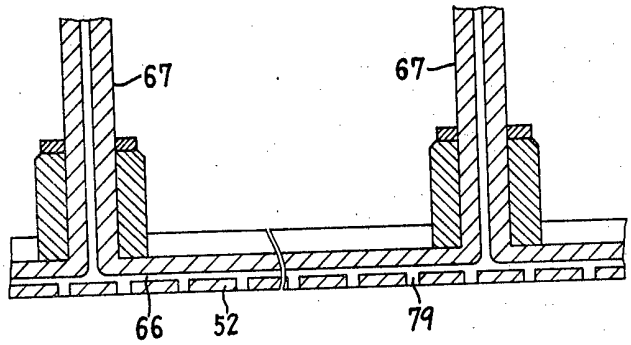
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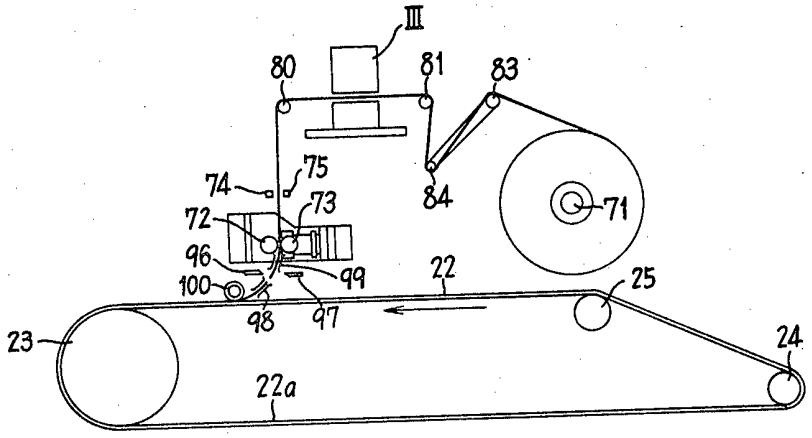
FIG. 11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1582216 COMPLETE SPECIFICATION
9 SHEETS This drawing is a reproduction of the Original on a reduced scale
Sheet 9

FIG. 12