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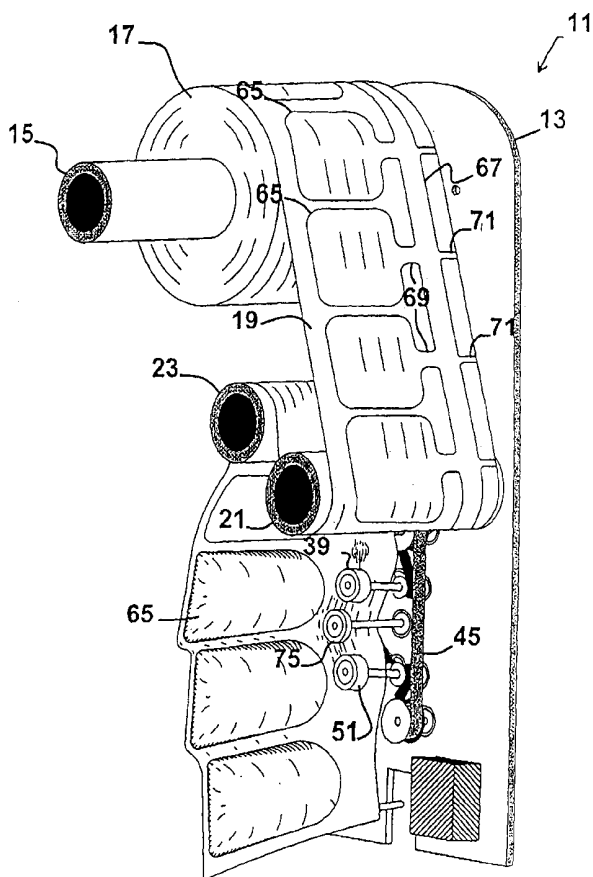
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(54) Title: METHODS AND APPARATUS FOR INFLATING AND SEALING PILLOWS IN PACKAGING



(57) Abstract: A machine (11) which inflates and seals pillows in packaging is compact in overall size and can be operated to produce varied lengths of strips of inflated pillow-type packaging (65) as needed. Production can begin immediately after being held out of a production cycle for the inflated pillow-type packing (65). A heat sealing element (75,81,83) is applied directly to and in sliding contact with a web of film for sealing an inlet port which was used for inflating the pillow-type packaging (65).



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METHODS AND APPARATUS FOR INFLATING AND SEALING PILLOWS IN PACKAGING

BACKGROUND OF THE INVENTION

This invention relates to methods and apparatus for inflating and sealing pillows in packaging.

This invention relates particularly to the construction and operation of a machine which is small enough to be installed for operation on site where
5 articles packaged for transport are placed in shipping containers with protective inflated pillow-type strip packaging.

This invention relates particularly to a machine which is compact in overall size, which can be conveniently operated to produce varied lengths of strips of inflated pillow-type packaging as needed, which can begin
10 production of inflated pillow-type strip packaging immediately after being held out of a production cycle for some period of time and which applies a heated sealing element directly to and in sliding contact with a web of film to securely seal the inlet port of an inflated pillow while the pillow is under pressure and as the web of film is continuously and uninterrupted
15 through the machine.

This invention relates particularly to a machine which forms the seal complete and secure during a short path of travel and during a short interval of time. The seal is made without the need for additional pressing together of the film after the sealing and without the need for additional cooling of the
20 seal after the sealed inlet port moves out of contact with the sealing structure.

Webs of plastic film which are constructed to permit the production of strips of air filled envelopes, cushions and pillows have (in the past ten years

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or so) been used extensively for cushioning objects to be transported in containers.

The thin webs of plastic film are inexpensive, tough, resilient and recyclable. Strips of inflated pillow packaging which are created from these webs of plastic film are used for void-fill packaging to replace products such as crumpled paper or polystyrene peanuts and for protective packaging to replace molded or extruded foams.

U.S. Patent Number 5,454,642; U.S. Patent Number 5,651,237; U.S. Patent Number 5,755,328; U. S. Patent Number 4,017,351; and U.S. Patent Number 5,824,392 disclose methods, apparatus, and webs of plastic film used for making strips of inflated pillow packaging of this general kind. Each of these U.S. patents is incorporated by reference in this application.

Co-pending Application Serial Number 09/207,129 filed December 8, 1998 and entitled "Method and Apparatus for Manufacturing Air-Filled Sheet Plastic Shipping Cushions and the Like", Nicholas P. De Luca and Andrew Perkins, inventors and co-pending Application Serial Number 09/439,552 filed November 12, 1999 and entitled "Machine and Method for Manufacturing a Continuous Production of Pneumatically Filled Inflatable Packaging Pillows", Andrew Perkins, Philipp Borchard, and Nicholas P. De Luca, inventors also disclose methods, apparatus and webs of plastic film of this general kind. Each of these two co-pending applications is assigned to the same assignee as the assignee of this application. Each of these two co-pending applications is incorporated in this application by reference.

Sealing an inflated pillow made a web of plastic film while the air inflates the pillow under pressure and while the web of plastic film is being transported through the machine presents problems.

The seal must be secure and must not leak in order for the inflated pillow packaging to be used effectively for cushioning objects transported within a container.

The seal needs to be formed efficiently, quickly and without extensive, related pressing and/or cooling structure in order to make the machine as compact as possible in size and as efficient as possible in production rate.

To simplify machine construction and to provide a high efficiency of production, it is desirable to be able to make the seal as the web of plastic film is moved continuously and without any interruption and/or intermittent stopping of the film transport during the sealing operation.

5 It is a primary object of the present invention to construct and to operate a machine which is compact in size, which is efficient in production, which is continuous and uninterrupted in operation and which produces seals which are secure and which do not leak.

SUMMARY OF THE PRESENT INVENTION

10 In a specific embodiment of the present invention, a machine inflates and seals pillows in packaging while continuously and uninterruptedly advancing a web of film through an inflating station and a sealing station. The inflating station sequentially inflates pillows at preformed patterns in the web of film by introducing pressurized air through a narrow width inlet port
15 of a preformed pattern. The sealing station seals each inlet port by applying a heated sealing element directly to and in sliding contact with the web of film while the air in an inflated pillow is under pressure as the inlet port moves across the heated sealing element.

The web of film has an uninflated pillow pattern and an uninflated
20 inflation channel preformed in the film. The uninflated pillow patterns comprise multiple, spaced apart, pillow patterns aligned along one side of an inflation channel. The inflation channel extends longitudinally and continuously along the entire length of the film. Each uninflated pillow pattern has a narrow width inlet port extending generally transversely to the
25 longitudinally extending inflation channel and connecting the uninflated pillow pattern to the uninflated inflation channel so that, when pressurized air is introduced into the inflation channel, the pressurized air can be transmitted through the inlet port to inflate the pillow pattern. In some cases the preformed pattern is also formed with outlet ports connected to the inflation
30 channel in such a way that air entering the inflation channel can move into a pillow through an inlet port and can also exit out of the inflation channel

through the outlet port. The outlet port is generally shaped smaller than the inlet port.

By allowing the air above a desired pressure to escape through an outlet port or ports, the pressure in the inflation channel is maintained at a
5 desired level for inflating the pillows without creating over-pressurization.

The air escaping through the outlet port is also sensed to detect where the pillows are in the machine. These detected outlet port positions are then used as signals for an associated electronic unit to count the number of pillows inflated in a particular run through the machine. This also facilitates
10 being able to stop the movement of the film through the machine after one production run of a selected number of inflated pillows at a position which is the right position to start a subsequent production run of a selected number of inflated pillows.

In a specific embodiment of the present invention, the web of film with
15 the preformed patterns is stored on a storage roller of the machine and is advanced through the machine by a first set of nip rollers and a second set of nip rollers at a respective first film transport station and a second film transport station.

Pressurized air is introduced into the inflation channel of the web of
20 film at an inflating station as the web of film is transported through the first film transport station. The pressurized air inflates at least one of the pillow patterns prior to the time the web of film is continuously transported through a sealing station.

Pressure is maintained in the inflated pillow pattern within a calibrated
25 pressure range during the time that the web of film is continuously transported through the sealing station.

At the sealing station the inlet port of an inflated pillow is sealed by
30 applying a heated sealing element directly to and in sliding contact with the web of film. The heated sealing element slides across the inlet port while the air in the inflated pillow is under pressure and as the web of film is continuously and uninterruptedly advanced throughout all components of the machine.

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The heated sealing element has a relatively small longitudinal dimension in the direction of movement of the web of film. In a specific embodiment the length of the heated sealing element is about the same as the width of the inlet port of a pillow pattern. This small size of the heated
5 sealing element helps minimize the amount of sealing heat applied to the web of film.

The sealing station includes a sealing roller disposed alongside the heated sealing element so as to permit the web of film to be advanced between the sealing roller and the heated sealing element. Adjustable
10 biasing means provide for adjustment of the force with which the heated sealing element and the sealing roller are pressed toward engagement with one another.

The sealing roller is positioned with respect to the first and second pairs of nip rollers so as to cause the web of film to wrap around a part of the
15 peripheral surface of the sealing roller both in a circumferential direction and also in a lateral direction. This helps create a dead and flat zone right at and adjacent to the line of sealing across the inlet port. This in turn facilitates making a secure seal without leaking while the pillow is inflated under pressure.

The axes of rotation of at least the second pair of nip rollers are preferably canted at a slight angle with respect to the axis of rotation of the
20 sealing roller.

The second pair of nip rollers are preferably rotated at a speed slightly faster than the speed of rotation of the first pair of nip rollers so as to
25 maintain tension in the web of film between the second and first pair of nip rollers.

In one specific embodiment of the present invention the heated sealing element is a fabric covered Nichrome wire disposed at the end of a bar element which is biased toward engagement with a sealing roller. The fabric
30 covering of the Nichrome wire has a Teflon coating on its outer surface for facilitating sliding of the heated sealing element on the engaged surface of the film as the web of film is advanced through the machine.

The bar on which the heated sealing element is mounted is a composite bar. The very tip of the bar is a ceramic having good insulating qualities, and the remainder of the bar is a different material selected to provide enhanced mechanical durability.

5 The seal is formed complete and secure during a short path of travel through the sealing station.

The seal is complete and secure at the time the web of film moves out of contact with the wheel at the sealing station and without the need for additional pressing together of the film after the sealing station and without
10 the need for additional cooling of the film across the sealed inlet port after the sealed inlet port moves out of contact with the sealing station.

In a second specific embodiment of the present invention the sealing wheel is pressure biased toward engagement with the heated sealing element.

15 In both the first and second specific embodiments the heated sealing element and the sealing wheel are spaced apart from one another when the machine is not transporting the web of film through the machine in a production run. This enables the heated sealing element to be maintained at a desired temperature level while preventing contact with and possible
20 burning of the unmoving film at the sealing station.

In one specific embodiment of the invention the fabric covering for the Nichrome wire is held in a fixed position at the end of the bar element and is replaced as needed.

25 In another specific embodiment of the invention the heating station includes a cartridge unit which can be quickly and easily interchanged with another cartridge unit. The cartridge unit includes an elongated strip of the fabric covering. The strip is mounted on two rotatable reels. The fabric always covers the Nichrome wire, as in the first specific embodiment, and the fabric has a Teflon coating on the side which engages the film in sliding
30 contact, as in the first specific embodiment. The elongated strip of fabric covering is wound between the two reels so as to be moved across the length of the Nichrome wire at a speed which is much slower than the speed

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of movement of the film through the machine but which is fast enough to ensure that the covering strip of fabric is always effective to function properly without any burn through of the fabric or damage to the film from the heated Nichrome wire. The cartridge unit permits the Nichrome wire of the heated
5 sealing element to be easily disconnected from its power supply. The cartridge units are constructed to be readily interchanged as units, rather than having to replace individual components of the cartridge unit.

Methods and apparatus which incorporate the features noted above and which are effective to function as described above comprise further,
10 specific objects of this invention.

Other and further objects of the present invention will be apparent from the following description and claims and are illustrated in the accompanying drawings, which by way of illustration, show preferred embodiments of the present invention and the principles thereof and what are now considered to
15 be the best modes contemplated for applying these principles. Other embodiments of the invention embodying the same or equivalent principles may be used and structural changes may be made as desired by those skilled in the art without departing from the present invention and the purview of the appended claims.

20 **BRIEF DESCRIPTION OF THE DRAWING VIEWS**

Figure 1 is an isometric view of a machine, constructed in accordance with one embodiment of the present invention, for inflating and sealing pillows in packaging. Figure 1 is a general view which illustrates how a web of film is transported through the machine. Figure 1 shows how the web of film has
25 a preformed pattern of spaced-apart, inflatable pillows aligned along one side of a longitudinally extending inflation channel. Figure 1 illustrates how rollers (at a first transport station, at a sealing station, and at a second transport station) are positioned to engage the underside (as viewed in Figure 1) of the web of film.

30 Figure 2 is another isometric view of the machine shown in Figure 1, but in Figure 2 the lower part of the figure has been revised to (in effect) see through the web of film in order to show details of certain structure of the

machine. Figure 2 shows the inflation tube of the inflating station, the nip rollers of the first transport station, the heated sealing element and the associated sealing roller at the sealing station, and the nip rollers at the second transport station.

5 Figure 3 is an isometric view of the machine of Figures 1 and 2, but without the web of film material. Figure 3 shows the main structural and operative features of the machine itself.

10 Figure 4 is an isometric, enlarged view showing details of the features of the first film transport station, the inflation station structure, the sealing station structure, the slitting station structure, and the second film transport station structure.

15 Figure 5 is an isometric, enlarged view like Figure 4 but shows details of just the mechanism for driving the various rollers of the machine. Figure 5 does not show the inflation station structure, the heated sealing element at the sealing station, or the slitter structure for opening up the inflation tube of the web of film after the sealing station.

20 Figure 6 is an isometric view showing details of the structure of the sealing station. Figure 6 shows the heated sealing element pressed toward engagement with the sealing wheel in the positions occupied by those two components during a production run of the inflated pillow packaging through the machine.

25 Figure 7 is a top plan view, taken along the line and in the direction indicated by the arrows 7-7 in Figure 6, but showing the heated sealing element retracted away from the sealing wheel in the positions occupied by those two components when no film is being transported through the machine.

30 Figure 8 is a top plan view of a specific embodiment of a web of film constructed in accordance with the present invention and having a specific pattern of inflatable pillows, inlet ports for permitting inflation of the pillows, and escape ports for preventing over pressurization of the pillows and for also permitting more accurate position sensing of the pillows as the web of film moves through the machine.

Figures 9A-9G are a series of the isometric views showing details of the structure, components and sequence of assembly of certain components of the heated sealing element at the sealing station.

5 Figure 10 is an isometric view of a machine constructed in accordance with a second embodiment of the present invention. The embodiment of the machine shown in Figure 10 includes a cartridge unit which is mounted on a separate sub-plate or sub-frame and which permits all of the components of the cartridge unit to be quickly and easily removed and replaced by another, replacement cartridge unit.
10 The cartridge unit provides the heated sealing element components for the sealing station. Figure 10 shows the sealing wheel of the sealing station positioned to engage the web of film in sliding contact with the heated sealing element during a production run of packaging.

15 Figure 11 is an isometric view like Figure 10 but showing the sealing wheel moved to a retracted position which permits the web of film to move out of contact with the heated sealing element when the machine is stopped between production runs and the film is not being transported through the machine.

20 Figure 12 is an enlarged, isometric view of the replaceable cartridge unit itself. Figure 12 shows the strip of covering fabric in stored positions on the reels of the cartridge unit prior to installation of the cartridge unit in the machine. When installed in the machine, a portion of the strip of covering fabric is positioned over the wire of the heating element (as illustrated in Figures 10 and 11).

25 Figure 13 is an enlarged, isometric view of the sealing wheel and the related actuator mechanism for positioning the sealing wheel at the sealing station.

Figure 14 is an enlarged, side elevation view of the sealing station structure with the structure in the operative position shown in Figure 10; and,

30 Figure 15 is an enlarged, side elevation view of the sealing station structure with the structure in the non-operating position shown in Figure 11.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

Figures 1, 2 and 3 are isometric view of a machine, constructed in accordance with one embodiment of the present invention, for inflating and sealing pillows in packaging.

5 The machine is indicated by the general reference numeral 11 in each of Figures 1, 2 and 3.

The machine 11, as most easily viewed in Figure 3, comprises a main plate 13 on which various structural and operational features are mounted.

10 A support tube 15 is mounted at the upper (as viewed in Figures 1-3) of the main plate 13 for supporting a roll 17 of a web of film 19 (see Figures 1 and 2).

Guide tubes 21 and 23 are mounted on the plate 13 below the tube 15. The tubes 21 and 23 serve to guide the web of film 19 from the roll 17 to the operating mechanism 25 of the machine 11. The operating
15 mechanism 25 is described in more detail below.

The mechanism 25 is illustrated in detail in Figure 4 and comprises a first film transport station 27, a second film transport station 29, an inflating station 31, a sealing station 33, and a slitting station 35.

20 The first film transport station 27 includes a first pair of nip rollers 37 and 39 for gripping the web of film 19 (see Figure 1) and for pulling the web of film 19 from the roll 17 and under and over the guide tubes 21 and 23 and through the first film transport station 27 when the nip rollers are rotated by associated drive gears 41, 43 and a drive belt 45. The nip rollers 37 and 39 are rotated in the directions indicated by the direction arrows on the drive
25 gears 41 and 43 shown in Figure 4.

The drive belt 45 is driven by a drive gear 47 which is in turn driven by a motor 49 (see Figure 5).

30 The second film transport station 29 comprises a second pair of nip rollers 49 and 51 which grip the web of film 19 to continuously advance the web of film 19 from the first transport station 27 to and through the inflating station 25 and to and through the sealing station 33 and then to and through the second film transport station 29.

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The nip rollers 49 and 51 are driven by drive gears 53 and 55 and in the rotational directions indicated by the directional arrows on the drive gears 53 and 55 in Figure 4.

5 Drive shafts 40 and 44 transmit the drive from the drive gears 41 and 43 to the nip rollers 37 and 39.

Drive shafts 50 and 52 transmit the drive from the drive gears 53 and 55 to the nip rollers 49 and 51.

10 With continued reference to Figure 4, the drive belt 45 passes about an idler gear 57. The drive gears 41, 43, 47, 53, 55 and idler gear 57 are all mounted for rotation on and are supported by the main plate 13.

15 The inflating station 31 includes an inflation tube 59 and a generally spherically shaped and partially Teflon coated ball 61 located at the upper end (as viewed in Figure 4) of the tube 59. The ball 61 has a plurality of openings 63 for injecting pressurized air into an inflation channel in the web of film 19.

20 As illustrated in Figures 1, 2 and 8, the web of film 19 as stored on the roll 17 shown in Figure 1 has a pattern of pillows 65, a longitudinally extending inflation channel 67, inlet ports 69, and outlet ports 71 preformed in the web of film. The pillows 65, channel 67, ports 69 and ports 71 are uninflated in the web of film as stored on the roll 17.

The uninflated pillow patterns 65 are longitudinally spaced apart from one another and are aligned (in the embodiment of the web of film 19 illustrated in the drawings) along one side of the inflation channel 67.

25 The inflation channel 67 extends longitudinally and continuously along the entire length of the web of film 19.

The inflation channel 67 is dimensioned to provide a close, sliding fit over the Teflon coated ball 61.

30 Each pillow 65 is connected to the inflation channel 67 by an inlet port 69. The inlet port 69 extends generally transversely to the longitudinally extending inflation channel 67 and has a narrow interior width which is positioned at the sealing station 33 (in a manner to be described more fully below) to facilitate quick and secure sealing of pressurized air within an

inflated pillow 65 in a small path of travel and in a short time of continuous, uninterrupted travel through the sealing station 33.

The outlet ports 71 are shaped to be somewhat smaller than the inlet ports 69. These outlet ports 51 are located on the side of the channel 67
5 opposite the inlet ports 69 and are generally aligned with the inlet ports 69.

As will be described in greater detail below, the outlet ports 71 allow air to escape in a way to maintain pressure in the channel 67 and in the inflated pillows at a calibrated, desired level without creating over-pressurization in the pillows.

10 In addition, the air that exits from an outlet port 71 can be sensed by a pressure transducer 73 (see Figure 8) to allow for accurate position sensing of the pillows as the pillows move through the machine 11.

The air escaping through the outlet ports is sensed to detect where the pillows are in the machine. These detected outlet port positions are then
15 used as signals for an associated electronic unit to count the number of pillows inflated in a particular run through the machine. This also facilitates being able to stop the movement of the film through the machine, after one production run of a selected number of inflated pillows, at a position which is the right position to start a subsequent production run of a selected number
20 of inflated pillows.

The upper end of the inflation tube 59 is formed with a small curvature so as to better follow the path of the film 19 as the film is advanced through the first transport station 27 and the sealing station 33.

Details of the construction and mode of operation of the sealing station
25 33 are illustrated and will be described with reference to Figures 4, 6 and 7.

The sealing station 33 comprises a sealing roller 75 mounted on a shaft 77 which is in turn mounted for rotation in a bearing assembly attached to the main plate 13.

The sealing station 33 also comprises a heated sealing element
30 located at the outer end (the right hand end as viewed in Figure 7) of a bar 81. The very tip 80 of the bar 81 is a ceramic of aluminum silicate to provide

an insulation function, and the remainder of the bar 81 is a different material selected for mechanical durability.

The bar 81 is mounted for sliding motion within a support 83.

5 A spring 85 and an adjustment screw 87 provide a selectable bias force for biasing the bar 81 toward the opposed periphery of the roller 75 so that the film 19 (in the longitudinally extending strip which crosses the inlet ports 69) is pressed in rolling contact with the outer periphery roller 75 and in sliding contact with the end surface of the bar 81 as the first and second film transport stations continuously advance the web of film 19 through the
10 sealing station 33.

An actuator 89 is included in the sealing station 33 for retracting the bar 81 against the bias of spring 85 and away from engagement with the roller 75 when the film 19 is not being advanced through the machine 11. This facilitates keeping the heating element energized at the proper heating
15 level and out of contact with the film 19 during time intervals when the machine 11 is not being used to produce inflated pillow packaging.

Details of the structure, components and sequence of assembly of components of the heated sealing element are shown in the exploded views of Figures 9A-9F.

20 The heating element disposed at the end of the bar 81, in a specific embodiment of the present invention, comprises at least one Nichrome wire 70 which runs vertically (as viewed in Figures 9A-9G) along the right hand end of the bar 81.

The Nichrome wire 70 at this location has a length about the same as
25 the throat width of an outlet port 69 in the film 19, and the Nichrome wire 70 is covered by a fabric 72 having a Teflon coating on the surface which contacts the film 19. The fabric covering 72 helps to form the wire 70 to a preferred shape for engagement with the film 19, and the Teflon coating facilitates sliding movement of the film 19 with respect to the heated sealing
30 element.

The heated sealing element comprises at least one Nichrome wire 70, but (as illustrated in Figures 9A-9F) the present invention also encompasses

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using a plurality of parallel extending and laterally spaced apart Nichrome wires 70 for providing multiple seal lines across inlet ports 69 of the pillows 65.

5 As best illustrated in Figures 6 and 7, wires 91 and 93 conduct electricity to the Nichrome wire for heating the Nichrome wire.

10 The slitting station 35 (see Figure 4) includes a blade 95 attached to the inflation tube 59 and positioned to slit the inflation channel 67 in the film 19 after the outlet port 69 of a pillow 65 has been sealed at the sealing station 33. This enables strips of inflated packaging to be removed from the machine 11.

15 It is an important feature and benefit of the present invention that the components of the mechanism 25 and the coaction between those components enable a seal to be formed complete and secure in a short path of travel of the film through the sealing station 33 and in a short period of time and without the need for additional pressing together of the web of film after the sealing station and without the need for additional cooling of the seal across the inlet port after the sealed inlet port moves out of contact with the sealing station. The sealing of the inlet port at the sealing station is performed by applying the heated sealing element directly to and in sliding contact with the web of film and across the inlet port while the air and the inflated pillow is under pressure and as the web of film is continuously and uninterruptedly advanced through the mechanism 25 shown in Figure 4.

20 A number of features of the present invention contribute to obtaining this efficient and beneficial sealing result.

25 As described above, the outermost tip of the bar 81 is a ceramic material which functions as an insulator to help confine the heat of the heating element to substantially just the linear area of contact of the fabric covered Nichrome wire with the film 19.

30 The roller 75 is laterally offset outwardly (as viewed in Figures 1-5) and is positioned with respect to the pairs of nip rollers 37-39 and 49-51 so as to cause a bump in the film 19 at the sealing station 33. This helps to create a dead zone adjacent the inlet port 69 to be sealed by causing the

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web of film 19 to wrap around a part of the peripheral surface of the sealing roller 75 both in a circumferential direction and also in a lateral direction.

Driving the second pair of nip rollers 49-51 at a slightly higher speed than the first pair of nip rollers 37-39 helps to insure that the film 19 is maintained flat and in substantially pressure sealing engagement with the periphery of the sealing roller 75.

As best shown in Figure 5, the axes of rotation of at least the second set of nip rollers 49-51 are preferably canted at a slight upward (as viewed in Figure 5) angle with respect to the axes of rotation of the main drive gear 47 and the sealing roller 75.

In a specific embodiment of the present invention the axes of rotation of the first set of nip rollers 37-39 are also canted at this same slightly upwardly inclined angle.

The inclusion and positioning of the outlet ports 71 (see Figure 8) and the smaller size of these outlet ports contribute to allowing air to escape through the outlet ports in an amount to maintain sufficient pressure in the channel 67 without permitting over-pressurization in that channel 67 or in the pillows 65.

The present invention permits sealing the inlet port at a sealing station by applying a heated sealing element directly to and in sliding contact with the web of film and across the inlet port while the air and the inflated pillow is under pressure and as the web of film is continuously and uninterruptedly advanced through each of the first transport station, inflating station, sealing station, second transport station and slitting station.

In Figures 1, 2 and 8 of the drawings the pillows 65 are shown in a generally rectangular-shaped pattern. It should be noted, however, that the pillows 65 can be any preformed pattern configuration. The patterns of the pillows 65 can, for example, include preformed seal line elements within the interior of the pillows which permit the pillows to be folded along one or more of the preformed interior seal lines. This in turn permits one pillow to cushion an object in more than one direction when placed within a shipping container.

Score lines (not illustrated in the drawings, but similar to score lines shown in webs of plastic film described in numerous ones of the prior U.S. patents incorporated by reference in this application) permit ready detachment of single ones or groups of inflated pillows from the film 19 after the pillows are inflated and sealed.

A number of different film compositions (also as noted in U.S. patents incorporated by reference in this application) can be used as the composition material for the web of film 19.

The machines that are used to preform the patterns on the web of film 19 include conventional presses which impress multiple pillow patterns (and the related ports and inflation channel) on a strip of film 19 on each pressing operation. The pattern is formed while there is no inflation pressure anywhere in the web 19.

The preformed pattern can also be formed by a roller arrangement in which at least one roller is heated and configured to form the desired patterns.

Pattern forming machines of these kinds are also disclosed in several of the U.S. patents incorporated by reference in this application.

Such machines for forming preformed patterns in the film 19 can be associated with the machine 11 shown in Figure 1 to replace the storage roll 17 so that the preformed patterns can be preformed continuously at the site where the machine 11 is installed. However, in most cases it is more practical to use a storage roll 17 with preformed patterns than it is to preform the patterns at the job site where the machine 11 is to be used.

A second embodiment of a machine constructed in accordance with the present invention is illustrated in Figures 10-15 of the drawings. This second embodiment is indicated by the general reference numeral 101.

The components and parts of the machine 101 which correspond to the machine 11 shown in Figures 1-9 are indicated by corresponding reference numerals.

The machine 101 includes a cartridge unit 103 (see Figure 12) which is mounted on a separate sub-plate or sub-frame 105. The sub-frame 105

is mounted on the main plate or main frame 13. This cartridge unit technique permits the components of the entire cartridge unit to be quickly and easily interchanged (as a unit) with another replacement cartridge unit. Individual components of the cartridge unit do not have to be removed and replaced.

5 In the machine 101 shown in Figures 10-15, the construction and mounting of the cartridge unit 103 permits the entire cartridge unit to be pulled out of a box and plugged in as a unit at the production site. This cartridge unit permits all of the components of the cartridge unit to be replaced as a unit. It is never necessary, for example, to replace the
10 Nichrome wires as individual elements in the field. Instead, the entire cartridge unit is just pulled out and replaced as a unit with a replacement cartridge unit.

The structure, components and mode of operation of the first film transport station 27, the second film transport station 29, the inflation station
15 31, and the slitting station 35 are the same as the corresponding mechanism, components and mode of operation described above with reference to the machine 11, and will not be reviewed in more specific detail at this point.

The specific structure of the sealing station 33 of the machine 101 is different from the machine 11 and will be described in more detail below.
20 However, the method of making seals across the inlet ports 69 in the machine 101 is the same as the method of machine 11, as will be understood from the description to follow.

One difference between the sealing station structure of the machine 11 and the sealing station structure of the machine 101 is in the way that the
25 heated sealing element and the sealing wheel are moved apart from one another during those times when the machine is stopped between production runs of inflated pillows.

In the machine 11 (and as illustrated in Figure 7) the heated sealing element which is mounted on the end of the bar 81 is retracted away from
30 the sealing wheel 75. In the machine 11 the shaft 75 of the heated sealing wheel 75 is held in a fixed position with respect to the frame 13 in all modes of operation of the machine 11.

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5 In the machine 101 the heated sealing element is held in a fixed position with respect to the frame 13. The rotational shaft 77 of the sealing wheel 75 is mounted for rotation in a movable support bracket 75 so that the sealing wheel 75 is movable toward and away from the heated sealing element.

As best illustrated in Figure 13, the support bracket 75 is mounted on a rod 82 of an actuator 84. The actuator 84 is mounted on a support plate 86, and the support plate 86 is mounted on the main plate 13 of the machine 101.

10 The actuator 84 extends and retracts the rod 82 to move the sealing wheel 75 between the retracted position of the rod 82 shown in Figures 11 and 15 and the extended position shown in Figures 10 and 14.

15 In the retracted position illustrated in Figures 11 and 15 the sealing wheel 75 is positioned to let the film 19 remain out of contact with the heated sealing element when the machine 101 is not operated in a production run.

In the extended position shown in Figures 10 and 14 the sealing wheel 75 is positioned to engage the film 19 and to press that film 19 in sliding contact with the heated sealing element as the film 19 is continuously and uninterruptedly advanced through the machine during a production run of
20 inflated pillows.

The force with which the film 19 is engaged in sliding contact with the heated sealing element is determined by selecting the pressure level within the actuator 84.

25 As best illustrated in Figures 12, 10, and 14, the cartridge unit 103 comprises a guide block 107 mounted in a fixed position on the sub-plate 105, two reels 109 and 111, each mounted for rotation on the sub-plate 105, and a guide post 113 mounted on the sub-plate 105.

30 The reels 109 and 111 are storage and take-up reels for a strip of covering fabric 72. The fabric 72 has a Teflon coating on the side engaged in sliding contact with the film 19.

The strip of covering fabric 72 is trained around a guide post 113 and into the guide slots 115 and 117 which are recessed within the outer and forward surfaces of the flanges 119 and 121 of the guide block 107.

5 The way that the strip of covering fabric 72 is conveyed from the storage roller 109, around the guide post 113, through the guide slot 115, over the Nichrome wires 70, through the guide slot 117 and onto the reel 111 is best illustrated in Figures 10, 11, 14 and 15.

10 In a specific embodiment of the machine 101 the lower reel 111 is driven, through reduction gearing, and by an electric motor (not shown), to pull the strip of covering fabric 72 across the Nichrome wires 70 at a relatively slow speed (a speed considerably slower than a speed at which the web of film 19 is transported through the machine 101 during a production run), but at a speed fast enough to insure that no part of the covering fabric 72 is ever in contact with the Nichrome wires 70 long enough to permit any
15 burn through of the fabric by the Nichrome wires 70. The reel storage of the covering fabric 72 and the slow movement of the fabric with respect to the Nichrome wires 70 during operation of the machine 101 thus insure that the area of the fabric engageable with the Nichrome wires is, in effect, renewed soon enough to prevent any burn through.

20 As best illustrated in Figures 12 and 15, the outer tips of the flanges 119 and 120 extend slightly beyond the outer surfaces of the Nichrome wires 70. This insures that the covering fabric 72 is engaged with the Nichrome wires 70 only when the sealing wheel 75 is moved to the position shown in Figures 10 and 14 during a production run of the machine 101.

25 The strip of covering fabric 72 is held out of contact with the Nichrome wires 70 when the machine 101 is not being operated in a production run of packaging.

30 While not illustrated in Figures 10-15, the Nichrome wires 70 are energized by detachable leads 91 and 93 (as illustrated for the machine 11 in Figures 9A-9G).

The sealing roller 75 of the machine 101 is laterally offset outwardly in the same way as the sealing roller 75 of the machine 11 so as to cause

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5 a bump in the film 19 at the sealing station 33. This helps to create a dead zone adjacent the inlet port 69 to be sealed by causing the web of film 19 to wrap around a part of the peripheral surface of the sealing roller 75 both in a circumferential direction and also in a lateral direction (as described above with reference to the machine 11).

10 The machine 101 permits sealing the inlet port at a sealing station by applying a heated sealing element directly to and in sliding contact with the web of film and across the inlet port while the air in an inflated pillow is under pressure and as the web of film is continuously and uninterruptedly advanced through each of the first transport station, inflating station, sealing station, second transport station and slitting station.

15 While we have illustrated and described the preferred embodiments of our invention, it is to be understood that these are capable of variation and modification, and we therefore do not wish to be limited to the precise details set forth, but desire to avail ourselves of such changes and alterations as fall within the purview of the following claims.

THE CLAIMS

1. A machine for inflating and sealing pillow patterns in a web of film while continuously and uninterruptedly advancing the web of film through the machine, said machine comprising,

5 a first film transport station for gripping and advancing a web of film in the machine,

said web of film having uninflated pillow patterns and an uninflated inflation channel which are preformed in the web of film before the web of film is gripped at the first film transport station,

10 said uninflated pillow patterns comprising multiple, spaced-apart, pillow patterns aligned along one side of the inflation channel which extends longitudinally and continuously along the entire length of the web of film,

15 each uninflated pillow pattern having a narrow width inlet port extending generally transversely to the longitudinally extending inflation channel and connecting the uninflated pillow pattern to the uninflated inflation channel so that when pressurized air is introduced into the inflation channel the pressurized air can be transmitted through the inlet port to inflate the pillow pattern,

an inflating station for inflating pillows in the web of film,

20 a sealing station for sealing inflated pillows by sealing the narrow width inlet port,

a slitting station for slitting the inflation channel to permit removal of a strip of inflated, sealed pillows from the machine, and

a second film transport station for gripping and advancing the web of film,

25 said sealing station including a sealing wheel and a heated sealing element biased toward engagement with a preselected force,

30 and wherein a longitudinally extending portion of the web of film which contains the inlet ports is interposed between and pressed between the heated sealing element and the sealing wheel with one film surface engaged directly and in sliding contact with the heated sealing element and the other film surface wrapped in rolling contact around a part of the peripheral surface

of the sealing roller as the web of film is continuously and uninterruptedly advanced through the sealing station,

and wherein the seal is formed complete and secure at the time the web of film moves out of rolling contact with the sealing wheel without the need for additional pressing together of the web of film after the sealing station and without the need for additional cooling of the seal across the inlet port.

5 2. The machine defined in claim 1 wherein the web of film is gripped at the first film transport station between a first pair of nip rollers and wherein the film is gripped at the second film transport station between a second pair of nip rollers and

5 wherein the sealing roller is positioned with respect to the first and second pairs of nip rollers so as to cause the web of film to wrap around a part of the peripheral surface of the sealing roller both in a circumferential direction and also in a lateral direction to create a dead zone in the area where the inlet port is being sealed.

3. The machine defined in claim 1 including adjustable means for adjusting the amount of said preselected force.

4. The machine defined in claim 1 wherein the sealing wheel is mounted for rotation at a fixed location in the machine and the heated sealing element is movable toward and away from the sealing wheel.

5. The machine defined in claim 1 wherein the heated sealing element is mounted at a fixed location in the machine and the sealing wheel is movable toward and away from the heated sealing element.

6. The machine defined in claim 2 wherein the axes of rotation of at least the second pair of nip rollers are canted at a slight angle with respect to the axis of rotation of the sealing roller.

7. The machine defined in claim 2 wherein the second pair of nip rollers are rotated at a speed slightly faster than the speed of rotation of the first pair of nip rollers so as to maintain tension in the web of film between the second and first pair of nip rollers.

8. The machine defined in claim 1 wherein the heated sealing element has a longitudinal dimension, in the direction of movement of the web of film, which is about the same as the width of the inlet port of a pillow pattern.

5 9. The machine defined in claim 1 wherein the inflating station includes an inflation tube which is inserted within the inflation channel of the web of film so that air under pressure can be introduced into the inflation channel and wherein the inflation tube includes a generally ball-shaped outlet end having a diameter which is substantially the same diameter as the inside diameter of the inflation channel in the web of film and wherein the spherical shaped end of the inflation tube has an outer coating of Teflon for facilitating sliding movement of the inflation tube within the inflation channel of the web of film.

10. The machine defined in claim 1 wherein the heated sealing element comprises a fabric covered Nichrome wire with a Teflon coating on the side of the fabric which is engaged in sliding contact with the web of film.

11. The machine defined in claim 1 wherein the sealing station includes a ceramic part which mounts the Nichrome wire within the ceramic material so that the ceramic part provides insulation against the spread of heat into the mounting structure for the Nichrome wire.

5 12. The machine defined in claim 1 wherein the preformed pattern in the web of film includes a series of longitudinally spaced outlet ports on the side of the inflation channel opposite the side having the inlet ports for maintaining calibration of the pressure within the inflation channel and for preventing excessive pressure buildup in the inflation channel and in the inflated pillows.

5 13. The machine defined in claim 12 including a sensor positioned to monitor flow of pressurized air out of the outlet ports and wherein the monitored flow can be used for counting the number of inflated pillows produced in a production run and can be used also for maintaining accurate positioning of the web of film within the machine.

14. The machine defined in claim 2 wherein the preformed pattern in the web of film includes a series of longitudinally spaced outlet parts on the

side of the inflation channel opposite the side having the inlet ports and wherein the outlet ports provide an outlet for pressure in the inflation channel during the time when the film adjacent the inlet port being sealed is being pulled closed in the dead zone of the film engaged with the periphery of the sealing wheel.

15 5 15. The machine defined in claim 5 including a cartridge unit which contains the heated sealing element and which is constructed so as to be removed and replaced as a unit without the need to replace any individual components of the cartridge unit, said cartridge unit comprising a sub-frame, a guide block having an opening in one end for the heated sealing element, at least one Nichrome wire mounted within the opening in the guide block, a storage reel and a take-up reel, a strip of fabric for covering the Nichrome wire and wound on the storage reel and the take-up reel, and a drive for rotating the take-up reel, said strip of fabric having a Teflon coating on a side engageable in sliding contact with a surface of the film at the sealing station and wherein the strip of fabric extends across said opening in the guide block so as to cover the Nichrome wire when the sealing wheel is moved to a position in which the sealing wheel pushes the film against the fabric and the underlying Nichrome wire during continuous movement of the film through the machine.

10 16. A machine for inflating and sealing pillow patterns in a web of film while continuously and uninterruptedly advancing the web of film through the machine, said machine comprising,

5 a first film transport station for gripping and advancing a web of film in the machine,

 said web of film having uninflated pillow patterns and an uninflated inflation channel which are preformed in the web of film before the web of film is gripped at the first film transport station,

10 said uninflated pillow patterns comprising multiple, spaced-apart, pillow patterns aligned along one side of the inflation channel which extends longitudinally and continuously along the entire length of the web of film,

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each uninflated pillow pattern having a narrow width inlet port extending generally transversely to the longitudinally extending inflation channel and connecting the uninflated pillow pattern to the uninflated inflation channel so that when pressurized air is introduced into the inflation channel the pressurized air can be transmitted through the inlet port to inflate the pillow pattern,

5 an inflating station for inflating pillows in the web of film,
a sealing station for sealing inflated pillows by sealing the narrow width inlet port,
10 a slitting station for slitting the inflation channel to permit removal of a strip of inflated, sealed pillows from the machine, and
a second film transport station for gripping and advancing the web of film,

said sealing station including a sealing wheel and a heated sealing element biased toward engagement with a preselected force,
15 the heated sealing element being mounted at a fixed location in the machine and the sealing wheel being movable toward and away from the heated sealing element,

and wherein a longitudinally extending portion of the web of film which contains the inlet ports is interposed between and pressed between the heated sealing element and the sealing wheel with one film surface engaged directly and in sliding contact with the heated sealing element and the other film surface wrapped in rolling contact around a part of the peripheral surface of the sealing roller as the web of film is continuously and uninterruptedly advanced through the sealing station,

20 a cartridge unit which contains the heated sealing element and which is constructed so as to be removed and replaced as a unit without the need to replace any individual components of the cartridge unit,

said cartridge unit comprising a sub-frame, a guide block having an opening in one end for the heated sealing element, at least one Nichrome wire mounted within the opening in the guide block, a storage reel and a take-up reel mounted for rotation on the sub-frame, a strip of fabric for
30

covering the Nichrome wire and wound on the storage reel and the take-up reel, and a drive for rotating the take-up reel, said strip of fabric having a Teflon coating on a side engageable in sliding contact with a surface of the film at the sealing station, and wherein the strip of fabric extends across said opening in the guide block so as to cover the Nichrome wire when the sealing wheel is moved to a position in which the sealing wheel pushes the film against the fabric and the underlying Nichrome wire during continuous movement of the film through the machine.

and wherein the seal is formed complete and secure at the time the web of film moves out of rolling contact with the sealing wheel without the need for additional pressing together of the web of film after the sealing station and without the need for additional cooling of the seal across the inlet port.

17. A method of inflating and sealing pillow patterns in a web of film while continuously and uninterruptedly advancing the web of film through a machine, said method comprising,

gripping a web of film at a first film transport station to draw a web of film from a store,

said web of film having an uninflated pillow pattern and an uninflated inflation channel which are preformed in the web of film before the web of film is gripped at the first film transport station,

said uninflated pillow patterns comprising multiple, spaced-apart, pillow patterns aligned along one side of the inflation channel which extends longitudinally and continuously along the entire length of the web of film,

each uninflated pillow pattern having a narrow width inlet port extending generally transversely to the longitudinally extending inflation channel and connecting the uninflated pillow pattern to the uninflated inflation channel so that when pressurized air is introduced into the inflation channel the pressurized air can be transmitted through the inlet port to inflate the pillow pattern,

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introducing pressurized air into the inflation channel in the web of film at an inflating station and inflating at least one of pillow patterns prior to the time the web of film is transported through a sealing station,

gripping the web of film at a second film transport station to
5 continuously advance the web of film from the first transport station to and through the sealing station and then to and through the second film transport station,

maintaining pressure in the inflated pillow pattern during the time that the web of film is being transported through the sealing station,

10 sealing the inlet port at the sealing station by applying a heated sealing element directly to and in sliding contact with the web of film and across the inlet port while the air in the inflated pillow is under pressure and as the web of film is continuously advanced through the sealing station,

said sealing station including a sealing roller disposed opposite the
15 heated sealing element,

said sealing roller having part of its periphery engaged in rolling contact with the film at the sealing station on the side of the film opposite that engaged in sliding contact with the heated sealing element,

20 positioning the sealing roller to create a dead zone in the area of the film engaged in rolling contact with the periphery of the sealing roller, and

forming the seal complete and secure by the time the web of film moves out of contact with the sealing wheel without the need for additional pressing together of the film after the sealing station and without the need for additional cooling of the seal across the sealed inlet port.

18. The method defined in claim 17 wherein the pre-formed pattern in the web of film includes a series of longitudinally spaced outlet ports on the side of the inflation channel opposite the side having the inlet ports and wherein the outlet ports provide an outlet for pressure in the inflation channel
5 during the time when the film adjacent the inlet port is being pulled closed in the dead zone of the film engaged with the periphery of the sealing wheel.

19. The method defined in claim 17 wherein the pattern on the web of film includes longitudinally spaced outlet ports connected to the side of the

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inflation channel opposite the side of the inflation channel having the inlet ports and wherein the outlet ports maintain calibration of the pressure within the inflation channel and prevent excessive pressure buildup in the inflation channel and in the inflated pillows.

20. The method defined in claim 19 including sensing the flow of pressurized air out of the outlet ports and monitoring the flow to count the number of pillows inflated in a production run of the film through the machine.

21. A web of film formed with a pattern of pillows to be inflated and sealed and then used in packaging, said web of film and pattern comprising, two sheets of plastic film overlaid one on the other to form a web of film,

said web of film being sealed together in a pattern,
said pattern comprising,

an inflation channel which extends longitudinally and continuously along the entire length of the web of film,

multiple, spaced-apart, pillow patterns aligned along one side of the inflation channel,

each pillow pattern having a narrow width inlet port extending generally transversely to the longitudinally extending inflation channel and connecting the pillow pattern to the inflation channel so that when pressurized air is introduced into the inflation channel, the pressurized air can be transmitted through the inlet port to inflate the pillow pattern,

a plurality of longitudinally spaced-apart outlet ports on the side of the inflation channel opposite the side having the inlet ports,

and wherein the outlet ports are constructed to permit exhausting the overflow of pressure in the inflation channel while the pillow patterns are being inflated and being sealed under pressure.

Fig 1

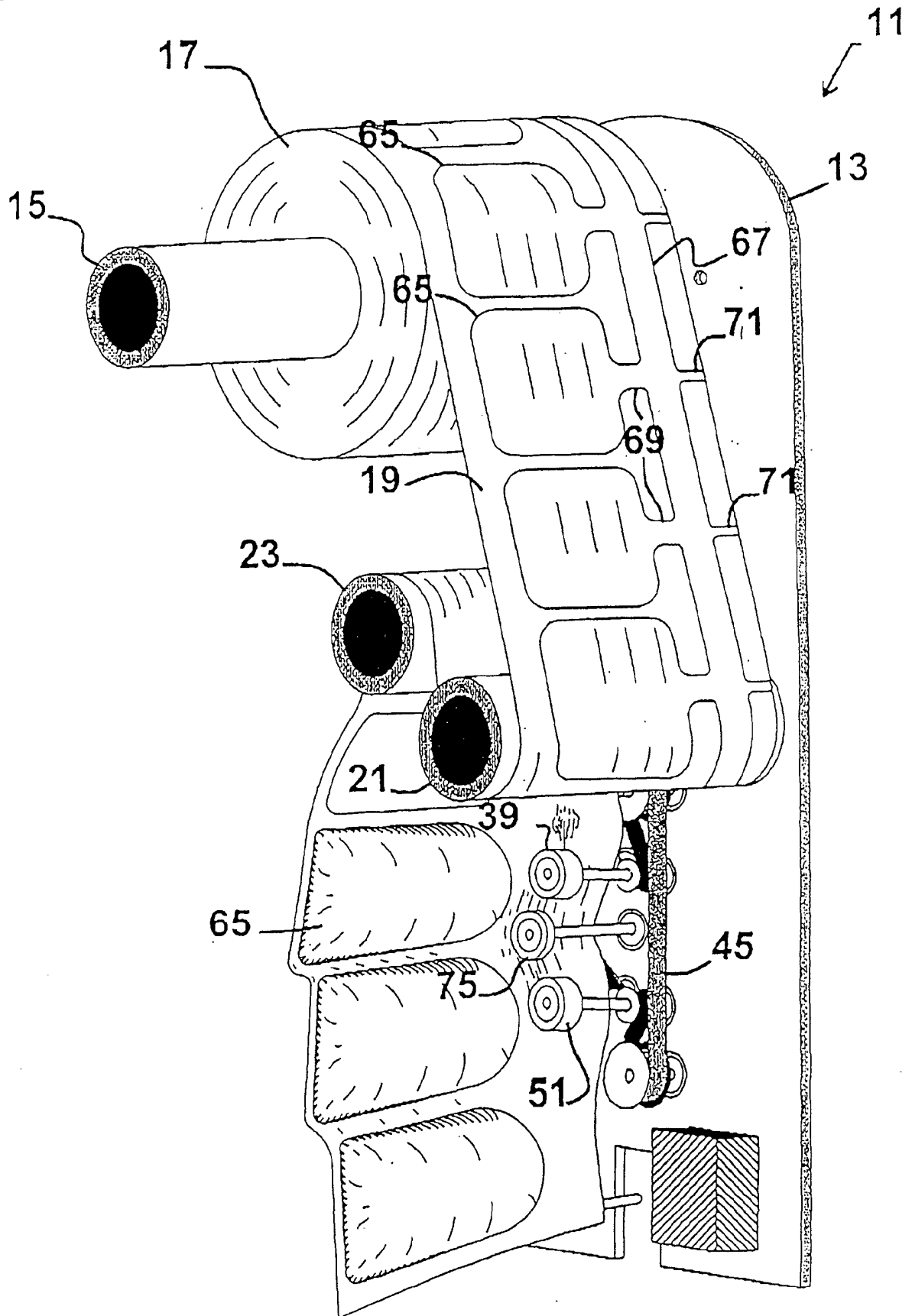


Fig 2

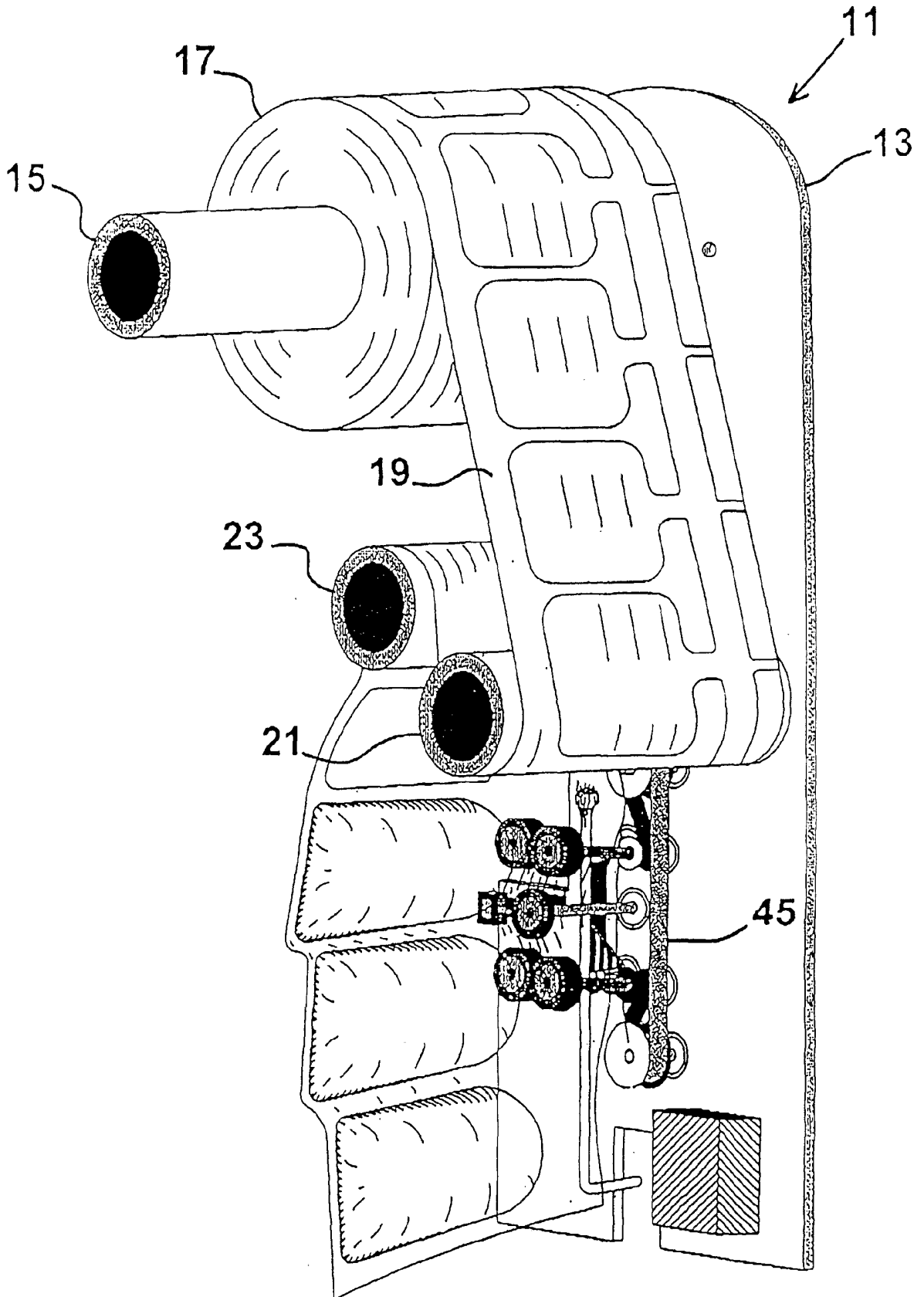


FIG. 3

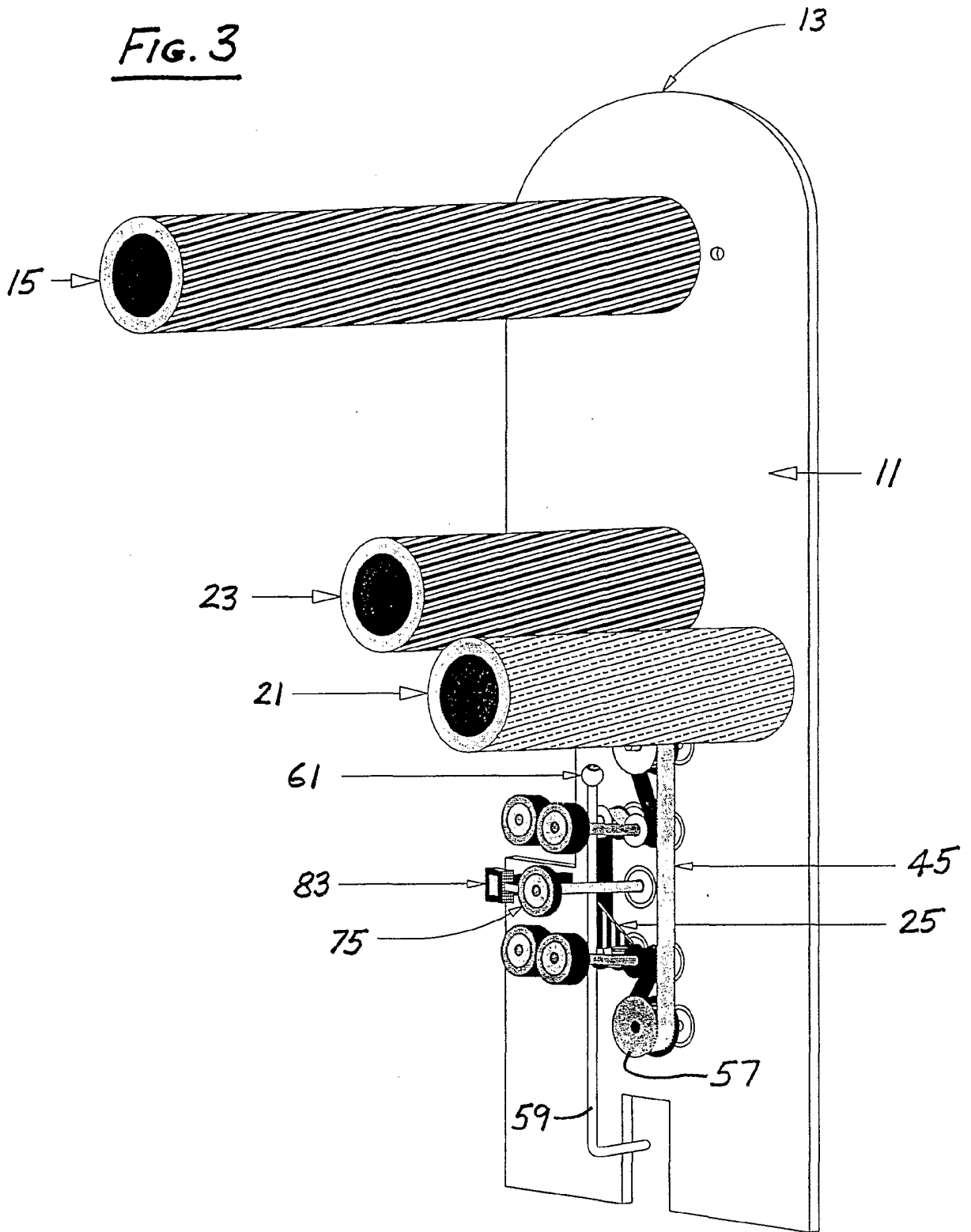
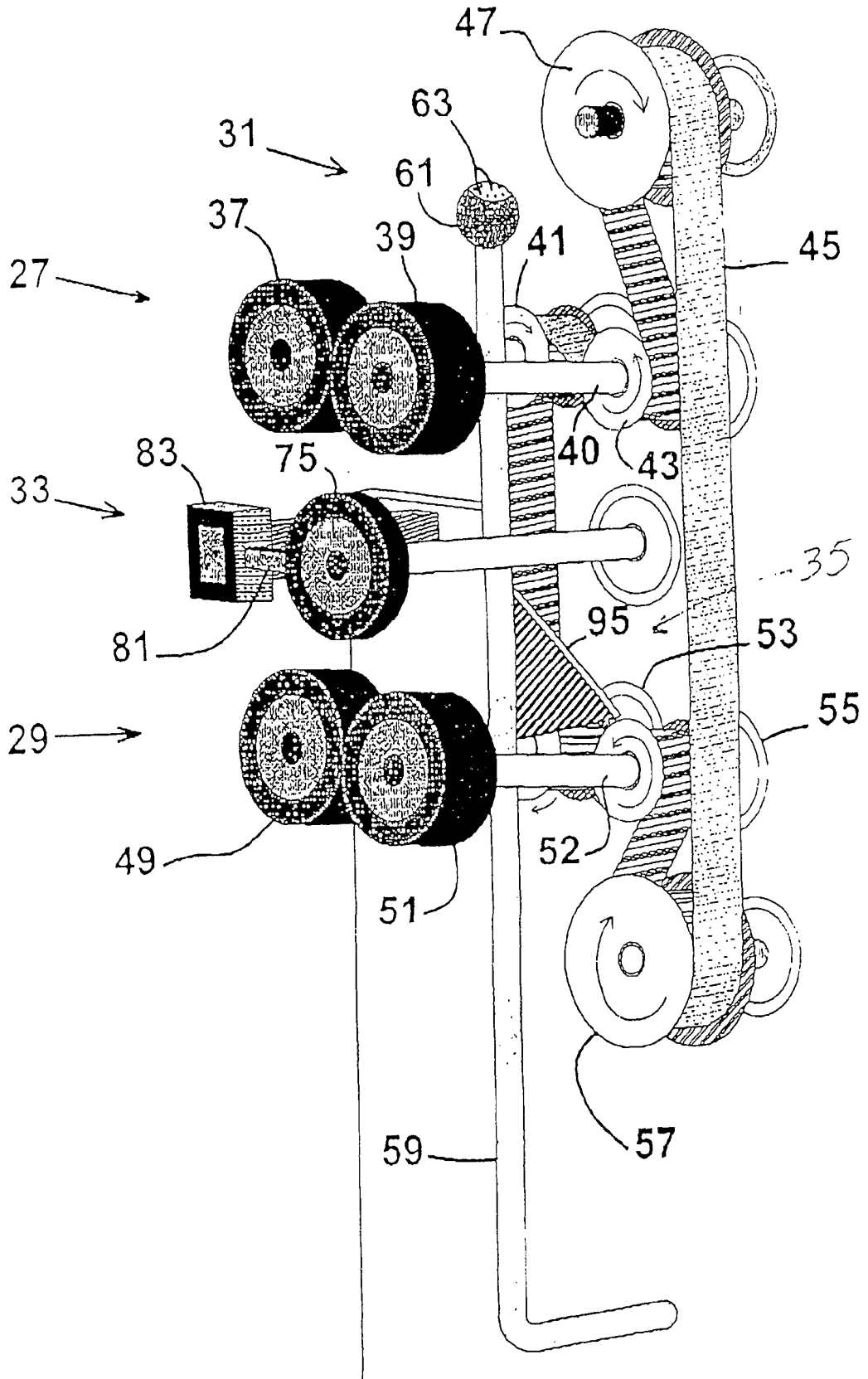


Fig 4



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Fig. 5

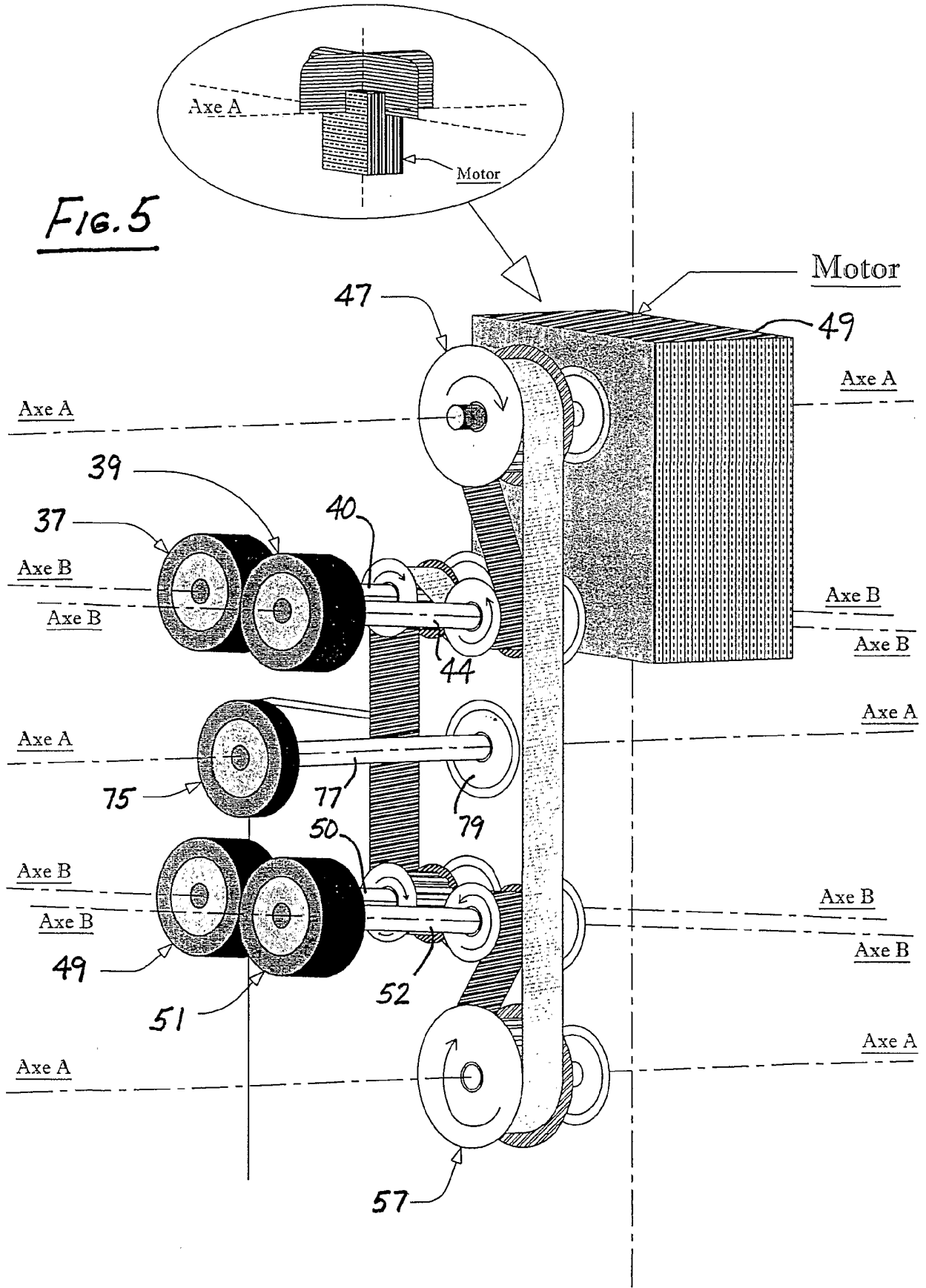


Fig 7

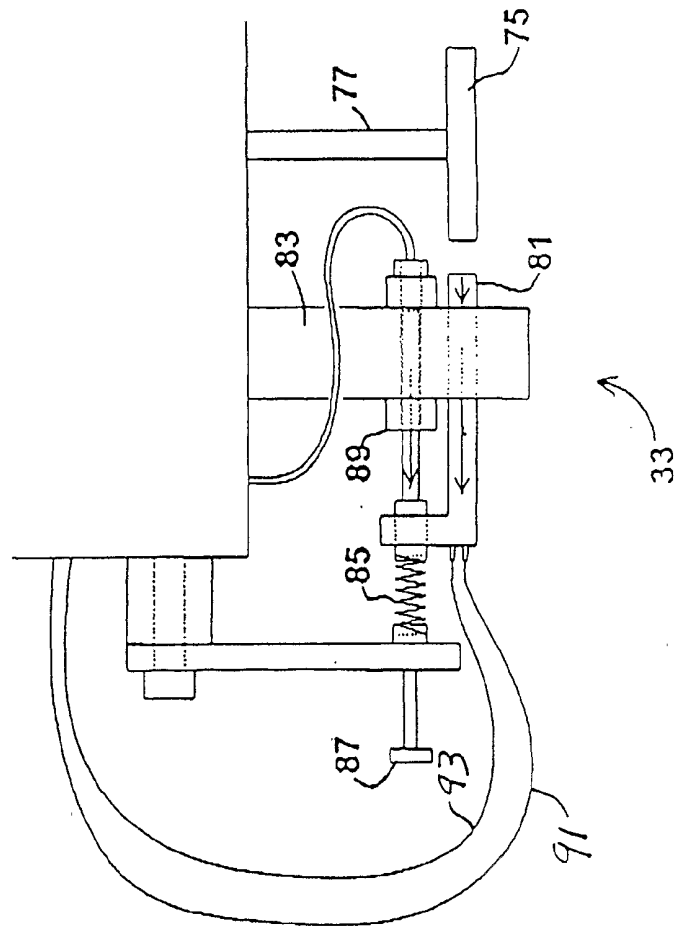
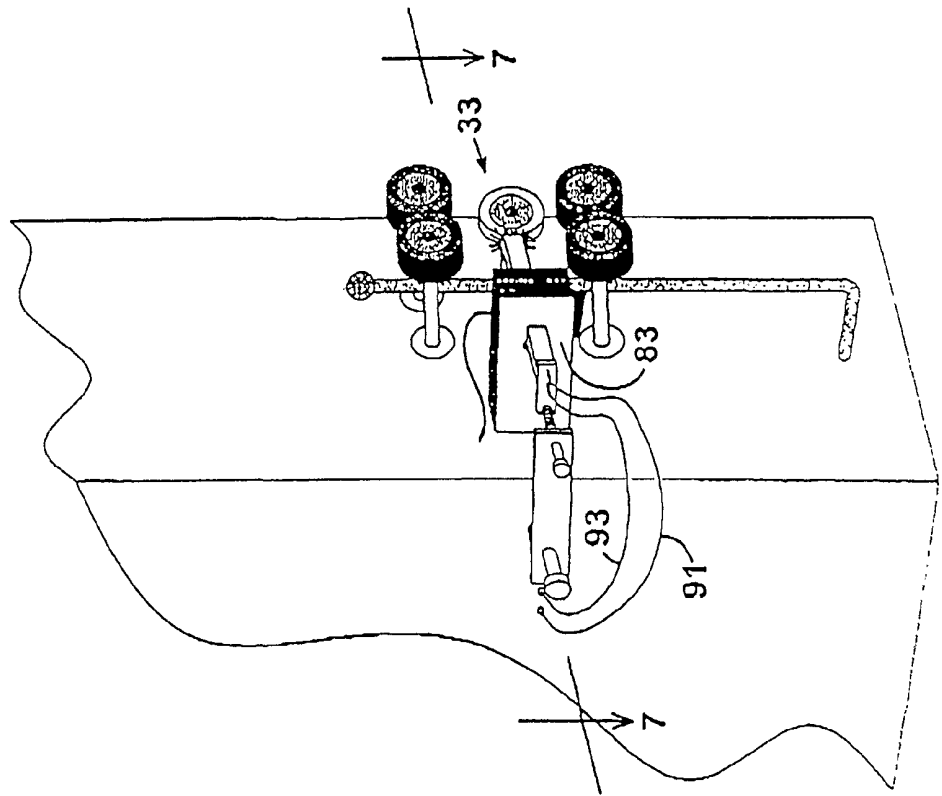
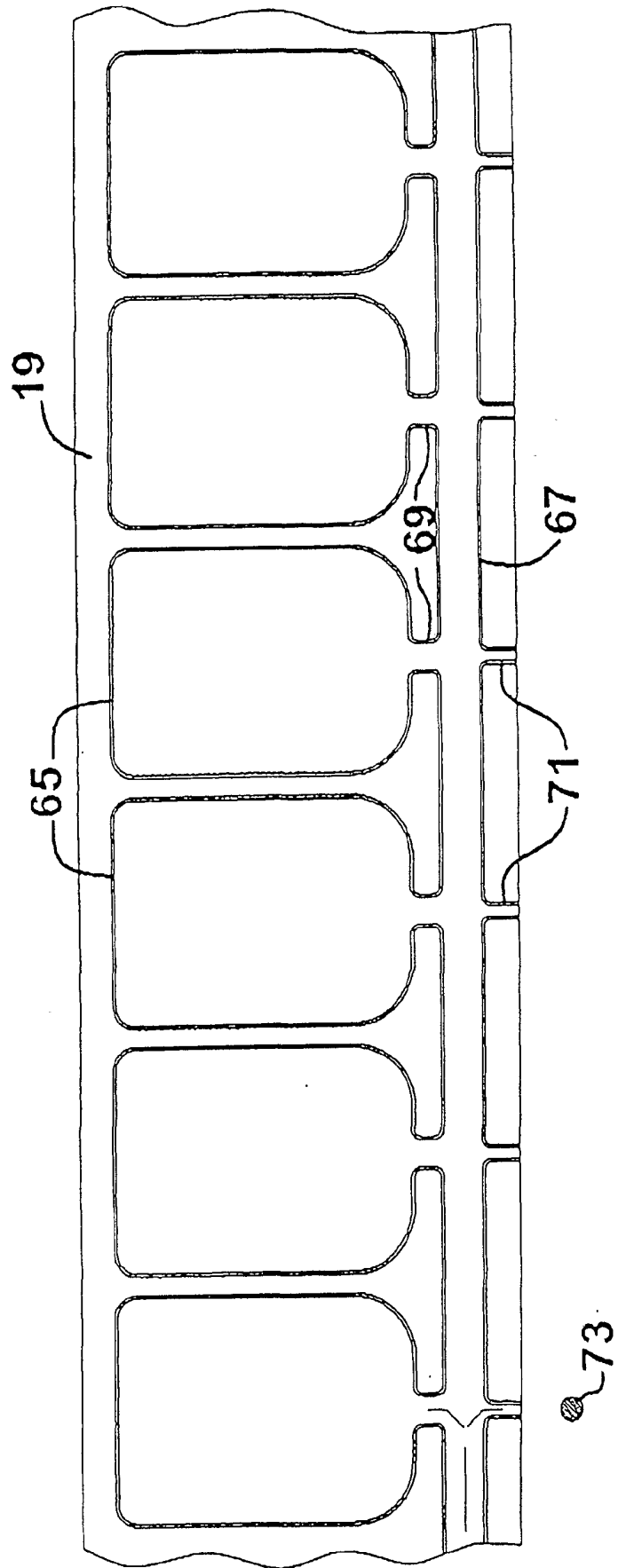
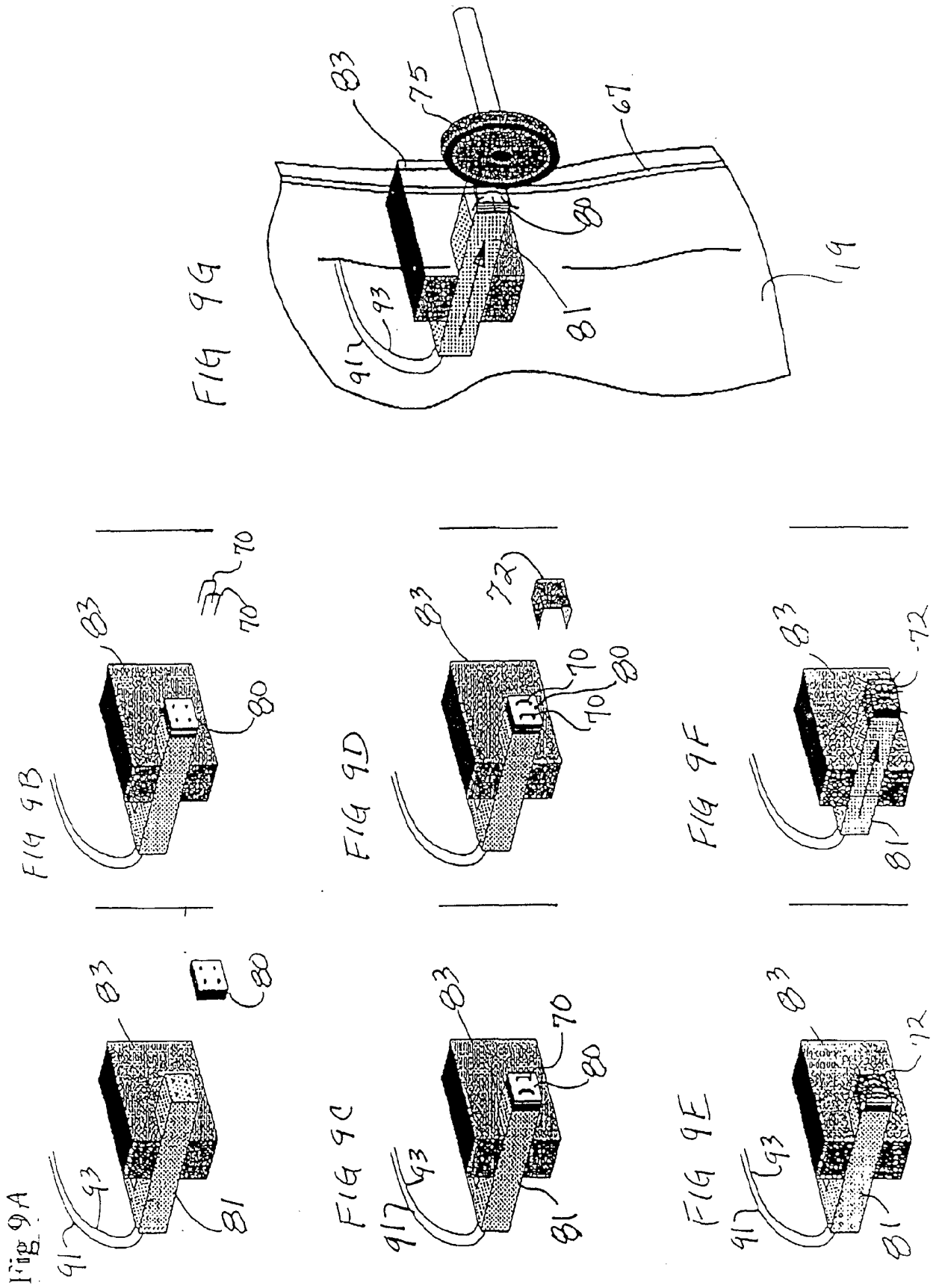
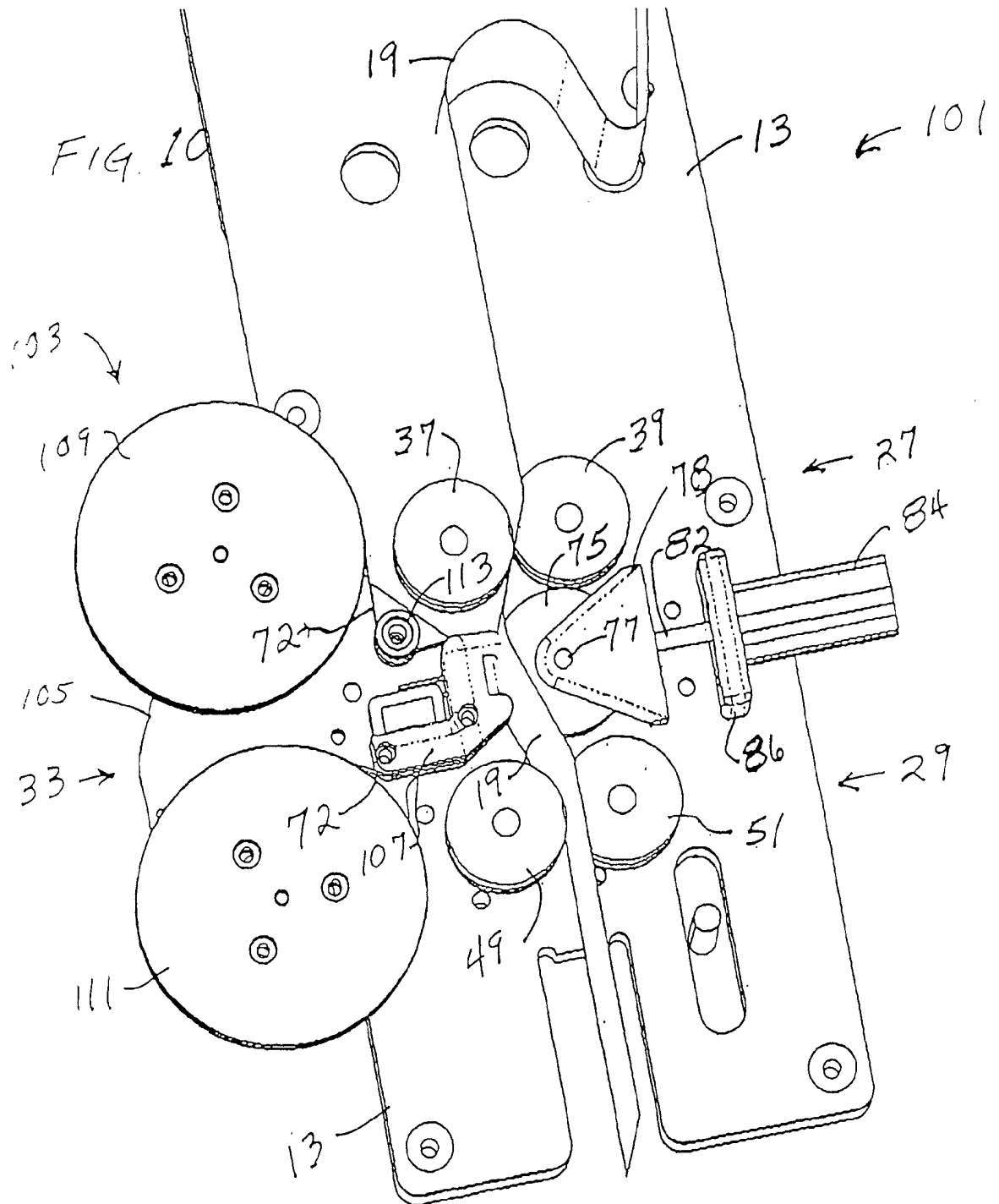


Fig 8







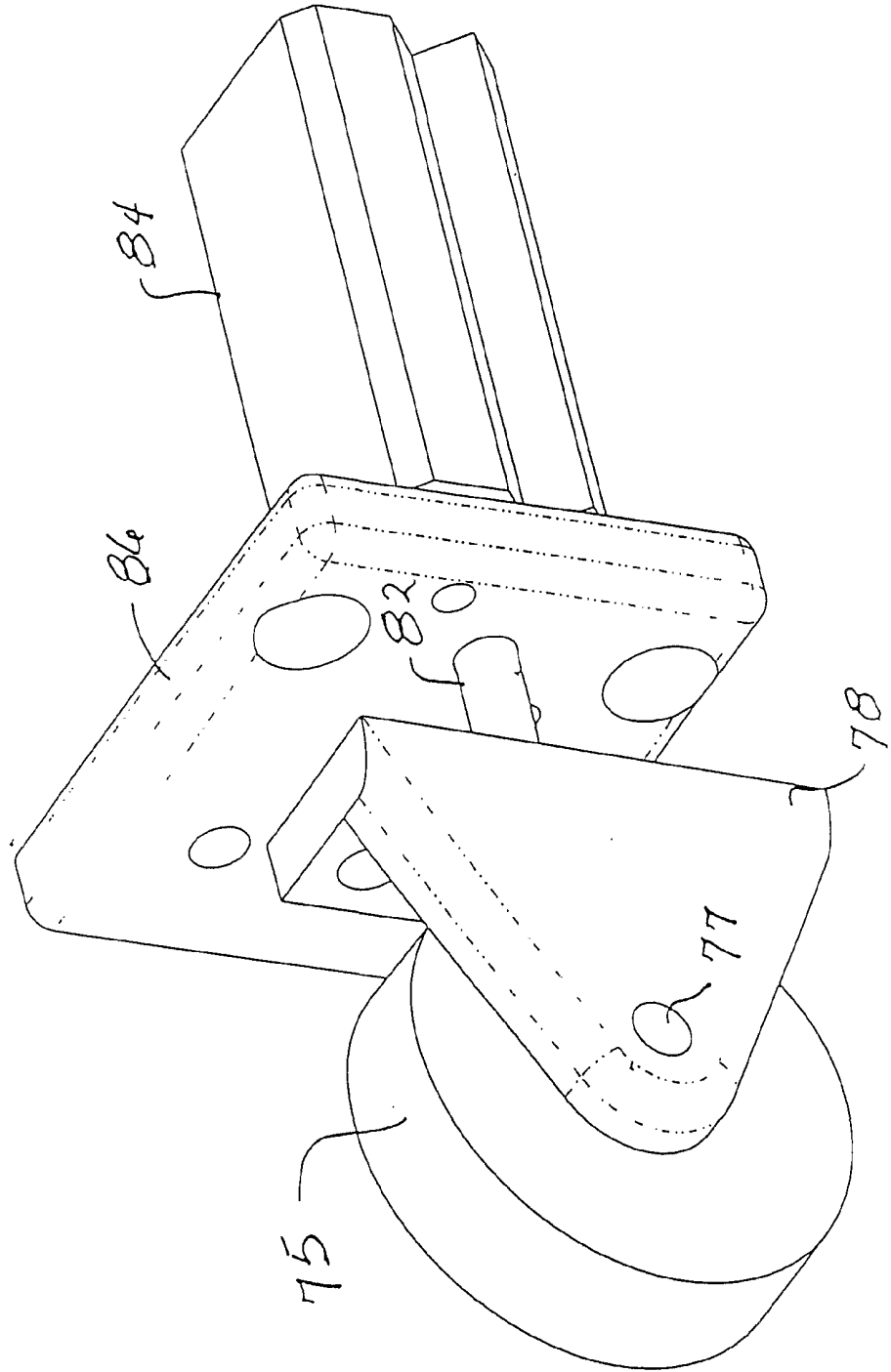
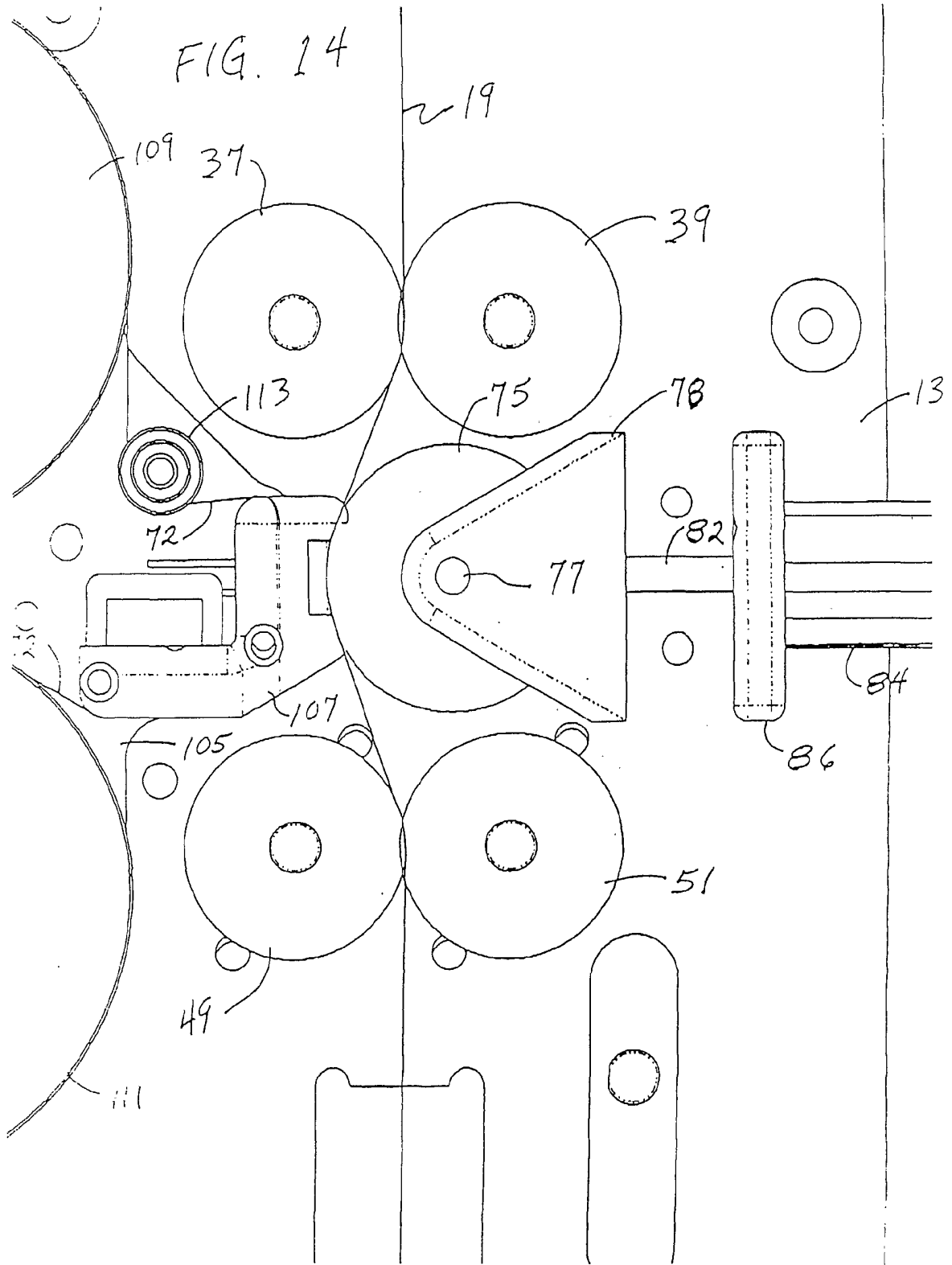


FIG. 13



INTERNATIONAL SEARCH REPORT

International application No.

PCT/US01/41589

A. CLASSIFICATION OF SUBJECT MATTER

IPC(7) : B65B 31/00

US CL : 53/79, 512; 156/145, 147, 292, 308.4; 383/3

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

U.S. : 53/79, 512; 156/145, 147, 292, 308.4; 383/3

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched
none

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

none

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	US 4,169,002 A (LARSON) 25 September 1979 (25.09.79), entire document.	1-21
Y	US 4,096,306 A (LARSON) 20 June 1978 (20.06.78), entire document.	1-21
Y	US 4,017,351 A (LARSON ET AL) 12 April 1977 (12.04.77), entire document.	1-21
Y	US 5,581,983 A (MURAKAMI) 10 December 1996 (10.12.96), entire document.	1-21
Y	US 5,427,830 A (PHARO) 27 June 1995 (27.06.95), entire document.	1-21
Y,P	WO 00/64672 A1 (SIMHAE) 02 November 2000 (02.11.00), entire document.	1-21

Further documents are listed in the continuation of Box C.

See patent family annex.

* Special categories of cited documents:	"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
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"E" earlier document published on or after the international filing date	"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)	"&" document member of the same patent family
"O" document referring to an oral disclosure, use, exhibition or other means	
"P" document published prior to the international filing date but later than the priority date claimed	

Date of the actual completion of the international search

30 OCTOBER 2001

Date of mailing of the international search report

26 NOV 2001

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