April 5, 1960 J. F. HOBBINS 2,931,075

METHOD AND APPARATUS FOR COMPRESSING AN ARTICLE

Filed Nov. 4, 1955 7 Sheets-Sheet 1

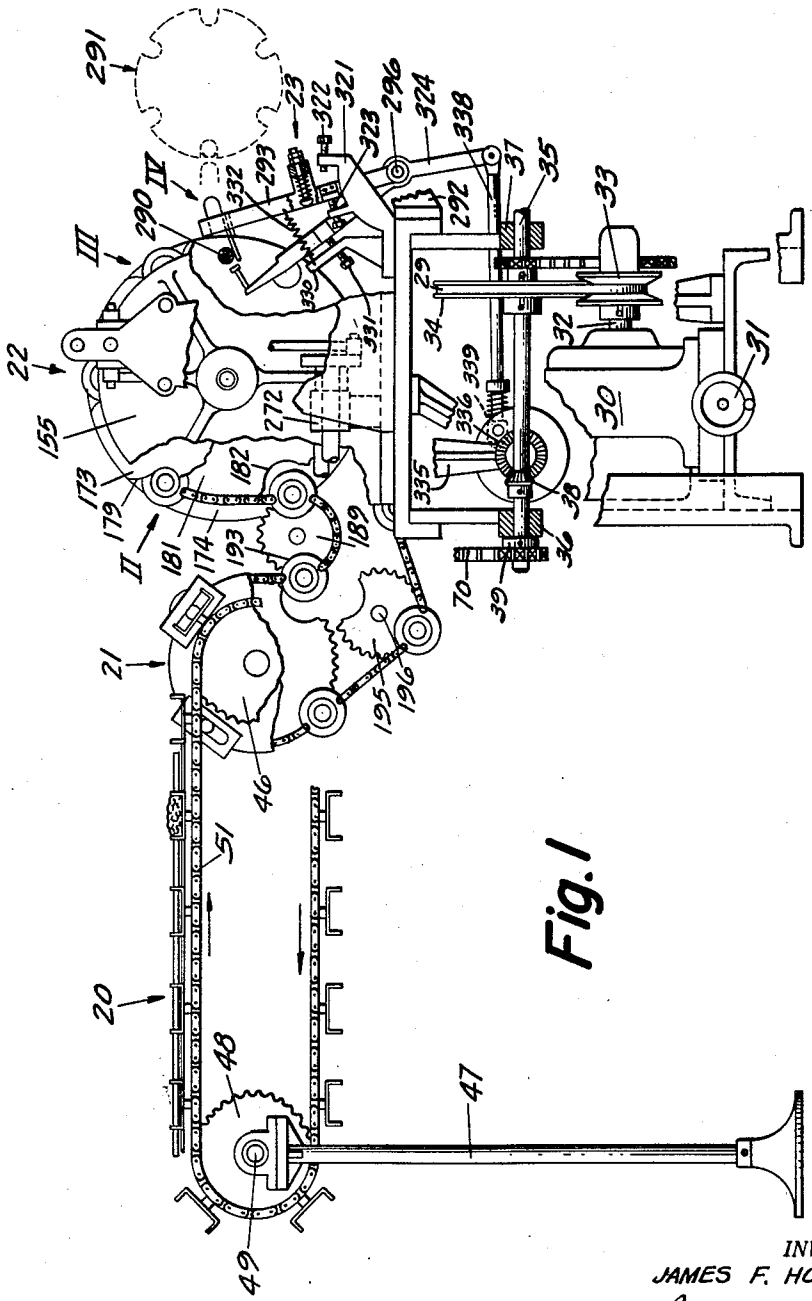



Fig. 1

INVENTOR.
JAMES F. HOBBINS
BY Robert K. Gaut
ATTORNEY

April 5, 1960 J. F. HOBBINS 2,931,075

METHOD AND APPARATUS FOR COMPRESSING AN ARTICLE

Filed Nov. 4, 1955 7 Sheets-Sheet 2

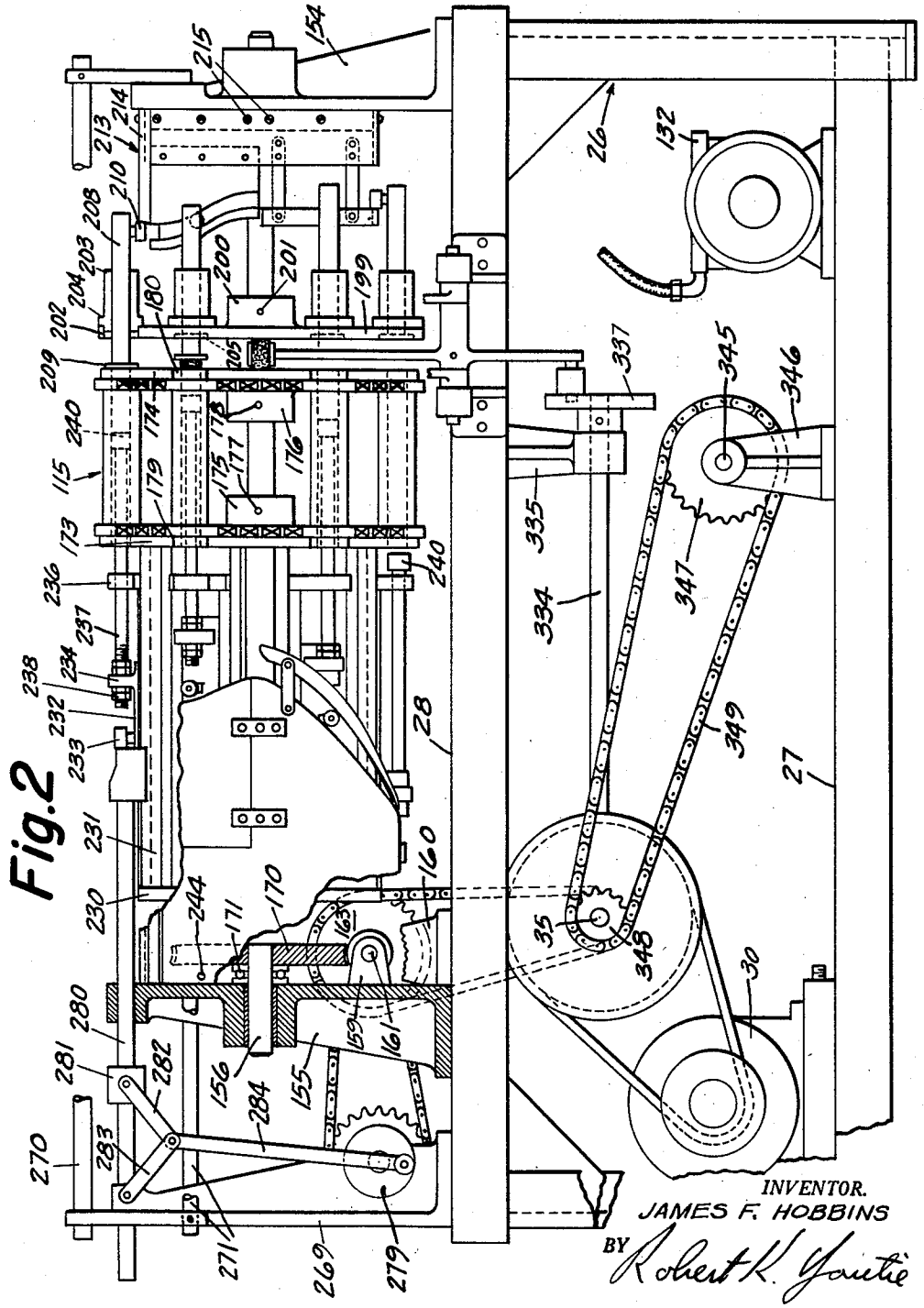



Fig.2

INVENTOR.
JAMES F. HOBBINS
BY Robert K. Gauthier
ATTORNEY

April 5, 1960 J. F. HOBBINS 2,931,075

METHOD AND APPARATUS FOR COMPRESSING AN ARTICLE

Filed Nov. 4, 1955 7 Sheets-Sheet 3

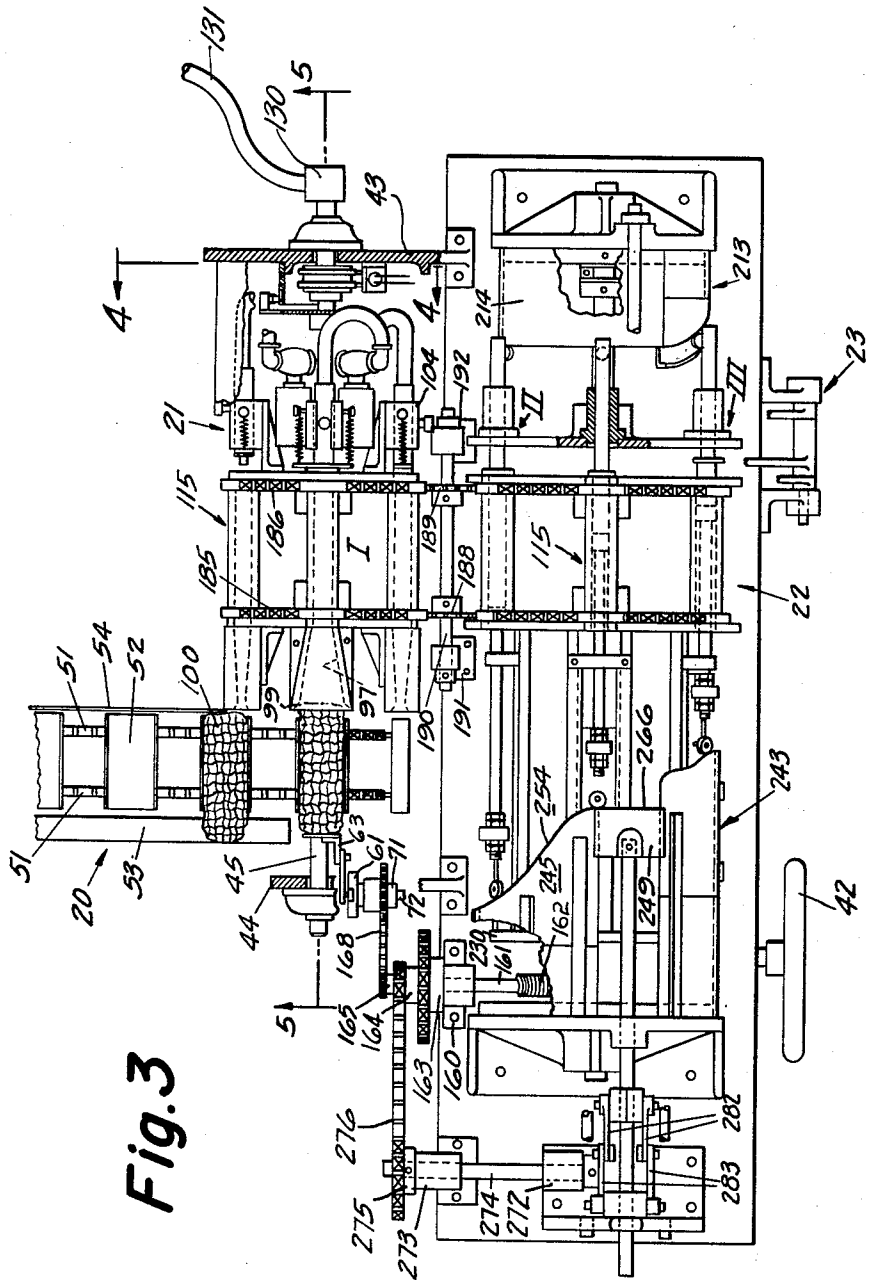


Fig.3

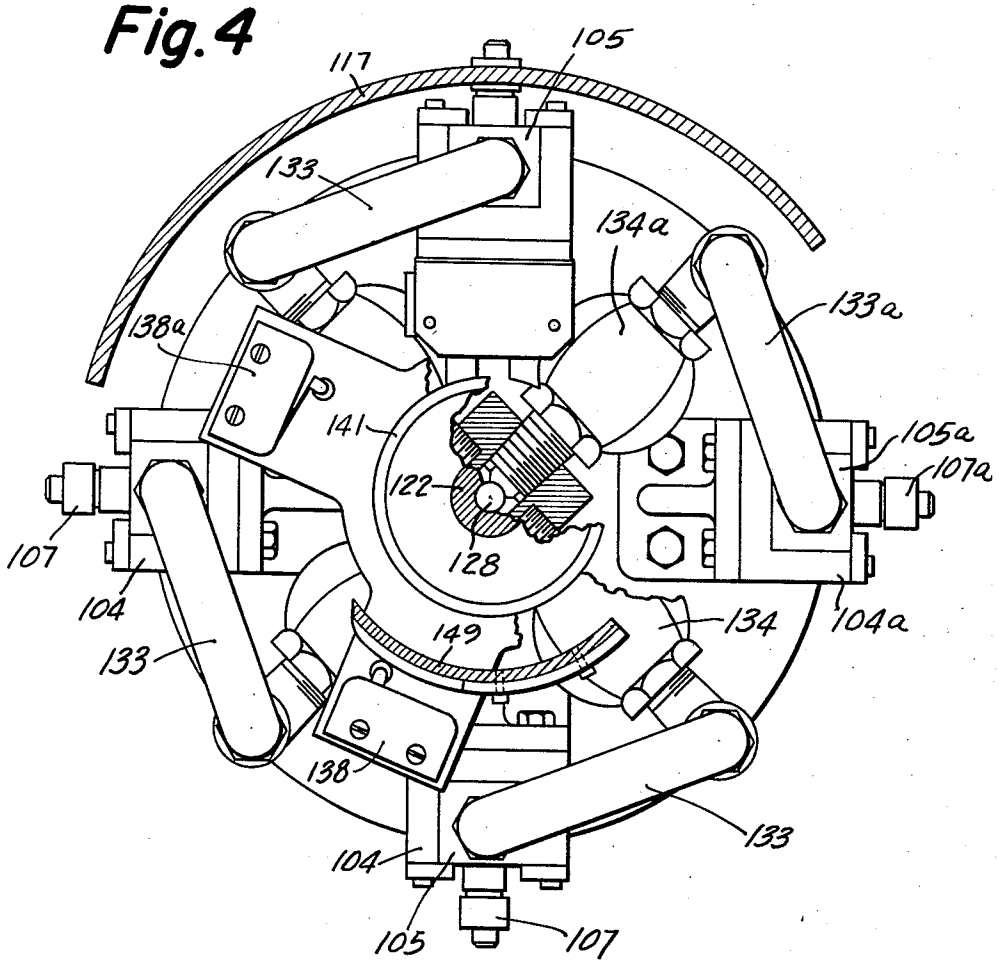
INVENTOR.
JAMES F. HOBBINS
BY Robert K. Gaultie
ATTORNEY

April 5, 1960 J. F. HOBBINS 2,931,075

METHOD AND APPARATUS FOR COMPRESSING AN ARTICLE

Filed Nov. 4, 1955 7 Sheets-Sheet 4

Fig. 4



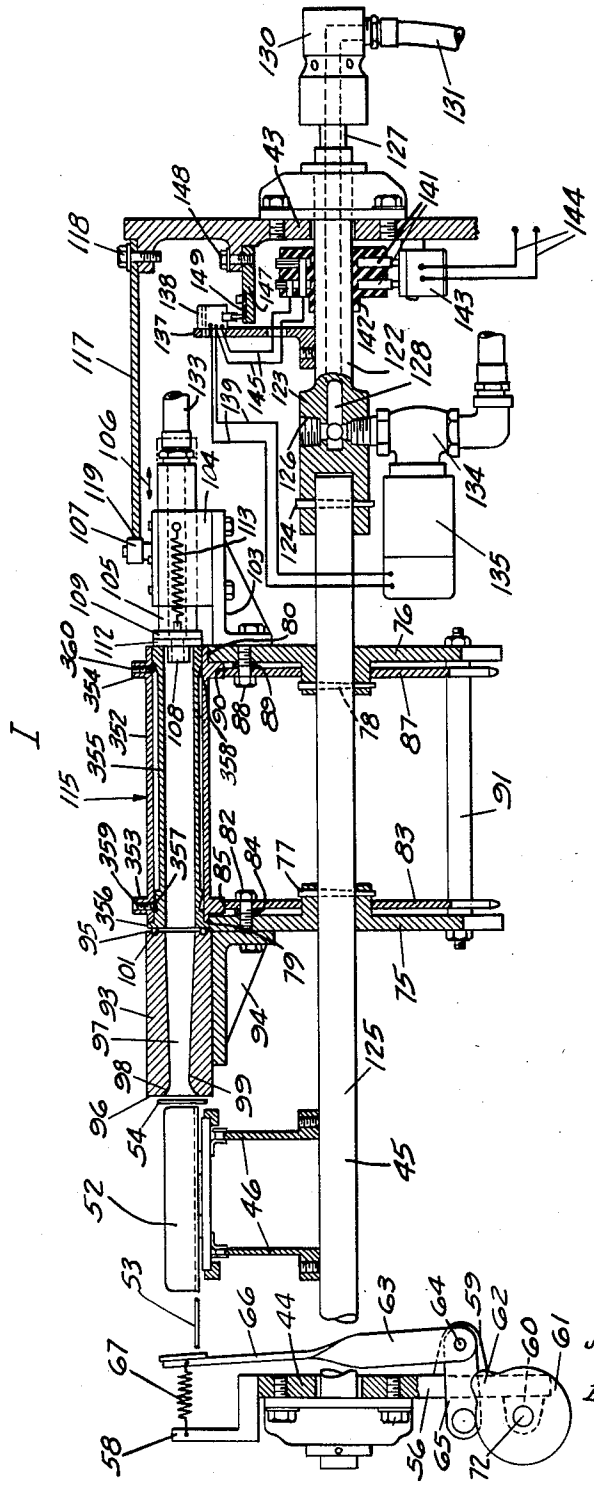

INVENTOR.
JAMES F. HOBBINS
BY Robert K. Youtie
ATTORNEY

April 5, 1960 J. F. HOBBINS 2,931,075

METHOD AND APPARATUS FOR COMPRESSING AN ARTICLE

Filed Nov. 4, 1955 7 Sheets-Sheet 5

Fig. 5




INVENTOR.
JAMES F. HOBBINS
BY Robert K. Young
ATTORNEY

April 5, 1960 J. F. HOBBINS 2,931,075

METHOD AND APPARATUS FOR COMPRESSING AN ARTICLE

Filed Nov. 4, 1955 7 Sheets-Sheet 6

Fig. 6

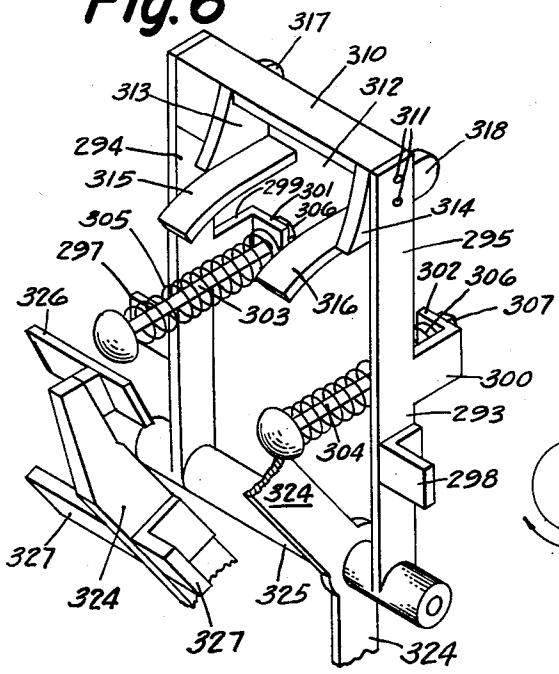



Fig. 7

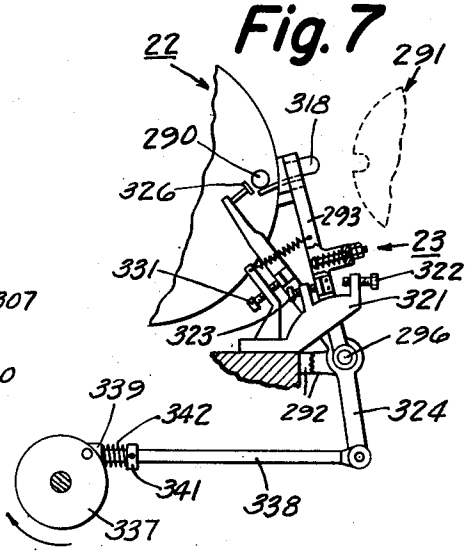



Fig. 8

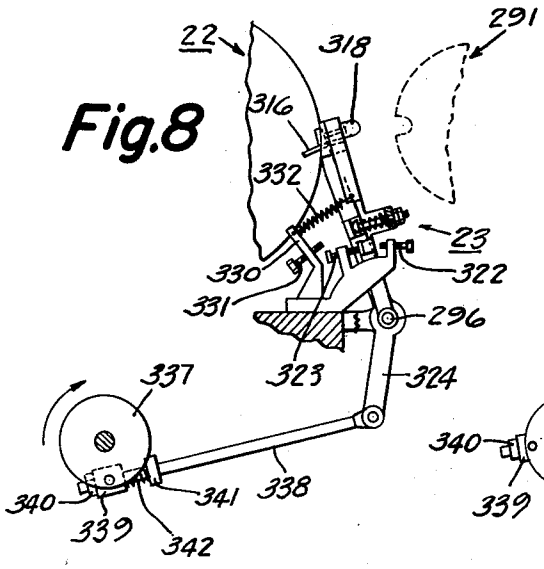
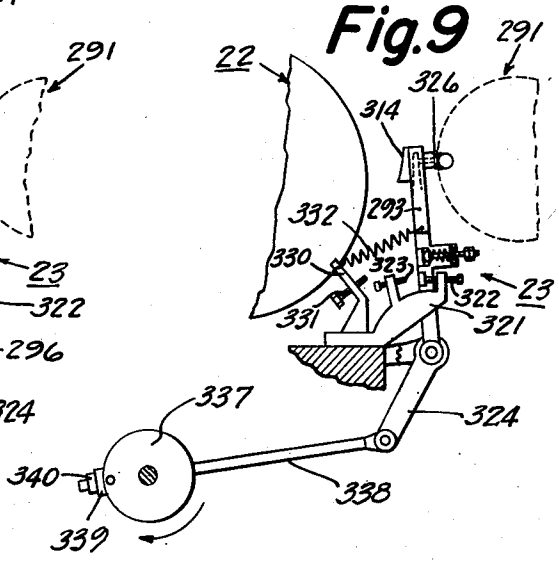



Fig. 9



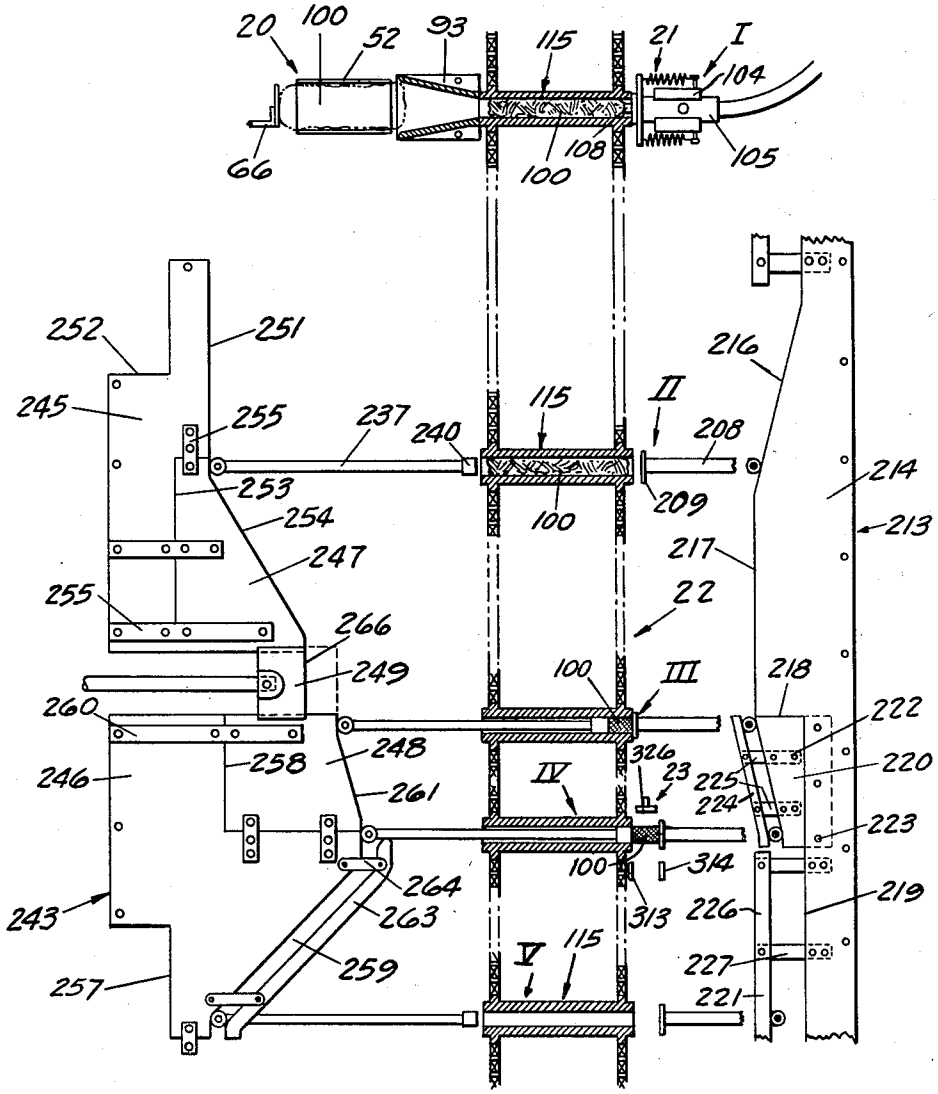

INVENTOR.
JAMES F. HOBBINS
BY Robert K. Gaultie
ATTORNEY

April 5, 1960 J. F. HOBBINS 2,931,075

METHOD AND APPARATUS FOR COMPRESSING AN ARTICLE

Filed Nov. 4, 1955 7 Sheets-Sheet 7

Fig. 10




INVENTOR.
JAMES F. HOBBINS
BY Robert K. Gaultie
ATTORNEY

United States Patent Office

2,931,075

Patented Apr. 5, 1960



2,931,075

# METHOD AND APPARATUS FOR COMPRESSING AN ARTICLE

James F. Hobbins, Philadelphia, Pa.

Application November 4, 1955, Serial No. 544,941

20 Claims. (Cl. 19—144.5)

This invention relates to a method and apparatus for reducing or compressing a relatively soft, compressible article, substance or commodity.

While the present invention has been primarily developed and employed for reducing or compressing sanitary napkins of the external type, and will be illustrated and described hereinafter with particular reference thereto, it is appreciated that the instant method and apparatus are capable of very wide application, as in the reduction of any substance or commodity having the necessary softness and compressibility, and it is intended that all such applications be comprehended within the scope of the invention.

As is well known to those versed in the art, conventional external type sanitary napkins, which are approximately 9 inches long, 3¼ inches wide and 1 inch thick, may be greatly reduced in size, say to a cylinder of 2 inch length and ⅞ inch transverse dimension or diameter, without adversely affecting the napkin strength, absorbency, or other essential qualities. That is, the reduced or compressed napkin may be readily expanded to its original size, and thus prepared for use, by a simple, manual "shaking" operation. While this reduction in napkin size presents many advantages, such as minimizing space requirements for shipping and storage, and ease of portability by the user, it has not been widely practiced as prior methods and apparatus for reducing the napkins were not entirely satisfactory. For example, previous machines intended for compressing sanitary napkins and like articles required intermittent, or stop and go motion of compression chambers or the compressing elements, and were therefore very limited in operating speed and production output. Further, compression machines heretofore employed were relatively complex in construction, and involved high initial and maintenance costs.

Accordingly, it is one object of the present invention to provide a method and apparatus for reducing compressible articles, which overcome the difficulties mentioned in the foregoing paragraph, which are extremely simple and reliable in operation, and wherein compression is adapted to take place in continuously moving chambers to achieve a relatively high and economical rate of production.

It is a more particular object of the present invention to provide a method of reducing compressible articles, wherein the articles are reduced in at least one dimension by pneumatic means. More specifically, the instant invention contemplates the pneumatic conveyance of an article into a constriction to reduce the article to the internal size of the constriction.

It is another object of the present invention to provide apparatus for reducing compressible articles, which is completely automatic in operation, simple and inexpensive in construction, durable and economic in use, and which is highly versatile in that it is capable of being quickly and easily adapted to produce compressed articles of different sizes and shapes.



It is a further object of the present invention to provide apparatus having the advantageous characteristics mentioned in the foregoing paragraphs, wherein reduction of the article is positively controlled, and which is capable of delivering compressed articles in a predetermined timed relation, say to a wrapping machine or the like, for applying a film wrapper to the compressed article.

Other objects of the present invention will become apparent upon reading the following specification and referring to the accompanying drawings, which form a material part of this disclosure.

The invention accordingly consists in the features of construction, and combinations of elements and method steps, which will be exemplified in the following description, and of which the scope will be indicated by the appended claims.

In the drawings:

Figure 1 is a side elevational view showing the compressing apparatus of the present invention, with parts broken away for clarity of understanding, and schematically illustrating in dashed outline part of an overwrapping machine;

Figure 2 is a front elevational view of the apparatus of Figure 1, somewhat enlarged and partially broken away to better illustrate operation of the device;

Figure 3 is a top plan view showing the device of Figures 1 and 2 also partly broken away for better illustration;

Figure 4 is an enlarged, sectional view, taken substantially along the line 4—4 of Figure 3;

Figure 5 is an enlarged sectional view taken substantially along the line 5—5 of Figure 3, with parts removed and rearranged to facilitate understanding of the operation;

Figure 6 is a partial perspective view illustrating a mechanism for removing a compressed article from the apparatus, and delivering or transferring the article in compressed condition to other processing equipment, say a wrapping machine;

Figure 7 is a sectional, elevational view showing the transfer mechanism of Figure 6 in position for receiving a compressed article from the compressing apparatus;

Figure 8 is a sectional elevational view similar to Figure 7 showing an intermediate stage in removing the compressed article from the compressing apparatus;

Figure 9 is a view similar to Figures 7 and 8 showing the transfer mechanism delivering the compressed article to additional processing equipment; and

Figure 10 is a somewhat diagrammatic plan view illustrating operation of the compressing apparatus and movement of an article being compressed through the apparatus.

Referring now more particularly to the drawings, and specifically to Figure 1 thereof, the apparatus may be considered as composed essentially of article feeding means, generally designated **20**, pneumatic article reduction means, generally designated **21**, mechanical article compression means, generally designated **22**, and article removal or transfer means, generally designated **23**. Further, the articles being operated upon by the apparatus will pass through the several parts in the order enumerated, as will appear hereinafter in greater detail.

The apparatus is mounted, for the most part, see Figure 2, on a table-like frame, generally designated **26**, having a generally horizontal lower support or bed plate **27**, and an upper or top generally horizontal support or bed plate **28**. A drive motor **30** is mounted on the lower bed plate **27**, on the left hand side in Figure 2, and is adjustable laterally of the frame by actuation of a hand wheel **31**, see Figure 1. Projecting forwards from the motor **30** is a drive shaft **32** which carries a drive pulley **33** rotatable with the drive shaft.

Arranged below the upper bed plate 28, to the right of the motor 30 in Figure 2, is a generally horizontal, forwardly and rearwardly extending shaft 35, which is rotatably supported by a pair of fixed journal bearings 36 and 37 depending from the upper bed plate 28. Carried by the shaft 35 adjacent to and forward of the journal bearing 36 is a bevel gear 38; and, a sprocket wheel 39 is carried by the shaft 35 just rearward of the bearing 36. In substantial alignment with the motor pulley 33, a relatively large pulley 34 is fixed to the shaft 35 and driven from the motor pulley by a belt 29, to rotate the latter shaft. On the forward end of the shaft 35 is a hand wheel 42. As will appear presently, the feeding means 20, pneumatic reducing or compressing means 21, mechanical compression means 22 and transfer means 23 are all driven in timed relation from the shaft 35.

*Article feeding means*

Projecting rearward and upward from the rear of the upper bed plate 28, the left hand side as seen in Figure 3, are a pair of laterally spaced bearing brackets 43 and 44. A generally horizontal laterally extending shaft 45 extends between and has its opposite end portions journaled in the brackets 43 and 44. Fixed to the shaft 45, adjacent to but inward of the bearing bracket 44, see Fig. 5, are a pair of spaced sprocket wheels 46, 46. A standard or auxiliary support 47, see Fig. 1, is arranged rearward of the shaft 45 and carries a pair of laterally spaced sprocket wheels 48, 48 supported in substantial alignment with the sprocket wheels 46, 46 for rotation about the axis of a generally horizontal shaft 49. Trained over the sprocket wheels 46 and 48 are a pair of endless conveyor chains 51, 51, which define forwardly and rearwardly extending generally horizontal upper and lower stretches. A plurality of open ended, napkin conveying plates or trays 52 are carried by the chains 51, exteriorly thereof, and arranged in spaced relation about the length of the chains. More specifically, each of the conveyor plates 52 extends laterally between and is supported by both of the chains 51, and has its opposite sides opening beyond the adjacent chain.

Extending along the upper stretch of the conveyor chains 51, on one side thereof adjacent to the frame bracket 44, is a fixed strip or apron 53, for slidably supporting an end portion of each article or napkin 100 carried by the trays 52. Adjacent to the other side of the conveyor chains 51, extending along the upper stretch thereof, is a fixed rail or guide bar 54 for retaining the napkins on the trays. The apron 53 and guide rail 54 may be supported by any suitable means, such as by the standard 47.

The apron 53 terminates at its forward end just short of the shaft 45. The bearing bracket 44 includes a vertical mounting plate or bar 56, see Figure 5, which has its upper end portion 58 offset laterally outwards, over the shaft 45. The lower end portion of the mounting plate 56 is provided with a forwardly projecting ear or lug 59, and a rearwardly projecting ear or lug 60 at a lower level than the lug 59. A cam 61, formed with a protuberance 62, is supported in the lower lug 60 for rotation about a generally horizontal axis, while a crank or lever 63 is pivoted, as at 64 to the lug 59, and includes a follower arm 65 adapted to ride on the rotatable cam 61, and an upwardly extending napkin pusher arm 66 having its upper end portion adjacent to the forward end of the apron 53. A tension spring 67 is connected between the pusher arm 66 and upper extension 58 of the mounting member 56 to yieldably urge the pusher bar laterally outwards and maintain the follower arm 65 in engagement with the cam 61. Rotation of the cam will thus effect intermittent rotary oscillation of the pusher arm 66 toward and away from the conveyor chains 51 and trays 52.

The cam 61 is driven from the shaft 35 through a chain 70 trained over the sprocket wheel 39 and also over a sprocket wheel 71. The latter sprocket wheel is carried by the shaft 72, which also carries the cam 61, and is rotatably supported by the journal lug 60. The cam is therefore driven from the shaft 35, and by its protuberance 62 causes intermittent oscillation of the pusher arm 66. Further, cam rotation is timed so as to oscillate the pusher arm 66 toward the open end of each successive tray 52 as the trays pass beyond the forward end of the apron 53 to push inward on a napkin supported by each tray.

*Pneumatic article reducing means*

Also fixed to the shaft 45 for axial rotation therewith are a pair of generally parallel, laterally spaced plates or discs 75 and 76. The discs 75 and 76 are pinned or otherwise secured, as at 77 and 78, to the shaft 45, the former disc being adjacent to and spaced from the sprocket wheels 46, while the latter is remote from the sprocket wheels 46. The discs 75 and 76 are generally circular in configuration, and provided, respectively, with a plurality of circumferentially spaced, peripheral cutouts, openings or pockets 79 and 80. The pockets 79 of disc 75 are in alignment, longitudinally of the shaft 45, with respective pockets of the disc 76; and adjacent pockets of each disc are linearly spaced from each other a distance equal to the distance between adjacent trays 52.

Fixedly secured in adjacent, facing relation with respect to the disc 75, as by bolts 82, is a toothed, sprocket wheel 83. The sprocket wheel 83 is spaced from its associated disc 75 by spacers 84, and formed with a plurality of circumferentially spaced peripheral cutouts or notches 85, each in substantial alignment with a respective notch 79 of the disc 75. A similar sprocket wheel 87 is fixedly secured in facing spaced relation with respect to the disc 76, by bolts 88 and spacers 89, and is formed with a plurality of circumferentially spaced peripheral cutouts or pockets 90 in alignment, respectively, with the disc pockets 80. In practice, the discs 75 and 76, and their associated sprocket wheels 83 and 87, may each be formed with four pockets, but the number may, of course, be more or less if desired. In addition to the above structure, the relationship between the discs 75 and 76, and sprocket wheels 83 and 87 may be straightened and rigidified by employing a plurality of shouldered tie bolts 91 extending longitudinally of the shaft 45 and secured to the plates and sprocket wheels.

Projecting from the disc 75, at circumferentially spaced points thereabout, toward the sprocket wheels 46, are a pair of open ended, tubular passage members or funnels 93. More specifically, each of the passage members 93 is arranged generally longitudinally of the shaft 45 and fixedly but detachably secured, as by a bracket 94, with one end 95 adjacent to and in alignment with a respective disc pocket 79, and the other end 96 extending toward and terminating just short of the trays 52. The internal passageway 97, defined by each funnel 93, has its entrance opening 98, adjacent to the funnel end 96, smoothly curved to facilitate the entry of an article, and diverges slightly from the narrow region or restriction 99 to the funnel end 95. However, as seen in Figure 3, which is taken at right angles to Figure 5, the passageway 97 converges rapidly from the restriction 99 to the funnel end 95 so that the passageway is of gradually reducing cross section from the restriction 99 to the funnel end 95. As will be described hereinafter in greater detail, each of the funnel passageways 97, from the restriction 99 to the funnel end 95 is of less cross sectional area or transverse dimension than that of an article 100 to be compressed. Hence, the funnels 93 serve to constrict and reduce the cross section of compressible articles passing into and through the funnels. On each of the funnel ends 95, embedded therein or otherwise fixedly secured thereto, is provided a yieldable sealing member or O-ring 101.

It will be noted that the funnels 93 are equally spaced

circumferentially about the disc 75 a distance equal to the distance between the trays 52. Further, the funnels 93, and hence the disc pockets 79 and 80, are arranged to travel at the same linear speed and in alignment through a portion of their path of movement with the trays 52.

A plurality of brackets 103 are fixed at circumferentially spaced points about the disc 76, each in alignment with one of the pockets 80, and project longitudinally of the shaft 45 away from the disc 75. Fixed on each bracket 103, longitudinally of the shaft 45, is an outwardly opening channel like guide member 104 which defines an outwardly opening guideway in alignment with the adjacent pocket 80. An elongate, open ended tubular suction member or pipe 105 is arranged longitudinally in each guide channel 104 in substantial alignment with the adjacent disc pocket 80, and slidably supported therein for longitudinal reciprocation toward and away from the adjacent disc pocket, as indicated by the arrow 106. Projecting outwards from each vacuum or suction tube 105, extending through the open outer side of the associated guide channel 104, is a cam follower, roller or stud 107. One end portion 108 of each tube 105, adjacent to the disc 76 is reduced to form an inlet nozzle, and is provided wtih a transverse enlargement or cross piece 109 extending outwards beyond opposite sides of the associated channel 104 and spaced from the free end of the nozzle. Circumposed about each nozzle 108, in facing engagement with adjacent cross piece 109, is a yieldable sealing ring or gasket 112. A pair of tension springs 113 are secured between opposite end portions of each cross piece 109 and the proximate side wall of the respective channel 104 to normally urge the associated tube 105 away from the disc 76 toward a limiting position with its cross piece 109 abutting the channel.

As will appear more fully hereinafter, a plurality of open ended cylinders or chambers, generally designated 115, are each seated in one aligned pair of disc pockets 79 and 80 and movable with the discs through a portion of disc rotation. During this portion of disc rotation, the tubes 105 are slidable in their respective channels 104, so that the tube nozzles 108 are received in the adjacent cylinder 115, and the gaskets 112 abut against and seal the adjacent cylinder end. Reciprocation of the tubes 105 is effected by an arcuately bent plate or cam 117 fixed to the journal bracket 43, as by bolts 118, and having one contoured edge 119 engageable with the followers or studs 107 to shift the tubes 105 toward the disc 76 against the force of the springs 113, and permit return of the tubes away from the discs, all in properly timed relation.

In Figure 5 it will be observed that the shaft 45 includes a hollow end section 122 having an enlarged inner portion 123 pinned, as at 124, or otherwise fixed in end to end aligned relation with a main section 125 of the shaft. The enlarged shaft portion 123 is located in spaced relation between the disc 76 and bracket 43, and provided with a plurality of internally threaded generally radially extending bores 126 corresponding in number to the tubes 105. The shaft section 122 is rotatably supported in and extends through and outwards beyond the bearing bracket 43, as at 127, and is provided with a longitudinal internal passageway or bore 128 communicating between the bores 126 and the outwardly through extending shaft end portion 127. On the extending end portion of the shaft section 122 is provided a rotary joint or fluid coupling 130 adapted for attachment, as by a hose or conduit, to a vacuum pump or other suitable source of vacuum.

Associated with each tube 105 is a conduit or hose 133 connected between the tube end remote from the disc 76 and a valve 134, preferably of the solenoid type, which is connected to the enlarged shaft portion 123 in a respective one of the bores 126. Hence, the shaft passageway 128, which communicates with a vacuum source, is communicable through the valves 134 and hoses 133 with the interiors of the tubes 105 when the respective valves are open. The valves 134 are normally closed, and each provided with electrical operating means 135 connected to the respective valve. A mounting plate 137 is fixedly circumposed about and rotatable with the shaft section 122, and carries a plurality of spaced switches 138 each electrically connected, as by conductors 139 with a respective valve operating mechanism 135. Also fixedly circumposed about the shaft section 122, between the plate 137 and bracket 43, are a pair of electrically conductive slip or collector rings 141, which may be embedded in or otherwise carried by a hub 142 for rotation with the shaft 45. A brush assembly 143 is fixedly mounted on the bracket 43 in electrical contact with the slip rings 141, and adapted for connection, as by conductors 144 to a suitable source of electric power. Electricity is thus carried to the rotatable slip rings 141, which are electrically connected, as by a plurality of pairs of conductors 145, with each of the valve actuating switches 138.

An arcuate cam plate 147 is fixed, as by bolts 148 to the bracket 43, in position to be engaged by the switches 138 upon rotation of the latter. In this manner the switches 138 are successively closed to energize their respective operating mechanisms 135 and open the associated valves 134. An arcuate strip or segment 149 is adjustably fixed to the cam plate 147 to vary the position during which the switches are actuated.

It will be appreciated, that the valve 134 and switch 138 are not shown in their correct positions in Figure 5, but rather, are swung about the axis of the shaft 45 for clarity of illustration. The true positions of the several tubes 105, conduits 133, valves 134, and switches 138, are shown in Figure 4, wherein one cooperating set of such elements is designated by the corresponding numeral and the letter *a*.

*Mechanical article compression means*

The mechanical compression means 22 is mounted on the upper level or bed plate 28 of the supporting table 26, and includes a pair of laterally spaced, facing bearing pedestals or stands 154 and 155, see Figures 2 and 3. The bearing stands 154 and 155 are bolted or otherwise secured on the table top or bed plate 28 and extend upwards therefrom for rotatably supporting opposite end portions of a generally horizontal shaft 156 extending laterally between the bearing stands. Projecting inwards from the bearing pedestal 155, below and forward of the shaft 156, and fixed relative to the pedestal, is a wall-type journal bearing 159. Mounted on the upper frame level 28, rearwards of and in alignment with the bearing 159, is an upstanding journal bearing 160. The bearings 159 and 160 cooperate to rotatably support a generally horizontal shaft 161 extending forwards and rearwards, below and transverse of the shaft 156. Intermediate the journal bearings 159 and 160, directly below the shaft 156, the shaft 161 carries a worm gear 162, for rotation with the latter shaft; and, the shaft 161 extends rearwards beyond the bearing 160 and the frame top 28, and carries on its rearwardly extending portion a plurality of sprocket wheels 163, 164 and 165. The shaft 161 is driven by the shaft 35 through the sprocket chain 70 which is trained over the sprocket wheels 39 and 163, while a sprocket chain 168 is trained over the sprocket wheels 165 and 71 to drive the shaft 72 from the shaft 161.

A worm wheel 170 is keyed or otherwise fixed to the shaft 156 for rotation therewith, and meshes with the worm 162 to rotate the shaft 156 upon rotation of the worm shaft 161. Interposed between the worm wheel 170 and bearing stand 155 may be a bearing 171 to transmit thrust from the shaft 156 to the last named bearing stand.

Axially circumposed about the shaft 156 are a pair of

parallel spaced plates or discs 173 and 174 in substantial alignment with the discs 75 and 76, respectively. The discs or plates 173 and 174 are provided, respectively, with hubs 175 and 176 fixed to the shaft 156, as by pins 177 and 178, or other suitable means. The discs 173 and 174 are substantially identical to each other, and similar to the discs 75 and 76, each including a plurality of circumferentially spaced, peripheral cutouts or pockets 179 and 180, respectively, with the pockets of one disc being in alignment with the pockets of the other disc longitudinally of the shaft 156. Further, a sprocket wheel is fixedly secured in adjacent, facing relation with respect to each of the discs 173 and 174, such as the sprocket wheel 181 associated with the latter disc, see Figure 1. The sprocket wheels associated with the respective discs 173 and 174 are also formed with peripheral cutouts or pockets, as at 182.

It will be noted that the pockets 179 and 180 of each disc 173 and 174 are spaced apart from each other circumferential distances equal to the circumferential spacing of the pockets 79 and 80 in the discs 75 and 76. A sprocket chain 185 is trained about the sprocket wheels of the aligned discs 75 and 173, while a second sprocket chain 186 is trained about the sprocket wheels of the aligned discs 76 and 174. Thus, upon rotation of the discs 173, 174, 75 and 76, the chains 185 and 186 will travel simultaneously about parallel, endless paths having upper and lower stretches. The cylinders 115 are arranged in laterally spaced relation with respect to each other, and each extends between and has its opposite end portions secured in the chains 185 and 186. Further, the cylinders 115 are spaced along the chains 185 and 186 at distances equal to each other and to the circumferential spacing of the disc pockets 79, 80, 179 and 180. By this construction, the cylinders 115 will move with the chains 185 and 186 about the closed path thereof, and be received in the pockets of the respective discs when moving thereabout.

In the upper run or stretch of the path of chains 185 and 186 are provided a pair of laterally spaced idler sprocket wheels 188 and 189, which are supported on a generally horizontal, laterally extending shaft 190 journaled in pillow boxes 191 and 192 mounted on the frame top 28. The sprocket wheels 188 and 189 are also fomed with peripheral cutouts or pockets, as at 193 in Figure 1, for receiving the cylinders 115. A similar pair of laterally spaced, idler sprocket wheels, one being shown at 195 in Figure 1, are carried by a shaft 196 for rotation about the axis thereof and meshing engagement with the chains 185 and 186 on the lower run of their path of movement. The shaft 196 may be rotatably supported by any suitable means, such as the bearing brackets or pillow boxes 191 and 192. It will now be understood that rotation of the discs 173 and 174 about the axis of shaft 156, as powered from the shaft 35, through the chain 70, worm 162 and worm wheel 170, will effect movement of the chains 185 and 186, and hence of the cylinders 115, over the discs 75 and 76, under the idler sprocket wheels 188 and 189, over the discs 173 and 174, and under the idler sprocket wheels 195. In the illustrated embodiment, this cylinder movement will proceed in a generally clockwise direction, as viewed in Figure 1.

Also fixedly circumposed axially about the shaft 156, spaced between the disc 174 and bearing standard 154, is a plate 199 having a hub 200 pinned, as at 201, or otherwise fixed to the shaft 156. The plate or disc 199 has one surface in facing spaced relation with respect to the outer surface of the disc 174, and is provided with a plurality of through apertures or holes 202, each in alignment with one of the disc pockets 180. Inserted laterally inwards, into and partially through each of the disc holes 202 is one end portion of an open ended cylinder or tube 203. An annular abutment or collar 204 is provided on each of the tubes 203 for engagement with the outer surface of the plate 199 to limit insertion of the tubes into the respective holes 202. Thus, the tubes 203 combine with the plate 199 to define a plurality of spaced recesses 205 facing toward the disc 174, each in alignment with one of the disc pockets 180; and, the tubes 203 further provide through passageways opening into the recesses.

Extending slidably through each of the cylinders or tubes 203 is an elongate backing shank or rod 208 which has its opposite ends projecting beyond opposite ends of the respective tube. On the inner end of each shank 208 is a generally circular, flat backing head or plate 209 of a size adapted to be comformably received in the adjacent recess 205 of the plate 199, substantially flush with the latter plate, when the respective rod 208 is shifted to its extreme outward position, to the right as seen in Figure 2. In the extreme inward position of movement of each rod 208, its head 209 is disposed in closing engagement with respect to one end of a cylinder 115, when such cylinders are received in the pockets of discs 173 and 174. A transversely projecting roller or stud 210, or other suitable cam follower is provided on the outer end of each rod or shank 208.

Fixed on the inner side of the bearing stand 154, and extending toward the plate 199, is a generally cylindrical plate-like cam 213 for controlling or actuating shifting movement of the rods 208 in the tubes 203. More particularly, the cam 213 includes a main section or cam plate 214 bent into an annular or generally cylindrical configuration, arranged concentrically about the shaft 156, and fixedly secured to the bearing stand 154, as by fasteners 215. The inner edge of the main plate 214 is, for the most part, cammed or contoured to engage with the followers 210 as the shanks 208 rotate with the plate 199, and shift the shanks 208 in a desired manner within their respective tubes 203. As best seen in Figure 10, wherein the cam 213 is illustrated in developed condition, the inner edge of the main cam plate 214 is shaped to provide an edge portion or cam surface 216 extending generally in a plate disposed at an oblique angle with respect to the shaft 156, and an edge portion or cam surface 217 extending from the inner end of the edge portion 216 and disposed in a plane arranged generally normal to the shaft 156. The cam edge portion 217 terminates, remote from the cam edge portion 216 in an edge 218 which extends outwards generally parallel to the shaft 156. From the outer end of the edge 218, in a plane generally normal to the shaft 156, extends an edge 219 which terminates at the outer end of the angularly disposed cam edge 216.

As will appear more fully hereinafter, the plate edges 216 and 217 serve as open-type cams for shifting the shanks 208 and their heads 209 into end closing relation with respect to the cylinders 115, while the main cam plate 214, in the region of the edge 219, is provided with removable cam sections 220 and 221 for withdrawing the shank heads 209 from their cylinder closing relation. That is, the cam section 220 includes a plate 222 detachably secured, as by fasteners 223, to the main cam plate 214, and a cam, bar or strip 224 arranged in spaced relation with respect to the plate 222 and fixed relative to the latter by tie bars 225, or other suitable means. The space between the plate 222 and bar 224 is so shaped and arranged as to receive the followers 210 of the shanks 208 and positively control movement of the latter to withdraw the shank heads 209 from their cylinder closing relation. The removable cam section 221 includes a strip or bar 226 extending along and spaced from the edge 219 of the main plate 214, and detachably secured to the latter by any suitable means, such as stays 227. The bar 226 of the cam section 221 is engageable with the cam followers 210 to retain the shank heads 209 in their respective recesses 205 away from the cylinders 115.

Arranged in spaced relation between the disc 173 and worm wheel 170, and fixedly secured coaxially about the shaft 156, is a generally circular plate or disc 230. Thus,

the discs 173 and 230 rotate together with the shaft 156. Extending longitudinally of the shaft 156 between the discs 173 and 230, and fixedly secured to said discs, are a plurality of circumferentially arranged, outwardly opening channel-like slideways or guides 231. Further, each slideway or channel 231 is located adjacent to and radially inwards of one disc pocket 179. Mounted in each of the slideways 231 for sliding movement toward and away from the disc 173 is a cross head or slide 232. A roller, stud or other type cam follower 233 projects outwards from each slide 232, adjacent to the disc 230, while an outstanding ear or lug 234 is provided on each slide adjacent to the disc 173. Fixed to each slideway 231, and projecting outwards therefrom, adjacent to the disc 173, is a guide or bearing 236, in substantial alignment with the ear 234. A plurality of rods, plungers, or rams 237 are each slidably received in one of the bearings 236 and has one end anchored in the adjacent ear 234, as by nuts 238. On the other end of each rod 237, remote from the slide 232, is preferably detachably secured a head 240. The rods 237 are each in alignment with a respective disc pocket 179 and mounted for rotation with the disc 173 as well as sliding movement relative to the latter disc between a retracted position located entirely in the space intermediate the discs 173 and 230 and a projected position with the ram head 240 and the adjacent rod portion extending through and beyond the adjacent disc pocket 179. Further, the rods heads 240 are shaped for sliding engagement inwards through an end of a cylinder 115 located in the adjacent disc pockets.

Fixedly secured on the inner side of the bearing stand 155, and projecting inwards therefrom, is a generally cylindrical cam, generally designated 243, for engagement with the cam followers 233 of the slides 232 to effect reciprocation of the latter, and hence of the plungers or rods 237. The cam 243 includes a plurality of bent plates secured, as by fasteners 244, to the bearing stand 155, and is illustrated in its developed condition in Figure 10. The cam 243 includes a pair of spaced apart, main cam plates or section 245 and 246 which are fixed to the bearing stand 155, and a pair of spaced apart, removable cam plates or sections 247 and 248 detachably secured, respectively, to the main sections 245 and 246. In addition, the cam 243 includes a movable cam section 249 which is located between and cooperates with the cam sections 247 and 248.

More specifically, the main cam section 245 is of generally rectangular configuration, and formed with a cam surface or edge 251 disposed in a plane generally normal to the shaft 156. Along the outer edge of the cam section 245 is provided a clearance cutout 252, while the inner edge of the cam section 245 is cut away, as at 253, to receive the detachable cam plate or section 247 which has a cam surface or edge 254 extending from the cam edge 251 and inclined or angulated inwards so as to lie substantially in a plane oblique to the axis of shaft 156. Straps 255, or other suitable means, may be employed to detachably secure the cam section 247 to the cam section 245.

The other main cam section 246 also has a clearance cutout, as at 257, formed on its outer edge, and an additional cutout 258 provided on its inner edge for receiving the cam section 248. A generally angulated or inclined cam, surface or edge is formed along the inner edge of the cam section 246, merging at its outer end with the cam, surface or edge 261 and terminating at its inner end at the cutout 258. The cam section 248 is detachably secured to the cam section 246 by straps 260, or other suitable means, and is provided with a cam surface edge 261 which extends generally outwards from the inner end of the cam edge 259 so as to be disposed generally in a plane oblique to the shaft 156. Extending along and spaced inwards from the cam edge 259 of the cam section 246 is a cam bar 263, which is fixedly secured to the cam section 246 by any suitable means, such as straps 264.

From Figure 10, it will be observed that the cam sections 247 and 248 are arranged in spaced relation with respect to each other and that the adjacent ends of their cam edges 254 and 261 terminate at substantially different distances from the disc 173, the former terminating appreciably outwards of the latter. Slidably interposed between the cam sections 247 and 248 is the additional cam section 249 which is provided with a cam surface or edge 266 movable from the solid line position as a continuation of the cam edge 254 to the dashed line position as a continuation of the cam edge 261. Appropriate means are provided, as will appear in detail hereinafter, for shifting the cam section 249 between its solid and dashed line positions in properly timed relation.

It will now be appreciated that the rotation of the slides 232 and rods 237 with the discs 173 and 230 will effect movement of the cam followers 233 along the edges of the cam 243, in the downward direction as shown in Figure 10. That is, movement of a cam follower 233 along the cam edge 251 will effect no lateral shifting of the respective rod 237, while upon continued movement of each cam follower along the cam edge 254, its respective rod 237 will be shifted laterally inwards to insert the rod head 240 through and into one open end of the aligned cylinder 115. As each cam follower 233 leaves the inner end of the cam surface 254, the cam section 249 will be arranged in its solid position of Figure 10 to smoothly receive the cam follower on its cam edge 266; and, while the cam follower is in engagement with the latter cam edge, the cam section 249 will shift to its dashed line position with the cam edge 266 substantially flush with the cam edge 261. That is, the cam section 249 is shifted to further insert each successive rod head 240 into its respective cylinder 115. The rods 237 continue in their path of rotation about the shaft 156 and the followers 233 move along the cam edge 261 of the cam section 248, being shifted further inwards thereby, to a position with each rod head 240 substantially flush with the distal end of its receiving cylinder 115. The rods 237, and their heads 240 are then retracted from the cylinders 115 by movement of the respective followers 233 outwards along the cam edge 259 of the cam section 246. The cam bar 263 operates to maintain the cam followers 233 in substantial engagement with the cam edge 259 and insure retraction of the rods 237 to their initial, uppermost position of Figure 10.

Mounted on the frame top 28, laterally outwards of the bearing stand 155, is an upstanding pedestal or stand 269, which has its upper end portion secured to the upper end portion of the remote bearing stand 154 by a tie rod or bolt 270, and is secured to the adjacent bearing stand 155 by a pair of spaced stay bolts 271.

A pedestal type shaft bearing 272, see Figures 1 and 3, is provided on a lower region of the stand 269, and an additional pedestal type bearing 273 is fixed on the frame top 28 rearwards of and in alignment with the bearing 272, overhanging the rearward edge of the frame top. Journaled in the bearings 272 and 273 is a generally forwardly and rearwardly extending shaft 274, which carries on its rear end a sprocket wheel 275 in substantial lateral alignment with the sprocket wheel 164. A chain 276 is trained over the sprocket wheels 164 and 275 to drive the shaft 274 from the shaft 161. On the forward end of the shaft 274 is fixed a crank or crank wheel 279 for rotation with the latter shaft.

Extending slidably through the upper regions of the stands 155 and 269 is a laterally extending shaft or bar 280 which has its inner end detachably fixed to the movable cam section 249 for effecting movement of the latter. Viewed otherwise, the rod, shaft or bar 280 is disposed in parallelism with the shaft 156, having its inner end detachably secured to the cam section 249, and is mounted in the stands 155 and 269 for sliding movement longitudinally of the shaft 156. Fixed on the rod 280 between the stands 155 and 269, for movement with the rod, is a

cross head or block 281. A pair of links 282 are arranged on opposite sides of the cross head 281 and each pivotally connected at one end to the cross head for rotation about a generally forwardly and rearwardly extending axis. Arranged on opposite sides of the rod 280 are a pair of links 283 which each have one end pivoted to the stand 269 for rotation about a generally forwardly and rearwardly extending axis. The pair of links 282 and 283 on each side of the rod 280 have their other ends pivotally connected to each other to define a pair of toggle linkages on opposite sides of the rod; and, a connecting rod 284 had its lower end pivotally connected eccentrically to the crank wheel 279 and its upper end pivoted to the connected end of the toggle linkages 282—283. Upon rotation of the shaft 274 and crank 279, the connecting rod 284 will shift generally vertically to oscillate the links 283 about their fixed pivot, and hence, through the links 282, reciprocate the block 281 and rod 280 for shifting the cam section 249. Rotation of the shaft 274 is, of course, timed to shift the cam section 249 in proper relation with respect to rotation of the shaft 156 and of the rods 237 about the latter shaft.

*Transfer mechanism*

As will appear hereinafter in greater detail, the articles being operated upon arrive successively in fully compressed condition, between the discs or plates 174 and 199 at the front of the apparatus, as at 290 in Figure 1. The transfer mechanism 23 serves to remove the article 290 and deliver the latter in its fully compressed condition to a suitable packaging machine 291, such as overwrapping machine or the like. The transfer mechanism 23 is located on the front side of the frame 26, adjacent to the plates 174 and 199, and includes a bearing bracket 292 fixed to and projecting forwards from the front side of the frame top 28. A generally inverted, U-shaped carrier 293, see Fig. 6, has the lower ends of its legs 294 and 295 rotatably supported by a laterally extending, horizontal shaft 296 in the bracket 292. Projecting laterally outwards from each leg 294 and 295 of the carrier 293 is a stop lug or ear, as at 297 and 298, respectively. A pair of forwardly projecting, generally L-shaped extensions or brackets 299 and 300 are fixed on the carrier legs 294 and 295, respectively, each located between the upper carrier leg end and the associated stop lug 297 and 298, and each having its forward portion turned inwards, as at 301 and 302. Extending slidably through the inturned bracket end portions 301 and 302, respectively, are a pair of elongate abutment members or headed bolts 303 and 304. It will be observed that the headed ends of the abutment bolts 303 and 304 extend rearwards, and that coil compression springs 305 nad 306 are respectively circumposed about the bolts to resiliently urge the latter toward their extreme rearmost position with stop nuts 306 and 307 engaging the forward surfaces of the bracket portions 301 and 302, respectively.

The bight portion of the inverted, generally U-shaped carrier 293 is defined by a block or head 310 extending between and detachably secured to the upper end portions of the legs 294 and 295, as by fasteners 311. The head 310 is formed with a through undercut or passageway 312 opening rearwards toward the space between the plates 174 and 199, and opening forwards toward the wrapping machine 291. Extending rearwards from the block 310, on opposite sides of the passageway 312 are a pair of facing, laterally spaced shoes or ears 313 and 314. The rearward edges of the ears 313 and 314 are arcuately contoured for conforming engagement with the edges of plates 199 and 174, respectively, while the inner or facing surfaces of the ears are substantially flush with the inner or facing surfaces of the respective plates when the ears are swung to their rearmost position adjacent to the plates. A pair of generally parallel, laterally spaced receiving bars or ways 315 and 316 are fixed to the block and extend inwards from the lower regions of the ears 313 and 314, respectively, into the passageway 312. Further, the ways project rearwards from the block 310 for insertion into the space between the plates 174 and 199 when the carrier 293 is swung rearwards. Extending forwards from the block 310, on opposite sides of the passageway 312, and having their inner surfaces substantially flush with the passageway walls and the facing surfaces of the shoes 313 and 314, are a pair of facing spaced fingers or ears 317 and 318. The fingers 317 and 318 are adapted to enter the wrapping machine 291 for delivering a compressed article thereto, as will be described in greater detail hereinafter.

A pair of upwardly and forwardly extending brackets 321, see Figure 1, are fixed to the frame top 28 on opposite sides of the carrier 293, and provided with adjustable stop screws 322 and 323 engageable with the ears 297 and 298 to limit forward and rearward swinging movement of the carrier 293 about the axis of the shaft 296. Also mounted on the pivot shaft 296, for rotation thereabout, is a generally vertically disposed lever arm 324. More specifically, the lever arm 324 is provided intermediate its ends with a hub 325 circumposed about the shaft 296 intermediate the carrier legs 294 and 295. The upper end of the lever arm 324 is disposed in alignment with the space between the receiving bars 315 and 316 for movement therebetween, while an enlarged head or pusher 326 is fixed on the upper end portion of the lever bar and movable therewith through the block passageway 312. Intermediate the hub 325 and the upper end portion of the lever arm 324, a laterally extending cross piece 327 is fixed to the lever arm and has its opposite end portions engageable with the headed ends of the resiliently biased abutment members 303 and 304 upon forward swinging movement of the pusher 326 toward the passageway 312. An additional upstanding bracket 330 is fixed on the frame top 28, just rearwards of the lever arm 324, and provided with adjustable stop screws 331 engageable with the cross piece 327 to limit rearward swinging movement of the latter to a position with the pusher 326 disposed in the space between the plates 174 and 199. Connected between the bracket 330 and the lever arm 324, above the pivot 296, is a tension spring 332 which resiliently urges the carrier 293 to its extreme rearward position. In this extreme rearward carrier position, the bars 315 and 316 extend into the path of and receive thereon a compressed article as at 290 in Figure 1.

In Figures 1 and 2 it will be seen that a laterally extending, generally horizontal shaft 334 is journaled below the frame top 28 in hanger bearings 335, and is provided on one end with a bevel gear 336 in meshing engagement with the bevel gear 38 on the shaft 35 so as to drive the shaft 334. On the other end of the shaft 334 is fixed a crank or crank wheel 337 for rotation with the shaft; and, a connecting rod or link 338 is pivotally connected between the lower end of the lever arm 324 and an eccentric point on the crank wheel 337 to effect rotary oscillation of the lever arm upon rotation of the shaft 334. In particular, a block 339 is slidably mounted on the link 338 between a pair of stop collars 340 and 341, see Figure 8, and resiliently biased toward the former collar by a coil compression spring 342. The block 339, being pivoted to the crank 337 permits sufficient dwell or layover time of the block 310 in its rearwardly swing position for a compressed article to be deposited on the ways 315 and 316, as will appear presently.

Where it may be advantageous to drive the wrapping machine from the motor 30, a generally horizontally disposed shaft 345 is rotatably supported in a pedestal bearing 346 on the lower frame level 27, and is in driving connection with the wrapping machine. A sprocket wheel 347 is keyed, or otherwise fixed to the shaft 345, and a sprocket wheel 348 is keyed, or otherwise fixed to the shaft 35, so that a sprocket chain 349 trained over the

sprocket wheels 347 and 348 rotates the shaft 345 to drive the wrapping machine.

*Cylinder construction*

The cylinders or tubular chambers 115 are all identical in construction, and their structural details are best seen in Figure 5. Each includes a cylindrical outer shell or sleeve 352 having its opposite ends open and provided with external annular collars 353 and 354 adjacent to and spaced inwards from opposite shell ends. The collars 353 and 354 are pivotally connected at diametrically opposed points to links of the chains 185 and 186, so that the shells are interposed in the chains and extend therebetween. A generally cylindrical, open ended inner bushing or liner 355 is inserted longitudinally into the sleeve 352, and is provided with an external end shoulder 356 engageable with an end of the sleeve to limit insertion of the liner. Inclined surfaces 357 and 358 are formed exteriorly on the liner 355; and, retaining screws 359 and 360 extend in threaded engagement radially inwards through the collars 353 and 354 into engagement with the surfaces 357 and 358, respectively, to positively retain the liner shoulder 356 in end engagement with the sleeve 352. By this construction, the liner 355 may be quickly and easily removed and replaced upon slight withdrawal of the screws 359 and 360.

*Operation of apparatus*

In Figure 10 the apparatus is shown schematically, to illustrate various steps in the method of the present invention, rather than in its true structural relationship. An early stage is represented at station I in the pneumatic reducing mechanism 21, wherein an article 100 to be compressed is conveyed by the tray 52 into adjacent relation with respect to the larger end of the funnel 93. While the operations will be described as being performed at several stations, it is, of course, understood that the cylinders 115 and other elements are constantly moving so as to progress continuously through and between the several stations. At station I the funnel 93 is arranged in end to end aligned abutment with one end of the cylinder 115. The pusher arm 66 moves toward the tray 52 and engages with the article 100, as shown in dashed outline, to shift the latter slightly into and in closing relation with respect to the adjacent end of the funnel 93. Thus, the funnel 93 and the article 100 inserted partially therein, combine to close the adjacent end of the cylinder 115. The vacuum tube 105 is simultaneously shifted in its slideway or channel 104 into closing relation with the other end of the cylinder 115, with its reduced inlet nozzle 108 inserted in the cylinder. Upon the application of vacuum through the tube 105 into the cylinder 115, the article 100 is pneumatically conveyed through the funnel 93 and into the cylinder 115, from its dashed line position to its solid line position, by the pressure differential existing between the interior and exterior of the cylnder. As the article 100 passes to its solid line position within the cylinder at station I, its transverse cross section is gradually reduced in conformance with the transverse cross section of the funnel 93; and, it finally assumes the transverse dimension, throughout its entire length, of the cylinder interior when disposed entirely within the latter. That is, the cylinder or chamber 115 serves as a constriction to transversely compress and reduce the article 100 to a predetermined cross section, namely that of the interior of the cylinder. Slight endwise elongation of the article may be effected by this transverse reduction. When the article 100 engages with the vacuum nozzle 108, movement of the article will be stopped, and the application of the vacuum may be discontinued.

While the article being operated upon is illustrated herein as having the configuration of a sanitary napkin, it is, of course, appreciated that articles of widely varying configurations may also be compressed in accordance with the method and by the apparatus of the instant invention. Hence, the terminology of transverse and longitudinal article compression are employed only for simplicity and clarity without limitation as to the configuration of the article. Stated otherwise, the term transverse compression as employed herein denotes the pneumatic operation at station I, while the term longitudinal compression, as employed hereinafter, denotes mechanical compression at subsequent stations.

Upon continued movement of a cylinder 115, with the transversely compressed article therein, the cylinder moves away from the funnel 93 and vacum tube 105, and into endwise alignment with a ramrod 237 and a backing shank 208, disposed exteriorly and at opposite ends, respectively, of the cylinder, as at station II. The ramrod 237 and backing shank 208 move with the cylinder 115 through station II, and are actuated, respectively, by the cams 243 and 213 to shift the rod head 240 into the adjacent end of the cylinder, and shift the shank head 209 into abutting, closing relation wtih respect to its adjacent cylinder end. Thus, upon movement through station II, the rod or plunger head 240 effects longitudinal compression of the article 100 against the backing member head 209. Further, final longitudinal compression of the article 100 is effected by inward movement of the cam section 249, to shift the ramrod 237 further into the cylinder 115, while the backing shank head 209 remains in covering relation with respect to its adjacent cylinder end.

At station III the article 100 is fully compressed, and the rod 237 and shank 208 are simultaneously shifted in the same direction to remove or eject the fully compressed article from the cylinder while holding the article in compression.

This condition is illustrated at station IV. In particular, the article 100 at station IV is mechanically held in longitudinal or endwise compression between the rod head 240 and shank head 209; and, the article thus held retains itself in transverse compression. That is, a characteristic of sanitary napkins and like articles is the self-retention of transverse compression subsequent to transverse and longitudinal compression. At station IV the fully compressed article 100, disposed exteriorly of the cylinder 115, is removed from the compression apparatus by the pusher 326 of the transfer mechanism 23, which pushes the article into position between the ears 313 and 314 for transfer to the wrapping machine.

Further movement of the cylinder 115 to station V effects withdrawal of the rod 237 and shank 208 from the cylinder, under the control of cams 243 and 213, respectively, for return of the cylinder to the pneumatic compressing mechanism of station I.

As best seen in Figures 1 and 3, the continuously moving trays 52, driven from the shaft 45, position successive articles 100 in adjacent relation with respect to successive, continuously moving funnels 93. Rotation of the pusher actuating cam 61, see Figure 5, is timed to shift each successive article into closing relation with respect to its adjacent funnel, and hence into closing relation with respect to the associated cylinder 115. That is, the cylinders 115 during their rotation about the shaft 45 are received in the disc pockets 79 and 80 in end to end alignment with respective funnels.

As the cylinders 115 move into station I, see Figures 3 and 5, the vacuum tubes 105 are shifted inwards by the fixed cam 117 engaging with the followers 107, so that the nozzles 108 extend into their respective cylinders and the seal rings 112 tightly close the adjacent cylinder ends. Further, as the cylinders 115 are carried by the relatively loose chains 185 and 186, and allowed appreciable longitudinal shifting in the disc pockets 79 and 80 by the collars 353 and 354, bearing engagement of the seal rings 112 on the adjacent cyinder ends will shift the cylinders into tight sealing engagement with the respective O-rings 101 of the adjacent funnels 93.

When the seal ring 112 is in bearing engagement with its respective cylinder end and an article 100 has been partially inserted into the associated funnel 93, the valve 134 corresponding to the particular vacuum tube 105 is actuated by its associated switch 138 to apply vacuum to the interior of the cylinder. As seen in Figure 4, when the vacuum tube 105*a* rotates so as to be shifted by the cam 117 into closing relation with its respective cylinder, the corresponding switch 138*a* rotates into engagement with the cam 149 to electrically energize the valve operation mechanism 135 and open the valve 134. This permits the substantially instantaneous application of vacuum from the shaft passageway 128, through the valve 134 and tube 133 into the vacuum tube 105. As the switch 138*a* rotates beyond the fixed cam 149 and disengages therewith, the valve operating mechanism 135 is de-energized, closing the valve 134. The springs 113, of course, maintain the vacuum tube cam follower 107 in engagement with the cam edge 119 (see Figure 5), and after closure of the valve 134 the springs serve to move the vacuum tube 105 away from the cylinder 115. Of course, each vacuum tube 105, and its corresponding switch 138 and valve 134 are successively actuated in the same manner by the cams 117 and 149.

The cylinders 115 then proceed beneath the sprocket wheel 189 to the mechanical compression mechanism 22 and are received in the disc pockets 179 and 180 for movement through the stations II, III and IV. At station II, see Figure 3, the shank 208 is moved by the cam edges of the main cam section 214 to place backing head 209 in firm abutment with and closing the adjacent end of the respective cylinder 115, and the corresponding rod 237 is moved by the cam edge 254 of the cam section 245 to shift the rod head 240 into the respective cylinder and compress the contained article longitudinally against the backing head 209. Further, as the cam follower 233 associated with each ramrod 237 engages with the edge 266 of the movable cam section 249, the latter is shifted inwards, as described hereinbefore, to effect final longitudinal compression of the article within the cylinder. In station III, each backing shank 208 is withdrawn away from the respective cylinder 115 by engagement of the associated cam follower 210 in the cam section 220; and, the aligned rod 237 is simultaneously inserted further into the cylinder by the engagement of its follower 233 with cam edge 261 of cam section 248. The cam sections 220 and 248 are so constructed as to maintain the facing surfaces of the backing head 209 and ram head 240 at a substantially constant distance through station III until the entire article 100 is disposed exteriorly of the cylinder.

In this condition, the article arrives at station IV, and the facing surfaces of the backing head 209 and ram head 240 are maintained, for at least a short period, flush with the facing surfaces of the discs 199 and 174, respectively. That is, the backing head 209 is received in the adjacent recess 205 of plate 199 and the ram head 240 is substantially flush with the plate 174 and end surface of its respective cylinder, in which condition the article is delivered to the transfer means 23.

Just after the transfer means 23 removes the fully compressed article from between the plates 174 and 199, the backing shank follower 210 engages with the cam section 221 to retain the backing head 209 away from the cylinder 115, and the ram rod follower 233 engages between the cam edge 259 and 263 to withdraw the ram head 240 from the cylinder, all in preparation for repetition of the above described procedure.

As each successive fully compressed article passes from station IV to station V, it is delivered to or deposited on the ways 315 and 316 of the carrier 293 as illustrated in Figure 7. In properly timed relation the crank wheel 237 rotates to swing the lever arm 324 clockwise, as seen in Figures 7 and 8, so that the pusher 326 pushes the received article 100 from between the plates 174 and 199 through the passageway 312 and into the space between the fingers 317 and 318. Movement of the carrier 293 is thus far resisted by the tension springs 332. However, in the position of Figure 8, the cross piece 327 of the lever arm 324 is just about to engage the relatively strongly biased abutment pins 303 and 304. As the abutment pin springs 305 and 306 are relatively strong, engagement thereby of the cross piece 327 will effect swinging, clockwise rotation of the lever arm 324 to its position of Figure 9, against the force of the springs 332. However, when the ears 297 and 298 of the carrier 93 engage with the stop members 322, the abutment pins 303 and 304 will shift yieldably forwards to permit ejection of the article by the pusher 326 from between the fingers 317 and 318 for transfer to the wrapping machine.

Upon continued rotation of the crank wheel 337, the lever arm 324 and carrier 293 return counterclockwise to their limiting positions in engagement with the stop members 331 and 323, respectively, and dwell a sufficient period to receive the next compressed article.

The apparatus of the present invention is admirably well suited for compression of articles having widely varying shapes and sizes, both before and after compression. For example, if it is desired to produce a compressed article having other than a cylindrical configuration, the cylinder liners 355 may be readily replaced, as described hereinbefore, with liners having the desired internal cross sectional configuration. Under these conditions, it may or may not be necessary to replace the funnels 93, which can also easily be accomplished. The ram heads 240 may also be replaced with heads suitable for sliding insertion into and withdrawal from the cylinder liners. For changing the length of the compressed product or article, it is only necessary to shift the plate 199 on the shaft 156, replace the detachable cam sections 247, 248, 220 and 221, and adjust the block 281 on the rod 280. In order to accommodate a compressed article of different length the transfer mechanism head 210 may be replaced by a similar head having its ears 313 and 314, and fingers 317 and 318 properly spaced apart for receiving the article. Also, the abutment bolts or pins 303 and 304 may be adjusted for different size finished or fully compressed articles to insure proper ejection or delivery of the article from the fingers 317 and 318 to the wrapping machine.

From the foregoing, it is seen that the present invention provides a method of compressing compressible articles, and apparatus for use therein, which fully accomplish their intended objects and are well adapted to meet practical conditions of use.

Although the present invention has been described in some detail by way of illustration and example for purposes of clarity of understanding, it is understood that certain changes and modifications may be made within the spirit of the invention and scope of the appended claims.

For example, while the compression of stations III and IV has been termed mechanical, this is intended to denote the use of ramrods and backing members, without limitation as to the actuating components, so that hydraulic or other suitable means may be substituted for the cams 243 and 213 to effect the mechanical compression.

What is claimed is:

1. Apparatus for compressing a compressible article, said apparatus comprising a hollow chamber having an internal dimension smaller than said article and formed with an opening communicating between the interior and exterior of said chamber, means mounting said chamber for continuous movement about a closed path, an open ended funnel member having its opposite ends respectively larger and smaller than said article and mounted for movement relative to said hollow chamber into and out of position with its smaller end opening in fluid communication into said chamber opening during movement of said chamber through one segment of said path, means for feeding an article into the larger end of said funnel

to close the latter during movement of said chamber through one segment of said path, said funnel and its received article thus cooperating to close said chamber opening, and means for evacuating said chamber during its movement through said path segment to pneumatically convey said article from said closing relation through said funnel into the interior of said chamber, whereby said article is reduced to the internal dimension of said chamber.

2. Apparatus according to claim 1, in combination with a ram mounted for movement into and out of said chamber during movement of the latter through another segment of said path to further compress said article.

3. Apparatus for compressing a compressible article, said apparatus comprising an open-ended tubular member having an internal dimension smaller than said article and mounted for lateral movement about a closed path, an open-ended funnel member having its opposite ends respectively larger and smaller than said article and mounted for movement with said tubular member through a portion of said closed path in position with its smaller end opening in fluid communication into one end of said tubular member, means for feeding an article into the larger end of said funnel member to close the latter during its movement with said tubular member, said funnel member and its received article thus cooperating to close said one end of said tubular member, and vacuum-producing means communicable through the other end of said tubular member with the interior thereof to pneumatically convey said article from said closing relation through said funnel into the interior of said tubular member, whereby said article is reduced to the internal dimension of said tubular member.

4. Apparatus according to claim 3, in combination with a backing member mounted for movement into and out of covering relation with respect to said other tubular member end, and a ram movable into and out of said one tubular member end to further compress said article between said ram and backing member and shift the compressed article out of said tubular member.

5. Apparatus for compressing compressible articles, said apparatus comprising a plurality of open ended tubular members arranged in side by side relation and mounted for simultaneous lateral movement about a closed path, said tubular members each having an internal dimension appreciably smaller than one of said articles, a plurality of funnel members each having its opposite ends respectively larger and smaller than one of said articles and mounted for movement with said tubular members with each funnel member having its smaller end opening in fluid communication into one end of a respective tubular member, means for feeding said articles into the larger ends of said funnel members to close the latter and said one end of the respective tubular member during movement of the latter through one segment of said path, and vacuum producing means communicating with the interior of each tubular member through the other end thereof during movement of the respective tubular member through said one path segment to pneumatically convey an article from said closing relation to the interior of the adjacent tubular member, whereby each of said articles is reduced to the internal dimension of its adjacent tubular member.

6. Apparatus according to claim 5, in combination with a backing member mounted for movement into and out of covering relation with respect to an end of each tubular member during movement of the respective tubular member through another segment of said path, means controlling the movement of said backing member in timed relation with movement of the respective tubular member through said other path segment, a ram mounted for movement into and out of the end of each tubular member remote from said backing member during movement of the respective tubular member through said other path segment, and means controlling the movement of said ram in timed relation with said backing member to further compress the article in the respective tubular member between said ram and backing member and shift the compressed article exteriorly of said tubular member.

7. Apparatus for compressing a compressible article, said apparatus comprising a plurality of open ended tubular members arranged in side by side relation and mounted for simultaneous lateral movement about a closed path, said tubular members each having an internal dimension smaller than one of said articles, means for feeding an article into closing relation with respect to one end of each tubular member during movement of the respective tubular member through one segment of said path, vacuum producing means communicating with the interior of each tubular member through the other end thereof during movement of said tubular members through said one path segment to pneumatically convey an article from said closing relation into the interior of the respective tubular member, a backing member mounted for movement into and out of covering relation with respect to an end of each tubular member during movement of the respective tubular member through another segment of said path, means controlling the movement of said backing members in timed relation with movement of the respective tubular members through said other path segment, a ram mounted for movement into and out of the end of each tubular member remote from said backing member during movement of the repsective tubular member through said other path segment, means controlling the movement of said ram in timed relation with said backing member to further compress the article in the respective tubular member between said ram and backing member and shift the compressed article exteriorly of the repsective tubular member while held between the facing surfaces of said ram and backing member, a pair of facing spaced plates mounted adjacent to said backing member for movement with said tubular members through said other path segment and arranged with their facing surfaces substantially flush with the facing surfaces of said ram and backing member when said compressed article is held by said ram and backing member exteriorly of said tubular member, and a transfer mechanism extending between said plates for receiving said compressed article and transferring the same to a wrapping machine.

8. Apparatus according to claim 7, said transfer mechanism comprising a carrier element mounted for rotary movement between a receiving position adjacent to said plates and a delivery position adjacent to said wrapping machine and resiliently biased toward said receiving position, said carrier element extending between said plates when in said receiving position for receiving said compressed article, a pusher element mounted for rotary movement between an idling position between said plates and an ejecting position adjacent to said wrapping machine and engageable with said carrier element upon movement toward said wrapping machine to move said carrier element to its delivery position and push said compressed article into said wrapping machine.

9. Apparatus for compressing a compressible article, said apparatus comprising a plurality of open-ended tubes each having an internal dimension smaller than said article, means mounting said tubes in side-by-side spaced relation for continuous lateral movement about a closed path, means for feeding an article into closing relation with respect to one end of each tube as it enters a loading segment of said path, a plurality of closure members mounted for movement into and out of closing relation with respect to the other ends of said tubes during tube movement through said loading path segment, continuously operating vacuum-producing means communicable through each of said closure members with the interior of the respective tube during tube movement through said loading path segment, quick-acting valve means interposed in fluid communication between each of said

closure members and said vacuum-producing means to transmit a surge of vacuum to the interior of each tube during tube movement through said loading path segment, to thereby pneumatically squeeze an article into each of said tubes, a plurality of backing members mounted for movement into and out of covering relation with respect to the other ends of said tubes during tube movement through a pressing segment of said path spaced from said loading path segment, a plurality of rams each mounted for movement into and out of said one end of a respective one of said tubes during tube movement through said pressing path segment, and control means for operating each of said rams in timed relation with respect to one of said backing members to compress articles between said backing members and their rams during tube movement through said pressing path segment and shift the compressed articles out of the respective tubes as the latter leave said pressing path segment.

10. In the method of compressing an article, the steps which comprise: pneumatically conveying an uncompressed article in one direction into a constriction having an internal size in a plane normal to said one direction substantially less than the size of said article in a plane normal to said one direction when said article is uncompressed to reduce the article to a predetermined cross section in a plane normal to said one direction, and pressing said reduced article in said one direction while in said constriction to reduce the dimension of said article in said one direction without increasing its cross section in a plane normal to said one direction.

11. The method according to claim 10, further characterized by pneumatically conveying said article through a funnel just prior to conveying said article into said constriction to gradually reduce the cross section of said article in a plane normal to said one direction.

12. The method according to claim 10, wherein said constriction is evacuated to pneumatically convey said article into said constriction.

13. In the method of compressing an article, the steps which comprise; positioning said article exteriorly of and in closing relation with respect to an open end of an elongate tube of appreciably less internal dimension than said article, and evacuating said tube through the other end thereof to pneumatically convey said article into said tube and reduce the transverse cross section of said article to the internal dimension of said tube.

14. The method according to claim 13, further characterized by pressing said transversely reduced article endwise in said tube to reduce the longitudinal dimension of said article without increasing the transverse dimension.

15. The method of compressing an article having the characteristic of retaining itself transversely compressed subsequent to transverse and longitudinal compression, said method comprising pneumatically conveying said article into a constriction to reduce the article to a transverse cross section equal to the internal dimension of said construction, pressing said transversely reduced article endwise while in said constriction to reduce the longitudinal dimension of said article without increasing its transverse dimension, and removing said transversely and longitudinally reduced article from said constriction while holding said article in longitudinal compression, whereby said article is removed from said constriction in substantially fully compressed condition both transversely and longitudinally.

16. The method according to claim 15, further characterized by pneumatically conveying said article through a funnel just prior to conveying said article into said constriction to gradually reduce the transverse cross section of said article.

17. The method according to claim 15, wherein said constriction is evacuated to pneumatically convey said article into said constriction.

18. Apparatus for compressing a compressible article, said apparatus comprising a plurality of open ended tubes each having an internal dimension smaller than said article, means mounting said tubes in side-by-side relation for continuous lateral movement about a closed path, means for feeding an article into closing relation with respect to one end of each tube as it enters a loading segment of said path, a plurality of closure members mounted for movement into closing relation with respect to the other ends of said tubes during tube movement through said loading path segment, continuously operating vacuum producing means communicable through each of said closure members with the interior of the respective tube during tube movement through said loading path segment, quick acting valve means interposed in fluid communication between each of said closure members and said vacuum producing means to transmit a surge of vacuum to the interior of each tube during tube movement through said loading path segment, and a plurality of funnels mounted for movement with said tubes in aligned relation with said one tube ends during tube movement through said loading path segment, said funnels being arranged to successively receive a portion of successive articles fed from said feeding means and combining with said articles to close said one tube ends, whereby an article is pneumatically squeezed through one of said funnels and into an aligned one of said tubes.

19. Apparatus for compressing a compressible article, said apparatus comprising an open-ended tubular member having an internal dimension smaller than one of said articles, means for feeding an article into closing relation with respect to an end of said tubular member, vacuum-producing means communicating with the interior of said tubular member through the end thereof remote from the end closed by an article, to pneumatically convey the article from said closing relation into the interior of said tubular member, a backing member mounted for movement into and out of covering relation with respect to an end of said tubular member, a ram mounted for movement into and out of the end of said tubular member remote from said backing member, and means controlling the movement of said ram in timed relation with said backing member to further compress the article in said tubular member between said ram and backing member and shift the compressed article exteriorly of said tubular member while held between the facing surfaces of said ram and backing member.

20. Apparatus according to claim 19, in combination with a pair of facing spaced plates arranged with their facing surfaces substantially flush with the facing surfaces of said ram and backing member when said compressed article is held by said ram and backing member exteriorly of said tubular member, and a transfer mechanism extending between said plates for receiving said compressed article and transferring the same through the space between said plates to a wrapping machine.

**References Cited** in the file of this patent

UNITED STATES PATENTS

| | | |
|---|---|---|
| 2,076,389 | Voss | Apr. 6, 1937 |
| 2,458,685 | Crockford | Jan. 11, 1949 |
| 2,690,597 | Greiner et al. | Oct. 5, 1954 |