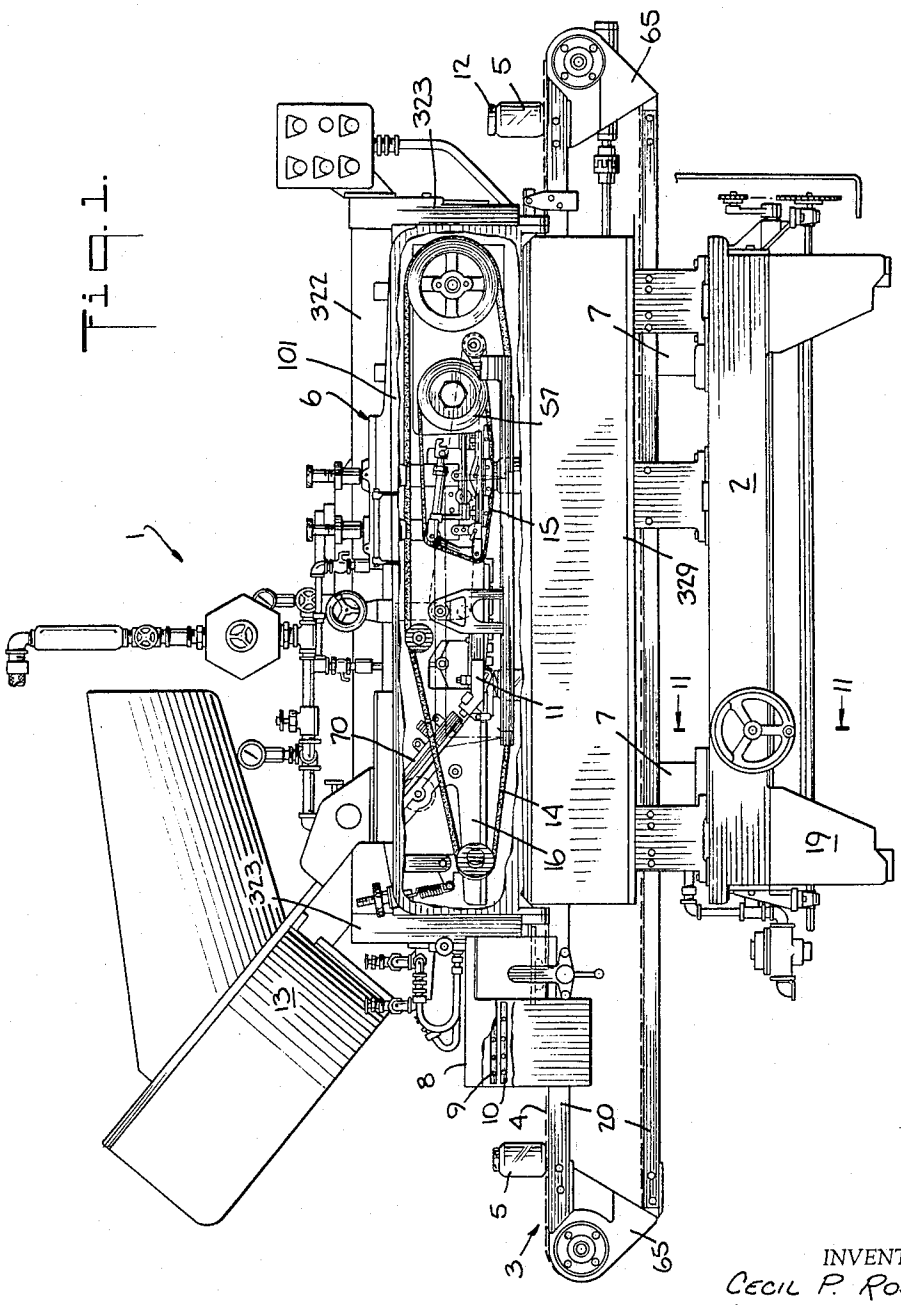
Sept. 27, 1966 C. P. ROBERTS ET AL 3,274,748

SEALING MACHINE AND METHOD

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Fig. 1.




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SEALING MACHINE AND METHOD

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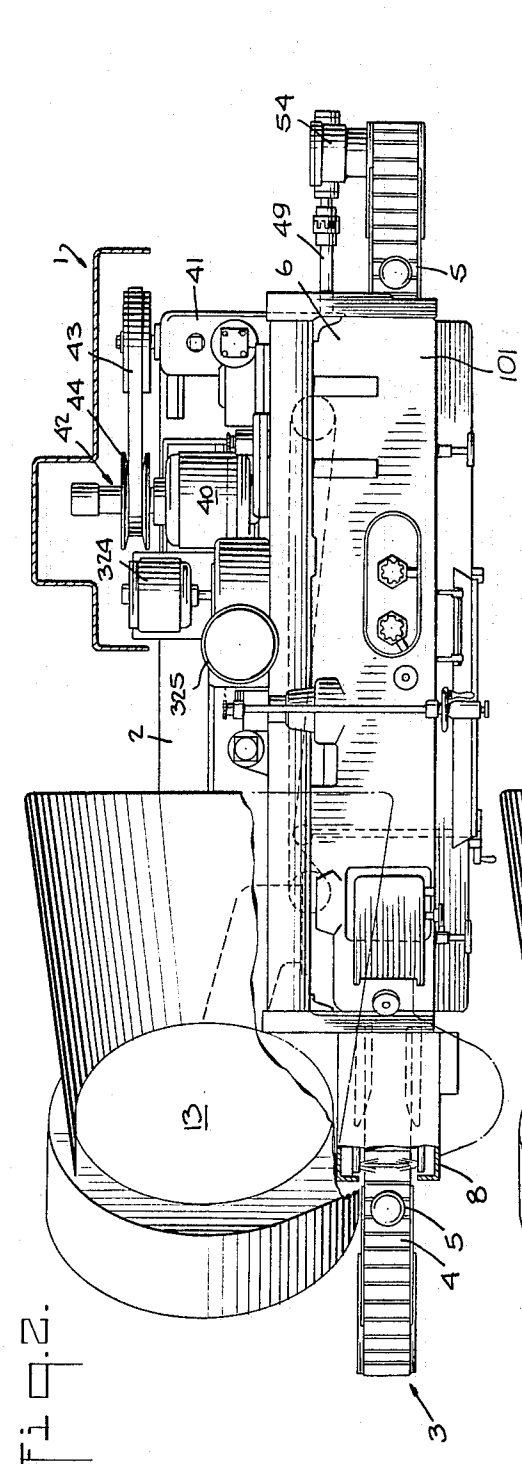



Fig. 1.

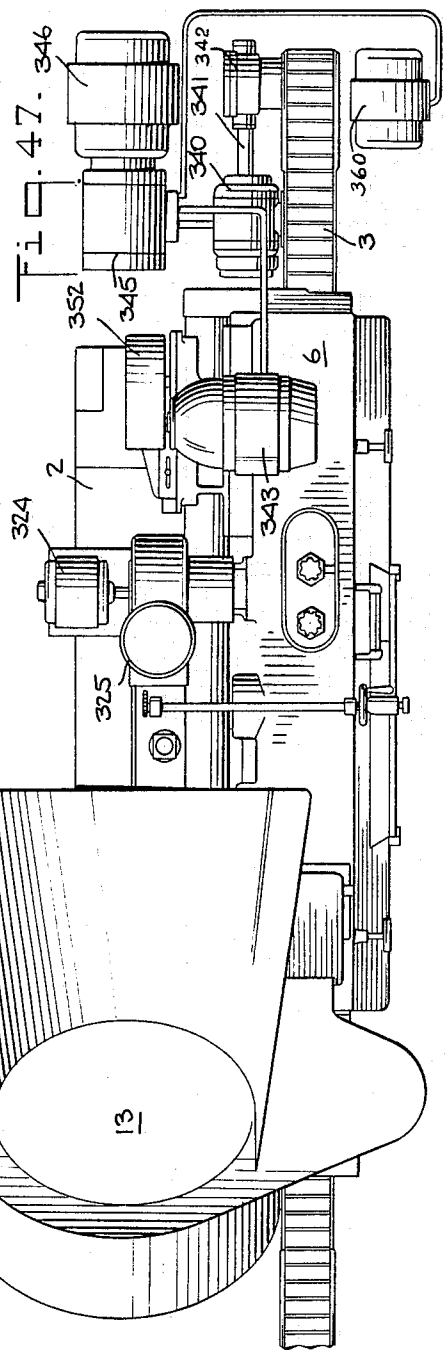



Fig. 47.

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SEALING MACHINE AND METHOD

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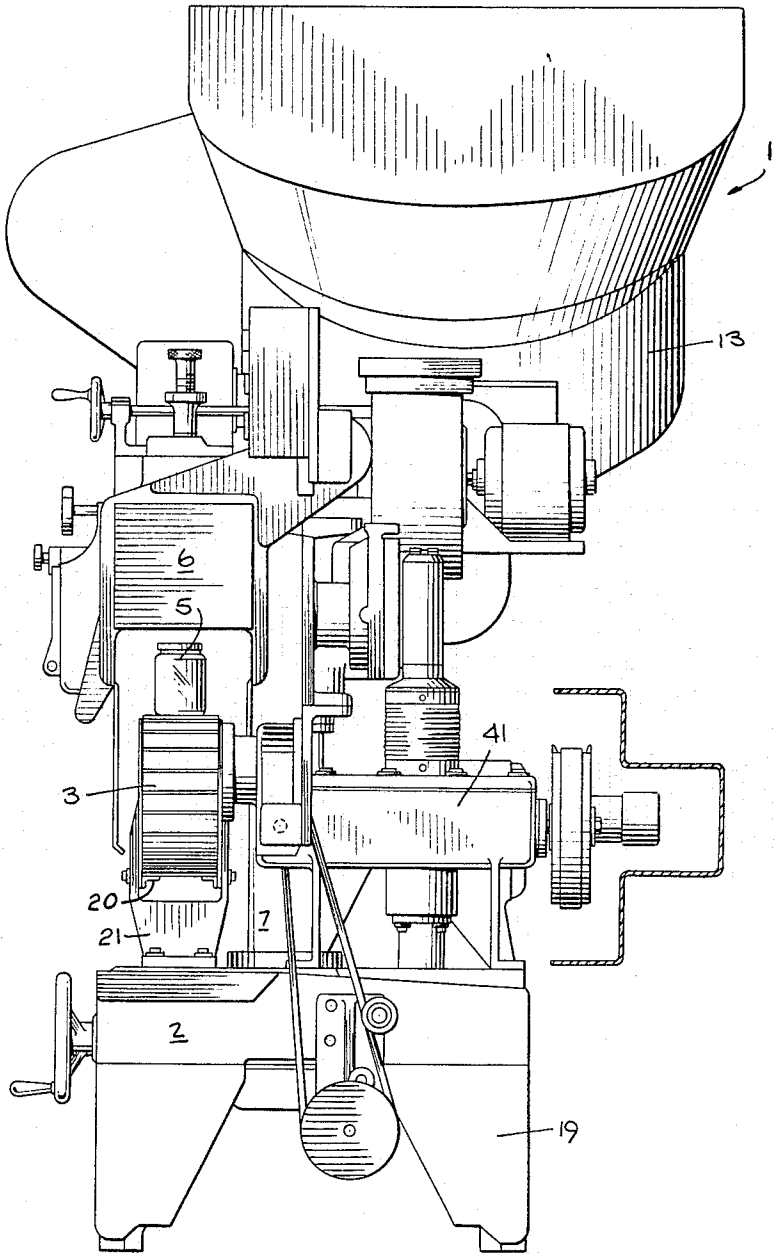



Fig. 3.

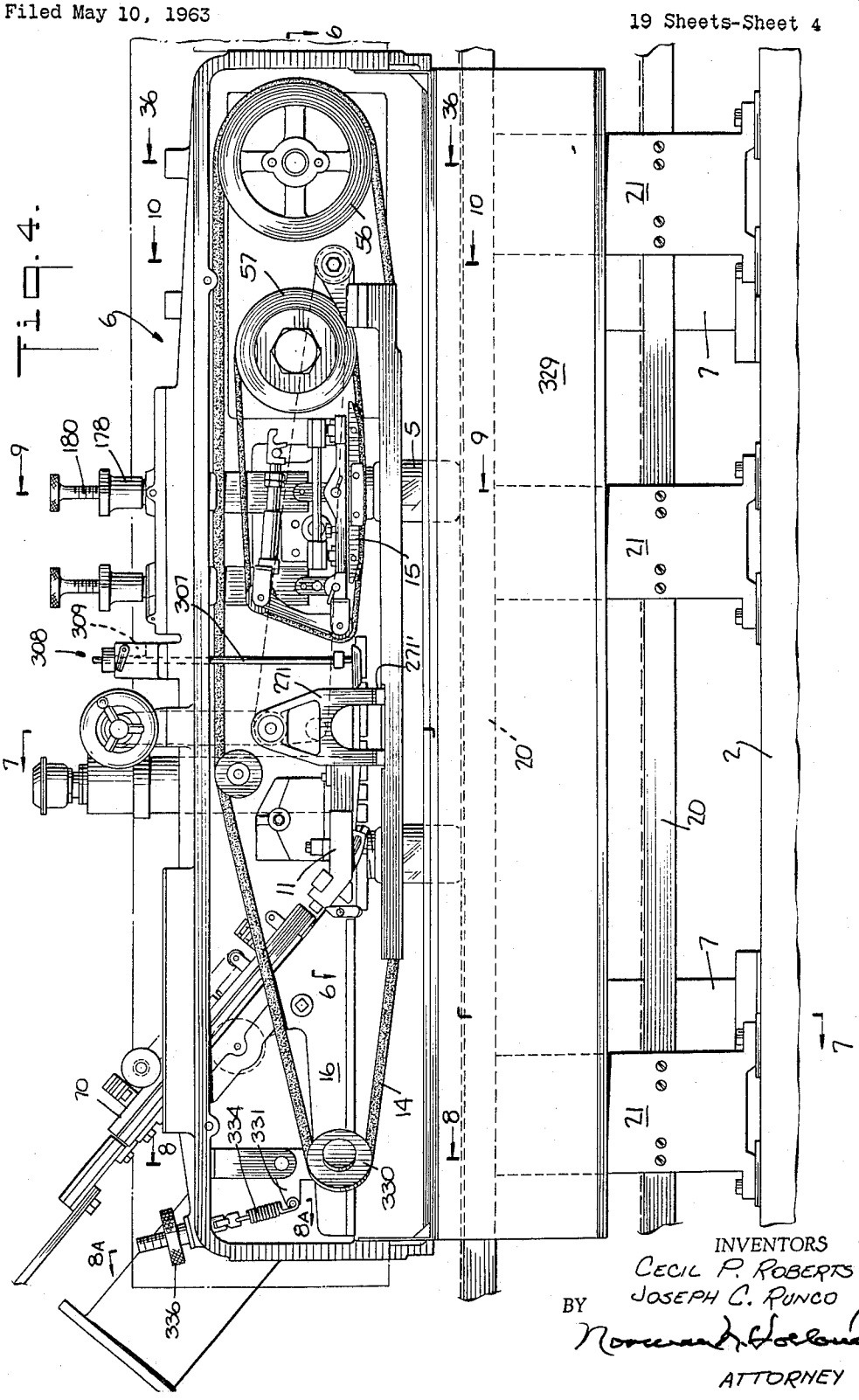
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SEALING MACHINE AND METHOD

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Fig. 4.




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SEALING MACHINE AND METHOD

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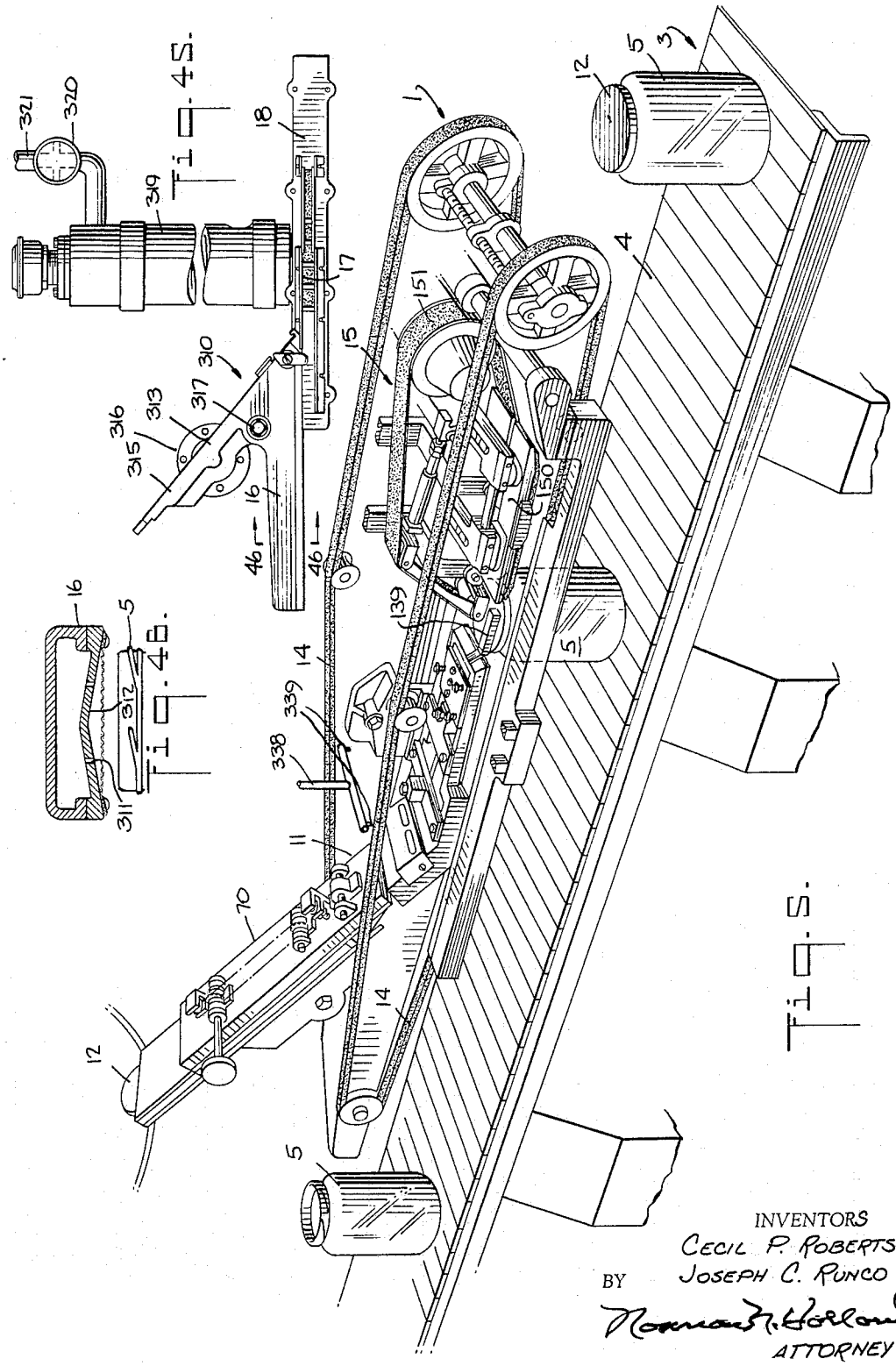



Fig. 4A.

Fig. 4B.

Fig. 5.

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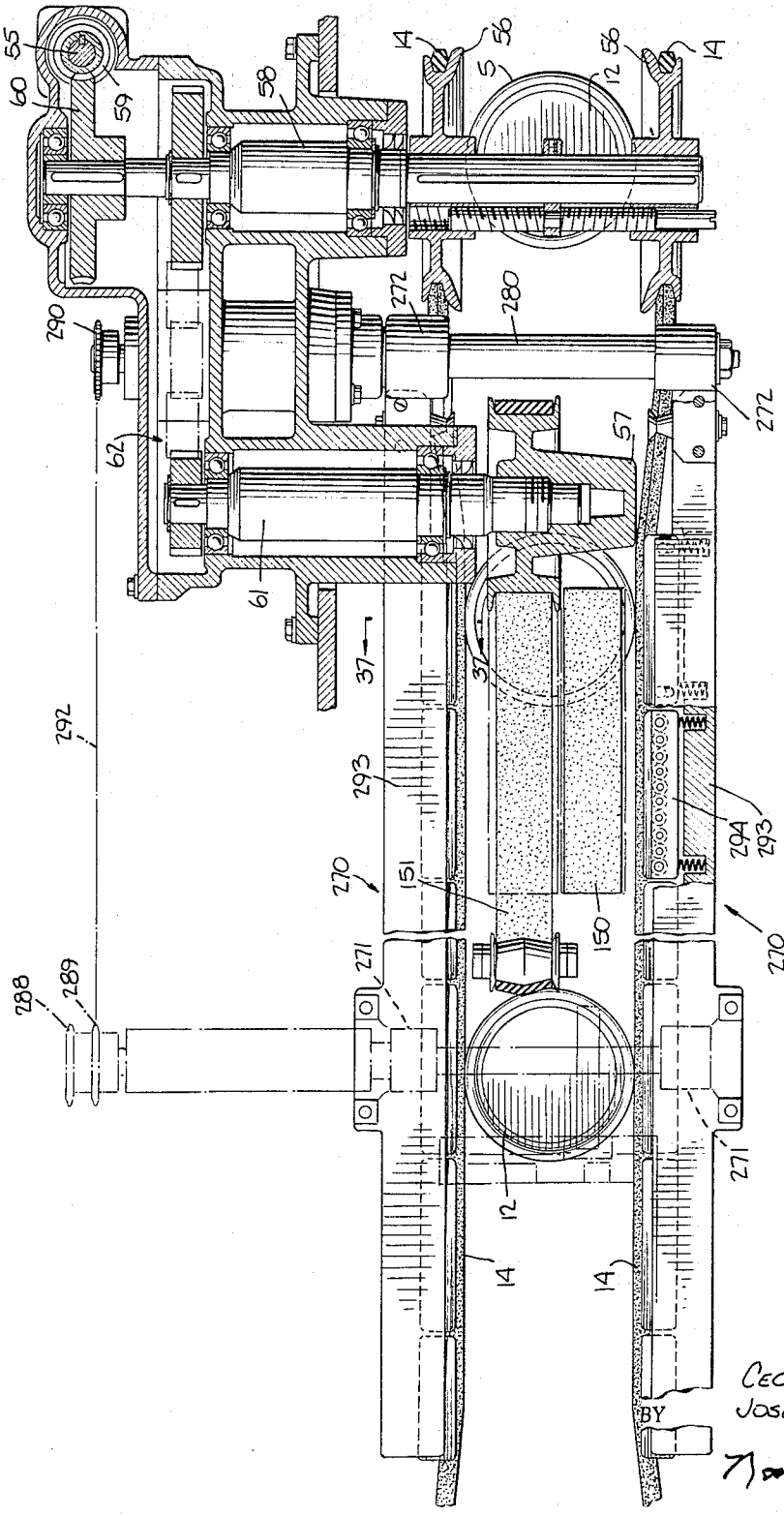



Fig. 6.

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SEALING MACHINE AND METHOD

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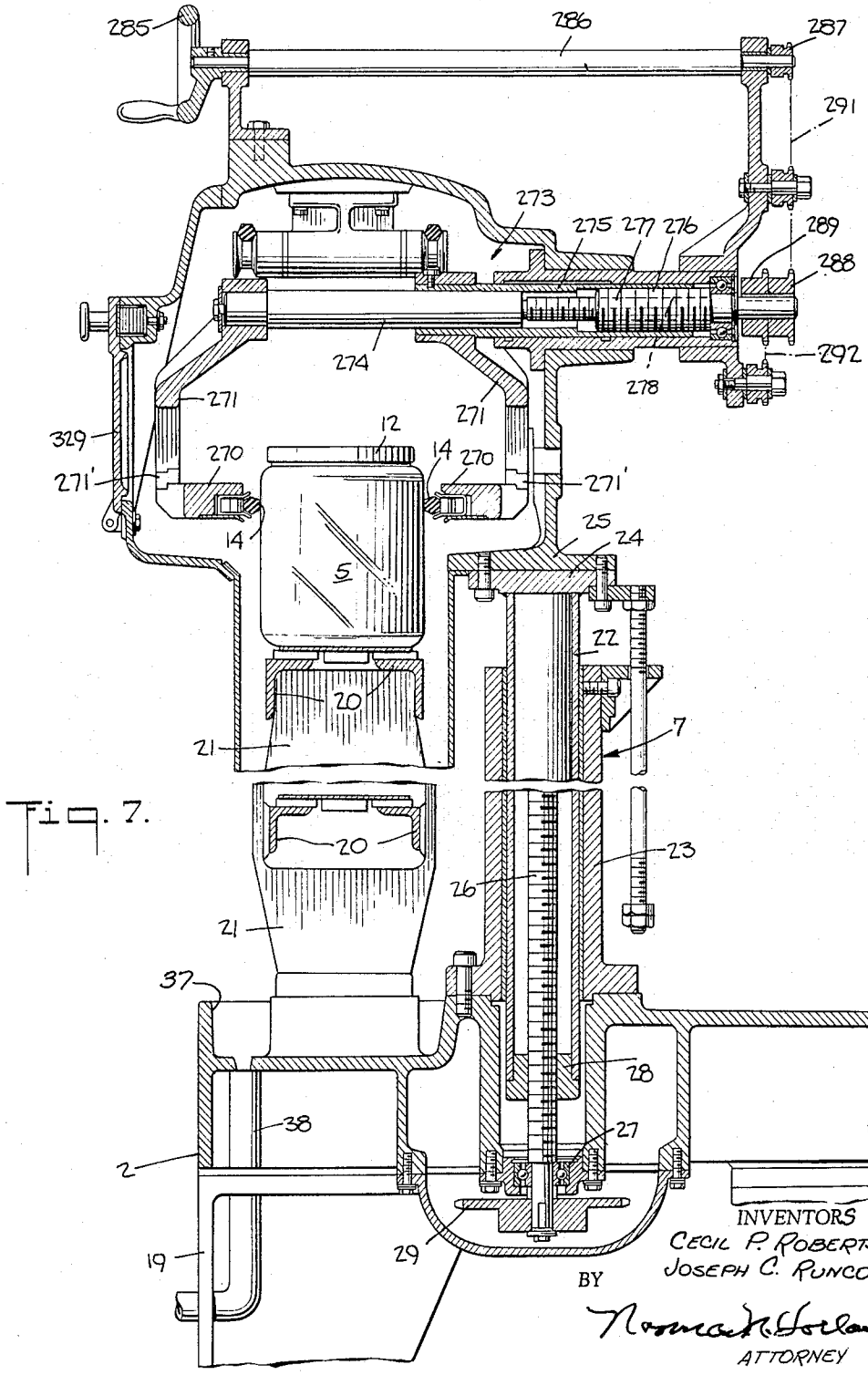



Fig. 7.

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Fig. 10.

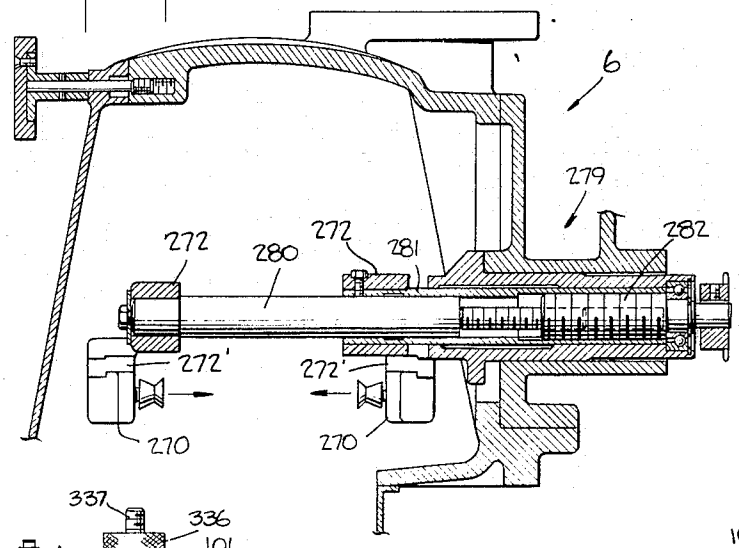
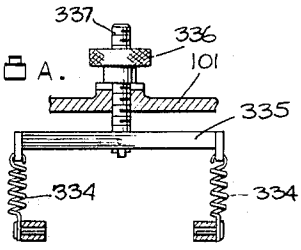



Fig. 8A.



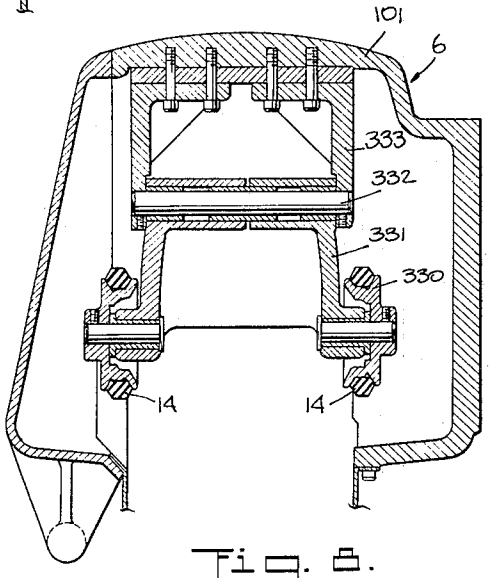




Fig. 8.

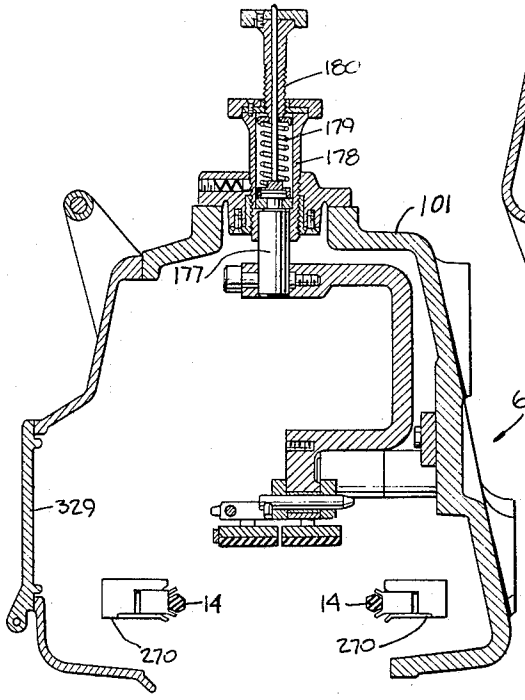



Fig. 9.

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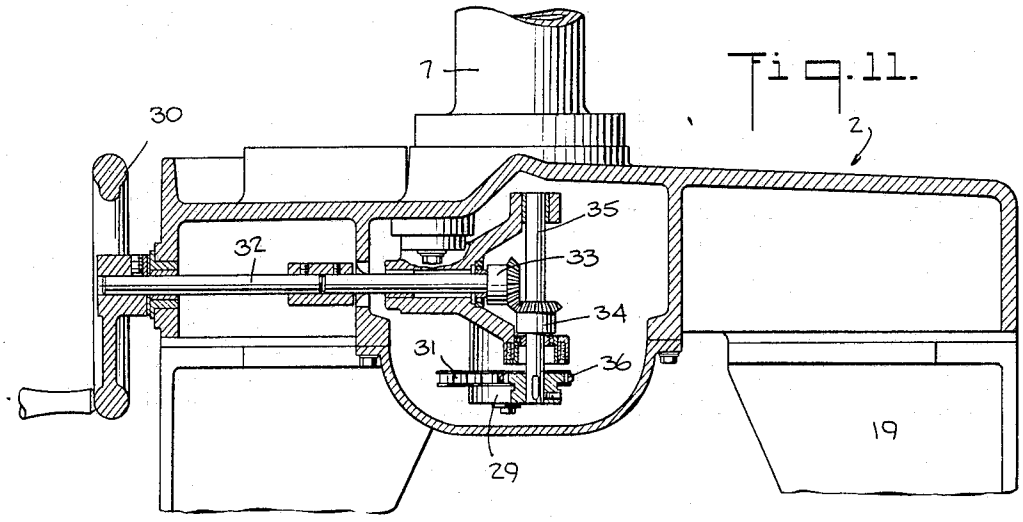
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Fig. 11.



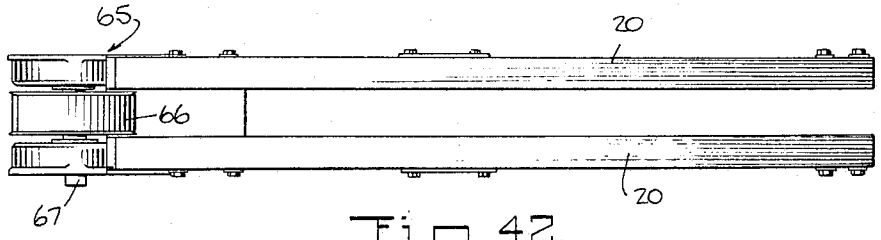




Fig. 42.

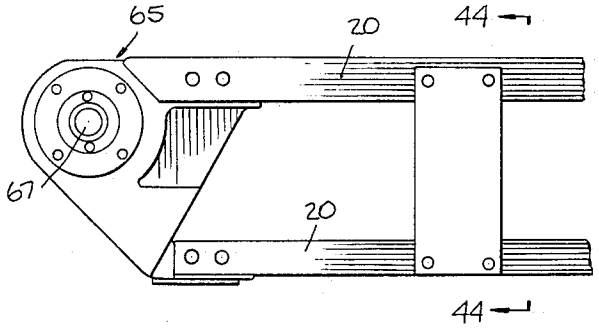
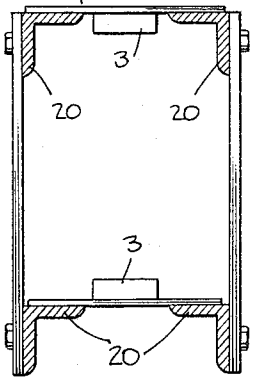



Fig. 43.

Fig. 44.




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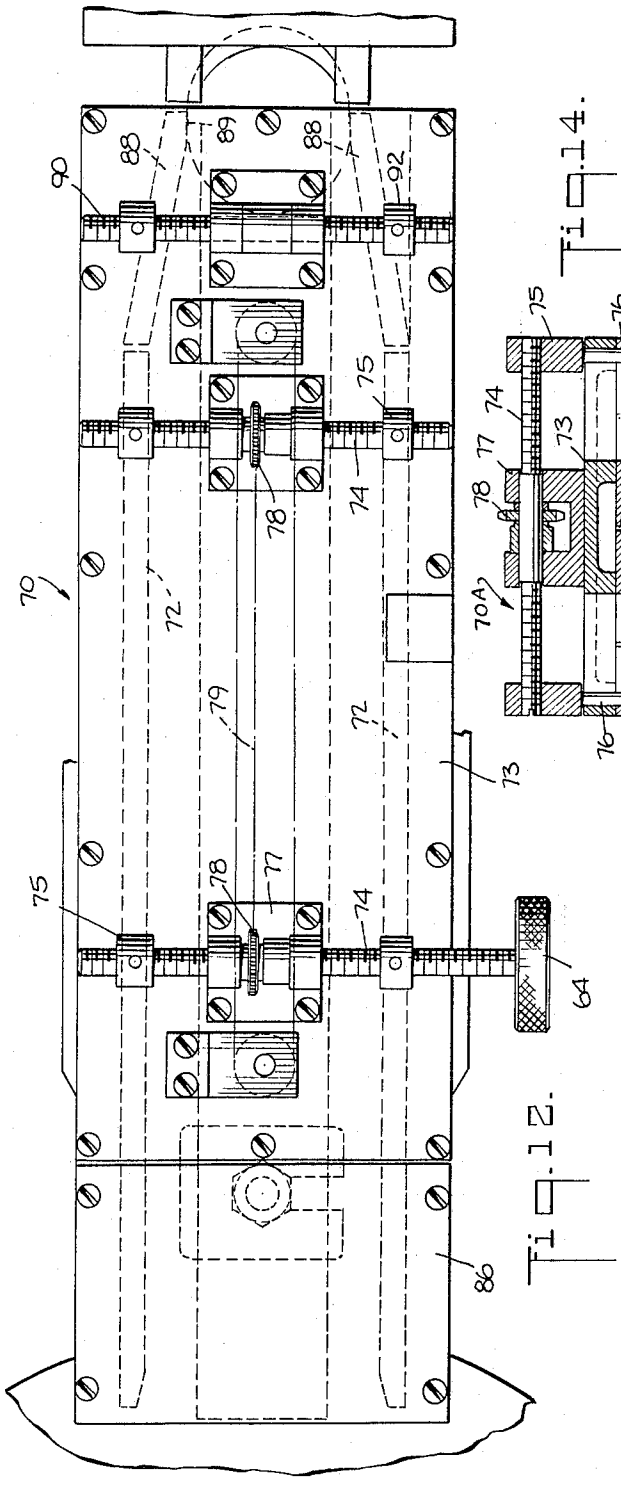


Fig. 12.



Fig. 14.

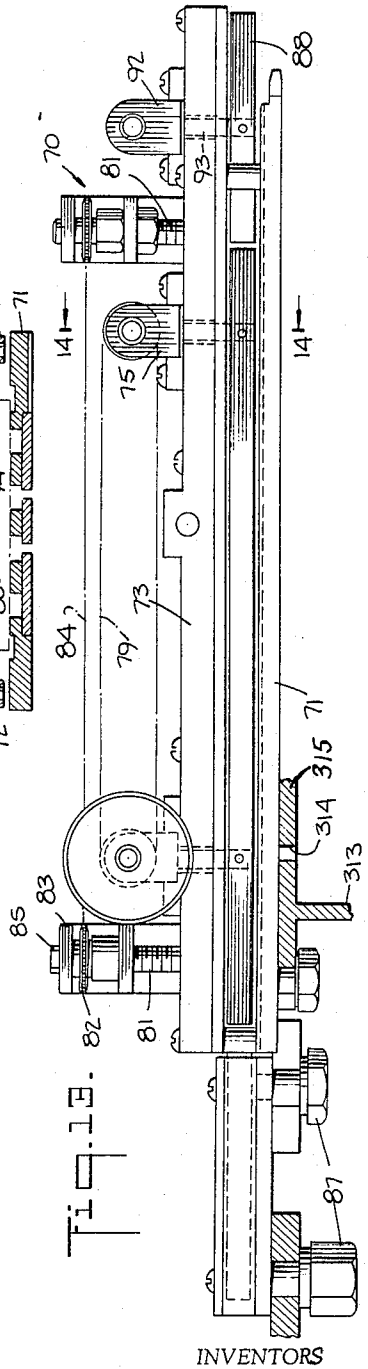


Fig. 13.

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ATTORNEY

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Fig. 15

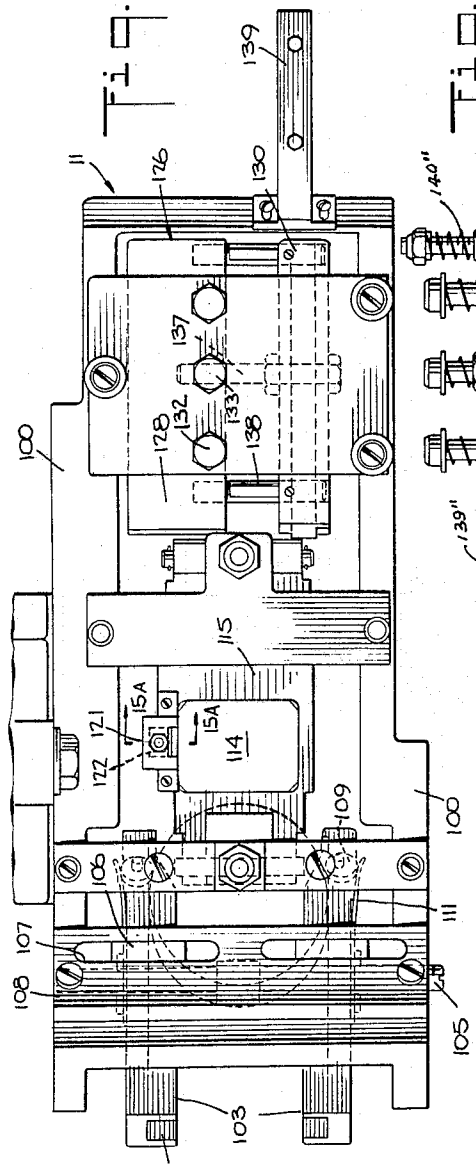


Fig. 15A

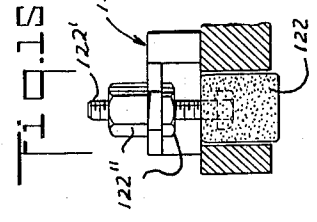


Fig. 16A

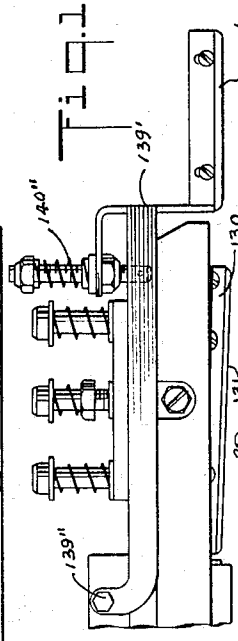


Fig. 16



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Sept. 27, 1966 C. P. ROBERTS ET AL 3,274,748

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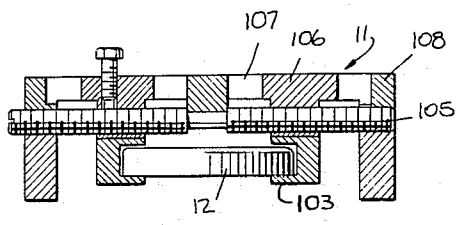



Fig. 17.

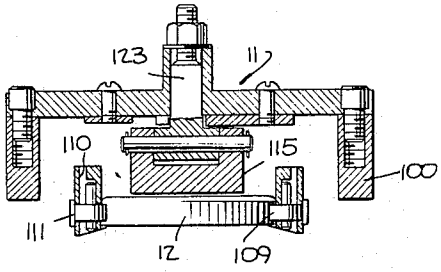



Fig. 18.

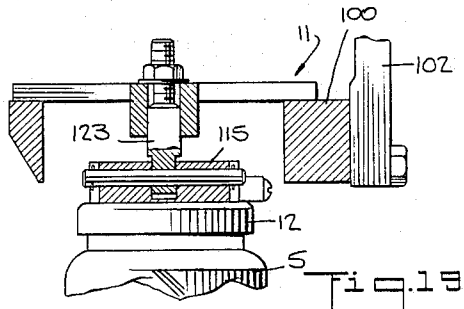



Fig. 19.

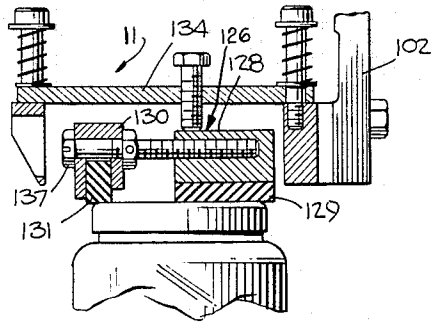



Fig. 20.

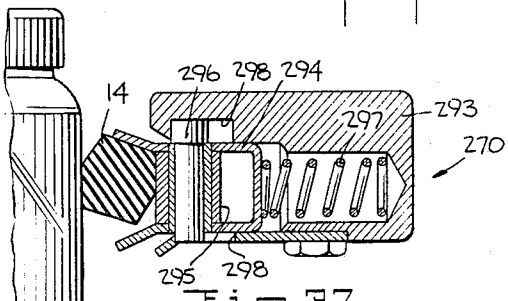



Fig. 37.

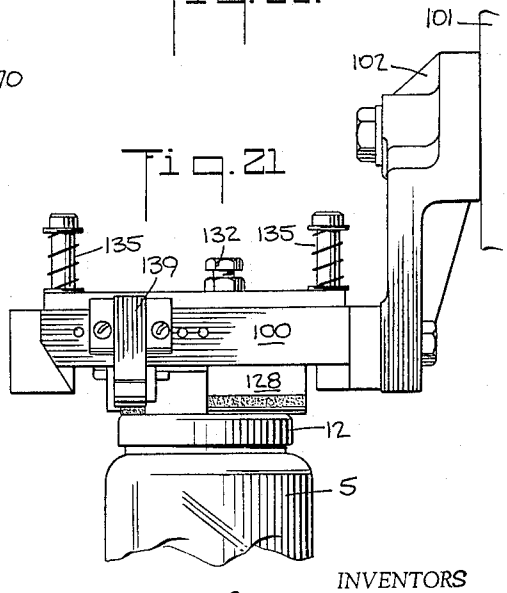



Fig. 21

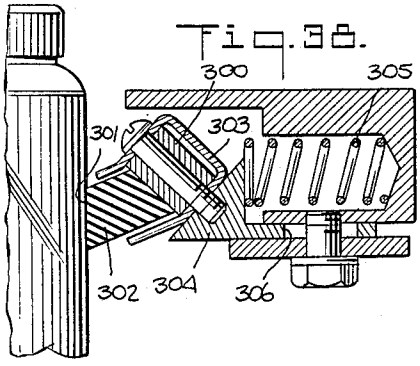



Fig. 38.

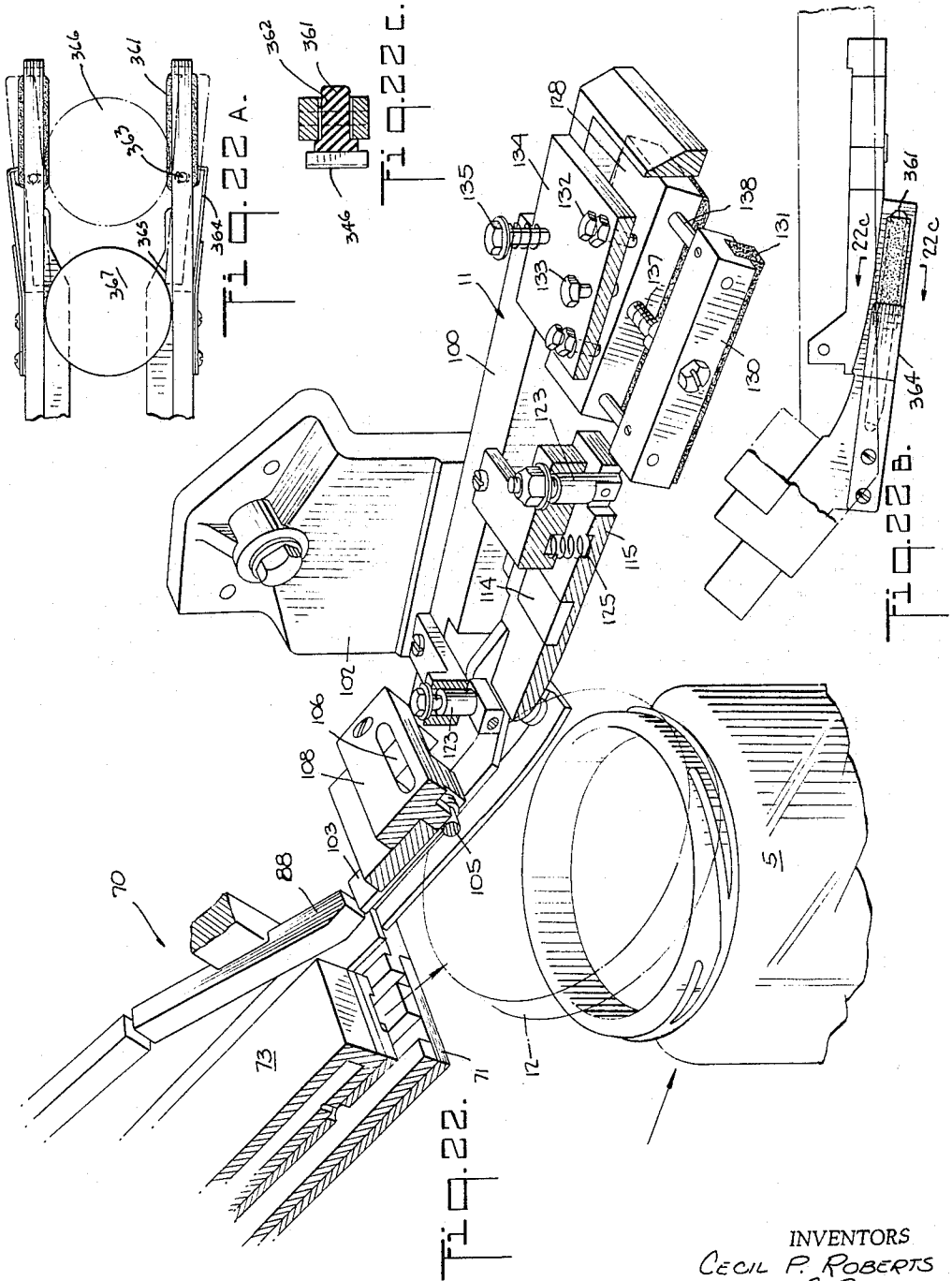
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SEALING MACHINE AND METHOD

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Fig. 23.

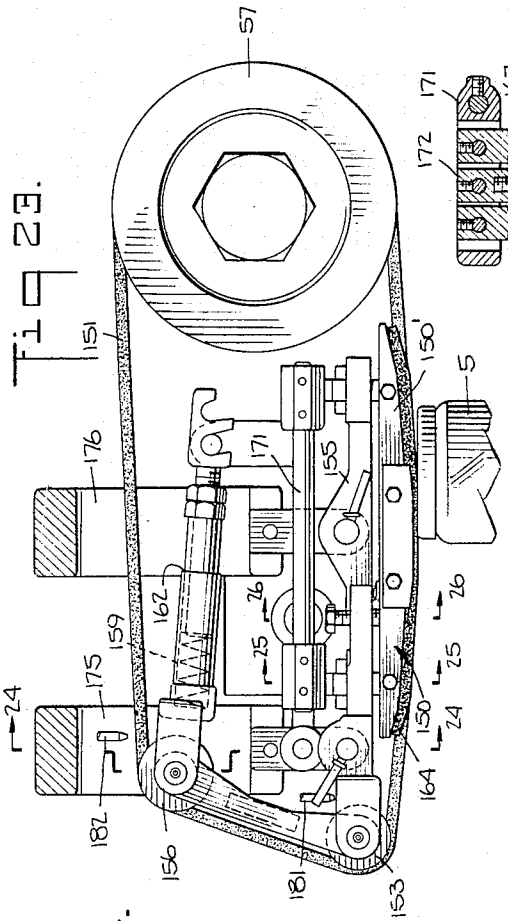



Fig. 25.

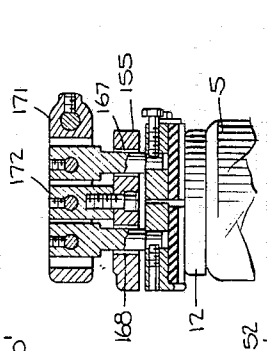



Fig. 23A.

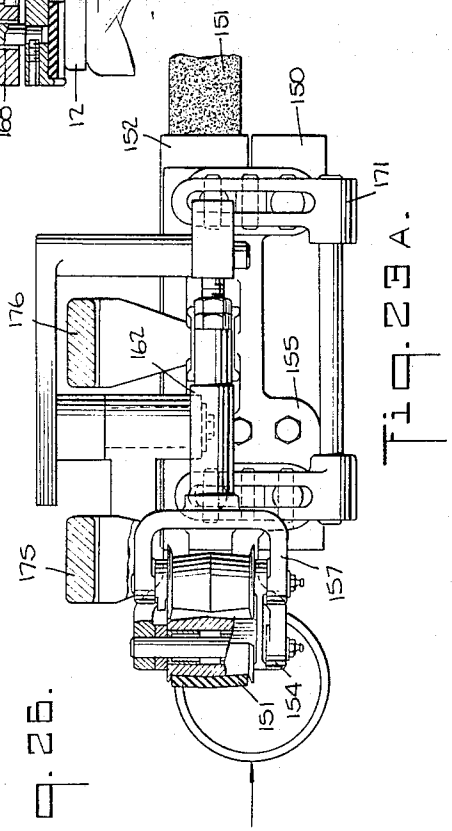



Fig. 24.

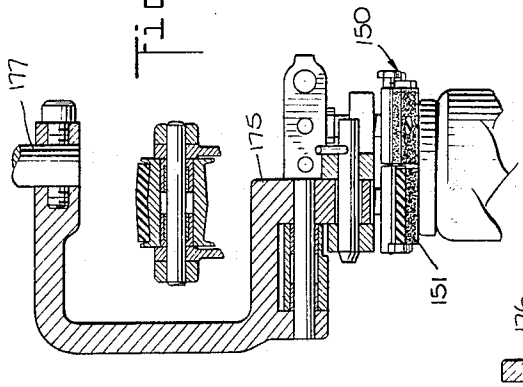
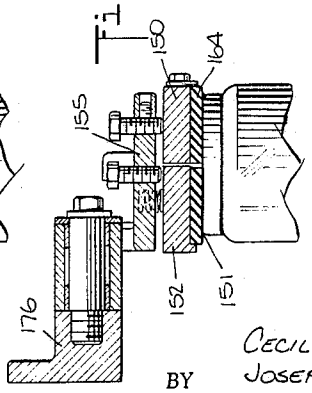



Fig. 26.




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SEALING MACHINE AND METHOD

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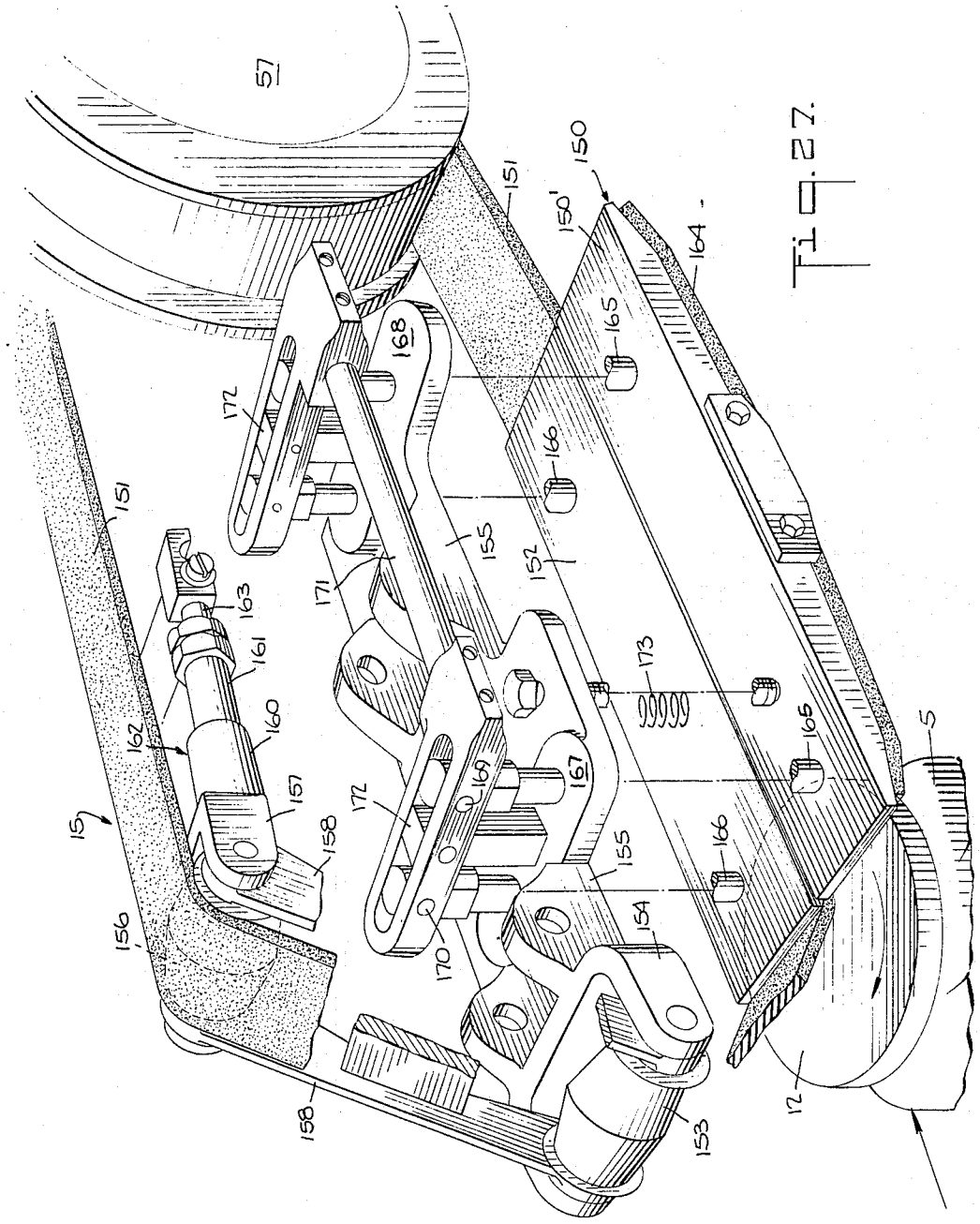



Fig. 27.

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SEALING MACHINE AND METHOD

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Fig. 28.

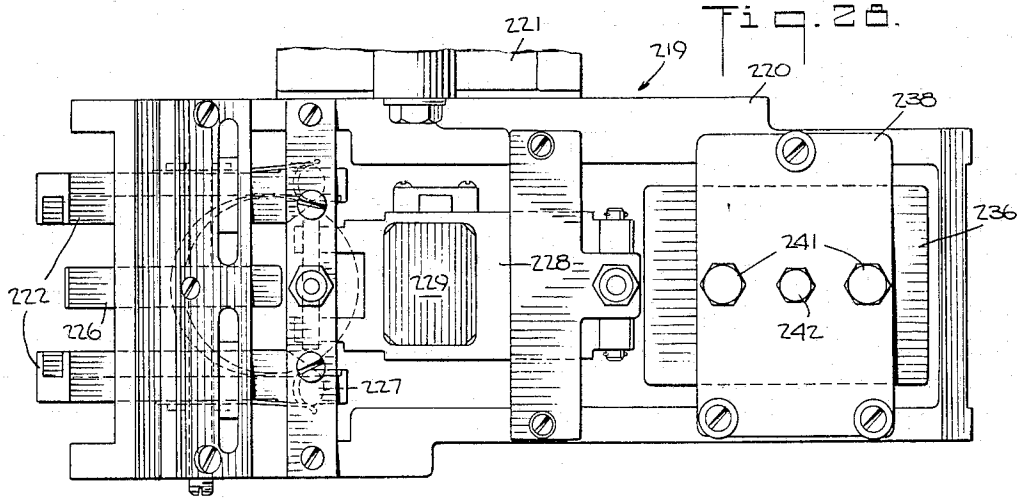



Fig. 29.

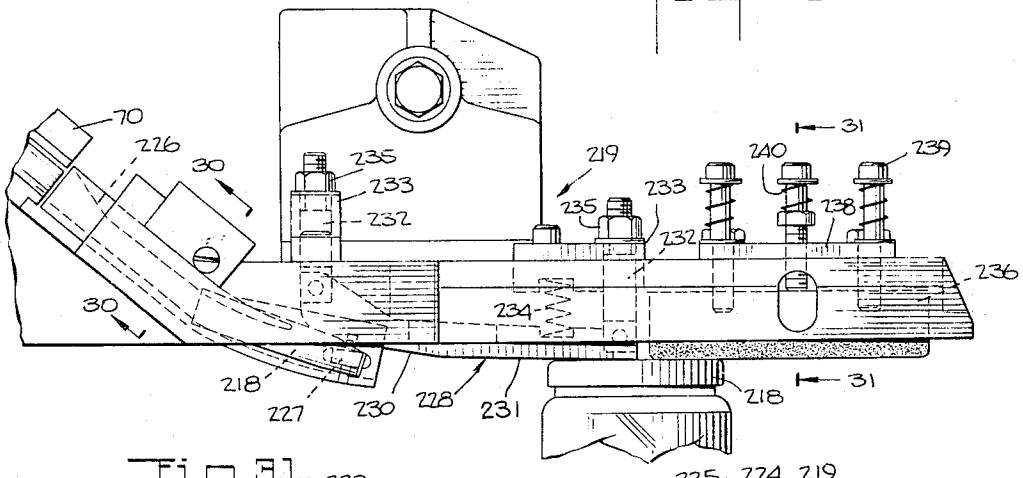
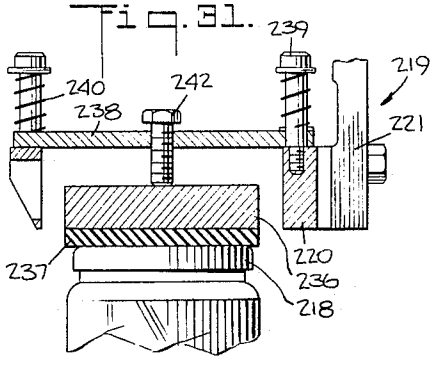



Fig. 31.



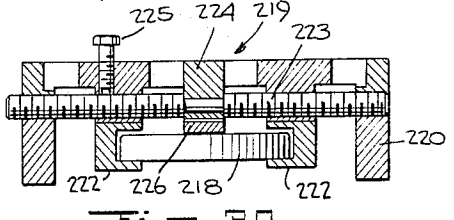




Fig. 30.

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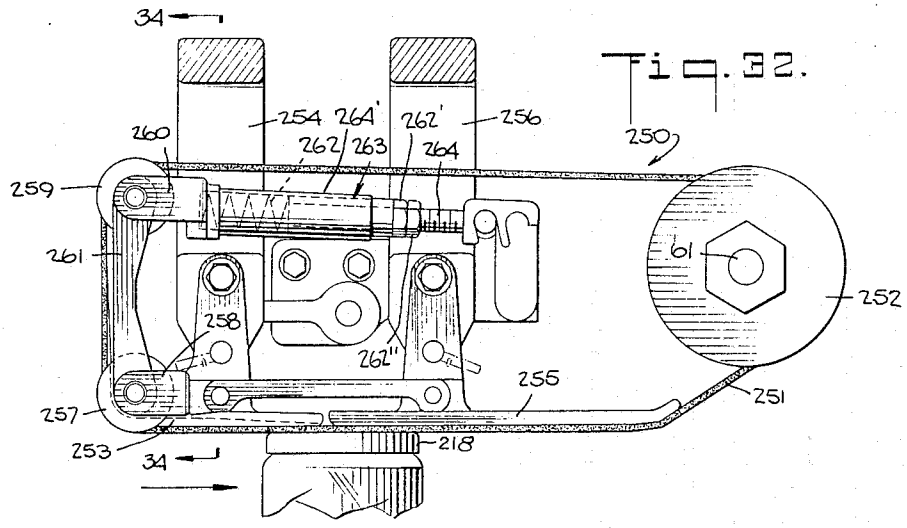



Fig. 32.

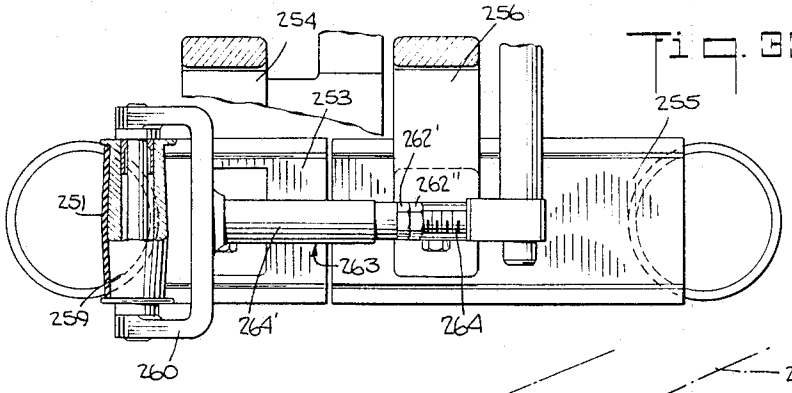



Fig. 33.

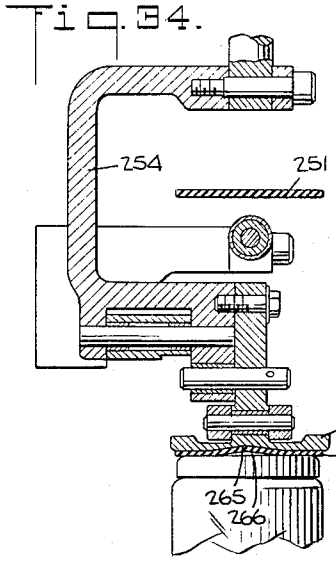



Fig. 34.

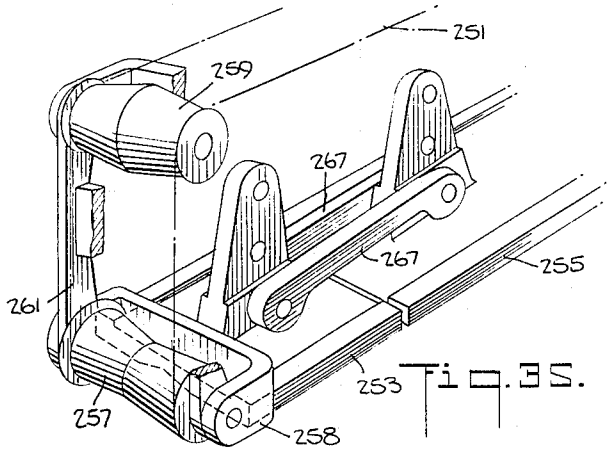



Fig. 35.

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Fig. 4B.

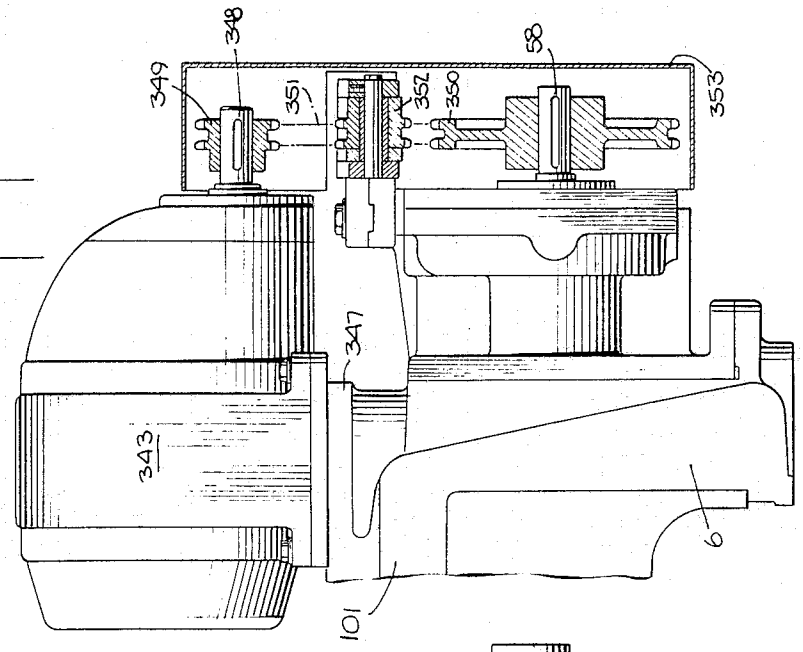
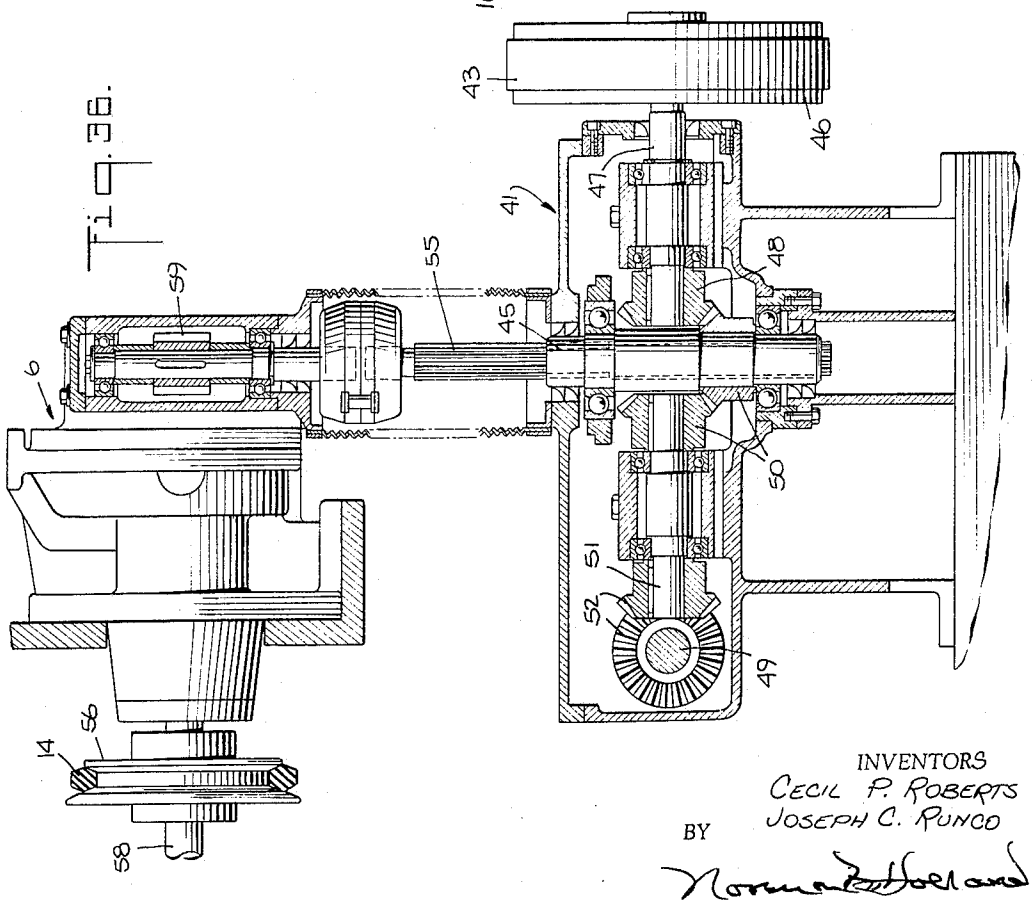



Fig. 3B.




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JOSEPH C. RUNCO

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ATTORNEY

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Fig. 40.

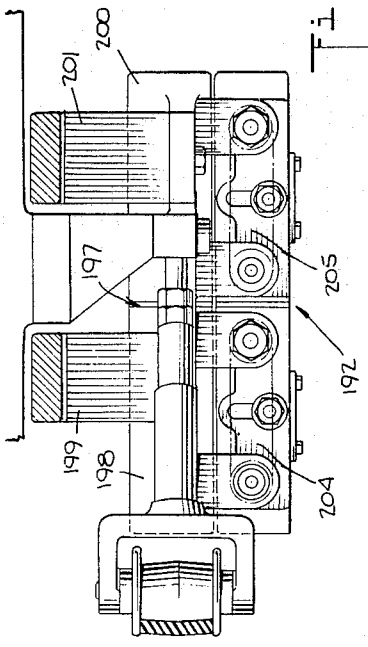



Fig. 39.

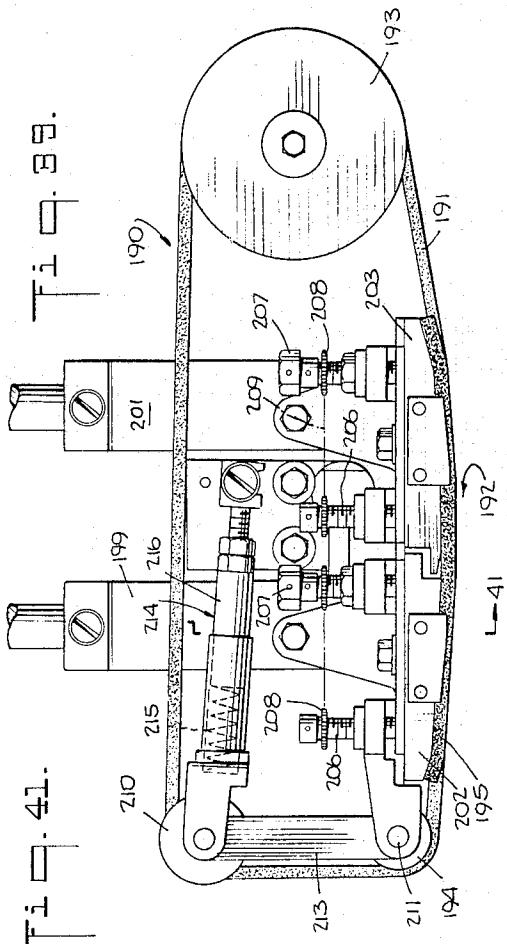
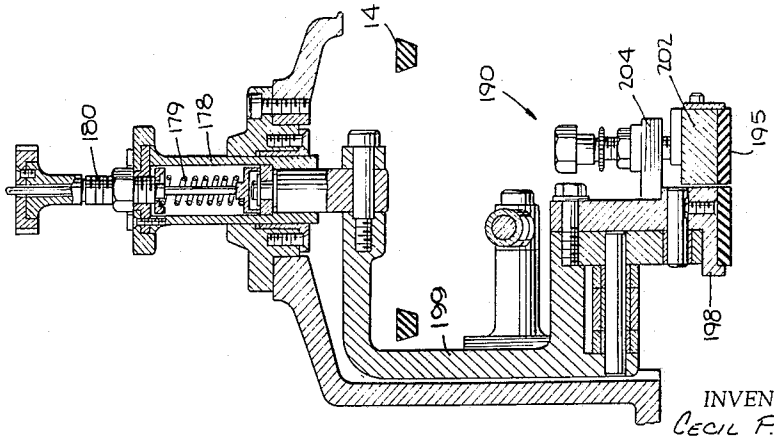



Fig. 41.




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JOSEPH C. RUNCO

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United States Patent Office 3,274,748 Patented Sept. 27, 1966



3,274,748

# SEALING MACHINE AND METHOD

Cecil P. Roberts and Joseph C. Runco, Lancaster, Ohio, assignors to Anchor Hocking Glass Corporation, Lancaster, Ohio, a corporation of Delaware

Filed May 10, 1963, Ser. No. 279,458
25 Claims. (Cl. 53—38)

The present invention relates to the sealing art and more particularly to a method and machine for sealing closure caps to glass containers. The invention is an improvement upon the machine and method described and claimed in United States Letters Patent No. 3,054,234 owned by the assignee of the present application.

The preferred embodiment of the invention is primarily for the application of closures which are applied to containers by a rotary or twisting action. Certain features of the invention are also applicable to machines for the application of so-called "press-on" closures in which the closures are applied by downward pressure.

The term, "screw caps," is used generically herein and is intended to include the usual continuous thread caps, in which a full turn or more is required to seal, and the divided thread or lug caps which may be sealed by a quarter turn. The latter are sometimes called lug caps, divided thread caps, and twist caps. As indicated above, "screw cap," as used herein, is intended to include the group.

The present invention aims to provide an improved sealing mechanism in which screw caps are more evenly applied with a more uniform torque to provide removal without undue effort on the part of the housewife and at the same time to securely seal the product for safekeeping until it is opened for use. The invention achieves the above results with containers and closures which vary slightly in size due to limitations in the machinery for manufacturing the closures and the containers.

The invention extends the life and minimizes the replacement of the friction members which apply the torque for screwing the caps on the containers; thus not only increasing production and reducing maintenance but also assuring uniformity in the sealing operation.

The invention provides improvements in the mechanism for initially applying the closures to the containers so that they reach the sealing head, where the final sealing operation is performed, with the closures initially threaded sufficiently far on the threads to facilitate materially the final sealing operation. The invention provides easy adjustment of both the initial cap applying elements and the final sealing elements to compensate for variations in the height of the containers and other irregularities; thus minimizing shutdowns and providing more uniform sealing.

One embodiment of the invention provides for the simultaneous adjustment of the operating speeds of all moving parts so that the speed of the various elements of the sealing machine and the speed of related devices in a sealing line, such as fillers and spacers, can be readily changed and at the same time kept in timed relation.

A further improvement enables the sealing elements of the machine to be readily observed while the machine is being run at full speed to permit adjustments required to give optimum performance.

Accordingly, an object of the present invention is to provide an improved sealing machine and method for sealing closure caps to containers.

Another object of the invention is to provide an improved sealing machine for sealing screw closure caps to containers.

Another object of the invention is to provide a sealing machine for screw closures having greatly improved life for the cap engaging elements which must normally be replaced in such machines.



Another object of the invention is to provide an improved sealing machine for screw closures which remains in adjustment for extended periods by automatically compensating for part wear.

Another object of the invention is to provide an improved sealing machine for use with both screw closures and press-on closures and one which may be readily converted for either use.

Another object of the invention is to provide an improved vacuum type sealing machine which may be fully uncovered for observation and adjustment while running at normal operating conditions and speeds.

Another object of the invention is to provide an improved sealing machine which may be quickly, conveniently and simply adjusted for varying closure and container sizes.

Another object of the invention is to provide an improved sealing machine wherein the speed of the moving parts may be conveniently adjusted without changing the synchronization of the related parts.

Another object of the invention is to provide an improved sealing machine wherein simultaneous adjustment may be made of the various related and synchronized moving parts and other cooperating machines.

Other and further objects of the invention will be obvious upon an understanding of the illustrative embodiment about to be described or will be indicated in the appended claims, and various advantages not referred to herein will occur to one skilled in the art upon employment of the invention in practice.

A preferred embodiment of the invention has been chosen for purposes of illustration and description and is shown in the accompanying drawings, forming a part of the specification, wherein:

FIG. 1 is a front elevational view of the sealing machine in accordance with the invention;

FIG. 2 is a top plan view of the sealing machine of FIG. 1;

FIG. 3 is an end view of the sealing machine of FIG. 1;

FIG. 4 is an enlarged detailed side view of the head assembly;

FIG. 5 is a detailed perspective view of the head assembly with the cover removed;

FIG. 6 is a horizontal sectional view of the head assembly taken along line **6—6** of FIG. 4;

FIGS. 7 to 10 are vertical sectional views of the head assembly taken along lines **7—7**, **8—8**, **8*a*—8*a***, **9—9**, and **10—10** respectively of FIG. 4;

FIG. 11 is a vertical sectional view of the sealing machine base taken along line **11—11** of FIG. 1;

FIG. 12 is an enlarged detailed top plan view of a preferred embodiment of the cap feed chute;

FIG. 13 is a side elevational view of the cap chute of FIG. 12;

FIG. 14 is a vertical sectional view of the cap chute taken along line **14—14** of FIG. 13;

FIG. 15 is a top plan view of a preferred embodiment of the cap applicator for screw caps;

FIG. 15A is a sectional view taken along the line **15A—15A** of FIG. 15;

FIG. 16 is a side elevational view of the cap applicator of FIG. 15;

FIG. 16A is a fragmentary side elevational view of an alternate embodiment of the applicator of FIG. 15;

FIGS. 17 to 20 are vertical sectional views of the cap applicator taken along lines **17—17**, **18—18**, **19—19**, and **20—20** respectively of FIG. 16;

FIG. 21 is an end view of the cap applicator of FIG. 15;

FIG. 22 is a perspective view, partially cut away, of the cap applicator of FIG. 15;

FIGS. 22A and 22B are top plan and side elevational views respectively of an alternate embodiment of the applicator of FIG. 15;

FIG. 22C is a sectional view taken along line 22C—22C of FIG. 22B.

FIG. 23 is an enlarged detailed front elevational view of a preferred embodiment of the sealing head for screw caps;

FIG. 23A is a top plan view partially cut away of the sealing head of FIG. 23;

FIGS. 24 to 26 are vertical sectional views taken along lines 24—24, 25—25, and 26—26 respectively of FIG. 23;

FIG. 27 is a perspective view partially cut away of the sealing head of FIG. 23;

FIG. 28 is a top plan view of a preferred embodiment of the cap applicator for press-on caps;

FIG. 29 is a side elevational view of the cap applicator of FIG. 28;

FIGS. 30 and 31 are vertical sectional views taken along lines 30—30 and 31—31 respectively of FIG. 29;

FIG. 32 is an enlarged detailed front elevational view of a preferred embodiment of the sealing head for press-on caps;

FIG. 33 is a top plan view, partially cut away of the sealing head of FIG. 32;

FIG. 34 is a vertical sectional view of the sealing head taken along line 34—34 of FIG. 32;

FIG. 35 is a perspective view, partially cut away, of the sealing head of FIG. 32;

FIG. 36 is a vertical sectional view taken along line 36—36 of FIG. 4;

FIG. 37 is an enlarged detailed vertical sectional view of a preferred embodiment of the back-up bar for a double-V container side belt taken along line 37—37 of FIG. 6;

FIG. 38 is an enlarged detailed vertical sectional view of another embodiment of a side belt back-up bar;

FIG. 39 is an enlarged detailed front elevational view of another embodiment of a sealing head for screw caps;

FIG. 40 is a top plan view of the sealing head of FIG. 39;

FIG. 41 is a vertical sectional view of the sealing head taken along line 41—41 of FIG. 39;

FIG. 42 is a detailed top plan view of the conveyor support assembly;

FIG. 43 is a side elevational view of the conveyor support of FIG. 42;

FIG. 44 is a vertical sectional view of the support taken along line 44—44 of FIG. 43;

FIG. 45 is a front elevational view of the steam injection equipment;

FIG. 46 is a vertical sectional view taken along line 46—46 of FIG. 45;

FIG. 47 is a top plan view of another embodiment of the sealing machine using an electrical speed control system; and

FIG. 48 is a fragmentary side elevational view partially in section illustrating the head assembly drive coupling for the machine of FIG. 47.

## GENERAL DESCRIPTION

The sealing machine 1 has a base 2 which supports an elongated conveyor 3 whose upper run 4 is positioned to carry a succession of containers 5 through a sealing head assembly 6 positioned above the conveyor 3 and also mounted on the base 2 on suitable adjustable support posts 7. The containers 5 to be sealed and which may be regularly or randomly spaced on conveyor 3 are first moved through a washer 8 which has a steam spray 9 to clean the jar finish and a water spray 10 to clean the jar body below the finish. Thereafter, the containers 5 are conveyed beneath a cap applicator 11 which applies a cap 12 in telescoping relationship to the top of each container 5 and which lightly twists screw caps into engagement with the container threads. A continuous supply of caps 12 is fed to the cap applicator 11 from a cap hopper 13 whose details do not form a part of the present invention.

Such hoppers are described for example in U.S. Patents Nos. 2,863,588 and 3,029,918 owned by the assignee of the present invention.

As each container 5 moves beneath the applicator 11 it is gripped between a pair of moving side belts 14 which are driven at the conveyor speed and which insure continued movement of each container 5 at the conveyor speed as the container passes beneath the cap applicator 11.

The moving side belts 14 and the conveyor 3 next carry each container 5 beneath a sealing head 15 which engages the cap 12 on each container 5 and firmly moves the cap 12 into sealing engagement with the container finish. During this sealing operation, the side belts 14 hold the container 5 upright and against rotation.

When press-on caps are used for sealing, the applicator 11 is replaced by a press-on applicator such as the applicator 219 illustrated in FIGS. 28 thru 31. This applicator levels each cap on a moving container and presses it lightly and in level position onto the container finish.

The press-on caps next are engaged by an alternate sealing head 250 (FIG. 32) replacing sealing head 15 (FIG. 1) which presses the cap downwardly onto the container finish by means of the downward pressure of a pair of pressure shoes 253 and 255 which act on the cap through the sealing belt 251 as the belt 251 moves at the conveyor speed.

Should either the screw cap applicator 11 or the press-on applicator fail to apply a cap or should a cap be tilted for any other reason, the cap is detected by a feeler arm 307 of a cocked cap detector 308 mounted between the applicator 11 and the sealing head 15 as illustrated in FIG. 4. The feeler arm 307 is lifted by the improperly applied cap to close a switch 309 to operate a signal or a container removal device such as a blower or plunger.

Referring now to FIGS. 45 and 46, as each container 5 moves beneath the applicator 11 the empty headspace in the container 5 is filled with steam injected into the headspace from apertures 311 in a steam tunnel 16 and also from spaced steam ports 17 positioned in the side of an elongated steam distributor 18. The injection of steam into the container headspace before and during the sealing of the container causes air to be displaced from the headspace and steam be trapped therein. When the container 5 cools after passing out of the sealing machine, the condensation of the steam in the headspace results in a partial vacuum therein. This is to avoid deterioration of the product resulting from its contact with oxygen which would otherwise be present in the air trapped in the headspace of the sealed container.

## BASE AND DRIVE

The sealing machine 1 had a base 2 which in the preferred embodiment comprises a hollow casting including spaced support legs 19. As best illustrated in FIGS. 3 and 4, the conveyor 3 is mounted on the top of the base 2 on support rails 20 attached to posts 21 which position the upper run 4 of the conveyor 3 at a convenient height above the base 2. In order to seal containers of varying heights, the head assembly 6 is adjustably mounted on the base 2 in telescoping support posts 7 so that the height of the support posts 7 may be adjusted to vary the height of the head assembly 6 with respect to the conveyor 3 surface. The top surface of base 2 is formed as a catch basin 37 beneath the lubricated members of the head assembly 6 and preferably includes a convenient drain 38, as illustrated in FIG. 7.

FIG. 7 illustrates the details of the two support posts 7 each of which has an upper portion 22 telescopically

mounted within a lower portion 23 and has a flange 24 bolted to a suitable support flange 25 on the head assembly 6. The height of the head assembly 6 is adjusted by vertical adjusting screws 26 rotatably mounted in bearings 27 in the base 2 and engaging nuts 28 attached to the lower end of the upper post portions 22. The adjusting screws 26 have sprockets 29 attached to their lower ends and are simultaneously rotated to adjust the height of the head assembly 6 by a control wheel 30 (FIG. 11). A chain 31 connects the two sprockets 29 and is driven by the control wheel 30 through the intermediation of shaft 32, bevel gears 33 and 34, shaft 35, and drive sprocket 36. It will be seen that rotation of the control wheel 30 raises or lowers the entire sealing head assembly 6 as desired to position the head assembly 6 elements including cap applicator 11 and sealing head 15 as a unit to the proper height with respect to the containers 5 on the moving conveyor 3. Additional fine adjustments of the applicator 11, the sealing head 15 and the side belts 14 are independently made as will be described below. The above described height adjustment means for the head assembly 6 is fully enclosed within the posts 7 and the base 2 for its own protection and to insure operating cleanliness to better adapt the machine to a food sealing operation.

The base 2 also mounts a drive motor 40 which provides the motive power for moving the conveyor 3, the side belts 14 and the driven elements of the sealing head 15 which are all connected to the drive motor 40 by a positive coupling to provide for their movement in synchronism.

As illustrated in FIG. 2, the drive motor 40 is preferably coupled to a speed reduction and power take-off box 41 through the intermediation of a conventional Reeves speed control 42 including a drive belt 43 and a Reeves pulley 44. The details of the box 41 are illustrated in FIG. 36. As shown therein, the motor power is transmitted to a vertical output shaft 45 through the intermediation of pulley 46, shaft 47, and bevel gear 48 and is transmitted to a horizontal drive shaft 49 for the conveyor 3 through the further intermediation of a bevel gear 50, a drive shaft 51 and bevel gear 52. As shown in FIG. 2, the horizontal drive shaft 49 is coupled to the conveyor by a conventional right angle drive box 54.

The drive coupling between the motor 40 and the head assembly 6 includes a splined shaft 55 slidably coupled to the vertical drive shaft 45 to permit vertical movement of the head assembly 6 when the height of the head assembly 6 is adjusted. The principal driven members within the head assembly 6 include a pair of side belt drive pulleys 56 (FIG. 6) and a sealing belt drive pulley 57. The side belt drive pulleys 56 are coupled to a horizontal drive shaft 58 which is coupled to the upper portion of the splined vertical drive shaft 55 through the intermediation of a worm 59 and a gear 60 shown in FIGS. 6 and 36. The drive pulley 57 for the sealing belt, whose function will be more fully described below, is driven in synchronism with the side belt drive pulleys 56 through the intermediation of a rotatably mounted drive shaft 61 and a gear train 62 which couples the drive shaft 61 with the drive shaft 58 for the side belt drive pulleys 56.

## CONVEYOR ASSEMBLY

As described above, the conveyor 3 is mounted at a fixed height above the base 2 and includes a support frame formed of rails 20 (FIGS. 7 and 44). The preferred conveyor 3 has an endless chain 4 formed of pivotally connected plates. The plates of the upper run of the chain 4 are slidably mounted on the horizontal portions of support rails 20 preferably a pair of conventional angle irons cut to the desired length and bolted to the support posts 21.

The lower run of the chain 4 is supported by the upper horizontal flanges of a similar pair of rails 20 also bolted to the posts 21 at the desired position. End pulley assemblies 65 are bolted to the upper and lower rails 20 (FIGS. 1 and 43) and the chain 4 is driven by drive sprockets 66 (FIG. 42) attached to the end shafts 67 of the end pulley assemblies 65. It can be seen that the above described support structure for the chain 4 permits the conveyor length to be easily adjusted for the particular machine application by simply adding or removing plates in the chain 4 and by replacing or changing the length of the four angle iron rails 20 which provide the support for the upper and lower runs of the chain 4. Since the angle irons are regular stock material, an extremely simple, adaptable and accessible conveyor support is provided for the sealing machine conveyor 3.

## CAP FEED

A continuous supply of caps 12 is provided for the containers 5 from a suitable storage bin and feed hopper 13 shown generally on FIGS. 1 to 3. Caps 12 are fed by the hopper 13 in a continuous stream into an inclined feed chute 70 which carries the caps 12 downwardly to the applicator 11 so that one cap is applied to each moving container as will be more fully described below.

A hopper 13 may be used such as is described in U.S. Patent No. 2,863,588 in combination with a cap orienting chute as described in U.S. Patent No. 3,029,918 both owned by the assignee of the present invention. Such a cap feed places a solid line of caps into a chute and the orienting chute arranges all of the caps with their tops facing in the proper direction for the action of the cap applicator at the lower end of the chute. Alternatively, a cap feeding hopper may be used which has an integral cap orienting device so that all caps passing out of the hopper to the chute have their tops oriented in the same direction. Such feed hoppers are described, for example, in U.S. Patents Nos. 3,095,957 and 3,065,841 dated July 2, 1963, and November 27, 1962, respectively and owned by the assignee of the present invention.

In order to handle caps of varied sizes, the preferred embodiment of the sealing machine has an adjustable cap feed chute 70 whose details are illustrated in FIGS. 12 to 14. This adjustable cap chute 70 has a lower cap guide plate 71 on which the caps 12 slide between a pair of spaced guide rails 72. A hollow steam chamber 73 provides a top closure for the cap chute 70 and also provides a mounting for the adjustable guide rail support 70A. The preferred embodiment of the adjustable guide rail support comprises a pair of turnbuckle screws 74 which threadedly engage the opposite ends of the rail supports 75 whose lower pin-like extensions 76 are connected to the rails 72. In order to provide for the simultaneous adjustment of all supports 75, a central bearing block 77 is provided for each of the screws 74, and sprockets 78, mounted within the bearing blocks 77 and attached to the screws 74, are connected by a suitable chain 79. Rotation of one screw 74 by the control knob 64 is thus seen to provide a corresponding rotation of the other screw 74 so that a simultaneous adjustment of the side rails 72 is obtained.

An adjustable top spacing plate 80 is illustrated in FIG. 14 whose height above the guide plate 71 is determined by spaced mounting screws 81 (FIG. 13) which threadedly engage spaced portions of the chamber 73. These spaced screws 81 are also simultaneously adjustable through the intermediation of sprockets 82 mounted thereon at the bearing block supports 83 and interconnected by a suitable chain 84. Rotation of the keyed upper end 85 of one screw 81 thus provides for a corresponding rotation of the other screw 81 and thus gives an even adjustment of the top plate 80 spacing.

In FIG. 12 a suitable channeled connecting portion 86 for the cap chute 70 is illustrated connecting the chute 70 to the particular hopper or cap orienting device being

used. This section is conveniently mounted by a pair of removable bolts **87** (FIG. 13).

The caps **12** pass from the lower end of the chute **70** into the cap applicator **11** and a pair of converging centering rails **88** at the lower end of the chute **70** are provided to exactly center each cap **12** as it passes to the applicator **11**. The guide rails **72** are preferably spaced somewhat further apart than the cap diameter to provide for the free passage of caps **12** down the chute **70**. The lower ends **89** of the centering rails **88** are closely adjusted to about the cap diameter to insure a precise centering of each cap. The centering rails **88** are adjustably mounted by means of a threaded turnbuckle-type screw **90** which engages threaded upper portions of the centering rail support members **92**. Pin-like lower portions **93** of the support members **92** are connected to the centering rails **88** and are contained in suitable slots in the steam chamber portion **73** of the cap chute **70**.

The chamber portion **73** is provided with steam outlets **94** which direct steam over caps **12** in the chute **70** to warm the caps to prevent premature condensation of vapor within the caps. The steam vacuum forming system will be further described below.

## CAP APPLICATOR FOR SCREW CAPS

The cap applicator **11** (FIGS. 15 thru 22) is mounted at the lower end of the cap feeding chute **70**. The applicator **11** applies screw caps and lightly turns these caps into engagement with the container threads preparatory to the final sealing by sealing head **15**. Applicator frame **100** is detachably connected to the head assembly **6** enclosure **101** (FIG. 21) by a suitable bracket **102**. A pair of spaced end rails **103** are adjustably mounted at the entrance end of the applicator **11** and are positioned to act as an adjustable cap chute end. The rails **103** are adjustably mounted so that the spacing of their cap guide channels **104** is set to correspond to the width of the lower end of the cap feed chute **70** for the particular cap being used. As best illustrated in FIGS. 15 and 17, the spaced rails **103** are threadedly connected to a turnbuckle-type adjusting screw **105** and each of rails **103** is adjustably held in position by a guide **106** slidably contained in an elongated positioning slot **107** formed in a cross-member **108** connected to the cap applicator frame **100**. At the lower end of each of the rails **103**, a detent wheel **109** is slidably mounted in a cut out portion **110** (FIG. 18) of the rail **103** and each of the detent wheels **109** releasably engages the skirt of the lowermost cap **12**. A spring finger **111** urges each of the detent wheels **109** towards its cap retaining position and permits the detent wheels **109** to move outwardly to release the lowermost cap as a moving container **5** engages the cap **12** as illustrated in FIG. 16. The end rails **103** have their cap guiding channels **104** downwardly sloped as illustrated in FIG. 16 to present a leading portion **112** of the lowermost cap skirt to the finish **113** of a moving container **5**.

An alternate embodiment of the cap restraining detents is illustrated in FIGS. 22A, 22B and 22C. The elongated detents **361** have a mounting slot **362** which cooperates with a mounting pin **363** to permit outward and swinging movement of the detents **361** against the force of springs **364**. The lowermost cap **366** after being engaged by a moving container slides the front of the detents **361** outwardly and also swings their rear ends **365** inwardly to temporarily engage the next cap **367**. The detents **361** are formed of friction material or alternatively of metal which may be magnetized to improve the cap controlling action.

A cap leveling plate **115** (FIG. 22) is mounted in the open center of the cap applicator frame **100**. The leveling plate **115** is provided with a magnet **114** which attracts the metallic caps **12** so that they engage and slide along the lower surface of the leveling plate **115**. As illustrated in FIG. 16, the leveling plate **115** has a curved end **117** adjacent the end rails **103** to facilitate passage of each cap past the detents **109**. A downwardly inclined portion **118** of the leveling plate beyond the curved end portion leads to a generally horizontal portion **119** which acts to level each cap with respect to the container top while the leveling plate **115** supports the cap with its threads or lugs slightly above the container threads **120**.

In order to assure this leveling action and to prevent premature engagement of cap and container threads or lugs and a resulting cocking of the cap, a reversing drag **121** having a rubber or other friction member **122** is mounted on the inner side of the leveling plate **115**. The reversing drag **121** lightly engages the top of each cap and causes the cap to turn in a direction which disengages the cap and the container threads. As illustrated in FIG. 15A, the friction member **122** is mounted for vertical adjustment on screw **122'** and is locked in position by nuts **122''**.

Opposite ends of the cap leveling plate **115** are pivotally attached to the lower ends of two support rods **123** slidably contained in bearings **124** which are supported by the applicator frame **100**. A compressed coil spring **125** urges the leveling plate **115** toward its normal downward position which is set by the adjusting nuts **127** which support the upper threaded ends of the support rods **123**. A cap coaxing plate **126** is mounted in the exit end of the applicator frame **100** for the purpose of lightly twisting each cap **12** into engagement with the container threads. In the preferred embodiment illustrated in FIGS. 15 and 20, the coaxing plate **126** has a bearing member **128** with a non-friction coating or cover **129** on its bottom which slidably engages one portion of each cap top and has a coaxing drag **130** which includes a rubber or other friction element **131** which engages and retards an oppositely spaced portion of each cap top. The action of the coaxing drag **130** is to turn the cap onto the container threads as the bearing member **128** simultaneously holds the cap level and permits it to rotate.

In order to compensate for the downward movement of the cap, the coaxing plate **126** is mounted in a downwardly inclined position by means of two spaced support screws **132** and a locking screw **133**. The support screws **132** attach the coaxing plate **126** to a floating mounting plate **134** which is slidably mounted for vertical movement by three spaced bolts **135** having compressed coil springs **136** which urge the coaxing plate downwardly toward its normal operation position. The coaxing drag **130** is adjustably mounted on the bearing member **128** for adjustment laterally of the conveyor **3** by adjustment bolt **137** and guide rods **138**.

A holding drag **139** with a cap engaging friction member **140** is mounted generally in line with the coaxing drag **130** and extending beyond the end of the cap applicator frame **100**. The holding drag **139** counteracts any tendency of the applied cap to back off the container threads after the application has been completed and before the cap is engaged by the sealing head. Since the cap is in engagement with the container threads as it is contacted with the holding drag **139** no bearing surface is required on the opposite side of the cap top at this position. FIG. 16A illustrates another embodiment wth an elongated arm **139** pivotally mounted at **139''** and urging a holding member **140'** against the cap under the force of spring **140''**.

## SEALING MECHANISM FOR SCREW CAPS

The preferred embodiment of the sealing head **15** which is illustrated in detail in FIGS. 23 to 28 is an improvement upon the sealing head described in U.S. Patent No. 3,054,234 owned by the assignee of the present invention.

After each container **5** is moved beyond the cap applicator **11** by the moving conveyor **3**, it is carried beneath the final sealing head **15**. This is clearly illustrated in

perspective FIG. 5 where the container **5** is seen leaving the cap applicator **11** with the holding drag **139** retaining the cap **12** in position on the container threads. The container **5** now moves beneath the sealing head **15** where one portion of the cap top is now engaged by a pressure member or a drag shoe **150** while an opposite portion of the cap top is engaged by a sealing belt **151** being driven faster than the conveyor **3** and in the same direction. The shoe **150** is mounted over the front side of the conveyor **3** and the sealing belt **151** is mounted over the rear side of the conveyor **3** so that the combined drag of the drag shoe **150** and the forward motion of the belt **151** combine to turn the cap to its final sealed position on the container threads.

The pulley **57** drives the belt **151** at any suitable speed preferably one substantially faster than the speed of the conveyor. The sealing belt **151** is held in contact with cap top by a pressure member or back-up pad **152** which is mounted for vertical movement as will be described below. An end pulley **153** mounted in a yoke **154** (FIG. 27) on the sealing head frame **155** directs the sealing belt **151** over a tensioning pulley **156**. The tensioning pulley **156** is rotatably mounted on a yoke **157** pivotally attached to yoke **154** by a pair of links **158**. The pulley **156** is held against the sealing belt **151** by the force of a compressed spring **159** fitted between telescoping portions **160** and **161** of yoke support arm **162** which acts to force the tensioning pulley **156** against the sealing belt **151** to hold it under tension. The belt tension is adjusted by the positioning of the threaded sleeve **161** on the threaded rod **163** using nut **161** and locknut **161''** to change the compression of the coil spring **159**.

The pressure member or shoe **150** includes a back-up plate having a friction pad or lining **164** attached to its lower surface to provide the above described retarding action on the cap top. The shoe **150** is also movably mounted for vertical motion and it is interconnected with the movably mounted sealing belt pad **152** to provide a compensating action as follows.

As best illustrated in FIGS. 25 and 27, the drag shoe **150** and the sealing belt pad **152** each have a pair of spaced mounting posts **165** and **166** respectively rigidly connected thereto. The posts **165** and **166** pass upwardly through bearings **167** and **168** in the sealing head frame **155** and are pivotally attached at **169** and **170** to the upper ends of a stabilizer **171**. The stabilizer **171** is pivotally attached to the sealing head frame **155** on posts **172** so that upward or downward movement of the sealing belt pad **152** causes a simultaneous but opposite motion in the drag shoe **150**. A compressed coil spring **173** is positioned between the sealing head frame **155** and the sealing belt pad **152** to compensate for the upward force of the sealing belt **151** and to cause the sealing belt pad **152** and the drag shoe **150** to normally engage each cap top with equal force.

The above described pivotal mounting including the stabilizer **171** causes the sealing belt **151** and friction pad **164** on the drag shoe **150** to each firmly engage each cap cover to twist the cap into sealing engagement with the container. Should the sealing belt **151** or the drag shoe **150** tend to wear unevenly, the stabilizer **171** will keep the belt **151** and the drag shoe **150** in proper engagement with the cap top so that a continuing automatic adjustment of these elements is obtained. The use of the stabilizer **171** also lengthens the life of the belt **151** and the drag shoe friction pad **164** by compensating their friction forces and by eliminating points of excess friction and unnecessary wear.

As seen in FIGS. 24 and 26, the frame **155** for the sealing head **15** is mounted on the sealing head assembly **6** by means of the spaced support members **175** and **176** which are connected to the sealing head enclosure **101** as illustrated in FIG. 9 by a mounting pin **177** and a hollow threaded pin support **178**. Each of the support members **175** and **176** is adjusted for its lowermost position by the adjustment of the threaded pin supports **178** on the enclosure **101** and the downward sealing pressure of the sealing head **15** is adjusted by compressing the coil springs **179** by threaded adjusting screws **180**.

Water outlets **181** and **182** (FIG. 23) supply water to the inside and outside of the sealing belt respectively to lengthen belt life by reducing friction and by causing the belt to run cooler. The water is supplied in small amounts preferably by being dripped onto the belts by the outlets **181** and **182**.

## ALTERNATIVE EMBODIMENT OF SEALING MECHANISM FOR SCREW CAPS

Another embodiment of a sealing head for performing the final sealing action on screw caps is illustrated in FIGS. 39 to 41. The sealing head **190** utilizes a moving belt **191** and a drag shoe **192** to provide a twisting action or sealing torque of the proper amount on the tops of the screw caps **12**. The sealing head **190** is an improvement over the sealing head of U.S. Patent No. 3,054,234. The sealing head **190** compensates for variations in container heights as well as for uneven belt and shoe wear and it is particularly useful in a sealing run where the heights of the sealed packages vary due to limitations in the machinery for manufacturing containers and closures.

The sealing head **190** has an endless belt **191** driven by a drive pulley **193** and guided by an idler pulley **194** similar to those described above for the sealing head **15**. A friction pad **195** mounted on drag shoe **192** is used in combination with the sealing belt **191** in the manner described for the sealing head **15**.

In order to compensate for variations in container height, both the support pad **197** for the moving belt **191** and the drag shoe **192** are formed in two sections comprising an entrance and an exit section. The entrance section **198** of the sealing belt support pad **197** is mounted on a support arm **199** independently of the exit portion **200** which is similarly mounted on a support arm **201**. The support arms **199** and **201** are similar to arms **175** and **176** described above for sealing head **15** and they are both yieldably mounted for vertical movement with respect to the head assembly **6** under the control of adjustable hold down spring members **179** (FIG. 41). Containers **5** under the front and rear sections of the pad **197** of differing height will both be subjected to a generally uniform downward belt pressure as each of the separate pad portions **198** and **200** will be raised on their separate support arms **199** and **201** the necessary amount and independently of one another.

The corresponding entrance and exit sections **202** and **203** of the drag shoe **192** are mounted independently of one another on support brackets **204** and **205** extending from the entrance and exit sections **198** and **200** of the belt support pad **197**. These separate sections thus will correspondingly accommodate themselves to varying container heights. Each of the shoe sections **202** and **203** is adjustably mounted with respect to the support brackets **204** and **205** by a pair of threaded bolt members **206** and **207**. The bolt members **206** and **207** are simultaneously rotated to raise and lower the shoe portions as sprockets **208** on each of the bolts **206** and **207** are connected by suitable chains **209**. Adjustment of the height of the sections with respect to the sections **198** and **200** for the belt **191** is obtained by rotating the bolts **206** as necessary.

Proper tension is maintained on the endless sealing belt **191** by the tensioning pulley **210** which is pivotally mounted on the axle **211** for the lower idler pulley **194** by a pair of pivot links **213** and by the telescopic yoke support arm **214** containing an adjustable coil spring **215** whose force is set by adjusting the length of the adjustable portion **216** of the support arm **214**.

## PRESS-ON CAP APPLICATOR

FIGS. 28 to 31 illustrate an alternate embodiment of a cap applicator to adapt the sealing machine for sealing

press-on caps 218 to containers. This applicator 219 has a frame 220 attached to the sealing head assembly 6 by means of a suitable bracket 221. A pair of spaced chute end rails 222 receive the caps 218 from the lower end of the adjustable cap chute 70 and present them to moving containers. As illustrated in FIG. 30 the end rails 222 are adjustably mounted for handling caps 218 of varying sizes. For this purpose each of the end rails 222 is threadedly connected to a turnbuckle-type adjustment screw 223 rotatably mounted in a suitable bearing 224. A set screw 225 locks the end rails 222 in their adjusted position.

As illustrated in FIGS. 29 and 30 an elongated curved cap guide member 226 is positioned centrally of the end rails 222 and positioned to engage and guide the tops of caps 218 as they enter the guide rails and pass to a pair of spring loaded detent wheels 227. The detent wheels 227 releasably hold the lowermost cap 218 in position at the lower end of the end rails 222 to present it to a moving container on the sealing machine conveyor 3 so that the moving container will engage the cap 218 and draw it out of the rails 222 and into telescoping relationship with the container top.

A magnetic leveling plate 228 is mounted so that it extends from the end of the end rails 222 in the direction of container travel. The leveling plate 228 is magnetized by a suitable magnet 229 so that it supports the cap 218 above the container finish in a generally horizontal position. Its lower cap engaging surface curves from a slightly inclined entrance portion 230 to a generally horizontal surface 231 at its exit end. The magnetic leveling plate 228 is mounted on a pair of support posts 232 slidably mounted on suitable bearings 233 on the applicator frame 220 and the leveling plate 228 is held in its lower position by a compressed spring 234. The threaded upper portions of the support posts 232 and adjusting nuts 235 determine the normal downward cap engaging position of the leveling plate 228.

A pressure plate 236 is mounted beyond leveling plate 228 in position to lightly press the cap 218 against the container finish in a level position so that the cap is level on the container finish as the container moves beyond the applicator 219 and beneath a final sealing head. As illustrated in FIG. 31, the pressure plate has a non-friction member 237 fastened to its lower surface to facilitate the passage of the cap beneath the plate. The pressure plate 236 is floatingly mounted on the applicator frame 220 through the intermediation of a mounting plate 238. As seen in FIGS. 28 and 31, the mounting plate 238 is slidably mounted on three retaining posts 239 for vertical movement against the force of compressed coil springs 240 contained by the three posts 239. This permits the pressure plate 236 to rise in a generally level position against the force of the three springs 240 as it presses each cap lightly downwardly onto the container finish.

The relative angular position of the pressure plate 236 with respect to the cap tops is set by a pair of coupling bolts 241 and a locking bolt 242 which adjustably couple the pressure plate 236 and the mounting plate 238 together.

## SEALING HEAD FOR PRESS-ON CAPS

When the sealing machine is used to apply press-on caps, the sealing head 15 for screw caps is replaced by a press-on sealing head. A preferred embodiment of such a press-on type of sealing head 250 is illustrated in FIGS. 32 to 35. The sealing head 250 uses a single sealing belt 251 driven by a drive pulley 252 mounted on the same drive shaft 61 used for the screw cap sealing head drive pulley 57. The lower run of the sealing belt 251 is positioned by an entrance pressure shoe 253 mounted on a rear support bracket 254 and by an exit pressure shoe 255 mounted on a forward support bracket 256. The sealing belt 251 passes over an end pulley 257 mounted on a yoke 258 formed on the entrance sealing shoe 253 and also over a belt tensioning pulley 259 mounted on a separate yoke 260. The tensioning pulley 259 is pivotally mounted by a pair of spaced link members 261 on the lower yoke 258 and is resiliently urged against the sealing belt 251 to hold it under tension by a compressed coil spring 262 positioned between the hollow telescoping portions 264 and 264' of yoke support 263. Adjustment of the length of the support 263 and thus the tension of the sealing belt 251 is made by turning adjusting nut 262' on threaded portion 264. A locknut 262'' is provided.

In order to facilitate the initial engagement between the sealing belt 251 and the lightly applied cap 218 on each container, the entrance sealing shoe 253 has a concave lower surface 265 as illustrated in FIG. 34 and the lower guide pulley 257 has a correspondingly curved concave cross section as best illustrated in FIG. 35. This curvature of the pressure shoe 253 and of the guide pulley 257 causes the center portion 266 of the belt 251 to be higher than the marginal portions. This in turn results in the initial contact between the belt 251 and the closure cap 218 being on the margins of the cap rather than on the forward edge so that the application of pressure applied to the cap by the belt 251 tends to force the cap downwardly onto the container without any tilting force such as results when the belt initially applies substantial pressure to the portion of the closure cap.

The exit pressure shoe 255 illustrated has a level lower surface where the final downward sealing force is applied uniformly over the entire cap surface with the sealing belt horizontal so that a flat topped cap is applied in a level position to the container. The lower surface may have other shapes and angles for other closure types.

The sealing belt 251 is driven by the drive pulley 252 at the same speed as the conveyor 3 to prevent any tilting of the container.

One or more link members 267 are pivotally connected to the entrance and exit shoes 253 and 255 to serve as stabilizers and thrust members for the pressure shoe 255.

## SIDE BELT STRUCTURE

As best illustrated in FIGS. 4 to 6, each container 5 is gripped between a pair of moving side belts 14 as the container passes beneath the cap applicator 11 and beneath the sealing head 15. The side belts 14 are held against each container 5 with sufficient force to insure the container remaining upright and to prevent its turning during cap application and the final cap sealing. For this purpose the side belts 14 are positioned and resiliently urged against the containers 5 by a pair of back-up bars 270 adjustably positioned on either side of the conveyor 3.

The back-up bars 270 are each mounted on an entrance support arm 271 and an exit support arm 272. The two entrance support arms 271 are mounted on the adjustable support arm spacing device 273 illustrated in FIG. 7. When the size of the containers 5 being sealed is changed, it is necessary to move each of the support arms 271 laterally of the conveyor by equal amounts and in opposite directions to keep the containers centered with respect to the conveyor 3. The adjusting device 273 of FIG. 7 provides such control by having one support arm 271 connected to a slidable support rod 274 and by having the other support arm 271 connected to a sleeve 275 surrounding the support rod 274. Simultaneous and oppositely directed movement is provided for the rod 274 and the sleeve 275 by a rotatably mounted hollow member 276 which has a threaded outer portion 277 threadedly engaging the sleeve 275 and a threaded inner portion 278 threadedly engaging the support rod 274. Rotation of the threaded member 276 in one direction causes the sleeve 275 and the support rod 274 to move the support arms 271 simultaneously towards one

another and rotation in the opposite direction moves the support arms **271** and the back-up bars **270** further apart as the threads or the rod **274** are opposite hand threads from those of the sleeve **275**. The exit ends of the two back-up bars **270** mounted on the support arms **272** are adjusted by a similar device **279** (FIG. 10) where a support rod **280** and a surrounding sleeve **281** are also both threadedly connected to a hollow threaded member **282** arranged to move the support arms **272** towards each other when the threaded sleeve member is turned in one direction and further apart when turned in the opposite direction. Simultaneous adjustment of the two devices **273** and **279** is obtained by the control handle **285** (FIG. 7) which is coupled to the threaded adjustment members **276** and **282** through the intermediation of a shaft **286**, sprockets **290** and two chains **291** and **292** (FIG. 6).

As best illustrated in FIGS. 7 and 10, spacers **271'** and **272'** are positioned between the back-up bars **270** and the rear and front supports **271** and **272**. Changing these spacers permits both adjustment of the side belt height and the tilting of the side belts **14** when desired such as a slight downward tilt to insure the containers remaining firmly in place on the conveyor **3**.

As seen in FIG. 6, each of the back-up bars **270** comprises an elongated frame **293** resiliently supporting individual roller mounts **294**. The side belts **14** engage a group of individual rollers **295** rotatably mounted on each roller mount **294**.

Where a double V-belt is used as a side belt, the rollers **295** (FIG. 37) are arranged in the roller mount **294** on vertical mounting pins **296** and each of the roller mounts **294** is held in its upward position by a pair of coiled springs **297** which urge the roller mount **294** toward the container with the extreme inner and outer positions controlled by slots **298** which engage opposite ends of the pins **296**.

Where a single V-belt is used, the preferred embodiment (FIG. 38) has the rollers **300** mounted on an inclined axis to present a vertical surface **301** of the belt **302** to the container side wall and the individual roller mounts **303** are connected to a pair of separate support arms **304**. Each of the support arms **304** is urged toward the container by a coil spring **305**, and a control slot **306** in the arm **304** determines the extremities of belt movement.

The above described back-up bar mounting is seen to provide for the complete side belt control and for side adjustment independently of the steam chamber cover **329** (FIG. 7) or other related elements so that the back-up bars **270** may be fully adjusted with the cover open and while the machine is in full operation at the final sealing speeds. This feature combined with the above described cap applicator and sealing head adjustments provides for a convenient, complete and accurate adjustment of the sealing machine for its regular operating speed while the various elements are under full observation by the machine operator.

These side belts **14** are held under tension by the adjustable end pulleys **330** illustrated in FIGS. 4, 8 and 8*a*. As seen in FIG. 8 each of the pulleys **330** is pivotally mounted on a support arm **331** on a horizontal shaft **332** attached to the head assembly **101** by a bracket **333**. Each of the support arms **331** are held under tension by coil springs **334** and the two springs **334** are connected to a common cross bar **335**. The force of the springs **334** is simultaneously adjusted by tension control knob **336** threadedly connected to the threaded center pin **337** which extends through the head assembly cover **101**. The cross bar **335** is pivotally mounted on the lower end of the pin **337** to insure equal tension on both of the belts **14**.

The life of the side belts **14** is lengthened by lubricating the belts by drops of water applied from a conveniently positioned supply tube **338** (FIG. 5) with spaced perforations **339**. This lubrication cools the belts, reduces the frictional wear of the belts, and tends to keep the belts clean of any product transferred from the containers.

## VAPOR SEALING

The improved sealing machine is particularly adapted for sealing both screw caps and press-on caps with vacuum seals. The steam distribution system of the machine provides the desired degree of vacuum and also provides for improved control of the degree of vacuum obtained with a minimum moisture content in the evacuated headspace.

Filled containers entering the sealing machine are preferably passed through an auxiliary device known as a headspacer (not shown). Headspacers insert a plunger into a mouth of each container to assure an empty space or headspace of predetermined volume at the top of each container and also to insure the lowering of any solid products below a predetermined level.

FIGS. 4, 45 and 46 best illustrate the steam distribution system for forming a vacuum in the container headspace. In general, the method consists of replacing the air of the container headspace with a condensable vapor which is normally steam. After the container is sealed, the condensation of the vapor results in the formation of a vacuum within the sealed-off headspace.

In the sealing machine **1** the filled containers first pass under a horizontal steam tunnel **16** provided in the hollow lower portion of the cap chute support **310** (FIG. 45). Steam is directed vertically downwardly into the container headspace through a series of injector ports **311** (FIG. 46) spaced along the lower surface **312** of the chamber tunnel **16**. This downward injection of steam causes a displacement of the headspace air by the steam so that the container headspace is filled with steam as the container **5** reaches the lowermost cap **12** in the cap chute end rails **103**.

To further insure the formation of a vacuum in the container headspace, the upper portion of the cap chute support **310** also includes a hollow steam chamber **313** and steam is injected into the under sides of caps **12** in the chute **70** through a series of ports **314** (FIG. 13) provided in the upper inclined surface **315** of this steam chamber **313**.

Steam is fed to the cap chute support **310** by a supply pipe **316** (FIG. 45). Preferably the tunnel portion **16** of the hollow support **310** receives its steam from upper portion **313** through a valve **317**. This permits independent control of the steam supply for tunnel **16**. Steam is not needed in the tunnel **16** at low sealing speeds and may be undesirable for certain dry products.

In addition, as illustrated in FIGS. 13 and 14 the upper surface of the cap is also subjected to steam from the upper steam chamber **73** on the cap chute **70** to raise the temperature of the caps to prevent premature condensation of steam or vapor within the caps before and during the sealing operation, and to soften by preheating some lining materials used in caps thereby reducing the sealing pressure required.

Thus, when each cap is drawn onto the top of a moving container **5** at the bottom of the cap chute, the air has been displaced by steam in both the container headspace and in the inside of the caps.

To insure the retention of the steam within the container headspace and to further insure the final removal of any remaining air, an elongated steam distributor **18** extends at cap level alongside of the cap applicator **11**. The steam distributor **18** comprises a hollow chamber filled with steam from supply stack **319** and having a series of ports **17** which direct a cloud of steam around the container top and the closure cap to complete the displacement of air and to prevent the reentry of air between cap and the container during the cap application.

The volume and pressure of steam issuing from the ports **17** of the steam distributor **18** determines the degree of vacuum. A simple and effective control for the vacuum is provided by a multiple position pet cock **320** in the steam supply line **321** for the steam supply stack **319**. Two or more bores of predetermined size are pro-

vided in the pet cock 320 and the vacuum is set by turning the pet cock 320 to the correspondingly calibrated bore.

When the containers leave the cap applicator, they are each lightly sealed with a screw-on or a press-on cap and steam is trapped in the sealed container headspace. This trapped steam remains in the headspace during the subsequent sealing at the sealing head and when the container cools, condensation of the steam forms a vacuum above the product to thereby prevent spoilage of the container contents from contact with the oxygen in the air.

Excess steam is exhausted from the head assembly cover 101 through manifold 322 (FIGS. 1 and 2) whose opposite ends 323 communicate with the interior of the head assembly cover 101. An exhaust fan 324 draws the steam out of a central exhaust stack 325 to a suitable exhaust system.

With certain products, it is desirable to replace air which would normally be in the headspace with an inert gas, such as nitrogen or carbon dioxide, for example. In such cases, the above steam supplying mechanism may be utilized to supply an inert gas to the container headspace.

## IMPROVED DRIVE

The above described sealing machine has the various moving parts such as conveyor 3, the side belts 14 and the sealing head 15 synchronized by being coupled through positive mechanical drive connections to a single main drive motor 40. An alternative embodiment of a synchronized drive system is illustrated in FIGS. 47 and 48 which uses separate drive motors for the different driven elements of the sealing machine and provides an adjustable and electrically synchronized system to keep the independent drive motors in synchronism with one another.

In particular, one drive motor 340 (FIG. 47) is coupled to the conveyor 3 through a suitable shaft 341 and a right angle coupling 342 and a second drive motor 343 (FIG. 48) is used for the driven elements such as the sealing head 15 and the side belts 14. This use of a second drive motor 343 mechanically isolated from the machine base 2 and the conveyor 3 permits the cap applicator 11 and the sealing head 15 to be adjusted in height for varying container sizes without requiring a corresponding adjustment in a mechanical drive motor coupling. As illustrated in FIG. 48, the drive motor 343 for the head assembly 6 is mounted on a suitable flange 347 on the head assembly cover 101. The drive shaft 348 of the motor 343 is coupled to the main drive shaft 58 of the head assembly 6 and thus to the various driven elements of the head assembly 6 through the intermediation sprockets 349 and 350, chain 351 and a chain tension idler sprocket 352. The coupling between drive shaft 58 and the other moving elements of the head assembly 6 has already been described. The above connection is housed in a suitable cover 353.

This alternate embodiment of the drive system thus is particularly advantageous where spacing adjustments are required between two portions of the sealing machine 1 which have driven elements which must be synchronized. In addition, this system permits the use of independent drive motors on other related machines in a sealing line such as fillers, headspacers, and labeling machines where it is desired to simultaneously adjust and to synchronize all machine speeds including the speed of the sealing machine sealing head, conveyor and side belts. A motor for such a related machine is illustrated at 360 in FIG. 47.

The preferred embodiment of this drive uses A.C. electric motors such as induction motors or synchronous induction motors whose speed is proportional to the frequency of the electric current supplied for driving the motors. A common power supply is used for all the machine motors comprising an A.C. generator 345 coupled to a variable speed drive motor 346. The speed of each of the individual motors including motors 340, 343 and 360 is thus simultaneously adjusted by varying the speed of the generator drive motor 346 so that the frequency of the generator 345 output varies in accordance with the speed change desired. One such generator system is known as a Varidyne drive and this generator system is commercially obtainable as a packaged unit. It includes means to keep the individual motors operating at constant power during speed changes by adjusting the generator output voltages along with the frequency.

## OPERATION

As described above in the detailed description of the sealing machine, the improved machine is characterized by its ability to be quickly changed to handle both caps and containers in varying sizes and the necessary adjustments for size changes are made readily and largely without changing parts.

Only two major adjustments are required to set the machine for a particular container size. The first is the adjustment of the height of the sealing head 6 above the conveyor 3 using the control wheel 30 which raises or lowers the entire sealing head unit 6 as described above. The side belts 14 which carry the containers beneath the sealing head 6 are set for the desired container diameter by the control handle 285 which simultaneously adjusts the position of the front and rear side belts 14.

The machine is adjusted for the particular cap size being used by adjusting the width and height of the cap chute 70. The width of the cap chute is adjusted by control knob 64 and the height by the single adjusting screw 81. The centering rails 88 on the lower end of the cap chute are also adjustable for the particular cap diameter to direct the cap into the chute end rails 103. The centering rails 88 are adjusted by the single adjustment screw 90 and the chute end rails 103 which present each cap to a moving container are also adjusted to the cap diameter by the adjusting screw 105.

In the operation of the cap applicator 11 for screw caps and applicator 219 for press-on caps, each moving container draws the lowermost cap from the cap chute end rails 103 or 222 so that the cap tends to drop into telescoping relationship on the top of the moving container. Thereafter in the case of both the applicator 11 for screw caps and the applicator 219 for press-on caps, the cap is held in a level position above the container top by the generally horizontal magnetic leveling plate. Leveling plate 115 prevents premature engagement of the threads in the case of threaded caps and leveling plate 228 levels the press-on caps with respect to the plane of the container finish.

In the case of screw caps, the applicator 11 now lightly rotates the leveled cap downwardly onto the container threads as the drag 130 engages an off-center portion of the cap top while an opposite portion of the cap top is slidably positioned beneath a spaced leveling plate 128. This drag operation lightly spins or twists each cap into engagement with the container threads.

Where press-on caps are being applied by applicator 219 the caps are carried on the moving containers from the magnetic leveling plate 228 to a generally horizontal pressure plate 236 which lightly presses each cap downwardly into engagement with the container finish so that the cap is level on the container finish when the cap reaches the press-on sealing head 250.

The height of the applicators 11 and 219 is set first by the adjustment of the position of the entire sealing head 6 by control wheel 30 as described above and fine adjustments of the magnetic leveling plates, and drag or the pressure plates are made by the individual adjusting screws described above.

In order to prevent a screw cap from backing off the container threads after it leaves the drag 130 and before the cap is engaged by sealing head 15, a holding drag 139 engages an off-center portion of the cap top

so that its drag force holds the cap against any tendency to back off.

In operation the improved sealing head **15** provides for an automatic adjustment during sealing thereby eliminating the continuing adjustments necessary on the present machines and it also provides for lengthened life of the sealing head parts by both reducing wear and by automatically compensating for wear.

These improved results will be more fully understood from the following description of the operation of the sealing head **15**.

As best illustrated in FIG. 27, each container **5** moves beneath the sealing head **15** with a screw cap **12** resting in light engagement with the container threads. The sealing head **15** completes the sealing operation by firmly twisting the cap **12** with a predetermined sealing torque so that the gasket in the cap **12** is moved into sealing engagement with the container sealing finish. This final sealing torque is adjusted to permit subsequent removal of the screw cap **12** within a removal torque range suitable for the consumer.

The final sealing torque is supplied by cooperative action of the sealing belt **151** and the drag shoe **150**. The sealing belt **151** is being driven faster than the conveyor, i.e., faster than the movement of the jar top. The friction pad **164** of the drag shoe **150** frictionally engages one off-center portion of the cap top thereby retarding this portion of the cap while the sealing belt simultaneously frictionally engages an opposite off-center portion of the cap to urge it forward with relation to the moving conveyor. These forces are applied in such a direction as to tighten the cap on the container threads. While this rotational effect is being applied, both the belt **151** and the drag shoe **150** are being pressed downwardly against the cap top under the force of the two mounting springs **179** for the sealing head **15**. The belt **151** and the drag shoe **150** are movably mounted with respect to one another through the pivotally mounted stabilizer **171**. Upward movement of either the drag shoe **150** or the belt **151** causes a corresponding and compensating downward movement of the other as the drag shoe **150** and the sealing belt pressure pad **152** are connected to opposite sides of the stabilizer **171** through mounting posts **165** and **166**. It, therefore, is clear that the belt **151** and the drag **150** will remain at all times in engagement with the top of the cap **12** even though the cap top may not be level and even though the belt **151** and the friction surface **164** on the drag **150** wear unevenly. Thus, should the friction member **164** tend to wear more rapidly than the belt **151**, the drag **150** will move downwardly to remain in engagement with the cap top and the support pad **152** for the belt **151** will move upwardly to compensate for the wear.

The main pressure springs **179** (FIG. 9) operate to continually hold both the drag shoe **150** and the belt **151** in engagement with the cap top as their relative positions continuously adjust themselves in this manner.

The alternate embodiment of the sealing head for screw caps as illustrated at **190** in FIGS. 39 to 41 is particularly adapted for use in a sealing operation where the overall height of the sealed packages tends to vary from package to package due to slight differences in container size or due to variations in the exact shape of the particular closure cap being applied. As described more fully above, this sealing head is characterized by the formation of both the back-up pad **197** for the sealing belt **191** and the drag shoe **192** with entrance and exit sections. In operation, this permits the isolation of the entrance section of the sealing head from the exit section so that each of these sections may accommodate itself to the particular container therebelow. Thus, if a slightly higher container happens to follow a shorter container, they both will be fully sealed as the exit sections of the sealing head will remain at the lower height and in contact with the top of the shorter container while the entrance sections of the sealing head raise sufficiently to accommodate a taller container. During this accommodation, both portions will retain their original orientation with respect to the plane of the conveyor so that full effect is obtained from the cap rotating action of the drag friction pad **195** and the cooperating sealing belt **191**.

The third embodiment of the sealing head **250** (FIGS. 32 to 35) for press-on closures also has its pressure means for backing up the sealing belt **251** divided longitudinally of the conveyor with an entrance shoe **253** isolated from an exit shoe **255**. This permits the sealing belt **251** to accommodate itself to containers of differing heights where one container is beneath the entrance shoe **253** and where the other moves into the exit portion **255**. When the containers reach this position, individual shoes **253** and **255** will move independently to the necessary height to provide uniform pressure on the respective caps so that the caps are applied in a level position to the container finishes.

In moving to the necessary level determined by the package height, the separate shoes **253** and **255** are held generally horizontal by the mounting arms **254** and **256** and by the stabilizing action of the pivotally connected links **267** between the shoes **253** and **255**.

The preferred embodiment of the entrance pressure shoe **253** also has a tunnelled lower surface described in detail above. In operation, this tunnel acts to prevent tilting of the cap as the cap moves beneath the sealing belt **251** since it will be seen that the belt first makes contact with spaced side portions of the cap rearwardly of the leading edge of the cap such as would normally be first engaged by a flat sealing belt.

The operation of the machine includes provision for vacuum sealing the containers. The containers travel through a chamber tunnel **16** where steam displaces air from the headspace of the containers.

Each cap positioned on the cap chute **70** has its underside filled with steam to likewise displace air. To prevent premature condensation of the trapped steam, the outer side of each cap is heated as described above.

As each container receives its cap, the vapor is trapped in the headspace by the cap. To prevent re-entry of air into the container or to the underside of the cap prior to sealing, a cloud of steam is directed around the cap and the upper portion of the container as the cap is applied to and prepared for sealing upon the container.

As described above, controls are provided to determine the degree of vacuum desired, by admitting steam through a pet cock having several calibrated bores.

It will be seen that the method and machine provide for high speed and self-adjusting vacuum sealing of threaded-type containers with lug, threaded, or interrupted thread closure caps. The machine also brings a new degree of utility to the sealing of both screw closures and press-on closures due to its unique combination of adjustability for varying cap and container sizes and types and its equally advantageous long life and automatic adjustment. Rapid wear of sealing elements, particularly in sealing machines for screw closures, has heretofore been a serious drawback preventing the efficient application of straight line sealing machines to this use. Where straight line sealing machines have been thus applied, their design has required continuing adjustment of the sealing elements and a rapid replacement of the sealing head parts.

The above improved features have also been incorporated in a unique design characterized by ready accessibility for adjustment, observation, and cleaning. The improved machine also includes a basic conveyor structure quickly and readily adaptable for use in any given sealing line. An improved vacuum system is also shown which

normally operates in an enclosed chamber with minimal steam escape but which also operates in an initial set-up permitting operation with the cover open. Improved related and cooperating elements including cap chute, cap applicator and side belt structures are disclosed to provide the above improved results in combination with the improved sealing heads.

An alternate embodiment of the improved sealing machine is particularly adapted for use where the machine is to be used in a sealing line in combination with auxiliary devices such as fillers, headspacers, labelers and so forth and where simultaneous speed adjustment is provided for all drive motors. This simultaneous adjustment is also taken advantage of within the sealing machine itself by replacing mechanical coupling with the use of conveniently positioned independent drive motors. In the improved system, speed adjustment of all elements of the sealing machine is accomplished with a single control knob.

As various changes may be made in the form, construction and arrangement of the parts herein without departing from the spirit and scope of the invention and without sacrificing any of its advantages, it is to be understood that all matter herein is to be interpreted as illustrative and not in a limiting sense.

Having thus described our invention, we claim:

1. In a machine for sealing containers with closure caps the combination of means for conveying containers, spaced means engaging opposite off-center portions of caps on the containers being conveyed for applying closure caps to the containers, and means interconnecting said spaced means for simultaneous movement to equalize the force applied to the closure caps at said off-center portions.

2. In a machine for sealing containers with closure caps, the combination of means for conveying containers, spaced friction means for engaging opposite off-center portions of caps on the conveyed containers for applying closure caps to the containers, and means pivotally interconnecting said spaced friction means for equalizing the force applied to the closure caps at said off-center portions and thereby compensate for uneven wear on said spaced friction means.

3. In a machine for sealing containers with closure caps, the combination of means for conveying containers, a plurality of spaced friction members for engaging opposite off-center portions of caps on the conveyed containers for twisting caps onto the containers, coupling means pivotally and resiliently interconnecting said spaced friction members whereby movement in one direction of one of said friction members produces a corresponding movement of another of said friction members in an opposite direction.

4. In a machine for sealing containers the combination of a belt positioned with its lower run moving in the same direction as conveyed containers and engaging an off-center portion of the tops of closure caps on conveyed containers, a member mounted adjacent said belt and having a friction surface for engaging and retarding an opposite off-center portion of the tops of the closure caps, a pressure member slidably engaging the upper surface of the lower run of said belt, and mounting means for said retarding member and said pressure member whereby vertical movement of one of the members causes an opposite vertical movement of the other member.

5. In a machine for sealing containers the combination of a belt positioned with its lower run moving in the same direction as conveyed containers and engaging an off-center portion of the tops of closure caps on conveyed containers, a member mounted adjacent said belt and having a friction surface for engaging and retarding opposite off-center portions of the tops of the caps, a pressure member slidably engaging the upper surface of the lower run of said belt, and a stabilizer pivotally mounted about an axis generally parallel to the container path, means for mounting the pressure member on said stabilizer and spaced from its axis, means for mounting the engaging and retarding member on the opposite side of said axis whereby upward movement of one member causes a downward movement of the other member.

6. In a sealing machine for twisting closure caps onto containers the combination of a belt positioned with its lower run moving in the same direction as conveyed containers and engaging an off-center portion of the tops of closure caps on conveyed containers, a member mounted adjacent said belt for engaging and retarding an opposite off-center portion of the tops of the closure caps, a pressure member slidably engaging the upper surface of the lower run of said belt, a stabilizer pivotally mounted about an axis generally parallel to the container path, means for mounting the pressure member on said stabilizer and spaced from its axis, resilient means urging said pressure member toward the top of the cap, means for mounting the engaging and retarding member on said stabilizer on the opposite side of said axis whereby upward movement on one member causes a downward movement of the other member and said belt and said retarding member continuously adjust their position for engaging and twisting the caps.

7. In a machine for sealing containers with screw caps the combination of means for conveying containers, a pair of side belts positioned to engage opposite sides of containers on said conveyor, means for driving said conveyor and said side belts at the same speed, spaced friction members positioned above the conveyor for engaging opposite off-center portions of caps on the containers, at least one of said friction members comprising an endless belt, drive means for moving the lower run of said belt faster than the conveyor, a first pressure means for urging one of said friction members against the caps, a second pressure means for urging the other friction member against the caps, a mounting for each of said pressure means providing for movement of each pressure means toward and away from the conveyor, and means operatively connecting said mountings for providing movement of one member away from the conveyor when the other pressure means is moved toward the conveyor whereby the force of the members against the tops of the caps is substantially equalized.

8. The machine as claimed in claim 7 in which said means for driving said conveyor means comprises a first alternating current electric motor whose speed is proportional to the frequency of its input current, said drive means for said side belts and said endless belt comprises a second alternating current motor whose speed is proportional to the frequency of its input current, and an adjustable frequency electric generator coupled to said motors for driving them in synchronism at speeds proportional to the generator output frequency.

9. The method of sealing a container with a screw cap which comprises the steps of loosely threading the cap to the top of the containers, and thereafter moving the container to carry an off-center portion of the top of the cap into sliding frictional engagement with a retarding member and an opposite off-center portion into frictional engagement with a moving endless belt, moving said endless belt at a speed greater than the speed of the moving container and in the same direction, and equalizing the downwardly directed forces against the cap top by said retarding member and said belt member by transmitting a generally vertical movement in one to an opposite generally vertical movement of the other member.

10. In a container sealing machine a sealing head having an endless belt with its lower run held in engagement with caps on moving containers by a pressure plate the improvement which comprises means for forming a lateral curvature in the belt at the lower belt engaging entrance portion of the plate whereby the entrance portion of the pressure belt has its center portion more remotely

spaced from the caps than the side portions causing the belt to initially engage spaced off-center portions of the caps to minimize their tilting as they move into engagement with the belt.

**11.** In a machine for sealing containers with closure caps, the combination of means for engaging the tops of caps for pressing the caps onto conveyed containers, at least two pressure members being vertically adjustable independently of each other and arranged consecutively in the direction of container travel for applying pressure to said engaging means, and a device coacting with one of said pressure members for forming a downwardly facing channel shape on said engaging means to minimize cap tilting during press-on.

**12.** The means as claimed in claim **11** which further comprises a pair of said pressure members, and a stabilizing link member pivotally connected at its opposite ends to said pressure members and aligned in the direction of container movement.

**13.** In a machine for sealing containers with closure caps the combination of an endless sealing belt positioned with its lower run engaging closure cap tops seated upon moving containers, drive means for said belt for moving the lower run in the direction of the moving containers, a first pressure member slidably engaging the container entrance portion of said belt, a mounting means for said first pressure member and providing for vertical movement thereof, a second pressure member slidably engaging the exit portion of said belt, a mounting means for said second pressure member and providing for vertical movement thereof, and a downwardly facing channel in the lower belt engaging portion of the first pressure member whereby the entrance portion of the sealing belt has a downwardly facing channeled shape.

**14.** In a machine for sealing containers with closure caps, the combination of means for engaging the tops of caps for pressing the caps onto conveyed containers, a plurality of members being vertically adjustable independently of each other and arranged consecutively in the direction of container travel for applying pressure to said engaging means, a device coacting with one of said pressure members for forming a downwardly facing channel shape on said engaging means to minimize cap tilting during press-on, and means pivotally interconnecting said pressure members for holding them level with respect to each other.

**15.** In a cap applicator for applying caps to moving containers the combination of a pair of adjustably positioned converging centering rails, a pair of spaced end rails beyond said converging rails for engaging opposite sides of a cap fed thereto and for supporting said cap in an inclined position, means for releasably engaging spaced portions of a cap in the end rails, and means for simultaneously adjusting the spacing of said end rails and said cap engaging means.

**16.** In a machine for sealing caps to containers carried therethrough on a moving conveyor a cap feed chute comprising the combination of an elongated inclined cap support having its lower end positioned above the conveyor to present caps to containers on the conveyor, a first pair of spaced cap guide members on said cap support, first spacing means interconnecting said members and adapted to simultaneously move both members laterally of the support to vary the distance therebetween, a second pair of spaced cap centering guide members at the exit end of said support and being arranged in converging relationship, and second spacing means interconnecting said second pair of spaced guide members and adapted to simultaneously move the members to vary the distance therebetween.

**17.** In a machine for sealing caps to containers carried therethrough on a moving conveyor a cap feed chute comprising the combination of an elongated inclined cap support having its lower end positioned above the conveyor to present caps to containers on the conveyor, a first pair of spaced cap guide members on said cap support, first rail spacing means interconnecting said members and adapted to simultaneously move both members laterally of the support to vary the distance therebetween, a second pair of spaced guide members at the exit end of said support and being arranged in converging relationship, second spacing means interconnecting said second pair of spaced guide members and adapted to simultaneously move the members to vary the distance therebetween, a top guide movably mounted above the cap support, and means to adjust the position of said top guide.

**18.** A cap feed chute for a sealing machine comprising the combination of an elongated inclined cap support, a first pair of spaced cap guide members on said cap support, first spacing means interconnecting said members and adapted to simultaneously move both members laterally of the cap support to vary the distance therebetween, a second pair of spaced guide members at the exit end of said chute and being arranged in converging relationship, second spacing means interconnecting said second pair of spaced guide members and adapted to simultaneously move the rails to vary the distance therebetween, a top guide movably mounted above the cap support, means to adjust the position of said top guide, and vapor distribution means at said top guide.

**19.** In a machine for sealing containers with closure caps having a conveyor for moving containers, a cap applicator for placing caps on containers and a sealing head for sealing caps on said containers, the combination of a pair of endless side belts for engaging said moving containers, at least two pairs of members for guiding said belts, and means for pivotally and resiliently mounting one of said pairs of guiding members with respect to said machine for simultaneously adjusting the tension in each side belt.

**20.** The machine as claimed in claim **19** which further comprises an elongated belt back-up bar positioned adjacent a run of each side belt, a plurality of roller mounting members resiliently attached to each of said backup bars, and a plurality of belt engaging rollers rotatably mounted on each of said mounting members for supporting and guiding the said runs of said side belts.

**21.** The machine as claimed in claim **19** in which said applicator comprises a first friction means for engaging an off-center portion of the caps for rotating the caps in a reverse direction, a second friction means positioned beyond said first friction means for engaging an off-center portion of the caps for rotating the caps towards their container sealing position, and a third friction means intermediate said second friction means and said sealing head for engaging an off-center portion of the caps and for preventing reverse rotation of the caps on the containers prior to the caps being engaged by the sealing head.

**22.** In a machine for sealing containers with closure caps having a conveyor for moving containers, a cap applicator for placing caps on containers and a sealing head for sealing caps on said containers, the combination of a pair of endless side belts for engaging said moving containers, at least two members for guiding each of said belts, means for pivotally and resiliently mounting one of said guiding members with respect to said machine for maintaining the tension in each side belt, and a device for adjustably mounting said tension means on said machine.

**23.** In a machine for sealing containers the combination of a conveyor for moving containers, means for applying caps to containers on said conveyor, means in advance of the applicator means for directing a gaseous fluid into containers, means for sealing the caps onto the containers, means at said applicator means for directing a cloud of gaseous vapor at the caps and containers, means for at least partially enclosing the applying and sealing means, and spaced exhaust ports in said enclosing means coupled to a common exhaust means.

**24.** The machine as claimed in claim **23** in which said applicator comprises a first friction means for engaging an off-center portion of the caps for rotating the caps towards their container sealing position and second friction means between said first friction means and said seal-

ing head for engaging caps and preventing reverse rotation of the caps on the containers.

25. In a cap applicator for applying caps to moving containers the combination of a pair of spaced rails for engaging the opposite sides of caps aligned between said rails and for presenting the endmost of the caps to a moving container, a cap retarding member on each rail, means for movably mounting at least one of said members, means for urging said members into engagement with the endmost of the caps, and said one member being elongated and said mounting therefor being intermediate its ends whereby movement of the endmost cap by a container past the retarding members moves a rearward portion of said one member into engagement with the next of the aligned caps.



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