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Holstein

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[54] CLOSURE CAP APPLYING APPARATUS

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[51] **Int. Cl.** **B67b 3/18;** B65b 7/28

[58] **Field of Search** 53/334, 338, 339, 340, 53/329, 350, 368, 365, 42

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Assistant Examiner—Horace M. Culver
Attorney, Agent, or Firm—Fitch, Even, Tabin & Luedeka

[57] **ABSTRACT**

Apparatus for applying a closure cap or the like to the threaded neck portion of a container, wherein a toggle linkage arrangement is operative in response to movement of an actuating rod to effect movement of forming rollers against the annular skirt portion of the closure cap when disposed on the neck of a container, the toggle linkage arrangement being adapted to accommodate variations in container height and cap size without damage to the container and associated closure cap.

13 Claims, 8 Drawing Figures

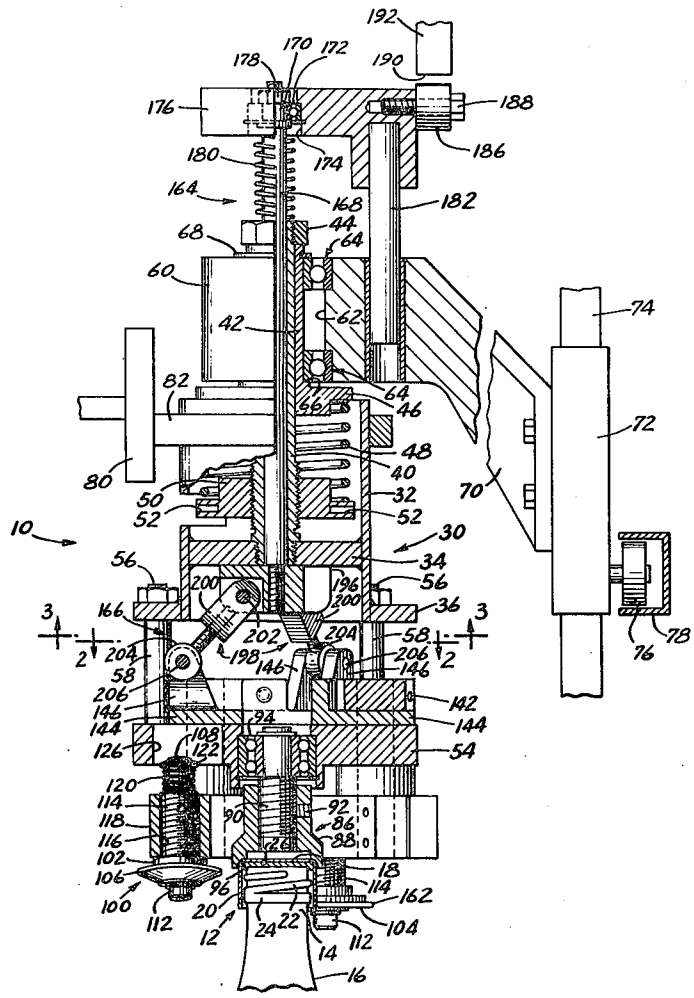
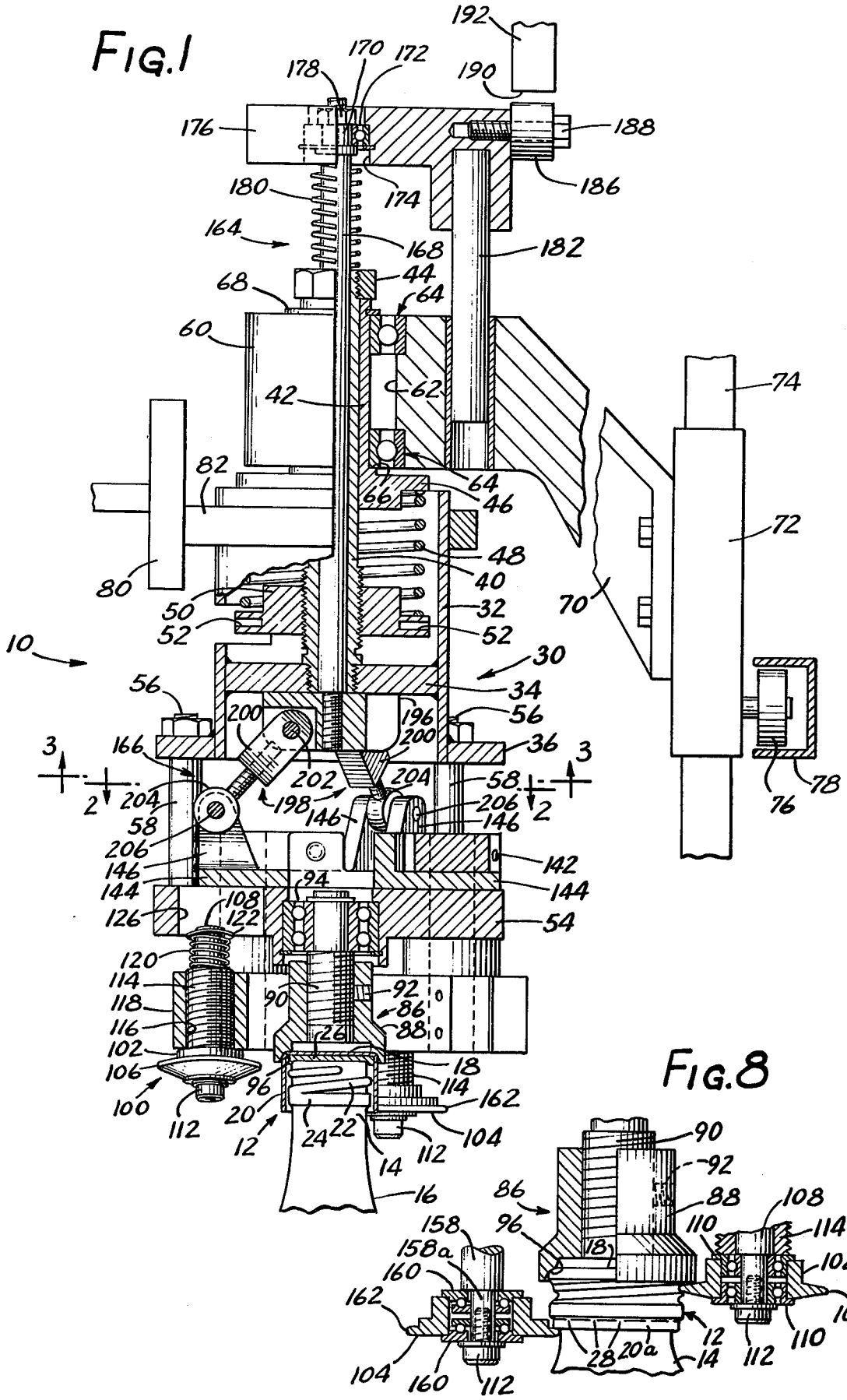


FIG. 1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114
92
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118
86
116
88
102
26
106
18
96
114
162
100
112
20
22
104
12
24
112
14
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76
78

FIG. 8

90
92
86
88
108
96
110
114
158
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158a
102
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162
106
12
110
28
20a
14
112
104
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FIG. 5

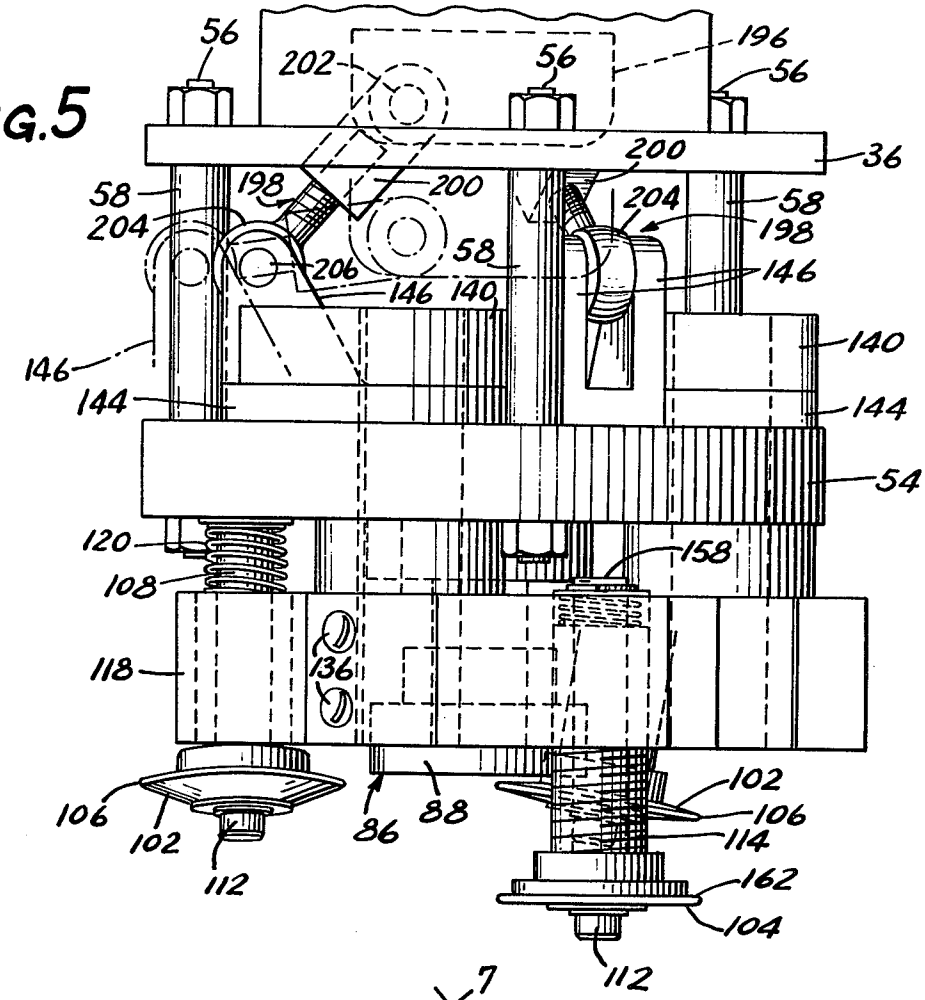
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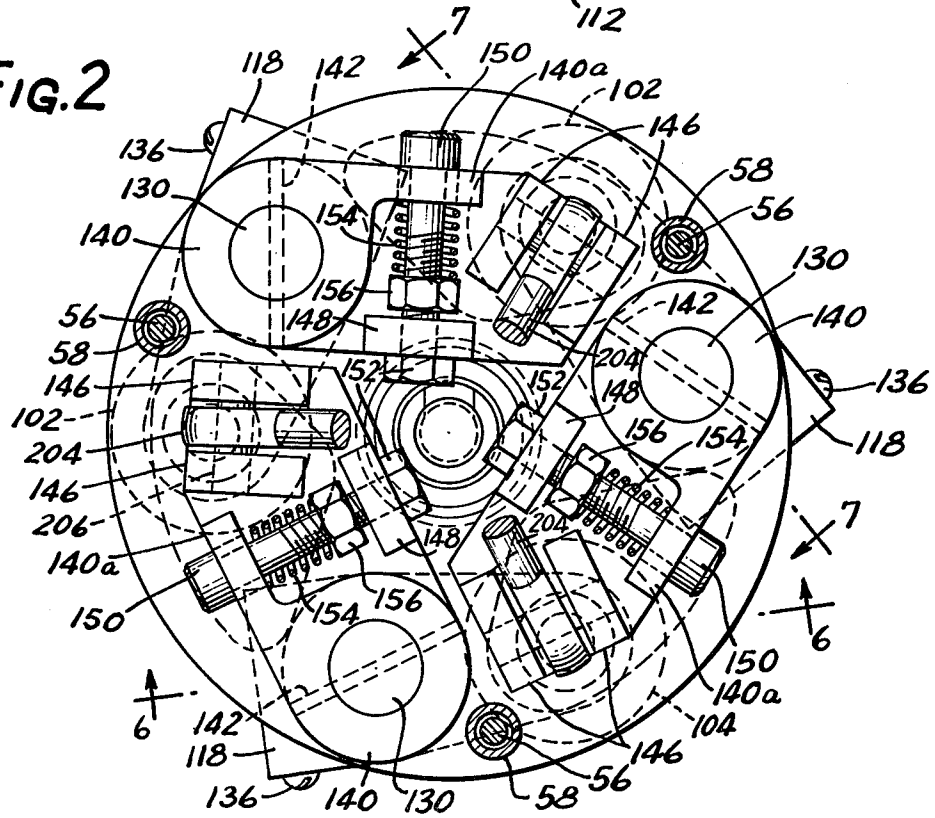
FIG. 2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152
136
146
148
102
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154
118
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146
206
7
140a
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FIG. 3

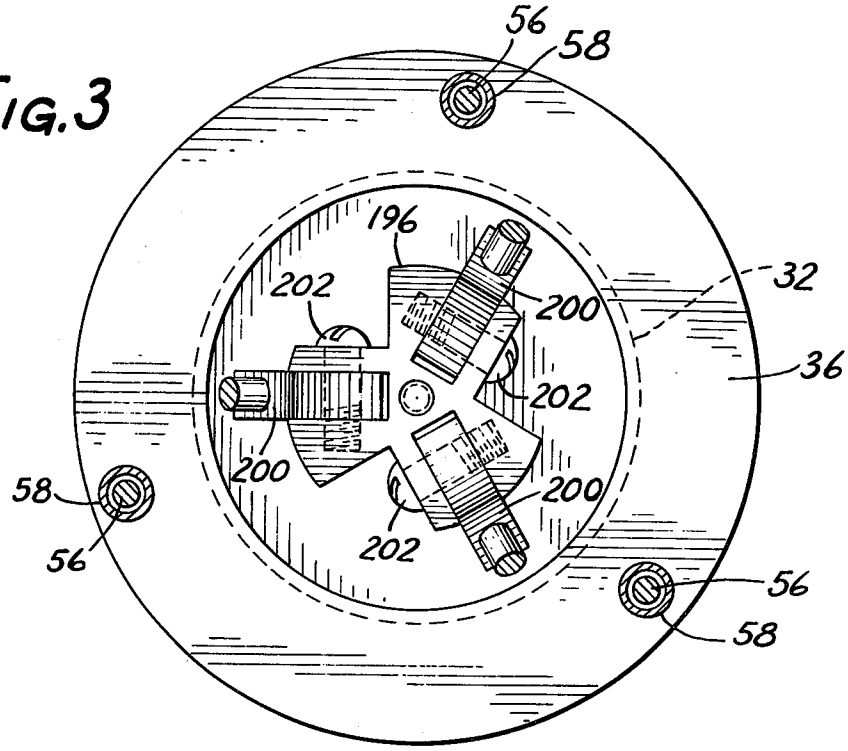
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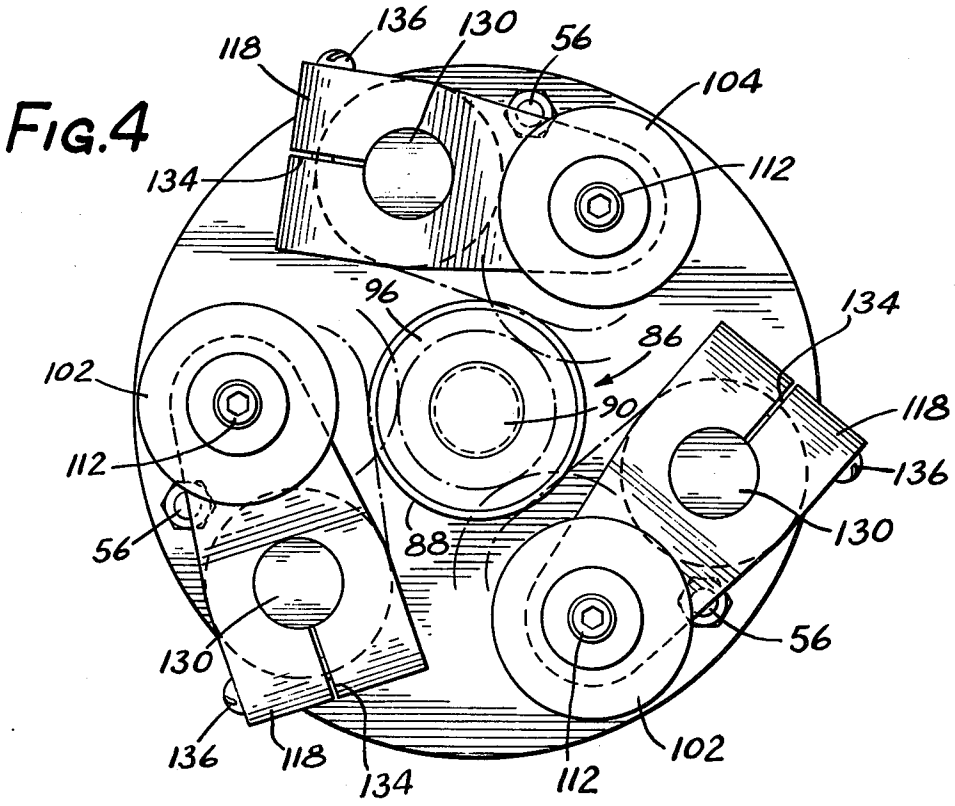
FIG. 4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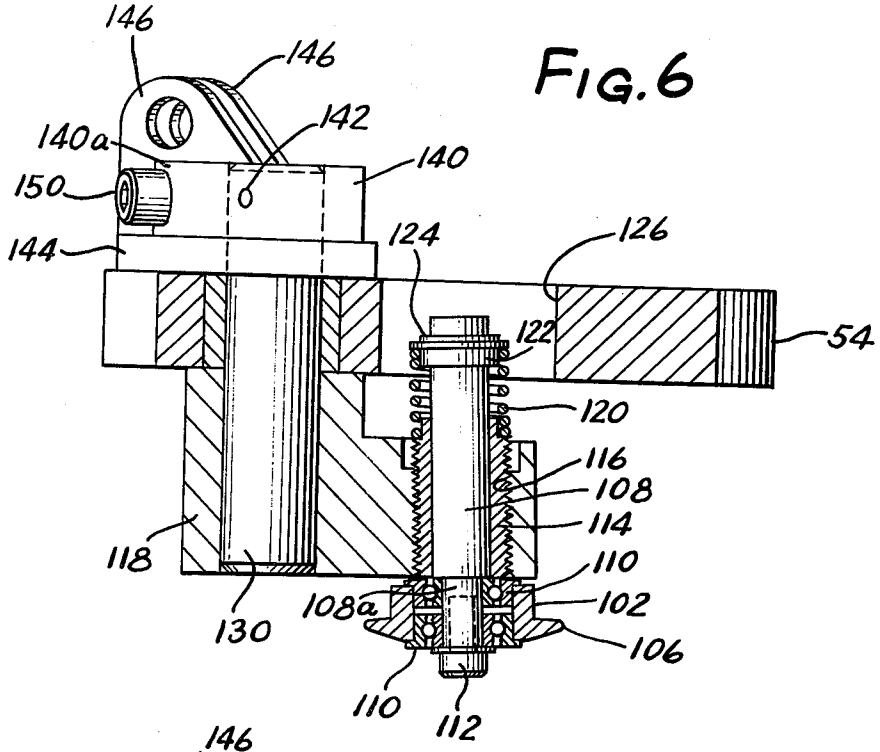
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FIG. 6

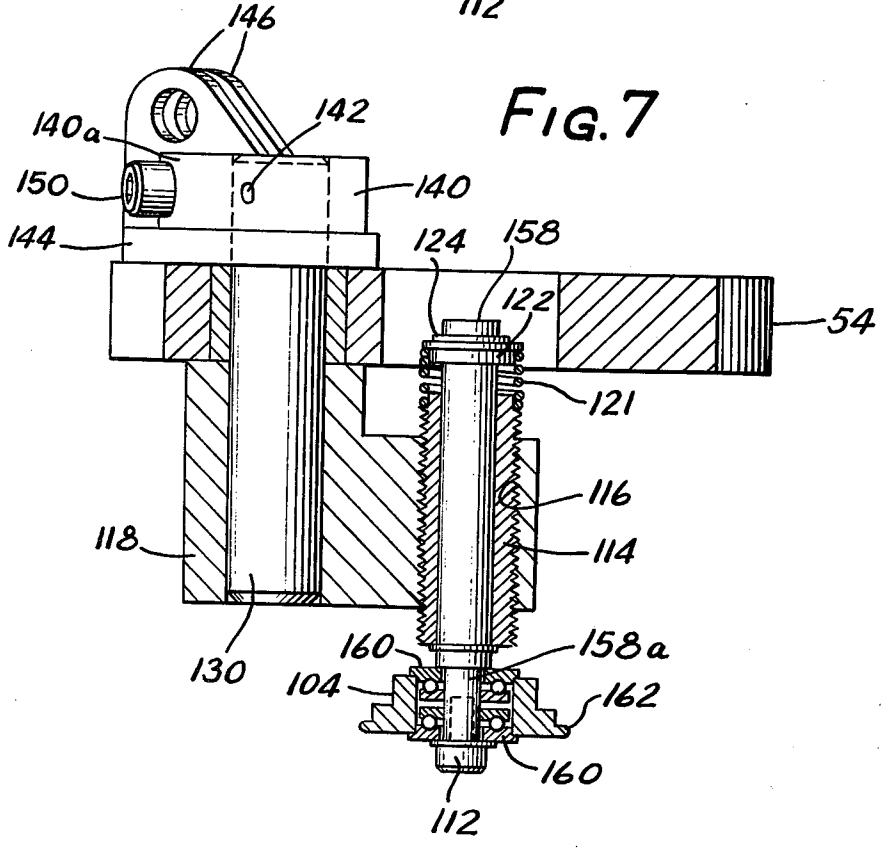
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FIG. 7

CLOSURE CAP APPLYING APPARATUS

The present invention relates generally to closure applying apparatus, and more particularly to a closure applying apparatus of the roll-on type having forming rollers and novel toggle linkage operating means which accommodates variations in container height and neck size without causing damage to the closure caps and associated containers by the forming rollers.

It is generally known to apply closure caps to the upper open ended neck portions of containers by forming or "rolling on" an annular depending skirt of a closure cap against thread conformations or the like generally adjacent the open end of the container. In applying tamper-proof type closure caps, the upper portion of the closure skirt is conventionally formed or spun against a thread conformation by a thread forming roller while the lower edge of the skirt, termed the pilfer ring, is formed inwardly about an annular shoulder on the container by one or more pilfer rollers. The pilfer ring portion of the closure cap skirt is interconnected to the upper cap portion through frangible "bridges" such that when the closure cap is removed from the container the bridges are ruptured indicating that the container has been opened.

The known machines for applying closure caps by the roll-on technique generally include a vertically disposed pressure head which is movable to engage the upper end of a closure cap and urge it downwardly onto the open ended neck of the container, the depending skirt being thereafter formed against the conformations on the container neck. The pressure head is normally positioned relative to a container conveyor or platform means so as to accommodate a predetermined container height when presented for applying a closure cap. In the known capping machines, the forming rollers are generally cammed inwardly to engage the depending skirt of the closure cap by means movable in response to engagement of the closure cap by the pressure head. If a container having a height greater than the predetermined height for which the capper is set is presented for capping, the forming rollers undergo inward over-travel and are caused to engage the skirt of the closure with substantially greater forces than are required with normal size containers, with the result that the closure and/or the container is frequently damaged due to the grinding action of the closure against the container. The present invention overcomes the disadvantages in the known roll-on type closure applying apparatus by providing a novel construction wherein containers varying in height from the normal height for which the apparatus is initially adjusted may have closure caps applied thereto without damage to the container or the associated closure cap.

Accordingly, one of the primary objects of the present invention is to provide novel closure applying apparatus adapted to accommodate variations in container height without damage to the closure cap or container.

Another object of the present invention is to provide closure applying apparatus having at least one forming roller movable to engage the depending skirt of a closure cap and form it against the conformations on the neck portion of a container, the apparatus further including novel toggle linkage means for effecting movement of the forming rollers in a manner to accommodate variations in container height without significantly

increasing the inward forces applied by the forming rollers when applying a closure cap.

Still another object of the present invention is to provide closure applying apparatus as described wherein a plurality of forming rollers are operable to simultaneously form the skirt of the closure cap against an external thread and an annular retaining shoulder on the neck portion of a container, and wherein the toggle linkage means includes a toggle linkage operatively associated with each of the forming rollers in a manner to move the forming rollers radially inwardly a limited distance even though a container having an above-average height is presented to the closure applying apparatus, the limited movement of the forming rollers preventing damage to the container or associated closure cap.

Another object of the present invention is to provide closure applying apparatus as described wherein the forming rollers are rotatably carried on support arms in a manner to accommodate variations in the diameters of container neck portions without damaging the closure caps or containers.

A feature of the present invention is the provision of a novel toggle linkage arrangement operative to effect inward movement of the forming rollers in response to axial movement of an actuating rod, wherein the force required to move the actuating rod during forming of the annular skirt of a closure cap against the container decreases as the actuating rod is moved froms its non-operating position through an operating cycle.

Further objects and advantages of the present invention, together with the organization and manner of operation thereof will become apparent from the following detailed description of the invention when taken in conjunction with the accompanying drawings wherein like reference numerals designate like elements throughout the several views, and wherein:

FIG. 1 is an elevational view, partially in longitudinal section, of a closure applying apparatus according to the present invention in operative association with a container and closure cap;

FIG. 2 is an enlarged transverse sectional view taken substantially along the line 2—2 of FIG. 1, looking in the direction of the arrows;

FIG. 3 is an enlarged transverse sectional view taken substantially along the line 3—3 of FIG. 1, looking in the direction of the arrows;

FIG. 4 is an enlarged bottom view of the apparatus of FIG. 1;

FIG. 5 is an enlarged partial side elevational view of the apparatus of FIG. 1 without the container and associated closure cap;

FIG. 6 is a partial sectional view taken substantially along the line 6—6 of FIG. 2;

FIG. 7 is a partial sectional view taken substantially along the line 7—7 of FIG. 2; and

FIG. 8 is an elevation view, taken partially in longitudinal section, of a portion of the apparatus of FIG. 1, the forming rollers being illustrated in engagement with the associated closure cap.

Referring now to the drawings, and in particular to FIG. 1, a closure applying apparatus in accordance with a preferred embodiment of the present invention is indicated generally at 10. The closure applying apparatus 10 may alternatively be termed a capper chuck or roll-on capper which is adapted to apply a closure cap, such as indicated generally at 12, onto the upper

threaded neck portion 14 of a container such as partially illustrated at 16. The closure cap 12 is illustrated by way of example only and includes an upper closed end portion 18 and an integral depending annular skirt 20 having an internal diameter sufficient to allow the closure cap to be readily assembled onto the upper neck end 14 of the container 16 over an external thread conformation 22 formed integral on the container 16 adjacent the upper open end thereof. The closure cap 12 is preferably made of a suitable metallic material. The external thread 22 terminates at its lower end in an integral annular ring or flange 24 which defines an annular shoulder beneath which the lower end of the skirt 20 is formed.

A circular sealing disc or closure liner 26 is secured within the closure cap 12 beneath the upper closed end 18 thereof and serves to directly engage the upper open end of the neck portion 14 of the container 16 in sealing relation therewith when the closure cap 12 is applied to the container 16. With reference to FIG. 8, the lower end of the annular skirt 20 of the closure cap 12 is defined by a "pilfer ring" 20*a* which is integrally connected to the remaining upper portion of the skirt 20 through a plurality of circumferentially spaced frangible bridges 28. When the closure cap 12 is applied to a container 16 with the pilfer ring 20*a* formed beneath the lower annular shoulder of the flange 24, subsequent removal of the closure cap from the container will sever the bridges 28 such that the pilfer ring 20*a* is separated from the remaining portion of the closure cap as a telltale sign that the container upon which the closure 16 is assembled has been opened. The closure cap 12 may also be of the type wherein the pilfer ring has a plurality of circumferentially spaced vertically disposed lines of weakness which allow the pilfer ring to burst and come off with the cap when removed from its associated container after assembly thereon.

While the container 16 is described herein as having an external thread conformation 22 on the upper neck portion 14 thereof against which the closure cap 12 is formed, it will be understood that substantially any closure retaining means, such as multiple thread, interrupted threads, and detents, all of which represent commercially acceptable closure retaining means, may be substituted for the single thread 22 illustrated.

The closure applying apparatus 10 includes housing means, indicated generally at 30, which defines a longitudinal axis for the closure applying apparatus 10. The housing means 30 is adapted for rotation about its longitudinal axis and includes an annular walled spring housing 32 having a circular transverse plate 34 secured therein and having an annular flange 36 secured to the outer peripheral surface adjacent the lower end as illustrated in FIG. 1.

The plate 34 has a threaded central opening 38 therethrough which provides means for securing the spring housing 32 to the lower threaded end of a tubular guide and support member 40 the upper portion of which is slidingly received through a spring retainer member 42. A nut 44 is threadedly secured on the upper end of the support member 40 and limits the extent of sliding movement of the support member 40 downwardly within the spring retainer member 42. The lower end of the spring retainer member 42 terminates in an annular flange 46 against which is disposed the upper end of a coil compression spring 48. The lower end of the coil compression spring 48 abuts an annular spring nut 50 which is adjustable threadedly secured on the support member 40. A plurality of circumferentially spaced radial openings, two of which are indicated at 52, are provided in the nut 50 to allow adjustment of the nut. In this manner, it can be seen that the compression spring 48 resists upward longitudinal movement of the support member 40 and spring housing 30 relative to the spring retainer member 42 while the nut 44 limits their relative downward longitudinal movement.

The housing means 30 further includes a generally circular platform or support member 54 which is secured to and suspended in axial spaced relation below the spring housing 32 by three equidistantly circumferentially spaced bolts 56 suitably secured to and between the platform 54 and the flange 36 of the spring housing 32. Each bolt 56 has a spacer sleeve 58 disposed thereon between the platform 54 and the lower surface of the flange 36. As will be described more fully hereinbelow, the platform 54 provides means for supporting a plurality of forming rollers which are operative to form the depending skirt 20 and pilfer ring 20a of the closure cap 12 against the thread conformation 22 and the annular flange 24, respectively, on the container 16.

The spring retainer member 42 provides means for supporting the closure applying apparatus 10 on a support arm 60 for movement of the apparatus 10 along a predetermined path during a capping operation. The retainer member 42 is supported within a suitable stepped bore 62 of the support arm 60 by a pair of axially spaced anti-friction ball bearing assemblies each of which is indicated generally at 64. The inner races of the bearings 64 are secured on the peripheral surface of the spring retainer member 42 between a shoulder surface 66 and a snap ring 68. In this manner, the housing means 30 is rotatable about its longitudinal axis as the closure applying apparatus 10 is carried along a predetermined path of travel by the support arm 60.

The support arm 60 has a downwardly inclined portion 70 suitably fixedly secured to a support block 72 which is vertically slidable on a pair of parallel vertically disposed guide rods, one of which is indicated at 74. In this fashion, the support arm 60, and thus the closure applying apparatus 10, may be selectively moved vertically upwardly or downwardly during a capping operation. The support block 72 has a can follower wheel 76 rotatably supported thereon which is received within a can guide channel 78 having a predetermined profile so as to effect selective vertical movement of the closure applying apparatus 10 as it is moved linearly along the aforementioned predetermined path of travel during a capping operation. The manner of supporting the closure applying apparatus 10 for selective rotation about the longitudinal axis of the housing means 30 and for selective vertial movement relative to a horizontal conveyor means adapted to convey a plurality of containers 16 into positions such that each container underlies as associated closure applying apparatus 10 in axial alignment therewith is illustrated and described more fully in Instructional Manual No. 5363-72 published by the assignee of the present invention.

As illustrated in the reference Instructional Manual, a plurality of the closure applying apparatuses 10 may be supported for movement along a generally oval path of travel. Containers, such as 16, are fed along a conveyor means to a station wherein a closure cap 12 is

loosely inserted over the upper threaded end portion of each container. Thereafter, each container is moved to a position underlying a closure applying apparatus **10** in axial alignment therewith whereupon the associated support arm **60** is moved downwardly by the control cam channel **78** to move the associated apparatus **10** into a closure applying or assembling postion. A rub rail or friction plate, such as indicated at **80** in FIG. **1**, is adapted for engagement by an annular friction ring **82** secured on the peripheral surface of the spring housing **32** to effect rotation of the housing means **30** about its longitudinal axis during a capping operation. It will be appreciated that the particular machine with which the closure applying apparatus **10** in accordance with the present invention may be employed may take other forms than the machine illustrated in the aforereferenced Instructional Manual No. 5363-72.

The closure applying apparatus **10** includes pressure head means, indicated generally at **86**, supported by the housing means **30** and adapted for engagement with the upper end of a closure cap **12** when a container **16** having the closure cap loosely supported on its upper neck portion is brought into underlying axial alignment with the apparatus **10** and the apparatus is moved downwardly under the control of the cam channel **78**. The pressure head means **86** includes a pressure block **88** which is threadedly adjustably secured on the lower threaded end portion of a support stud **90** and retained thereon by a set screw **92**. The support stud **90** is supported by the platform member **54** through an antifriction bearing **94** such that the longitudinal axis of the support stud is axially aligned with the longitudinal axis of the housing means **30** and is freely rotatable about its longitudinal axis.

The lower end of the pressure block **88** is appropriately recessed at **96** to accommodate the upper end of the closure cap **12** and effect sealing of the closure cap and associated sealing liner **26** against the upper end of the container **16** when the pressure block **88** is brought downwardly into engagement with the closure cap against the upper end of the container. The action of the pressure block **88** in sealing the closure cap **12** against the upper end of the container **16** is effected prior to rolling of the depending skirt portion **20** and pilfer ring **20***a* of the closure cap against the conformations **22** and **24** on the neck portion **14** of the container.

When the housing means **30** is moved vertically downwardly to effect engagement of the pressure head means **86** with a closure cap **12** disposed on the upper neck portion of a container **16** through downward movement of the support arm **60** under the control of the cam channel **78**, the downward force exerted by the pressure head means on the closure cap is determined by the spring rate of the selected compression spring **48**. Spring **48** is selected such that the pressure head means **86** effects the aforenoted sealing of the closure cap and sealing liner **26** with the upper neck portion of the container **16** without crushing or otherwise damaging either the closure cap or associated container **16**. The compression spring **48** also serves to accommodate variations in container height without causing damage to the closure caps and associated containers **16** even though a container having a height greater than the height for which the vertical travel of the closure applying apparatus **10** is initially set is introduced to the closure applying apparatus **10** during a capping operation.

After a container **16** having a closure cap blank **12** loosely carried on the upper end thereof is presented to the closure applying apparatus **10** and the housing means **30** is moved downwardly to effect pressure contact of the pressure head means **86** against the closure cap **12**, the depending annular skirt **20** and pilfer ring **20a** of the closure cap are deformed inwardly by forming roller means, indicated generally at **100**. In the illustrated embodiment, the forming roller means **100** includes two identically shaped and identically supported thread forming rollers **102**, and one pilfer ring forming roller **104**.

With particular reference to FIG. **6**, each of the thread forming rollers **102** is made from a suitable material, such as hardened metal, and has an annular surface portion **106** which is caused to engage and effect inward deformation of the skirt portion **20** of a closure cap **12** during a capping operation. Each of the thread forming rollers **102** is rotatably supported on a reduced diameter lower end portion **108***a* of a support shaft **108** through a pair of radial anti-friction bearings **110**. The outer races of the bearings **110** capture the associated thread forming roller **102** with the bearings being retained on the end portion **108***a* of the shaft **108** by a retaining washer and socket head screw **112**. Each support shaft **108** is longitudinally slidable in a tubular bushing **114** the outer surface of which is threaded for cooperation with a threaded bore **116** in a support arm **118**.

A compression spring **120** is captured between the upper end of each bushing **114** and an annular spring retainer member **122** secured on the upper end of the associated support shaft **108** by a suitable snap ring **124**. In this manner, the compression springs **120** serve to bias the support shafts **108** upwardly relative to the bushings **114** while allowing downward movement of the shafts **108** and associated thread forming rollers **102** during a thread forming operation. The compression springs **120** are selected to allow the thread forming rollers **102** to follow the thread conformation **22** on the threaded neck portion **14** of the container **16** downwardly when the thread forming rollers are moved to a position engaging the annular skirt **20** of the closure cap during a capping operation. The support platform **54** of the housing means **30** is provided with suitable openings **126** therethrough to allow free movement of the upper ends of the support shafts **108** during movement of the thread forming rollers **102** both longitudinally and in radial directions toward the longitudinal axis of the closure applying apparatus **10**, as will become more apparent hereinbelow.

The support arm **118** for each of the thread forming rollers **102** is secured on the lower end of a pivot shaft **130** which is received upwardly through a sleeve bearing **132** in the support platform **54** in a manner to allow rotation of the pivot shafts **130** about their longitudinal axis. Each of the support arms **118** has a slot **134** therein (FIG. **4**) intersecting the opening receiving the associated shaft **130** therethrough, and has a pair of tightening screws **136** therein which may be tightened to fixedly secure the support arms **118** on their associated support shafts **130** while allowing relative angular adjustment therebetween in a known manner.

An actuating arm **140** (FIGS. **2**, **6** and **7**) is fixedly secured to the upper end of each of the pivot shafts **130** through a transverse lock pin **142** such that rotating the actuating arms **140** will effect a corresponding rota-

tional movement of the associated pivot shafts **130.** A pivot arm **144** is pivotally supported on each of the pivot shafts **130** and is captured between the upper surface of the support platform **54** and the associated actuating arm **140.** The pivot arms **144** are freely rotatable about their associated pivot shafts **130** and have parallel spaced upstanding yoke legs **146** formed integral therewith.

Each of the pivot arms **144** has an upstanding leg portion **148** thereon which is connected to a generally radially extending arm portion **140***a* of the associated actuating arm **140** through a socket head screw **150.** Each screw **150** is received through a suitable opening in the arm portion **140***a* of the associated actuating arm **140** and has its threaded shank portion received through a suitable opening in the upstanding leg **148** of the associated pivot arm **144.** A jam nut **152** is secured on the end of each screw **150** adjacent the associated upstanding leg **148** to limit the extent of relative pivotal movement between each pivot arm **144** and its associated actuating arm **140.** A coil compression spring **154** is disposed about the shank of each of the screws **150** between the associated arm **140***a* and a lock nut **156** in a manner to provide resilient connection between the respective pairs of actuating arms **140** and pivot arms **144.** It can be seen that pivotal movement of the pivot arms **144** in a counterclockwise direction relative to their associated pivot shafts **130,** considered in FIG. **2,** will effect a corresponding counterclockwise pivotal movement of the associated actuating arms **140** through the compression springs **154** to effect a corresponding rotational movement of the pivot shafts **130.** Such movement of the pivot shafts **130** effects counterclockwise pivotal movement of the associated support arms **118** with a corresponding generally radially inwardly directed movement of the thread forming rollers **102** toward the longitudinal axis of the housing means **30.** The actuating arms **140** and associated pivot arms **144** serve as actuating arm means secured to the pivot shafts **130.**

With reference to FIG. **6,** the support shaft **108** for each of the thread forming rollers **102** is supported by its associated support arm **118** such that the axis of each support shaft **108** is canted relative to the longitudinal axis of the housing means **30.** For example, the included angle between the longitudinal axis of the pivot shaft **130** and the longitudinal axis of the support shaft **108,** considered in the plane of FIG. **6** which contains both axes, is approximately equal to the lead angle of the thread conformation **22** on the upper threaded end **14** of the container **16.** In this manner, the annular forming surfaces **106** on the thread forming rollers **102** will readily follow the external thread **22** on the container **16** when the thread forming rollers are brought into engagement against the skirt portion **20** of the closure cap **12** during a capping operation.

The single pilfer ring forming roller **104** is adapted to form the pilfer ring **20***a* on a closure cap **12** inwardly beneath the annular shoulder defined by the annular flange **24** on the neck portion **14** of the container **16,** as best shown in FIG. **8.** Noting FIG. **7,** the pilfer ring forming roller **104** is supported on the lower end **158***a* of a support shaft **158** through a screw **112** and a pair of anti-friction bearings **160** which serve to capture the forming roller **104** and retain it on the lower end portion **158***a* of the support shaft **158** in generally similar fashion to the mounting of the thread forming rollers **102.** The support shaft **158** associated with the pilfer ring forming roller **104** is longitudinally slidable within a bushing **114** secured within a support arm **118** and is urged longitudinally upwardly relative to the support arm by a compression spring **121** retained between the upper end of the bushing **114** and a spring retainer member **122** secured on the shaft **158** by a snap ring **124.** The pilfer ring forming roller **104** is not canted relative to the longitudinal axis of the closure applying apparatus **10** as are the thread forming rollers **102.** The pilfer ring forming roller **104** is positioned relative to its support arm **118** so that an outer edge **162** of the roller **104** is in horizontal alignment with the lower outer edge surface of the annular flange **24** when the capping apparatus **10** is in a capping position as shown in FIG. **8.** When the roller **104** is moved generally radially inwardly during capping, the roller is caused to move downward against the action of spring **121** to form the pilfer ring **20***a* beneath the flange **24.** The spring **121** has a compression force of **14** pounds while the compression springs **120** associated with the thread forming rollers **102** are relatively light, being just strong enough to return the thread forming rollers to their upward positions after a thread forming cycle.

The threaded connections between the bushings **114** and their associated threaded bores **116** in the respective support arms **118** allows vertical positioning of the thread forming rollers **102** and pilfer ring forming roller **104** relative to their associated support arms **118** for establishing proper operating conditions for closure caps having predetermined configurations, i.e., vertical heights. Conventionally, the "at rest" positions of the two thread forming rollers **102** and the pilfer roller **104** are adjusted for a predetermined closure cap and container size and are not changed until the closure applying apparatus **10** is employed with a different "run" of containers and associated closure caps.

The compression springs **154** are selected to effect inward forces on the corresponding thread forming rollers **102** and the pilfer ring forming roller **104** sufficient to effect inward deformation of the depending skirt **20** and pilfer ring **20a** against the thread conformation **22** and flange **24** on the upper neck portion of the container **16,** but assist in preventing damage to the closure cap or the container during a capping operation.

The pilfer ring roller **104** is adapted for movement between an outer position spaced generally radially outwardly from a closure cap **12** and associated container **16** when the closure applying apparatus **10** is brought downwardly to a position wherein the pressure head means **86** engages the closure cap, to a generally radial inward position wherein the pilfer ring forming roller **104** is operative to form the pilfer ring **20***a* beneath the annular flange **24** on the container **16.** Such movement of the pilfer ring forming roller **104** is effected in a manner similar to radial movement of the thread forming rollers **102** by pivotal movement of the associated pivot shaft **130** through an actuating arm **140** and pivot arm **144** mounted thereon in similar fashion to the above described actuating arms and pivot arms for the thread forming rollers **102.**

To effect selective movement of the thread forming rollers **102** and the pilfer ring forming roller **104** from their outer positions to their inward forming positions, the closure applying apparatus **10** includes actuating rod means, indicated generally at **164,** and toggle linkage means, indicated generally at **166,** which cooperate

with the thread forming and pilfer ring forming rollers in a manner to effect selective movement thereof in response to longitudinal movement of the actuating rod means **164.**

Again referring to FIG. **1,** the actuating rod means **164** includes an elongated rod **168** which is longitudinally slidable within the tubular guide member **40** of the housing means **30.** The upper end of the rod **168** has a stepped diameter bearing sleeve **170** supported thereon which serves to support the inner race of a radial ball bearing **172** the outer race of which is fixedly secured within a bore **174** in a thrust block **176.** A nut **178** is threadedly secured on the upper end of the rod **168** to retain the inner race of the bearing **172** in fixed position on the bearing sleeve **170.** A coil compression spring **180** has its opposite ends abutting the nut **44** on the upper end of the guide member **40** and the bearing sleeve **170** and serves to normally maintain the rod **168** in an uppermost position relative to the housing means **30** as shown in FIG. **1.**

The thrust block **176** has a depending guide rod **182** secured thereto for movement therewith, the lower end of the guide rod **182** being slidingly received within a bearing sleeve **184** secured within the support arm **60.** The guide rod **182** serves to maintain the thrust block **176** in predetermined relation relative to the support arm **60** during longitudinal movement of the actuating rod **164.** The thrust block **176** also supports a cam follower roller **186** through a suitable support screw **188.** The cam follower roller **186** is mounted for selective engagement with a cam surface **190** on an actuator cam plate **192** supported externally of the closure applying apparatus **10** for effecting selective downward movement of the thrust block **176** and thereby the actuating rod **168** relative to the support arm **60.** The actuator cam plate **192** may be mounted in a manner as illustrated in the aforereferenced Instructional Manual No. 5363-72 of the assignee of the present invention.

The lower end of the actuating rod **168** has threadedly mounted thereon a toggle clevis block **196** which limits the extent of upward movement of the rod **168** within the guide member **40** and also serves as a pivotal connecting means for a plurality of toggle linkages each of which is indicated generally at **198.** Each of the toggle linkages **198** includes an upper block portion **200** which is pivotally connected through a pivot pin **202** to the clevis block **196.** Each toggle linkage **198** also includes a lower end portion **204** which is pivotally secured to and between one of the pairs of upstanding yoke legs **146** through a pivot pin **206.** Each lower end portion **204** of the toggle linkages **198** is mounted on its associated pivot pin **206** through a spherical self-aligning bearing (not shown) which articulates and compensates for changes in radial alignment between the clevis block **196** and yoke legs **146** during pivoting of the pivot arms **144.** The lower portions **204** of the toggle linkages **198** are threadedly connected to the upper block portions **200** thereof to allow selective varying of the length of each of the toggle linkages **198.**

In the illustrated embodiment of the closure applying apparatus **10,** the toggle linkages **198** are inclined upwardly from their associated pivot arms **144** and the clevis block **196** so as to form included angles of approximately 40° between the longitudinal axes of the respective toggle linkages and the longitudinal axis of the actuating rod **168.** With reference to FIG. **1,** it can be seen that downward longitudinal movement of the actuating rod **168** relative to the spring housing **32** serves to effect outward movement of each pair of yoke legs **146** through the associated toggle linkages **198** so as to effect a pivotal movement of the pivot arms **144** about their associated pivot shafts **130.** Such movement of the pivot arms **144** effects a corresponding rotational movement of the actuating arms **140** to rotate the pivot shafts **130** and effect inward movement of the support arms **118** and associated thread forming rollers **102** and pilfer ring forming roller **104** toward the longitudinal axis of the housing means **30.** By providing variable length toggle linkages **198,** the radial "throw" of the thread forming rollers **102** and the pilfer ring forming roller **104** may be varied both by varying the lengths of the toggle linkages **198** and by angular adjustment of the support arms **118** on their associated pivot shafts **130.**

As briefly described above, the closure applying apparatus or capper chuck **10** may be mounted on a capper machine of the type illustrated, by way of example, in the referenced Instructional Manual No. 5363-72 for applying closure caps **12** to the upper threaded neck portions **14** of containers **16.** The closure applying apparatus **10** is carried along in overlying relation to a generally horizontal container conveying track by the support arm **60** to a position wherein the cam control channel **78** effects a downward movement of the support block **72** on the support rods **74** whereby to effect a corresponding downward movement of the housing means **30** relative to the conveyor track. Such downward movement effects engagement of the pressure head means **86** against the upper end of a closure cap **12** loosely carried on the upper end of a container **16.** Thereafter, the closure applying apparatus **10** and associated container **16** and closure cap **12** are moved along the predetermined path to a position wherein the cam surface **190** on the actuator cam **192** engages the cam follower **186** and effects a downward movement of the thrust block **176** and thereby the actuator rod **168.** Such downward movement of the actuator rod **168** effects a generally radially inward movement of the thread forming rollers **102** and the pilfer ring forming roller **104** as above described.

Simultaneously with downward movement of the actuator rod **168** under the influence of the actuator cam **192,** the friction ring **82** is caused to engage the friction plate **80** and effect rotational movement of the housing means **30** and the associated forming roller means **100,** toggle linkages **198** and actuating rod means **164** about the longitudinal axis of the actuating rod **168** relative to the support arm **60** and the thrust block **176.**

The positions of the support arm **60** and the cam surface **190** of the actuator cam **192** relative to the horizontal container conveyor track surface (not shown) are established such that the pressure head means **86** and actuator rod means **164** are moved downwardly "normal" distances as necessary to properly cap a container of predetermined height during a capping operation. Such "normal" downward movement of the pressure head means **86** and actuating rod means **164** is established to effect proper sealing pressure contact of the pressure head means **86** against the closure cap **12** and effect proper inward movement of the thread forming rollers **102** and pilfer ring forming roller **104** against the depending skirt **20** and pilfer ring **20***a*, respectively, of the closure cap **12** to form or roll them against the thread **12** and beneath the annular flange **24** on the

container **16** during rotation of the housing means **30.**

In a capping operation as described wherein the closure applying apparatus is set up for a predetermined normal container height, the extent of downward longitudinal movement of the actuating rod **168** relative to the housing means **30** may vary if containers **16** of heights varying from the "normal" predetermined height are presented to the closure applying apparatus **10** for capping. For example, if the support arm **60** is moved downwardly a predetermined distance as established by the cam channel **78** and a container **16** of above-average height is engaged by the pressure head means **86,** the housing means **30** will not move downwardly as far as it would with a "normal" height container **16.** In this event, the actuating rod **168,** which is moved downwardly a predetermined distance as established by the actuator cam **192,** will move longitudinally downwardly a greater distance relative to the housing means **30** such that "over-travel" of the actuator rod results. With capper chucks or capper applying apparatus of known design, such "over-travel" effects substantially greater inward movement of the thread and pilfer ring forming rollers and may result in severe damage to the container and associated closure cap, or may damage the capper chuck if the container and associated closure cap resist inward movement of the forming rollers.

In accordance with one embodiment of the closure applying apparatus **10** of the present invention, the lengths of the toggle linkages **198** were set so that the forming rollers **102** and **104** reached their normal desired inward forming positions when the toggle linkages were disposed in positions wherein the longitudinal axes of the linkages were inclined slightly upwardly from the horizontal at angles of approximately nine degrees, as shown in phantom in FIG. **5.** In this manner, if a container **16** is presented for capping which has a height greater than the "normal" for which the closure applying apparatus **10** and associated capper machine are set to receive and properly cap, any downward "over-travel" of the actuating rod **168** relative to the housing means **30,** as may result from the above-average height container, will effect only nominal further inward movement of the rollers **102** and **104** against the closure cap **12** and neck portion **14** of the container. This is due to the fact that as the toggle linkages **198** approach substantially horizontal positions, further downward movement or over-travel of the actuator rod **168** and clevis block **196** will effect only nominal further outward pivotal movement of the pivot arms **144** resulting in nominal inward movement of the forming rollers. It has been found that the closure applying apparatus **10** may readily accommodate variations of plus three-sixteenths inch in height of the containers **16** from the "normal" container height without damage to the container and associated closure cap or to the closure applying apparatus **10.**

In addition to being capable of accommodating substantial variations in height between containers during a capping operation, the closure applying apparatus **10** in accordance with the present invention provides a mechanical advantage which results in a reduced force needed to depress the actuator rod **168** as it approaches its fully depressed position. For example, through the use of toggle linkages **198** as described, the downward force on the actuating rod **168** required to effect radial inward movement of the rollers **102** and **104** to deform the depending skirt **20** and pilfer ring **20a** against the thread and flange conformations **22** and **24** on the container **16** decreases as the toggle linkages **198** approach their substantially horizontal positions.

It has been found that by mounting the forming rollers **102** and **104** on anti-friction bearings **110** and **160,** respectively, substantially less rotational torque is required to effect rotation of the housing means **30** and associated components carried thereby during a capping operation. The known capping apparatuses of the roll-on type employ thread forming and pilfer ring forming rollers which are formed integral with hardened and ground stems that spin in hardened and ground bushings and require special lubricants to operate properly. By mounting the forming rollers **102** and **104** on their respective support shafts **108** and **158** through anti-friction bearings, the lubrication problems inherent in the prior art constructions are eliminated.

While a preferred embodiment of the present invention has been illustrated and described, it will be understood to those skilled in the art that changes and modifications may be made therein without departing from the invention in its broader aspects. Various features of the invention are defined in the following claims.

What is claimed is:

1. Closure applying apparatus of the roll-on type for applying a closure to the neck portion of a container having conformations thereon adjacent the neck portion, the closure having an upper end and a generally annular skirt portion adapted to be received over the neck portion of the container adjacent the conformations thereon, said apparatus comprising, in combination, housing means defining a longitudinal axis for said apparatus and being adapted for rotation about said longitudinal axis, pressure head means supported by said housing means for engagement with the upper end of a closure when disposed on the neck portion of a container, actuating rod means supported by said housing means for longitudinal movement between normal first and second positions relative to said housing means, at least one rotatable forming roller, support means supporting said forming roller for movement between a first position spaced outwardly from the skirt portion of a closure when said closure is engaged by said pressure head means and a second position wherein the peripheral edge of the roller engages the skirt portion of the closure for forming the skirt portion against at least a portion of the conformations on the neck portion of the associated container during rotation of said housing means, and toggle linkage means interconnecting said actuating rod means and said support means such that said forming roller is moved inwardly from its said first position to a predetermined second position upon movement of said actuating rod from its said first position to a predetermined second position as established by the normal height of a container being capped, said toggle linkage means being adapted to accommodate longitudinal over-travel of said actuating rod beyond its said predetermined second position without effecting an appreciable further movement of said forming roller inwardly toward said closure beyond said predetermined second position of said forming roller whereby to prevent damage to said closure and said container upon over-travel of said actuating rod.

2. Closure applying apparatus as defined in claim 1 including means biasing said actuating rod means toward its said first position.

3. Closure applying apparatus as defined in claim 1 wherein the conformations on the neck portion of the container include an external thread and an annular shoulder disposed below the thread, and wherein said apparatus includes at least one thread forming roller adapted to form the depending skirt portion of the closure against said external thread, and at least one forming roller adapted to form the lower edge of the skirt inwardly beneath said annular shoulder, said support means including means for separately supporting each of said forming rollers, and said toggle linkage means being adapted to effect simultaneous movement of said forming rollers upon actuation of said actuating rod means.

4. Closure applying apparatus as defined in claim 3 wherein said thread forming roller is supported for movement in a direction generally parallel to the longitudinal axis of said housing means, said thread forming roller being adapted for engagement with the annular skirt of said closure adjacent the upper end thereof when said actuating rod means is moved to its said second position, said thread forming roller being further adapted to move longitudinally downwardly and form said annular skirt against said thread conformation as said housing means is rotated about its longitudinal axis during a closure applying cycle.

5. Closure applying apparatus as defined in claim 1 wherein said support means includes at least one pivot shaft supported by said housing means for rotation about an axis parallel to the longitudinal axis of said housing means, a support arm secured on said pivot shaft for rotatably supporting said forming roller, and actuating arm means secured to said pivot shaft, said toggle linkage means interconnecting said actuating arm means to said actuating rod means such that said toggle linkage means effects rotational movement of said pivot shaft and movement of said forming roller toward its said second position upon actuation of said actuating rod means toward its said second position.

6. Closure applying apparatus as defined in claim 5 wherein said pressure head means includes a generally circular pressure head supported by said housing means for rotation relative to said housing means about an axis coincident with the longitudinal axis of said housing means.

7. Closure applying apparatus as defined in claim 5 wherein said actuating arm means includes a first arm portion rotatable about the axis of said pivot shaft and secured to said toggle linkage means, a second arm portion secured to said pivot shaft, and means interconnecting said first and second arm portions such that movement of said first arm portion urges said second arm portion in a corresponding rotational direction.

8. Closure applying apparatus as defined in claim 7 wherein said means interconnecting said first and second arm portions includes resilient means adapted to allow limited movement of said first arm means without a corresponding movement of said second arm means when the associated forming roller is prevented from inward movement in response to movement of said actuating rod means toward its said second position.

9. Closure applying apparatus as defined in claim 1 wherein said toggle linkage means includes a toggle link pivotally connected to said actuating rod means for pivotal movement in a substantially vertical plane, said toggle linkage being inclined upwardly when said actuating rod means is disposed in its said first position, and being disposed substantially horizontally when said actuating rod means is moved to its said second predetermined position.

10. Closure applying apparatus as defined in claim 1 which includes three forming rollers, and wherein said support means includes three pivot shafts supported by said housing means for rotational movement about axes parallel to the longitudinal axes of said housing means, a support arm secured to each of said pivot shafts for rotatably supporting one of said forming rollers, and an actuating arm secured to each of said pivot shafts, said toggle linkage means including a toggle linkage interconnecting each of said actuating arms to said actuating rod means such that simultaneous movement of said forming rollers is effected upon actuation of said actuating rod means.

11. Closure applying apparatus as defined in claim 10 wherein each of said forming rollers is movable in a generally radial direction relative to the longitudinal axis of said housing means, and wherein each of said toggle linkages has its opposite ends pivotally connected to the associated actuating arm and said actuating rod means, each of said toggle linkages being pivotal in a plane containing the longitudinal axis of said housing means and forming an acute angle between said longitudinal axis of said housing means and the longitudinal axis of the toggle linkage, said toggle linkages providing a mechanical advantage such that the force necessary to move said actuating rod means to its said second position decreases as said actuating rod means approaches its said second position.

12. A closure applying apparatus comprising, in combination, housing means having a longitudinal axis and adapted to be supported for rotation about said longitudinal axis, pressure head means supported by said housing means for rotation relative to said housing means about an axis coincident with the longitudinal axis of said housing means, actuating rod means supported by said housing means for longitudinal movement between first and second positions relative to said housing means, at least one pivot shaft supported by said housing means for rotational movement about an axis parallel to the longitudinal axis of said housing means, a support arm secured to said pivot shaft for rotational movement therewith, a forming roller rotatably carried by said support arm, actuating arm means secured to said pivot shaft and movable to effect rotational movement of said support arm and said forming roller toward the longitudinal axis of said pressure head means, and toggle linkage means interconnecting said actuating arm means to said actuating rod means such that said forming roller is disposed outwardly from the longitudinal axis of said pressure head means when said actuating rod means is in its said first position, said toggle linkage means being adapted to effect movement of said actuating arm means a predetermined distance to move said forming roller toward the longitudinal axis of said pressure head means when said actuating rod means is moved to its said second position, said toggle linkage means being further adapted to effect a progressively decreasing differential movement of said actuating arm means as said actuating rod means is moved toward its said second position so as to accommodate longitudinal over-travel of said actuating rod

means beyond its said second position without effecting appreciable further movement of said forming roller toward said axis of said pressure head means.

13. A closure applying apparatus of the roll-on type for applying a closure to the open ended neck portion of a container, the neck portion of the container having conformations thereon generally adjacent the open end thereof, and the closure having a closed upper end and a generally annular depending skirt adapted to be received over the conformations of the neck portion of the container, said apparatus comprising, in combination, housing means defining a longitudinal axis for the apparatus and being rotatable about said longitudinal axis and movable in the direction of said axis, pressure head means supported by said housing means, said pressure head means being adapted to engage the upper closed end of a closure and urge the closure down over the neck portion of a container when the container is brought to a position in underlying axial alignment with said pressure head means, actuating rod means supported by said housing means for longitudinal movement between first and second positions, at least one rotatable forming roller, support means secured to said housing means and rotatably supporting said forming roller for movement between a first position spaced from the skirt portion of a closure when said closure is engaged by said pressure head and a second position wherein the peripheral edge portion of said roller engages the outer surface of the depending skirt of the closure in a manner to form said depending skirt against the conformations on the container during rotation of said housing means, and toggle linkage means interconnecting said support means to said actuating rod means such that said toggle linkage means is effective to move said forming roller toward its said second position when said actuating rod means is moved from its said first position toward its said second position, said toggle link means being of a configuration such that the downward force on said actuating rod means to effect a substantially constant inward force on said forming roller decreases as said actuating rod means moves from its said first position toward its said second position.

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