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APPARATUS FOR APPLYING CAPS TO NECKS OF CONTAINERS

Filed Aug. 17, 1959

3 Sheets-Sheet 1

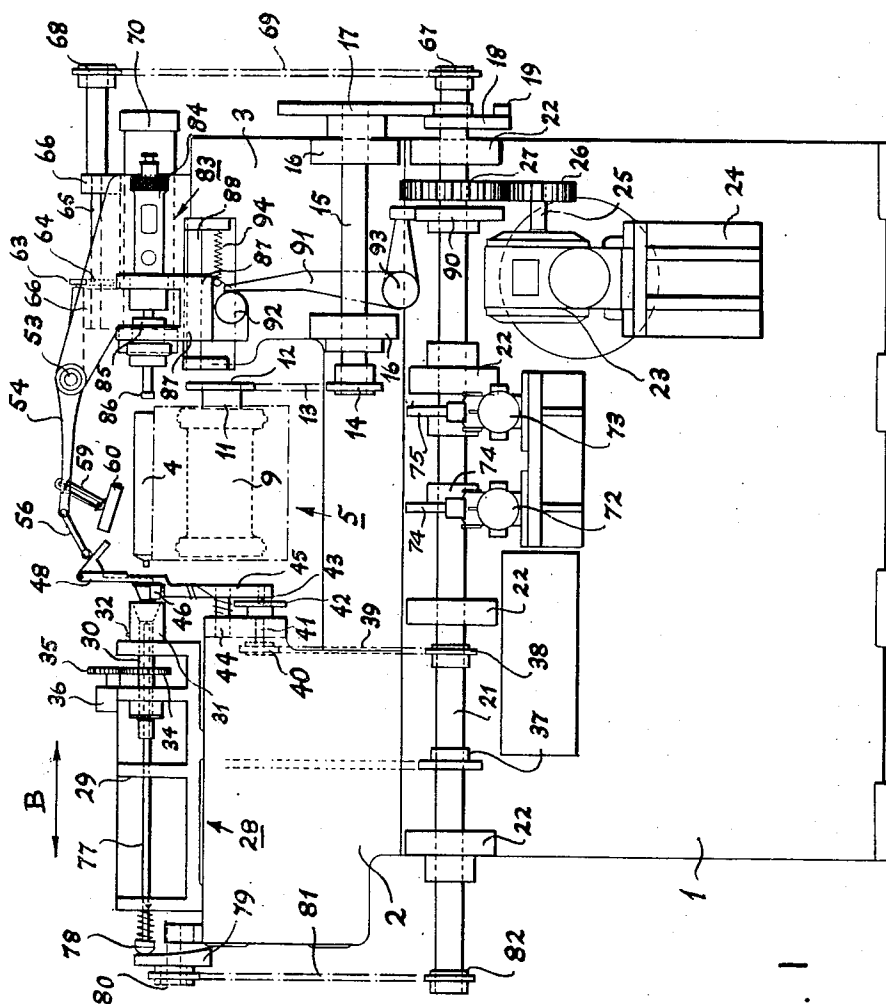


FIG. 1

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3 Sheets-Sheet 2

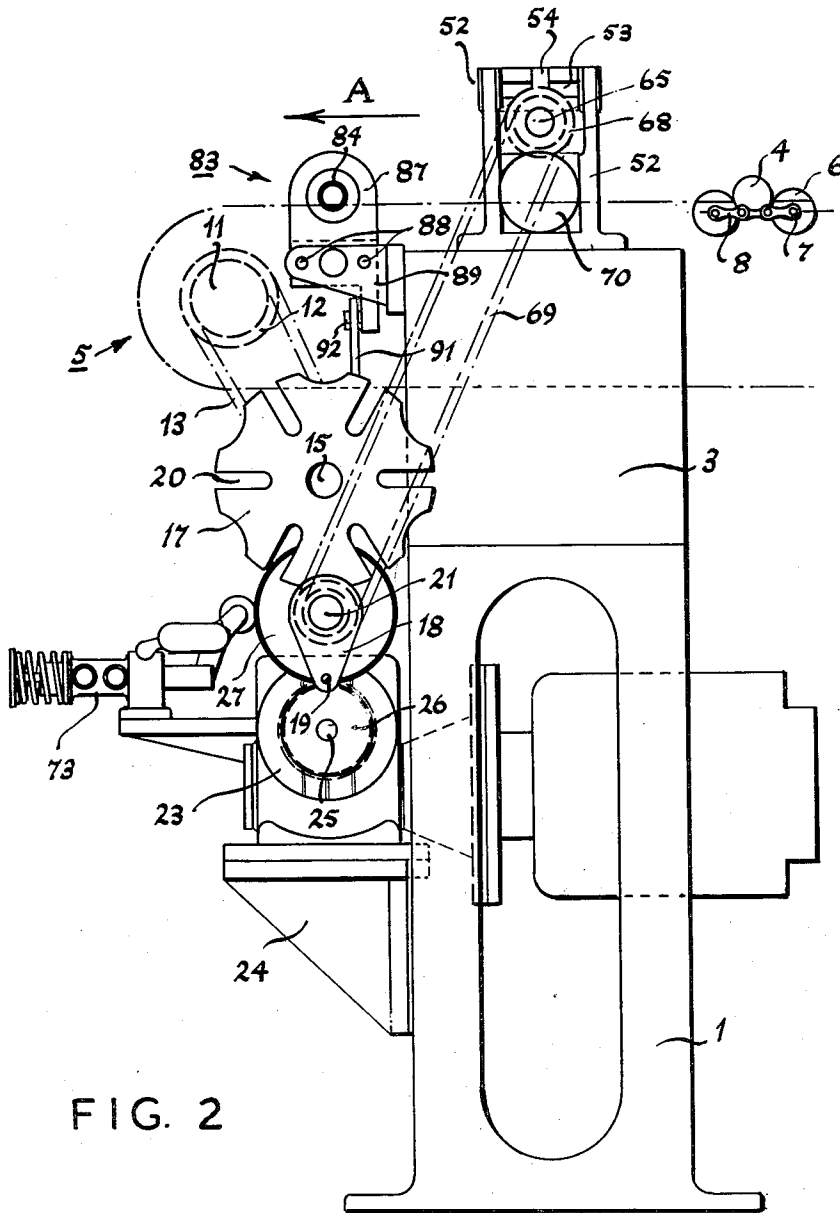


FIG. 2

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3 Sheets-Sheet 3

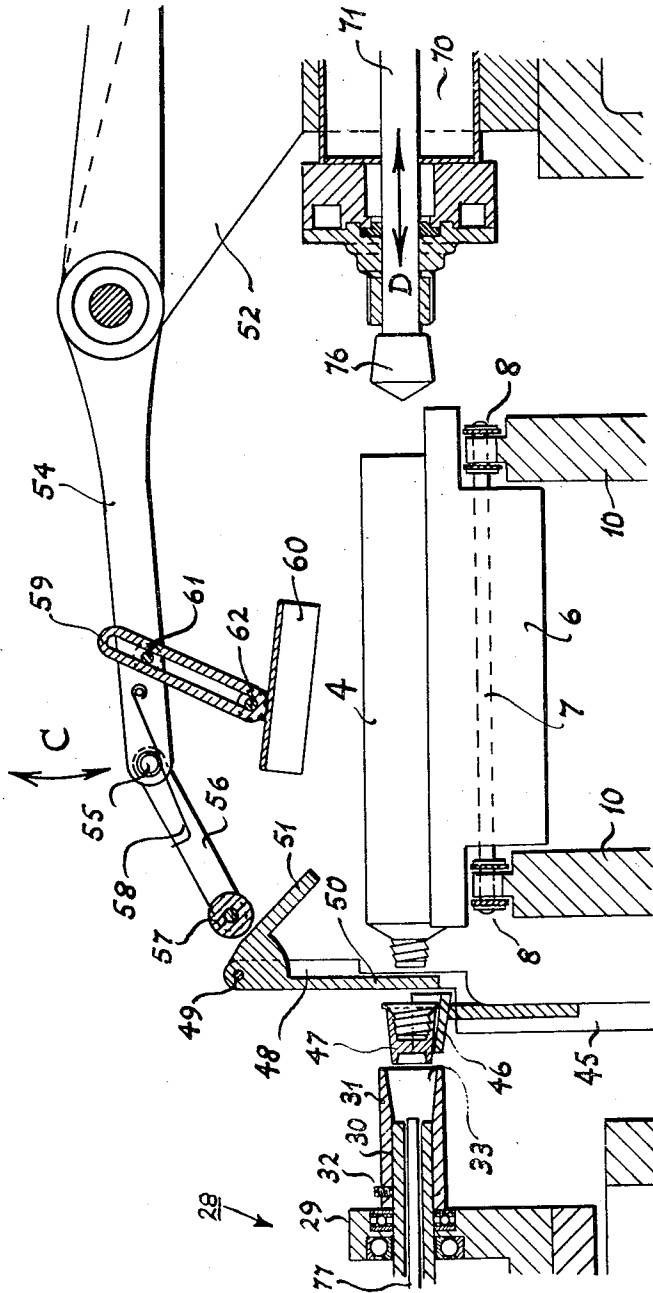


FIG. 3

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APPARATUS FOR APPLYING CAPS TO NECKS OF CONTAINERS

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12 Claims. (Cl. 53-317)

The present invention relates to an improved method of and apparatus for applying caps to empty containers, an operation generally known as "capping." Throughout this specification, "container" will be deemed to refer to a container having a substantially cylindrical body terminated at one end by a shoulder, a part of said shoulder being a screw-threaded opening, the other end (hereinafter called the "bottom end") being either open or closed.

It is normal procedure for the capping operation to take place as a final manufacturing process after the surface of the container has been enamelled and/or printed. In the case of more complex types of container, such as collapsible tubes, however, the capping operation is sometimes associated with other finishing operations. Collapsible tubes are normally filled from the open bottom end, which is then permanently closed by folding and crimping, so that, once capped, the cap of a collapsible tube is not normally removed until it is desired to use some of the contents. Even though containers having the bottom end closed have to be filled through the screw-threaded opening, such containers are nevertheless frequently supplied empty with their caps in position.

Hitherto, automatic machines suitable for capping containers with open bottom ends have comprised a rotatable arbor or mandrel onto which the open bottom end of the container is slid, a stationary arm adapted to hold the cap in axial alignment with the container mounted on said arbor, and adjacent the screw-threaded opening thereof, the threading of the cap onto the container being accomplished by rotating the rotatable arbor with respect to the cap. Capping by machines of the type just described is dependent on the frictional engagement between the arbor and the container and it is therefore necessary to make the arbor a reasonably good fit inside the container, and sometimes it is useful to provide, in addition, a rubber nose to the arbor to enhance said frictional engagement. Disadvantages arise when machines of this type are used for capping collapsible tubes. Firstly, since the arbor is required to be a snug fit inside the tube, precision aligning is required between tube and arbor, thus making the machine unnecessarily complicated and relatively slow in operation. Secondly, the presence of the arbor inside the tube and/or any relative slip between the arbor and the tube is liable to damage the tube, particularly if internal protective coatings are present.

A capping machine in accordance with the present invention overcomes these disadvantages in that it comprises means for aligning the screw-threaded opening of a container of the kind specified with a screw cap, means for bringing the cap into contact with the screw-threaded opening, means for frictionally holding the container against rotational movement, and means for rotating the cap to screw it onto or into the screw-threaded opening.

The invention also includes a method of capping containers having a screw-threaded opening wherein the containers are brought sequentially into alignment with both a receptacle holding a cap and with frictional means, the receptacle and container are brought together to bring the cap into contact with the screw-threaded

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opening, and the frictional means is moved to a position in which it holds the container against rotational movement, the receptacle being rotated with its contained cap at least when the cap is in contact with the screw-threaded opening of the container.

A preferred capping machine according to this invention comprises a rotatable chuck for holding a screw cap, conveying means for effecting axial alignment of a container and the chuck, the screw-threaded opening of the container being adjacent the chuck, means for supplying the cap to the rotatable chuck, means for bringing the cap into contact with the screw-threaded opening, means for rotating the rotatable chuck and the cap therein at least after said cap and screw-threaded opening have been brought into contact, and frictional means for engagement with a part of said container during at least the latter part of the period in which the cap is rotating with respect to the screw-threaded opening.

The advancement of the containers past the rotatable chuck can conveniently be of a step-by-step nature with the capping being accomplished during the dwell periods. The conveying means can take the form of peripheral recesses in a rotatable disc or an endless track conveyor.

The supply of caps to the rotatable chuck is co-ordinated with the advance of containers, said supply being accomplished by any conventional means.

When containers with closed bottom ends are to be capped, the frictional means may conveniently engage the closed bottom end of the container. When containers with open bottom ends are used, the frictional means may take the form of a cylindrical arm with a cross-sectional diameter considerably smaller than the internal diameter of the body of the container, said arm having a head of a shape designed to engage with a substantial part of the internal surface of the shoulder. Such a frictional means is of considerable advantage in the case of containers of the collapsible tube type having an open bottom end, since the shoulder of such tubes is substantially non-collapsible. The cylindrical arm is arranged to be inserted reciprocally into each container and its head to make contact with the internal shoulder thereof just before the cap is applied to the screw-threaded opening, said arm being withdrawn from said container at the conclusion of the capping and prior to the next sequential advance of the conveying means.

One form of container capping machine in accordance with this invention, particularly suitable for the automatic capping of containers with open bottom ends, will now be described with reference to the accompanying drawings in which:

FIGURE 1 is a side view of a capping machine,

FIGURE 2 is an end view of a part of the machine of FIGURE 1, and

FIGURE 3 is an enlarged sectional view of a part of the machine of FIGURE 1.

Referring to the drawings, the base of the machine is formed of three machined castings 1, 2 and 3, bolted to each other. Containers 4, coming off a production line prior to capping, drop at a controlled rate on to a horizontally disposed roller track conveyor generally designated 5 and comprising rollers 6 fixedly mounted on axles 7, the axles being maintained in parallel spaced relationship by two chains 8. The rollers 6 are made from a resilient material such as rubber. The chains 8 pass round a driven chain roller 9 and an idler chain roller (not shown), the links of the chain meshing with teeth on the peripheries of the chain rollers. Side plates 10 support the links of the chains 8 along the straight lengths of the conveyor track. The containers 4 occupy positions on the conveyor track in which the body of each container lies between two rollers and in contact with both. The rate at which containers drop onto the con-

veyor track is controlled so that there is one container between each pair of rollers.

The driven chain roller 9 is fixedly mounted on an axle 11, to one extremity of which is keyed a toothed wheel 12 which is connected by a chain 13 to a second toothed wheel 14 keyed to one end of a shaft 15. The shaft 15 is rotatably mounted in bearings 16 on the base member 3 and has keyed to its extremity a Geneva wheel 17. The Geneva wheel is actuated by an actuating cam 18, the pin 19 of which engages in slots 20, thereby rotating the Geneva wheel through 60° for each complete revolution of the cam 18. The cam 18 is keyed to a main shaft 21 adjacent one end thereof, the main shaft being rotatably mounted in bearings 22 on the base member 1. The shaft 25 of an electric motor 23, mounted on a bracket 24 of the base member 1, is keyed to a gear wheel 26, which gear wheel drives a second gear wheel 27 keyed to the main shaft 21.

With the motor 23 running, it is arranged that the roller track conveyor advances in step-by-step manner in the direction of the arrow A in FIGURE 2, it being further arranged that each advance made by the conveyor is equal to the axial separation of adjacent rollers 6.

Mounted on the base member 2 is a capping head generally designated by 28. The capping head comprises a frame 29 slidably mounted on the base member 2. Rotatably mounted in bearings on the frame 29 is a spindle 30 and keyed to the spindle 30 by a grub screw 32 is a sleeve 31, the spindle 30 and the sleeve 31 forming together a cap chuck recess 33. The shape of the chuck recess can be changed to accommodate a cap of a different size and/or shape by changing the sleeve 31. A gear wheel 34 is keyed to the spindle 30 and meshes with a second gear wheel 35 keyed to the drive shaft of a pneumatic torque mechanism 36, the latter being essentially similar in design to the standard type of pneumatic screwdriver. The sliding frame 29 reciprocates as shown by the arrow B of FIGURE 1 actuated by a cam-driven mechanism (not shown) contained within the base member 2, the cam mechanism being chain-driven from the toothed wheel 37 keyed to the main shaft 21.

A second toothed wheel 38 is also keyed to the main shaft 21 and connected by chain drive 39 to a toothed wheel 40. A shaft 41, rotatably mounted in bearings in the base member 2 has keyed to the two ends thereof the toothed wheel 40 and a cam 42. A plate 45 is mounted for rotation about a spindle 44 and on this plate 45 is mounted a pin 43 which is urged by a spring against the surface of the cam 42.

Integral with the plate 45 is an arcuate cradle 46 adapted to hold a screw cap 47. Passing adjacent the extremities of two arms 48 (only one being shown in the drawings) is a spindle 49 on which is rotatably mounted a flick arm which comprises a longer plate 50 which normally lies substantially vertically, and a shorter plate 51 at an angle thereto.

Two plates 52 are mounted on the base member 2 and between them is fixedly mounted a rod 53. Mounted for rotation on the rod 53 is an arm 54 adjacent one end of which is a pivot 55 on which is mounted a smaller arm 56; rotatably mounted adjacent the other end of the arm 56 is a roller 57. A wire spring 58 urges the arm 56 against a stop (not shown) on the arm 54. A slotted arm 59 is adjustably mounted on the arm 54 and loosely mounted at one end of the slotted arm 59 is an arcuate pressure plate 60. The adjustment of the positions of the slotted arm 59 with respect to the arm 54, and the pressure plate 60 with respect to the slotted arm 59, is controlled respectively by screwed pins 61 and 62. The end of the arm 54 moves in the directions of the arrow C (see FIGURE 3), the reciprocal motion of the arm 54 resulting from a wheel 63 contacting the surface of a cam 64. Cam 64 is keyed to a shaft 65 mounted for rotation in bearings 66. The drive for the shaft 65 is

effected from the main shaft 21 via toothed wheels 67 and 68 and a chain 69.

Mounted on the base member 3 and in axial alignment with the spindle 30 is a pneumatic cylinder 70 and a co-operating plunger 71. The details of the cylinder are not shown in the drawings since the cylinder and plunger are of conventional double-action type. The plunger 71 carries a washer which radially divides the cylinder 70 into two parts whereby the plunger 71 can be driven positively in the directions shown by the arrow D (FIGURE 3) by the admission of compressed air to one or other of the two parts of the cylinder. The control of the supply of compressed air to said two parts of the cylinder 70 is effected by means of two valves 72 and 73 connected by pipes (not shown) to the cylinder 70. The valves 72 and 73 are operated by two cams 74 and 75 respectively, the cams being keyed to the main shaft 21.

The end of the plunger 71 externally of the cylinder 70 carries a boss 76 designed to have a profile corresponding to the contour of the internal shoulder of the container.

The sequence of operations of the machine is as follows:

A container having an open bottom end, which will be assumed by way of example to be a collapsible tube, comes from the final decorating operation and falls onto the endless track conveyor 5, occupying a position between two rollers and axially aligned therewith. The conveyor 5 advances the tube intermittently, each advance being followed by a dwell period, towards the capping chuck 33. As each tube is moved along, it passes a metal guide plate spaced a short distance above the upper surface of the track conveyor, which plate bears against the open bottom end of the tube and roughly aligns it with respect to the sides of the track. Eventually each tube comes to rest in line with the cap chuck 33 and the pneumatically operated plunger 71. Cradle 46 of the plate 45 having been supplied with a cap from a conventional dispensing hopper (not shown), pivots into position in front of the cap chuck. Arm 54 is then lowered, thereby causing tensioning of the spring 58. As the arm 56 pivots with respect to the arm 54, tensioning continues until a stage is reached where the roller 57 moves rapidly along the arm 51 causing the arm 50 to flick the cap from the cradle 46 into the recess 33. As the arm 53 reaches the limit of its travel, the arcuate pressure plate 60 applies light restraining pressure to the body of the tube. Plate 45 carrying cradle 46 now pivots away from the front of the cap chuck and at the same time the plunger 71 enters the tube, the boss 76 engaging the inside surface of the shoulder. The pneumatic torque-producing assembly 36 now causes the cap chuck to rotate and at the same time the carriage 29 moves forward closing the gap between the rotating cap and the screw-threaded end of the stationary tube. The plunger 71 with its attached boss 76 now performs the two-fold service of locating the tube at the correct distance from the cap chuck and of providing a backing against the pressure of the chuck. The rotating cap engages the thread and the cap is screwed onto the tube. The final stages of the cycle of operations are the withdrawal of the carriage 29 and the plunger 71 and the lifting of the arm 53. The track now starts moving away from its indexed position with a capped tube and the cycle of operations is repeated as the next tube moves into index position.

A safety ejector 77 passes axially through a hole in the spindle 30, the end remote from the spindle being terminated in a domed member 78. A cam 79, fixedly mounted on a spindle, is connected to a toothed wheel 80, which is in turn connected via a chain 81 to a second toothed wheel 82 keyed to the main shaft 21. The safety ejector ensures that should there be a gap in the sequence of tubes arriving at the cap chuck for capping, the cap remaining in the chuck after the retraction of the carriage 29 is positively removed before the cradle 46 re-

turns to the position in front of the chuck with a fresh cap.

Two index positions later than the index position at which capping is performed, there is provided an additional unit generally designated 83 for spraying sealing compound onto the inside of the wall of the tube adjacent the open bottom end. The spray unit comprises a modified spray gun 84, an air turbine unit 85 and a rotatable dispensing head 86. Sealing compound stored in a reservoir remote from the machine is passed through tubes (not shown) to the spray unit. Compressed air supplied to the unit causes the air turbine to rotate the dispensing head 86 at high speed at the same time causing the modified spray gun to deliver a metered quantity of sealing compound to the dispensing head. The sealing compound, atomized by the combined action of the compressed air blast and the high speed of rotation of the head, passes out through a series of small holes in the head as a fine radically-directed spray. The spray unit 83 is mounted on a support member 87 which is slidably mounted on two parallel cylindrical guide rods 88 forming part of a frame 89. The frame 89 is fixed to the base member 3. A cam 90, keyed to the main shaft 21, bears against one end of a bellcrank lever 91, the other end of the bellcrank lever bearing against a pin 92 mounted on the support member 87. The bellcrank lever is pivoted at 93 to the base support member 3. Two springs 94 (only one being shown) connected between the support member and the frame 89, urge the pin 92 against the bellcrank lever 91.

The operation of the spray unit is timed so that during a dwell period, cam 90, actuating via the lever 91 and the support member 87, causes the dispensing head to be inserted into the open bottom end of a capped tube, the pneumatic supply from one of the valves 72 and 73 being used to actuate the turbine 85 and the gun 84, and thereby to deposit a thin layer of sealing compound inside the tube adjacent the open bottom end thereof. After the completion of the spraying process and before the end of the dwell period, the head 86 is withdrawn from the open bottom end of the tube by the action of the springs 94.

The apparatus also includes safety devices of a mechanical, pneumatic or electric nature which arrest the motion of the machine in the event of a cap or container being misplaced or faulty.

By slight modification, the apparatus may be made suitable for the application to containers of push-on caps or push-in plugs or stoppers; in this case it is not necessary to rotate the cap-applying member or to hold the container against rotation.

What I claim is:

1. A capping machine comprising, in combination, a rotatable chuck means for holding a screw cap; conveyor means for successively moving a series of collapsible tubes including an open substantially cylindrical body terminated at one end by a shoulder having a threaded neck into an operating position in which said chuck means and a screw cap held thereby are located on one side of said conveyor means aligned with and confronting the neck of the respective tube; a support element located on the other side of said conveyor means aligned with said chuck means and being movable toward and away from the same and to a position projecting into the cylindrical body of a tube in said operating position and frictionally engaging said shoulder for holding the tube in said operating position against axial and rotary movements; moving means for placing said chuck means and said support element in a closely spaced position in which the cap and the neck of the tube engage each other; means for rotating said chuck means at least in said closely spaced position so that the cap is screwed onto the neck while said support element holds the tube; and control means for operating said moving means in timed relation with said conveyor means so that the cap is screwed on and

said support element withdrawn from the tube before said conveyor means advances the next following tube to said operating position.

2. A capping machine as claimed in claim 1 wherein said conveyor means are operated by said control means to move in a step-by-step motion, and to stop between advancing steps for a time period during which the cap is screwed on, and said support element advanced and retracted.

3. A capping machine as claimed in claim 1 wherein said conveyor means is a roller track conveyor having rollers with axes parallel to the axis of rotation of said chuck means, each pair of adjacent rollers being adapted to support a tube.

4. A capping machine as claimed in claim 1 wherein said support element includes a rod, and a head portion fixed to said rod and adapted to match the inner surface of the shoulder of a tube, the cross-section of said head being smaller than, but matching the cross-section of the cylindrical body of the tube.

5. A capping machine as claimed in claim 1 and including a positioning means having a concave surface matching the cylindrical body of the tube, and being movable to and from a position cooperating with said conveyor means for positioning a tube in said operating position.

6. A capping machine comprising, in combination, a rotatable chuck means for holding a screw cap, said chuck means having an axis of rotation; supporting means supporting said chuck means for rotary movement and for reciprocating movement in direction of said axis; conveyor means for successively moving a series of collapsible tubes including an open substantially cylindrical body terminated at one end by a shoulder having a threaded neck into an operating position in which said chuck means and a screw cap held thereby are located on one side of said conveyor means aligned with and confronting the neck of the respective tube; a support element located on the other side of said conveyor means aligned with said chuck means and being movable toward and away from the same and to a position projecting into the cylindrical body of a tube in said operating position and frictionally engaging said shoulder for holding the tube in said operating position against axial and rotary movements; first moving means for moving said support element to and from said projecting position; second moving means for moving said chuck means in axial direction to and from a position closely spaced from said support element in said projecting position so that the cap and the neck of the tube engage each other; means for rotating said chuck means at least in said closely spaced position so that the cap is screwed onto the neck while said support element holds the tube; and control means for operating said first and second moving means in timed relation with said conveyor means so that the cap is screwed on and said support element withdrawn from the tube before said conveyor means advances the next following tube to said operating position.

7. A capping machine comprising, in combination, a rotatable chuck means for holding a screw cap, said chuck means having an axis of rotation; supporting means supporting said chuck means for rotary movement and for reciprocating movement in direction of said axis; conveyor means for successively moving a series of collapsible tubes including an open substantially cylindrical body terminated at one end by a shoulder having a threaded neck into an operating position in which said chuck means and a screw cap held thereby are located on one side of said conveyor means aligned with and confronting the neck of the respective tube; supply means for successively placing screw caps in a position aligned with said chuck means and a tube in operating position, said supply means being located between said conveyor means and said chuck means; charging means for transferring screw caps in said

aligned position to said chuck means; a support element located on the other side of said conveyor means aligned with said chuck means and being movable toward and away from the same and to a position projecting into the cylindrical body of a tube in said operating position and frictionally engaging said shoulder for holding the tube in said operating position against axial and rotary movements; first moving means for moving said support element to and from said projecting position; second moving means for moving said chuck means in axial direction to and from a position closely spaced from said support element in said projecting position so that the cap and the neck of the tube engage each other; means for rotating said chuck means at least in said closely spaced position so that the cap is screwed onto the neck while said support element holds the tube; and control means for operating said supply means, said charging means, and said first and second moving means in timed relation with said conveyor means so that the cap is screwed on and said support element withdrawn from the tube before said conveyor means advances the next following tube to said operating position.

8. A capping machine comprising, in combination, a rotatable chuck means for holding a screw cap, said chuck means having an axis of rotation; supporting means supporting said chuck means for rotary movement and for reciprocating movement in direction of said axis; conveyor means for successively moving a series of collapsible tubes including an open substantially cylindrical body terminated at one end by a shoulder having a threaded neck into an operating position in which said chuck means and a screw cap held thereby are located on one side of said conveyor means aligned with and confronting the neck of the respective tube; supply means for successively placing screw caps in a position aligned with said chuck means and a tube in operating position, said supply means being located between said conveyor means and said chuck means; charging means for transferring screw caps in said aligned position to said chuck means; said charging means comprising a pivoted member having an arm located opposite said chuck means and said supply means, a rocking lever, and a spring-loaded member engaging said pivoted member and operated by said rocking lever to effect a rapid charging motion of said arm; a support element located on the other side of said conveyor means aligned with said chuck means and being movable toward and away from the same and to a position projecting into the cylindrical body of a tube in said operating position and frictionally engaging said shoulder for holding the tube in said operating position against axial and rotary movement; first moving means for moving said support element to and from said projecting position; second moving means for moving said chuck means in axial direction to and from a position closely spaced from said support element in said projecting position so that the cap and the neck of the tube engage each other; means for rotating said chuck means at least in said closely spaced position so that the cap is screwed onto the neck while said support element holds the tube; and control means for operating said supply means, said charging means, and said first and second moving means in timed relation with said conveyor means so that the cap is screwed on and said support element withdrawn from the tube before said conveyor means advances the next following tube to said operating position.

9. A capping machine comprising, in combination, a rotatable chuck means for holding a screw cap, said chuck means having an axis of rotation; supporting means supporting said chuck means for rotary movement and for reciprocating movement in direction of said axis; conveyor means for successively moving a series of collapsible tubes including an open substantially cylindrical body terminated at one end by a shoulder having a threaded neck into an operating position in which said chuck means and a screw cap held thereby are located on one side of

said conveyor means aligned with and confronting the neck of the respective tube; a support element located on the other side of said conveyor means aligned with said chuck means and being movable toward and away from the same and to a position projecting into the cylindrical body of a tube in said operating position, said support element including a rod and a head fixed to the end of said rod and having a surface matching the inner surface of the shoulders of the tubes and a cross-section smaller than the cross-section of the cylindrical bodies of said tubes, said head frictionally engaging said shoulder when said supporting element is in said projecting position for holding the tube in said operating position against axial and rotary movement; first moving means for moving said support element to and from said projecting position; second moving means for moving said chuck means in axial direction to and from a position closely spaced from said support element in said projecting position so that the cap and the neck of the tube engage each other; means for rotating said chuck means at least in said closely spaced position so that the cap is screwed onto the neck while said support element holds the tube; and control means for operating said first and second moving means in timed relation with said conveyor means so that the cap is screwed on and said support element withdrawn from the tube before said conveyor means advances the next following tube to said operating position.

10. A capping machine comprising, in combination, a chuck means for holding a cap; conveyor means for successively moving a series of collapsible tubes including an open substantially cylindrical body terminated at one end by a shoulder having a neck into an operating position in which said chuck means and a cap held thereby are located on one side of said conveyor means aligned with and confronting the neck of the respective tube; a support element located on the other side of said conveyor means aligned with said chuck means and being movable toward and away from the same and to a position projecting into the cylindrical body of a tube in said operating position and engaging said shoulder for holding the tube in said operating position against axial movements; moving means for placing said chuck means and said support element in a closely spaced position in which the cap and the neck of the tube engage each other while said support element holds the tube; and control means for operating said moving means in timed relation with said conveyor means so that the cap is attached to the neck and said support element withdrawn from the tube before said conveyor means advances the next following tube to said operating position.

11. A capping machine comprising, in combination, a chuck means for holding a cap; supporting means supporting said chuck means for reciprocating rectilinear movement; conveyor means for successively moving a series of collapsible tubes including an open substantially cylindrical body terminated at one end by a shoulder having a neck into an operating position in which said chuck means and a cap held thereby are located on one side of said conveyor means aligned with and confronting the neck of the respective tube; a support element located on the other side of said conveyor means aligned with said chuck means and being movable toward and away from the same and to a position projecting into the cylindrical body of a tube in said operating position and engaging said shoulder for holding the tube in said operating position against axial movements; first moving means for moving said support element to and from said projecting position; second moving means for moving said chuck means to and from a position closely spaced from said support element in said projecting position so that the cap and the neck of the tube engage each other while said support element holds the tube; and control means for operating said first and second moving means in timed relation with said conveyor means so that the cap is attached to the neck and said support element withdrawn

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from the tube before said conveyor means advances the next following tube to said operating position.

12. A capping machine comprising, in combination, a chuck means for holding a cap, said chuck means having an axis of rotation; supporting means supporting said 5 chuck means for rotary movement and for reciprocating movement in direction of said axis; supporting means supporting said chuck means for reciprocating rectilinear movement; conveyor means for successively moving a series of collapsible tubes including an open substantially 10 cylindrical body terminated at one end by a shoulder having a neck into an operating position in which said chuck means and a cap held thereby are located on one side of said conveyor means aligned with and confronting the neck of the respective tube; a support element lo- 15 cated on the other side of said conveyor means aligned with said chuck means and being movable toward and away from the same and to a position projecting into the cylindrical body of a tube in said operating position and engaging said shoulder for holding the tube in said operat- 20 ing position against axial movements; first moving means

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for moving said support element to and from said projecting position; second moving means for moving said chuck means to and from a position closely spaced from said support element in said projecting position so that the cap and the neck of the tube engage each other while said support element holds the tube; and control means for operating said first and second moving means in timed relation with said conveyor means so that the cap is attached and said support element withdrawn from the tube before said conveyor means advances the next following tube to said operating position.

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