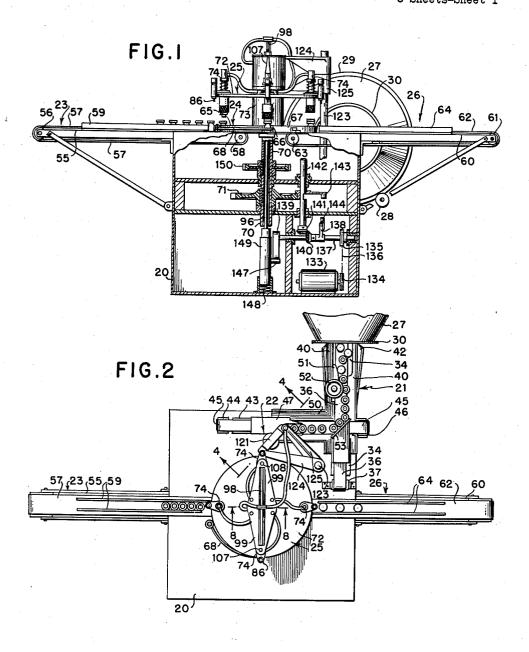
Filed March 7, 1955

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INVENTOR. Frank E. Brown

BY Adams, Jouward & McLean Attorneys

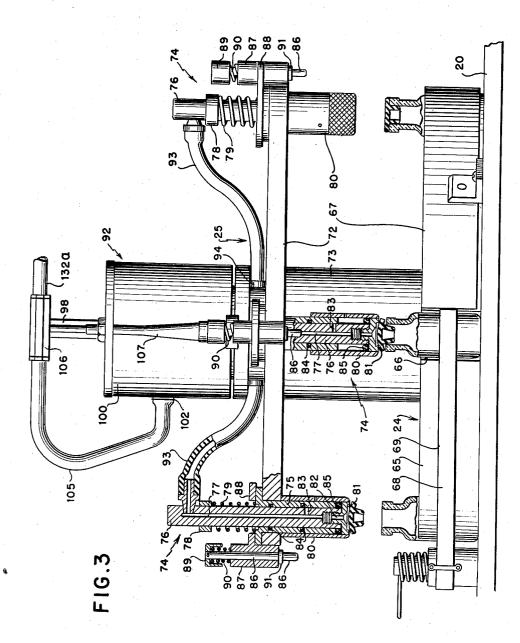
July 1, 1958

F. E. BROWN STOPPERING APPARATUS

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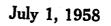
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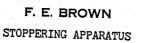


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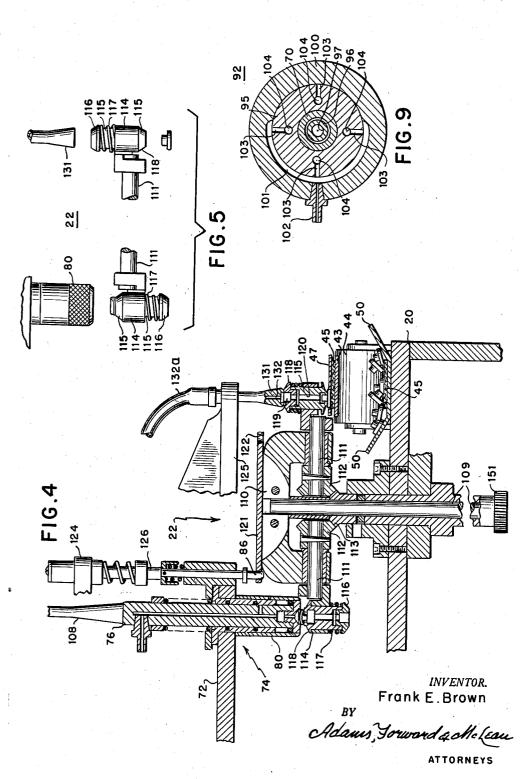
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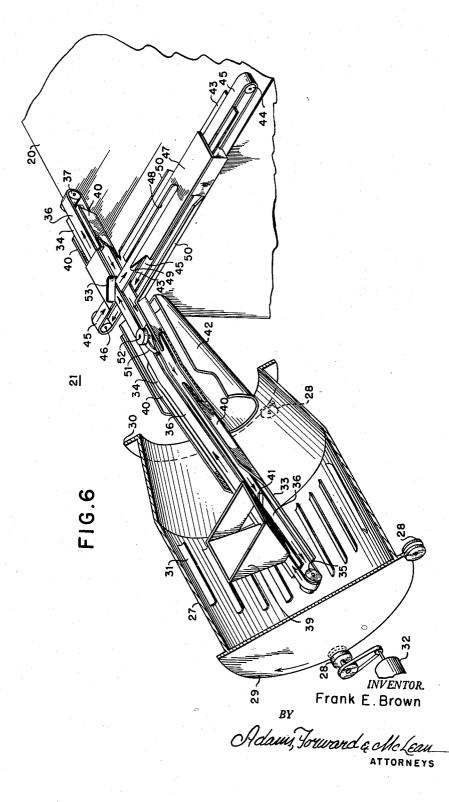
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F. E. BROWN STOPPERING APPARATUS



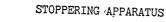
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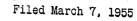
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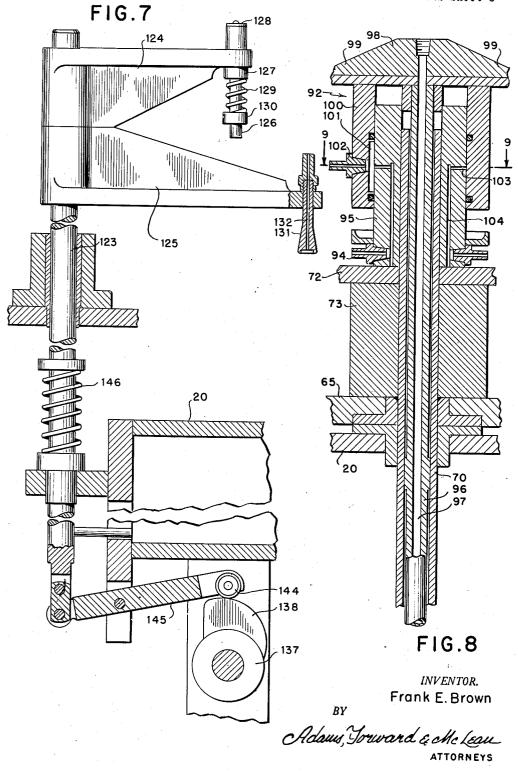
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United States Patent Office

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2,840,970

STOPPERING APPARATUS

Frank E. Brown, Glendale, Calif., assignor to Unette Corporation, Burbank, Calif., a corporation of Delaware

Application March 7, 1955, Serial No. 492,461

7 Claims. (Cl. 53-324)

My invention relates to applying closures to containers and in particular provides a machine for inserting resilient stoppers into the mouths of small bottles, such as are commonly used to contain injectable pharmaceutical preparations.

These bottles, known as vaccine bottles, are conventionally supplied with stoppers formed of rubber or a similar material. The stopper includes a flat diaphragm which is positioned across the mouth of the bottle with its peripheral undersurface resting on the flange part of the bottle which surrounds the mouth opening. A cylindrical skirt depends centrally from the undersurface of the stopper diaphragm laterally engaging the cylindrical inner surface of the mouth opening with sufficient pressure to stopper the bottle. Conventionally the stopper is held in place by an aluminum cap which is provided with a central opening to provide access for insertion of the needle of a syringe to permit withdrawal of the contents of the bottle under completely aseptic conditions.

Because the fluid compositions which are conventionally contained by such bottles are medicinal preparations, it is absolutely essential that the bottles, after having been filled with the fluid, be stoppered and capped under aseptic conditions. Although a number of available machines, which are readily sterilizable and can be main-40 tained aseptic for long periods of time by ultraviolet radiation, will perform the function of filling the bottle and applying the cap, there have been relatively few machines developed which are capable of inserting a stopper for the reason, at least in part, that when a stopper is pushed into a bottle filled with fluid, the resulting compression of the small quantity of air within the bottle above the fluid tends to force the stopper back out of the bottle before a cap can be applied.

It is a principal object of my invention to provide a 50 device for emplacing stoppers in vaccine bottles in such a manner that little or no compression of compressible contents of the bottles occurs, thus facilitating handling of the bottles prior to applying caps. It is also an object of my invention to provide a device for emplacing stop-55 pers in vaccine bottles, which device is readily sterilizable and capable of being maintained in aseptic condition for a considerable period of time by such conventional methods as ultraviolet radiation. It is yet another object of my invention to provide a device for sorting and orienting stoppers of the type described for proper emplacement. It is still another object of my invention to provide an automatic bottle stopper inserting device which is capable of rapid operation with a minimum of supervision.

These and other objects of my invention which will 65 become apparent hereinafter are illustrated by the apparatus described by the accompanying drawings in which:

Figure 1 is an elevational view in partial section illustrating a bottle-stoppering machine constructed in accordance with my invention;

Figure 2 is a plan view of the machine shown in Figure 1;

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Figure 3 is an enlarged fragmentary elevational view shown partially in section of the stopper-emplacing assembly and bottle-holding assembly of the machine shown in Figures 1 and 2;

Figure 4 is an enlarged fragmentary section of the stopper transfer and inverting assembly taken along line 4-4in Figure 2;

Figure 5 is a fragmentary elevational view of the essential operating parts shown in Figure 4;

Figure 6 is an isometric view of the machine seen from the left rear in Figure 1 and illustrating particularly the stopper-feeding assembly;

Figure 7 is a fragmentary elevation showing certain operating parts of the machine;

Figure 8 is a fragmentary sectional view taken along line 3-8 in Figure 2; and

Figure 9 is a cross-section taken along line 9-9 in Figure 8.

Referring to the drawings, the reference numeral 20 20designates a hollow cubical base upon which a bottlestoppering machine according to my invention is supported. The machine itself, broadly speaking, includes a stopper-feeding assembly 21 mounted on the rear face of cubical base 20. Assembly 21 is constructed to feed a supply of stoppers, sorted and oriented in inverted position, to stopper transfer and inverting assembly 22 mounted on top of cubical base 20. Bottle feed assembly 23, mounted on one side of cubical base 20, feeds unstoppered vaccine bottles filled with a fluid, such as in injectable pharmaceutical composition, into bottle-holding assembly 24 which is mounted on top of base 20. Stopperemplacing assembly 25, which is supported above cubical base 20 directly over bottle-holding assembly 24, receives the stoppers from stopper transfer and inverting 35 assembly 22 and then emplaces the stoppers in the vaccine bottles held by bottle-holding assembly 24. The

stoppered vaccine bottles are removed from bottle-holding assembly 24 by bottle removal assembly 26, which is mounted on the side of cubical base 20 opposite bottle feed assembly 23.

Referring more particularly to Figures 2 and 6, it will be seen that stopper-feeding assembly 24 includes a cylindrical hopper 27 which is supported in an axially horizonal position to the rear of cubical base 20 by three wheels 28, two of which engage a flange 29 extending radially about the closed bottom of hopper 27 and one of which engages a flange 30 surrounding the mouth opening in the apex of the conical neck of hopper 27. Hopper 27 is provided with a series of short curved baffles 31 extending lengthwise along, and spaced at equal arcuate intervals about, the internal cylindrical surface of hopper 27. A motor 32 driving one of wheels 28 rotates hopper 27 in a counterclockwise direction (as seen in Figure 1) about its horizontal axis.

A flat metal conveyor track 33 attached to the rear face of conical base 20 flush with the upper surface of cubical base 20 extends horizontally toward the mouth opening in hopper 27 and then is inclined downwardly into the cylindrical portion of hopper 27. Spaced im-60 mediately above track 33 is a second flat metal conveyor track 34 which extends partially across the upper surface of base 20. A spool 35 is mounted at the lower ends of tracks 33 and 34 within hopper 27 to guide conveyor belt 36 from the upper surface of track 33 to a return path across the upper surface of track 34. The width of conveyor belt 36 is less than the width of either track 33 or 34. A return spool 37 is mounted on top of conical base 20 to guide conveyor belt 36 from the upper surface of track 34 to the upper surface of track 33. 70 Speel 37 is continuously driven by a motor (not shown) located within cubical base 20 in a direction such that conveyor belt 36 moves downwardly along the upper

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surface of track 33 into hopper 27 and upwardly along the upper surface of track 34.

Within hopper 27 and mounted above the lower end of track 34 is a pyramid-like funnel attachment 39 which is open at its lower apex end where conveyor belt 36 passes upwardly along the inclined upper surface of track 34. The face of funnel 39 nearest base 20 is cut away to provide additional clearance to permit the passage of stoppers from within funnel 39 upwardly along the upper path of travel of conveyor belt 36.

A strip of sheet metal 40 is secured along each dege of track 33 and inclined outwardly and upwardly to approximately the level of the upper surface of track 34. Sheets 40 extend well into the mouth of hopper 27. Beyond the ends of sheets 40 within hopper 27 and 15 spaced between tracks 33 and 34 is a transverse inclined blade 41 which is spaced above track 33 just a sufficient distance to permit the passage of conveyor belt 36. A segmental conical baffle 42 is secured at its narrow end to the rear face of cubical base 20 beneath tracks 33 and 20 34 with its wider end extending into the mouth of hopper 27.

A flat metal conveyor track 43 is mounted spaced above the upper surface of cubical base 20 along the rear edge of cubical base 20 intersecting track 34 at right angles. A spool 44 is mounted at the remote end of track 43 from track 34 to pass a conveyor belt 45 from the upper surface of track 43 to the upper surface of base 20. Conveyor belt 45 crosses underneath conveyor belt 36 in both paths of travel at the intersection of tracks 34 and 43. At the outer end of track 43 belt 45 passes around spool 46. Spool 44 is driven intermittently as hereinafter described.

Toward the center rear of cubical base 20 a flat guide plate 47 is supported spaced above track 43 to permit conveyor belt 45 to pass between it and the upper surface of track 43. Guide plate 47 is provided with an opening slot 43 which extends into guide plate 47 lengthwise of the path of travel of conveyor belt 45 from the end of guide plate 47 facing the intersection of conveyor belts 36 and 45. The transverse measurement of slot 48 is equal to the diameter of the diaphragm portion of the stoppers which are handled by stopper feed assembly 21.

The slotted end of guide plate 47 is desirably shaped 45to prevent jamming of stoppers at the opening of slot 48. This shape can assume a number of variations dependent upon the relative proportions of the transverse measurement of belt 45 and the diameter of the diaphragm portion of the stoppers. Where such diameter is less than half 50 such transverse measurement, as in the illustrated case, the opening of slot 48 is located off-center sufficiently that stoppers jamming in the opening to one side will tend to fall off belt 45. In this design the opposite shoulder of the opening is sharply pointed, as indicated by the reference numeral 49. With larger diameter stoppers both shoulders in the opening can be approximately right-angled provided that when two stoppers jam across the opening, at least one will fall off belt 45.

Flat track 43, like track 34, rides between upwardly and outwardly inclined strips of sheet metal 59 which are secured at their lower edges to the surface of base 20 immediately under track 43 over which conveyor belt 45 rides. Sheets 50 connect with sheets 40 which similarly enclose track 34. Thus the arrangement formed by sheets 40 and 50 functions to collect stoppers which fall off belts 36 and 45 to guide them onto the lower return paths of conveyors 36 and 45 by which the stoppers are returned into the mouth of hopper 27 and from which they are removed by scraper blade 41. 70

Stopper feeding assembly 21 is completed by the sorting action which includes horizontal blade 51 supported spaced above track 34 with its edge angularly disposed partly across the path of travel of conveyor belt 36 to guide stoppers traveling on conveyor belt 36 75 moval station."

to a path of travel limited to the right edge of conveyor belt 36 as seen in Figure 2. A circular disc 52, which is mounted on track 34 for free rotation about a vertical axis, is positioned with respect to blade 51 such that it rides over the tip of blade 51 facing toward cubical base 20 and such that its outer edge will engage with the stopper skirt of any stoppers riding in inverted position on conveyor belt 36 to force the stoppers toward the right edge (as seen in Figure 2) of conveyor belt 36 such that the centers of the stoppers are beyond the edge of conveyor belt 36 and ride past disc 52 only because their diaphragm portion is engaged beneath wheel 52. Appropriately, track 34 is cut away in the vicinity of disc 52 such that its right edge (as seen in Figure 2) is aligned with the right edge of conveyor belt 36.

In addition, a vertical deflector blade 53 is supported angularly across the line of intersection of conveyor belts 36 and 45 such that inverted stoppers riding on belt 36 are guided by deflector blade 53 from conveyor 36 onto 20 conveyor 45. The end of deflector 53 facing inwardly toward cubical base 20 is curved slightly in the direction of travel of the upper section of conveyor 45 but extends outwardly beyond the edge of track 43 for reasons which will be hereinafter described. Between deflector 25 53 and guide plate 47, track 43 is the same width as conveyor belt 45, such that any stopper falling off belt 45 also falls off track 43.

The bottle feed assembly 23 includes a horizontal flat metal track 55 having one end flush with the upper sur-30 face of cubical base 20 and extending to the left outwardly from such upper surface as seen in Figure 1. An idler spool 56 is mounted beneath the outer left end of track 55 for passing conveyor belt 57 from beneath track 55 to a return path toward cubical base 20 supported by the upper surface of track 55. A spool 58 mounted 35 near the center and directly beneath the upper surface of base 20 is continuously driven by a motor (not shown) located within base 20 to return conveyor belt 57 to idler spool 56. Thus conveyor belt 57 travels inwardly along the upper surface of track 55 across the upper surface of cubical base 29 almost to the center of cubical base 20. A pair of vertical guide flanges 59 extend lengthwise above the upper surface of track 55 onto the upper surface of cubical base 20, one being positioned on each side of belt 57.

Bottle removal assembly 26 similarly includes a horizontal flat metal track 60 mounted flush with the upper surface of cubical base 20 and extending horizontally therefrom to the right as seen in Figure 1. An idler spool 51 is mounted beneath the outer end of track 60 to redirect the path of travel of conveyor belt 62 from the upper surface of track 60 to beneath track 60. A speel 63 is mounted within cubical base 20 directly beneath the upper surface thereof in such a position that conveyor belt 62 is passed from beneath track 69 and the upper surface 55of cubical base 20 to a return path starting near the center of the upper surface of cubical base 20 and extending cutwardly to the top of idler spool 61. Spool 63 is continuously driven by a motor (not shown) located within base 20. A pair of guide flanges 64 are mounted above track 60, one on each side of conveyor belt 62, extending across the upper surface of cubical base 20. Bottle-holding assembly 24 includes a star wheel 65 mounted for rotation about a vertical axis on top of the upper surface of cubical base 20. Star wheel 65 is provided with four vertical bottle-receiving slots 66 located 65 at equal arcuate intervals about its periphery. As will be further described hereinafter, star wheel 65 can be indexed in four positions of 90° movement. In each such indexed position one slot 66 is aligned over the inner end of conveyor belt 57 in what will be described hereinafter as the "bottle-receiving station." At the indexed position another slot 66, displaced 180° from the bottle-receiving station, is located over the inner end of conveyor belt 62

in what will be described hereinafter as the "bottle-re-

About the left-hand front edge as seen in Figure 1, the periphery of star wheel 65 is enclosed by a curved vertical flange 67 mounted flush with the edge of star wheel 65 on the upper surface of cubical base 20. Flange 67 extends through approximately a quadrant representing the 5 spacing between two successive indexed positions of movement of star wheel 65. The left end of flange 67 extends up to the line of forward guide flange 64 if extended.

The left forward peripheral quadrant of star wheel 65 as seen from Figure 1 cooperates with spring-biased arm 10 68 which is pivoted for movement about a vertical axis located close to the inner end of forward guide flange 59. The tip of arm 68 cooperates with a horizontal slot 69 extending about the entire periphery of star wheel 65 such that the spring-biasing of arm 68 will force arm 68 15 into contact with a bottle in a slot 66 in the first quadrant of movement of star wheel 65 from the bottle-receiving station.

Star wheel 65 is mounted on a vertical hollow tube member 70 which is supported in suitable bearings within 20 base 20 and which is rotated about its axis by Geneva wheel 71 as will be described further hereinafter. Star wheel 65 is affixed to tube 70 for rotation therewith.

Stopper emplacing assembly 25 includes a horizontally positioned supporting disc 72 which is affixed also to tube 25 70 for rotation therewith but which is spaced above star wheel 65 by means of spacer cylinder 73 coaxially positioned about tube 70. Spaced at equal arcuate intervals about the outer periphery of supporting disc 72, each immediately over a bottle-receiving slot 66, are four stopper 30 receivers 74.

Each stopper receiver 74, as seen most clearly in Figure 3, includes a vertical sleeve 75 affixed to disc 72 and depending therefrom toward the associated bottle slot 66. Coaxially extending through sleeve 75 is an elongated plunger 76 which is provided with a hollow bore 77 entering plunger 76 radially near its upper end and extending axially downward therethrough, terminating in an internally threaded opening at the lower end of plunger 76. A flange 78 located near the upper end of plunger 76, 40 below the radial outlet from its bore, supports plunger 76 on the upper end of a helical spring 79 coiled about plunger 76 and resting at its lower end on disc 72. A receiving cap 89 which coaxially encloses the lower end of sleeve 75 is threadedly engaged near its center with the lower end of bore 77 in plunger 76 and thus limits 45upward movement of plunger 76 against the expansive force of spring 79.

The bottom face of cap 80 is provided with a circular recess 81 having a diameter just larger than that of the skirt portion of the stopper to be emplaced. The center of recess 81 communicates with a short vertical axial bore 82 which extends upwardly in communication with bore 77 of plunger 76.

A short radial port 83, positioned near the lower end of plunger 76, communicates with center bore 77 in such a position that when plunger 76 is forced downwardly against spring 77 to emplace a stopper, port 83 just clears the lower end of sleeve 75 to communicate bore 77 with the atmosphere through the loose-fitting connection between cap 80 and sleeve 75. If this connection is not of cap 80 can be utilized to supplement the action. Suitable 0 ring bushings and gaskets can be employed to improve the normal position seal between bore 77 and the atmosphere, as indicated, for example, in Figure 3 by 0 65 ring bushings 84 and 0 ring gasket 85.

As previously described the movement of star wheel 65 is indexed at four positions of 90° movement. This same indexed movement, of course, also applies to supporting disc 72. In each position a stopper receiver 74 70 is held above stopper transfer and inverting assembly 22. This position will hereinafter be described as the "stopperreceiving station." This stopper-receiving station is located 90° clockwise (as seen in Figure 2) of the bottlereceiving station. Opposite the stopper-receiving station 75 (180°) a stopper receiver is held in position above an unstoppered bottle retained in slot 66 by arm 63. This will be hereinafter described as the "stopper-emplacing station."

Supporting disc 72 also supports four indexing pins 86, the operation of which will be more fully described hereinafter. Indexing pins 86 are coaxially mounted in vertical sleeves 87, seen most clearly in Figure 3, which are in turn mounted on arms 88 affixed at equal arcuate intervals about the periphery of supporting disc 72 such that one sleeve 87 containing an indexing pin 86 projects a short distance beyond the edge of disc 72 at the location of each stopper receiver 74. Each indexing pin 86 is provided with a cap 89 having a depending skirt which rests upon the upper end of sleeve 87. Indexing pin 86 is limited in upward travel under the expansive force of spring 90 by a radial flange 91 which bears against the under surface of sleeve 87.

Each stopper receiver 74 has its bore 77 connected to a valve 92, positioned about the upper end of tube 70, by means of a flexible hollow conduit 93 which is connected at one end with the upper radial opening of bore 77 in plunger 76 and which is connected at its other end with a radial valve port 94. Valve port 94 is one of four such ports, each other of which is similarly connected to a stopper receiver 74. Ports 94 are located in vertical sleeve 95 which is affixed at its conter about the upper end of tube 70. Thus valve sleeve 95 rotates with tube 70, bottle-holding star wheel 65 and supporting disc 72.

Referring particularly to Figure 8, it will be seen that a tube 96 having axial bore 97 extends coaxially through the center of tube 79 in vertical and rotatable sliding engagement therewith. The upper end of tube 96 terminates in crosshead 98 which, referring particularly to Figure 2, is provided with a pair of arms 99 extending horizontally in opposite directions. A sleeve 100 forming a part of valve 92 depends from the under side of crosshead 98 coaxially about valve sleeve 95 in vertical and rotatable sliding engagement with the outer surface of sleeve 95.

Near the center of its engagement with sleeve 95, sleeve 100 is provided with a semi-cylindrical cavity 101. Near the center of cavity 101 sleeve 100 is provided with a port 102 (see Figures 8 and 9) which communicates with cavity 101. Inner sleeve 95 is provided with four radial ports 103 in its outer surface, three of which register with opening 101 in each indexed position of bottle-emplacing assembly 25 and thus communicate with port 102. Cavity 101 has sufficient height such that vertical movement of tube 96, and consequently crosshead 98 and sleeve 100, sufficient to operate stopper emplacer 74, as more fully described hereinafter, will not cause ports 103 which register with cavity 101 to slide vertically out of com-munication with cavity 101. Each port 103 is connected by a vertical passage 104 within sleeve 95 to a radial port 94 near the base of sleeve 95, and thus in each indexed position of stopper-emplacing assembly 25, port 102 is in communication with the bores 82 in three of receiving caps 80.

Port 102 is connected by a flexible hollow conduit 105 to T-connection 106 in crosshead 93 at the upper end of bore 97.

Arms 99 of crosshead 98 support vertical tappets 107 and 103. Tappet 107 is located, as seen most clearly in Figures 2 and 3, immediately over the upper end of plunger 76 such that vertical downward movement of tube 96 will drive tappet 107 down to push plunger 76 into a position shown most clearly as the center position in Figure 3. Again referring to Figure 2, tappet 108 is positioned behind stopper-emplacing assembly 25 and is aligned immediately over a plunger 76.

Stopper transfer and inverter assembly 22, shown most

clearly in Figures 4 and 5, performs the function of transferring stoppers from their inverted position at the inner end of slot 43 in guide plate 47 to the underside of a receiving cap 30 while inverting them at the same time.

Assembly 22 is supported on vertical shaft 109 which is journaled in the upper surface of base 20 between the stopper-receiving station of stopper-emplacing assembly 25 and the inner end of slot 48 in guide plate 47. The lower end of shaft 109 by a suitable gear transmission is driven with tube 70 by Geneva wheel 71, as will be 10 more fully described hereinafter. The upper exterior end of shaft 109 is affixed in horizontal cross-arm 110, each arm of which supports a rotatable, horizontal shaft 111. The inner end of each shaft 111 carries a bevel gear 112 15 which engages a bevel gear 113 carried by shaft 109. Bevel gears 112 each have the same number of teeth as bevel gear 113. Thus each half turn of shaft 109, which is produced by a quarter turn of tube 70, causes each shaft 111 to make a half turn.

The outer end of each shaft 111 carries a sleeve 114 in 20 which a pluuger 115 is slidably positioned. One end of each plunger 115 is provided with a cap 116 which retains between it and sleeve 114 a small helical spring 117. The other end of each plunger 115 is provided with a flange 118 which limits movement of plunger 115 under the influence of spring 117. Flanged end 118 of each plunger 115 is provided with an axial bore 119 of a dimension which provides a loose-fitting frictional engagement with the skirt of a stopper of the size for which the apparatus is designed to emplace. Bore 119 is connected to an axial bore 120 which extends through plunger 115 and through the center of cap 116.

The gearing arrangement is such that in the indexed position each plunger 115 is vertically aligned, in one case beneath receiving cap 80 of the stopper receiver 74 at the stopper-receiving station and in the other case immediately over the closed end of slot 48 in guide plate 47. The gearing is further arranged such that the plunger 115 located beneath receiving cap 80 of the stopper receiver 74 in the stopper-receiving station has its cap 116 end pointing down and its bore 119 pointing up toward recess 81 in cap 80 and such that the bore 119 of the plunger 115 located over slot 48 points downwardly and cap 116 is up.

A flat horizontal plate 121 is affixed on the upper side of cross-arm 110. Plate 121 is provided at each end with a vertical hole 122. When the stopper-emplacing assembly 25 is in indexed position, one hole 122 is positioned aligned with the indexing pin 86 at the stopperreceiving station such that downward movement of pin 86 will assure accurate alignment between plunger 115 and receiving cap 80 while aligning the other plunger 115 accurate indexing of the bottle-receiving station, the stopper-emplacing station and the bottle removal station of star wheel 65 and supporting disc 72.

Movement of each indexing pin 86 into a hole 122 simultaneously with movement of plunger 115 over slot 48 to pick up a stopper is accomplished by vertical movement of vertical shaft 123 which is journaled for vertical movement through the upper surface of base 20 as is shown in detail in Figure 7. Shaft 123 on its upper end carries a pair of bracket arms 124 and 125.

Arm 124, which is positioned above arm 125, at its outer end carries a tappet 126 which is slidable vertically 65 through sleeve 127 affixed at the outer end of arm 125. Tappet 126 at its upper end is provided with a flat disc 128 which limits its downward movement. Beneath the lower end of sleeve 127 a small helical spring 129 is positioned about tappet 126. The upper end of spring 126 70 bears against the lower end of sleeve 127, and the lower end of spring 126 bears against a flange 130 affixed near the lower end of tappet 126. Arm 124 is positioned such that tappet 126 is aligned over the position of the indexing pin 86 at the stopper-receiving station. 75

Arm 125 carries in fixed position at its outer end a vertical tappet 131 which in the indexed position of rotating assemblies 22, 24 and 25 is aligned over the cap 116 of the plunger 115 which is located above the closed end of slot 48 in guide plate 47. Tappet 131 is provided with a vertical bore 132 which, when shaft 123 is moved downward vertically to engage tappet 131 with cap 116, registers with bore 120 in plunger 115 and cap 116. The upper end of tappet 131 is provided with a flexible hollow conduit 132*a* in communication with bore 132 at one end and attached to T-connection 106 at its other

end. Referring more particularly to Figure 1, the mechanism for driving the various elements heretofore described is shown somewhat schematically and comprises generally motor 133 which, by means of pulleys 134 and 135 and chain 136, drives horizontal shaft 137. Shaft 137 carries a pair of eccentrics 138 and 139 as well as a bevel gear 140.

Bevel gear 140 drives a bevel gear 141 located at the lower end of vertical shaft 142 on which is mounted Geneva wheel driving cam 143 which cooperates with Geneva wheel 71 to rotate Geneva wheel 71 a quarter of a revolution for every complete revolution of shaft 142. Geneva wheel 71 remains stationary between each quarter revolution for a substantial period during each revolution of shaft 142.

Eccentric cam 138 has a slow rise-quick fall profile as seen more clearly in Figure 7 and engages the cam follower 144 on the end of a pivoted lever 145, the other end of which lever 145 is pivotally connected to the lower end of shaft 123. Shaft 123 is spring-biased by spring 146 toward the upper position. Since the profile of eccentric cam 138 causes downward movement of shaft 123 only for a short portion of the entire period of revolution of shaft 137, throughout the major portion of each cycle of operation shaft 123 normally remains in an upper position with tappet 126 and tappet 131 out of engagement with indexing pin 86 and cap 116, respectively.

Eccentric cam 139, which has a profile similar to that shown in Figure 7 for eccentric cam 138, rides on cam follower 147 to urge tube 96 down against the biasing of spring 148 to cause tappets 107 and 108 to engage opposite plungers 76 and drive the associated stopper receiving caps 80 downwardly.

Within the base 149 of tube 96 to which cam follower 147 is attached there is also provided a suitable connection (not shown) from bore 97 of tube 96 to a vacuum line or pump (not shown). Thus, the bore 132 of tappet 131 is continuously in communication with the evacuation system while the bores 82 and recesses 81 of three receiving caps 80 when indexed at the stopper-receiving station, bottle-receiving station and stopper-emplacing station are similarly in communication with the evacuation system.

Affixed to rotate with Geneva wheel 71 and tube 70 is a spur gear 150 which is connected through an idler (not shown) to spur gear 151 located at the lower end of shaft 109. Thus counterclockwise rotation of bottleholding assembly 24 and stopper-emplacing assembly 25 is accompanied by counterclockwise rotation of stopper transfer and inverting assembly 22.

The timing of eccentric cams 138 and 139 is such that they engage their respective cam followers 144 and 147 approximately simultaneously during the interval in which Geneva cam 143 is out of engagement with Geneva wheel 71. Movement of tappets 107, 108, 126 and 131 is therefore approximately simultaneous and timed during the interval when bottle-holding assembly 24, stopper-70 emplacing assembly 25 and stopper transfer and inverting assembly 22 are at rest in indexed position.

Spool 44, which drives conveyor belt 45, is driven intermittently during the rotational movement of assemblies 22, 24 and 25 by a suitable take-off (not shown) 75 from spur gear 150. 5

In operation vaccine bottles filled with an injectable fluid are fed to the outer end of conveyor belt 57 which draws them between guides 59 toward star wheel 65 (see Figures 1 and 2). At the same time hopper 27 containing a number of stoppers of suitable size for the vaccine bottles is rotated counterclockwise (as seen in Figure 1).

The rotation of hopper 27 causes the stoppers to be collected by baffles 31 and carried up over the mouth of funnel 39 into which they fall from baffles 31. At the lower end of funnel 39 conveyor belt 36 draws the stop- 10 pers up over track 34 toward sorting blade 51 (see Figure 2). Those stoppers on the inclined portion of track 34 which are not resting on their inverted position, because of the inclination of track 34, tend to roll back into hopper 27. As the stoppers are drawn toward blade 51 15 (see Figure 2) engagement with the edge of blade 51 forces them toward the opposite edge of track 34 which is at that point flush with the edge of conveyor belt 36.

Those stoppers which are not in inverted position are thus pushed from belt 36 and track 34 by contact with 20 wheel 52 and fall into the elongated funnel formed by sheet metal strips 40 whence they are guided onto the return path of conveyor belt 36 on track 33. Those stoppers which are in inverted position pass wheel 52 with the flange-like extension of their diaphragms run-25 ning beneath wheel 52 and are carried by belt 36 up to deflector blade 53 which guides them in a line toward the inner edge of conveyor belt 45 on track 43 (see Figure 2).

When track 43 is not moving (during stopper trans-30fer and emplacement operations when Geneva cam 143 is out of engagement with Geneva wheel 71) deflector blade 53 permits the stoppers to slide off the edge of belt 45 and track 43 into the extended funnel formed by flat metal sheets 50 which guides the stoppers onto the return path of belt 45 along the upper surface of base 20 to carry the stoppers back to the return path of belt 36 and thence back to hopper 27. Inclined blade 41 (see Figure 6) functions to remove the stoppers from belt 36 before they are carried into spool 35. (Spool 35, although not so illustrated in order to clarify operation, is actually encased with a suitable cover which extends along the sides of tracks 33 and 34 up to scraper blade 41 in order to prevent stoppers from falling into contact with spool 35 and jamming its operation.)

Upon the next subsequent movement of Geneva wheel 71, conveyor belt 45 moves across track 43 toward guide plate 47 drawing with it in a line along its inside edge the stoppers which have been and are being fed by belt 36 into contact with deflector 53. The same movement 50 draws previously removed stoppers into slot 48 up to its end. This movement is calculated to feed about four stoppers into slot 48 in each sequence of operation in order to assure an adequate supply of stoppers. Thus at all times except for an instant after removal of a 55 stopper from the inner end of slot 48 a series of stoppers are lined up within slot 48 filling it completely (see Figure 2).

During the next stopped position of assemblies 22, 24 and 25, shaft 123 moves downwardly causing tappet 60 126 to engage the indexing pin 86 located at the stopperreceiving station and drive it into the hole 122 in plate 121 of the stopper transfer and inverter assembly 22 located beneath the pin 86, thus assuring alignment of all rotating parts (see Figure 4). 65

At the same time, tappet 131 descends downwardly into abutting contact with cap 116 driving plunger 115 down upon the skirt end of the stopper at the inner end slot 48 causing the skirt of that stopper to enter bore 119 in the end of plunger 115 (see Figure 4; Figure 5 70 illustrates the relative position of the stopper before this step). The vacuum connection to the bore 132 of tappet 131 assists in drawing the skirt of the stopper into bore 119.

pin 86 and plunger 115. Cam 143 again rotates Geneva wheel 71 another quarter of a turn. This operation causes shaft 109 to rotate a half turn in a counterclockwise direction as seen in Figure 2 producing at the same time a rotation of plunger 115 such that at the end of the Geneva wheel 90° movement, the stopper which has been frictionally engaged in bore 119 of plunger 115 is pushed beneath an empty receiving cap 80 located in the stopper-receiving station (see Figure 5). The diaphragm portion of the stopper, because plunger 115 has also rotated a half turn about a horizontal axis, faces recess \$1.

At the end of the Geneva wheel movement an indexing pin 86 is again driven into hole 122 to assure proper indexing. At the same time eccentric cam 139 drives tube 96 downwardly carrying with it crosshead 98, arms 99 and in particular tappet 108 which engages the upper end of the plunger 76 secured to the cap 80 which has just been positioned at the stopper-receiving station over the stopper held in plunger 115. At the same time (referring to Figures 8 and 9) bore 77 of the same plunger 76 is placed in communication with the evacuation system so that, as tappet 108 drives plunger 76 and cap 80 downwardly, when recess 81 meets the diaphragm of the stopper held in plunger 115, the pressure within bore 82 is rapidly reduced and the stopper held firmly on the lower end of cap 39 (see Figure 4). As shaft 109 thereafter rises upon release from cam 139, the stopper is withdrawn with cap 30.

The next quarter turn movement of stopper-emplacing assembly 25 carries the cap 80 holding the stopper to the bottle-receiving station over the end of conveyor 57. At the same time conveyor 57 in the next stationary portion of the cycle of operation forces a filled vaccine bottle into the slot 66 of star wheel 65 which is located immediately below the cap 80 at the bottle-receiving station. (This position is most clearly shown at the left hand of Figure 3.) The next movement of Geneva wheel 71 rotates star wheel 65 and supporting disc 72 another quarter of a turn carrying the bottle and stopper to the stopper-emplacing station. As the bottle moves through this first quarter of a turn in slot 66, arm 68 rides along the edge of the bottle holding it in position and remains holding the bottle when the bottle 45 is at the stopper-emplacing station (see Figure 1).

The next downward movement of tube 96 drives tappet 107 against the end of the plunger 76 at the stopperemplacing position. This movement is a sufficient distance to push the stopper into the mouth opening of the vaccine bottle held in the slot 66 at the same station.

It will be noted in Figure 3 that the vacuum connection to the recess 81 of cap 80 so reduces the pressure behind the stopper diaphragm that the stopper diaphragm is distorted into the recess causing the skirt of the stopper to contract slightly (this contraction is shown with exaggeration in Figure 3). Such contraction of the stopper skirt is highly important because it permits the stopper to be inserted into the filled vaccine bottle with ease and without increasing the pressure of the compressible fluids, e. g., air, contained within the vaccine bottle, and hence the stopper in the inserting operation is not impeded when it enters the mouth of the bottle and can be readily placed and left without danger that the stopper will ride upwardly out of the mouth of the

bottle because of an increased pressure within the bottle. Such contraction occurs as soon as the stopper is received by cap 80 at the stopper-receiving station and remains as the stopper is rotated with cap 80 past the bottle-receiving station up to and including the stopperemplacing station. At the bottom of the stroke of plunger 76 at the stopper-emplacing station, as cap 80 forces the stopper skirt into the mouth opening of the bottle with the flange around the mouth opening of the Shaft 123 then rises releasing tappets 126 and 131, 75 bottle in contact with the peripheral undersurface of the

diaphragm, port 83 becomes extended beneath the underedge of sleeve 75, thus permitting air to enter bore 77 of plunger 76 and increase the pressure within recess \$1 releasing the stopper diaphragm and permitting it to expand to its normal shape emplaced fully within the bottle. (Figure 3 shows the stopper at the stopper-emplacing station just before the release of the stopper from cap 80.)

Thereafter tube 96 and tappet 107 again rise permitting cap 80 to lift from contact with the stopper, leaving the 10 stopper emplaced within the vaccine bottle. The Geneva wheel 71 is then rotated again a quarter of a turn and thus star wheel 65 carries the bottle containing the emplaced stopper from the stopper-emplacing station to the bottle-removal station over the inner end of conveyor belt 62. The bottle is held in slot 66 during this rotation by flange 67. Conveyor belt 62 then removes the bottle from slot 66 and carries it off between guides 64 along track 60 (see Figures 1 and 2) to a capping machine (not shown) which may be of any suitable construction.

In describing the operation above I have, of course, traced the sequence of operations for one stopper and one bottle. It will be understood that all operations which are stated to occur during movement of assemblies 22, 24 and 25 occur simultaneously. Similarly all operations which are described as occurring when assemblies 22, 24 and 25 are stationary also occur simultaneously.

It will be further understood that although I have described an indexing assembly having four positions, rapid operation indicates the desirability of a number of idle positions. Thus a star wheel having ten bottle slots 66 with a corresponding ten-movement Geneva wheel has been successfully employed in which the stopper-receiving station is separated from the bottle-receiving station by two empty positions in which the latter is in turn separated from the stopper-emplacing station by one empty position, while the stopper-emplacing station and the bottle-removal station are separated by two empty positions and the bottle-removal station and stopper-receiving station are separated by one empty position. Such a device can be made to operate with great rapidity and stopper bottles at a rate of, for example, 40 or 50 per minute without difficulty and with substantially 100 percent efficiency.

It will be further apparent that the desirability of 45such idle positions for the sake of increasing the speed of operation indicates the desirability of using the idle indexed position between the bottle-receiving station and stopper-emplacing station as a bottle-filling station, thus permitting empty bottles to be fed to the machine 50 and filled employing the same indexing assembly as the stoppering machine of my invention. Suitably also idle indexed positions between the stopper-emplacing station and bottle-removal station can desirably be employed to locate cap spinners. Thus a machine can readily be constructed which, by movement of one indexing wheel, will accept empty bottles and eject filled bottles which are both stoppered and capped. Suitable speeds of such machines can be increased by employing even larger indexing wheels with duplicate or triplicate action. Such variations, however, do not require description in detail. What I have described above with reference to the drawing is merely an illustration of one example of the manner by which the principles of my invention can be applied to such machines.

I claim:

1. An apparatus for emplacing resilient bottle stoppers of the type having a flat diaphragm with a skirt depending centrally therefrom which comprises a stopper receiver having a recess in its undersurface, the transverse dimensions of said recess being less than the transverse dimensions of the diaphragm portion of the stopper to be emplaced, means for positioning a stopper with its diaphragm covering said recess with the edges of said

recess, means for evacuating said recess whereby the center of the diaphragm portion of a stopper covering said recess is drawn inwardly to retain said stopper on said stopper receiver, a bottle receiver having a vertical aperture aligned vertically with and spaced beneath said stopper receiver, means for positioning an unstoppered bottle in said vertical aperture with the open mouth of said bottle facing said stopper receiver, means for moving said stopper receiver toward said bottle receiver to position the skirt of a stopper retained on said stopper receiver in the mouth of a bottle positioned in said bottle receiver while rendering said evacuating means ineffective at the end of such movement whereby said stopper is released in the mouth of said bottle by said stopper receiver, means for removing said stoppered bottle from said 15 bottle receiver, indexing means carrying said stopper receiver and said bottle receiver through four indexed stations wherein said means for positioning a stopper cooperates with said stopper receiver at one station, said 20bottle-positioning means cooperates with said bottle receiver at a second station, said means for moving said stopper receiver toward said bottle receiver operates at a third station and said means for removing a bottle cooperates with said bottle receiver at a fourth station.

25 2. An apparatus for emplacing resilient bottle stoppers of the type having a flat diaphragm with a skirt depending centrally therefrom which comprises a stopper receiver having a recess in its undersurface, the transverse dimensions of said recess being less than the transverse 30 dimensions of the diaphragm portion of the stopper to be emplaced, means for positioning a stopper with its diaphragm covering said recess with the edges of said diaphragm portion extending over the edges of said recess, means for evacuating said recess whereby the cen-35

ter of the diaphragm portion of a stopper covering said recess is drawn inwardly to retain said stopper on said stopper receiver, a bottle receiver having a vertical aperture aligned vertically with and spaced beneath said stopper receiver, means for positioning an unstoppered 40bottle in said vertical aperture with the open mouth of

said bottle facing said stopper receiver, means for moving said stopper receiver toward said bottle receiver to position the skirt of a stopper retained on said stopper receiver in the mouth of a bottle positioned in said bottle receiver while rendering said evacuating means ineffective at the end of such movement whereby said stopper is released in the mouth of said bottle by said stopper receiver, means for removing said stoppered bottle from said bottle receiver, a rotary indexing means carrying said stopper receiver and said bottle receiver through four indexed stations wherein said means for positioning a stopper cooperates with said stopper receiver at one station, said bottle-positioning means cooperates with said bottle receiver at a second station, said means for moving 55 said stopper receiver toward said bottle receiver operates at a third station and said means for removing a bottle cooperates with said bottle receiver at a fourth station.

3. An apparatus for emplacing resilient bottle stoppers of the type having a flat diaphragm with a skirt depending centrally therefrom which comprises a stopper receiver having a recess in its undersurface, the transverse dimensions of said recess being less than the transverse dimensions of the diaphragm portion of the stopper to be 65 emplaced, means supplying stoppers oriented in inverted position to a pick-up station, means for transferring stoppers from said pick-up station while inverting them to a position in which the diaphragm portions of each stopper is placed over the recess with the edges of said diaphragm portion extending over the edges of said re-70cess in said stopper receiver, means for evacuating said recess whereby the center of the diaphragm portion of a stopper covering said recess is drawn inwardly to retain said stopper on said stopper receiver, a bottle receiver diaphragm portion extending over the edges of said 75 having a vertical aperture aligned vertically with and

spaced beneath said stopper receiver, means for positioning an unstoppered bottle in said vertical aperture with the open mouth of said bottle facing said stopper receiver, means for moving said stopper receiver toward said bottle receiver to position the skirt of a stopper retained on 5 said stopper receiver in the mouth of a bottle positioned in said bottle receiver while rendering said evacuating means ineffective at the end of such movement whereby said stopper is released in the mouth of said bottle by said stopper receiver, and means for removing said 10 stoppered bottle from said bottle receiver.

4. An apparatus according to claim 3 in which said means for transferring stoppers includes a stopper transfer arm mounted for rotation about a vertical axis, a plunger on an end of said arm mounted for rotation 15 thereon about a horizontal axis, said plunger being reciprocable transversely to said horizontal axis, means defining a bore in one end of said plunger, resilient means biasing the other end of said plunger away from said horizontal axis, means for rotating said arm between a 20 first position in which said plunger is vertically aligned beneath said stopper receiver and a second position in which said plunger is vertically aligned above said stopper pick-up station, means for rotating said plunger operable in timed relation with said means for rotating said transfer arm to position said plunger with said one end facing upwardly at said first position and with said one end facing downwardly at said second position, means for reciprocating said plunger downwardly at said second position, and means for moving said stopper receiver 30 of the type having a flat diaphragm with a skirt depending downwardly at said first position while rendering effective said evacuating means.

5. An apparatus for emplacing resilient bottle stoppers of the type having a flat diaphragm with a skirt depending centrally therefrom which comprises a horizontally positioned disc mounted for rotation about a vertical axis, a stopper receiver mounted adjacent to the perimeter of said disc for vertical movement between a first position and a second position lower than said first position, resilient means biasing said receiver toward 40 said first position, means defining a recess in the undersurface of said stopper receiver, the transverse dimensions of said recess being less than the transverse dimensions of the diaphragm portion of the stopper to be emplaced, means for evacuating said recess, a wheel mounted hori-45 zontally and spaced beneath said disc for rotation therewith about said vertical axis, bottle receiver means defining a vertical aperture in said wheel aligned vertically with and spaced beneath said stopper receiver, rotary indexing means for rotating said disc and wheel through 50 four indexed stations of said stopper receiver and said bottle receiver, means for supplying stoppers oriented in inverted position to a pick-up station, a stopper transfer arm mounted for rotation about a vertical axis, a plunger on the end of said arm mounted for rotation thereon about 55 a horizontal axis, said plunger being reciprocable transversely to said horizontal axis, means defining a bore in one end of said plunger, resilient means biasing the other end of said plunger away from said horizontal axis, means for rotating said arm in synchronism with said indexing 60 means between a first position in which said plunger is vertically aligned beneath said stopper receiver at a first station of said indexing means and a second position in which said plunger is vertically aligned above said pick-up 65 station, means for rotating said plunger operable in timed relation with said means for rotating said transfer arm to position said plunger with said one end facing upwardly at said first position and with said one end facing downwardly at said second position, means operable in timed 70

relation in said rotary indexing means to move said stopper receiver downwardly to said second position thereof and simultaneously render effective said evacuating means when said transfer arm is in said first position thereof, means for reciprocating said plunger downwardly when said transfer arm is in said second position, means located at a second said indexed station for positioning an unstoppered bottle in said bottle receiver with the open mouth of said bottle facing said stopper receiver, means located at a third said indexed station for moving said stopper receiver from said first to second position thereof while rendering said evacuating means ineffective at the end of such movement, and means located at a fourth said indexed station for removing a stoppered bottle from said bottle receiver.

6. An apparatus according to claim 5 which further includes a pin mounted on said disc adjacent to said stopper receiver for vertical movement between an upper first position and a lower second position, means biasing said pin toward said first position thereof, means operable in timed relation with said indexing means for reciprocating said pin to said second position at said first indexed station, said transfer arm at a said first station being positioned beneath said pin, and means defining an aperture in said arm aligned vertically beneath said pin at said first position of said arm whereby reciprocation of said pin to said second position thereof engages said pin in said aperture.

7. An apparatus for transferring resilient bottle stoppers centrally therefrom which comprises a stopper receiver mounted for vertical movement between a first position and a second position lower than said first position, resilient means biasing said receiver toward said first posi-35 tion, means defining a recess in the undersurface of said stopper receiver, the transverse dimensions of said recess being less that the transverse dimensions of the diaphragm portion of the stopper to be emplaced, means for evacuating said recess, means for supplying stoppers oriented in inverted position to a pick-up station, a stopper transfer arm mounted for rotation about a vertical axis, a plunger on the end of said arm mounted for rotation thereon about a horizontal axis, said plunger being reciprocable transversely to said horizontal axis, means defining a bore in one end of said plunger, resilient means biasing the other end of said plunger away from said horizontal axis, means for rotating said arm between a

first position in which said plunger is vertically aligned beneath said stopper receiver and a second position in which said plunger is vertically aligned above said pick-up station, means for rotating said plunger operable in timed relation with said means for rotating said transfer arm to position said plunger with said one end facing upwardly at said first position and with said one end facing downwardly at said second position, means for moving said stopper receiver downwardly to said second position thereof and simultaneously rendering effective said evacuating means when said transfer arm is in said first position thereof, and means for reciprocating said plunger downwardly when said transfer arm is in said second position.

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