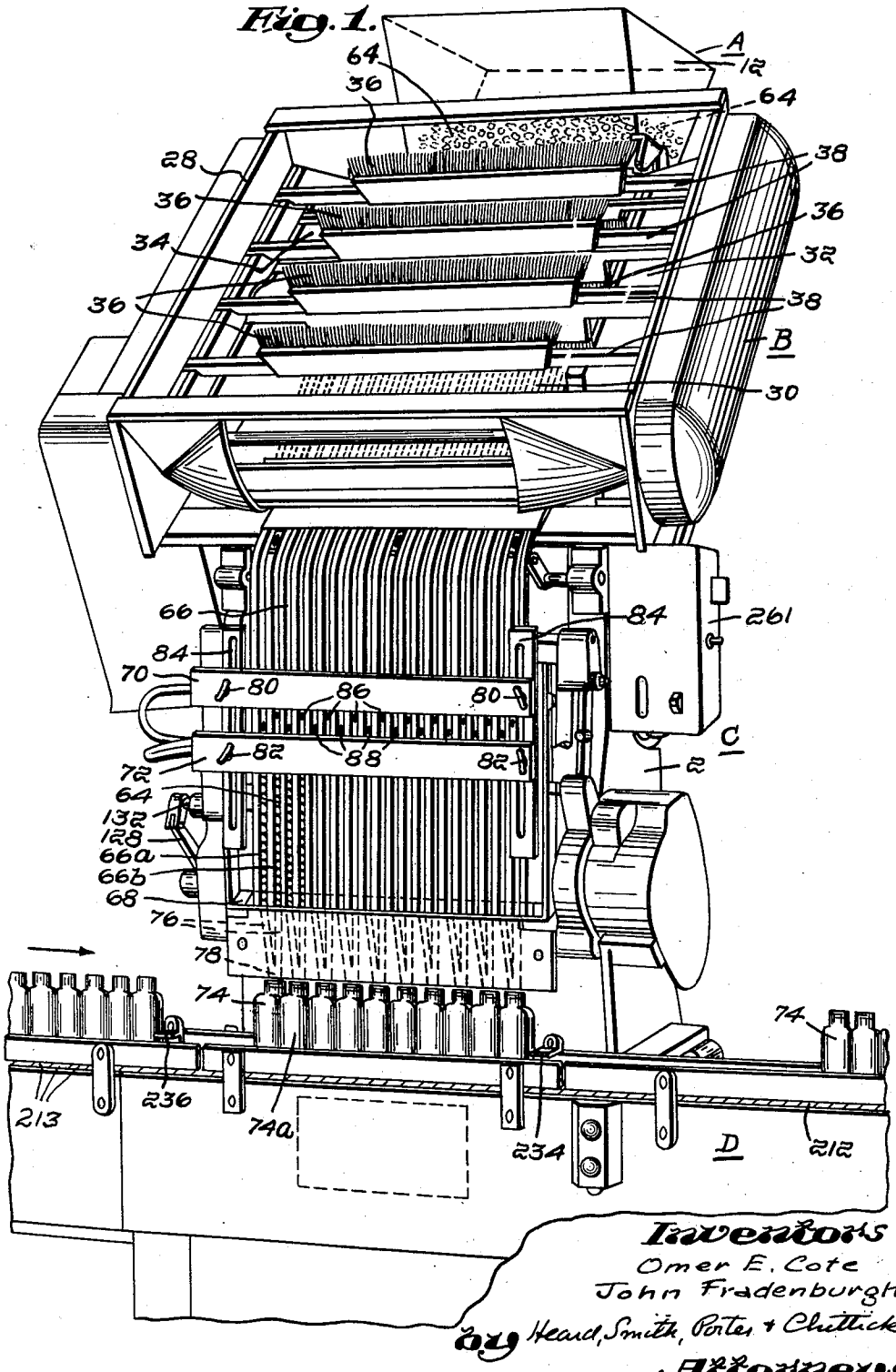
Aug. 5, 1958 O. E. COTE ET AL 2,845,759

METHOD OF AND MACHINE FOR FILLING BOTTLES WITH CAPSULES

Filed Sept. 26, 1955 6 Sheets-Sheet 1

Fig. 1.



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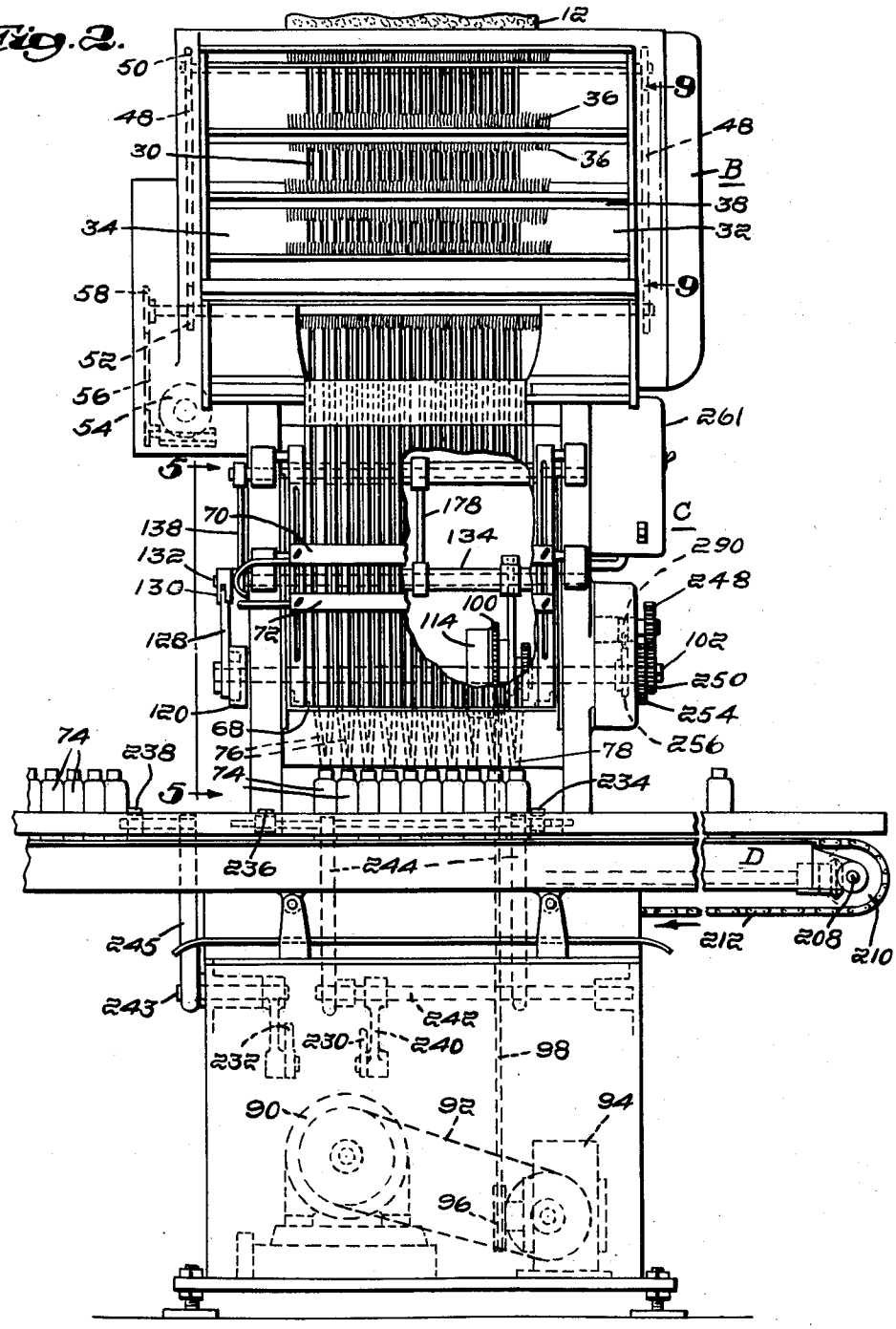
Aug. 5, 1958 O. E. COTE ET AL 2,845,759

METHOD OF AND MACHINE FOR FILLING BOTTLES WITH CAPSULES

Filed Sept. 26, 1955 6 Sheets-Sheet 2

Fig. 2.



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METHOD OF AND MACHINE FOR FILLING BOTTLES WITH CAPSULES

Filed Sept. 26, 1955 6 Sheets-Sheet 3

Fig. 5.

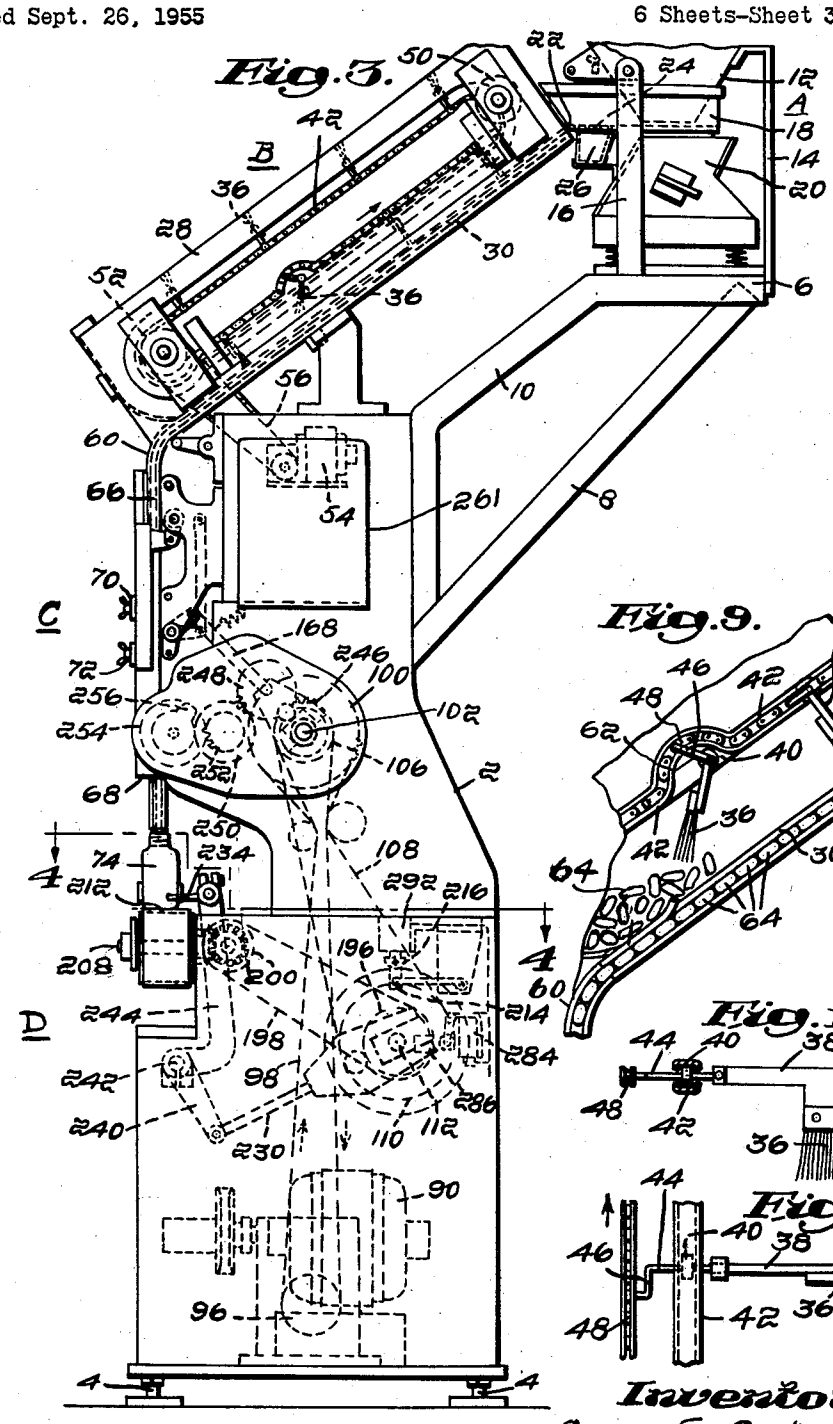

Fig. 9.

Fig. 10.

Fig. 11.

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Aug. 5, 1958 O. E. COTE ET AL 2,845,759

METHOD OF AND MACHINE FOR FILLING BOTTLES WITH CAPSULES

Filed Sept. 26, 1955 6 Sheets-Sheet 4

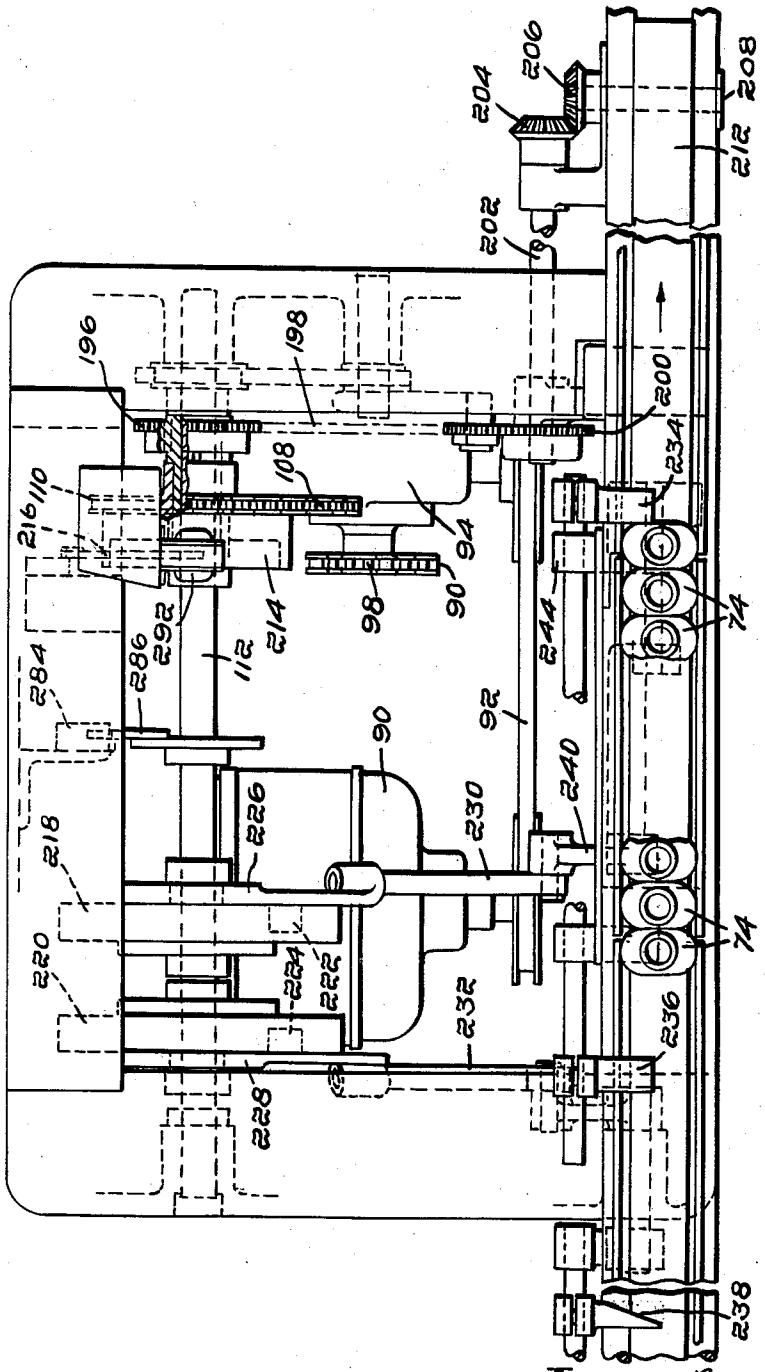

Fig. 4.

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Aug. 5, 1958 O. E. COTE ET AL 2,845,759

METHOD OF AND MACHINE FOR FILLING BOTTLES WITH CAPSULES

Filed Sept. 26, 1955 6 Sheets-Sheet 5

Fig. 5.

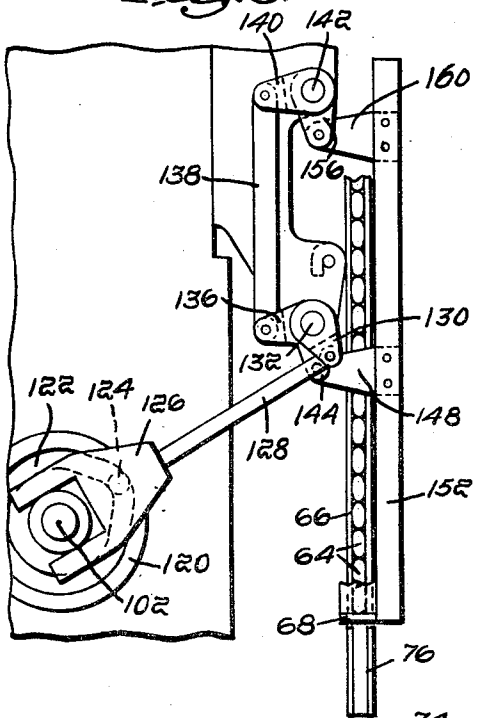


Fig. 6.

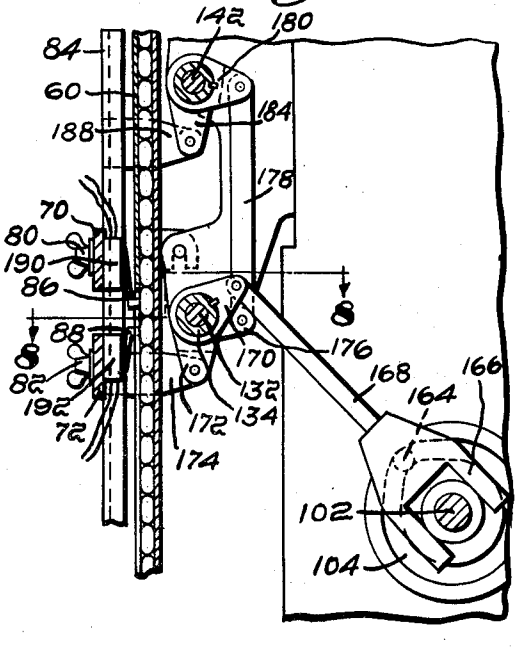


Fig. 8.

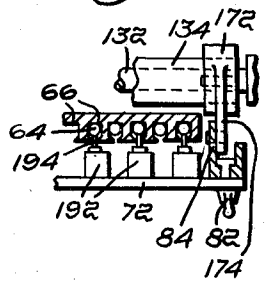
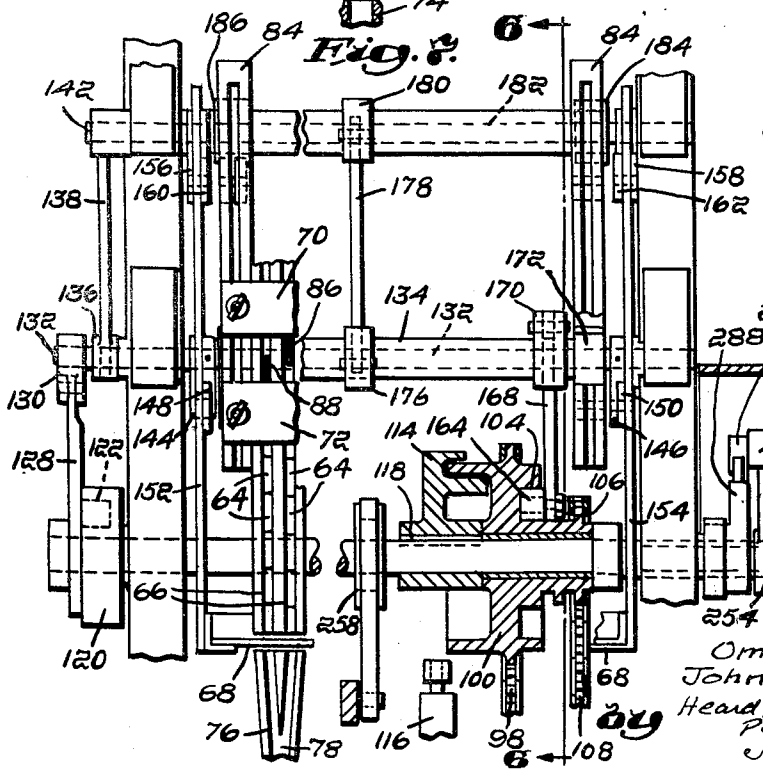


Fig. 7.



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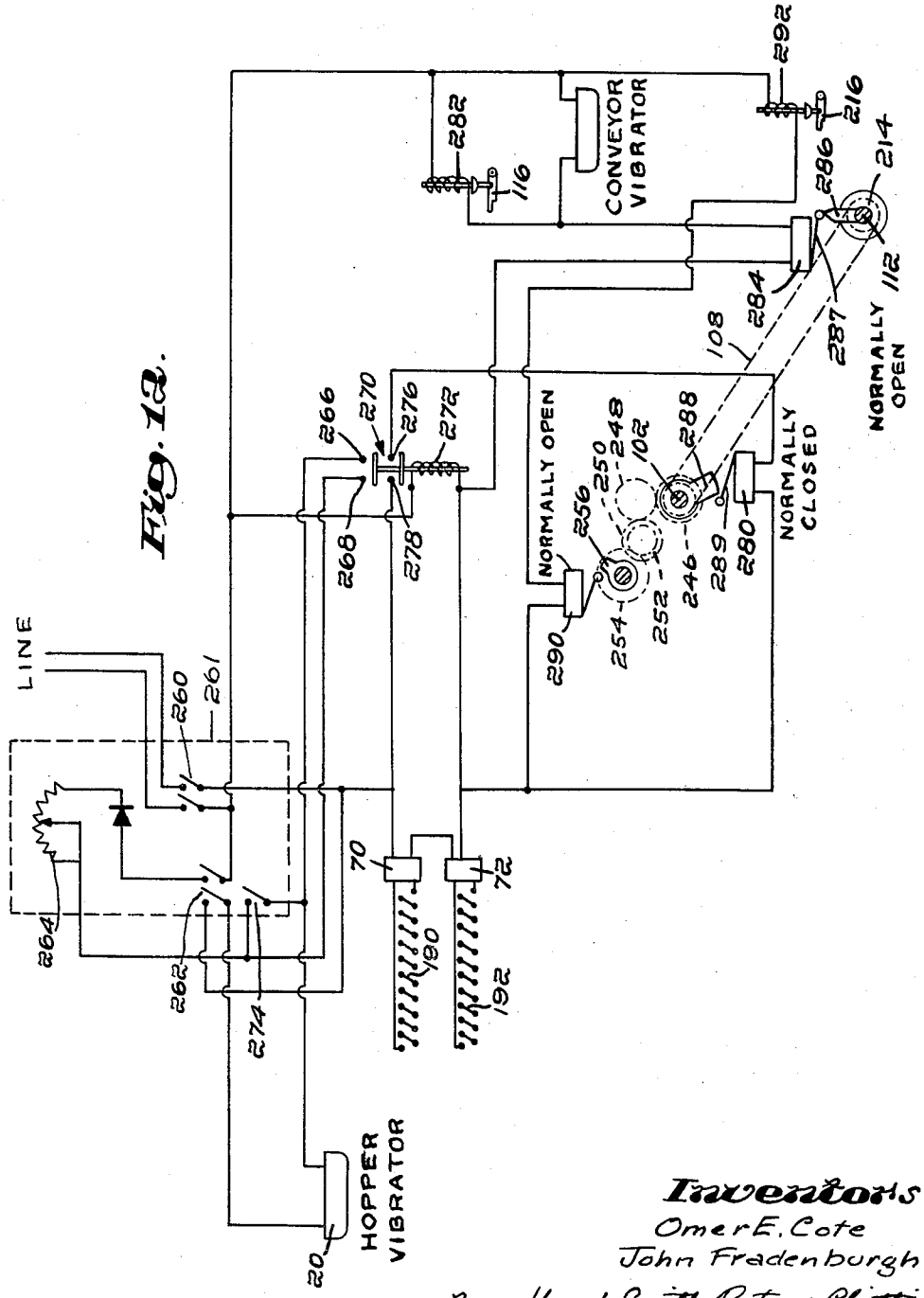
METHOD OF AND MACHINE FOR FILLING BOTTLES WITH CAPSULES

Filed Sept. 26, 1955 6 Sheets-Sheet 6

Fig. 12.



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United States Patent Office

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METHOD OF AND MACHINE FOR FILLING BOTTLES WITH CAPSULES

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Application September 26, 1955, Serial No. 536,668

9 Claims. (Cl. 53—61)

This invention relates to an improved machine designed to fill bottles or other containers with an exact number of generally uniformly-shaped objects. In the ordinary case, the container to be filled will be a bottle and the objects to be placed in the bottle will be medicinal capsules or pills. The invention, however, is not to be limited in any way as to the specific type of container or the article with which the container is to be filled. For convenience, the term capsule will be used to designate the article with which the container is filled.

The invention also contemplates a new and novel method of filling containers with capsules. The method may be performed by the machine herein disclosed but it will be apparent that other mechanisms might be devised to carry out the required steps.

It is customary in the pharmaceutical trade to sell certain types of medicines in capsule form, each bottle to contain a specified number of pills or capsules. As the cost of such medicines is more than nominal, it is the practice to place an exact number of capsules in each bottle and the number of such capsules is customarily noted on the label.

Heretofore, machines have been designed for filling bottles with specified numbers of capsules but, due to the complexity of the mechanism, they have not worked well, the capsules jamming in the delivery tubes and the count often being inaccurate. Furthermore, machines of prior construction have not included means for causing automatic stopping of the machine upon failure of the proper number of capsules to be put in delivery position prior to delivery to the container.

Accordingly, it is an object of the present invention to provide a machine for automatically filling bottles with capsules in which: (1) each bottle may be filled with any desired number of capsules; (2) the machine includes means whereby the size of the capsule may be varied on different runs and differing-sized bottles may be used; (3) improved hopper and feeding mechanisms are provided which insure that so long as the machine is in operation all of the chutes leading to the bottles will be completely filled so that the correct number of capsules will be available at each cycle of operation of the machine to enter the appropriate bottle; (4) interchangeable means is provided whereby the dimensions of the capsule-containing delivery chutes may be varied according to requirements determined by the size of the capsule; (5) there are interlocking electrical circuits which function to stop the machine instantly upon failure of the correct number of capsules to be delivered to any one of the plurality of chutes leading to the bottles.

These and other objects of the invention will be more clearly understood as the description proceeds with the aid of the accompanying drawings in which—

Fig. 1 is a front elevation of the machine in perspective, showing the hopper, the brush-distributing means, the chutes, the count bars, the bottles in position to receive the capsules, and the conveyor.

Fig. 2 is a front elevation of the complete machine broken away in part to show some of the operating mechanism and with other actuating elements shown in dotted line in the lower portion.

Fig. 3 is a side elevation looking from the right of Fig. 2.

Fig. 4 is a horizontal section taken on the line 4—4 of Fig. 3, showing the bottles in position on the conveyor and the mechanism for controlling the stop elements that locate the bottles with respect to the delivery chutes.

Fig. 5 is a vertical, partial side elevation taken approximately on the line 5—5 of Fig. 2, showing the gate-actuating mechanism.

Fig. 6 is a vertical section taken approximately on the line 6—6 of Fig. 7, showing the mechanism for actuating the count bars with the feeler fingers that are designed to sense the presence of capsules in the delivery chutes and to hold capsules thereabove from descending during the period of delivery of capsules therebelow.

Fig. 7 is an enlarged front elevation of the central portion of the machine with all but two of the delivery chutes removed and the other two broken away to show portions of the operating mechanism.

Fig. 8 is a horizontal section taken on the line 8—8 of Fig. 6.

Fig. 9 is an enlarged side elevation of the brush mechanism as viewed in the upper part of Fig. 3 and approximately on the line 9—9 of Fig. 2.

Fig. 10 is a front elevation of a portion of one of the brushes, showing its left-hand end supported in a track with a lever extension connected to a power-driven chain.

Fig. 11 is a plan view of Fig. 10.

Fig. 12 is a wiring diagram.

In the detailed description which now follows, the machine is considered in four major portions: (1) the hopper; (2) the chute-loading means; (3) the capsule-holding and releasing mechanism; and (4) the bottle-feeding means. All of the parts function together to produce the end result of loading bottles with a specified number of capsules, some of the parts operating continuously and others, intermittently to bring about the completed filling operation.

Referring to Fig. 1, the hopper section is shown at A, the chute-loading means at B, the capsule-holding and releasing mechanism at C, and the bottle-feeding means at D. The capsules that are to be loaded into the bottles are poured into the hopper at A, from which they descend by gravity into the chute-loading means B in which is a series of continuously-moving brushes which agitate the capsules so that in due course the capsules will fall into alined positions in a plurality of inclined chutes. On entering the chutes the capsules will descend by gravity to the vertical portions of the chutes at the section C wherein is provided a common gate at the lower ends of the vertical parallel chutes to prevent further descent of the capsules until such time as the bottles have come into position thereunder. Thereafter capsule-restraining fingers are applied to a certain capsule in each chute a counted number above the gate, after which the gate is swung away permitting the counted capsules to fall the remainder of the way through pairs of converging chutes to enter the bottles. Upon closure of the gate, the restraining fingers are withdrawn permitting the capsules thereabove to fall to the gate.

Section D includes a conveyor designed to bring a specified number of bottles into alined position under the chutes and to maintain these bottles in correct position until the gate has been opened and the counted capsules have fallen into the several bottles. The conveyor then functions to remove the filled bottles and to bring a new batch of bottles into position to receive the next batch of counted capsules.

It should be understood that the parallel capsule chutes that are shown in the several figures, particularly Figs. 1 and 2, may be readily removed to be replaced by other parallel chutes of differing dimensions to accommodate capsules or pills of different sizes. In such cases, the bottle sizes will be correspondingly changed so that the conveyor will bring the correct number of bottles to filling position.

The machine, generally

Referring to Fig. 3, it can be seen that the machine comprises a unit consisting of a housing 2 within which the various mechanisms are contained. The housing includes the structural framework elements needed to support the several moving parts. The machine stands on adjustable legs 4 and has, at its upper rear, a platform 6 carried by the supports 8 and 10 bolted to the rear of the supporting framework. A capsule-receiving hopper 12 is carried by supports 14 and 16. The lower end of the hopper empties into a tray 18 which tray rests on the top of an electromagnetic vibrator 20, which is spring-mounted on the platform 6. Operation of vibrator 20 shakes the tray 18 and the capsules which have descended from the hopper into the tray so that they will flow continuously through a narrow slot 22 at the front of the tray into the chute-loading means. A plurality of small holes 24 are present in the front bottom portion of the tray to allow accumulated dust to fall into dust collector 26.

So long as the machine is in proper operation, the vibrator 20 continues to function, thus insuring a steady flow of capsules into the chute-loading means B at a rate at least as great and preferably somewhat greater than the number of capsules required to fill each batch of bottles as they arrive in loading position.

Chute-loading means

Chute-loading means B is shown in Figs. 1, 2 and 3. It consists of an open, rectangular container 28 having along its bottom a plurality of parallel chutes or grooves 30 (see Figs. 1, 2, 3 and 9), each of appropriate width to receive in easy sliding relation a capsule after it enters container 28 from the tray 18.

The sides 32 and 34 of container 28, laterally of chutes 30, slope inwardly so that all capsules within the container will be in the chute area.

In order to insure that the capsules be continuously disturbed after entering the container from tray 18, a moving brush mechanism is provided which continuously agitates the capsules resulting in the capsules falling into the chutes as they happen to be alined by the moving brushes. These brushes are shown in Figs. 1, 2, 3, 9, 10 and 11 and are indicated by the numeral 36. The brushes are carried by crosswise-extending bars 38 on the outer ends of which are rollers 40 (see Figs. 10 and 11) which rollers run in a track 42. This track is oval in shape and in a vertical plane and may best be seen in Fig. 3. The bars 38 have outward extensions 44 with crank arms 46, the extremities of which are connected to a continuous chain 48, mounted on sprockets 50 and 52. This chain is driven by means of a motor 54 through a suitable gear reduction and a chain 56 to a sprocket 58. Thus, as long as motor 54 continues to run, the series of brushes 36, of which eight are indicated in Fig. 3, moves in the direction of the arrow so as to engage the capsules 64 as the brushes move in succession upwardly over and along the chutes 30.

As shown in Fig. 9, the chutes at the lower portion of container 28 are covered by a sheet of material indicated at 60, which material preferably is transparent plastic so that the capsules in the chutes thereunder may be observed.

In order to provide improved circulation of the capsules in the container prior to their entry into the chutes, it has been found desirable to cause each brush as it moves upwardly over and along the chutes to be temporarily lifted therefrom. This is accomplished by the mechanism shown in Figs. 9, 10 and 11, in which the arm 46 is caused to be raised by chain 48 as the chain rides up over a raised support 62. This causes the brush to be swung away from chutes 30, but it is restored to its normal position shortly thereafter as indicated by the brush thereabove in Fig. 9.

From the description thus far it is apparent that by filling the hopper 12 with capsules 64, the capsules will flow first into tray 18, thence through opening or slot 22 into container 28 to aline themselves in the plurality of sloping parallel chutes 30. In the present illustrative machine there are twenty such chutes and, with the machine in normal operation, the capsules being indicated at 64 in Fig. 9 slide down the chutes into the vertical portions of the chutes as at 66 in Fig. 1. All twenty chutes will be solidly filled with capsules down the front of the machine to the gate 68.

Capsule-holding and releasing mechanism

The upper portion of the capsule chutes immediately below the container 28 is covered with a transparent plastic sheet 69, as shown in Figs. 3, 6 and 9, which sheet extends downwardly to a position behind the upper count bar 70. From thereon down to the gate 68 the chutes are open at the front, but such openings are not large enough to permit the escape of the capsules. Accordingly, the machine will reach a condition of operation in which all of the chutes 66 are filled with capsules from the gate 68 upwardly to the container 28 of the chute-loading means. The count bar 70 cooperates with a second or a lower count bar 72 to control the number of capsules that will be permitted to drop from the chutes into the bottles or containers 74 through the converging chutes 76. The converging chutes have their upper ends in exact alinement with the lower ends of the twenty vertical chutes 66, and their lower ends merge, as at 78 (Figs. 1 and 2), to provide an exit mouth directly over the neck of the associated bottle. Thus, capsules running out of the first and second capsule chutes 66*a* and 66*b* (Fig. 1) will run through the converging chutes 76 to fall into bottle 74. Similarly, those capsules in the third and fourth chutes, counting from the left, will fall into jar 74*a*, and so on.

As previously pointed out, there is normally positioned under the lower ends of chutes 66 a gate 68 shown in Figs. 1, 2, 3 and 5. Mechanism is provided which periodically slides this gate in a horizontal direction toward the rear of the machine to uncover the lower ends of chutes 66 so that capsules in the chutes may fall into the associated bottles.

In order to limit the number of capsules that may fall into the bottles when the gate 68 is opened, means associated with the count bars 70 and 72 is provided which acts to press against one capsule in each of the chutes, thereby holding that capsule in fixed position in its chute and preventing any downward movement of the capsules thereabove. Those capsules in the chutes 66 below the capsules that are being held by the count-bar mechanisms will fall freely into the bottles as soon as the gate is opened by being moved to the rear.

Referring to Figs. 1 and 6, it will be observed that the count bars 70 and 72 are held in adjustable vertical position by means of thumbscrews 80 and 82 cooperating with vertical supports 84. By loosening these thumbscrews, count bars 70 and 72 may be shifted vertically with respect to supports 84. The purpose of providing this adjustability is so that certain fingers mounted on the rear of the count bars, which fingers are shown at 86 and 88 in Figs. 1, 6 and 7, may be brought to bear against specifically located capsules in chutes 66. Thus, for example, let us suppose that in referring to Fig. 1, finger 86 is brought to bear against the fourteenth capsule in chute 66*b* counting upwardly from gate 68 and finger 88 is

brought to bear against the thirteenth capsule counting upwardly from gate **68** in chute **66***a*. Then it should be apparent that, if gate **68** is opened, thirteen capsules will fall downwardly through chute **66***b* and twelve capsules will fall downwardly through chute **66***a*, to fill bottle **74** with twenty-five capsules.

Thus, by shifting the vertical position of count bars **70** and **72** to bring the fingers **86** and **88** against capsules selectively located above the gate **68**, the number of capsules falling into bottle **74** when gate **68** is opened may be exactly determined.

If it is desired to fill the bottle **74** with fifty capsules, this may be achieved by closing gate **68**, moving count bars **70** and **72** outwardly so that fingers **86** and **88** no longer press against the respective capsules in the chutes **66***b* and **66***a* thereby permitting the capsules in the chutes to slide downwardly until stopped by gate **68** thereby again filling the chutes through their entire lengths. The count bars **70** and **72** are then moved inwardly so that fingers **86** and **88** again engage the fourteenth and thirteenth capsules in the chutes **66***b* and **66***a* and, while these capsules are being held against downward movement, the gate is opened so that twenty-five additional capsules will now run down into bottle **74**. By this procedure with the count bars **70** and **72** correctly positioned, any number of capsules may be supplied to bottle **74** within the range of all normal, commercial requirements.

As a further example of filling bottles with another number of capsules, suppose the desired number is twenty. Count bar **72** will first be moved down until the fingers **88** are at a level in their chutes to engage the eleventh capsule up from the gate. Count bar **70** will then be moved down so that fingers **86** will engage in their appropriate chutes the eleventh capsule up from the gate. This is possible because when the count bars are in engagement with each other, the fingers **86** and **88**, functioning in alternate chutes will be on the same level. Then when gate **68** is opened 20 capsules (10 from each of two adjacent chutes) will fall into the bottle.

Twenty capsules could also be delivered in the following manner. Count bar **70** could be positioned to have fingers **86** engage the twelfth capsule in alternate chutes while count bar **72** is positioned so fingers **88** engage the tenth capsule in alternate chute. Then upon opening of gate **68**, 20 capsules will fall into the bottle (11 from one chute and 9 from the adjacent chute)

With the count bar set to deliver 20 capsules for each opening of gate **68**, it is apparent that any multiple of 20 capsules can also be delivered by opening the gate a suitable number of times in timed relation with the movement of the count bars **70** and **72**.

From the foregoing it is believed apparent that by proper vertical adjustment of the count bars coupled with the proper number of cycles of gate openings, any required number of capsules may be delivered to the bottles.

Gate and count-bar actuating means

The mechanism that actuates the gate **68** and the count bars **70** and **72** will now be described. We will first consider the movement of the gate.

Referring to Figs. 2 and 3 there is shown a motor **90** driving through belt **92** a gear-reduction unit **94**, which in turn through sprocket **96**, drives chain **98** and sprocket **100**. (See also Fig. 7.)

Sprocket **100**, driven by motor **92**, rotates continuously and freely on shaft **102**. A cam track **104** fixed to sprocket **100** is utilized in the actuation of the count bars which will be described in more detail hereinafter. A smaller sprocket **106**, also fixed to sprocket **100**, continuously drives chain **108** and sprocket **110** mounted for free rotation on a lower shaft **112**. The function of sprocket **110** will likewise hereinafter be explained.

Referring now to sprocket **100** which is mounted for continuous free rotation on shaft **102**, it will be seen in Figs. 2 and 7 that there is an associated conventional clutch **114** brought into actuation by operation of the solenoid-controlled element **116** (see Fig. 12). Upon actuation of element **116** through electrical circuits to be described hereinafter, gear **100** will be locked in engagement with clutch **114** which clutch is splined as at **118** to shaft **102**, thus setting shaft **102** in rotation to continue in rotation so long as element **116** remains in actuated position.

A the left hand end of shaft **102** as shown in Figs. 2, 5 and 7 is an element **120** containing a cam track **122**. In this cam track is a follower **124** (see Fig. 5) connected to fork **126**, the ends of which straddle and are guided by shaft **102**. Extending from fork **126** is rod **128** connected with lever **130** which lever is secured to shaft **132** running interiorly of a tubular shaft **134** and freely rotatable therein. To shaft **132** is affixed a lever **136** connected by bar **138** to another lever **140** secured to an upper shaft **142** parallel to shaft **132**.

On shaft **132** are secured two levers **144** and **146** (see Figs. 5 and 7), each of which is pivotally connected to extensions **148** and **150** connected respectively to the vertical gate-carrier bars **152** and **154** on which at their lower ends is mounted gate **68**. Similarly, levers **156** and **158** are connected with upper extensions **160** and **162** of gate-carrier bars **152** and **154**.

By this construction it is believed apparent that, when shaft **102** and element **120** affixed thereto are rotated, rod **128** as viewed in Fig. 5 will first be moved to the left by virtue of cam track **122** to shift gate-carrier bars **152** and **154** to the left thereby moving gate **68** to the left so that it will no longer block the lower ends of capsule chutes **66** thereby permitting the capsules **64** to fall through the converging chutes **76** into bottle **74**. As pointed out above, only those capsules that are located below the fingers **86** and **88** of the count bars will drop when gate **68** is moved in the manner just explained.

The mechanism for actuating the count bars will now be explained.

It will be remembered that sprocket **100** rotates continuously and this sprocket contains the cam track **104**. Fitting in this track is a follower **164** (Figs. 6 and 7) connected to fork **166** from which extends rod **168**. The upper end of rod **168** is pivotally connected to lever **170** which is affixed to tubular shaft **134**. Affixed to tubular shaft **134** are a pair of spaced levers **172** which are pivotally connected to spaced extensions **174** of the two count-bar supports **84**. Another lever **176** secured to shaft **134** is pivotally connected to rod **178** which in turn is pivotally connected to lever **180** secured to the tubular shaft **182**. On shaft **182** are two additional spaced levers **184** and **186** connected to spaced upper extensions **188** of the count-bar supports **84**.

It is believed apparent from this description that as gear **100** rotates the count-bar supports **84** and the count bars **70** and **72** mounted thereon will be continuously moved toward and away from the vertical chutes **66**.

Referring now to Figs. 6 and 8, it will be noted that there are mounted on the inner sides of the horizontally-extending count bars **70** and **72** a plurality of micro-switches or the equivalent thereof, those on the upper count bar being numbered **190** and those on the lower count bar being numbered **192**. The switches **192** are shown in Fig. 8 in plan view and each of these switches **190** and **192** have extending therefrom switch arms **194** with fingers **86** and **88** on their ends, which fingers enter through the front open channels of chutes **66** to press against the capsules **64** which may be located at the level of such fingers or feeler elements. The count bars, when moved toward the capsules, are moved far enough so that the fingers will exert sufficient pressure against the capsules that they may engage to hold such capsules firmly in position in the chutes **66** and thereby prevent any downward movement of all capsules located thereabove whenever gate **68** has been opened to permit the capsules therebelow to fall into the bottle **74**.

Obviously the timing of the movement of gate **68** and

count bars 70 and 72 must be such that the gate can be opened only when the fingers are pressing against capsules in chutes 66.

More specifically the timing of the count bars with respect to the gate is as follows: The count bars 70 and 72 go through a complete in and out cycle for one revolution of cam 104 and gate 68 also goes through one complete cycle for one revolution of shaft 102 which is tied to cam 104 by clutch 114. In other owrds whenever gate 68 is in actuation it is synchronized with count bars 70 and 72. The timing is this. Starting with the gate closed, shaft 102 is brought into operation by clutch 114. Fingers 86 and 88 move in to grip their appropriate capsules. Gate 68 then opens to dump the capsules. Gate 68 then closes while fingers of 86 and 88 are still in and holding. The fingers move out so additional capsules may fall to engage gate 68 and fill the chutes. The fingers move in, engage the capsules and the cycle is then repeated.

The gate's position is normally closed. The number of gate openings in timed relation with the count bars is controlled by the gearing between shaft 102 and cam 256, namely gears 246, 248, 250, 252 and 254. If the gear ratio is one to one, the gate will open only once and then remain closed while the bottles are being moved. If the ratio is four to one, for another example, the gate will open four times in timed relation to the count bars and will then stay closed while the ten filled bottles are removed.

Operation of the conveyor

Means must be provided for presenting the proper number of bottles at exact locations under the ten converging pairs of chutes 76 that feed the capsules from the twenty vertical chutes 66 into the bottles 74. The conveyor mechanism functions as follows.

As has been pointed out above, the sprocket 100 runs continuously and this drives chain 108 and sprocket 110 likewise continuously. Sprocket 110 is freely rotatable on shaft 112 (see Figs. 3 and 4). Fixed with respect to sprocket 110 is sprocket 196 which drives chain 198 and sprocket 200. This latter sprocket is fixed on shaft 202 on the other end of which is bevel gear 204 meshing with bevel gear 206, which latter gear drives shaft 208 carrying a gear 210 which actuates continuously the conveyor 212. This conveyor may be the form of a series of small flat plates 213 as shown in Fig. 1, linked together and presenting a smooth metallic surface on which the bottles 74 rest. Conveyor 212, being driven by the continuously-rotating sprocket 110, moves continuously, constantly urging the bottles in the direction of movement of the conveyor shown by the arrow in Fig. 4. When unrestrained, bottles positioned thereon will move continuously with the conveyor but, when restrained by suitable stops, the bottles may be held in fixed, accurately-located positions.

The character of the stops for controlling the location of the bottles on the conveyor will now be explained.

Referring to Fig. 4, there is shown schematically a clutch mechanism 214, one part of which is keyed to shaft 112. This clutch is caused to function by operation of a solenoid-controlled element indicated at 216 (see Figs. 4 and 12). Thus, whenever element 216 is actuated, shaft 112 is caused to rotate correspondingly. Means will hereinafter be described which causes shaft 112 to be put into rotation periodically for one revolution. Affixed to shaft 112 are two cam elements 218 and 220 containing cam tracks 222 and 224. Suitable cam followers located in the cam tracks 222 and 224 cause movement of the forked elements 226 and 228 from which extend in a downward direction rods 230 and 232. Rod 230 when actuated causes simultaneous movement of stops 234 and 236 (see Figs. 3 and 4), while movement of rod 232 causes actuation of the single stop 238. The linkage shown in Figs. 2, 3 and 4 actuated by rod 230, is as follows: A lever 240 pivoted at 242 and having upper extensions 244 will be swung back and forth once for a single revolution of shaft 112. The cam tracks 222 and 224 are so designed that all of the stops 234, 236 and 238 will be in position over the conveyor to hold the bottles in correct position when shaft 112 is not rotating. It is during this period when shaft 112 is stationary that shaft 102 under control of clutch 114 is in operation. Thus, for example, stop 234 will hold ten bottles in exact correct position while the gate 68 and the count bars 70 and 72 are going through their motions.

When shaft 112 is rotating, shaft 102 will be stationary with the gate 68 closing the lower end of chutes 66 so that, upon simultaneous withdrawal of stops 234, 236 and the subsequent properly timed withdrawal of stop 238, the filled bottles may be moved to the right by the conveyor 212 to leave the machine. A second set of ten bottles previously held between stops 236 and 238 will be moved into position under converging chutes 76 between stops 234 and 236 and a new set of ten bottles previously restrained by stop 238 will move forward to engage repositioned stop 236 and the following bottles will be cut off by timely repositioning of stop 238.

Gearing for controlling the number of filling operations before shifting bottles

If, for example, it is desired to fill each of the bottles 74 with one hundred capsules, it will be necessary for the shaft 102 to make four complete revolutions, allowing capsules to fill the space in the chutes 66 between gate 68 and the fingers 86 and 88 of the count bars four times, dropping into each bottle 74 twenty-five capsules four times for a total of one hundred. When this has been completed, it then becomes necessary to stop rotation of shaft 102 so that further filling will be prevented and bringing into operation shaft 112 which will cause withdrawal of the stops to permit the filled bottles to be carried off and a new batch of unfilled bottles to be brought into filling position. This is achieved by virtue of an electric circuit, which will be explained hereinafter, aided by a gear train which causes the circuit to function at a predetermined time. This gear train is shown in Figs. 2, 3 and 12.

On the end of shaft 102 is a gear 246 meshing with gear 248 which in turn meshes with gear 250, and a smaller gear 252 associated with gear 250 drives gear 254 mounted on a shaft which carries a cam 256. The teeth of the gears are so arranged that four revolutions of shaft 102 will result in one revolution of cam 256. Thus, after the bottles have been filled four times by four revolutions of shaft 102, cam 256 will act to close a switch 290 (see Figs. 2, 7 and 12) which puts shaft 112 in operation and slight initial rotation of shaft 112 breaks a circuit causing shaft 102 to stop rotating by virtue of the throwing out of clutch 114. Immediately upon disengagement of clutch 114, a brake 258 (see Fig. 7) functions to bring shaft 102 to a substantially instantaneous halt. At this point, however, cam 256 will have released its switch lever putting the circuits in condition so that, upon the completion of one revolution of shaft 112, the circuit controlling the solenoid-operated element 116 will function to restore operation of shaft 102. Shaft 112 ceases its rotation at the end of one revolution because it is controlled by a so-called "one-revolution clutch," which automatically throws out after the shaft has made one revolution. Thus, the process is repeated again and again so that automatic filling of the bottles is carried out in a continuous manner.

Safety mechanism

Means is also provided to stop the operation of the machine whenever the fingers 86 and 88 of the switches 190 and 192 do not engage capsules when the fingers are moved into the chutes 66. Obviously, if a capsule is missing at the finger locations, it means that a full

count of capsules will not be fed to the related bottle on either that feeding or the next or both. This safety feature is achieved by a wiring circuit which requires that each of the twenty finger-carrying arms of the switches 190 and 192 must close their contacts at each inward movement of count bars 70 and 72, if the machine is to continue functioning. If one or more of the switches 190 or 192 are not closed, this means that a capsule is missing at the finger position in one or more of the chutes 66. Failure of one or more switches to close prevents current from flowing through these switches, which are arranged in series, and this results in the instantaneous breaking of relay-controlled switches which shuts down the machine and prevents further operation until the difficulty has been remedied and the machine started up again by manual operation of other switches.

The controlling electrical circuit

Reference is now made to Fig. 12 to explain the operation of the machine in further detail.

110-volt, 60-cycle alternating current is supplied from the line. A double-pole, single-throw switch 260 is used to connect the circuit to the line. A toggle switch 262 on the front of the cover of the controller 264 is used to operate a syntron vibrator 20 already referred to and shown in Fig. 3 for agitating the feed hopper. The vibrator circuit is in parallel with the count-bar switches 190 and 192, and the two top contacts 266 and 268 of the relay 270.

Relay 270 is energized through a circuit in series with the count-bar switches. In other words, if each of the chutes 66 is filled with capsules, all of the switches 190 and 192 will be closed as the count bars 70 and 72 move inward and the fingers 86 and 88 engage capsules, thus completing a series circuit through these switches. The count-bar switches must all be closed to complete the circuit 272 of the relay 270. Absence of one or more capsules at the finger positions in any of the chutes 66 will result in the failure of one or more of the switches 190 and 192 to close and, as a result, the relay 270 cannot operate. If the relay 270 does not close, then it is apparent that vibrator 20 cannot function.

From the foregoing it will be seen that at the start, the chutes 66 being empty before any capsules from the hopper 12 have entered and filled the chutes, no vibration will occur and, therefore, no capsules will flow from the hopper to fill the chutes.

To overcome this situation, a so-called "momentary switch" 274 is utilized to manually close the circuit to the vibrator 20 and thus to start the capsules flowing from the hopper 12 into the various chutes 66.

As pointed out above, as soon as motor 90 has been started the count bars 70 and 72 commence their steady oscillation which continues uninterruptedly throughout the functioning of the machine. Thus, when the chutes 66 have been filled with capsules by virtue of holding the monentary switch 274 closed until enough capsules have entered container 28 from hopper 12, have been distributed by brushes 36 and have worked their way down through the chutes (it being understood that motor 54 has also been put into operation to cause the brushes 36 to do their work in the container 28), the fingers of switches 190 and 192 will, in time, find the chutes full and all of the switches 190 and 192 will then simultaneously close thus energizing relay 270 causing the two pairs of contacts 266, 268 and 276, 278 to be closed. Momentary switch 274 may now be released as a circuit has been established for vibrator 20 which will remain closed so long as relay 270 continues to be energized. Closing of relay 270 also establishes a holding circuit through contacts 276, 278 and the normally-closed switch 280. At the same time the clutch-actuating element 116, moved by solenoid 282, will be in clutch-operating position by virtue of the normally-opened switch 284 being closed at this time because of the position of cam 286 that is mounted on shaft 112 (see Figs. 4 and 12). Operation of solenoid 282 and element 116 throws clutch 114 into operation and starts shaft 102 rotating. On shaft 102 is cam 288 which is adapted to open switch 280 on each revolution of shaft 102.

The position of cam 288 is timed with respect to the motion of the count bars 70 and 72 so that, when the switches 190 and 192 are all closed by fingers in engagement with capsules in chutes 66, the switch 280 will be opened by engagement of cam 288 with the switch arm 289. Opening of switch 280, however, does not deenergize solenoid 282 nor the relay 270, as the circuit is preserved by the switches 190 and 192.

Thereafter, when cam 288 rotates farther, switch 280 will be reclosed just before count bars 70 and 72 move away from the chutes 66 to cause opening of the switches 190 and 192. In this way the circuit through the coil 272 of relay 270 is preserved and the circuit through solenoid 282 remains in force through switch 280, the continued closed contacts 276 and 278, and switch 284 which is closed so long as shaft 112 does not rotate.

In this way, even though the switches 190 and 192 are constantly opening and closing as the count bars 70 and 72 move out and in, still the circuits are preserved through relay 270 and solenoid 282 because switch 280 is closed and opened by cam 288 in time with the opening and closing of switches 190 and 192 to preserve the circuits. This manner of operation is also necessary in order to save the wear and noise which would occur should the coil 272 be energized and deenergized at each filling cycle.

It will also be seen that the timed relation of the count-bar switches 190 and 192 to switch 280 will result in the immediate opening of relay 270 if any capsules are missing from one or more chutes when the fingers of count bars 70 and 72 are in capsule-engaging position. At that point switch 280 will be opened by cam 288 and the series circuit through the count-bar switches 190 and 192 will not be completed because of the absence of one or more capsules at the finger-engaging positions in chutes 66. Thus, the circuit through coil 272 will be broken and the double sets of contacts opened. Coil 282 is deenergized because there is no longer a circuit either through switch 280 and the contacts 276 and 278 or through the count-bar switches. This also stops the hopper vibrator and any further movement of the gate 68 which is controlled by rotation of shaft 102, which rotation has ceased by virtue of the disengagement of clutch 114 under the influence of the broken circuit through coil 282.

In summary, up to this point, the normally-closed switch 280 is opened by cam 288 at every cycle of the machine, each cycle including an in-and-out movement of the count bars 70 and 72 and an opening and closing of the gate 68 operated by rotation of shaft 102.

All of the count-bar switches must be closed if the relay coil 272 is to be energized initially, but thereafter it may be maintained energized by the cooperation of normally-closed switch 280.

Functioning of circuit after the bottles have been filled with the desired number of capsules

It is apparent that after shaft 102, carrying cam 288, has made an appropriate number of rotations to introduce the proper number of capsules into the bottles, it must stop rotating to maintain the gate 68 closed while the bottle stops 234, 236 and 238 are removed from the path of the bottles so that the filled bottles can be taken away by the conveyor and a new batch of bottles brought into position. The chutes 66 hold a limited number of capsules between the gate 68 and the fingers 86 and 88 on the count-bar switches. Thus, when a large count of capsules is required in the bottles, a number of filling cycles must follow consecutively, the number of continuous cycles being determined by the required count.

Let us assume that a count requires four filling cycles. The set of change of gears already referred to and shown in Figs. 2, 3, 7 and 12, namely, gears **246**, **248**, **250**, **252** and **254**, are installed to give a four-to-one ratio between the main filling mechanism shaft **102** and the shaft on which is mounted cam **256**. After four cycles, or, that is, four rotations of shaft **102**, cam **256** will close switch **290** and thus energize the lower-clutch solenoid **292**. The circuit at that instant is either through the count-bar switches **190** and **192** or through the normally-closed switch **280**. Actuation of solenoid 292 operates clutch **214** by means of movement of element **216**, thus throwing shaft **112** into operation. Clutch **214** is a single-revolution clutch so that at the end of one revolution shaft **112** will come to a halt and, when in stopped position, cam **286** will be in engagement with the arm **287** of switch **284** thereby to hold that switch in closed position, in which condition it remains until the shaft **112** is again put into rotation by subsequent operation of solenoid **292**.

From the foregoing it can be seen that, whenever shaft **112** is brought into rotation, shaft **102** will stop as soon as cam **286** leaves switch arm **287** to open switch **280**. Thus, while shaft **112** rotates to withdraw the bottle stops so that the filled bottles may be moved away from the filling stations and a new batch of bottles brought into position, the gate **68** which is controlled by rotation of shaft **102** remains in closed position, the shape of cam track **122** being such to insure this condition. While shaft **102** is stationary, the gear **100** of course continues to rotate and therefore the count bars **70** and **72** continue their in-and-out motion.

However, during the period of rotation of shaft **112** during which time switch **284** is open, it is apparent that the repeated closings of switches **190** and **192** cannot reestablish the circuit through solenoid **282** and therefore there can be no further rotation of shaft **102** until shaft **112** has completed its single revolution and switch **284** is again closed with cam **286** coming to rest against switch arm **287**. It might also be pointed out that, when the switches **190** and **192** are opened, as count bars **70** and **72** move away from the chutes, relay **270** will remain closed for the reason that cam **288** on the now stationary shaft **102** will have stopped just short of opening switch **280**. Thus, with switch **280** closed, the holding circuit for coil **272** remains effective while shaft **112** is in operation and swtiches **190** and **192** are periodically opened.

After the bottles have shifted their position upon withdrawal of stops **234**, **236** and **238**, which shift of position is completed when the stops are brought back to position over the conveyor prior to the conclusion of the single revolution of shaft **112**, the switch **284** will be closed by cam **286** engaging the switch lever **287** and this then immediately energizes solenoid **282** putting clutch **114** back into operation to cause the synchronized operation of the gate and the capsule-holding fingers on switches **190** and **192**. Thus, the filling operation is repeated and this continues until the machine is intentionally shut down or until one or more capsules are missing from a chute and hence not engaged by the appropriate switch fingers.

It is our intention to cover all changes and modifications of the example of the invention herein chosen for purposes of the disclosure which do not constitute departures from the spirit and scope of the invention.

We claim:

1. A machine for filling containers with a specific number of identical articles, said machine comprising a plurality of generally vertical parallel chutes, means for constantly filling said chutes with said articles, a motor, a continuously driven element, a gate under said chutes, gate actuating means for opening and closing said gate, a clutch between said element and gate actuating means, article holding means continuously reciprocated by means driven by said element, said gate and holding means being timed with respect to each other so that said gate is open only when said holding means is holding articles in said chutes, a conveyor, a second clutch, means controlled by said second clutch for controlling movement of said containers by said conveyor, and mechanically controlled circuitry for causing substantially simultaneous disengagement of said first clutch to stop said gate under said chutes and engagement of said second clutch and then to disengage said second clutch after said conveyor has moved a fresh set of containers to position under said chutes and to engage said first clutch to cause reopening and closing of said gate in timed relation with said holding means whereby a specific number of articles will fall into said containers on each opening of said gate and gearing associated with said circuitry for controlling the number of actuations of said gate prior to disengagement of said first clutch and engagement of said second clutch.

2. A machine for filling containers with a specific number of identical articles, said machine comprising, in combination a plurality of parallel chutes, means for continuously introducing said articles one above the other into the upper portions of said chutes, a movable gate at the lower end of said chutes for limiting downward movement of said articles, a plurality of containers removably positioned below said chutes, means for releasably holding an article at a selected level in each chute in fixed position, means for moving said gate to open position when said holding means is holding all of said articles at said selected levels whereby all articles in said chutes below each said held article may fall into said containers, means for thereafter sequentially closing said gate and releasing said holding means whereby said held articles and articles thereabove in said chutes may again fill the chutes between said gate and said holding means, and control means carried by said holding means for preventing opening of said gate when an article is missing from said selected level in one of said chutes.

3. A machine for filling containers with a specific number of identical articles, said machine comprising, in combination a plurality of parallel chutes, means for continuously introducing said articles one above the other into the upper portions of said chute, a movable gate at the lower end of said chutes for limiting downward movement of said articles, a plurality of containers removably positioned below said chutes, means for releasably holding an article at a selected level in each chute in fixed position, said article-holding means comprising a bar having a plurality of series-connected switches each provided with an extended actuating finger for engaging articles at said selected levels in said chutes, said chutes each being provided with openings for receiving said fingers, means for moving said gate to open position, a control circuit including said series-connected switches for actuating said gate-moving means to open said gate when all of said switches are actuated by engagement of said fingers with articles in said chutes, whereby all articles in said chutes below the articles engaged by said fingers may fall into said containers.

4. A machine as defined by claim 3, further including means for sequentially closing said gate and releasing said holding means, whereby articles in said chutes may again fill the chutes between said gate and said holding means.

5. In a bottle filling machine the combination comprising a plurality of parallel vertical channels sized to guide articles in single file, means for continually depositing articles in the upper end of each channel, gate means at the bottom end of each channel for preventing release of article therefrom, holding means for limiting downward flow of articles in each channel, said latter means being periodically inserted into said channels at selected points above said gate to engage articles therein, mechanical means for withdrawing said gate to release articles positioned below said holding means, and means preventing operation of said mechanical means for with-

drawing said gate until articles in all of said channels at said selected points are engaged by said holding means.

6. In a bottle filling machine the combination comprising a plurality of parallel vertical channels sized to guide articles in single file, means for continually depositing articles in the upper end of each channel, gate means at the bottom end of each channel for preventing release of articles therefrom, holding means for limiting downward flow of articles in each channel, said latter means being periodically inserted into said channels to engage selected articles therein, and mechanical means for periodically withdrawing said gate to release articles positioned below said holding means, said mechanical means for withdrawing said gate comprising a solenoid-actuated clutch and means controlled by said holding means for energizing the solenoid of said clutch only when said holding means engage an article in each of said channels, said clutch-actuating solenoid being de-energized when said holding means fails to engage an article in all of said channels.

7. A machine for filling containers with a specific number of identical articles, said machine comprising in combination, a plurality of parallel chutes, means for continuously introducing said articles one above the other into the upper portions of said chutes, a movable gate at the lower end of said chutes for preventing discharge of said articles from said chutes, a plurality of containers positioned below said chutes to receive articles discharged from said chutes, holding means for engaging and holding an article at a selected level in each chute, means for causing said holding means to move into and out of said chutes repeatedly to engage and disengage articles at said selected levels, means for moving said gate to open position only when articles fill each chute from said gate to said selected level and the articles at said selected level are held by said holding means, whereby all articles in each chute below said holding means are discharged by gravity into said containers, means for sequentially closing said gate and moving said holding means out of said chutes whereby said held articles and additional articles above said held articles may fall and again fill said chutes between said gate and said holding means, means for holding said gate closed after a predetermined number of cycles of movement of said holding means and said gate, means operative after said predetermined number of cycles of movement and while said gate is closed to advance said plurality of containers out from under said chutes and to position additional containers beneath said chutes, and means for causing said gate moving means to again open and close said gate for said predetermined number of cycles in cooperation with said holding means after said additional containers are positioned beneath said chutes.

8. A machine as set forth in claim 7, wherein said article-holding means comprises a plurality of fingers, one finger for each chute, said fingers being associated with the actuating arms of a plurality of interconnected electrical switches, said switches all being actuated when said fingers engage and hold articles in said chutes, thereby to maintain a circuit controlling said gate-moving means.

9. A bottle filling machine comprising storage means having a plurality of parallel compartments for storing articles of identical size in parallel inclined rows, means for feeding articles to the upper end of said compartments, a gate at the bottom end of said compartments, said gate normally being positioned to prevent articles from dropping by gravity out of said compartments, means for moving said gate out of said normal position to release articles in said compartments and for returning said gate to said normal position after said articles have been released, a bar carrying a plurality of switches, each switch having an actuating finger extending therefrom said bar being mounted transversely of said compartments with each finger in alignment with one of said compartments, means for moving said bar toward and away from said compartments, each of said actuating fingers upon movement of said bar toward said compartments penetrating one of said compartments at a predetermined point relative to said gate, the distance between said gate and said point being slightly in excess of a whole multiple of the axial length of said articles so that each of said fingers will bear against an article in one of said compartments when said compartments are fully loaded, said switches being actuated by said fingers only when the latter engage articles in said compartments, electrically operated means responsive to simultaneous actuation of all of said switches for actuating said gate moving means to withdraw said gate and release articles from said compartments, said bar moving means being adapted to hold said bar in position to maintain said fingers in engagement with articles located at said predetermined points in said compartments until said gate has completed its cycle of movement away from and back to said compartments whereby to prevent all articles at and above said point in each compartment from being released while said gate is open, and means for moving a set of containers in position to be filled beneath said compartments and for moving said set of containers away after they have received a predetermined number of articles.

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