Aug. 27, 1963 A. H. WEBSTER 3,101,830

BOTTLE-TRANSFER MECHANISMS

Filed March 24, 1961 5 Sheets-Sheet 1

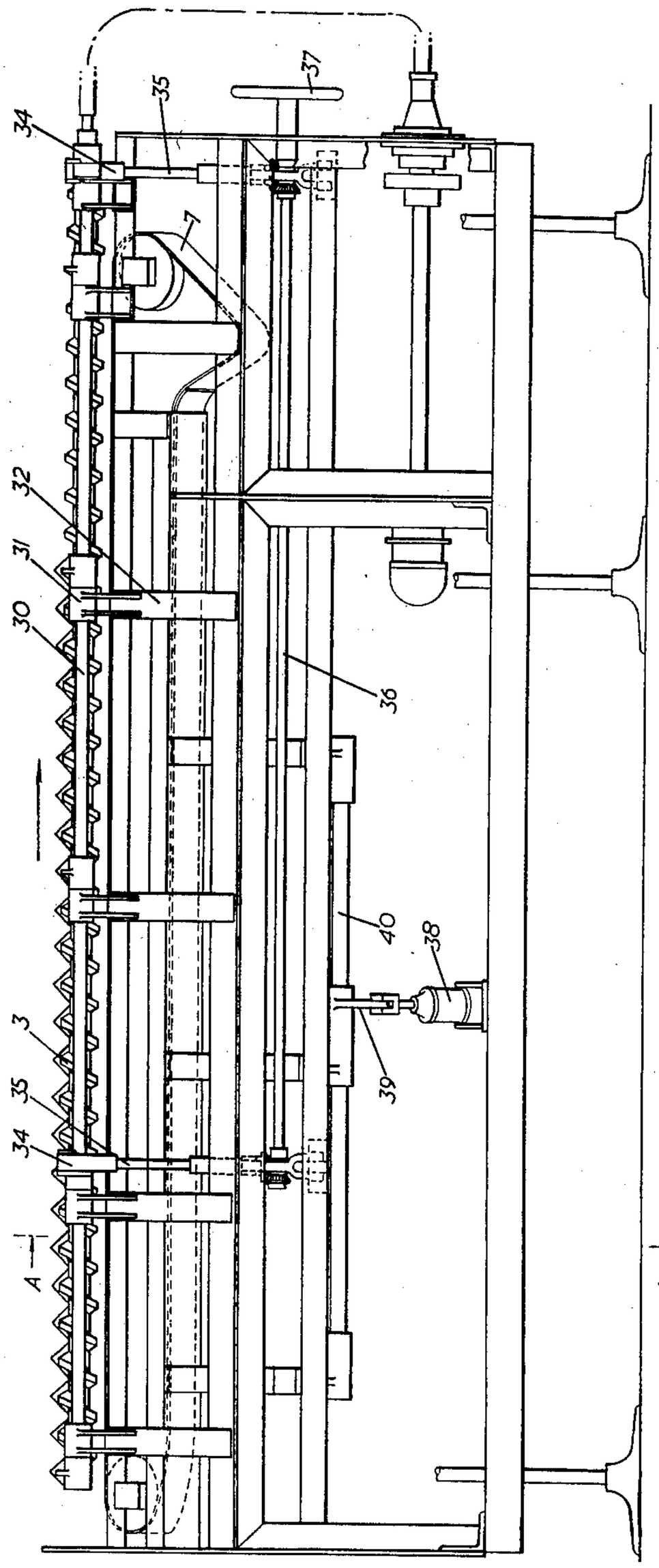

FIG. 1.

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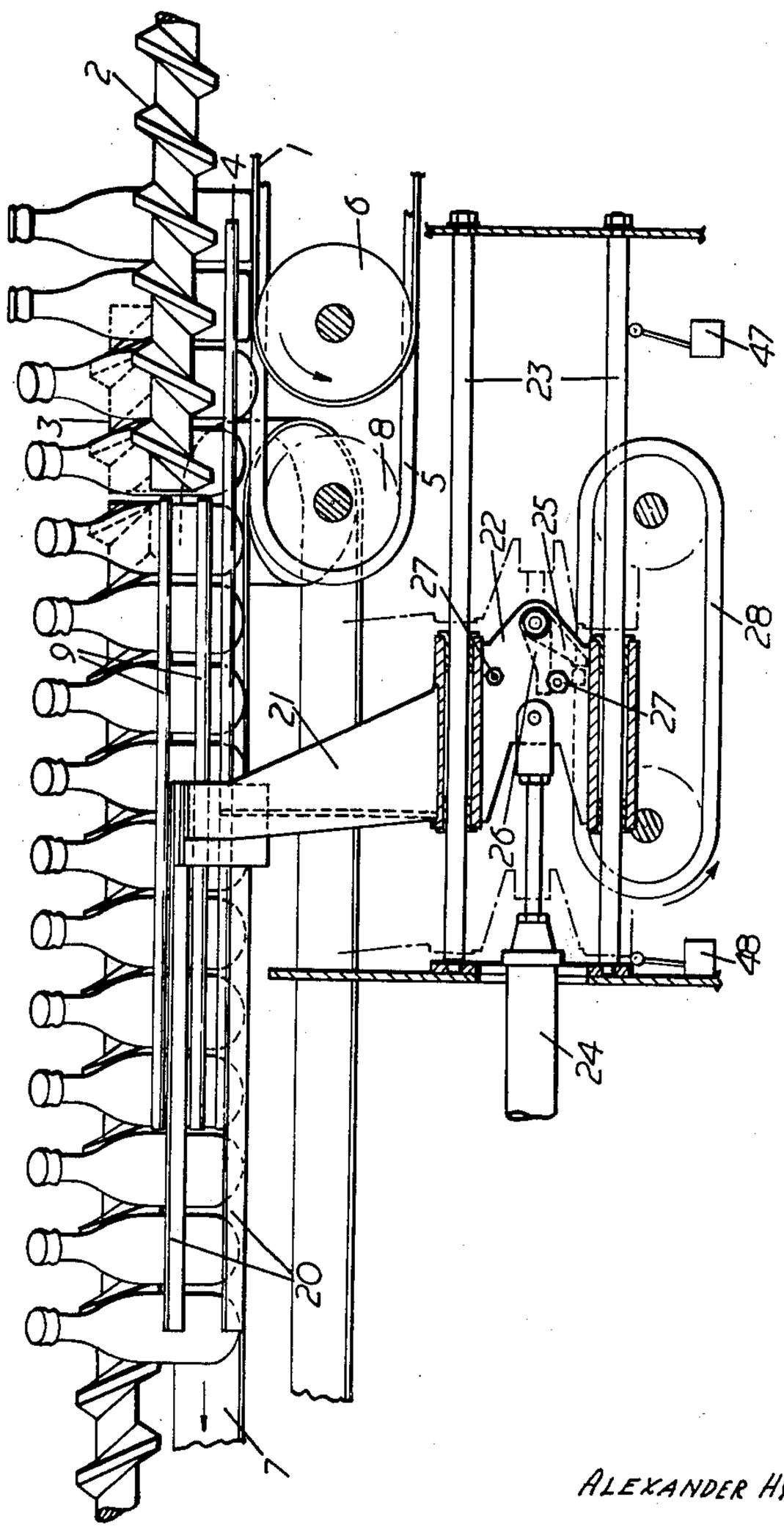

FIG. 2.

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BOTTLE-TRANSFER MECHANISMS

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FIG. 3.

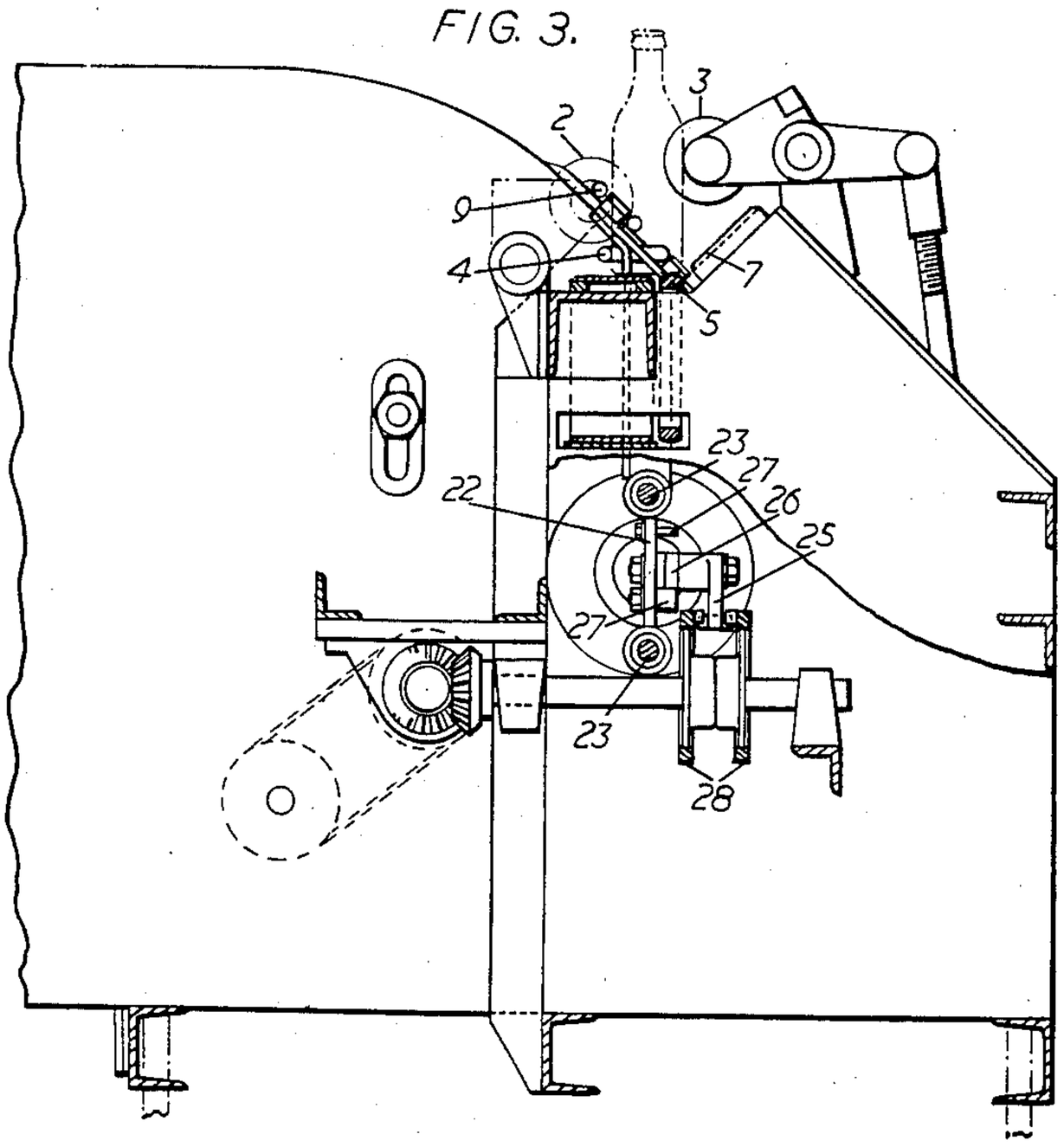
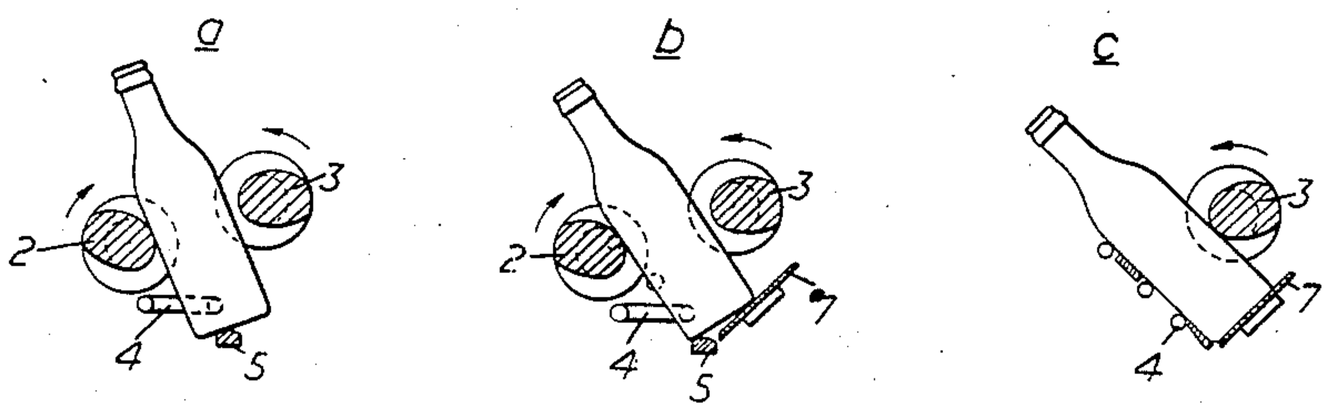


FIG. 4.



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BOTTLE-TRANSFER MECHANISMS

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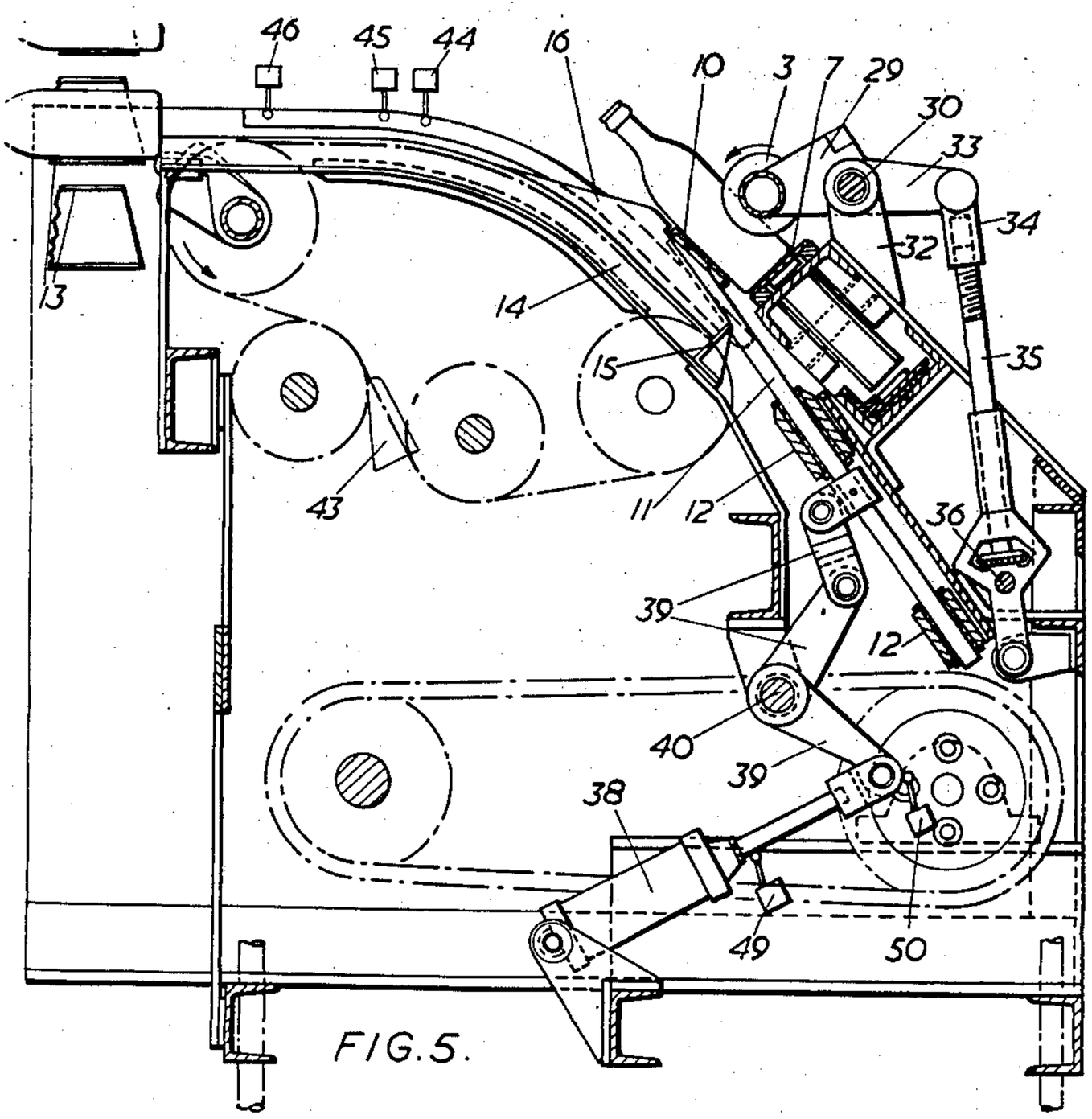

FIG. 5.

FIG. 6.

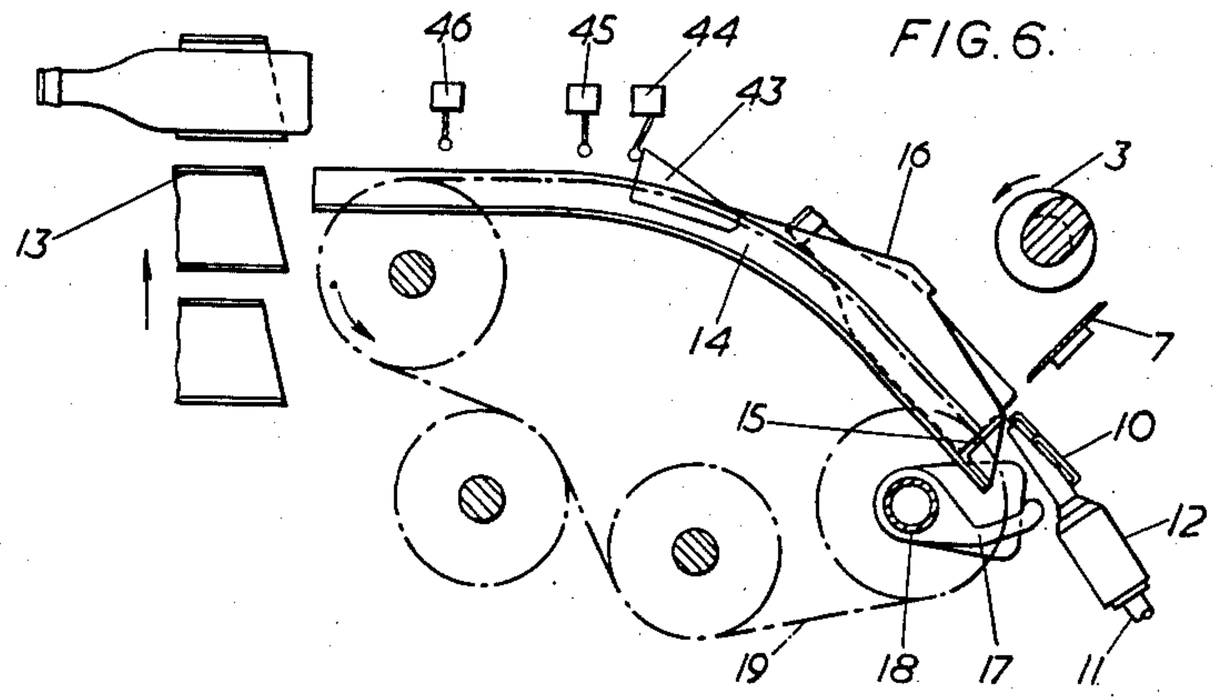

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FIG. 7.

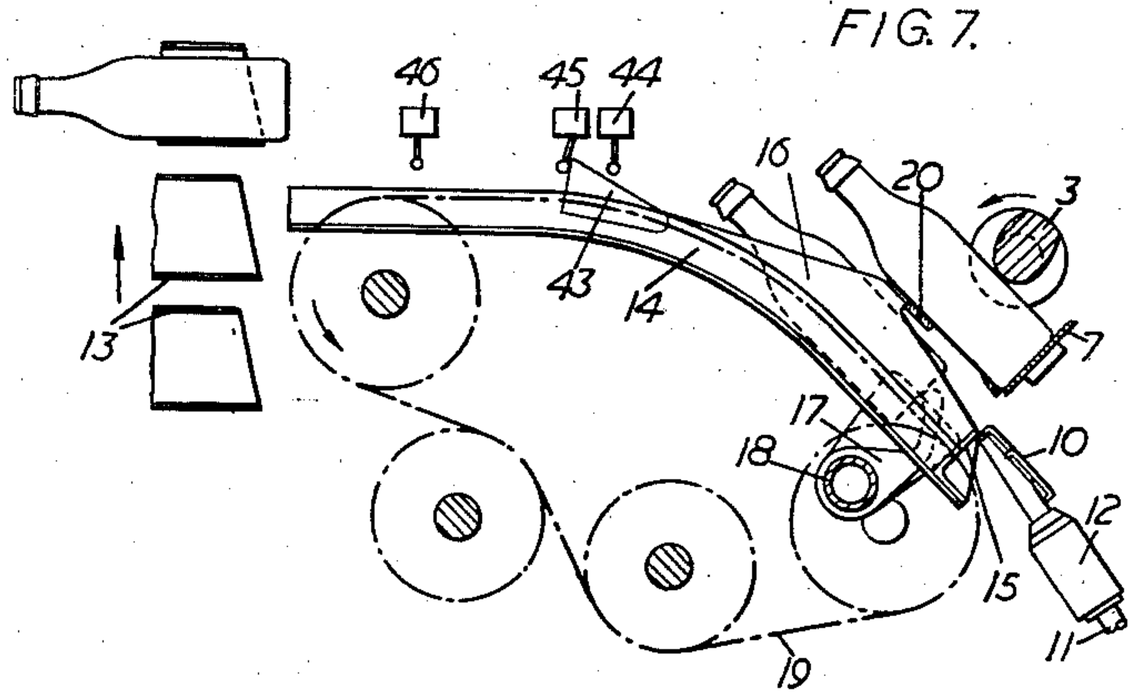
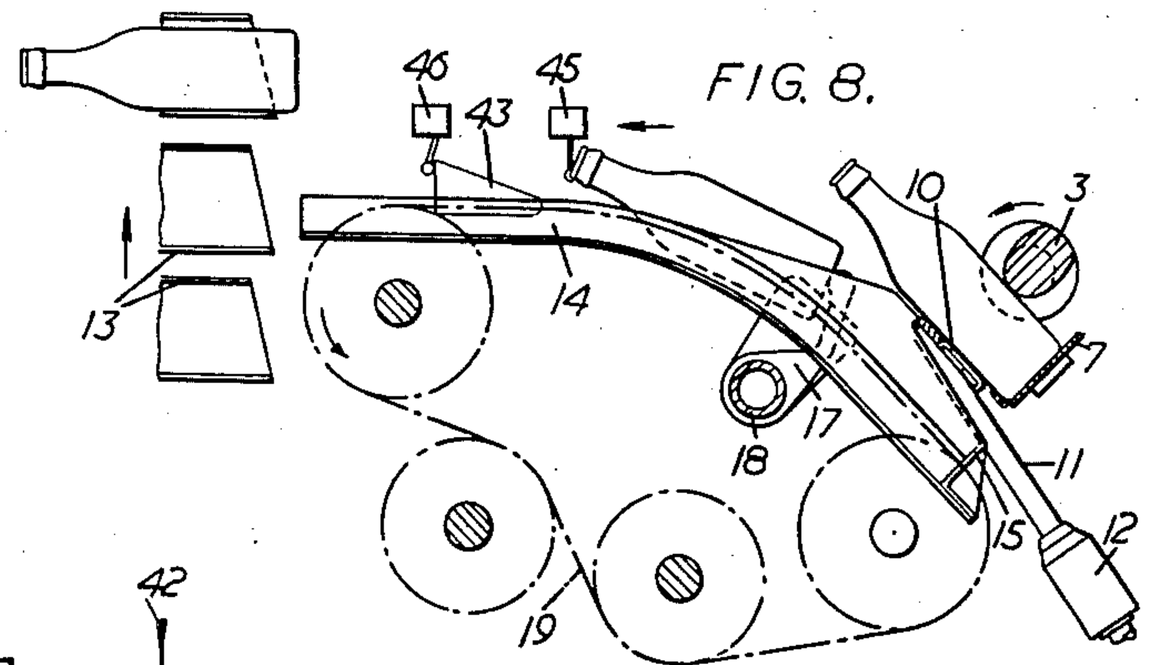


FIG. 8.



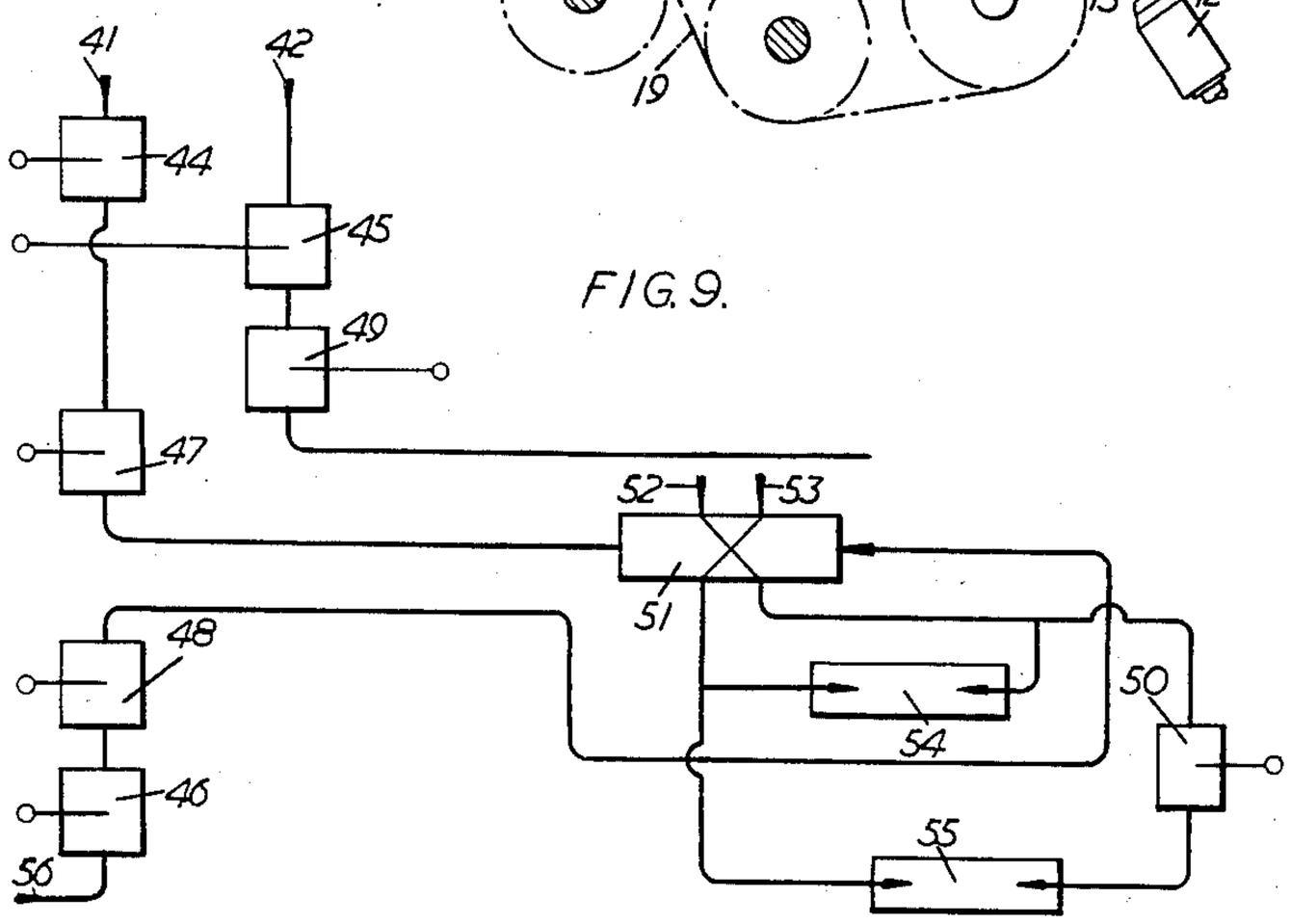


FIG. 9.

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BOTTLE-TRANSFER MECHANISMS

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Claims priority, application Great Britain Apr. 7, 1960
10 Claims. (Cl. 198—31)

This invention relates to bottle-transfer mechanisms, and is concerned with the means whereby a row of bottles is marshalled, suitably spaced, and is transferred to other equipment, such as a washing machine, a filling machine, a sterilising machine or the like. In such transfer devices it is important that the bottles advancing in a row to the position from which they are transferred elsewhere, shall be maintained in a closely controlled and accurately spaced relationship with one another. In known devices bottles are fed in spaced relationship on to a transverse conveyor, the spacing being effected by a worm or by a star wheel from which they are released when they pass on to the conveyor. Since the conveyor must advance until a row of spaced bottles thereon numbers, perhaps, 40 or 50 bottles, before the row is transferred (usually by a pusher device) it is found that the spacing of the bottles in the row on the conveyor is not always as accurate as desired. This is due to the fact that the accuracy of spacing depends upon maintenance of a very exact synchronous speed relationship between the conveyor and the spacing device, and slight variations introduce errors in spacing. Moreover if for any reason the conveyor should be stopped and restarted it may slip to a greater extent under one bottle in the row thereon than under another, which also introduces errors in spacing.

One object of the present invention is to provide a bottle-transfer mechanism free from the aforesaid defect, and with this end in view the invention consists in bottle-transfer mechanism comprising means for controlling the spacing of bottles in an advancing row which remain operatively in control of all the bottles until all the bottles of a row have reached prearranged positions, e.g. their positions from which they are transferred to the next stage of handling, e.g. into pockets of a belt for carrying them through a washing machine. The control means may conveniently comprise a worm, extending along substantially the full length of the row in transfer position (i.e. across substantially the full width of the machine), adapted to control the positions of the bottles being advanced by a conveyor.

According to a further feature of the invention a bottle-transfer mechanism comprises a conveyor on which bottles in spaced relationship are advanced in a row to transfer positions, the conveyor being so arranged that the row of bottles is transfered from one side of the conveyor by gravitational forces. The pusher device commonly employed in known transfer mechanisms is thus eliminated.

For the aforesaid purpose the bottles as they advance into the row may be tilted from their initial upright, vertical, positions to inclinations of, say, 45° to the vertical, being held in those positions by suitable supporting means which may be displaceable in order to allow gravitational transfer of the row to take place. According to yet another feature of the invention a bottle-transfer mechanism comprises means for tilting bottles, during their advance in a row, from initial vertical positions to inclined positions, e.g. to one side of the direction of advance. Care is taken to maintain the desired accurate spacing of the bottle during this tilting movement prior to the transfer operation. For example if and when the spacing is controlled by a worm the tilting of a bottle while in contact with the worm would result in advance or retardation of the bottle by a distance depending upon the angle of tilt

and the pitch upon the worm, and to avoid this the pitch of the worm may vary along its length to compensate for displacement due to tilting.

The invention will be clearly understood from the following description of one form (given, however, merely by way of example) which it may assume, and this description will be more readily followed by reference to the accompanying drawings wherein

FIGURES 1, 2 and 3 represent respectively in front elevation, rear elevation, and transverse sectional elevation, views of a bottle-transfer mechanism according to the invention, the section of FIGURE 3 being taken along the line A—A of FIGURE 1:

FIGURE 4 represents diagrammatically successive stages of tilting of a bottle as it advances through the machine shown in FIGURES 1–3:

FIGURE 5 represents in sectional elevation the means for holding a row of bottles during advance, and for releasing the row for transfer:

FIGURES 6, 7 and 8 represent views, similar to that shown in FIGURE 5, of successive stages of a transfer operation: and

FIGURE 9 is a diagram of control and synchronising arrangements for the mechanism shown in FIGURES 1–8.

In carrying the invention into effect in one convenient manner as shown in the aforesaid drawings a bottle-transfer mechanism is adapted to receive a line of bottles delivered to it by a conveyor, and to effect spacing of the bottles, and to maintain such spacing, as the bottles continue to advance. At the same time means are provided to tilt the bottles from initial vertical positions to inclined positions (e.g. at 45° to the vertical) to one side of the conveyor, and supporting them at these inclined positions, while still accurately maintaining the relative spacing of the bottles. When a prearranged number of inclined bottles completes a row the support is withdrawn, and owing to their inclination, the bottle in the row thereupon slide sideways off the conveyor to be received by other devices, e.g. carrier bolts which transfer them to pockets in a conveyor chain whereby they can be carried through a washing machine, a sterilising machine or the like. After the row of bottles has been thus discharged from the transfer conveyor, the support is returned to a position for receiving and supporting another row of tilted bottles. Means may be provided for temporarily supporting the leading bottles following the discharged row of bottles which are being advanced and are in process of being tilted before the row-support is restored to its supporting position.

Referring to FIGURES 1–3 of the aforesaid drawings bottles are delivered to the mechanism by a conveyor **1** of conventional form on which they are carried on orderly single file and usually in contact with one another. This conveyor **1** brings the bottles to a worm **2**, above and adjacent to the side of the conveyor on its rear side (i.e. the row-delivery side of the mechanism), against which worm the bottles may be held by guide rails or the like. The worm **2**, fitted with suitable trip gates and of increasing pitch, engages the contacting bottles and spaces them apart as they advance. The speed of the conveyor **1** is preferably controlled to hold the bottles against the rear face of the worm **2**, so that the conveyor is responsible for advance of the bottles, and the worm effects relative positional control.

At the joint of the mechanism parallel to, but spaced from, the worm **2** is a second worm **3**, and the progressing bottles, suitably spaced by the worm **2**, advance between the worms **2** or **3**, being engaged on opposite sides by both worms (FIGURE 4). A deflector rail **4** may be provided to ensure engagement of the bottles with the worms **3** and to assist in control of subsequent movement.

At this point of advance the tilting of the bottles, pre-

viously vertical on the conveyor **1**, is initiated. Owing to the rail **4** the base of each bottle is caused to slide transversely off the conveyor **1** on to the adjacent narrow belt conveyor **5**, and the conveyor **1** terminates by running over its end sprocket **6**, the bottles here being supported solely by the belt between the worms **2** and **3**. As they are carried further the bottles are increasingly tilted by the rail **4**, until they reach an inclination of about 45° to the vertical to one side of their line of advance, and at this point the bases of the bottles slide off from the belt **5** to a conveyor **7** running in a plane inclined to the horizontal to receive the bases of the tilted bottles. Successive stages of tilting of a bottle are illustrated in FIGURES 4, *a*, *b* and *c*. When the tilting is completed the belt **5** drops away round its end sprocket **8**. The advancing bottles are here supported in their positions by the rail **4** and by associated guides **9**, and it will be noted that the bottles remain in engagement with the worm **3**, which continues to control their spacing. As seen in FIGURE 1 this worm extends across the full width of the machine, and maintains spacing control of all the bottles as long as they are assembled tilted in a row on the conveyor **7**.

It will be noted from FIGURE 4 that the rotation of the worms **2** and **3** is such that in both cases their upper faces move inwards towards the bottles. It will also be noted that the tilting of a bottle provides additional relative rotational movement between the bottle and a worm, which would modify the linear advance of the bottle. In order to avoid undesired resultant displacement of the bottle the pitches of the worms are modified, the pitch of worm **2** being progressively decreased by about ⅛ pitch (being the proportion corresponding to a bottle tilt of about 45°, which is ⅛ of a full 360° turn) over the length between the point of initiation and point of completion of bottle tilting, while the pitch of worm **3** is likewise progressively increased by about ⅛ pitch over the corresponding length. The contours of the worms are carefully formed and adjusted at all points to conform and mesh with the tilting bottles, and the form of the guide rails **4** and **9** carefully formed to provide smooth control of motion of the bottles from upright to fully tilted positions.

The tilted bottles are advanced by the conveyor **7**, under spacing control by the worm **3**, until a complete row extends across the mechanism, and the row is then transferred from the conveyor.

One convenient arrangement for effecting this transfer operation is illustrated in FIGURES 5–8 of the drawings. The guide rails **4** and **9** terminate a short distance from the point of completion of tilting of the bottles, and thereafter the advancing bottles are supported in tilted positions by an inclined plate or frame **10** located to receive the inner walls of the bottles, in continuation of the rails **9**. This drop plate **10** is mounted on rods **11** slidable in bearings **12** so that it can be reciprocated between an upper, bottle-supporting, position (FIGURE 5), and a lower position (FIGURE 6) where it is free from the bottles and the conveyor **7**. The bearings **12** are preferably located so that during downward movement of the plate **20** it also moves somewhat away from the bottle (FIGURE 5).

When the drop plate **10** is in the lower position the bottles are free to slide, under gravitational forces, away from the control worm **3**, off the conveyor **7**, to other handling means, e.g. conveyor means described more fully below for carrying the bottles to pockets **13** of a conveyor chain about to receive them. As also described more fully below the operations of the mechanism are appropriately timed and synchronised to ensure that when the advancing row of tilted, spaced, bottles is aligned with the pockets **13** to receive them, the drop plate **10** is moved down (FIGURE 6) to release the bottles which, as shown in FIGURES 5–8, thereupon drop into slotted V-shaped slides or guides **14**, located behind the upper

position of the plate **10**, and conveniently formed of a resilient substance, such as rubber or a plastic compound, to avoid shock. The base of a bottle rests on a slotted abutment **15** at the lower end of the slide **14**, and fins **16**, e.g. of stainless steel or a resilient material, may be provided between the slides **14** to ensure and maintain separation of the bottles. These fins may extend almost into contact with the bottles before release in order to ensure separation as the bottles escape from the worm.

At the moment of entry of bottles into the slides **14**, feed fingers **17** mounted on a bar **18** carried between a driven pair of endless chains **19** approach the bases of the bottles (FIGURE 6) and move them upwards in the curved slides **14** (FIGURE 8) into a substantially horizontal position in which they enter the pockets **13**.

The conveyor **7** and worm **3** are driven continuously and thus during the time the drop plate **10** is withdrawn from transfer of a row of tilted bottles, other tilted bottles following the row being transferred, continue to advance and pass beyond the ends of the fixed supporting rails **4** and **9**. Means are provided to support these following tilted bottles, after they leave the rails **4** and **9**, for such time as is necessary for the assembled row to be transferred from the conveyor **7** and the drop plate **10** again raised to a supporting position.

These means comprise parallel arms **20** (FIGURE 2), in the same plane as the rods **9**, extending from a support **21** upstanding from a frame **22** slidably mounted on rods or the like **23**, and reciprocable thereon by a pneumatic cylinder **24**. The carriage **22**, **21** remains in retracted position (i.e. displaced to the right as seen in FIGURE 2) while a row of tilted bottles is being built up for transfer. When the drop plate **10** is withdrawn to initiate transfer of a row, the carriage is moved by the cylinder **24**, in the same direction and at the same speed, as the bottles following the row being transferred (i.e. from right to left as seen in FIGURE 2), and the arms **20** support the bottles after they have passed the ends of the rails **9**. When a row of bottles has moved off from the conveyor **7**, and been lifted sufficiently far by the fingers **17** to allow return of the drop plate **10** to supporting position, the drop plate is raised, as previously explained, and the carriage **22**, **21** arrested, and reversed, by the cylinder **24**, to its retracted position. While the arms **20** may be as long as desired, and have a stroke of any required length, it is found that it is usually necessary for the arms **20** to support only four bottles beyond the end of the rails **9** prior to return of the drop plate **10** to its supporting position. The drop plate **10** may, if desired, be cut away at its top and bottom edges, at the end adjacent to the arms **20**, in order that even in its uppermost position the arms **20** will not be obstructed by the plate **10**.

In order accurately to control movement of the traverse carriage **22**, **21**, there may be provided on the carriage a freely pivoted pawl **25** (FIGURES 2 and 3), with an integral weighted lever **26**, normally urging the pawl downwards. The lever **26** is movable between stops **27**. Adjacent to the lower rod **23** are mounted side by side, on suitable sprockets, two spaced endless chains **28** which run one past each side of the pawl **25**. At a selected point there is secured between the chains **28** a block or bridge piece which, as the chains rotate, rides under, and lifts, the pawl **25**. The chains **28** are driven at the same linear speed as the advancing bottles on the conveyor **7**, and while the carriage **22**, **21** is held in retracted position by the cylinder **24** the block on the chains **28** rides under the pawl **25**, temporarily displacing the pawl but otherwise having no effect. When, however, the cylinder **24** advances the carriage **22**, **21**, the pawl **25** engages behind the block carried by the chains **28**, and the speed of advance of the carriage is controlled by the chains and is not, therefore, more than the speed of advance of the bottles. This allows greater accuracy of control than would be easily possible by controlling the air supply to the cylinder **24**.

As seen from FIGURES 1 and 5 it is preferred to mount the worm **3** in such a manner that it can be adjusted to cope with bottles of different sizes. For this purpose the worm is formed in sections secured together by thin bearing plates **29** (FIGURE 5) secured to a rod **30** mounted in bearings **31** on upstanding supports **32**. Arms **33** extending from the rod **30** carry each a sleeve **34** in which engages a screw-threaded rod **35** having at its other end bevel engagement with a transverse rod **36**, rotatable by a hand wheel **37** at one end. By turning the hand wheel **37** all the rods **35** are rotated, to screw into or out of the sleeve **34**, thus rocking the rod **30** and adjusting the plates **29** (and with them the worm **3**) about the axis of the rod **30**. As also seen from FIGURE 5 the reciprocation of the drop plate **10** is effected by a pneumatic cylinder **38** operating through linkage elements **39** on a shaft **40**.

One form of pneumatic circuit, according to the invention, which may be employed to control and operate the mechanism described above, is illustrated diagrammatically in FIGURE 9 of the drawings. Air under pressure is supplied to two lines, **41** and **42**, in each of which are incorporated valves adapted to be depressed by abutments on the mechanism during operation. For example a projection or block **43** on the chain **19** carrying the feed bar **18** (FIGURES 6, 7 and 8) actuates valves, by depressing the arms thereof, as the chain **19** runs round its sprockets.

Valves **44**, **45** and **46** are adapted to be actuated by the abutment on the chain **19**. Valves **47** and **48** are operable by the traverse carriage **22**, **21** or an abutment thereon, and valves **49** and **50** are operable by the drop plate **10**, or an abutment thereon. In the case of valve **50** the valve is normally open for passage of air, but is closed when its arm is depressed: in all other cases the valves tend normally to be closed, but are opened by depression of their arms.

The sequence of operations is as follows:

At a prearranged timing the abutment **43** of the chain **19** operates valve **44** and opens the line to the valve **47**. The valve **47** is depressed by the traverse carriage **22**, **21** when in its fully retracted position, and would therefore be open provided the carriage were retracted. In these circumstances operation of valve **44** allows passage of air to actuate a relay cylinder **51**, connected to air lines **52**, **53**. The cylinder **51** thereupon admits air to a drop cylinder **54** adapted to operate the drop plate **10**, and to a holding cylinder **55**, adapted to operate the traverse carriage. The positions of the valves in the mechanism are preferably adjustable, and the valve **44** is so positioned (FIGURE 6) as to be depressed by the block **43** as the feed fingers **17** approach the position for picking up bottles in the **V**-slides **14**, and it will be seen that the drop cylinder is thereupon operated to withdraw the drop plate **10** (allowing a row of bottles to fall into the **V**-slides to be picked up by the fingers **17**); and also the holding cylinder **55** is actuated to advance the traverse carriage **22**, **21** from its fully retracted position (at a speed limited by the belts **28** as previously described).

The plate **10** drops to its lowermost position very quickly and almost immediately after depressing the valve **44** the block **43** operates the valve **45** admitting air to the valve **49**, which is operated by the plate **10** in its lowermost position. If, therefore, the plate **10** fails, or takes too long, to reach its lowermost position, air passes through valve **49** to operate directly on the clutch relay of the mechanism and thus to arrest the whole machine. If, however, valve **49** is closed before valve **45**, due to the rapid drop of plate **10**, the machine continues to run, and the block **43** thereafter depresses valve **46**, admitting air from line **56** to valve **48**, which is adapted to be actuated by the traverse carriage in its most advanced position. It is necessary to ensure that the carriage is fully advanced and has thus correctly supported bottles, in order that the drop plate **10** may be restorted to its upper position.

Provided the carriage has been fully advanced the valve **48** is open, and actuation of valve **46** admits air to the side of the relay cylinder **51** opposite to that connected to the valves **46** and **47**. The relay cylinder **51** being thrown vents the pressure sides of the cylinders **54** and **55**, and applies air to the return side of the drop cylinder **54**, thereby rapidly raising the drop plate **10** to its uppermost position. In this position the plate **10** actuates valve **50** and thereby admits air to the return side of the holding cylinder **55**, which thereupon retracts the traverse carriage **22**, **21**. When fully retracted this carriage opens valve **47**, and the circuit is reset for the next cycle of operations, commencing when the block **43** on its next circuit actuates the valve **44** again.

In addition to the above there may be incorporated in the circuit other trips (not shown). For example, a valve lever or like sensitive finger may be located at the end of the worm **3**, to be actuated by a bottle held in the worm by the plate **10** after it should have dropped out and therefore advanced to the end of the worm. When actuated this trip would arrest the machine. The worm itself may be driven by a sensitive slip clutch adapted to depress a trip and arrest the machine in case of jamming or other fault in the worm drive. An operator's trip would also normally be included for stopping the machine whenever required.

From the above description it will be seen that the invention provides effective means for the rapid transfer of bottles, marshalled in rows, to pockets in a chain, or like equipment, for further handling, but it should be understood that the invention is not limited solely to the details of the form described above, which may be modified, in order to meet various conditions and requirements encountered, without departing from the scope of the invention.

What I claim is:

1. Bottle-transfer mechanism comprising a first substantially horizontal conveyor for feeding a line of bottles to said mechanism, a second conveyor for receiving said infed bottles and conveying them to spaced transfer positions, said second conveyor being inclined to the horizontal in a transverse direction, means for tilting bottles from a substantially vertical attitude on said first conveyor to an inclined attitude as the bottles pass from said first conveyor to said second conveyor, means for supporting said bottles in inclined attitudes during their advance on said second conveyor, worm means adjacent to said second conveyor adapted to control the movement and spacing of said bottles on said second conveyor throughout the time the said bottles are being conveyed to, and become located at, said respective transfer positions by said second conveyor, and means for effecting simultaneous transfer from one side of said second conveyor, of all the spaced bottles lined on said second conveyor when they respectively reach the said transfer positions thereon.

2. Bottle-transfer mechanism according to claim 1 wherein said means for supporting bottles in inclined attitudes comprise, adjacent to one side of said second conveyor, movable guide means against which said inclined bottles rest and slide, and said means for effecting said transfer of said bottles from said second conveyor comprise a mechanism for moving said guide means away from said bottles thus allowing said bottles to slide off said second conveyor.

3. Bottle-transfer mechanism comprising a first substantially horizontal conveyor for feeding a line of bottles to said mechanism, a second transversely inclined conveyor for receiving said infed bottles and conveying them to spaced transfer positions, a first worm means adjacent to said first conveyor on one side of the line of advance of said bottles, a second worm means adjacent to said second conveyor on the opposite side of the line of advance of said bottles, said second worm means being adapted to control the movement and spacing of

said bottles on said second conveyor throughout the time the said bottles are being conveyed to, and become located at, said respective transfer positions by said second conveyor, means for tilting said bottles in passing from said first conveyor to said second conveyor, and means for effecting simultaneous transfer from one side of said second conveyor, of all the spaced bottles lined on said second conveyor when they respectively reach the said transfer positions thereon.

4. Bottle-transfer mechanism according to claim 3 wherein said first worm means and said second worm means overlap in longitudinal extent, whereby over part of their path of advance bottles are engaged respectively by both said worm means on opposite sides, and wherein said means for tilting said bottles comprise guide means whereby the base of each bottle is displaced transversely of its line of advance while the bottle is engaged by both said worm means.

5. Bottle-transfer mechanism according to claim 3 wherein said first and said second worm means overlap in longitudinal extent whereby over part of their path of advance bottles are engaged respectively on opposite sides by both said worm means, said bottles being tilted while engaged by both said worm means, and the pitches of said worm means being modified to eliminate undesired displacement of a bottle in its direction of advance as a result of being tilted while in engagement with said worm means.

6. Bottle-transfer mechanism comprising a first substantially horizontal conveyor for feeding a line of bottles to said mechanism, a second transversely inclined conveyor for receiving said infed bottles and conveying them to spaced transfer positions, means for tilting said bottles in passing from said first conveyor to said second conveyor, guide means adjacent to one side of said second conveyor adapted to support said bottles in inclined positions thereon, worm means adjacent to the opposite side of said second conveyor adapted to control the movement and spacing of said bottles on said second conveyor throughout the time the said bottles are being conveyed to, and become located at, said respective transfer positions by said second conveyor, and means for temporarily displacing said guide means downwardly in relation to said bottles supported thereby, freeing all said bottles on said second conveyor, for simultaneous transfer by sliding from one side of said second conveyor, when they respectively reach the said transfer positions thereon.

7. Bottle-transfer mechanism according to claim 6 wherein the means for displacing said guide means from supporting position in relation to said bottles impose

upon said guide means movement in a direction having a component away from the bottles perpendicular to said bottle axes.

8. Bottle-transfer mechanism according to claim 6 wherein bottles are fed continuously on to said second conveyor, and comprising auxiliary bottle supporting means for supporting inclined bottles being advanced on to said second conveyor during the time the guide means are displaced to allow transfer from said second conveyor of a line of bottles when they have reached their respective transfer positions.

9. Bottle-transfer mechanism comprising a first substantially horizontal conveyor for feeding a line of bottles to said mechanism, a second transversely inclined conveyor for receiving said infed bottles and conveying them to spaced transfer positions, means for tilting said bottles in passing from said first conveyor to said second conveyor, main supporting means for supporting said inclined bottles on said second conveyor, worm means adjacent to said second conveyor adapted to control the movement and spacing of said bottles on said second conveyor throughout the time the said bottles are being conveyed to, and become located at, said respective transfer positions by said second conveyor, means for displacing said main bottle-supporting means in order to allow simultaneous transfer from one side of said second conveyor, of all the spaced bottles lined on said second conveyor when they respectively reach the said transfer positions thereon, slidable auxiliary bottle supporting means movable beside said second conveyor, means for advancing said auxiliary supports beside, and in support relation to, bottles advanced on to said second conveyor, during the time said main bottle-supporting means are displaced to allow transfer of a preformed line of bottles spaced in their respective transfer positions.

10. Bottle-transfer mechanism as claimed in claim 9 comprising means for restoring said main bottle-supporting means to a bottle-supporting position after transfer of a line of bottles from transfer positions on said second conveyor, and for simultaneously withdrawing said auxiliary bottle-supporting means.

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