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[54] **FILLING MACHINE FOR CONTAINERS**

[75] Inventor: **Paul R. Fechheimer,** Worcester, Mass.

[73] Assignee: **A-T-O Inc.,** Willoughby, Ohio

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[21] Appl. No.: **287,660**

Related U.S. Application Data

[62] Division of Ser. No. 85,442, Oct. 30, 1970, abandoned.

[52] **U.S. Cl.** **141/147,** 141/152

[51] **Int. Cl.** **B65b 43/42,** B67c 3/04

[58] **Field of Search** 141/135–152, 141/120, 181, 198, 230, 191, 263, 264, 270, 279, 284, 266

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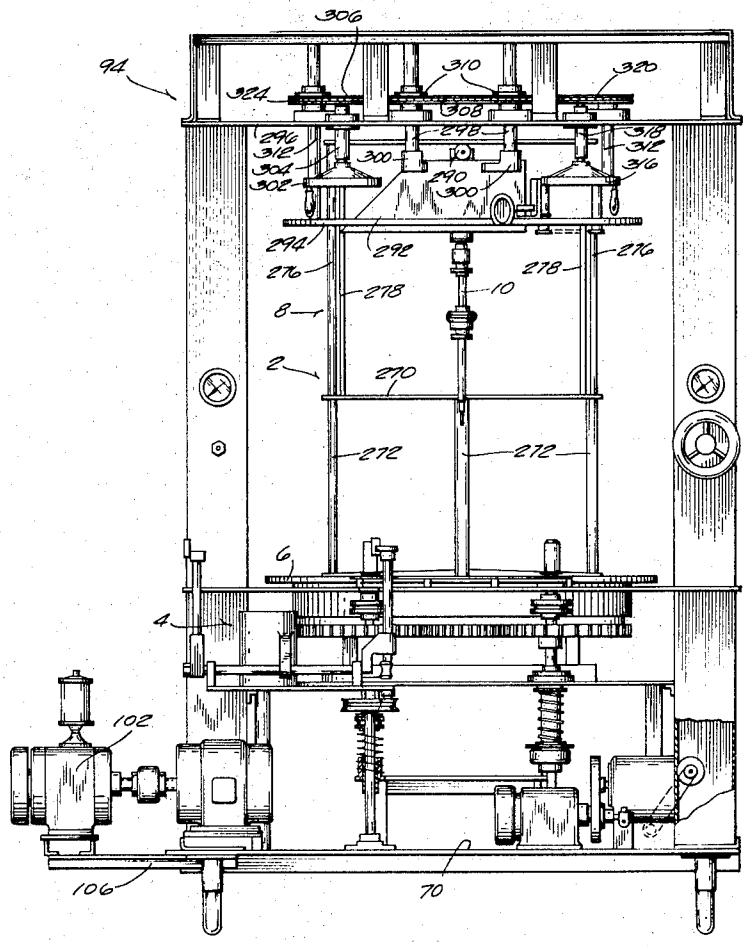
Primary Examiner—Houston S. Bell, Jr.

[57] **ABSTRACT**

A rotary acting filler machine for containers such as bottles includes a series of vertically reciprocable filling nozzles adapted to be moved under the control of cam means between raised, inoperative positions to a container with the lower end or tip of the nozzle above the upper end thereof and lowered, operative positions thereto with the tip of the nozzle projecting axially within the container. The upper limit of movement of the nozzles in the filler is controlled by a main plate-type cam which is vertically adjustable in the filler whereby to permit containers of varying overall heights to be accommodated for filling action in the filler without obstruction from the nozzles at the same time while permitting the nozzles to be brought rapidly into filling positions to the containers to attain maximum production output in the filler for any particular type of container.

The axial penetration of the nozzles into the containers is controlled by a secondary cam means in the form of a ring which is also vertically adjustable in the filler so as to permit the axial position of the nozzles in the containers being filled in any particular operating run of the filler to be regulated in a manner as will provide a rapid, accurate filling of such containers.

3 Claims, 6 Drawing Figures



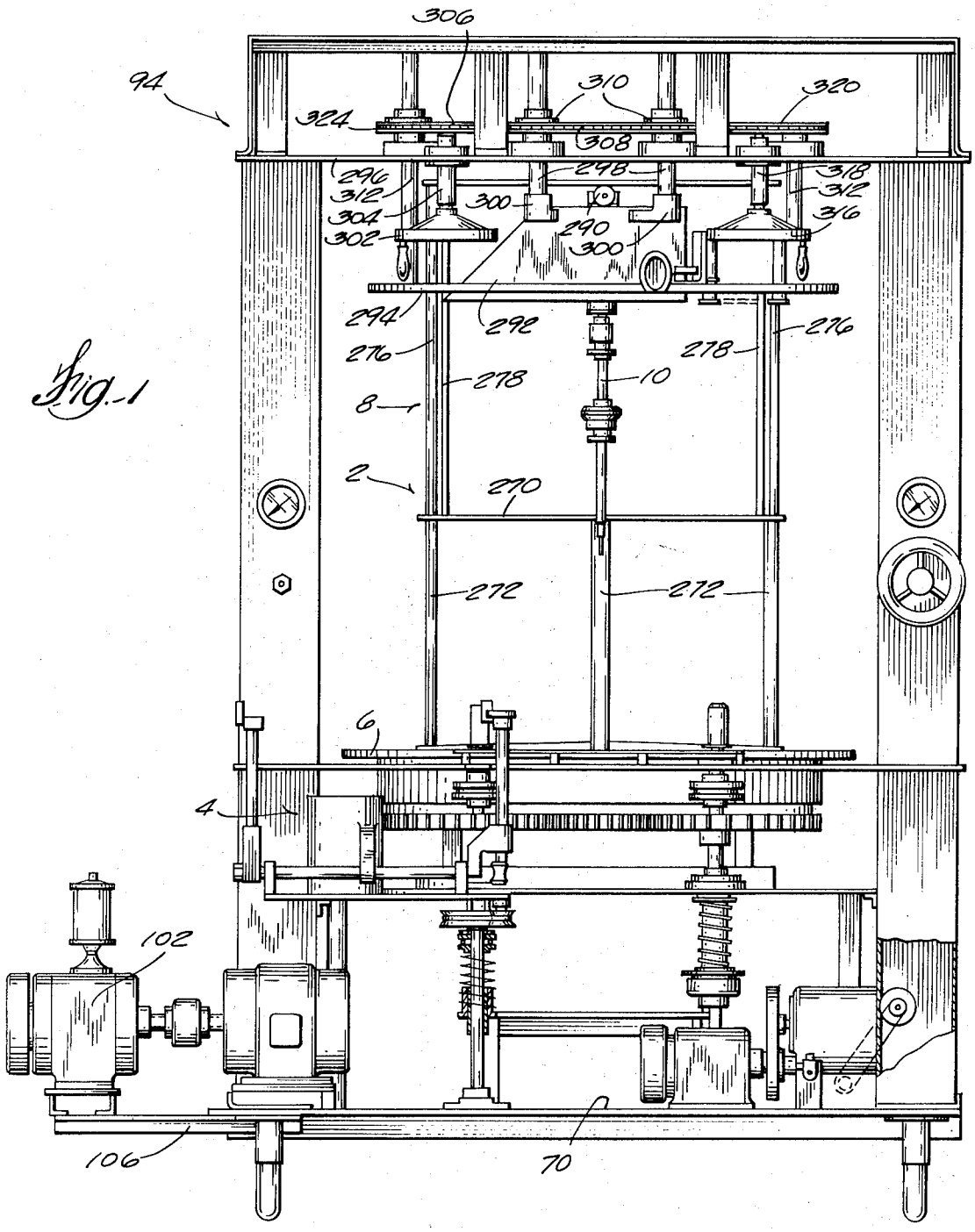
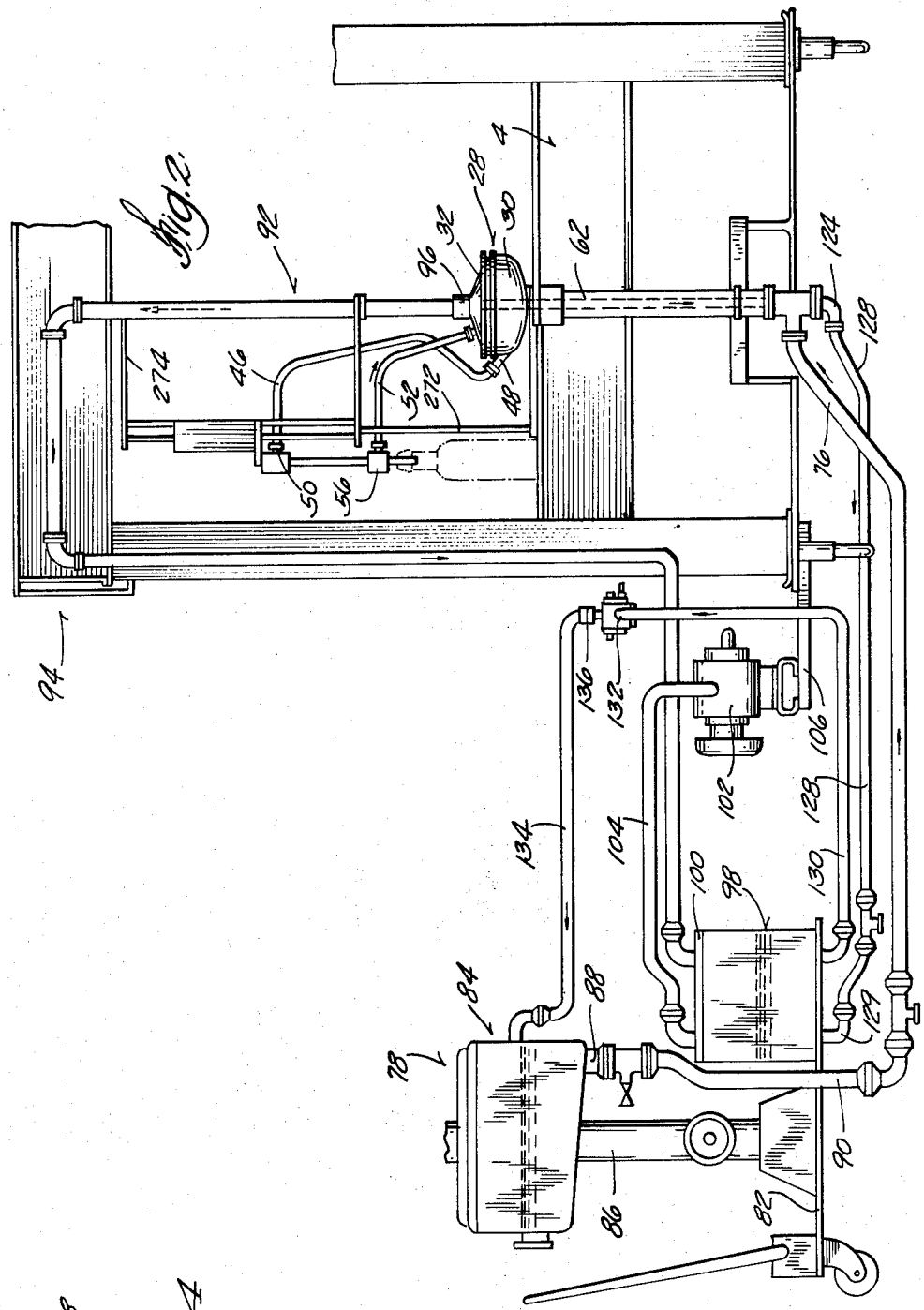
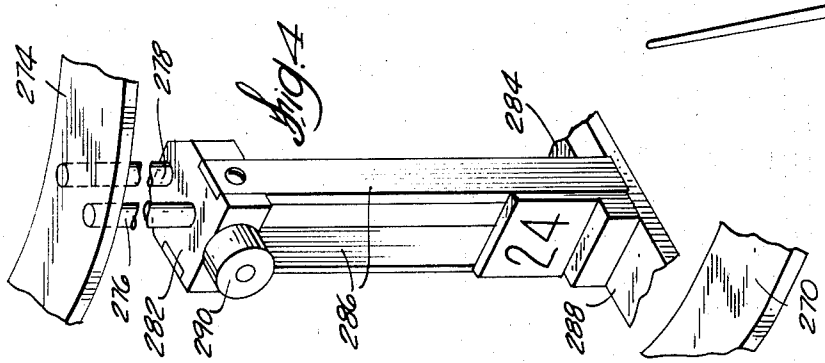

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Fig. 1


Fig. 2
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Fig. 4
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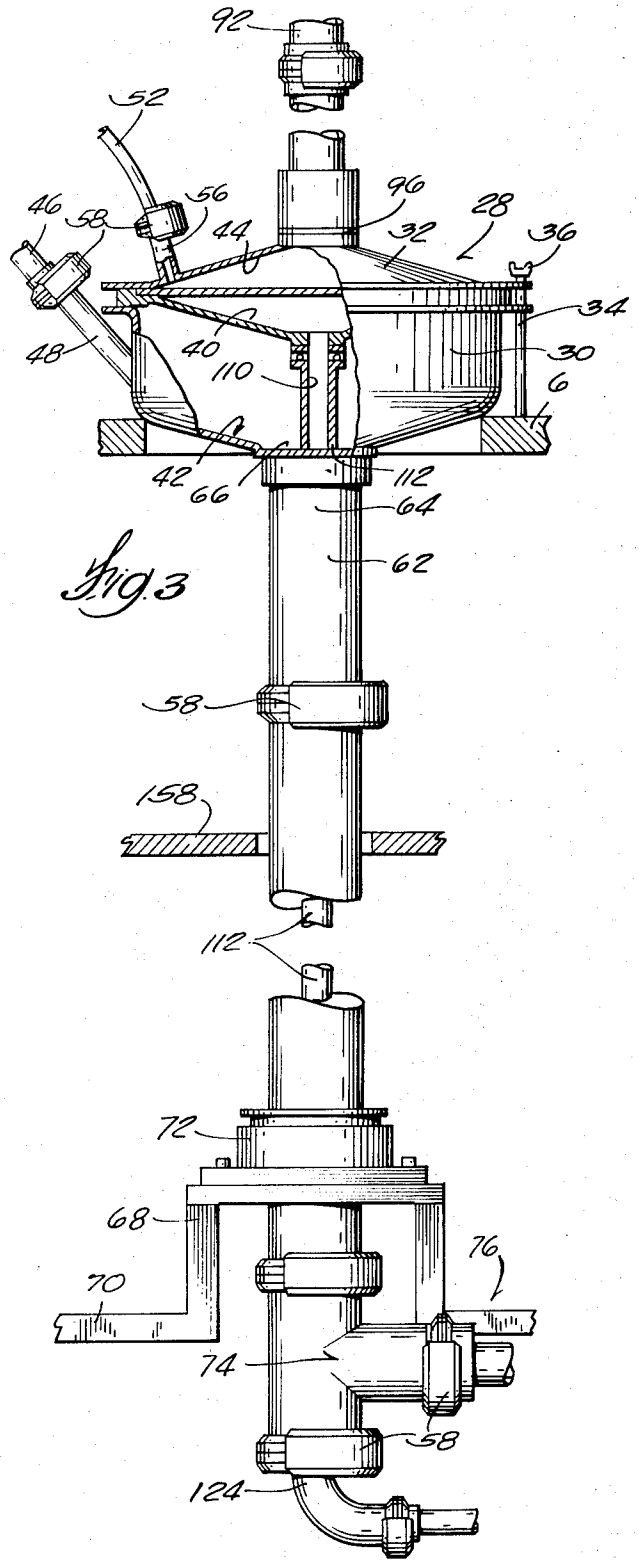


Fig. 3

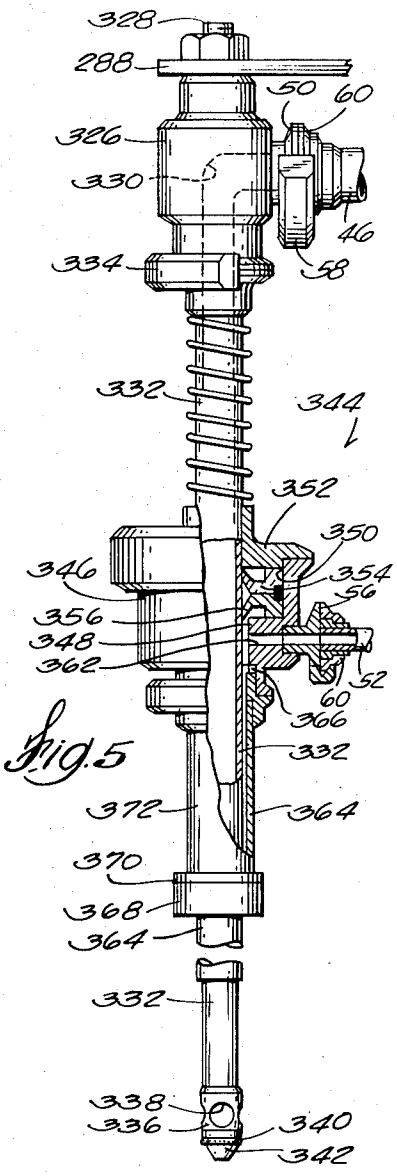


Fig. 5

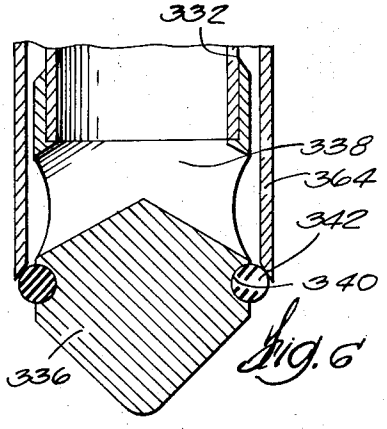


Fig. 6

FILLING MACHINE FOR CONTAINERS

This application is a Division of United States Patent application Ser. No. 85,442, filed Oct. 30, 1970, now abandoned.

This invention relates to a container filling machine of the constant level type and more particularly concerns a filling machine wherein the filling is controlled by individual filling nozzles which are adapted to be inserted axially into the containers for filling and wherein vacuum, pressure or combined vacuum pressure principles may be selectively employed to effect a filling flow of liquid to the containers.

Filling machines of the present type are used to effect the constant level filling of bottles, cans, jars and like containers with a wide variety of liquids and particularly those liquids having a low to moderate viscosity and which are relatively quiescent or are of a "still" nature as opposed to liquids such as carbonated soft drinks and beer which contain large amounts of dissolved gas and which are relatively unstable.

Various forms of vacuum and/or gravity type filling machines have been developed and put in use over the years for carrying out the filling of containers with so-called "still" liquids, and reference is made to U.S. Pat. Nos. 2,660,357 to Fechheimer, 3,037,536 to Fechheimer et al., and 3,195,585 also to Fechheimer for typical examples of these prior filler constructions.

While for the most part commercially satisfactory and acceptable, these prior devices were not particularly well adapted to the handling of more than a limited number of different types of containers and, in many instances, in operating these prior devices with containers of a style or type other than that for which the machine was specifically designed, it was difficult to attain a high degree of filling accuracy in the containers and/or to maintain a satisfactory level of operational efficiency. Also, in many of these prior fillers, such change parts and modifications as were provided to enable the successful, accurate filling of differing types and/or styles of containers in the machine were not readily susceptible of being incorporated therein with the result that the changing of the filler from one run of container to another often entailed considerable down time and corresponding loss of production.

The principal object of the present invention is the provision of a filler machine wherein the aforegoing shortcomings and drawbacks of existing fillers are essentially overcome or greatly minimized through an improved arrangement and construction of the various filler machine parts and mechanisms and wherein such parts and mechanisms as are present combine to provide highly efficient and accurate filling results with a relatively wide range of different styles and sizes of containers and with several types of liquids.

The above and other more specific objectives and advantages of the invention are achieved in a filling machine which, in a preferred embodiment, includes a rotary filling head having a plurality of filling nozzles mounted circumferentially around the periphery of a horizontally extending, container support table for vertical movement between normally raised, inoperative positions to the table and lowered, operative positions thereto. The movement of the nozzles is controlled in part by means of a main cam plate adapted to be engaged by a follower on the nozzles as the latter are moved in a rotational travel path by the head, with the

cam plate having an upper dwell portion for maintaining the nozzles in a raised, inoperative position to the containers and angled leading and trailing edges for moving the nozzles successively into and out of lowered or operative positions thereto in the course of a filling cycle. The cam plate, in accordance with a particular feature of the invention, is adapted to be adjusted vertically in the filler head through means of a screw-jack type mechanism whereby to permit the raised or inoperative positions of the nozzles in the head to be adjusted between runs of containers of varying overall heights for the purpose of avoiding interference between the nozzles and the incoming containers with a minimum drop required in the nozzles to commence filling thereof.

The head further includes a secondary, generally circular cam plate or ring for interacting with the followers of the nozzles during movement to lowered or filling position to the bottles to control the extent of axial penetration of the nozzles in the containers. The secondary cam is also adjustable vertically in the head through an additional jack-screw mechanism to permit the axial penetration of the nozzles into the containers to be regulated to provide optimum filling action in terms of filling speeds and fill height accuracy, over a wide range of bottle sizes and shapes. The secondary cam or ring has a corollary purpose of maintaining the nozzles above a prescribed level in the head when, for one reason or another, there is an absence of a container below the nozzle.

The foregoing objects and advantages, together with others, will appear hereinafter or become apparent to the skilled worker in the art to which the invention relates, are accomplished by the exemplary embodiments of the invention which are illustrated in the accompanying drawings.

In the drawings:

FIG. 1 is an elevational view of a container filling machine which incorporates the improvements of the invention, certain parts of the filler being omitted for clarity of illustration;

FIG. 2 is an elevational view showing the general paths of liquid and air flow in and between the filling machine and the external sources of liquid and vacuum supply provided for the filler;

FIG. 3 is an enlarged elevation of the manifold structure employed in the filler between the individual filling nozzles thereof and the liquid and vacuum sources, with the manifold being partially broken away to reveal details of interior construction;

FIG. 4 is a perspective view of one of the slidable carrier portions of the filling nozzles in mounted relation to a pair of rods of the nozzle supporting cage;

FIG. 5 is an elevational view of one of the nozzles which are employed in the filler of the invention for effecting the filling of a container with liquid, parts of the nozzle being broken away and shown in section to reveal details of interior construction;

FIG. 6 is an enlarged view of the lower tip portion of the filling nozzle of FIG. 5, showing the particular relationship of the O-ring sealing member to the vacuum tube of the nozzle.

Referring now to the drawings and to FIG. 1 in particular illustrating the general form of a filler machine embodying the present invention, a filling head 2 is supported in a base structure 4 for rotatable movement about a vertical axis through the center of the filler.

Filling head 2 has a horizontally disposed filler table 6 constituting a support for the containers which are to be filled, herein shown as bottles B, and to which is secured an upstanding ring or cage structure 8 forming a support for a series of identically constructed, individual filling spouts or nozzle assemblies 10. The nozzle assemblies are arranged in equi-circumferentially spaced relation to one another around the cage structure as is conventional to provide a series of individual filling stations for the bottles or other containers which are to be filled. As will be explained in detail hereinafter, the nozzle assemblies 10 are supported for vertical slide movement in cage structure 8 and in the course of moving circumferentially with he filler table during rotation thereof slide vertically in a predetermined or pre-established manner successively from and between a raised or inactive position above the bottles and a lowered or active position in which the nozzle assemblies are engaged with the containers for filling action.

While not shown, the filler head has generally conventional type starwheel devices associated with it for delivering bottles or other containers onto the tube 6 for filling action by the nozzle assemblies and for removing the bottles therefrom when filling is completed, these feed and discharge devices being driven in synchronous relation with the head to provide a smooth, continuous flow of bottles through the filling machine.

In accordance with the invention, the filler machine is adapted to effect the filling of the containers either by gravity or combined gravity and vacuum means or by vacuum means alone as may be desired or selected to best meet the particular requirements of the containers and/or liquid being handled in the filler in any given operating run thereof, and it is a particular feature of the present filler that relatively rapid and convenient procedures are provided for converting the machine from one such filling mode to another.

Before adverting to the details of filler construction, however, it is well to first consider the overall arrangement of the liquid and vacuum system with which the filler is associated. For this purpose, attention is directed to FIGS. 2 and 3 wherein it may be seen that a sealed supply manifold 28 having a main bowl-like body portion 30 and a cover or top closure 32 is mounted in the center of filler table 6 as by a number of mounting studs 34 affixed vertically to the table and extending through registering openings in the flanged periphery of body portion 30 and of cover or closure 32 for receiving wing nuts 36 or other threaded fastening means. Suitable gasketing is interposed between the mating edge portions of the body and closure of the manifold so as to seal these members to one another upon the wing nuts being tightened to the studs.

The manifold is divided internally by a conical separator plate 40 fitting horizontally between body portion 30 and cover 32 into a lower, liquid chamber 42 and an upper, vacuum chamber 44. Liquid chamber 42 is in communication with each of the individual nozzle assemblies 10 via a corresponding one of a series of flexible conduits 46 attached at one end to an individual one of a series of nipples 48 located around the bowl of the manifold and attached at the other end to a nipple-like fitting 50 on each of the nozzle assemblies. Vacuum chamber 44 is connected to each of the nozzle assemblies through a similar series of flexible conduits 52 connected at one end to an individual one of a series of fittings 54 tapped into the cover of the manifold and attached at the other end to a second nipple-like fitting 56 on each of nozzle assemblies 10.

These several attachments of the flexible liquid and vacuum conduits 46 and 52 respectively to the separate parts of manifold 30 and to the individual nozzle assemblies are preferably effected through quick release, sanitary type clamps 58 of the design and construction set forth in applicant's co-pending patent application Ser. No. 72,920, filing data Sept. 17, 1970, now abandoned, and which has the same assignee as that of the instant invention. As fully shown and described in such patent application, these clamps are in the nature of a resiliently flexible C-ring having an internal locking or clamping groove for receipt of like shaped, tapered shoulders or flanges especially provided or formed integrally with members or parts which are to be connected and having an arcuate extent well in excess of 130° whereby to define or present opposed gripping arms or segments cooperating to yieldingly, firmly engage over and between such shoulders or flanges upon the clamp being mounted circumferentially thereonto. In the construction illustrated, the necessary flanges or shoulders are, in the instance of the flexible conduits 46 and 52, formed as a part of a separate fitting 60 attached to the opposite ends of each of the conduits 46 and 52, while the companion flanges or shoulders therefor on the nozzle assemblies and manifold are formed integral with the aforesaid nipples 50 and 56 of the nozzle assemblies and with the fittings 48 and 54 of the manifold. Conventional O-rings are interposed between the engaging surfaces of the flanges in each of the joints to seal the members or parts to one another when the clamp is in place. These clamps are particularly advantageous because not only may they be installed and removed in an extremely rapid manner thereby to facilitate any necessary servicing or replacing of the conduits as well as the nozzle assemblies and the manifold but also, as explained in greater detail in the aforementioned patent application, the joint which results from these clamps may be effectively cleaned without being dismantled through a simple flushing of the conduits with suitable cleaning liquids. The overall cleanability of the filler is thus enhanced.

The liquid chamber 42 of the manifold is adapted to be supplied with liquid through a pipe or conduit 62 supported vertically in the center of base structure 4 in endwise coupled relationship with a hub-like member 64 which surrounds an opening 66 in the bottom of manifold bowl 30. The lower end of conduit 62 is affixed to a support bracket 68 secured to a horizontal bottom plate 70 of filler base structure 4 through a conventional rotary joint 72 which includes a suitable packing gland to seal the pipe to the bracket while permitting the pipe to rotate therein. An inlet tee 74 is attached to the supply pipe below the rotary joint with the tee being coupled, in turn, through its lateral branch 74a to a liquid supply line 76. The supply line may be connected directly to customer's storage tank or other supply source, but rather than this the invention contemplates providing a separate liquid supply source for use with the filler machine and which is designed to be adjusted vertically to provide a gravity assist to the liquid as and when desired in the operation of the filler. This separate source may take the form of a portable stand 78 which includes a main column or

beam **80** extending vertically from a wheel carrying base plate **82** and a tank or reservoir **84** supported on the column by a U-section slide bracket, not shown. Suitable means, of either a mechanical or hydraulic nature is incorporated within the stand for adjusting the bracket vertically of the column as desired to correspondingly vary the elevational position on the column of the supply tank.

The aforesaid liquid inlet line **76** connects to a fitting **88** in the bottom of the tank through a vertical pipe or line **90** with the tank bottom preferably being tapered downwardly to the fitting to facilitate the drainage of the tank at the conclusion of a run of any particular liquid. The tank also has a suitable inlet fitting which is adapted to be coupled to a supply line from customer's storage tank (not shown) to supply liquid to the tank as and when required during operation of the filler with a float or other control means being provided within the tank to maintain a substantially constant level of liquid therein during operation.

With further reference now to the vacuum portion of the manifold, there is connected to the center of the enclosure or cover portion **32** of the manifold a conduit **92** which extends vertically to the canopied superstructure **94** of the filler machine. Conduit **92** is stationary and is coupled to the manifold cover **32** in direct communication with vacuum chamber **44** through a conventional, sealed rotary joint **96** similar to the joint **72** described previously between liquid supply pipe **62** and mounting bracket **68** so as to permit the manifold to rotate relatively of the conduit **92** while maintaining the parts in sealed relation to one another. The upper end of the conduit **92** is attached by way of a series of additional, interconnected conduits in the canopy and in an enclosed side portion of the filler machine to an overflow tank **98** which is associated with the portable liquid supply mechanism **78,** being mounted on the base plate **82** thereof. Tank **98,** as will be more particularly explained hereinafter, serves as an air trap or air-liquid separator for the liquid entering into the vacuum side of the filler and is connected through a top plate or cover **100** to the intake side of a vacuum pump **102** via a conduit **104,** the pump for convenience being mounted on a plate **106** extending from the side of base structure **4.** In this way, the vacuum chamber is connected to the vacuum pump and with the latter in operation a vacuum will be drawn in the tank above the liquid level therein and also in the vacuum chamber of the manifold. This, in turn, results in a vacuum being drawn in the filling nozzle spout assemblies through the flexible conduits **52.**

Vacuum chamber **44** has an additional connection with the overflow tank and which is designed to direct into the overflow tank that portion of the liquid which is drawn back out of the containers through the vacuum lines in the final stages of the filling cycle while permitting such air as is drawn out of the containers with the liquid to pass back into the tank through the conduit arrangement previously described. For this purpose, a liquid return tube or conduit **112** is extended axially the height of the liquid inlet conduit **62** with the upper end of the tube **112** in a flush position with respect to a suitable drain hole **110** in the center of the separator plate **40.** The lower end of tube **112** is journaled within a suitable bearing (not shown) in the vertical leg portion of tee fitting **74** and is coupled directly to an elbow **124** which is sealingly secured to the tee fitting as by another of the C-clamps **58.** Elbow **124** is secured to the vertical leg of the tee fitting and connects conduit **129** leading to a fitting in the bottom of the overflow tank to thereby establish a liquid flow path between the vacuum chamber and the overflow tank.

At this point, it will be further observed that another line or conduit **130** is connected into the bottom of tank **98** through another fitting and leads to the intake side of a liquid pump **132,** the discharge side of which is connected to a line **134** which empties into the supply tank **84** of portable stand **78.**

With the above arrangement, it will be seen that any liquid which is drawn into the vacuum lines from the individual nozzle or stem assemblies will, in passing into the vacuum chamber, drop onto the separator plate and flow downwardly therealong into center drain hole **110,** while any air or gas which is brought into the chamber with the liquid will tend to rise in the chamber and to flow out through the line **92.** The liquid and air or gas are thus enabled to follow separate paths in passing to overflow tank **98** and there is as a result of this a reduced turbulence in the overflow liquid and a reduced time during which the air and liquid are exposed to one another in the confined space of the flow conduits. This aids materially in reducing the volume of air or other gas present in the overflow liquid at the point where it enters the oveflow tank. At the same time, the liquid in passing onto separator plate **40** distributes itself as a thin film and, inasmuch as vacuum chamber **44** is under subatmospheric pressure, such gas as is dissolved in the liquid will tend to be forced out of solution and to pass into the conduit **92** for eventual exhaustion from the system by vacuum pump **102.** In this way, a relatively efficient initial air separating action is effected in the overflow liquid and which action as later supplemented by the action in the overflow tank at the liquid-gas interface therein results in a negligible amount of air remaining in the liquid at the point where the latter is returned to supply tank **84.** Generally to insure proper air-liquid separation in the vacuum chamber, the diameter of the upper conduit **92** must be somewhat larger than that of return conduit **112.** Good results have been obtained by providing the conduit **92** with a diameter twice that of the return conduit **112.**

The conduits **130, 134** and pump **132** are provided, of course, to periodically divert overflow liquid from the overflow tank **98** to the main supply tank and, in the usual instance, overflow tank **98** will be provided with a float or other liquid level sensing means for automatically starting the pump when the liquid rises to a given level in the overflow tank and for stopping operation when a lower level is produced. A check valve **136** is provided in the line **134** to prevent liquid from flowing into the overflow tank from the supply tank.

With regard now to the details of construction and operation of the nozzle assemblies, the filler table **6,** as previously mentioned, has a cage **8** attached thereto. This cage includes a lower ring **270** connected with the table by a number of support posts **272** mounted vertically between the table and the ring **270** and removably secured to the table and ring as by cap nuts threaded onto the ends of the posts. An upper cage ring **274** is supported above lower ring **270** by a series of rods **276** and **278** located in sets around the circumference of the cage structure and which, as in the case of posts **272,** have threaded ends fitting through the rings to re-

ceive cap nuts which releasably secure the rods in place. A set of the rods **276, 278** is provided for each of the nozzle assemblies and they are arranged in equi-circumferentially spaced relation to one another around the cage as the nozzles have a uniform pitch spacing to one another. The radially outer of the rods of each set, viz, rod **276,** has a carrier **280** of the nozzle assemblies slidably mounted thereonto and serves to guide the carrier for vertical sliding movement in the cage structure while the other or inner of the rods on each set, viz, rod **278,** rides against a vertical edge of the carrier in a manner as will appear to prevent the carrier and the nozzle assemblies as a whole from rotating relatively of the rod **276.**

The carriers **280** are identically constructed of an upper and a lower bearing block **282** and **284** respectively and which are connected with a desired spacing therebetween by a pair of the plates **286** secured to the opposed sides of the blocks as by screws. Blocks **282, 284** are provided with generally circular cut-outs along their radially inner edges for seating the inner rod **276** of each of the sets of rods for the hereinbefore mentioned purpose of fixing the nozzle assemblies against rotation in the cage structure.

The lower bearing block of each of carriers **280** has a relatively flat, rectangular plate **288** secured thereto as by screws and this plate extends radially outwardly of cage structure **8** to provide support to the filling head portion of the nozzle assemblies. Slide movement of the carriers on the rods and corresponding vertical movement of the filling heads relatively of the filler table is controlled through means of a cam follower roller **290** rotatably mounted to the radially outer edge or wall of the upper of the bearing blocks **282** and which, in moving around the pitch circle of the filler table with its associated nozzle assembly, is adapted to selectively engage a main cam plate **292** positioned along the front of the filler machine and/or a full 360° stem support ring **294** located outside of and in generally concentric relation to cage structure **8.** Cam plate **292** serves to control the nozzle assembly for movement relatively into and between raised, inactive positions to the containers and lowered, active positions thereto and, as shown herein, is provided with a generally trapezoidal-like shape, being characterized by relatively steep or abrupt vertical edges on either side of an upper horizontal edge, is dependingly supported from a horizontal plate **296** in superstructure **94** of the filler machine frame by a pair of threaded mounting rods **298** located one to each end of cam plate **292.** Rods **298** are journaled in the plate **296** through conventional bearing means and are in threaded engagement with bracket means **300** on the cam plate so as to provide the latter a conventional screw type adjustment for permitting the elevational position of the cam plate in the filler to be varied. This adjustment is adapted to be effected manually through a hand wheel **302** carried on a shaft **304** which is jouranled in the aforesaid plate **296** and which has keyed thereto a sprocket **306** connected by an endless precision chain **308** to like sprockets **310** on the upper ends of mounting rods **298.** Through this adjustment of the cam plate, the upper or raised position of the nozzles in the head may be set such that the bottles, in any particular run, may enter onto the table without obstruction from the nozzles while at the same time the clearance between the bottles and the nozzles may be minimized so as to permit the nozzles to be brought into filling relation with the bottles with a minimum further movement along the pitch circle of the filler of the nozzles. This adjustability of the cam is of considerable benefit, particularly in a filler which is to handle containers having a wide range of heights, inasmuch as it enables a maximum operating efficiency and production output to be achieved in the filler for any particular style of container.

The stem support ring **294** acts as a stop for the cam follower rollers whereby to limit the carriers **280** for slide movement downwardly in the cage structure for purposes of controlling the axial penetration of the filling nozzles into the containers or, in the case of the absence of a container, to prevent the assemblies from dropping fully downwardly in the cage structure and causing the lower bearing block **284** to strike the lower ring of the cage structure. The ring **294** is dependingly supported from the superstructure of the filler by a number of threaded mounting rods **312** journaled in the aforesaid plate **296** of the superstructure, there being a total of four rods to support the ring, with the rods located one in each quadrant of the ring. Rods **312** are threadably engaged within bushings **314** on ring **294** to provide the latter a conventional screw type adjustment which enables the ring to be adjusted vertically in the filler as desired. For effecting this adjustment, there is provided a second hand wheel **316** carried on a shaft **318** journaled in the plate **296** and which has keyed thereto a sprocket **320** connected by another precision chain **322** to like sprockets **324** attached to the upper ends of the mounting rods **312.**

The filling heads, as will now be described, are of the normally closed, sleeve-type construction and are adapted for gravity, vacuum and/or combined gravity-vacuum filling as desired. Each such filling head is comprised generally of a relatively large diameter stem casing **326** which attaches directly to the stem support plate **288** of a carrier **280** as by a cap nut threadably connected to a stud-like projection **328** formed integral with the upper end of the casing and which fits upwardly through an aperture in plate **288.** Stem casing **326** has a center chamber **330** in communication with the aforementioned fitting or nipple **50** provided the nozzle assemblies for coupling with the liquid inlet conduits **46** and which is connected therewith by one of the aforesaid C-clamps **58.** Connected axially to the lower end of casing **326** is an elongated filling tube or stem **332,** the chamber of the casing being enlarged to receive a boss on the tube and the casing and tube being formed integrally with tapered, mating attachment flanges to permit the coupling to be effected by another of the C-type clamp devices **334.** An O-ring or other siding means is provided between the boss and an interior shoulder in the chamber **330** to seal the tube **332** to the casing when the C-clamp is in place.

The tube **332** defines an axial flow passage in the filling head for the liquid and projects relatively axially inwardly of a container when the head is lowered into an active or filling position. Normally, the tube is of a length as will position the lower end or tip of the tube in the upper end portion of the container being filled under the conditions described and it will be appreciated therefore that the length of the stem is a function, among other things, of the height of the containers being filled in any given run of the filler machine. In actual practice and where containers of widely varying height are to be handled in the machine, several differ-

ent stem lengths would be provided to provide the particular tip positioning desired in the container in any given run of the machine.

Stem **332** carries a plug-like element **336** in its lower end or tip and which is provided with a series of relatively large side openings **338** for accommodating liquid flow into a container from the stem. The ends of plug **336** are expanded radially as respects the stem to which it is attached with the lower expanded portion of the plug being provided with a circumferentially extending groove **340** which seats an O-ring **342**, the function of which will become readily apparent hereinafter.

The filling tube or stem **332** has further mounted thereon a vertically slidable vacuum body and tube assembly indicated as a whole in the drawings by the reference numeral **344.** Assembly **344** comprises an enlarged, cylindrical vacuum body **346** having an axially extending bore **348** for receiving the tube or stem **332** and which is open to an enlarged recess **350** in the upper end of the body, as shown. A separate cover **352** is provided the vacuum body, being releasably connected thereto by another of the C-type clamps fitting over and between mating beveled flanges on the cover and on the upper end of the body. The vacuum body **346** is slidingly engaged with the filling tube or stem through structure which includes a centrally sliding seal **354** which fits in the recess **350** with the inner lip-like edge **356** of the split seal segments engaging the tube **332.** An O-ring **358** is fitted between the mating outer edge portions of the seal segments to seal the body itself to the cover **352** when the C-clamp is in place.

The axial bore **348** of vacuum body **346** communicates laterally via a port **362** in the body to one of the aforesaid nipples **56** provided the filling nozzles for coupling to the aforesaid flexible vacuum conduits from the center manifold.

Mounted axially to the lower end of the vacuum body **346** is a vacuum tube **364** of a slightly larger inside diameter than the outside diameter of the filling tube or stem **332.** Tube **364** has a flanged upper end and is secured through such flange to a mating flange on the lower end of the vacuum body by a still further of the C-type clamp devices. As in the instance of the coupling between the filling tube and the stem casing, the flanged end of the vacuum tube is embossed and an O-ring **366** seats against a shoulder in the counterbored lower end of the vacuum body to provide a liquid seal between the tube and such body when the C-clamp is applied.

The vacuum tube **364** terminates above the free, lower end of the filling stem **332** and is normally maintained by the weight of the combined vacuum body and tube assembly **344** or by a spring in an axially lower slide position on the stem with the tip of the tube in an engaged closed position against the aforesaid O-ring **342** carried in the plug **336** in the stem. The O-ring **342** as thus positioned provides a valve action between the liquid and vacuum tubes **332** and **364** respectively, whereby to control the opening and closing of these members and thereby control the flow of liquid through the nozzle assemblies. The O-ring **342** further serves as a retainer for holding the vacuum body and tube assembly **344** onto the liquid tube or stem and to this end the O-ring is sized, as respects its inside diameter, relatively of the groove **340** so as to require some stretching of the O-ring to enable its installation, thereby to insure the O-ring being retained tightly on the plug. At the same time, however, the O-ring should not be stretched to the extent as would preclude the relative ready removal of the O-ring from the groove when O-ring replacement is required or when removal of the vacuum tube from the filling stem is desired.

The outside diameter of the O-ring must, of course, be related to the vacuum tube diameter in a way as will produce the aforesaid closing engagement of the lower end of the vacuum tube by the O-ring when the vacuum tube is in the normal, lower axial slide position on the filling stem. Over and above this, however, the vacuum tube **364** itself generally will be made as large as possible in outside diameter while still providing clearance with the sides of the containers when inserted axially thereinto, allowing for the normal tolerances in container neck openings which have been established in the container industry, and for this reason it is preferred that O-ring **342** be further dimensioned such that its outside diameter, as measured with the O-ring installed in the groove and in a stretched condition, is at a value which lies between the inside and outside diameters of the vacuum tube.

The O-ring as thus dimensioned and positioned on the filling stem acts further to shroud the end of the vacuum tube from the containers during the lowering of the nozzle assemblies to filling positions thereto. This is desirable in that it protects the sealing edge of the vacuum tube from possible damage in the event of any misalignment between the containers and nozzles. Such damage is to be avoided, of course, as it would invariably impair the sealing action between the O-ring and the vacuum tube and cause a malfunctioning of the nozzle assemblies.

The filling head portions of nozzle assemblies **10** are each further provided with a resiliently deformable disc-like member **368** which is designed to seal the container to the nozzle assemblies **10** when the latter are in filling relation to the containers. Disc member or seal **368,** and which in the usual instance is composed of soft, resilient material such as rubber for example, is carried on vacuum tube **364** and is preferably backed by a stiffener washer **370** to prevent the seal from deflecting in its unsupported section when in engagement with a container. The lower face of disc **368** may be provided with a Teflon liner if desired so as to afford the seal a measure of protection against the action of the product being filled and/or to minimize adhesion between the seal and the container at the point in the filling cycle when the nozzle assemblies are retracted from the containers.

The seal itself is in frictional sliding engagement with vacuum tube **364** through O-ring means or other conventional sealant means carried in suitable grooves in the bored portion of the seal and thus may be adjusted axially of the vacuum tube **364** to control the axial projection of the vacuum tube into the container during the filling cycle. The extent of this projection into the container of the vacuum tube, as will be explained in more detail hereinafter, controls the height within the containers to which the liquid will be filled and thus it may be appreciated that the axial location of sealing member **368** on the vacuum tube **364** is a critical matter and considerable accuracy and care are necessary to provide the exact fill height required in any particular type of container. In order to facilitate the accurate setting of the seal on the vacuum tube, it is contem-

plated as a still further feature of the invention to provide for use with the vacuum tube a special spacer tube **372** which has a snap-on fit with tube **364** and which when assembled to the tube provides a stop or seat thereon for the sealing member **368.** Spacer tube **372** preferably takes the form of a longitudinally split, C-section type plastic extrusion such as the type commonly used as wear strips on conveyor guide rails, for example, and which has sufficient resiliency as will permit its ready application to and removal from the vacuum tube by manual means. When this tube is in place, the container seal **368** is adjusted axially of the vacuum tube to a position against the lower, free end of the tube whereby to provide an exact setting of the seal on the tube **364** and a corresponding exactness in the length of the portion of the vacuum tube which will enter the container when the latter is in filling position against the seal. A number of tubes of different predetermined lengths generally may be provided for use where containers of varying heights are to be handled in a given filler machine so that when changing to a run of containers of any given height the set of spacer tubes which have been designed for such containers may be readily assembled onto the vacuum tubes.

In the operation of the nozzle assemblies as equipped with the afore-described sleeve-type filling heads, the bottles in initially feeding onto the rotary filling table along what may be termed as the front of the machine through the action of the timing screw and the feed star align vertically with a corresponding one of the nozzle assemblies which as they are rotated by the table to pitch positions along the front of the machine are brought to and held momentarily in raised, non-obstructive positions to the incoming containers by the action of the cam follower rollers **290** engaging the upper dwell portion **292***c* of the main cam plate **292.** The nozzle assemblies **10** are then caused to be lowered into filling positions with respect to the containers by the cam follower roller **290** riding off the upper dwell section **292***c* of main cam plate **292** and moving downwardly on edge portion **292***b* of the cam plate. Assuming that the bottle is correctly indexed to the nozzle assembly, as the nozzle assemblies are lowered the tip portions of filling stem **332** and vacuum tube **364** enter the mouth of the container and progress thereinto as a unit to the point where the mouth of the container engages the container sealing member **368.** The stem support ring **294** is positioned in the head so that at the point that the container sealing member engages the mouth of the container the follower roller **390** will be above stem support ring **294** and as a result thereof the filling stem **332** will move or penetrate progressively further into the container by slide movement relatively of the now fixed vacuum tube **364** thereby causing the O-ring **342** to unseat from the end of the vacuum tube to open the filling stem **332** for filling action. At this point, and if it be assumed that the liquid supply tank **84** is elevated on the vertical column **80** to a position where it is above filler table **6** so as to provide gravity flow of liquid to the containers and that the vacuum pump **102** is in operation, air will start to be exhausted from the container through vacuum tube **364** concurrently as liquid commences to fill the container by gravity flow thereinto through the filling stem **332** and the filling ports **338** in plug **336.** Air and liquid interchange in the container continue in the manner indicated to cause the container to progressively fill with liquid to the level at which the liquid closes the and of the vacuum tube **364.** Upon this occurrence, liquid flow to the container is abruptly slowed and only so much additional liquid is admitted to the container from the filling stem as will result in the air in the head space of the container compressing to the point where the head space pressure balances the head on the liquid and to replace the slight amount of liquid as will be drawn out of the container through the vacuum tube. The filling of the container in the manner described generally is correlated with the rotation of the filler table in a way as will result in any given filling nozzle and container moving somewhere in the range of from 270° to 290° around the pitch circle of the table in the time required for the nozzle assemblies **10** to move from a fully raised to a lowered or filling position to the containers and for the liquid to have filled the container to the level at which the container and liquid pressures are in balance as indicated. In any event, after the liquid has risen to above the end of the vacuum tube and liquid flow to the container is interrupted, the nozzle assembly **10** is caused to retract from the container by the engagement of the cam follower roller **290** with the leading or forward edge **292***a* of cam plate **292** and which is angled upwardly in the abrupt fashion as described for the trailing edge **292***b* of the cam plate. In this withdrawal or retraction of the nozzle assembly, the vacuum tube **364** remains stationary to the container during the brief period which is required for O-ring **342** on the filling stem **332** to engage the tip of the vacuum tube at which point the tubes **332** and **364** move as a unit out of the container as the nozzle assembly is raised by the cam roller **290** riding up the leading edge of the main cam plate **292.** The container is free to be moved off the table as soon as the lowermost portion of the nozzle assembly has cleared the upper end of the container but normally some slight further travel is provided the container on the pitch of the table between the position at which this occurs and the position of the container at which it enters a pocket of the discharge wheel. Generally a total pitch travel of say 10° to 20° is provided the containers from the time the retraction of the nozzle assemblies is initiated to the entry of the container into the discharge wheel, making the total pitch travel of the container from the point on the table where it is aligned below a nozzle assembly to the point where it enters the discharge wheel of from 280° to 310°. Adding another 5° to 10° of pitch travel for the container to move into filling position from the infeed wheel, a complete filling cycle typically may or will entail a pitch travel of anywhere from 285° to 320°.

In the course of the withdrawal of the nozzle assembly from the container, it will be understood that the liquid level in the container will drop somewhat to compensate for the liquid displacement in the upper end or neck portion of the containers of the plug member in the tip of the liquid tube so that the final liquid level in the container will be slightly below the level initially produced therein. Generally, the liquid drop-off from one container to the next will be substantially constant and it is only necessary then to attain a final, desired level of liquid in any particular type of container to determine for such container the axial position on the vacuum tube of the sealing member which will provide the initial fill height of liquid in the container as will give the desired final liquid level when the plug is retracted fully from the container. Once this set-

ting is determined, a set of spacer tubes of the requisite length may then be prepared so that in running this type of container the tubes could be employed with the nozzle assemblies to give the control desired over liquid fill height. It is to be noted that while the axial penetration of the vacuum tube into the container is controlled by the length of the spacer **372** which is placed on the tube, the axial penetration into any given style of container by the stem **332** is a function of the vertical placement in the filler head of the stem support ring **294.** As previously pointed out, the ring must be set low enough in the head to insure that full downward movement of the stem assembly as a whole is completed only after the sealing member is brought into engagement with the mouth of the container. Any lower setting of the ring beyond this level will result in a deeper penetration of the container by the filling stem and, in the case where a spring is interposed between the stem casing **326** and vacuum casing **346,** an increased sealing pressure between the container and member **368** will also result from a lowering into the head of the ring. In actual practice, this adjustment is used to attain an optimum flow pattern of liquid in any given style and size of container and, in changing from one style or size of container to another, the stem may be brought readily to a position in the container which is best suited to the successful, accurate filling thereof. This adjustment permits the filling nozzles to be readily and conveniently adapted for use with a variety of different types or styles of containers and gives the individual bottler a highly useful means for maximizing production in any particular operating run of the filler.

The various adjustments described herein for the container filling machine of the invention when taken individually or severally at a time render the machine highly adaptable for use with a wide variety of different styles, sizes and shapes of containers and with liquids having widely differing characteristics. These adjustments are of signal importance where, as is the case in the present instance, the filler is provided with the capability of being operated either through vacuum or gravity means or by combined vacuum-gravity means.

Various modes of carrying out the present invention are contemplated as being within the scope of the following claims particularly pointing out and distinctly claiming the subject-matter regarded as the nature of the invention.

I claim:

1. In a container filling machine having a rotatably mounted filling head assembly which includes a horizontal filler table for supporting the containers during filling and a series of individual filling nozzles mounted radially above said table for vertical slide travel relatively between raised, inactive positions to the containers and lowered, filling positions thereto and adapted to receive containers at an infeed station located at a first circumferential position relatively of the filling head assembly, and to then move the containers through a filling cycle and to a discharge station located at a second circumferential position relatively of the filling head assembly, means for controlling the filling nozzles for vertical slide movement during rotation of the filling head assembly which comprises, a cam follower roller associated with each of the filling nozzles, a main cam plate fixedly mounted along the outer periphery of the filling head assembly to extend relatively between the infeed and discharge stations and having opposed vertical edge portions and an upper, horizontal dwell portion intermediately thereof cooperating with the cam follower rollers of the filling nozzles to cause the filling nozzles to lower to filling positions along the container infeed station and to move to raised, inactive positions along the container discharge station in rotating through a filling cycle, and a ring member positioned horizontally above the table concentrically to the center thereof for limiting the cam follower rollers of the filling nozzles for downward slide travel in the filling head assembly, said ring member normally located to permit the filling nozzles to lower freely into filling positions with respect to the containers under the action of the main cam plate while preventing an unrestricted lowering thereof in the absence of a container below the filling nozzle.

2. The construction of claim **1** wherein the ring member is vertically adjustably supported in the filling machine through a screw mechanism with which is associated a manually operable chain-and-sprocket means to permit the lowered, filling position of the filling nozzles to be vertically adjusted to suit the filling requirements of any particular container being handled in the machine.

3. The construction of claim **2** wherein the main cam plate is vertically adjustably supported in the filling machine through a second screw mechanism with which is associated another manually operable chain-and-sprocket means whereby to permit the raised, inactive positions of the filling nozzles to be adjusted vertically to suit the filling requirements of any particular container.

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