Nov. 24, 1942. S. B. HOAR 2,302,693

VACUUM FILLING MACHINE

Filed Sept. 1, 1939 7 Sheets-Sheet 1

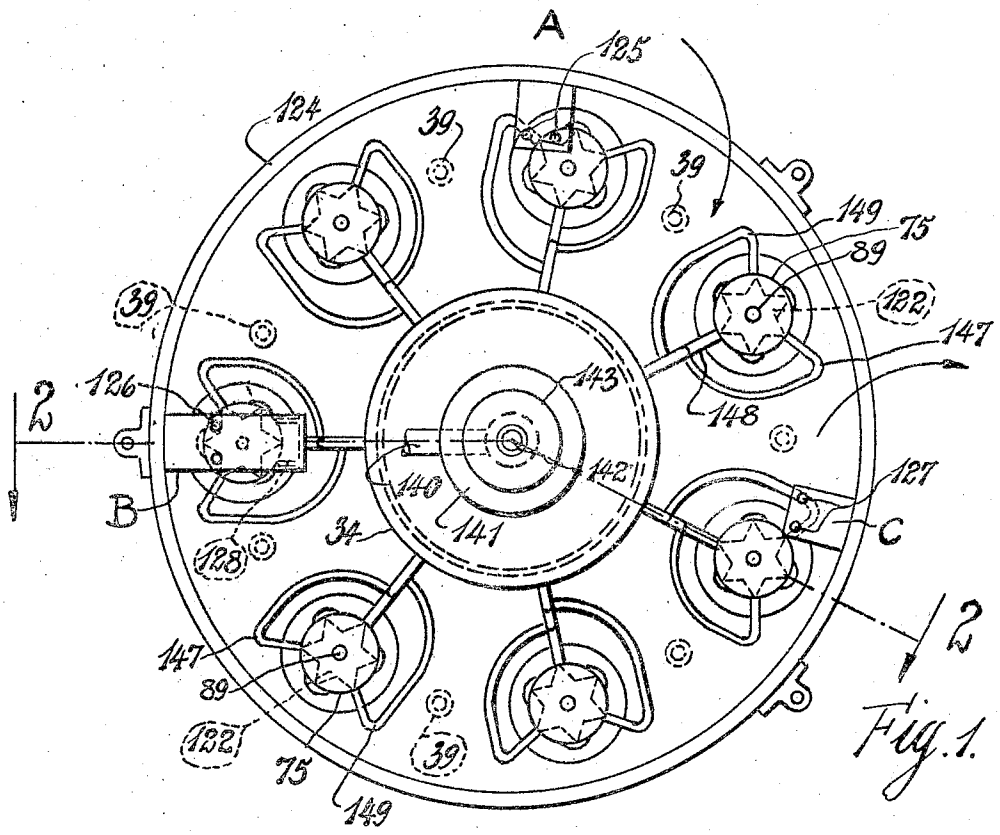


Fig. 1.

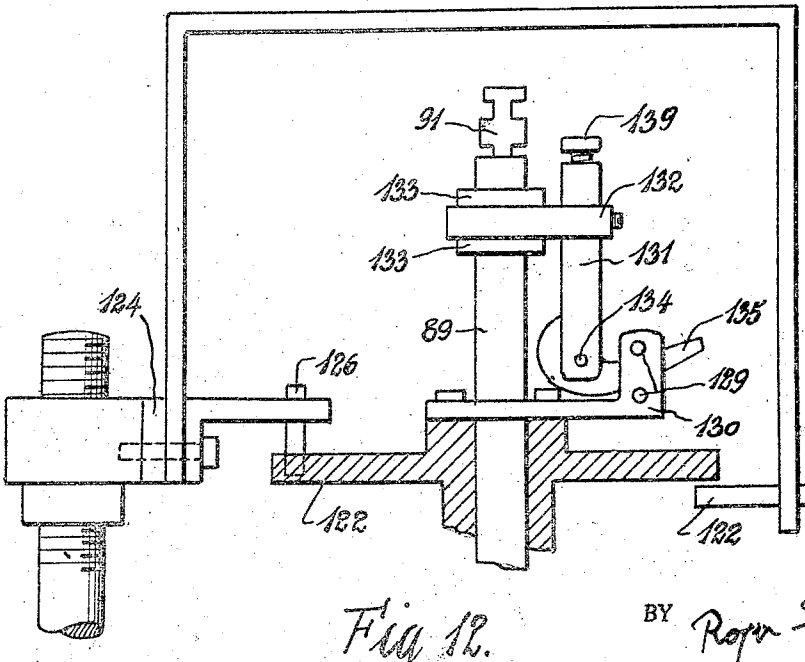


Fig 12.

Stedman B. Hoar,
INVENTOR.

BY Roger Sherman Hoar

ATTORNEY.

Nov. 24, 1942. S. B. HOAR 2,302,693

VACUUM FILLING MACHINE

Filed Sept. 1, 1939 7 Sheets-Sheet 2

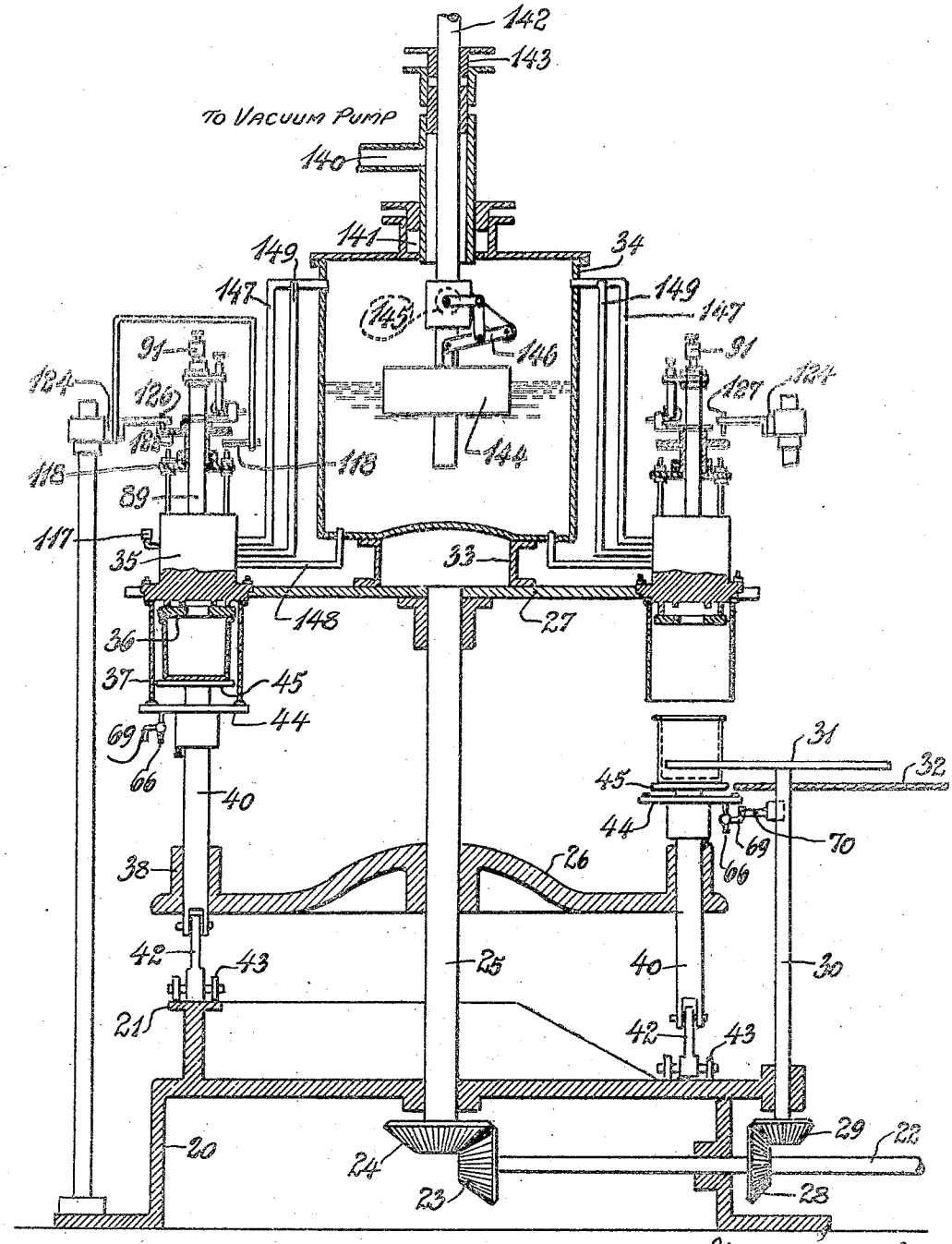


Fig. 2.

Stedman B. Hoar,
INVENTOR.

BY Roger Sherman Hoar

ATTORNEY.

Nov. 24, 1942. S. B. HOAR 2,302,693

VACUUM FILLING MACHINE

Filed Sept. 1, 1939 7 Sheets-Sheet 3

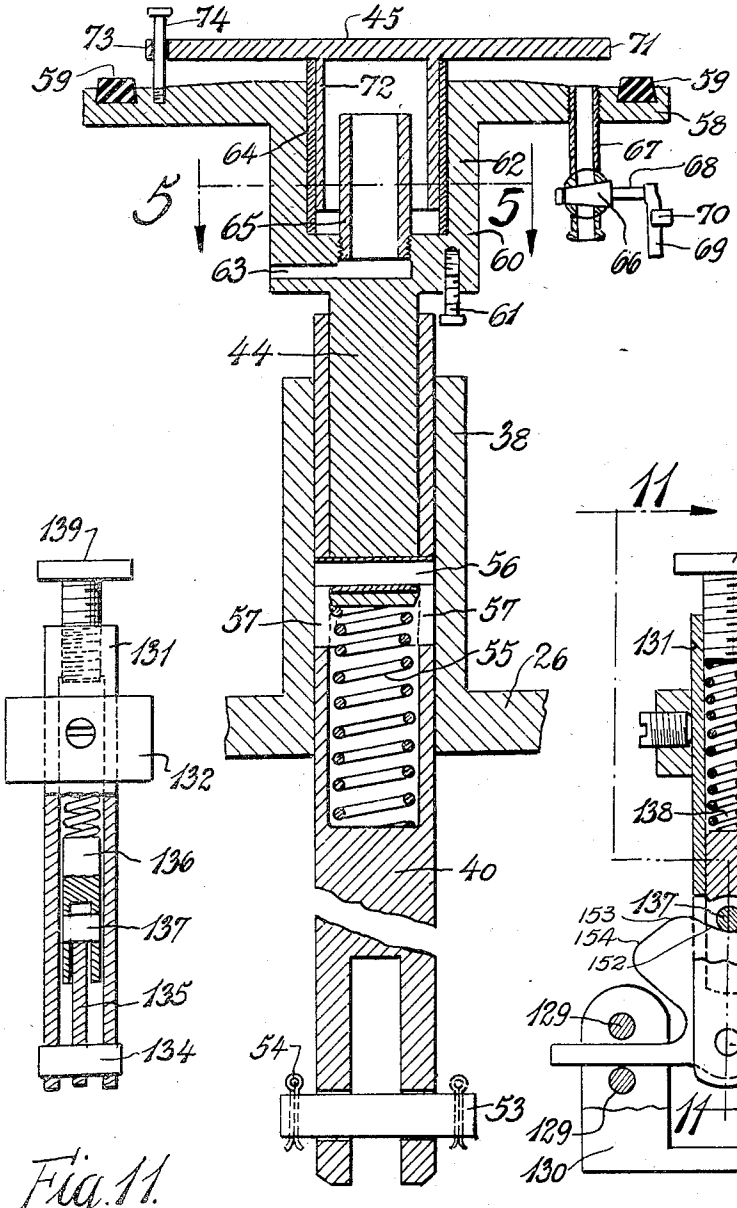


Fig. 3

Fig. 11.

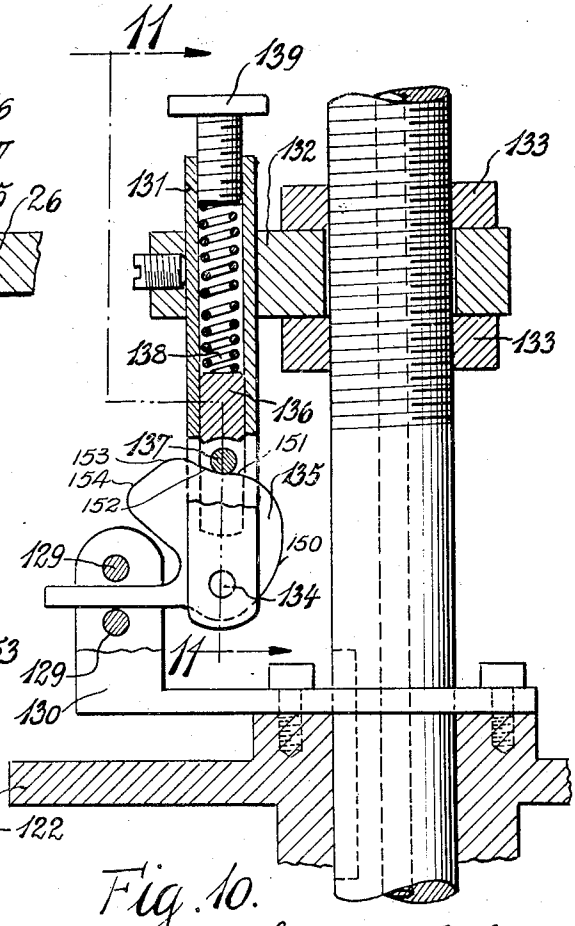


Fig. 10.

Stedman B. Hoar,
INVENTOR.

BY Roger Sherman Hoar

ATTORNEY.

Nov. 24, 1942. S. B. HOAR 2,302,693

VACUUM FILLING MACHINE

Filed Sept. 1, 1939 7 Sheets-Sheet 4

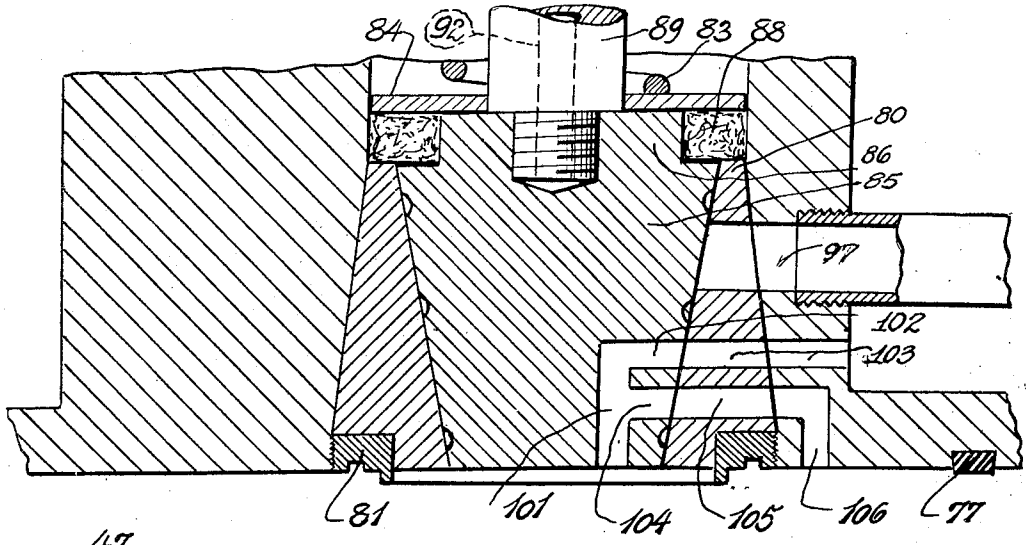


Fig. 14.

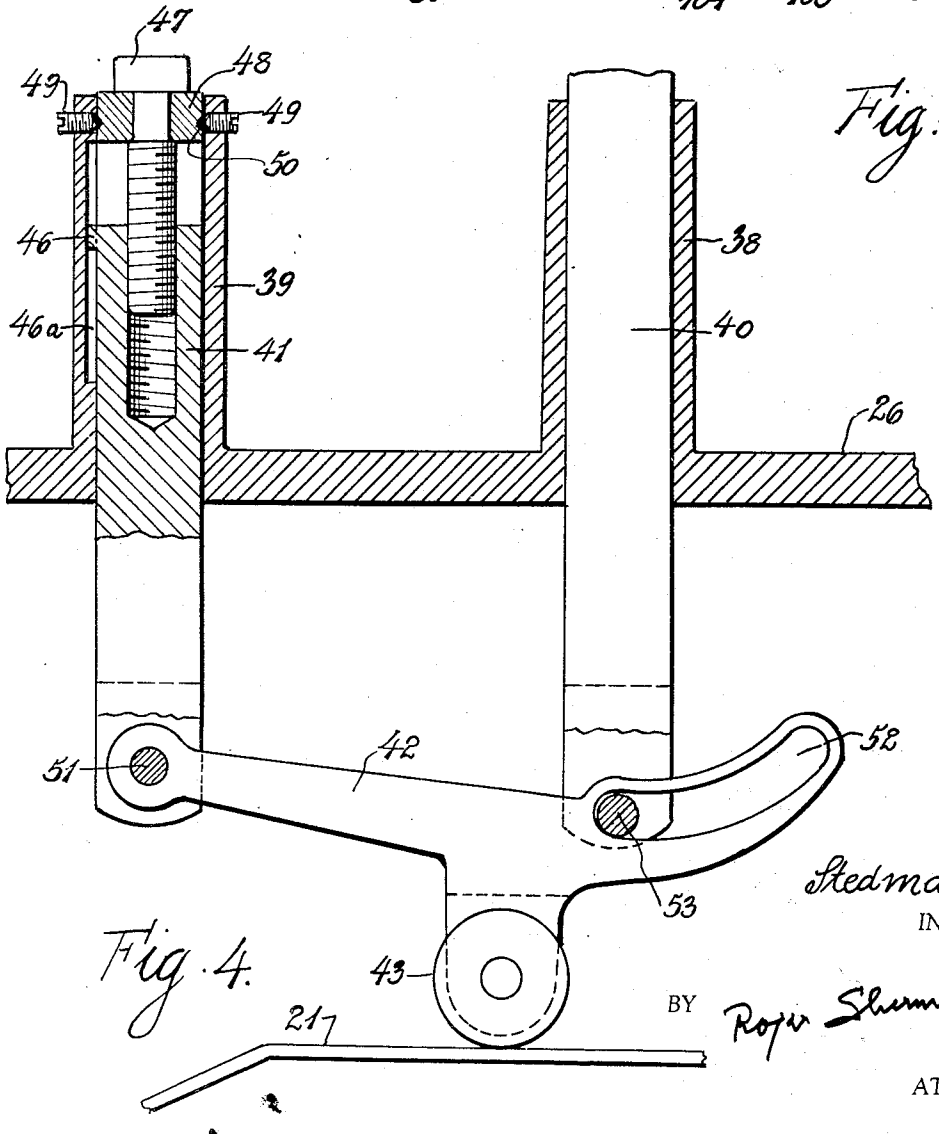


Fig. 4.

Stedman B. Hoar,
INVENTOR.

BY Roger Sherman Hoar

ATTORNEY.

Nov. 24, 1942. S. B. HOAR 2,302,693

VACUUM FILLING MACHINE

Filed Sept. 1, 1939 7 Sheets-Sheet 5

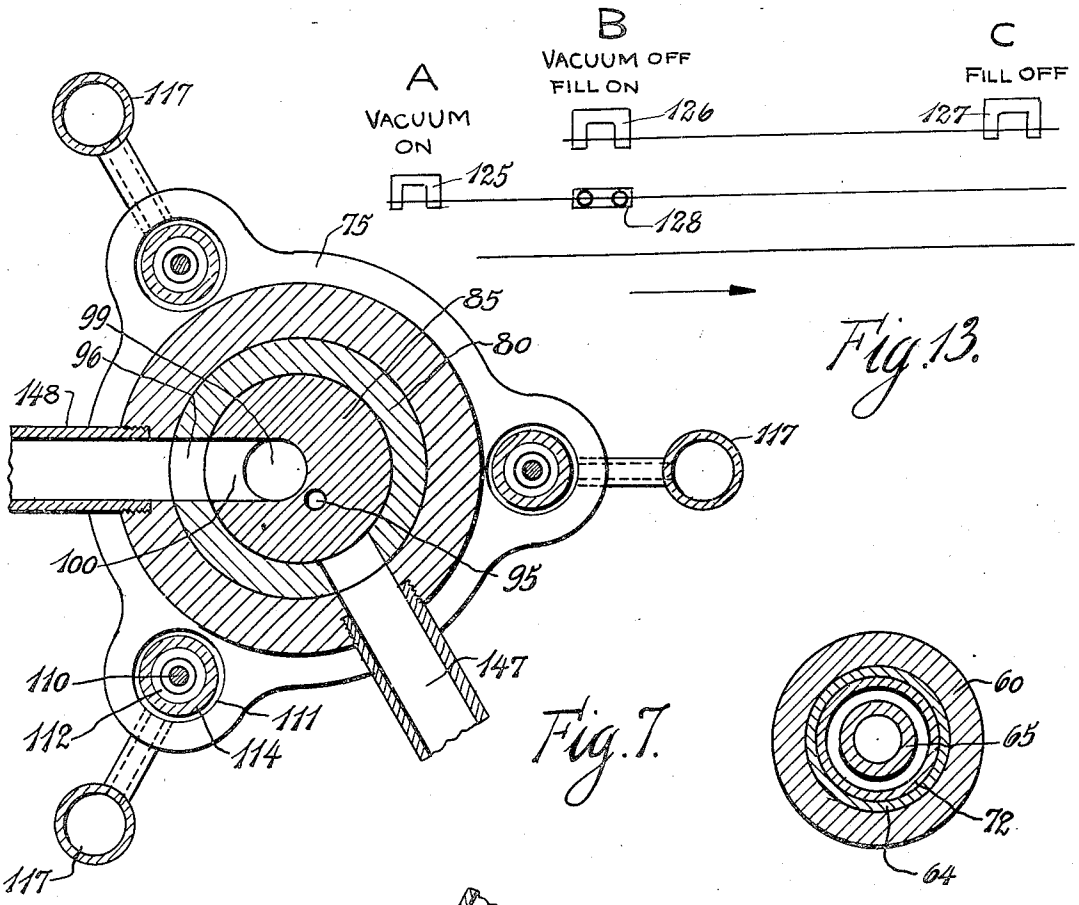


Fig. 13.

Fig. 7.

Fig. 5.

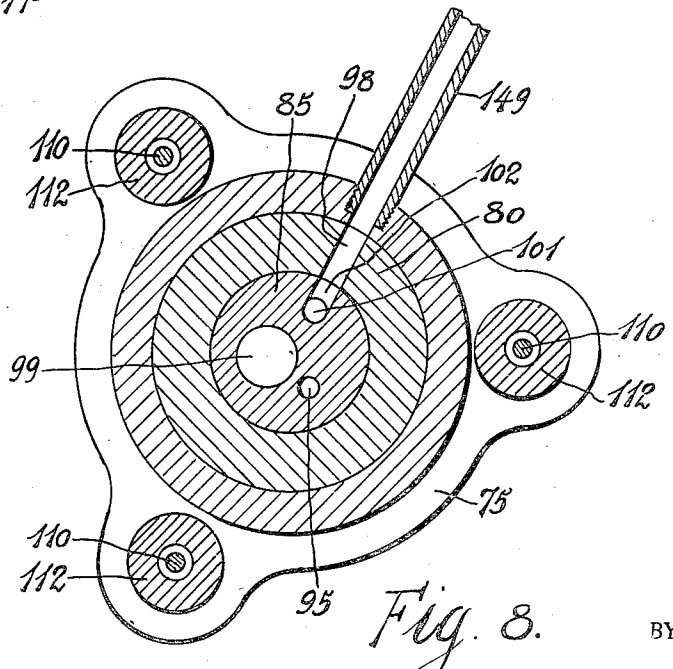


Fig. 8.

Stedman B. Hoar,
INVENTOR.

BY Roger Sherman Hoar

ATTORNEY.

Nov. 24, 1942. S. B. HOAR 2,302,693

VACUUM FILLING MACHINE

Filed Sept. 1, 1939 7 Sheets-Sheet 6

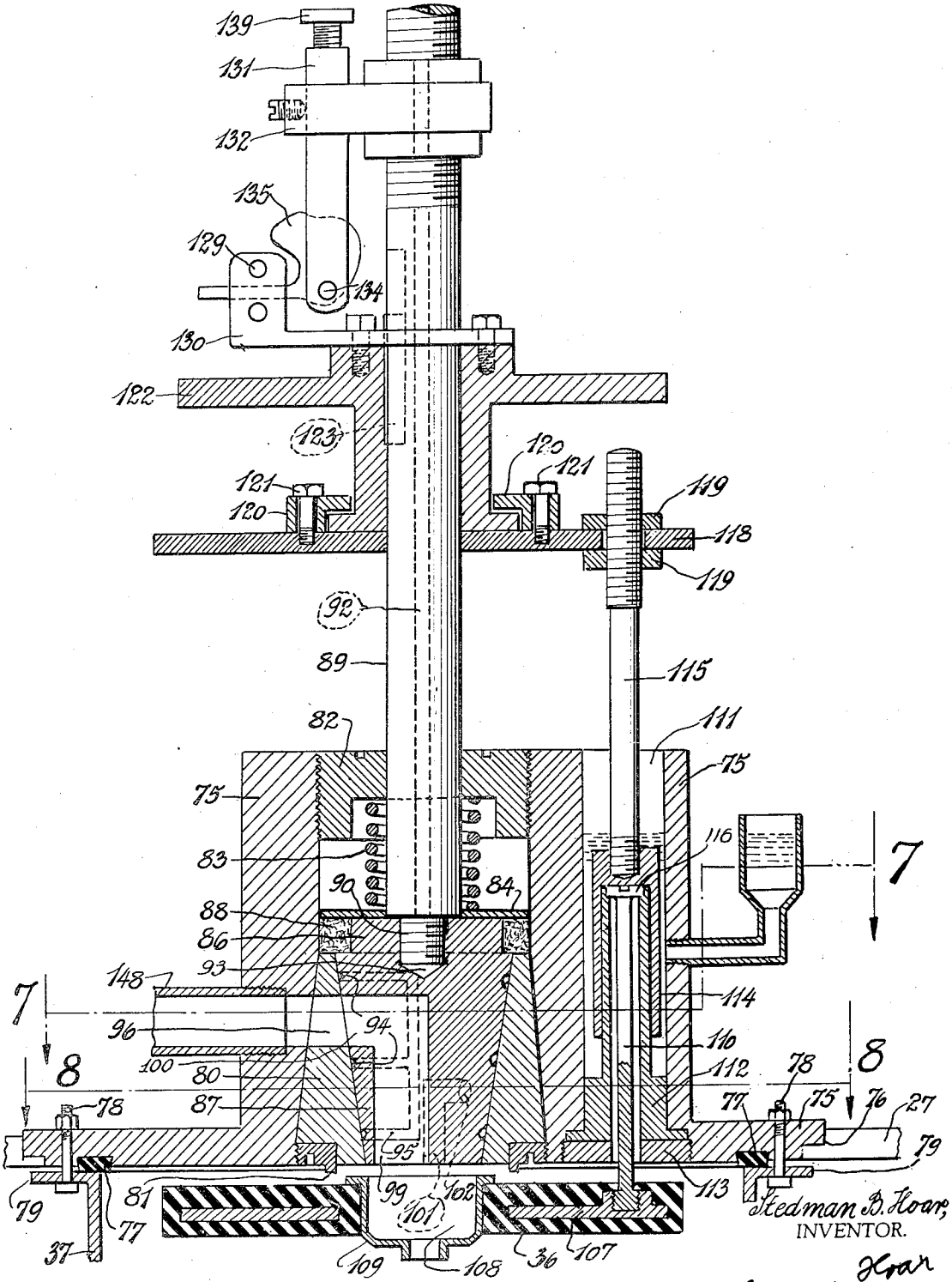


Fig. 6

Stedman B. Hoar,
INVENTOR.

BY Roger Sherman Hoar

ATTORNEY.

Nov. 24, 1942. S. B. HOAR 2,302,693

VACUUM FILLING MACHINE

Filed Sept. 1, 1939 7 Sheets-Sheet 7

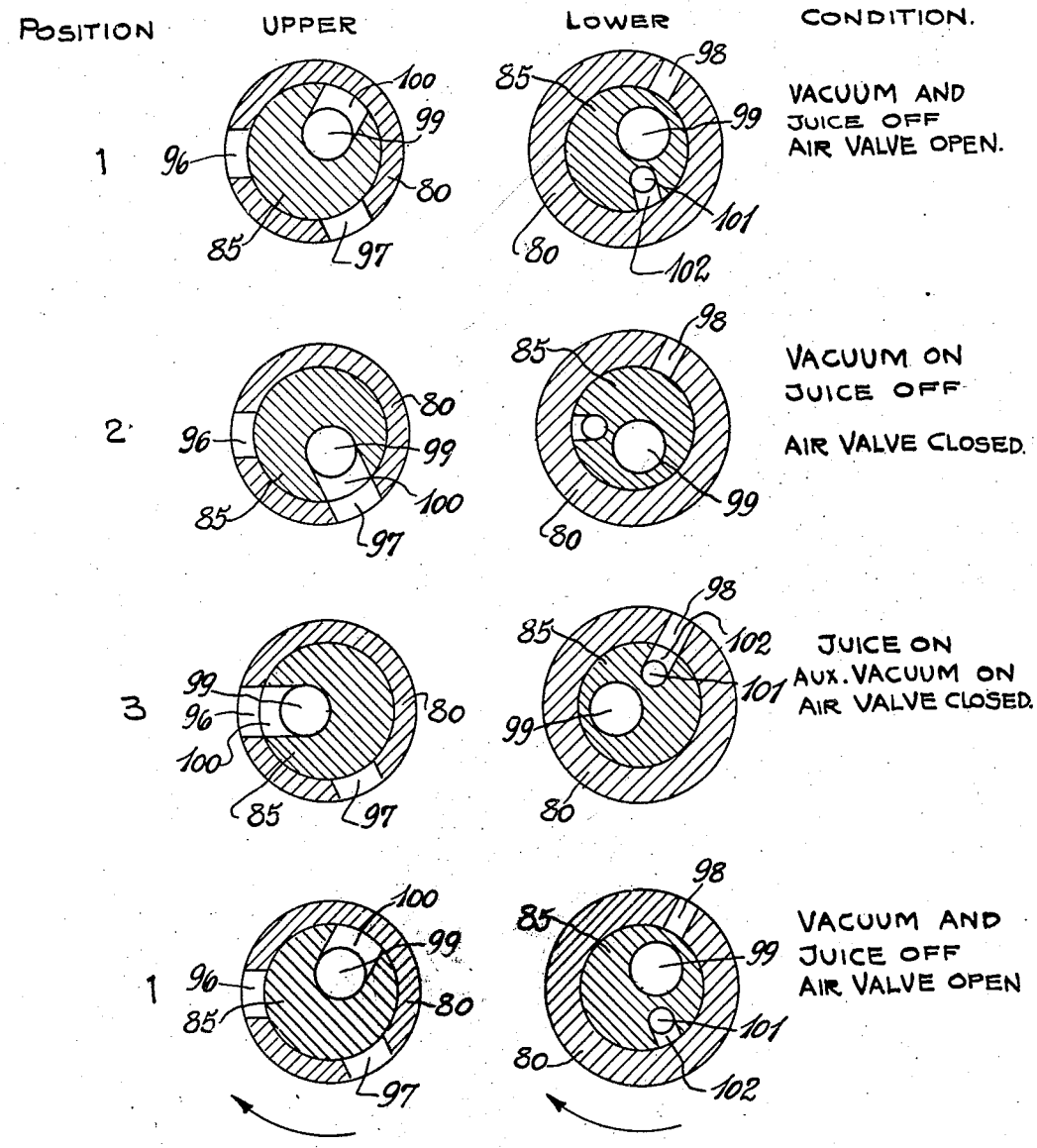


Fig. 9.

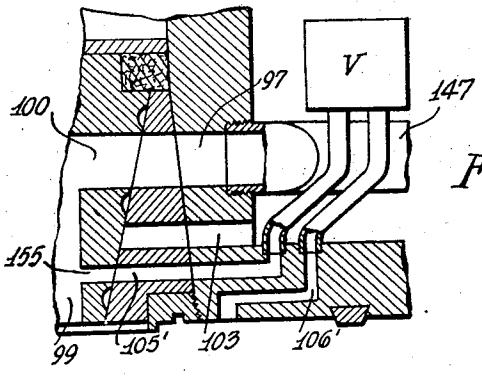


Fig. 15.

Stedman B. Hoar,
INVENTOR.

BY Roger Sherman Hoar

ATTORNEY.

Patented Nov. 24, 1942 2,302,693

UNITED STATES PATENT OFFICE

2,302,693

VACUUM FILLING MACHINE

Stedman B. Hoar, Orange, Calif.

Application September 1, 1939, Serial No. 293,099

20 Claims. (Cl. 226—116)

My invention relates to vacuum filling-machines, for filling liquids into cans under high vacuum.

In my United States Patent No. 2,070,302, issued February 7, 1937, I set forth the difficulties encountered in the prior art in filling a deaerated liquid into a container without reincorporating air in the liquid or wasting part of the liquid, and disclosed a valve action and a system of valve-reservoir connections which permitted the maintenance of balanced pressure within the container and the reservoir and thereby permitted filling uniformly and without reincorporation of air at any degree of vacuum capable of being attained by the vacuum-producing apparatus. But due to the fact that it exposes the exterior of the can to atmospheric pressure while exhausting the interior of the can to a very high degree, it is suitable only for use on cans small enough and/or strong enough to resist the pressure-differential without collapsing.

With the popularity of canned juices ever increasing and with an increasing demand for the larger sizes of containers, not only from hotels, hospitals and restaurants but for family use, it has become more important to devise efficient means for filling large and collapsible containers without sacrificing the high degree of vacuum which is essential to quality of the product. In fact the problem relates not only to the filling of such liquids as juices but to syruping cans filled with solids or semi-solids. Various means have been employed but they represent largely a concession to the degree of vacuum employed, or else they are slow and of the type aptly termed "vacuum hogs."

Attempts have been made to solve the problem by placing the container in a sealed chamber which can be exhausted to any degree desired, with equal pressures inside and outside of the can. This method has been long in use, with numerous machines devised to accomplish it. It presents, however, several difficulties. There is always some space between the container and the chamber wall which must be exhausted to the same high degree as the interior of the container. This is not a serious objection when low vacuum is used, but when it is necessary to exhaust very close to the boiling point of the liquid to prevent reaeration, this represents a great loss of time, pump capacity, and power. The importance of this loss will be realized when one considers that the time required, all other things being equal, to exhaust to a vacuum of 29" of mercury is more than double that required to exhaust to 28". Modern developments in vacuum filling of cans with deaerated liquid have shown that a vacuum of 28" is not nearly low enough, due to the danger of reaeration during filling at that pressure. So we must exhaust to 29". Yet every cubic inch of space that does not have to be exhausted to 29" represents a worthwhile saving of time, pump capacity, and power.

Still another difficulty in such all-enclosing machines is that of procuring an automatic even fill. Premeasuring is impracticable, as it enhances the opportunities for reaeration. A sealing-pad, within the chamber, for the top of the can, was also formerly supposed to be impracticable, due to the fact that the mechanism connected therewith if within the chamber required the chamber to be large and hence difficult to evacuate, or if outside the chamber had to operate through stuffing-boxes which were a source of leakage. Furthermore the force employed to seal the pad set up a reaction tending to unseal the chamber.

In working with high vacuum, it is important not only to have the vacuum chamber as small as possible and to have all actuating and controlling apparatus outside of the chamber, but to have the construction as simple, frictionless, and leak-proof as possible. An amount of leakage insignificant at lower vacuum will rapidly change a high vacuum to a low vacuum.

It is accordingly the principal object of my present invention to provide a simple rugged machine for filling large cans in which only the interior of the can itself is exhausted to high vacuum, and the outside of the can is exhausted only to the degree necessary to prevent collapse of the can, thus saving a large part of the load on the exhausting means.

Another object is to make the moderate exhaustion of the space around the can a preliminary step to the high exhaustion of the interior of the can so that during the latter stage the entire capacity of the exhausting means can be most effectively applied.

A further object is to provide means whereby the exhaustion of the vacuum chamber outside of the container may be regulated to the proper degree.

Still another object is, by exhausting the outer chamber to only a moderate degree, to make practicable the use of a chamber large enough to permit the use of automatic can-placing and can-removing equipment.

Another object is to provide a double seal be-

tween the highly exhausted interior of the can and the outside atmosphere, with an intervening space between seals exhausted to an intermediate degree so that the pressure differential across either seal is moderate and the tendency to leakage thereby lessened.

Still another object is to make use of atmospheric pressure as the force to seal the can, rather than to use apparatus whose presence within the vacuum chamber would increase the space to be exhausted; and to utilize this force in such a way that it does not set up a reaction tending to unseal the chamber.

A further object is to provide means for transmitting power, such as the atmospheric pressure mentioned above, into and out of a vacuum chamber in a leak-proof and nearly frictionless manner that will eliminate the conventional stuffing box.

Another object is not only to provide a no-can no-fill mechanism which is common in most modern filling machines but to provide a no-vacuum no-fill mechanism whereby, if optimum conditions of vacuum can not for any reason be obtained in the vacuum chamber, the can will not be filled and no product will be spoiled by re-aeration.

My invention consists in the novel parts and in the combination and arrangement thereof defined in the appended claims.

These parts could be combined in a single head filler or in a multiple head straight-line filler or in other forms with suitable motivating means, but are herein described as combined in a multiple-head rotary filler, but with no intention of limiting the invention to combination in that type.

Throughout the following description the same reference number is applied to the same member or similar members.

Figure 1 is a plan view of my rotary-type multiple-head filling machine.

Figure 2 is a vertical section of my machine, partly also in elevation, taken along line 2—2 of Figure 1.

Figure 3 is a vertical section of one of the double pedestals and its lift rod of my machine.

Figure 4 is a vertical section of one of the pedestal lift rod levers and its adjustable pivot.

Figure 5 is a cross section of one of the pedestal sealing wells taken along line 5—5 of Figure 3.

Figure 6 is an enlarged vertical section of one of the valves shown solid in Figure 2, taken along the line 6—6 of Figure 8. Although the valve itself is shown in the filling position, the valve-positioning means shown in connection with it is shown, for greater clarity, in an intermediate position, i. e., the position it would have at the instant exhaustion of the filling chamber begins.

Figure 7 is a horizontal section of this valve taken along line 7—7 of Figure 6.

Figure 8 is a horizontal section of this valve taken along line 8—8 of Figure 6.

Figure 9 is a diagrammatic representation of the three successive positions of both levels of my valve, throughout the cycle of operation of my machine.

Figure 10 is a vertical section of one of the pressure-regulators which regulates the pressure in the vacuum chambers.

Figure 11 is a frontal view of part of the pressure-regulator shown in Figure 10.

Figure 12 is a side elevation of the valve positioning mechanism and no-vacuum no-fill control shown at B on Figure 1.

Figure 13 is a diagrammatic representation of the valve positioning mechanism and no-vacuum no-fill control.

Figure 14 is an alternative arrangement of a part of Figure 6. All portions of Figure 6 not shown in Figure 14, and all portions of Figure 14 numbered the same as in Figure 6 are to be assumed to be the same as shown in Figure 6.

Figure 15 is a reproduction of a portion of Figure 14, to illustrate a slight variant thereof, partly diagrammatic.

Beginning with Figure 2, we see that 20 is a base carrying an annular cam-rail 21. 22 is the main drive-shaft from a motor or other driving means (not shown). By means of bevel gears 23 and 24, this shaft transmits its rotation to a vertical shaft 25 which supports and turns the lower table 26 and the upper table 27, both of which are keyed to the shaft 25. By means of bevel gears 28 and 29, shaft 22 also drives vertical shaft 30 to the head of which is affixed a transfer lever 31 for transferring cans to the can-table or conveyor disc 32 from the machine. A similar transfer lever (not shown) may be similarly driven to feed cans into the machine. Such transfer devices, being well known in the art and not forming per se any part of my present invention, are only suggested and conventionally described; any mechanic familiar with the art will understand their placement and timing. The same is true of the can-table or conveyor disc.

Upper table 27 supports centrally, on brackets 33, a reservoir 34, and also around its edge a plurality of valve-mechanisms 35 (of which the machine now described carries seven) each carrying a sealing-pad 36 within a depending vacuum-chamber 37.

On lower table 28 there are a plurality of bearings 38, one corresponding to each of the valve mechanisms 35 and set vertically below it. Alternating with the seven bearings 38 are seven similar bearings 39, whose positions are best shown in Figure 1. Through each of the bearings 38 there reciprocates vertically a lift-rod 40; and in each of the bearings 39 is fastened a pivot-supporting rod 41, carrying a lift-rod lever 42, also connected to an adjacent lift-rod 40, and equipped with a roller 43 which runs upon cam-rail 21 and at appropriate times raises the lift-rod 40, as will be more fully described later in connection with Figure 4. Each lift-rod 40 supports a lower, or sealing, pedestal 44, which in turn carries an upper, or can-supporting pedestal 45, as will be more fully described later in connection with Figures 3 and 5.

Except between the two curved arrows of Figure 1, which indicate the ingress of an empty can to the filler and the egress of a filled can therefrom (as by transfer lever 31), the cam rail 21 is of sufficient height to hold the lower pedestal 44 in seal-contact with its corresponding vacuum chamber 37.

Turning now to Figure 4, we see that pivot-supporting rod 41 is held from turning in bearing 39 by a key 46 which slides in key-way 46a. Into rod 41 is threaded a bolt 47, which has a narrow unthreaded portion at its upper end surrounded by a split collar 48. Collar 48 is held in bearing 39 by set-screws 49 which for greater security may be set into a groove 50 of the collar. Rod 41 is forked at its lower end and through the forks it carries bearing 51 upon which and between the forks is mounted lift-rod lever 42. It will be seen that by turning bolt 47, the vertical position of bearing 51 may be changed without changing its angular rela-

tion to the frame of the machine by reason of key 46.

Lift rod lever 42 has a cam-slot 52 which encloses a roller 53, carried by the forked lower end of the lift rod 40, between the forks of which lift rod lever 42 also passes. Roller 53 may be held in place by cotter pins 54 as best shown in Figure 3.

From Figure 3 we also see that lift rod 40 is hollowed through its upper portion to receive the lower end of lower pedestal 44, and a spring 55. The lower end of pedestal 44 is pierced for a pin 56, and lift rod 40 is slotted with slots 57 to receive the ends of pin 56. Pedestal 44 has a surface plate 58 which carries a gasket 59, and a central body 60, and is so mounted in lift rod 40 that when spring 55 holds pin 56 against the top of slots 57, the lower face of body 60 is slightly above the top of lift rod 40. This allows a degree of resiliency when lift rod 40 raises pedestal 44 so that gasket 59 is in sealing contact with the bottom of vacuum chamber 37, but spring 55 should be strong enough to maintain pin 56 against the top of slots 57 at all other times, to insure that, if movement of the lift rod is adjusted with reasonable accuracy, the gasket will be forced against the vacuum chamber.

It will be seen that the amount of movement given to the lift rod depends not only upon the height of cam-rail 21, but upon the adjustment of the height of bearing 51 by means of bolt 47. A distance-screw 61 in the lower face of pedestal body 60 is adjusted to bear on the top of boss 38 when the pedestal is lowered, thus regulating the height of the pedestal with relation to the can-conveyor 32 for the easy transfer of cans. As this screw 61 limits the drop of the pedestal, and consequently of the lift rod and lift rod lever, the roller 43 may leave track 21 and hang above it during its travel through the space delimited by the curved arrows in Figure 1. From Figure 4 it is evident that, when lift rod lever 42 and lift rod 40 are in the raised position, roller 53 is towards the end of cam slot 52 nearest pivot supporting rod 41. If pivot supporting rod 41 is raised above the position shown in Figure 4, a shorter stroke is obtained on lift rod 40; and conversely, if it is lowered below the position shown, a longer stroke is obtained; always provided that screw 61 is adjusted to allow a longer or shorter drop.

Referring now to Figure 3 and to Figure 5, we see that head 60 of pedestal 44 has a pressure cylinder 62, not necessarily cylindrical, hollowed in its center, with a port 63 open from the bottom of the cylinder to the atmosphere, the cylinder being wider in its upper portion than in its lower portion. A smooth sleeve 64 is fitted tight into the upper portion of the cylinder, extending slightly above the upper surface of plate 58. A tube 65 is threaded into the narrower lower portion of the cylinder extending upwardly to slightly below the upper surface of plate 58. A stop-cock 66 is suspended from plate 58 by a nipple 67, on the side of plate 58 which is outermost as the machine revolves, and with the nipple passing through plate 58 at a point slightly inside gasket 59. The stop-cock shaft 68, extending outwardly, carries a two-armed handle 69, the arms being set at right angles to each other so that one is always vertical if the other is horizontal. Suitable pins 70, supported by elements (not shown) connected with the non-revolving base, and positioned to contact handle 69 just before roller 43 starts down the incline of cam rail 21 and again just before it starts up the following incline, serve to open and close stop-cock 66.

Sleeve 64 supports, in the manner hereinafter described, can-pedestal 45 which consists of a round plate 71 and a hollow piston 72, the latter being ground to a slide fit with sleeve 64. Thus piston 72 slides up and down in sleeve 64, and plate 71 when in its lowered position rests on the top of sleeve 64. Plate 71 is perforated near its inner edge by a hole 73, through which is loosely fitted a bolt 74 threaded into plate 58. The head of this bolt 74 serves as a stop-guide to cans placed upon plate 71, and to limit the lift of pedestal 45 in relation to pedestal 44, as will be later more fully described.

The annular space between tube 65 and sleeve 64 is in operation filled nearly to the top of tube 65 with a light lubricating oil, or other sealing liquid, for example mercury. As sleeve 64 and piston 72 are closely fitted, this liquid serves not only to lubricate them but also to act as a seal between them. It would be no departure from my invention to have piston 72 fit tube 65 instead of sleeve 64; compare elements 112 and 114, hereinafter discussed. But it is highly preferable to have the sealing liquid lie on the pressure side of the slip fit.

The upper edge of sleeve 64, extending above the surface of plate 58, serves as a support for can-pedestal 45 and also to prevent any liquid which may be spilled in filling operations from penetrating between sleeve 64 and piston 72 and from thus contaminating or diluting the oil seal. To secure drainage of spilled liquid, the upper surface of plate 58 may be bevelled towards its periphery as shown in Figure 3.

For the detail of a valve mechanism 35, turn now to Figures 6, 7, 8 and 9. Beginning with Figure 6, valve mechanism 35 is housed in housing 75 which consists in a central vertical cylindrical portion which houses the valve itself and three semi-cylindrical vertical bosses spaced 120° apart and housing part of the valve-positioning mechanism to be described later, all mounted on a base plate which may be cast integrally with the rest of the housing. The base plate of housing 75 has an annular shoulder 76, by which it is supported by upper table 27, the central portion of the base plate extending downward through upper table 27 and carrying near its periphery a gasket 77. Bolts 78 passing through the base plate outside of gasket 77 serve to clamp the flange 79 of vacuum chamber 37 to gasket 77 and also, by an overlap of flange 79 and table 27, to hold housing 77, the table 27, and the vacuum chamber 37 securely together.

Vacuum chamber 37 may be of any conventional type, but is preferably a hollow open-ended cylinder of suitable dimensions for enclosing the cans to be filled, the can pedestal 45, and the sealing pad 36, and may be made of glass if it is desired to observe the operations within it, or of any other suitable material. In the particular embodiment illustrated, it has a smooth lower edge to contact gasket 59 on sealing pedestal 44, and as above stated an upper flange to contact gasket 77 and to secure it to the rest of the mechanism.

The central cylindrical part of valve housing 75 is vertically bored, the lower part of the bore being tapered to receive valve-sleeve 80 and being threaded to receive annular ring 81, which secures valve-sleeve 80 in place, and also as will

be explained later, acts as a sealing ring against pad 36. The upper part of the bore is threaded to receive annular ring 82 which through spring 81 and washer 84 holds valve 85 in firm contact with valve-sleeve 80.

Valve 85 has a vertical cylindrical portion 86 above the conical portion 87 and forming a shoulder with it, so that when the valve is firmly seated in valve-sleeve 80, the upper surfaces of the valve-sleeve and of the shoulder of the conical portion of the valve are approximately at the same level. The annular space bounded by these level surfaces, the vertical cylindrical portion of the valve, washer 84, and housing 75 is filled with a packing ring 88 of grease-soaked felt, leather or other suitable material. The annular space around spring 83 may also be packed with heavy grease.

Valve 85 is mounted on valve stem 89 by means of threaded portion 90. Valve stem 89 is fitted with a grease cup 91 (Figures 2 and 12) at its upper end and is traversed throughout its length by a grease-passage 92, which opens into a small recess 93 in valve 85. Valve 85 bears annular grease rings 94, connected with recess 93 by suitable passages 95 and located above, between, and below the port levels of the valve to prevent leakage as well as to lubricate.

The ports of valve 85, valve sleeve 80, and valve housing 75, are in general similar to those described in my Patent No. 2,070,302. Hole 96 in sleeve 80 is for the admission of liquid, and hole 97 is for the extraction of air, i. e., is the vacuum line. Although I have shown both the liquid line and the vacuum line as running from the reservoir to the valve, as in Figure 2 of my said earlier patent, any one of the variant pipings of Figures 7 to 10 of that patent might equally well be used.

Hole 98 is an auxiliary hole, connecting with the vacuum system.

The valve has a vertical port 99 which may be located a little off its axis, and connecting therewith a horizontal hole 100 to contact selectively liquid hole 96 and vacuum hole 97.

The valve also has another and smaller vertical port 101, set off center, and connecting therewith a small horizontal hole 102, to contact, in appropriate positions, auxiliary vacuum hole 98.

In operation, the valve is turned through three successive positions and around to the first one again as illustrated in Figure 9. In position 1, the large hole 100 is blanked, so that there is no connection either to hole 96 (liquid) or to hole 97 (vacuum). Auxiliary hole 102 is also blanked, being two-thirds of a turn (in direction of rotation) from its outlet hole 98.

In position 2, hole 100 is in line with hole 97, so as to exhaust the vacuum chamber 37; and hole 102 remains blanked one-third of a turn from its outlet.

In position 3, also illustrated in Figures 7 and 8, hole 100 is in line with hole 96, for the admission of liquid; and hole 102 is in line with its outlet hole 98, for the exhaustion of residual air while the can is filling.

The valve then turns to position one, and the stop-cock 66 is turned to open, simultaneously with this movement (or fractionally later), to admit air to the vacuum chamber. When the valve turns to position 2 again, stop-cock 66 is closed off.

It will be noted that my present valve does not include the air connection of the valve in my Patent No. 2,070,302, its place being taken by stop-cock 66 in sealing pedestal 44. I have found this arrangement to be preferable with the present type of machine as it is of primary importance to release the vacuum in the vacuum chamber outside of the can, after which the filled can with sealing pad and attendant mechanism will fall by its own weight. However, if it be desired to accomplish the whole operation by a simple valve instead of by a valve and a stop-cock, it is perfectly possible to do so as is shown in the alternative valve construction in Figure 14.

As shown in Figures 8 and 9 there is only one opening, i. e., hole 98, through sleeve 80 at the lower level of the valve. It will also be seen that in position 1, hole 102, connecting with port 101, is blanked below hole 97, the main vacuum connection. If now an opening 103 (Figure 14) is drilled in sleeve 80 and valve housing 75 below hole 97 at the level of hole 102, hole 102 will connect with it in position 1 and admit air through port 101 into the can. It is necessary, however, to release the vacuum outside the can in the vacuum chamber at least simultaneously with the release of the vacuum in the can, to prevent liquid from being blown from the top of the filled can. This is accomplished by drilling a hole 104 directly below hole 102 and parallel with it, and connecting passages 105 and 106 through sleeve 80 and housing 75 respectively, also directly below hole 97, with passage 106 opening through the base of housing 75 outside of annular sealing ring 81 but inside of gasket 77. Thus in position 1, there is an air connection through port 101 into the can and through passage 106 to the vacuum chamber outside of the can, all other connecting ports and holes of the valve being blanked.

Similarly, as by passage 106, it would be possible to exhaust the chamber other than through that portion of the filling head which seals to the can. Thus the can could be sealed to the filling head from the very start of the exhausting, and passage 106 could be closed when the vacuumizing had progressed to a predetermined degree. This could be accomplished by a small side passage 155, from port 99, connecting with passage 105, when the valve is in position 2, all as shown in Figure 15, in which figure passage 105 because of its slightly changed shape and functions is renumbered to be 105'. A pressure shut-off valve symbolically represented by V, connects passage 105' to passage 106 (renumbered as 106' in Figure 15) until the pressure in the chamber is about half an atmosphere, whereupon it shuts off. Inasmuch as such valves form an article of commerce, and the details thereof constitute no part of my invention, the details are not shown.

Returning now to Figure 6, we see that sealing pad 36 comprises a metal core 107 with upper and lower surfaces of a resilient sealing material, and with a central opening 108. The lower surface of pad 36 is adapted to seal against the upper end of a can and the upper surface of the pad is adapted to seal against sealing ring 81. When both surfaces are so functioning, valve 85 connects with the can through the central opening 108, and is sealed off from the rest of the vacuum chamber, unless the alternative system of passages 103, 104, 105 and 106 is used and then only when the valve is in position 1.

A spider 109 is suspended in the central opening 108 by an annular lip and from it is suspended (not shown) a displacer of suitable size and shape. This displacer should be in volume equal to the volume of port 99 and hole 100 and the unfilled part of central opening 108 plus the

volume of head-space which it is desired to leave in the can, thus allowing the liquid to drain from the above passages and not over-fill the can when the displacer is removed.

Pad 37 is suspended in three places by lift-rods 110 which may be screwed into metal core 107, and which extend upward into the semi-cylindrical bosses previously referred to as forming part of valve housing 75. Each of these bosses has a central well 111 into which is fitted the larger lower end of hollow plug 112, the upper end of which is smaller to allow for an annular space between it and the wall of the well. The plug is flanged at its lower end and held in place by threaded ring 113. Piston 114 fits around plug 112 with a sliding fit, not completely filling the annular space between plug 112 and the wall of the well. Into its upper end is threaded the lower end of extension rod 115. A cap 116 forms the upper end of lift rod 110 and is so proportioned as not to pass through the hollow center of plug 112 and yet to allow considerable freedom of motion within the walls of piston 114. Cap 116 may conveniently be slotted to assist in assembling lift rod 110 with metal core 107.

The annular space in well 111 is filled with a light oil, or other sealing liquid, for example mercury, which may be supplied from cup 117.

It will be seen that by the above-described combination of parts, motion of pad 36 is transmitted to extension rods 115 without binding or friction other than that between lubricated surfaces of plug 112 and piston 114. Lift rod 110 may play loosely within plug 112, but will exert a positive upward push against piston 114 and thus to extension rod 115. Downward motion is provided for by the weight of the above mentioned moving parts and others connected to them, and by vacuum suction exerted on the inside of piston 114, and at a crucial moment by a cam and spring action, to be presently described.

At the same time, the oil seal between plug 112 and piston 114 prevents any leakage of air.

The function of lift rods 110 and extension rods 115 is to place in operating position the mechanism for positioning valve 85, and also to transmit the regulating force which controls the differential of pressure inside and outside of the can in vacuum chamber 37 and thus position the valve for filling or not filling. The importance of having these rods move with the minimum of friction will be at once realized.

Extension rods 115 are passed loosely through a plate 118, which may be adjusted for elevation upon them by nuts 119. A split collar 120, bolted to plate 118 by bolts 121, extends over the lower flange of star-wheel 122, holding it from vertical movement with relation to plate 118 but allowing it horizontal angular movement. Star-wheel 122 is keyed by key 123 to valve stem 89. Rotation of the star-wheel thereby causes the valve stem and valve to rotate, while plate 118 remains held stationary by extension rods 115.

Turning to Figures 1 and 2, we see that a ring 124 which does not revolve with the tables but is fastened to the base of the machine, supports successive pairs of vertical pins 125, 126 and 127, at positions marked A, B, and C on Figure 1, and at B also supports a pair of horizontal pins 128, in the manner best shown in Figure 12. If a can is placed on one of the pedestals, then as the tables revolve counter-clockwise cam-rail 21 will, through the means already described, cause the top of the can to contact and raise sealing pad 36, and thus through the action of the lift rods 110 and extension rods 115, cause the star-wheel to lift from the position indicated by the lower line of Figure 13 to the position indicated by the middle line of that figure. Vertical pins 125 at position A then contact the star-wheel and turn it from position 1 to position 2 of Figure 9: i. e., so that the valve is in position to exhaust the vacuum chamber.

Similarly, when the vacuum chamber reaches a suitable stage of exhaustion, can-pedestal 45 is raised by atmospheric pressure under it and causes the can, through the above described linkage, to lift the star-wheel to the position indicated by the top line of Figure 13. By a proper adjustment of weight of the parts, spring 138, capacity of vacuum pump, speed of rotation of the table, and location of the various sets of vertical pins, the degree of exhaustion of the chamber at this stage, and the degree of subsequent exhaustion of the container, can be readily adjusted. Vertical pins 126 at position B then turn the valve to position 3 of Figure 9: i. e., so that the valve is in filling position.

But if insufficient vacuum exists in the filling chamber to cause the can pedestal to be raised, the star-wheel remains on the level indicated by the middle line of Figure 13 and contacts horizontal pins 128, which operate on the reverse side of the star to turn the valve back to the neutral position 1 of Figure 9.

Otherwise the star proceeds on the top level of Figure 13 to vertical pins 127 at position C which turn it again to complete the cycle, returning it to position 1 of Figure 9.

If no can was present in the vacuum chamber, there would be no lift of the star-wheel, and the valve would remain in position 1 of Figure 9 during the full revolution of the machine.

Turning now to Figures 10 and 11, we see the device which regulates the degree of vacuum to be obtained in the vacuum chamber before the star wheel will lift to contact vertical pins 126.

A pair of rollers 129 are mounted in a forked bearing 130 bolted to star-wheel 122 and turning with it and with the valve-stem 89. To avoid interference by these parts with pins 125, 126 and 127, these parts are mounted on a point of the star which never points radially outward during the cycle. A hollow cylinder 131 is supported by strap 132 which in turn is supported by valve stem 89, being adjustable in height by nuts 133. Cylinder 131 is forked at its lower end and bears, across the fork, pivot 134 on which is mounted cam 135. Cam 135 has a lever arm which passes with sufficient clearance to allow angular movement between rollers 129. Sliding within the cylinder 131 is a piston 136, also forked and carrying cam-roller 137. Cam-roller 137 is held in contact with cam 135 by spring 138, the tension of which is adjustable by bolt 139.

It will be seen that by manipulation of bolt 139 greater or less resistance can be made to the turning of cam 135, and consequently to the lift of the star-wheel 122 and through intervening linkage to the sealing pad 36. The cam is so cut and so positioned vertically by nuts 133, that the compression stroke is completed just before sealing pad 36 makes sealing contact with sealing ring 81. Thereafter the cam is free to turn on its outer circle 154, and the pad is able to make and hold sealing contact with the ring with no further spring tension.

Similarly on the release stroke, the pad, linkage and star-wheel start downward by gravity, but almost immediately the cam-roller passes over

the shoulder 153 of the cam and exerts a downward pressure through the star-wheel and linkage to the pad. This is a useful feature because by keeping the pad in firm contact with the top of the can, spillage is avoided while the displacer is being withdrawn from the can and headspace is being created.

To achieve the best results, the inside diameter of piston 72 of can pedestal 45 should be as large as is conveniently possible, and the weight of the parts lifted by the lifting action of can pedestal 45 should be as little as conveniently possible. The lifting force is the pressure differential on the roof of the hollow piston 72, and consequently a larger area gives larger force. The force is resisted by the weight of the parts lifted, the friction of those parts (which is reduced to a minimum by the use of oil-sealing self-aligning sealing devices) and the compression of spring 138. It is desirable to have as large a part of the resistance as possible under the control of the adjustment of the compression on spring 138; by that means the total pressure remaining in vacuum chamber 37 when that chamber is cut off from further exhaustion may be accurately adjusted to the maximum which will permit a very high vacuum to be drawn within the can without causing the can to collapse or panel, thus saving the exhausting means from unnecessary load.

Returning again to Figure 2, we shall consider the reservoir 34, and its connections, which are the same as those in my Patent No. 2,070,302. Pipe 140, which does not revolve, enters the top of reservoir through stuffing-box 141; it leads to a vacuum pump (not shown). Pipe 142 which also does not revolve enters the top of the reservoir through stuffing box 143; it leads from a source of liquid (not shown).

A float 144, controlling the main liquid valve 145 through linkage 146, maintains the liquid at a constant level in the reservoir.

From the top of the reservoir 34, a vacuum pipe 147 leads to vacuum hole 97 of each valve mechanism 35.

From the bottom of the reservoir 34, a liquid pipe 148 leads to liquid hole 96 of each valve mechanism 35.

From the upper part of each vacuum pipe 147, an auxiliary vacuum pipe 149 leads to the auxiliary vacuum hole 98 of the corresponding valve mechanism 35.

For diagrammatic simplicity, liquid pipe 148 is shown in Figure 2 as entering the valve mechanism 35 below pipes 147 and 149, instead of at the same level as pipe 147 and above pipe 149 as it actually does. Compare Figure 6.

To understand how my machine operates, let us assume that a pedestal is at the point where the transfer lever (not shown) feeds cans onto the pedestal. The sealing pedestal 44 is resting on distance-screw 61, with roller 43 on the low part of cam-rail 21 or even suspended above it. The outer edge of sealing pedestal 44 is below can-table 32, and can-pedestal 45, which is resting on the rim of sleeve 64, is exactly level with table 32 to facilitate the transfer of cans. Stop-cock 66 is open. Valve 85 is at position 1 of Figure 9. Sealing pad 36 is at its lowest position (i. e., cap 116 of lift rod 110 is resting on the upper rim of plug 112), and consequently the star-wheel 122 is at its lowest point and cam-roller 137 is resting on the inner circle 150 of cam 135.

A can is fed into can-pedestal 45 and rotation of the machine begins (or continues). Stop-cock handle 69 is contacted by pin 70, closing stop-cock 66. Roller 43 contacts the rising incline of cam-rail 21 and acting through lift-rod lever 42 and lift-rod 40 causes sealing pedestal 44 to lift to make a sealing contact between gasket 59 and vacuum chamber 37, spring 55 being slightly compressed by the pressure of sealing. At the same time, the top of the can contacts sealing pad 36 and lifts it slightly, raising star-wheel 122 to its intermediate position. Cam 135 is thereby turned until cam-roller 137 is just at the foot 151 of the incline 152 on cam 135.

A further short rotation of the machine brings star-wheel 122 in contact with pins 125 at position A, causing the valve 85 to rotate to position 2. Exhaustion of the sealed vacuum chamber 37 then begins.

When the difference of outside and inside pressure on can-pedestal 45 is sufficient to overcome the weight of the various parts to be lifted and the pressure of spring 138, can-pedestal 45 will lift and, acting through the can, will lift sealing pad 36 and the star-wheel 122, and will cause cam 135 to rotate against the pressure of spring 138. Just before the upper side of sealing pad 36 contacts sealing ring 81, cam-roller 137 reaches the outer shoulder 153 of the cam-incline and rolls out on the outer circle 154 of the cam, thus cocking the spring so that its pressure no longer resists rotation of the cam; this permits a quick and firm seal between sealing-pad 36 and sealing-ring 81. The last part of this lifting motion places star-wheel 122 in its top position.

The inside of the can is now sealed from the rest of vacuum chamber 37, and exhaustion continues only within the can.

Rotation of the machine now brings the station in question to position B. The timing of the machine is such as to allow time between position A and position B for the entire vacuum chamber 37 to be exhausted to the desired pressure, governed by spring 138, and for the pressure inside of the can to be brought to equalization with that in reservoir 34.

At position B, the star-wheel 122, being at its highest level, contacts pins 126, causing the valve 85 to turn to position 3. The can then fills, aided by continued exhaustion within the can only through auxiliary vacuum port 101 and its connections.

If the pressure differential on can-pedestal 45 is insufficient to cause it to lift, star-wheel 122 at position B contacts pins 128, instead of pins 126, and the valve 85 is turned back to neutral position 1.

Further rotation of the machine now brings the fully-raised star-wheel 122 to position C where it contacts pins 127 and turns the valve 85 to position 1, completing its cycle. At the same time stop-cock handle 69 is contacted by the second pin 70, causing stop-cock handle 69 to open and release the vacuum in vacuum chamber 37. The pressure on both sides of can-pedestal 45 being equalized, can-pedestal 45 drops to rest against sleeve 64. As the can is now filled with liquid and the valve 85 above it is closed, sealing pad 36 will unseal from sealing ring 81; and the can, the sealing pad, and the connected mechanism above the sealing pad, will drop with the can pedestal 45. As previously explained, this drop is assisted and the sealing-pad 36 is kept in close contact with the can until the displacer is partly withdrawn, by the action of spring 138 on cam 135. Although the cam portion of cam 135 might be dispensed with, and spring 138 be arranged to bear directly on the lever arm portion of cam

135, and although theoretically this might seem preferable, I have found in practice that the presence of the cam portion produces a smoother operation and a firmer seal.

It will be seen that if it is not desired to fill the can full and a measuring device is inserted between reservoir 34 and valve mechanism 35 (as might be desirable in syruping operations), the use of the alternative vacuum-breaking system of passages 103, 104, 105 and 106 presents a method of breaking the still-existing vacuum within the can and permitting it to break away from pad 36.

Roller 43 now reaches the downward incline of cam-rail 21, permitting sealing pedestal 44 to break contact with vacuum chamber 37, and both pedestals drop together in time for sealing pedestal 44 to pass under the edge of can-table 32.

The filled can is now removed by transfer lever 31 and the machine moves on to the position occupied at the beginning of the herein described cycle.

For further description of any parts or functions more fully described in my Patent No. 2,070,302, I refer to that patent.

Having now described and illustrated one form of my invention, I wish it understood that my invention is not limited to the specific arrangement of parts hereinbefore described, or even to the variants suggested, except insofar as such limitations are specified in the appended claims.

In the claims, whenever I mention valve means capable of performing several functions, I wish it understood that I contemplate indiscriminately a single valve or a plurality of valves. Whenever I mention a valve means position as performing several functions, I wish it understood that these functions need not be performed with exact simultaneity. In the process claims, steps are not to be construed as necessarily successive, unless coupled by the word "then."

I claim:

1. In the process of filling a container with liquid, the steps which consist in: placing the container within a vacuum chamber, so contrived and arranged that it is possible therein to exhaust the chamber and the container separately to different degrees of vacuum; temporarily sealing the chamber from the atmosphere, and the container from the chamber; exhausting the chamber to a desired degree of vacuum, but no further, and exhausting the container to a higher degree of vacuum than the chamber; and then admitting the liquid to the container; whereby there is avoided on the one hand wasting pump capacity by exhausting the chamber to the same extent as the container, and on the other hand subjecting the container to a crushing external pressure when exhausted.

2. In the process of filling in vacuo a container susceptible to injury by excessive external air-pressure, the steps which consist in: placing the container in a vacuum chamber; then temporarily sealing the chamber from the atmosphere; then exhausting the chamber to a pressure at which the container will be protected from injury when the interior of the container is subsequently further exhausted to a desired lower pressure; then temporarily sealing the interior of the container from the chamber; then continuing to exhaust the container alone to the desired lower pressure; and then filling the container; whereby there is avoided on the one hand wasting pump capacity by exhausting the chamber to the same extent as the container, and on the other hand subjecting the container to a crushing external pressure when exhausted.

3. A gas-seal between two vertically relatively reciprocating elements, consisting of: an annular well, defined by an inner wall and an outer wall, and carried by the lower of the two elements, to contain a sealing liquid; and a piston, carried by the upper of the two elements, and projecting into the well, and having a close slip fit with a wall of the well below the level of the top of the other wall thereof.

4. A gasketless gas-pressure cylinder and piston assembly, consisting of: a vertical pressure cylinder, open at the top; an element extending upwardly within the cylinder from the bottom portion thereof, so as to form an annular well between these two elements to contain a sealing liquid; a hollow piston, open at the bottom, and having a close slip fit with one of the first two mentioned elements below the level of the top of the other of said two elements; and means for admitting the actuating gas into the space between said other element and the piston.

5. In a machine for filling liquid into containers, the combination of: exhausting means; a liquid reservoir; a vacuum chamber; a filling head within the chamber; means for sealing the chamber; valve means for connecting the exhausting means and the reservoir to the filling head and the chamber, and for connecting the chamber to the atmosphere, said valve means having three positions, namely: (1) vacuum and liquid off, chamber open to atmosphere, (2) vacuum on, liquid off, chamber closed to atmosphere, and (3) vacuum and liquid on, chamber closed to atmosphere; means actuable through the body of a container sealed within the chamber to change from position 1 to position 2; pressure responsive means, responsive to the attainment of a predetermined degree of vacuum within the chamber for then sealing the filling head to the container; means to then change from position 2 to position 3; means to then change from position 3 to position 1; means, operating alternatively to the last three mentioned means, and responsive to the non-attainment of the sealing of the filling head to the container, to change from position 2 directly to position 1; and means, operating after the attainment of position 1 in either of the above two alternative manners, to then unseal the chamber, to permit the removal of the container.

6. In a machine for filling liquid into containers, the combination of: exhausting means; a liquid reservoir; a vacuum chamber; a filling head within the chamber; means for closing the chamber from the atmosphere; means for connecting the chamber to the exhausting means; means actuable only through the body of a container within the chamber for placing said connecting means in operating position; pressure respensive means, responsive to the attainment of a predetermined degree of vacuum within the chamber for then sealing the filling head to the container, and for sealing the exhausting means from the chamber; means for then connecting the filling head to the reservoir; means for then closing the filling head and for opening the chamber to the atmosphere; and means for then unsealing the chamber.

7. In a machine for filling liquid into containers, the combination of: exhausting means; a liquid reservoir; a vacuum chamber; a filling head within the chamber; means for closing the chamber from the atmosphere; means for con-

necting the chamber to the exhausting means; means actuable through the body of a container within the chamber for placing said connecting means in operating position; means, comprising a can pedestal actuated by atmospheric pressure, acting against a predetermined resistance, for then sealing the filling head to the container, when the vacuum in the chamber has attained a predetermined degree, and for sealing the exhausting means from the chamber; means for then connecting the filling head to the reservoir, continuing the exhausting of the container to compensate for the admission of liquid; and means for then closing the filling head and for opening the chamber to the atmosphere, thereby permitting gravity to unseal the chamber.

8. In the vacuum chamber assembly of a machine for filling liquid into containers, the combination of: the chamber proper; a seal for the chamber proper; means to raise this seal into contact with the chamber proper; a can pedestal carried by the seal, and vertically reciprocable with respect thereto; means whereby atmospheric pressure tends to raise the can pedestal and a container carried thereby, without thereby tending to unseal the chamber; a filling head in the top of the chamber, having ports for the exhausting of air and the admission of liquid; a sealing pad, floating between this head and the position of the top of the container; and means for controlling within a predetermined range the degree of vacuum within the chamber at which the can pedestal and the container thereon will raise this pad into sealing position.

9. In the vacuum chamber assembly of a machine for filling liquid into containers, the combination of: the chamber proper; a seal for the chamber proper; a filling head within the chamber; means for exhausting the air from the chamber and from a container within the chamber; and means for then sealing the container to the filling head, whereby further exhaustion is restricted to the container alone.

10. In the vacuum chamber assembly of a machine for filling liquid into containers, the combination of: the chamber proper; means to seal the chamber proper; a can pedestal in the chamber, vertically reciprocable with respect thereto; means whereby atmospheric pressure tends to raise the can pedestal and a container carried thereby; a filling head in the top of the chamber, having ports for the exhaustion of air and the admission of the liquid; a sealing pad, floating between this head and the position of the top of the container; and means for controlling within a predetermined range the degree of vacuum within the chamber at which the can pedestal and the container thereon will raise this pad into sealing position, said means serving also to hold the pad against the top of the container during part of the descent of the container.

11. In a machine for filling liquid into containers, the combination of: exhausting means; a liquid reservoir; a vacuum chamber; a filling head within the chamber; valve means connecting the exhausting means and the reservoir to the filling head and the chamber, said valve means having three positions, namely: (1) vacuum and liquid off, (2) vacuum on and liquid off, and (3) vacuum off and liquid on; means progressively carrying containers through the machine; valve control means, having three zones, the first of which is inert to affect any control; means, responsive to the presence of a container in the chamber and its progress a short distance through the cycle, to shift the control means to the second zone; means thereafter encountered in the second zone to actuate the control means to turn the valve means to position 2; means, responsive to a predetermined degree of vacuum within the chamber to then cut off the chamber from further exhausting, while still leaving the container susceptible to further exhausting, and to shift the control means to the third zone; means thereafter encountered in the third zone, to actuate the control means to turn the valve means to position 3; substantially contemporaneous means in the second zone to actuate the control means to turn the valve means to position 1; and means thereafter encountered in the third zone to actuate the control means to turn the valve means to position 1.

12. In the vacuum chamber assembly of a machine for filling liquid into containers, the combination of: the chamber proper; a seal for the chamber proper; means to raise this seal into contact with the chamber proper; a can pedestal carried by the seal, and vertically reciprocable with respect thereto; a filling head in the top of the chamber; and means, responsive to atmospheric pressure, to raise the can pedestal, so as to seal a container, carried thereby, against the filling head, without thereby tending to unseal the chamber.

13. In a machine for filling containers in vacuo, the combination of: a vacuum chamber; means for sealing the chamber; means for partially exhausting the chamber and a container within it; means for sealing the exhausting means from the chamber, while still maintaining the container connected to the exhausting means; and means, actuated by atmospheric pressure outside the chamber, for bringing the last-mentioned sealing means into sealing position.

14. In a machine for filling containers in vacuo, the combination of: a vacuum chamber; means for sealing the chamber; means for partially exhausting the chamber and a container within it; means for sealing the exhausting means from the chamber, while still maintaining the container connected to the exhausting means; and means, actuated by atmospheric pressure outside the chamber, for bringing the last-mentioned sealing means into sealing position; and means for controlling within a predetermined range the degree of vacuum within the chamber at which said atmospheric pressure actuated means will bring said sealing means into sealing position.

15. In a machine for filling containers in vacuo, the combination of: a vacuum chamber; means for sealing the chamber; means for partially exhausting the chamber and a container within it; means for sealing the exhausting means from the chamber, while still maintaining the container connected to the exhausting means; means, actuated by atmospheric pressure outside the chamber, for bringing the last-mentioned sealing means into sealing position; means for controlling within a predetermined range the degree of vacuum within the chamber at which said atmospheric pressure actuated means will bring said sealing means into sealing position; and means, at a certain later stage of the cycle and actuable only if the last mentioned sealing means are out of sealing position, to disconnect the exhausting means.

16. In a machine for filling liquids into a con-

tainer, the combination of: a vacuum chamber; means for sealing the chamber; means for partially exhausting the chamber and a container within it; means for sealing the exhausting means from the chamber, while still maintaining the container connected to the exhausting means; means, actuated by atmospheric pressure outside the chamber, for bringing the last-mentioned sealing means into sealing position; means for controlling within a predetermined range the degree of vacuum within the chamber at which said atmospheric pressure actuated means will bring said sealing means into sealing position; a liquid reservoir; valve means connecting the reservoir to the container; and means, at a certain stage of the cycle and actuable only when the last mentioned sealing means are in sealing position, to operate said valve means.

17. In a machine for filling liquids into a container, the combination of: a vacuum chamber; means for sealing the chamber; means for partially exhausting the chamber and a container within it; means within the chamber for sealing the exhausting means from the chamber, while still maintaining the container connected to the exhausting means; means, actuated by atmospheric pressure outside the chamber, for bringing the last-mentioned sealing means into sealing position; means for controlling within a predetermined range the degree of vacuum within the chamber at which said atmospheric pressure actuated means will bring said sealing means into sealing position; a liquid reservoir; valve means connecting the reservoir to the container; means, at a certain stage of the cycle and actuable only when the last-mentioned sealing means are in sealing position, to operate said valve means; and means, at a substantially contemporaneous stage of the cycle and actuable only if the last mentioned sealing means are out of sealing position, to disconnect the exhausting means.

18. In a machine for filling containers in vacuo, the combination of: a vacuum chamber; means for closing the chamber from the atmosphere; exhausting means; means for connecting the exhausting means to the chamber and to a container within the chamber; and pressure responsive means, responsive to the attainment of a predetermined degree of vacuum within the chamber, for sealing the exhausting means from the chamber, while leaving the exhausting means connected to the container.

19. Means for imparting linear motion through the wall of a chamber, which means comprises: an annular well, defined by an inner hollow wall and an outer wall, to contain a sealing liquid, and carried by the wall of the chamber; a hollow piston, projecting into the well from above, embracing the inner wall of the well, and having a close slip fit with one of the walls of the well; and a rod projecting from below into the inner hollow wall of the well, and engaging the piston, whereby inward linear movement of either can be converted into outward linear movement of the other.

20. Means for imparting linear motion through the wall of a chamber, which means comprises: a vertical cylinder, in the wall of the chamber, open at the top; a hollow element extending upwardly within the cylinder from the bottom portion thereof, and rigid therewith, so as to form an annular well between these two elements to contain a sealing liquid; a hollow piston open at the bottom, embracing the hollow element, and having a close slip fit with one of the two elements which constitute the well, below the level of the top of the other of these two elements; and a rod projecting into the hollow element from below, and engaging the piston, whereby upward linear motion of the rod can be transferred to the piston, and whereby downward linear motion of the piston can be transferred to the rod.

STEDMAN B. HOAR.