Sept. 17, 1935. J. H. STALEY 2,014,597

MEANS FOR CHANGING GASEOUS CONTENTS OF SWITCH TUBES

Filed Dec. 21, 1933 4 Sheets-Sheet 1

Fig. 1.

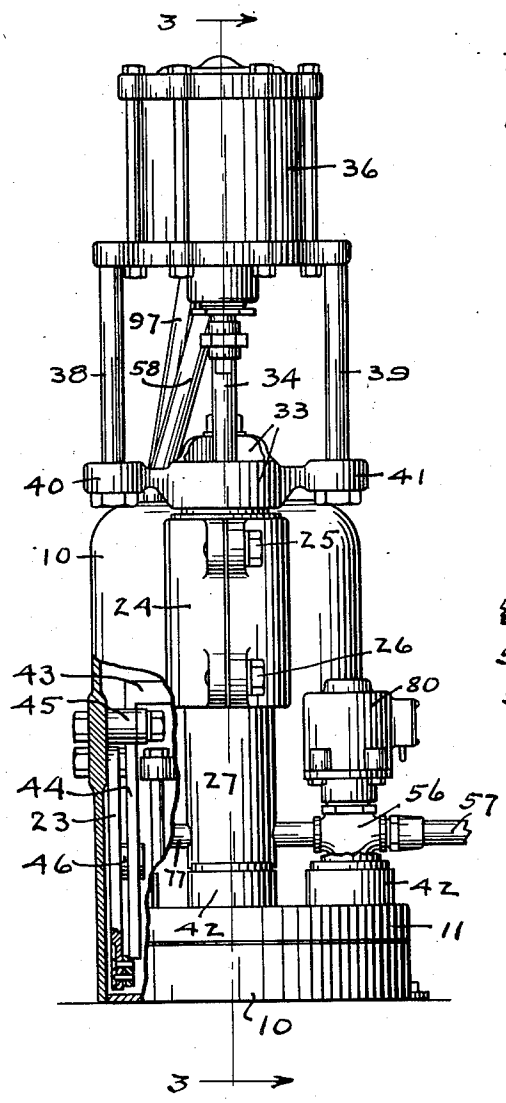
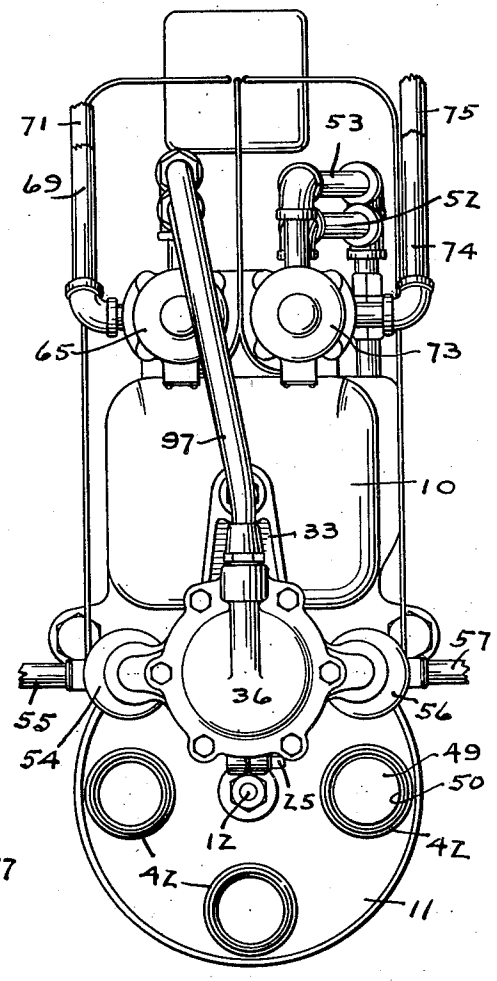


Fig. 2.



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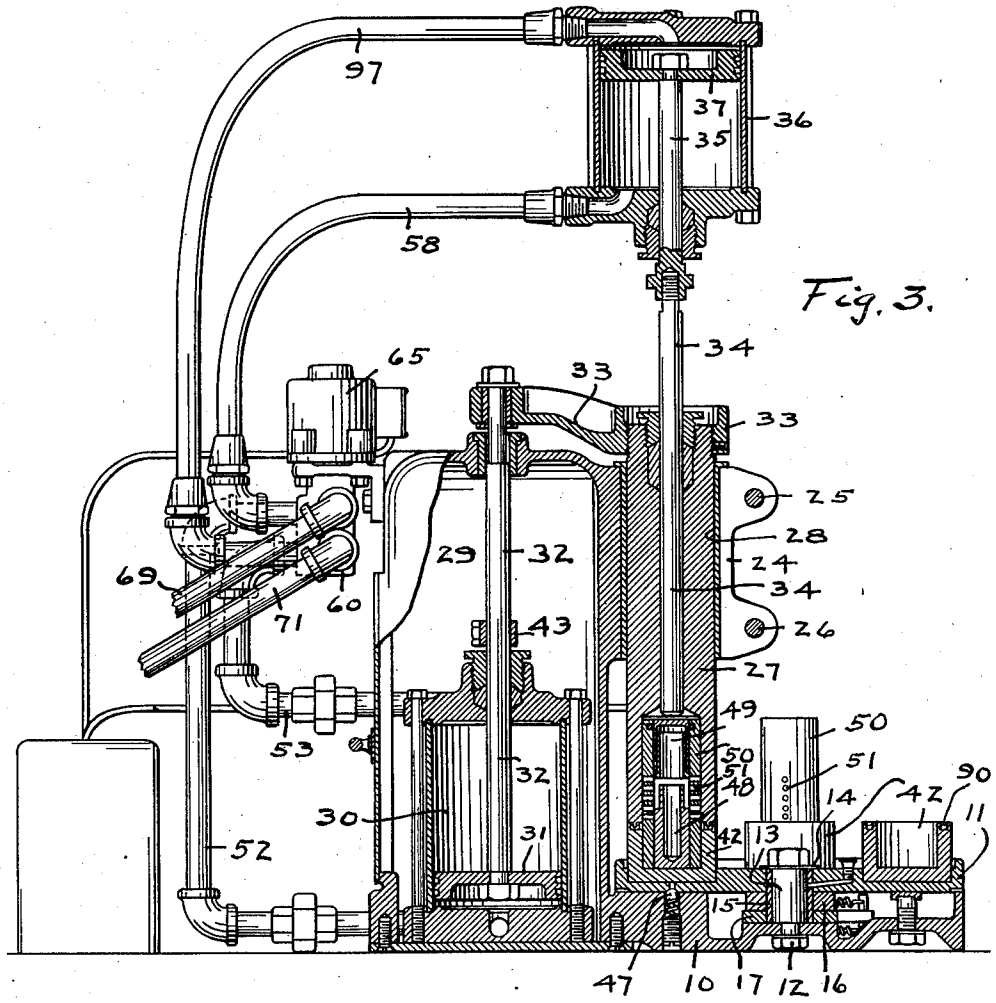


Fig. 3.

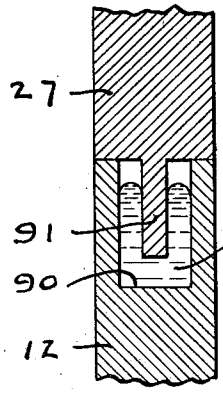


Fig. 4

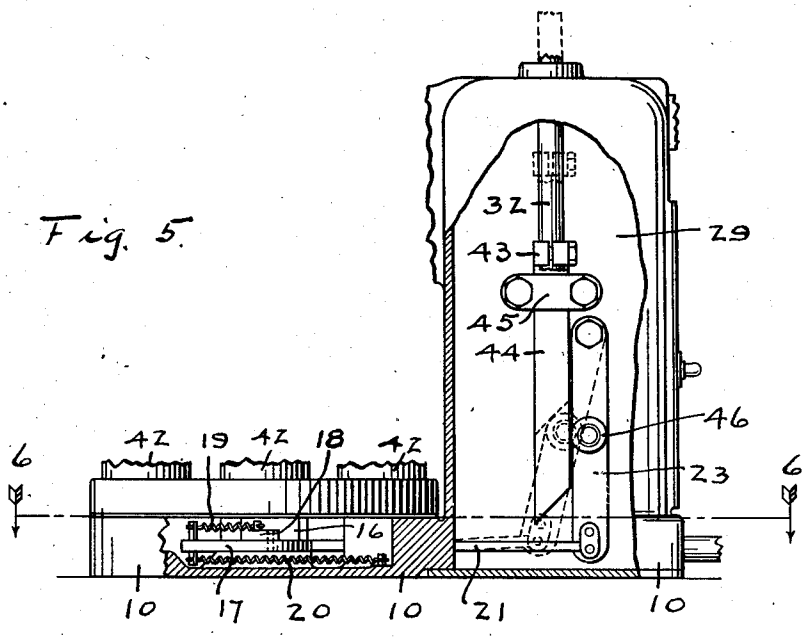
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Fig. 5.



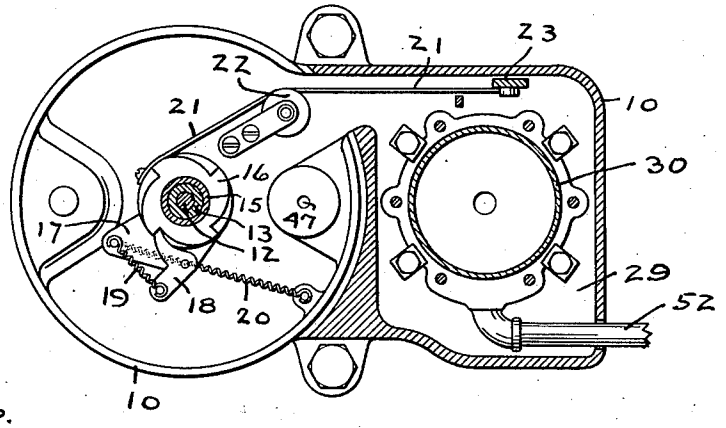


Fig. 6.

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MEANS FOR CHANGING GASEOUS CONTENTS OF SWITCH TUBES

Filed Dec. 21, 1933 4 Sheets-Sheet 4

Fig. 7.

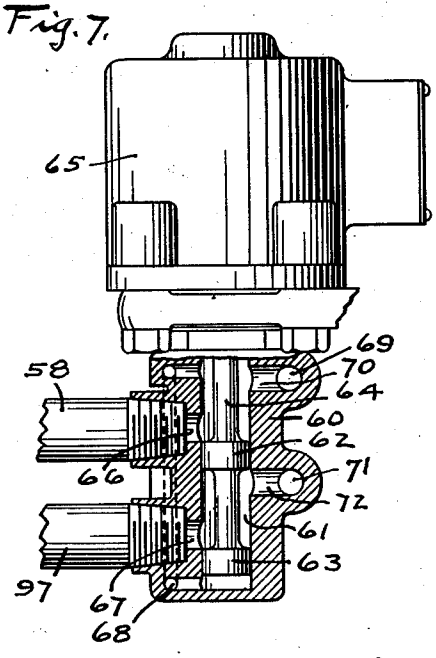
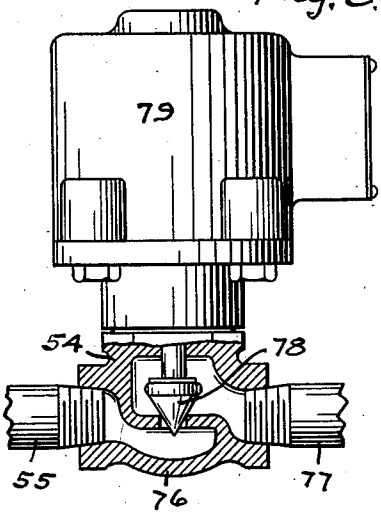


Fig. 8.



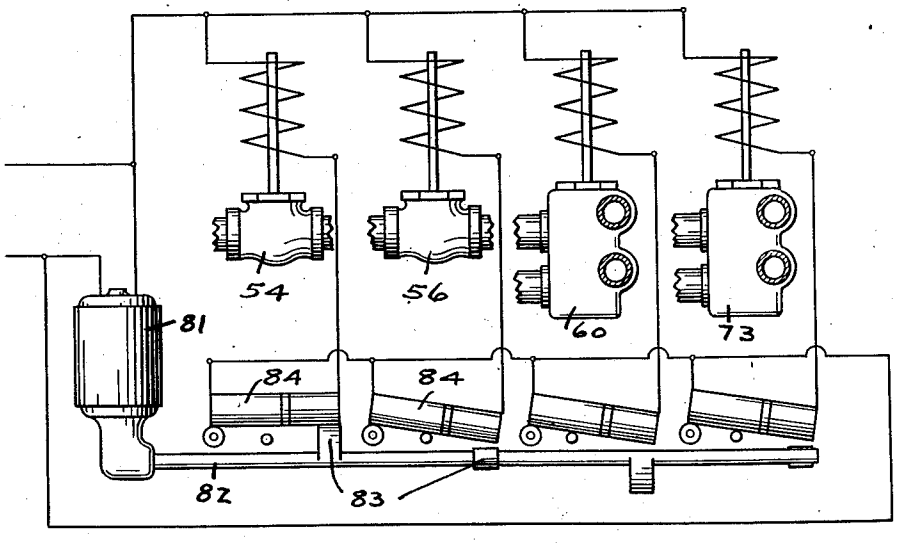


Fig. 9.

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Patented Sept. 17, 1935 2,014,597

UNITED STATES PATENT OFFICE

2,014,597

MEANS FOR CHANGING GASEOUS CONTENTS OF SWITCH TUBES

Joseph H. Staley, Columbus, Ind.

Application December 21, 1933, Serial No. 703,499

11 Claims. (Cl. 226—73)

This invention relates to means for evacuating, gas filling, and sealing receptacles. The particular form of the invention herein described and used to illustrate the invention is that adapted for the filling of metallic walled mercury tube switches, it being understood that such a type switch is but one of many products that may be employed within the scope of the invention.

It is a primary object of my invention to provide a simple structure both from the standpoint of manufacture and of operation which will permit the receptacle to be operated upon to be evacuated and gas filled at will or to be evacuated, gas filled, evacuated and again gas filled to secure a "washing" of atmospheric air from the receptacle.

A further important object of my invention is to provide means for operating the machine in timed sequence whereby the various operations may be automatically performed one after another as may be predetermined.

A still further important object of the invention is to provide means for sealing within a chamber the receptacle to be operated upon and following the evacuation and gas filling steps, means for sealing the receptacle to retain the vacuum or gas as may be the ultimate condition desired.

A still further important object of the invention is to provide an operating mechanism which, if electrically controlled, may have the various movements of the machine parts effected through cushioned or rather fluid flows at definite pressures rather than through shocks or impulses as would be the case were solenoid magnets employed to operate the shiftable parts directly.

These and other objects such as the particular combinations of elements to effect the results desired as hereinafter set out in the claims, will become apparent to those versed in the art by the following description of one particular form of the invention as illustrated in the accompanying drawings, in which

Fig. 1 is a fragmentary front elevation of a device embodying my invention;

Fig. 2, a top plan view;

Fig. 3, a central vertical section on the line 3—3 in Fig. 1;

Fig. 4, a detail in vertical section of the seal between chamber members;

Fig. 5, a detail in fragmentary vertical section of the table indexing mechanism;

Fig. 6, a horizontal transverse section on the line 6—6 in Fig. 5;

Fig. 7, a detail in fragmentary section of a four-way solenoid controlled valve;

Fig. 8, a detail in fragmentary section of a solenoid controlled two-way valve, and

Fig. 9, a diagrammatic representation of the electrical control.

Like characters of reference indicate like parts throughout the several views in the drawings.

I form a base 10 on the upper side of the forward portion of which is revolubly secured a table 11 by means of the central pivot bolt 12 which grips a sleeve 13 between the base 10 and a washer 14 extending circumferentially beyond the sleeve to lap over on the upper side of the table 11. Preferably the table is provided with a bushing 15 which slidably fits about the sleeve 13 and extends downwardly toward the base to carry therearound a ratchet member 16 here shown as having four teeth, Fig. 6. This ratchet member 16 is fixed to the table 11 with the bushing 15 extending therethrough in fixed relation. Under the ratchet member 16 is revolubly mounted about the bushing 15 a rocker plate 17 which is normally free to rock about the bushing 15 between the under side of the ratchet member 16 and the upper face of the table 11. A dog 18 is rockably mounted on the upper side of the plate 17 and has a spring 19 interconnected between it and the plate 17 so as to pull the dog around against the peripheral face of the ratchet member 16 to permit the dog to drop against the teeth thereon. A spring 20 is interconnected between the plate 17 and the base 10 in such manner, Fig. 6, as to tend to pull the plate 17 around the bushing 15 in a counter-clockwise direction which will tend to pull the dog 18 out of engagement with the teeth on the ratchet member.

A flexible steel tape 21 is fixed to the periphery of the plate 17 and carried horizontally around an idler roller 22 back under the table 11 to be secured by its other end to the lower end of a rocker arm 23 whereby backward movement of the arm 23 will tend to revolve the plate 17 clockwise against the pull of the spring 20 so as to carry the dog 18 into engagement with a tooth on the member 16 and thereby revolve the member 16 and the table 11 thereabove.

The base 10 extends upwardly at the rear of the table 11 to assume the shape of a hollow member providing a chamber therein, in which the upper end of the arm 23 is rockably secured. This upper extension of the base 10 is provided with a forwardly extending guide 24 having a cylindrical bore extending vertically therethrough and being slotted from the forward side

whereby the guide may have its internal bore slightly reduced in diameter by springing in the front ends as separated by the slot. This variation of the internal bore is achieved by means of cap screws 25 and 26 revolubly extending through ears on one side of the slot and screw-threadedly engaging in like ears on the other side. A cylindrical head 27 is provided to slidably fit within the bore of the guide 24, preferably within a bushing 28 carried therein.

The chamber within the rear upper extension of the base 10 will hereinafter be designated by the numeral 29. Within this chamber 29 is placed a cylinder 30 carrying a piston 31 from which extends a piston rod 32 upwardly through a stuffing box and on out through a guide in the top of the chamber 29 to be attached to an arm 33 which extends across and engages the upper end of the head 27. By forcing the piston 31 upwardly in the cylinder 30, the head 27 may be raised correspondingly.

A post 34 slidably enters the head 27 axially and is of sufficient length to extend down into an enlarged bore in the lower end of the head. The upper end of the post 34 is removably attached to the lower end of a piston rod 35 which passes through a stuffing box to enter within the upper cylinder 36 and be secured to the piston 37 therein. The cylinder 36 is supported directly upon the arm 33 by means of the posts 38 and 39 which are carried by the ears 40 and 41 respectively on the arm 33. That is the cylinder 36 is always located in a fixed position in relation to the arm 33 and the head 27 and is lifted and lowered therewith upon travel of the piston 31 in the lower cylinder 30.

Referring again to the table 11, this table is provided with a plurality of bases 42 here shown as four in number and equally spaced apart at a common radial distance from the center of the table. Each of these bases 42 is here shown as having an annular groove 90 adapted to receive therewithin a tongue 91 extending around the lower end of the head 27 and some means, such as mercury 92, is provided to secure a gas tight connection between the head and the base member when the base member is brought around under the head and the head lowered compressively thereagainst. A seal between the head 27 and base 42 is effected by causing the head 27 to abut by its lower end the base with a ground joint and to have the tongue 91 extend down into the mercury 92, with clearance therearound, Fig. 4, so that, should gas leak through one side of the joint, the mercury will be moved around against the other side of the joint to cover over it. An arm 43 engages the connecting rod 32 within the chamber 29 and extends over to one side of the cylinder 30 to carry a downturned leg 44 slidably guided through the guide 45 fixed on the wall of the chamber to extend down in front of a roller 46 mounted on the side of the rocker arm 23 whereby the leg 44 when in the lower position will be on the forward side of the roller 46 and will hold the arm 43 in its rearmost position to have pulled the tape 21 backwardly to retain the dog 18 against a tooth of the ratchet member 16. Upon upward travel of the leg 44 as is occasioned by upward travel of the piston 31, the roller 46 may move forwardly when the leg 44 is carried thereabove. This forward movement is occasioned by the pull of the spring 20 carrying the dog 18 back to engage with the next adjacent tooth on the ratchet member 16. The table 11 is held stationary under this return movement of the dog 18 by reason of a ball 47 being spring pressed against the table 11 to enter a detent therein, this detent being so located as to be on the axis of a base member 42 thereabove, and the location of the ratchet member 16 as to the relative position of its teeth and the dog 18 also being such as to have brought one of the base members 42 into axial alignment with the head 27 when the arm 23 is pushed into its rearmost position by the leg 44, Fig. 4.

The receptacle to be filled is here shown as comprising a body 48 and a cap 49 formed to telescope one with the other. These members 48 and 49 are initially placed in a carrier 50 comprising a tube open at both the upper and lower ends and slidably engaging within the base members 42 and also in the bore in the lower end of the head 27. This tube 50 is provided with a plurality of holes 51 through its wall so as to permit passage of gases between the counter-bore in the head 27 and between the head and cap members 48 and 49 within the tube 50.

In operating the device, a tube 50 is loaded with a base 48 and cap 49 and placed by one end in a base member 42. The body part 48 drops to the bottom of the tube 50 to rest against the lower end of the base member 42 while the cap member 49 is frictionally retained in the upper end of the tube 50 to be spaced apart from the body 48, Fig. 3. The cylinder 30 is then supplied with some fluid preferably oil through a supply pipe 52 below the piston 31 so as to lift the piston and thereby lift the head 27, the lifting distance being sufficient to permit clearance under the head for passage of the tube 50 thereunder. This distance is also sufficient to have carried the lower end of the leg 44 up just above the roller 46 so as to have released the arm 23. The head 27 is also lifted a sufficient distance above the tube 50 so that when the fluid is permitted to exhaust from below the piston 31 through the pipe 52 and fluid is supplied to above the piston to the pipe 53, the initial downward movement will pull the arm 23 back by means of the leg 44 riding past the roller 46, the lower end of the leg 44 being beveled to facilitate this movement, this initial movement will revolve the table 11 through the tape 21 to bring the base member 42 carrying the loaded tube 50 around under the head 27. It is understood that the base member 42 next adjacent that member previously under the head is the one which has been loaded. Continued downward movement of the piston 31 will then bring the head 27 down over the tube 50 to envelop it within the lower bore and eventually bring the head into sealed contact with the base member 42. Pressure is maintained within the cylinder 30 above the piston 31 to maintain this sealed connection.

While this sealed connection is maintained, a valve 54 carried by the head 27 and being in a vacuum line 55 is opened. The line 55 is flexible and is interconnected with the head 27 to provide a communication directly within the bore in the lower end of the head, the valve 54 being placed in this line as a control means. Upon opening of the valve 54, the chamber formed within the lower end of the head 27 and the base member 42 is evacuated to a rather high degree such as is commercially attainable following which the valve 54 is closed and a valve 56 also carried by the head 27 and being in a gas supply line 57 is opened, the line 57 being flexible and affording a passage into the bore of the head 27 from some suitable supply of gas. The chamber which has just been evacuated is thus filled with the gas flowing through the line 57, preferably under some pressure. This

gas entering the chamber of course receives therewith as a mixture what traces of the atmospheric air may have been left after the evacuation through the line 55. The valve 56 is then closed to shut off the supply of gas and the valve 54 opened to permit the second evacuation of the chamber so as to withdraw the gas along with the atmospheric air which has become mixed therewith. Then the valve 54 is again closed. If the receptacle is to remain evacuated, then no further manipulation of the valves 54 and 56 is had, but if the receptacle is to be gas filled, then the valve 56 is opened to permit the flow of gas within the chamber under pressure again.

In either case whether the receptacle is to remain evacuated or is to be gas filled, both valves 54 and 56 are then closed and fluid is carried into the upper cylinder 36 through the pipe 97 to force the piston 37 downwardly and thereby carry the post 34 down through the head 27 to push the cap 49 down over the end of the body 48, the two members being formed to provide a press fit. Thus the receptacle is sealed while either evacuated or gas filled under pressure. Following the down stroke of the post 34, fluid is then entered into the cylinder 36 through the pipe 58 from the under side of the piston 37 to force it upwardly and carry the fluid thereabove back out through the pipe 97. Also, preferably simultaneously, fluid is then entered into the cylinder 30 through the pipe 52 under the piston 31 to lift it so as to raise the head 27 while the post 34 is also being lifted. Repeated up and down movements of the head 27 index the table 11 to bring the respective base members 42 out from under the head 27 to permit removal of the tubes 50 having the sealed receptacles and the replacement thereof by additional filled tubes 50 with the receptacle parts in the separated relationship as above indicated.

The foregoing description has been made without specifying how the fluid is to be controlled in its flow to and from the cylinders 30 and 36. It is possible of course to have a manual control, that is valves can be turned on and off by hand to regulate the flow of fluid. It is preferable however to provide some automatic means for controlling this flow so that the operator of the machine may be free to place his entire attention upon the supplying of the receptacle parts to the table for filling and removal of the filled receptacles.

One particular system for automatically controlling the flow of fluid is illustrated by the drawings and is effected by solenoid operated valves controlled by a timing device. To control the flow of fluid to and from the upper cylinder 36, I provide a four-way valve 60 as indicated in Fig. 7 to have a central bore 61 within which a pair of interconnected pistons 62 and 63 are free to be moved up and down by a rod 64 passing upwardly to serve as an armature under the influence of a magnetic winding within the housing 65. The pipe 58 leading from the bottom of the cylinder 36 is interconnected with the valve 60 to be in communication with a passageway 66 leading from the bore 61 immediately above the piston 62 when that piston is in the lower position. Likewise the pipe 97 leading from the top of the cylinder 36 is interconnected with the valve 60 to be in communication with the passage 67 which leads from the bore 61 immediately above the piston 63 when it also is in the lower position. A passageway 68 is provided in the body of the valve 60 to lead around from the lower end of the bore 61 and up and back into the upper end of that bore. A fluid supply line 69 is connected to the valve 60 to communicate with the passageway 70 leading into the bore 61 near the upper end thereof and above the passage 66. A fluid discharge line 71 is connected to the valve 60 to be in communication with a passage 72 communicating with the bore 61 near its center and between the passages 66 and 67.

With the pistons 62 and 63 in the positions indicated in Fig. 7 the winding of the solenoid is not energized and fluid enters through the pipe 69 under pressure to flow through the passageway 70 into the bore 61 and down to strike the top side of the piston 62 so as to prevent flow therebelow. The fluid thus may flow out through the passage 66 into the pipe 58 and into the cylinder 36 to carry the piston 37 upwardly and cause fluid thereabove to exhaust out through the pipe 57, through the passage 67 into the bore 61 above the piston 63 and on out through the passage 72 into the discharge line 71.

When the piston 37 is to be forced downwardly, the winding of the solenoid is energized to pull the rod 64 upwardly to shift the pistons 62 and 63 to be respectively above the passages 66 and 67 and just below the passages 70 and 72 so that the lower piston 63 then provides a partition in the bore 61 between the passages 66 and 72, the lower piston 63 moving up to take the place of the piston 62. In this position the fluid entering the passage 70 is prevented from passing down the bore 61 and escapes therefrom around from the passage 68 into the lower part of the bore under the piston 63 and out the passage 67 through the pipe 57 into the top of the cylinder 36. Fluid is exhausted from the cylinder 36 from under the piston 37 in this case through the pipe 58 into the bore 61 to between the pistons 62 and 63 and out through the passage 72 into the discharge line 71.

In the same manner fluid is controlled through the solenoid valve 73 to flow to and from the lower cylinder 30, this valve 73 being an exact duplicate of the valve 60 above described and operating in the identical manner. The valve 73 has the fluid feed line 74 and the fluid discharge line 75. Both the valves 60 and 73 are supported on the back of the chamber 29, Figs. 2 and 3.

To secure complete automatic operation, it is necessary to introduce some means for controlling the evacuation and gas filling of the chamber formed between the head 27 and base 42. For this purpose I employ the two simple valves 54 and 56 controlled by solenoids and of the same type as that of the valve 54 illustrated in Fig. 8 wherein the vacuum line 55 is connected to the valve body 76 and the interconnecting pipe 77 connects the valve body with the head 27, Figs. 1 and 2. The valve member 78 is here shown to be a conical member adapted to be raised by the magnetic winding carried within the housing 79 mounted on the body 76 whereby energizing of that winding will lift the member 78 to permit flow between the pipes 55 and 77. Likewise the valve 56 is operated through the magnetic winding within the housing 80 carried thereon.

Now in order to coordinate the various solenoid controlled valves, namely valves 60, 73, 54 and 56 to bring the various steps into proper sequence for full automatic operation, I provide some timing means for connecting and taking out of an electrical circuit the various windings of the solenoids. One particular way herein shown as an illustration is to employ a motor 81 to drive

some timing means such as a shaft **82** which has lugs or cams **83** carried thereon to rock mercury switch tubes **84**, the tubes herein being shown as dropping by one end by gravity to a closed circuit position and being formed to be in an open circuit position when rocked. In the form herein shown, Fig. 9, a switch **84** is provided for each respective winding of the various valves so that these windings may be intermittently placed in and taken out of the electrical circuit. By suitably positioning the cams **83** and forming them to have the correct contour the various switches **84** may be operated in the desired sequence so as to effect the flow of the fluids as above described. It is to be understood that while I prefer an automatic control of the structure herein described and shown, my present invention does not reside in the structural details of that control and the form indicated in Fig. 9 is merely illustrative of one possible means for effecting such a control. Of course in such a form the speed of the shaft **82** would have to be reduced from that of the motor **81** so as to permit the proper timing to be secured.

While I have herein shown and described my invention in the best form as now known to me, it is obvious that structural changes may be made without departing from the spirit of the invention and I therefore do not desire to be limited to that precise form beyond the limitations as may be imposed by the following claims.

I claim:

1. A device, for changing the gaseous condition in a two part receptacle and sealing the same, comprising a reciprocable head, a head closure member, said head and member defining a chamber to be closed therebetween and adapted to receive said receptacle therein, means for relatively shifting said head and member together, a gas controlling valve in a line intercepting said chamber, a tube carried by said member formed to releaseably carry said receptacle parts in spaced apart relation, a post movably entering said chamber to selectively contact with one of said parts and push it along said tube against the other part to cause closing of the receptacle, shiftable means carrying said member, and means shifting said member carrying means.

2. A device, for changing the gaseous condition in a two part receptacle and sealing the same, comprising a reciprocable head having a chamber therein, a closure member, said head being adapted to receive said receptacle therein, means for relatively shifting said head and member together, a gas controlling valve in a line intercepting said chamber, a tube carried by said member formed to releasably carry said receptacle parts in spaced apart relation, a post movably entering said chamber to selectively contact with one of said parts and push it along said tube against the other part to cause closing of the receptacle, shiftable means carrying said member, and means shifting said member carrying means, said member being formed to carry the receptacle therewith.

3. A device, for changing the gaseous condition in a two part receptacle and sealing the same, comprising a reciprocable head, a head closure member, said head and member defining a chamber to be closed therebetween and adapted to receive said receptacle therein, means for relatively shifting said head and member together, a gas controlling valve in a line intercepting said chamber, a tube carried by said member formed to releasably carry said receptacle parts in spaced apart relation, a post movably entering said chamber to selectively contact with one of said parts and push it along said tube against the other part to cause closing of the receptacle, and means automatically operating said head, said valve, and said post in timed sequence.

4. A device, for changing the gaseous condition in a two part receptacle and sealing the same, comprising a reciprocable head, a head closure member, said head and member defining a chamber to be closed therebetween and adapted to receive said receptacle therein, means for relatively shifting said head and member together, a gas controlling valve in a line intercepting said chamber, a tube carried by said member formed to releasably carry said receptacle parts in spaced apart relation, a post movably entering said chamber to selectively contact with one of said parts and push it along said tube against the other part to cause closing of the receptacle, a closure member carrying member, means for shifting the carrying member to move the closure member into and out of alignment with said head, and actuating means for shifting said head, closure member carrying member, valve, and post in timed sequence to close said chamber, change the gaseous content thereof, and seal the receptacle.

5. A device, for changing the gaseous condition in a receptacle, comprising a reciprocable head having a chamber with an opening therein, a gas line connecting with said head to communicate with the chamber, a control valve in the line, a closure member formed to fit over the chamber opening, a shiftable table adapted to hold one or more of said closure members, the movement of the table being such as to carry the closure member into alignment with the head opening and thereaway, a cylinder, a piston in the cylinder interconnected with said head, a valve controlling flow of fluid for operating the piston, a post movably entering said chamber, a second cylinder, a piston in the second cylinder, a valve for controlling flow of fluid for operating the last named piston, said last piston being interconnected with said post, and electric means actuating said valves.

6. A device, for changing the gaseous condition in a receptacle, comprising a reciprocable head having a chamber opening from one end, a gas line connecting with said head to communicate with the chamber, a control valve in the line, a base member formed to fit over the open end of the head to close the chamber, a shiftable table adapted to hold one or more of said base members, the movement of the table being such as to carry the base into alignment with the head and thereaway, a cylinder, a piston in the cylinder interconnected with said head, a valve controlling flow of fluid for operating the piston, a post slidably entering said chamber, a second cylinder, a piston in the second cylinder, a valve for controlling flow of fluid for operating the last named piston, said last piston being interconnected with said post, and electric means actuating said valves, and automatic means selectively controlling said electric means.

7. A device, for changing the gaseous condition in a receptacle, comprising a reciprocable head having a chamber opening from its lower end, a gas line connecting with said head to communicate with the chamber, a control valve in the line, a base member formed to fit over the open end of the head to close the chamber, a shiftable table adapted to hold one or more of

said base members, the movement of the table being such as to carry the base into alignment with the head and thereaway, a cylinder, a piston in the cylinder interconnected with said head, a valve controlling flow of fluid for operating the piston, a post slidably entering said chamber, a second cylinder, a piston in the second cylinder, a valve for controlling flow of fluid for operating the last named piston, said last piston being interconnected with said post, and electric means actuating said valves, and automatic means selectively controlling said electric means, and means shifting said table in timed sequence with said head.

8. A device, for changing the gaseous condition in a receptacle, comprising a reciprocable head having a chamber opening from its lower end, a gas line connecting with said head to communicate with the chamber, a control valve in the line, a base member formed to fit over the open end of the head to close the chamber, a shiftable table adapted to hold one or more of said base members, the movement of the table being such as to carry the base into alignment with the head and thereaway, a cylinder, a piston in the cylinder interconnected with said head, a valve controlling flow of fluid for operating the piston, a post slidably entering said chamber, a second cylinder, a piston in the second cylinder, a valve for controlling flow of fluid for operating the last named piston, said last piston being interconnected with said post, and electric means actuating said valves, and automatic means selectively controlling said electric means, and means shifting said table in timed sequence with said head, said last means comprising an indexing mechanism moving said table step by step upon each reciprocation of said head.

9. A device for changing the gaseous condition within a receptacle and sealing same, comprising a chamber member, a shiftable closure member, a receptacle part carrying member receivable within the chamber member and formed to initially hold one of the parts spaced from the other whereby the interior of both parts is fully exposed to the gaseous condition in the chamber, means for changing the gaseous condition within the chamber, and means for moving said one part toward and into sealing contact with the other while subjected to said gaseous condition.

10. A device for changing the gaseous condition within a receptacle and sealing same, comprising a chamber member, a shiftable closure member, a receptacle part carrying member receivable within the chamber member and formed to initially hold one of the parts spaced from the other whereby the interior of both parts is fully exposed to the gaseous condition in the chamber, means for changing the gaseous condition within the chamber, and means for moving said one part toward and into sealing contact with the other while subjected to said gaseous condition, said closure member being formed to support said part carrying member to be movable therewith, one of said parts resting on said closure member and aligned by the carrying member, said carrying member being formed to frictionally support the other part above the lower part.

11. A device for changing the gaseous condition within and sealing a two part receptacle, comprising a receptacle receiving chamber, a closure member adapted to close the chamber, a shiftable table formed to hold one or more of said closure members, a post reciprocably entering said chamber, a receptacle part holder formed to be carried by the closure member, said holder being shaped to initially support one of said parts spaced from the other on the closure member, means for shifting the table to bring said closure member into alignment with the chamber to permit insertion of said holder therewithin, means for relatively bringing said chamber and said closure member one against the other, and means subsequently moving said post into engagement with said one part to carry it on against said other receptacle part, said holder serving as a part aligning means.

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