

Nov. 1, 1960

C. H. MAYER, JR

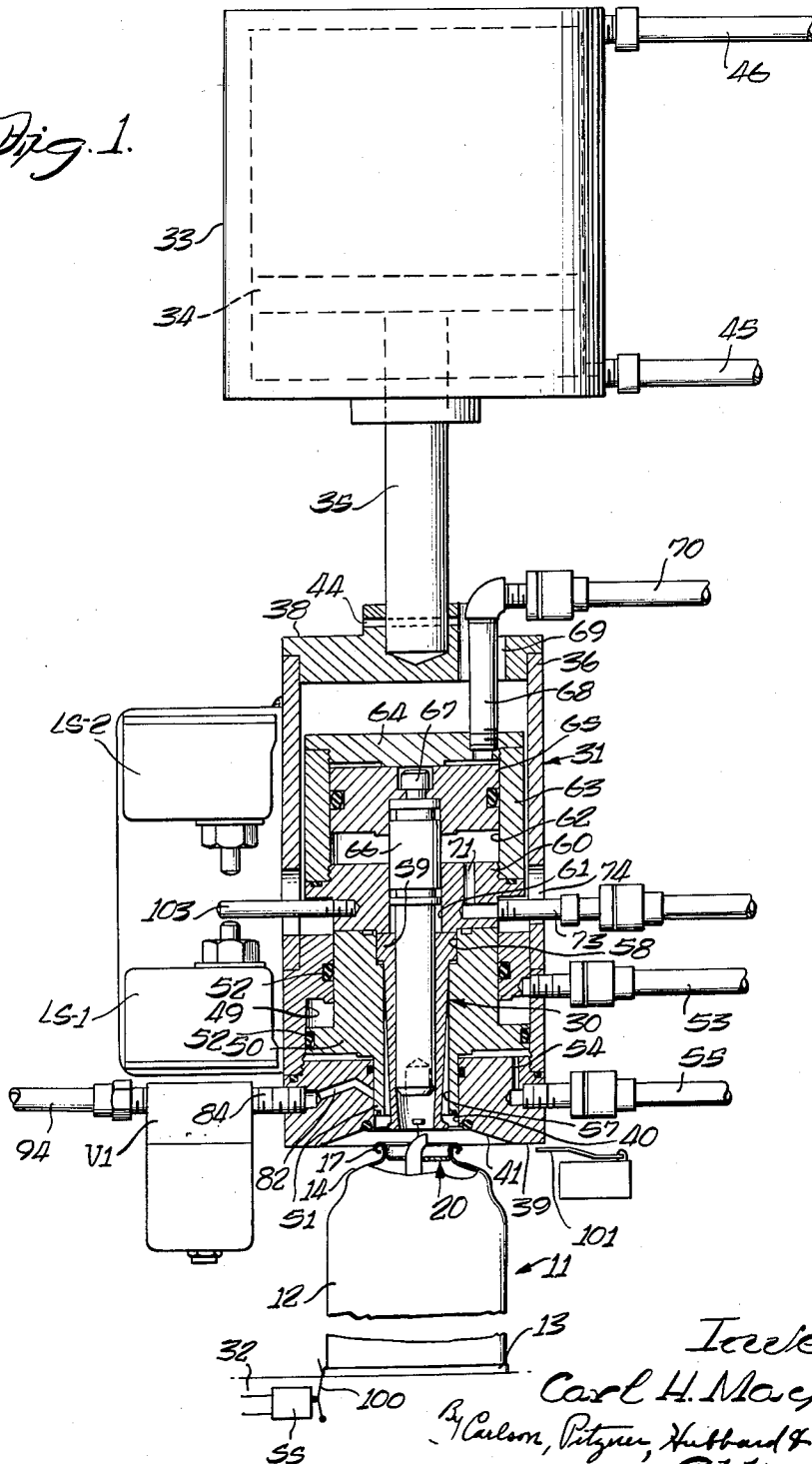
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APPARATUS FOR FILLING AND CLOSING AEROSOL-TYPE DISPENSERS

Filed Dec. 28, 1955

5 Sheets-Sheet 1

Fig. 1.



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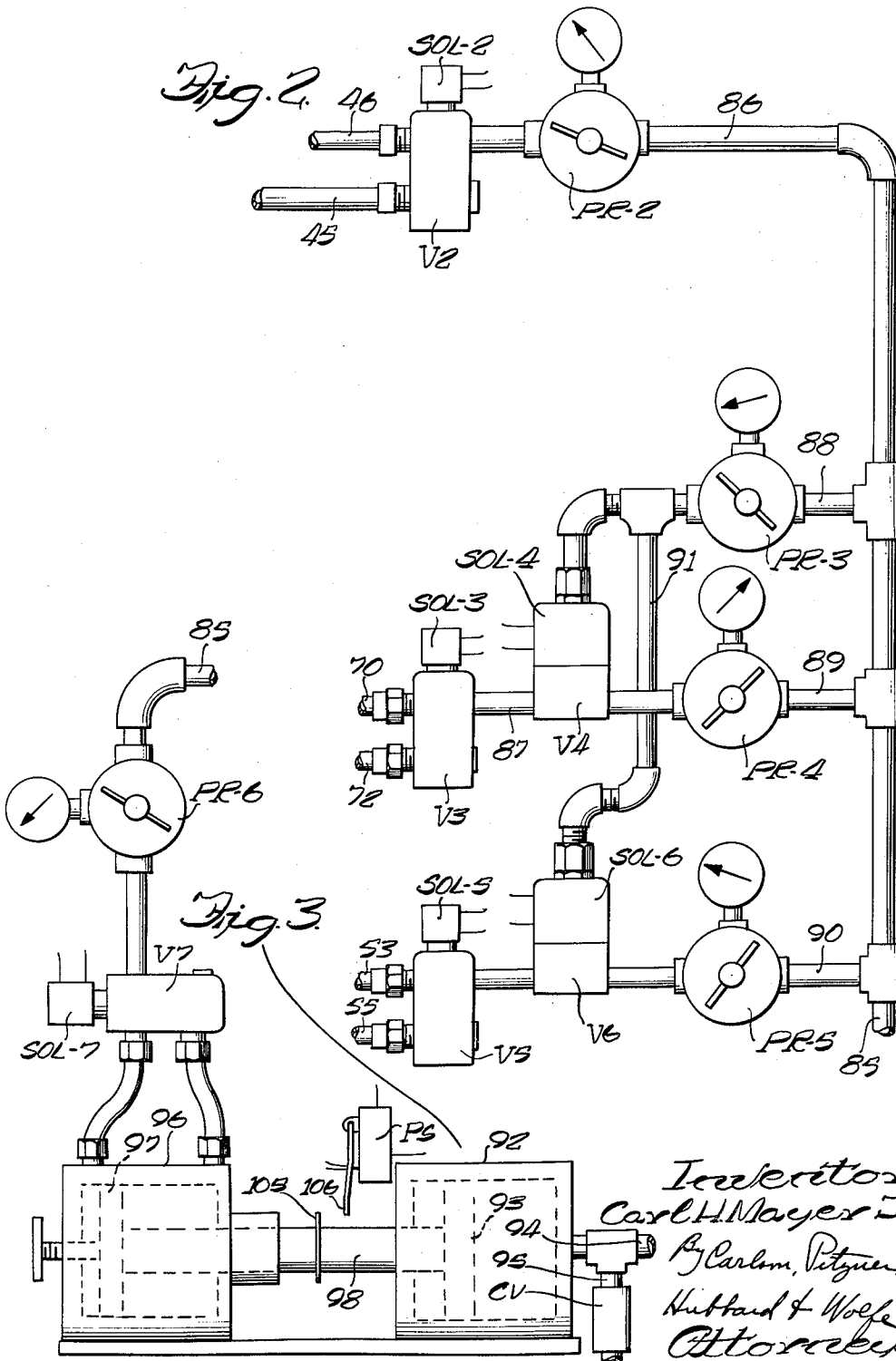
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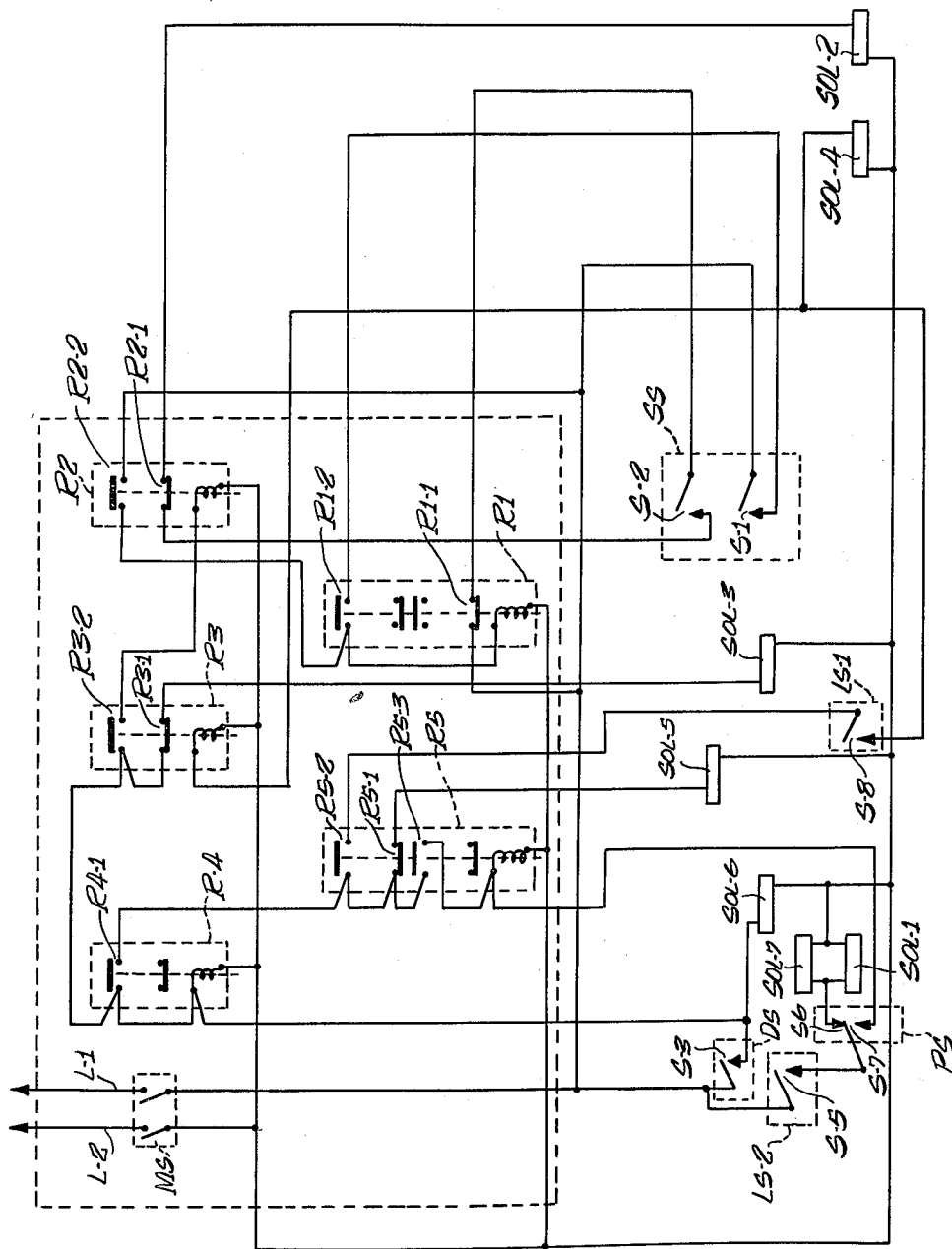


Fig. 4.

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Fig. 5.

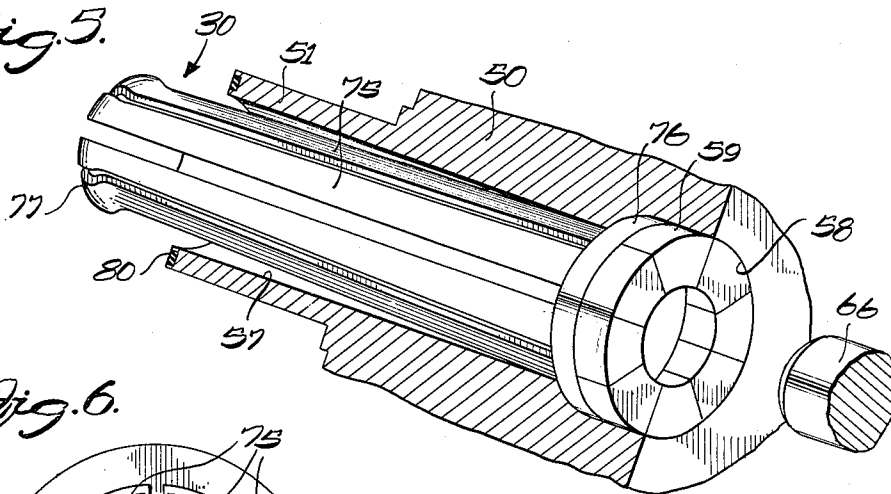


Fig. 6.

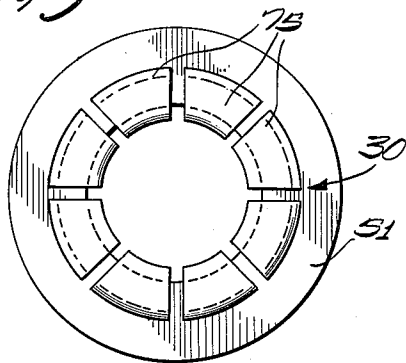
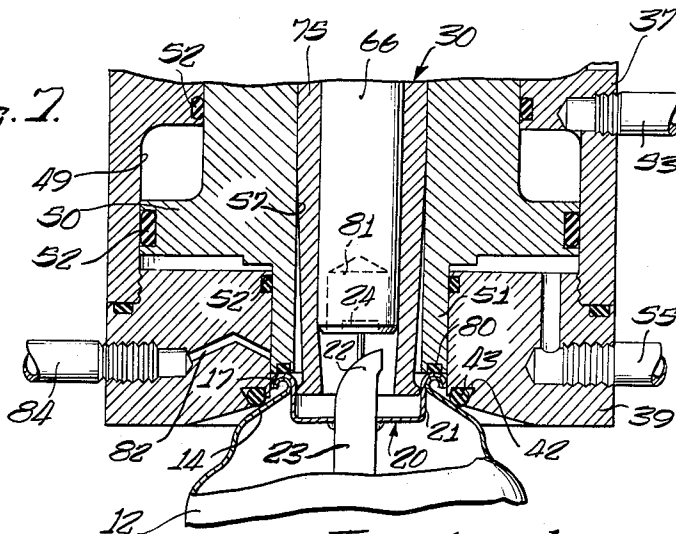


Fig. 7.



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Fig. 8.

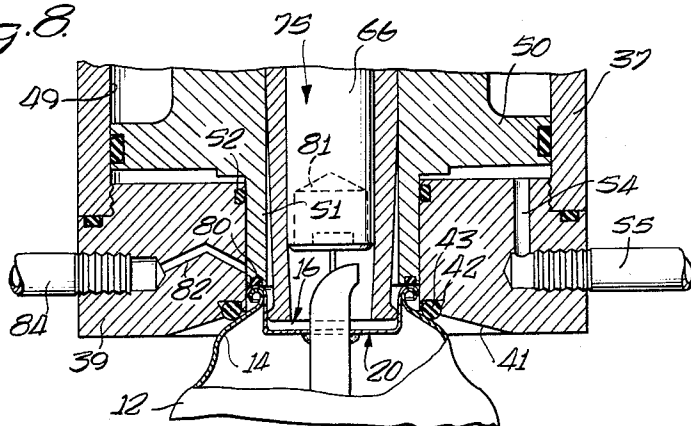


Fig. 9.

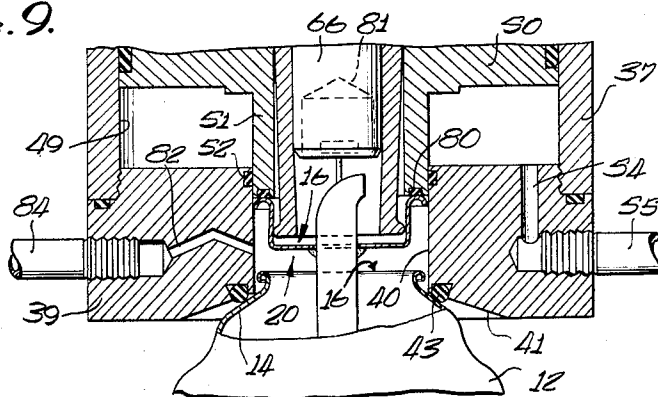
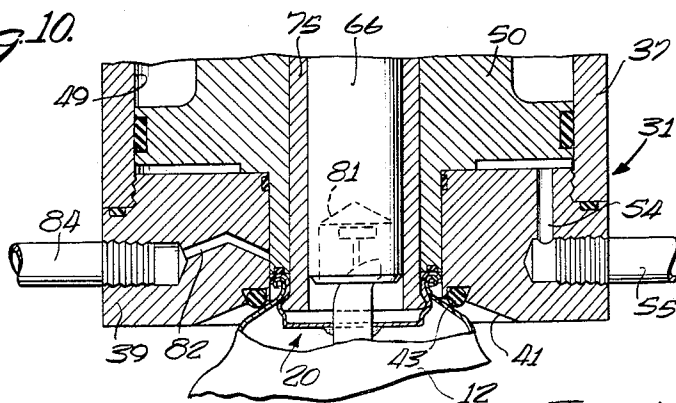


Fig. 10.



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2,958,170

APPARATUS FOR FILLING AND CLOSING AEROSOL-TYPE DISPENSERS

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Filed Dec. 28, 1955, Ser. No. 555,978

15 Claims. (Cl. 53—76)

The invention relates to the filling and closing of aerosol-type dispensers, and more particularly to dispensers of the type in which a closure top is assembled with and secured to the container after the latter has received its charge of material to be dispensed and pressurizing gas.

The container portion of aerosol-type dispensers of the above general character usually comprises a metal can having an opening of substantial size at its upper end to facilitate filling with the liquid or powdered material to be dispensed. The upper end of the container around the filling opening is desirably reduced in diameter to form a neck for convenience in handling, and to simplify the attachment of the closure top. To resist displacement of the top due to the pressure in the container, and to provide a sufficiently tight seal to preclude leakage of pressurizing gas, the top is usually expanded or crimped into the neck portion of the container. This latter operation presents a number of difficulties due to the fact that the crimping has to be done after the container is pressurized.

One object of the present invention is to provide an improved method of pressurizing and closing aerosol dispenser containers which materially simplifies those operations and substantially eliminates loss of pressurizing gas.

Another object is to provide an improved method of handling the container closure tops which permits the pressurizing and closing operations to be carried out more expeditiously and in a more efficient manner than has heretofore been practicable.

Another object is to provide efficient and dependable apparatus for carrying out the improved method.

A more specific object is to provide improved apparatus whereby the loosely applied closure top of a container filled with suitable material to be dispensed is mechanically raised from the container for pressurizing by means which subsequently acts to replace the closure top and crimp it to the body of the container.

Still another object is to provide for effectively sealing a space around the upper portion of the container and the raised closure top during the pressurizing operation to minimize loss in pressurizing gas.

Still another object is to provide controls for container pressurizing and closing apparatus which renders the operation substantially automatic.

Other objects and advantages of the invention will become apparent from the following detailed description of the preferred embodiment illustrated in the accompanying drawings, in which—

Figure 1 is a vertical sectional view through the head of the container pressurizing and closing apparatus.

Fig. 2 is a partly diagrammatic view of the pneumatic controls for the apparatus.

Fig. 3 is a partly diagrammatic view of that portion of the apparatus concerned with pressurizing the container.

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Fig. 4 is a circuit diagram of the electrical controls for the apparatus.

Fig. 5 is a partly sectioned perspective view of the top transfer plunger and the top expanding or crimping die.

Fig. 6 is an end elevational view of the plunger and die shown in Fig. 5.

Fig. 7 is an enlarged fragmentary sectional view of the container pressurizing and closing head showing the position of the parts as the head is initially advanced into engagement with the container.

Fig. 8 is a sectional view similar to Fig. 7 showing the head and associated parts in a more advanced position with the crimping die partially expanded to frictionally grip the closure top.

Fig. 9 is a sectional view similar to Fig. 7 showing the head in its lower position with the plunger and crimping die retracted to withdraw the closure top and thereby condition the container for receiving a charge of pressurizing gas.

Fig. 10 is a sectional view similar to Fig. 7 showing the head and associated parts in their lowermost positions with the crimping die fully expanded to crimp the closure top to the container.

While the improved method of the present invention may be practiced in a number of ways, I have shown in the drawings and will describe herein in detail, a preferred form of apparatus for that purpose. This apparatus, it will be understood, is susceptible to various modifications and alternative constructions and the detailed disclosure is not intended to limit the invention to the specific form shown. On the contrary the intention is to cover all modifications and adaptations falling within the spirit and scope of the invention as expressed in the appended claims.

By way of illustration, the improved apparatus provided by the invention has been shown and will be described along with the improved method as applied to the pressurizing and closing of aerosol dispensers of the type disclosed in my co-pending application, Serial No. 462,639, filed October 18, 1954. Such a dispenser, indicated at 11 (Fig. 1) comprises a pressure vessel or container 12 in the form of a cylindrical can of steel or other suitable material closed at its lower end by a conventional pressure-resisting bottom member 13. For the convenience in handling and to facilitate application of a top closure, the upper end of the container is reduced in diameter, preferably in two or more steps, to present a sloping shoulder 14, merging into a neck 15 defining a filling opening 16 (Fig. 9). The upper edge of the neck is desirably reinforced by a rolled bead 17.

The substantial size of the opening 16 facilitates filling of the container with the material to be dispensed which may be in either liquid or powder form. After filling, the opening is sealed by a closure top 20 which is expanded or crimped into the neck of the container to make it, in effect, an integral part of the finished dispenser.

The closure top 20, in its preferred form, is a generally cup-shaped sheet metal stamping formed with a cylindrical wall portion 21 (see Fig. 7) dimensioned to fit tightly in the opening 16 of the container. In the exemplary dispenser, the top carries a valved discharge nozzle 22, which has a tube portion 23 extending through the cover and down close to the bottom of the container to permit complete discharge of the contents of the container. A conventional valve controlling discharge through the nozzle is adapted to be actuated by a finger operated button 24 disposed adjacently projecting into the nozzle.

In carrying out the improved method of pressurizing and closing dispensers, the containers 12 are filled with the material to be dispensed in the usual way with con-

ventional filling machines which insert a measured amount of material through the top openings 16 of the containers. After such filling, a closure top 20 is loosely assembled in the filling opening of each container. With the closure top in place, the upper portion of the container is sealed off from the atmosphere, preferably in the area of the shoulder 14. A similar seal is established about the rim of the closure 20 and at the same time an expansible crimping die 30 of suitable construction is inserted in the open end of the closure top. It will be understood, of course, that a suitable structure or head 31 is provided for establishing the above mentioned seals and for supporting the crimping die and parts essential for its operation.

With the parts related as above described, the crimping die 30 is expanded to frictionally grip the wall 21 of the closure top but without exerting sufficient pressure to deform or expand the wall. While so expanded and with the seals against the container and the top maintained, the crimping die and the top sealing instrumentality are retracted to withdraw the top from the container and establish a space around the open upper end of the container that is completely sealed off from the atmosphere. Suitable means is provided, of course, for introducing into the sealed off space a charge of pressurizing gas, usually one of the fluoro-chloro hydrocarbons or Freons, preferably in a liquid state. The crimping die and top sealing means are then advanced toward the container to reset the top in the opening 16 of the container and the crimping die is further expanded to deform or crimp the closure top into the neck of the container as above described.

The crimping die and top sealing means may now be retracted and closed by the retraction of the head leaving the dispenser in finished form, that is, fully charged with the material to be dispensed and with pressurizing gas and with the closure top securely closing the container. The improved method and apparatus whereby the pressurizing and closing of the container are effected as single, multi-step operation, together with the use of the crimping die for temporarily withdrawing the top to permit introduction of pressurized gas materially simplifies the production of aerosol-type dispensers. Furthermore, it speeds up production, substantially reduces costs and minimizes loss of pressurizing gas.

In the preferred form of the apparatus for carrying out the above described method, the head 31 is mounted above a support 32 upon which the assembled containers and closure tops are presented one-by-one in an upright position for coaction with the head as shown in Fig. 1. The upper portion of a container may thus be brought into operative relation to the head by relative vertical movement of the head and support. In the exemplary apparatus, the head is mounted for movement toward and from the support which is stationary. Movement is imparted to the head through the medium of a pressure fluid operated actuator herein shown as comprising a cylinder 33 having a working piston 34. A rod 35 extending from the piston through a suitable gland at one end of the cylinder is suitably anchored to the head as explained hereinafter.

The head 31, as shown, comprises two hollow cylindrical sections 36 and 37, secured together in end-to-end relation. The upper end of the cylindrical structure thus formed is closed by a top plate 38 and the lower end by a bottom plate 39. The bottom plate has a central bore 40 coaxially aligned with a shallow, generally frusto-conical recess 41 formed in the lower face of the plate. The bore 40 is dimensioned to afford ample clearance for the neck of the container 12 and the surface defined by the recess 41 is sloped to provide clearance for the wider parts of the container. An annular groove 42 (Fig. 8) is formed in the sloping face of the recess adjacent and concentric with the bore 40 for seating and retaining a sealing ring 43 adapted to sealingly engage the shoulder

14 of the container when the container and head are brought into operative relationship.

As shown in Fig. 1, the top plate 33 is recessed to receive the projecting end of the piston rod 35 which is rigidly anchored to the plate as by a cross-pin 44. The top plate and the head 31, of which it forms a part, are thus reciprocable with the piston 34. Accordingly, the head may be raised or lowered by admitting pressure fluid to the lower or upper end of the cylinder 33. Suitable ports are provided in the cylinder for connection with conduits 45 and 46, respectively, supplying the upper and lower ends of the cylinder. The valving for controlling the pressure fluid supply through those conduits is described in detail hereinafter.

The lower casing section 37 of the head has a stepped internal cylindrical surface, the larger end of which is disposed adjacent the bottom plate 39 and with it defines a cylinder 49 for a piston 50. This piston, conveniently called the transfer piston, has a cylindrical extension 51 dimensioned for a sliding fit in the bore 40 of the bottom plate. Sealing rings 52 are provided where necessary to afford gas tight seals between the cylinder and piston elements.

Pressure fluid such as compressed air is admitted to the cylinder 49 above the piston 50 through a port provided in the casing section 37 by way of a connecting conduit 53. Admission of fluid to the lower end of the cylinder below the piston 50 is by way of a port in the bottom plate 39 communicating with the cylinder through a passage 54. A conduit 55 delivers pressure fluid to this port and passage.

As will be seen by reference to Fig. 1 of the drawings, the upper end portion of the piston 50 is reduced in diameter and has a sliding fit with the smaller end of the casing section 37. A concentric bore 57 (Figs. 1, 5 and 7) extends through the piston and through the extension 51 for the accommodation of the expansible crimping die 30. For present purposes it is sufficient to note that the bore 57 has a counterbore 58 at its upper end to accommodate a clamping flange 59 provided at the upper end of the crimping die. A plate 60, centrally apertured as at 61 and bolted or otherwise rigidly secured to the top of the piston 50 overlies the marginal edge portion of the flange 59 and serves to clamp the crimping die securely against endwise movement relative to the piston.

Incorporated in the transfer piston structure and reciprocable with it as a unit is a pressure fluid actuator for expanding the crimping die 30. In the exemplary head, the cylinder 62, for that actuator, is defined by a cylindrical member 63 screw-threaded to the reduced upper end portion of the plate 60 which thus forms the bottom wall of the cylinder. A top plate 64 closes the upper end of the cylinder. Cylinder 62 is fitted with a working piston 65 having a central recess in its lower face for receiving the upper end of a die actuating plunger 66. The plunger is rigidly secured to the piston as by a machine screw 67 and extends downwardly therefrom through the aperture 61 and through the crimping die 30. Preferably, the upper section of the plunger is dimensioned for a tighter fit in the aperture 61 to preclude leakage around the same.

Pressure fluid such as compressed air admitted to the upper end of the cylinder 62 moves the piston 65 and plunger 66 downwardly to actuate or expand the crimping die. For supplying pressure fluid to the upper end of the cylinder, the plate 64 is formed with a port threaded for the reception of the pipe or nipple 68 which extends upwardly through a clearance opening 69 in the casing top plate 33 and connects with a supply conduit 70. Pressure fluid is supplied to the lower end of the cylinder 62 by way of a laterally opening port in the bottom plate 60 which communicates with the cylinder by way of a passage 71. This port receives pressure fluid from a conduit 72 connected thereto by a nipple 73 which ex-

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tends through a clearance slot 74 in the casing section 36. The opening 69 and slot 74 permit the conduits and their connections to reciprocate as a unit with the cylinder structure relative to the casing or head within which the cylinder is disposed.

The crimping die 30 may be of any preferred construction. In the form shown in Figs. 5 and 6 of the drawings it comprises a tubular assembly of elongated resilient strips 75 locked in places by a snap ring 76. At its upper end, each strip 75 has a segmental enlargement and these enlargements fit together to define the locking flange 59 when the strips are assembled.

The strips 75 taper gradually both in thickness and in width toward their lower ends as shown in Fig. 7 and each terminates in an outwardly directed lip 77 which constitutes the closure top deforming portion of the die. Strips 75 are made of tough, resilient metal, preferably steel, and are shaped so that their lower ends tend to spring inwardly or contract to a diameter such that the lower end of the die can readily enter the cup-shaped closure top 20. It will be understood that the internal diameter of the die when so contracted is smaller than the diameter of the plunger 66.

Expansion of the crimping die or outward movement of the free ends of the strips 75 is effected by advancing the plunger 66 into the die element or downwardly in the present instance. As the plunger advances, it cams the ends of the strips outwardly toward the wall portion of the closure top which is deformed outwardly as shown in Fig. 10. Upon retraction of the plunger, the strips 75 spring back to their normal contracted position for withdrawal from the closure top.

To pressurize and close a dispenser, a container 12 filled with material to be dispensed and having the closure top 20 loosely assembled in the opening 16, is placed on the support 32 in an upright position below the head 31, the latter being in the raised position shown in Fig. 1. The head is then lowered until the sealing ring 43 makes initial engagement with the shoulder 14 of the container as shown in Fig. 7. It will be observed that the transfer plunger, extension 51, terminates inwardly of the end of the bore 40 and that it carries on its lower end a sealing ring 80. The extension is dimensioned so that this sealing ring engages the rim of the closure top 20 at the same time or shortly before the ring 43 engages the container. Upon further downward movement of the head from the position shown in Fig. 7, the sealing rings are compressed to effect a gas-tight seal with the container elements. For the latter portion of the downward stroke of the head, the piston 50 is displaced upwardly against the pressure exerted on the upper face of the piston, thus insuring maintenance of a tight seal between the ring 80 and the closure top.

As shown in Fig. 8, the crimping die 30 projects beyond the end of the piston extension 51 and accordingly enters the closure top as the head moves downwardly. The internal diameter of the die is sufficient to accommodate the nozzle 22 and valve actuator 24 carried by the closure top. The plunger 66 is enabled to clear those parts of the dispenser by reason of the recess 81 formed in its lower head.

When the head 31 reaches its lower limit position, the plunger 66 is advanced to expand the lower end of the crimping die 30 but with only sufficient pressure to frictionally grip the side wall 21 of the closure top without deforming the same as shown in Fig. 8. The degree of die expansion is determined by regulation of the pressure applied to the upper face of the piston 65 as will appear presently. While the die element retains its grip on the closure top, pressure fluid is admitted to the lower end of the cylinder 49 to retract the piston 50 and the plunger 66 as a unit. During this operation the head stays down and the ring 43 maintains the gas tight seal around the upper end portion of the container 12.

In the upward movement of the piston 50 and plunger

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66, the crimping die, through its frictional grip on the cover top 20, withdraws the top from the container and maintains it in sealing engagement with the ring 80 of the transfer piston extension. Accordingly the closure top is lifted to the position shown in Fig. 9 and a space is established within the bore 40 around the open end of the container which is effectively sealed off from the atmosphere. Into this space pressurizing gas such as liquid Freon is introduced by way of a passage 82 formed in the bottom plate 39 of the head.

It will be observed that the passage 82, enters the bore 40 in a downwardly sloping direction. This serves to direct liquified gas into the opening of the container with a minimum of turbulence or splashing. It will also be observed that the passage 82 is normally closed off from the bore 40 by the extension 51 of the transfer piston and is opened only when the piston is retracted for withdrawal of the closure top. Loss of pressurizing gas by leakage is thus minimized. To further guard against leakage a shutoff valve V1 is interposed in the gas supply line, the valve being located close to the head and connected to the passage 82 by a short nipple 84.

Pressure fluid from any suitable source may be utilized for operating the various actuators of the exemplary pressurizing and closing apparatus. The particular apparatus shown is designed for operation by compressed air delivered by way of an air line 85 (Fig. 2) at a pressure at least as high as the maximum required for any actuator. From the air line, the compressed air is distributed to the actuators through suitable regulating and solenoid operated control valves which may be of conventional construction.

Referring first to the head reciprocating actuator, the pressure fluid supply for the cylinder 33 is controlled by a direction valve V2 having an operating SOL-2 (see Fig. 2). This valve receives compressed air from the line 85 by way of a branch line 86 in which is interposed a pressure regulator PR-2. In the exemplary apparatus, this regulator has been shown as set for the delivery of air to the cylinder at an intermediate pressure, as for example, approximately 75 lbs. per square inch. Valve V2 is normally operative to direct air to the lower end of the cylinder 33 while connecting the upper end of the cylinder to exhaust. Energization of the solenoid SOL-2 operates the valve to direct the pressure air to the upper end of the cylinder and to connect the lower end to exhaust.

A reversing valve V3 operated by a SOL-3 controls the supply of air to the die actuator cylinder 62. As this actuator is required to expand the die element only sufficiently to grip the closure top in one operation, and further sufficiently to deform or crimp the closure top to the container in another operation, provision is made for supplying air to the control valve selectively at low or high pressures as required by the operation. The pressure selection is made by a selector valve V4 operated by a SOL-4. As shown, the outlet for the selector valve is connected to the valve V-3 by a conduit 87. One inlet of the selector valve is connected with the pressure line 85 by a branch conduit 88 in which is interposed a pressure regulator PR-3. This pressure regulator is set to deliver relatively low pressure air to the selector valve, for example, at 20 lbs. per square inch.

The other inlet to the selector valve V4 is connected with the pressure line 85 by a branch conduit 89 in which is interposed a pressure regulator PR-4. This regulator is set to deliver air to the selector valve at a substantially higher pressure, as for example, 160 lbs. per square inch. The selector valve V4 normally directs low pressure air to the control valve and shifts to high pressure air when the SOL-4 is energized.

Control of the direction of movement of the transfer piston 50 is effected by a valve V5 operated by a SOL-5. The transfer actuator is also arranged to operate at different pressures selected by a selector valve V6 which

has an operating solenoid SOL-6. The selector valve receives high pressure air from the line 85 through a branch conduit 90 equipped with a pressure regulator PR-5 shown as set for delivery of air at approximately 60 lbs. per square inch. Low pressure air is delivered to the selector valve V6 from the pressure regulator PR-3 by way of a branch 91 of the conduit 88. As in the case of the companion selector valve, the valve V6 normally delivers low pressure air to the associated control valve but switches to high pressure air when the solenoid SOL-6 is energized. Control valve V5 is set so that it normally directs air to the upper end of the cylinder 49 and the air connections are reversed to direct air to the lower end of the cylinder when the associated solenoid SOL-5 is energized.

The improved container pressurizing and closing apparatus also utilizes pressure fluid operated pump means for delivering measured charges of pressurized gas to the container. This pump means, as shown in Fig. 3, comprises a pump cylinder 92 fitted with the working piston 93. One end of the cylinder is provided with a combined inlet and outlet port connected by a conduit 94 with the shutoff valve V1 associated with the head 31 as previously described. A branch 95 from the conduit 94 extends to the tank or other suitable gas storage container. The branch conduit is fitted with a check valve CV permitting flow of gas from the tank to the cylinder 92 when the piston 93 moves towards the left end of the cylinder. Valve CV closes when the piston movement is reversed and the pressurized gas is consequently delivered through the conduit 94 to the control or shutoff valve V1.

Reciprocation of the pump piston 93 is effected by a pressure fluid operated actuator comprising a cylinder 96 fitted with a working piston 97. Piston 97 is operatively connected to the piston 93 by a piston rod 98 so that the two pistons reciprocate as a unit. Compressed air is directed alternately to opposite ends of the cylinder 96 by a reversing valve V7 having an operating SOL-7. The compressed air source may be the air line 85 and, in that case, a pressure regulator PR-6 is interposed ahead of the control valve. The pressure of the gas delivered by the pump to the container being pressurized may thus be controlled by the appropriate setting of the regulator PR-6. The setting, of course, may be varied as required, but with Freon or the like, it will ordinarily be in the neighborhood of 70 to 75 lbs. per square inch.

While it will be evident that the various control and selector valves above described may be operated manually to perform the pressurizing and closing operation, the invention provides a simple, effective electrical control system for automatically actuating the valves in proper sequence to carry the apparatus through a complete cycle each time a container is presented to the apparatus. Referring to Fig. 4 of the drawings, the control system as shown diagrammatically is supplied with operating current from a power line comprising conductors L-1 and L-2. A main switch MS in the power line provides for shutting off the current supply when the apparatus is idle. It will be noted that the various valves and solenoids above mentioned all have one terminal connected to the line conductor L-2. Likewise the various relays included in the control system have a terminal connected to that line conductor as will appear presently.

With the main switch closed, an operating cycle of the apparatus is started by presentation of a container 12 to the head 31 either manually or by suitable power operated transfer mechanism. The container, when properly positioned on the support 32 as shown in Fig. 1, engages a switch lever 100 to actuate a starting switch SS. This switch, as shown in Fig. 4, has two normally open switch contacts S-1 and S-2, both of which are closed upon actuation of the switch.

Closure of switch contacts S-2 completes an energizing circuit for solenoid SOL-2 by way of normally closed contacts R1-1 of a relay R1 and normally closed con-

tacts R2-1 of a relay R2. Energization of the solenoid operates the direction valve V2 to direct air to the upper end of the cylinder 33. The head 31 is accordingly advanced to bring the sealing ring 43 into engagement with the shoulder 14 of the container 12 as before described.

As the head 31 approaches its lower limit position, it engages a switch arm 101 (Fig. 1) to actuate a head "down" switch DS. As shown in Fig. 4, this switch has a normally open set of switch contacts S-3. Closure of the contacts S-3 completes energizing circuits for solenoids SOL-3 and SOL-6. The circuit for the solenoid SOL-3 includes normally closed contacts R3-1 of a relay R3. Solenoid SOL-6, when energized, operates selector valve V6 to increase downward pressure on the transfer piston 50.

Solenoid SOL-3, when energized, operates valve V3 to direct air to the upper end of the cylinder 62. Since selector valve V4 is not operated at this time, the air supplied to cylinder 62 is low pressure air and consequently piston 65 and plunger 66 are advanced to partially expand the die element 30 into gripping engagement with the closure top of the container.

Closure of the "down" switch contacts S-3 also completes an energizing circuit for a relay R-4. This relay, after a delay to permit ample time for the solenoids SOL-3 and SOL-6 to act, closes its switch contacts R-4-1 to complete an energizing circuit for solenoid SOL-5 by way of normally closed switch contacts R5-1 of a relay R5. Solenoid SOL-5 operates valve V5 to reverse the connection to the cylinder 49, shifting the transfer piston 50 and the plunger 66 upwardly. The low pressure air supply to the die actuator cylinder 62 maintains the plunger 66 in gripping position and consequently the upward movement of the transfer piston withdraws the closure top from the container as previously described. As shown in Fig. 1, the piston 50 has a radially projecting arm 103 by which it actuates a pair of limits which is LS-1 and LS-2. Switch LS-1 has a set of switch contacts S-4 that are open when the piston is in an upper position and closed as the piston moves down. Switch LS-2 has contacts S-5 that are open when the piston is down and closed when it is up.

Closure of switch contacts S-5 completes energizing circuits by way of normally closed switch contacts S-6 of a pump switch PS for solenoids SOL-1 and SOL-7. Solenoid SOL-1 operates to open valve V1 in the gas supply line to the head. Solenoid SOL-7 operates valve V7 to direct air under pressure to the left end of the cylinder 96. It will be understood that in the previous operating cycle of the apparatus the piston 97 was moved to the left end of the cylinder thereby causing a charge of gas to be sucked into the pump cylinder 92. The piston 97 and the pump piston 93 are now advanced (to the right) to discharge the gas from the pump cylinder through the conduit 94, valve V-1, nipple 84, and passage 82, into the sealed space within the bottom plate 39 in the head and thence into the container 12.

It may be noted that the initial operation of the transfer piston to seal off and grip the closure top as above explained, actuated limit switch LS-1. The switch actuation at that time is without effect, however, due to the open circuit at the switch contacts RS-2 of relay R5.

As the actuator and pump pistons approach the end of their forward or pumping stroke, a dog 105 on the piston rod 98 engages a switch operating lever 106 for the pump switch PS. Such engagement opens the switch contacts S-6 and closes contacts S-7. The opening of contacts S-6 allows solenoids SOL-1, SOL-7 to de-energize, the first mentioned solenoid permitting the shutoff valve V1 to close. Solenoid SOL-7 allows valve V7 to return to normal position and reverse the air supply to the cylinder 96 so as to initiate return movement of the actuator and pump pistons. The pump piston, in its return movement, sucks a fresh charge of gas

into the pump cylinder 92 for charging the container in the next operating cycle.

Closure of switch contacts S-7 completes an energizing circuit for relay R5 by way of limit switch contacts S-5 which are closed with the transfer piston in its upper position. Relay R5, after a delay sufficient to permit the valves V1 and V7 to function, closes switch contacts R5-3 to complete a holding circuit for itself independently of the limit switch contacts S-5 which open when the transfer piston descends. This holding circuit includes contacts R4-1 of relay R4 which remain closed as long as the "down" switch DS is actuated.

Relay R5, when energized, opens contacts R5-1 to interrupt the circuit for solenoid SOL-5 which permits valve V5 to return to normal position and direct air to the upper end of cylinder 49. Transfer piston 50 and the die mechanism which it carries are accordingly advanced to reset the closure top 20 in the opening of the container 12.

As the transfer piston approaches the end of its advancing stroke, contacts S-8 of limit switch LS-1 are closed. Since relays R4 and R5 are energized, closure of contacts S-8 completes a circuit by way of relay contacts R4-1 and R5-2 for energizing solenoid SOL-4. This solenoid operates valve V4 to change the air supply for the die actuator from low pressure through the regulator PR-3 to high pressure through the regulator PR-4. Accordingly, piston 65 of the actuator which has been urged downwardly by low pressure air to maintain a grip on the closure top, is now advanced through the remainder of its stroke by the high pressure air to force the plunger 66 farther into the crimping die 30. The die is thus expanded and crimps the closure top to the container as before described.

Closure of limit switch contacts S-8 also completes an energizing circuit for relay R3. This relay, after a delay sufficient to permit the crimping operation to be completed, closes its switch contacts R3-2 to complete an energizing circuit for relay R2. Relay R3 also opens contacts R3-1 to interrupt the circuit for solenoid SOL-3. This permits valve V3 to return to normal position and initiate upward or retracting movement of the crimping plunger 66. Retraction of the plunger allows the crimping die to contract so that it can be withdrawn from the closure top.

Simultaneously, with the opening of the solenoid circuit as above described, relay R3 closes its contacts R3-2 to complete an energizing circuit for relay R2. After a delay to permit contraction of the crimping die, relay R2 closes switch contacts R2-2 to complete an energizing circuit for relay R1. Relay R2 also opens contacts R2-1 to interrupt the circuit for solenoid SOL-2. This solenoid permits valve V2 to return to normal position and initiate the withdrawal movement of the head reciprocating piston 34. Relay R1 upon energizing closes switch contacts R1-2 to complete a holding circuit for itself by way of contacts S-1 of the starting switch SS. The relay also opens contacts R1-1 to interrupt the starting circuit including switch S-2. Due to this holding circuit, relay R1 remains energized and prevents initiation of another operating cycle until the starting switch SS has been released by removal of the completed dispenser from the apparatus. Upon such removal, switch SS opens the holding circuit for relay R1 which becomes deenergized and conditions the apparatus for the start of another operating cycle similar to that above described.

It will be apparent from the foregoing that the invention provides a novel and advantageous method for pressurizing and closing aerosol-type dispensers together with improved apparatus for carrying out the method. The method contemplated by the invention speeds up the pressurizing and closing operations, reduces costs, and minimizes loss of pressurizing gas. The apparatus provided by the invention embodies novel features of con-

struction which permit the pressurizing and crimping operations to be performed substantially automatically with a minimum of manual labor or supervision. The apparatus is simple in construction, positive and efficient in operation and has relatively few parts requiring service or adjustment or likely to become worn in use. In general, it will be evident that the improved method and apparatus greatly facilitates the final pressurizing and closing operations involved in the manufacture of aerosol-type dispensers, reduces costs, and insures a properly filled and closed dispenser.

I claim as my invention:

1. In an apparatus for pressurizing and closing aerosol dispenser containers presented with a cup-shaped closure top loosely assembled in the filling opening of the container, a head having a chamber opening from one end and dimensioned to receive the upper end of the container, a sealing ring encircling the open end of the chamber engageable with the container to form a gas tight seal around the filling opening of the container, a tubular transfer member reciprocable in said chamber, a sealing ring carried on the end of said member engageable with the closure top to form a gas tight seal around the marginal edge of the top, an expansible crimping die disposed within said tubular member and projecting therefrom into the interior of the closure top when said member is in sealing engagement with the top, means for expanding said die to frictionally grip the closure top, and means for retracting said member and said die as a unit to withdraw the closure top from the container while maintaining the seals around the container and the closure top intact.

2. In an apparatus for pressurizing and closing aerosol dispenser containers presented with a cup-shaped closure top loosely assembled in the filling opening of the container, a head having a chamber opening at one end dimensioned to receive the upper end portion of the container, a sealing ring encircling the open end of the chamber engageable with the walls of the container to form a gas tight seal around the filling opening of the container, said head having a passage opening into said chamber for admitting gas under pressure thereto, a tubular transfer member reciprocable in said chamber, a sealing ring at the lower end of said member engageable with the closure top to form a gas tight seal around the marginal edge of the top, an expansible crimping die disposed within said tubular member and projecting therefrom into the interior of the closure top, means for expanding said die to frictionally grip the closure top, and means for retracting said member and said die as a unit to withdraw the closure top from the container while maintaining both of said seals intact to prevent escape of pressurizing gas admitted to the chamber through said passage.

3. In an apparatus for pressurizing aerosol dispenser containers presented with a cup-shaped closure top loosely assembled in the filling opening of the container, a head having a chamber opening at one end dimensioned to receive the upper end portion of the container, an expansible crimping die extending through said chamber and adapted to project into the closure top when the head is operatively related to the container, means operable to expand said die with sufficient pressure to frictionally grip the closure top without deforming the same, actuating means operable to retract the expanded die to withdraw the closure top from the container and permit entry of pressurizing gas thereto, said actuating means being operable to return the expanded die to a position to reset the closure top in the container opening, and said expanding means being operable after such resetting to further expand said die to deform the walls of the closure top outwardly into tight sealing engagement with the body of the container.

4. Apparatus of the character set forth in claim 3 in

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which the actuating means for retracting and returning the expanded die element is pneumatically operated.

5. Apparatus of the character set forth in claim 3 in which the means for expanding the crimping die is pressure fluid operated and in which operating fluid at relatively low pressure is supplied for expanding the die to grip the closure top and at a substantially higher pressure to expand the die for crimping the closure top to the container.

6. Apparatus of the character set forth in claim 3 in which means is provided for maintaining a gas tight seal around the top of the container and around the closure top while the latter is withdrawn from the opening in the container.

7. Apparatus of the character set forth in claim 3 in which the head is brought into operative relation to the container by a pneumatically operated actuator and in which the crimping die is retracted, advanced and expanded by pneumatically operated actuators.

8. An aerosol dispenser container pressurizing and closing head comprising, in combination, a casing defining a cylinder opening through a bore in one end of the casing, a piston assembly reciprocable in said cylinder, an extension of said piston assembly projecting into said bore, said piston assembly defining a second cylinder opening through a second bore extending centrally through the piston assembly and said extension, a tubular crimping die seated in said second bore and projecting beyond the end of said extension, a piston reciprocable in said second cylinder, a plunger rigidly attached to said second piston and extending through said crimping die, means for supplying pressure fluid to said first cylinder to advance and retract the piston assembly and crimping die relative to the head, and means for supplying pressure fluid to said second cylinder to advance and retract said plunger for actuating said crimping die.

9. Apparatus for pressurizing and closing aerosol dispenser containers as set forth in claim 2 in which a valve is provided for controlling the admission of pressurized gas to said passage together with controls operated automatically as an incident to the withdrawal of the closure top from the container for opening the valve.

10. Apparatus for pressurizing and closing aerosol dispenser containers as set forth in claim 2 in which the advance of said tubular transfer member incident to the re-

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setting of the top in the container is effective to close the pressurized gas passage and thereby preclude escaped gas when the head is retracted from the container.

11. Apparatus for pressurizing and closing aerosol dispenser containers as defined in claim 2, in which the tubular transfer member is urged against the marginal edge portion of the closure top with sufficient pressure to produce an effective seal and yet permit the plunger to retreat in the continued advance of the head.

12. In an apparatus having a support for an aerosol dispenser container, a head reciprocable toward and from said support, a pneumatically operated actuator for reciprocating said head, said head having a chamber at its lower end dimensioned to receive the upper portion of the container, pneumatically operated transfer means carried by said head including a piston reciprocable relative to the head and having a tubular extension engageable with a closure top loosely assembled in the top of the container on the support, a crimping die projecting through said extension and into the closure top when the top is engaged by the extension, a pneumatically operated actuator for actuating said die, a compressed air supply system including valves controlling the delivery of air to said actuators, and an electrical control system operative to initiate operation of said valves in a predetermined sequence.

13. Apparatus as defined in claim 12 in which the electrical control system includes a cycle starting switch actuated by the presentation of a container on the support.

14. Apparatus as defined in claim 13 in which the compressed air supply system includes pressure regulating means and a selector valve for varying the pressure of the air supplied to the die actuator in different portions of the operating cycle of the apparatus.

15. Apparatus as defined in claim 14 in which the head is provided with means for supplying pressurizing gas to the container and in which the control system automatically initiates the operation of the gas supplying means at a predetermined point in the operating cycle of the apparatus.

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