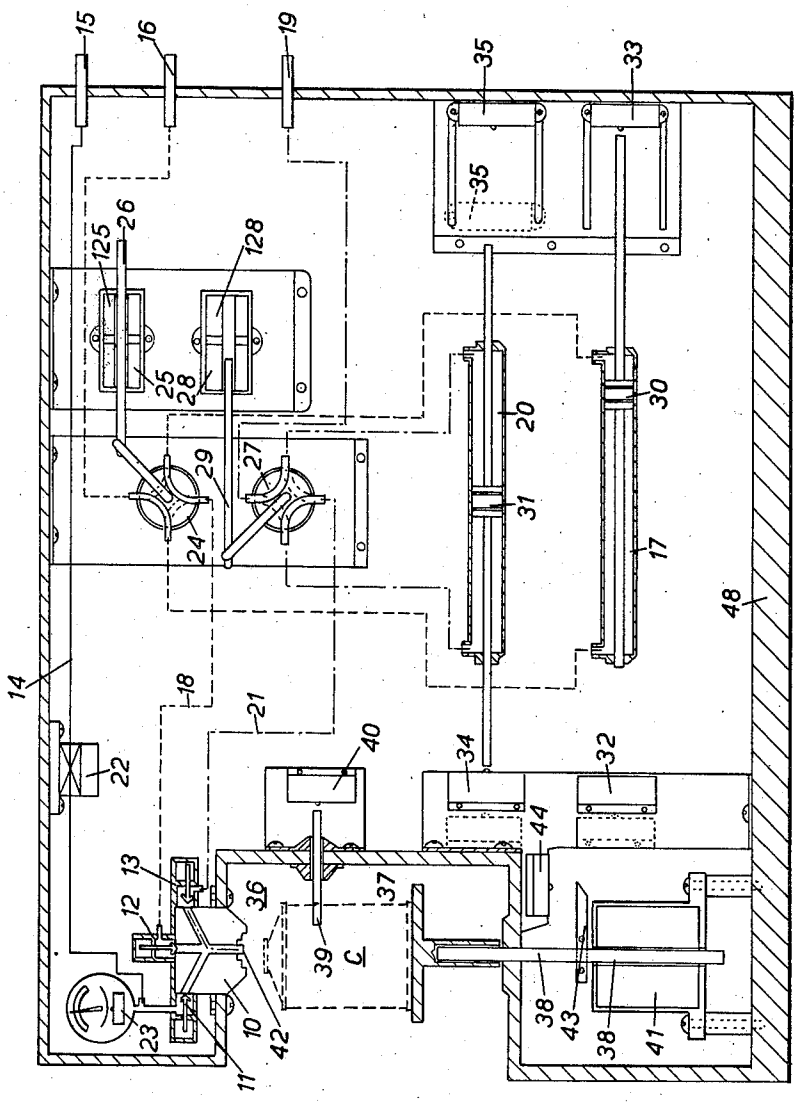
Sept. 25, 1962 H. P. SCHOFIELD 3,055,402

FILLING OF PRESSURIZED CONTAINERS WITH LIQUIDS OF LOW BOILING POINT

Filed April 15, 1959 2 Sheets-Sheet 1



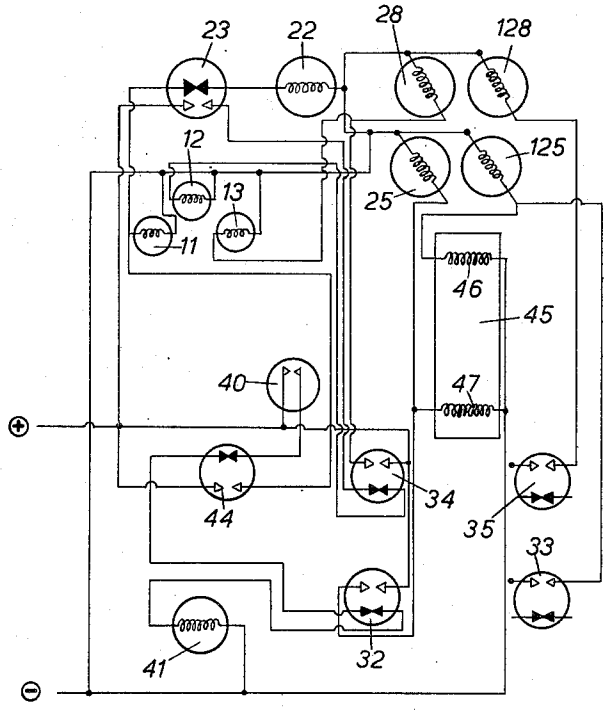
—FIG. 1.—

INVENTOR
HUBERT P. SCHOFIELD
BY
ATTORNEY

Sept. 25, 1962 H. P. SCHOFIELD 3,055,402

FILLING OF PRESSURIZED CONTAINERS WITH LIQUIDS OF LOW BOILING POINT

Filed April 15, 1959 2 Sheets-Sheet 2



—FIG. 2.—

HUBERT P. SCHOFIELD
INVENTOR

BY

ATTORNEY

United States Patent Office 3,055,402
Patented Sept. 25, 1962

3,055,402

FILLING OF PRESSURIZED CONTAINERS WITH LIQUIDS OF LOW BOILING POINT

Hubert P. Schofield, Windsor Forest, England, assignor to Surplice & Tozer Engineering Co. Limited, Windsor, England, a company of Great Britain

Filed Apr. 15, 1959, Ser. No. 806,616
Claims priority, application Great Britain Apr. 17, 1958
5 Claims. (Cl. 141—20)

The present invention relates to the filling of pressurized bottles, canisters, cans or other containers including, for example, those of the type known as aerosols and others such as fire-extinguishers, gas cigarette lighters and portable heaters.

In general practice, pressurized containers of the type referred to are filled under refrigerating conditions so as to prevent vaporizing of the propellant liquid which is to be added to the product within the containers for subsequent ejection thereof. However, this involves high capital outlay and difficult and unpleasant working conditions. Occasionally pressure filling of the propellant liquid is employed, and the approximate volume of propellant used is estimated by the pressure reached in the container, but this requires compensation for variations in ambient temperatures. In filling containers by present methods, the successive operations of filling with the product and the propellant generally take place at different times and, where these operations are also performed in different rooms or at different localities, transport is involved.

The object of the present invention is to enable the filling operation with both the product and the propellant to be performed under normal conditions of varying ambient temperature and to a consistently high degree of accuracy, and with only one handling of the container.

In apparatus for the filling of pressurized containers according to the present invention, means are provided which, on establishing connection between an inlet orifice of the container and a nozzle of a charging head of the apparatus, initiate the communication between said inlet and a vacuum source, a product metering device, and a propellant metering device either separately or selectively in any two-stage or three-stage sequence consistent with a predetermined setting of control means associated with said vacuum source and said metering devices.

Where the product to be ejected from the containers may itself be utilized as the propellant, such as, for example, in the case of fire-extinguishers using carbon tetrachloride, a two-stage operation is performed in accordance with the invention, which consists of the application of a predetermined degree of vacuum to the container and the filling thereof with the required product acting also as the propellant. If there is no disadvantage in having air under pressure within the container, it will be appreciated that a single stage operation is all that is required.

Where, however, the propellant is a different medium than the product and the pressure of oxygen is undesirable, three stages are involved, namely the application of a predetermined degree of vacuum, the insertion of a predetermined volume of the product and the insertion of a predetermined volume of the propellant. The insertion of the product may precede that of the propellant or follow it as desired, while the predetermined degree of vacuum may be applied initially or as the second stage between either the insertion of the product and the propellant or the insertion of the propellant and the product, as the case may be.

Further, if desired, the vacuumizing means, or the product or the propellant supply means may be energized simultaneously with the termination of the act of placing each container in position on or in the charging head.

In a convenient form of construction consistent with the present invention a container to be filled is placed on a vertically displaceable platform which is adapted to be automatically raised to bring the inlet of the container into operative engagement with a stationary nozzle by electric, pneumatic, hydraulic, or other means energized by each container itself when it reaches a predetermined position on the platform. The sealing of a container inlet by the nozzle in turn automatically energizes the vacuumizing means and the product and propellant supply means consistent with the predetermined setting of the device to meet particular container loading requirements.

The invention is more particularly described with reference to the accompanying drawings which illustrate one embodiment thereof merely by way of example. In the drawings:

FIGURE 1 is a diagrammatic representation of a general arrangement of the apparatus and

FIGURE 2 is a wiring diagram.

Referring to FIG. 1 in detail, it will be seen that the apparatus includes a charging head capable of conducting three operations in a predetermined order on each of a number of canisters or other containers C supplied in succession to the apparatus. The charging head embodies a dispensing valve assembly **10** consisting of three solenoid operated valves **11**, **12** and **13**, respectively. The valve **11** controls a vacuum line **14** from a vacuum source **15** to the valve assembly **10**. The valve **12** controls the supply of the product from a source **16**, through a metering cylinder **17** and pipe line **18**. The valve **13** controls the supply of a propellant from a source represented at **19** through a metering cylinder **20** and a pipe line **21**. The valves **11**, **12**, **13** are normally urged towards their closed positions by spring means.

A solenoid controlled valve **22** and a vacuum sensitive micro-switch **23** are located in the pipe **14** which is shown in full lines. In the pipe line **18** shown in broken lines and extending from the product supply source **16** to the valve **12**, there is located a two-position, four-way valve **24**, the through passages in one position being shown in full lines and the through passages in the alternative position being shown in dotted lines. In the former position, the line from the valve **24** leads to the left hand end of the metering cylinder **17** while the opposite end of said cylinder is connected to the valve **12**, and, in the alternative position of the valve **24**, the source **16** is in communication with the right hand end of the cylinder **17** and the product flows from the left hand end of cylinder **17** to said valve **12**. Solenoids **25**, **125** are adapted to oppositely displace an arm **26** for the purpose of rotating the valve **24** through an angle of 90° between the two above described positions of the valve.

Similarly, the pipe line **21** includes a two-position, four-way valve **27** for alternatively establishing communication between one end of the metering cylinder **20** and the propellant supply source **19** while the other end of the cylinder is in communication with the valve **13**, and between that other end of cylinder **20** and source **19** while the first mentioned end of the cylinder is in communication with valve **13**. The control of the valve **27** is effected by oppositely acting solenoids **28**, **128** and an operating arm **29**.

In each of the metering cylinders **17** and **20** there is located a freely floating double acting piston **30** and **31**, respectively. Communication between one end of the related cylinder and a pressure source **16** or **19**, as the case may be, causes the longitudinal displacement of the piston **30** or **31** to a predetermined extent to effect delivery from the other end of the cylinder to the appropriate valve **12** or **13** of a predetermined volume of product or propellant. The delivered volume of product

or propellant is wholly independent of ambient temperature.

The limits of the displacement of the piston **30**, in one direction, is controlled by a combined micro-switch and mechanical stop member **32** and, in the other direction, by an adjustable combined micro-switch and mechanical stop member **33**. Thus, the delivered volume of liquid resulting from each stroke of the piston **30** in response to operation of the valve **24** may be infinitely varied by changing setting of the member **33**. Similarly, the displacement of the piston **31** may be controlled by a fixed combined micro-switch and stop member **34** and a combined micro-switch and mechanical stop member **35** which is infinitely adjustable between any of the extreme positions shown respectively in full and dotted lines.

A recess **36** is formed in the charging head, and a vertically displaceable platform **37** is detachably mounted on a shaft **38** projecting upwardly from the head into the recess **36**. A locating element **39** is provided at the rear of the recess **36** above the platform. The locating element operates as a trigger for energising the required means for elevating the platform **37** when a container is placed on the latter and pushed towards the rear of the platform to act against the locating element **39** so as to displace the latter.

In the construction consistent with the diagrammatic representation of FIGURE 1, the locating element **39** is in the form of a V-shaped member which is adapted for contact with a micro-switch **40** interposed in the electrical energizing circuit for a solenoid **41**. When solenoid **41** is energized, it raises the platform and the container to effect a seal between the inlet of the container and a nozzle **42** located in the ceiling of the recess **36** of the charging head. However, the platform **37** may be raised hydraulically, pneumatically or by the application of vacuum in any well known manner. It may also be lowered by any desired means (not shown).

In general the valves **11**, **12**, **13** work independently and in a correct sequence. The discharge point or nozzle **42** is arranged, in relation to the height of the interchangeable platform **37** and the location of the V-shaped member at **39**, so that, on raising the platform with a container C placed on it, the valve at the orifice of the container registers exactly with the nozzle **42**, and the latter effects a seal with the container orifice and also forces open the usual valve at container orifice to permit filling of the container. When the platform **37** descends after a filling operation, the valve in the container C automatically re-closes, this return operation being effected by gravity, by a spring, or electrically, hydraulically or pneumatically or any other means.

An adjustable striker arm **43** is mounted on the shaft **38** so as to contact a micro-switch **44** when the interchangeable platform **37** reaches that position at which the valve at the orifice of the container C is opened by the nozzle **42**. The micro-switches **40**, **44** act also as mechanical stop members.

Referring now to FIG. 2, it will be seen that, in the electrical circuit of the apparatus shown in FIG. 1, all of the micro-switches with the exception of the micro-switch **40** carry both normally-closed and independent normally-open contacts. In the drawings they are shown in the spring loaded rest position. The contacts of these micro-switches all reverse upon the triggering of the switch.

An automatic change-over relay or switch **45** incorporating two coils **46**, **47** is included in the electrical circuit, one coil **46** being in the circuit of the solenoids **25**, **28** and the other coil **47** in the circuit of the solenoids **125**, **128**.

The coils **46** and **47** are alternatively connected in the electrical circuit by the switches **32** and **33** and selectively operate alternative sets of changeover contacts which, at the end of a cycle of operations, puts the opposite sides of the dual solenoids **25**, **125** and **28**, **128** and the appropriate switch of the pair **32**, **33** and of the pair **34**, **35** into the electric circuit for the next cycle, while leaving disconnected those switches which were responsible for the completed cycle.

The various components are mounted on a chassis **48** (FIG. 1) which is housed within, or forms the frame of, a cover or casing having the recess **36** at the front thereof.

In considering a sequence of operations on each container C it will be understood that the reference numeral **16** constitutes an inlet to the apparatus from a source of supply of the liquid product at a suitable pressure, which may for example be as low as say 20 lbs. per square inch or as high as 2,000 lbs. per square inch. Similarly reference numeral **19** represents the connection to a source of supply of propellant at equally widely different pressures. The electrical source is omitted from FIGURE 2 for the sake of clarity as are the change-over wiring and contacts for ensuing disconnection of some micro-switches simultaneously with others being energised. The various supporting brackets for the different components, such as the metering cylinders **17**, **20**, are also omitted for the same reason.

A can, canister, bottle or other container to be filled, which is diagrammatically represented at C, is placed on the platform **37** and pushed back against the V-shaped forward end of the arm **39** to retract the latter and thereby contact the micro-switch **40** which also acts as a mechanical stop to locate the container C in the required vertical alignment with the nozzle **42** of the valve assembly **10**. Contact of switch **40** initiates a complete cycle of operations by energizing the solenoid **41** through the normally closed contacts of switches **44** and **32** to cause the shaft **38** and platform **37** to rise until the valve controlled orifice (not shown) of the container C nests satisfactorily in sealed relationship with the nozzle **42**. Simultaneously with this the arm **43** of the shaft **38** comes into contact with the micro-switch **44** which acts as a mechanical stop to prevent any undue elevation of the platform **37** which might tend to damage the container C.

Triggering of the micro-switch **44** automatically opens the valves **22** and **11** in the vacuum line **14** so that a predetermined degree of vacuum is created within the container C. When this predetermined degree of vacuum has been achieved, the switch **23** is automatically operated to cause the valves **22** and **11** to close and to effect opening of the valve **12**.

At the instant of opening of the valve **12**, the four-way valve **24** is in the correct position for the necessary pressure supply of liquid product to the metering cylinder **17** so as to move the freely floating piston **30** thereof and discharge a measured dose of product to the container via the pipe line **18**, the valve **12** and the nozzle **42**. The volume of product in such dose is determined by the positions of the micro-switches **32**, **33** which limit the displacement of the piston **30**. According to the direction of displacement of the piston **30** in discharging this measured dose, one or other of micro-switches **32**, **33** will be triggered at the end of said displacement to displace the four-way valve **24** through 90° and also close the valve **12**. Such displacement of the valve **24** is, of course, achieved by the solenoid **25** or the solenoid **125** according to the direction of displacement of the piston and the particular micro-switch **32** or **33** which has been actuated. However, the arrangement is such that, when the valve **12** is re-opened during the next sequence of operations on a succeeding container, the charge at **16** is immediately available to displace the piston **30** in the opposite direction within its metering cylinder **17** due to the changed position of the four-way valve.

In addition to closing the valve **12**, the appropriate micro-switch **32**, **33**, as the case may be, simultaneously opens the valve **13** and this permits a similar action to be taken with the propellant. Thus, a supply of propellant

from the source 19 is passed through the four-way valve 27 to the metering cylinder 20 where it displaces the freely floaitng piston 31 thereof either to the left or to the right according to the position of the four-way valve 27 until such time as the predetermined dose is discharged via the pipe line 21, the valve 13 and the nozzle 42 to the container C. Operation either of the micro-switch 34 or 35 at the end of the stroke of the piston 31 energizes the solenoid 28 or the solenoid 128 to displace the four-way valve 27 to its alternative position so as to enable a similar dose of propellant to be inserted in the next succeeding container at the appropriate stage in the next complete cycle of operations.

The appropriate micro-switch 34, 35 acted upon at the end of the stroke of the piston 31 also operates to close the valve 13 and thus the nozzle 42 and also to cut off or to reverse the supply of current to the solenoid 41. The solenoid 41 then permits the shaft 38 and the platform 37 to descend, so that the filled container C may be withdrawn and the apparatus is ready to take another empty container for repetition of a similar complete cycle of operations.

It will be appreciated that in one complete cycle of operations the left-hand micro-switches 32, 34 and the solenoids 25, 28 are actively engaged and energized at appropriate parts of the cycle, while, during the next cycle of operations on a succeeding container C the right-hand micro-switches 33, 35 and the solenoids 125, 128 perform their required operations at the appropriate times.

It will also be appreciated that, by virtue of the fact that the piston 30 or 31 in the metering cylinder 17 or 20 is of the freely floating type and serves solely for metering, as distinct from liquid displacement purposes, any leakage which occurs between one side of the piston and the other has no effect on the quantity of liquid delivered during each piston stroke. Thus with apparatus embodying the present invention, a delivery accuracy in the region of 99.5% can be maintained. This is in favorable contrast to the accuracy achieved when a measured volume of liquid is inserted into a cylinder and then delivered therefrom by the hydraulic or other displacement of its piston. In the above arrangement, a number of factors, such as, the speed of displacement of the piston, the abruptness of starting and stopping of the piston, the load on the piston and the wear thereof leading to leakage between the piston and the cylinder walls combine to render it impossible to maintain a delivery accuracy greater than 95.0%.

Numerous modifications may be adopted without departing from the invention and its scope. Thus a switch (not shown) may be incorporated in each of the three circuits to enable any circuit to be cut out, when desired, without interfering with the starting and stopping of the apparatus on initiating and completing a predetermined sequence.

For the purpose of simplifying the structure, the triggering operations of the micro-switches may be effected by an intermediate mechanism which may be in the form of a bank of cams having a series of positions consistent with the cycle of operations to be performed. Thus, instead of effecting the triggering operations directly by the micro-switches referred to herein, these triggering operations may be achieved indirectly by the sequence control device described in the provisional specification of U.K. patent application No. 34,665/1958.

I claim:

1. Apparatus for filling pressurized containers; comprising a charging head having a nozzle adapted for connection to the inlet orifice of a container to be filled, a source of vacuum and at least first and second sources of fluids under pressure, said head having a passage extending to said nozzle for each of said sources, a shut-off valve means for closing each of said passages, conduit means connecting said source of vacuum with the related passage of said head, a metering cylinder for each source of fluid under pressure, a piston movable axially in said cylinder,

reversing valve means for each metering cylinder, conduit means extending from said reversing valve means to the related source of fluid under pressure, to the related passage of said head and to the opposite ends of the metering cylinder, said reversing valve means having a first operative position in which one end of said cylinder is communicated with the related source of fluid under pressure while the other end of the cylinder is communicated with the related passage of said head and a second operative position in which said related passage of the head and said source of fluid under pressure are respectively communicated with said one end and said other end of the cylinder, actuating means for each reversing valve means operative to dispose the latter alternatively in said first and second operative positions, and sequence control means including means operative to initially open the shut-off valve means associated with the passage of said head connected to said source of vacuum, means operative to close said shut-off valve means of the vacuum passage when a predetermined vacuum is attained in a container to be filled having its inlet orifice connected to said nozzle and to open the shut-off valve means of the passage for the first source of fluid under pressure so that fluid from said first source is discharged from an end of the related metering cylinder while fluid under pressure is admitted from said first source to the opposite end of said metering cylinder to displace said piston in the latter, and means responsive to a predetermined displacement of said piston to close said shut-off valve means of the fluid supply passage for the first source of fluid, to operate said actuating means for the related reversing valve means and to open the shut-off valve means of the passage for the second source of fluid under pressure so that fluid from said second source is discharged from an end of the related metering cylinder while fluid under pressure is admitted from said second source to the opposite end of the related metering cylinder to displace the piston in the latter, and means responsive to a predetermined displacement of the piston in the metering cylinder associated with said second source to close the related shut-off valve means and to operate the actuating means for the related reversing valve means.

2. Apparatus for filling pressurized containers; comprising a charging head having a nozzle adapted for connection to the inlet orifice of a container to be filled, a source of vacuum, a propellant source and a liquid product source, said head having passages communicating with said nozzle for the vacuum, propellant and product, respectively, and shut-off valve means for each of said passages, conduit means connecting said source of vacuum to said vacuum passage of the head, a metering cylinder for the propellant, a metering cylinder for the product, each of said metering cylinders having a piston movable axially therein, reversing valve means for each metering cylinder, conduit means extending from each reversing valve means to the related source and the related passage of said head and to the opposite ends of the related metering cylinder, each reversing valve means having a first operative position in which one end of the related metering cylinder is connected to the related source and the opposite end of the related cylinder is connected to the related passage of said head, and a second operative position in which said related passage and source are respectively connected to said one end and said opposite end of said related metering cylinder, actuating means for each reversing valve means operative to dispose the latter alternatively in said first and second operative positions, and sequence control means including means operative to initially open said shut-off valve means of the vacuum passage upon the connection of said nozzle to the inlet orifice of a container to be filled, means operative to close said shut-off valve means of the vacuum passage when a predetermined vacuum is attained in the container to be filled and to open the shut-off valve means of the product passage so that liquid product is discharged from an end of the related metering cylinder while liquid product

under pressure is supplied from the source thereof to the opposite end of the cylinder to displace said piston in the latter, means responsive to a predetermined displacement of the piston in the metering cylinder for the liquid product to close said shut-off valve means of the product passage and open said shut-off valve means of the propellant pasage, and to operate said actuating means for the reversing valve means associated with the product metering cylinder, and means responsive to a predetermined displacement of the piston in the metering cylinder for the propellant to close said shut-off valve means of the propellant passage and to operate said actuating means for the reversing valve means associated with the propellant metering cylinder.

3. Apparatus as in claim 2; wherein each of said means responsive to a predetermined displacement of the piston in the metering cylinder includes mechanical stop members adjustable parallel to the axis of the related metering cylinder and operative to limit the displacement of the piston in the latter in opposite directions, and micro-switches carried by said stop members and actuated upon the displacement of the related piston to the limit permitted by the related stop member.

4. Apparatus for filling pressurized containers; comprising a charging head having a downwardly projecting nozzle adapted for connection to the inlet orifice of a container to be filled, a vertically movable platform disposed below said nozzle and adapted to support a container to be filled, means responsive to the positioning of a container on said platform to effect upward movement of the latter so as to connect said nozzle with the inlet orifice of the container, a source of vacuum, conduit means connecting said source to said nozzle and having first and second valves in series therein, means opening said first and second valves in response to a predetermined upward movement of said platform, pressure responsive means closing said second valve upon the attainment of a predetermined vacuum in a container connected to said nozzle, at least one source of a fluid under pressure, a metering cylinder for each source of a fluid under pressure and having a piston movable axially therein, reversing valve means for each metering cylinder, conduit means connecting said reversing valve means to the related source and said nozzle and to the opposite ends of the related metering cylinder, said reversing valve means having a first operative position in which said source of fluid and said nozzle are connected to the opposite ends of said metering cylinder by way of said reversing valve means, and a second operative position in which the connections of said source of fluid and nozzle to the opposite ends of the metering cylinder are reversed, actuating means for said reversing valve means operative to dispose the latter alternatively in said first and second operative positions, a shut-off valve in said conduit means between said reversing valve means and said nozzle, means opening said shut-off valve upon the closing of said second valve by said pressure responsive means so that the fluid under pressure admitted to one end of said metering cylinder then displaces said piston in the latter to discharge the fluid from the opposite end of the metering cylinder to said nozzle, control means responsive to a predetermined displacement of said piston to close said shut-off valve and to operate said actuating means for the reversing valve means, a second source of fluid under pressure constituting a propellant and having associated therewith a second metering cylinder with a piston movable axially therein, a second reversing valve means with a corresponding second actuating means therefor, conduit means connecting said second source and nozzle to said second reversing valve means and connecting the latter to the opposite ends of said second metering cylinder, and a second shut-off valve in said conduit means between said second reversing valve means and said nozzle, said control means responsive to displacement of the piston of the first mentioned metering cylinder also causing opening of said second shut-off valve so that the propellant then admitted to said second metering cylinder causes displacement of the piston in the latter to effect discharge from said second metering cylinder to the nozzle of the propellant previously admitted to the second cylinder, and second control means responsive to a predetermined displacement of the piston in said second metering cylinder to close said second shut-off valve and to operate said second actuating means, whereby metered quantities of the liquid product and of the propellant are discharged through said nozzle into a container to be filled following the establishment of a vacuum in the container.

5. Apparatus as in claim 4; wherein each of said metering cylinders has piston rods projecting axially from the related piston through the opposite ends of the cylinder; and wherein each of said control means includes mechanical stop members interposed in the paths of movement of said piston rods and being adjustable parallel to said paths of movement for varying the lengths of the operating strokes of said piston, and micro-switches carried by said stop members and actuated by said piston rods at the ends of the operating strokes of the related piston.

References Cited in the file of this patent

UNITED STATES PATENTS

2,518,064	Rapisarda	Aug. 8, 1950
2,536,300	Martin	Jan. 2, 1951
2,661,885	McBean	Dec. 8, 1953
2,882,999	Morgan	Apr. 21, 1959