

Aug. 19, 1947.

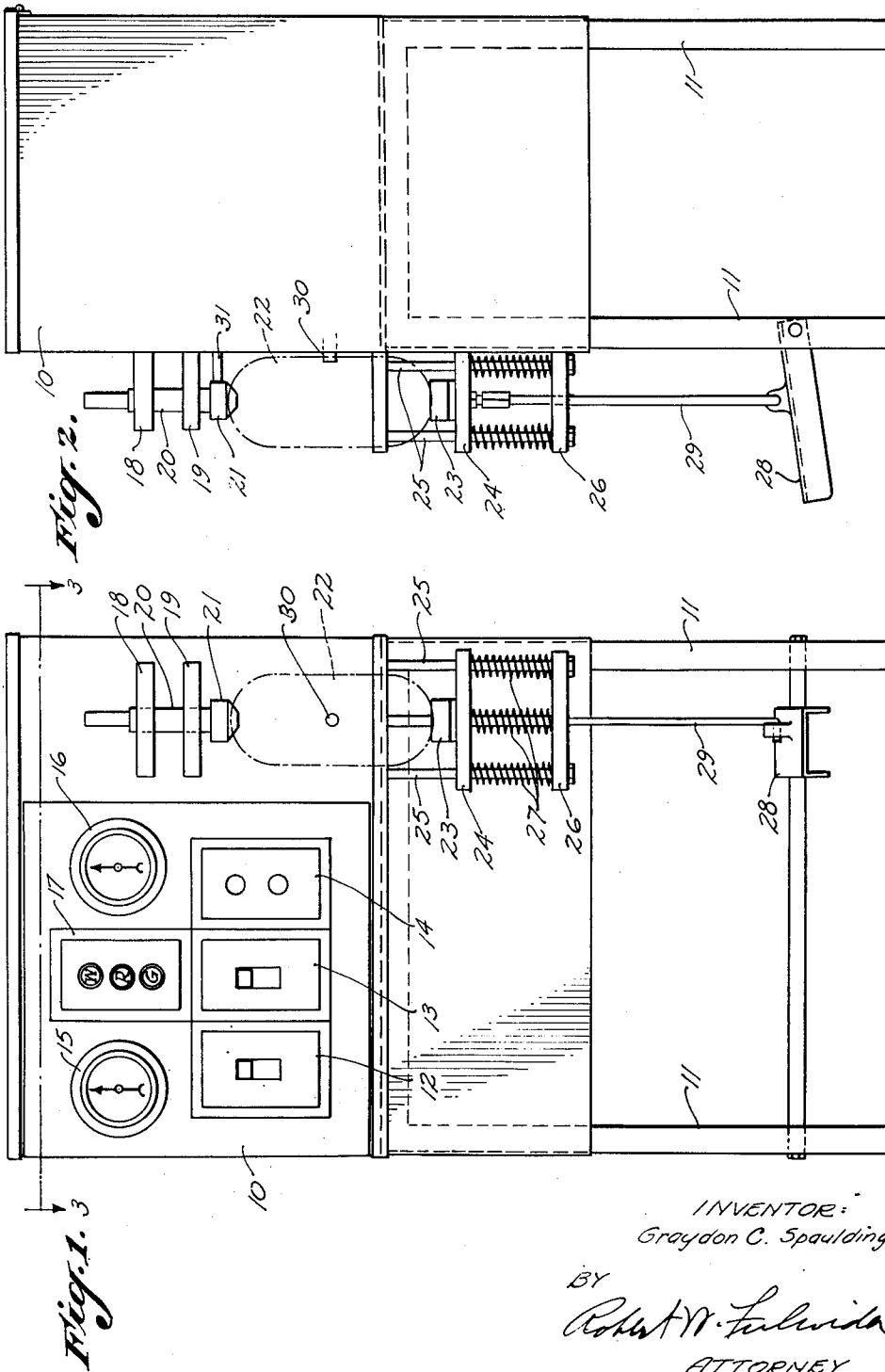
G. C. SPAULDING

2,425,844

APPARATUS FOR FILLING CONTAINERS WITH WEIGHED QUANTITY OF GASEOUS FLUID

Filed Nov. 30, 1943

5 Sheets-Sheet 1



INVENTOR:
Graydon C. Spaulding;

BY
Robert W. Furlow
ATTORNEY.

Aug. 19, 1947.

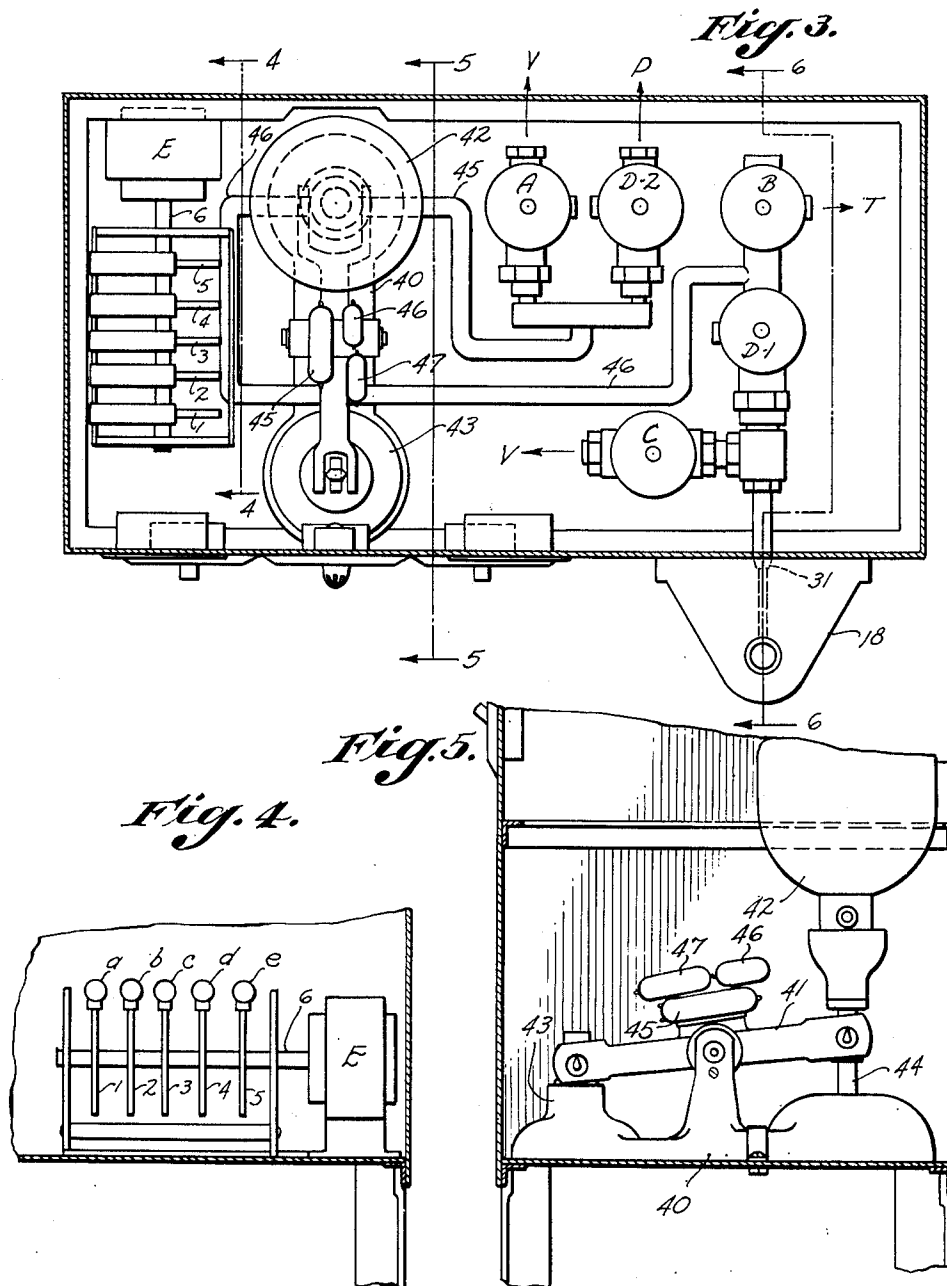
G. C. SPAULDING

2,425,844

APPARATUS FOR FILLING CONTAINERS WITH WEIGHED QUANTITY OF GASEOUS FLUID

Filed Nov. 30, 1943

5 Sheets-Sheet 2



INVENTOR.
Graydon C. Spaulding;

BY
Robert W. Fulwider
ATTORNEY.

Aug. 19, 1947.

G. C. SPAULDING

2,425,844

APPARATUS FOR FILLING CONTAINERS WITH WEIGHED QUANTITY OF GASEOUS FLUID

Filed Nov. 30, 1943

5 Sheets-Sheet 3

Fig. 6.

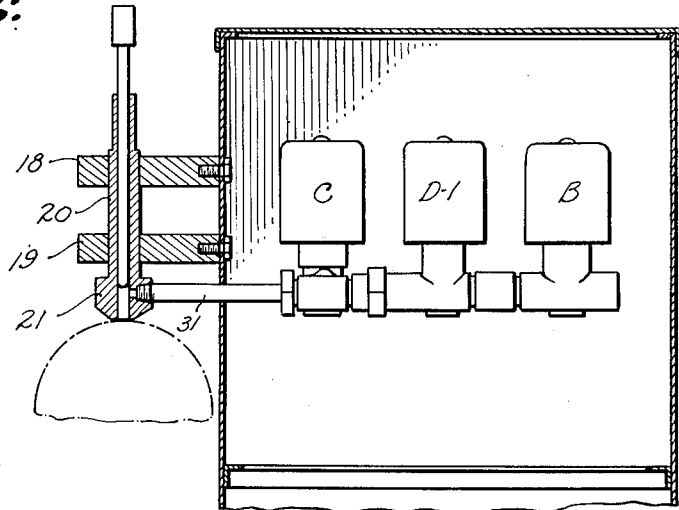
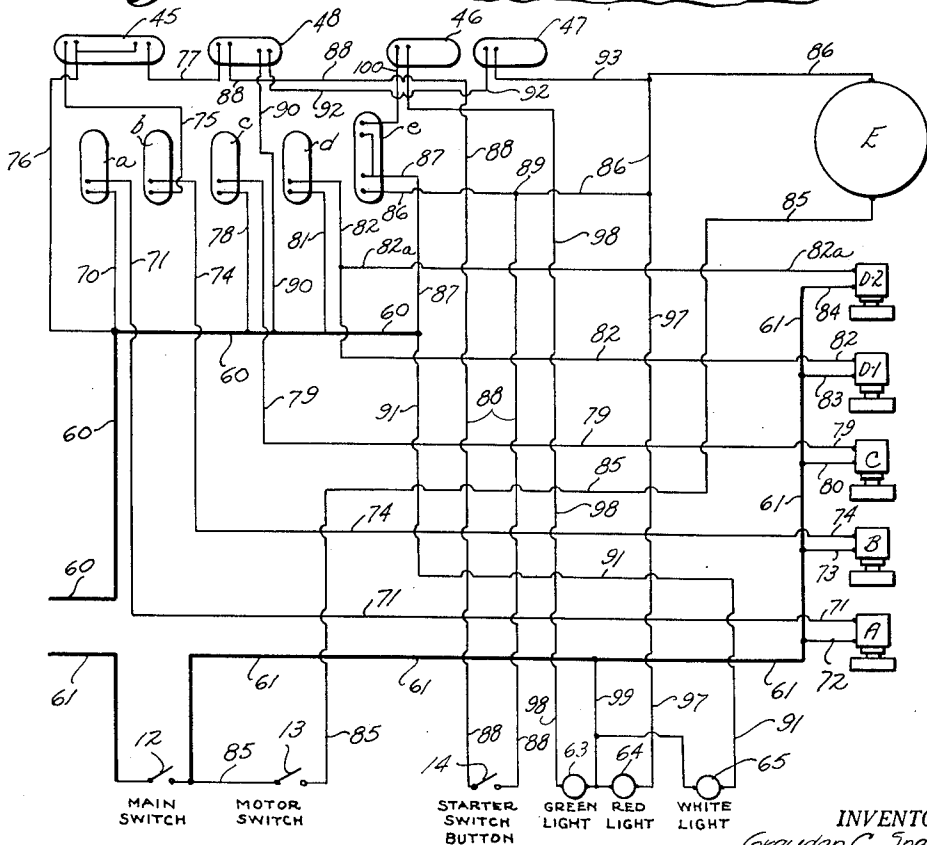


Fig. 7.



INVENTOR.

Graydon C. Spaulding;

BY

Robert W. Lulwida

ATTORNEY.

Aug. 19, 1947.

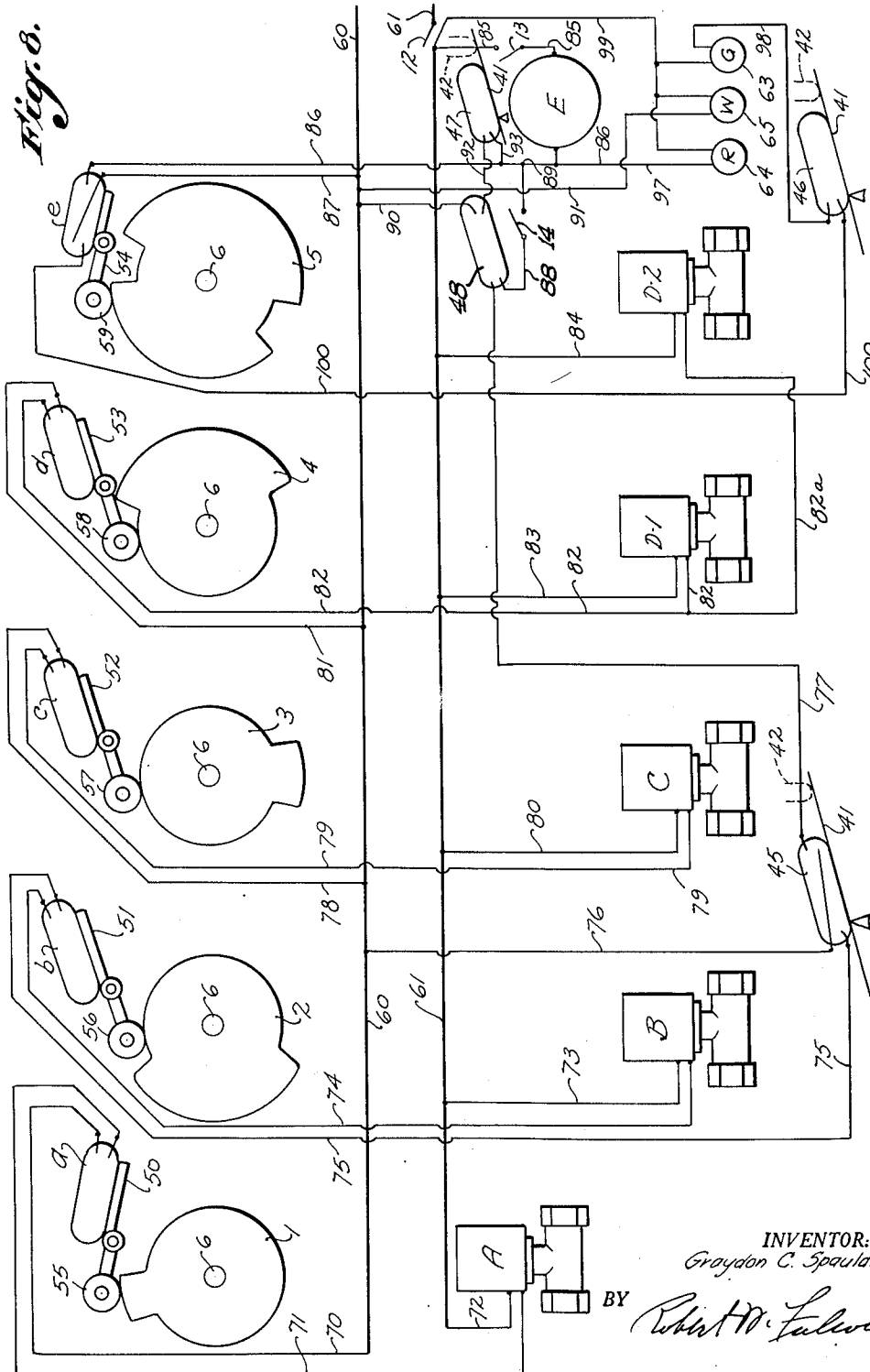
G. C. SPAULDING

2,425,844

APPARATUS FOR FILLING CONTAINERS WITH WEIGHED QUANTITY OF GASEOUS FLUID

Filed Nov. 30, 1943

5 Sheets-Sheet 4



INVENTOR:

Graydon C. Spaulding;

BY

Robert W. Lulwiler

ATTORNEY.

Aug. 19, 1947.

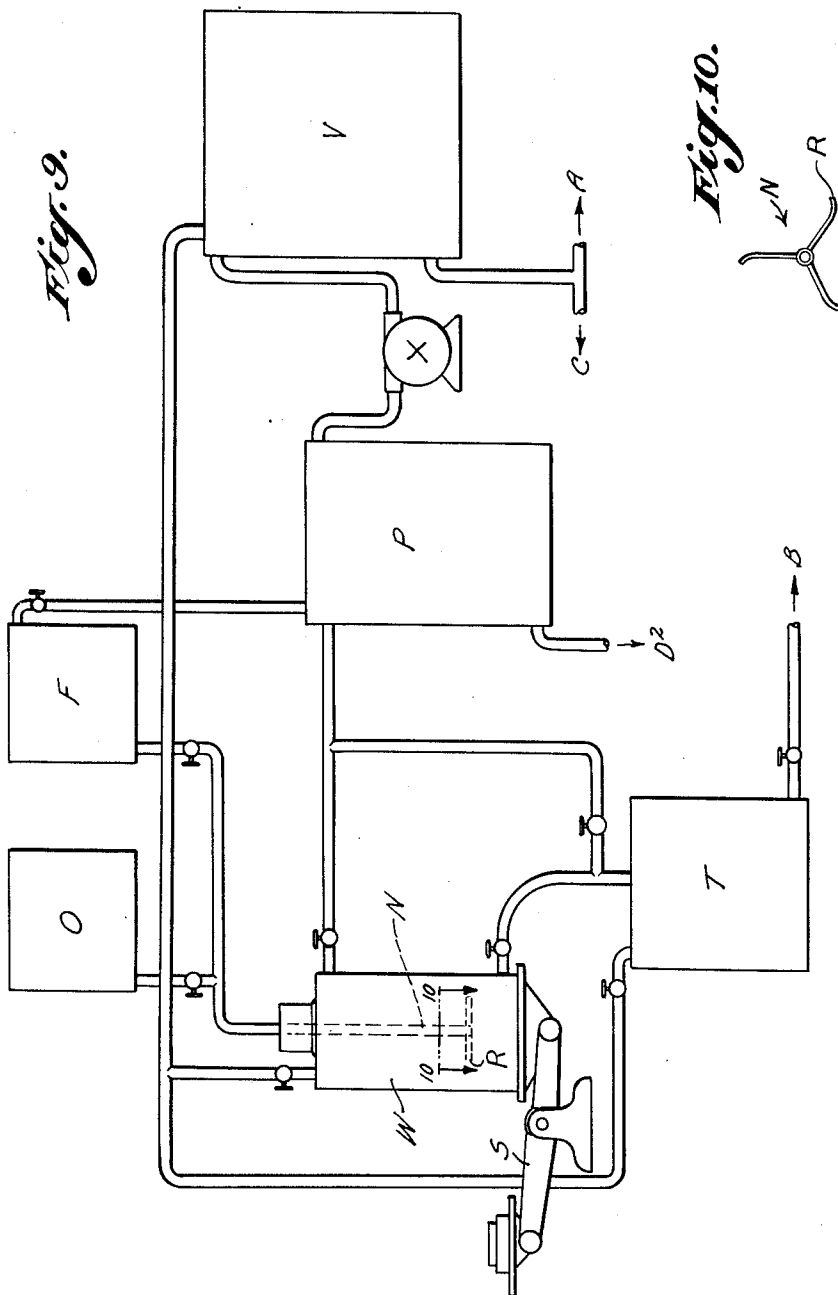
G. C. SPAULDING

2,425,844

APPARATUS FOR FILLING CONTAINERS WITH WEIGHED QUANTITY OF GASEOUS FLUID

Filed Nov. 30, 1943

5 Sheets-Sheet 5



INVENTOR.
Graydon C. Spaulding,
BY *Robert W. Lulwid*
ATTORNEY.

UNITED STATES PATENT OFFICE

2,425,844

APPARATUS FOR FILLING CONTAINERS
WITH WEIGHED QUANTITY OF GASEOUS
FLUIDGraydon C. Spaulding, Los Angeles, Calif., as-
signor to Industrial Management Corporation,
Los Angeles, Calif., a corporation of California

Application November 30, 1943, Serial No. 512,391

20 Claims. (Cl. 249—2)

1

My invention relates generally to the art of intimately mixing fluids having diverse vapor pressures, and the charging of the mixed fluid into containers from which it can be subsequently dispensed. More particularly, my invention relates to apparatus for accomplishing the foregoing where one or more normally liquid fluids are to be combined with one or more normally gaseous fluids to form a mixture which can be stored under pressure in the liquid phase, and which, upon the release will vaporize and discharge from the container by reason of the vapor pressure of the fluid.

The apparatus of my invention finds particular utility in the manufacture of aerosol insecticides, such for example as the one now being generally used by the Army which comprises 93% Freon-12 (dichlorodifluoromethane), 5% dewaxed pyrethrum extract, and 2% refined sesame oil. These ingredients when thoroughly mixed give a resultant product which has a vapor pressure of zero at -29° F., approximately 82 pounds at 70° F., and 500 pounds at 212° F. However, since pyrethrum extract and sesame oil are normally liquid at room temperatures and pressures, while Freon is normally gaseous under these conditions, considerable difficulty has been experienced in properly mixing these ingredients and charging them into dispensing containers suitable for individual use as insecticide sprays. These difficulties are eliminated by the use of my closed circuit method employing pressure differentials as a medium of transfer, the mixing being done on a weight, rather than a volumetric basis.

The major object of my invention is to provide apparatus for accomplishing the mixing, transferring and storing of ingredients of the above-mentioned type in a practical and efficient manner with an apparatus that is substantially automatic and foolproof.

It is a further object of my invention to provide an apparatus which accurately weighs and mixes the necessary ingredients and then charges a predetermined amount by weight of the mixture into a dispensing container.

It is also an object of my invention to provide weighing apparatus which is automatic in its operation so that when the required amount of the mixture has been fed into the weigh scale, the inlet valve is automatically closed, and the weighed quantity of fluid is thereupon charged into the dispensing container.

Another object of my invention is to provide a filling apparatus in which the automatic discharge of fluid from the weigh scale to a con-

2

tainer is prevented unless the container is in proper position for the filling operation. In this connection signal lights are provided so that the operator has visual notice at all times concerning the progress of the filling operation.

In general, I accomplish the foregoing and other objects by first mixing the desired fluid ingredients in the proper proportions, then charging the mixture into a weigh scale tank which has been previously evacuated, then transferring the weighed quantity of mixture to an evacuated dispensing container, and finally sealing the container so that it can be transported for use. I have found that by employing the apparatus of my invention, I am able to accomplish these functions rapidly and economically and that a single operator can handle the filling of a large number of containers during a given working period.

Referring now to the attached drawings which illustrate a preferred embodiment of the apparatus of my invention;

Fig. 1 is a front elevational view of a filling apparatus embodying my invention and showing the control panel and the charging and sealing means for the dispensing containers;

Fig. 2 is an end elevation of the apparatus shown in Fig. 1;

Fig. 3 is a top plan view of the apparatus with the cover removed taken substantially on the line 3—3 of Fig. 1 the letters and arrows indicating connections to similarly lettered parts of the apparatus of Fig. 9;

Fig. 4 is a vertical cross-section of the control cam apparatus taken on the line 4—4 of Fig. 3;

Fig. 5 is a vertical cross-section taken on the line 5—5 of Fig. 3, the upper portion thereof broken away;

Fig. 6 is a vertical cross-section taken on the line 6—6 of Fig. 3 with the lower portion thereof broken away;

Fig. 7 is a wiring diagram of the apparatus;

Fig. 8 is a diagrammatic view showing the relationship of the various control cams with their respective valves; and

Fig. 9 is a diagrammatic view illustrating one suitable arrangement of apparatus for employing my method of mixing the necessary fluid ingredients, the arrows and letters indicating connections to similarly lettered parts of the apparatus of Fig. 3.

Fig. 10 is a horizontal partial section taken on line 10—10 of Fig. 9.

Referring now to the drawings, and particularly to Fig. 9 thereof, the letter X indicates a compressor with its low pressure side connected

3

to a vacuum tank V and its high pressure side connected to a pressure tank P. A suitable scale S has a tank W balanced thereon having connections leading to a supply tank O containing normally liquid fluid, a supply tank F containing a normally gaseous fluid such as Freon, and a transfer tank T for receiving the mixture and transferring it to the filling apparatus shown in Figs. 1-8, inclusive. The weighing tank W and the transfer tank T are each connected to the high pressure line coming from pressure tank P and the low pressure line coming from the evacuated tank V.

Using the above apparatus in the production of aerosol by way of example, substantially the correct proportions of pyrethrum and sesame oil are mixed in the tank O and allowed to flow by gravity into the weighing tank W which has been previously evacuated by opening its valve connection with the tank V. The scale is then set to balance when the correct amount of Freon has been added to the tank W, and the valve connecting the tank W to the Freon storage tank F is opened and kept open until the correct amount of Freon has been admitted. A suitable mixing nozzle such as the nozzle N illustrated in Fig. 10 comprising a tube extending downwardly in the tank W and provided with a plurality of curved radial outlets R is preferably employed to secure a thorough mixture of the ingredients. This mixture is then transferred to tank T which has been previously evacuated by connection with low pressure tank V, the complete transfer from tank W to tank T being assisted by connecting tank W to high pressure tank P. When the transfer has been completed the tank W is again evacuated in order to be ready for the next mixing operation, which can be effected during the period when fluid is being drawn from tank T to the filling apparatus of Figs. 1-8, inclusive.

It will be understood of course that when the compressor is initially started preparatory to getting the apparatus in functional condition that the entire system has substantially all the air removed therefrom and replaced with Freon vapor so that subsequent applications of pressure to the tanks W and T from tank P will be accomplished with Freon gas instead of air. The system being a closed circuit, once this condition has been obtained, it will of course continue until such time as it may be necessary to shut down for repairs.

It will be apparent that by employing a system of pressure differentials as above described, I am able to secure thorough mixing of the two types of fluids with accurate proportioning thereof, and that the apparatus for accomplishing these results is simple and easy to operate.

Referring now to Figs. 1 and 2 of the drawings, the numeral 10 indicates a cabinet of suitable size supported by any convenient means, such as a plurality of legs 11. The front wall of the cabinet provides a control panel having thereon a main power switch 12 and a motor switch 13, and a push button starter switch 14, whose function will be discussed later. The control panel may also include vacuum and pressure gauges 15 and 16, and a signal light panel 17 having white, red, and green lights thereon, as indicated in Fig. 1. Mounted on the forward wall of the cabinet 10 and adjacent the control panel I provide outwardly extending brackets 18 and 19, in which a vertically disposed filling and capping tube 20 is held. The tube 20 terminates in a

4

filling head 21 on its lower end which has a conical base adapted to engage the filling end of a dispensing container 22 which is held in tight engagement therewith. Suitable clamping means is provided for holding the dispensing container 22 in filling position against the filling head 21, such for example as the treadle operated spring-powered clamping head 23 carried by a horizontally disposed bracket 24 which is vertically slidable on a set of guide rods 25. A fixed horizontal bracket 26 is secured to the lower ends of the guide rods 25 and compression springs 27 are provided between the brackets 24 and 26 to urge the movable bracket 24 upwardly to force the clamping head 23 against the container 22 and hold the same in filling engagement with the filling head 21. A treadle 28 may be connected by a vertical tension rod 29 to the movable bracket 24 so that downward pressure on the treadle will pull the bracket 24 and clamping head 23 downwardly to release the container 22 for removal from the machine and to permit the insertion of a new container to be filled.

A horizontal plunger 30 is movably mounted in the forward wall of the cabinet 10 and is connected to a mercury switch as hereinafter described. The plunger 30 is engageable with the container 22 so that unless a container is in filling position the switch operated by the plunger 30 prevents passage of the filling fluid to the filling head 21 through the duct 31. It will be understood of course that various types of containers can be filled by the method and apparatus of my invention, and that the filling head 21 and clamping head 23 may therefore be modified as required for particular containers.

The cycle of operations involved in the filling operation is similar to that previously described for the mixing operation except that all of the valves are electrically operated either by movement of the weigh scale or by a bank of novel control cams. In general the series of operations is as follows: the weigh scale tank is first evacuated and then filled with the correct amount of fluid drawn from the storage tank T shown in Fig. 9; the dispensing container to be filled is evacuated and the fluid is transferred from the weigh scale tank to the dispensing container with the aid of a booster pressure supplied by the high pressure tank P of Fig. 9; and the dispensing container is then sealed and removed from the machine which is ready for another cycle.

In my preferred apparatus for accomplishing the above cycle, I provide a weigh scale 40 having a balance arm 41 upon one end of which is disposed a closed container 42 of substantially the same size as the dispensing container 22. The free end of the balance arm 41 is provided with adjustable balance weights (not shown) removably positioned on a depending rod vertically movable in a hollow guide housing 43 open at its upper end for the insertion or removal of said weights. The end of the balance arm which carries the weighing container 42 is also provided with a vertical guide arm 44 for preventing lateral movement of the balance. The various transfers of the fluids are controlled by a plurality of solenoid operated valves indicated by the letters A, B, C, D1 and D2 in the drawings. The valves A, and D2 connect the scale container 42 with the vacuum tank V and the high pressure tank P, respectively as indicated diagrammatically by arrows in Fig. 3. Valves C and D1 are each con-

5

connected to the charging outlet 31 leading to the dispensing container 22 to be filled, the other side of valve C being connected to the vacuum tank V, and the other side of valve D1 being connected to the weighing tank 42. The valve B connects the weighing container 42 to the transfer tank T.

The valves A, B and C are electrically operated through mercury switches a, b, and c which are in turn operated by cams 1, 2 and 3 which are rotatable with a cam shaft 6 operated by a motor E. (See Figs. 3 and 4.) A mercury switch d operated by a cam 4 on shaft 6 controls the operation of valves D1 and D2 while a mercury switch e operated by a cam 5 serves to start and stop the cam shaft motor E. These electrical connections are best seen in Figs. 7 and 8.

The balance arm 41 of the scale 40 carries three mercury switches 45, 46 and 47, and a mercury switch 48 is pivotally mounted adjacent the inner end of the plunger 30 so as to be operated by the container 22. These switches are best seen in the wiring diagram of Fig. 7 and in the plan view of Fig. 3. As seen in Fig. 8, the various mercury switches a, b, c, d and e are mounted on pivoted arms 50, 51, 52, 53 and 54, respectively, said arms being provided with cam followers 55, 56, 57, 58 and 59 adapted to ride on cams 1, 2, 3, 4, and 5, respectively. In each instance, the cam and switch are so arranged that when the cam follower is riding the high face of the cam, the switch is closed and during the balance of the cycle, the switch remains open.

The circuit connections for the above-described parts are as follows: Numerals 60 and 61 indicate the main leads from a source of electric power, there being a main control switch 12 to disconnect the apparatus entirely. The solenoid valve A and its mercury switch a are connected across the main lines 60 and 61 by means of leads 70, 71, and 72 so that when the follower 55 is riding the high face of the cam 1 the circuit from main 60 comprises lead 70, switch a, lead 71, solenoid A and lead 72 back to main 61. A lead 73 connects the main 61 with the solenoid B from which a connector 74 runs to one side of the mercury switch b, the other side of which has a connector 75 extending to one terminal of the weight trip mercury switch 45 mounted on the balance arm 41. This circuit is completed by a lead 76 running from the other terminal of the switch 45 to the main 60. The mercury switch 45 is positioned so that when the weighing container is empty and the balance arm consequently assumes the position shown diagrammatically in Fig. 8, switch 45 is closed completing the circuit for solenoid valve B. It will be noted however that when the weighing container 42 is filled and the balance arm 41 rocks in a clockwise direction, the connection between leads 75 and 76 is broken, thus disconnecting the solenoid B and closing its valve. However, the switch 45 is of the double type so that when its right end is rocked downwardly, the circuit is closed between live lead 76 and a lead 77 running to one terminal of mercury switch 48 which is operated by the dispensing container 22.

The solenoid C which evacuates the dispensing container is connected directly across the main lines 60 and 61 through lead 78 running from the main 60 to the mercury switch c, lead 79 running from the switch c to the solenoid C and the lead 80 tying back into line 61. A lead 81 connects main 60 to switch d from which a connector 82 runs to solenoid D1 whose circuit is closed by

6

lead 83 connecting with main 61. The connector 82 has a branch 82a leading to one side of the solenoid D2, the circuit for which is completed through a lead 84 to main 61. It is thus seen that operation of the cam 4 and switch d simultaneously opens or closes valves D1 and D2.

The primary circuit for the cam shaft motor E comprises a lead 85 running directly from main 61 through motor switch 13 to the motor E, the other side of which is connected by a lead 86 to one terminal of mercury switch e, which is actuated by the motor cam 5, and thence to main 60 by means of a connector 87. An auxiliary motor circuit is provided through lead 76, weight trip switch 45, lead 77, mercury switch 48, lead 88, switch 14, junction 89, the motor, and lead 85 back to main 61. It will be noted that this circuit is set up when the weighing container 42 is full so as to depress mercury switch 45, and a dispensing can 22 is in position to move mercury switch 48 to the position shown in Fig. 8. With the switches 45 and 48 in closed position, depression of the starter button 14 closes the auxiliary circuit and operates the motor E. A second auxiliary circuit is provided to operate the motor E when there is no dispensing can in filling position and the mercury switch 48 is consequently rotated clockwise from the position shown in Fig. 8, which rotation closes the pair of terminals in the right end of the switch. However this circuit is not completed unless a third mercury switch, indicated by the numeral 47, which is mounted on the balance arm 41 is in the position shown in Fig. 8, i. e., when the weighing container 42 is empty. With these two switches in closed position the circuit is completed by means of a lead 90 connecting the switch 48 directly to main 60, a second lead 92 which connects switch 48 with switch 47, and a third lead 93 running from switch 47 to lead 88.

A lead 99 running from main 61 has branches which connect with each of the lamps 63, 64 and 65. The free terminal of lamp 65, which is the white light, is connected by means of a connector 91 directly to main 60 so that this lamp glows at all times during the operation of the machine to indicate that the power is on. The free terminal of the green lamp 63 is connected through a lead 98 to one terminal of the solenoid switch 46 which is carried on balance arm 41 in such a manner that when the weighing container 42 is empty and the balance arm is in the position shown in Fig. 8, the switch 46 is closed and connects lead 98 with lead 100 which goes to the single terminal side of mercury switch e. It will be seen that switch e closes this circuit through connector 87 when the follower 59 drops into either of the dwells on cam 5. In other words, the green lamp 63 is illuminated whenever the weighing container 42 is empty and the motor e is not operating. The red lamp 64 is connected in parallel with the motor E and therefore glows whenever the motor is operating.

Assuming cams 1 to 5 to be in the position shown in Fig. 8, with a dispensing container 22 in filling position to cause plunger operated switch 48 to assume the position shown in Fig. 8, and assuming that the weighing container 42 is empty so that the balance 41 is in the position shown in Fig. 8, the cycle of operations will be as follows: The switch 12 is first closed which causes the white light 65 to glow showing that the circuit is live, and the motor switch 13 is closed to energize the motor circuit through the mercury switch e. With rotation of the motor E

7

the cam shaft 6 and the cams 1 to 5 start rotating and since the high face of cam 1 is engaging follower 55, mercury switch *a* is closed which opens valve A between the weighing container 42 and the vacuum tank V. With the cam faces proportional substantially as shown in the drawings, and with the motor rotating at the speed now being used in the bottling of aerosol, the evacuating valve A remains open for approximately five seconds, which is sufficient to substantially evacuate the weighing container 42. At the end of this time the cam follower 55 drops down to the low portion of cam 1 opening mercury switch *a* and closing solenoid valve A. At the same time the high side of cam 2 engages its follower 56 which rocks mercury switch *b* clockwise to close the same and complete the circuit to filling valve B which stays open for approximately 27½ seconds. However the closing of valve B is controlled by the weight trip mercury switch 45 on balance arm 41 so that when the required weight of aerosol has been injected into the weighing container 42, the balance 41 will rotate clockwise to open the circuit of valve B and close the circuit to the switch 48. By this time the follower 59 has reached its first dwell portion on the motor cam causing the mercury switch *c* to open, thus breaking the primary motor circuit. This break in the primary motor circuit is a safety feature to prevent transferring the aerosol from the weighing tank 42 to the filling duct 31 unless a dispensing container 22 is in place to receive the fluid.

Assuming that a dispensing container 22 is properly positioned in the apparatus for filling, the operator pushes the push-button switch 14 which completes the motor auxiliary circuit through mercury switches 45 and 48. The switch 14 is held down until the follower 59 rises up on the next high portion of the cam 5 which closes the primary motor circuit through switch *c* and permits switch 14 to be released. This further rotation of the cam shaft causes the high face of cam 3 to engage its follower 57 thus closing the switch *c*, and opening the valve C to evacuate the dispensing container 22. This evacuation usually takes approximately five seconds, at the end of which time the cam 3 causes the switch *c* to open, thereby closing valve C and disconnecting the vacuum tank V from the dispensing container. The high side of cam 4 has now come around to a position where it raises its follower 58, closing mercury switch *d* and opening valves D1 and D2. The opening of valve D1 opens the line between the weighing container 42 and dispensing container 22 to allow flow of fluid thereto; and the opening of valve D2 connects the weighing container to the pressure tank P thus admitting Freon gas under pressure to boost the liquid mixture from the weighing container to the dispensing container. The transferring operation usually occupies 27½ seconds whereupon switch D is opened by cam 4 and the follower 59 has reached the second dwell in the motor cam 5 bringing the motor to rest. Since the weighing container 42 has now been emptied the balance arm 41 rotates counter-clockwise back to the position shown in Fig. 8 which opens the first auxiliary motor circuit and sets up the green light circuit through switch 46. Since cam follower 59 on cam 5 is in its lowermost position the switch *e* is rotated counter-clockwise and secondary contact therein is closed, thus completing the green light circuit and illuminating the bulb 63 to indicate to the operator that the dispensing

8

container has been filled, the motor has come to rest, and he may proceed to seal the dispensing container and remove the same from the apparatus. While various types of dispensing containers can be employed, I prefer to use one having a shape substantially as shown, with a small filling tube in the base thereof, the container being placed in the machine in inverted position. The sealing can be accomplished in any convenient manner.

The second auxiliary circuit will remain closed while the weighing container 42 is being evacuated, and until it has been filled. However when the proper weight of fluid has been introduced into the weighing container it will rock the balance 41 as previously described, shutting off the filling valve B and also rocking the automatic starting mercury switch 47 on the balance arm 41, thus breaking the second auxiliary motor circuit, and unless the follower 59 is on the high face of the motor cam 25, the motor comes to rest. Since the cams are proportioned so that the weighing balance always rocks down before the cam motor follower reaches its dwell, the opening of the second auxiliary motor circuit is always assured, and the machine will come to rest. Normally the operator will have placed a new dispensing container in position to be filled so that he will immediately press the push-button switch 14 to cause the apparatus to resume its cycle. However if for any reason he has not placed a container in position to be filled, closing of the starting switch 14 will not operate to start the motor E and consequently there can be no loss of Aerosol by reason of discharging it into the air. The red light 64 being connected in parallel with the motor will be lighted whenever the motor is operating and will be dark when the motor is stopped. This gives the operator a continuous check on the operation of the machine, and in the event that the red light does not come on according to schedule he will have visual notice that something needs repairing.

It will be understood that while the apparatus herein shown and described in detail is now believed to be the preferred form for practicing my invention, I do not mean to be limited to the precise arrangement of parts, times, or proportions shown, but intend that my invention shall be accorded the full scope of the appended claims.

I claim:

1. In apparatus for mixing fluids the combination of: a compressor; a tank connected to the intake side of said compressor; a tank connected to the outlet side of said compressor; a tank on a weigh scale connected to each of said first mentioned tanks; a plurality of feed tanks connected to said weight scale tank, one of said feed tanks being also connected to said pressure tank; a transfer tank connected to said weigh scale tank and to each of said first mentioned tanks; and valve means between all of said tanks whereby said weigh scale tank may first be evacuated, then filled with liquids, and then emptied of said liquids.

2. In fluid handling apparatus the combination of: weighing means including a container; means for periodically connecting said container to an evacuating means; means for introducing fluid into said container after it has been evacuated; electrically operated valve means actuated by said weighing means for discontinuing the flow of fluid thereto; means for evacuating a second container; means for connecting said containers; and valve means permitting transfer of said fluid

from said first container to said second container.

3. In fluid handling apparatus the combination of: weighing means including a container; electrically operated valve means for evacuating and filling said container; a switch on said weighing means adapted to discontinue said filling operation when a predetermined weight of said fluid has entered said container; electrically operated valve means for evacuating a second container and transferring said fluid thereto from said first container; and valve means for connecting said first container to a source of gas pressure to boost the fluid therefrom to said second container.

4. In fluid handling apparatus the combination of: weighing means including a container; electrically operated valve means for evacuating and filling said container; a switch on said weighing means adapted to discontinue said filling operation when a predetermined weight of said fluid has entered said container; electrically operated valve means for evacuating a second container and transferring said fluid thereto from said first container; electrically operated valve means for connecting said first container to a source of gas pressure to boost the fluid therefrom to said second container; and cam and switch means for operating said valves in a predetermined order to effect said cycle of operations.

5. In fluid handling apparatus the combination of: weighing means including a container; a solenoid valve connecting said container to an evacuating means; a second solenoid valve connecting said container to a source of fluid under pressure; switch means on said weighing means adapted to close said second valve when a predetermined quantity of fluid has entered said container; a third solenoid valve connecting a second container with said evacuating means; a fourth solenoid valve adapted to connect said first container to said second container to permit transfer of said fluid; separate cam operated switch means for each of said valves; a motor for operating said cams in timed relationship; a cam driven by said motor for controlling the starting and stopping thereof; and auxiliary switching means for starting said motor irrespective of the position of its said controlling cam.

6. In fluid handling apparatus the combination of: weighing means including a container; a solenoid valve connecting said container to an evacuating means; a second solenoid valve connecting said container to a source of fluid under pressure; switch means on said weighing means adapted to close said second valve when a predetermined quantity of fluid has entered said container; a third solenoid valve connecting a second container with said evacuating means; a fourth solenoid valve adapted to connect said first container to said second container to permit transfer of said fluid; separate cam operated switch means for each of said valves; a motor for operating said cams in timed relationship; a cam driven by said motor for controlling the starting and stopping thereof; and switch means connected to said weighing switch means and to said motor to close the motor circuit only when said weighing container is full and said second container is in position to be filled.

7. In fluid handling apparatus the combination of: weighing means including a container; a solenoid valve connecting said container to an evacuating means; a second solenoid valve connecting said container to a source of fluid under pressure; switch means on said weighing means adapted to close said second valve when a prede-

termined quantity of fluid has entered said container; a third solenoid valve connecting a second container with said evacuating means; a fourth solenoid valve adapted to connect said first container to said second container to permit transfer of said fluid; separate cam operated switch means for each of said valves; a motor for operating said cams in timed relationship; a cam driven by said motor for controlling the starting and stopping thereof; a first switch in a circuit for said motor carried by said weighing means and adapted to close when said weighing container is empty and to open when said container is filled; and a second switch in said motor circuit and adapted to close only when there is no second container in position to be filled.

8. In fluid handling apparatus the combination of: weighing means including a container; a solenoid valve connecting said container to an evacuating means; a second solenoid valve connecting said container to a source of fluid under pressure; switch means on said weighing means adapted to close said second valve when a predetermined quantity of fluid has entered said container; a third solenoid valve connecting a second container with said evacuating means; a fourth solenoid valve adapted to connect said first container to said second container to permit transfer of said fluid; separate cam operated switch means for each of said valves; a motor for operating said cams in timed relationship; a cam driven by said motor for controlling the starting and stopping thereof; switch means connected to said weighing switch means and to said motor to close the motor circuit only when said weighing container is full and said second container is in position to be filled; an auxiliary circuit for said motor; a first switch in said auxiliary motor circuit carried by said weighing means and adapted to close when said weighing container is empty and to open when said container is filled; and a second switch in said auxiliary circuit and adapted to close only when there is no second container in position to be filled.

9. In fluid handling apparatus having a source of fluid, a source of vacuum, weighing means including a container and a switch movable therewith, a plurality of electrically operated valves and connections adapted to first evacuate and then fill said container with liquid under pressure, and then to evacuate a second container and transfer said liquid thereto, the combination of: cam operated switches for operating each of said valves; a motor for operating said cams in timed relationship; a cam operated by said motor and adapted to open the motor circuit upon the completion of the filling of said weighing container; an auxiliary motor circuit which is set up by the filling of said first container and the presence of the second container in position to have said liquid transferred to it; and a manually operated switch in said auxiliary circuit for closing the same.

10. In fluid handling apparatus having a source of fluid, a source of vacuum, weighing means including a container and a switch movable therewith, a plurality of electrically operated valves and connections adapted to first evacuate and then fill said container with liquid under pressure, and then to evacuate a second container and transfer said liquid thereto, the combination of: cam operated switches for operating each of said valves; a motor for operating said cams in timed relationship; a cam operated by said motor and adapted to open the motor circuit upon the

11

completion of the filling of said weighing container; an auxiliary motor circuit which is set up by the filling of said first container and the presence of the second container in position to have said liquid transferred to it; a manually operated switch in said auxiliary circuit for closing the same; a second auxiliary motor circuit comprising a switch carried by said weighing means and adapted to close when said weighing container is empty and to open when said container is filled; and a switch in said second auxiliary circuit, operated by means engageable with said second container when the latter is in position to be filled, and adapted to be closed when no container is in filling position to thereby complete said second auxiliary circuit.

11. In fluid handling apparatus the combination of: weighing means including a container; a solenoid valve connecting said container to an evacuating means; a second solenoid valve connecting said container to a source of fluid under pressure; switch means on said weighing means adapted to close said second valve when a predetermined quantity of fluid has entered said container; a third solenoid valve connecting a second container with said evacuating means; a fourth solenoid valve adapted to connect said first container to said second container to permit transfer of said fluid; separate cam operated switch means for each of said valves; a motor for operating said cams in timed relationship; a cam driven by said motor for controlling the starting and stopping thereof; switch means connected to said weighing switch means and to said motor to close a first motor circuit only when said weighing container is full and said second container is in position to be filled; a starter switch in a second motor circuit carried by said weighing means and adapted to close when said weighing container is empty; and a second switch in said second motor circuit and adapted to close only when there is no second container in position to be filled; a third switch carried by said weighing means adapted to close when said weighing container is empty to complete a lamp circuit which has a second switch therein adapted to be closed when said motor is not operating; a solenoid operated valve operated by the cam and switch that operate the liquid transfer valve and adapted to connect said weighing container to a source of gas pressure; and a signal light connected in parallel with said motor and adapted to light when said motor is operating.

12. In apparatus for handling fluids the combination of: a compressor; a container connected to the intake side of said compressor; a container connected to the outlet side of said compressor; a container on a weigh scale connected to each of said first-mentioned containers; a supply container connected to said weigh scale container; a transfer container connected to said weigh scale container; and valve means between all of said containers whereby said weigh scale container may first be evacuated, then filled with liquid, and then said liquid may be transferred to said transfer container.

13. In fluid handling apparatus the combination of: weighing means including a container; means for periodically connecting said container to an evacuating means; means for introducing fluid into said container after it has been evacuated; means for discontinuing the flow of fluid into said container when said weighing means balances; means for evacuating a second container; means for connecting said containers;

12

and valve means permitting transfer of said fluid from said first container to said second container.

14. In fluid handling apparatus the combination of: weighing means including a container; means for periodically connecting said container to an evacuating means; means for introducing fluid into said container after it has been evacuated; means for discontinuing the flow of fluid into said container when said weighing means balances; means for evacuating a second container; means for connecting said containers; valve means permitting transfer of said fluid from said first container to said second container; and valve means for connecting said weighing container to a source of gas pressure to boost the fluid therefrom to said second container.

15. In fluid handling apparatus the combination of: weighing means including a container; means for periodically connecting said container to an evacuating means; means for introducing fluid into said container after it has been evacuated; means actuated by said weighing means for discontinuing the flow of fluid thereto; means for evacuating a second container; means for connecting said containers; electrically controlled valve means permitting transfer of said fluid from said first container to said second container; and cam and switch means for operating said valves in a predetermined order to effect said cycle of operations.

16. In fluid handling apparatus the combination of: weighing means including a container; electrically operated valve means for evacuating and filling said container; a switch operable in response to movement of said weighing means adapted to discontinue said filling operation when a predetermined weight of said fluid has entered said container; electrically operated valve means for evacuating a second container and transferring said fluid thereto from said first container; cam operated switches for operating each of said valves; a motor for operating said cams in timed relationship; means operated by said motor adapted to open the motor circuit upon the completion of the filling of said weighing container; an auxiliary motor circuit which is set up by the filling of said first container and the presence of the second container in position to have said liquid transferred to it; and a switch in said auxiliary circuit for closing the same.

17. In fluid handling apparatus the combination of: weighing means including a container; electrically operated valve means for connecting said container to evacuating means; electrically operated valve means for connecting said container to a supply of fluid; a switch on said weighing means adapted to discontinue said filling operation when a predetermined weight of said fluid has entered said container; electrically operated valve means for connecting a second container to evacuating means; and electrically operated valve means for transferring said fluid to said second container from said first container.

18. In fluid handling apparatus the combination of: weighing means including a container; means for periodically connecting said container to an evacuating means; means for introducing fluid into said container after it has been evacuated; means actuated by said weighing means for discontinuing the flow of fluid thereto; means for evacuating a second container; means for connecting said containers; valve means permitting transfer of said fluid from said first container to said second container; and means oper-

able by said second container to prevent the transfer of said fluid from said first container unless said second container is in proper position to receive the same.

19. In apparatus for handling fluids the combination of: a low pressure container; a high pressure container; means for maintaining a pressure differential between said containers; a container on a weigh scale connected to each of said first-mentioned containers; a supply container connected to said weigh scale container; a transfer container connected to said weigh scale container and to each of said first-mentioned containers; and valve means between all of said containers whereby said weigh scale container may first be evacuated, then filled with fluid, and then said fluid may be transferred to said transfer container.

20. In apparatus for handling fluids the combination of: a low pressure container; a high pressure container; means for maintaining a pressure differential between said containers; a container on a weigh scale connected to each of said first-mentioned containers; a supply container connected to said weigh scale container; and valve means between all of said containers whereby said weigh scale container may first be evacuated, then filled with fluid and then emptied of said fluid.

GRAYDON C. SPAULDING.

5

10

15

20

25

30

REFERENCES CITED

The following references are of record in the file of this patent:

UNITED STATES PATENTS

Number	Name	Date
484,078	Wittmann	Oct. 11, 1892
678,862	Cleveland	July 23, 1901
2,138,356	Ryan et al.	Nov. 29, 1938
1,089,851	McNeill	Mar. 10, 1914
1,591,932	Young	July 6, 1926
1,296,920	Chambers	Mar. 11, 1919
2,132,237	Haegle	Oct. 4, 1938
2,140,811	Poole	Dec. 20, 1938
2,232,404	Pratt	Feb. 18, 1941
2,287,829	Bryan	June 30, 1942
517,161	Hunt	Mar. 27, 1894
2,037,467	Hapgood	Apr. 14, 1936
2,361,863	Miller	Oct. 31, 1944
2,048,897	Staber	July 28, 1936
2,075,408	Sholes	Mar. 30, 1937

FOREIGN PATENTS

Number	Country	Date
677,850	Germany	July 4, 1939
94,612	Germany	Oct. 23, 1897
375,918	Great Britain	July 7, 1932
563,393	France	Sept. 25, 1923

Certificate of Correction

Patent No. 2,425,844.

August 19, 1947.

GRAYDON C. SPAULDING

It is hereby certified that errors appear in the above numbered patent requiring correction as follows: In the grant, line 1, name of inventor, for "Graudon C. Spaulding" read *Graydon C. Spaulding*; column 8, line 58, for "weight" read *weigh*; and that the said Letters Patent should be read with these corrections therein that the same may conform to the record of the case in the Patent Office.

Signed and sealed this 25th day of November, A. D. 1947.

[SEAL]

THOMAS F. MURPHY,
Assistant Commissioner of Patents.