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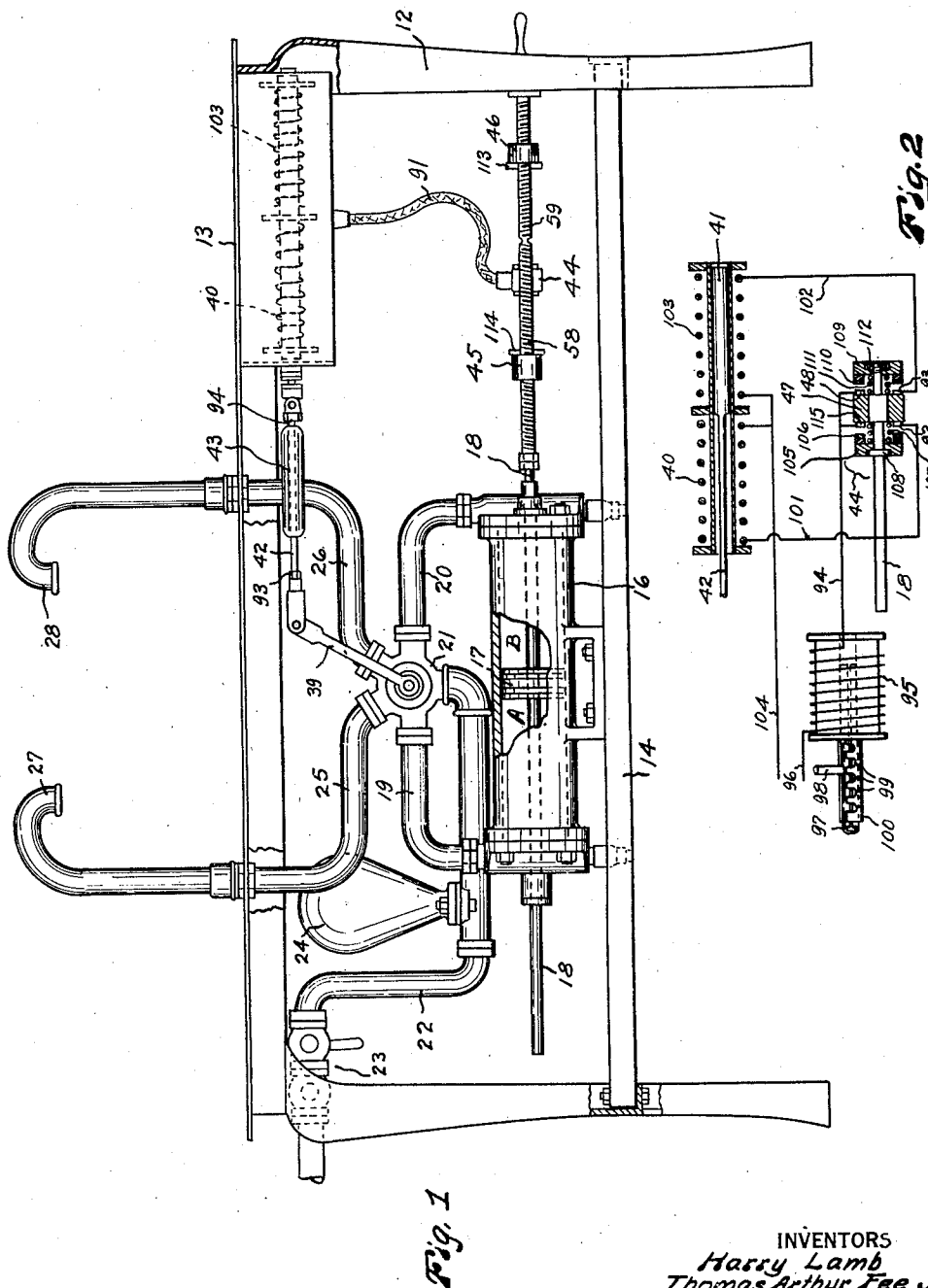
H. LAMB ET AL

1,932,976

METERING-FILLING MACHINE

Filed June 16, 1926

3 Sheets-Sheet 1



INVENTORS
Harry Lamb
Thomas Arthur Fee Jr.
BY
G. Wright Arnold
ATTORNEY

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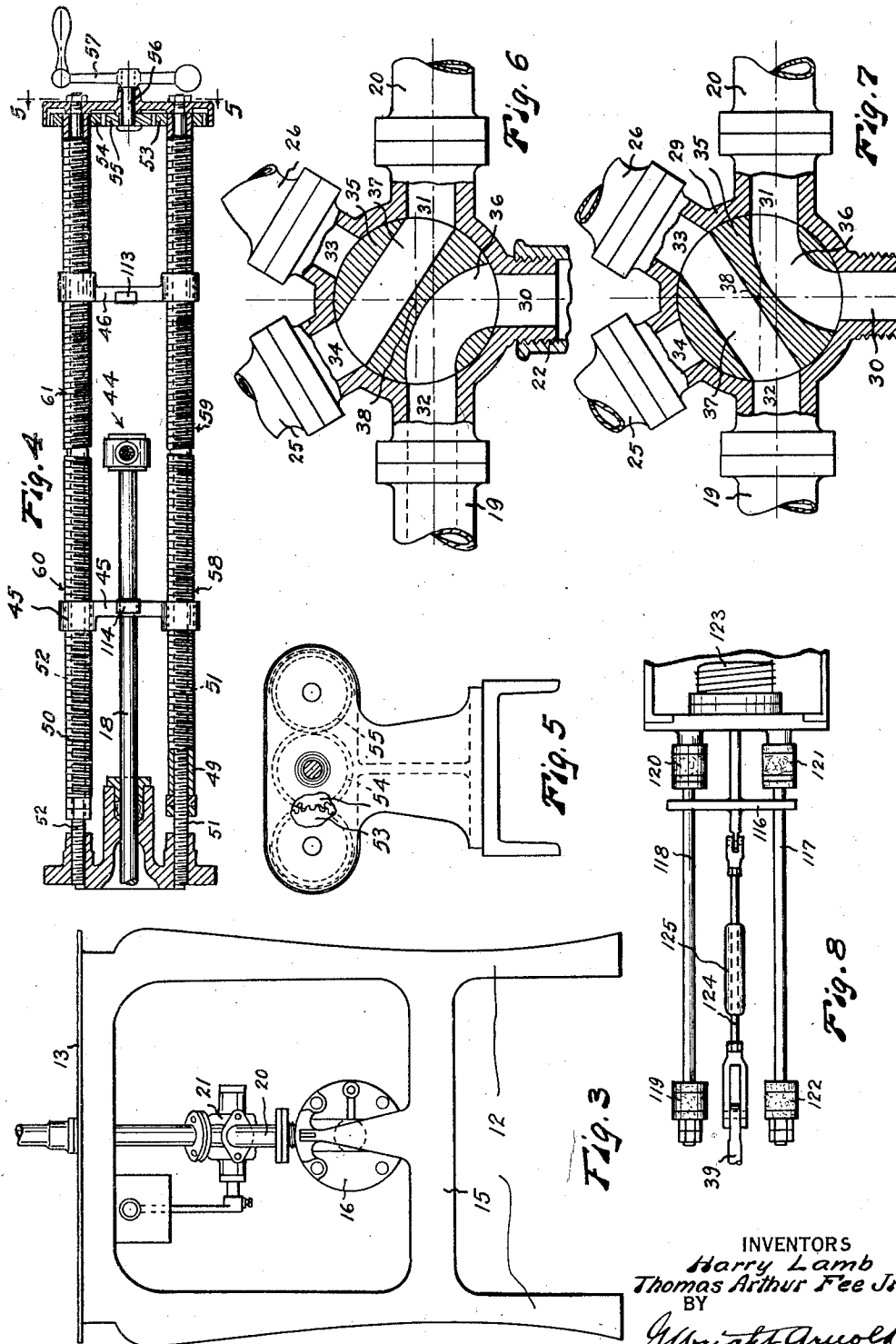
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INVENTORS
Harry Lamb
Thomas Arthur Fee Jr.
BY
Gibright Arnold.
ATTORNEY

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3 Sheets-Sheet 3

Fig. 9

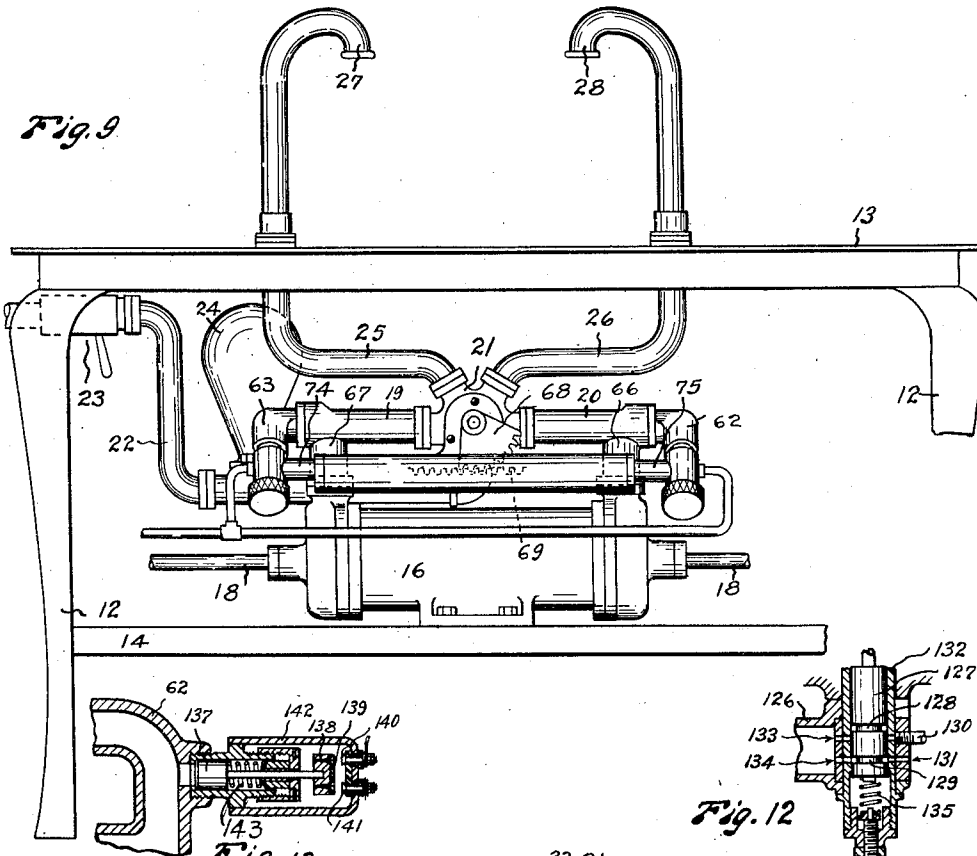


Fig. 13

Fig. 12

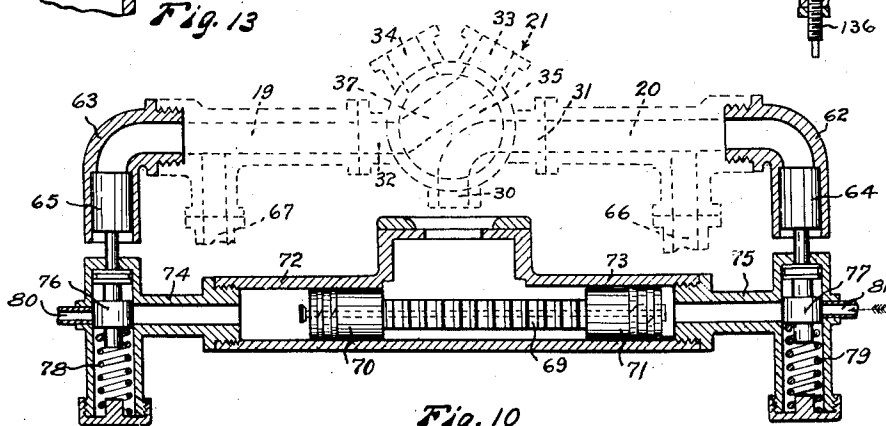


Fig. 10

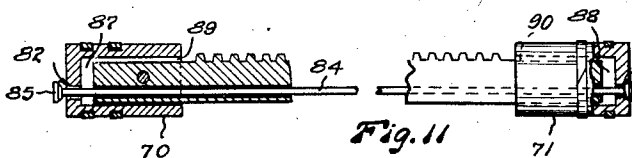


Fig. 11

INVENTORS
Harry Lamb
Thomas Arthur Fee Jr.
BY
Gilbert Arnold
ATTORNEY

UNITED STATES PATENT OFFICE

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METERING-FILLING MACHINE

Harry Lamb, Seattle, Wash., and Thomas Arthur Fee, Jr., Vancouver, British Columbia, Canada, assignors to Illum Incorporated, Seattle, Wash., a corporation of Washington

Application June 16, 1926. Serial No. 116,330

21 Claims. (Cl. 73—30)

Our invention relates to a metering and filling machine.

Our invention will be described as applied to filling containers with lard and compound, i. e., a mixture of cottonseed oil and tallow; but, of course, the invention is not to be restricted to any such specific application, but is applicable to all uses involving similar conditions and problems. Other fields which may be named as illustrative, and in some of which it has been actually applied, are the filling of containers with peanut butter, the filling of pails with paint, and the filling of pails with lubricating compounds or oils, etc.

There have been designed heretofore metering devices which function to take a quantity of liquid and measure the quantity of the mass without separating the mass into its separate units and disposing of these units in separate containers. In contrast with a strictly metering apparatus is our device which not only operates to divide a mass into separate equal units by way of measuring, but also functions to dispose of these units in separate containers. In other words, there is a substantial distinction between a mere metering device, and a metering-filling device. A measuring and filling device is illustrated in the prior art by United States Letters Patent granted to me, Lamb, October 9, 1923, No. 1,470,381. One primary distinction between said devices is that there must be intermittent action in the discharge, in order to permit the placing and removal of the containers. Hence, there must be a stopping of the flow of the material during the period necessary to replace the containers. Nevertheless, great speed is required in operation to provide efficiency, and therefore the measuring piston itself should not have intermittent action but should be in continuous operation. A primary purpose of the present application is to provide a device that will accomplish these results. We provide the intermittent action by having two outlets having their inlet ports positioned adjacent to each other, in conjunction with a single five way valve.

In the device of the aforesaid patent granted, as well as in the machine herein described, the measuring piston was operated by pressure applied to the fluid material being measured. So long as this pressure was uniform, the said machine operated accurately. However, there are situations where the pressure is not uniform. For example, in some lard-packing plants a rotary pump is used to pump the lard and place it under pressure in feeding it to the metering device. Such a pump provides a fairly uniform pres-

sure that gives accurate results. However, there are plants that use a piston pump and this type provides an irregular pressure, i. e., one which is pulsating in character. It will be noted by reference to the aforesaid patent that there is a point in the operation of the valves when both the valves on one side are in partially open position, so that an open passage is provided from the inlet pipe directly to the container. During the period when the valves are in this position, there may be a rush of material to the containers that is absent in other periods of the movement of the valves. In other words, it will be noted from the construction of the device of the said granted patent that there is a period when there is a direct open passageway from the source of the material to the container, which obviously permits a greater velocity to the material during that momentary period of the position of the valves than there is immediately prior or subsequently. A primary purpose of our invention is to overcome this difficulty and to provide a machine which will allow the pressure of the material being operated upon to be communicated to the material that is being expelled from the measuring cylinder only through the piston operating in the measuring cylinder, and at no time to permit the pressure of the material in the source of supply to be communicated in a direct passageway to the material being discharged.

Furthermore, considering the result when the valves are in said partially open position: It may be that when there is a varying pressure, the pressure may be greatest at the time when these valves are in said partially open position, and when the filling is taking place from the opposite outlet the low pressure point may occur at the time when the valves are in said open position on the opposite side. Therefore, irregularity of feed may result which would destroy the complete accuracy of the device. Furthermore, variation may develop in the quantity supplied to successive containers when it was desired to increase the speed from one thousand to two thousand containers per hour, owing to the fact that it was necessary to increase the pressure on the fluid material to be measured. This resulted in jamming the piston with considerable momentum against the electrical contact members which would tend to spread the said members so that the contact was made for a perceptibly longer period of time than when the piston moved slowly while filling one thousand containers for example, and hence there was not the prompt reversal of the piston neces-

sary to assure accurate measuring. It must always be remembered that accuracy is a fundamental requisite. A primary object of our invention is to overcome this difficulty due to the variation in the quantity measured incident to the operation of the contact members and increased speed. This we accomplish by providing an adjustable stop on which are mounted contact members which stop affords a positive fixed length of stroke to the measuring piston, thus rendering the length of stroke indifferent to the degree of pressure to which the liquid substance being measured may be subject.

Besides functioning as a filling device, it is manifest that the device in question must also operate as a measuring or scale device. It is axiomatic that a scale that does not measure accurately is no scale at all. Precision therefore is a matter of the utmost importance in a device of the character in question. In order to afford precision of operation, a device, which is required to operate with the great speed necessary to permit it to measure and fill twenty-five hundred one-pound cartons of lard an hour, must be characterized by the elimination of all moving valves possible, and all similar points of constriction. A primary object of our invention is to provide a device characterized by its precision of operation. A further object is to provide a device having but a single five-way valve, and one which is self-correcting in its operation.

A further difficulty which arises in providing uniformity of the measured units is due to the presence of air within the liquid to be measured. This difficulty may be due to the air that is in the machine at the time it first commences to operate, i. e., before the liquid is admitted to the cylinders and pipes which are of course filled with air; or, this difficulty may arise from air which may become entrapped in the liquid to be measured after the machine has been in operation for some time. In either case, however, it is manifest that the presence of air will prevent the unit being measured from being accurate, as said occupiees space and prevents the filling of the cylinder with the liquid to be measured. A primary object of our invention is to provide a measuring and filling device with the outlet conduits upwardly disposed so that the air may rise and escape and prevent any discrepancies in the units measured other than in the two or three units with which the air is discharged.

Furthermore, the material to be metered and supplied to separate containers may be of a character which varies in density, such as compound formed of cottonseed oil and tallow. This compound is characterized by whipping up, i. e., having much air interposed within its structure,—this condition resulting from the action of the worm beaters. Since our invention is characterized by having a measuring cylinder, it is a "volume" device, and since the goods may be of a varying density as respects one cubic foot and another cubic foot of the material in the conduit, it is necessary in order that the same be metered and supplied to the containers, that it be reduced to a common density. A primary of our invention is therefore to provide a device which will meter the material, supply it to separate containers, and reduce the said material to a common standard of density.

In providing for a machine having greater capacity, i. e., one which operates at relatively

high speed, for example, handling eight thousand pounds of lard per hour, it is necessary that the valves be of a type which will not stick, but will always be free to move and be actuated by the same amount of power, and it is our purpose to provide such a valve. This we do by means of the five-way rotary valve herein set forth, the inlet and outlet ports of which close and open in direct proportion.

Furthermore, where a solenoid is employed as the means to actuate the valve, there must be means provided to limit the throw of the solenoid core. Where a wedge-shaped valve is used, it is difficult to adjust any stopping mechanism because the accurate operation of the wedge-shaped valve such as that shown in the aforesaid patent requires it to be thrown into closed position with considerable force to make it hold tightly, but this results in its sticking and introducing a period of hesitancy upon its being moved into open position. We propose providing a measuring and filling device in which if the solenoid is employed as the actuating means for the valve, stopping means may be provided on the core of said solenoid to positively limit its movement, and, furthermore, we propose providing a single solenoid to move the valve and thus eliminate all question of synchronizing the solenoids connected with separate valves.

Furthermore, in a measuring and filling device having the necessary speed of operation hereinabove explained, it is necessary if a solenoid is to be employed as the actuating means for the valve, to provide means for eliminating the rebound action of the solenoid core and valve. That is, it is necessary, when the valve is once moved to full open position, that it remain in full open position and not flutter or slightly oscillate. In other words, the full open area of the valve must remain uniformly open, in order that there may be no variation in the quantity of the material being measured, and it is a purpose of our invention to provide means connected with the solenoid which prevents any such tendency to flutter or oscillate on the part of the valve.

As a further aid to accuracy and precision of measurement, it is important that the current which operates the solenoid be carefully adjusted, so that it will energize the solenoid with just that amount of force which is required to actuate the valves, and to this end it is a purpose of our invention to provide means for carefully adjusting the current for said purpose.

In providing a measuring-filling device as herein set forth, which has a fixed length of throw for the measuring piston, the limitation being imposed by fixed stops, it results that when the piston rod strikes against the said fixed stop, the flowing fluid comes suddenly to a stop, so that the pressure immediately becomes greatly increased,—possibly two or three times as much as ordinarily obtains. In the device as set forth in the aforesaid patent, this difficulty was eliminated, but was eliminated because there were no fixed stops. However, in the present instance special provision must be made to overcome the building up of such increased pressures upon the stopping of the moving of the piston, particularly when heavy viscous-like fluids are being measured. We propose providing means which will eliminate the building up, or reduce the effect, of such pressures and this we do by providing an air chamber which may act as a surge reservoir and compress the air contained therein as a means of absorbing the shock which

would otherwise develop upon the valve and upon the piston.

A further primary purpose of our invention is to provide a metering-filling machine which employs the increased pressure developed as explained above upon the measuring piston coming to a stop at the end of its stroke, to actuate means which directly or indirectly causes the reversal of the valve and the measuring piston.

The above mentioned general objects of our invention, together with others inherent in the same, are attained by the device illustrated in the following drawings, the same being preferred exemplary forms of embodiment of our invention, throughout which drawings like reference numerals indicate like parts:

Figure 1 is a view in side elevation in part broken away of a metering-filling machine embodying our invention;

Fig. 2 is a diagrammatic plan view of the solenoid circuits and stroke adjusting mechanism;

Fig. 3 is a view in end elevation of the metering-filling machine embodying our invention as respects the solenoid end thereof;

Fig. 4 is an enlarged plan view of the electrical contact and stroke adjusting mechanism;

Fig. 5 is a view on dotted line 5, 5 of Fig. 4;

Fig. 6 is an enlarged view in vertical section of the rotary five-way valve and associated conduits, with the valve in open position with respect to the left hand outlet;

Fig. 7 is an enlarged view in vertical section of the rotary five-way valve and associated conduits, with the valve in open position with respect to the right hand outlet;

Fig. 8 is a modified form of a solenoid core mounting means;

Fig. 9 is a view in side elevation of a modified form of our invention, which utilizes the increased pressure occurring at the moment of reversal of direction of the measuring piston to actuate means which in turn causes the reversal of the five-way valve and hence the direction of the measuring piston;

Fig. 10 is an enlarged view in longitudinal section of the form shown in Figure 9 showing the conduits and one form of means which may be employed to cause reversal of the measuring piston;

Fig. 11 is an enlarged view of the piston and rack means shown in Fig. 10;

Fig. 12 is a view of a modified form of air valve means; and

Fig. 13 is a view of a modified form of means to utilize the suddenly developed increased pressure to close an electric switch.

Upon the frame of a table having legs 12, top 13, longitudinal brace 14 and transverse brace 15, the following parts of a metering-filling machine are mounted: A measuring cylinder 16 has mounted therein a freely movable piston 17 having piston rods 18. The end portions of cylinder 16 have conduits 19 and 20 connecting them to the five-way valve 21. An inlet conduit 22 connects the reservoir of lard (not shown) to the five-way valve 21. Valve 23 controls the flow of the lard in the inlet pipe. This inlet pipe conduit is also provided with a surge reservoir 24. Two upwardly directed filling conduits 25 and 26, having downwardly directed nozzles 27 and 28, are also connected to the five-way valve 21.

The five-way valve 21, (see Figs. 6 and 7), is constructed as follows: In the housing 29 are the following ports: inlet port 30, outlet ports 31 and 32, and outlet filler ports 33 and 34. In this hous-

ing 29 is rotatably mounted valve member 35, having conduits 36 and 37 disposed therethrough. The valve is rotatable upon the axis 38, so that by oscillating the valve ninety degrees from the position shown in Fig. 6 to that shown in Fig. 7 the new connections are established, as indicated in Fig. 7. Secured to valve member 35 is a lever 39.

Next will be described the mechanism which actuates the valve 21. Solenoids 40 and 103, having a slidably mounted core 41 operatively disposed therein, are connected to a rod 42, which is connected to valve lever 39. Upon rod 42 is slidably mounted a ram weight 43. Contact member 44, mounted on ring 47, is fixedly mounted upon piston rod 18. Said ring 47 bears four split copper rings, 115, 48, 92 and 93. Rings 115 and 48 have a common connection 94 to a solenoid coil 95 functioning as a control member, which is connected by wire 96 to one terminal of a source of electrical energy. Solenoid coil 95 has an iron core 97 having handle 98 which may drop into notches 99 in a housing member 100 and hold the core 97 within the coil 95 to an extent desired, thereby choking off the current to the desired strength. Split rings 92 and 93 are respectively connected by wires 101 and 102 to solenoids 40 and 103. These solenoids 40 and 103 have a common connection 104 to the other terminal of the source of electrical energy. A slidingly mounted ring 105 carries a copper ring 106. Ring 105 is yieldingly held in spaced relation to ring 47 by spring 107 against fixed stop 108. Ring 109 is likewise slidingly mounted and carries copper ring 110 and is yieldingly held in spaced relation to ring 47 by spring 111 against stop 112. Manifestly, in operation when the piston rod 18 is moving to the right and comes in contact with adjustable stop 46, the stop portion 112 passes into an opening 113 in the stop 46 and thereby allows ring 109 to be moved relative to rod 18 towards ring 47, so that copper contact rings 110 and 48 are pressed hard against each other, so that the gap between rings 48 and 93 is bridged by the continuous ring 110, thereby establishing connection across these terminals. Manifestly, when the piston rod 18 moves in the opposite direction, i. e., to the left, it moves until stop 108 enters opening 114 in stop 45, and ring 105 is thereby pressed towards ring 47, bringing ring 106 in contact with split ring 115. Upon so doing, the circuit is reversed in the solenoid, and core 41 and its rod 42 are moved to the left, thus moving lever 39 and valve 35 and causing a new registration of the ports and conduits. The adjustable stops are threadedly mounted upon tubes 49 and 50, which are in turn revolvably mounted upon rods 51 and 52. Tube 49 has keyed thereto gear 53, while tube 50 has keyed thereto gear 54, which gears intermesh with gear 55, which is keyed to shaft 56 upon which is mounted crank 57. Threads 58 are oppositely directed to threads 59, and likewise threads 60 are oppositely directed to threads 61, so that upon turning crank 57 the stops 45 and 46 may be moved towards or away from each other to adjust the stroke of the piston rod 18, which of course determines the stroke of the piston 17 within the measuring cylinder 16.

In the modified form shown in Figs. 9, 10 and 11, a fluid pressure means is shown for actuating the valve member 35, in contrast to the solenoid member above described. The parts in this form, which are the same as those hereinabove described, will bear the same numerals and only those parts that are new will be given new numerals. An elbow 62 is mounted on conduit pipe 150

20 and an elbow 63 is mounted on conduit pipe 19. In elbows 62 and 63, pistons 64 and 65 are respectively mounted. Conduits 19 and 20 communicate directly with the ends of the measuring cylinder 16 as in Fig. 1 through conduits 66 and 67.

Secured to valve member 35 is a sector of a pinion 68 in operative engagement with rack 69, which rack has pistons 70 and 71 mounted in cylinders 72 and 73, respectively. In the end portion of cylinders 72 and 73 are secured respectively cylinder heads 74 and 75 having valve members 76 and 77 mounted therein, the same bearing upon helical springs 78 and 79. The said valve members 76 and 77 respectively control the admission of fluid pressure in conduits 80 and 81. The pistons 70 and 71 have valve seats 82 and 83 respectively, (see Fig. 11). Rod 84 has valve members 85 and 86 mounted thereon, which control the ducts 87 and 88 respectively, which have outlets 89 and 90. Obviously, rod 84 is disposed to slide back and forth in the pistons and open and close the ducts 87 and 88, thereby providing for the escape of the compressed fluid which had previously actuated the piston, which permits the rack 69 to be actuated in a reciprocating manner.

A modified form of solenoid core mounting means, (see Fig. 8), has a cross member 116, which is mounted on two guide rods 117 and 118, having felt cushion means 119, 120, 121 and 122 to absorb the shock incident to the throw of the solenoid core 123, which is fixedly secured to the cross member 116. The cross member 116 is hingedly connected by rod 124, corresponding to rod 42, to valve lever 39. On rod 124 is slidably mounted a ram weight 125, corresponding to weight 43. This modified form of mounting the solenoid core has proven in actual experience to be very efficient. It provides accurate operation of the solenoid core.

In Fig. 12, a modified form of the cylinder head 126 is shown, having valve member 127 mounted therein, which has annular recesses 128 and 129, which are adapted to register respectively with inlet passageway 130 and exhaust passageway 131 on one side of the valve housing 132, and with corresponding inlet passageway 133 and exhaust passageway 134 on the opposite side of the housing 132. Valve member 127 is yieldingly supported by spring 135, which is adjustably mounted on screw 136. This valve head 126 is duplicated on the opposite side of the machine, corresponding to the functions performed by valve heads 74 and 75. When a sudden rise in pressure depresses valve member 127 against spring 135, thereupon the compressed air is admitted through inlet 130, which compressed air passes around valve member 127 in recess 128 and thence through passageway 133 and actuates piston 71, (describing herein only the operation on the right hand side, of the figure shown in Fig. 10). Then when piston 71 moves back towards the right hand side, the sudden pressure, which brought annular passageway 128 in registration with inlet 130, has exhausted itself in the meantime, and valve member 127 has been forced upwardly by spring 135, which thereupon brings passageways 134 and 131 in registration with recess 129, which permits the air in the end of cylinder 73 to exhaust.

In Fig. 13, a modified form of means is shown to utilize the sudden development of pressure, which means establishes electrical contact, which may thereupon actuate a solenoid in the same manner as heretofore described, such as 40, which may actuate the valve member 35 precisely as

hereinabove described. Instead of the contact member being mounted on the rod 18, the modified means illustrated in Fig. 13 may be utilized. On valve member 137 is mounted a contact member 138 bearing an electric conductor 139 on the face thereof, which operates to bridge the gap between posts 140 and 141 operatively disposed in the end of valve housing 142. Spring 143 yieldingly holds valve member 137 in spaced relation with electric posts 140 and 141.

The mode of operation of a machine embodying our invention is as follows:

The material to be operated upon is subjected to pressure, and is forced through inlet pipe 22 upon the opening of valve 23 to the five-way valve 21. Assuming the said five-way valve 21 is in the position shown in Fig. 6, the material would obviously pass into conduit 19 and thence into the side A of the measuring piston 17.

The material would then press against piston 17 and force the piston towards the end B until the contact member 44 comes in contact with the adjustable stop 46. Contact member 48, carried by member 44 is connected by cable 91 to the solenoid 40. When the contact member 44 strikes against stop member 46, then the circuit is completed, energizing solenoid 40, which operates to push out the core 41 and the rod 42 connected thereto, that is, said core and said rod are moved to the left of the drawing, thereby moving the five way valve into the position shown in Fig. 7, whereupon the material under pressure in the inlet conduit 22 flows through the valve conduit 36 into conduit 20 and thence into the end B of the measuring cylinder 16. The material thereupon presses against piston 17 whereupon said piston is pushed to the A end of the cylinder. This movement of the piston 17 forces the material that is in the A end of the cylinder 16 and also the material that is in the conduit 19 upwardly into filling conduit 26, and out of nozzle 28. Thereupon the material falls into containers (not shown) which containers may be placed on the table top 13. Of course, said containers may normally be placed on the well-known endless chain form of carrier that would carry the containers directly under the outlets 28 and 27.

The piston 17 continues moving towards the A end until the contact member 44 comes into engagement with the adjustable stop 45, which thereupon establishes electrical connection through cable 91 with the solenoid 103. When this solenoid is energized, the core 41 is drawn in, or to the right of the drawing, so that the five way valve is turned causing it to assume the position shown in Fig. 6. In this position the material flows from conduit 22 through the valve and into conduit 19, thence into the A end of the measuring cylinder 16 so that the piston 17 is forced toward the B end, whereupon material in the B end of the cylinder, as well as in the conduit 20, is forced upwardly through valve conduit 37 into filler conduit 25 and out of nozzle 27. The operation of the cylinder and the valve follows this mode of operation, metering and discharging to separate containers a carefully gauged amount of material.

It will be noted that as the valve member 35 rotates, the cutting off of the material from the inlet pipe 22 coming through port 30 is in exact proportion to the opening of the ports into conduit 37. There is, therefore, no unevenness in the openings provided in the valves, and, therefore, accuracy of measurement is provided. Obviously, it is important that when the valve is

suddenly thrown into a new position, it should remain there and not rebound so as to partially cut off the opening. To guard against any such inaccuracy of measurement as would result from such rebounding or fluttering or oscillating of the valve, a ram weight 43 is designated, because its action is that of a ram against the shoulders 93 and 94 provided on the end of the rod 42. Manifestly, as the valve comes to the position shown in Fig. 6, with the ram weight 43 as shown in Fig. 1, it has come against the shoulder 94 with a ram effect force that holds the valve against any tendency to rebound to any objectionable extent. In short, the fluttering or rebound action is eliminated so far as introducing any objectionable inaccuracy in the metering-filling operation.

Manifestly, having the single five-way valve establishing connections between the ends of the measuring cylinder and the filler conduits eliminates all question of synchronizing its action with any other valve. It is the one and only valve involved, and therefore provides for automatic self-correction of any inaccuracies. This results from the fact that the opening and closing of the ports is in direct proportion and there is no sticking and therefore lagging which would produce discrepancy in the quantities supplied to different containers. The adjustment of the stops 45 and 46 is accomplished by turning crank 57, which in turn moves stops 45 and 46 towards or away from each other, so that the length of throw of piston 17 may be precisely determined.

At the moment when piston 17 is about to be reversed in its action, the incoming material finds it impossible to push the piston further, and for that instant the pressure suddenly builds up and the shock thus developed is cushioned by compressing the air in the surge tank 24.

In the modified form which is shown in Figs. 9 and 10, advantage is taken of the sudden rise in pressure as just indicated to actuate valves which in turn sets in action fluid pressure which in turn results in oscillating the valve. To take up the device in detail: Referring to Fig. 10, the material has been flowing through conduit 20 and into the B end of the cylinder 16, and the material in the A end has been forced out through conduit 19 and through valve conduit 37 into filler tube 26, and finally comes to a stop as contact 44 strikes stop 45. Thereupon, the pressure suddenly rises, as explained in the paragraph next above, and impinges against piston 64, which compresses spring 79, and thereby moves valve member 77 downwardly, permitting compressed air to flow from conduits 81 into cylinder 73 and strike against piston 71, which is mounted upon the end portion of rack 69. As rack 69 is forced to the left, the pinion 68 is caused to revolve clock-wise and thereby cause valve member 35 to assume the position shown in Fig. 6, whereupon the measuring piston 17 is forced to the B end of the cylinder, and when it comes to a stop, the sudden rise in pressure impinges upon piston 65, which forces downwardly valve member 76, opening conduit 80, which admits fluid pressure into cylinder 72 and against piston 70.

It will be seen upon reference to this description that the material driving the piston must build up a pressure to overcome the springs 78 and 79 on the air valve. The material here referred to is of a compressible type such as lard or shortening compound which has air dispersed therethrough—there being much more air ordinarily provided in the so-called compound short-

ening than in lard. This means that the end portion of the measuring chamber will continue to be filled with the incoming material even though the piston has stopped at the end of its stroke until such quantities of the solid part of said material are supplied that the pressure to which the springs 78 and 79 are adjusted permits the depression of the pistons 64 and 65, so that the five-way valve may be reversed. It would seem that the air dispersed through the material is compressed to permit the introduction of the necessary additional solid material to make up the given weight unit being measured at that time. So far as known, there is no machine designed to meter and fill containers with compound, owing to its varying density. The device herein disclosed accomplishes the result of metering said compound and supplying it to separate containers with a degree of accuracy very much in excess of the present methods of weighing and by so much the more well within the limits required by the trade. In the above it will be noted that the supplied material to the cylinder is independent of movement of the piston. That is, material may be continued to be supplied to the cylinder after the piston has stopped. Upon reversal of the valve 21 it is equally manifest that the material may be discharged in part independently of the movement of the piston in view of the compression to which it is subjected.

The rod 84 thus has the valve member 86 in closed position with respect to valve seat 83, which results in valve member 85 being in open position with respect to valve seat 82, so that as piston 71 moves to the left, the air in cylinder 72 may escape past the valve seat 82 and into duct 87, and escape through outlet 89, so that there is no trapping of the air and back pressure developed with respect to the movement of the valve 70. A duplication of this construction and operation for the piston 71 results in the same escape of air in piston 73 when the movement of the rack 69 is reversed.

Therefore, in the metering-filling machine embodying our invention the pressure to which the material is subjected functions in three ways,—first, to move the material through the pipe; second, to actuate the metering piston 17; and, third, to operate a valve means which results in the oscillation of the five-way valve. The various features which have been thus emphasized as characterizing our invention results in providing a metering-filling machine which experience has shown to operate with a very high degree of accuracy, very greatly within the limits allowed for variation, and also to operate at a great speed, filling as many as twenty-five hundred two-pound lard containers in one hour.

By utilizing the building up of pressure in the conduits after the piston has reached the end of its stroke, the device embodying our invention overcomes another difficulty which was inherent in devices as heretofore commonly designed. Speeding up the machine in such former devices had the serious defect of increasing the material dischargeable. In other words, accuracy in metering by such device depended upon uniformity of flow of the material. This is very difficult to regulate and, therefore, a successful metering-filling device, particularly as applied to the field of lard and shortening compounds, requires that the device operate in a manner which will be indifferent to the rate of flow of the material. This result is provided in the machine embodying our invention by requiring that the pressure in the

cylinder and the inlet conduits be developed to a certain magnitude before the valve is thrown. In handling compressible material, the device must be one in which the maximum pressure obtaining in the metering cylinder at the moment of throwing of the valve is independent of the pressure required to drive the piston.

The discharging of the material from the measuring cylinder in an upward direction provides for the escape of air that may be trapped in the conduits and in the cylinder when the machine is put into operation. This will be readily understood by referring to Fig. 1. Assuming that the machine is just being put into operation and there is no material on the B end of the cylinder: When the material enters through conduit 19 to the A end of the cylinder and presses the piston 17 towards the B end, there would be air from the point of the piston around through the conduit 20 to the valve 21. When the piston is reversed in its movement, and the material being metered flows into the conduit 20, obviously the air will be pushed forward and compressed in the B end of the cylinder and will rise to the top of the measuring cylinder 16, and will be confined there during the period when the material is pushing the piston 17 towards the A end. When the direction of the piston is reversed and the contents of the B end of the cylinder are discharged, obviously the compressed air which has in the meantime risen in the conduit 20, (seeking the surface of the liquid in which it is confined), has attained a position near the valve 21, upon the opening of which it escapes upwardly through filler conduit 25 and as the material follows it is discharged from the nozzle 27. Obviously, after one or two operations all air which would reside in the device is dispelled, and thereafter true measurements of material are supplied. Obviously, if the discharge outlets were downwardly directed, the air would flow back to the surface of the liquid and be trapped in the measuring cylinder upon the material being admitted to that given end of the cylinder. This is the situation in the device illustrated in the patent which has been heretofore mentioned.

The above describes the situation in starting the machine. However, after the machine is in operation, it so happens that the material is not supplied at a fast enough rate to keep the conduit leading to the rotary pump entirely filled, and the worm beater therefore works considerable air into the fluid. When the operator observes this condition, he stops the metering-filling machine herein described until such time as the supply is increased to a quantity which permits the conduit leading to the rotary pump to be completely filled, and then starts the machine again. It is necessary to discharge the air to make provision for the air that thus finds its way into the material in this manner. The provision for the discharge of air as herein disclosed eliminates the air which finds its way into the machine at the commencement of its operation and also provides for the elimination of the air which finds its way into the machine during its run or operation.

Obviously, changes may be made in the forms, dimensions and arrangement of the parts of our invention, without departing from the principle thereof, the above setting forth only preferred forms of embodiment.

We claim:—

1. A metering-filling machine embodying a measuring cylinder; a piston reciprocally mount-

ed in said cylinder; a five-way valve; a conduit leading to said valve, whereby material to be operated upon may be supplied to said valve; two conduits connecting the ends of said cylinder to separate ports in said valve; two filling conduits extending from separate ports in said valve; and means whereby said valve may be actuated.

2. A metering-filling machine embodying a measuring cylinder; a piston reciprocally mounted in said cylinder; a five-way valve; a conduit leading to said valve, whereby material to be operated upon may be supplied to said valve; two conduits connecting the ends of said cylinder to separate ports in said valve; two filling conduits extending upwardly from separate ports in said valve; and means whereby said valve may be actuated.

3. A metering-filling machine embodying a measuring cylinder; a piston reciprocally mounted in said cylinder; adjustable stops, whereby the length of stroke of said piston is fixed; a five-way valve; a conduit leading to said valve, whereby material to be operated upon may be supplied to said valve; two conduits connecting the ends of said cylinder to separate ports in said valve; two filling conduits extending from separate ports in said valve; and means whereby said valve may be actuated.

4. A metering-filling machine embodying a measuring cylinder; a piston reciprocally mounted in said cylinder; a five-way valve; a conduit leading to said valve, whereby material to be operated upon may be supplied to said valve; a surge reservoir in said conduit; two conduits connecting the ends of said cylinder to separate ports in said valve; two filling conduits extending from separate ports in said valve; and means whereby said valve may be actuated.

5. In combination with a metering-filling machine having a metering cylinder, a metering piston therein operated by the fluid being measured, inlet conduits whereby the material to be measured is conducted to said cylinder, and valve means in said conduits; valve means connected to said conduits, and rack and pinion-sector means operatively connecting said last named valve means to the valve means in the said conduits, whereby the sudden pressure developed in the material when the metering piston stops actuates said last named valve means and thus reverses the movement of the piston.

6. A metering-filling machine embodying a measuring cylinder; a piston reciprocally mounted in said cylinder; a five-way valve; a conduit leading to said valve, whereby material to be operated upon may be supplied to said valve; two conduits connecting the ends of said cylinder to separate ports in said valve and two filling conduits extending from separate ports in said valve whereby all of the material to be operated upon by said machine passes through said valve in entering and discharging from said machine and provision is made for the intermittent flow of the material and alternate discharge of the same from the filling conduits.

7. A metering-filling machine embodying a measuring cylinder; a piston reciprocally mounted in said cylinder; a five-way valve, a conduit leading to said valve, whereby material to be operated upon may be supplied to said valve; two conduits connecting the ends of said cylinder to separate ports in said valve and two filling conduits extending upwardly from separate ports in said valve and a conduit leading to said valve

whereby all of the material to be operated upon by said machine passes through said valve in entering and discharging from said machine and provision is made for the intermittent flow of the material and alternate discharge of the same from the filling conduits.

8. A metering-filling machine embodying a measuring cylinder; a piston reciprocally mounted in said cylinder; valve means, a conduit leading to said valve means, whereby material to be operated upon may be supplied to said valve means; two conduits connecting the ends of said cylinder to separate ports in said valve and two filling conduits extending upwardly from separate ports in said valve, whereby all of the material to be operated upon by said machine passes through said valve in entering and discharging from said machine and provision is made for the intermittent flow of the material and alternate discharge of the same from the filling conduits.

9. A metering-filling machine embodying a measuring cylinder; a piston reciprocally mounted in said cylinder; valve means; two conduits connecting the ends of said cylinder to said valve means and two filling conduits extending upwardly from said valve means and a conduit leading to said valve means, whereby all of the material to be operated upon by said machine passes through said valve in entering and discharging from said machine and provision is made for the intermittent flow of the material and alternate discharge of the same from the filling conduits.

10. In a device of the character described, the combination consisting of a valve housing, a turnable valve member operatively disposed therein having two separate and distinct conduits therethrough, a measuring cylinder wherein a fluid may be metered, a piston reciprocally and unobstructedly movable in said cylinder against said fluid, two conduits having one end of each communicating with said valve housing operatively disposed to register with said valve member conduits and the other end of each conduit communicating with one end portion of said cylinder, said conduits functioning alternately as inlet and outlet conduits for said fluid to be metered by said cylinder; a source of fluid pressure distinct and separate from the fluid being metered; actuating means for said valve member connected to said source of fluid pressure; and pressure operated control means for said actuating means, said control means being operatively connected to said conduits, whereby the pressure developed in said conduits determines the operation of said actuating means.

11. A metering-filling machine embodying a measuring cylinder, a piston reciprocally mounted in said cylinder, a valve, a conduit leading to said valve whereby material to be operated upon may be supplied to said valve, two inlet-outlet conduits each respectively connecting one end of said cylinder to said valve, two filling conduits extending from said valve, actuating means for said valve; and control means operatively connected to said inlet-outlet conduits which determine the operation of said actuating means.

12. A metering-filling machine embodying a measuring cylinder, a piston reciprocally mounted in said cylinder; a valve; a conduit leading to said valve whereby material to be operated upon may be supplied to said valve; two inlet-outlet conduits, each respectively connecting one end of said cylinder to said valve; two filling conduits extending from said valve; actuating means for said valve; and control means operatively con-

nected to said inlet-outlet conduits which determine the operation of said actuating means, said control means comprising a piston-valve housing for each of said inlet-outlet cylinder conduits whereby the pressure obtaining in said conduits may be directly communicated to said housings, piston-valve members disposed in said housings, means whereby said piston-valve members may be normally maintained in a given position, a rack having piston heads, a pinion mounted on said valve means, operatively engaging said rack, a fluid line communicating with each of said piston heads, the valve means of said piston-valve member being operatively disposed in said fluid line.

13. In a metering-filling machine, the combination of a measuring cylinder, a valve, two inlet-outlet conduits one end of each respectively communicating with one end portion of said cylinder and the other end of each communicating with said valve, two filling conduits extending from said valve, actuating means for said valve, control means for said actuating means operatively connected to said conduits whereby the pressure developed in said conduits determines the operation of the actuating means.

14. In combination with a metering-filling machine embodying a valve, a solenoid core for actuating said valve, and a rod connecting said core and said valve; a ram member slidably mounted on said rod whereby said valve, when actuated, is held against fluttering.

15. The combination with a fluid measuring cylinder and piston, a pressure-supply conduit thereto, a rotatable valve, two inlet-outlet conduits having one end of each communicating with said valve and the other end of each, respectively, communicating with the end portions of said cylinder, of means for operating the valve, said means embodying a compressed fluid line separate and distinct from the material being metered, and mechanism actuated by a pressure of a uniformly predetermined magnitude in the inlet-outlet conduits.

16. In combination with a metering-filling machine having a metering cylinder, a metering piston therein operated by the fluid being measured, inlet-outlet conduits whereby the material to be measured is conducted to and from said cylinder, and valve means in said conduits, branch conduits from said conduits; actuating pistons mounted in said branch conduits; a fluid-pressure line separate and independent of the material being metered, said line being disposed adjacent said conduits; valve means in said line, said valve means being connected to said actuating pistons; a rack having piston means on each end thereof, said piston means being operatively disposed in said fluid pressure line; a pinion-sector engaging the rack and mounted on the valve means of said inlet-outlet conduits whereby the pressure developed in the material when the metering piston stops actuates the piston in the branch conduits and thus reverses the movement of the piston.

17. In combination with a metering-filling machine having a metering cylinder, a metering piston therein operated by the fluid being measured, inlet-outlet conduits whereby the material to be measured is conducted to and from said cylinder, and valve means in said conduits; branch conduits from said conduits; electric switch means yieldingly disposed in said branch conduits; solenoid means operatively connected to said electric switch means and to the valve means of said inlet-

outlet conduits whereby the pressure developed in the material when the metering piston stops actuates the switch means.

18. In the process of dividing a compressible viscous liquid mass of non-uniform density into separate units of a predetermined weight, the steps of introducing said liquid under pressure into a confined chamber of predetermined volume; adding more of said liquid under pressure to said chamber until said chamber is filled and a predetermined pressure in said liquid is developed; and discharging said predetermined volume of said compressed liquid as a separate integral unit, whereby a predetermined unit volume of said viscous liquid is obtained having a predetermined weight.

19. The method of continuously dividing a viscous fluid containing entrained air into units of a predetermined weight, comprising continuously feeding such fluid to a chamber, compressing the fluid and air in the chamber until the fluid reaches a density corresponding to a predetermined weight per volume of the chamber, and then automatically discharging the unit from the chamber and simultaneously feeding a new charge thereto.

20. In a metering-filling machine, the combination of a measuring cylinder; a valve; two inlet-outlet conduits, one end of each respectively communicating with one end portion of said cylinder

and the other end of each communicating with said valve, a source of fluid pressure distinct and separate from the fluid being metered; fluid pressure operated actuating means for said valve connected to said source of fluid pressure; and pressure operated control means for said actuating means, said control means being operatively connected to said conduits, whereby the pressure developed in said conduits determines the operation of said actuating means.

21. In a metering-filling machine, the combination of a measuring cylinder; a valve; two inlet-outlet conduits, one end of each respectively communicating with one end portion of said cylinder and the other end of each communicating with said valve, a source of fluid pressure distinct and separate from the fluid being metered; fluid pressure operated actuating means for said valve connected to said source of fluid pressure; and pressure operated control means for said actuating means, said control means being operatively connected to said conduits, whereby the pressure developed in said conduits determines the operation of said actuating means after the termination of each stroke of the piston.

HARRY LAMB.

THOMAS ARTHUR FEE, JR.

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35	110
40	115
45	120
50	125
55	130
60	135
65	140
70	145
75	150