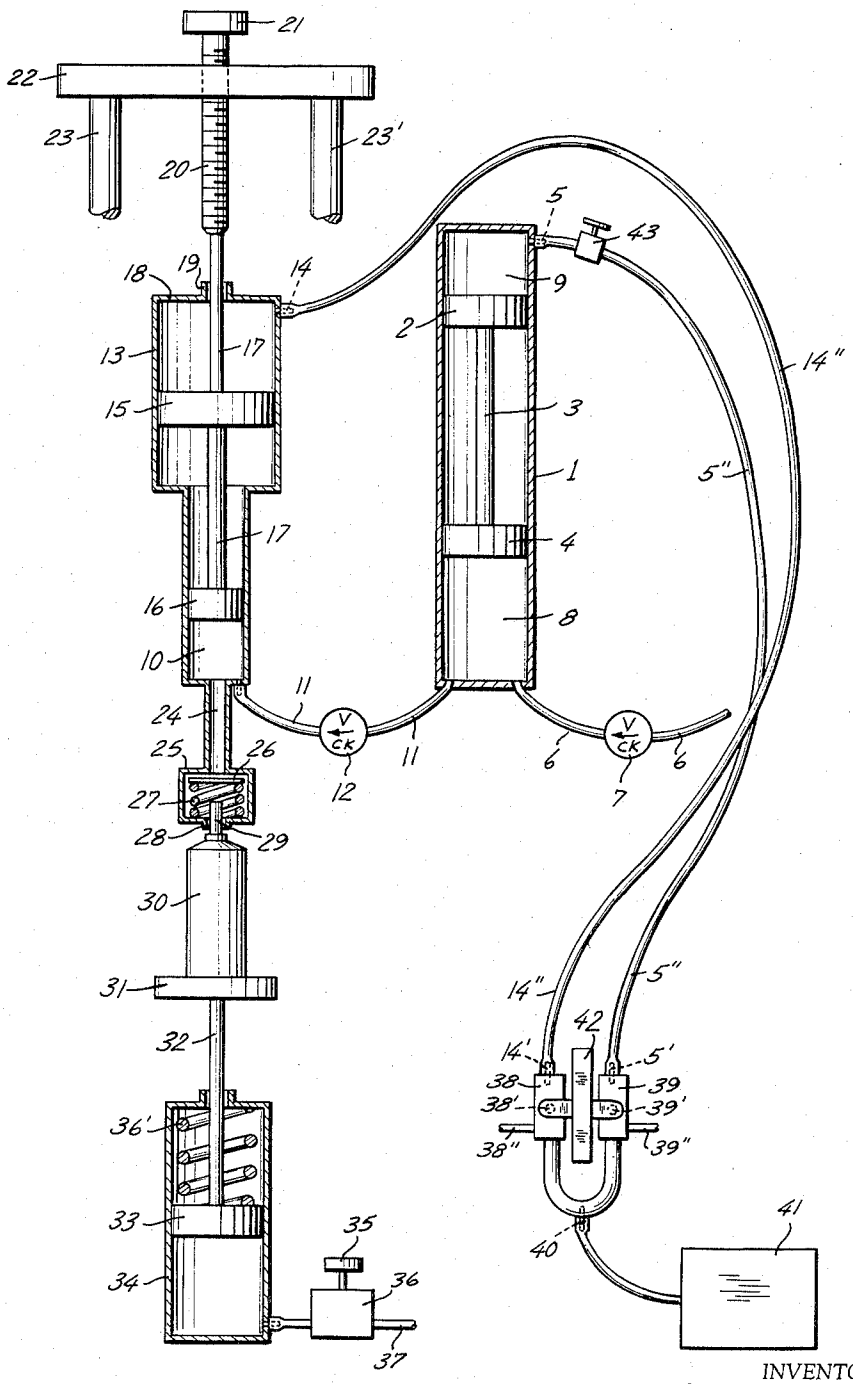
Oct. 12, 1965 E. J. HONISCH 3,211,191

APPARATUS FOR MEASURING A VOLATILE LIQUID AND FOR FILLING A CONTAINER

Original Filed Feb. 6, 1956



INVENTOR.
Egon Johann Honisch

BY

Richard J. Striker
Atty

United States Patent Office

3,211,191

Patented Oct. 12, 1965

3,211,191

APPARATUS FOR MEASURING A VOLATILE LIQUID AND FOR FILLING A CONTAINER

Egon Johann Honisch, Rapperswil, Switzerland

Continuation of application Ser. No. 563,735, Feb. 6, 1956. This application July 16, 1964, Ser. No. 384,045

Claims priority, application Switzerland, Feb. 4, 1955, 15,673/55

11 Claims. (Cl. 141—20)

The present application is a continuation application of my copending application Serial No. 563,735 filed February 6, 1956, now abandoned.

The invention relates to an apparatus for metering and bottling pressurized liquids.

By the term "pressurized liquids" are meant gases which are liquid under pressure at room temperatures, but which under a decreasing pressure, for example, when flowing out into the atmosphere, enter into the gaseous phase. Such pressurized liquids are, for example, liquid carbon dioxide, dichlorodifluoromethane and similar substances of the same family which, for example, are available on the market under the trade name "Freon" and have found widespread use in the manufacture of aerosol liquids.

The term "pressurized liquid" further includes any mixture of a liquid gas and another substance, preferably a liquid, in other words a liquid containing a volatile propellant fluid such as a mixture of 75 percent by volume of Eau de Cologne and 25 percent by volume of dichlorodifluoromethane.

The difficulty in bottling such pressurized liquids is caused by the following fact: These liquids in their pressure containers are considered to be in a boiling state so that the lower portion of the container is filled with liquid, and the upper portion is filled with the vapor of the liquid. When supplying such a pressurized liquid into a bottling apparatus, vapor formation is inevitable even if the apparatus is only slightly warmer than the pressurized liquid. If such formation takes place in the metering portion of the bottling apparatus, it is evident that as far as the weight is concerned, the desired quantity is not fed.

The present invention has the object to eliminate difficulties encountered by known apparatus and to provide a particularly practical pressure bottling apparatus.

As mentioned before, the pressurized liquids are, so to speak, in a boiling state. The well known mixture of the trademarks "Freon 11" and "Freon 12," for example, has a vapor pressure of 2.5 atmospheres gauge at 20° C. If this liquid were compressed so as to assume a pressure of for example ten atmospheres, it is evident that at 20° C. no evaporation would take place.

The apparatus according to the invention is utilized for compressing the pressurized liquid to such a degree that the pressure thereof is above the vapor pressure which corresponds to the temperature of the pressurized liquid in the bottling apparatus.

The apparatus comprises a metering piston pump for the pressurized liquid to be bottled and a preliminary piston pump of greater volume directly connected to the metering pump.

An embodiment of the invention is shown, by way of example, in the accompanying drawing, in which the single figure is a fragmentary schematic section through the apparatus.

In the cylinder 1 of a preliminary feeding pump is disclosed an axially movable compound piston system. The latter comprises a driving piston 2, a piston rod 3 and a pump piston 4 having a surface area equal to that of piston 2. The compressed air or other drive medium

required for operating the driving piston 2 of the preliminary pump enters and leaves through a port 5 in driving portion 9 of cylinder 1. A conduit 6 connects the supply container (not shown) of the pressurized liquid to the pumping chamber portion 8 of cylinder 1 of the preliminary feeding pump through a check valve 7, chamber 8 being situated below the pumping piston 4. When the driving portion 9 of the cylinder 1 of the preliminary pump is closed to the compressed air and vented to the atmosphere as will be described below, the pressurized liquid can flow through the conduits 6 and via valve 7 into pumping chamber 8 where the compound piston system is pushed upwardly by the expanding pressurized liquid so that the lower portion of chamber 8 is filled by liquid and the upper portion partly by vapor. Chamber 8 has a larger volume than a metering chamber portion 10 of the cylinder of a metering pump 13 to be described later. For example the volume of cylinder chamber 8 is twice the volume of cylinder chamber 10.

The vapor quantity contained in the space of cylinder portion 8 does not exert any detrimental effect since first it is condensed by the subsequent compression in accordance with the invention and, second, the pressurized liquid flows from the preliminary pump to the metering pump through a conduit 11 with check valve 12 connecting the bottom ends of both pumps so that only liquid but no gas may enter into cylinder space 10 of the metering pump. The compressed air in driving cylinder 9 may depress the compound piston system 2, 3, 4 only so far until the desired filling of metering chamber 10 of the cylinder of the metering pump is attained. The excess of pressurized liquid remains in pump chamber 8 of the preliminary pump and, together with the pressurized liquid entering at the next-following working cycle, serves again for filling the pumping cylinder portion 8 of the preliminary pump. Conduits 6 and 11 constitute a feed line directly connecting the supply container of the pressurized liquid with the metering pump, pump chamber 8 being also directly connected with metering chamber 10 and inserted into feed line 6, 11.

The metering pump comprises a power cylinder 13 which has an inlet and outlet port 14 for compressed air, and power piston 15. The latter together with a metering piston 16 and a piston rod 17 also forms a compound piston system. Piston rod 17 projects out of the cylinder cover 18 through a stuffing box 19. In the drawing, piston rod 17 is shown in a position in which it just abuts against a stop in the form of a threaded spindle 20 which is readily adjustable by means of a knob 21. Spindle 20 is rotatable in a threaded bore of a yoke 22 carried by columns 23 and 23' which are only partly shown. The remaining machine frame, being of conventional construction, is not shown.

From the metering pump extends a feed conduit 24 to a filling head 25. The latter comprises in its interior a valve plate 26 whose top face adjacent conduit 24 is provided with an elastic gasket (not shown). Valve plate 26 and the gasket are pressed by a helical spring 27 against the lower end of conduit 24 so as to attain a closure in the direction towards the pump as long as the pressure in cylinder portion 10 is not sufficient to overcome the force of spring 27. The filling head 25 is provided with a filling opening 28 which on the inside is provided with a gasket (not shown). The valve stem 29 of an aerosol container 30 to be filled is inserted into opening 28. Container 30 is set on a table 31 which is raised by means of a piston rod 32 and piston 33 in a lifting cylinder 34 when, by depressing a knob 35 of an air inlet valve 36, compressed air from an air compressor (not shown) is allowed to flow through a conduit 37 into lifting cylinder 34. As soon as knob 35 is released, piston 33 returns by virtue of the expansion of the previously tensioned spring 36'.

The apparatus is controlled by means of a foot pedal valve comprising two three-way valves 38 and 39. Two push-buttons 38′ and 39′ are depressable by means of a foot-pedal valve plate 42 and control valves 38, 39 to operate as follows:

A conduit 40 leading to valves 38, 39 is connected to a source of compressed air 41. The outlet tube 14′ of valve 38 is connected to port 14 of power cylinder 13 of the metering pump by conduit 14″. The outlet tube 5′ of valve 39 is connected to port 5 of the preliminary pump by conduit 5″. The two three-way valves 38, 39 are so constructed that, when the pedal plate 42 bears on the buttons 38′ and 39′, valve 38 allows air to flow from source 41 to cylinder 13 while valve 39 does not allow air to pass throughout vents cylinder portion 9 to the atmosphere through opening 39″. Due to this valve operation, the pressurized liquid is allowed to flow into cylinder portion 8 and to fill the space in the same, while the pressurized liquid present in metering cylinder portion 10 is forced by the action of the air on power piston 15 and thus on piston 16 to flow through filling head 25 into the aerosol container 30. Valve plate 26 yields under the action of the pressure so that the liquid flowing out of space 10 may enter the container 30. As soon as the pressure in space 10 upon reversal of the two valves 38 and 39 drops, as will be explained hereinafter, the helical spring 27 pushes the valve plate 26 firmly against the lower end of feed conduit 24 which thereby is closed. When the operator's foot is lifted from the pedal plate 42 so that the latter is raised, for example by a spring, not shown, the pressure on the two knobs 38′ and 39′ is relieved.

The process now is reversed in this position and valve 38 does not allow the passage of air and, at the same time, vents cylinder 13 to the atmosphere through opening 38″. On the other hand, valve 39 permits the passage of air which flows into power cylinder space 9 and depresses the compound piston system 2 to 4, whereby the pressurized liquid present in space 8 is compressed to such a degree that any vapors which may have formed are condensed. At the same time, the pressurized liquid is forced through check valve 12 into space 10 of the metering pump. The two check valves 7 and 12 prevent backward flow of liquid in the feed line. By means of stop spindle 20, the desired metered filling quantity may be accurately adjusted, for which purpose suitably a scale (not shown) of the adjusted volume of space 10 is mounted adjacent to spindle 20.

The apparatus according to the described embodiment affords the great advantage that it operates without electricity and, thus, without spark formation. The apparatus is controlled and operated exclusively by compressed air which may be produced in an adjoining room, so as to exclude the possibility of explosions of pressurized liquids which may be present because of leakage through a pipe joint. The operator attending the apparatus only has to set container 30 on table 31 and push knob 35 whereby the container with valve opening 29 is tightly inserted into port 28 of filling head 25. He then actuates the foot pedal 42 whereby the metered quantity of pressurized liquid present in space 10 is charged into container 30. When now knob 35 and the foot pedal plate are released, plate 31 returns to its initial position and the filled container 30 may be removed. At the same time, space 10 of the metering pump is again filled with a fresh supply of pressurized liquid in the manner described above, and this with exactly the same quantity as has been set by means of spindle 20. The cycle then may start over again. It is essential that only liquid is contained in the metering chamber 10 of the metering pump since otherwise no exact quantity can be dispensed. In order to avoid transfer of any vapor from the preliminary feeding pump, pumping chamber 8 is made of a greater volumetric capacity than metering chamber 10 so that any gases, which may form in cylinder portion 8 and collect at the upper part of chamber 8 under piston 4, will not be discharged through the lower outlet of the preliminary pump into the feeding conduit 11 or introduced into the metering pump. Therefore, the fact that vapors collect in the pumping chamber of the preliminary feeding pump does not affect the accuracy of the metering operation or of the feeding operation, since no gas or vapor is fed to the metering pump due to the fact that the volume of the chamber of the feeding pump is larger than the volume of the chamber of the metering pump and that the volume of the liquid in chamber 8 is greater than the volume of chamber 10.

The diameter of piston 15 substantially greater than that of metering piston 16. When for example, the proportion of these two surfaces is 4:1 and when the pressure of the air entering through conduit 14 is 10 atmospheres, a pressure of 40 atmospheres is built up in space 10, which permits rapid filling of container 30.

In place of the intermittently operating preliminary pump, a continuously operating pump such as a rotary pump or a diaphragm pump may be used as preliminary pump.

Practice has shown that a gradual rise of the speed of the compound piston system 2 to 4 prevents an excessive vapor formation in chamber 8. For such purpose, the driving portion of the preliminary pump is controlled by a speed-regulating means such as a valve 43 in conduit 14″.

The apparatus of the invention could be constructed in details differently from that shown, without departing from the spirit of the present invention.

It will be understood that each of the elements described above, or two or more together, may also find a useful application in other types of bottling apparatus differing from the types described above.

While the invention has been illustrated and described as embodied in an apparatus for pumping and metering a liquid containing a volatile gas, it is not intended to be limited to the details shown, since various modifications and structural changes may be made without departing in any way from the spirit of the present invention.

Without further analysis, the foregoing will so fully reveal the gist of the present invention that others can by applying current knowledge readily adapt it for various applications without omitting features that, from the standpoint of prior art, fairly constitute essential characteristics of the generic or specific aspects of this invention and, therefore, such adaptations should and are intended to be comprehended within the meaning and range of equivalence of the following claims.

What is claimed as new and desired to be secured by Letters Patent is:

1. An apparatus for filling a container with a liquid including a volatile propellant fluid, comprising, in combination, a metering pump formed with a metering chamber having a first variable volume; a feed line for supplying only said liquid to said metering chamber from a source of supply; a preliminary feeding pump formed with a pump chamber having a second variable volume greater than said first variable volume and connected to said feed line, said feed line having a conduit portion directly connecting the lower portion of said pump chamber of said preliminary feeding pump with said metering chamber of said metering pump; means for charging said liquid from said metering pump into a container; and drive means fluid-tightly separated from said chambers for operating said pumps so that liquid is fed from said lower portion of said pumping chamber under pressure through said conduit portion directly into said metering chamber while vapor gathering in the upper portion of said pump chamber is not pumped into said metering chamber due to the fact that the volume of said pump chamber exceeds the volume of said metering chamber.

2. An apparatus for filling a container with a liquid including a volatile propellant fluid, comprising, in combination, a metering pump formed with a metering chamber having a first variable volume; means fluid-tightly

separated from said metering chamber for operating said metering pump; a feed line for supplying only said liquid to said metering chamber from a source of supply; a feeding pump comprising a cylinder having a driving cylinder portion and a driving piston therein, said cylinder having a pumping portion and a pumping piston therein, said pistons being directly connected for simultaneous movement and movable by introduction of a driving medium into said driving portion of said cylinder, said pumping cylinder and pumping piston defining a pump chamber having a second variable volume greater than said first variable volume and being fluid-tightly separated from said driving portion of said cylinder, said feed line being connected to the lower portion of said pumping portion of said cylinder so that only liquid is pumped through said feed line into said metering chamber while vapor gathering in the upper portion of said pumping portion of said cylinder and under said pumping piston does not enter said metering chamber due to the greater volume of said pumping chamber; and means for charging said liquid from said metering chamber into a container.

3. An apparatus for filling a container with a liquid including a volatile propellant fluid, comprising, in combination, a metering pump for said liquid; a feed line for supplying said liquid to said metering pump from a source of supply; a feeding pump connected to said feed line and being directly connected to said metering chamber for feeding said liquid under pressure into said metering chamber by the pressure of said feeding pump, said feeding pump comprising a cylinder having a driving portion and a driving piston therein, said cylinder having a pumping portion and a pumping piston therein, said pistons being directly connected for simultaneous movement and movable in one direction by introduction of a driving medium into said driving portion of said cylinder, the pumping capacity of said pumping portion of said cylinder being greater than the pumping capacity of said metering pump so as to insure that said volatile propellant fluid in said liquid is compressed to liquid state before being fed into said metering pump; and means for charging said liquid from said metering pump into a container.

4. An apparatus for filling a container with a pressurized liquid comprising, in combination, a metering pump for said liquid, said metering pump comprising a power cylinder and a power piston therein, a metering cylinder and a metering piston therein, said pistons being connected for simultaneous movement, and means for moving said power piston by introduction of a driving medium into said power cylinder, said metering piston defining in said metering cylinder a metering chamber of a variable first volume; a feed line for supplying said liquid to said metering chamber from a source of supply; a feeding pump having a pumping chamber of a second volume greater than said first volume and being connected to said feed line, said feed line directly connecting a lower portion of said pumping chamber with said metering chamber so that said liquid is fed under pressure into said metering chamber by said feeding pump while vapor accumulating in the upper portion of said pumping chamber is not pumped into the metering chamber due to the greater volume of said pumping chamber; and means for charging said liquid from said metering pump into a container.

5. An apparatus for filling a container with a liquid including a volatile propellant fluid, comprising, in combination, a metering pump for said liquid, said metering pump comprising a power cylinder and a power piston therein, a metering cylinder and a metering piston therein, said power piston and said metering piston being operatively connected for simultaneous movement, and said metering piston defining in said metering cylinder a metering chamber having a first variable volume, means for moving said power piston in one direction by introduction of a driving medium into said power cylinder only; a feed line for supplying said liquid to said metering chamber from a source of supply; a feeding pump comprising a cylinder having a driving portion and a driving piston therein and having a pumping portion and a pumping piston therein, said driving piston and said pumping piston being operatively connected for simultaneous movement and movable in one direction by introduction of a driving medium into said driving portion only of said cylinder, said pumping piston defining in said pump portion of said cylinder a pumping chamber having a second volume greater than said first volume, said feed line having a conduit portion directly connecting the lower portion of said pumping portion with said metering chamber so that only liquid is pumped from said pumping chamber into said metering chamber due to the greater volume of said pumping chamber; control means for controlling the movement of the driving medium to said driving portion of said cylinder of said feeding pump and to said power cylinder, said control means being movable between a first position in which said driving medium is admitted into said driving portion of said feeding pump while said driving medium is vented from said power cylinder, and a second position in which said driving medium is supplied into said power cylinder of said metering pump while said driving medium is vented from said driving portion of said cylinder of said feeding pump; and means for charging said liquid from said metering pump chamber into a container.

6. An apparatus for filling a container with a liquid including a volatile propellant fluid, comprising, in combination, a metering pump for said liquid and having a metering chamber of a first variable volume; drive means fluid-tightly separated from said metering chamber for driving said metering pump; a feed line for supplying said liquid to said metering chamber from a source of supply; a feeding pump having a pumping chamber connected to said feed line, said feed line having a conduit portion directly connecting the lower portion of said pumping chamber with said metering chamber; drive means fluid-tightly separted from said pumping chamber for driving said feeding pump so that a pressure for liquefying the volatile propellant fluid is produced in said feed line while vapor contained in the upper portion of said pumping chamber does not enter said feed line and said metering chamber due to the greater volume of said pumping chamber; a check valve inserted into said feed line conduit between said metering chamber and said pumping chamber for preventing the return of the compressed liquid from said metering chamber to said pumping chamber; and means for charging said liquid from said metering chamber into a container, said last-mentioned means including a filling head for connecting a container to be filled with said metering chamber, biased pressure valve means in said filling head for preventing outflow of said liquid from said metering chamber under the pressure of said feeding pump and for permitting outflow of said liquid from said metering chamber only after a predetermined higher discharge pressure has been produced in said metering chamber, and means for placing a container in a filling position in which it is connected with said filling head for being filled therethrough.

7. An apparatus is set forth in claim 6 in which said means for placing a container in a filling position include a lifting cylinder and a piston therein, a piston rod connected to said piston, a support member carried by said piston rod and adapted to carry a container to be filled, means for introducing a driving medium into said lifting cylinder for raising said piston and said support member, and control means for controlling the introduction of said driving medium into said lifting cylinder in order to move a container into said filling position.

8. An apparatus for filling a container with a liquid including a volatile propellant fluid, comprising, in combination, a metering pump for said liquid, said metering pump comprising a power cylinder and a power piston

therein, a metering cylinder and a metering piston therein, said power piston and said metering piston being operatively connected for simultaneous movement; means for moving said power piston in one direction by introduction of a driving medium into said power cylinder; a feed line for supplying said liquid to said metering pump from a source of supply; a preliminary pump inserted into said feed line, said preliminary pump being directly connected to said metering pump for feeding said liquid under pressure into said metering pump by the pressure of said preliminary pump, said preliminary pump comprising a cylinder having a driving portion and a driving piston therein, a pumping portion and a pumping piston therein, said driving piston and said pumping piston being operatively connected for simultaneous movement and movable in one direction by introduction of a driving medium into said driving portion of said cylinder, said pumping portion having a greater volume than said metering cylinder; control means comprising two separate three-way valves for controlling the movement of said driving medium toward said metering pump and said preliminary pump, said control means being movable between one position in which said driving medium is admitted into said driving portion of said preliminary pump while said driving medium is released from said power cylinder of said metering pump, and the position in which said driving medium is admitted into said power cylinder of said metering pump while said driving medium is released from the driving portion of said preliminary pump, and a common operating members for moving said control means between said two positions; and means for charging said liquid from said metering pump into a container.

9. An apparatus for metering the liquid part of a fluid in boiling condition comprising, in combination, a feeding pump having an expansible and contractable pump chamber having a first volume; and having a lower portion for containing the liquid phase of said fluid, and an upper portion for containing the vapor phase of the fluid; first drive means for driving said feeding pump and being fluid-tightly separated from said pump chamber; a feed line for supplying said fluid to said pump chamber; a

metering pump having an expansible and contractable metering chamber of a volume smaller than the volume of said pump chamber and than said lower portion of the same; second drive means for driving said metering pump and being fluid-tightly separated from said metering chamber; a conduit directly connecting said metering chamber with said lower portion of said pump chamber; and control means for alternately operating said first and second drive means of said feeding pump and of said metering pump so that liquid contained in said lower portion of said pump chamber is supplied to said metering chamber while vapors gathering in the upper portion of said pumping chamber are not pumped through said conduit into said metering chamber due to the fact that the volume of said pumping chamber is greater than the volume of said metering chamber.

10. An apparatus as set forth in claim **9** and including a check valve located in said conduit for preventing flow of liquid from said metering chamber into said pumping chamber.

11. An apparatus as set forth in claim **9** wherein said metering pump includes a cylinder and a piston defining in said cylinder said metering chamber; and wherein said feeding pump includes a cylinder and a piston in said cylinder defining said pump chamber, said last-mentioned piston in its advanced position defining the smallest volume of said pump chamber, said smallest volume being greater than the greatest volume of said metering chamber in the retracted position of said piston of said metering pump.

References Cited by the Examiner

UNITED STATES PATENTS

2,641,399	6/53	McBean	141—3
2,661,885	12/53	McBean	141—20
2,684,805	7/54	McBean	141—3
2,785,537	3/57	Mojonnier	141—3 XR

LAVERNE D. GEIGER, *Primary Examiner.*