

April 9, 1963

F. M. McDOUGALL
LIQUID INJECTOR

3,084,634

Filed Jan. 19, 1961

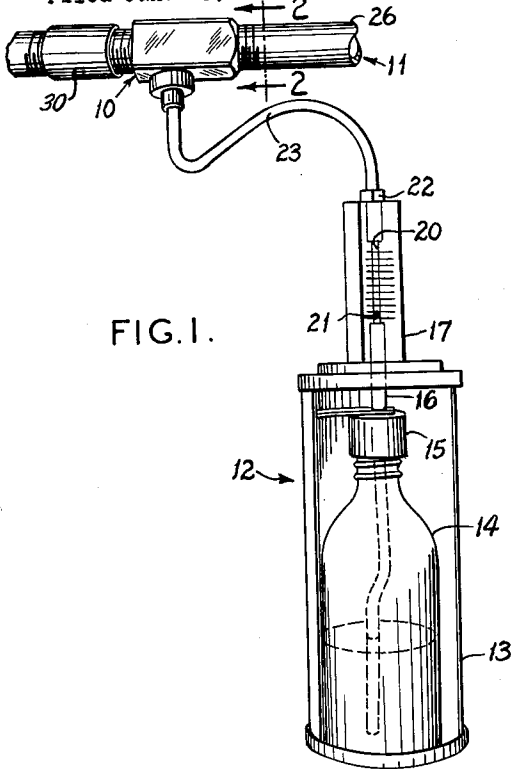


FIG. 1.

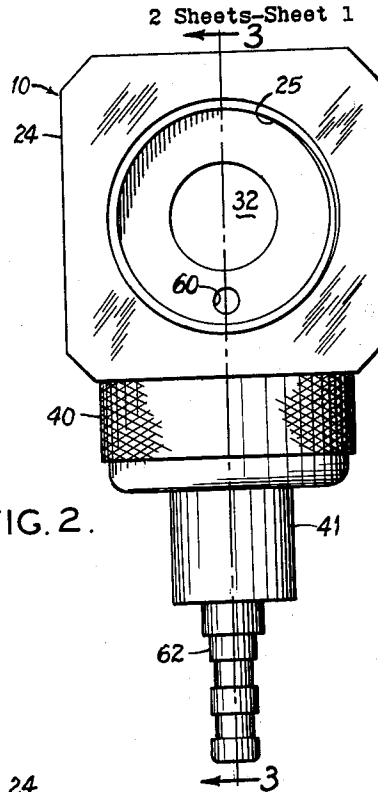


FIG. 2.

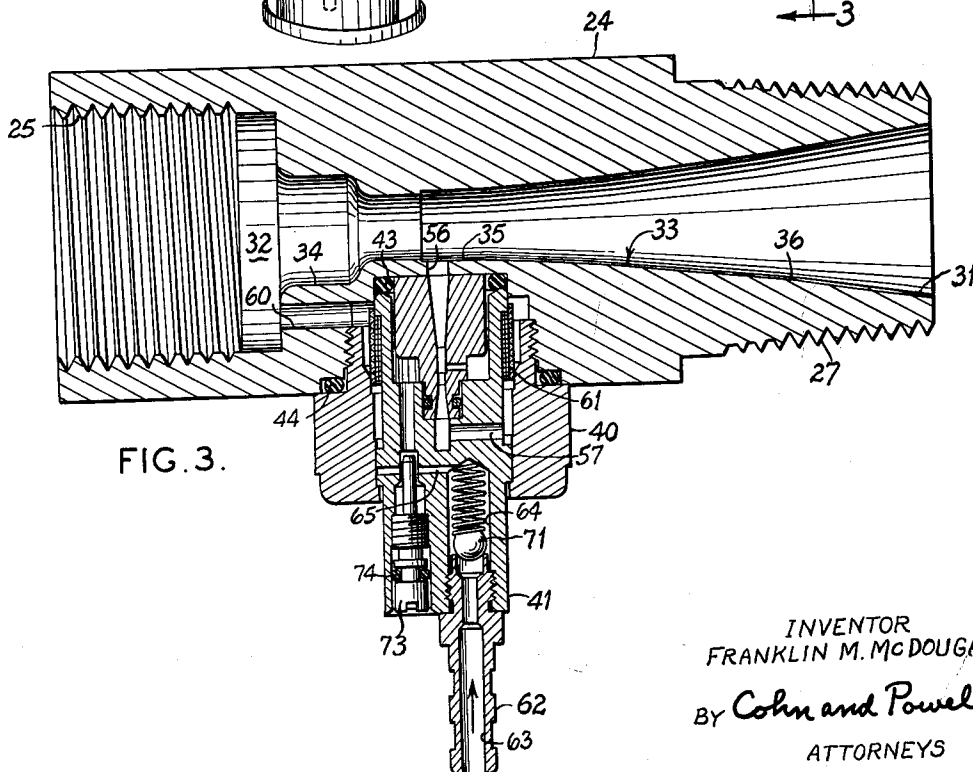


FIG. 3.

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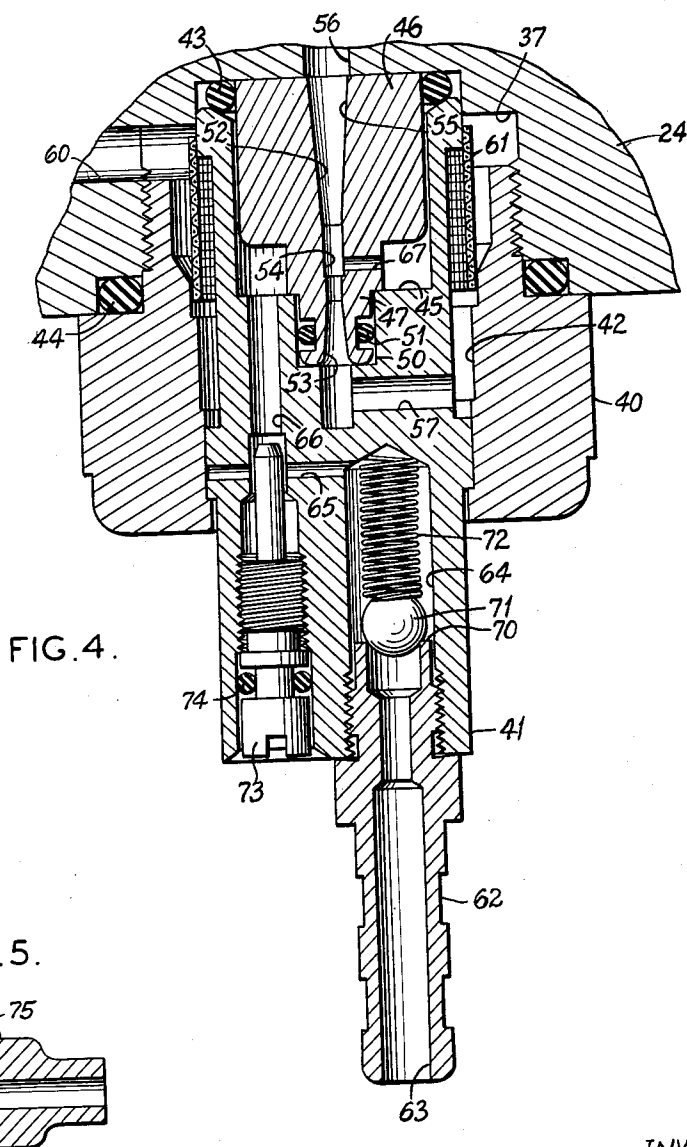
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LIQUID INJECTOR

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5 Claims. (Cl. 103-262)

This invention relates generally to improvements in a device adapted to inject a fluid into the moving stream of another fluid under pressure, and to the method of such injection. More particularly, it relates to an improved mechanism for and method of introducing a liquid detergent, disinfectant, wetting agent or other chemical into water flowing through a closed conduit.

Although suitable for many other uses, as suggested above, it is an important object to provide an improved device for injecting a small quantity of liquid rinse additive into the final rinse water of a mechanical dishwasher.

The heretofore conventional rinse injectors, which is the usual term for such devices, fall into two general categories. In the first category, a Pitot tube is inserted into the rinse water line and is connected to a small bottle of rinse additive. The flow of rinse water past the Pitot tube creates a small differential pressure which is transmitted by suitable lines to the top and bottom of the additive container. The additive is displaced by water and is forced into the rinse water stream.

With the Pitot tube type of injector, the dishwasher must be shut down to stop the rinse water flow before the supply of rinse additive is replenished. Also the Pitot tube must not be installed in the rinse line ahead of a shutoff valve, otherwise a hydraulic shock could be transmitted to the relatively fragile rinse additive container. Finally, the rinse additive must not be readily miscible with water so that the water can displace the rinse additive without diluting it in the container.

In the second category, a motor driven reciprocating pump draws rinse additive from a container at atmospheric pressure and forces it into the rinse water stream. The power means consists of either an electric motor or a water motor such as that commonly used in water meters.

The motor driven injector employs moving parts which are subject to wear and which require periodic servicing. Also, this type of injector is inherently more expensive. Where an electric motor is used to power the injector, means must be provided for starting and stopping the motor in response to the rinse water flow. Such a motor is a constant speed power source, so the additive feed rate is constant without regard to fluctuation in the rinse water flow.

An important object is realized by providing a simple device, with no moving parts, adapted to draw a fluid from a container at atmospheric pressure and to inject it into a fluid flowing through a conduit at a pressure above atmospheric.

Another important objective is achieved by providing an injector that is readily responsive to the rate of rinse water flow in feeding of the liquid additive. The structural arrangement creates a partial vacuum at the throat of one venturi through which a small portion of the water is diverted from the main stream, the partial vacuum operating to draw in the rinse additive at rates which vary according to the rinse water flow, thereby maintaining a reasonably constant proportion of liquid additive to rinse water.

Other important advantages are realized because of the fact that the liquid additive supply can be kept at atmospheric pressure. The injector embodies means for pre-

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venting the escape of fluid under pressure from the conduit in which the item is installed, into the container of fluid to be inducted. Because the container is never subjected to any pressure, rinse additive may be drawn from any size container.

Still another important objective is achieved by providing a structural arrangement of the component parts of the injector which permits the device to be easily serviced without tools.

Yet another important object is achieved by providing for a fine adjustment of the flow of the inducted fluid to permit setting at very small flow rates.

Another important objective is achieved by providing a liquid injector that is simple and durable in construction, economical to manufacture, efficient in operation, and which can be quickly and easily installed into a closed conduit, and particularly into the rinse line of a dishwashing system, by any one with only a minimum of instruction.

The foregoing and numerous other objects and advantages of the invention will more clearly appear from the following detailed description of a preferred embodiment, particularly when considered in connection with the accompanying drawings, in which:

FIG. 1 is a perspective view illustrating the liquid injector installed into a system such as the rinse line of a dishwasher, and illustrating the connection to a liquid reservoir;

FIG. 2 is an enlarged end elevational view of the liquid injector;

FIG. 3 is a cross sectional view of the injector as seen along line 3-3 of FIG. 2;

FIG. 4 is an enlarged fragmentary view of the meter body shown in FIG. 3, and

FIG. 5 is a cross sectional view of a nozzle that can be selectively inserted.

Referring now by characters of reference to the drawing, and first to FIG. 1, the liquid injector generally indicated at 10 is operatively connected in a closed conduit referred to at 11. Although the injector has many applications and fields of use as suggested previously, for purposes of illustration and disclosure the conduit 11 will be hereinafter referred to as the rinse line leading to a dishwasher.

The reservoir generally indicated at 12 in FIG. 1 is intended for remote installation on any convenient vertical wall or surface. The reservoir 12 includes a cylindrical bracket 13 that is open at one side to permit the insertion of an additive bottle 14. A hood 15 attached to and carried by the bracket 13 is adapted to slip over the open neck of bottle 14. A flexible hose 16 is attached to the outlet of a flow indicator 17 and extends through hood 15.

The flexible hose 16 enables a full bottle 14 to be inserted easily within the bracket 13 and under the hood 15, and permits an empty bottle to be as readily withdrawn. Although not shown in FIG. 1, the hood 15 may be adjusted vertically within the bracket 13 to a position whereby to accommodate any bottle 14 within a reasonable range of sizes.

The flow rate indicator 17 is constructed of a transparent plastic such as Lucite, the indicator 17 being provided with a passageway 20 therethrough in which a flow indicator ball 21 is movable. The body of the indicator 17 is provided with graduations from which the rate of flow through the passageway 20 can be visually determined when compared with the position of the ball 21. Attached to the top of the indicator 17 and communicating with the outlet of the passageway 20 is a nipple 22 to which a flexible hose 23 is attached, the hose 23 communicating directly with the liquid injector 10.

From FIGS. 2-4 inclusive, it is seen that the injector 10 includes an injector body 24 having an inlet 25 at one

end which is internally threaded to receive a threaded conduit portion 26 (FIG. 1) of the rinse line. The opposite reduced end 27 of injector body 24 is provided with external threads to which a sleeve coupling 30 (FIG. 1) is attached incident to installing the injector in the rinse line 11. This reduced end 27 of injector body 24 is provided with an outlet 31.

Extending through the injector body 24 and interconnecting the inlet 25 and outlet 31, is a primary passage indicated at 32 in FIG. 3 through which the main stream of fluid flows under pressure. As is best seen in FIG. 3, the primary passage 32 includes a first stage venturi 33 having an inlet converging portion 34, a constricted throat 35 and a following divergent portion 36.

Formed in the side of injector body 24 adjacent the throat 35 of the first stage venturi 33, is a recess 37 (FIG. 4) that is internally threaded to receive a tubular nut 40 constituting a cap or knob. A cylindrical meter body 41 is seated in the recess 37 and is carried by the tubular nut 40, the nut 40 and meter body 41 engaging with a press-fit. Furthermore, the nut 40 and meter body 41 are formed to provide an annular groove 42 therebetween which opens into the recess 37. When installed, the inner end of meter body 41 is sealed with the injector body 24 by an O-ring 43. In addition, the nut 40 is sealed with the injector body 24 by an O-ring 44.

As is best seen in FIG. 4, the inner end of meter body 41 is provided with an end open socket 45 in which a plug 46 is received. The plug 46 extends outwardly beyond the end of meter body 41 and engages the bottom of the injector body recess 37. The O-ring 43 embraces the periphery of plug 46. Also, the plug 46 includes a reduced portion 47 that provides a chamber in the socket 45 between the plug 46 and the meter body 41. The reduced plug portion 47 interfits a compatible socket 50 formed in meter body 41 and is maintained in sealed relation by an O-ring 51.

A second stage venturi 52 is formed through the plug 46, the venturi 52 including a converging inlet portion 53, a constricted throat 54 and a diverging outlet portion 55. The outlet of the second stage venturi 52 is placed in operative connection with the throat 35 of the first stage venturi 33 by port 56 formed in injector body 24. A passage 57 formed in meter body 41 interconnects the annular groove 42 with the inlet to the second stage venturi 52.

A port 60 is formed in injector body 24 and communicates the annular groove 42 with the primary passage 32 on the inlet side of the first stage venturi 33. Preferably, the port 60 extends parallel to, yet is spaced laterally offset from the longitudinal axis of the primary passage 32.

A very small portion of the moving liquid under pressure is diverted from the primary passage 32 and flows through the above described secondary passage. More particularly, in flowing through the secondary passage, a small portion of the flow from the primary passage on the inlet side of the first stage venturi 33 passes through the port 60 and into the annular groove 42. Such liquid then flows through the passageway 57, thence through the second stage venturi 52, and is then discharged through port 56 into the throat 35 of the first stage venturi 33.

The capacity of the secondary passage is very small compared with the primary passage 32 so that only a very small portion of the liquid under pressure is diverted.

Slipped over the end of the meter body 41 is a screen sleeve 61 that has a cloth backing. The screen sleeve 61 extends between the meter body 41 and the attached nut 40 and extends across the annular groove 42. Flow of the liquid through the secondary passage is filtered by the screen sleeve 61 to remove any foreign objects that might clog or otherwise damage the parts of the injector. If the screen sleeve 61 becomes excessively clogged, the performance of the unit will be affected. To clean the screen sleeve 61, the meter body 41 is removed from the

injector body 24, and the screen sleeve 61 is slipped off of the end, cleaned and replaced.

Threadedly attached to the outer end of meter body 41 is a hose nipple 62 which is operatively attached to the additive hose 23 in the system shown in FIG. 1. The liquid induction passage for introducing additive from hose 23 consists of a center bore 63 extending through nipple 62 which leads to an elongate chamber 64 formed in meter body 41. The liquid induction passage also includes a small transverse passage 65 in meter body 41 that communicates with the bottom of chamber 64 and is closed at the other end by the press-fit of nut 40 with the periphery of meter body 41. A longitudinal passage 66 communicates the small transverse passage 65 with the socket 45, and specifically with the chamber around the reduced plug portion 47. A small transverse port 67 is formed in the reduced plug portion 47, the port 67 placing the socket chamber in communication with the throat 54 of the second stage venturi 52.

The inner end of nipple 62 is formed to provide a valve seat 70 engageable by a valve ball 71. A compression spring 72 located within chamber 64 engages the valve ball 71 and tends to urge the valve ball 71 in a direction to close the valve seat 70 against the action or flow of the liquid additive through the liquid induction passage.

An adjustment mechanism is provided to regulate the flow of liquid additive through the liquid induction passage more precisely. This mechanism consists of a metering screw 73 threadedly connected within the meter body 41. Disposed about the metering screw 73 is an O-ring that places the screw 73 in sealed relation with the meter body 41. The stem of the metering screw 73 operates in the longitudinal passage 66 and is adapted to control the effective opening of such passage 66.

To install the injector, the injector body 24 is connected in the rinse line 11 in the manner disclosed in FIG. 1 so that the direction of water flow is from left to right in FIG. 3.

The bottle holder or bracket 13 is mounted on any convenient vertical surface. One end of the plastic supply hose 23 is attached to the fitting 22 on top of the flow indicator 17 and the other end is attached to nipple 62 on the injector 10. To attach the hose 23, the hose is simply pushed over the fitting 22 and nipple 62 as far as it will go. Of course, the hose 23 may be cut off to any length required.

The position of the bottle hood 15 is determined by the size of bottle utilized. The plastic hose 16 extends through the hood 15. With the hood 15 in the correct position, the cap of the rinse fluid bottle is removed and the bottle is placed in the bracket 13 by inserting the hose 16 into the bottle first and then shoving the bottle top up under the hood 15. The unit is now ready to be put into operation.

When the water is turned on and the rinse valve is actuated, flow of liquid under pressure through the rinse line 11 begins. The main flow of the water is through the primary passage 32. As the water flow continues through the first stage venturi 33, the constricted throat 35 increases the velocity and reduces the pressure. However, the pressure of this main flow at the venturi throat 35 usually is slightly above atmospheric pressure. As the main flow then continues through the venturi, the diverging portion 36 reduces the velocity and recovers most of the initial pressure.

Only a very small portion of the water is diverted from the primary passage 32 and flows through the secondary passage. This secondary flow of water flows through port 60 into the annular groove 42 and past the screen 61, and then flows through the passageway 57 and into the second stage venturi 52. The flow of water from the secondary passage is discharged from the second stage venturi 52 through port 56 into the throat 35 of the first stage venturi 33.

As this secondary water flow passes through the con-

stricted throat 54 of the second stage venturi 52, a partial vacuum is created in the venturi throat in the region of the discharge port 67 of the liquid induction passage. This differential in pressures induces flow from the liquid additive reservoir 12 through the liquid induction passage and into the second stage venturi 52.

Specifically, the liquid additive flows through passage-way 63 and past the valve ball 71 into the chamber 64. The valve ball 71 is unseated to open the liquid induction passage as the flow of liquid additive is induced therethrough. The liquid additive then flows through the small transverse bore 65, through the passage 66 into the chamber of socket 45 surrounding the reduced plug portion 47, and thence through the port 67 into the throat 54 of the second stage venturi 52.

The partial vacuum created in the second stage venturi 52 increases and decreases with the rinse water flow rate. This partial vacuum draws in the rinse additive at rates which vary according to the rinse water flow, thereby maintaining a reasonably constant proportion of additive to rinse water in the primary passage 32.

The position of the ball 21 in the flow indicator 17 indicates the rate at which rinse additive is being injected into the rinse water. To inject more additive, the adjustment screw 73 is turned counterclockwise to widen the effective opening of passage 66. To reduce the flow of additive through the liquid induction passage, the adjustment screw 73 is turned clockwise to reduce the effective opening of passage 66. The indicator ball 21 will rise or fall depending on whether the adjustment screw 73 was opened or closed.

The appropriate setting of the adjustment screw 73 will depend on the type of rinse additive and the rinse water flow. In a dishwashing system, the condition of the dishes as they leave the washer is noted to determine whether more or less additive is needed. Water spotted dishes indicates insufficient rinse additive, while a soapy appearance indicates that too much additive is being used. Once the proper setting is achieved, no further adjustment is necessary, nor should the operator ever need to tamper with the setting.

On installation where the water pressure is subject to fluctuation, the flow indicator ball 21 will move up and down from the original setting while the unit is in operation. This indicates that the rate of rinse fluid induction is changing in order to compensate for the change in water flow pressures. The present injection maintains the correct proportions of rinse fluid to rinse water, regardless of pressure fluctuations.

The check valve prevents the flow of rinse water into the additive supply line. If the injector is installed ahead of a shut-off valve in the rinse line of the system, and the shut-off valve is closed, the check valve in the injector is also closed immediately to prevent the flow of rinse water in a reverse direction through the liquid induction passage. Therefore, it is seen that the bottle 14, or in other words the liquid reservoir 12, is never subjected to any pressure above atmospheric pressure.

The injector unit is adaptable to all makes and sizes of dishwashing machines. The water flow rate through the rinse line is determined principally by the supply pressure and the size of the nozzle at the outlet of the rinse line. There is a considerable difference between the rinse flow rate of different sizes of dishwashers. This problem is overcome by providing a selection of interchangeable water nozzles of the type indicated at 75 of FIG. 5, such nozzles 75 being adapted to interfit the inlet converging portion 34 in the first stage venturi 33. Such a nozzle 75 provides a smaller throat for the first stage venturi 33. By selecting the appropriate nozzle 75, optimum performance, that is to say, positive injection at minimum pressure differential, is obtained on any size of dishwasher.

Although the invention has been described by making detailed reference to a single preferred embodiment,

such detail is to be understood in an instructive, rather than in any restrictive sense, many variants being possible within the scope of the claims hereunto appended.

I claim as my invention:

1. A liquid injector comprising an injector body having an inlet and an outlet interconnected by a primary passage, said primary passage including a first stage venturi, a meter body having one end detachably connected to said injector body, said meter body end being provided with a socket, a separable plug detachably and sealably carried in said socket, said separable plug being provided with a second stage venturi, means in said injector body and meter body placing the inlet of said primary passage in communication with the inlet to said second stage venturi the last said means diverting only a small portion of the flow from said primary passage, means in said injector body placing the outlet of said second stage venturi in communication with the throat of said first stage venturi, and a liquid induction passage in said meter body and plug communicating with the throat of said second stage venturi.

2. A liquid injector comprising an injector body having an inlet and an outlet interconnected by a primary passage, said primary passage including a first stage venturi, the injector body being provided with a recess, a meter body having one end disposed in said recess and detachably connected to said injector body, a secondary passage including a groove between the meter body end and the injector body, the injector body being provided with a port communicating the groove with the inlet of said primary passage, a passage in said meter body communicating with said groove and having a second stage venturi, means placing the outlet of said second stage venturi located closely adjacent and at substantially right angle to the first stage venturi in communication with the throat of said first stage venturi, a liquid induction passage in said meter body communicating with the throat of said second stage venturi, and a screen sleeve detachably slipped over the meter body end and extending across said groove.

3. A liquid injector comprising an injector body having an inlet and outlet interconnected by a primary passage, said primary passage including a first stage venturi, the injector body being provided with a recess, a meter body having one end disposed in said recess and attached to said injector body, said meter body end being provided with a socket, a secondary passage including an annular groove between the meter body and the injector body, the injector body being provided with a port communicating the groove with the inlet of said primary passage, a separable plug detachably and sealably carried by said meter body in said socket, said separable plug being provided with a second stage venturi, a passage in said meter body communicating the groove with the inlet to said second stage venturi, and means placing the outlet of said second stage venturi in communication with the throat of said first stage venturi, and a liquid induction passage in said meter body communicating with the throat of said second stage venturi.

4. A liquid injector comprising an injector body having an inlet and an outlet interconnected by a primary passage, said primary passage including a first stage venturi, the injector body being provided with a recess, a meter body disposed in said recess and attached to said injector body, a secondary passage including a groove between the meter body and the injector body, the injector body being provided with a port communicating the groove with the inlet of said primary passage, said meter body being provided with a socket in one end, a separable plug received in said socket and sealably carried by said meter body, said plug being provided with a second stage venturi, a passage in said meter body communicating said groove with the inlet of said second stage venturi, means placing the outlet of said second stage venturi in communication with the throat of said

first stage venturi, a screen sleeve slipped over the end of the meter body and extending across the secondary passage, and a liquid induction passage in said meter body communicating with said socket and including a passage in said plug communicating with the throat of said second stage venturi.

5. A liquid injector comprising an injector body having an inlet and an outlet interconnected by a primary passage, said primary passage including a first stage venturi, the injector body being provided with a recess, a meter body, a cap secured to said meter body, said cap being attached to said injector body to seat said meter body in said recess, a secondary passage including an annular groove between said cap and meter body, the injector body being provided with a port communicating the groove with the inlet of said primary passage, the meter body being provided with a socket in its inner end, a separable plug received in said socket and carried by said meter body, said plug being provided with a second stage venturi, a passage in said meter body communicating said groove with the inlet to said second stage venturi, means in said injector body placing the outlet of said second stage venturi in communication with the throat of said first stage venturi, the plug having a re-

duced portion around the throat of the second stage venturi to provide a chamber in the socket between the plug and meter body, a screen sleeve detachably slipped over the meter body and extending across the annular groove of the secondary passage, and a liquid induction passage in said meter body communicating with said chamber in the socket and including a port in said plug communicating said chamber with the throat of said second stage venturi.

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