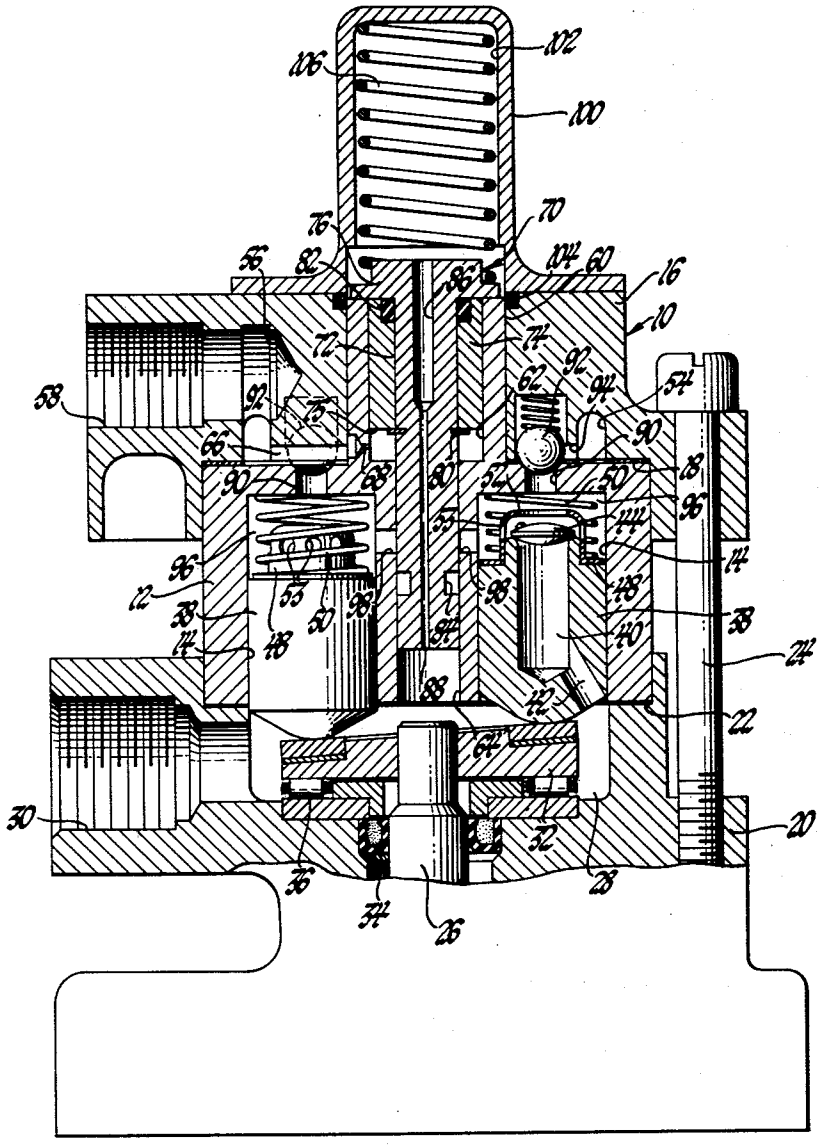
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MULTI-CYLINDER PUMP

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INVENTORS.
Manfred P. H. Schlanzky
BY & Joseph G. Zubaty
George E. Johnson
ATTORNEY

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MULTI-CYLINDER PUMP

Manfred P. H. Schlanzky and Joseph G. Zubaty, Flint, Mich., assignors to General Motors Corporation, Detroit, Mich., a corporation of Delaware

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This invention relates to pumps and more particularly to pumps of the multi-cylinder type which preferably include wobble plate operated pumping elements.

In pumping liquids and particularly in handling fluids which are volatile, it is desirable to control the pump discharge pressure without churning the fluid or dropping the pressure of any of the fluid already pressurized. If gasoline, for example, is discharged at a pressure which is subsequently reduced by returning gasoline to the intake of the pump, churning in combination with the pressure drop will result to such an extent that vapor formation is encouraged. This gasoline return tends toward vapor formation because of the pressure drop alone although it be assumed that churning were somehow avoided. It has now been found in practicing the present invention that much churning of the fluids being pumped can be avoided and depressurizing to pump inlet pressure are effects which are not necessary in achieving automatic pump pressure discharge regulation in a multi-plunger pump.

To this end, an object of the present invention is to provide an improved multi-cylinder pump in which pressure regulation may be achieved with a minimum of churning of liquid being handled. Another object is to provide a multi-cylinder type of liquid pump in which depressurizing of any substantial quantity of the pump discharge fluid is substantially eliminated as a factor in controlling the discharge pressure.

A feature of the present invention is a multi-cylinder pump provided with valve means for automatically connecting the discharge portions of the pump cylinders upon the attainment of a predetermined pump discharge pressure. Another feature is a pump having multiple cylinders adapted to effect sequential discharges through corresponding discharge valves to a common discharge passage or chamber until a predetermined pressure in the latter is attained, this arrangement being in combination with spring and pressure actuated valve means giving communication between the cylinders when that pressure is reached for exceeded, the result being automatic regulation of the pump discharge pressure.

These and other important features of the invention will now be described in detail in the specification and then pointed out more particularly in the appended claims.

The drawing shows an elevation view of a fuel pump as one embodiment of the present invention, a major portion being in section in two planes better to illustrate the construction. It will be appreciated as the description proceeds that although plungers are disclosed as the preferred pumping elements for applying pressure to the fluid, the invention may also be utilized with the use of diaphragms such as are disclosed in the United States Patent 2,991,723, granted July 11, 1961, in the name of Joseph Zubaty. The use of diaphragm or plungers as pumping elements are disclosed in the United States Patent 2,955,475, granted October 11, 1960, also in the name of Joseph Zubaty. Also, the pumping elements may be operated sequentially by cam action derived from a driver mechanism other than a wobble plate although the latter is preferred.

In the drawing, the fuel pump is shown as including a multi-part body portion generally indicated at 10. This body portion includes a main body 12 defining a circular

series of cylinders such as the cylinders 14. A top body portion 16 is attached to the main body portion 12 with a gasket 18 interposed. A bottom portion 20 is fixed to the underside of the main body 12 with a sealing gasket 22 interposed. These three parts making up the body portion 10 are held together by means of bolts such as the bolt 24. Several of these bolts are utilized although not shown in the drawing and are placed around the main body portion 12.

The bottom body portion 20 is not shown in detail but it will be appreciated that it is designed for the inclusion of a driving shaft 26 which is adapted to be driven by an electric motor or other power device. This shaft extends upwardly through the bottom body portion 20 into an inlet chamber 28. A threaded inlet 30 is formed in the bottom body portion 20 for the reception of an inlet connection and communicates with the inlet chamber 28. The latter is of such dimensions as to receive a wobble plate indicated at 32 which is keyed to the upper end of the shaft 26 for rotation therewith. Sealing means 34 and thrust bearing 36 are arranged with respect to the shaft 26 and the wobble plate 32 so that leakage from the chamber 28 down into the bottom body portion 20 is avoided. Details regarding the wobble plate 32 and its particular mode of mounting or sealing are not given herein as they form no part of the present invention.

The main body portion 12 is provided with plungers such as the plungers 38 and which are reciprocable in the cylinders 14. These plungers are similar in that each one bears a central passage 40 having an oblique inlet passage 42 leading to the chamber 28. Each plunger 38 is also provided with a valve element 44 which is adapted to seat upon the upper wall of the plunger to close the passage 40. An inverted and flanged cup 48 is retained on the plunger 38 by means of a coiled spring 50. The cup 48 is centrally apertured as at 52 and bears side openings 53. It serves to limit valve lift.

The top body portion 16 bears an annular outlet chamber or groove 54 and this is connected with a vertically extended branch chamber 56 in turn in communication with a threaded outlet 58 adapted to be in connection with a discharge line. The main body portion 12 also has an upstanding central boss 60 which is bored to form a pressure chamber 62. Coaxial with this chamber 62 is a smaller diameter chamber 64 which extends downwardly through the portion 12 and communicates with the inlet chamber 28. The annular groove 54 and its branch chamber 56 are in communication with the chamber 62 by means of a groove 66 formed in the top portion 16 and a small drilled opening or restrictive passage 68 which passes through the lower part of the wall of the boss 60.

A cylindrical slide valve generally indicated at 70 constitutes a unitary valve means and includes a reduced diameter portion 72, a lower portion of which is reciprocable in the bore 64. It also includes an annular sleeve or cylindrical member 74 retained around the upper portion of the portion 72 and which is axially slidable in the chamber 62. At the upper end of the valve portion 72 is an enlargement 76. The cylindrical sleeve 74 is held tightly and in sealed relation with the enlarged portion 76 by means of a spring clip 80 and an O-ring 82 and presents a shoulder 75. Valve 70 is provided with an annular groove 84 near its lower end. It is also provided with a vertical bypass port 86 which is reduced in diameter as shown at 88. Each cylinder 14 is provided with a vertical port 90 which is controlled by a ball check valve 92 so that flow from the port 90 may pass into the annular groove 54 by way of a radial port 94 when the corresponding plunger 38 develops sufficient pressure in its pumping chamber 96. Each pumping chamber 96 is provided with

an auxiliary port **98** leading to an intermediate zone of the chamber **64**.

A cap member **100** bearing a spring chamber **102** therein is fixed to the top pump body portion **16** by means not shown and leakage from between the two portions is prevented by an O-ring **104**. The chamber **102** is coaxial with the valve means **70** and encloses a coil spring **106** which bears down on the valve member so that during pump discharge before the predetermined pump discharge pressure is developed, the annular passage **84** will be below and out of communication with the fixed auxiliary ports **98**.

Assuming that gasoline is admitted through the threaded inlet **30** to the chamber **28** and that the wobble plate **32** is rotated to effect a pumping action, the annular series of plungers **38** will reciprocate in sequential pumping cycles. During the upstroke of each plunger **38**, the valve **44** will be closed and fuel will be pulled into the chamber **40** and during the downstroke of each plunger **38** that fuel will be caused to open the one-way valve **44** and flow into the pumping chamber **96** with the check valve **92** closed. From chamber **96** during the subsequent upstroke the fluid will be forced up through the ball check valve **92** into the annular chamber **54** and out through the connection to the threaded outlet **58**. Assuming that the latter is restricted by a carburetor or some other device requiring a given pressure of fluid to operate the plungers, the sequential action of the latter will continue to build up the pressure until eventually the predetermined pressure in the annular chamber **54** will be conveyed by way of the groove **66** and the restrictive outlet **68** into the pressure chamber **62** and will exert itself with sufficient force against the annular shoulder **75** to elevate the valve means **70** against the loading of the spring **106**. When the predetermined discharge pressure has been reached, the annular groove **84** will communicate with the ports **98** with the result that the ball check valves **92** will close and the pumping chambers **96** will be directly interconnected. The throttling action between the valve **70** and the auxiliary ports **98** will therefore automatically control the delivery or discharge pressure of the pump and without any substantial loss of pressure. The discharge pressure of the pump is determined by the loading placed upon the spring **106**.

The bypass port **86** serves to return to the pump intake any gasoline which may leak past the valve **70** into the spring chamber **102**. This has no relation to the operation other than to dispose of the leakage. It should also be appreciated that when the predetermined pump discharge pressure is attained, the intake valves **44** remain closed because each pumping chamber **96** remains filled with gasoline acquired from other pumping chambers.

We claim:

A pump having a body portion forming a plurality of cylinders in an annular series arrangement, pumping means in said cylinders and cooperating with the latter in defining pumping chambers, one-way inlet valve means connected to admit fluid from a fluid supply source to said pumping chambers, means connected to said pumping means for reciprocating the latter in sequence, a discharge port in said body portion for each of said pumping chambers, a common discharge passage in said body portion leading from the discharge ports of said pumping chambers, one-way outlet valve means positioned to control the flow from each of said discharge ports to said common discharge passage, auxiliary ports in said body portion leading directly from said chambers and independent of said fluid supply source, unitary valve means in said body portion and coaxial with said series of cylinders, said body portion defining a restrictive passage connecting said common discharge passage to said unitary valve means, and the latter being controlled by pressure derived from said restrictive passage simultaneously to connect said auxiliary ports whereby said fluid may flow directly from one of said pumping chambers to another when a predetermined pressure in said common discharge passage is effected.

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