

[54] **SYSTEM FOR CONTROL OF OIL WELL PRODUCTION**

[76] Inventors: **Henry D. Nettles**, 1806 Swan St.;
Bazzell, John S., 1604 W. Marshall Ave., both of Longview, Tex.

[22] Filed: **May 22, 1969**

[21] Appl. No.: **826,848**

[52] U.S. Cl. **137/391, 137/412**

[51] Int. Cl. **G05d 9/12**

[58] Field of Search **137/391, 412; 55/167**

[56] **References Cited**

UNITED STATES PATENTS

2,126,238	8/1938	Whitson	137/412 X
2,180,844	11/1939	Dahl	137/412 X
2,986,154	5/1961	Pintz	137/391 X
3,188,061	6/1965	Alguire	137/391 X

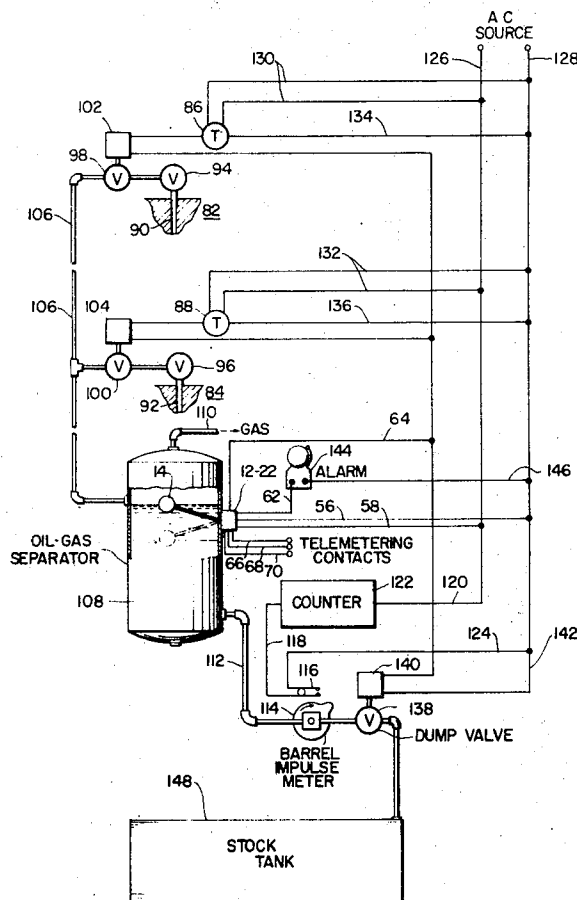
Primary Examiner—Robert G. Nilson

Attorney—Charles F. Steininger

[57] **ABSTRACT**

A system for operating and controlling production of oil from a plurality of wells in which oil from the wells is passed to an oil and gas separator and a float switch mechanism is mounted in the oil and gas separator in which the float of the float switch contacts a normally-open microswitch, when it reaches its uppermost limit, which sends a signal to an alarm and also operates appropriate valves which shut off the flow of oil from the wells and pass oil from the oil-gas separator to an appropriate storage tank, a holding relay holds this particular signal until the float reaches its lowermost position, the float contacts a normally-closed microswitch, when it reaches its lowermost limit, which sends a signal which releases the alarm and control condition and the holding relay holds this signal until the float again reaches its upper position. The system may also be provided with an automatic counting system to count the total number of barrels produced from the entire group of producing wells during a particular day to thereby meet allowable limits for the field.

4 Claims, 6 Drawing Figures



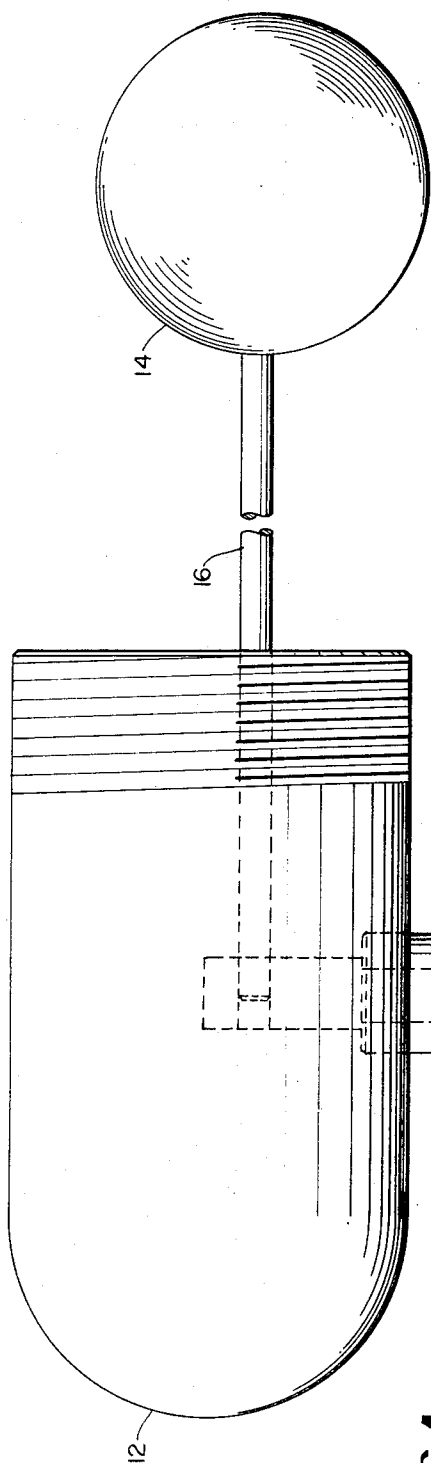


FIG. 1

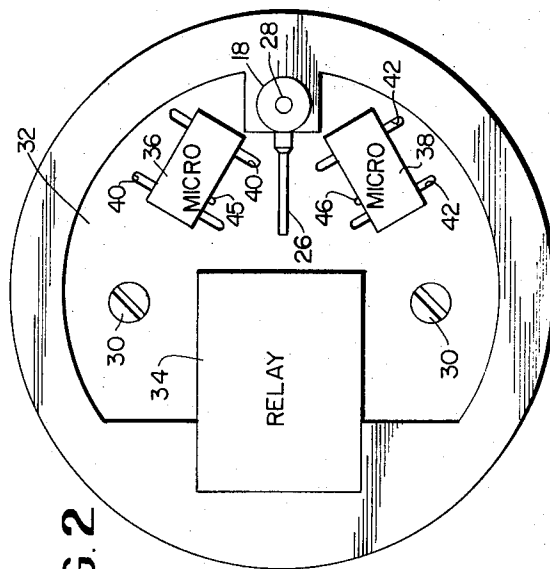
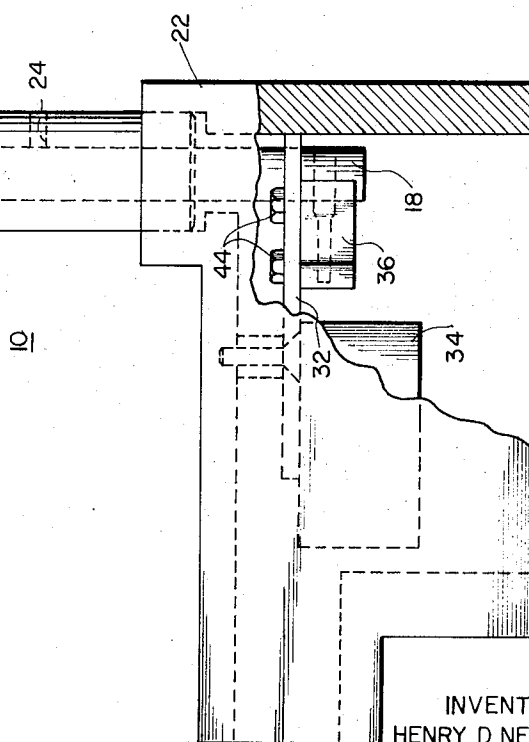


FIG. 2



INVENTOR
HENRY D. NETTLES

BY *Charles F. Steininger*
ATTORNEY

FIG. 3

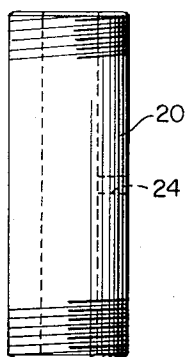


FIG. 4

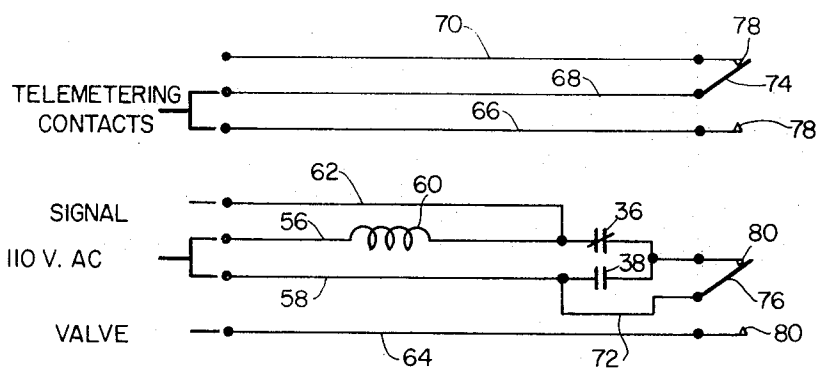
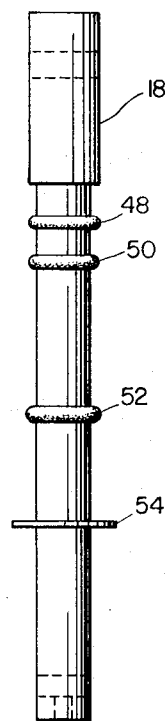


FIG. 5

INVENTOR
HENRY D. NETTLES

BY
Charles F. Steininger

ATTORNEY

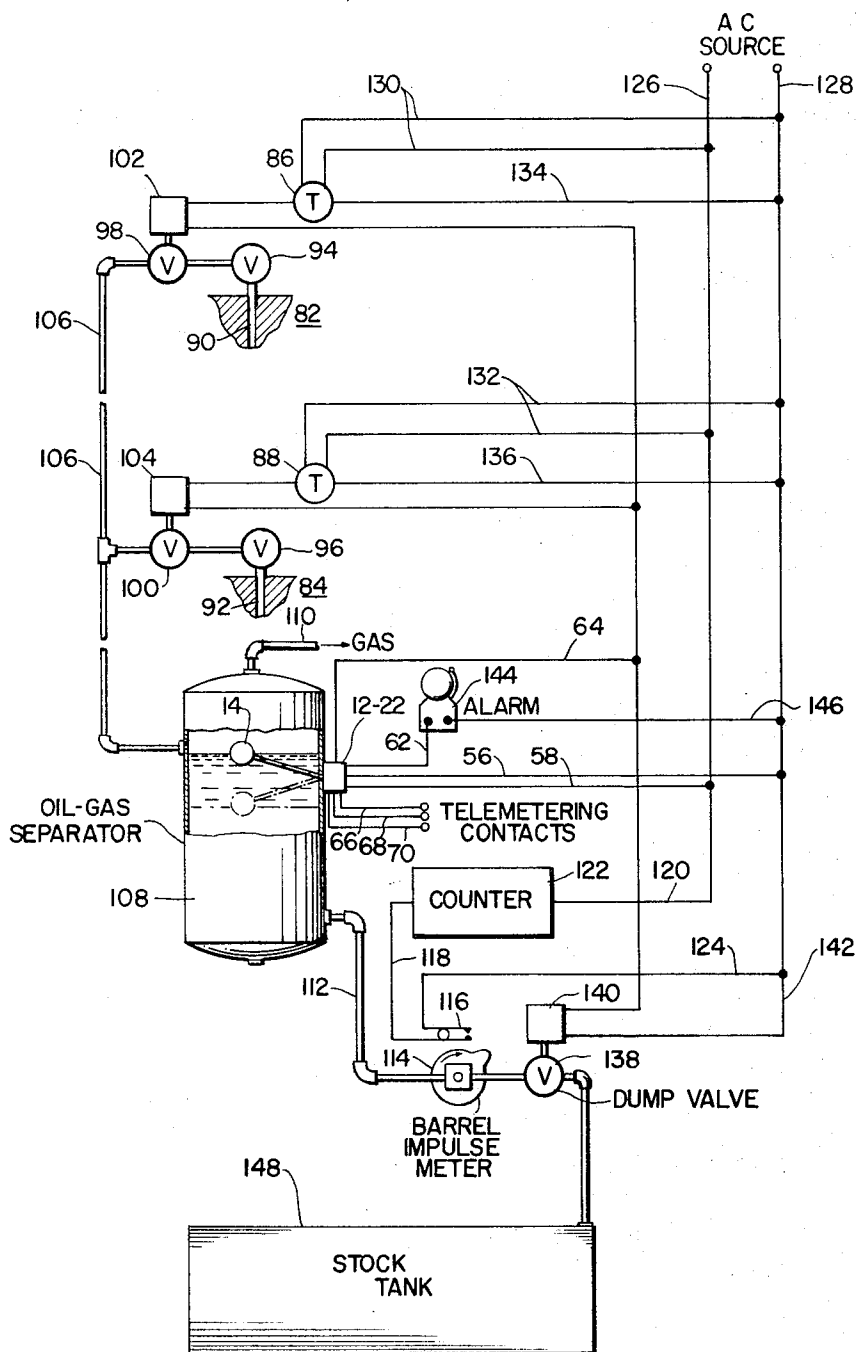


FIG. 6

INVENTOR
HENRY D. NETTLES

BY *Charles F. Steininger*
ATTORNEY

SYSTEM FOR CONTROL OF OIL WELL PRODUCTION

BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention relates to the control of oil production and in particular provides apparatus for achieving maximum permissible production from a group of wells in accordance with arbitrarily assigned limitations on the rate of oil production.

2. The Prior Art

In many oil-producing localities, conservation of oil reserves is now being practiced by assignment, either by agreement between producers in the area or by law, of arbitrary maximum limits on the quantity of oil produced in a given period of time, either from each well or from a unit area or field. Such arbitrary limits on oil production are commonly referred to as "allowables." The utilization of chokes and similar mechanical devices is frequently resorted to in order to adjust the flow from each well to the allowable for the well. Such mechanical mechanisms, however, are not altogether reliable in the sense that changes in subsurface conditions, such as pressure, or the inclusion of dirt, sediment or other foreign matter in the flow regulating surfaces of the choke or other mechanical flow regulator cause changes in the rate of oil production from that to which the choke or other device is initially set. In operating a field of wells, such departures from set flow rates can render it extremely difficult to control the production from the field, such that daily allowable production is not exceeded and yet such that total production is not substantially short of the daily allowable for the field. As a consequence, there is a demand for a system of operating an oil lease in which such departures from set flow rate are nullified and oil production up to the maximum allowable can be achieved without constant attention by an operator or operators.

It is therefore desirable to automatically or at least semi-automatically operate the entire field thereby eliminating the need for manual control. When automation equipment for the operation of a lease has been installed in the past, efforts have been made to utilize liquid level controllers in the oil and gas separators of the producing system in the same manner as these switches had previously been used for manual or open flow operation. However, these controllers experienced considerable trouble when utilized with the automatic system. The mechanical dump valves on the separator were often changed to snap-action dump valves and a combination of factors such as dump valve failure, schedule of wells, pipe line pressure, etc., caused the increased use of safety float switches. However, failures of the float switch caused the oil production to be routed down the gas gathering lines which resulted in a loss of oil production and a nuisance to the gasoline plant operation. Further, the float travel in existing float switches and the turbulence in the oil and gas separator caused the switch to turn the motor valves located at the well site on and off numerous times before final shut-down of the well and on numerous occasions, these switches failed to shut in the lease. It was therefore concluded that a more reliable and better switch was necessary to obtain optimum control.

It is therefore an object of the present invention to provide an apparatus for effectively controlling oil well production from one or a plurality of wells to match a

predetermined volume of production. Another object of the present invention is to provide an apparatus for changing a given condition of operation by means of a simple, yet effective float valve switch. Still another object of the present invention is to provide an improved and highly effective float switch mechanism.

These and other objects and advantages of the present invention will be apparent from the following detailed description.

BRIEF DESCRIPTION OF THE INVENTION

The present invention relates to a novel float switch mechanism in which the float mechanism operates a first switch which, in turn, applies a signal to an external system and this signal is held by a holding relay until the float mechanism reaches its maximum travel in the opposite direction at which time the float operates a second switch to transmit a second signal to the external system. The external system may be a system for controlling production from one or more oil wells and in one extreme position, the float closes a valve in the oil-producing line while opening a valve from an accumulating tank, while in the other extreme position, the valve in the producing line is opened and the discharge valve is closed.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 of the drawings shows in some detail and partially in section the novel float switch of the present invention;

FIG. 2 shows a bottom view of the switch mechanism of FIG. 1;

FIG. 3 shows a bushing of the system of FIG. 1;

FIG. 4 shows the operating post of the mechanism of FIG. 1;

FIG. 5 is a schematic electrical diagram of the switch of FIG. 1; and

FIG. 6 shows an automatic oil lease control system utilizing the switch mechanism of FIG. 1.

DETAILED DESCRIPTION OF THE INVENTION

In accordance with FIGS. 1 and 2 of the drawings, a seamless bull plug 12 is threaded on its open end and adapted to fit into an appropriate female fitting in an oil and gas separator, as hereinafter referred to. Float element 14 is mounted on rod 16. Rod 16 passes through the open end of bull plug 12 and is screwed into one end of a mounting shaft 18. Mounting shaft 18 passes through bushing 20 and into housing 22. Bushing 20 was threadably coupled into bull plug 12 and housing 22. Bushing 20 also is provided with weep hole 24. Mounted on the opposite end of shaft 18 is contact pin or arm 26. Contact pin 26 is held in shaft 18 by means of an Allen screw 28. Mounted within housing 22 by means of screws 30 is mounting plate 32. A relay 34 is appropriately mounted on mounting plate 32 as are microswitches 36 and 38, respectively. Mounting plate 32 is provided with adjustment slots 40 and 42, respectively, through which microswitches 36 and 38 are mounted. By means of mounting through adjusting slots 40 and 42, microswitches 36 and 38 may be moved toward or away from contact pin 26 as desired. This adjustment may be made by means of nuts 44 which are positioned on the mounting posts of microswitch 36. Similar nuts are, of course, mounted on the mounting post of microswitch 38 to permit adjustment of the position of this microswitch. Contact arm 26

contacts and operates operating buttons 45 and 46 of microswitches 36 and 38, respectively.

FIG. 3 shows bushing 20 while FIG. 4 shows shaft 18 in some detail. Shaft 18 is provided with appropriate annular grooves in which are mounted O-rings 48, 50 and 52. O-rings 48, 50 and 52, of course, prevent fluid from passing from the oil and gas separator through bull plug 12 to housing 22, which houses the electrical mechanism. Weep hole 24 in bushing 20 also aids in releasing any fluids which might get by O-rings 48 and 50 before such fluids pass into the housing 22. Shaft 18 is held in place in the float switch mechanism by means of lock ring 54.

FIG. 5 shows the electrical system of the float switch. A 110-volt AC signal is supplied to the switch through lines 56 and 58. Line 56 has mounted therein the coil 60 of holding relay 34. Also mounted in line 56 is normally-closed microswitch 36. Mounted in line 58 is normally-open microswitch 38. Line 62 leads to a signal or alarm, which is hereinafter discussed. Line 64 leads to an appropriate hydramotor of an operating valve which is also discussed hereinafter. Lines 66, 68 and 70 are provided for telemetering purposes but are not utilized in the specific example discussed herein. Line 68 and line 72 lead to the operating arms 74 and 76, respectively, of relay 34. Relay 34 is a double-pole, double-throw relay. Contacts 78 and 80 are associated with operating arms 74 and 76, respectively, of the relay.

The operation of the float switch as described thus far is relatively simple as compared with the previously discussed prior art devices. Specifically, the float 14 travels approximately 10 inches and such travel can be varied by changing the length of the float arm, the size of the bull plug fitting or the spacing between the microswitches in the switch housing. This large arc of travel of the present switch compares with the travel of approximately 1 inch, which is a built-in disadvantage of the prior art switches. The float travel is transmitted to the control mechanism by means of the O-ring-sealed shaft and bushing arrangement. The control mechanism is designed with a holding relay 34 which holds the signal generated at the point of either high or low contact. When the float rises to its highest point, it contacts the lower microswitch 38 and operates both the alarm or signal and the control valve. The system stays in this alarm and control position until the float drops with the fluid level to its lowest point and contacts the upper microswitch 36. Upper microswitch 36 releases the alarm condition and changes the operating system back to normal operation. This signal is also held until the float again travels to its uppermost position and again contacts microswitch 38.

An appropriate relay for use in accordance with the present invention is rated at 10 amps. and 115 volts AC, while appropriate microswitches have a 5 amp. rating at 115 volts AC.

FIG. 6 of the drawings shows a system for automatically controlling oil well production by use of the switch mechanism 10 of the present invention. In accordance with FIG. 6, wells or groups of wells 82 and 84 are shown to be independently operable by means of the float switch mechanism together with timer mechanisms 86 and 88, respectively. The well or group of wells 82 or 84 may also be manually put on and taken off stream, thereby eliminating the timers. The timers may also be mechanical. Leading from well 82

is production string 90, while leading from well 84 is production string 92. At the top of production string 90 is choke valve 94 while choke valve 96 is positioned on production string 92. Choke valves 94 and 96 may be utilized to control the flow from wells 82 and 84 if less than the full potential of the well is to be produced during a given operating period. Oil from well 82 passes through hydramotor valve 98, which is simply an electrically controlled, fluid operated, piston valve for opening and closing a fluid line, while oil from well 84 passes through hydramotor valve 100. Hydramotor valve 98 is operated by an appropriate solenoid 102 while hydramotor valve 100 is operated by solenoid 104. Fluids from either well 82 or 84 pass into header 106. From header 106, the fluids pass to oil and gas separator 108. Mounted in the side of oil and gas separator 108 is the bull plug-housing arrangement 12-22. Leading from the bull plug and into the interior of separator 108 is float 14. Oil and gas separator 108, of course, separates gas from liquids and the gas is discharged through line 110 while the liquid is discharged through line 112. Oil discharged through line 112 passes through barrel impulse meter 114. Barrel impulse meter 114 may be mechanical as shown or an appropriate electrical meter. In any event, each time a barrel of oil passes through barrel impulse meter 114, it closes switch contacts 116. Line 118, from switch 116, and power line 120 are connected to counter 122. Counter 122 is adapted to keep a record of the total number of barrels passed through meter 114 in a given day. Counter 122 may be operated manually so that the system is shut off completely when the counter reaches the maximum allowable for the field in a given day or it may be completed automatic and automatically shut off the entire system when the flow allowable has been produced. Counter 122 can also be mechanical. Line 124 supplies power to the other of switch contacts 116. From an AC source of power not shown, power to the system is supplied through lines 126 and 128. Power is supplied to timer 86 through lines 130 and to timer 88 through lines 132. Power from line 128 passes to solenoid 102 through line 134, to solenoid 104 through line 136, to dump valve 138 through its solenoid 140 by means of line 142, to alarm 144 through line 146, and to the float switch mechanism through lines 56 and 58. Oil after passing through impulse meter 114 is passed by dump valve 138 into one or more stock tank units 148. Dump valve 138 may be operated by gas from the gas space of separator 108 by contacting a line through a valve operated by the float 14.

In the operation of the system in accordance with FIG. 6, either well 82 or well 84 or groups of wells represented by these wells flows fluid through header 106 to oil and gas separator 108. When the float in oil and gas separator 108 reaches its upper limit, it, as previously indicated, closes normally-open switch 38. This, in turn, sends a signal to alarm 144 and to hydramotor valves 98 or 100 and hydramotor valve 138. This signal closes the appropriate valve located at the well head and opens dump valve 138. As previously indicated, barrel impulse meter counts each barrel of oil discharged through dump valve 138 and records this on counter 122. The holding relay of the float switch system holds the alarm and control condition until the level in oil and gas separator 108 falls and float 14 reaches its lower limit. When the float reaches its lower limit, it contacts microswitch 36 opening this switch

5

and thereby releasing the alarm and control condition. Valve 98 or 100 is opened to continue production and valve 138 is closed. This signal is also held by the holding relay until oil and gas separator 108 again fills to the maximum limit and float 14 reaches its uppermost condition.

We claim:

1. A system for controlling the production of liquid from at least one liquid producing well, comprising; producing flow line means leading from said well to accumulator tank means; discharge flow line means leading from said accumulator tank to at least one storage tank means; valve means mounted in said producing line means; valve means mounted in said discharge line means; float means mounted in said accumulator tank means; switch means operatively connected to said float means, including, a first switch operated by said float means when said float is in a first of its two extreme positions; a second switch operated by said float when said float is in the second of its two extreme positions; electrical power means operatively connected to said first valve means and said second valve means through said switch means and holding relay means

6

electrically connected to said first and said second switch means and adapted to hold the signal selected by each of said first and second switches irrespective of the subsequent movement of said float means until the other of said switches is operated by said float means.

2. A system in accordance with claim 1 wherein the float means includes a rotatable arm adapted to be rotated by the float of said float means and to operatively contact each of the switches of the switch means upon rotation thereof.

3. A system in accordance with claim 2 wherein the float of the float means is located within the accumulator tank means, the electrical portion of the system is located outside the accumulator tank means, and the rotatable arm passes through the wall of the accumulator tank means.

4. A system in accordance with claim 3 wherein the float means includes seal means mounted about the rotatable arm and adapted to provide a fluid seal between the float of said float means and the electrical portion of the system.

* * * * *

25

30

35

40

45

50

55

60

65