Feb. 23, 1937. B. S. NELSON ET AL 2,071,703

AUTOMATIC SUCTION PRIMER FOR OIL FIELD SERVICE

Filed Dec. 11, 1934 2 Sheets-Sheet 1

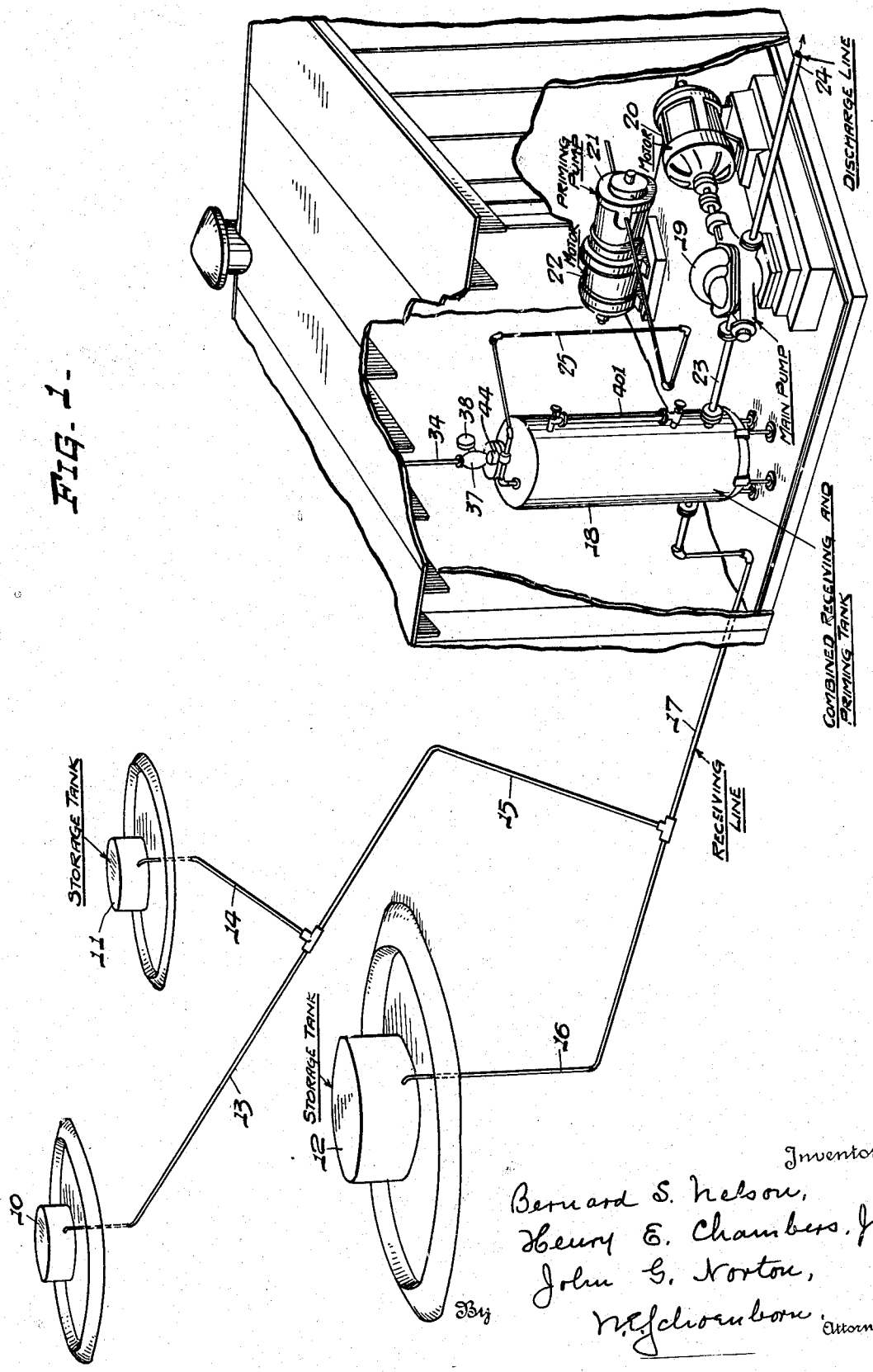

FIG. 1.

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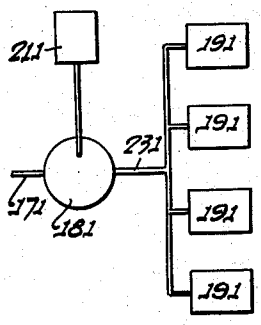
FIG. 6.



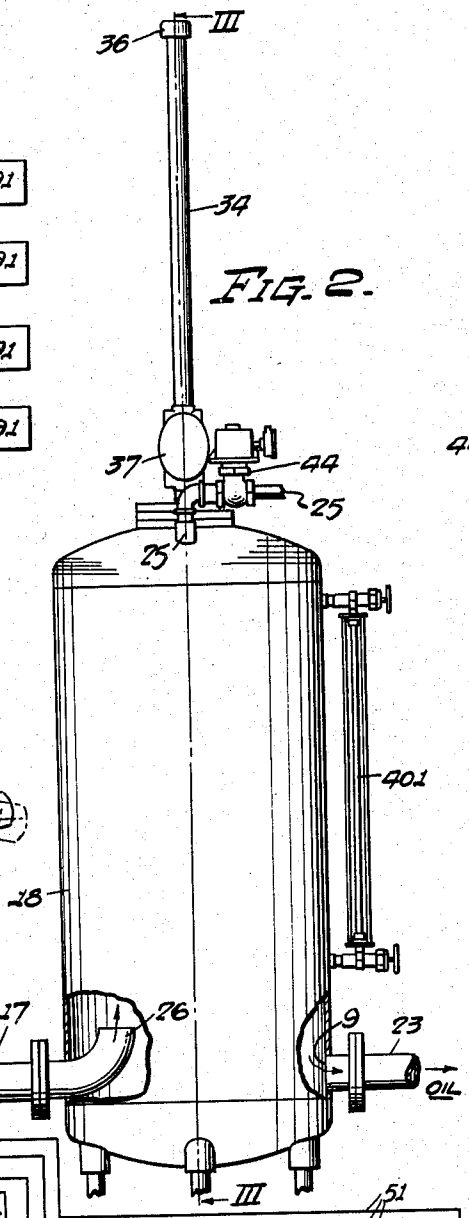


FIG. 2.

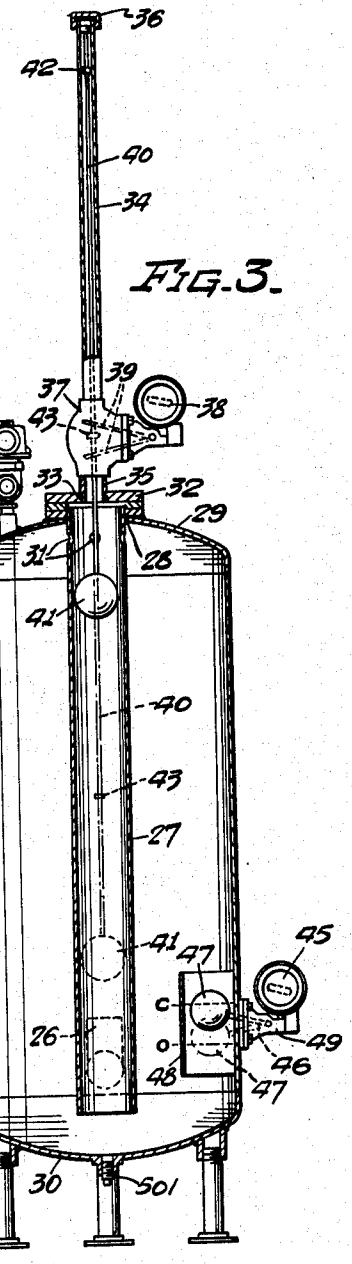


FIG. 3.

FIG. 4.

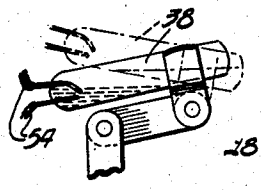
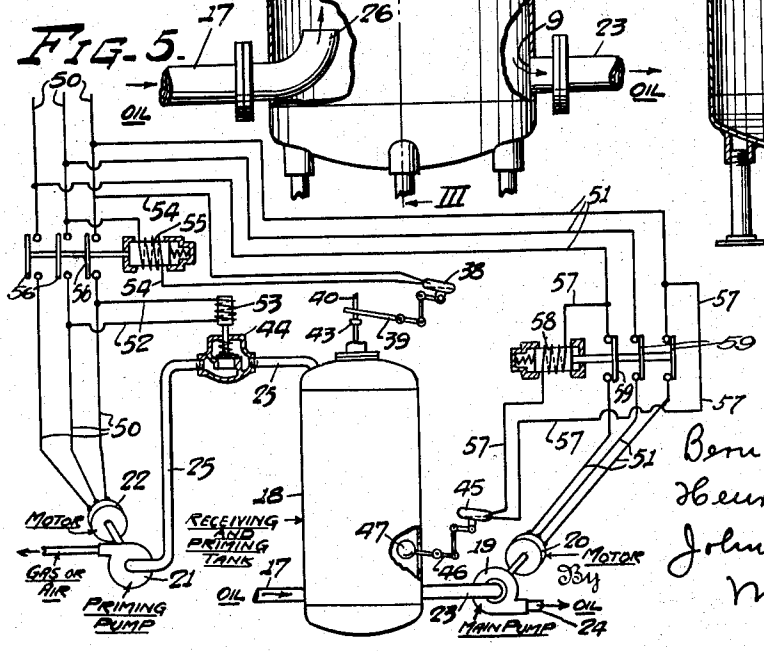


FIG. 5.



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UNITED STATES PATENT OFFICE

2,071,703

AUTOMATIC SUCTION PRIMER FOR OIL FIELD SERVICE

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Application December 11, 1934, Serial No. 757,056

1 Claim. (Cl. 103—113)

This invention relates more particularly to means for automatically keeping primed the pumping plant which picks up the crude oil from an oil producing field and pumps said oil into a pipe line system which conveys the oil to distant storage stations, refineries, or other removed points of consumption.

In an oil producing field, the crude oil from the various wells is gravitated or deposited by various means into a number of scattered field storage tanks set above ground. From said storage tanks, which may be disposed over a considerable area and located at different elevations, the oil flows by gravity into a gathering or collecting line, which leads to a pumping system comprising one or a plurality of pumps, which, in turn, convey said oil to a shipping point or distillation plant.

With a number of tanks scattered over a field and under more or less haphazard methods and irrespective of the most favorable oil field operating conditions, the flow of oil through the gathering line to the pumping system is spasmodic or interrupted due to an operator allowing a field tank to completely empty and thereby permitting a large quantity of air to enter the suction or gathering line.

When this situlation occurs, the emptied tank is required to be shut off and a second gathering tank under pressure allowed to flow, or another tank be immediately cut in at required vacuum to lift the oil into the gathering line, thereby necessitating the gathering pumps, at times, to handle air or gases liberated by the oil, or act under conditions of pressure or vacuum.

Due to the foregoing described variations of and interruptions of oil supply to the gathering pumps or pumping system, it has been impracticable to use centrifugal pumps, which displace or injure their internal cooperating valves or parts, if allowed to run dry, owing to having no self-priming function.

Great difficulty has been experienced and trouble encountered in oil pipe systems when a reciprocating pump is used, for the reason when a pump of this type takes air and later picks up the oil, there is a decided hammer reaction which displaces its valves and causes additional and serious mechanical damages, requiring cutting out the pump and thereby interrupting the flow of the oil.

While the invention herein disclosed is more particularly described with reference to the use of oil pipe systems, such reference is intended to illustrate and include other applicable uses in which the same conditions and problems are involved.

The object of the present invention is to provide a compact, efficient and automatic means requiring a minimum cost for installation and upkeep, and insuring at all times a continuous and uniform flow of oil, irrespective of the pumping conditions heretofore explained, due to accumulation of air or gas or varying static pressure in the pipe lines, difference in elevation of the ground level and size of said pipe lines, quantities of oil being handled, or failure of the operators to cut off a field tank receiving oil from the well.

A further object of the invention is to devise and arrange the elements comprising the invention whereby is assured a constant flow of fluid or oil to the pumping system, thereby enabling the use of not only centrifugal pumps, which have many advantages over other forms used at present for this purpose, but also adapted for use with any other form of reciprocating pump with better operation and less repairs due to the elimination of herein referred to water hammer caused by the presence of gas and air in the fluid pumped.

The foregoing and other objects and advantages of the invention will be more clearly understood from the following description, taken in connection with the accompanying two sheets of drawings, and the distinctive features of novelty will be thereafter pointed out in the appended claim.

Referring to the drawings, in which similar reference characters indicate the same parts in the several figures,

Figure 1 is a perspective view, showing the invention as applied to oil gathering and pumping system of an oil field;

Figure 2 is a side elevation of the chamber receiving the oil from the field tanks;

Figure 3 is a vertical section of the receiving chamber taken on line III—III of Figure 2;

Figure 4 is an enlarged and fragmentary view of a Mercoid switch, used in connection with the receiving chamber;

Figure 5 is a diagrammatic view showing the electrical circuits, switches and their cooperating actuating means for controlling the actuation of pumps functioning with the receiving chamber; and,

Figure 6 is a diagrammatic view showing the use of a plurality of pumps.

Referring to Figure 1 of the drawings, 10, 11 and 12 are a number of tanks distributed or properly arranged, and at various elevations, about an oil field and adapted to receive and store crude oil received from various wells, not shown, as is common in this class of operations, and need no further disclosure.

Said tanks 10, 11 and 12 are connected by means of a series of gathering or collecting pipe lines 13, 14, 15 and 16 to a single pipe line 17, which conveys the crude oil by gravity, or otherwise, to an improved pumping system, which picks up said crude oil and forces it through a pipe line to a shipping point, refinery, or other

desired destination, in a manner to be presently described.

Said pumping system, as shown in Figure 1, comprises a crude oil receiving tank 18 of adequate volume, a main centrifugal oil pump 19 operated by an electric motor 20, preferably of alternating three phase type, and a rotary priming pump 21 operated by a similar type of electric motor 22.

The interior of the lower section of the receiving tank 18 is in communication with and receives crude oil from the pipe line 17, while the other side of the lower section of the tank 18 from that in communication with pipe line 17 is in communication, by discharge pipe line 23, with the suction end of said main centrifugal pump 19, which, in turn, conveys and forces the oil through pipe line 24, leading to any desired destination, shipping point or refinery, not shown, and in a manner to be hereinafter explained.

It is to be understood that the length of said pipe 23 can be increased or decreased so that the connection of the suction end of said pump 19 can be disposed as shown in Figure 1, or adjacent to or in contact with the exterior of the discharge opening or fluid outlet 9, without departure from the present invention.

The suction end of priming pump 21 is connected by means of piping 25 with the interior of the upper section of tank 18, as shown, for purposes of withdrawing any excessive accumulation of entrained air or gas freed from the oil and for purposes described later.

Referring to Figures 2 and 3, the inner end of the oil pipe 17, leading into the lower section of receiving tank 18, is provided with an upturned section 26 for the purpose of deflecting the incoming oil upwardly and towards the top section of said tank 18, and diverting said oil from being drawn towards and passing directly through the oppositely disposed discharge oil pipe 23, leading to main oil pump 19, which diversion of the crude oil permits the liberation, and accumulation in the upper end of said tank 18, of any gas or air entrained in said oil, and thereby prevents said entrained air or gas from being conveyed to and freed within the casing of the main pump 19, and which would allow said pump to run dry or produce an undesirable and injurious hammer action, causing injury to the pump, and finally a complete shut down of the pumping system.

An enlarged and open ended tube 27 is vertically supported within the tank 18 and extends from an opening 28 in upper end 29 of said tank 18 to a short distance from its bottom 30, as shown in Figure 3, said tube 27 being provided with a series of openings 31 for the purpose of permitting the escape of gas or air, or flow of oil within the upper section of said tube 27 into the upper end of tank 18, for purposes readily understood.

Attached to a plate 32 having a threaded central opening 33, and secured over the upper open end of the tube 27, is a second and smaller vertical tube 34, having its lower open end 35 secured into the central opening 33, and its upper end closed with a cap 36, the vertical axes of said tubes 27 and 34 and cylindrical receiving tank 18 being coincident, as shown, and for purposes to be presently disclosed.

Interposed between and separating the upper and lower sections of said tube 34 is a casing 37 of an electric switch 38, preferably of the Mercoid type, operated by an oscillating arm 39, as shown in Figures 3, 4 and 5, and while said type is herein referred to and well adapted, any other form of mechanical or electric switch could be used or substituted, if so desired.

40 is a rod centrally disposed within the bores of said tubes 27 and 34, and having secured to its lower end a float 41, adapted to rise and fall in said tube 27 with the level of oil within the tank 18 and elevate or lower the stops 42 and 43 attached, respectively, to the upper and lower portion of said rod 40, as shown, and adapted to cooperate with and oscillate the arm 39 of switch 38, for purposes of opening and closing said Mercoid switch 38.

A normally closed and electrically operated valve 44, for closing or permitting communication of pipe 25 with the upper portion of tank 18 and suction end of priming pump 21, is arranged above said tank, as shown in Figures 2 and 3, and disposed in said pipe line 25, as indicated in Figure 5, and whose operation will be more fully hereinafter indicated.

Near the bottom and exterior of the tank 18 is arranged the casing 49 of a second Mercoid switch 45, controlling the actuation of the main centrifugal pump 19.

The oscillating arm 46, operating said switch 45, extends into the interior of the tank 18 and is provided at its end with a float 47 protected by an open ended shield 48, as shown in Figure 3, said float 47 being adapted to move between the levels indicated by lines *c* and *o* and respond to the level of the oil in said tank 18, for purposes and in a manner to be later explained.

401 is the usual gauge, indicating at all times the level of the oil within the combined receiving and priming tank 18.

501 is a removable screw plug in the bottom 30 of tank 18, for purposes of draining said tank, if found necessary.

Referring to Figure 5, which diagrammatically illustrates an arrangement of electrical circuits for actuation of the several cooperating elements of the invention, lines 50, 50 indicate the source of current from any suitable three phase electric generator, not shown, leading to motor 22 of priming pump 21.

51, 51 are circuits properly tapped from lines 50, 50 and leading to motor 20 of main pump 19. 52, 52 are circuits tapped, as indicated, for energizing a solenoid 53 for opening normally and spring closed valve 44. 54, 54 are circuits tapped, as shown, leading to Mercoid switch 38 and controlling the solenoid 55, which is capable of closing a normally spring actuated open switch 56, which, in turn, is adapted to simultaneously close the circuits 50, 50, and 52, 52, so that the valve 44 is opened at the same time when the priming pump 21 is started and operating.

57, 57 are circuits tapped from lines 51, 51, which lead to Mercoid switch 45, actuated by float 47, said switch 45 controlling the energizing of a solenoid 58 to close the normally open spring actuated switch 59, when said float 47 is at its elevated position or at or above line *c*, due to oil level being above discharge opening 9 of tank 18 and pipe line 23, and, hence, will only operate motor 20 and main pump 19, when sufficient oil is supplied from the combined receiving and priming tank 18 to said pump 19 to properly and continuously prime the same and thus prevent any gas or air liberated and accumulated in the tank 18 from the received oil to have access to the main pump 19.

The several elements of the pumping system

being constructed and arranged, as explained, and the cooperating electrical circuits connected, as indicated, the manner of operating the same is as follows:

Assuming no oil is in the tank 18, the floats 41 and 47 will be in their lowest and dotted positions, shown in Figure 3, and the upper stop 42 on rod 40 has depressed the oscillating lever 39 and closed the pilot Mercoid switch 38.

The float 47, being in its lowest position, the pilot Mercoid or magnetic switch 45 is open, and, as heretofore explained, the solenoid actuated or magnetic switch 50 is also open and, hence, the main pump 19 is inactive, as desired, in view of the proper head of oil in the tank 18 for priming said pump 19 being absent.

The necessary electrical current being supplied to circuits 50, 50 and 51, 51, shown in Figure 5, the pilot switch 38 being closed, the current travels in the circuit lines 54 and 54 and energizes the solenoid 55, closing switch 56, which, in turn, closes circuit lines 52 and 52, thereby energizing the solenoid 53 to lift or open the valve 44 and simultaneously start the priming pump 21, as will be clearly understood, and needs no further explanation.

The priming pump 21 operating and the valve 44 being open, the air or gas in the combined priming and receiving tank 18 exhausts through the pipe connection 25, the pressure within said tank 18 is reduced below normal atmospheric pressure, the crude oil gravitates into the pipe line 17 and is drawn into the tank 18.

As the oil flows into the tank, the float 41 rises and should the level of the oil reach a predetermined level, the lower stop 43 engages and lifts lever 39, breaking the Mercoid switch 38, which operation de-energizes the solenoids 53 and 55, and simultaneously restores the valve 44 to its closed position and stops the operation of the priming pump 21.

During the admission of the oil into the tank 18, the float 47 rises from a level indicated at *o* and position shown in dotted lines in Figure 3; as soon as the level of the oil reaches a point *c*, and the float 47 assumes a position indicated in full lines, the pilot Mercoid switch 45 is closed and through the tapped circuits 57, 57, the solenoid 58 is energized, which closes the magnetic switch 59 and starts the operation of the main pump 19 and forces the crude oil received from pipe 23 through the pipe line 24 to the desired point of consumption or shipment.

Should there by any failure to properly and fully supply the necessary oil to the tank 18, or said tank or its fittings should leak and the level of the oil in tank 18 sink to the lower line *o*, the float 47 would again assume the indicated lower dotted position and put the pilot Mercoid switch 45 in its open position and de-energize the solenoid switch 59 and cut out the current to the motor 20 operating the main pump 19, thereby not only conserving sufficient crude oil in said tank 18 and pipe 23 to properly prime said pump 19 when its operation is resumed, but also preventing injury to the pump 19 for lack of fluid passing through the same.

It will also be seen, in the event the priming pump 21 failed to function, or an excess of entrained gas came over with the oil and was liberated in the tank 18 so that the pressure of the accumulated gas within the tank 18 would depress the oil level below the line *c*, the float 47 would operate the pilot switch 45 and open the switch 59 to stop the main pump 19, as heretofore explained.

When the pumping system works under pressure, due to the accumulation of gas in the tank 18, should an excessive pressure suddenly develop the solenoid actuated combined cutoff and relief valve 44 would be lifted from its seat, due to said abnormal pressure of gas, and permit its escape, and restore normal and desired pressure in said tank.

The invention is not restricted to a single pump of the rotary or reciprocating type, but a single combined receiving and priming tank 18 can be utilized with a plurality or battery of main pumps arranged as illustrated in Figure 6, in which 181 is the single combined receiving and priming tank having a priming pump 211, supply inlet pipe 171, and branched discharge pipe 231, leading to a plurality of main pumps 191, 191.

While one embodiment of the invention is herein disclosed, it will be readily manifest to any one skilled in the art that many changes or substitutions would be suggested, and although rotary pumps are shown, those of the reciprocating, centrifugal, or other types could be substituted.

Other electric switch operating mechanism or mechanical means for controlling the operation of the main and priming pumps and cooperating valve for outlet or release of the accumulated gas in the priming tank could be installed for the specific arrangement herein disclosed, whereby a single pumping system having a single combined receiving and priming tank is capable of handling the entire oil field gathering pumping station, whether employing one or a plurality of rotary or reciprocating pumps, and insuring the constant and satisfactory priming and operation of all of said pumps.

What we claim is:

An automatic primer for a pumping system comprising a receiving line, a vertical cylindrical combined liquid receiving and priming chamber having a liquid inlet at its lower section in communication with said receiving line, said liquid inlet being provided with a pipe having an upturned section within and at the bottom of said chamber for the vertical and upward introduction of the liquid within said chamber, an independent liquid outlet disposed at the bottom and opposite side of said chamber from that of said liquid inlet, an upper accumulated gas outlet provided with a normally closed cut-off valve, a normally operative main pump having its suction end in communication with said liquid outlet, a vertical tube axially arranged within and connected to the top of and communicating with the bottom section of said chamber below the upper end of said upturned pipe section, means controlled by the level of the liquid within said receiving and priming chamber for controlling the actuation of said normally operative main pump in communication with said liquid outlet, an independent and normally inoperative second pump in communication with said gas outlet for removing liberated gas within said chamber, and a movable float within said vertical tube and controlled by the level of the liquid within said tube for simultaneously actuating said normally closed cut-off valve and said normally inoperative second pump.

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