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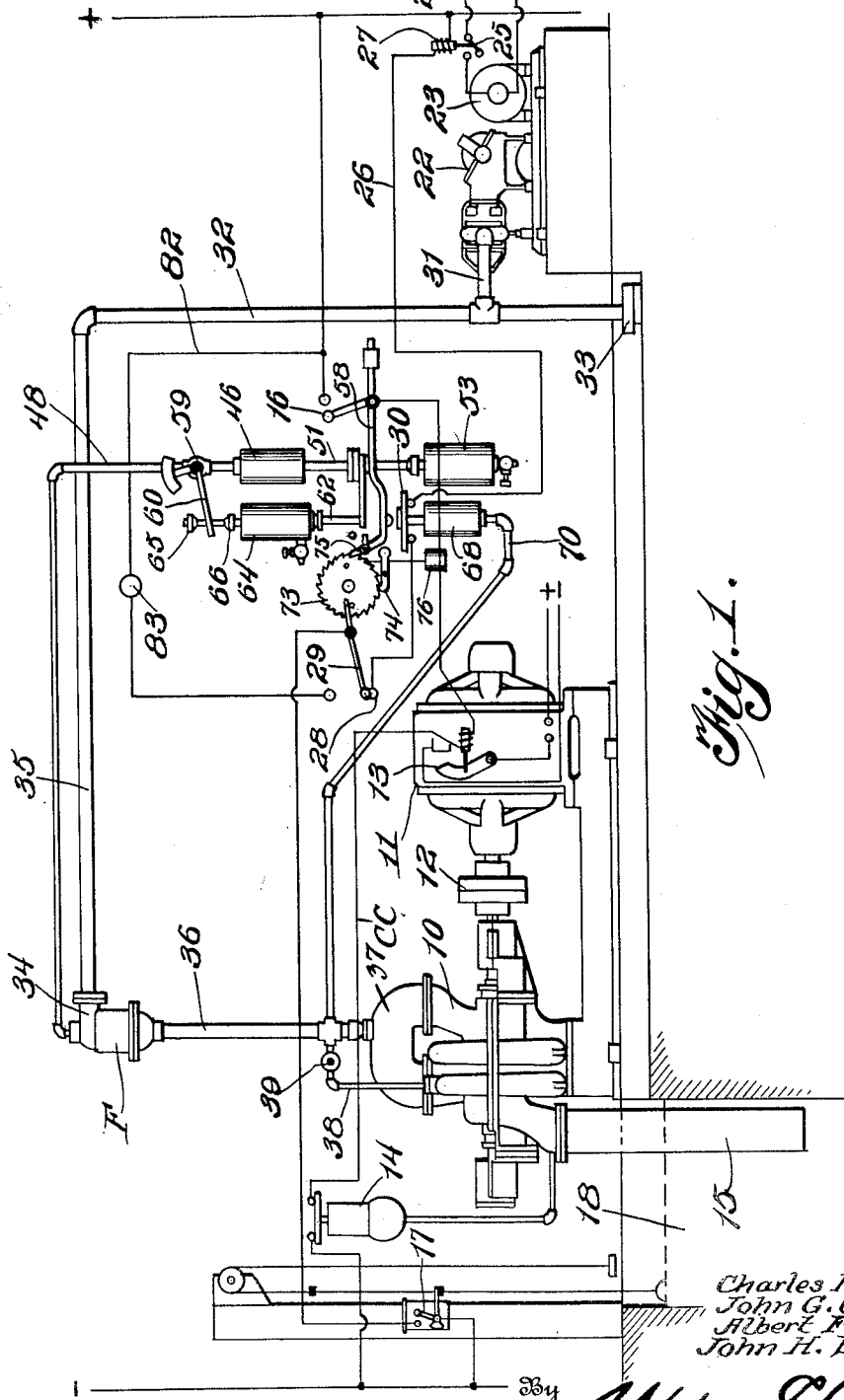
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C. H. GOYNE ET AL

PUMP SYSTEM

Filed ~~Dec.~~ 124, 1925

3 Sheets-Sheet 1



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PUMP SYSTEM

Filed Dec. 24, 1925

3 Sheets-Sheet 2

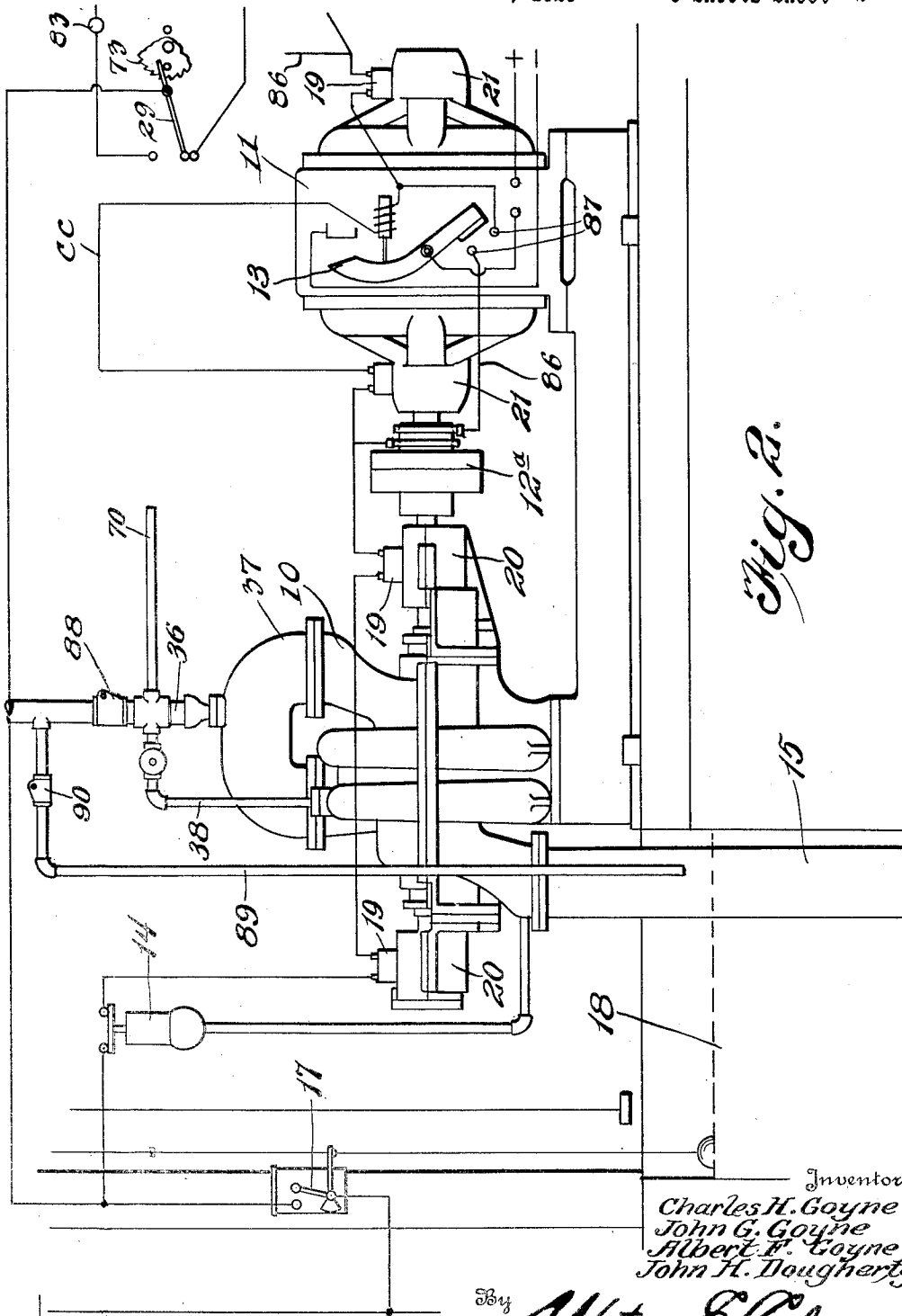


Fig. 2.

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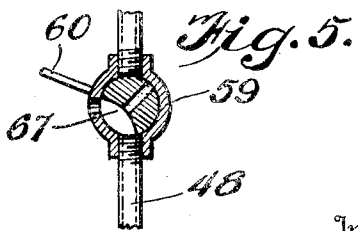
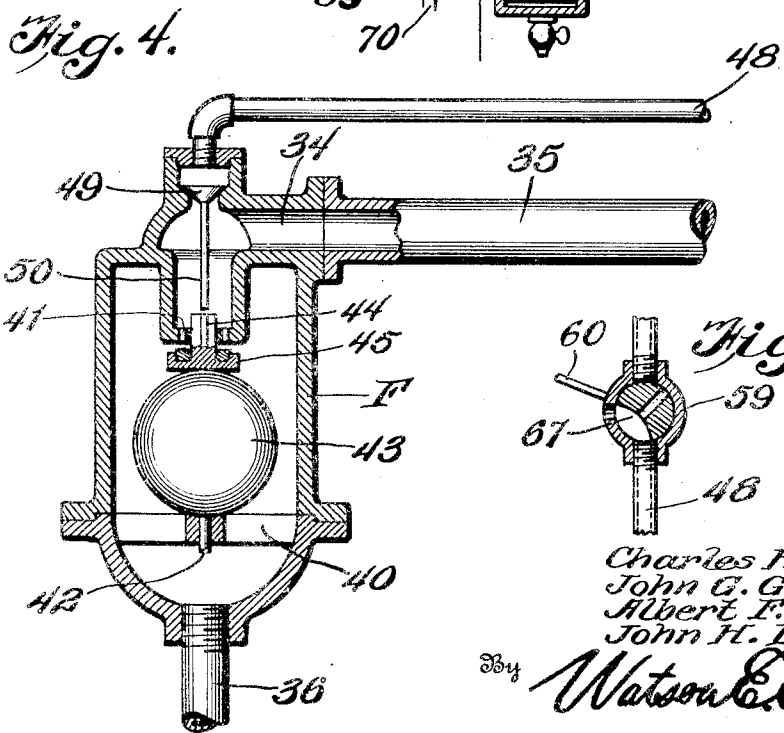
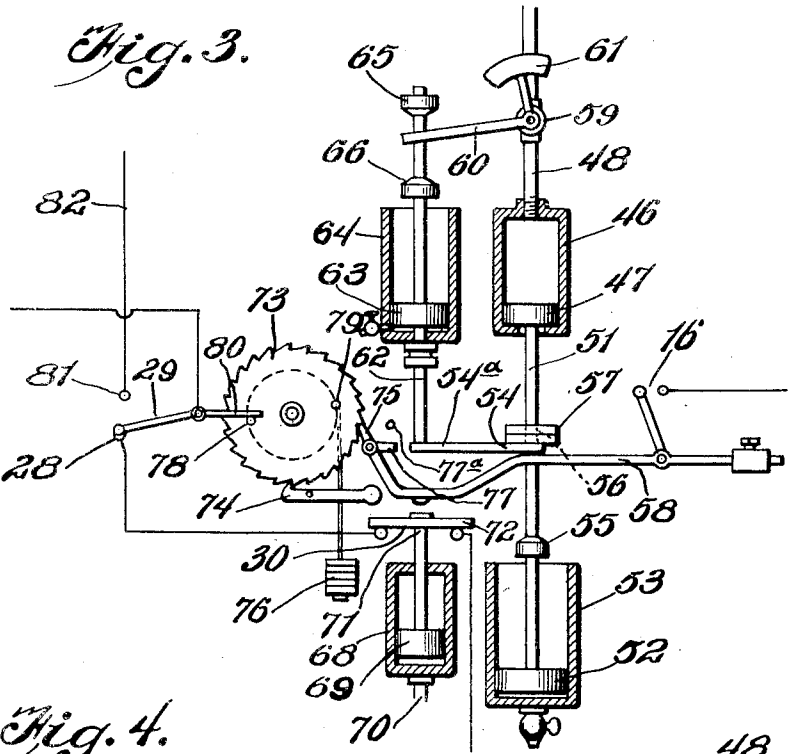
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PUMP SYSTEM

Filed Dec. 24, 1925

3 Sheets-Sheet 3



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UNITED STATES PATENT OFFICE.

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PUMP SYSTEM.

Application filed December 24, 1925. Serial No. 77,490.

This invention relates to pump systems and more particularly to pump systems employing a centrifugal pump and a priming pump therefor.

5 An important object of the invention is the production of a system of this character which will be entirely automatic in its operation and which is accordingly suitable for use in pumping mine sumps and the like
10 without requiring the services of an attendant.

A further and more specific object of the invention is to provide an automatic pump system wherein the pump in its operation is
15 automatically primed and started and in event of its failure to produce a working pressure after such priming and starting, stops, is reprimed and restarted in further attempts to produce a working pressure.

20 It is additionally an object to provide means whereby upon failure of the pump to operate after a predetermined number of attempts to start the same, the pump is automatically prevented from restarting, thus
25 preventing undue strain upon the pump due to such starting and stopping operations.

A further object of the invention is to provide means for automatically stopping the pump in event any of the bearings of either
30 the motor or the pump become overheated.

A further object of the invention is to provide in combination with a motor operated centrifugal pump a circuit controlling the operation of the motor including a switch
35 and means for temporarily closing the switch when the pump is primed together with a means for locking the switch in its closed position, when the motor has been started and the centrifugal has generated working
40 pressure.

We have found that in the automatic operation of centrifugal pumps, there are a number of factors of operation which must be considered. A centrifugal pump after
45 priming, if the priming fluid contain a large percentage of air, may be started and generate absolutely no pressure or it may generate a pressure of, for example, one hundred and forty-five pounds where the actual working
50 pressure of the pump is two hundred pounds. Accordingly, an important object of this invention is to provide a system which stops the operation of the centrifugal after a priming and starting thereof when-

ever the generated pressure is less than the 55 actual working pressure of the pump.

Under some circumstances, it is desirable to operate centrifugal pumps with synchronous motors, which must be brought up to synchronous speed before applying the working 60 load. Accordingly, a further object of the invention is to provide means for fully priming the centrifugal pump, bringing the synchronous motor to synchronous speed, and then transmitting motor operation to primed 65 centrifugal pump.

A further object of the invention is the provision in a pump system employing a motor operated centrifugal pump and a suction priming pump for the centrifugal, a 70 suction operated switch controlling the operation of the motor and means for transferring the suction of the priming pump from the centrifugal to said means when the centrifugal has been primed. 75

A further and important object of the invention is to provide in a priming system of centrifugal pumps of that type wherein the cycle of operations of priming and starting the centrifugal is continued through several 80 "trys" in an attempt to bring the centrifugal to working pressure, a construction whereby the priming pump may be continuously operated during these attempts, thus doing away with the shocks and jars to which 85 the priming pump is ordinarily subjected in starting the same. It is here pointed out that the ordinary type of priming pump employed with such devices is a suction pump operated from a motor and 90 having a chain drive connection therewith. The motor, being started, is usually thrown directly across the service line with the result that it practically instantaneously jumps 95 to top speed, placing considerable strain upon the priming pump. This renders it necessary that the priming pump be given frequent attention to assure its being kept in working condition and consequently detracts 100 from the value of the usual automatic system which otherwise requires little, if any, attention.

These and other objects we attain by the construction shown in the accompanying drawings, wherein for the purpose of illustration is shown a preferred embodiment of our invention and wherein:—

Figure 1 is a view partially diagrammatic

of a pumping system constructed in accordance with our invention;

Figure 2 is an enlarged fragmentary diagram showing a slightly different control circuit for synchronous motors in which thermostatic switches are employed and the motor is stopped by the sump switch:

Figure 3 is an enlarged view partially in section of the try limiting mechanism;

Figure 4 is an enlarged detail sectional view of the float chamber and the associated mechanism;

Figure 5 is an enlarged detail sectional view taken through the valve controlling communication with the vacuum operated switch control.

Referring now more particularly to the drawings, the numeral 10 generally designates a centrifugal pump operated from a motor 11. This motor may be directly connected to the pump, as indicated at 12 in Figure 1, or may be connected to the pump through a magnetic clutch 12^a, as indicated in Figure 2. A control circuit CC for the motor is provided and includes a motor starting solenoid switch 13, the circuit of which, as disclosed in Figure 1, includes a vacuum operated switch 14 opening the circuit upon the formation of an excessive vacuum in the suction pipe 15 of the centrifugal and a further switch 16, the purpose of which will hereinafter appear.

In the form shown in Figure 2, the motor circuit CC includes a sump switch 17 opened and closed by the level of water in a slump 18 and a plurality of thermostatically controlled switches 19 of which there is one for each of the bearings 20 of the centrifugal and bearings 21 of the motor. These last named switches open the circuit in event of excessive heating of any of the bearings 20 or 21, thus preventing burning out thereof.

The numeral 22 generally designates a priming pump and 23 an operating motor therefor, the service line 24 of which includes a normally open solenoid operated switch 25. A control circuit 26 for the motor 23 is provided including the solenoid winding 27 of the solenoid operated switch 25, one contact 28 and the blade of a double-throw switch 29, a normally closed pressure operated switch 30 and the sump switch 17 hereinbefore mentioned. The intake 31 of the suction pump 22 is connected intermediate the ends of a vertical riser 32 having at its lower end a check valve 33 and communicating at its upper end with the exhaust 34 of a float chamber F through a conduit 35. This float chamber has its intake connected by a conduit 36 with the high point of the centrifugal pump. In the present illustration, the pump is disclosed as a two stage centrifugal and the conduit 36 communicates with the high point of the cross-over 37 connecting the stages. The remaining high points of

the pump are connected with the conduit 36, as indicated at 38, a check valve 39 of any suitable type being arranged in the connection so that communication between the higher and lower stages of the pump is prevented when the pump is in operation.

The float chamber includes guides 40 and 41, the guide 40 receiving a tail stem 42 upon a float ball 43 while the guide 41 receives the usual wing guides formed upon the stem 44 of a check valve 45 carried by the ball. While the above check valve structure has been illustrated, it will, of course, be understood that any type of float controlled check may be employed where this is found desirable.

The switch 16 has associated therewith a cylinder 46 having a piston 47 therein. The upper end of this cylinder is connected through a conduit 48 with the exhaust port 34 of the float chamber, a check valve 49 being arranged in said connection and closing toward the exhaust port. This check valve has a stem 50 arranged in the path of movement of the stem 44 of the float controlled check valve 45 to be engaged thereby as the float operated check valve is seated whereby the check valve 49 opens as the check valve 45 closes, placing the upper end of the cylinder 46 in communication with the suction pump, whenever the float valve 45 is closed.

The stem 51 of the piston 47 has attached thereto the piston 52 of a dash-pot cylinder 53 which is loosely directed through the lower wall of the cylinder 46. This stem has arranged thereon spaced stops 54, 55, and is adapted, as at 56, for the support of counterweights 57 constantly urging the piston 47 and 52 toward the lower end of the cylinders. The movement of the piston to the lower end of the cylinder after it has once been elevated is resisted by air cushioning beneath the piston of the dash-pot and this air slowly leaking from the dash-pot together with the counterweights determines the speed with which the piston returns to its lowermost position. The switch 16 has an operating arm 58 extended between the stops 54 and 55 and as the piston is elevated upon the creation of a vacuum in the upper end of the cylinder, the stop 55 will engage this arm and close the switch while as the piston lowers under the influence of the counterweights, the stop 54 will engage this arm and open the switch.

It will, of course, be obvious that in order to permit this piston to lower, communication between the cylinder 46 and the vacuum pump must be discontinued. For this reason, we arrange in the conduit 48 a valve 59, the operating arm 60 of which has a counterweight 61 moving the valve quickly to either open or closed positions after the operating arm has been moved a prede-

terminated distance. The stop 54 is elongated to provide an arm 54^a which coacts with the lower end of the stem 62 of the piston 63 of a dash-pot 64. The upper end of this stem 5 has a pair of spaced stops 65 and 66 between which the operating arm 60 of the valve 59 extends. The dash-pots 53 and 64 operate at different speeds, the piston of the dash-pot 53 settling more rapidly than the piston 10 of the dash-pot 64. When the piston 47 elevates, this elevation will cause elevation of the dash-pot piston 63 and closing of the valve 59, thereby cutting off communication between the vacuum pump and the cylinder, 15 even though the valve 49 be open.

Any suitable means may be provided for breaking the vacuum of the cylinder 46 when this valve is closed. This means may be included in the valve 59 and in the present instance is shown as a conduit 67 formed in the rotating element of the valve communicating at one end with the atmosphere and aligning at its opposite end with the bore of that portion of the conduit 48 communicating with the cylinder 46 when the valve 59 is in its closed position. The switch 20 employed will be of such character that after the switch is in its closed position, an additional movement of the arm 58, in the same 25 direction as its movement in closing the switch, may be had without affecting the position of the switch, for a purpose presently to appear.

A pressure cylinder 68 is provided having a piston 69 arranged therein. The lower 35 end of the cylinder is in communication with the interior of the pump and accordingly subject to the pressure therein through a conduit 70. The stem of the piston, indicated at 71, supports a switch element 72 of the switch 30 and the extremity of the arm 58 projects over this switch element and into the path of movement thereof. The arm 58 may elevate independently of 40 the element 72 but when it is in its raised position, if the element elevates in response to a predetermined pressure generated within the centrifugal, the arm is moved to and held in a slightly higher position and the 45 switch 16 is maintained in its closed position. The piston 69 also serves as a means for opening the switch 30 of the priming pump motor control circuit 26 and thus serves the dual functions of stopping the 50 priming pump and maintaining the control circuit CC of the motor of the centrifugal.

The operation of the mechanism hereinbefore described is as follows:—Assuming the 55 sump switch 17 to be closed and that there is no pressure within the centrifugal, the priming pump motor control circuit 26 is completed at the switches 30 and 29 and the priming pump is started. The section of the priming pump draws fluid from the 60 sump 18 into and through the centrifugal

until this fluid reaches the float chamber, causing the float 43 to elevate and the check valve 45 controlled by this float to close. The closure of the check valve 45 causes opening of the valve 49 with the 70 result that the suction of the priming pump is transferred from the centrifugal to the cylinder 46. This causes elevation of the piston 47 and its stem with the result that the switch 16 is closed. At the same time, 75 the valve 59 is closed and the vacuum of the cylinder 46 broken, permitting the piston to slowly recede under the influence of its counterweights against the action of the dash-pot 53. The time required for this piston 80 to recede sufficiently to permit the stop 54 to engage with the arm 58 and open the switch 16 will be sufficient to permit the motor 11 to come to operating speed and the centrifugal 10 to generate working pres- 85 sure.

The closure of the switch 16 closes the control circuit CC of the motor and this motor is started in an attempt to generate working pressure. If the prime is faulty 90 or for any reason the centrifugal failed to generate working pressure, the piston 69 of the pressure cylinder will remain stationary with the result that there is nothing to interfere with movement of the switch 95 16 to its open position. When the switch 16 is moved to its open position, the control circuit of the motor 11 is opened and the centrifugal stopped, permitting the priming fluid to recede and the float 43 to withdraw 100 the check valve 45 from its seat, it being understood that this ball and its associated parts has sufficient weight either of itself or through associated leverage to cause this withdrawal of the check valve against the 105 vacuum produced by the vacuum pump. This permits the vacuum of the vacuum pump to be again applied to draw fluid from the sump 18 through the centrifugal in a repeated attempt to prime the same and 110 the above cycle of operations is repeated unless the centrifugal generates working pressure.

In some instances, the pressure generated is less than working pressure and under these 115 circumstances, a pressure will be maintained until the motor 11 has completely stopped. It will, of course, be understood that this motor, when starting under the influence of the switch 16, will attain a predetermined 120 speed and that as this speed is necessarily high when the circuit is broken, operation of the centrifugal will continue for a short period. This pressure may cause the float check 45 to remain against its seat in which 125 event the valve 49 would be open and accordingly the vacuum pump would immediately again close the switch 16 unless the mechanism operating the valve 59 were such that this valve did not open until after the cen- 130

trifugal had ceased to operate and accordingly all pressure had been removed from the float and check valve 45. The dash-pot 64, however, since it does not operate as rapidly as the dash-pot 53, does not bring its stop into operating engagement with the arm of the valve 59 until the switch 16 has been open for a predetermined period, thus giving the motor time to stop and all pressure to be dispersed before the valve is re-opened. Since the float 43 will drop as soon as pressure is relieved, it follows that the valve 49 will be closed and the suction from the pump will be first directed through the centrifugal to prime the same and then to the cylinder 46 in the order above described. As will hereinafter appear, other means may be provided for insuring opening of the check 45 and closing of the check 49, if so desired. If the centrifugal generates working pressure, this pressure is transmitted to the piston 69, causing the same to elevate with the result that the element 72 will prevent lowering movement of the arm 58 and accordingly prevent opening of the switch 16 and thereby maintain the control circuit CC closed until this pressure drops below such working pressure. Operation of the piston 69 under the influence of working pressure likewise opens the control circuit 26 of the priming pump motor at the switch 30 so that the priming pump is stopped. It will be obvious that during operation of the priming pump, the check valve 33 will be maintained in closed position and it will also be obvious that any water which may pass the check 45 will collect within the lower end of the vertical leg 32 above this valve. Accordingly, when the pump 22 is stopped, the check valve will open, permitting escape of this water. Thus, the lower end of this leg serves as a trap and while the construction illustrated is preferred, it will be obvious that this trap may be placed at any point beyond the float chamber from the centrifugal and in the connection between the centrifugal and the priming pump.

It will be obvious that with the structure above recited, in event something, as for example, a leak at one of the joints of the centrifugal, interfered with the formation of working pressure in the centrifugal, the cycle of operations would be continued indefinitely, subjecting the priming pump, centrifugal and the motors thereof to a needless wear and tear. For this reason, we have provided in combination with the above structure a means for limiting the number of priming attempts which may be made in event the centrifugal pump fails to generate proper pressure. This means may embody any of the well known try limiting switches commonly employed in safe-guarding electrical appliances for a number of years. In the present instance, this try limiting device

embodies the usual ratchet wheel 73 having associated therewith a holding pawl 74 and an operating pawl 75 by means of which the ratchet wheel 73 may be advanced against a counterweight 76, which gives a bias to the ratchet wheel.

This operating pawl is carried by the end of the switch arm 58 of the switch 16. The tail of the holding pawl 74 is arranged in the path of the switch element 72 so that as the piston 69 moves in response to pressure within the centrifugal, this holding pawl is withdrawn. The operating pawl 75 has a tail 77 coacting with a trip stop 77^a against which the tail engages upon sufficient elevation of the arm 58 to cause release of the operating pawl. The normal movement of the arm 58 is sufficient to bring this tail into engagement with the stop 77^a and when the piston 69 is operated under working pressure, the element 72 is raised so as to disengage the pawl 74 from holding the ratchet wheel 73 and it will be obvious that the bias 76 will return the ratchet disk to its normal position. This ratchet disk has a pair of contact pins 78 and 79 coacting with a tail 80 formed upon the switch 29. After a predetermined number of steps of the ratchet disk, one of these stops 79 engages the tail 80, shifting the switch blade of the switch 29 so that this blade is caused to disengage from the contact 28 and engage a contact 81, closing a circuit 82 having arranged therein a signal 83 which may be located at any convenient point and serve as an indication of trouble with the pump.

Since the system above described is operable by operation of the priming pump alone, a signal will be given whether the motor of the main pump is started or not, and accomplished during continual operation of the priming pump, by causing a predetermined number of ratchet steps, as described heretofore. Thus, if the main motor circuit is broken at one of the thermostatic switches 19 or at any point in the line, the system is automatically rendered inoperative and the signal operated after a single starting of the vacuum pump. We have previously mentioned the use of the magnetic clutch 12^a and in Figure 2, we have diagrammatically indicated the circuit for operating the same at 86. This circuit includes spaced contacts 87 bridged by complete closure of the motor starter which may be of any suitable character.

In Figure 2, we have illustrated a modification of the structure, as regards the connections between the float chamber and the centrifugal pump. In the structure above described, the float 43 is subjected to the pressure of the centrifugal while in operation and this renders it necessary that a relatively heavy float be employed and like-

wise, where the pressure is extreme, necessitates the use of leverage for connecting the float and check valve. In the modification illustrated in this figure, a pressure operated
 5 check valve 88 is arranged immediately above the point of communication of the conduit 70 with the conduit 36. Above this check valve, a sump return line 89 is connected and led to a suitable drain or to the
 10 sump. In this line, a check valve 90 is arranged opening toward the sump. The check valve 90 will be closed and the valve 88 will be open while the suction pump is acting to prime the centrifugal pump. When, how-
 15 ever, the centrifugal pump is in operation and pressure is generated, this pressure will close the check 88, the line 89 relieving the conduit 36 between the check 88 and the float valve to permit the check 88 to seat.
 20 The check 90 will then remain in open position until the water above the check 88 has been drained from the connection, thus allowing the float valve to open against the suction of the suction pump by its own
 25 weight and the weight of the float. By this arrangement, the float is not subjected continuously to the pressure of the centrifugal and may be made considerably lighter and at the same time properly perform its func-
 30 tion. Furthermore, since relief of the conduit 36 insures against any pressure which will act with the vacuum of the vacuum pump to hold the ball valve 45 against its seat, this structure with some slight modifi-
 35 cations will permit the cylinder 64 and its associated mechanism to be dispensed with. In this case, the arm of the valve 59 will be operated directly from the arm 54 instead of through the dash-pot connection employed
 40 in the structure previously described.

Since it is obvious that the structure hereinbefore set forth is, to a great extent, merely illustrative and capable of a wide range of change and modification without
 45 materially departing from the spirit of our invention, we do not limit ourselves to such specific structure except as hereinafter claimed.

We claim:—

50 1. In a pumping system, a centrifugal pump, a suction priming pump therefor, means for starting the priming pump, suction operated means for starting the centrifugal pump, means for transferring the suc-
 55 sion of the priming pump to said means when the centrifugal pump is primed, means for stopping the centrifugal pump after a predetermined period of operation and means operated by the generation of operat-
 60 ing pressure in the centrifugal pump for rendering said stopping means inoperative.

2. In a pumping system, a centrifugal pump, a suction priming pump therefor, means for starting the priming pump, suc-
 65 tion operated means for starting the cen-

trifugal pump, means for transferring the suction of the priming pump to said means when the centrifugal pump is primed, means for stopping the centrifugal pump after a predetermined period of operation, means
 70 operated by the generation of operating pressure in the centrifugal pump for rendering said stopping means inoperative and stopping said priming pump.

3. In a pumping system, a centrifugal
 75 pump, a suction priming pump therefor, means for starting the priming pump, suction operated means for starting the centrifugal pump, means for transferring the suction of the priming pump to said means
 80 when the centrifugal pump is primed, means for stopping the centrifugal pump after a predetermined period of operation, means operated by the generation of operating pressure in the centrifugal pump for ren-
 85 dering said stopping means inoperative and stopping said priming pump and means automatically stopping the centrifugal upon failure of the centrifugal pump to generate working pressure during a predetermined
 90 number of starts.

4. A pump system comprising a centrifugal pump, an electrical motor therefor, a suction pump for priming the centrifugal pump, a switch controlling the operation of the
 95 motor, suction operated means for closing the switch, means for automatically connecting the suction operated means to the suction pump upon completion of the priming operation, means giving the switch bias normally
 100 maintaining the switch in open position and returning the switch to open position at a predetermined interval after operation thereof by said suction operated means and means responsive to operating pressure within the
 105 centrifugal pump for preventing opening of the switch by said bias.

5. A pump system comprising a centrifugal pump, an electrical motor therefor, a suction pump for priming the centrifugal
 110 pump, a switch controlling the operation of the motor, suction operated means for closing the switch, means for automatically connecting the suction operated means to the suction pump upon completion of the
 115 priming operation, means giving the switch bias normally maintaining the switch in open position and returning the switch to open position at a predetermined interval after operation thereof by said suction oper-
 120 ated means and means responsive to operating pressure within the centrifugal pump for preventing opening of the switch by said bias and rendering said priming means in-
 125 operative.

6. A pump system comprising a centrifugal pump, an electrical motor therefor, a suction pump for priming the centrifugal pump, a switch controlling the operation
 130 of the motor, suction operated means for

closing the switch, means for automatically connecting the suction operated means to the suction pump upon completion of the priming operation, means giving the switch bias normally maintaining the switch in open position and returning the switch to open position at a predetermined interval after operation thereof by said suction operated means, means responsive to operating pressure within the centrifugal pump for preventing opening of the switch by said bias, and means limiting the number of operations which may be had for said means for temporarily closing the circuit of the motor without an operation of the last named means.

7. In a pumping system, a centrifugal pump, a suction priming pump therefor, a connection between the centrifugal and priming pump including a float, suction operated means for starting the centrifugal pump and means operated by said float cutting off communication between the centrifugal and priming pump and opening communication between said suction operated means and priming pump when the centrifugal is primed.

8. A pump system comprising a centrifugal pump and an electrical motor therefor and normally disconnected therefrom, a suction pump for priming the centrifugal pump, a switch controlling the operation of the motor, means operated from the suction pump for closing said switch when the centrifugal pump is primed and means for automatically connecting the centrifugal pump to the motor when the motor comes to operating speed.

9. In a pumping system, a centrifugal pump, a suction priming pump therefor, a connection between the centrifugal pump and priming pump including a float, suction operated means for starting the centrifugal pump, means operated by said float cutting off communication between the centrifugal pump and priming pump and opening communication between said suction operated means and priming pump when the centrifugal pump is primed, pressure operated means closing communication between the centrifugal pump and the float and means for draining that portion of the connection lying between the float and the last named means after operation of the last named means.

10. A pump system comprising a centrifugal pump, an electrical motor therefor, a suction pump for priming the centrifugal pump, a switch controlling the operation of the motor, suction operated means for temporarily closing said switch, means for automatically connecting said suction operated means to the suction pump upon completion of the priming operation, means controlled by the generation of working pressure by the centrifugal pump when started for main-

taining said switch in closed position, means operatively connected with the switch for cutting off communication between the suction pump and said suction operated means as the switch is closed and means giving the switch bias opening the switch in a predetermined interval after operation of the last named means.

11. A pump system comprising a centrifugal pump, an electrical motor therefor, a suction pump for priming the centrifugal pump, a switch controlling the operation of the motor, suction operated means for temporarily closing said switch, means for automatically connecting said suction operated means to the suction pump upon completion of the priming operation, means controlled by the generation of working pressure by the centrifugal pump when started for maintaining said switch in closed position, means operatively connected with the switch for cutting off communication between the suction pump and said suction operated means as the switch is closed and means giving the switch bias opening the switch in a predetermined interval after operation of the last named means and means stopping the priming pump upon closure of the switch a predetermined number of times without operation of the centrifugal pump.

12. A pump system comprising a main pump and a priming pump and an electric motor for the main pump, a float chamber in the connection between the priming pump and the main pump, a switch controlling operation of the main pump motor, suction operated means for temporarily closing said switch, float operated means for cutting off communication between the priming pump and the main pump and for placing the priming pump in communication with said suction operated means and means for rendering the closure of the switch permanent upon functioning of the main pump.

13. A pump system comprising a centrifugal pump, an electrical motor therefor, a suction pump for priming the centrifugal pump, a switch controlling the operation of the motor, suction operated means for closing the switch, means for automatically connecting the suction operated means to the suction pump upon completion of the priming operation, means giving the switch bias normally maintaining the switch in open position and returning the switch to open position at a predetermined interval after operation thereof by said suction operated means, means responsive to operating pressure within the centrifugal pump for preventing opening of the switch by said bias and means controlled by closing of the switch cutting off communication between the suction operated means and the suction pump for an interval sufficient to permit said switch to open under the influence of its bias

and the centrifugal pump to come to a stop.

14. A pump system comprising a centrifugal pump, an electrical motor therefor, a suction pump for priming the centrifugal pump, a switch controlling the operation of the motor, suction operated means for closing the switch, means for automatically connecting the suction operated means to the suction pump upon completion of the priming operation, means giving the switch bias normally maintaining the switch in open position and returning the switch to open position at a predetermined interval after operation thereof by said suction operated means, means responsive to operating pressure within the centrifugal pump for preventing opening of the switch by said bias and means delaying re-closing of the switch when open by said bias to permit the centrifugal pump to come to a stop.

15. In a pump system, a main pump, a priming pump therefor, means automatically starting the main pump when primed and stopping the main pump in a predetermined interval upon failure of the pump to perform its function, means controlling communication between the main and suction pumps cutting off communication therebetween when the main pump is primed and automatically re-establishing such communication upon failure of the main pump to start or perform its function after starting, retarding means associated with the first named means and delaying its function in starting the pump after the pump has once been started preventing operation thereof until the pump has come to a complete stop and means stopping the priming pump after a predetermined number of operations of said means controlling communication between the main and priming pumps.

16. A pump system comprising a centrifugal pump, an electrical motor therefor, a suction pump for priming the centrifugal pump, a switch controlling the operation of the motor, suction operated means for temporarily closing said switch, means for automatically connecting said suction operated means to the suction pump upon completion of the priming operation, means controlled by the generation of working pressure by the centrifugal pump when started for maintaining said switch in closed position, means operatively connected with the switch for cutting off communication between the suction pump and said suction operated means as the switch is closed, means giving the switch bias opening the switch in a predetermined interval after operation of the last named means, means stopping the priming pump upon closure of the switch a predetermined number of times without operation of the centrifugal, means giving said means bias cutting off communication between the suction pump and suction oper-

ated means to move the same to open position and re-establish such communication and means delaying operation of said means until the bias of the switch has opened the switch and the centrifugal pump has come to a stop.

17. In a pumping system, a centrifugal pump, a suction priming pump therefor, an electric motor for the centrifugal pump, a normally open circuit for the motor, means for starting the priming pump, suction operated means for temporarily closing the circuit of the centrifugal pump motor, means for transferring the suction of the priming pump to said means when the centrifugal pump is primed, means operated by the suction operated means for closing communication between the suction operated means and the priming pump and means stopping the operation of the priming pump upon failure of the centrifugal pump to start or perform its functions after the circuit has been closed a predetermined number of times.

18. In combination, a centrifugal pump, an electric motor for the pump, means for introducing a priming charge to the pump, a switch controlling the pump motor, means rendered operative by the introduction of a priming charge to the pump for closing the switch for an interval normally sufficient to permit the generation of working pressure in the pump and then tending to reopen the switch, means controlled by the generation of working pressure in the pump operatively engaging the first named means to prevent said means from opening the switch.

19. In combination, a centrifugal pump, an electric motor therefor, a priming pump for the centrifugal pump, an electric motor for the priming pump, a normally open switch controlling the centrifugal pump motor, means rendered operative by the introduction of a priming charge to the centrifugal pump closing said switch for an interval normally sufficient to permit the generation of working pressure in the centrifugal pump, means operated by the generation of working pressure in the centrifugal pump operatively engaging the first named means to prevent said means from opening the switch, said means comprising a switch opening the circuit of the priming pump motor under the influence of working pressure in the centrifugal pump.

20. In combination, a centrifugal pump, an electric motor for the pump, a circuit for the motor including a normally open switch, a control circuit for the switch likewise including a second normally open switch, means for introducing a priming charge to the pump, means rendered operative by the introduction of a priming charge to the pump for closing said second switch for an interval normally sufficient to permit genera-

tion of working pressure in the centrifugal pump and means controlled by the generation of working pressure in the centrifugal pump maintaining said second switch in closed position.

21. A pump system comprising a centrifugal pump, an electrical motor therefor, a suction pump for priming the centrifugal pump, a switch controlling the operation of the motor, suction operated means closing said switch, means operating independently of the centrifugal pump and at an interval after the closing of the switch normally sufficient for the generation of working pressure in the pump tending to reopen the switch in the absence of the generation of working pressure in the centrifugal pump, means for automatically connecting said suction operated means to the suction pump upon completion of the priming operation and means controlled by the generation of working pressure in the centrifugal pump when starting for maintaining said switch in closed position.

22. A pump system comprising a centrifugal pump, an electrical motor therefor, a suction pump for priming the centrifugal

pump, a switch controlling the operation of the motor, suction operated means closing said switch, means operating independently of the centrifugal pump and at an interval after the closing of the switch normally sufficient for the generation of working pressure in the pump tending to reopen the switch in the absence of the generation of working pressure in the centrifugal pump, means for automatically connecting said suction operated means to the suction pump upon completion of the priming operation, means controlled by the generation of working pressure in the centrifugal pump when starting for maintaining said switch in closed position, and means operatively connected with the switch for cutting-off communication between said suction pump and said suction operated means as the switch is closed.

In testimony whereof we hereunto affix our signatures.

CHARLES H. GOYNE.
JOHN G. GOYNE.
ALBERT F. GOYNE.
JOHN H. DOUGHERTY.