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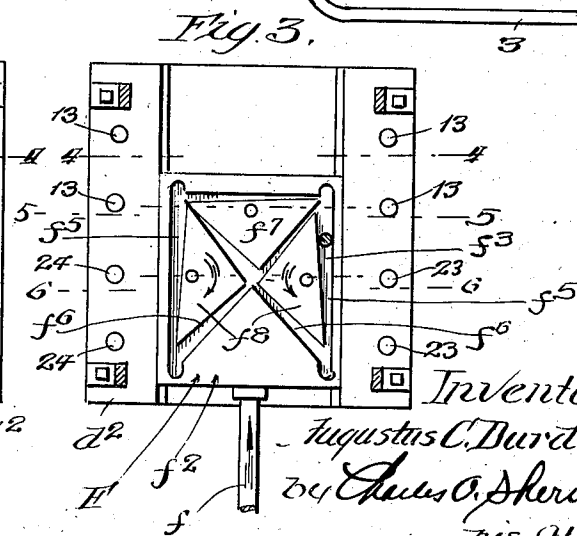
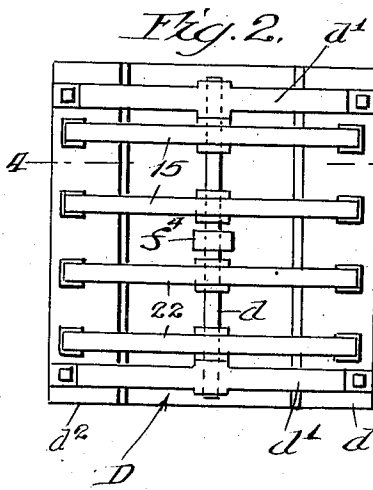
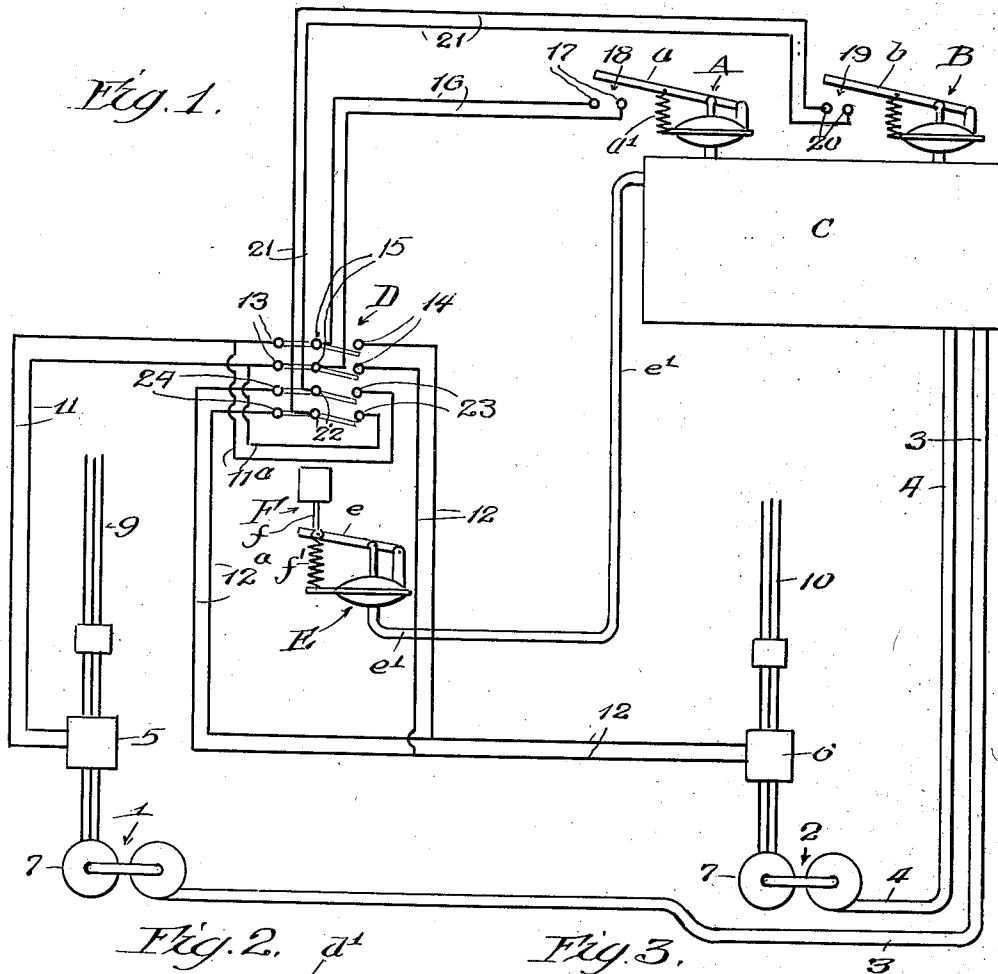
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1,819,774

AUTOMATIC CONTROL FOR MOTORS

Filed Nov. 10, 1928

2 Sheets-Sheet 1



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Aug. 18, 1931.

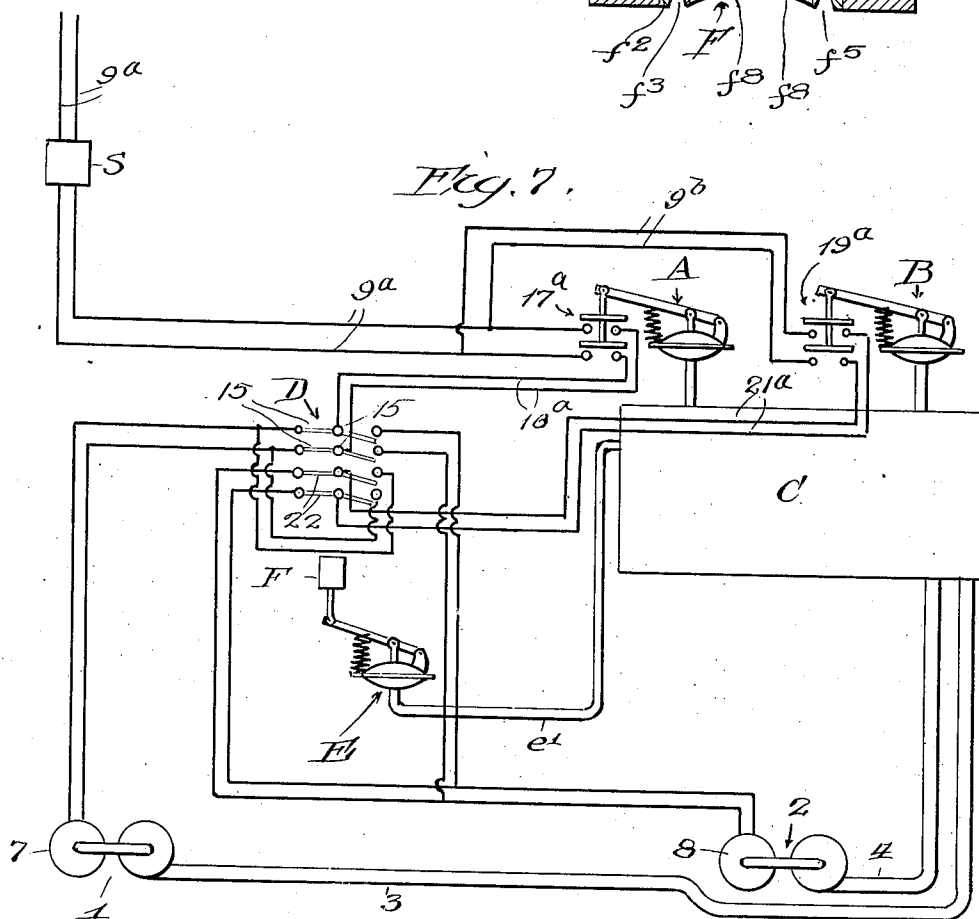
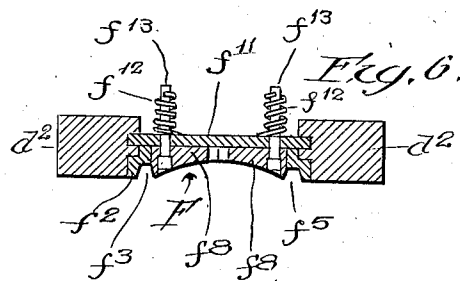
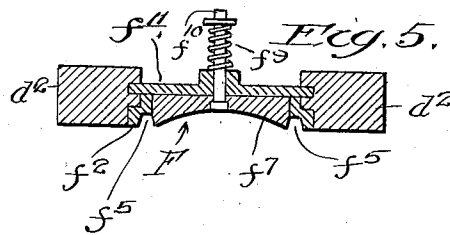
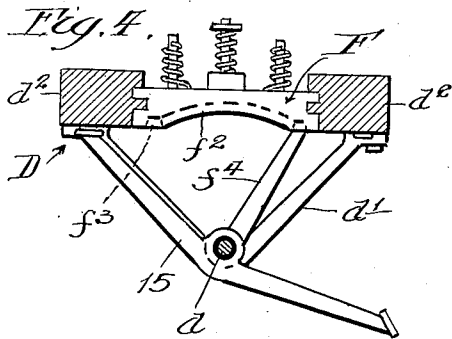
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1,819,774

AUTOMATIC CONTROL FOR MOTORS.

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2 Sheets-Sheet 2



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UNITED STATES PATENT OFFICE

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AUTOMATIC CONTROL FOR MOTORS

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The invention relates to automatic control for motors, and its principal object is to provide automatic pneumatically controlled mechanism for alternately starting electric motors and stopping the active motor after its work has been done, which mechanism is made responsive to changes of pressure in a tank or other part of a pneumatic system.

In systems using air pressure or vacuum, it has been found that the use of two electric motor operated pumps for creating pressure or vacuum is advantageous, since it avoids discontinuance of the service in case one of the pumps becomes disabled, or in case one of the pumps is unable to supply the necessary pressure or vacuum. Furthermore, by employing two pumps and causing them to operate alternately, the wear and tear on the motors and pumps is lessened.

With these and other objects and advantages in view, this invention consists in a pneumatic control for motors embodying a double throw switch, or other switch mechanism, for two motors, which switch mechanism is operated, so as to cause alternate operation of the motors, by a pneumatically actuated device connected to the tank or other part of the system in which pressure or vacuum is to be maintained. It further consists in an apparatus of the above described character in which the electric circuit through the double throw or other switch mechanism is opened and closed by a pneumatically operated device which is made responsive to the changes of pressure in the tank or other part of the pneumatic system.

It further consists in an apparatus as above described in which the circuit through said switch mechanism to the idle motor is closed whenever the pressure in the tank or other part of the system falls to an abnormally low degree, whereby the idle motor will be started as an auxiliary to the active motor. The invention further consists in the several novel features hereinafter fully set forth and claimed.

The invention is clearly illustrated in the drawings accompanying this specification in which—

Figure 1 is a diagrammatic view illustrat-

ing a simple form of the present invention;

Fig. 2 is a front elevation of one form of double throw switch used;

Fig. 3 is a front elevation of said switch with the movable contact members thereof omitted;

Fig. 4 is a detail horizontal section taken on the line 4—4 of Figs. 2 and 3;

Fig. 5 is a detail horizontal section taken on the line 5—5 of Fig. 3;

Fig. 6 is a detail horizontal section taken on the line 6—6 of Fig. 3; and

Fig. 7 is a diagrammatic view illustrating a modified form of the invention.

Referring to said drawings, and first to Figs. 1 to 6 inclusive which illustrate one embodiment of the invention applied to a pressure system, the reference character C designates a pressure tank in which it is desired to maintain a predetermined pressure. Two electric motor driven pump units 1 and 2 are employed for supplying compressed air to the tank C, the pump of the pump unit being connected thereto by a pipe 3 and the pump of the pump unit 2 by a pipe 4. Starters 5 and 6 are provided for the electric motors 7 and 8 of the pump units, and from said starters 5 and 6 run the electric conductors 9 and 10 which are connected to any suitable source of electric supply.

For causing the motors to operate alternately, a double throw switch D, or other switch mechanism for controlling the circuits to two motors, is employed, which switch mechanism is actuated by mechanism made responsive to the variations of pressure in the tank C, so as to cause the alternate operation of the two motors, as will be hereinafter explained. Electric conductors 11 and 12 from the starters 5 and 6 run to the stationary contact members 13 and 14 of the double throw switch D. From the movable contact members 15 of the switch, both circuits are continued through electric conductors 16 to stationary contact members 17 of a switch 18 which is actuated by a pneumatically operated circuit closing device, or pressure switch, here shown in the form of a diaphragm device A connected to the tank C.

It is to be understood that as the pressure

in the tank rises, the arm *a* of the diaphragm device A is moved upwardly against the action of a spring *a'*, and that when the pressure in the tank is sufficient to overcome the action of the spring *a'*, the diaphragm arm *a* is raised, thereby breaking the circuit between the stationary contact members 17. Whenever the pressure in the tank falls below a predetermined point, the spring *a'* lowers

the arm *a* and closes the circuit through the stationary contact members 17, thereby closing the circuit to one of the starters 5 and 6, depending upon which circuit is closed through the double throw switch D.

A second pneumatically operated circuit controlling device or pressure switch, here shown in the form of a diaphragm device B, is connected to the pressure tank C, which diaphragm device is set to operate and thereby close the circuit to the idle pump motor whenever the pressure in the tank C falls below that required to start either pump motor. The diaphragm device B actuates a switch 19 containing stationary contact members 20 from which lead electric conductors 21 which run to the movable contact members 22 of the double throw switch D, and from the terminals 23 and 24 of said double throw switch B, branch conductor wires 11^a and 12^a run to and join with the electric conductors 11 and 12. It will be seen, therefore, that if the circuit to the motor 7 of the pump unit 1 is closed by the diaphragm A and the pump unit 1 fails to supply the necessary pressure in the tank C, or at least in case the pressure in the tank C continues to fall below the pressure at which the pump unit 1 was started, then the arm *b* of the diaphragm device B will be drawn down by the spring, thereby closing the circuit through the stationary contact members 20 and through the motor 8 of the pump unit 2, and both pump units therefore will continue to operate until the pressure in the tank rises sufficiently to actuate the diaphragm device B and thereby break the circuit to one of the starters, after which the other motor will continue to operate and build up pressure until the diaphragm device A is actuated, thereby breaking the circuit to the starter of the active pump.

The double throw switch D is actuated by a switch actuating member F which is actuated by a pneumatic device E, here shown in the form of a diaphragm device connected to the pressure tank by pipe *e'*. The arm *e* of the diaphragm device E is connected to the switch operating member F by a link or rod *f*. A coiled spring *f'* is provided for moving the diaphragm device arm *e* downward against the air pressure exerted on the diaphragm of the diaphragm device E, and said spring is regulated so as to move the arm *e* down to thereby actuate the switch operating member F before the pressure on the underside of the diaphragm of the diaphragm de-

vice E falls below the pressure required to cause the diaphragm device A to operate in closing the circuit for one of the idle pump motors.

A double throw switch has been chosen for the purpose of illustrating the invention, although no particular form of switch is essential to the invention broadly considered, the one shown comprises movable contact members which are in the form of arms 15 and 22 rigidly mounted upon a rock shaft *d* and insulated away from each other and from the shaft. The conductors 16 and 21 from the diaphragm devices A and B run to the movable contact members 15 and 22, as has been explained, and by rocking said movable contact members from one side to the other of the switch thereby making contact with the stationary contact members, the circuit to either pump motors 7 or 8 is closed through the switch, depending upon which side of the switch the contact is made. The rock shaft *d* is rotatably mounted in bearing brackets *d'* secured upon the frame member *d*² of the switch.

The switch operating member F may take any suitable form for actuating the double throw switch. It is here shown as comprising a block *f*² slidably guided upon the frame member *d*² and having a continuous cam groove *f*³ in which is held one end of an arm *f*⁴ which is rigidly mounted upon the rock shaft *d* of the double throw switch. The cam groove *f*³ contains two parallel portions *f*⁵ which are joined adjacent the top and bottom thereof by oblique portions *f*⁶ and *f*⁶. For guiding the end of the arm *f*⁴ to follow the proper course through the continuous groove *f*³, one side wall of which groove is formed by oscillatory blocks *f*⁷ and *f*⁸ which are pivotally mounted on the main block *f*² and normally held with their side edges out of alignment with the grooves, as is clearly shown in Fig. 3.

The block *f*⁷ is frictionally or otherwise held in any position occupied by it by a spring *f*⁹ (see Fig. 5) surrounding the spindle *f*¹⁰ that forms the pivot upon which the block *f*⁷ turns, and bearing against the back plate *f*¹¹ in which the spindle is rotatably mounted. The back plate *f*¹¹ is rigidly fastened or formed as a part of the body portion of the main block *f*². The blocks *f*⁸ are spring pressed in the direction of the arrows indicated therein in Fig. 3 by springs *f*¹² (see Fig. 6) which surround the spindles *f*¹³ of the blocks *f*⁸, and have their outer ends secured to the spindles and their inner ends secured to the back plate *f*¹¹.

It is to be observed that when the switch operating member F is moved upwardly, the end of the arm *f*⁴ tracks in the upright part *f*⁵ of the groove, during which time the movable contact members of the double throw switch remain in contact with the stationary

contact members on the left hand side of the switch. When the switch operating member F moves downwardly, the end of the arm f^4 tracks along the oblique portion f^6 of the cam groove to the top thereof, spreading apart the blocks f^7 and f^8 and entering the upper end of the other upright groove f^5 . During the movement of the arm f^4 through the oblique portion f^6 of the cam groove, the movable contact members of the switch are thrown over to the other side, thereby making contact with the stationary contact members on the right hand side of the switch-board. When the switch operating member F is next moved down and up again, the same action upon the arm f^4 takes place as has been above described, except that the arm f^4 moves up the other inclined portion f^6 of the cam groove and is swung to the right as viewed in Fig. 3, and the movable contact members are moved into contact with the stationary contact members at the left of the switch-board.

It is to be observed that the switch is thrown while the pressure in the tank is lowering, and, consequently, while the motors are at rest, and in order to accomplish this, the diaphragm devices are adjusted, so that the circuit through either motor will not be closed by the diaphragm device A until the diaphragm device E has thrown the double throw switch D.

In the modified form of the invention illustrated in Fig. 7 the pressure switches A and B, the pumping units 1 and 2, the double throw switch D, the switch throwing device F therefor, and the pneumatically operated device E for actuating the switch throwing device F, are the same as in the preferred form, and the pressure switches A and B and pneumatic device E are connected to the pressure tank C in the same manner as in the preferred form. However, the motors of the pump units are of the type which do not require starters and, consequently, the starters shown in the preferred form are omitted. The wiring between the switches and motors is substantially the same as that of the preferred form, except that the service wires 9^a run through a switch S and thence to a double pole switch 17^a which is actuated by the diaphragm device of the pressure switch A, and from said double pole switch 17^a, the electric conductors 16^a run to the movable contact members 15 of the double throw switch D.

A double pole switch 19^a is provided in connection with the diaphragm device of the pressure switch B and electric conductors 9^b run from the electric conductors 9^a to said double pole switch 19^a, and from thence the electric conductors 21^a run to the other two movable contact members of the double throw switch D. The circuits in the modified form can be readily traced to both motors from the starting switch and through the

pressure switch and double throw switch. The operation of the pneumatic control illustrated in Fig. 7 is substantially the same as that of the preferred form.

In the operation of either form, when the pressure in the tank C lowers sufficiently to permit the pressure switch A to close the circuit through the switch element 17 thereof, one of the pump motors 7 or 8 is started, depending upon which circuit happens to be closed by the double throw switch. The pump driven by said motor thereupon continues to operate and build up the pressure in the pressure tank until the pressure switch A is actuated to break the circuit through the switch 17, whereupon the active motor stops.

When the pressure in the tank falls to a predetermined point, the diaphragm device E is actuated by a spring in a direction to move the switch operating member F in a downwardly direction, thereby throwing the movable contact members of the double throw switch over and closing the circuit through said double throw switch to the motor of the other pump unit, and when the pressure in the tank falls to the predetermined low point for closing the circuit through the switch 17 of the pressure switch A, then the last mentioned pump motor is started and continues to run until pressure is built up in the pressure tank to the point required to actuate the pressure switch A and break the circuit through the switch element 17 thereof. In this manner, the motors are started alternately and the active motor continues to operate until the necessary pressure is built up.

In the event that the pressure in the pressure tank falls below that required to start an idle pump so that the working pump is unable to build up the pressure, then the pressure switch B is operated to close the circuit through the switch element 19 thereof, whereupon the idle pump unit is started as an auxiliary to the other active pump. The circuit through the pump which is acting as an auxiliary is broken as soon as the pressure in the tank is increased sufficiently to actuate the pressure switch B and break the circuit through its switch 19.

While the invention has been shown and described as applied to a pressure system wherein compressed air is employed, it may be used in a vacuum system with equal facility and only such slight changes in the pressure devices A, B and E are required as will adapt them to vacuum in place of plus pressure.

It is to be understood that the pumps of the pumping units may be in the form of water pumps for pumping liquids into or out of the tank C, and that the pipes which connect the diaphragm devices with the tank or other receptacle may open into the same above or

below the water level therein. Furthermore, that while the switch operating devices A, B and E are illustrated in the form of diaphragm devices, other types of switch actuating devices responsive to variations or changes of the conditions in the tank or other receptacle C may be substituted for the diaphragm devices. Furthermore, that although the switch mechanism for controlling the two circuits for the two motors has been shown and described as a double throw switch, other equivalent switch mechanism may be employed whereby the circuits to the two motors may be alternately closed and opened.

I claim as new, and desire to secure by Letters Patent:

1. The combination of two electric pump units opening to the same source and capable of operating in a regular sequence, a single pressure operated starting and stopping switch for both motors of said units, and automatic sequence control means associated with said starting and stopping switch and having an element whereby first one motor is started while another is quiescent and whereby said other motor is started while the first mentioned one is quiescent.

2. The combination of a tank, two electric pump units, each having a pump opening to said tank, a single pressure operated electric switch mechanism for closing the circuits to both electric motors of said pump units, said electric switch mechanism being responsive to variations of pressure in the tank, and automatic sequence control means for the circuits to the motors of said pump units whereby the pump units are started in alternate sequence.

3. The combination of two electric motor operated pump units connected to a tank, and automatic pressure operated electric switch mechanism including sequence controlling mechanism for the motors of said pump units operating to start said motors alternately, said mechanism being responsive to variations of pressure in the tank.

4. The combination of two automatically controlled electric motor pump units connected to a tank and capable of operating in a regular sequence, a single electric pressure operated switch starting and stopping mechanism therefor responsive to variations of pressure in the tank, and automatic sequence control means associated with said starting and stopping switch mechanism and having an element whereby first the motor of one unit is started while the motor of the other is quiescent and whereby the motor of the other unit is started when the first one is quiescent.

5. The combination of a tank, two electric pump units, each having a pump opening to said tank, electric switch mechanism for closing the circuits to the electric motor of said pump units, said electric switch mechanism being responsive to variations of pressure in

the tank, and automatic sequence control means for the circuits to the motors of said pump units whereby the pump units are started in alternate sequence, said sequence control means having an actuating means responsive to variations of pressure in the tank.

6. Pneumatic control means for a plurality of motors comprising a pneumatically operated electric switch for starting and stopping the motors, and a pneumatically operated sequence controlling switch mechanism for establishing electrical connections between said switch and the motors in sequence, the pneumatic element of said switch and switch mechanism being connected to a pneumatic system and responsive to variations of pressure therein.

7. Means for controlling the sequence of operation of a plurality of electric motors comprising two electric circuits including an electric motor associated with each circuit, a pressure operated sequence controlling switch mechanism for the two circuits, responsive to variations of fluid pressure in a system, and other separately operating circuit controlling switch mechanisms, one for each circuit, and responsive to changes of conditions in said system.

8. Means for controlling the sequence of operation of a plurality of pump motors comprising an automatically operating electric switch for starting and stopping the motors, said switch being responsive to changes of conditions in a fluid pumping system, and a pneumatically operated sequence controlling switch mechanism for establishing electrical connections between said switch and the motors in sequence, the pneumatic element of said sequence controlling mechanism being responsive to variations of pressure in said pumping system.

9. Control means for a plurality of motors comprising two electric circuits including an electric motor in each circuit, a fluid pressure operated sequence controlling switch mechanism for both motors, and a circuit controlling pressure switch for both motors, the pressure operated element of said sequence controlling switch mechanism and pressure switch being connected to a fluid pressure system and responsive to variations of pressure therein.

10. Control means for a plurality of motors comprising two electric circuits including an electric motor in each circuit, a fluid pressure operated double throw sequence controlling switch for the motors, and a circuit controlling pressure switch for both motors, the pressure operated elements for operating said double throw switch and said pressure switch being connected to a fluid pressure system and responsive to variations of pressure therein.

11. Control means for a plurality of mo-

tors comprising two electric circuits including an electric motor in each circuit, a fluid pressure operated sequence controlling switch mechanism for the motors, and two circuit controlling pressure switches for the motors, the fluid pressure operated elements of said sequence controlling switch and said pressure switches being connected to a fluid pressure system and responsive to variations of pressure therein, one pressure switch being operable at a different pressure than the other pressure switch, whereby one or both motors may be started in response to variations of pressure.

12. Control means for a plurality of motors comprising two electric circuits including an electric motor in each circuit, sequence controlling switch mechanism for the motors, and a circuit controlling pressure switch for both motors connected to a fluid pressure system and responsive to variations of pressure therein, in combination with a fluid pressure operated switch throwing device for said sequence controlling switch, the pressure operated element of said switch throwing device being connected to a fluid pressure system and responsive to variations of pressure therein.

13. Control means for a plurality of motors comprising two electric circuits including an electric motor in each circuit, a double throw sequence controlling switch for the motors, and a circuit controlling pressure switch for both motors and connected to a fluid pressure system and responsive to variations of pressure therein, in combination with a fluid pressure operated switch throwing device for said double throw switch, the pressure operated element of said switch throwing device being connected to said fluid pressure system and operated at a higher pressure than that required to actuate said pressure switch.

14. Control means for a plurality of motors comprising electric switch sequence controlling mechanism for the electric circuits of two motors, a fluid pressure operated switch connected to a fluid pressure system and interposed in the circuit through said sequence controlling mechanism, and fluid pressure operated means for actuating said sequence controlling mechanism.

15. Control means for a plurality of motors comprising electric switch sequence controlling mechanism for the electric circuits to two motors, a fluid pressure operated switch connected to a fluid pressure system and interposed in the circuit through said sequence controlling mechanism, and fluid pressure operated switch throwing means connected to said fluid pressure system and actuating said sequence controlling mechanism.

16. Control means for a plurality of motors comprising a double throw switch for

controlling circuits to two motors, a pressure switch connected to a fluid pressure system and interposed in the circuit through the double throw switch, and switch throwing means connected to said fluid pressure system and operating the double throwing switch. 70

17. Control means for a plurality of motors comprising a double throw switch for controlling electric circuits to two motors, a pressure switch connected to a fluid pressure system and interposed in the circuit through the double throw switch, a pressure actuated device connected to said fluid pressure system, and switch throwing mechanism connected to and operated by said pressure actuated device. 75 80

18. Control means for a plurality of motors comprising electric switch mechanism for controlling electric circuits to two motors, a pressure operated electric switch connected to a fluid pressure system and interposed in the circuit through said electric switch mechanism, said pressure operated electric switch acting to close the circuit through said electric switch mechanism when the pressure in the system falls to a predetermined low point, and pressure operated means for actuating said electric switch mechanism, said last mentioned pressure operated means being set to operate at a higher pressure than the pressure operated electric switch, whereby the electric switch mechanism is actuated when the circuit there-through is broken. 85 90 95

19. Control means for a plurality of motors comprising electric switch mechanism for controlling electric circuits to two motors, fluid pressure operated means for actuating said electric switch mechanism and connected to a fluid pressure system, a fluid pressure operated switch connected to said fluid pressure system and interposed in the circuit through said electric switch mechanism, an auxiliary fluid pressure operated electric switch connected to said fluid pressure system and interposed in the circuit through the electric switch mechanism, said last mentioned fluid pressure operated switch being set to operate at a lower pressure than the first mentioned fluid pressure operated electric switch. 100 105 110

20. Control means for a plurality of pump motors comprising a double throw switch for controlling two circuits to two pump motors, fluid pressure actuated switch throwing means connected to a fluid pressure system and acting to throw said switch while the pressure in the system is falling, and a pressure switch connected to said fluid pressure system and interposed in the circuit through the double throw switch.

21. In automatic control mechanism for pumping apparatus, the combination of a tank, a pair of fluid pressure operated and electrically controlled alternately acting mo-

- tor driven pumps connected to said tank, and fluid pressure operated control means for said pumps including pressure switches and a sequence controlling mechanism, said control means being responsive to variations of pressure in the tank.
22. In pumping control mechanism for pumping apparatus, the combination of a liquid receiving tank, a pair of electrically controlled alternately operating motor driven pump units operating to pump the liquid entering said receptacle, and fluid pressure operated electric control means including sequence controlling mechanism for starting and stopping said pump units alternately, said means being responsive to variations of conditions in the tank.
23. Control motors for two electric pump motors comprising fluid pressure operated electric switches for starting and stopping both motors, the one switch being set to operate at a different pressure than the others and there being one switch for each motor, and fluid pressure operated sequence control switch mechanism for establishing electrical connection between said switches and the motors, the pressure operated element for said switch and switch mechanism being connected to a fluid pressure system and responsive to variations of pressure therein.
24. Control means for a plurality of motors comprising a plurality of electric circuits including an electric motor for each circuit, a fluid pressure operated sequence controlling switch mechanism for the motors, and a plurality of fluid pressure circuit controlling switches for the motors co-operating with the sequence controlling switch mechanism to cause operation of said motors in sequence and in unison, the pressure operated element of said electric switch mechanism being connected to a fluid pressure system and responsive to variations of pressure therein.
25. Means for controlling the sequence of operation of a plurality of electric pump motors comprising two electric circuits including an electric motor associated with each circuit, and fluid pressure operated sequence controlling switch mechanism for the two circuits, the fluid pressure operated element of said switch controlling mechanism being responsive to variations of fluid pressure in a system, and separately operating other circuit controlling mechanism, one for each electric circuit and responsive to changes of conditions in said system.
26. Control means for a plurality of motors comprising a fluid pressure operated electric switch for starting and stopping the motors, sequence control switch mechanism for establishing electrical connection between said switch and the motors, in sequence, a second fluid pressure operated electric switch for starting and stopping the motors, the pressure operated element of said electric switches being connected to a fluid pressure system and responsive to variations of pressure therein, the pressure operated element of one of said electric switches being set to operate at a different pressure than the other one whereby an idle motor is started under abnormal conditions while the other motor is running.
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