

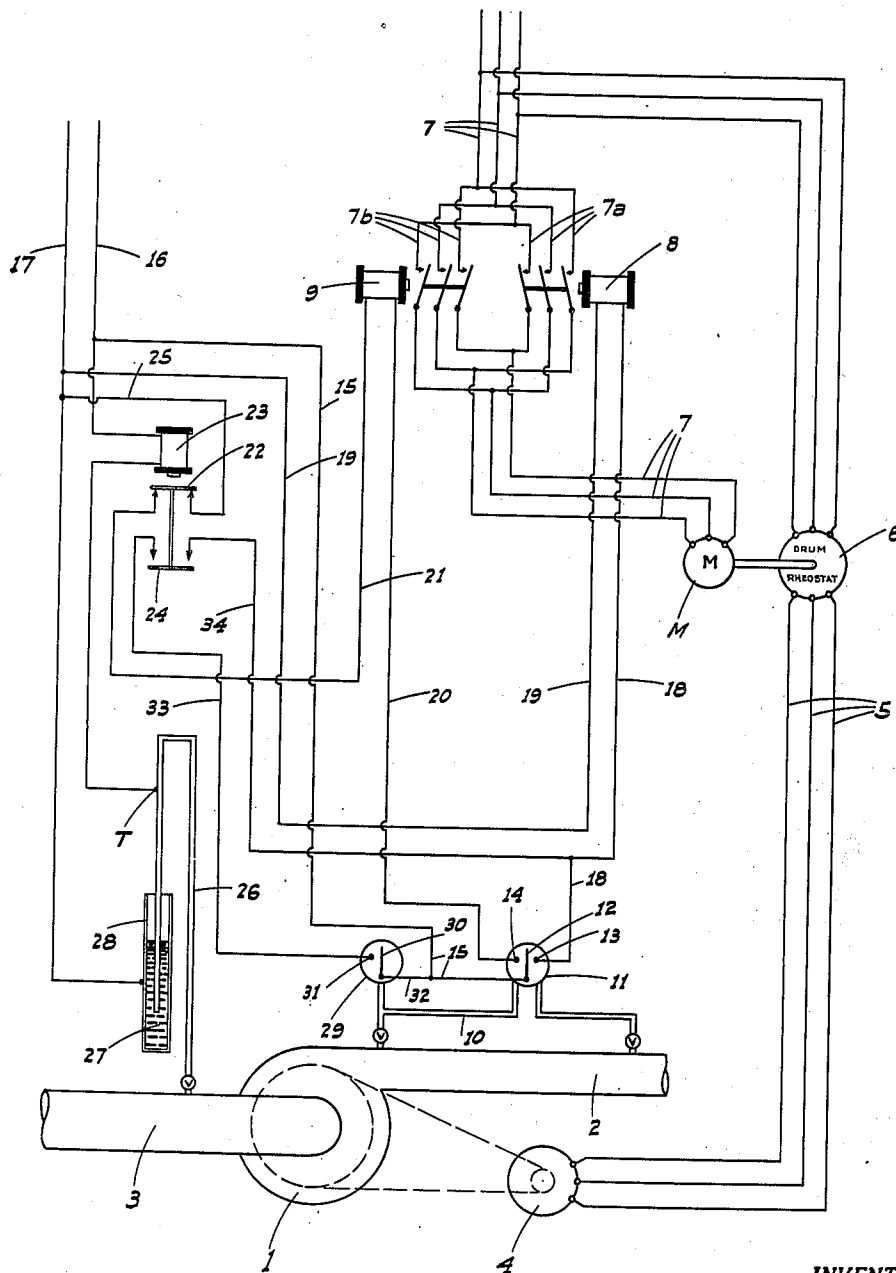
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SUCTION DREDGE PUMP CONTROL SYSTEM

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SUCTION DREDGE PUMP CONTROL SYSTEM

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This invention relates in general to a suction dredge pump control system, and in particular the invention is directed to—and it is my principal object to provide—a system for automatically controlling the speed of a dredge pump for the purpose of maintaining a constant velocity of the material being pumped through the discharge pipe; this automatic control system being actuated through the medium of a switch unit arranged in combination with a flow or velocity meter connected in communication with said discharge pipe of the pump.

Another object of the invention is to provide a system, of the type described, which is operative to automatically speed up the pump motor when the velocity in the discharge pipe decreases a predetermined amount, and to slow down such motor if the velocity in such pipe increases a predetermined amount.

It is also an object of the invention to provide means to "lock" the system and particularly to prevent operation thereof to raise the speed of the pump when a velocity decrease in the discharge pipe is due to plugging of the suction pipe and resulting vacuum therein; there being other means included which are arranged to circumvent such a "locked" condition of the system and to reduce the pump speed if the plug or the like does not promptly clear and the vacuum increases to a critical point on the suction side of the pump and the pressure on the discharge side drops correspondingly.

A further object of the invention is to produce a simple and inexpensive pump control system and yet one which will be exceedingly effective for the purpose for which it is designed.

These objects I accomplish by means of such structure and relative arrangement of parts as will fully appear by a perusal of the following specification and claims.

The figure of the drawing is a diagrammatic illustration of the system and included circuits.

Referring now more particularly to the characters of reference on the drawing, the numeral 1 indicates the pump of a suction dredge; such pump being arranged at the outlet side with a discharge pipe 2 and provided with a suction pipe 3, all as is usual. The pump 1 is driven in suitable manner by means of an electric motor

4. Current is supplied to motor 4 through a three phase circuit, indicated generally at 5, and which circuit has a master controller such as a drum rheostat 6 interposed therein. This rheostat controls the speed of pump motor 4, and the rheostat is driven in one direction or the

other by a suitable connected reversible motor M. The motor M is energized through a three phase circuit 7 including reversing circuit portions 7a and 7b; these circuit portions having normally open relays 8 and 9 respectively interposed therein.

The discharge pipe 2 of the dredge pump 1 is provided with a relatively small diameter pipe 10 which is tapped into and extends longitudinally from point to point therein. A flow or velocity meter 11 is interposed in pipe 10, and this meter includes a switch having a movable switch arm 12 connected with the meter shaft and switch contact points 13 and 14 disposed on opposite sides of switch arm 12; such points preferably being adjustable in a direction toward or away from the arm. When the velocity in the discharge pipe 2 is normal, the switch arm 12 is free of the contact points, as shown.

The switch arm 12 is connected by a wire 15 with one wire 16 of a two wire current supply circuit including said wire 16 and another wire 17. A wire 18 leads from contact point 13 to one terminal of the coil of relay 8, while the other terminal of said coil is connected by a wire 19 with current supply wire 17.

Contact point 14 is connected by a wire 20 with one terminal of the coil of relay 9; the other terminal being connected with a wire 21 which leads to one side of a switch 22 which is included in an opposed switch relay 23; said relay having another switch 24 associated therewith. Switch 22 is normally closed and switch 24 normally open for the reason which will hereinafter appear. The other side of switch 22 is connected by a wire 25 with supply wire 17.

When the velocity of the material being pumped through discharge pipe 2 remains within a predetermined normal range, switch arm 12 on the velocity meter 11 remains clear of contact points 13 and 14. However, if the velocity increases beyond such normal range, contact arm 12 moves into engagement with contact points 13. This closes the energizing circuit (wires 15, 18 and 19) for relay 8 resulting in actuation of said relay and closing of the corresponding switch thereof in the portion 7a of three phase circuit 7. With circuit 7 closed through portion 7a, motor M revolves to actuate rheostat 6 in a direction to reduce the speed of pump motor 4 and pump 1 whereupon the velocity in pipe 2 decreases to its normal range. When this occurs, switch arm 12 breaks from contact 13 opening relay 8 and stopping motor M.

If the velocity in pipe 2 decreases to below the

normal range, contact arm 12 closes with contact point 14 energizing relay 9 (through wires 15, 20, 21, switch 22, and wire 25); the relay 9 in turn closing portion 7b of circuit 7. Motor M then actuates rheostat 6 in a direction to speed up pump motor 4 and pump 1 so as to return the velocity in pipe 2 to its normal range.

In the event that the suction pipe 3 should plug, as frequently occurs, the velocity in pipe 2 will decrease but in such event means must be provided so that the pump will not automatically speed up as would otherwise occur in the above described system. The resulting vacuum in suction pipe 3 would cause serious damage if the pump speeded up when a plug occurs. To prevent such speeding up under such circumstances, I provide the following control means in the system.

A mercury type manometer is connected with suction pipe 3 and includes a dielectric tube 26 having one end projecting into a mercury supply 27 in a reservoir 28. The current supply wires 16 and 17 lead to the tube and reservoir respectively, and wire 16 includes a terminal T on tube 26 above reservoir 28 and with which terminal the mercury 27 can make contact if it rises sufficiently in said tube. The coil of relay 23 is connected in series in wire 16 ahead of the manometer.

If the vacuum in suction pipe 3 becomes excessive, the mercury rises in tube 26 and closes the circuit between wires 16 and 17, which energizes relay 23 and opens switch 22 thereof. This breaks the circuit for relay 9 and even though contact arm 12 is in engagement with contact point 14, the relay 9 cannot function to cause the pump motor to speed up. In other words, the pump motor speed is "locked" if excessive vacuum occurs in pipe 3 and even though the discharge pipe velocity has dropped to a point where speeding up of the pump motor and pump would otherwise occur.

If the cause of the excessive vacuum in pipe 3 does not promptly relieve, it is desirable that the speed of the pump motor and pump be decreased, in order to assure safe operation. This is accomplished as follows:

A pressure gauge 29, including a pressure actuated switch arm 30 and a contact point 31, is connected with pipe 10; the arm 30 normally being clear of contact point 31. A wire 32 connects arm 30 with wire 15, while another wire 33 leads from contact point 31 to one side of switch 24 of relay 23. The other side of switch 24 is connected by a wire 34 with wire 18 in the "reduce speed" circuit.

The pressure gauge 29 is set so that if the pressure in pipes 2 and 10 drops to a predetermined amount by reason of excessive and continued vacuum in suction pipe 3, switch arm 30 closes with contact point 31. As switch 24 is already closed due to the influence of such excessive vacuum on the manometer, as previously described, a circuit is now closed which energizes relay 8, causing the speed of pump motor 4 to be decreased. The pressure gauge circuit thus circumvents the aforesaid "locked" condition of the velocity meter automatic switching system. Of course, pressure gauge 29 is set so that its switching mechanisms 30 and 31 engage only under an extremely critical condition, and in no event until after the velocity meter switching system has been "locked" as above described.

From the foregoing description it will be readily seen that I have produced such a pump control

system as substantially fulfills the objects of the invention as set forth herein.

While this specification sets forth in detail the present and preferred construction of the pump control system, still in practice such deviations from such delay may be resorted to as do not form a departure from the spirit of the invention, as defined by the appended claims.

Having thus described my invention, what I claim as new and useful and desire to secure by Letters Patent is:

1. In combination with a suction pump including a suction pipe and a discharge pipe, and a power drive for the pump; velocity responsive mechanism associated with the discharge pipe and operated by the velocity of the material passing through said pipe, means to control the speed of the power drive, other means connected between said mechanism and the control means and arranged to actuate the latter to vary the speed of the power drive inversely to and upon predetermined variation of the velocity of said material in the discharge pipe, a vacuum responsive mechanism associated with the suction pipe of the pump, instrumentalities between said vacuum responsive mechanism and said other means and arranged to prevent actuation of the latter upon operation of said vacuum responsive mechanism; said mechanism being operative only under the influence of predetermined excess vacuum in the suction pipe; a pressure responsive unit associated with the discharge pipe, and separate means connected with said unit and including said other means in part and arranged to actuate said control means to reduce the speed of the power drive upon predetermined drop in the pressure in the discharge pipe and irrespective of the operative condition of said instrumentalities.

2. In combination with a suction pump including a suction pipe and a discharge pipe, and a power drive for the pump; electrically actuated means to control the speed of the power drive, a circuit for said electrically actuated means, velocity responsive mechanism associated with the discharge pipe and operated by the velocity of material passing therethrough, said mechanism including a normally open switch, said switch being interposed in series in the circuit, and the mechanism being operative to close said switch upon a predetermined variation in the velocity of the material in said discharge pipe.

3. A combination as in claim 2 including a separate normally closed switch in the circuit, a vacuum responsive mechanism associated with the suction pipe, said mechanism including a normally open switch, an electrically actuated device arranged to open said separate switch, and another circuit connected between the normally open switch of the vacuum responsive mechanism and said electrically actuated device; said mechanism being operative to close its included switch only under the influence of predetermined excess vacuum in the suction pipe.

4. In combination with a suction pump including a suction pipe and a discharge pipe, and a power drive for the pump; means including a reversing motor adapted to control the speed of the power drive, a reversing circuit for the motor, said circuit including separate normally open relays, a separate energizing circuit for each relay, a velocity responsive mechanism associated with the discharge pipe and operated by the velocity of material passing through said pipe, said mechanism including a normally open switch unit, 75

said unit being interposed in said separate relay energizing circuits, and the mechanism being arranged to actuate the switch unit so as to close on relay energizing circuit or the other upon a predetermined decrease or increase in the velocity of the material passing through the discharge pipe.

5. In combination with a suction pump including a suction pipe and a discharge pipe, and a power drive for the pump; means including a reversing motor adapted to control the speed of the power drive, a reversing circuit for the motor, said circuit including separate normally open relays, a separate energizing circuit for each of said relays, a velocity responsive mechanism associated with the discharge pipe and operated by the velocity of the material passing through said pipe, said velocity responsive mechanism including a normally open switch unit, the unit being interposed in the relay energizing circuits, and said velocity responsive mechanism being arranged to actuate the switch unit and close one relay energizing circuit or the other upon a predetermined increase or decrease respectively in the velocity of the material passing through the discharge pipe, closing of said one relay energizing circuit effecting an increase in the speed of the power drive, a third relay, said relay being normally closed and interposed in said one circuit, a vacuum responsive mechanism associated with the suction pipe of the pump, said vacuum responsive mechanism including a normally open switch, and a separate energizing circuit for said third relay, the normally open switch of the vacuum responsive mechanism being interposed in said separate energizing circuit and said mechanism being operative to close its included switch, to effect opening of said third relay, only under the influence of predetermined excess vacuum in the suction pipe.

6. A combination as in claim 5 in which said third relay includes opposed switches, the normally closed switch being the one interposed in said one circuit; a pressure responsive mechanism connected with the discharge pipe, said pressure responsive mechanism including another normally open switch, a by-pass circuit circumventing the switch unit actuated from the velocity responsive mechanism and connected with the other of said relay energizing circuits, the normally open switch of said third relay and the other normally open switch included with said pressure responsive mechanism being interposed in said by-pass circuit, said pressure responsive mechanism being operative to close said other normally open switch only upon predetermined drop in pressure in the discharge pipe of the pump.

7. In combination with a suction pump having a discharge pipe, and a variable speed power drive for the pump; means arranged to alter the speed of the power drive in inverse relation to the velocity of material in said discharge pipe upon variation of such velocity from a predetermined normal, and other means arranged to prevent increase of the speed of said power drive by said first named means upon occurrence of excessive vacuum in the suction side of the pump above a predetermined normal.

8. A device as in claim 7 including separate

means arranged to reduce the speed of said power drive upon such excessive vacuum reaching a predetermined amount.

9. A device as in claim 7 including separate means arranged to reduce the speed of said power drive upon such excessive vacuum reaching a predetermined amount; said separate means being operative only subsequent to actuation of said other means.

10. A device as in claim 7 including separate means arranged to reduce the speed of said power drive upon such excessive vacuum reaching a predetermined amount; said separate means including a pressure responsive mechanism mounted in communication with said discharge pipe.

11. In combination with a suction pump including a suction pipe and a discharge pipe, a variable speed power drive for the pump, and control means to vary the speed of said drive; velocity responsive mechanism mounted in communication with the discharge pipe and operated by the velocity therein, other means responsive to said mechanism and connected between the same and said control means arranged to actuate the latter to vary the speed of the power drive in inverse relation to and upon predetermined variation of the velocity in said discharge pipe, a vacuum response mechanism mounted in communication with said suction pipe, and normally inactive instrumentalities between said vacuum responsive mechanism and said other means arranged to prevent the latter from actuating said control means to increase the speed of the motor, said instrumentalities being actuated by said vacuum responsive mechanism and only upon occurrence of excess vacuum in said suction pipe above a predetermined normal.

12. A device as in claim 5 including separate means associated with the pump and arranged to cause said other means to actuate said control means to decrease the speed of the pump, said separate means being operative only upon such excess vacuum reaching a predetermined amount.

13. In combination, a pump, a variable speed drive therefor, instrumentalities arranged to increase or decrease the speed of said drive in inverse relation to the velocity of the material being pumped, and means responsive to excess vacuum in the suction side of the pump above a predetermined normal to lock said instrumentalities to an extent to prevent actuation thereof to increase the speed of said drive.

14. In combination, a pump, a variable speed drive therefor, instrumentalities arranged to increase or decrease the speed of said drive in inverse relation to the velocity of the material being pumped, means responsive to excess vacuum in the suction side of the pump above a predetermined normal to lock said instrumentalities to an extent to prevent actuation thereof to increase the speed of said drive, and other means operative to effect actuation of said instrumentalities to reduce the speed of said power drive; said other means being operative only upon such excess vacuum reaching a predetermined amount above that required to operate said first named means.

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