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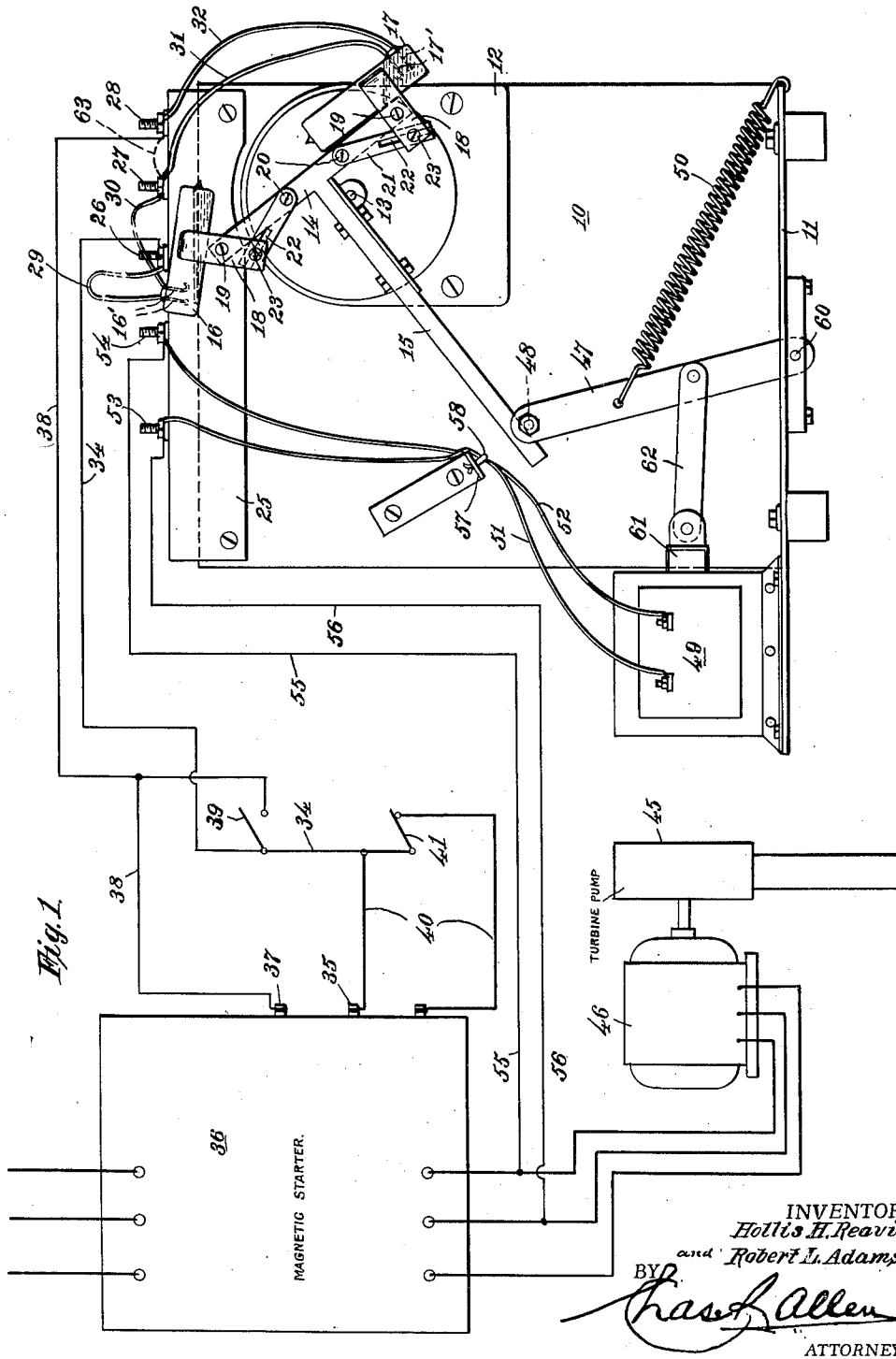
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AUTOMATIC DELAY STARTING AND LOCK-OUT SWITCH MECHANISM

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AUTOMATIC DELAY STARTING AND LOCK-OUT SWITCH MECHANISM

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This invention relates to an automatic delay starting and lock-out switch mechanism for controlling the operation of magnetic starters for electric motors; and particularly, the motors employed for driving the pumps in irrigation systems.

In many large areas, the water for irrigation is supplied from a plurality of wells which vary in depth, the water being delivered by motor driven pumps to irrigation ditches or canals from which it is drawn off and supplied to the fields by a series of siphon tubes. A sufficient number of such tubes is provided to siphon out the maximum amount of water supplied to the ditches or canals by the pumps.

The power for the pump motors is supplied over many miles of lines; and due to weather conditions, and/or other factors, the power to the pumps is frequently interrupted, causing the farmers, ranchers, and others, serious inconveniences and expense.

After an interruption of the power supply, the motors must be started as soon as possible after resumption of the supply to avoid having the water in the ditches drop below the siphon tubes which would require each of the many tubes to be reprimed.

The motors for driving the individual pumps are each provided with a magnetically actuated starter, usually controlled by a manually actuated switch of any suitable type; and the starters could be so wired that the several starters would all be actuated as soon as power on the line is resumed. However, this is impracticable as it would frequently result in serious damage to some of the motors and pumps. As soon as power has been interrupted, the pumps and motors start in reverse due to the water in the pump flowing back into the wells. It is obvious that this draining of the pumps takes a longer time in the deep wells than in the more shallow ones. This time factor in the several wells may vary from about thirty seconds to several minutes; and should the power be resumed before the pumps of the deeper wells have been fully drained and the reverse movement of the pumps and motors stopped, such pumps and motors would be seriously damaged. For this reason it has heretofore been necessary to have an attendant at each pumping station, which stations are frequently miles apart, to set into operation the pump under his care as soon as, but not before, the pump is fully drained. This is done by closing a switch in the circuit to the actuating coil of the magnetic starter. As such starters are old and well known in the art, specific details of the same are unnecessary.

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The object of the present invention is to provide an automatic delay starting mechanism at each pumping station which shall close the circuit to the magnetic starter when, and only when, the respective pump has been fully drained and the reverse movement of the pump and motor has stopped.

A further object of the invention is to provide a device of the class mentioned which shall be of comparatively simple construction, and which may be readily installed at relatively small cost.

A further object of the invention is to provide a device as mentioned which may be readily timed to coordinate the same to the time required to drain the pump with which it is installed.

A further object of the invention is to provide an automatic delay starting switch which will operate successfully irrespective of the number and frequency of the current interruptions.

Other objects will appear hereinafter.

With these objects in view, the invention comprises a tiltable timing arm upon which is mounted a pair of mercury switches, which are connected in series with each other and in series with the magnetic starter of a pump actuating motor with which the device is to be used. The mercury switches are angularly arranged with relation to each other so that when the timing arm is slowly tilted by suitable means releasable upon failure of power of the motor, both switches are closed for a predetermined time during the movement of the timing arm; but at or near the limit of movement in either direction, one of said switches is open. Should the power be resumed during the period when both of said switches are closed, the circuit to the motor starter will be completed, and the pump started into operation. Should the resumption of power be delayed until the arm has moved sufficiently to break the circuit in one of the switches, the motor will be locked out of operation until the circuit to the motor starter has been manually closed, as will be fully described hereinafter.

The invention further consists in means whereby the angular positions of the mercury switches may be readily adjusted in order to synchronize the period within which both switches remain closed to the time required to drain the pump of the well with which the device is to be used.

The invention further consists in means whereby the timer will be automatically reset as soon as power in the motor circuit is resumed.

The invention further consists in various details of construction and arrangement of parts, as will be described hereinafter and particularly pointed out in the claims.

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The invention will be more readily understood by reference to the accompanying drawings, forming a part of this specification and in which:

Fig. 1 is a front elevation of a switch mechanism embodying the invention, illustrating the several elements in their normal positions when the power current is on and the motor and pump in operation; together with a diagram of the circuits to the motor and the usual magnetic starter;

Fig. 2 is a similar elevation of the device, with the elements at the extreme opposite positions they may assume when the current is off;

Fig. 3 is an end view of the same, with the reset spring broken away;

Fig. 4 is a detail view illustrating the switch elements in an intermediate position, and

Fig. 5 is a detail sectional view illustrating the timing adjustment of the switches.

The mechanism comprising the invention may be mounted in any suitable manner, such as a vertical supporting panel 10 having a horizontal base 11. This may be made of sheet metal of suitable gauge; and the entire mechanism may be enclosed in a box or case which is not illustrated, as it forms no part of the present invention.

Secured to the panel 10 is a timing device which comprises a spring actuated clocking mechanism 12, and a timer shaft 13 upon which is fixed a preferably T-shaped member comprising a timing arm 14 and a depending reset arm 15.

Mounted upon the arm 14 is a pair of mercury switches 16 and 17, which will be hereinafter referred to as the "starting switch" and the "lock-out" switch, respectively. The switches 16 and 17 are each provided adjacent one end with the usual contacts 16' and 17'; and said switches are preferably arranged with these contact ends remote from each other.

The switches 16 and 17 are each supported in a clamp bracket 18 pivotally connected as by bolts 19, to the arm 14 adjacent the ends thereof, so that the angular positions of the switches may be adjusted to time the operation of the device, as will be more fully described hereinafter. Pivotaly connected to the arm 14 as by bolts 20, are brace arm 21 having slots 22 to receive bolts 23 which extend through the lower ends of the clamp brackets 18. It is obvious that by this arrangement the switches may be readily adjusted to the desired angle and securely clamped in position by tightening the several bolts.

Supported upon the panel 10 above the timing mechanism 12 is a bar 25, preferably of insulating material, and provided with terminals 26, 27, and 28. One contact of the timing switch 16 is connected by a flexible conductor 29 to the terminal 26, and the other contact thereof to the terminal 27 by a conductor 30. The contacts of the switch 17 are connected to the terminals 27 and 28 by flexible conductors 31 and 32 respectively.

The terminal 26 is connected by a line 34 to one terminal 35 of the magnetic starter 36, and the terminal 28 is connected to another terminal 37 of the starter by a line 38. A normally open, manually controlled switch 39 is shunted across the lines 35 and 38 for a purpose hereinafter described. A starter maintaining line 40 is provided with a normally closed switch 41 whereby the motor may be readily stopped when necessary while the power is on.

In the diagram included in Fig. 1, 45 indicates a turbine pump, and 46 a three phase motor for operating the same.

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The normal position of the timing arm 14 is as illustrated in Fig. 1, and the arm is held in this position by a reset mechanism. The reset mechanism comprises generally a reset lever 47 having a detent 48 for engaging the reset arm 15 of the timer, a solenoid 49 for normally holding the arm 15 in "set" position when the motor 46 is running, and a spring 50 for retracting the lever 47 when power to the motor is interrupted, thereby releasing the timing mechanism. The solenoid 49 is shunted across the motor circuit between the starter and the motor, as indicated in Fig. 1. Conductors 51 and 52 connect the solenoid to terminals 53 and 54 on the bar 25, and said terminals are connected across the motor circuit by lines 55 and 56. An arm 57 extends outwardly from the panel 10 constituting a safety stop for the reset arm 15; and the conductors 51 and 52 leading from the solenoid 49 to the terminals 53 and 54 extend through a supporting loop 58 on said arm.

The reset lever 47 is pivotally mounted on the base, as at 60, and is connected to the movable core 61 of the solenoid 49 by a link 62.

The operation of the device is as follows: When the power to the motor is on, the magnetic starter is maintained in closed position by the usual magnetic coil, the circuit of which includes the maintaining line 40. As such starters are of various well known designs, and as the details of the starter constitute no part of the present invention, detail description and illustration thereof is believed to be superfluous. Also, when the motor is in operation the solenoid 49 is energized, thereby maintaining the reset lever 47 in position to hold the timing mechanism in inoperative position, as illustrated in Fig. 1. As soon as the current to the motor is interrupted to solenoid 49 is de-energized and the spring 50 retracts the reset lever into the position illustrated in Fig. 2. This permits the timing mechanism to start moving the T-shaped member 14—15 slowly in a counterclockwise direction.

It will be noted that initially the contacts 17' in the lock-out switch 17 are closed by the mercury therein, whereas the contacts 16' in the starter switch 16 are open. As the movement of the arm 14 continues the timer switch is tilted until the mercury therein engages the contacts 16', closing the switch and connecting the two switches 16 and 17 in series with each other, and in series with the magnetic starter.

Fig. 4 illustrates a position where both switches are closed.

Should the power be resumed while both switches 16 and 17 are closed, the magnetic starter will be energized, closing the circuit to the motor and starting the pump into operation.

As soon as the motor is started the solenoid 49 will be energized thereby quickly throwing the lever 47 into initial position; and the detent 48 thereon will engage the arm 15 and restore the timing mechanism to normal position and at the same time rewind the clock-work timing mechanism.

Should the current remain "off" until the lock-out switch 17 has moved into position to open the same, the mechanism will be locked so that the motor cannot start upon resumption of power until the switch 39 is manually closed. This is necessary, as when the pumps are inactive for a longer period than timed by the switches, it is likely that the siphon tubes will need repriming before the pumps are started; and should the pumps start working automatically without the

owner or attendant having knowledge of the conditions, considerable damage would usually be incurred.

It is necessary when power to a turbine pump motor fails, that the power shall not be restored to the motor until the water has completely drained from the pump, and all reverse movement of the pump and motor has ceased, as herebefore explained. Also it is necessary to start the motor as soon as possible after the power has been resumed. Therefore each of the starting mechanisms must be timed according to the depth of the well with which it is used. It is for this purpose that the mercury switches are mounted for angular adjustment on the timer arm 14. By this arrangement the length of time that the contacts of both tubes remain simultaneously closed may be nicely regulated. After the solenoid has been de-energized, it takes approximately ten minutes for the reset arm 15 to be moved by the spring mechanism from the position shown in Fig. 1 to that shown in Fig. 2; and as the time necessary to drain the pumps varies from about thirty seconds to approximately four minutes, a proper adjustment of the device for use with a specific well may readily be made.

The manner of adjusting a switch is illustrated in Fig. 5.

When the device is once timed, no further adjustment is necessary. The time desired for closing the starting switch 16 will average about one and a half minutes; and the average time for opening the lock-out switch 17 will vary from about six to nine minutes. In cases where a lock-out is not necessary, a connection or jumper may be provided to connect the terminals 27 and 28. Such connection is indicated by dotted line 63 in Fig. 1.

While a specific form of the invention has been illustrated and described, it is to be understood that various changes may be made therein without departing from the invention as defined in the accompanying claims.

We claim:

1. In an irrigation system, a turbine pump, a motor for actuating said pump, and a magnetic starter for said motor, in combination with control mechanism for said starter comprising a tiltable member, clockwork timing mechanism for actuating said tiltable member, a pair of mercury switches mounted on said tiltable member and connected in series with each other, and in series with said starter, a solenoid shunted across the motor circuit normally holding said tiltable member in position to maintain one of said switches in closed position, and the other switch in open position, spring means operable upon failure of current in said starter and said solenoid for releasing said tiltable member to permit said timing mechanism to gradually move said tiltable member to close the normally open switch and after a predetermined time to open the normally closed switch.

2. The combination as set forth in claim 1, further characterized by means for adjustably mounting said switches on said tiltable member.

3. The combination as set forth in claim 1, further characterized by a manually operable, and normally open, switch shunted across the circuit between said mercury switches and said starter.

4. In an irrigation system, a turbine pump, an electric motor for said pump and a magnetic starter for said motor, a timing shaft, escapement controlled spring actuated means for gradually rotating said shaft when released, a tiltable timing arm fixed to said shaft, a normally open starting switch and a normally closed lock-out switch, both of the mercury type and each adjustably mounted on said timing arm, said switches being connected in series with each other, conductors connecting said switches in series with said starter, a normally open manually operable switch shunted across said conductors, a reset arm extending rigidly from said timing arm, a pivotally mounted reset lever, a solenoid shunted across said motor circuit between said starter and said motor and adapted when energized to retract said reset lever, a detent on said reset lever adapted to engage said reset arm and hold said timing arm in normal position when said solenoid is energized, and a spring for retracting said reset lever and releasing said reset arm when said solenoid is de-energized.

5. In an irrigation system, a turbine pump, a motor for said pump, and a magnetic starter for said motor, in combination with control mechanism for said starter comprising a tiltable member, a pair of mercury switches mounted in said tiltable member and connected in series with each other and in series with said starter, one of said mercury switches comprising a lock-out switch and the other a starting switch, a solenoid shunted across the circuit to said motor for normally holding said tiltable member in position to maintain said locking switch closed, and the starting switch open, means operable upon failure of current in said motor and said solenoid for releasing said tiltable member, and means for gradually tilting said tiltable member to close said starting switch and to open said lock-out switch at a predetermined time thereafter.

6. The combination as set forth in claim 5, further characterized by a manually operable, normally open starting switch shunted across the circuit between said mercury switches and said magnetic starter.

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