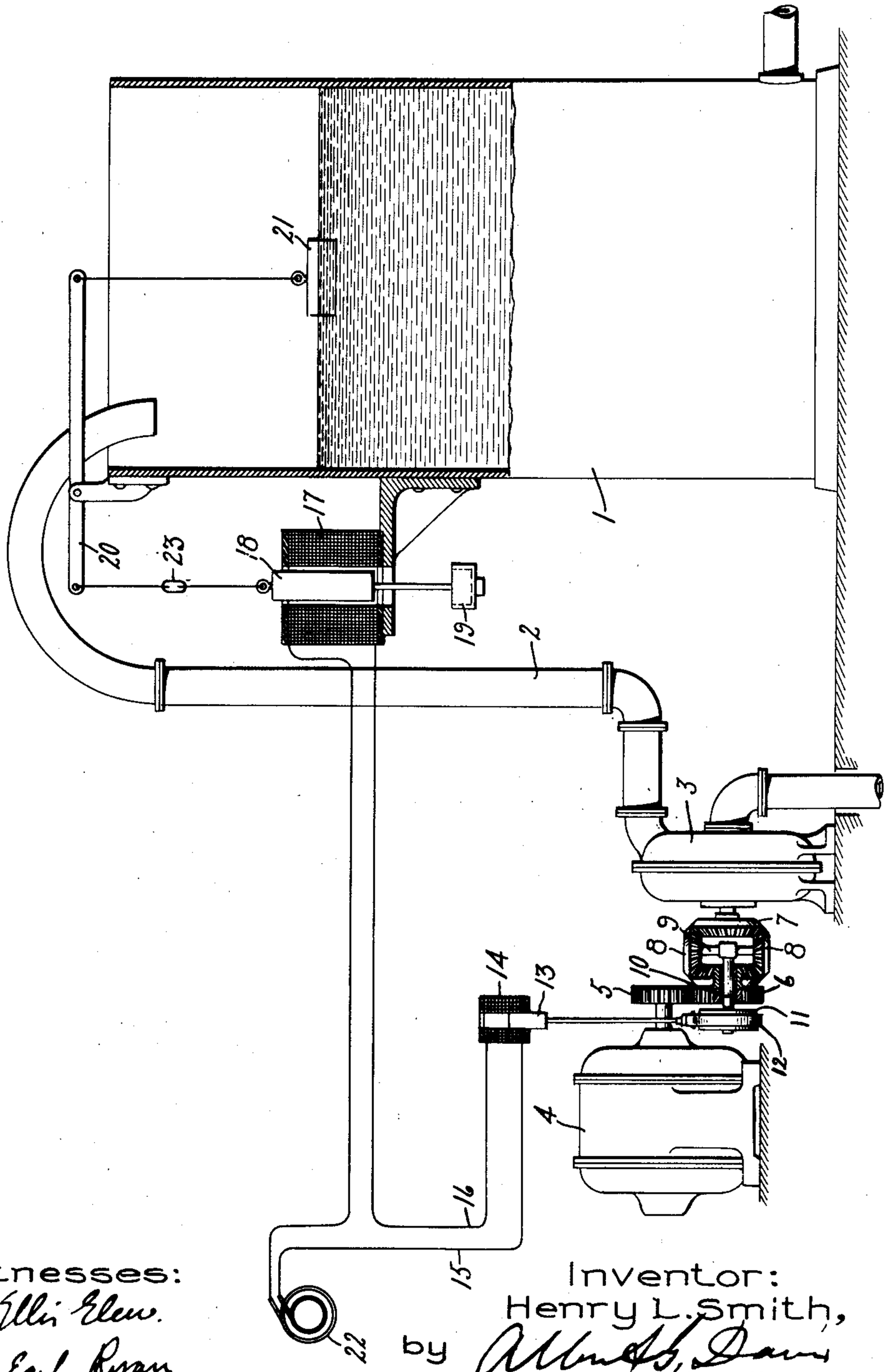
H. L. SMITH.

ELECTROMAGNETIC CONTROL SYSTEM.

APPLICATION FILED OCT. 27, 1909.

998,647. Patented July 25, 1911.



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UNITED STATES PATENT OFFICE.

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ELECTROMAGNETIC CONTROL SYSTEM.

998,647. Specification of Letters Patent. Patented July 25, 1911.

Application filed October 27, 1909. Serial No. 524,925.

To all whom it may concern:

Be it known that I, HENRY L. SMITH, a citizen of the United States, residing at Schenectady, in the county of Schenectady, State of New York, have invented certain new and useful Improvements in Electromagnetic Control Systems, of which the following is a specification.

My invention relates to means for controlling electromagnets energized by alternating current, and although capable of wide application relates more particularly to control systems in which the flow of current through an electromagnet must be frequently varied to a sufficient extent to control the action of the electromagnet, as, for example, in devices for automatically filling a tank from which fluid is drawn in large quantities and at frequent intervals.

Opening and closing of the highly inductive circuit of an electromagnet by means of separable contacts produces severe and destructive arcing at the contacts, and the object of my invention is to provide a simple and reliable control system in which the flow of current in an electromagnet may be controlled to the desired extent without using contacts and without opening the circuit through the electromagnet, which is particularly useful where an electromagnet must be frequently operated, and which when used in conjunction with a pump for supplying fluid to a tank and with an electromagnet for controlling the action of the pump furnishes a system of control which is particularly desirable where the amount of fluid in the tank is subjected to frequent and wide variations.

My invention will best be understood in connection with the accompanying drawing, which shows one of the various forms in which it may be embodied and which shows a mechanism for automatically maintaining a predetermined amount of liquid in the tank, parts of the mechanism being shown in section, and part of the electrical connections being diagrammatic.

Although my invention is capable of general application and may be embodied in many forms of control systems in which the flow of alternating current through an electromagnet is to be controlled, it is of particular value where the flow of current must be frequently varied and for purposes of illustration I have shown my invention embodied in a system for automatically controlling the level of water or other liquid in a tank 1, to which the liquid is supplied through a delivery pipe 2 of a centrifugal pump 3. The impeller of the pump may be driven from any suitable source of power and through any suitable driving mechanism, but in the preferred construction a continuously running synchronous motor 4, supplied from any suitable circuit, is connected to the impeller of the pump 3 through gearing, such as the pinion 5 in mesh with a pinion on a bevel gear 6 mounted coaxially with a corresponding bevel gear 7 keyed to the impeller of the pump 3, the two bevel gears being in mesh with pinions 8, which are rotatably mounted on a cross bar 9 supported on one end of a shaft 10, which extends through the gear 6 and carries on the other end a friction disk 11. In this form of gearing, the gear 6 and pinions 8 will rotate without producing any rotation of the impeller of the pump 3 as long as the friction disk 11 is free to turn, but if by any suitable means the friction disk 11 is held stationary, the pinions 8 are also held stationary and transmit the rotation of the gear 6 to the gear 7, and consequently the impeller of the pump 3 is driven by the motor 4 whenever the friction disk 11 is held stationary. The motor and gearing constitute a driving mechanism in which holding or releasing the friction disk 11 will start and stop the pump.

In accordance with my invention, the pump 3 is started and stopped by means of any suitable holding device for the friction disk 11, such as a band brake 12 mounted in position to engage the friction disk and actuated to grip the disk by the core 13 of a controlling electromagnet 14, which is supplied with alternating current through the leads 15 and 16, by which it is connected to any suitable source of alternating current. The pump is started by energizing the electromagnet 14, which lifts the core 13 and thereby causes the band brake to grip the friction disk 11, while the pump is stopped by decreasing the current through the electromagnet to such a point that the magnet is deënergized and the core drops, opening the band brake and moving it out of engagement with the friction disk, there-

by permitting the driving mechanism to run free while the impeller of the pump remains stationary.

The circuit through the electromagnet 14 is highly inductive, and there are objections to controlling the electromagnet by opening and closing the circuit, consequently the amount of current which flows through the electromagnet 14 is varied to the extent necessary to secure the required control by varying the amount of impedance in the circuit of the electromagnet, the impedance being so proportioned that the current can be cut down to such an amount that the core 13 drops and opens the band brake, thereby leaving the friction disk free to rotate, or the current can be increased to such an amount that the core 13 and brake shoe 12 are lifted into engagement with the disk 11 and hold it with sufficient force to enable the motor 4 to drive the pump, this variation being thereby obtained without opening or closing the circuit of the electromagnet. The impedance of the circuit of the electromagnet 14 may be varied in any suitable way and by any suitable form of variable inductance, such as a coil 17 connected in series with the electromagnet 14 in the lead 16 of the supply circuit and having an iron core 18 in inductive relation to the coil 17, the coil and core being relatively movable and so proportioned that when in one extreme position the inductance of the circuit of the electromagnet 14 is so great that the current is cut down to such an amount that the core 13 drops, while the coil 17 and core 18 in the other extreme position permit enough current to flow through the electromagnet 14 to hold the friction disk 11 against rotation, while any desired amount of current between these extremes may be obtained by properly positioning the coil 17 and core 18.

Since the circuit of the electromagnet 14 is not opened and closed, and hence no difficulty is experienced by arcing at separable contacts, the system of control embodying my invention is particularly applicable for automatic operation, and this result is easily obtained by automatically controlling the position of the core 18 with relation to the coil 17. Merely for purposes of illustration, I have shown in the drawings means controlled by the level of the liquid in the tank 1 for automatically controlling the amount of inductance in the circuit of the electromagnet 14, and in the specific form of mechanism shown the core 18 is movably mounted in the winding 17, and sudden variations in its position are prevented by means of some suitable damping device, such as a dash pot 19. The core is connected to one end of a lever 20, which is pivoted to the tank 1 and has the other end connected to a float 21, which moves up and down with changes in the level of the liquid in the tank 1. The float 21 is large enough to move the core 18 and the amount of inductance in the circuit of the electromagnet 14 depends upon the level of the liquid in the tank 1, which in turn is dependent on the driven member or impeller of the pump 3.

The coil 17 and electromagnet 14 are connected in series and may be energized from any suitable source of alternating current, and in order to make a complete diagram of the connections I have shown diagrammatically an alternator 22 for supplying alternating current to the leads 15 and 16, the electromagnet 14 being connected to the alternator 22 to form a closed circuit which contains a variable inductance formed by the winding 17 and core 18.

The normal position of the core 18 in relation to the coil 17 may be adjusted in any suitable way, such as a turnbuckle or similar device 23 in the connection between the core 18 and the lever 20, by means of which the relation of the core 18 to the float 21 may be varied at will.

The operation of the device is as follows: With the parts in the position shown in the drawing, the liquid in the tank 1 is at the desired level, the core 18 is in such relation to the winding 17 that the impedance of the circuit containing the electromagnet 14 is the maximum, and there is not enough current flowing through the electromagnet 14 to maintain the brake shoe 12 in engagement with the friction disk 11, consequently the impeller of the pump 3 is stationary and the driving mechanism is running free. As the level of the liquid in the tank 1 falls, the core 18 is lifted out of the winding 17, whereupon the impedance in the circuit of the electromagnet 14 is gradually decreased, while at the same time the amount of current flowing through the electromagnet is gradually increased. Eventually a point is reached where the amount of current flowing through the electromagnet 14 is sufficient to lift the core 13, thereby causing the band brake to grip the friction disk 11 and prevent further movement of the disk 11, whereupon the motor 4 begins to drive the impeller of the pump 3 and more liquid is pumped into the tank 1. As the level of the liquid in the tank rises, and the core 18 returns to the position shown in full lines, the impedance of the circuit increases until the electromagnet 14 is no longer able to hold the band brake 12 in position to grip the friction disk 11 and the band brake opens up, whereupon the pump stops. This action may be repeated very rapidly and very frequently without injury to any part of the control circuit, since the circuit of the electromagnet 14 is never opened and there are no contacts to be destroyed by severe arcing.

By properly proportioning the parts, the

electromagnet 14 may be energized from the same circuit which supplies the synchronous motor 4. The continuously running synchronous motor is not a disadvantage, because such a motor acts as a rotary condenser and improves the power factor of the system of distribution.

In its broadest aspect my invention is applicable to any control system in which an alternating current electromagnet is to be energized and deënergized at will, and is particularly applicable to an automatically controlled system in which the driven member, such as the impeller of the pump 3, is to be automatically started and stopped, and since the invention may be embodied in many other forms than that shown and described, I do not desire to limit myself thereto, as various modifications thereof will suggest themselves to those skilled in the art without departing from the spirit and scope of my invention as set forth in the annexed claims.

What I claim as new and desire to secure by Letters Patent of the United States, is—

1. The combination with a tank, of a pump for delivering fluid to said tank, a continuously running motor normally disconnected from the pump, an electromagnet arranged to effect a driving connection between the motor and the pump, an alternating current circuit connected to said electromagnet, and means controlled by the fluid in said tank for automatically varying the impedance of said circuit and thereby controlling said electromagnet.

2. The combination with a tank, a pump for delivering fluid to said tank, a motor, and gearing between said motor and said pump, of an electromagnet coöperating with said gearing to start and stop said pump, an alternating current circuit connected to said electromagnet, and means controlled by the fluid in said tank for automatically varying the impedance of said circuit and thereby controlling said electromagnet.

3. The combination with a tank, a pump for delivering fluid to said tank, and driving mechanism for said pump, of an electromagnet for controlling said mechanism to start and stop said pump, an alternating current circuit connected to said electromagnet, a winding connected in series with said electromagnet, an iron core movably mounted in inductive relation to said winding, and means actuated by the fluid in said tank to move said core and thereby control said electromagnet.

4. The combination with a tank, a pump for delivering liquid to said tank, and driving mechanism for said pump, of an electromagnet coöperating with said mechanism to start and stop said pump, an alternating current circuit connected to said electromagnet, a winding connected in series with said electromagnet, an iron core movably connected in inductive relation to said winding, and a float in said tank connected to said core to move it relatively to said winding and thereby vary the impedance of said circuit to energize and deënergize said electromagnet.

In witness whereof, I have hereunto set my hand this 22nd day of October, 1909.

HENRY L. SMITH.

Witnesses:

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