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ELECTRIC REGULATOR

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Fig. 1.

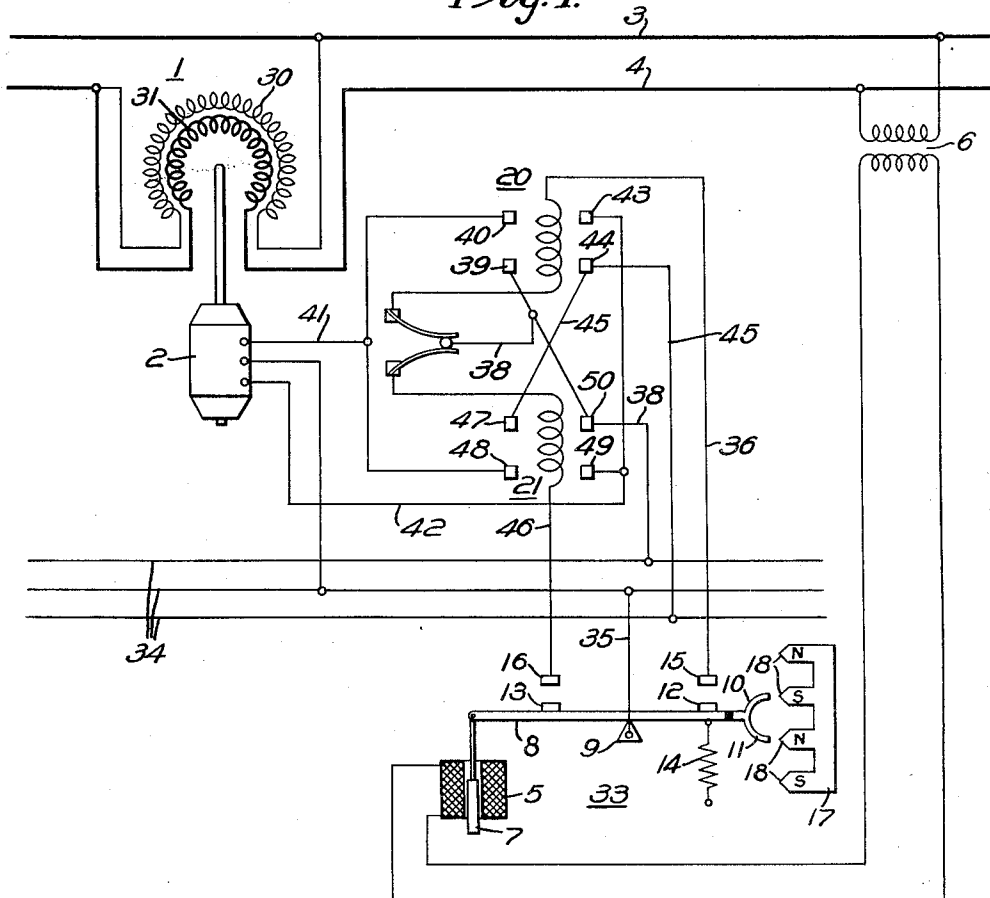
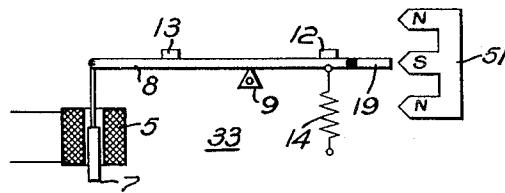


Fig. 2.



WITNESSES:

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ELECTRIC REGULATOR

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2 Claims. (Cl. 200—98)

My invention relates to electric regulators and particularly to contact making relays therefor, and has application to primary relays for use with induction regulators, although it is not limited to such use.

Primary relays used for controlling electric regulators comprise an armature or contact carrying arm that is operated by a solenoid energized in accordance with the electric quantity to be regulated, and which operate circuit closing contact members and mechanism controlled thereby for returning the regulated quantity to its desired value upon variations therefrom. Since the regulated quantity varies gradually, it is frequently desirable to have some device which provides for positively operating the contact members to insure a definite make and break of the circuits controlled thereby. It is customary to employ electromagnets energized by a circuit through the contacts of the relay. These, however, are not energized until the relay contact members close in the one or the other direction.

It is an object of my invention to provide a means for closing and interrupting the control circuits of a regulator that is simple in construction, efficient and reliable in operation, and low in cost.

Another object of my invention is to provide means that is positive in operation for causing the engagement and separation of the contact members that govern regulator control circuits.

Other objects of my invention will become evident from the following detailed description, taken in conjunction with the accompanying drawing, in which:

Figure 1 is a diagrammatic illustration of apparatus and circuits arranged in accordance with one embodiment of my invention; and

Fig. 2 is a view of a portion of a modified form of the primary relay shown in Fig. 1.

While the present invention may be adapted to other uses, it is particularly useful, as shown in Fig. 1, for controlling the operation of an induction regulator 1 comprising a primary or stator winding 30 connected between the conductors 3 and 4 of a circuit to be regulated, and a secondary or rotor winding 31 connected in series with one of the conductors 4 and inductively related to the primary winding. The position of the rotor winding is determined by operation of a motor 2. A primary relay 33 is provided to actuate secondary relays 20 and 21 to control the operation of the motor 2 in accordance with variations of a regulated quantity, such as voltage, of the circuit 3—4 for the purpose

of causing the regulator 1 to maintain the voltage of circuit 3—4 substantially uniform at a desired value. The relay 33 comprises a main actuating coil or solenoid 5 that is connected, preferably, as here shown, through a transformer 6 to the conductors 3—4 of the regulated circuit. The degree of energization of the solenoid 5 depends on the value of the voltage in the circuit 3—4. Cooperating with the solenoid 5 is a movable core 7 that is actuated thereby and is suspended from one end of a lever 8, that is pivotally supported at 9. The other end of the lever 8 is provided with pole pieces 10 and 11 of magnetizable material. The lever 8 carries contact members 12 and 13, that cooperate with the stationary contact members 15 and 16, respectively, to close motor control circuits for operating the motor 2 in the one or in the other direction. A spring 14 is attached to the lever 8 and partially overcomes the effect of the downward pull caused by the weight of the core 7, which is pulled upwardly by the magnetic action of the coil 5. The tension of the spring is so adjusted that the lever will be in its illustrated or open circuit position when the voltage of the circuit 3—4 is at its desired value. Adjacent the armature pole pieces 10 and 11, a stationary permanent magnet 17, having two or more poles 18, is so disposed as to cooperate with the moving armature poles 10 and 11. If the armature pole pieces 10 and 11 are disposed adjacent two of the poles 18 of the stationary magnet 17 the magnet will hold the armature against movement from that position until an appreciable moving force is obtained, at which time, the armature poles 10 and 11 will slip to the next set of stationary poles 18. If the lever 8 is in one of its stable positions, such, for example, as the illustrated or open circuit position of the relay, and a force is exerted sufficient to move it to its next stable position, it will, as soon as the pole pieces 10 and 11 are moved sufficiently from one position, be positively biased to the next position. For example, if the right hand end of the lever 8 is moved in either direction away from its mid-position sufficiently to overcome the attraction of the two central poles of the magnet 17 for the pole pieces 10 and 11 they will be attracted by a pair of end poles of the magnet, thus forcing the lever 8 into one of its circuit closing positions. This action gives a very definite movement of the contact carrying lever 8 from a gradually varying force, and insures the necessary pressure between cooperating contact members.

In the operation of the primary relay 33, the

varying voltage between conductors 3 and 4 causes the coil 5 to exert a varying pulling force upon the core 7 tending to rotate the lever 8 about the pivot 9 in a clockwise direction and the weight of the core tends to cause its rotation in the opposite direction, so that the one or the other of the contact members 12 or 13 is caused to engage its associated stationary contact member 15 or 16. The movable armature poles 10 and 11 will be attracted by the stationary poles 18 of the permanent magnet 17, and upon engagement of one pair of contact members the lever 8 is biased to force the movable contact member into positive engagement with its cooperating stationary contact member until the regulating force causes an opposite movement of the lever 8.

The stationary and movable contact members 12, 13 and 15, 16, respectively, upon engagement and separation, control circuits for effecting the energization of the control windings of the two secondary relays 20 and 21 which, in turn, control the direction of rotation of the motor 2. The current for energizing the windings and for the operation of the motor may be derived from any suitable source, as, for instance, from the supply conductors 34.

Upon engagement of the contact members 12 and 15, a circuit is closed that may be traced from the middle supply conductor 34, through conductor 35 to lever 8, through contact members 12 and 15, conductor 36, the operating winding of the relay 20 and conductor 38 to the upper supply conductor 34. The above traced circuit, when energized, causes the relay 20 to close a circuit to operate the motor 2 in a voltage increasing direction. This circuit may be traced from the upper phase conductor 34, through conductor 38, contact members 39 and 40 of the relay 20, and conductor 41 to the upper terminal of the motor 2, and from the lower motor terminal through conductor 42, contact members 43 and 44 of the relay 20 and the conductor 45 to the lower phase conductor 34. The middle phase conductor 34 is permanently connected to the middle terminal of the motor 2.

Similarly, engagement of the primary relay contact members 13 and 16 closes a circuit that causes the secondary relay 21 to close, which may be traced from the middle phase conductor 34, through conductor 35, contact members 13 and 16, conductor 46, the winding of relay 21 and by

conductor 38 to the upper phase conductor 34. Upon closing of the relay 21, a circuit is completed from the lower phase conductor 34, through conductor 45, contact members 47 and 48 of the relay 21, and conductor 41 to the upper motor terminal, and from the lower motor terminal, through conductor 42, the contact members 49 and 50 of the relay 21, and the conductor 38 to the upper phase conductor 34, thus causing the motor 2 to operate in a voltage decreasing direction.

Fig. 2 shows the use of a relay lever having a single movable armature pole piece 19 instead of the two poles 10 and 11 used in Fig. 1. The cooperating magnet 51 is provided with three poles, instead of four as is the magnet 17 of Fig. 1. This construction may be used where a relatively small pull on the armature is required.

It is apparent that the illustrated means for making and breaking electric circuits by causing positive movement of the circuit controlling contact members may be applied to such contact members operated by a float valve, thermostat, variable pressure, or other similar device actuated by a gradually varying force.

It will be apparent to those skilled in the art that modifications may be made in the apparatus described without departing from my invention and I do not wish to be limited, except by the accompanying claims.

I claim as my invention:

1. A relay device comprising, in combination, a stationary contact, a movable contact adapted to co-operate therewith, electro-responsive means for actuating said movable contact, a magnetic pole piece carried by said means, and means comprising a permanent magnet having alternate north and south poles cooperating with said first-named pole piece to provide a positive make and break action for said contacts.

2. A relay device comprising, in combination, a stationary contact, a movable contact adapted to cooperate therewith, an armature for actuating said movable contact having a bifurcated end of magnetizable material, and means comprising a permanent magnet having a plurality of poles spacedly positioned along the line of travel of said bifurcated armature end in cooperative relation thereto to provide a positive engagement and separation of said device contacts.

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