D. LARSON.

ALTERNATING CURRENT CONTROLLER.

APPLICATION FILED OCT. 2, 1905.

1,011,212.

Patented Dec. 12, 1911.

2 SHEETS—SHEET 1.

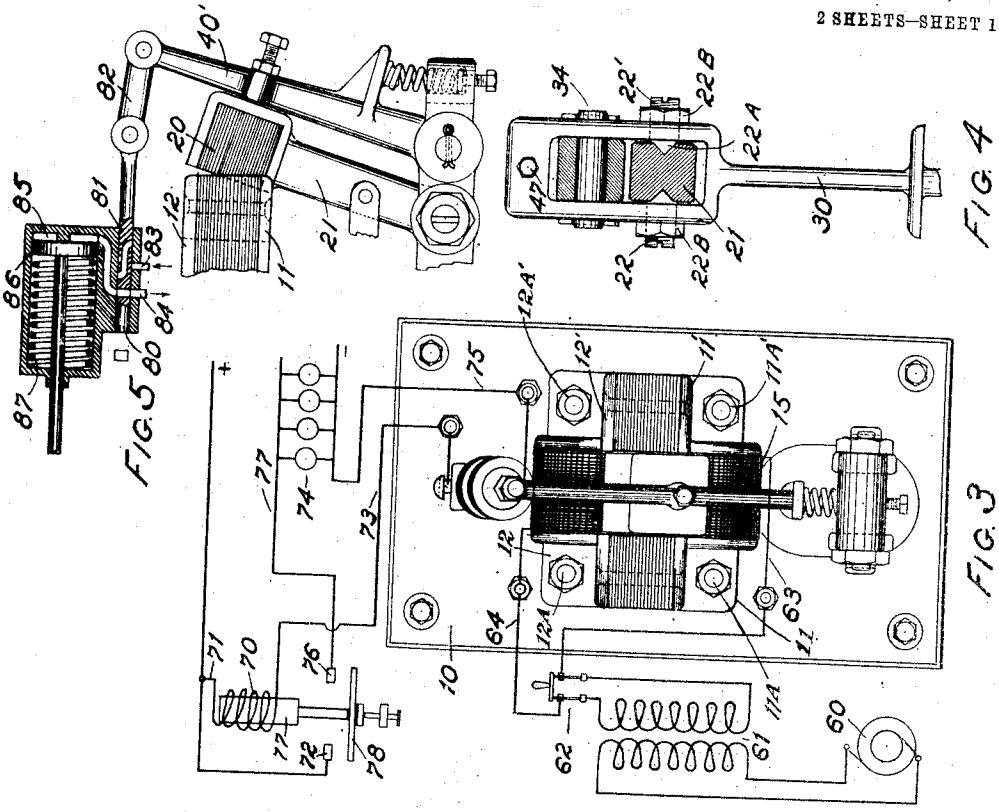

FIG. 4

FIG. 5

FIG. 3

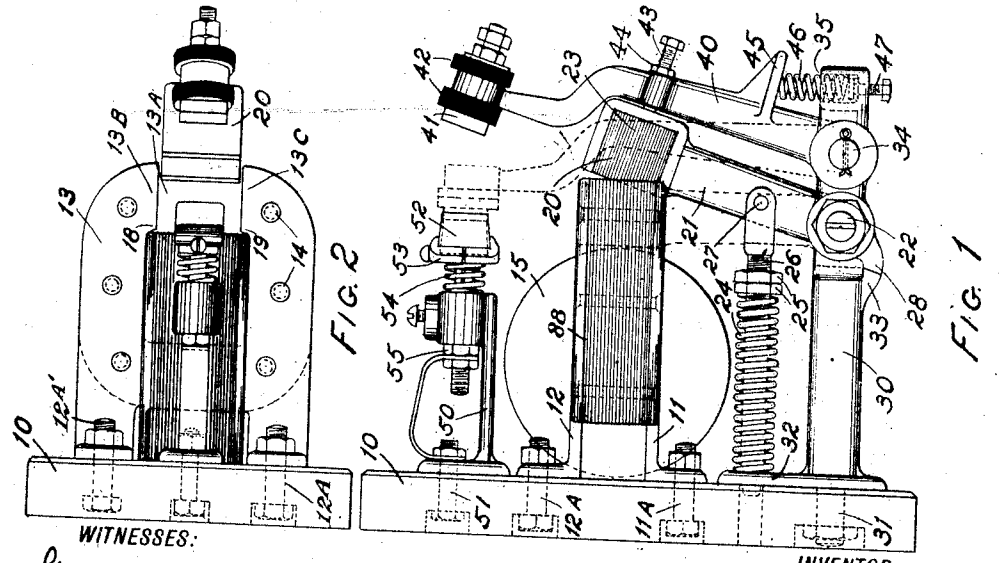

FIG. 2

FIG. 1

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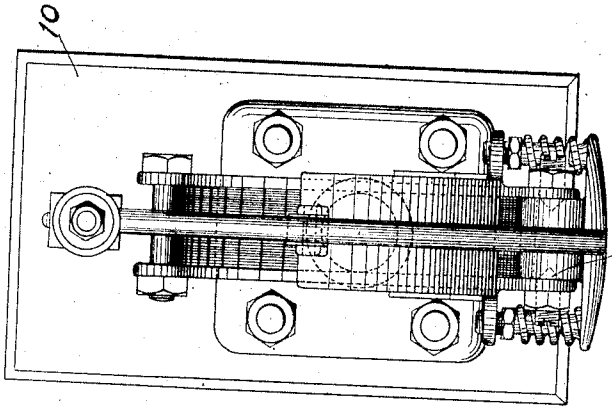

FIG. 7

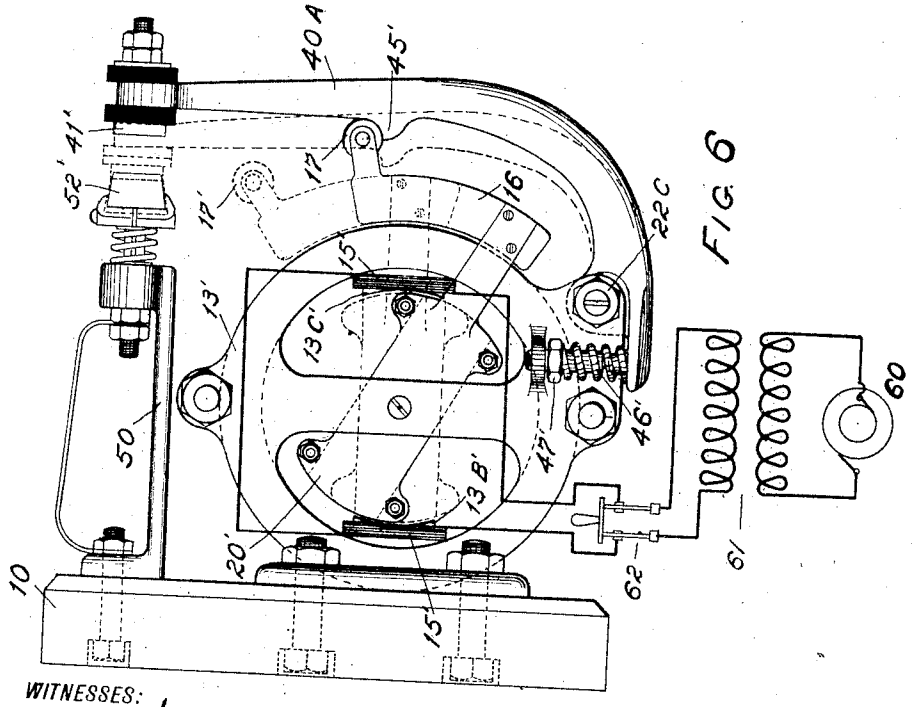

FIG 6

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ALTERNATING-CURRENT CONTROLLER.

1,011,212. Specification of Letters Patent. Patented Dec. 12, 1911.

Application filed October 2, 1905. Serial No. 280,976.

To all whom it may concern:

Be it known that I, DAVID LARSON, a subject of the King of Sweden, and a resident of the city of Yonkers, Westchester county, New York, have invented certain new and useful Improvements in Alternating-Current Controllers, of which the following is a specification.

My invention relates to an electro-magnetic switch or actuating device which is operated by alternating, intermittent or pulsating currents, without the vibrations or chattering which is usually present in apparatus of this kind.

I will describe my invention in the following specification, and point out the novel features thereof in claims.

Referring to the drawings, Figure 1 represents in side elevation a controller constructed according to my invention, and arranged to control a switch or circuit closer. Fig. 2 is a plan view of the apparatus shown in Fig. 1. Fig. 3 is a front elevation of the same apparatus with certain electrical circuits shown diagrammatically. Fig. 4 illustrates a detail of construction. Fig. 5 shows a portion of the device shown in Fig. 1, but arranged to control a valve. Figs. 6 and 7 are side and front elevations showing a modification of the invention.

Like characters of reference designate corresponding parts in all of the figures.

11, 11′ and 12, 12′ are bracket plates preferably of non-magnetic material which may be bolted rigidly to the base or support 10 by means of bolts 11^A, $11^{A'}$, and 12^A, $12^{A'}$. These sets of bolts are spaced apart to permit the magnet spool 15 to fit between the plates 11, 12, and 11′, 12′.

The electro-magnet designated as a whole by the reference number 13, comprises the winding spool 15 and the bundle of U-shaped laminations 88 on which the spool 15 is placed and wound with insulated wire, the projecting or exposed portions of the laminations being clamped between the plates 11, 12 and 11′, 12′ respectively. The covered portion of the laminations constitutes the core of the electro-magnet and the outside portions the poles which in this instance extend forwardly from the board 10. These extensions are preferably curved so that their ends face each other across the space 13^A. Two magnet poles 13^B, 13^C are thus formed with the gap 13^A between the faces of the same.

Movable between the poles 13^B and 13^C is a laminated armature 20, which in this instance is shown as supported in a frame at the outer end of a lever 21, preferably of non-magnetic material, such as brass. This lever is pivoted at 22 on the outer end of the bracket 30 which may be attached to the base board 10 as shown at 31.

The armature 20 may be held in its outer or initial position by gravity or by some mechanical device such as a helical spring 24. A rod 26 extends through and supports this spring, and is guided at its inner end through the extension 32 of the bracket 30 and a hole in the base board 10. The outer end of this rod is pivoted at 27 to the lever 21. An intermediate portion of the rod is threaded to receive the nuts 25 by which the position of the spring 24 may be adjusted. Connected rigidly with the lever 21 is the lower extension 28 which abuts against a stop lug 33 on the bracket 30, to limit the outward movement of the armature 20.

In Fig. 4 is shown a plan view of the bracket 30 including its outer rectangular portion in which is pivoted the lever 21. It is an important feature of my invention that this lever is so pivoted as to have minimum friction and be free from lateral vibrations, and still be so arranged as to be laterally adjustable so as to bring the armature into symmetrical position with respect to the poles 13^B and 13^C. In such event the armature poles and the bracket 30 may be so arranged as to compel the armature 20 to move between the poles 13^B, 13^C, to a position where the magnetic pull on both sides of the armature 20 will be substantially equal, and therefore the tendency for lateral vibration reduced. It is found, however, that the armature 20 will not always occupy a magnetic symmetrical position and therefore it is desirable to have the armature lever 21 laterally adjustable to a position where the hum or chattering due to unequal pulls is reduced to such an extent that it is practically negligible.

As indicated in Fig. 4 set screws 22, 22′ are screw-threaded through the rectangular portion of the bracket 30 and their inner

conical ends 22^A fit into corresponding lateral recesses in the lever 21. Now after the screws 22, 22′ have been moved inwardly to such a position that all lost motion is taken up and the lever 21 has been moved to such a position that the armature 20 will occupy a magnetically symmetrical position between the poles 13^B and 13^C, the lock nuts 22^B are turned to clamp the screws 22, 22′ and the conical bearings 22^A rigidly in their adjusted positions. At 34 is pivoted in any desired manner an additional lever 40 which has no direct connection with the lever 21, the swinging arm or lever 40 is provided with an adjustable set screw 43 against which the lever 21 rests when the magnet is not energized. The position of the set screw 43 may be adjusted so as to change the initial position of the armature 20 with respect to the poles 13^B, 13^C. A lock nut 44 is provided for holding the set screw 43 in adjusted position. A lug 45 near one end of the swinging arm 40 is provided between which and the outer portion of the bracket 30 a spring 46 may be spaced. This spring is supported in a recess 35 and its position in said recess may be varied or adjusted by the screw 47. Above the magnet 13 is another bracket 50 attached to the base 10 by the bolt 51. The outer end of this bracket supports a contact holder 53 the stem of which passes loosely through the bracket 50. The holder 53 carries the contact 52 and is held in its outer position by the spring 54, such outer position being limited by the adjustable nuts 55. The contact 52 is directly in the path of movement of the contact 41 carried by the upper end of the swinging arm or lever 40.

The control of the levers 21 and 40 will now be described. The spring 46 has sufficient strength to move the lever 40 to its dotted line position where the contact 41 engages the contact 52, provided the lever 21 is moved to its dotted line position by the energization of the magnet. The spring 24 is of sufficient strength to overcome the action of the spring 46 and to hold the swinging lever 40 and contact 41 in their positions shown in full lines in Fig. 1. The weight of the armature 20 and the lever 21 may be arranged to assist the spring 24 in performing its function. The relative positions of the levers 21 and 40 may be adjusted by the threaded bolt 43. This also adjusts the air gaps between the poles 13^B, 13^C and the armature 20. Now when the magnet 13 is energized and pulls its armature 20 between its magnet poles 13^B and 13^C the swinging armature supporting lever 21 is pulled away from the swinging lever 40 after contact 41 engages the contact 52. During the first motion, however, the spring 46 causes the lever 40 to follow the lever 21, but after the contact 41 engages the contact 52 the lever 21 is given an additional movement so as to be entirely out of mechanical contact with the inner end of the screw 43 or any portion of the lever 40. The spring 54 will cushion the blow of the contact 41 against the contact 52 and said contacts will be brought squarely into engagement with each other since the stem of the holder 53 extends loosely through the bracket 50. It will therefore be evident that the electric switch comprising the contacts 41 and 52 will be held closed by the spring 46 independently of the electro-magnet and its armature. The armature 20 and its supporting lever being entirely clear and free from the swinging lever 40 no vibration from the armature can be transmitted to the lever 40 or the contacts 41, 52. This will eliminate all chattering between the contacts 41 and 52 with its attendant difficulties such as sparking and noise. When the current is cut off from the magnet 13, the spring 24 pushes the lever 21 back against the lever 40 and the latter will therefore be moved against the action of the spring 46 back to its initial position, thereby separating the contacts 41 and 52.

It is a well known fact that an electro-magnet energized by alternating current will have a pulsating effect upon its armature due to the current fluctuations, there is therefore a tendency of the magnet to vibrate the lever 21 when the magnet is energized. It will be observed, however, that the lever 21 is supported on anti-friction bearings which are laterally adjustable. The laminations 88 and the laminations of the armature 20 are horizontally arranged in this instance. So far as is practicable the armature is mounted symmetrically with respect to the pole faces of the magnet, but due to irregularities of the pole faces or of the size of the armature, the latter may not be in exactly midway position between the pole faces, magnetically speaking. The conical bearings may however be shifted sideways so as to obtain a position for the armature where minimum humming will be produced when the magnet is energized and the armature is in its attracted position. It should also be noted that when the magnet is energized and the armature 20 brought to its dotted line position as indicated in Fig. 1, the magnetic circuit is almost entirely closed which materially reduces the current taken by the magnet. The spring 24 should be so adjusted with respect to the pull of the magnet that the armature 20 is not brought into contact with any portion of the magnet. In other words the armature should be brought by the pull of the magnet against the action of the spring 24 in a state of equilibrium where the armature will not be permitted to touch anything and thereby produce chattering noises.

In order to show the practical application of my invention I have illustrated in Fig. 3

a source of singlephase alternating current 60 connected through the transformer 61 to the conductors 63 and 64 which are connected to the terminals of the magnet solenoid 15. A manual switch 62 may be used to control the flow of current through the magnet solenoid. To the binding post which is connected to the contact 41 but insulated from the lever 40 by the insulating blocks 42 is connected a conductor 75 leading to the incandescent lamps 74. The other contact 52 of the electric switch is connected by the conductor 73 to the solenoid 70 in which is movable a plunger 77. This solenoid is connected by the conductor 71 to the conductor marked + and leads to a suitable source of direct current supply. Conductor 75 is connected to the — lead of the said source of direct current supply. Now when the switch 62 is closed and the alternating current generator 60 is operated the solenoid 15 will receive alternating current and the armature 20 will be moved to a position of equilibrium disconnected from any portion of the magnet. Upon the initial movement of the armature 20 the spring 46 will cause the lever 40 to follow the lever 21 until the contact 41 engages the contact 52. Thereupon the circuit through the solenoid 70 will be completed and the plunger 77 will be lifted and with it the circuit closer 78 to connect the contacts 72 and 76. The circuit will then be closed through the lamps 74 and the solenoid 70 will still receive current through a circuit in parallel with the circuit through the lamps. The circuits and connections of Fig. 3 are merely for the purpose of illustration of an application of my invention, it being understood that it may have a general application. For instance it may be used as an electro-magnetic switch in electric elevator apparatus.

In Fig. 5 I have shown my invention applied to valve mechanism. Here a swinging arm or lever 40′ is connected by a link 82 to a valve 81 which is slidable in the guideway 80. This valve may be arranged to control inlet and outlet passages 83 and 84 to the inclosed chamber 85 in which is shown a piston 86 arranged to be moved against the action of a returning spring 87.

In Figs. 6 and 7 is shown a modification of my invention in which the magnet frame 13′ is circular in form with two inwardly protruding magnet poles $13^{B'}$ and $13^{C'}$ between which a pivoted rotatable armature 20′ is placed. The exciting coils 15′, 15′ are placed upon the magnet poles. A weighted member 16 is connected to one end of the armature 20′. Upon the upper end of the member 16 may be placed an anti-friction roller 17, which initially rests against a lug 45′ of the swinging lever 40^{A}. When the magnet is deënergized the weighted member with its roller 17 resting upon a lug 45′ will cause the armature 20′ to assume the position shown in Fig. 6, where it extends diagonally from the upper portion of one pole to the lower portion of the other. The position of the lug 45′ and the other parts are such that when the roller 17 is limited in its downward movement by the said lug the armature still connects the poles with the exception of small air gaps. It will therefore be evident that initially the magnetic circuit is almost entirely closed and still sufficient movement of the armature may be obtained to effect the operation of the electric switch. Now when a current is sent through the windings 15′, 15′, by closing the switch 62 as before described in connection with Fig. 3, the magnet 13′ will be energized and the armature 20′ will be turned about its pivot into the position indicated by dotted lines in Fig. 6 to more completely close the magnetic circuit; or in other words, to include a maximum number of the magnetic lines of force. In so doing the roller 17 will be moved into its dotted line position 17′. The lever 40^{A} will follow the roller 17 until the contact 41′ engages the contact 52′, after which the roller 17 will be moved entirely out of engagement with the lever 40^{A}. The roller 17 being entirely free and clear from the lever may have a considerable vibration, such as that due to fluctuations in the exciting current without coming into contact with the lever 40^{A}. It will be observed that the springs 46′ rotate the lever 40^{A} on its pivot 22^{C} when the weight 16 is moved to its dotted line position. The tension of the springs 46′ may be independently adjusted by the adjusting devices 47′. When the exciting current is cut off the member 16 will move the roller 17 back to its full line position and move the lever 40^{A} to its initial position against the action of the springs 46′. The contacts 41′, 52′ will thereby be separated.

In the apparatus disclosed the vibrations of the alternating current magnet are entirely removed from the electric switch which it controls, and therefore chattering noises and infirm electrical connections at the contacts are eliminated. Furthermore, since the armature is firmly pivoted or mounted on anti-friction bearings, and is held from coming into contact with the pole pieces of the magnet when it is drawn to attracted position all other noises are also reduced to a minimum. I have shown my invention in two different forms and have shown it applied to different kinds of apparatus in order to demonstrate that it is not limited to any specific construction or to any specific use.

My invention contemplates such modifications as come within the scope of the appended claims.

Having thus fully described my invention,

what I claim and desire to have protected by Letters Patent of the United States is:

1. The combination with an alternating current magnet comprising a magnet frame having two poles, of an armature, a pivoted member supporting said armature and securely held against lateral movement, an adjustable spring arranged to act against said pivoted member, connections for restricting the movement of said armature to a position of equilibrium between the pull of the magnet and the action of the spring, and an independent swinging arm situated in close proximity to said pivoted member but arranged to have its movement controlled by said member, and independent adjustable mechanism for moving said swinging arm when the armature is pulled into a state of equilibrium by the magnet.

2. The combination with an alternating current magnet, of a movable body, an armature resting against said movable body, connections to effect the movement of said armature from the path of movement of the movable body into a state of equilibrium, an appliance for actuating said movable body when the armature is pulled away from the path of movement of the same, a device for adjusting said actuating appliance, and adjustable yielding abutments to limit the movement of the movable body.

3. The combination with an alternating current magnet having a laminated frame, of an armature having laminations substantially in the same plane as the laminations of said frame when the armature is in attracted position, means for adjusting the position of the armature with respect to the frame and an independently movable body controlled by the movement of the said armature.

4. The combination with an alternating current magnet comprising a laminated frame, of an armature having laminations substantially in the same plane as the laminations of the frame when the armature is in attracted position, a lever for supporting the armature, conical bearings for said lever, means for adjusting the position of said bearings to shift the position of said lever and a movable switch arm.

5. The combination with an alternating current magnet having laminated pole pieces, of an armature having its laminations extending substantially in the same plane as the laminations of the pole pieces when the armature is in attracted position, means for adjusting said armature to a magnetically symmetrical position between said pole pieces and a movably adjustable switch arm.

6. The combination with an alternating current magnet having two laminated pole pieces, of an armature having laminations extending in the same direction as the laminations of the poles, a lever for carrying said armature, conical bearings to prevent lateral vibration of said armature and lever, means for adjusting said bearings to shift said lever and armature laterally until the armature occupies a magnetically symmetrical position between the poles, a switch comprising a switch arm, controlled by the said armature and a stop to regulate the movement of the arm.

7. The combination of an alternating current magnet comprising a magnetic frame, an armature movable into and out of a position of equilibrium between the pole faces of the magnet, a pivoted arm carrying the armature, and a pivoted member in the path of the armature and movable into a position substantially parallel with said arm when the armature is in its attracted position.

8. The combination with an alternating current magnet and its armature, of an armature lever, a pivoted member in the path of movement of the lever and substantially parallel with said lever when the magnet is deënergized, but disconnected from said lever, and means for causing said member to follow the armature during a portion only of the armature's movement when the latter is moved to attracted position.

9. The combination with an alternating current magnet, of an armature movable into a position of equilibrium between the poles of the magnet, a pivoted lever carrying the armature, a switch lever in position to be held open by the armature and having its pivot in proximity to that of the armature, means for causing the switch lever to follow the armature as the latter moves to attracted position, and a stationary switch member in position to intercept the switch lever before the armature reaches its attracted position.

In testimony whereof, I have signed my name to this specification in the presence of two subscribing witnesses.

DAVID LARSON.

Witnesses:
JOSEPH E. CAVANAUGH,
ERNEST W. MARSHALL.

Copies of this patent may be obtained for five cents each, by addressing the "Commissioner of Patents, Washington, D. C."