C. J. ANDERSON.

SOLENOID.

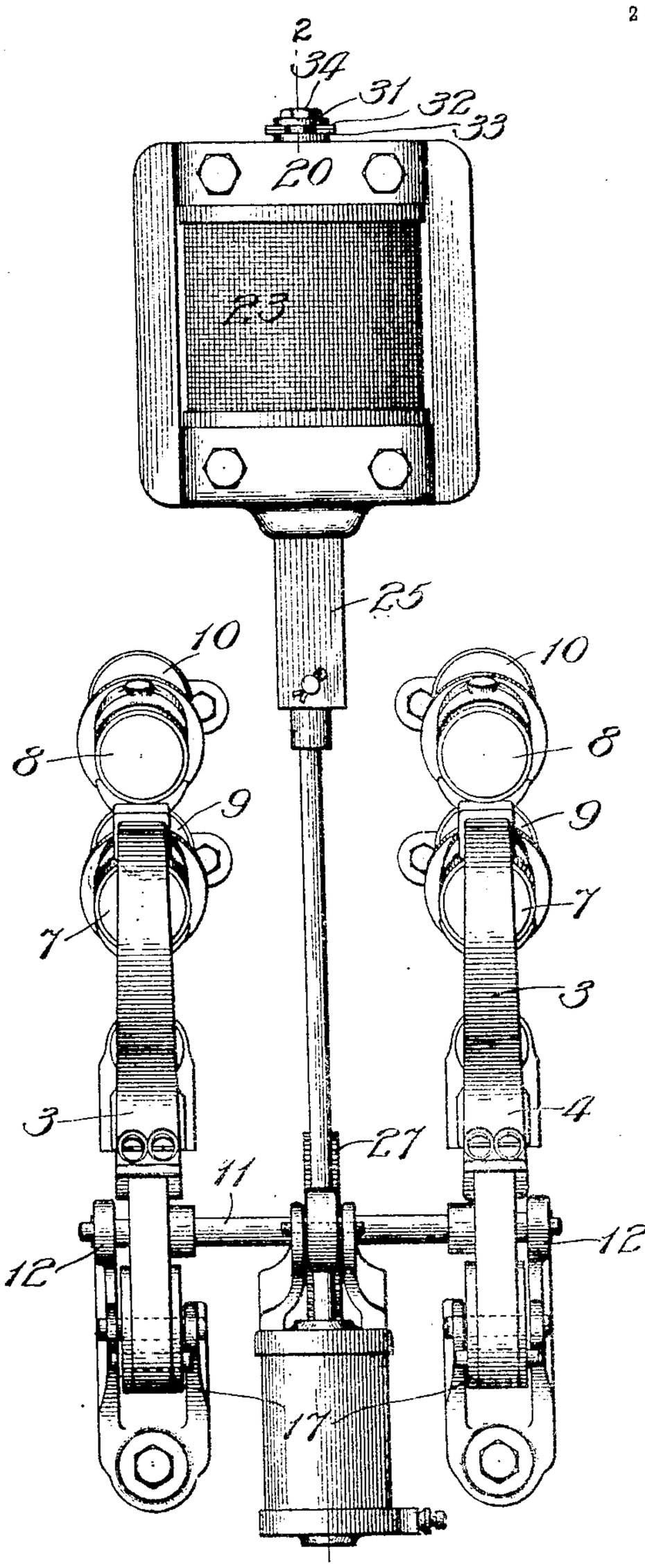
APPLICATION FILED OCT. 16, 1908.

919,672.

Patented Apr. 27, 1909.

2 SHEETS—SHEET 1.

Fig. 1.



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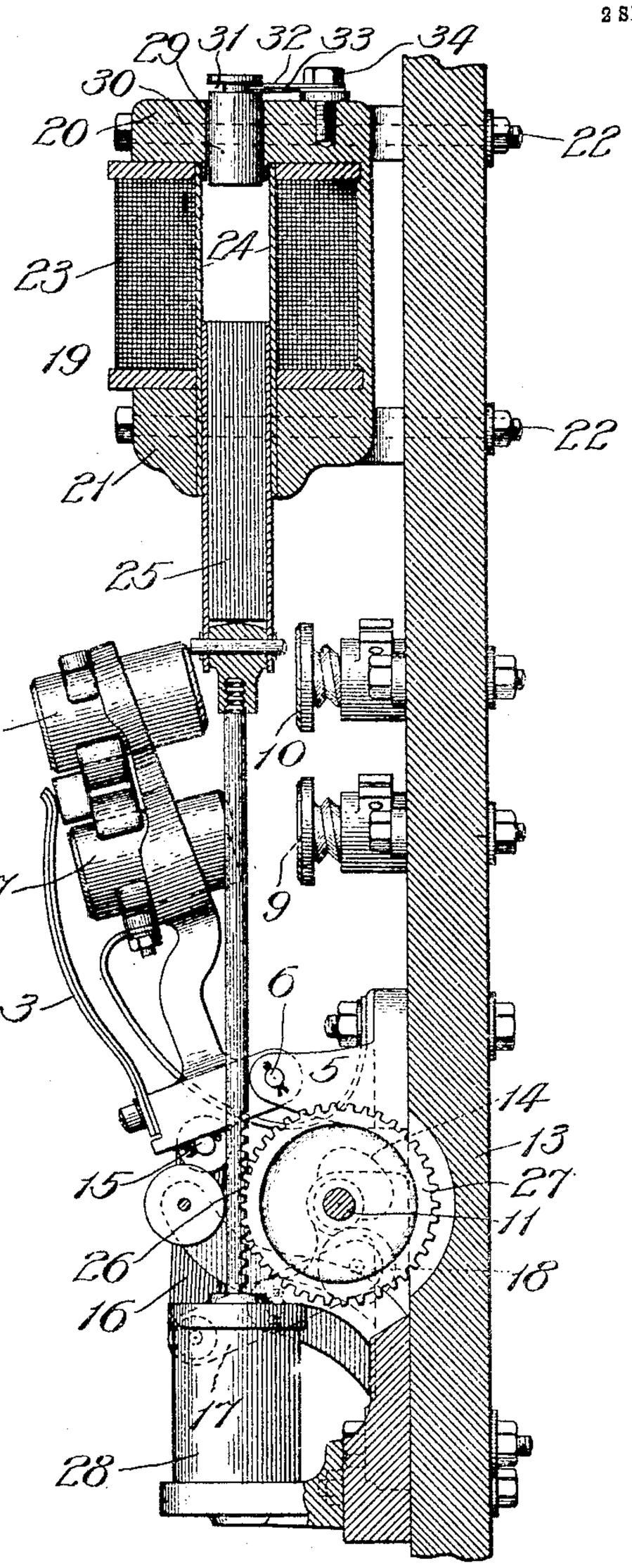
2 SHEETS—SHEET 2.

Fig. 2.



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UNITED STATES PATENT OFFICE.

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SOLENOID.

No. 919,672. Specification of Letters Patent. Patented April 27, 1909.

Application filed October 16, 1908. Serial No. 458,002.

To all whom it may concern:

Be it known that I, CARL J. ANDERSON, a citizen of the United States, residing at Chicago, in the county of Cook and State of Illinois, have invented a new and useful Improvement in Solenoids, of which the following is a specification.

My invention relates, more particularly, to alternating current solenoids; and my primary object is to dispense with the hammering or humming noise which attends the operation of this class of solenoids as commonly hitherto constructed, owing to the continuous hammering of the core, when operating against a resistance, upon the end-plate of the solenoid due to the fact that the lines of magnetic force are directed from the pole-piece of the solenoid in a direction substantially parallel with the core, and that the polarity of the pole-piece is continuously changing under the influence of the alternating current.

Referring to the accompanying drawings—Figure 1 is a face view of the construction of electrical apparatus for cutting out resistances in a circuit to be supplied with current, showing the switches as operated by a solenoid embodying my invention; and Fig. 2, a section taken at the line 2 on Fig. 1 and viewed in the direction of the arrow.

The apparatus in connection with which I have chosen to illustrate my invention comprises a series of three-point switches 3 and 4 spaced apart and of the lever-type illustrated, each pivoted near its lower end on a bracket 5 as indicated at 6. The upper end-portion of each switch carries two spring-pressed contacts 7 and 8 which are slidably mounted therein to engage with opposed contacts 9 and 10, respectively, for the purpose of producing electrical connection between the latter and the switches.

In the operation of the apparatus illustrated it is designed that the switches 3 and 4 be operated successively to successively cut out resistances in a circuit, not shown, to be supplied with current. The means for accomplishing this purpose comprise a shaft 11 journaled in bearings 12, 12, to extend between the switches and the supporting-plate 13 of the apparatus, with cams 14 fixed thereon, one opposite the other, to extend into different positions on the shaft; and lever-mechanism connected with said switch-lever, as indicated at 15, and consisting of a link 16 extending approximately vertical from the switch-arm, and a link 17 pivotally connected with the link 16 and carrying a roller 18 which bears against the shaft 11 by reason of exertion of gravity upon the switch-arms, which tends to cause them to drop to the position illustrated in Fig. 2.

In the construction illustrated, the switches 3 and 4 are shown to be operated by a solenoid 19 embodying my invention, the construction of the solenoid as shown in the drawings being as follows: Confined between top and bottom plates 20 and 21, respectively, fastened to the supporting-plate 13, as by bolts 22, is a coil 23 which surrounds a tube 24 preferably extending into the plates 20 and 21, as illustrated, and sliding in this tube is a core 25 of magnetic material provided on its lower end with a rack 26 engaging a gear-wheel 27 rigidly secured on the shaft 11 between the switches 3 and 4, the extreme lower end of the core 25 operating in a dash-pot 28, for the usual purpose. The plate 20 contains an opening 29 through it preferably of a diameter closely approximating that of the tube 24 and concentric with the latter, and slidably confined in this opening to permit it to move up and down therein, is a bar 30 of magnetic material, such as soft iron, containing a notch 31 in the form of an annular groove, in its upper end-portion, into which preferably two oppositely flaring leaf-springs 32 and 33 fixed to the plate 21, as by a screw 34, extend. The described parts are so constructed as to cause the lower end of the bar 30 to extend normally a slight distance below the plate 20 and into the path of the core 25.

When the current is directed through the solenoid coil, it causes the core 25 to rise with the result of turning the gear 27 and shaft 11, and with the latter the cams 14, which, as they successively engage with the rollers 18 of the respective switch-lever mechanisms, cause the switch-arms 3 and 4 to be forced rearwardly into engagement with the respective contacts 9 and 10, it being the design in such constructions to maintain a circuit through the solenoid to hold its core in raised position, so long as it is desired that the switches remain closed. As soon as the core 25 moves into contact with the bar 30, the latter, under the magnetic influence of the solenoid, becomes attracted to the core and clings to it and thus virtually becomes a part

of it while thus in contact and during the traverse of the current through the coil. By providing the opening 29 in the member 20 the lines of magnetic force instead of being directed downwardly in a direction longitudinally of the core, as is the case in the constructions commonly hitherto provided, are directed mainly in a radial horizontal direction from the wall of the opening. Thus, the continuous change in polarity of the solenoid, due to the action of the alternating current upon it, causes the magnetic influence to be directed from all sides with equal force against the bar 30, and practically no magnetic influence is exerted against it to retard its freedom of movement in the opening 29. The action of the alternating current upon the solenoid does, however, cause the core to vibrate somewhat even after it has been fully drawn into the coil 23. The springs 32 and 33 should be so constructed as to yieldingly support the bar 30 and of such flexibility as to permit the bar 30 to follow the core 25 and remain in magnetic contact therewith due to residual magnetism existing in the bar 30 during the movement of the core 25 produced by the alternations in the current. The springs, therefore, serve to prevent the bar 30 from unduly sinking in the solenoid but permit the bar to continually remain in magnetic contact with the core 25, with the result of preventing any hammering or humming noise usually produced in constructions as hitherto provided by the striking of a movable part against a stationary part of the solenoid.

While it is desirable to form the bar 30 of a diameter approximating the diameter of the tube 24 in order that as slight magnetic force be directed from the pole-piece to the core after the latter's engagement with the bar as possible, the opening and bar need not bear the proportions as represented relative to the core and tube in order to produce good results. In other words, the opening and bar may be made smaller than shown, in which case a portion of the magnetic force would be directed longitudinally of the core, which would tend to vibrate the core, but in a much less violent manner than is the case in constructions as hitherto provided. In such case, the springs will tend to prevent undue sinking of the core, but at the same time will permit the bar to remain in magnetic contact with the core during the vibrations of the latter, and thus hammering or humming noise will be avoided.

It is manifest that any other suitable means for yieldingly supporting the bar in the opening may be substituted for those illustrated.

A principal advantage of my improved construction is that it is not necessary to employ means for taking the weight off the core to prevent noise, as the bar 30 remains in magnetic contact with the core during the vibrations of the latter.

What I claim as new, and desire to secure by Letters Patent, is—

1. In an alternating current solenoid, the combination with the solenoid coil and solenoid core movable in the coil, of a pole-piece on the coil containing an opening, a member of magnetic material movable in said opening and adapted to be magnetically contacted with by said core, and means for yieldingly supporting said member in the opening in a manner to prevent it from unduly sinking therein.

2. In an alternating current solenoid, the combination with a solenoid coil and solenoid core movable in the coil, of a pole-piece on the coil containing an opening, a member of magnetic material movable in said opening and adapted to be magnetically contacted with by said core, and spring-means for yieldingly supporting said member in the opening in a manner to prevent it from unduly sinking therein.

3. In an alternating current solenoid, the combination with a solenoid coil and solenoid core movable in the coil, of a pole-piece on the coil containing an opening, a member of magnetic material movable in said opening and adapted to be magnetically contacted with by said core, and a leaf-spring engaging at its free end with the bar and serving to yieldingly support the latter in the opening in a manner to prevent it from unduly sinking therein.

4. In an alternating current solenoid, the combination with the solenoid coil and solenoid core movable in the coil, of a pole-piece on the coil containing an opening approximately of the same diameter as said core, a bar of magnetic material movable in said opening and normally extending at its lower end into the path of movement of the core with which latter it is adapted to magnetically contact, and means for yieldingly supporting said member in the opening in a manner to prevent it from unduly sinking therein.

CARL J. ANDERSON.

In presence of—
R. A. SCHAEFER,
A. U. THORIEN.