W. B. RICE.

RELAY.

APPLICATION FILED JULY 11, 1910.

985,705. **Patented Feb. 28, 1911.**

2 SHEETS—SHEET 1.

Fig. 1.

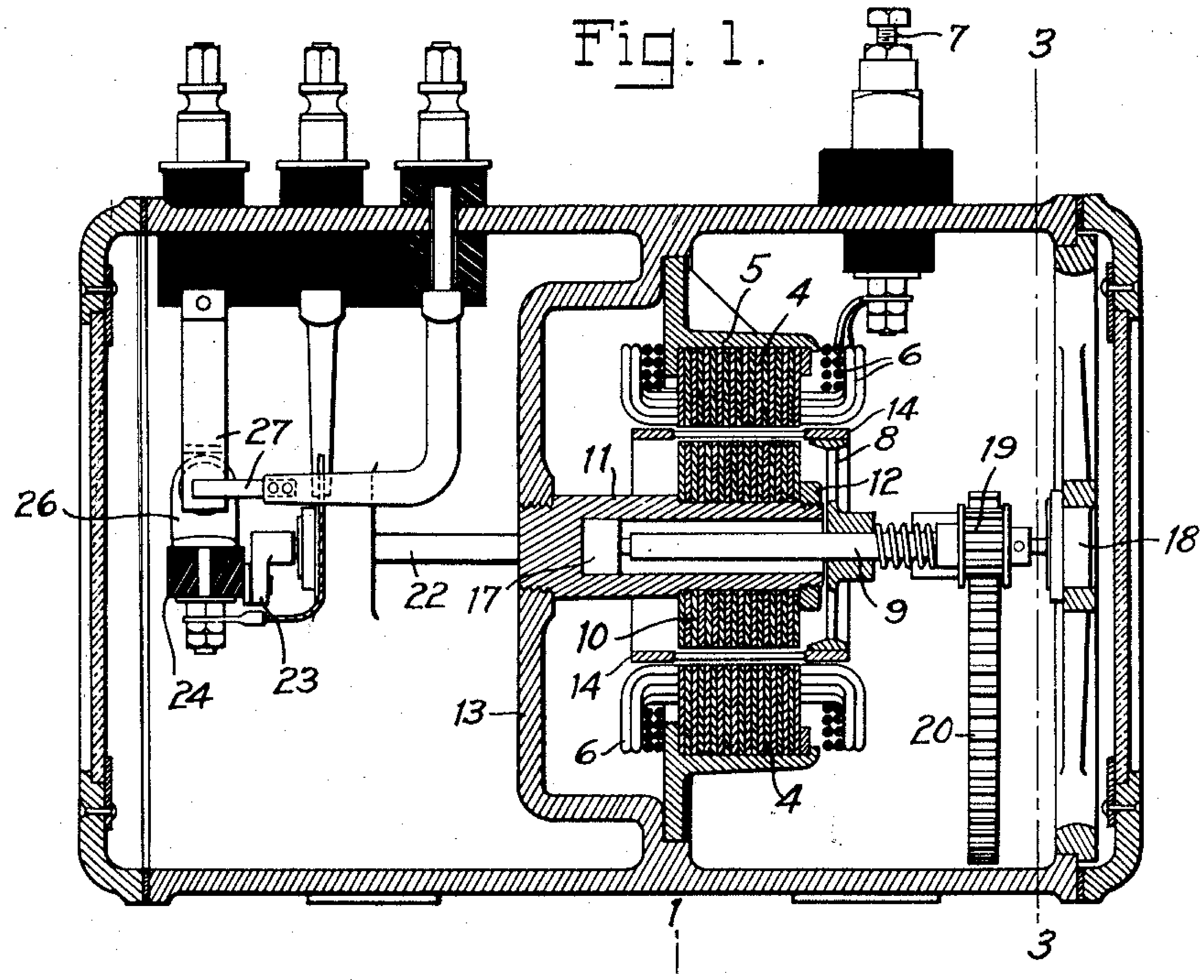
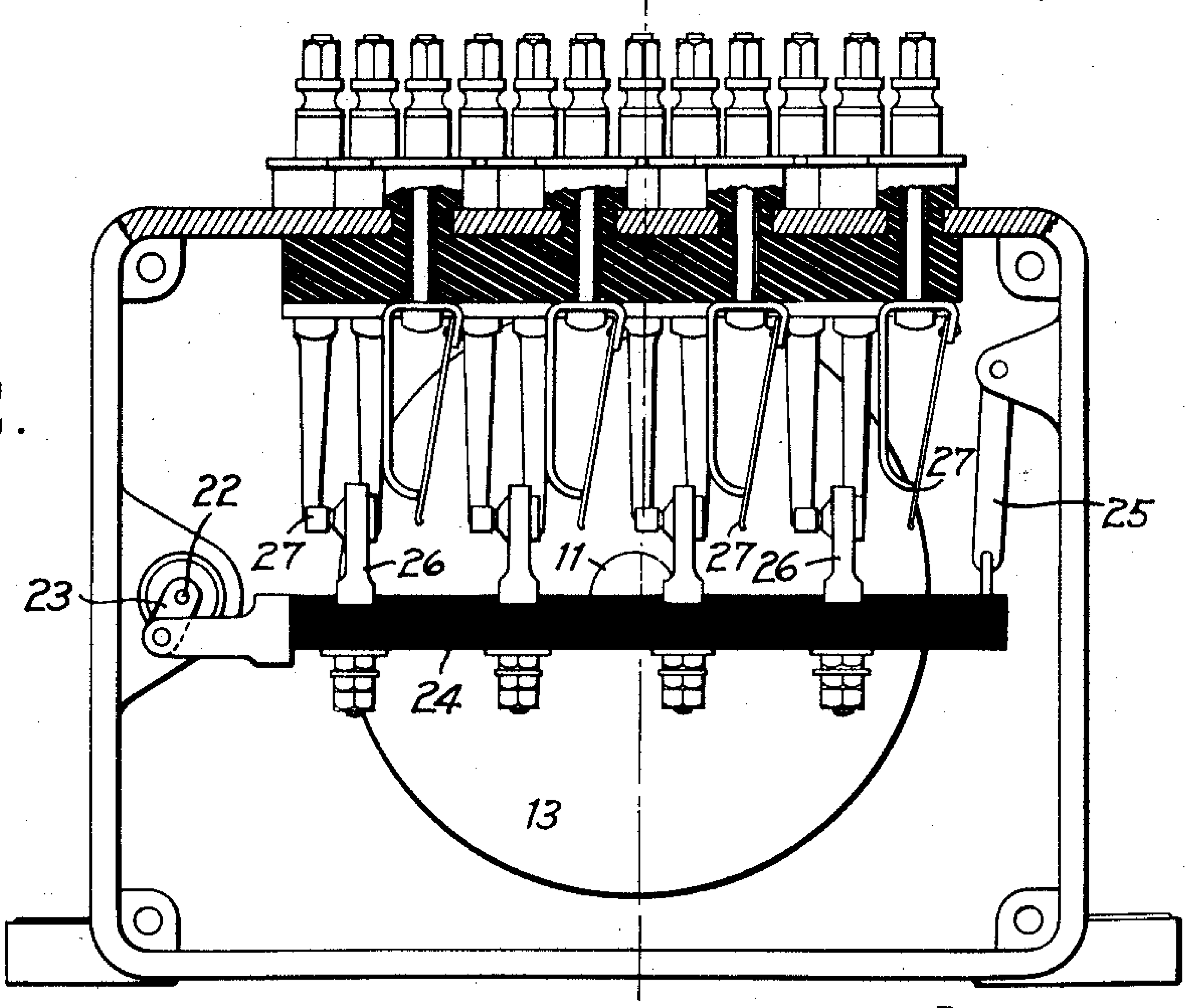


Fig. 2.



WITNESSES:

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2 SHEETS—SHEET 2.

Fig. 3.

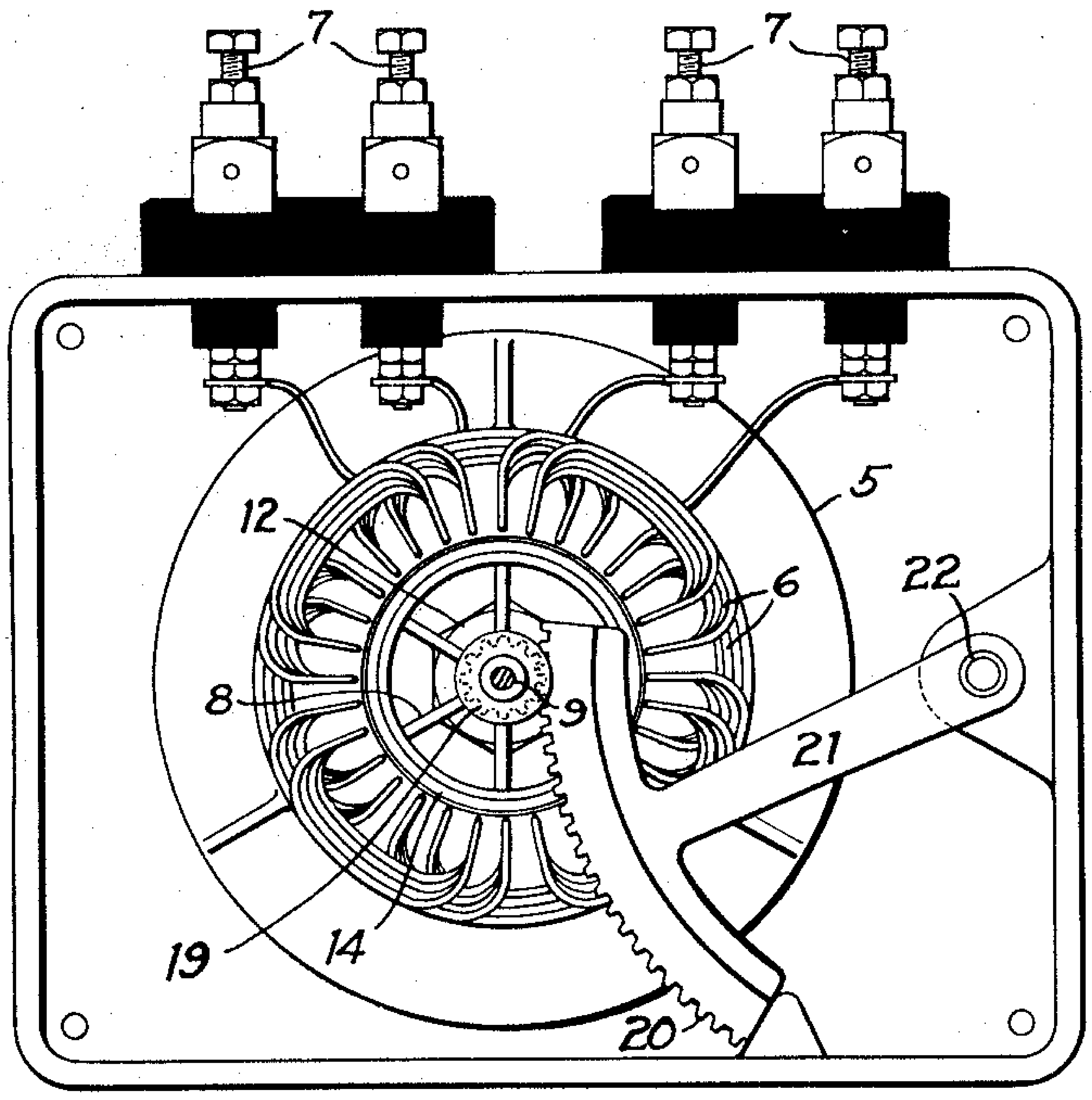
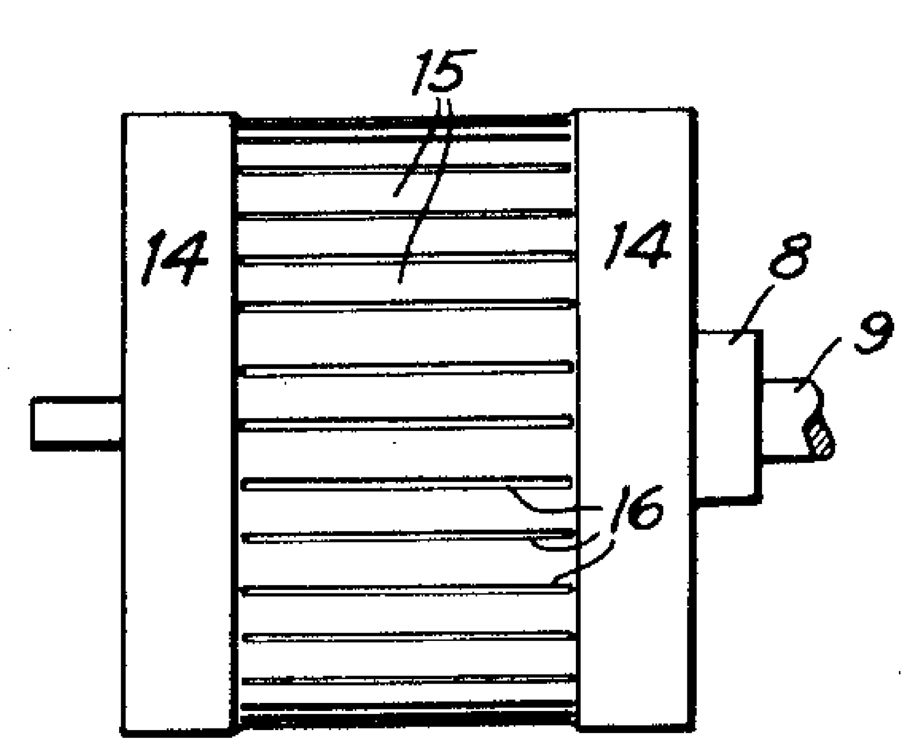


Fig. 4.



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UNITED STATES PATENT OFFICE.

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RELAY.

985,705. Specification of Letters Patent. Patented Feb. 28, 1911.

Application filed July 11, 1910. Serial No. 571,540.

To all whom it may concern:

Be it known that I, Willis B. Rice, a citizen of the United States, and resident of Rochester, in the county of Monroe and State of New York, have invented certain new and useful Improvements in Relays, of which the following is a specification.

This invention relates to electric relays adapted to respond to alternating currents. In modern railway-signal systems the use of such relays is common, and service in such connection requires that the relay respond readily and powerfully to comparatively faint alternating currents, while at the same time it must be substantially unresponsive to direct currents or to currents of any character different from that of the current to which the relay is intended to respond. To secure this result it has heretofore been proposed to employ, in an alternating-current relay, a polyphase field energized by the alternating current to which the relay is to respond, and a rotor of the ordinary Tesla type connected with and actuating the relay contacts through reducing-gearing. Such a rotor is unresponsive to direct currents, so far as normal operation is concerned, and the reducing gearing secures the necessary power to actuate the contacts by permitting a plurality of complete rotations of the rotor in performance of the function of the relay, in place of the slight angular movement of the rotor or armature common to relays of other forms.

While an alternating-current relay of the form just described is practically successful in operation, it is subject to improvement in several respects. It has been found, in the first place, that it is not entirely unresponsive to powerful direct current, but under certain conditions the rotor is moved by such current in the field and may even be caused thereby to take up a constant oscillating movement which interferes with the proper operation of the relay. Furthermore, a powerful direct current, in addition to the drag or retardation due to eddy currents in the rotor-conductors, may completely lock the rotor against operative movement, and the same thing may occur also with an alternating current, if of great magnitude and improper frequency. In the second place, a strong single-phase action may occur in such a rotor, so that if a strong local phase is employed the current in this phase, once the rotor is started in motion, tends powerfully to maintain the rotation regardless of the presence of current in the other phase, thereby interfering with the proper response of the relay to its controlling current and also producing injurious strains in the mechanism of the relay. In the third place, the inertia of the rotor results both in delay of the operation of the rotor in either direction, and also in the necessity of provision, in the reduction-gearing, of means for absorbing the momentum of the rotor at the ends of its rotative movement to prevent rebound or strain in the mechanism.

The object of the present invention is to improve relays of the type in question in the respects above referred to, and to this end I employ a rotor of novel form in connection with a polyphase field and a reduction-gearing or other suitable mechanism for connecting the rotor with the contacts, the rotor being characterized by the fact that it does not embody the magnetic core of the ordinary squirrel-cage rotor, but consists merely in a comparatively light conductive shell, which is preferably of squirrel-cage form, but consists of metal of low resistance, such as copper, and of nonmagnetic character. In connection with this rotor I employ a magnetic core which is mounted in fixed position within the rotor, so that it increases the efficiency of the rotor without adding to its weight or inertia.

In so far as alternating currents in the field are concerned, I have discovered that the arrangement above described almost completely eliminates the single-phase action hereinbefore referred to, though I am unable to state with certainty the reason for this result. I have further discovered that, except for the retardation in its movements due to eddy currents, this form of rotor is almost completely irresponsive to direct current of any strength, owing, apparently, to the fact that, since the magnetic core is not rotatable with the rotor, the tendency of the field to rotate the magnetic core, in consequence of the residual magnetism in the core, has no mechanical effect on the rotor.

In addition to the advantage above pointed out, the removal of the magnetic core from the rotor so diminishes the weight thereof that the inertia effects above referred to are substantially diminished, and the rotor is, therefore, both more easily set in motion and more easily brought to rest. This diminution of weight in the rotor has a further advantage in that it reduces friction in the bearings.

In the accompanying drawings: Figure 1 is a longitudinal section on the line 1—1 in Fig. 2, looking from right to left of a relay embodying the present invention; Fig. 2 is an end elevation of the relay of Fig. 1, looking from left to right, with the left-hand cover removed from the casing; Fig. 3 is a vertical section, looking from right to left, on the line 3—3 in Fig. 1; and Fig. 4 is an enlarged side elevation of the rotor.

The illustrated embodiment of the invention is the same, in general form and arrangement of parts, as the relay disclosed in the pending application of Winthrop K. Howe, filed May 6, 1907, Serial No. 372,077, to which reference is made by permission of the applicant, and the present relay is, in fact, in the nature of an improvement upon the relay of the said application.

The illustrated relay is provided with a laminated field-ring 4 mounted in a sleeve 5 forming a part of the frame of the relay. The field-ring is provided with a field-winding 6. The field-ring and the polyphase field-winding may be of any ordinary or suitable form, and, as they constitute no part of the present invention, they are not particularly illustrated and described herein. The terminals of the two phases of the field-winding are connected with four binding-posts 7 mounted on the top of the relay.

The rotor of the illustrated relay is in the form of a light open-ended hollow cylinder of copper, or other highly conductive material, which is mounted at one end upon a spider 8 fixed upon a horizontal shaft 9 in position to rotate within the field-ring 4. Within the rotor is a magnetic core comprising a laminated cylindrical mass 10 of soft iron. While this magnetic core extends as close to the rotor as is consistent with the necessary clearance, it is in no way connected with the rotor, but is mounted stationary upon a sleeve 11, being clamped thereon by a nut 12 threaded on one end of the sleeve. The other end of the sleeve is screwed into a diaphragm 13 forming a part of the relay-frame. In order that the rotor may be sufficiently rigid and may have ample conductivity at its end portions, while at the same time being thin in the part between the magnetic cores so as to make the air gap in the magnetic circuit as short as possible, the rotor has the form illustrated particularly in Figs. 4 and 1. The annular end portions 14 of the rotor are of a thickness equal to substantially the full space between the field ring 4 and the core 10. Between the end portions 14 the thickness of the rotor is slightly reduced by the removal of a small amount of metal on either surface, and this portion of the rotor is also provided with narrow longitudinal slots 16 to give the rotor the squirrel-cage form and prevent eddy currents. The form of the rotor as above described is such that it has at its ends the greatest thickness which will permit it to be inserted between the field ring and the core, while after being so inserted, the necessary clearance to insure the free rotation of the rotor is afforded by the reduced thickness of the middle part 15. The thicker end portions 14 not only afford the necessary rigidity, but also afford conductive paths of low resistance between the ends of the longitudinal bars 15 formed by the slots 16.

The rotor shaft 9 is journaled at its left-hand end in a bearing 17 inclosed within the sleeve 11, and at its right-hand end in a bearing 18 mounted on the casing of the relay. These bearings are preferably anti-friction bearings of any ordinary or suitable form.

The reduction gearing between the rotor shaft and the relay contacts comprises a pinion 19 on the rotor shaft meshing with a gear segment 20 carried by an arm 21 fixed on the end of a horizontal rock-shaft 22 journaled in the relay casing. The pinion 19 is connected with the rotor shaft by a friction device, shown in Fig. 1, which constitutes no part of the present invention, and is not, therefore, particularly described herein.

The rock-shaft 22 carries at its left-hand end (Fig. 1) a depending crank arm 23 to which is pivoted one end of a horizontal bar 24 of insulating material carrying the moving contacts 26 of the relay. The other end of the bar 24 is suspended by a link 25 pivoted to the relay-casing. The moving contacts 26 coöperate with fixed contacts 27, and the several contacts are connected in the ordinary manner with the circuits to be controlled thereby. In the normal position, or deënergized condition of the relay, the parts are in the position shown, but when the relay-field is energized by alternating current of suitable phase relation the rotor is actuated and the gear-segment 20 is thus raised, rocking the rock-shaft 22 and moving the contact-bar 24 to the right of the position shown in Fig. 2 so as to move the contacts and change the circuits controlled thereby.

The contact devices of the illustrated relay are substantially the same as those disclosed in the application hereinbefore referred to, and, as they constitute no part of the present invention, their construction is not particularly described herein.

I am aware that the use, in other connections, of a nonmagnetic rotor in combination with a fixed magnetic core and a polyphase field is not novel, but, so far as I am aware, I am the first to adapt such a device to use in a relay, and my invention resides particularly in the combination of the elements in question with relay contacts and connecting mechanism in such a manner as to produce an alternating-current relay having the several advantages hereinbefore pointed out.

My invention is not limited to the embodiment thereof hereinbefore described and illustrated in the accompanying drawings, but may be embodied in various forms within the nature of the invention as it is defined in the following claims.

I claim:—

1. A relay having, in combination, a polyphase field, a stationary magnetic core, a rotor comprising a conductive shell surrounding the core, contact devices, and mechanism connecting the rotor with the contact device to actuate the latter by the rotation of the rotor.

2. A relay having, in combination, a polyphase field, a stationary magnetic core, a rotor comprising a conductive shell of squirrel-cage form and substantially nonmagnetic material, contact devices, and reduction gearing connecting the rotor with the contact devices to actuate the latter.

3. A relay having, in combination, a polyphase field having a magnetic field ring, a stationary substantially-cylindrical magnetic core mounted coaxially with the field ring, a rotor mounted coaxially with the field ring and the core and comprising a substantially-cylindrical shell having a portion of reduced thickness located directly between the field ring and the core, contact devices, and mechanism connecting the rotor with the contact devices to actuate the latter.

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Witnesses:
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Geo. H. Evans.