

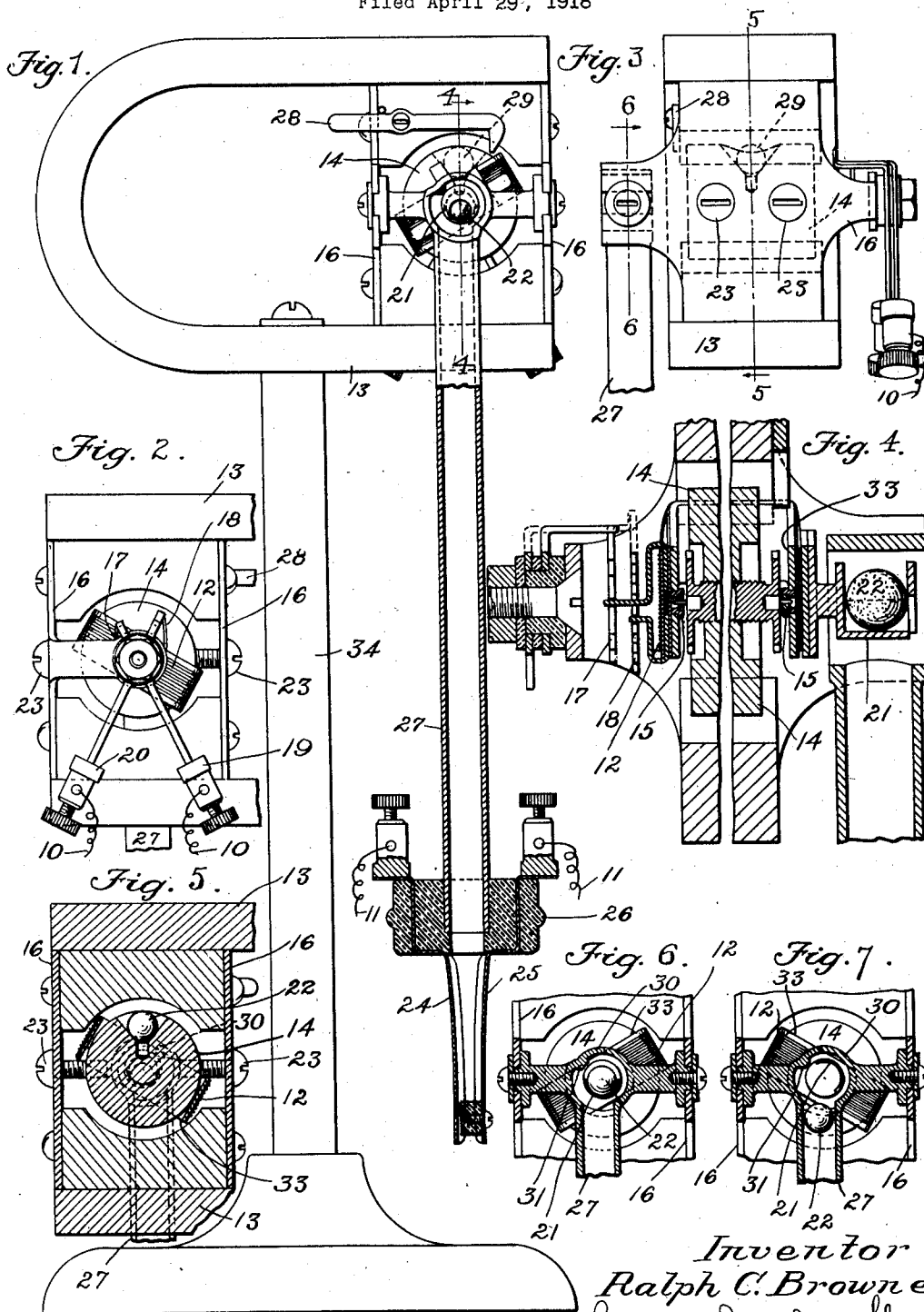
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R. C. BROWNE

ELECTRICAL RELAY

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## UNITED STATES PATENT OFFICE.

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## ELECTRICAL RELAY.

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*To all whom it may concern:*

Be it known that I, RALPH C. BROWNE, a citizen of the United States, residing at Salem, in the county of Essex and State of Massachusetts, have invented new and useful Improvements in Electrical Relays, of which the following is a specification.

This invention has particular relation to that class of relays in which the energy of one electrical circuit is caused to mechanically open, close or regulate a second circuit. As previously constructed, relays of this type have had a number of inherent defects, among which should be mentioned high resistance of the electrical circuit, sensitiveness to accidental operation through mechanical jar or vibration, imperfect operation of the contacts in the second circuit, due to oxide and dirt forming on them in sufficient quantities as to prevent the limited power of the moving parts to overcome sensitiveness to stray magnetic fields, etc.

The objects of the present invention are to overcome the defects referred to and in addition to provide an instrument which is capable of a greater range of usefulness, which is responsive to the most minute fluctuations of current in the controlling circuit, which is practically incapable of accidental operation, which can be subjected to vibration, jarring and dislocation without causing an accidental operation or impairing the efficacy of its operation when normal conditions are restored, and which may be adjusted to operate at a predetermined value of current in the controlling circuit.

Referring to the drawings,—

Figure 1 represents a side view of an instrument embodying the invention.

Figure 2 represents a view of the other side of the upper portion of said instrument, which includes the magnet, the coil, the cup, and other adjacent elements.

Figure 3 represents an end view of said upper portion.

Figure 4 represents an enlarged section on the line 4—4 of Figure 1, the intermediate portion being broken away.

Figure 5 represents a section on the line 5—5 of Fig. 3.

Figures 6 and 7 represent sections on the line 6—6 of Fig. 3, and show the cup in different positions.

I desire to have it understood that the invention is capable of many embodiments,

and consequently is not limited to the particular construction and arrangement of parts which have been illustrated as one concrete embodiment of the invention, nor to the details which are employed in such embodiment, and further that the phraseology and terminology, used herein in referring to the various elements constituting such embodiment, are not intended for purposes of limitation but of description or illustration.

Referring to the drawing, portions of two circuits are shown, one circuit 10 being referred to as the controlling circuit and the other circuit 11 as the controlled circuit. The controlling circuit includes a rectangular coil 12 mounted to rotate or oscillate in a magnetic field, preferably maintained by a permanent magnet 13, and through the annular magnetic air gap between a fixed cylindrical iron mass 14 and the poles of said magnet. The end portions of the rectangular coil are mounted in jewel or anti-friction bearings 15 at the ends of the mass 14, the latter being rigidly secured to the magnet by diamagnetic bars 16, 16, extending across the poles, and screws 23. The ends of the conductor forming the coil are connected to two oppositely and balanced fine hair springs 17, 18, electrically connected respectively to the binding posts 19, 20, which are of course insulated from each other. The ends of the conductors, forming a portion of the controlling circuit 10, may be attached to said posts.

At one end of said coil there is a member which I may call a cup 21 of semi-cylindrical shape, and in which is held or sustained a controlling member. In the present instance, said controlling member takes the form of a spherical weight 22, the cup and weight being located in the axis of movement of the coil, so that, when the cup is upright, the member 22 is in a state of equilibrium. The sustaining wall of the cup is concentric with the said axis, so that the equilibrium of the ball is not disturbed until the cup has been rotated far enough to let the ball roll out and drop. Normally the coil is in a position with the cup upright and engages a stop (one of the screws 23 in the present instance) which holds it against clockwise rotation. When caused to rotate by the passage of a current through the coil (or by the cessation of a current if the parts

are so adjusted), the coil rotates to an angular position to permit the ball to drop from the cup.

The controlled circuit 11 includes a pair of fixed contacts 24, 25, which are dependent from an insulating support 26, and which are shown as transversely curved resilient members arranged at an inclination to each other to form a V-shape space between them. If the controlled circuit is normally closed, the ends of the contacts are electrically engaged, and the ball or controlling member is in that case formed of glass, porcelain or other non-conducting material, so that, when dropped into the V-shaped space formed by the contacts, it will wedge them apart and open the circuit. If the controlling circuit, however, is normally open, the ball or controlling member is made of conducting material, and, on being dropped between the then normally separated contacts, closes the circuit through them. The ball is preferably provided with a roughened surface, so that it cleans away any dirt or deposit on the contacts and makes a good electrical connection therewith, in case it be used to close the controlled circuit. The contacts are spaced from the cup so that the ball or weight acquires sufficient momentum to wedge itself between the contacts and spring them apart, whereupon the ball thereafter will be clamped between them. It is desirable in many cases, in order to prevent a malfunction, to guide the ball to the contacts after it is released by the cup, and for this purpose I may employ a tube 27 which terminates just above the space between the upper portions of the contact.

In order that the instrument shall not function improperly, or at any time except in response to the presence or absence of a current in the controlling circuit and the coil, various devices may be employed. For example, I may employ a positive lock for preventing rotation of the coil. This I have shown as a lever 28, which may be moved by hand or otherwise into and out of the path of the coil. Again, to prevent the coil from being rotated when the instrument is located at an angle or is swung or jarred or vibrated, or subjected to other abnormal conditions, I may make use of a diamagnetic ball or member 29 located in a conical depression or recess 30, in the upper portion of the cylindrical mass 14. The recess is of such depth that the member 29 normally does not protrude beyond the circumference, and the angle of the side wall of the depression is about 40° to its axis, so that, when the instrument is rocked, violently jarred or vibrated, thrown on one side or turned upside-down, the ball will roll or bounce into the path of the coil and hold it against rotation.

I have found this a very effective device

for preventing the operation of the relay under abnormal conditions or where it is subjected to dislocation or vibration. It is also necessary to prevent the weight or spherical member from being accidentally dislodged from the cup, and, for this purpose, any suitable contrivance may be utilized. I preferably employ an encircling ring or casing 30, which is a little off center and which communicates with the upper end of the guide. This ring or casing has an internal boss or shelf 31 which just clears the cup and permits the ball to pass thereunder when the cup is rotated or moved anti-clockwise under normal conditions, but which also receives the impact of the ball in case the latter is thrown from the cup, and prevents it from moving the cup and the coil anti-clockwise.

By employing a controlling member for the controlled circuit in spherical form and locating it in a semi-cylindrical or semi-spherical cup in line with the axis of the coil, it is apparent that a minimum amount of energy is required to move the coil. Further, by employing the magnetic mass 14 between the pole pieces, a magnetic field of full strength and uniformity throughout the path of movement of the coil is maintained. The tension of the hair springs may be varied to permit the coil to move only when a current of the predetermined or desired value or electromotive force passes through the coil. The instrument may be preliminarily calibrated by any of the common methods. The rectangular coil is preferably wound about a metallic bobbin 33, which has local currents induced therein by reason of the surrounding magnetic field when it is moved, so that the coil is strongly damped and held against movement from mechanical causes.

It is evident that the number of cups carried by the coil may be increased so that a plurality of controlled circuits may be governed in operation by the controlling members normally resting loosely in the cups. The contacts of one of such controlled circuits may be normally separated and those of the other circuit normally closed, so that spilling the balls or controlling members from the cups results in closing one circuit and opening the other.

The magnet may, of course, be mounted in any suitable manner. I have shown it conventionally as supported by a standard 34 which also supports the insulating block for the controlled circuit contacts. Under certain conditions, an electro-magnet can be used.

From the foregoing description, it will be apparent, to persons skilled in the art, that the instrument which I have shown (which, so far as the magnetic field and the rotary coil are concerned, is substantially like

direct current volt meter of the D'Arsonval type) is extraordinarily sensitive, and yet is so safe-guarded that it is capable of rough usage without affecting its ability to function under normal conditions. The instrument may be locked against operation manually by the locking lever, or the said lever may be controlled automatically by any suitable electrical, hydraulic or pneumatic apparatus, according to the conditions of its use; and, when the positive lock is in inactive positions, the coil is prevented from rotating, and the ball or controlling member from being dislodged, except when the coil moves in response to a current fluctuation in or to the passage of a current of predetermined value, through the coil, by the gravity lock or ball 29, all according to the use to which it may be put. It is apparent that the instrument is capable of wide range of use in various industries.

Having thus explained the nature of my said invention and described a way of making and using the same, although without attempting to set forth all of the forms in which it may be made or all of the modes of its use, what I claim is:

1. A relay comprising a magnetic field, a coil adapted to rotate and cut the lines of force of said field, suitable connections for conducting an electrical current into said coil, a member normally held at the axis of said coil, and means for releasing said member upon the movement of said coil.

2. A relay comprising a magnetic field, a coil adapted to rotate and cut the lines of force of said field, suitable connections for conducting a current into said coil, a weight, a cup member adapted to hold said weight in stable equilibrium on the moving coil when in a normal position of rest, said cup being adapted to place said weight in unstable equilibrium upon the rotation of said coil.

3. A relay comprising a magnetic field, a coil adapted to rotate within the lines of force of said field, suitable connections for conducting electrical currents into said coil, a controlled circuit having stationary contacts, and means controlled by the moving coil for engaging said contacts, the subsequent operation of said means being independent of the operation of said coil.

4. A relay comprising a moving coil, a cup adapted to hold a ball carried by said coil, a member surrounding said cup, said member being adapted to prevent the ball falling from said cup in any but a predetermined position of said coil.

5. A relay comprising a moving coil, a cup carried by said coil, a ball lying in said cup, a member surrounding said cup and contained ball, and a boss extending from the said ring toward the ball for the purpose specified.

6. A relay comprising a moving coil, and a gravity-operated locking device arranged to obstruct the movement of said coil when the relay is placed in any but the intended position of operation.

7. A relay comprising a moving coil, a member adapted to prevent the movement of said coil, a receptacle therefor, said member being normally held away from said coil in said receptacle, the receptacle being so related to said member that a mechanical blow or jar will force said member from said receptacle and obstruct the movement of said coil as specified.

8. A relay comprising a controlled circuit, a moving coil, means controlled by said coil for establishing a predetermined condition in the controlled circuit, and a lever member adapted to obstruct the movement of said coil, said lever member being movable into and out of the path of said coil.

9. A relay comprising a moving coil, separated contacts, and a member carried by said moving coil for engaging said contacts, having a roughened surface adapted to engage the surfaces of the said separate contacts.

10. A relay comprising a pair of fixed contacts, and a freely movable unsecured weight normally separated from said contacts and being adapted when released to freely fall and electrically operate upon said fixed contacts permanently.

11. A relay comprising a magnetic field, a controlling circuit and a controlled circuit, said controlling circuit comprising a coil rotatable in said magnetic field and responsive to current fluctuation in the controlling circuit, a member for controlling the flow of current in the second-mentioned circuit and controlled in operation by said coil, and means for automatically preventing rotation of said coil except when the rotation is due to said current fluctuation in the controlling circuit.

12. A relay comprising a magnetic field, a controlling circuit and a separate controlled circuit, said controlling circuit comprising a coil rotatable in said magnetic field and responsive to current fluctuation in the controlling circuit, a member separable from said coil for controlling the flow of current in the second-mentioned circuit and controlled in operation by said coil, and a member mechanically movable into the path of said coil to hold it against rotation.

13. A relay comprising a magnetic field, a controlling circuit and a controlled circuit, said controlling circuit comprising a coil rotatable in said magnetic field and responsive to current fluctuation in the controlling circuit, a member for controlling the flow of current in the second-mentioned circuit and controlled in operation by said coil, and a normally inactive vibratable member re-

sponsive to mechanical jarring or dislocation of said relay for holding said coil against accidental rotation.

14. A relay comprising a circuit terminating in a coil rotatable in a magnetic field, a weight loosely carried by said coil at the axis thereof when the coil is in a predetermined position and dropped thereby when the coil reaches another angular position, and a second circuit having contacts spaced from said weight and located to be engaged thereby when the weight is dropped.

15. A relay comprising a magnet, a coil rotatable in the magnetic field thereof, a member normally sustained by said coil and released thereby when said coil has rotated through a predetermined arc, and a guard enclosing said member when sustained by said coil.

16. A relay comprising a magnet, a coil rotatable in the magnetic field thereof, and a member normally sustained by said coil at approximately the axis thereof and released thereby when said coil has rotated through a predetermined arc.

17. A relay comprising a magnet, a coil rotatable in the magnetic field thereof, a member normally sustained by said coil and released thereby when said coil has rotated through a predetermined arc, and means for locking said coil against rotation.

18. A relay comprising a magnet, a coil rotatable in the magnetic field thereof, a member normally sustained by said coil and released thereby when said coil has rotated through a predetermined arc, and a lock movable into and out of the path of said coil for holding it against rotation.

19. A relay comprising a magnet, a coil rotatable in the magnetic field thereof, a member normally sustained by said coil and released thereby when said coil has rotated through a predetermined arc, and a locking member adapted to be moved by vibration or abnormal movement of said relay into position to prevent movement of said coil.

20. A relay comprising a magnet, a coil rotatable in the magnetic field thereof, a member normally sustained by said coil and released thereby when said coil has rotated through a predetermined arc, and two locking members for preventing the rotation of said coil, one being normally active and rendered inactive under predetermined conditions, and the other being normally inactive but rendered active under predetermined conditions.

21. A relay comprising a pair of contact members, a weight adapted to wedge between members, a rotatable coil normally sustaining said weight out of contact with said members and arranged, when rotated through a predetermined arc, to release

said weight so that it may drop into wedging relation to said contact members, and means for automatically locking said coil against rotation when the relay is bodily vibrated.

22. A relay comprising a magnet and a magnetizable mass between the poles thereof and spaced therefrom to provide an annular magnetic air gap, a coil arranged to rotate through said air gap and responsive to current in a circuit including such coil, a sustaining member movable with said coil, a weight normally sustained by said member and released on rotation of said member to a predetermined position, and a locking member carried by said mass and movable into position to prevent rotation of said coil.

23. In combination, a coil rotatably responsive to current fluctuations therein, a cup located at the axis of the coil and normally in upright position, a ball normally in said cup and dropped therefrom when the cup is tilted, and means for preventing accidental dislocation of said ball.

24. In combination, a coil rotatably responsive to current fluctuations therein, a cup located at the axis of the coil and normally in upright position, a ball normally in said cup and dropped therefrom when the cup is tilted, and means for guiding the ball to a predetermined location when it is dropped from the cup.

25. In combination, a coil rotatably responsive to current fluctuations therein, a cup located at the axis of the coil and normally in upright position, a ball normally in said cup and dropped therefrom when the cup is tilted, a casing enclosing the ball and cup and having means for preventing accidental dislocation of said ball, and a guide below the cup for receiving the ball when dropped therefrom.

26. A relay comprising a rotatable cup, a loose member sustained normally therein, and a rotatable coil connected to said cup and arranged to tilt the cup to release the loose member therefrom when rotated through a predetermined arc.

27. In combination, a magnet, a controlling circuit including a coil rotatable in the magnetic field of said magnet, a second circuit, a cup attached to and rotatable with said coil, and a gravity-operated controlling member for the second circuit, normally held by said cup in inactive position and released to fall to active position on the rotation of said coil and cup.

28. In combination, a controlled circuit including a pair of contacts arranged at an inclination to each other, a member adapted to drop into wedging relation to said contacts, a controlling circuit including a rotatable coil, and a cup movable with

said coil for normally sustaining said member in an inactive position away from said contacts.

29. In combination, a controlled circuit including a pair of contacts arranged at an inclination to each other, a member adapted to drop into wedging relation to said contacts, a controlling circuit including a rotatable coil, a cup movable with said

coil for normally sustaining said member in an inactive position away from said contacts, and a guide for guiding said member to permit it to drop between said contacts when it is released by said cup. 10

In testimony whereof I have affixed my signature.

RALPH C. BROWNE.