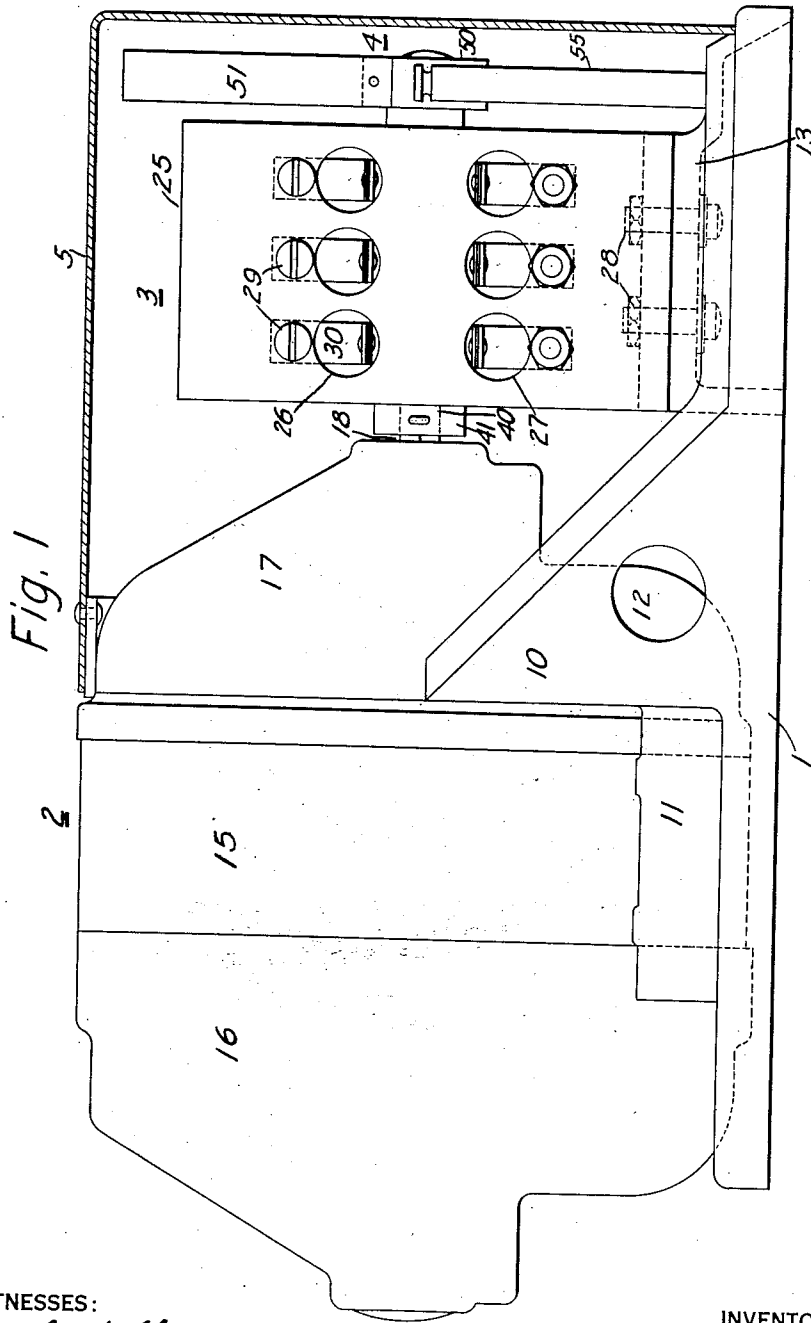


APPLICATION FILED JUNE 13, 1917.

1,302,035.

Patented Apr. 29, 1919.
3 SHEETS—SHEET 1.



WITNESSES:

Fred. C. Wilharm
W. R. Coley

INVENTOR

INVENTOR
Arthur J. Hall

BY

BY
Wesley E. Carr
ATTORNEY

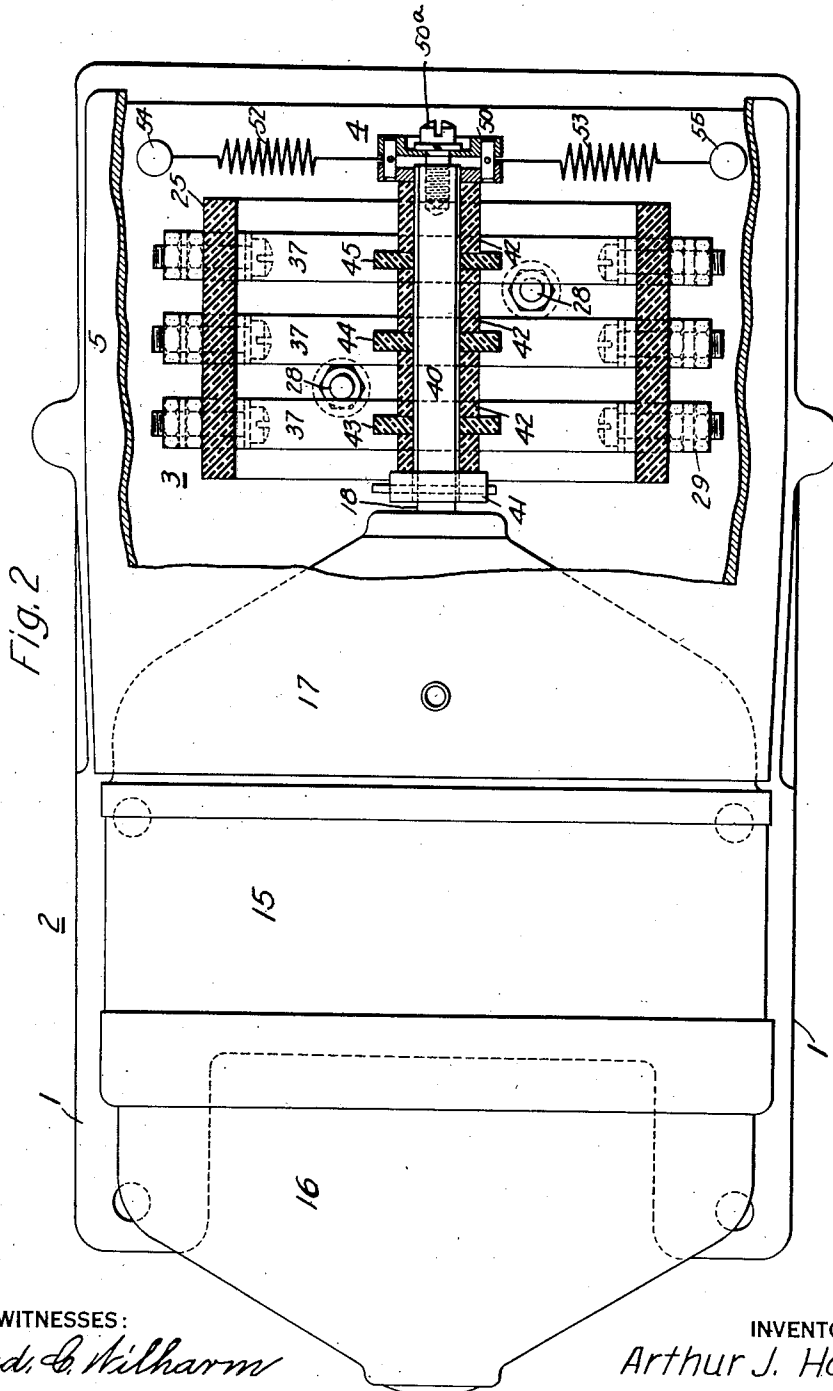
A. J. HALL.
RELAY DEVICE.

APPLICATION FILED JUNE 13, 1917.

1,302,035.

Patented Apr. 29, 1919.

3 SHEETS—SHEET 2.



WITNESSES:

Fred. C. Wilharm
W. R. Coleis

INVENTOR

Arthur J. Hall

BY

Wesley E. Carr
ATTORNEY

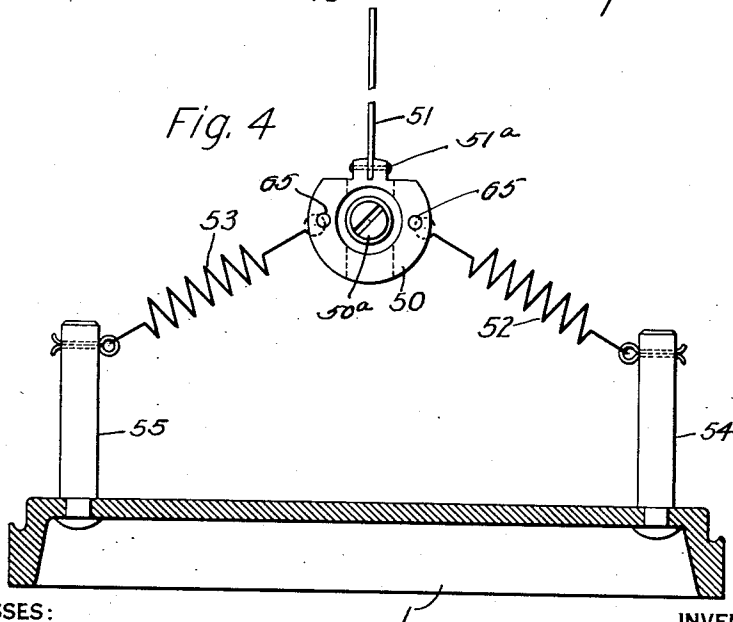
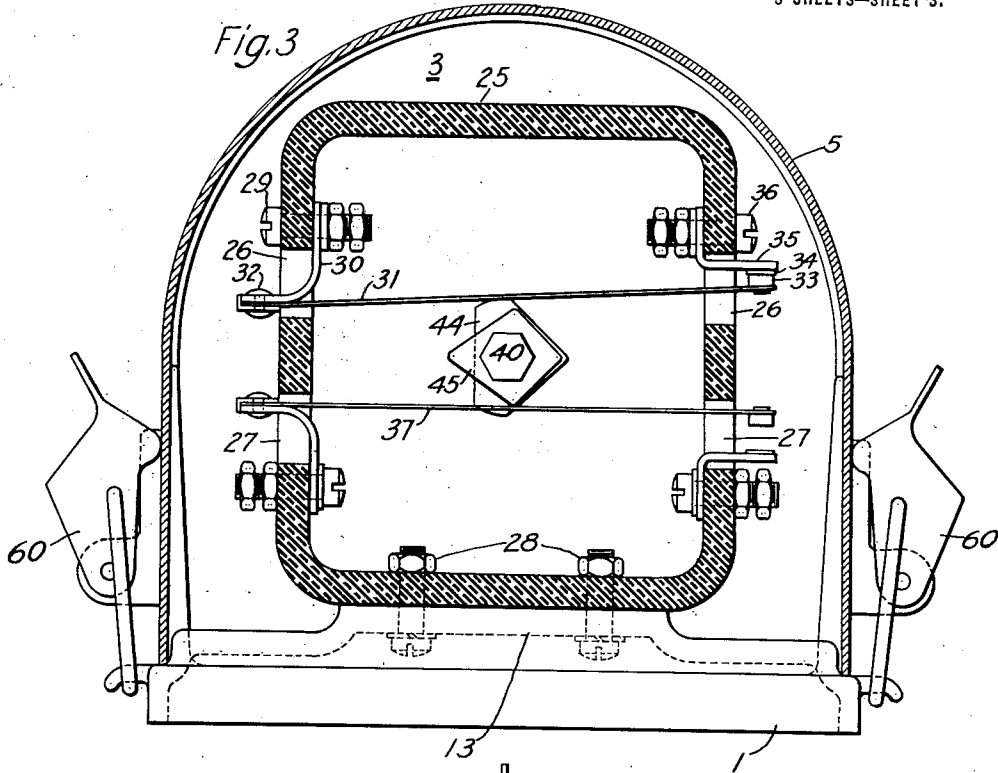
A. J. HALL.
RELAY DEVICE.

APPLICATION FILED JUNE 13, 1917.

1,302,035.

Patented Apr. 29, 1919.

3 SHEETS—SHEET 3.



WITNESSES:

Fred. C. Wilharm
W. R. Coley

INVENTOR

Arthur J. Hall

BY

Wesley C. Carr
ATTORNEY

UNITED STATES PATENT OFFICE.

ARTHUR J. HALL, OF WILKINSBURG, PENNSYLVANIA, ASSIGNOR TO WESTINGHOUSE
ELECTRIC & MANUFACTURING COMPANY, A CORPORATION OF PENNSYLVANIA.

RELAY DEVICE.

1,302,035.

Specification of Letters Patent.

Patented Apr. 29, 1919.

Application filed June 13, 1917. Serial No. 174,474.

To all whom it may concern:

Be it known that I, ARTHUR J. HALL, subject of the King of Great Britain, and a resident of Wilksburg, in the county of Allegheny and State of Pennsylvania, have invented a new and useful Improvement in Relay Devices, of which the following is a specification.

My invention relates to control apparatus and especially to relay devices of the torque-motor type.

One object of my invention is to provide a relay device of the above-indicated character which shall be compact and durable in construction and positive and reliable in action, and which shall have a relatively small total static and dynamic friction, whereby the device is rendered extremely sensitive in its operation.

Another object of my invention is to provide, in connection with a torque motor or other power device, a novel arrangement of stationary and movable contact members for closing certain circuits in any desired sequence upon rotative movement of the motor.

A further object of the present invention is to provide a torque-motor relay which is inherently self-inclosed and symmetrical in construction and which has no external projecting parts, whereby the entire device may be of substantially rectangular form and may be readily mounted in any convenient location in an electric locomotive or the like.

Other minor objects of my invention will become evident from the following detailed description and are pointed out with particularity in the appended claims.

In the accompanying drawings illustrating my present invention, Figure 1 is a view in side elevation, with a portion of an inclosing cover removed, of a complete torque-motor relay device constructed in accordance with the principles of the invention; Fig. 2 is a view, partially in plan and partially in horizontal section, of the structure that is shown in Fig. 1; Fig. 3 is a view, partially in end elevation and partially in vertical section, of the apparatus; and Fig. 4 is a view, in end elevation, of a portion of the structure that is illustrated in Fig. 1 and Fig. 2.

Referring to the drawings, the structure

shown comprises a suitable base or supporting stand 1 upon which are mounted an electric motor 2 and a stationary apparatus 3 which, together with a movable device 4, comprises the cooperating contact members of my relay device and an inclosing cover member 5 for the portions 3 and 4 of the apparatus.

The base 1 is provided with a plurality of pairs of upwardly-extending side projections or brackets 10 and 11 for suitably positioning the stator of the electric motor 2, one or both of the projections 10 being provided with apertures 12 through which appropriate conductors for the motor elements may be led. An intermediate raised portion or platform 13 of the base 1 is utilized for the purpose of carrying the stationary structure 3, as subsequently described in detail.

The electric motor 2 is shown as comprising a stator structure or magnetizable frame 15; a plurality of inclosing end-bells 16 and 17 and a rotatable shaft 18 upon which a suitable rotor (not shown) is mounted, in accordance with customary practice.

The construction of the electric motor 2 forms no part of my present invention, except in so far as it furnishes necessary motive power for actuating the movable contact-making and breaking device 4, as subsequently more fully set forth. It will be understood that any other form of prime mover may be utilized in connection with my invention, but, ordinarily, an electric motor will be more convenient and reliable for effecting the desired functions than any other form.

The preferred type of motor 2 should be constructed in accordance with the following characteristics:

(a) The motor should be adapted for both alternating-current and direct-current operation.

(b) The motor windings should be of sufficient capacity to continuously withstand the application of a locked or stationary rotor voltage of 9 volts, for example.

(c) The armature slots should be skewed so that the torque produced will be uniform and entirely independent of the angular position of the armature.

(d) The motor proper, as well as the contact-making and breaking devices should have a relatively low static and dynamic

friction and, consequently, ball or roller bearings will be advantageous in this connection.

(e) The motor should have a minimum amount of brush friction.

(f) The motor should be as light in weight as possible.

(g) The armature should have a relatively small diameter to reduce the radius of gyration.

(h) The magnetization or B-H curve of the torque motor should be of approximately the same shape as that of the railway or other main motors in connection with which the relay device is to be employed.

It is believed that, with the above list of characteristics, those skilled in the art will be able to readily devise a motor which will be particularly adapted for use in the present invention, and no further description of the motor is deemed necessary.

The stationary contact-making and breaking apparatus 3 comprises a supporting member or frame 25 of insulating material that is approximately a hollow square in transverse section, as clearly shown in Fig. 3, and is provided with a plurality of sets of alined apertures 26 in the upper half of each side of the frame and similar sets of apertures 27 in the lower halves thereof. A plurality of spaced bolts 28 or other clamping members are utilized to rigidly secure the frame 25 to the raised portion 13 of the base 1.

A corresponding number of binding-screws 29 are located above the apertures 26 in one side of the stationary frame 25, for the purpose of positioning stationary terminal members 30 that are approximately right-angled in form. The vertical arm of each terminal member 30 is clamped in position by the corresponding binding-screw 29, and a plurality of long conducting strips or lever members 31 of spring steel, or the like, have their fixed ends 32 severally riveted to the horizontal arms of the terminal members 30, which arms extend through the openings 26, while the free ends of the lever members are provided with contact tips 33 of silver or platinum or other suitable material.

A cooperating stationary contact tip 34 is located just above each movable contact tip 33, being mounted upon an L-shaped terminal member 35 that projects through the corresponding opening 26 and is rigidly secured in position by means of a binding-screw 36 that is located above the opening 26.

The lower sets of side openings 27 in the stationary frame member 25 are similarly utilized in connection with lever members 37 and stationary terminal members and binding-screws of the type just described, the ar-

rangement of parts being reversed with respect to the arrangement just recited, that is, the various binding-screws are located below the openings 27, and thus the sets of lever members 31 and 37 confront each other.

The movable portion 4 of the contact-making and breaking device comprises a shaft 40 of hexagonal form that may or may not be integral with the shaft 18 of the motor 2. A collar 41 is pinned to the shaft 40 for the purpose of partially positioning a plurality of insulating sleeve members 42 that surround substantially the entire length of the shaft 40. A plurality of suitably shaped cam members 43, 44 and 45 are rigidly positioned between adjacent insulating sleeves 42 for the purpose of engaging central portions of the upper and the lower lever members 31 and 37, respectively, as the shaft 40 is rotatably moved by the electric motor 2, to effect engagement between various sets of stationary and movable contact tips 34 and 33, respectively, in accordance with the configuration of the cam members.

In the structure just described, the cam-and-lever arrangement may be classified under the following terms: The fixed end 32 of the lever member 31, for example, constitutes a "fulcrum", while the corresponding cam member is the "power" or energy-producing element and the cooperating contact members 33 and 34 constitute the "load" which the lever member 31 attempts to lift.

The movable element 4 of the contact-making and breaking device is preferably provided with a combined biasing and indicating mechanism that normally maintains the torque motor 2 and the movable element 4 in the illustrated intermediate position, the open or closed condition of the various sets of contact members at this time being dependent upon the configuration of the corresponding cam members, as will be understood. The mechanism in question comprises a collar or clamping member 50 that is secured by a screw 50^a to the outer end of the shaft 40 for aiding to rigidly position the sleeve members 42 and the various cam members, and an upwardly-extending arm 51 is secured by a rivet 51^a to the collar 50, pin members 65 and 66 in opposite sides of which are suitably engaged by the hooked ends of coil spring members 52 and 53, the outer ends whereof are fastened to standards or side-posts 54 and 55, respectively, that are positioned near the outer edges of the base member 1. In the illustrated normal position, the indicating arm 51 extends vertically upwardly, thus immediately showing the condition of the contact-making and breaking device. As soon as the electric motor 2 is actuated in the one or the other direction, the indicating arm 51 moves ac-

cordingly and thus affords a ready indication, at all times, of the various sets of contact members that are closed.

The inclosing cover member 5 is of approximately the same outer diameter as the stator 15 of the electric motor, and the closed end thereof is located substantially flush with the outer edge of the base 1, while its open inner end rests upon the end-bell 17 of the motor and the brackets or side projections 10 of the base 1. The cover member 5 may, if desired, be detachably secured to the base 1 through the agency of suitable latches 60. Consequently, the entire structure, when using the illustrated inclosed type of motor, is fully protected from dust and injury of all kinds and, furthermore, the inclosed apparatus, considered as a unit, is of a convenient rectangular form which may readily be mounted in any desirable location and which presents a neat appearance.

Only a brief description of the operation of the apparatus will be necessary. As the torque of the electric motor 2 varies in magnitude and direction, according to the value of the currents traversing the stator and rotor windings, which may be connected in the circuit to be governed in accordance with any of the well-known arrangements, the cams 43, 44 and 45 are correspondingly turned in the one or the other direction to close various sets of stationary and movable contact members, as predetermined by the configuration of the cam members. Simultaneously, the indicating arm 51 is rotatively moved in a similar direction, and one of the springs 52 and 53 is shortened, while the other is extended. As soon as the motor torque diminishes, the springs act to return the various sets of contact members to the illustrated initial position, in readiness for any subsequent change in motor conditions.

It will be understood that the various sets of contact members may be utilized singly or in pairs to govern one or more circuits and that the particular number or initially open or closed condition of such contact members is immaterial to the present invention.

I have found that the device just described, employing a motor having the previously enumerated characteristics, is positive and reliable in its action, although very sensitive to slight voltage differences, which qualifications render the device very advantageous in many instances, such as the connection of momentum-driven, separately-excited dynamo-electric machines to a supply circuit when the machines attain a voltage substantially equal to the supply-circuit voltage.

I do not wish to be restricted to the spe-

cific structural details or arrangement of parts herein set forth, as various modifications thereof may be made without departing from the spirit and scope of my invention. I desire, therefore, that only such limitations shall be imposed as are indicated in the appended claims.

I claim as my invention:

1. The combination with a hollow supporting frame and a rotatable member located within said frame, of a plurality of binding-screws secured to the sides of said frame, stationary terminal members attached to said binding-screws, a plurality of lever members extending across the frame and each having one end mounted upon the terminal members on one side of the frame and the free other end located near the terminal members on the other side of the frame, and cam surfaces positioned on said rotatable member for effecting predetermined engagement of the free ends of said lever members with the adjacent stationary terminal members, and means for biasing said rotatable member to a predetermined position.

2. The combination with a hollow supporting frame and a rotatable member located within said frame, of an upper and a lower set of lever members mounted upon and extending across said frame, a plurality of stationary members located near the free ends of said lever members, and a plurality of cam members positioned on said rotatable member between said sets of lever members for effecting predetermined engagement thereof with the remaining terminal members, and opposing spring members for biasing said rotatable member to a predetermined position.

3. The combination with a hollow supporting frame and a rotatable shaft located within said frame, of an upper and a lower binding-screw secured to the sides of said frame, corresponding stationary terminal members attached to said binding-screws and extending toward each other, corresponding lever members extending across the frame and each having one end mounted upon a terminal member on one side of the frame and the free other end located near a terminal member on the other side of the frame, and a cam member positioned on said rotatable shaft between said lever members for effecting predetermined engagement thereof with the remaining terminal members.

In testimony whereof I have hereunto subscribed my name this 29th day of May, 1917.

ARTHUR J. HALL.