Feb. 16, 1932.

R. J. WISE

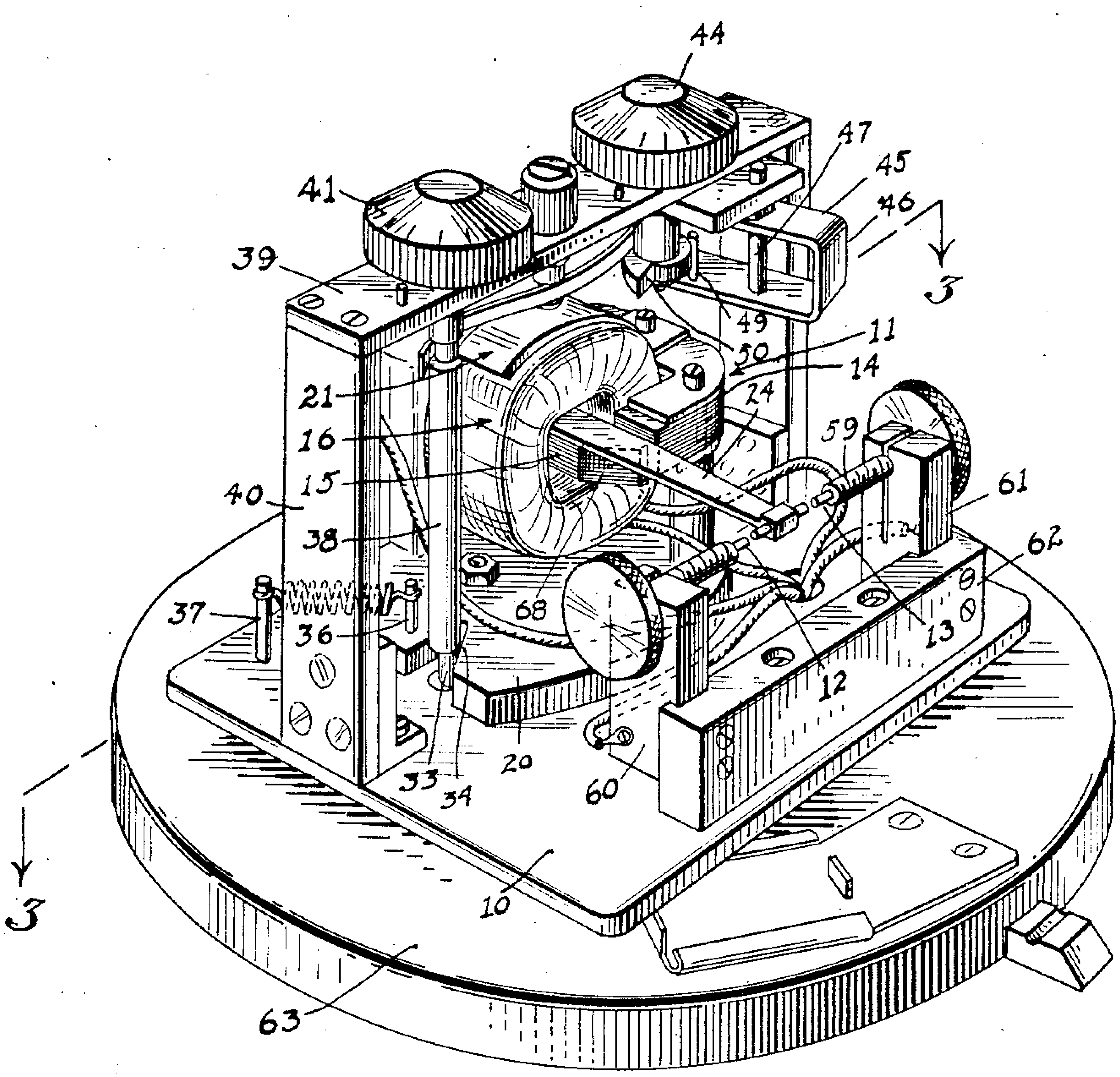
1,845,992

HIGH SPEED SINGLE CURRENT RELAY

Filed July 9, 1929

3 Sheets-Sheet 1

Fig. 1.



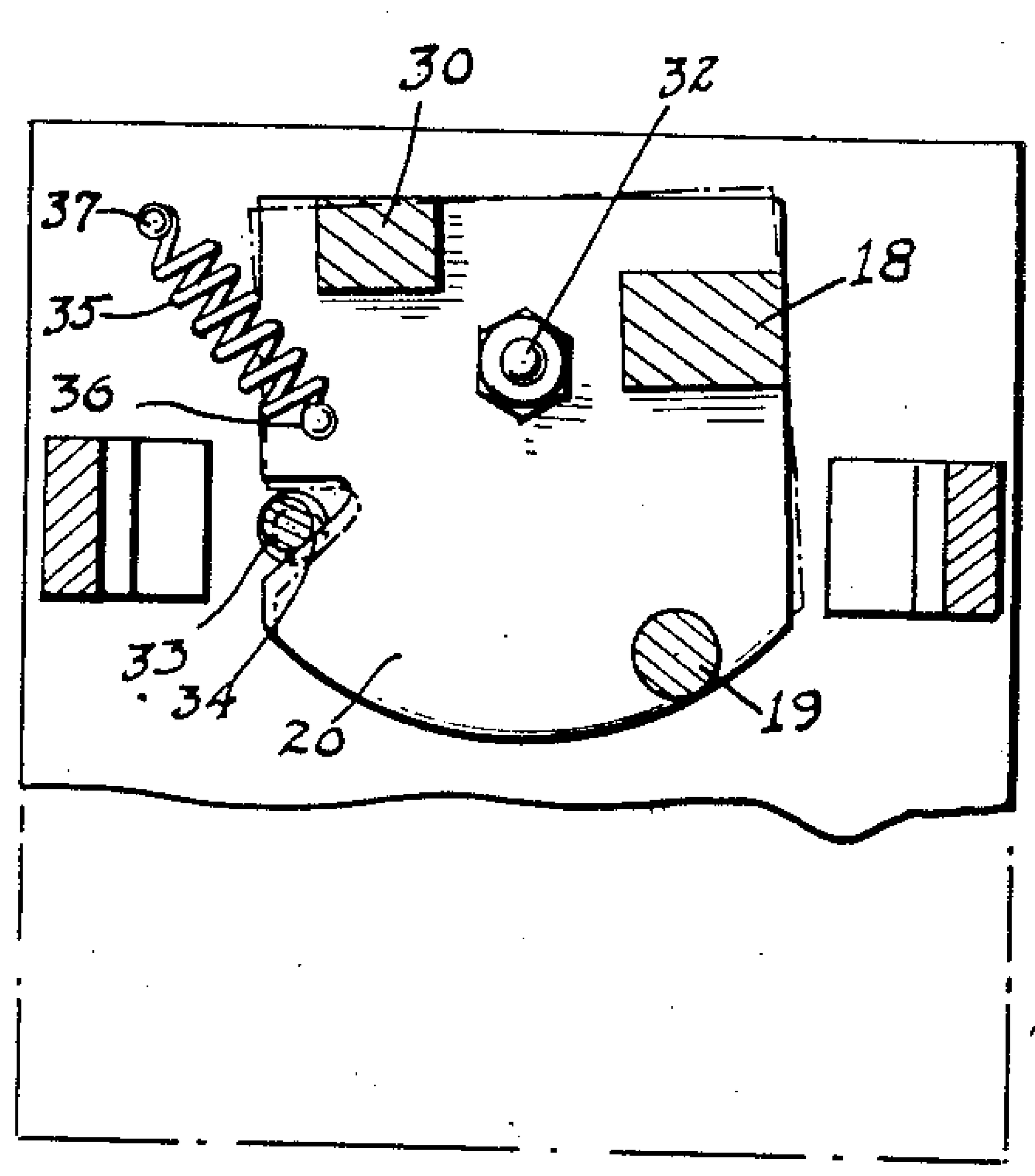


Fig. 2.

Inventor
Raleigh J. Wise

Eugene C. Brown
Attorney

Feb. 16, 1932. R. J. WISE 1,845,992

HIGH SPEED SINGLE CURRENT RELAY

Filed July 9, 1929 3 Sheets-Sheet 2

Fig. 3.

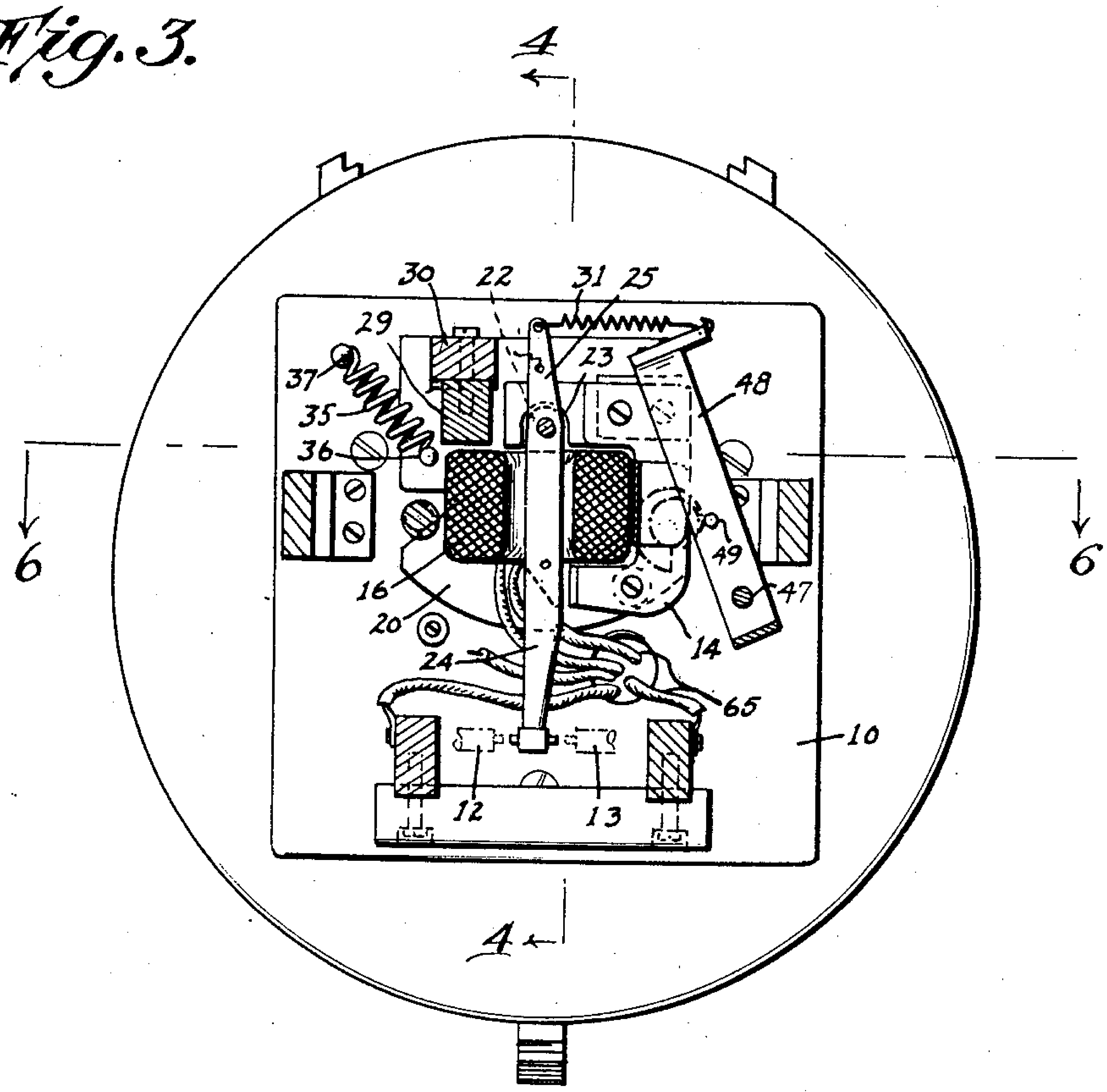
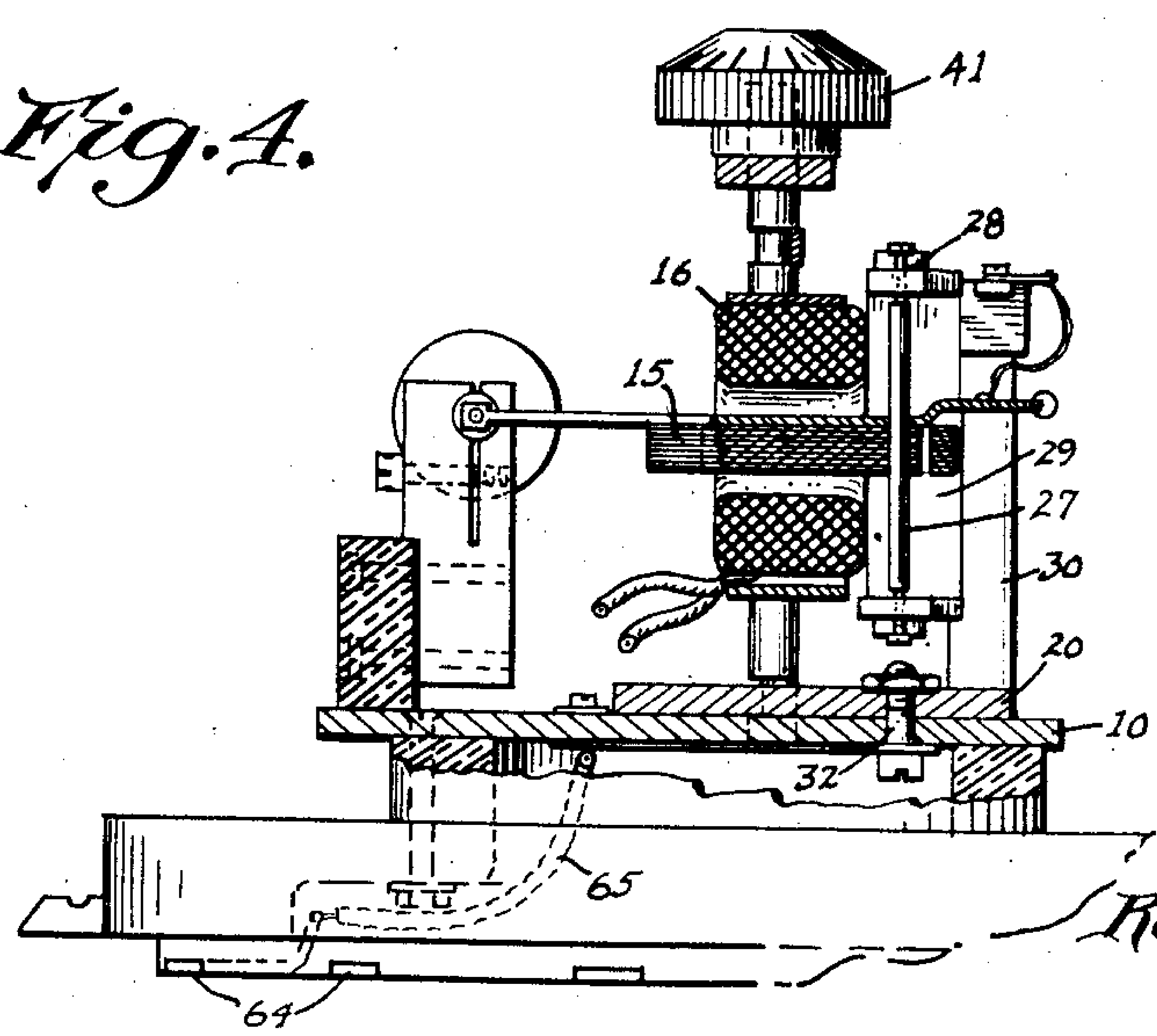


Fig. 4.



Inventor
Raleigh J. Wise

Eugene C. Brown
Attorney

Feb. 16, 1932.

R. J. WISE

1,845,992

HIGH SPEED SINGLE CURRENT RELAY

Filed July 9, 1929

3 Sheets-Sheet 3

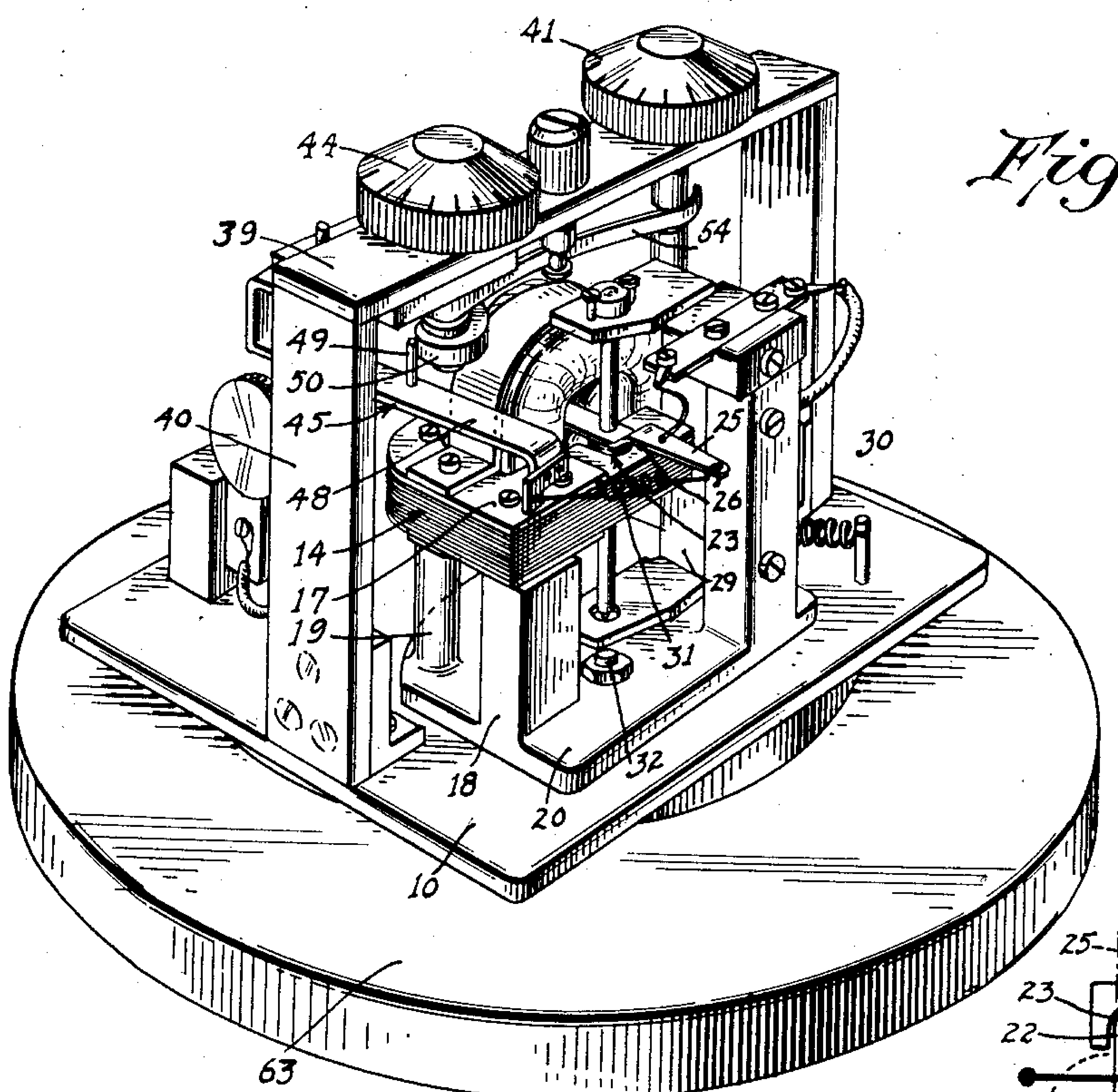


Fig. 5.

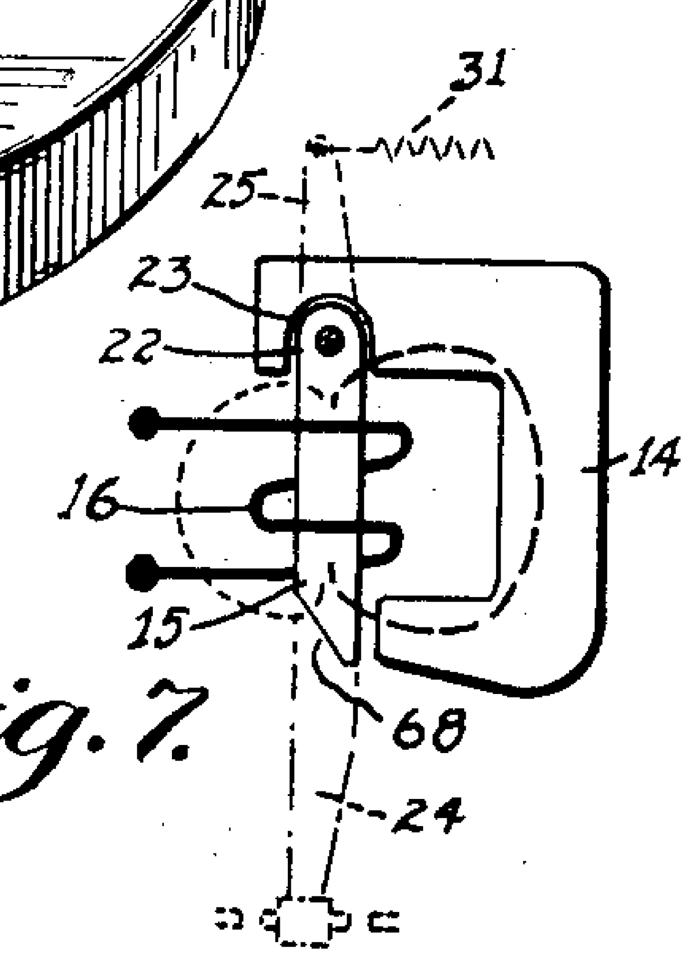


Fig. 7.

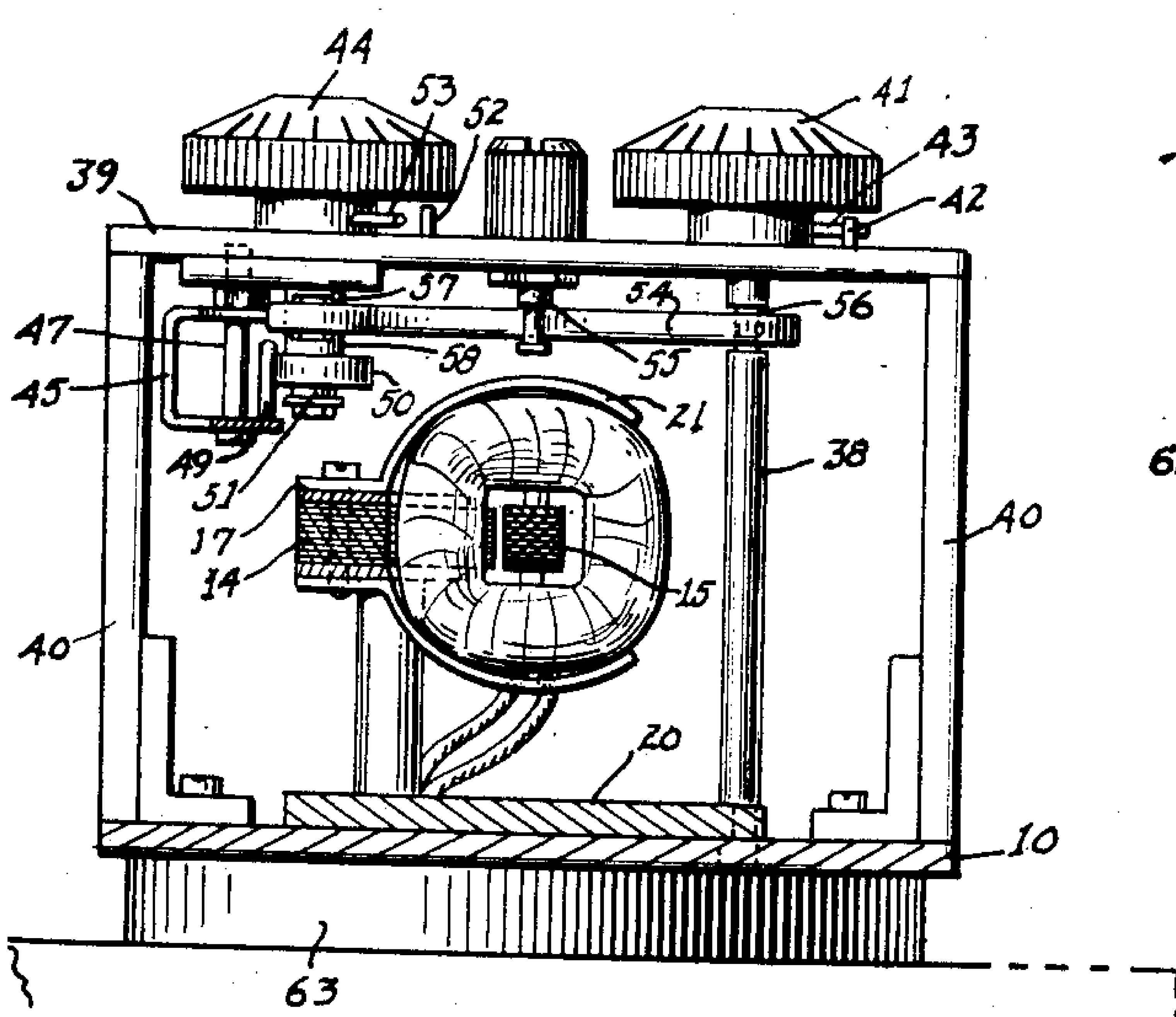


Fig. 6.

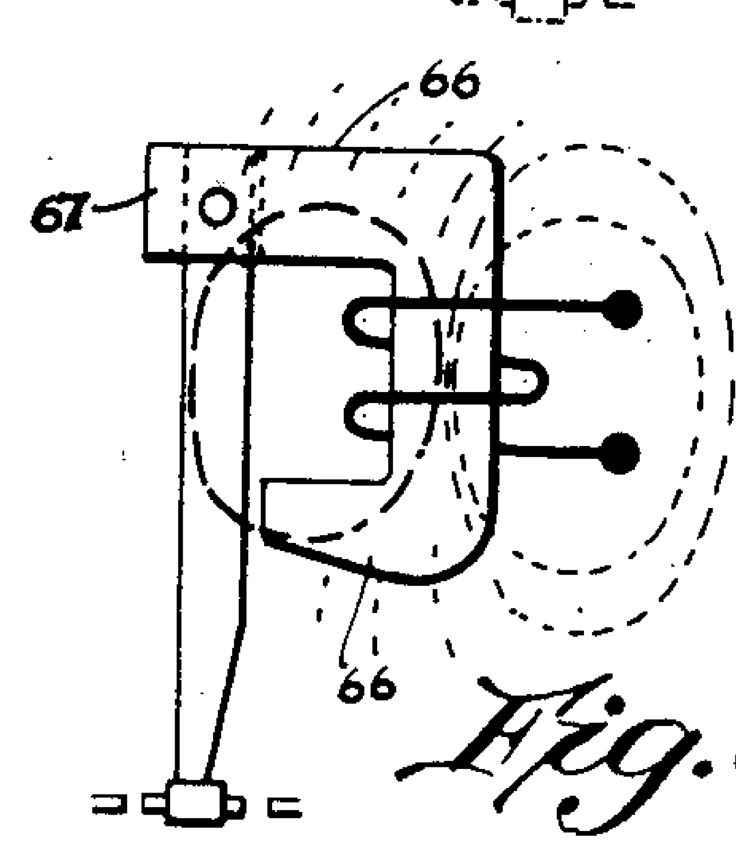


Fig. 8.

Inventor

Raleigh J. Wise

Eugene C. Brown

Attorney

Patented Feb. 16, 1932

1,845,992

UNITED STATES PATENT OFFICE

RALEIGH J. WISE, OF PLAINFIELD, NEW JERSEY, ASSIGNOR TO THE WESTERN UNION TELEGRAPH COMPANY, OF NEW YORK, N. Y., A CORPORATION OF NEW YORK

HIGH SPEED SINGLE CURRENT RELAY

Application filed July 9, 1929. Serial No. 376,986.

This invention relates to a single current electromagnetic relay, that is, to a relay which operates by virtue of the magnitude of the current irrespective of the direction thereof, and more particularly to a magnetic relay in which the travel time of the contact arm between the stationary contacts, is short.

In the usual relay construction there is an appreciable interval of time between the instant when the movable contact leaves one of the stationary contacts and the instant it makes contact with the opposite stationary contact. This is a serious objection in the use of the relay especially in connection with the operation of duplex telegraph systems, for instance, wherein it is essential that the shortest possible interval of time shall elapse between the instant one polarity of battery is removed from the line and the instant the opposite polarity of battery or the ground connection, is substituted therefor and to avoid such difficulty it is common practice to employ some form of continuity preserving contacts in conjunction with the relay.

This relatively slow movement of the armature which carries the contact arm is due mainly to the high moment of inertia of the armature and to the slow and incomplete magnetization and demagnetization of the magnet core. The rate of magnetization and demagnetization of the magnetic core is dependent upon a number of factors, such as, the residual magnetism in the core, flux, leakage, eddy currents, etc.

It is one of the objects of the present invention to overcome these difficulties and to produce a single current relay in which the travel time of the contact arm between the stationary contacts will be short.

Another object is to produce a high speed relay in which the magnetic circuit will be rapidly and more completely magnetized and demagnetized.

Another object is to reduce the flux leakage, and the residual magnetism in the magnetic circuit and eliminate eddy current effects.

A further object is to provide a convenient adjustment of the air gap between the armature and the magnetic pole faces.

A still further object is to provide a convenient adjustment of the tension of the retractile armature biasing spring.

Other objects and advantages will hereinafter appear.

In accordance with my invention I reduce the moment of inertia of the armature by directly mounting the same at one end, adjacent the yoke of the magnet, so that in place of the usual bodily movement of the armature, it has pivoted movement only about such end, no extra metal other than that composing the armature itself with its contact arm and the pivot, being required to be moved in response to the operating current. The armature is also shaped at the free end to eliminate all unnecessary metal and the switch arm which projects beyond the armature is preferably composed of a light material, such as aluminum.

In order to still further reduce the resistance to movement of the armature it is mounted upon jeweled bearings independently of the yoke of the magnet.

The demagnetization of the magnetic core is rendered more rapid by interposing an auxiliary air gap in the core. In the embodiment of the invention disclosed this gap is provided between the pivoted end of the armature and the yoke and in order that such gap will not unduly increase the reluctance of the magnetic circuit, the end of the armature is disposed in a recess in the yoke shaped to correspond to the shape of the pivoted end of the armature and thus provide a uniform short gap having opposed surfaces of relatively large area.

In order to reduce the flux leakage to a minimum and thus decrease the self inductance of the relay coil, I mount the coil directly around the armature rather than around the yoke, as in ordinary practice, and maintain the exposed surfaces at the ends of the armature small so that there is only a limited area available from which flux leakage may take place. Decreasing the self induction of the coil contributes to increased speed of operation as will be readily appreciated. Reduction of the leakage flux also increases the useful flux available.

The armature, due to its pivoted mounting may readily be laminated, thus reducing eddy currents and residual magnetism since eddy currents vary in intensity with changes in the amplitude of the received impulse, the elimination of eddy current effects tends towards more uniform operating conditions of the relay.

In order that the invention may be more fully understood reference will be had to the accompanying drawings, in which;

Fig. 1 is a perspective view of a relay embodying my invention, showing the front of the instrument;

Fig. 2 is a horizontal section of the relay showing the adjustable yoke supporting plate;

Fig. 3 is a sectional view on the line 3—3 of Figure 1;

Fig. 4 is a sectional view on the line 4—4 of Figure 3;

Fig. 5 is a rear perspective view of the instrument;

Fig. 6 is a sectional view on the line 6—6 of Figure 3;

Fig. 7 is a diagrammatic view of the arrangement of the relay winding on the armature of the relay; and

Fig. 8 is a diagrammatic view illustrating a prior art construction, and included for the purpose of comparison.

My improved relay comprises a suitable base plate 10 having the relay magnet 11 and the stationary relay contacts 12 and 13 independently mounted thereon so as to permit separate and relative adjustment of these members.

The relay magnet comprises the U-shaped laminated iron yoke 14, laminated armature 15 and a coil 16, the coil being disposed about the armature 15. The laminations comprising the yoke 14 are clamped between non-magnetic side pieces 17, preferably of brass and the yoke is rigidly supported upon posts 18 and 19 carried by an adjustable base or turntable 20. The coil 16 is supported from the yoke 14 by metal clamps 21 in such position as to surround the armature 15, the opening in the coil being sufficiently large to permit the required pivotal movement of the armature.

In order to increase the rapidity and completeness of the demagnetization of the magnetic core and maintain a uniform air gap between the pivoted end of the armature and the yoke in each position of the armature, the pivoted end 22 thereof is rounded and disposed within a concentric recess 23 in the yoke. One or more of the laminations of the armature may be extended both rearwardly and forwardly thereof to form the contact arm 24 and the tail piece 25, but I prefer to form the contact arm of a light non-magnetic material such as aluminum. The tail piece is flexed upwardly at 26 to clear the side of the yoke. The armature is supported by a vertical pivot 27 mounted in jeweled bearings 28 provided in the oppositely disposed arms of a U-shaped bracket 29 carried from the plate 20 by the post 30. The contact arm operates between the stationary contacts 12 and 13 and is normally biased towards one of the contacts 12, which may be the spacing contact, by a spring 31 attached to the tail piece 25.

The plate 20 upon which the relay magnet is carried is secured to the base 10 by a pin 32 which permits limited rotation thereof under the action of a cam 33. The cam 33 bears against an inclined face 34 forming one side of a substantially V-shaped slot in the plate and moves the plate and relay magnet assembly against the tension of a rectractile spring 35, the opposite ends of which are secured to a pin 36 extending from the plate 20 and a fixed pin 37 extending from the base 10.

The cam 33, as shown, consists of an eccentric portion of a vertical shaft 38 bearing at its opposite ends in the base 10 and in a bridge member 39 supported over the relay magnet by the brackets 40.

Rotation of the shaft 38 permits a convenient adjustment of the pole face of the yoke relative to the armature. A dial 41 which may be of any suitable form, is provided on the shaft 38 for convenience in operating the same. Rotation of the shaft in either direction is limited by a pin 42 projecting from the bridge member 39 into the path of a stop pin 43 projecting radially from the hub of the dial 41.

A second dial 44 is also provided on the bridge member 39, the function of which is to provide a convenient adjustment of the tension of the retractile spring 31. This adjustment is accomplished through the following mechanism. A lever 45 having one end bent in the form of a bail 46, is pivoted by a pin 47 below the bridge member 39, one arm 48 of the lever extending rearwardly and having one end of the retractile spring 31 attached thereto. The arm 48 has a pin 49 extending upwardly therefrom in such position as to be engaged by a cam 50 forming part of or mounted upon a shaft 51 bearing in the bridge member 39 and to which the dial 44 is secured.

Rotation of the cam 50 through the dial 44 causes the lever 45 to be rotated about its pivot to increase or decrease the tension of the spring 31. Rotation of the dial is limited by the stop pins 52 and 53.

The shafts 38 and 51 are maintained in their adjusted positions, against accidental movement, by a leaf spring 54 supported beneath the bridge member 39 by a stud 55. One end of the spring 54 is disposed in an annular recess 56 in the shaft 38, and exerts a pressure against the shaft to resist rotation thereof. The opposite end of the spring bears against the shaft 51 through an opening 57 in a spacing collar 58.

The stationary contacts 12 and 13, having threaded shanks 59, are mounted in the usual manner in two split blocks 60 and 61 supported in spaced relation by an insulating member 62.

The base plate 10 is secured to the usual insulating mounting 63 having contacts 64 to which the terminals of the coil 16, contact arm 24 and stationary contacts 12 and 13 are connected by insulated conductors 65.

Referring now to Figures 7 and 8 it will be noted that the concentric arrangement of the pivoted end of the armature in the recess 23 provides a uniform air gap of relatively large area in the magnetic circuit, thus increasing the rapidity and completeness of demagnetization without unduly increasing the reluctance. Furthermore, this air gap in conjunction with the air gap at the pole face of the magnet completely isolates the armature from contact with the relay yoke through magnetic material and limits the flux leakage to the small area of magnetic metal exposed beyond the ends of the coil 16, as shown in dotted lines in Figure 7. The flux leakage is dependent upon the exposed area of the surface of the core and is very small as compared to the usual arrangement shown in Figure 8 in which the coil is mounted upon the yoke leaving the exposed side arms 66 available for flux leakage.

A common form of armature mounting is shown in Figure 8 in which the armature is pivoted in the forked end 67 of the yoke in direct metallic contact therewith. It should be noted that in accordance with my invention I have mounted the armature of the relay independently of the yoke in the jeweled bearings 28. This independent mounting enables a much more delicate and better bearing to be obtained than is possible with the space limitation imposed when the armature is pivoted to the relay yoke.

The free end of the armature is cut off at an angle as indicated at 68 in order to reduce the moment of inertia of the armature and to reduce the area of the exposed end thereof, which is available for flux leakage. The contact arm 24 being composed of non-magnetic metal there is no leakage from the extended ends thereof.

The armature pivot 27 is disposed in alignment with the pivot 32 of the turntable or plate 20, as is clear from Figures 4 and 5, thus eliminating any longitudinal shifting of the yoke relative to the armature during adjustment of the air gap and hence maintaining the proper positioning of the armature opposite the pole face of the yoke at all times.

In adjusting the armature air gap and the spring tension for the best operation of the relay under the required conditions the dial 41 is turned to rotate the yoke to the limit of its movement toward the armature. The spacing contact 12 is then moved against the switch arm contact to position the armature so that it will have the minimum desired air gap in the open circuit position of the armature. The marking contact 13 is then adjusted to such a position that there will be a slight air gap between the armature and the pole face of the yoke when the relay is energized. In practice this gap is usually made about .002 inches. With this preliminary adjustment the armature air gap may be increased as operating conditions require. Thus for instance under marginal operation, the gap should be adjusted to obtain the maximum armature force for the operating range of current. Due to leakage conductance along the line, the current in the relay coils does not fall to zero upon opening of the transmitting circuit but is merely reduced in magnitude. The amount of the reduction in the current below the normal operating current determines the range or margin of operation and since this varies from time to time due to weather and atmospheric conditions it is necessary to make frequent adjustments of the air gap as well as the tension of the retractile spring 31.

A function of the spring 31 is, therefore, to bias the armature against this line leakage current. After the air gap has been adjusted to obtain the maximum armature force for the then existing marginal conditions, the biasing spring tension is adjusted by the dial 44 so that the armature will be released when the current in the relay coil is reduced below the normal line current and also to obtain the least signal distortion.

Due to the position of the adjusting dials on the top of the instrument, they are readily accessible even though the instrument be spaced close to the other apparatus.

While I have described my invention with particular reference to an electro-magnet relay, it is to be understood that it is not so limited but many features hereof are applicable to electro-magnetic motor apparatus of various natures and that many changes and modifications may be made in the invention without departing therefrom, and therefore, I do not desire to be limited to the particular details shown and described except in accordance with the appended claims.

What is claimed is:

1. An electro-magnetic device comprising a yoke having a recess therein and an armature having an end pivoted in said recess, the pivoted end of the armature being spaced from the walls of said recess by a non-magnetic gap.

2. An electro-magnetic device comprising a yoke having a recess therein and armature having one end pivoted in said recess, the pivoted end of the armature being shaped to

correspond with the shape of the recess and being spaced therefrom by a substantially uniform gap of non-magnetic material.

3. An electro-magnetic device comprising a yoke having a substantial semi-cylindrical recess therein and an armature having one end shaped to correspond to said recess pivoted in said recess, said end being disposed concentric with the walls of the recess and spaced therefrom by a non-magnetic gap.

4. An electro-magnetic device comprising a U-shaped yoke, an armature extending between the ends of said yoke and pivoted adjacent one end thereof and an energizing winding encircling the armature, the exposed free end of said armature being of small area and terminating closely adjacent the end of the yoke, whereby the available area for flux leakage is decreased and the moment of inertia of the armature reduced.

5. An electro-magnetic device comprising a U-shaped yoke, an armature extending between the ends of said yoke and an energizing winding encircling the armature and constituting the sole magnetizing means for said device, the exposed ends of the armature beyond the ends of said winding being of small area and isolated from said yoke by a non-magnetic gap.

6. An electro-magnetic device comprising a U-shaped yoke having a recess therein, an armature having one end pivoted in said recess and extending across said yoke and an energizing winding encircling said armature, the pivoted end of said armature being spaced from the walls of said recess by a non-magnetic gap.

7. An electro-magnetic device comprising a yoke having a recess therein and an armature composed of laminations having one end pivoted in said recess, the pivoted end of said armature being spaced from the walls of said recess by a non-magnetic gap.

8. An electro-magnetic relay comprising a U-shaped yoke, an armature extending across the ends of said yoke and pivoted to one end thereof and an energizing winding encircling said armature, the free end of the armature being reduced in area adjacent the end of the yoke, whereby the available area for flux leakage is decreased and the moment of inertia of the armature reduced, and a switch arm composed of non-magnetic material carried by said armature.

9. An electro-magnetic relay comprising an armature, a yoke and an energizing winding, a supporting plate therefor, means for mounting the armature and yoke independently of each other upon said plate, a stationary contact, means for maintaining the armature in a definite position relative to said contact and means for moving said plate to adjust the yoke with respect to the armature.

10. An electro-magnetic relay comprising an armature, a yoke and an energizing winding, a supporting plate therefor, means for mounting the armature and yoke independently of each other upon said plate, a stationary contact, means for maintaining the armature in a definite position relative to said contact and a cam associated with said plate for rotating the same to adjust the yoke with respect to the armature.

11. An electro-magnetic relay having a relay assembly comprising an armature, a yoke and an energizing winding, a supporting plate for said assembly, means for mounting said armature and yoke independently of each other upon said plate, a support disposed above said relay armature and means on said support for adjusting the yoke relative to the armature.

12. An electro-magnetic relay having a relay assembly comprising an armature, a yoke and an energizing winding, a supporting plate for said assembly, means for mounting the armature and yoke independently of each other upon said plate, a stationary contact, means for maintaining said armature in a definite position relative to said contact, a support disposed above said relay assembly and means on said support for rotating said plate to adjust the yoke relative to the armature.

13. An electro-magnetic relay having a relay assembly comprising an armature, a yoke and an energizing winding, a supporting plate for said assembly, means for mounting the armature and yoke independently of each other upon said plate, a switch arm carried by the armature, a stationary contact, means for biasing said switch arm towards said stationary contact, a support disposed above said relay assembly and means on said support for adjusting said biasing means.

14. An electro-magnetic relay having a relay assembly comprising an armature, a yoke and an energizing winding, a supporting plate for said assembly, means for mounting said armature and yoke upon said plate, a switch arm carried by said armature, a stationary contact, a support disposed above said relay assembly, a lever pivoted on said support, a retractile spring connected to an end of said lever and said switch arm for biasing said arm towards said stationary contact and means on said support for moving said lever to vary the tension of said spring.

15. An electro-magnetic relay having a relay assembly comprising an armature, a yoke and an energizing winding, a supporting plate for said armature, means for mounting the armature and yoke independently of each other upon said plate, a switch arm carried by said armature, a stationary contact, means for biasing said switch arm towards said stationary contact, a support disposed above said relay assembly, means on said support for adjusting the yoke relative to the arma-

ture and independent means mounted on said support for adjusting said biasing means.

16. An electro-magnetic relay having a relay assembly comprising an armature, a yoke and an energizing winding, a supporting plate for said armature, a base, means for pivotally mounting said supporting plate upon said base and means for independently pivotally mounting said armature on said plate, said plate and armature being pivoted about substantially the same axis.

17. An electro-magnetic relay having a relay assembly comprising an armature, a yoke and an energizing winding and means for pivotally mounting said armature and said yoke independently of each other about substantially the same axis.

18. An electro-magnetic device comprising a U-shaped yoke, an armature extending between the ends of said yoke, and an energizing winding encircling the armature, the major portion of the armature being contained within the confines of said winding, the exposed ends of the armature extending short distances only beyond the winding and terminating closely adjacent the ends of the yoke.

In testimony whereof I affix my signature.

RALEIGH J. WISE.