July 30, 1940. C. C. WHITTAKER 2,209,368

EDDY CURRENT RELAY

Filed March 25, 1938 2 Sheets-Sheet 1

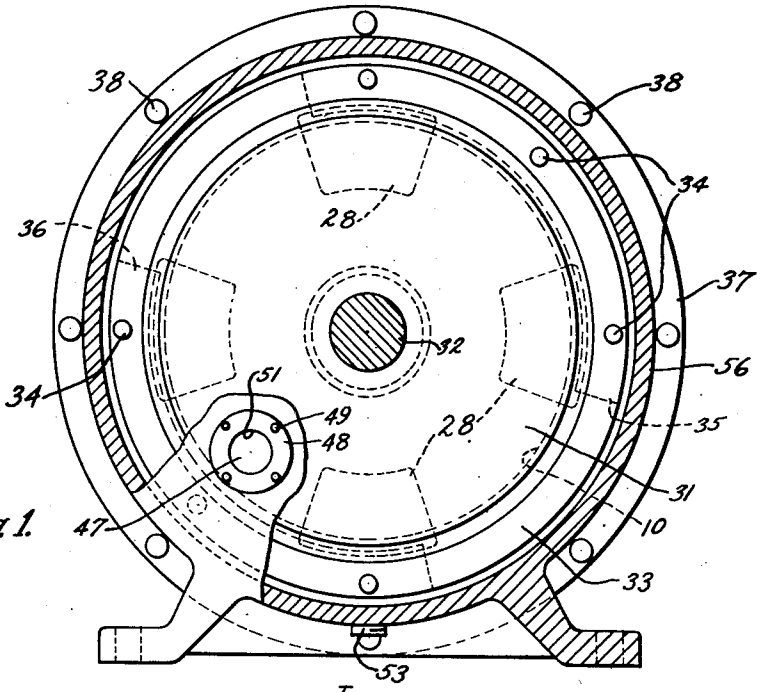


Fig. 1.

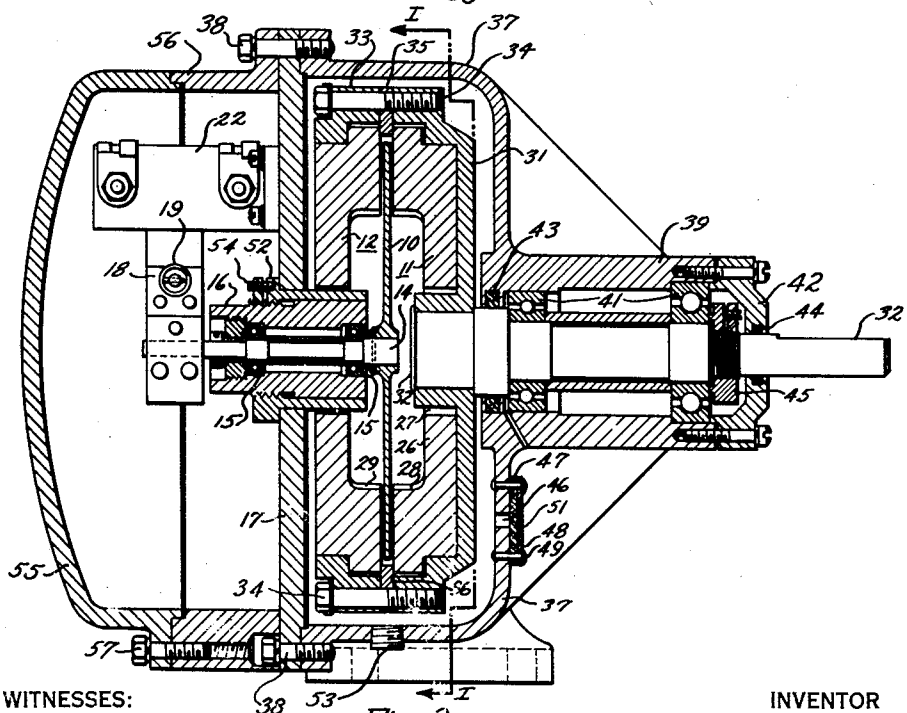


Fig. 2.

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EDDY CURRENT RELAY

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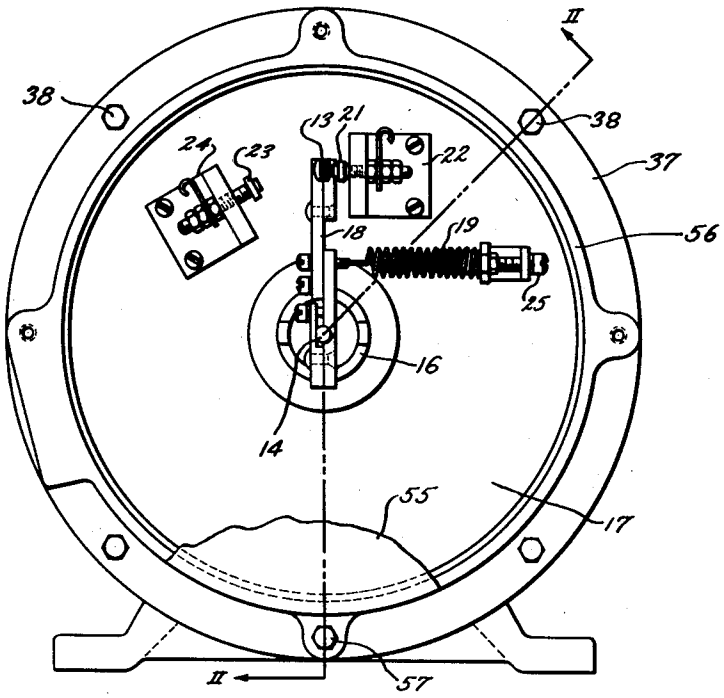


Fig. 3.

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UNITED STATES PATENT OFFICE

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EDDY CURRENT RELAY

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Application March 25, 1938, Serial No. 198,087

6 Claims. (Cl. 200—92)

My invention relates, generally, to speed-responsive relays and, more particularly, to relays of the eddy current or magnetic drag type.

While numerous devices which operate on the well-known magnetic drag principle have been utilized as speedometers for automobiles and other vehicles, none of the foregoing devices develop sufficient torque to make them suitable for use as speed-responsive relays having contact members which must carry a relatively high current.

An object of my invention, generally stated, is to provide a speed-responsive relay of the magnetic drag type which shall be simple and efficient in operation and which may be economically manufactured and installed.

A more specific object of my invention is to provide a relay of the magnetic drag type which shall be capable of developing a relatively high torque.

Another object of my invention is to provide a magnetic drag relay having substantially constant operating characteristics.

A further object of my invention is to provide a magnetic drag relay having relatively low eddy current losses.

A still further object of my invention is to provide a relay of the magnetic drag type which is readily adaptable to a wide variety of applications.

Other objects of the invention will be explained fully hereinafter or will be apparent to those skilled in the art.

In a relay constructed in accordance with the invention, eddy currents are set up in a rotatable disc by a rotating magnet of special construction, thereby causing a magnetic drag on the disc. The magnet is composed of an alloy having desirable magnetic properties, and is reinforced mechanically by a non-magnetic casting which encircles the magnet and is mounted on the driving shaft. A contact member is carried by the shaft of the disc and is biased to a predetermined position by a spring, the force of which is overcome by the torque of the disc when the magnet is driven at a predetermined speed.

For a fuller understanding of the nature and objects of the invention, reference may be had to the following detailed description, taken in conjunction with the accompanying drawings, in which:

Figure 1 is a view, partially in elevation and partially in section, of a relay embodying my invention, the sectional view being taken along the line I—I of Fig. 2;

Fig. 2 is a view, in section, taken along the line II—II of Fig. 3; and

Fig. 3 is a view, in end elevation, of the relay structure, a portion of the cover being broken away to show the arrangement of the contact members of the relay.

Referring now to the drawings, and particularly to Fig. 2, the speed-responsive relay shown therein is of the magnetic drag type and comprises a rotatable disc 10, which may be composed of copper, aluminum or other suitable non-magnetic material, a rotating magnet having two sections 11 and 12, which are disposed on opposite sides of the disc 10 to rotate in planes parallel to the disc, and a contact member 13 (see Fig. 3) actuated by the disc 10.

The disc 10 is mounted on one end of a shaft 14 carried by ball bearings 15 which are enclosed in a housing 16 supported by a partition member 17 of the relay structure. The wall 17 is preferably composed of brass or other non-magnetic material to prevent leakage of the flux established by the magnets 11 and 12.

The contact member 13 is carried by an arm 18 secured to the other end of the shaft 14 and a spring 19 is disposed to bias the arm 18 to a position in which the contact member 13 engages a contact member 21 mounted on a bracket 22 that is secured to the wall 17. When the torque of the disc 10 is sufficient to overcome the biasing force of the spring 19, the contact member 13 is disengaged from the contact 21 and actuated into engagement with a contact member 23 that is mounted on a bracket 24 also secured to the wall 17. The tension of the spring 19 may be adjusted by means of a screw 25 to vary the speed setting of the relay.

In this manner, the contact members of the relay may be utilized to perform switching operations in response to the speed at which the rotating magnets 11 and 12 are driven. In accordance with a principle well known in the art, eddy currents are set up in the disc 10 by the flux produced by the magnets and the rotation of the magnets causes a magnetic drag or torque on the disc which is proportional to the speed of rotation of the magnets.

Either one or two magnets may be utilized, depending upon the amount of torque required for a particular application of the relay. As shown, the magnet 11 comprises a circular plate 26 having a hole 27 at its center, and four equally spaced shoulders 28 at its periphery which constitute four magnetic poles. The magnet 12 is similar to the magnet 11, and has four poles 29

disposed on the opposite side of the disc 10 from poles of opposite polarity of the magnet 11.

The magnets 11 and 12 are composed of a special aluminum and nickel alloy which has desirable magnetic properties, but is weak mechanically, making it unsafe to rotate at high speeds. In order to overcome this difficulty, the magnet 11 is mounted in a circular casting 31, which is shrunk on the magnet, and also secured on the end of a driving shaft 32, which is coaxial with the shaft 14, thereby supporting the magnet 11 and rotating it in a plane parallel to the disc 10 at the speed of the shaft 32. The casting 31 may be composed of bronze or any other non-magnetic material having the desired mechanical strength.

When two magnets are utilized, as shown in the drawings, the second magnet 12 also has a bronze ring 33 shrunk on it. The two bronze rings are then bolted together by means of stud bolts 34 with non-magnetic spacing members 35 and 36 placed between them to determine the air gap between the two magnets. If the drag of one magnet is sufficient, the magnet 12 is replaced by a piece of soft steel which functions as an armature for the magnet 11.

In this manner, whether one or two magnets are utilized, there is no eddy current loss except that which occurs in the conductor disc 10, which is necessary and desired. In other speed-responsive devices of the magnetic drag type having a rotating magnet and a fixed armature for the return path of the magnetic flux, undesirable eddy current losses occur in the fixed armature.

The conducting disc 10 is made as a flat plate, which is the most simple structure, thereby permitting the material of which the disc is composed to be varied to provide relay characteristics suitable for various applications. In general, the material having the lowest resistance provides maximum torque on the disc shaft and copper or aluminum are suitable for most applications.

However, the heat generated in the device while in continued operation causes the resistance of the disc to change when it is composed of copper or aluminum. The change in resistance changes the operating characteristics of the relay which is undesirable in certain cases.

When it is necessary to provide a relay having constant characteristics, the disc may be composed of an alloy having a zero temperature coefficient of resistance. There are numerous alloys on the market which have a fine temperature characteristic and a relatively low specific resistance. The flat disc structure makes it possible to utilize these alloys which, because of their toughness, are difficult to shape into other forms of drag members, such as the cup members usually provided in speed-responsive devices of the magnetic drag type.

The rotating magnets and the disc are enclosed by a housing 37 and the partition 17 which is bolted to the housing 37 by bolts 38. The housing 37 is also provided with an integral bearing bracket 39 which supports the shaft 32 for the rotating magnets. The shaft 32 is mounted on ball bearings 41 enclosed by the cylindrical bearing bracket 39 which is provided with a removable cap 42. One end of the shaft 32 extends through the cap 42 and may be connected directly to a rotating machine or it may be geared or belted to the machine. Provision is made for lubricating the bearings 41 and felt washers 43 and 44 are provided for retaining the lubricant in the housing 39. A threaded collar 45 is provided for adjusting the shaft 32 in the bearings 41.

On account of the very strong magnets and small air gaps, it is necessary to have the operating parts completely enclosed to prevent iron particles, such as brake shoe dust, being attracted to the magnets. For this reason, a breather hole 46 covered by a felt filter 47 is provided in the housing 37. The filter 47 is secured to the housing 37 by a plate 48 and rivets 49. The plate 48 is provided with a hole 51 to permit air to pass through the filter 47. The breather hole 46 prevents air being forced out or sucked in through the ball bearings with each change in temperature of the imprisoned air. The form of the magnets is such that the pole pieces 28 and 29 function as paddle-wheel fans and circulate the air within the case to cause maximum radiation during the operation of the device.

As described hereinbefore, the shaft 14, which carries the disc 10, is supported by ball bearings 15 mounted in a housing 16. In order that the disc 10 may be centered between the magnets 11 and 12, the housing 16 is threaded into a sleeve 52 which is pressed into the wall 17. A hole at the bottom of the housing 37, normally closed by a pipe plug 53, permits a view of the position of the disc 10 in the air gap during assembly. The housing 16 is shifted axially until the disc is in the correct position and then locked by means of screw 54. This adjustment may be made by removing a cover 55 which protects the relay contact members. As shown in Fig. 2, the cover 55 is attached to a flanged ring 56 by bolts 57, the ring 56 being secured to the housing 37 by the bolts 38.

It will be understood that the contact arrangement can be varied greatly to suit different conditions, and that additional contacts may be readily provided, if desired. Furthermore, the relay may be designed to operate at various speeds or as a speed governor. It may also be utilized as a rotation detector relay by so arranging the contact members that one contact makes for either direction of rotation as soon as rotation occurs.

I do not desire to be restricted to the specific embodiment of my invention herein shown and described, since it is evident that it may be changed and modified without departing from the spirit and scope of my invention as defined in the appended claims.

I claim as my invention:

1. A speed-responsive relay comprising a rotatable metal disc, a shaft for supporting said disc, a rotating non-magnetic member, a shaft for supporting said rotating member independently of said disc, said shafts being disposed coaxially, a magnet disposed within the non-magnetic member and rotating therewith to cause a magnetic drag on the disc, said magnet being mechanically supported by said non-magnetic member, and switching means carried by the shaft of said disc.

2. A speed-responsive relay comprising a rotatable metal disc, a shaft for supporting said disc, a rotating non-magnetic member, a shaft for supporting said rotating member independently of said disc, said shafts being disposed coaxially, a magnet disposed within the non-magnetic member and rotating therewith to cause a magnetic drag on the disc, said magnet being mechanically supported by said non-magnetic member, means for moving one of said shafts

axially to adjust the position of said disc relative to the magnet, and a contact member actuated by the disc.

3. A speed-responsive relay comprising a rotatable metal disc, a shaft for supporting said disc, a rotating non-magnetic member, a shaft for supporting said rotating member independently of said disc, said shafts being disposed coaxially, a magnet disposed within the non-magnetic member and rotating therewith to cause a magnetic drag on the disc, said magnet being mechanically supported by said non-magnetic member, a contact member actuated by the disc, and means for biasing said contact member to a predetermined position.

4. A speed-responsive relay comprising a rotatable non-magnetic disc, a magnet disposed at one side of the disc to rotate in a plane parallel to the disc, a similar magnet disposed at the other side of the disc and rotating with the first magnet to cause a magnetic drag on the disc, a non-magnetic member encircling the magnets and rotating therewith, both of said magnets being mechanically supported by said non-magnetic member, and switching means actuated by the disc.

5. A speed-responsive relay comprising a rotatable metal disc, a rotating non-magnetic member disposed co-axially with the disc, a magnet disposed within the non-magnetic member and rotating therewith at one side of the disc, a similar magnet disposed at the other side of the disc, a non-magnetic ring encircling the second magnet, means for securing the ring to the rotating non-magnetic member, thereby causing the magnets to produce a magnetic drag on the disc, and switching means actuated by the disc.

6. A speed-responsive relay comprising a rotatable metal disc, a rotating non-magnetic member disposed co-axially with the disc, a magnet disposed within the non-magnetic member and rotating therewith at one side of the disc, a similar magnet disposed at the other side of the disc, a non-magnetic ring encircling the second magnet, means for securing the ring to the rotating non-magnetic member, thereby causing the magnets to produce a magnetic drag on the disc, a housing for enclosing the rotating members, means for adjusting the position of the disc between the magnets from the outside of the housing, and switching means actuated by the disc.

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