May 21, 1957 W. H. REICHARD 2,793,266

INDUCTION TYPE ALTERNATING CURRENT RELAY

Filed Oct. 23, 1953 3 Sheets-Sheet 1

FIG. 1.

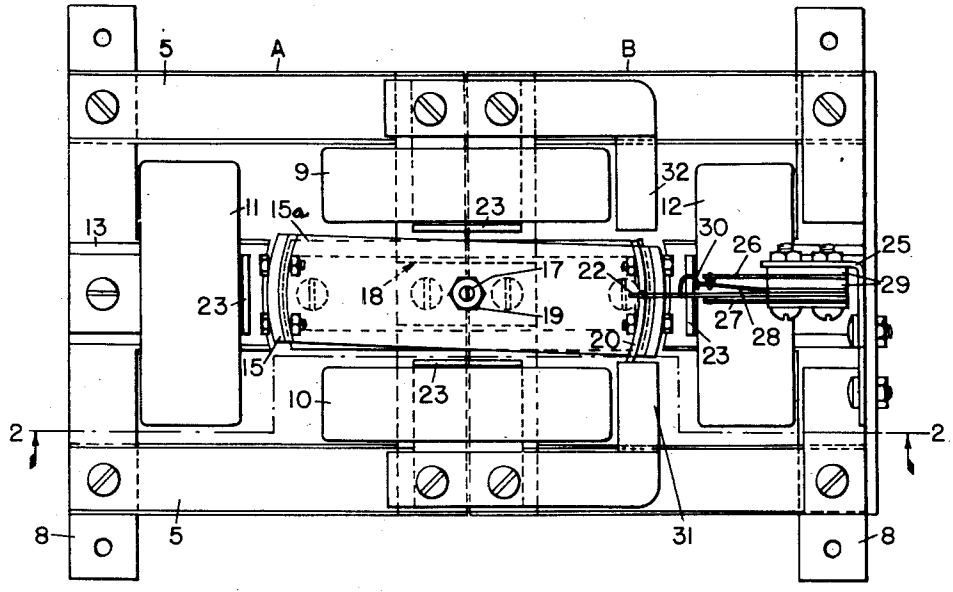
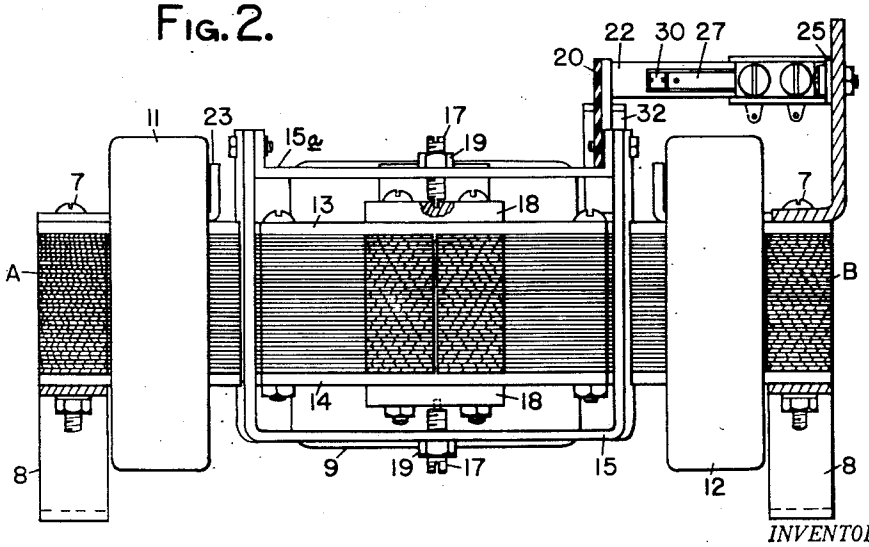


FIG. 2.



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Filed Oct. 23, 1953 3 Sheets-Sheet 2

FIG. 3.

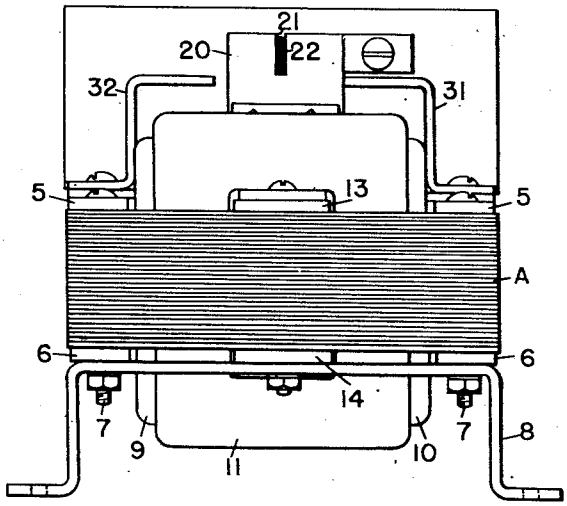
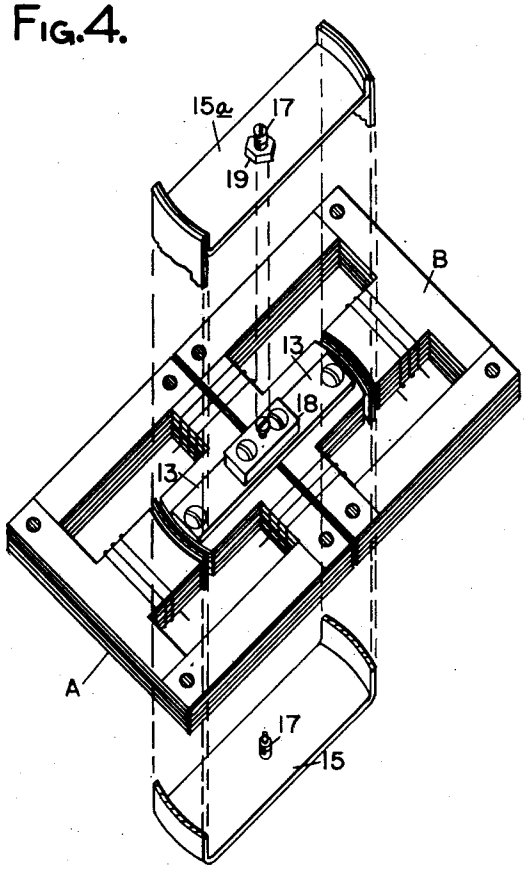


FIG. 4.



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INDUCTION TYPE ALTERNATING CURRENT RELAY

Filed Oct. 23, 1953 3 Sheets-Sheet 3

FIG. 5.

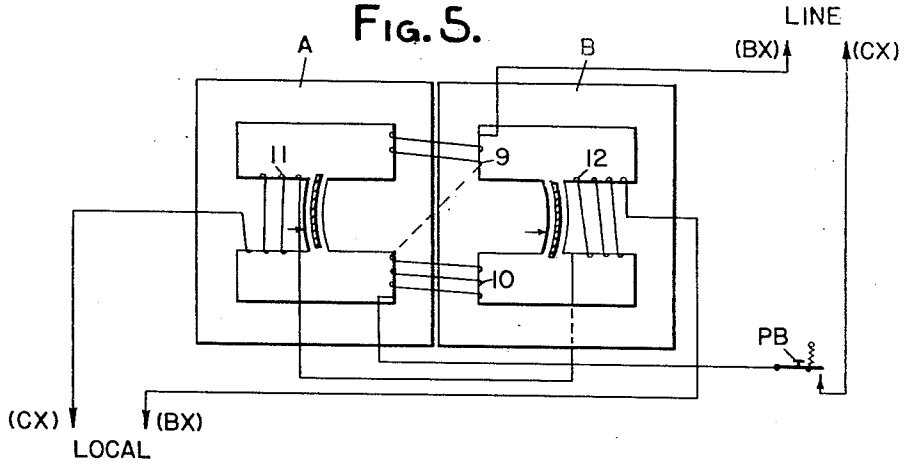


FIG. 6.

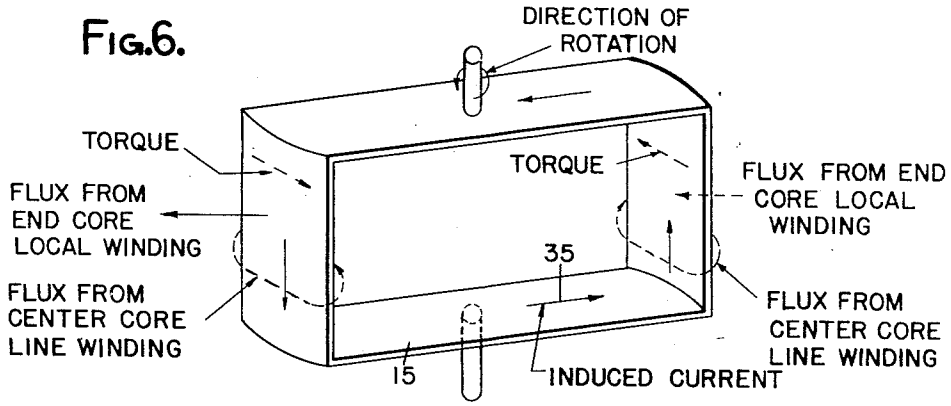
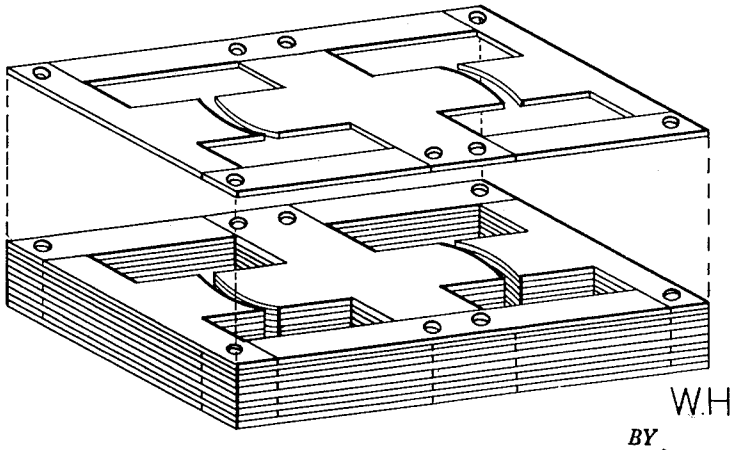


FIG. 7.



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2,793,266

INDUCTION TYPE ALTERNATING CURRENT RELAY

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Application October 23, 1953, Serial No. 387,991

1 Claim. (Cl. 200—91)

This invention relates to induction type alternating current relays, and more particularly pertains to a quick acting induction type relay adapted as a code following relay.

One of the objects of the present invention is to provide an induction type alternating current relay wherein an operating torque is provided when the two phase windings are supplied with alternating currents which are substantially in phase.

Another object of the invention is to provide a relay of this type which is quick acting in its response so as to be able to follow the usual code rates employed in coded track circuits in connection with railway signalling.

A further object of the present invention is to provide a relay structure in which the magnetic field that inductively produces the current in the rotor will be entirely free from air gaps to make for efficient operation of the rotor positioned so as to move in an air gap in the other magnetic field.

Another object of the present invention is to provide a core structure which will serve two magnetic fields without being magnetically coupled.

Other objects, purposes and characteristic features of the present invention will be in part obvious from the accompanying drawings, and in part pointed out as the description of the invention progresses.

In describing the invention in detail, reference will be made to the accompanying drawings, in which like reference characters designate corresponding parts throughout the several views, and in which:

Fig. 1 is a top view of a structure forming a relay embodying the present invention;

Fig. 2 is a side view of the structure shown in Fig. 1 with parts shown in section as taken on line 2—2 of Fig. 1;

Fig. 3 is an end view of the structure shown in Fig. 1;

Fig. 4 is an isometric exploded view to diagrammatically illustrate the association of the rotor and magnetic structure;

Fig. 5 is a diagrammatic view to show the connections of the windings for operation of the relay;

Fig. 6 is a diagrammatic view with arrows and legends to indicate the direction of the flux, currents and torque when the applied energy is in a rising positive quadrant; and

Fig. 7 shows the laminations in an isometric view of a consolidated magnetic structure as a modified form of the invention.

For the purpose of simplifying the illustration and facilitating in the explanation, the various parts of the relay embodying the present invention have been shown in their relative positions and functional relationships without making any effort to illustrate the most refined form both as to appearance and as to economical manufacture. Also, the functional characteristics have been illustrated without an effort to show the best form to accomplish those functions. For example, the bearings of the relay are shown as having a form which is functionally complete, but which in a commercialized structure may assume some form of frictionless bearing or the like.

In the diagram of Fig. 5 indicating the circuits, symbols (BX) and (CX) are employed to indicate the opposite terminals of a suitable alternating current source, and these designations represent the terminals as having a particular relative instantaneous phase relationship, the terminal (BX) being positive with respect to (CX). It is to be understood that the different pairs of terminals may be supplied with energy from the same source or from different sources so long as the currents from the two sources are substantially in phase with each other.

With reference to Fig. 1, it will be noted that the relay structure is made up of two stackings A and B of laminations each of which is in a form which can be more readily seen in Fig. 4, and which has a form of a figure S-shape. These two stackings A and B are held together by upper and lower frame bars 5 and 6 (see Fig. 3) which are fastened along the sides of the stackings by bolts 7. These bolts 7 also hold in position the supporting legs 8 which are located at opposite ends of the relay with extending feet as shown in Figs. 1 and 3 for fastening the relay to a suitable base.

Similar frame bars 13 and 14 are mounted above and below the stackings at their centers to which bearing supports 18 are fastened by suitable bolts.

It is, of course, understood that the stackings are assembled in a manner to include the coils 9, 10, 11 and 12 which are connected in a manner shown in detail in Fig. 5. Each of these coils is provided with suitable L-shaped brackets 23 for holding them in their respective positions.

Referring to Fig. 2, it will be noted that a rotor 15 is formed in a U-shape with a cross member 15*a* enclosing it. These two portions 15 and 15*a* are shown in the illustration as being bolted together; but it is to be understood that they could be welded or brazed together in any suitable manner so as to make a completely closed electrical circuit. The rotor 15 is pivotally mounted by having two bearing screws 17 fitting within the bearing supports 18 that are bolted to the laminated structure. Lock nuts 19 are employed to hold these bearing screws 17 in position after they have once been set.

The right-hand end of the rotor 15 (see Fig. 2) has attached to it a contact operator 20 which includes a slot 21 (see Fig. 3) for receiving the extending spring 22 of a contact assembly.

This contact assembly comprises a support bracket 25 to which is mounted back contacts 26 and 27 respectively on opposite sides of the contact operator 22 and the movable contact member 28. Suitable insulating spacers 29 are employed, so that separate electrical connections may be made to the back and front fixed contacts 26 and 27 and to the movable contact 28. A toggle spring member 30 is located between the contact operator 22 and the movable contact spring 28 in such a way that the contact operator 22 is normally biased to the position shown, and this causes the rotor 15 to assume the position shown with the contact operating member 20 acting to limit the rotor movement as it comes in contact with the stop member 31. When the rotor 15 is actuated to an operated position by the application of energy, it moves counterclockwise as viewed in Fig. 1 so that the contact operating member 20 touches the stop member 32. These stop members 31 and 32 are mounted on the top plates 5 by the same bolts that hold the members 23 so that the stop members extend upwardly as shown in Fig. 3.

Although the use of the toggle spring 30 makes the contact operation of the "snap-acting" type, it is to be understood that other forms of contact structure may be employed if desired. Also, the bias to the normal position of the rotor 15 is in the main provided by the deformation in the contact operating arm 22; but it is to be

understood that other arrangements of biasing means could be employed if desired.

Referring to Fig. 5, it will be seen that the windings 9 and 10 are connected in series with the wires extending to the line which is connected to the opposite terminals (BX) and (CX) of the source. In order to discuss the operation, without considering the specific ways the line may be controlled, a push button PB has been indicated as being in series in this circuit. This push button PB, or any suitable contacts may be manually or automatically operated to intermittently, or at whatever times desired, close the line circuit.

The coils 11 and 12 are connected in series and to a local source of energy having terminals (BX) and (CX) as indicated. It is noted that the windings 9 and 10 when energized, as by closure of contact PB, cause electromagnetic flux to circulate in the two independent magnetic circuits A and B. Since these windings are connected in series, the flux produced by one is in the same direction as the flux produced by the other and when the upper terminal of coil 9 is connected to the terminal (BX) and the lower terminal of coil 10 is connected to the terminal (CX), the rising current for a positive half cycle causes flux to flow in a clockwise direction in the right-hand magnetic circuit and in a counterclockwise direction in the left-hand magnetic circuit. This flux flowing in the directions indicated passes around the right and left-hand vertical legs of the rotor 15 as indicated in Fig. 6. This induces a circulating current in the rotor 15 having the directions of the arrow 35. The induced potentials in the vertical legs of the rotor are, of course, additive so these currents circulate in the same direction.

Assuming that the potential applied to the local windings 11 and 12 has the relative instantaneous polarities indicated, then the current flowing in windings 11 and 12 is in a direction to cause the flux to rise in its respective portions and in phase with the rise of current induced in the rotor 15. The flux produced by these coils 11 and 12 is in the same direction, and the reaction forces between this flux and the current flowing in the rotor is such as to produce opposite directions of torque as indicated in Fig. 6, because the direction of current flow are opposite in the two vertical legs of the rotor. This gives counterclockwise rotation to the rotor and actuates its against the stop 32 and in so doing the movable contact operator 22 is actuated to close the front contacts 26—28.

When the push button or contact PB is opened and energy is removed from windings 9 and 10, no current is induced in the rotor 15 and it is restored to its normal position with member 20 against the stop 31 by reason of the biasing spring action of the contact assembly.

In the above discussion, it has been stated that the current flowing in the local and line windings should be substantially in phase. In this connection, it should, of course be recognized that the current induced in the close-circuited rotor 15 will lag the potential applied to the line windings 9 and 10 a certain amount depending upon the values of the various component parts of the relay. However, since the rotor 15 is a single short-circuited turn this lagging of the current is kept at a minimum. For this reason, there is a substantial torque produced in the relay when the local and line windings are supplied with potentials exactly in phase; but it is to be understood that the currents from these potentials may be shifted with respect to each other by suitable well known means so as to cause the induced current in the rotor to be exactly in phase with the flux produced by the current local windings 11 and 12. When these conditions are present, the maximum torque per ampere of energization is, of course, produced.

If the instantaneous relative polarities are exactly reversed, any torque that is produced merely holds the rotor 15 more firmly against its stop member 31 and no actuation of the contacts is effected.

Even though the structure shown and described above is assumed to have separate iron laminae to make up the two stackings A and B, it is to be understood that these two stackings may be combined in a single consolidated stacking, if desired for structural strength and convenience in manufacture. It is possible to have the magnetic interconnection between the two ends of the relay because the coils 11 and 12 produce flux in the same direction. In effect, the common portions of the two stackings is at the center point of a bridge insofar as the flux circulating in the two paths is concerned, and for this reason the operation of the relay is exactly the same with this modification of its structure. Undoubtedly in a commercialized structure this form would be desirable to give added mechanical strength and simplify the manufacture; but the structure shown and discussed above where the two stackings are magnetically independent merely emphasizes the independence of the magnetic circuits and the operability of the relay. For the purpose of making clear this modified form of the invention, Fig. 7 shows a consolidated form of stacking of laminae to give the desired mechanical strength.

Having thus shown two forms of alternating current relay of the induction type as embodying the present invention, it is desired to be understood that these forms are selected to facilitate in the disclosure of the invention rather than to limit the number of forms which it may assume; and, it is to be further understood that various modifications, adaptations and alterations may be applied to the specific form shown to meet the requirements of practice, without in any manner departing from the spirit or scope of the present invention.

What I claim is:

In an alternating current relay structure, two separate stackings of soft iron laminate each having a figure 8 shape, said two stackings being placed with corresponding sides of their figure 8 shape in juxtaposition, a winding being placed around the adjacent sides of said two stackings, frame bars each being secured to both said stackings to hold them in position relative to each other, each of said figure 8 shaped stackings having an air gap in the cross portions thereof, a winding on said cross portion of each of said stackings, a box-shaped rotor of non-magnetic electrically conductive material being pivotally positioned by said frame bars with its vertical side portions extending through said air gaps, said windings on said cross portions being arranged in series and with such relative polarity that when energized the resulting magnetic field passes through both said air gaps in the same direction, circuit means for connecting said series-connected windings on the cross portions to a first source of alternating current, circuit means for selectively energizing said windings on the common portion of said stackings to a second source of alternating current of the same frequency as said first source when it is desired to actuate said relay, snap acting contact means being associated with said rotor, said contact means normally biasing said rotor to a particular position when said windings are deenergized, said rotor and said contact means being actuated to their opposite positions when said windings on the common portion are energized with alternating current.

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