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VIBRATOR

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Fig. 1.

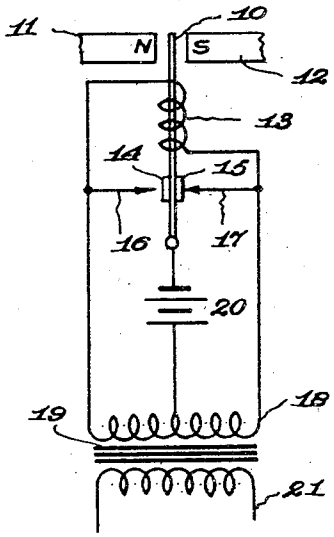


Fig. 2.

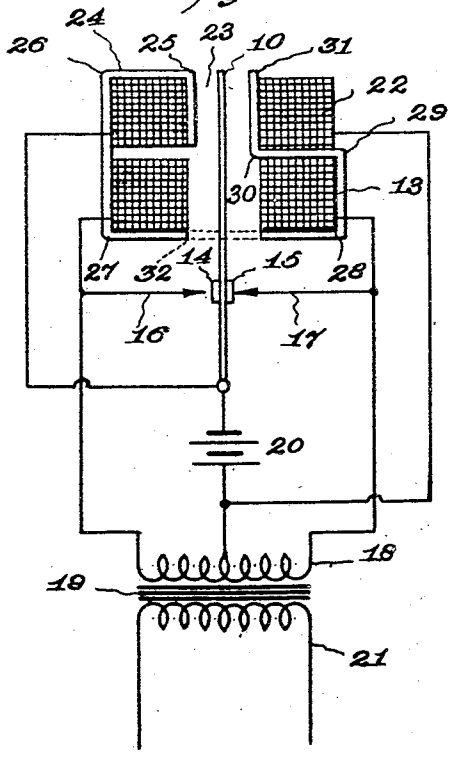
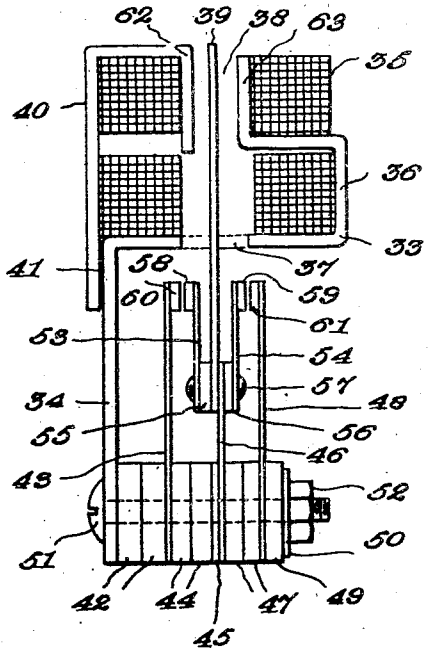


Fig. 3.



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VIBRATOR

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4 Claims. (Cl. 172—126)

1

The present invention relates to magnetic circuit and coil arrangements for relays, vibrators, and the like, and, more particularly, to a novel and improved vibratory interrupter embodying such arrangements.

It is an object of the present invention to provide a novel magnetic circuit and coil arrangement in which an armature is arranged in a substantially constant magnetic field and is adapted to be deflected in two different directions in accordance with the effective direction of a second or auxiliary magnetic field.

It is another object of the invention to provide an improved magnetic system for relays, vibrators, and the like, in which a deflectable armature is arranged in the field of a coil energized by unidirectional current and may be deflected in a direction determined by the flow of current through a second coil.

It is a further object of the invention to provide a vibratory interrupter organization including a pair of coaxially mounted coils, one of which upon being energized sets up a constant polarizing field, the other of which upon being energized alternately in opposite directions is adapted to maintain an armature in vibration.

It is also within the contemplation of the invention to provide a vibratory interrupter of the polarized type comprising a polarizing coil and a driver coil having aligned coaxial openings therein into which a vibratory armature may extend, said polarizing coil being unidirectionally energized and said driver coil being alternately energized in opposite directions through a system of contacts operable by the armature, thereby sustaining vibratory action of the armature.

The invention also contemplates a vibratory interrupter of the polarized type which is extremely simple in construction, does not require any permanent magnets, and which may be readily manufactured and sold on a practical and commercial scale at a low cost.

Other and further objects and advantages of the present invention will become apparent from the following description, taken in conjunction with the accompanying drawing, in which

Fig. 1 illustrates a circuit diagram of a polarized vibratory interrupter employing permanent magnets;

Fig. 2 depicts a diagrammatic view of the structure and of the circuit organization of a vibratory interrupter embodying the principles of the invention; and

Fig. 3 shows a preferred embodiment of the vibrator of the invention.

While a preferred embodiment of the invention is described herein, it is contemplated that considerable variation may be made in the method of procedure and the construction of parts without departing from the spirit of the invention. In the following description, and in the claims, parts will be identified by specific names, for convenience, but they are intended to be as generic in their application to similar parts as the art will permit.

2

Recent developments in the vibrator art have indicated the advantages of vibratory interrupters in which a vibratory armature is provided in a magnetic field of constant polarity, deflecting force being applied to said armature by alternately magnetizing the same in opposite directions by means of a driver coil. Polarized vibratory systems of this type have the advantage that deflection of the armature in either direction is positively controlled by the mutual attraction and repulsion of two fields, whereby more satisfactory operating characteristics and also higher operating frequencies may be obtained than with conventional vibrators. Polarized vibrators of this type are broadly disclosed and claimed in U. S. application Serial No. 543,255, of Robert J. Aust, filed July 3, 1944, to which application is hereby reference made.

The circuit organization of a typical polarized vibratory interrupter will be understood from Fig. 1 in which reference character 10 denotes a vibratory reed, the end of which extends into the magnetic field of poles of opposite polarity of permanent magnets 11 and 12. Windings of wire constituting a driver coil 13 are arranged around the armature, said coil upon being energized from a source of current is adapted to magnetize the armature in a direction determined by the direction of current flow through the coil. Armature 10 carries vibratory contacts 14 and 15 adapted to respectively cooperate with relatively fixed contacts 16 and 17, contacts 15 and 17 being normally closed. The ends of driver coil 13 are connected to fixed contacts 16 and 17 and also to the ends of primary winding 18 of a step-up transformer 19. A source of low voltage direct current 20 has its terminals connected between armature 10 and the center tap of the primary winding.

Considering the operation of this circuit, current will flow from the positive terminal of source 20 through the left hand half of the primary winding, through driver coil 13, and through contacts 15 and 17 and the armature back to the negative terminal of the source. At the same time a current of greater intensity will flow from the positive terminal of the source through the right hand half of the primary winding, contacts 17 and 15 and the armature back to the negative terminal of the source. The winding direction of the driver coil with respect to the polarity of the source is so determined that a South pole will be formed at the upper end of the armature and under the effect of the constant magnetic field of magnets 11 and 12 will

deflect the armature to the left until it closes contacts 14 and 16. It will be noted that in this position of the armature the direction of current flow in the driver coil will be reversed in that current will flow from the positive terminal of the source through the right hand half of the primary winding, and through the driver coil and through contacts 14 and 16 and the armature back to the negative terminal of the source. It is also to be observed that in this case the direction of the major portion of the current flowing through the primary winding will be likewise reversed, such flow being from the positive terminal of the source through the left hand half of the primary winding, through contacts 14 and 16 and the armature back to the negative terminal of the source. A North pole will now be induced at the free end of the armature, causing deflection thereof to the right where contacts 15 and 17 will be closed again and the operating cycle will begin anew. Clearly, the armature will be maintained in continuous vibration so long as energy is supplied to the system and the major portion of the current flow through the primary winding will be reversed synchronously with the vibrations of the armature whereby an alternating voltage is induced in secondary winding 21. This alternating voltage may be rectified in any conventional manner, such as by means of synchronous contacts carried by the armature or by means of a tube rectifier.

Polarized vibratory systems of the described character have been successfully constructed and operated. One of the practical difficulties experienced was connected with the provision of permanent magnets which are relatively expensive. In accordance with the principles of the present invention, these difficulties are eliminated by providing a novel magnetic circuit and coil arrangement in which permanent magnets are dispensed with and the polarizing and driver fields are obtained by means of a pair of coaxially mounted coils.

The invention will be best understood by referring to Fig. 2 in which reference character 22 denotes a polarizing coil and 13 denotes the driver coil corresponding in arrangement and function to coil 13 of Fig. 1. Coils 22 and 13 are coaxially mounted with respect to each other and have aligned central openings defining a space 23 into which the free end of the vibratory armature 10 extends. The magnetic circuit is determined by means of a ferromagnetic member 24, of which one end 25 extends into polarizing coil 22, is bent around coils 22 and 13 at 26 and 27, is carried across the bottom surface of coil 13, is bent up and around coil 13 at 28 and 29 and is finally bent again at 30, extending within coil 13 to 31. An opening 32 is provided in the lower horizontal portion of member 24 corresponding to opening 23 in the coils for permitting the armature to enter the inner coil space.

The circuit connections of the driver coil, of the contacts and of the transformer are identical with the circuit illustrated in Fig. 1 and similar reference characters have been employed to denote corresponding parts. It is to be noted, however, that permanent magnets 11 and 12 are replaced by polarizing coil 22 which is directly connected across source 20.

When the polarizing coil 22 is energized, the magnetic circuit may be traced from the extension of element 24 into the center of coil 22 through 25—26—27—32—28—29—31 and across the gap back to 25. This makes 25 and 31 opposite poles between which there is established a magnetic field.

Upon driver coil 13 being energized in one direction, the armature will be magnetized so as to be deflected to the left, making the magnetic circuit 25—26—27—32-air gap-armature-air gap-25. Energizing the driver coil in the opposite direction will force the armature to the right and will convert the magnetic circuit to armature-air gap-31—29—28-air gap-armature. In other words, polarizing coil 22 connected across the source 20 replaces the permanent magnets of Fig. 1.

From the foregoing description, the operation of the vibrator of the invention will be readily understood by those skilled in the art. As the circuit organization, apart from the connection of the polarizing coil, is identical with that of Fig. 1, it will not be necessary to repeat description of the same, particularly in view of the use of similar reference characters to denote corresponding parts in both figures. It will be sufficient to state that in the initial position one set of contacts is closed and the driver coil is energized in such direction as to cause deflection of the armature into a position in which the said set of contacts is opened and the other set of contacts is closed. This will energize the driver coil in the opposite direction and will cause return of the armature into its initial position where the cycle is repeated in a manner well understood. Thus, the armature will be maintained in vibration and current will be alternately passed through the two halves of primary winding 18 in opposite directions, thereby inducing an alternating voltage in the secondary winding 21. This induced alternating voltage may be rectified by means of synchronous contacts operated by the armature or in some other conventional way.

The structural organization of a preferred embodiment of the principles of the present invention into a vibrator is illustrated in Fig. 3. The vibrator is built around a flat strip of ferromagnetic material 33 having an elongated longitudinal portion 34 at one end thereof and provided with four right angle bends as indicated at the other end thereof to accommodate polarizing coil 35 and driver coil 36. Strip 33 is provided with an opening 37 aligned with openings 38 in the center of the coils through which armature 39 may extend. Ferromagnetic member 40 is likewise constituted of flat stock with two right angle bends as illustrated around coil 35 and is secured to the other ferromagnetic member 33 at 41, for example by means of spot welding. Members 33 and 40 are so constructed and arranged that after being secured together they will hold coils 35 and 36 tightly in place.

The stack is secured to the lower end of member 34 and comprises two insulative spacers 42, side spring 43, two insulative spacers 44, metal plate or spacer 45, hinge plate or reed 46 of the vibratory system, insulative spacers 47, side spring 48, insulative spacer 49, and metal plate 50. The stack is clamped together by means of bolts 51 extending through aligned holes of the several stack members and nuts 52. The said holes are large enough in diameter to accommodate insulative bushings (not shown) to insulate the several metallic members from each other.

The vibratory system is carried by the upper end of hinge plate 46 to which there are secured armature 39 and side arms 53 and 54 with the interposition of spacer plates 55 and 56 by means

of rivets 57. The free ends of side arms 53 and 54 carry vibratory contacts 58 and 59, respectively, cooperating with relatively fixed contacts 60 and 61. The magnetic system including pole pieces 62 and 63 within polarizing coil 35 and the initial position of armature 39 with respect thereto are so determined that both sets of contacts are open while the polarizing coil is not energized. Upon energizing said coil, however, the magnetic field between pole pieces 62 and 63 slightly displaces the armature into its normal initial position shown in Fig. 2 in which one set of contacts is closed to initiate the cycle of operation, as is explained more fully in connection with the said figure. In view of the foregoing detailed description of the structure and of the circuit organization of the vibrator, the operation of this preferred embodiment of the invention is obvious.

The principal advantages of the magnetic circuit and coil arrangement of the invention are its great structural simplicity and the facility of manufacture. The coaxially mounted polarizing coil provides a simple and highly efficient substitute for the expensive permanent magnets, and permits the vibrator to run from either polarity of the source of current. The single-legged frame structure shown in Fig. 3 permits easy adjustment by bending, for centering the armature between the coil sides of the holes.

It is also to be observed that the principles of the invention offer great advantages in the construction of vibrators of very small dimensions and having high operating frequencies. The principles of the invention are likewise applicable to the construction of polarized relays and of indicators or annunciators in which the operative condition of an electrical circuit is visually indicated by displacement of a disc or similar member attached to the end of the armature.

While the present invention, as to its objects and advantages, has been described herein as carried out in specific embodiments thereof, it is not desired to be limited thereby but it is intended to cover the invention broadly within the spirit and scope of the appended claims.

What is claimed is:

1. A vibratory interrupter comprising in combination a polarizing coil and a driver coil coaxially mounted with respect to each other and having aligned central holes therein, a ferromagnetic member having its ends extending into said polarizing coil from opposite directions and defining therein pole pieces of opposite polarity when said coil is energized, a ferromagnetic armature mounted for vibration extending into said coils and adapted to be deflected when said driver coil is energized, and a system of contacts operable by said armature to alternately energize said driver coil in opposite directions thereby to maintain the armature in vibration.

2. A vibratory interrupter comprising in combination coaxially mounted polarizing and driver coils having aligned central holes therein, a magnetic circuit for said coils including at least one ferromagnetic strip having its ends extending into the polarizing coil in opposite directions and having its intermediate portion bent around said coils to hold them in fixed relative position, the ends of said strip defining spaced pole pieces of opposite polarity when said polarizing coil is energized, a hole in said strip substantially in

alignment with the holes of said coils, an armature mounted for vibration extending through said holes into cooperating relation with said pole pieces, vibratory contacts on said armature, and relatively fixed stationary contacts cooperating with said vibratory contacts, said contacts being adapted to be electrically associated with the driver coil and a source of current to alternately pass current in opposite directions through said coil thereby to maintain said armature in vibration.

3. A polarized vibratory interrupter comprising in combination a polarizing coil and a driver coil having a central hole therein coaxially mounted with respect to each other, a pair of ferromagnetic strips having one of their ends extending in opposite directions into said polarizing coil to constitute pole pieces of opposite polarity when said coil is energized, said strips being secured together and at least one of them being extended away from said coils, a stack mounted on the end of said extended strip, a vibratory armature clamped in said stack at one end thereof and having its free end extending into said coils in cooperative relation with said pole pieces, vibratory contacts on said armature, relatively fixed contacts cooperating with said vibratory contacts, and stack-clamped means for supporting said fixed contacts, said driver coil being adapted to be alternately energized in opposite directions through said contacts thereby to maintain the armature in vibration.

4. A polarized vibratory electromagnetic interupter comprising in combination an upper polarizing coil and a lower driver coil having aligned central holes therein, a first ferromagnetic strip having one end extending into the upper coil and being formed with two right angle bends to extend downwardly along one side of said coils, a second ferromagnetic strip having one end upwardly extending into said upper coil and being formed with four right angle bends to extend around one side and the bottom surface of the lower coil and to further extend downwardly along with and beyond the lower end of the first strip, means for securing said strips together, a hole in the second strip aligned with the holes of said coils, a stack mounted on the lower end of said second strip, an armature mounted for vibration in said stack bearing vibratory contacts and extending through said holes into cooperative relation with said pole pieces, and stack-clamped stationary contacts adapted to cooperate with said vibratory contacts, said pole pieces being imparted opposite polarities when the said polarizing coil is energized and said driver coil being alternately energized through said contacts in opposite directions thereby to maintain the armature in vibration.

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