

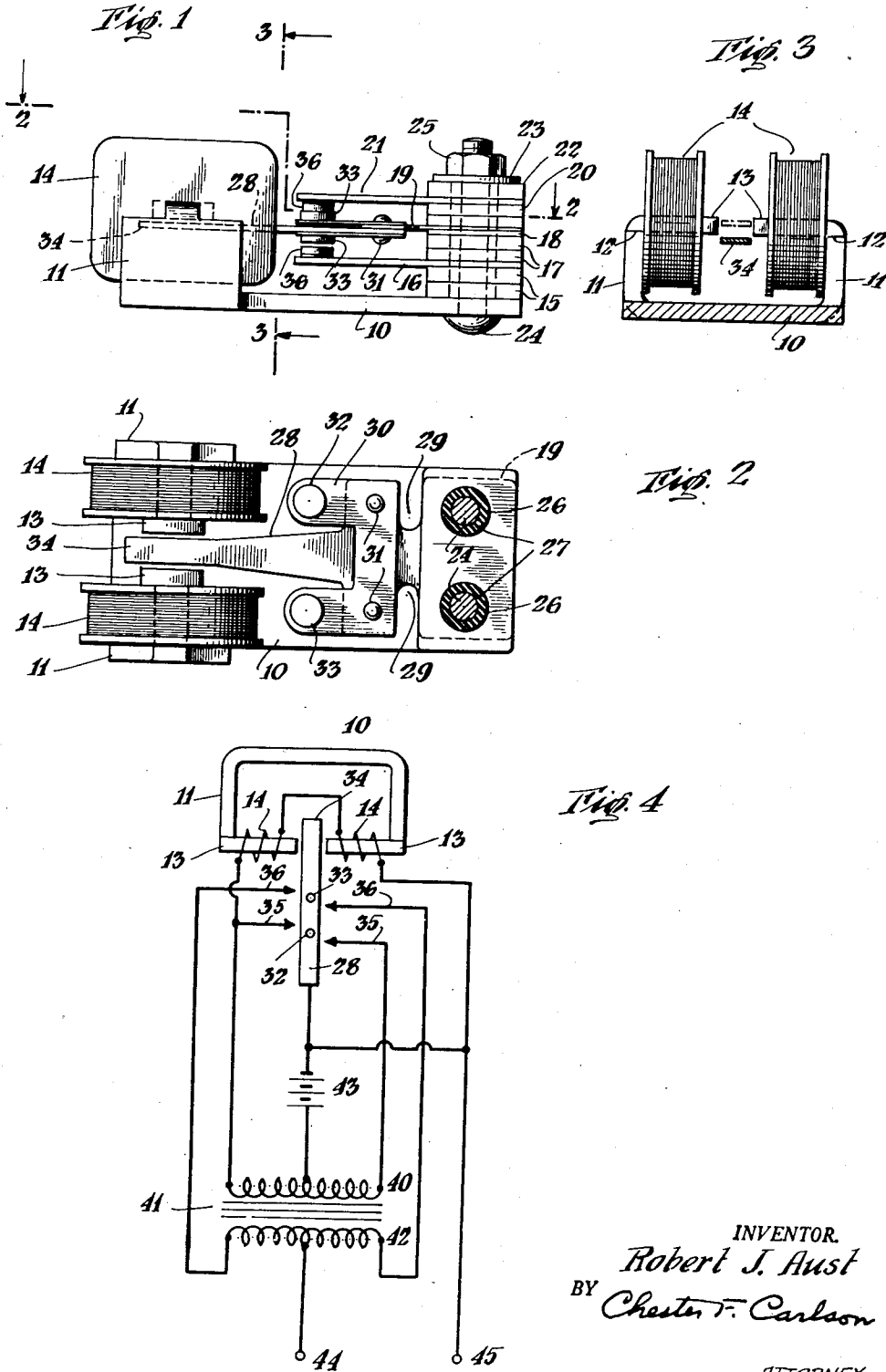
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R. J. AUST

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VIBRATOR

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INVENTOR.
Robert J. Aust
 BY *Chester F. Carlson*
 ATTORNEY

UNITED STATES PATENT OFFICE

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VIBRATOR

Robert J. Aust, Indianapolis, Ind., assignor to P. R. Mallory & Co., Inc., Indianapolis, Ind., a corporation of Delaware

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The present invention relates to vibrators, and, more particularly, to a vibratory electromagnetic interrupter of novel and improved character.

It is an object of the present invention to provide a vibrator with a magnetic circuit of increased efficiency.

It is another object of the present invention to provide a vibratory interrupter having a novel structural organization in which practically all of the magnetic flux is produced in ferromagnetic materials and in which air gaps are reduced to a minimum whereby a heretofore unobtainable magnetic efficiency is realized.

It is a further object of the invention to provide a vibratory electromagnetic interrupter in which a pair of pole pieces with a small gap therebetween are imparted opposite magnetic polarities whereby a vibratory armature is deflected into said gap and across said pole pieces.

It is also within the contemplation of the invention to provide a vibratory electromagnetic interrupter in which a pair of serially connected driver coils produce a strong magnetic field between two spacedly arranged pole pieces, said field being adapted to cause deflection of the end of a ferromagnetic armature controlling the system of contacts.

The invention also contemplates a vibrator of improved character which is very simple in structure, has a greatly increased magnetic efficiency 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 invention will become apparent from the following description, taken in conjunction with the accompanying drawing; in which

Fig. 1 illustrates a side elevational view of a vibrator embodying the principles of the present invention;

Fig. 2 depicts a sectional view taken on line 2-2 of Fig. 1;

Fig. 3 shows a section taken on line 3-3 of Fig. 1 and

Fig. 4 is a circuit diagram indicating a preferred form of circuit organization employed in connection with the vibrator of the present invention.

While a preferred embodiment of the invention is described herein, it is contemplated that considerable variation may be made in the method

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of procedure and the construction of parts without departing from the spirit of the invention. In the 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.

Referring now more particularly to Figs. 1 to 3 of the drawing, reference character 10 denotes a ferromagnetic frame having an elongated longitudinal portion and a pair of transverse extensions 11 bent upwards. To the ends of these extensions are welded at 12 cores or pole pieces 13 having a small gap therebetween. Around cores 13 there are arranged driver coils 14 which upon being energized from a source of current establish a strong magnetic field between the pole pieces.

On the end of frame 10 away from the coils there is mounted a stack comprising a pair of insulative spacers 15, two side springs 16, a pair of insulative spacers 17, a metal spacer 18, the clamped end 19 of a reed or hinge plate, a pair of insulative spacers 20, two side springs 21, an insulative spacer 22, and a metal spacer 23. The stack is held together by means of a bolt 24 and a nut 25, said bolt extending through aligned holes in the several clamped members. These holes 26 have a diameter which is large enough to permit the insertion of insulative bushings 27 around the bolt in order to prevent electrical contact between the bolt and the various metallic elements clamped thereby.

The construction of the vibratory system will be best understood from Fig. 2 from which it will be noted that the reed or hinge plate 19 has one of its ends clamped in the stack and has an elongated tapering ferromagnetic armature plate 28 secured to its other end. The intermediate portion of the hinge plate is cut out as indicated at 29 in order to increase its compliance while armature plate 28 is of a generally non-compliant character.

To the faces of armature plate 28 there are secured two U-shaped side arms 30, each of which carries a vibratory interrupter contact 32 and a vibratory rectifier contact 33. The side arms, the armature plate, and the hinge plate are secured together by means of rivets 31 extending through aligned holes therein. It will be noted that the edges of the terminal portion 34 of armature 28

are substantially parallel with each other and with the face of pole pieces 13 and that the said terminal portion extends into the region of the air gap between said pole pieces so that upon the driver coils being energized, the end of the armature plate will be pulled into the gap and across the pole pieces. As it will be best observed in Fig. 3, this structural organization provides a magnetic circuit with a minimum of air gap therein.

Vibratory interrupter and rectifier contacts 32 and 33 are adapted to cooperate with relatively fixed interrupter and rectifier contacts 35 and 36, respectively, carried at the ends of stack-clamped side springs 16 and 21 in a manner well understood.

The circuit organization of the vibrator of the invention will appear from Fig. 4 in which similar reference characters have been used to denote the corresponding parts of the vibrator. It will be noted that fixed interrupter contacts 35 are connected to the ends of primary winding 40 of step-up transformer 41 and fixed rectifier contacts 36 are connected to the ends of secondary winding 42 of said transformer. A source of low voltage 43 has its terminals connected between vibratory armature 28 and the center tap of primary winding 42. The two driver coils 14 are connected in series and their ends are connected to one of the fixed interrupter contacts 35 and armature 28, respectively. The rectified high voltage output is withdrawn at terminals 44 and 45 of which one is connected to the center tap of secondary winding 42 and the other is connected to the armature. Of course, buffer and filter condensers may be connected in the circuit in the conventional manner, if desired.

From the foregoing description, the operation of the vibrator of the invention will be readily understood by those skilled in the art. Upon the circuit being completed, current will flow from one terminal of low voltage source 43 through the two serially connected coils 14 and through one half of primary winding 40 back to the other terminal of the source, and will energize the coils. The winding direction and the connections of the coils are so determined that poles of opposite magnetic polarity will be formed at the ends of pole pieces 13 and a strong magnetic field will be set up in the gap therebetween. Consequently, the end of the armature plate, 34, will be pulled into the gap into a position in which it will substantially bridge the gap. The accompanying deflection of the armature plate will close the left hand set of interrupter contacts 35 and rectifier contacts 36. Closing of the said interrupter contacts will shunt coils 14 so that they will be deenergized and the compliance of hinge 19 will return the armature into the opposite direction, past its normal position of rest, until the other set of interrupter and rectifier contacts is closed. Thereafter, the driver coils again become controlling and the armature plate will be again deflected into the magnetic gap, etc. It will be readily seen that the armature will be maintained in continuous vibratory motion and that during such motion, current from the source will be alternately passed through the two halves of the primary winding. The high voltage alternating pulses induced in the secondary winding 42 will be rectified by the synchronous operation of the rectifier contacts 36 and the rectified high voltage output is withdrawn between terminals 44 and 45 in the conventional manner.

It will be noted that the vibrator of the invention provides a number of important advantages. Thus, first of all, the magnetic circuit of the novel vibrator is a great deal more efficient because the length of air gaps in the magnetic circuit is reduced to an absolute minimum. This will be readily appreciated for example from Fig. 3 showing that in the normal position of rest, end 34 of the armature plate is located in close proximity to pole pieces 13. Upon coils 14 being energized, opposite magnetic polarities will be imparted to the ends of the pole pieces and the armature plate will be pulled into the air gap, as indicated in dotted lines, practically completely filling out the gap. Such efficiency of the magnetic circuit was impossible to obtain with conventional vibrator structures.

It is also to be observed that, as shown by experiments, the principles of the invention are excellently adaptable for the construction of high frequency vibrators. Thus, frequencies as high as 400 cycles per second have been easily and reliably obtained. It is desirable to choose the mass and the compliances of the cooperating parts so as to obtain a reasonable degree of synchronous action in order to produce a symmetrical wave form over the voltage range that the unit has to operate. Of course, the principles of the invention are applicable with obvious modifications to the construction of nonsynchronous and driver contact vibrators.

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 electromagnetic interrupter comprising a ferromagnetic frame, a stack at one end of said frame, an elongated vibratile reed mounted in said stack having a tapered armature portion at the free end thereof, pole pieces disposed at the respective sides of said armature portion defining an unobstructed path for vibration of said reed, ferromagnetic means interconnecting said pole pieces to establish a closed magnetic circuit including said pole pieces and said reed, a pair of driver coils mounted, respectively, on said pole pieces, the axes of said coils being perpendicular to the longitudinal axis of said reed, and means including a set of contacts actuated by said reed for periodically energizing said driver coils thereby to effect vibratory movement of said reed, said armature portion, during each vibration of the reed, moving freely along the unobstructed path between said pole pieces, the direction of movement of said reed being perpendicular to the magnetic flux lines between said pole pieces.

2. A vibratory electromagnetic interrupter comprising a ferromagnetic frame, a stack at one end of said frame, an elongated vibratile reed mounted in said stack having a tapered armature portion at the free end thereof, pole pieces disposed at the respective sides of said armature portion defining an unobstructed path for vibration of said reed, said pole pieces being spaced inwardly from the free end of said reed, ferromagnetic means interconnecting said pole pieces to establish a closed magnetic circuit including said pole pieces and said reed, a pair of driver coils mounted, respectively, on said pole pieces, the axes of said coils being perpendicular to the

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longitudinal axis of said reed, the major portion of said coils being positioned along the respective sides of said armature portion, and means including a set of contacts actuated by said reed for periodically energizing said driver coils thereby to effect vibratory movement of said reed, said armature portion, during each vibration of the reed, moving freely along the unobstructed path between said pole pieces, the direction of movement of said reel being perpendicular to the magnetic flux lines between said pole pieces.

ROBERT J. AUST.

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