May 16, 1950 G. T. SOUTHGATE 2,507,940

MAGNETIC SWITCH

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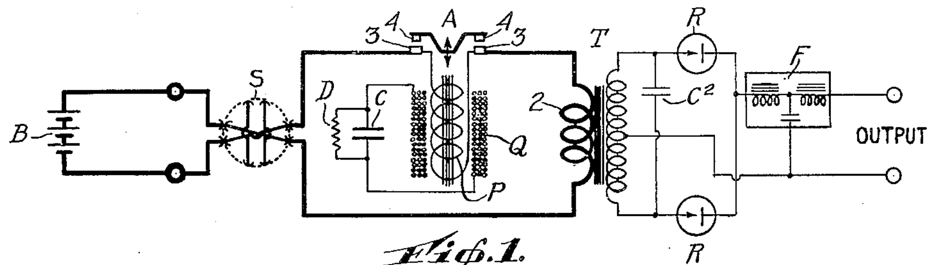

Fig. 1.

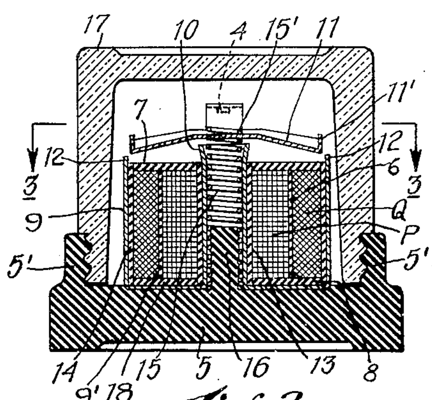

Fig. 2.

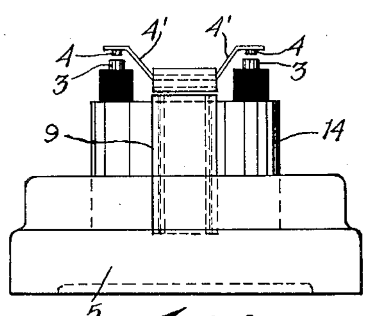

Fig. 4.

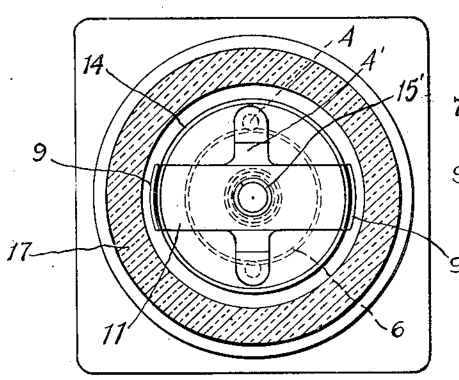

Fig. 3.

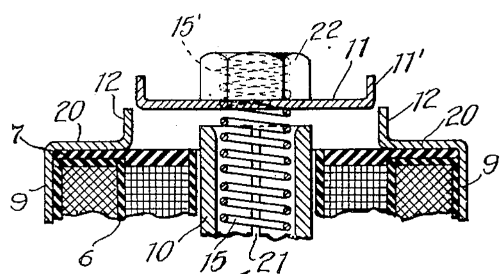

Fig. 5.

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MAGNETIC SWITCH

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5 Claims. (Cl. 200—87)

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This invention relates to direct current conversion means and system.

In electronic radio receivers, transmitters, and systems it is often desirable to use a direct current of a voltage different from the voltage of the available source of supply. For example, the plate circuit of a receiver, transmitter, or electronic system may require a comparatively high direct current voltage whereas the only available source is a battery of low voltage.

One object of the invention is a novel and improved vibrator structure for use in converting a direct current source of one voltage to a source of another voltage.

A further object of the invention is such a system embodying a novel and improved vibrator or interrupter unit which is characterized by its improved performance and dependability in operation.

A further object of the invention is a novel and improved electromagnetic interrupter unit.

Further objects of the invention will hereinafter appear.

For a better understanding of the invention reference may be had to the accompanying drawings wherein:

Fig. 1 is a schematic view of a direct current conversion system embodying the invention;

Fig. 2 is a vertical sectional view through an interrupter unit embodying certain features of the invention;

Fig. 3 is a sectional view along the line 3—3 of Fig. 2;

Fig. 4 is an elevational view of the interrupter at right angles to that of Fig. 2 with certain parts removed; and

Fig. 5 is a sectional view of a modified form of interrupter.

Referring to the drawings, an available source of direct current, as for example a low voltage battery, is indicated at B. The invention resides in the vibratory means used in the system for stepping up the voltage of the direct current source B to a voltage such as that required for instance to feed the plate circuits of a conventional radio receiver embodying electronic devices, or any other device requiring a higher direct current voltage than that available at the source B.

The means and system for converting the voltage of the direct current source B to the voltage of the output circuit comprises an input switch S, an interrupter or vibrator unit A, a transformer T, an output full wave rectifier or pair of rectifiers R, and of filter F in the circuit between the rectifiers and the output circuit.

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The vibrating unit A includes an electromagnetic coil P which is connected in series with the primary 2 of the transformer. The resistance of the coil P is very high as compared with the resistance of the primary 2 of the transformer and the variations of the current flow in primary 2 are effected by rapidly closing and opening a short circuit about the coil P. This rapid make-and-break means comprises a pair of stationary contacts 3 and a corresponding pair of movable contacts 4.

In addition to its function as an electromagnetic coil for operating the armature, more specifically described below and carrying the movable contacts 4, the coil P functions as the primary of a transformer in which the secondary of this transformer is indicated at Q. The secondary Q of the transformer has many more turns than the coil P, and accordingly the voltage generated across the stationary contacts 3 upon the interruption and closure of the circuit is multiplied across the secondary Q of the transformer. An electrostatic condenser C is connected across the secondary Q and a resistance D of small wattage is connected across the condenser.

The unit A is more specifically illustrated in Figs. 2–4. It comprises a base 5, preferably of some plastic material, as for example phenolic resin, upon which are mounted the coils P and Q, the coil P being disposed within the coil Q, the two being insulated from each other in any suitable manner, as for example by means of an insulating sleeve 6 therebetween. A disk 7 of insulating material is disposed on the top of the coils and a similar insulating disk 8 is disposed on the bottom of the coils. The magnetic circuits, all of magnetic material such as mild steel, comprise a pair of strips 9 diametrically disposed on the opposite sides of the coils, a centrally disposed elongated cylindrical split ring 10, and armature 11, and bottom parts 9′ which complete the circuits between the bottom of the ring 10 and the side strips 9. The strips 9 project slightly above the insulating disk 7 for cooperation with the ends 11′ of the armature 11, the projecting parts being designated 12. The parts 9, 9′ and 12 on each side are preferably integrally formed from sheet metal.

The armature 11 is just of sufficient length to bridge the gap between the projecting parts 12 forming a part of the magnetic circuit, sufficient clearance being provided between the ends of the armature and the parts 12 to avoid actual mechanical contact between them. The coil P is insulated from the split ring 10 by means of an insulating ring or sleeve 13 and the coil Q is insulated from the strips 9 by means of a ring or cylinder 14 of insulating material.

The armature 11 is carried on the upper end of a helical spring 15, this spring 15 being of any suitable metal, as for example steel. In the particular embodiment shown, this spring is anchored to the base by being screwed onto a stud 16 at or integral with the base. The spring wire is of the required diameter and the coil of the required coil diameter and of the required length to give the stiffness desired or computed for the requirements of the particular use. The spring is guided within the member 10 and the latter is shown as having a slightly outwardly flared opening at the top. The armature 11 may be fastened to the spring 15 in any suitable manner, but I have found a particularly advantageous method of fastening to consist of first forming an aperture in the armature 11 at approximately its central point with the walls of the aperture helically inclined to the surfaces of the armature, and then inserting the end of the wire through this opening and screwing the spring therethrough for a distance of one or more turns.

The arms 4' carrying the movable contacts 4 are integrally formed with the armature 11, and both of them together form a moline cross with the longer arms constituting the magnetic armature 11 and the shorter arm 4' forming a current bridge carrying the movable contacts. This moline cross member may be formed of sheet metal and readily stamped on a quantity production basis. By interrupting the circuit at two points, the contact openings are thus doubled, halving per gap the voltage and energy of any possible sparks. Molybdenum is preferred for the contact metal because of its sufficient refractoriness, better mechanical properties and greater availability than tungsten.

The vibratory actuation of the interrupter is effected on the short-out principle; the closing of the contacts shunting the main-circuit current from the actuative coil P (of relatively few turns), and thus releasing the armature. With the coil thus again energized by the opening of the contacts, the cycle is repeated at the natural frequency of the elastic system. The preferred frequency is 100 to 300 cycles per second.

In addition to the vibrator circuit, the converter system includes the other circuit described above and including the transformer secondary Q, the condenser C and the resistor D. This circuit is for the purpose of suppressing sparks at the contacts 3, 4 and for dissipating the energy thereof, thereby relieving the coils of this function. The coils of the unit A are, as indicated, the windings of a closely coupled transformer, stepping up the voltage at the contacts 3 and 4 and on the coil P to the much higher voltage at the terminals of the secondary Q. The effectiveness of the condenser C is thereby increased nearly as the square of the voltage ratio. A smaller condenser may thereby be used. It is preferably of the A.-C. dry electrolytic type for sturdiness, capacity, and high voltage adaptability.

In order to protect the vibrating mechanism against dust, changes in atmospheric conditions, etc., it is housed in a housing 17 as of glass. In the particular embodiment shown, this housing 17 is of cylindrical shape and is screw-threadedly attached to an annular flange 5' formed on

the base 5. The mechanism may thus be effectively insulated against moisture and the effects of large temperature changes are minimized. The elastic element or spring 15, if made of steel, may be slightly affected by large temperature changes but the change in the modulus of elasticity resulting from wide changes in temperature are insufficient in the ordinary case to impair unduly the efficiency of the system. If desired, the elastic member may be made of a metal which has a substantially constant modulus of elasticity over large temperature ranges, such for example as the alloys known in the trade as Monel metal and Elinvar.

In the particular embodiment of the invention shown, the condenser C and the resistor D are positioned outside of the housing 17. The resistor D dissipates the energy which is stored in the condenser C and accordingly the temperature problem is minimized since the coils are not required to dissipate this energy in the closed chamber 17.

In the embodiment of Fig. 5 (drawn on a larger scale) the armature 11 is of shorter length than that of the armature in Fig. 2 and accordingly the inertia effects of the vibrating armature are less. This shorter length of armature 11 is compensated for by bending the strips 9 over at right angles at the top to form inwardly extending parts 20 so as to bring the upwardly projecting parts 12 of the armature circuit closely adjacent the ends 11' of the armature. The tube or ring 10 is provided with the slit or slot 21 to form it into a split ring similarly to the ring 10 of Fig. 2, the slot there not being shown.

In this embodiment the spring 15 is screwed through the moline cross comprising the armature 11 and the arms 4' of the contacts so as to have a part 15' projecting above the armature 11 and this part 15' of several turns of the spring is utilized for screwing thereupon and tightly against the armature 11, a lock nut 22, the latter being illustrated as screwed tightly against the metal of the armature 11. A strong cement may be used to seal the lock nut.

The vibrator illustrated with the converter system above described may be used in any application where the voltage of a direct current source needs to be changed for use at a different voltage. In the particular embodiment shown, the system is designed for stepping up the voltage from a battery B to the voltage used in an electronic circuit, but the invention has other uses, as for example, systems employed in industrial control and operation. The parts of the system are mainly of noncritical materials and are particularly adapted to precision manufacture. The parts are rugged, durable and capable of withstanding rough usage.

The input switch S is indicated as of a rotary snap type that reverses the direction of the current through the vibrator at successive resumptions of service. This is an added safety feature in the event that the special cooperating spark preventing and dissipation circuit comprising the coil Q, condenser C and resistor D should for any reason become defective, in that the successive switch reversals would prevent cup and cone formation on the contacts.

The rectifying circuit includes as indicated above the electronic rectifiers R and the filter unit F. This circuit also includes a condenser C2 connected across the secondary of the transformer T. Its function is to supply the wattless current for magnetizing the transformer core and thus to relieve the primary circuit of that function.

As described above, the available source of direct current B in the particular embodiment shown is of a low voltage battery source. The system is adapted to the stepping up of the voltage of the battery B to any reasonable value within limits, as for example when the output circuit supplies the plate circuit of communication apparatus or equipment wherein the voltage desired may be from 100 to 500 volts.

I claim:

1. A vibratory means comprising an electromagnetic coil, a vibrating contact actuated by said coil, said contact being carried by an armature which is mounted upon and supported solely by a coil spring, said coil spring being fixed at one end and fastened to said armature at the other end by passing one or more turns of the wire of the spring through an inclined opening formed in the armature.

2. A vibratory means comprising an electromagnetic coil, a magnetic circuit for said coil comprising a centrally disposed member of magnetizable material, members of magnetizable material disposed on one end of said coil and on the sides thereof, and a movable armature at the other end bridging the side and central members of said magnetic circuit, said armature being mounted solely upon the end of a coil spring and being moved bodily against the tension thereof by the energization of the coil, and contacts carried by said armature, said armature being formed in the shape of a cross with one pair of arms forming the armature and the other arms carrying the two movable contacts.

3. A vibratory means comprising an electromagnetic coil, a magnetic circuit for said coil comprising a centrally disposed member of magnetizable material, members of magnetizable material disposed on one end of said coil and on the sides thereof and a movable armature at the other end bridging the side and central members of said magnetic circuit, said armature being mounted solely upon the end of a coil spring and being moved bodily against the tension thereof by the energization of the coil, and contacts carried by said armature, said armature being formed in the shape of a cross with one pair of arms forming the armature and the other arms carrying the two movable contacts, said armature being mounted upon and fastened to the upper end of said spring and having an inclined opening for facilitating the insertion of the end of the wire of the spring therethrough for fastening and accommodating and firmly holding one of the coils.

4. A vibratory means comprising an electromagnetic coil, a magnetic circuit for said coil comprising a centrally disposed member of magnetizable material, members of magnetizable material disposed on one end of said coil and on the sides thereof, and a movable armature at the other end bridging the side and central members of said magnetic circuit, said armature being mounted solely upon the end of a coil spring and being moved bodily against the tension thereof by the energization of the coil, and contacts carried by said armature, said armature being formed in the shape of a cross with one pair of arms forming the armature and the other arms carrying the two movable contacts, said armature being mounted upon and fastened to the upper end of said spring and having an inclined opening for facilitating the insertion of the end of the wire of the spring therethrough for fastening and accommodating and firmly holding one of the coils, and a lock nut screw-threadedly attached to the projecting part of the coil spring and clamping against the armature.

5. A vibratory means comprising an electromagnetic coil, a magnetic circuit for said coil comprising a centrally disposed member of magnetizable material, members of magnetizable material disposed on one end of said coil and on the sides thereof and a movable armature at the other end bridging the side and central members of said magnetic circuit, said armature being mounted upon the end of a coil spring and being moved bodily against the tension thereof by the energization of the coil, and a contact carried by said armature, the centrally disposed member of magnetizable material being in the form of a split ring and said coil spring being mounted within said split ring with the free end thereof fastened to the armature, and forming the sole support for said armature.

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REFERENCES CITED

The following references are of record in the file of this patent:

UNITED STATES PATENTS

Number	Name	Date
560,471	Chapman	May 19, 1896
848,720	Broc	Apr. 2, 1907
1,201,491	Neahr	Oct. 17, 1916
1,215,422	Spangler	Feb. 13, 1917
1,563,670	Spencer	Dec. 1, 1925
1,932,164	Petit	Oct. 24, 1933
2,009,892	Leece	July 30, 1935
2,025,859	Hartman	Dec. 31, 1935
2,040,688	Drury	May 12, 1936
2,107,742	Ruben	Feb. 8, 1938
2,253,602	Barrett	Aug. 26, 1941
2,360,664	Field	Oct. 17, 1944