

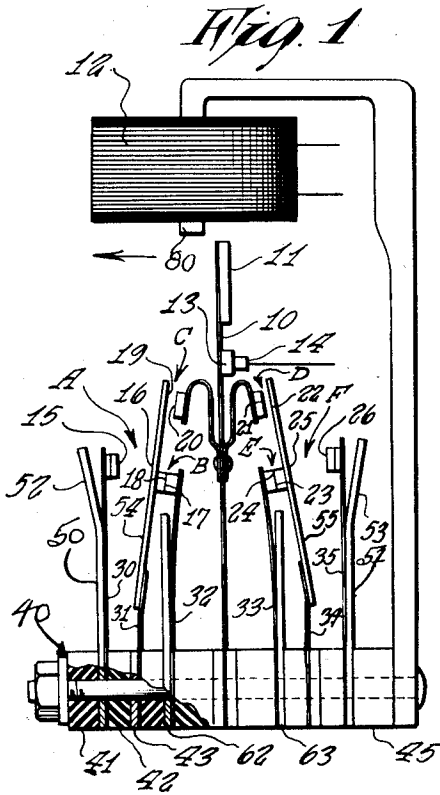
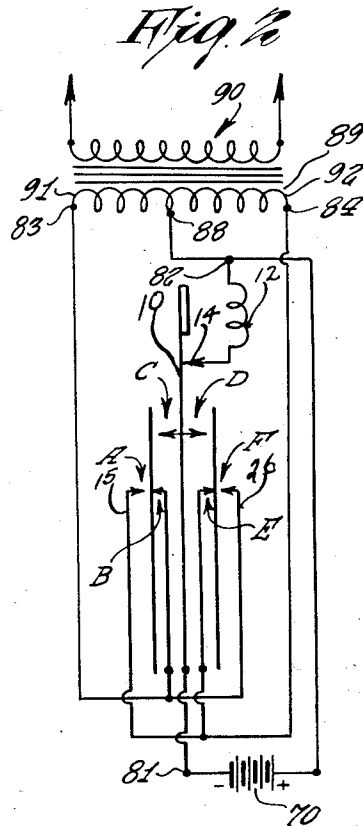
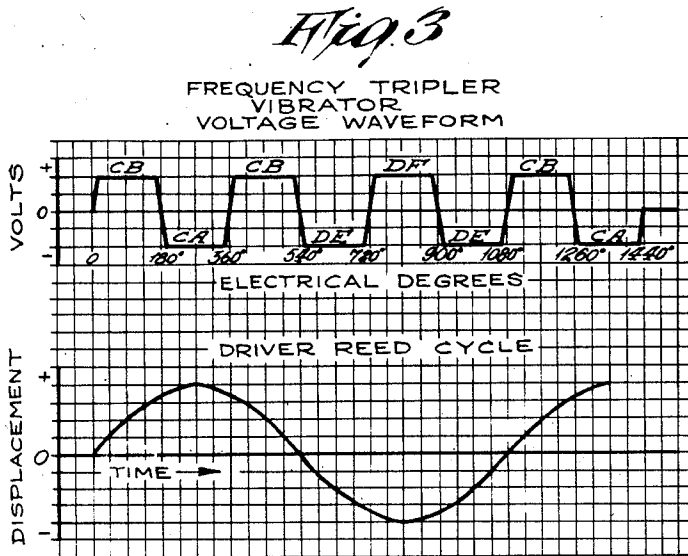
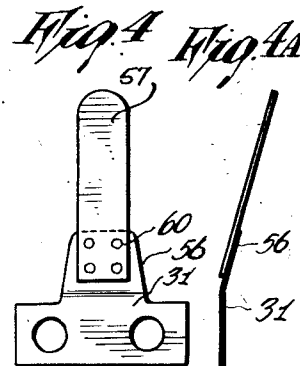
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ELECTROMAGNETIC INTERRUPTER DEVICE

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2,790,129

ELECTROMAGNETIC INTERRUPTER DEVICE

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13 Claims. (Cl. 321-49)

The present invention relates to electromagnetic vibratory interrupters, and, more particularly, to vibratory interrupters and vibrator systems of novel and improved character capable of producing interruptory action at relatively high frequencies by means of vibratory structures operated at considerably lower frequencies.

As is known, electromagnetic vibratory interrupters are used at present on a substantial scale for converting direct current drawn from a low-voltage source into alternating current of relatively high voltage which after rectification may supply the plate circuits of radio transmitting and receiving equipment.

It would be advantageous to employ vibrators capable of being operated at relatively high frequencies, for example, triple output frequencies, as this makes it possible to use transformers and filters of small dimensions. Great practical difficulties have heretofore been encountered, however, in the design and production of such high-frequency triple-frequency vibrators.

In a U. S. Patent 2,445,398, issued to Clarence Huetten, July 20, 1948, a vibrator system was disclosed which allowed a double frequency. The present invention advances the art beyond the device shown there by effectuating a new vibrator system having many advanced and novel constructional features in the driver, contact and circuit arrangement.

It is therefore an object of the present invention to provide a novel vibrator which overcomes the foregoing difficulties and which is capable of producing interruptory rates of triple frequency.

It is another object of the present invention to provide a vibratory interrupter of novel and improved character which includes a frequency-multiplying principle in its structural and circuit organization whereby the vibratory system is operated at relatively low frequencies but interruptory actions at higher and triple frequencies may be obtained.

It is also within the contemplation of the invention to provide a vibratory interrupter and a novel circuit organization therefor having a vibratory system operated at conventional low frequencies and capable of controlling a plurality of electrical circuits at rates corresponding to three times such frequencies.

The invention also contemplates a high-frequency electromagnetic vibratory interrupter with a relatively low-frequency vibratory system which is very simple in construction, and presents few, if any, engineering difficulties in quantity production, and which may be readily manufactured and sold on a practical and commercial scale at a low cost.

It is also an object of the present invention to provide a vibrator developing a voltage waveform which has a frequency three times that of the vibrator reed.

It is still another object of the present invention to provide an improved vibrator and vibrator circuit.

It is yet another object of the present invention to provide an improved frequency tripler vibrator.

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It is another object of the present invention to provide an electromagnetic vibratory interrupter capable of developing a relatively high frequency voltage wave form while retaining low frequency reed driving characteristics.

It is a further object of the present invention to provide a frequency tripler vibrator adapted to operate in ordinary, conventional and standard vibrator sockets.

It is another object of the present invention to provide a vibrator having a high frequency voltage waveform for use in applications where size, weight and cost are power supply considerations.

The invention, in another of its aspects, relates to novel features of the instrumentalities described herein for teaching the principal objects of the invention and to the novel principles employed in the instrumentalities whether or not these features and principles may be used in the said object and/or in the said field.

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:

Figure 1 is a vertical cross-sectional representation of a preferred embodiment of the present invention of a frequency tripler vibratory device as adapted to illustrate the constructional features thereof and for effectuating a triple frequency operation therein;

Figure 2 is a diagrammatic and electrical schematic illustrative of the triple frequency vibrator of the present invention;

Figure 3 is a plot chart illustrating the frequency tripler vibrator voltage waveform as compared to the waveform of the driver reed cycle and as illustrating the frequency tripling effect thereof; and

Figures 4 and 4a are plan and side views of the molybdenum leaf spring construction used by the contact arms 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 of procedure and in 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.

Generally speaking, the present invention comprises a vibrator which is adapted to develop a voltage waveform having a frequency three times the frequency of its associated vibrator reed. This is accomplished by utilizing a unique construction for the vibrator system wherein six pairs of contacts or contacting surfaces are utilized. Thus, when the frequency of the vibrator reed is 200 cycles then the power supply frequency becomes 600 cycles.

Referring now more particularly to Fig. 1 of the drawing, illustrating a preferred embodiment of the invention, the vibrator organization is of the general type in which the vibratory reed acts as a "pusher" to selectively actuate systems of contacts arranged at the sides thereof.

The vibratory interrupter essentially comprises a vibratory reed 10 clamped at one end thereof and carrying an armature or weight 11 at the other end thereof. Reed 10 may be deflected by the magnetic field of a driver coil 12, the circuit of which is controlled by means of a vibratory driver contact 13 mounted on the reed, co-operating with a normally closed stationary driver contact 14.

The vibratory reed 10 is arranged to control six pairs of contacts, i. e. a system of three pairs of contacts

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arranged on follower reeds or spring arms situated on each side of the driver reed. The first system placed, as shown in the drawing, to the left of the reed, comprises contact pairs 15, 16; 17, 18; and 19, 20. The second system comprises the sets of contacts placed to the right of the reed, as shown in the drawing, namely, contacts 21, 22; contact pairs 23, 24; and 25, 26, respectively. It is to be seen that when the reed is at rest, contact pairs 17, 18 and contact pairs 23, 24 are in a closed relationship. The other contact pairs, on the other hand, are in an open condition, with the result as hereinafter described.

The individual contacts of the vibrator are each mounted at the end portions of spring arms 30-35, with contacts 20 and 21 mounted at the end of reed arm 10. The contact spring arms are individually retained and clamped at the contact opposing ends within stack 40 of the vibrator by means of bolts which are adapted to penetrate apertures in each end of the spring arms. The arms are separated from each other in the stack as by means of insulator spacers such as 41 and 42 while individual conductive terminals such as 43 may be connected to the individual end thereof. The symmetry of the system is apparent from the constructional arrangement of the vibrator and as shown in the drawing, with the left hand side being exactly like the right hand side.

In the construction of each system, backing stop members 50 and 51 are placed behind and underlie springs 30 and 35. The tops 52 and 53 of members 50 and 51 are angulated so as to limit the excursion or travel range of contacts 15 and 26. Contacts 19 and 22 are the topmost portions of biased and pivotable springs 54 and 55. The construction of springs 54 and 55 allowing them to move in an essentially pivotable manner, respectively, is shown more explicitly in Figs. 4 and 4a. Each spring 54 comprises clamping end portions 31 and 34, a conjoining section 56 angulated somewhat from the vertical plane of portions 31 and 34 and top sections 57 joined thereat by means of welds 60. Top sections 57 are thin leaves of molybdenum metal having their tip ends acting as contacts 19 and 22, respectively, while somewhat lower down therefrom are placed contacts 17 and 25 which are adapted to mate with contacts 18 and 24 held by contact arm springs 32 and 33. Underlying contact arm springs 32 and 33 are supporting members 62 and 63 which abut springs 32 and 33 for a considerable length therealong until each spring is bent away therefrom to a degree dependent upon the mating force of cooperating contacts 17 and 18 and 23 and 24. Thus the resilience and biasing characteristics of the spring construction adapt the contacts for efficient operation.

As shown in the electrical schematic of Fig. 2, all of the circuits of the vibratory interrupter including the driver circuit and the circuits of the two systems of contacts, are energized from a common source of low voltage direct current 70, and include reed 10, driver contact 13, stationary fixed driver contact 14, driver coil 12, and normally closed contacts 17, 18; 23 and 24.

The low voltage D. C. source has its positive terminal directly connected to the midpoint 88 of the center tapped primary winding 89 from whose secondary winding 90 the A. C. output source triple frequency voltage is taken. Ends 91, 92 of the center tapped primary transformer 89 are respectively connected to contacts 26 and 15 of the vibrator. These contacts are normally open, while associated contacts 17, 18 and 23, 24 are closed and contacts 19, 20 and 21, 22 are open. Reed 10 is directly connected to the negative side of the D. C. source. Driver coil 12 is connected between stationary driver contact 14 and the center tap 88 of transformer 89.

From the foregoing description, the operation of the vibratory system as a frequency tripler will now be un-

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derstood. In considering the operation of the vibratory system, consideration should be given to Fig. 3 wherein the chart will be useful to illustrate the functional results hereof. In the description hereafter contacts 15 and 16 will be designated pair "A," contacts 17 and 18 will be designated pair "B," contacts 19 and 20 will be designated pair "C," contacts 21 and 22 designated pair "D," contacts 23 and 24 designated pair "E," and contacts 25 and 26 designated pair "F."

The operation of the vibrator may be understood by assuming that the reed and contacts are in the positions shown in Figs. 1 and 2; that the reed is moving in the direction indicated by the arrow, under steady state operation and in the following sequence as understood by reference to Fig. 3 to show the time sequence and voltage waveforms during the cycle of operation. Thus as reed 10 moves in the direction of pole 80, the following sequence of events take place.

1. As the reed moves in the pole direction, contact pair "C" closes. Since contact pair "B" is closed initially, dwell period CB shown in the voltage waveform of Fig. 3 occurs.

2. As the reed moves farther in the pole direction, contact pair "B" opens and contact pair "A" closes. Since contact pair "C" remains closed, dwell period CA occurs.

3. As the driver reed passes maximum displacement in the pole direction and moves in the inertia direction, contact pair "A" will open and contact pair "B" will close again. Since contact pair "C" will still be closed, another CB dwell period will occur.

4. As the reed moves back past center, contact pair "C" will open and contact pair "D" will close. Since contact pair "E" is closed, dwell period DE will occur.

5. As the reed moves toward its maximum displacement in the inertia direction, contact pair "E" will open and contact pair "F" will close. Since contact pair "D" will remain closed, dwell period DF will occur.

6. As the reed passes its maximum swing in the inertia direction and moves in the pole direction, contact pair "F" will open and contact pair "E" will close. Since contact pair "D" will remain closed, dwell period DE will occur.

7. As the reed moves through the neutral position in the pole direction, contact pair "D" will open and contact pair "C" will close. This will start the repeat of the process described in step 1 of steps 1 through 6.

Examination of the above sequence will show that three full voltage cycles have occurred during one driver reed cycle. Therefore, the effect has been to triple the frequency of the voltage waveform applied to the transformer over the frequency of the driver reed. This vibrator would be of use in applications where size, weight, and cost were power supply considerations, since a high frequency voltage waveform can offer these design possibilities, while the relatively low reed frequency would offer simplified reed drive problems.

Examination of the circuit diagram shown in Fig. 2 shows that the practicality and efficiency of the system is further enhanced since by wiring internally as shown, only four terminals 81, 82, 83 and 84 are required. Therefore, the vibrator is evolved to operate in standard circuits provided with ordinary, four-prong sockets.

Although the present invention has been described as relating to a frequency tripler vibrator, it is not intended that the scope of the invention be limited thereby but that it encompass its proper scope as adapted to be carried over to various fields and arts.

What is claimed:

1. A vibrator system comprising in combination, a transformer having a center tap primary winding, a driver coil having a pole extending therethrough, a vibratory reed having an armature at the end thereof, two contact systems, each system comprising three pairs of contacts, a driving reed placed between said contact systems, said

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driving reed deflected by the effect of a magnetic field induced in said driver coil pole upon the excitation thereof and adapted to make or break each of said pairs of contacts in each of said systems, said driving reed having a contact adapted to mate with a stationary contact, said driver coil being connected to said stationary contact and said center tap of said primary winding, a source of low voltage, said driving reed connected to one terminal of said source of low voltage, said center tap of said primary winding connected to the other terminal of said source of low voltage, and the respective ends of said primary winding being connected to one contact of a pair of contacts in each of said individual contact systems.

2. A vibrator system comprising in combination, a transformer having a center tap primary winding, a driver coil having a pole extending therethrough, a vibratory reed having an armature at the end thereof, two contact systems, each system comprising three pairs of contacts, a driving reed placed between said contact systems, said driving reed being deflected by the effect of a magnetic field induced in said driver coil pole upon the excitation thereof and adapted to make or break each of said pairs of contacts in each of said systems, said driving reed having a contact adapted to mate with a stationary contact, said driver coil being connected to said stationary contact and said center tap of said primary winding, a source of low voltage, said driving reed connected to one terminal of said source of low voltage, said center tap of said primary winding connected to the other terminal of said source of low voltage, and the ends of said primary winding being connected to one contact of a pair of contacts in each of said individual contact systems, said latter pair of contacts being normally in an open condition, while the pair of contacts adjacent thereto are in a closed condition.

3. A vibrator system comprising in combination, a transformer having a center tap primary winding, a driver coil having a pole extending therethrough, a vibratory reed having an armature at the end thereof, two contact systems, each system comprising three pairs of contacts, a driving reed placed between said contact systems, said driving reed being deflected by the effect of a magnetic field induced in said driver coil pole upon the excitation thereof and adapted to make or break each of said pairs of contacts in each of said systems, said driving reed having a contact adapted to mate with a stationary contact, said driver coil being connected to said stationary contact and said center tap of said primary winding, a source of low voltage, said driving reed connected to one terminal of said source of low voltage, said center tap of said primary winding connected to the other terminal of said source of low voltage, and the ends of said primary winding being connected to one contact of a pair of contacts in each of said individual contact systems, said latter pair of contacts being normally in an open condition, while the pair of contacts adjacent thereto are in a closed condition, said latter closed contact pair having one of its individual contacts connected to a side of said center tap transformer and its associated contact free of any electrical connection.

4. A vibrator system comprising in combination, a transformer having a tapped primary winding, a vibratory reed, two contact systems, each system comprising three pairs of contacts, one pair of which is normally closed and the other two pairs in open relationship, a driving reed placed between each of said contact systems, the deflection of said driving reed adapted to make or break each of said pairs of contacts in each of said systems, a source of low voltage, said driving reed connected to one terminal of said source of low voltage, and said center tap of said primary winding connected to the other terminal of said source of low voltage.

5. A vibrator system comprising in combination, a transformer having a tapped primary winding, a vibratory reed, two contact systems, each system comprising

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three pairs of contacts, one pair of which is normally closed and the other two pairs in open relationship, said pair in closed relationship having one of its contacts supported on a spring arm which also contains one of said open contacts, said first contact being below said open contact, a driving reed placed between each of said contact systems, the deflection of said driving reed adapted to make or break each of said pairs of contacts in each of said systems, a source of low voltage, said driving reed connected to one terminal of said source of low voltage, and said center tap of said primary winding connected to the other terminal of said source of low voltage.

6. A vibrator system comprising in combination, a transformer having a tapped primary winding, a vibratory reed, two contact systems, each system comprising three pairs of contacts, one pair of which is normally closed and the other two pairs in open relationship, said pair in closed relationship having one of its contacts supported on a spring arm which also contains one of said open contacts, said first contact being below said open contact, said contact being open adapted to mate with a contact on a driving reed, said driving reed placed between each of said contact systems, the deflection of said driving reed adapted to make or break each of said pairs of contacts in each of said systems, a source of low voltage, said driving reed connected to one terminal of said source of low voltage, and said center tap of said primary winding connected to the other terminal of said source of low voltage.

7. A vibrator system comprising in combination, a transformer having a tapped primary winding and a secondary output winding, a vibratory reed having a fixed driver contact normally mating with an associated contact, a coil for said vibrator in said system, said coil having a pole placed substantially centrally therethrough connected between the said tapped primary winding and the fixed driver contact, an armature for said vibratory reed, two contact systems, each of said systems containing three pairs of contacts, said vibratory reed being placed between said two systems, and means for energizing said driver coil including a source of low voltage, said armature of said driving reed being deflected by the magnetic flux of said pole of said driver coil upon its activation.

8. A vibrator system comprising in combination, a transformer having a tapped primary winding and a secondary output winding, a vibratory reed having a fixed driver contact normally mating with an associated contact, a coil for said vibrator in said system, said coil having a pole placed substantially centrally therethrough connected between the said tapped primary winding and the fixed driver contact, an armature for said vibratory reed, two contact systems, each of said systems containing three pairs of contacts, said vibratory reed being placed between said two systems, means for energizing said driver coil including a source of low voltage, said armature of said driving reed being deflected by the magnetic flux of said pole of said driver coil upon its activation, and said driving reed being connected to one terminal of said low voltage source and said center tap being connected to the other terminal thereof, whereby upon deflection of said driving reed each of said pairs of contacts in each of said systems is acted upon so that an output voltage waveform is taken across said output secondary transformer having a frequency three times the vibrating reed frequency.

9. A vibrator system comprising in combination, a transformer having a tapped primary winding and a secondary output winding, a vibratory driving reed having a fixed driver contact normally mating with an associated contact, a coil for said vibrator in said system, said coil connected between the said tapped primary winding and the fixed driver contact having a pole placed substantially centrally therethrough, an armature for said vibratory reed, two contact systems, each of said

systems containing three pairs of contacts, said vibratory reed being placed between said two systems, said driving reed having contacts on each side of the reed adapted to act on one opposing contact in each contact system at different portions of said reed cycle, means for energizing said driver coil including a source of low voltage, said armature of said driving reed being deflected by the magnetic flux of said pole of said driver coil upon its activation, said driving reed being connected to one terminal of said low voltage source and said center tap being connected to the other terminal thereof, whereby upon deflection of said driving reed each of said pairs of contacts in each of said systems is acted upon so that an output voltage waveform is taken across said output secondary transformer having a frequency three times the vibrating reed frequency.

10. A vibrator system comprising in combination, a transformer having a tapped primary winding and a secondary output winding, a vibratory driving reed having a fixed driver contact initially mating with its associated contact, a driver coil for said vibrator in said system connected between the said tapped primary winding and the fixed driver contact, said coil having a pole placed substantially centrally therethrough, an armature for said vibratory reed, two contact systems, each of said systems containing three pairs of contacts, two pairs of which are initially open, said vibratory reed being placed between said two systems and bearing one of said open contacts, means for energizing said driver coil including a source of low voltage, said armature of said driving reed being deflected by the attraction and repulsion of said pole of said driver coil upon its activation, said driving reed being connected to one terminal of said low voltage source and said center tap being connected to the other terminal thereof, whereby upon deflection of said driving reed each of said pairs of contacts in each of said systems is acted upon so that an output voltage waveform is taken across said output secondary transformer having a frequency three times the vibrating reed frequency.

11. A vibrator system comprising in combination, a transformer having a tapped primary winding and a secondary output winding, a vibratory driving reed having a fixed driver contact initially mating with its associated contact, a coil for said vibrator in said system connected between the said tapped primary winding and the fixed driver contact, said coil having a pole placed substantially centrally therethrough, an armature for said vibratory reed, two contact systems, each of said systems containing three pairs of contacts, two pairs of which are initially open, said vibratory reed being placed between said two systems and having a contact on each side of the reed adapted to act on one opposing contact in each contact system at different portions of said reed cycle, means for energizing said driver coil including a source of low voltage, said armature of said driving reed being deflected by the attraction and repulsion of said pole of said driver coil upon its activation, said driving reed being connected to one terminal of said low voltage source and said center tap being connected to the other terminal thereof, whereby upon deflection of said driving reed each of said pairs of contacts in each of said systems is acted upon so that an output voltage waveform is taken across said output secondary transformer having a frequency three times the vibrating reed frequency.

12. A vibrator system comprising in combination, a transformer having a tapped primary winding and a

secondary output winding, a vibratory driving reed having a fixed driver contact initially mating with its associated contact, a driver coil for said vibrator in said system connected between the said tapped primary winding and the fixed driver contact, said coil having a pole placed substantially centrally therethrough, an armature for said vibratory reed, two contact systems, each of said systems containing three pairs of contacts, two pairs of which are initially open, said vibratory reed being placed between said two systems and bearing one of said open contacts, said adjacent contact being placed on a biased contact arm spring support assembly comprising an angulated first section to which a second section bearing said adjacent contact is mounted at the top end thereof with a second contact placed below said adjacent contact thereon and normally mating with an opposing contact supported on a separated spring arm, means for energizing said driver coil including a source of low voltage, said armature of said driving reed being magnetically deflected by the induced magnetic flux of said pole of said driver coil upon its activation, said driving reed being connected to one terminal of said low voltage source and said center tap being connected to the other terminal thereof, whereby upon deflection of said driving reed each of said pairs of contacts in each of said systems is acted upon so that an output voltage waveform is taken across said output secondary transformer having a frequency three times the vibrating reed frequency.

13. A vibrator system comprising in combination, a transformer having a tapped primary winding and a secondary output winding, a vibratory driving reed having a fixed driver contact initially mating with its associated contact, a driver coil for said vibrator in said system connected between the said tapped primary winding and the fixed driver contact, said coil having a pole placed substantially centrally therethrough, an armature for said vibratory reed, two contact systems, each of said systems containing three pairs of contacts, one pair of which is normally closed, said vibratory reed being placed between said two systems and bearing one contact of a pair of initially open contacts, said other contact of said pair being borne on the same spring arm of one contact of said closed pair, said spring arm having an angulated construction for biasing the contacts in proper mating relationship, means for energizing said driver coil including a source of low voltage, said armature of said driving reed being deflected by the attraction and repulsion of said pole of said driver coil upon its activation, said driving reed being connected to one terminal of said low voltage source and said center tap being connected to the other terminal thereof, whereby upon deflection of said driving reed each of said pairs of contacts in each of said systems is acted upon so that an output voltage waveform is taken across said output secondary transformer having a frequency three times the vibrating reed frequency.

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