April 16, 1957 W. W. BROCKWAY 2,789,177

SYNCHRONOUS VIBRATORS

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Fig. 2

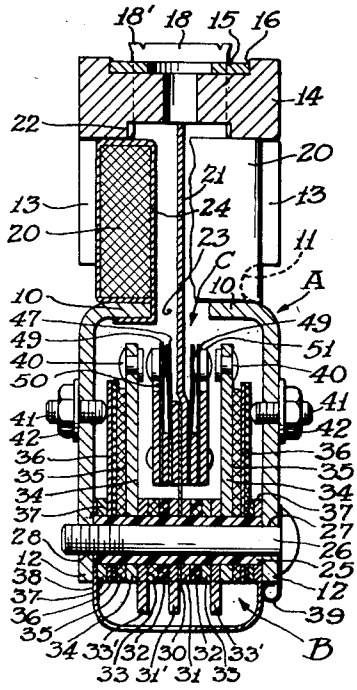
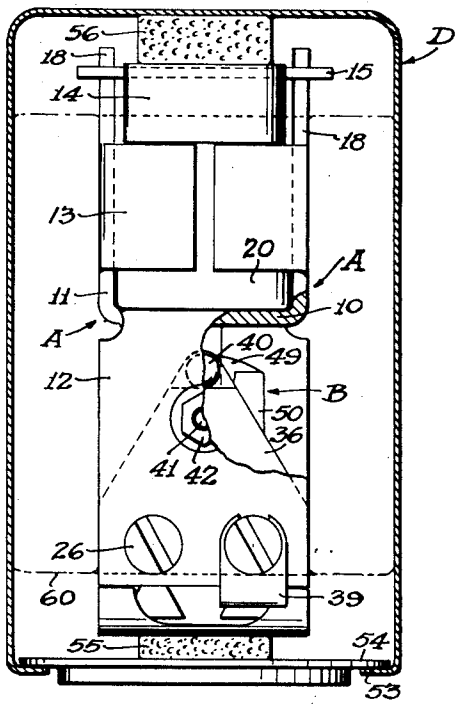


Fig. 1



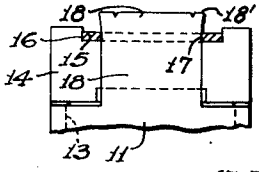


Fig. 6

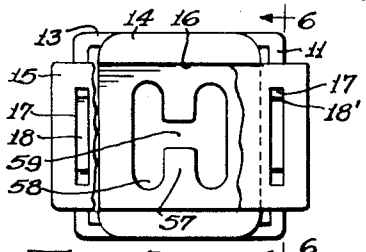


Fig. 3

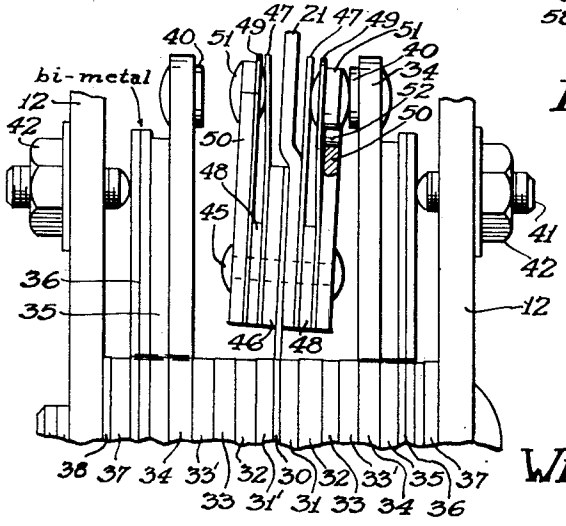


Fig. 4

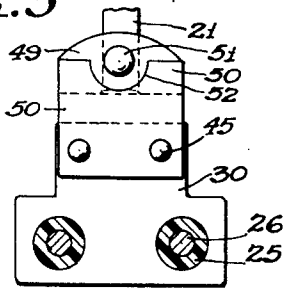


Fig. 5

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SYNCHRONOUS VIBRATORS

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This invention relates to apparatus for converting direct electric current into alternating current of square wave type, commonly known as synchronous vibrators and often referred to as "choppers." A general object of the invention is to provide a vibrator of this type, adapted to embody prescribed phase characteristics with reference to amount of dwell time as well as coil specifications.

An object of the invention is to provide such a vibrator having an improved, simplified, one-piece frame.

Another object of the invention is to provide an improved vibrator construction embodying an armature and contact assembly which is constructed as a unit assembly and is inserted as such into the frame structure of the vibrator.

Another object is to provide a vibrator having an improved magnet designed for improved direction of flux into its center and concentration of the flux in a narrow gap between its poles without requiring the use of pole shoes.

Another object is to provide a vibrator having improved tuning and adjustment facilities.

Another object is to provide a vibrator having improved phase-adjustment mechanism.

A further object is to provide a vibrator having antirebound springs the tension of which is adjusted to control the "on-time" or dwell time.

A further object is to provide a vibrator having improved dampening characteristics, for minimizing high-frequency rebound during the contact making phase of operation. More specifically, the invention contemplates utilizing frictional snubbing action in dampening out high frequency rebound vibrations.

A still further object of the invention is to provide a vibrator having means for effecting compensation for the effect of temperature changes in the resilient, flexing parts of the vibrator, in a manner to retain uniformity of phase and dwell characteristics.

Other objects will become apparent in the ensuing specifications and appended drawing in which:

Fig. 1 is a side view of a vibrator embodying the invention, parts being broken away and the casing being shown in section;

Fig. 2 is a longitudinal sectional view of the mechanism;

Fig. 3 is a top plan view of the vibrator mechanism;

Fig. 4 is an enlarged fragmentary front view of the mechanism;

Fig. 5 is a sectional view showing the vibrating unit; and

Fig. 6 is a detail sectional view taken on the line 6—6 of Fig. 3.

As an example of one form in which the invention may be embodied, I have shown in the drawing a synchronous vibrator embodying generally a frame and coil assembly A; a fixed contact unit B; an armature (reed) and moving contact unit C, and a casing D. Units B and C are constructed as a unit assembly which is inserted as such into the frame A during initial assembly of the vibrator,

and which may be removed as a unit from the frame and adjusted or repaired as the occasion may require, with the removal and replacement of the assembly being relatively simple and not time consuming.

Frame assembly A embodies a novel one-piece stamped non-ferrous sheet metal frame including a central web 10, a pair of coil-supporting arms 11 bent upwardly from one pair of opposed sides of the web 10, and a pair of arms 12 bent downwardly from the alternate pair of opposed sides of web 10, in parallel planes at right angles to the parallel planes in which arms 11 are disposed. The lateral edges of arms 12 are disposed substantially in the extended planes of arms 11, and the lateral edges of arms 11 are disposed just inwardly of the planes of arms 12, sufficiently to provide for two pairs of tabs 13 which are bent laterally from the side edges of respective arms 11, the tabs of each pair projecting toward one another in a common plane which is the extended plane of a respective arm 12. Thus the frame partially encloses a prismatic space of square cross-section, of substantially uniform area from end to end of the vibrator, and the maximum of compactness is attained in the overall assembly, for occupancy of any space of prescribed maximum volume.

A permanent magnet 14 is positioned in the space between arms 11 above tabs 13, and is secured in place by an anchor plate 15 which is seated in a shallow groove 16 in magnet 14, the ends of anchor plate 15 being provided with slots 17 through which narrowed extensions 18 on the upper ends of arms 11 extend (Figs. 3 and 6). Extensions 18 may have an interference fit in slots 17, to secure plate 15 against displacement and thus lock the parts in assembly; or may have its corners spread laterally by staking, as at 18', to secure plate 15.

A coil 20 is caged in the space defined between arms 11, tabs 13, web 10 and magnet 14. Insertion and removal of the coil is controlled by removal of magnet 14, which acts as a cover for this coil-containing space and retains the coil when the latter is in place. Coil 20 is of square tubular cross-section, providing an axial space of adequate width to accommodate the vibration of the armature reed 21 of the assembly C which will be presently described. Magnet 14 has in its under side a recess 22 in which the tip of the reed 21 vibrates, in close association with the under side of the magnet. Frame web 10 has a central opening 23, registering with the axial space of coil 20, through which the reed 21 extends from the lower assembly of contacts etc., of units B and C. A lining 24 electrostatically shields reed 21 from coil 20.

Fixed contact assembly B comprises simply a stack of stamped sheet material parts which are strung on a pair of insulator sleeves 25, the latter being in turn mounted on a pair of mounting rods which may, as shown, comprise a pair of screws 26 extended through laterally spaced apertures 27 in one of the arms 12 and threaded into threaded openings 28 in the other arm 12.

Snugly embraced between the arms 12, and strung on the sleeves 25, is the stack of stamped parts including, at the center thereof, a vibrator spring 30 of thin spring sheet metal; a pair of spacer blocks 31, 31' on respective sides thereof; a pair of insulator blocks 32 flanking the spacer blocks 31, 31'; spacer blocks 33 flanking the insulator blocks 32; a pair of fixed contact terminal blocks 33' flanking the blocks 33; a pair of fixed contact supports 34 in electrical contact with the terminal blocks 33' and projecting upwardly to points near the web 10; a pair of insulator plates 35 backing up the supports 34; a pair of back-up plates 36 flanking the insulator plates 35; spacer blocks 37 flanking the back-up plates 36; and the anchored end of a U-shaped cover flap 38 which covers

the lower end of the assembly. The free end of flap 38 bears against spacer 37. A wire clamp 39 is secured under the head of one of the screws 26 (Fig. 1).

Contacts 40 are carried by the upper ends of supports 34. The positions of contacts 40 may be manually adjusted by means of abutment screws 41 which are threaded through frame arms 12 and are locked in position by lock nuts 42. The positions of contacts 40 may be further adjusted, automatically, during operation of the vibrator, to compensate for spring rate variations occurring as the result of temperature changes in the assembly. To this end, the back-up plates 36 are of bi-metal construction, so constituted, arranged, and regulated as to automatically move contacts 40 inwardly with increasing temperature, thus compensating for reduced elasticity or spring rate in the parts of the vibrating assembly, as more fully explained hereinafter.

Armature assembly C comprises a series of parts, carried by spring 30 and secured thereto by a pair of laterally spaced rivts 45 extending therethrough and through spring 30 (Fig. 4). These parts include: armature reed 21, in direct contact with one side of spring 30; a spacer block 46, corresponding to the thickness of reed 21, lying against the other side of spring 30; a pair of anti-rebound springs 47 flanking reed 21 and spacer block 46; a pair of spacer blocks 48 flanking the springs 47; a pair of contact mounting springs 49 flanking the blocks 48; and a pair of back-up arms 50 flanking the mounting springs 49. The heads of rivets 45 tightly engage back-up arms 50 to secure the parts in rigid assembly at rivets 45, with the springs 47 and 49 and back-up arms 50 projecting upwardly from spacer blocks 48 so that the springs 47, 49 may have controlled vibration between back-up arms 50 and armature 21, with reference to the fixed assembly of spacer blocks and back-up arms, while the entire reed assembly swings in synchronous vibration in response to electromagnetic impulses developed in the coil assembly. Moving contacts 51 are carried by the free ends of springs 49. Back-up arms 50 have their free ends bifurcated to provide recesses or notches 52 to receive contacts 51 so that springs 49 may directly engage the inner faces of back-up arms 50.

The vibrator is housed in a casing D which may be in the form of a cylindrical canister with a bottom flange 53 retaining a bottom cap 54 of disc form. The vibrator is mounted between cushion blocks 55, 56 engaged under compression between its respective ends and the ends of casing D. Blocks 55, 56 may be of sponge rubber or other equivalent material. The vibrator may be further cushioned by a felt blanket wrapped around it. Such blanket is indicated in phantom at 60 in Fig. 1.

Magnet 14 is of square, closed ring form, with poles 57 defined within an H-shaped internal space 58, the ends of poles 57 being spaced fairly closely to define a narrow air gap 59 in which the magnetic field of the magnet is largely concentrated. The end of reed 21 vibrates in close adjacency to the gap 59 so as to receive maximum excitation therefrom.

In accordance with conventional practice, coil 20 may have a center tap connected to one side of a direct current source, and respective ends connected to respective fixed contacts 40, with swinging contacts 49 having a common connection to the other side of the direct current source. From a secondary in coil 20, induced alternating current may be conveyed to an amplifier, then passed through a rectifier to provide a stepped-up direct current. Since such circuits are well known, none is illustrated herein, this description thereof being merely for the purpose of identifying the characteristics of the vibrator and its attendant problems.

The anti-rebound springs 47 are bent so as to normally assume diverging relation to reed 21, and bear yieldingly against contacts 51 with light spring pressure. As reed 21 reaches a limit of lateral swinging movement, the contact 51 on that side, having previously engaged the adjacent fixed contact 40, will be arrested, and springs 49 and 47 on that side will be flexed toward reed 21. During the flexing movement, contact 51 will slide slightly against spring 47, developing a frictional rubbing action which functions to control rebound in a manner to eliminate chatter. The tension in the springs 47 controls the "on-time" or dwell time. Such tension may be adjusted by bending springs 47, and the arrangement of parts in my vibrator is such that each spring 47 can thus be adjusted without disturbing the adjustment of other parts. Increased stressing of springs 47 shortens the dwell time.

Phase adjustment is accomplished by changing the setting of screws 41 to change the spacing of fixed contacts 40. The major factor in phase lag is inherent in the design of the coil, the magnet and the resultant magnetic circuits. The closer the in-phase relation, the smaller will be the lag between applied coil voltage and contact make and break.

I claim:

1. A synchronous vibrator of elongated form including: a frame comprising a square web disposed in a plane intermediate the ends of said vibrators and normal to its longitudinal axis, first and second pairs of arms, integral with and projecting in opposite directions from said web to said ends, parallel to one another and perpendicular to said web; a contact and vibrator unit assembly mounted between the first pair of arms; a square coil embraced between the second pair of arms and resting on said web; a square ring magnet embraced between said second pair of arms and engaging the outer end of said coil to retain the coil in assembly; and means securing said magnet between said second pair of arms; said web having a central opening, and said vibrator unit including a reed extending through said opening and through said coil into proximity to said magnet.

2. In a synchronous vibrator of elongated form: a frame comprising a rectangular web disposed in a plane intermediate the ends of said vibrator and normal to its longitudinal axis; and first and second pairs of arms, integral with and projecting in opposite directions from said web, parallel to one another and perpendicular to said webs; a contact and vibrator unit assembly mounted between the first pair of arms; a coil embraced between the second pair of arms and resting on said web; a magnet also embraced between said second pair of arms and superimposed upon said coil to retain the same in assembly; and means attached to said second pair of arms and securing said magnet therebetween; said web having a central opening, and said vibrator unit including a reed extending through said opening and through said coil and into proximity to said magnet.

3. A vibrator as defined in claim 2, including pairs of opposed tabs formed integrally with respective arms of said second pair of arms and bent at right angles to the respective arms, toward one another, in embracing relation to said coil, for securely positioning the coil in coaxial relation to the major axis of the vibrator.

4. A vibrator as defined in claim 3, wherein said arms and tabs cooperatively provide an enclosure of substantially square cross section and wherein said coil is of correspondingly square cross section.

5. A vibrator as defined in claim 2, including a pair of laterally spaced parallel mounting rods bridging between the arms of the first pair near the ends thereof, each rod having its respective ends extending through and mounted in the respective arms; and insulator sleeves around the respective rods; said contact and vibrator comprising a series of flat parts in face to face contact with one another, pierced by said sleeves, and clamped between said arms of the first pair.

6. A vibrator as defined in claim 2, including a pair of laterally spaced parallel mounting screws each having a

threaded end portion threaded into one of the arms of the first pair, a shank end portion rotatably extended through the other arm of said first pair and a head engaging said other arm; and insulator sleeves around the respective screws; said contact and vibrator assembly comprising a series of flat parts in face to face contact with one another, pierced by said sleeves, and clamped between said arms of the first pair, said screws being operable to draw said arms of the first pair into clamping engagement with said series of flat parts.

7. A synchronous vibrator as defined in claim 2, including: a pair of laterally spaced mounting rods mounted in and bridging between said first pair of arms near one end of the frame; insulator sleeves around said rods; and a unit assembly of flat parts including vibrator and contact parts threaded over and mounted upon said sleeves for unit insertion and removal between said arms, said rods being slidable axially through said arms in order to insert or remove the same, thereby to secure said sleeves and unit assembly to the arms or to release them for removal from between the arms.

8. A vibrator as defined in claim 2, including a pair of laterally spaced mounting rods mounted in and bridging between said first pair of arms near one end of the frame; insulator sleeves around said rods; and a unit assembly of flat parts including vibrator and contact parts threaded over and mounted upon said sleeves for unit insertion and removal between said arms, said rods being slidable axially through said arms in order to insert or remove the same, thereby to secure said sleeves and unit assembly to the arms or to release them for removal from between the arms; and wherein said parts include a pair of fixed contact supports near the outside of the assembly; two sets of spacer parts interposed between said supports, in series; fixed contacts carried by said supports; a leaf spring clamped between said sets of spacer parts, at the center of the assembly; and a reed and two sets of vibrator parts secured to the free end of said spring in sandwich assembly, said vibrator parts including movable contacts for engagement with said fixed contacts.

9. In a synchronous vibrator; a frame; a pair of fixed contacts mounted on said frame in substantially fixed, spaced, opposed positions; a leaf spring having one end portion fixed to said frame and a free end portion projecting along a median axis between said contacts; and a vibrator unit comprising an assembly of parts secured to said free end portion of the spring and including a reed having an end portion fixed against one side of free end portion of said spring, a spacer secured against the other side of said spring; anti-rebound leaf springs secured to the outer faces of said reed and spacer respectively and having free end portions in spaced relation to said reed; secondary spacers secured against the outer faces of said anti-rebound springs; contact support arms consisting in thin leaf springs secured to the outer sides of said secondary spacers and projecting in spaced relation to said anti-rebound springs; movable contacts carried by the free ends of said support arms; and a pair of back-up arms each anchored at one end in said assembly and having a projecting portion normally in contact with the outer side of a respective support arm and providing a substantially unyielding stop for determining the position of maximum distance of the respective movable contact from the reed, said contacts extending through said support arms and having back portions in sliding engagement with the respective anti-rebound springs.

10. A vibrator as defined in claim 9, wherein said reed is provided with an offset at the outer end of said vibrator spring, and includes a free swinging portion extending from said offset, centered in the plane of the vibrator spring, and equally spaced from the anti-rebound springs.

11. A vibrator as defined in claim 9, including a pair of fixed contact support arms of limited flexibility, each anchored at one end to the frame and having a free portion to which a respective fixed contact is secured; and adjusting means carried by the frame and arranged to apply pressure to the free end portions of the said fixed contact support arms for adjusting the positions of said fixed contacts.

12. In a synchronous vibrator; a frame including a pair of flat parallel spaced arms; a pair of laterally spaced mounting rods mounted in and bridging between said arms near an end of the frame; insulator sleeves around said rods and extending between said arms; a unit assembly of flat parts including spacers threaded over and mounted upon said sleeves for unit insertion and removal between said arms and clamped between said arms in the assembled vibrator, said assembly including a pair of bi-metal arms in adjacent spaced relation to the inner sides of said arms; a pair of fixed contact mounting arms supported by said insulator sleeves and spacers and disposed inwardly of and backed up by said bi-metal arms; fixed contacts carried by the free ends of said mounting arms; said bi-metal arms being thermo-responsive for adjusting the positions of said fixed contacts; a pair of spacing means arranged between said mounting arms, and a thin flat vibrator spring clamped between said spacing means and having a free portion projecting between said mounting arms; and a vibrator assembly including said free portion of said vibrator spring, a reed having an end portion fixed against one side of free end portion of said spring, a spacer secured against the other side of said spring; anti-rebound leaf springs secured to the outer faces of said reed and spacer respectively and having free end portions in spaced relation to said reed; secondary spacers secured against the outer faces of said anti-rebound springs; contact support arms consisting in thin leaf springs secured to the outer sides of said secondary spacers and projecting in spaced relation to said anti-rebound springs; movable contacts carried by the free ends of said support arms; and a pair of back-up arms each anchored at one end in said assembly and having a projecting portion normally in contact with the outer side of a respective support arm and providing a substantially unyielding stop for determining the position of maximum distance of the respective movable contact from the reed, said contacts extending through said support arms and having back portions in sliding engagement with the respective anti-rebound springs.

13. A vibrator as defined in claim 10, including adjusting screws mounted in said frame arms and adjustably engaging said bi-metal arms for determining positions of normal adjustment of said bi-metal arms and said fixed contacts.

14. A vibrator as defined in claim 9, wherein said back-up arms have bifurcated end portions bearing against the adjacent support arms and defining notches through which the respective movable contacts project for engagement with the respective fixed contacts.

References Cited in the file of this patent

UNITED STATES PATENTS

1,372,073	Hunt	Mar. 22, 1921
2,433,740	Collins et al.	Dec. 30, 1947
2,473,353	Aust	June 14, 1949
2,490,895	Aust et al.	Dec. 13, 1949
2,524,510	Blackhall et al.	Oct. 3, 1950
2,623,965	Clark	Dec. 30, 1952