July 31, 1945. C. S. WEYANDT 2,380,622

ELECTROMAGNETIC VIBRATOR

Original Filed Dec. 17, 1940 2 Sheets-Sheet 1

Fig. 3.

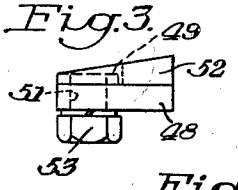


Fig. 1.

Fig. 4.

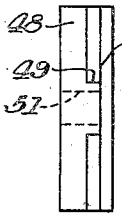


Fig. 2.

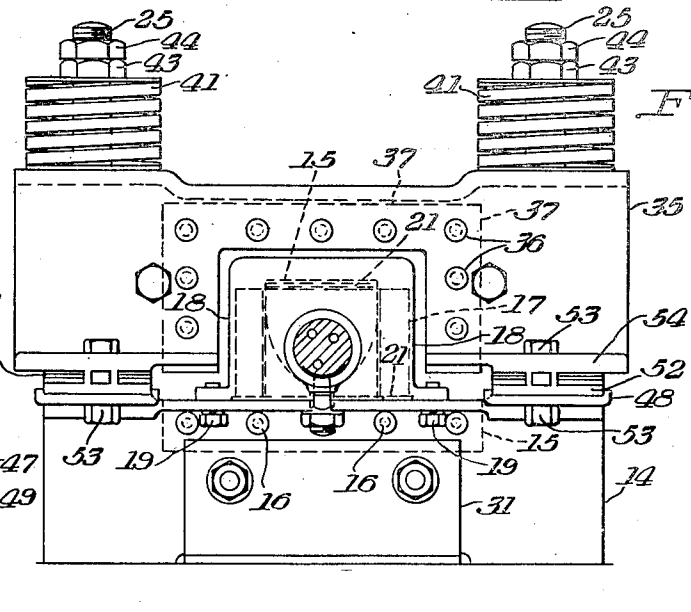
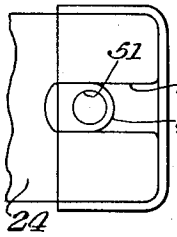


Fig. 5



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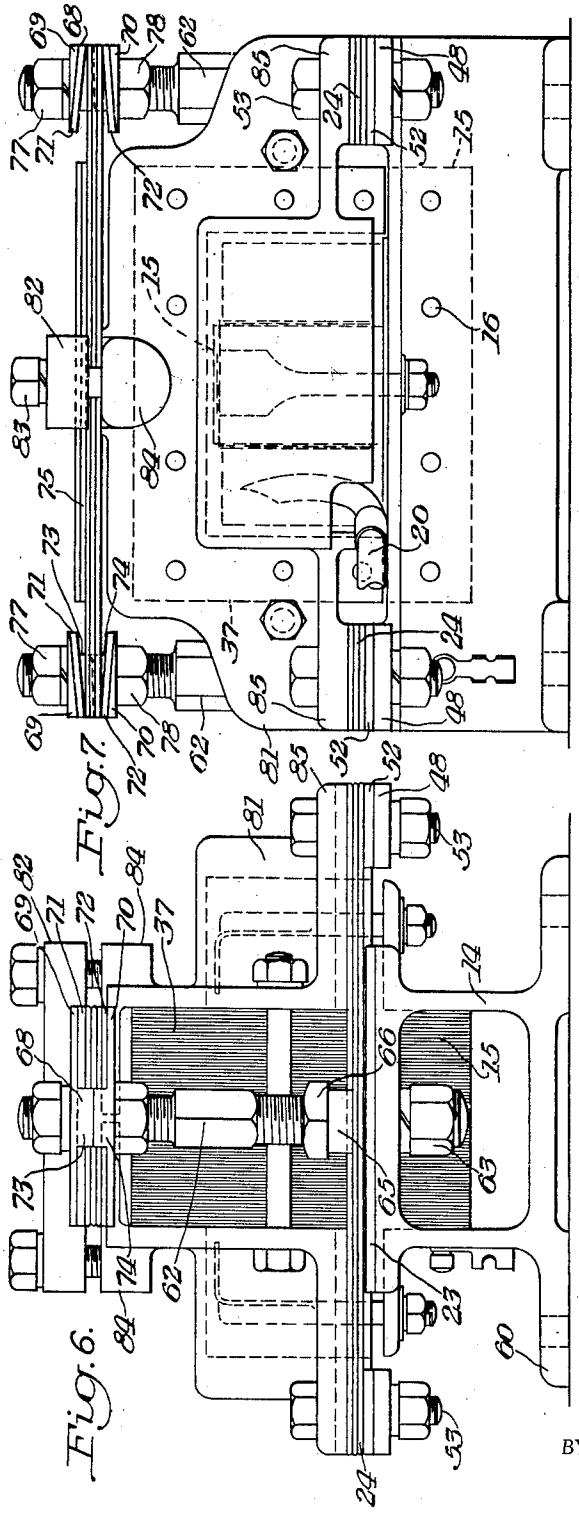


Fig. 6.

Fig. 7.

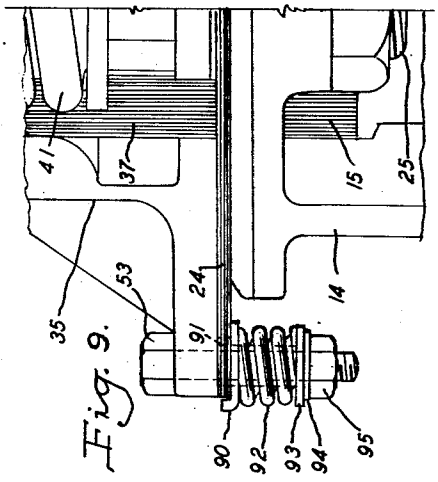


Fig. 9.

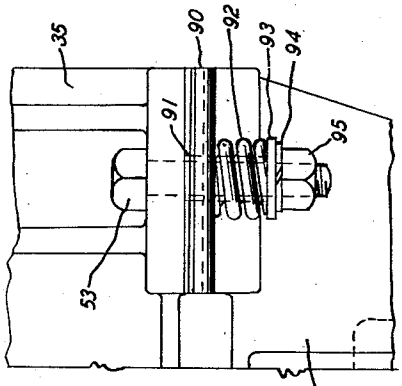


Fig. 8.

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2,380,622

ELECTROMAGNETIC VIBRATOR

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Original application December 17, 1940, Serial No. 370,465. Divided and this application June 26, 1942, Serial No. 448,545

10 Claims. (Cl. 172—126)

My invention relates to electromagnetic vibratory or reciprocatory motors of that type which comprises a captive armature and an electromagnet core that is periodically energized to effect vibratory movements of the armature. Such motors frequently are employed as vibrators designed and intended for vibrating various types of objects such as vibrator tables and screens, molds of various types, and chutes and spouts through which powdered or finely divided material is fed, or as an impact member for operating cutting or drilling tools or the like.

It is an object of the invention to provide a vibratory motor having means for adjusting the air gap between the armature and electromagnet.

A further object is the provision of a vibrator having novel spring means and mounting therefor connecting the vibrating armature to the base to eliminate noise and reduce wear.

Still another object of my invention is to provide a vibrating apparatus that is of simple and rigid construction, economical to manufacture, of small size and light weight, and which can be readily applied to a variety of apparatus with which it is adapted for use.

The preferred embodiments of my invention are shown in the accompanying drawings by way of example, wherein

Figure 1 is an end view of a preferred vibrator construction,

Figure 2 is a side elevation of the vibrator shown in Figure 1,

Figures 3, 4 and 5 are elevations of a detail,

Figure 6 is an end view of a further preferred vibrator construction,

Figure 7 is a side elevation of Figure 6,

Figure 8 is a fragmentary end view of a modification, and

Figure 9 is a side view of Figure 8.

Referring to Figures 1 and 2, I have shown a preferred type of motor employing a captive armature constructed according to the present invention. The motor is constructed to serve as a vibrator and comprises a base assembly made of a flanged channel shaped base 14 within which is set the electromagnet core 15 made of a group of inverted T-shaped laminations secured in place by means of rivets 16 passing through the core and the sides of base 14. The base may be made of a magnesium alloy casting, for strength and lightness, or of steel if desired, and the electromagnet core may be made of laminated silicon steel or other suitable magnetic material of low retentivity. A core winding or coil 17 surrounds the leg of the core 15 and is held in place thereon by a pair of angle plates 18 which are bolted at 19 to the base. By means of a cable 20 the coil 17 may be connected to a suitable source of power. Suitable insulating discs or washers 21 are provided at the upper and lower ends of the coil 17.

The ends of the base channel 14 have integral flanges 22 having holes therein, and an anvil plate 24 preferably of non-magnetic material such as fibre, stainless steel or bronze, is supported thereon at each end. A group or set of spring leaves 24 of magnetic or non-magnetic material, such as, for example, a chromium nickel alloy, are secured at their middle to the anvil plates 23 at each end of the base by bolts 25, preferably of non-magnetic material, which extend through the flanges 22 and anvils 23 and have nuts 26 at their lower ends. The bolts 25 have a hexagonal shoulder 27 and are threaded at each end. An adjustment nut 28 threaded thereon engages the grooved clamp piece 29 and the spring leaves and anvil plates are thus clamped to the base between the nuts 26 and 28 at each end of the base. Angle plates 31 are bolted to the base and provide a means for securing the base assembly to the object to be vibrated.

The armature assembly comprises a flanged casing 35 of inverted U-shape made up of two halves. Rivets 36 hold the casing halves and an armature 37 made up of a plurality of inverted U-shaped laminations together. Holes 38 are provided in the casing 35 at the ends to receive the bolts 25 and coil springs 39 at each end located around bolts 25 support the armature assembly. Coil springs 41 at each end are placed around bolts 25 above the armature assembly and springs 39 and 41 are compressed between adjustment nuts 42 and 43 the desired amount, lock nuts 44 and 45 holding the nuts 42 and 43 respectively in adjusted position.

The springs 24 have open-ended slots 47 at their extremities, which are received in spring holders secured to the armature casing. These holders comprise a steel plate 48 having a boss 49 on the inner side and a hole 51 therethrough, and a pad 52 of rubber is vulcanized or otherwise suitably secured thereto. The rubber pad 52 preferably is tapered. A bolt 53 passes through the flange 54 of the armature casing and through the hole 51 of the spring holder to retain the holder on the casing. The boss 49 engages the lower face of flange 54 so that in assembled position the spring leaves are not rigidly clamped in the holders, but are free to move endwise as they are flexed.

The armature assembly thus is secured to the base assembly by means of leaf springs 24 and pairs of coil springs 39 and 41. The natural or free period of vibration of the armature can be adjusted by adjusting either or both nuts 42 and 43, the natural or free period of vibration being shortened by compressing the springs. If the nuts 42 and 43 are unequally adjusted, the air gap between the armature and electromagnet core will be adjusted. However, I prefer to adjust this air gap by means of nuts 26 and 28, and by raising nut 28 the armature assembly may be lowered and locked in lowered position by nut 26.

The vibrator preferably is actuated by unidirectional substantially spaced current impulses obtained by a rectifier from an alternating current source. For example, when the vibrator is thus operated from a fifty cycle alternating current source there will be fifty impacts per second. When the vibrator is intended for vibrating a fixed load or for operating under a constant condition, I prefer to adjust the natural or free period of vibration of the armature and load close to or substantially at the electro-mechanical resonance point, thereby obtaining a more economical utilization of electrical energy. Under such condition, the natural period of the armature preferably is between 70% and 110% of electro-mechanical resonance. However, where the load or conditions of operation are variable, I prefer to adjust the springs and armature to within about 40% to 70% of electro-mechanical resonance, thus providing a stable forced vibration under variable conditions.

As the ends of the leaf springs 24 are free to move, the rubber pads or liners provide a cushioned or resilient grip on the ends keeping them firm and tight at all times and allowing movement of the spring ends. This avoids wear and gradual loosening of the springs which would cause the armature mass to change its natural or tuned frequency and change the force of vibration. The resilient gripping of the springs also eliminates noise and rattle heretofore caused by the springs striking the sides of the sockets.

The leaf springs 24 serve as impact receiving members which engage anvil 23 and also guide the armature in its vibration in proper relative alignment with the core. The springs 24 may readily be replaced when they become worn, and thus when new springs are inserted the proper air gap is retained.

In operation, when the coil 17 is energized, the armature is drawn sharply into engagement with the anvil surfaces as shown in Figure 1, thus producing an impacting force upon the base. When the current impulse dies to zero the springs 39 will effect retractive movement of the armature, such retractive movement being cushioned and limited by the springs 41 which will assist in overcoming the inertia of the armature upon the succeeding application of magnetic force thereto.

In the modification shown in Figures 6 and 7, wherein like parts are correspondingly numbered, the base 14 is made of a casting and has integral flanges 60 whereby it is bolted to the object to be vibrated. The bolts 62 at each end pass through the leaf springs 24 and anvil 23 at each end into the base and each bolt receives a nut 63 and a spring type lock washer 64 at their lower end. A grooved clamping piece 65 at each end engages the top leaf of the springs 24 and by means of a nut 66 each bolt 62 is clamped in position and holds the springs at their middles to the base.

Near the top the bolts 62 carry spring clips 68 comprising similar upper and lower plates 69 and 70 having rubber pads 71 and 72 suitably permanently secured thereto. Bosses 73 and 74 engage each other and prevent the leaf springs 75 from being rigidly clamped therein. The spring holders are held in place on bolts 62 by nuts 77 and 78 threaded thereon.

At their center, spring leaves 75 are clamped to an armature casing 81 by a recesed bar 82 and bolts 83 threaded into lugs 84 at the sides of the casing 81. The casing has flanges 85 at its ends to which are secured the springs 24 by holders constructed as described in connection with Figures 1 and 2.

In this modification, the natural period of the armature may be adjusted by shifting spring holders 68 on bolts 62 to flex the springs 75. Movement of holders 68 will also cause flexing of the springs 24. If it is desired to adjust the air gap without changing the natural period of the springs, the nuts 63 and 66 are adjusted to move the bolts 62 and armature assembly relative to the electromagnet 15.

In the modification shown in Figures 8 and 9, wherein like parts are correspondingly numbered, the spring holders 90 comprise perforate angle plates having bosses 91 through which pass the bolts 53 and they are backed by coil springs 92 coiled around the bolts and held in palce by washer 93, lock washer 94 and nut 95. The compression of springs 92 may be adjusted by turning nut 95. In operation, the leaf springs 24 straddle the bosses 91 and the resiliency of springs 92 allows the holders 90 to rock slightly to accommodate the bowing of the leaf springs while avoiding play or lost motion, and allows the slight longitudinal movement of the leaf springs.

This application is a division of my application for Reciprocatory motor and method of control thereof, filed December 17, 1940, Serial No. 370,465, issued on February 2, 1943, as Patent No. 2,310,185.

What I claim as my invention and desire to secure by United States Letters Patent is:

1. A vibrator comprising a base adapted to be secured to an object to be vibrated, an electromagnet mounted on said base, an armature, spring holders carried by said armature, leaf springs secured at their middles to the base and having their ends located in said holders, and rubber pads secured to said holders and yieldably engaging said spring ends.

2. A vibrator comprising a base, an electromagnet mounted on said base, an armature, end posts supported by said base, spring holders carried by said end posts, leaf springs secured at their middle to the armature and having their ends received in said holders, and means to adjust said posts relative to the base to adjust the air gap between the armature and electromagnet without substantially disturbing the natural period of vibration of the device.

3. A vibrator comprising a base, an electromagnet mounted on said base, an armature, spring supports carried by the base adjacent the ends thereof, springs carried by said supports secured to said armature, and means to adjust said supports relative to the base to adjust the air gap between the armature and electromagnet without substantially disturbing the natural period of vibration of the device.

4. A vibrator comprising a base member adapted to be secured to an object to be vibrated, an electromagnet member mounted on said base, an armature, spring holders carried by one of

said members having rubber pads secured therein, and leaf springs held at their ends by said pads and secured at the middles to the other of said members.

5. A vibrator comprising a base adapted to be secured to an object to be vibrated, an electromagnet mounted on said base, an armature, spring holders carried by said armature, leaf springs secured at their middles to the base and having their ends received in said holders, spring holders carried by said base, leaf springs secured at their middles to the armature and at their ends in said latter holders, and resilient means for gripping said springs in said holders to allow endwise movement of said springs.

6. A vibrator comprising a base member adapted to be secured to an object to be vibrated, an electromagnet member mounted on said base, an armature, spring clips carried by one of said members comprising plates, leaf springs held at their ends in said clips between said member and plates, and resilient means clamping said plates against said springs.

7. A vibrator comprising a base, an electromagnet mounted on said base, end posts secured to said base, independent resilient means carried by each post, an armature supported at its ends by said resilient means, spaced spring holders carried by said armature at each end thereof, leaf springs secured at their middle to said base by said posts and having their ends received in the holders on the armature, and means to adjust said posts relative to the base.

8. A vibrator comprising a base, an electromagnet mounted on said base, end posts secured to said base, an armature assembly resiliently carried by said end posts, spring holders carried by said armature assembly, leaf springs secured at their middle to said base by said posts and having their ends received in said holders, and means to adjust said posts relative to the base.

9. A vibrator comprising a base member adapted to be secured to an object to be vibrated, an electromagnet member mounted on said base, an armature, spring holders carried by one of said members, leaf springs secured at their middles to one of said members and having their ends received in said holders, and resilient means gripping said spring ends.

10. A vibrator comprising a base member adapted to be secured to an object to be vibrated, an electromagnet member mounted on said base, an armature, spring holders having sockets and carried by one of said members, leaf springs secured at their middles to one of said members and having their ends received in said holders, and resilient liners in said sockets gripping said spring ends.

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