Oct. 14, 1941. F. H. FLEISCHER ET AL 2,259,131

VIBRATOR

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Fig. 1.

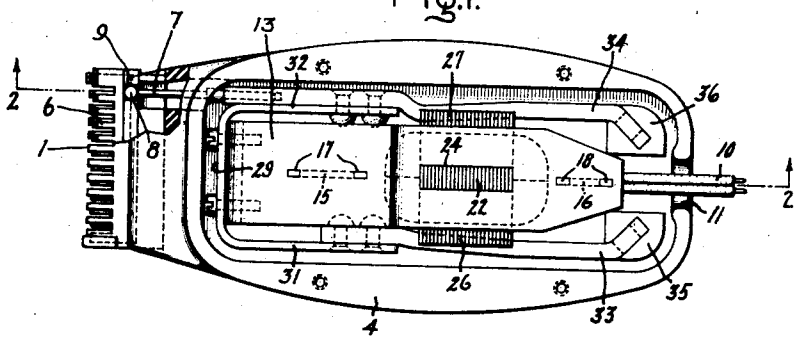

Fig. 2.

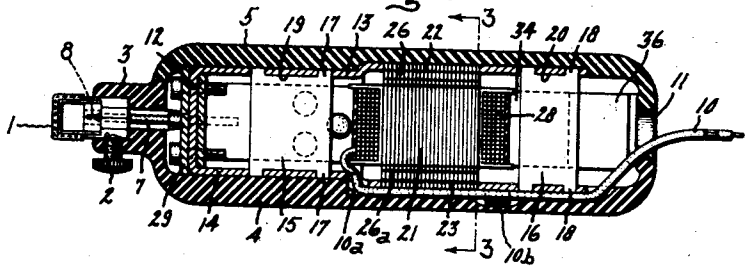

Fig. 3.

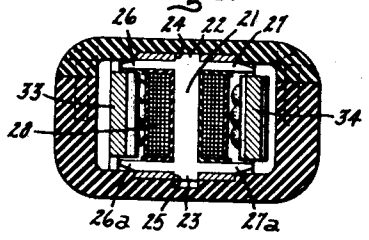

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Fig. 4.

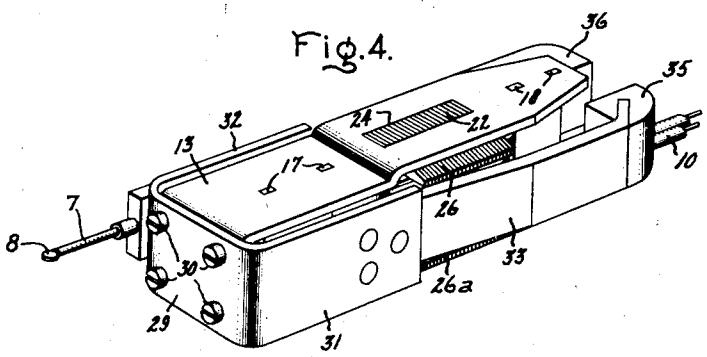
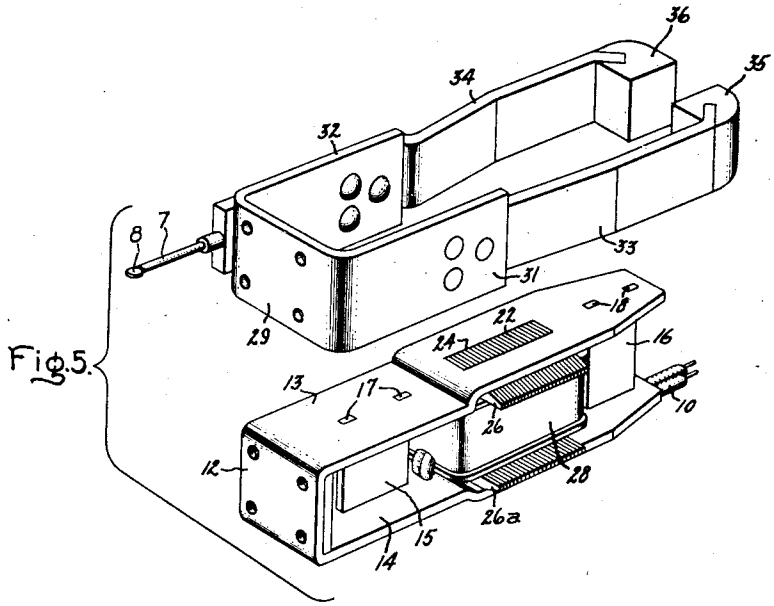


Fig. 5.



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UNITED STATES PATENT OFFICE

2,259,131

VIBRATOR

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Application May 5, 1939, Serial No. 271,948

1 Claim. (Cl. 172—126)

The present invention relates to electromagnetic vibrators for producing an oscillating or reciprocating movement such as may be used for operating electric shavers and the like.

The object of our invention is to provide an improved construction and arrangement in vibrators of this type, and for a consideration of what we believe to be novel and our invention, attention is directed to the following description and the claim appended thereto.

In the accompanying drawings, Fig. 1 is a top plan view of a shaver equipped with a vibrator embodying our invention, the upper half of the casing being removed; Fig. 2 is a sectional view taken on line 2—2 of Fig. 1; Fig. 3 is a sectional view taken on line 3—3 of Fig. 2; Fig. 4 is a perspective view of the vibrator; and Fig. 5 is an exploded view of the vibrator.

Referring to the drawings, the vibrator is shown applied to a shaver having a slotted shearing head 1 fixed by a set screw 2 to a reduced portion 3 at one end of the lower half 4 of a longitudinally split casing of molded insulating material. The upper half 5 of the casing is suitably fixed to the lower half of the casing, enclosing the vibrator. Within the shearing head 1 is a cutter 6 which is reciprocated by an operating lever 7 having a rounded end 8 fitting in a notch 9 in the cutter. It should be noted that the operating lever is connected to one end of the cutter. This reduces sliding of the rounded end 8 in the notch 9 as the operating lever is oscillated, thereby reducing wear and friction losses. This is due to the fact that the motion of the operating lever is almost wholly in the direction of movement of the cutter. The construction of the cutter and shearing head form no part of the present invention. Current is supplied to the vibrator by a conductor cord 10 led in through an opening 11 in the opposite end of the casing.

The vibrator has a U-shaped frame 12 having exposed longitudinally extending arms 13 and 14 fixed together by cross braces 15 and 16 having projections 17 and 18 which project through openings in the arms 13 and 14 and are riveted over the outer surfaces of the arms. This provides a rigid frame construction in which the arms are clamped against the ends 19 and 20 of the braces 15 and 16. Between the arms 13 and 14 and extending transversely or crosswise thereof is an electromagnet having a core 21 provided with projections 22 and 23 at opposite ends which fit in openings 24 and 25 in the frame arms 13 and 14. The core 21 comprises a plurality of laminations which extend perpendicular to the arms 13 and 14 of the frame. The laminations are in general H-shaped, the legs of the H projecting outward from opposite sides of the core adjacent the inner side of the arms 13 and 14 to provide pairs of spaced pole pieces 26 and 26a and 27 and 27a. The active faces of each pair of pole pieces are the inner or opposed faces which provide a recess for receiving an armature. The electromagnet is energized by a coil 28 on the core 21 and connected to the conductor cord 10 which is led along the under side of the frame arm 14 in a groove 10a in the casing. The conductor cord is held adjacent the frame arm 14 by a clip 10b thereon. The pole pieces 26 and 27 have a polarity opposite that of the pole pieces 26a and 27a. When the coil is energized from a source of alternating or pulsating current, the flux at the pole pieces fluctuates in magnitude in accordance with the variations in current flowing through the coil.

Fixed to the end of the frame 12 adjacent the shaving head is a U-shaped strip spring 29 having its central portion fixed by screws 30 to the end of the frame and having spring arms 31 and 32 extending along opposite sides of the frame. The arms 31 and 32 are perpendicular to the frame arms 13 and 14 and extend along the edges thereof so as to substantially enclose the space between the frame arms. Fixed to the spring arms 31 and 32 are armatures 33 and 34 arranged in the recesses between the inner or opposed faces of the pole pieces 26 and 26a and 27 and 27a respectively. The armatures are slightly narrower than the distance between the inner faces of the pole pieces and are supported by the spring arms for movement parallel to the inner faces of the pole pieces. The spring arms bias the armatures to an outer position in which the edges of the armatures are slightly beyond the ends of the pole pieces. As the current in the coil increases, the armatures are drawn inward toward the coil to a position in which the edges of the armatures are beneath the inner faces of the pole pieces. As the current in the coil decreases, the armatures are moved outward by the spring arms. The recesses provided by the pole pieces provide ample space for the oscillation of the armature without striking the coil. The direction of movement is such that the armatures move past rather than toward the pole pieces and, accordingly, cannot strike the pole pieces. This eliminates the need for stops. The strength of the springs and the weight of the armatures are adjusted so that the natural fre-

quency of vibration of the armatures is tuned to a frequency slightly below twice the frequency of the current energizing the coil. If the natural frequency of vibration of the armature were exactly equal to twice the frequency of the energizing circuit, the amplitude of oscillation of the armature would be limited by the friction load on the operating lever 7. In the particular application this would mean that as the cutter 6 encountered heavier or stiffer hair, the amplitude of movement of the cutter would decrease and might even decrease to such an extent as to prevent satisfactory cutting. By having the natural frequency of the armature slightly below twice the frequency of the current supply the amplitude of oscillation actually increases as the load on the cutter increases. This eliminates any possibility of unsatisfactory cutting due to a decrease of the cutter amplitude as the cutter load increases. The tuning or natural frequency of oscillation of the armatures is adjusted by weights 35 and 36 on the free ends of the armatures. The weights project beyond the end of the frame and, during oscillation, move between the frame arms 13 and 14. The armatures vibrate in synchronism with the pulsations of the current. Such armatures are known in the art as the vibrating reed type. Since the armatures move in opposite directions, the reaction forces transmitted from the spring arms 31 and 32 to the frame are neutralized. The end of the armature 34 opposite the end under the influence of pole pieces 27 and 27*a* is fixed to the operating lever 7. Since the spring arm 32 in effect supports the armature 34 for pivotal movement about a point adjacent the portion of the spring 29 connecting the arms 31 and 32, the armature is supported intermediate its ends. This has the advantage of applying greater leverage to the operating lever 7.

In use, the vibrator is supplied from a source of alternating or pulsating current of the proper frequency. As described above, this causes a synchronous vibration of the armatures 33 and 34. The vibration of the armature 34 is transmitted to the operating lever 7. The vibration of the armature 33, being equal and opposite to that of armature 34, neutralizes the reaction forces on the frame of armature 34 and accordingly prevents vibration of the shaver casing.

What we claim as new and desire to secure by Letters Patent in the United States is:

In an electromagnetic vibrator, a frame having spaced longitudinally extending arms, an electromagnet having an H-shaped core extending crosswise of said arms and fixed at each end to the adjacent arm, the arms of said core providing pairs of spaced pole pieces on opposite sides of the electromagnet, a coil on the central part of the core, longitudinally extending spring arms fixed to one end of the frame and extending toward the electromagnet, armatures fixed to the spring arms and supported thereby for pivotal movement about a point adjacent the point of attachment of the spring arms toward and away from a position bridging said pole pieces, said armatures extending beyond the electromagnet and having balance weights on the free ends, and an operating lever fixed to one of said armatures and extending away from the electromagnet and beyond the pivot point of the armature.

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