April 30, 1957 SARKIS DOCTOR ACOPIAN 2,790,276

VIBRATORY SANDING TOOL

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Fig. 1.

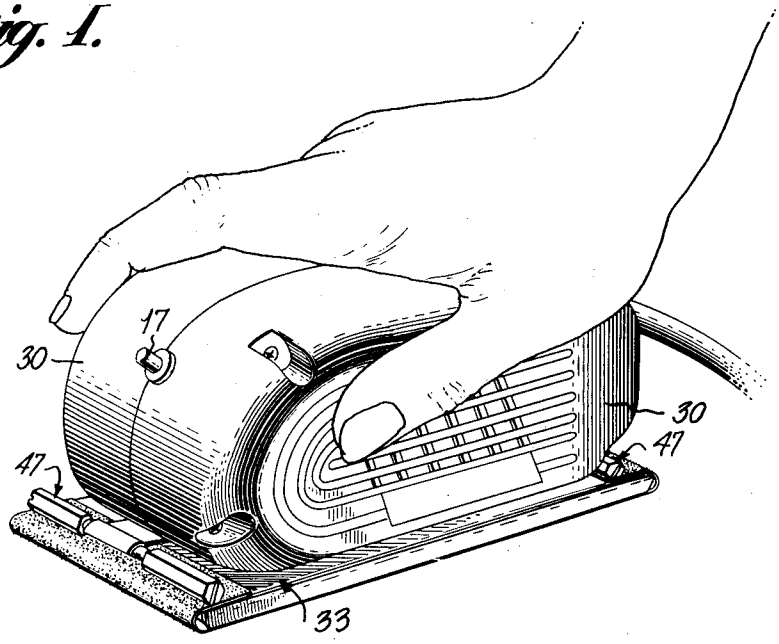
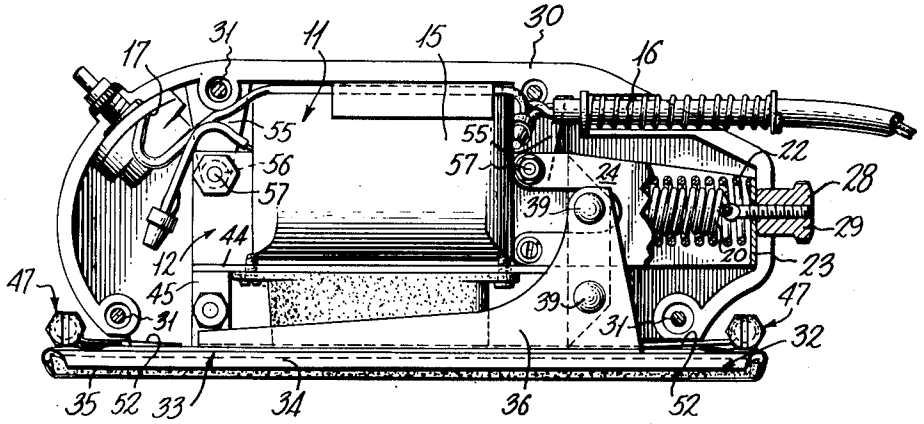


Fig. 2.



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Fig. 3.

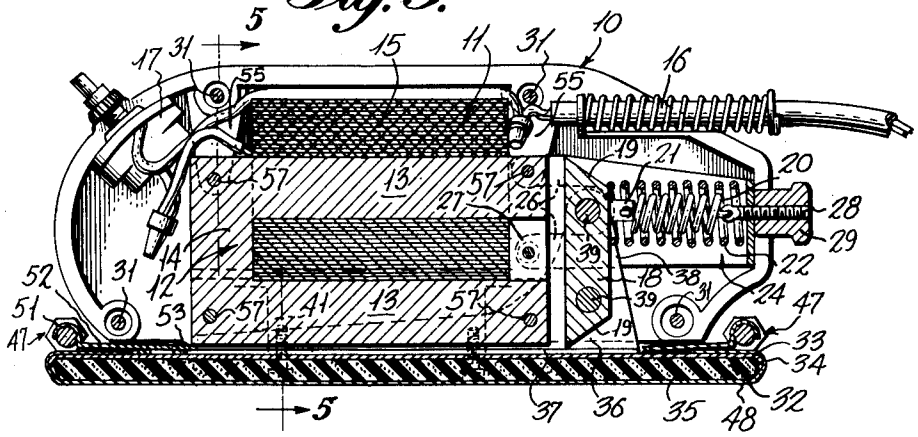


Fig. 4.

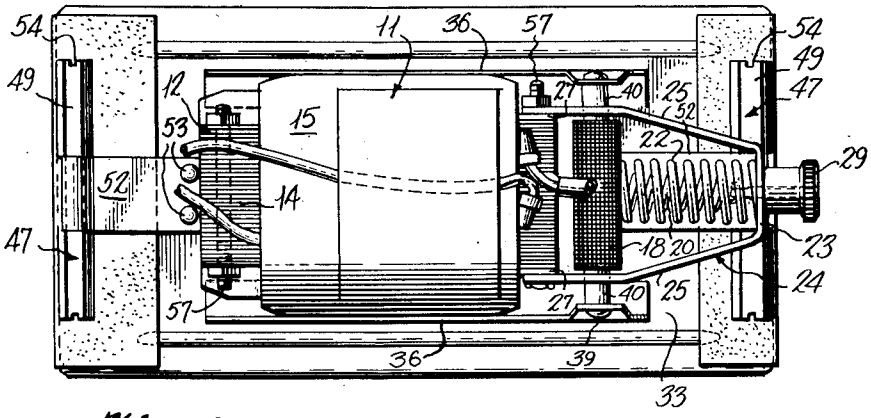
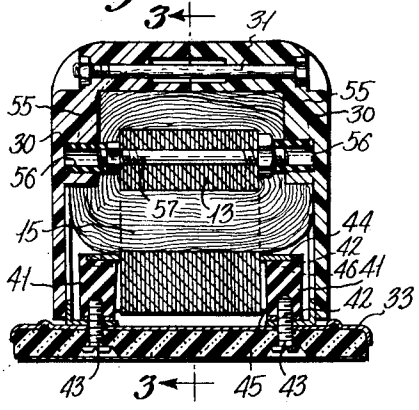


Fig. 5.



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VIBRATORY SANDING TOOL

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Application August 31, 1955, Serial No. 531,728

4 Claims. (Cl. 51—170)

The present invention relates in general to vibratory electric tools, and more particularly to portable vibratory devices for sanding, polishing, cleaning and like applications.

Many of the heretofore commercially available devices designed for sanding, polishing or cleaning surfaces employed a plate supporting an abrasive sheet or polishing pad and reciprocated by a rotary electric motor. These involved a relatively complex construction and, accordingly, high production costs. Such devices have also been responsible for damage to furniture or other work surfaces to which they were applied when not used with great care as the high rotary inertia of the rotating components and the rotary power present render the control of pressure upon the work surface rather critical. These factors have limited the field of usefulness of such devices.

Other manufacturers have employed vibratory motors for reciprocating the abrading or polishing pad of such tools, in order to reduce the complexity and production costs of the tool. These vibratory motors comprised an alternating current electromagnet having a stator core fixed to the tool casing associated with a movable armature connected to the plate supporting the abrading sheet or polishing pad to reciprocate the plate in the direction of armature movement. The armature in such tools has been uniformly pivoted at one end to the tool casing or the fixed support either by a pivot pin or a flat spring which acts as a pivot, and pivoted at the opposite end to the sheet supporting plate.

This construction results in two basic disadvantages. The vibrating end of the armature to which the plate is secured moves in an arc rather than a rectilinear path, thus giving arcuate motion to the abrading or polishing sheet which hinders uniform application of pressure to the work and may form indentations in the work surface. It also causes the work to impose on the sheet-supporting plate progressively increasing forces resisting movement of the plate as the plate arches toward its point of maximum projection from the casing at the medial point in its arcuate reciprocative path, increasing the load imposed on the vibratory motor and parts and therefore, the minimum practical size, weight, and power requirements of the tool. Further, such pivoting of the armature to the casing or stationary portion of the tool introduces a resistance to movement of the armature at the pivot point which consumes energy and does no useful work.

The pivoted types of armatures in vibratory tools impose other undesirable design limitations, as the nature of the pivoted armature construction requires a relatively larger overall tool height to obtain the necessary leverage to apply sufficient power to the reciprocative plate to overcome the resistance of the work surface on the plate, thereby resisting realization of a design which is of proper proportions and balance to commend it to convenient hand use. Also, the use of bearings between the stationary casing and plate components of the tool to guide the reciprocating plate and assist in supporting and locating the vibratory portions of the tool relative to the stationary portions, which has been the common practice in the trade, interposes problems in that the bearings are subject to wear and consume additional energy due to additional friction when load is applied to the plate during sanding or abrading operations.

An object of the present invention is the provision of a novel vibratory tool for sanding, polishing and like applications, which obviates the above-mentioned disadvantages and design limitations.

Another object of the present invention is the provision of a novel vibratory tool for sanding, polishing, cleaning and like operations, which may be conveniently held in the hand of the operator during use and which is readily portable.

Another object of the present invention is the provision of a vibratory sanding tool or the like, having a novel arrangement of components to produce smooth, high frequency reciprocating movement of a sanding plate in a rectilinear reciprocative path.

Another object of the present invention is the provision of a vibratory portable sanding tool or like tool having a novel association of a reciprocative armature and a sanding strip supporting plate confining movement of the plate to a straight line.

Another object of the present invention is the provision of a novel vibratory sander having reduced mechanical losses and wear in the components thereof.

Another object of the present invention is the provision of a vibratory sander having a novel suspension of the reciprocative sanding plate from the stationary components thereof and association of the plate with the electromagnet core to facilitate convenience of handling and efficiency of operation.

Other objects, advantages and capabilities of the present invention will become apparent from the following detail description, taken in conjunction with the accompanying drawing, showing one preferred embodiment of the invention.

In the drawing:

Figure 1 is a perspective view of a vibratory sander embodying the present invention;

Figure 2 is a side elevation of the vibratory sander, illustrated with one of the casing halves removed;

Figure 3 is a vertical longitudinal section view of the vibratory sander, taken along the line **3—3** of Figure 5;

Figure 4 is a top plan view of the sander, shown with the casing removed; and

Figure 5 is a vertical transverse section view, taken along the line **5—5** of Figure 3.

Referring to the drawings, wherein like reference characters designate corresponding parts throughout the several figures, there is illustrated a preferred embodiment of a vibratory tool embodying the present invention, which is specifically designed for use as a sander, and is indicated generally by the reference character **10**. The sander **10** is powered by an electromagnet **11** having a U-shaped core **12** formed of parallel horizontally disposed legs **13** arranged one over the other and a bridge portion **14** interconnecting the ends of the two legs **13** at one end thereof. Wound about the uppermost core leg **13** is an electromagnet coil **15** which is supplied with 60-cycle alternating current voltage at 110 volts through leads **16** controlled by a manual plunger switch **17**.

An armature **18** of the height of the core **12** and formed of iron core laminations is disposed closely adjacent the free ends of the armature core legs **13**. As will be noted in Figure 3 of the drawing, the armature **18** is of isosceles trapezoidal cross section having converging upper and lower sides **19** and the thickness of the armature **18** is somewhat reduced relative to that of the armature core legs **13** and bridge portion **14** to reduce the weight of the movable armature **18** and, therefore, of the moving

parts of the vibratory motor. From an electrical standpoint, the reduction of the flux path through the armature 18 in relation to the remaining path in the core 12 presents some losses but the advantages gained by reducing the weight of the moving parts outweighs the electrical losses interposed.

The armature 18 is supported from the core in floating condition by a tension coil spring 20 secured at its end adjacent the armature 18 to a lug 21 projecting from the armature 18, and by a larger diameter compression coil spring 22 coaxially disposed in surrounding relation about the tension spring 20 and bearing against the surface of the armature 18 remote from the core 12. The opposite end of the tension compression spring 22 bears against the bridge portion 23 of a generally U-shaped supporting bracket or frame 24 having legs 25 projecting toward the armature core 12 about opposite lateral ends of the armature 18. The legs 25 of the supporting bracket 24 terminate in bifurcated formations providing arms 26 which overlie a nonmagnetizable strap 27 bolted to and extending vertically between the free ends of the core legs 13 and are secured to the straps 27 by bolts, screws or other suitable fastening means.

The end of the tension coil spring 20 remote from the armature 18 is secured to a threaded adjusting screw 28 which extends through an aperture in the bridge portion 23 of the supporting bracket 24 and is threaded into an adjustment knob 29 bearing against the outer surface of the bridge portion 23.

A molded casing 30 formed of complementary halves extends about the above described assembly and is secured in surrounding relation to the same by means of bolts 31 extending through registering apertures provided in the casing halves 30 to clamp the casing halves in surrounding relation about the electromagnet 11 and associated components.

Mounted below the electromagnet 11 is a sandpaper supporting plate or shoe 32 comprising a substantially rectangular sheet metal platen 33 having downwardly flanged margins as indicated at 34 to position a resilient pad 35 of foam rubber or the like which is cemented to the under face of the platen 33.

Yoke members 36 having base flanges 37 secured to the upper surface of the platen 33 by screws or other convenient securing means extend over a major portion of the length of the platen 33 and are provided with erect extensions 38 which extend alongside the opposite lateral ends of the armature 18 and are secured thereto by bolts, rivets or the like, indicated at 39, having spacer sleeves 40 extending about the bolts 39 for precisely locating the armature 18 symmetrically between the yoke members 36. As will be observed from Figure 3, the uppermost bolts 39 and its associated spacer sleeve 40 extends between the arms 26 of the spring-supporting frame 24, and the lowermost bolt 39 lies below the frame 24.

Additionally, flexible rubber mounting blocks 41 of the type having tapped metallic mounting strips 42 embedded therein along the upper and lower faces of the blocks 41 are provided to suspend the sandpaper supporting plate 32 from the electromagnet core 12. Screws 43 extend upwardly through the platen 33 of the sandpaper supporting pad 32 and are threaded into the tapped openings in the lowermost tapped strip 42 of the rubber mounting blocks 41 to secure the shoe 32 to the blocks 41, and shoulder forming strips 44 extend along the length of the lowermost core leg 13 and having depending flanges 45 bolted to the core 12, screws 46 being threaded through the tapped openings in the uppermost securing strip 42 of the mounting blocks 41 and into the shoulder forming strips 44 to secure the upper ends of the mounting blocks to the core 12.

A gripping and tensioning mechanism 47 is provided at each longitudinal end of the sandpaper supporting plate 32 to grip the edges of the sandpaper sheet, such as indicated at 48, in tight condition extending about the lower face of the pad 35. This gripping and tensioning mechanism 47 in the preferred embodiment, comprises a bar 49 of hexagonal cross section along the major portion of its length and having a circular cross section intermediate portion 50 about which extends an inverted substantially U-shaped portion 51 of a leaf spring 52 which is secured at its other end to the platen 33 by rivets 53. The ends of the hexagonal bars 49 are slotted, as indicated at 54, to receive a screw driver blade or the like by which the gripping and tensioning devices may be rotated to effect tensioning of the sandpaper sheet 48 over the lower face of the pad 35.

Each of the casing halves 30 are provided with formations 55 on the inner surfaces thereof projecting toward the electromagnet 11 and extending downwardly from the top of the casing and upwardly from the bottom of the casing to provide apertures therein housing rubber sleeves 56 in alignment with the axes of the bolts 57 extending transversely through the laminations of the core 12 at each corner of the core, whereby the ends of the bolts 57 are designed to be projected into the hollow bores of the rubber sleeves 56 to provide a shock attenuating connection between the casing 30 and the electromagnet 11.

The sander is prepared for operation by placing a sheet of sandpaper or the like 48 over the downwardly facing surface of the sandpaper supporting plate 32, wrapping the longitudinal edges about the opposite ends of the plate 32 and inserting the edges of the sandpaper between the hexagonal bars 49 of the gripping and tensioning mechanisms 47 and rotating the bars 49 so as to draw the sandpaper sheet tightly across the plate 32.

When the switch 17 is actuated to close the energizing circuit to the coil 15 of the electromagnet 11, the armature 18 vibrates at twice the applied alternating current frequency toward and away from the adjacent core legs 13. The compression spring 22 assists the magnet in attracting the armature 18, and the tension spring 20 has the function of returning the armature to its outermost position during each decay of the flux established by current flow in the electromagnet coil 15 from a maximum to zero. In performing the function of returning the armature 18 to its outermost position, the tension spring 20 additionally imposes a compression on the compression spring 22, whereby the latter may supplement the flux in attracting the armature 18 during the next quarter cycle. It is desirable that the compression spring 22 which applies pressure to the armature 18 in the same direction as the pull of the electromagnet 11 reaches its free length, or very nearly its free length, when the armature 18 comes into engagement with the ends of the core legs 13. The two opposing springs 20 and 22 preferably have a spring rate of approximately 15 percent difference, and the heavier or tension spring 20 is coupled to the adjustment knob 29 so that effective adjustment to compensate for production variations in parts, assembly, spring rates, and operating line voltages may be made by slight turning of the knob 29. The springs are preferably selected to provide a total spring rate which will give the system substantially the same natural frequency as the operating frequency of 120 cycles per second. The tension spring 20 is, of course, adjusted so as to cause the armature 18 to reverse its direction of travel toward the core 12 just before the armature actually contacts the ends of the core legs 13 so as to eliminate chatter.

By virtue of the orientation and use of a U-shaped core 12 disposed on a horizontal axis and the positioning of the armature 18 relative thereto, the normal direction of the armature movement due to the magnetic pull of the core is parallel to the desired direction of sanding plate movement. Due to the particular manner in which the sanding plate 32 is suspended from the armature and electromagnet core, through the yoke ar-

rangement 36 projecting upwardly from the platen 33 and the flexible rubber mounting blocks 41, the sanding plate 32 is driven back and forth along a substantially straight line, without the use of any energy consuming bearings, and in such a manner that consumption of energy which does no useful work is minimized. These mounting blocks 41, due to their flexible nature, and their substantially rectangular configuration, maintain precise alignment of the plate 32 with the axes of the horizontal core legs 13 to achieve straight line motion, transfer even pressure to all points of the sanding plate 32, and eliminate vertical bounce. The disadvantages which flowed from the reciprocation of the sanding plate in an arcuate path are thereby completely obviated.

Also, the selection and orientation of the U-shaped electromagnet core 12 affords greater compactness and minimization of leverage problems. If an E-shaped core were used instead of the U-shaped laminations, the armature laminations would have to be some 30 percent longer in height in order to provide the same pole face area and the same flux density, thereby substantially increasing the height of the unit designed with the same power considerations. The height of the unit is also reduced, as before mentioned, by the elimination of a pivoted armature, since the leverage arm required above the armature in pivoted armature constructions is not a design factor in the present design.

While only one preferred embodiment of the invention has been particularly shown and described, it is apparent that other modifications may be made in the invention without departing from the spirit and scope thereof, and it is desired, therefore, that only such limitations shall be placed thereon as are imposed by the prior art and are set forth in the appended claims.

I claim:

1. A vibratory electromagnetic tool for sanding and the like comprising a horizontal reciprocative rectangular platen adapted to support a work-engaging sheet, an alternating-current electromagnet for reciprocating said platen including a U-shaped core having a pair of vertically spaced core legs disposed with their axes in parallelism with the plane of said platen terminating in vertically spaced pole faces lying in a plane perpendicular to said platen plane, an armature rigidly mounted on said platen in perpendicular ascending relation thereto and extending adjacent said pole faces in parallelism with said pole faces, a U-shaped supporting frame having transversely spaced legs secured to said core legs and projecting axially from the same beyond said armature in flanking relation with said armature and a bridge portion interconnecting said frame legs remote from said pole faces and extending transversely substantially in parallelism with said pole faces and said armature, resilient means extending from said bridge portion of said frame to said armature in opposite relation to said core in alignment with the medial axis of said core including a coil spring interconnected between said armature and said bridge portion for resiliently urging said armature away from said pole faces along said medial axis, means rigidly interconnecting said armature with said platen to dispose said armature in erect perpendicular relation to said platen in parallel overlapping relation with said pole faces, the pair of transversely spaced angle iron members having vertical flanges secured to the lowermost of said core legs in overlapping relation to the opposite sides thereof and horizontal flanges projecting oppositely from the opposite sides of said lowermost core leg and elongated flexible deformable blocks of substantially rectangular configuration having upper planar surfaces secured in underlying abutting relation to said horizontal flanges at a plurality of points spaced axially of said core legs and lower planar surfaces parallel to said upper planar surfaces secured in overlying abutting relation to said platen at a plurality of points spaced longitudinally of the platen

for dependingly supporting said platen from said core in parallelism with the medial axis of said core during reciprocation of said platen in correspondence with said armature, said flexible blocks being deformable in a manner permitting relative displacement of the upper and lower surfaces thereof along the longitudinal axes of said blocks while the same are maintained in their respective spaced planes in parallelism with each other for accommodating reciprocative movement of said platen and resiliently tending to confine reciprocative movement of said armature and platen to solely rectilinear translatory movement along a path parallel to the axis of said core legs.

2. A vibratory electromagnetic tool for sanding and the like comprising a reciprocative platen adapted to support a surface-treating sheet, an alternating current electromagnet for reciprocating said platen including a U-shaped core having a pair of vertically spaced core legs disposed with their axes in parallelism with the plane of said platen and terminating in a pair of vertically spaced pole faces lying in a plane perpendicular to the plane of the platen, an armature rigidly mounted on said platen in perpendicular ascending relation thereto adjacent said pole faces and extending in parallelism with said pole faces, flexible deformable rubber block means of substantially rectangular configuration depending from said core and affixed to said platen to support said platen and said armature from said core and resiliently accommodate movement of the platen in a single plane paralleling the axes of the core legs in response to magnetic forces of the core on the armature, supporting means mounted on said core and spaced from said pole faces beyond said armature, and resilient spring means extending between said supporting means and said armature for storing up energy during retraction and attraction strokes of said armature relative to said core to assist return of said armature toward said core from the remote limit position of said armature and for retracting said armature from said pole faces upon decay of magnetic flux.

3. A vibratory electromagnetic tool for sanding and the like comprising a reciprocative platen adapted to support a sanding sheet, an alternating current electromagnet for reciprocating said platen including a U-shaped core having a pair of vertically spaced core legs disposed with their axes in parallelism with the plane of said platen and terminating in a pair of vertically spaced pole faces lying in a plane perpendicular to the plane of said platen, an armature rigidly mounted on said platen in perpendicular ascending relation thereto adjacent said pole faces and extending in parallel overlapping relation with said pole faces, flexible deformable rubber block means of substantially rectangular configuration supported in depending relation from the lowermost core leg to support said platen and said armature from said core and accommodate reciprocative movement thereof, said rubber block means being deformable in a manner tending to resiliently maintain said platen in parallelism with the axes of said core legs during reciprocation of said platen, a U-shaped bracket including a bridge portion projecting from said pole faces in parallelism therewith beyond said armature and a pair of transversely spaced leg portions extending from said bridge portion to said core legs in flanking relation to said armature and rigidly secured to said core legs, and resilient means extending between said bridge portion and said armature including a tension spring connected therebetween for withdrawing said armature along a rectilinear axis in a direction away from said pole faces during decay of magnetic flux in said core.

4. In the combination recited in claim 1, said resilient means including a second coil spring extending between said bridge portion and said armature concentric with a projected axis of said core parallel with said core leg

axes and in coaxial surrounding relation with said first-mentioned coil spring, said second coil spring being under compression between the adjacent surfaces of said bridge portion and said armature over the major portion of the range of movement of said armature to store up energy upon retraction of said armature away from said core for assisting attraction of the armature toward said core upon production of magnetic flux and adjustable anchor means mounted on said bridge portion and coupled to the adjacent end of said first-mentioned spring for adjusting the tension of said springs to tune the natural frequency thereof to substantial resonance with the frequency of the magnetic field of said core and adjust the

tension of said first-mentioned coil spring to maintain said armature in spaced relation with said pole faces throughout reciprocative movement of said armature.

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