June 3, 1958 T. F. CARMICHAEL 2,836,940

ELECTROMAGNETIC RECIPROCATING TOOL MOTOR AND ARMATURE SUPPORT THEREFOR

Filed April 17, 1956 2 Sheets-Sheet 1

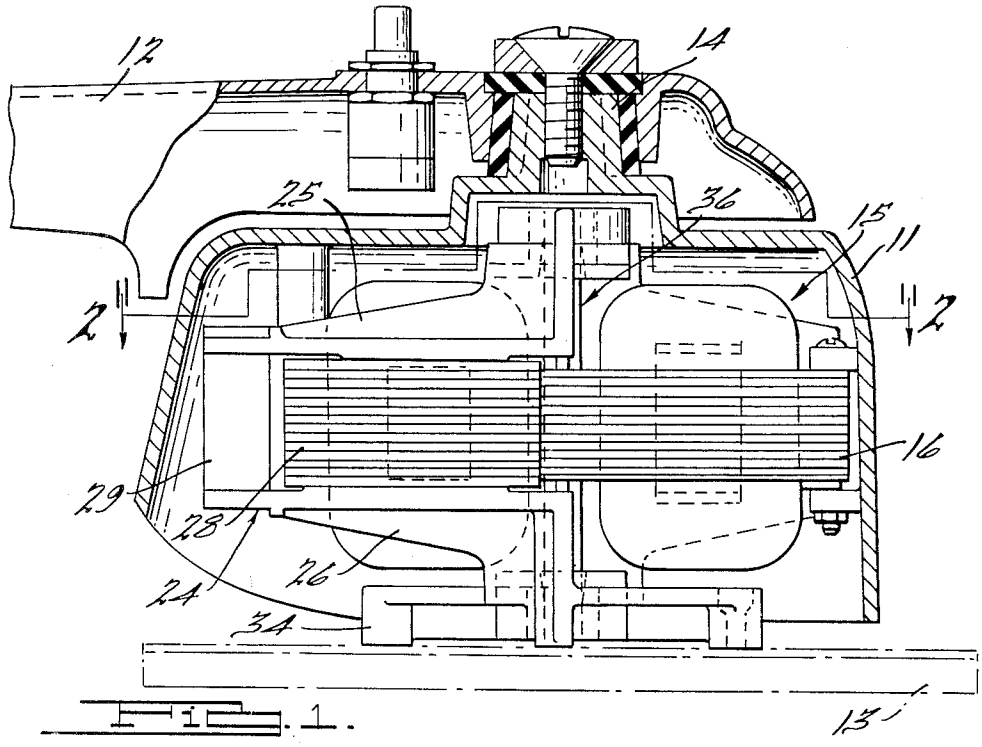


Fig. 1.

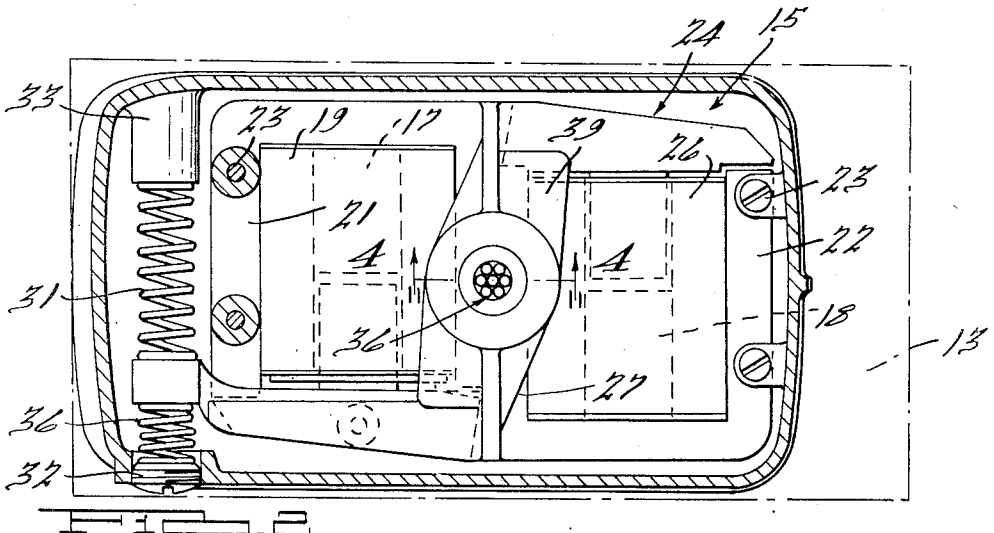


Fig. 2.

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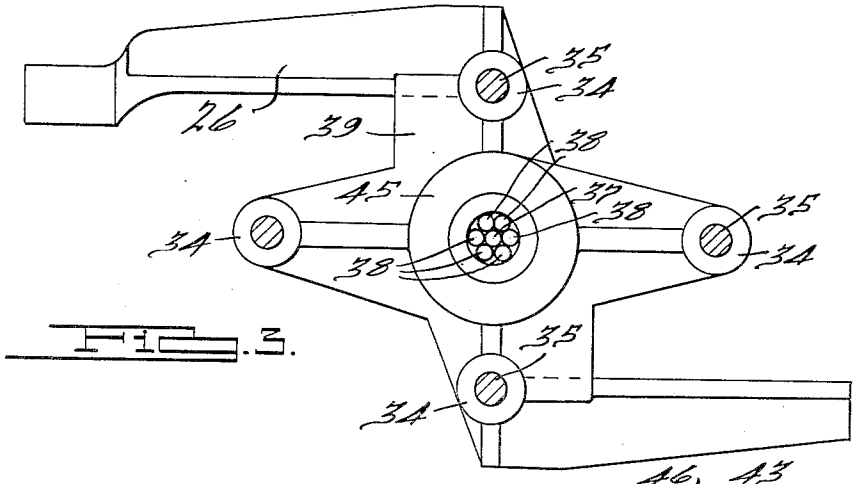


FIG. 3.

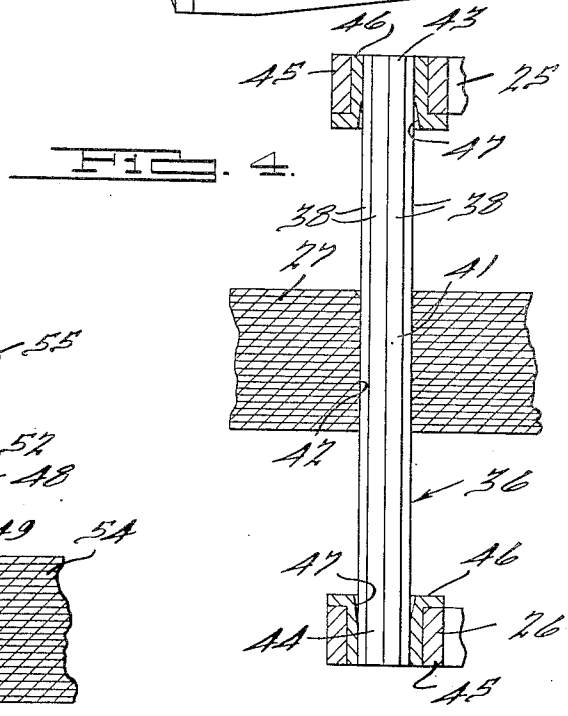


FIG. 4.

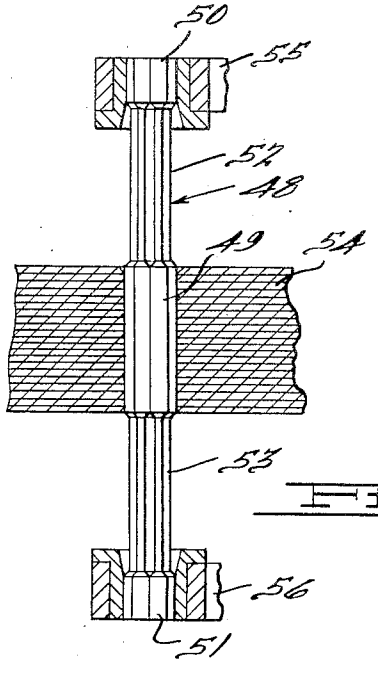


FIG. 5.

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ELECTROMAGNETIC RECIPROCATING TOOL MOTOR AND ARMATURE SUPPORT THEREFOR

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11 Claims. (Cl. 51—170)

This invention relates to motors for electromagnetic reciprocating tools, and more particularly to armature supports for such motors.

In the construction of power tools of the electromagnetic reciprocating type, such as portable sanders and jigsaws, the means for mounting of the armature is an important factor affecting operation of the tool. Generally speaking, the armature supports heretofore used in electromagnetic motors for power tools have included three main types. One of these is the conventional sleeve bearing construction in which a pin is pivotally mounted in one or more smoothly bored bushings. An example of this type of construction is shown in Patent No. 2,632,121, issued to the present applicant on March 17, 1953. A second known type of support for such armatures is the cantilever spring type, exemplified by Patent No. 2,324,292, issued to A. J. Dremel on July 13, 1943, while a third type consists of a rubber torsion bushing secured at its inner surface to one member and at its outer surface to the other. These known types of armature supports have been found to create several problems tending to hinder operational efficiency of reciprocating power tools such as sanders and jigsaws. It is a general object of the present invention to provide an improved armature support which overcomes these difficulties and greatly enhances tool operating characteristics when used in electromagnetic reciprocating motors for such tools.

It is another object to provide an improved armature support for the motor of an electromagnetic reciprocating power tool which is noiseless in operation and has no relatively movable parts which can cause a hammering effect after wear has created a clearance between these parts.

It is a further object to provide an improved armature support of the above nature which imposes no frictional energy loss between the motor and the tool, so that maximum power is available at the sandpaper platen, saw blade or other device driven by the motor.

It is another object to provide an armature support of this type especially adapted for use with portable sanders of the electromagnetic reciprocating type. In connection with this object, the improved armature support of this invention provides a constant fixed pivotal axis for the armature so that the tool has balanced operation with no tendency to move or "walk" to one side when the platen rests freely on the work.

It is also an object to provide an improved armature support of the above nature, which is not detrimentally affected by forces transferred to it when the tool is loaded, and which by eliminating frictional forces will prevent any damping effect on tool operation of the type which occurs with increased bearing friction.

It is a further object to provide an improved armature support of the above character, which inherently provides a spring effect on the reciprocating armature so that the strength and amplitude of its vibrations may approach more closely their optimum value for maximum tool efficiency.

It has another object to provide an improved armature support of the above nature which is economical to fabricate, requires no maintenance and occupies a minimum of space in the tool assembly.

Other objects, features, and advantages of the present invention will become apparent from the subsequent description, taken in conjunction with the accompanying drawings.

In the drawings:

Figure 1 is a side elevational view, partly in cross section, of an electromagnetic reciprocating portable sander having a motor which incorporates the novel and improved armature support of this invention;

Figure 2 is a plan cross-sectional view taken along the line 2—2 of Figure 1 and showing the configuration of the armature assembly;

Figure 3 is a bottom plan view of the lower armature bracket showing the manner of connection to the sandpaper platen;

Figure 4 is an enlarged cross-sectional view in elevation taken along the line 4—4 of Figure 2 and showing the manner of connecting the torsion rods of the armature support to the core and armature; and

Figure 5 is a view similar to Figure 4 showing a modified construction of the armature support.

The invention is shown in the illustrated embodiment as being incorporated in a portable sander of the electromagnetic reciprocating type, having a housing **11** which encloses the motor and a handle **12** for guiding the tool. Housing **11** has a shell-like configuration with an open bottom below which is disposed a sandpaper platen **13**. The upper end of housing **11** has a post **14** formed thereon to which handle **12** is secured, the handle extending to one side of the housing, and a switch is provided on handle **12** for controlling energization of the tool motor.

The motor is generally indicated at **15** and is disposed within housing **11**. In the present embodiment, the motor includes a laminated core **16** made up of two U-shaped portions facing in opposite directions and having a common leg. Within the two U-shaped portions of the core are core projections **17** and **18** respectively upon which are mounted coils **19** and **20**. The outer legs **21** and **22** of the U-shaped portions of the core are secured to housing **11** by means of bolts **23** so that the assembly of core and coils is fixed within the housing.

The armature is generally indicated at **24** and is approximately Z-shaped, its configuration being most clearly discernible in Figure 3. The armature comprises upper and lower Z-shaped brackets **25** and **26** respectively, the central legs of these brackets being disposed on opposite sides of central leg **27** of core **16** and spaced therefrom. Between the outer legs of brackets **25** and **26** are secured two sets of T-shaped laminations **28**, these laminations being disposed adjacent the oppositely facing pole faces of core **16**. A spring abutment member **29** is secured to one end of armature **24** between brackets **25** and **26**, this abutment being engageable on opposite sides by springs **30** and **31** respectively. Both springs are of the helical compression type and serve to maintain armature **24** in a neutral position slightly spaced from the pole faces of core **16**, aiding the vibrational movement of the armature when attracted by the pulsating flux. The outer end

of spring 30 rests against an adjustable screw 32 in housing 11 by means of which the spring forces may be varied, while spring 31 is provided with a housing abutment 33 for supporting its outer end. Bracket 26, disposed below core 16, is provided with a plurality of bosses 34 by means of which bolts 35 secure the armature assembly to platen 13.

Armature 24 is supported for pivotal movement on a vertical axis, so that movement of the sandpaper platen will consist of rapid oscillations in a horizontal plane about the axis of the armature support. The support, generally indicated at 36, comprises a bundle of rods so connected to the core and armature as to provide a torsional bearing support for the armature. The construction of the armature support is perhaps best seen in Figures 2, 3 and 4. The support comprises a central rod 37 surrounded by six rods 38, all rods being of equal length. The rods are fabricated of an appropriate metal having spring-like qualities and together form a compact circular bundle. Rods 37 and 38 are shown in the illustrated embodiment as being of equal diameter, although it will be understood that variations in the relative rod diameters and in the number of rods are contemplated within the principles of the invention. It is preferred however that rods 38 be evenly distributed around central rod 37.

The bundle of rods comprising armature support 36 are so mounted as to provide a double torsional connection between the central leg 27 of core 16 and the central legs 39 of upper and lower armature brackets 25 and 26. In particular, the intermediate portion 41 of bundle 36 is press-fitted into a circular aperture 42 extending through the central portion of core leg 27, while the outer ends 43 and 44 of the bundle are press-fitted to brackets 25 and 26 respectively. For this purpose, central legs 39 of the brackets are provided with central bosses 45 holding hardened bushings 46, the latter having bores tapered at one end 47 to facilitate the introduction of the bundle ends. One end of bore 42 in the core may also be tapered for assembly purposes.

During operation of the tool, the press fits of bundle 36 to the core and the armature brackets are such that no relative movement of the compressed portions of the bundle will be permitted with respect to these parts. Energization of coils 18 and 19 will cause rapid reciprocation of armature 24 about the pivotal axis created by bundle 36 at twice the current frequency. During this reciprocation, the free portions of bundle 36 extending between core leg 27 and armature brackets 25 and 26 respectively will be slightly twisted. In the case of central rod 37 this twisting action will consist of a torsional motion about its own axis, while in the case of outer rods 38, the twisting action will cause a combined motion including a twisting movement about each rod's own axis, plus an angular turning around the axis of central rod 37. The resultant motion of all rods in the bundle will thus be a true pivotal movement about a fixed axis without any components of motion which might cause an unbalancing effect on the tool.

When sandpaper platen 13 is applied to the work, the operator will begin to exert pressure on handle 12, such force having a downward component as well as a component in the desired direction of tool movement. The downward pressure will be realized as a thrust force on the armature support, and these forces will be resisted by the tight frictional connections between bundle 36 and the core and armature brackets. Preferably, the length of aperture 42 in core leg 27 and of the apertures in bushings 46 are sufficient to provide the required areas of contact with bundle 36 so that the frictional forces will be adequate to withstand the thrust forces on the connection.

Components of force parallel to platen 13, that is, at right angles to the pivotal axis, will create radial forces on the armature connection. These forces will be resisted by the radial pressure of the apertures in the armature bushings and core on bundle 36. Since there is no relative movement between contacting surfaces of the bundle and the core or armature, loading of the tool in this manner will not create frictional losses such as would be produced in ordinary sleeve bearings. The lack of such energy losses will result in efficient tool operation at all loads without the damping effect which bearing friction would incur. Moreover, since there are no wearing parts, the noise of operation which normally occurs due to hammering of parts having a relative clearance will be avoided.

The resultant of the thrust and radial forces on the sander will normally be a turning force tending to shift the position of the core with respect to that of the armature. For example, referring to Figure 1, the combination of a downward force and a rightward force on handle 12 (or housing 11) would result in a force tending to turn core 16 in a clockwise direction with respect to armature 24, since the latter is fixed to platen 13 which rests on the work. This will produce bending forces on the upper and lower free portions of bundle 36. To resist these forces, the length of the rods is preferably so chosen that there will be a negligible amount of transverse bending of bundle 36 under the stresses to which it will be subjected in normal operation. In this respect, it should be pointed out that the cross-sectional configuration of bundle 36, comprising separate rods 37 and 38, will inherently provide a relatively high moment of inertia particularly adapted to resist such bending forces.

Another advantage of the novel armature support is the fact that it provides spring action for the rapidly reciprocating armature such that the durability of stroke during operation of the sander will be enhanced. In this respect, the torsional properties of support 36 will aid the effect produced by the presence of springs 30 and 31, increasing the efficiency of tool operation. The lengths of the free portions of bundle 36 are so chosen as to permit the required oscillatory movement of armature 24 while at the same time providing a substantial degree of spring action. It should be pointed out that armature support 36 affords distinct advantages over known types of armature supports which provide spring action for the armature. For example, support 36 provides a fixed pivotal axis for the armature, contrary to cantilever spring types of armature supports which have been found to produce a "walking" tendency when used in motors for portable sanders due to the lack of a stable pivot axis. Unlike rubber torsion mounts, the present armature support occupies very little space, thus facilitating the arrangement of parts when constructing the tool. The wear, damping effect and inherent lack of stability of rubber torsion mounts are also avoided by the armature support comprising bundle 36.

Figure 5 illustrates a modified form of the invention which is generally similar to the first embodiment but in which the individual rods in the bundle have a somewhat different form. In this embodiment each rod, generally indicated at 48, comprises a central portion 49 and two outer portions 50 and 51 of relatively wide diameter, and intermediate portions 52 and 53 of relatively narrow diameter. The thicker portions of the rods are forced into apertures of appropriate size in core 54 and the upper and lower brackets 55 and 56 of the armature. The free portions of the bundle are thus composed of relatively slender components, permitting greater flexibility per unit length than would be the case if these free portions were of the same cross-sectional area as the fixed portions. With this arrangement, it is possible, for a required degree of flexibility in the armature support, to provide a relatively shorter support, thus conserving space in the assembly.

While it will be apparent that the preferred embodiments of the invention disclosed are well calculated to fulfill the objects above stated, it will be appreciated that the invention is susceptible to modification, variation and

change without departing from the proper scope or fair meaning of the subjoined claims.

What is claimed is:

1. In an electromagnetic reciprocating motor, a core, an electromagnetic coil mounted on said core, an armature adjacent said core, and means supporting said armature comprising a bundle of rods of spring-like quality, said bundle having two longitudinally spaced portions fixed to said core and armature respectively, whereby the flexibility of the free portion of said bundle between said fixed portions will permit reciprocation of said armature on a fixed axis toward and away from said core.

2. In an electromagnetic reciprocating motor, a core having an electromagnetic coil mounted thereon, an armature adjacent said core, and means for supporting said armature comprising a bundle of rods of spring-like quality, an apertured portion carried by said core, and a second apertured portion carried by said armature, longitudinally spaced portions of said bundle being disposed within said apertured portions, the diameters of said apertured portions relative to the size of said bundle being such that said bundle portions are frictionally held in fixed position, the free length of said bundle between said fixed portions being such as to permit pivotal movement of said armature toward and away from said core on a fixed axis.

3. In an electromagnetic reciprocating motor, a core carrying an electromagnetic coil, an armature adjacent said core, and means supporting said armature comprising a first rod of spring-like quality, and a plurality of rods of spring-like quality surrounding said first rod so as to form a compact bundle with said first rod at the center thereof, longitudinally spaced portions of said bundle being fixed to said core and armature respectively, the free length of said bundle being such as to permit movement of said armature toward and away from said core on a fixed axis.

4. In an electromagnetic reciprocating motor, a core having an electromagnetic coil, an armature adjacent said core, and means supporting said armature comprising a first rod of spring-like quality, a plurality of rods of spring-like quality surrounding said first rod so as to form a compact bundle with said first rod at the center thereof, and apertured portions carried by said core and armature respectively, longitudinally spaced portions on said bundle being disposed within said apertured portions, the diameters of said apertured portions relative to the size of said portions being such that said portions are frictionally held against movement within said apertured portions so as to be fixed to said core and armature respectively, the free portion of said bundle between said fixed portions being such that said armature is movable toward and away from said core on a fixed axis.

5. In an electromagnetic reciprocating motor, a core having an electromagnetic coil, an armature adjacent one portion of said core, and means for supporting said armature comprising a pair of brackets on said armature disposed on opposite sides of a second portion of said core and spaced therefrom, and a bundle of rods of spring-like quality having its intermediate portion fixed to said second portion of the core and its outer portions fixed to said brackets, the free portions of said bundle between said fixed portions being of such length that said armature is movable toward and away from said first portion of the core on a fixed axis.

6. In an electromagnetic reciprocating motor, a core having an electromagnetic coil, an armature adjacent one portion of said core, and means for supporting said armature comprising a pair of brackets on said armature disposed on opposite sides of a second portion of said core, a first rod of spring-like quality, and a plurality of rods of spring-like quality surrounding said first rod so as to form a compact bundle with the first rod at the center thereof, aligned apertured portions in said second portion of the core and in said brackets, spaced portions

of said bundle being disposed within said apertured portions, the diameters of said apertured portions being such that said spaced bundle portions will be frictionally held against movement therein, the free lengths of said bundle between said spaced portions being such that said armature is movable toward and away from the first portion of said core on a fixed axis.

7. In an electromagnetic reciprocating portable sander, a housing having an open bottom, an electromagnetic core fixed within said housing, a coil for said core, an armature within said housing adjacent said core, a sandpaper platen secured to said armature and disposed below said housing, and means for supporting said armature comprising a bundle of rods of spring-like quality disposed on an axis normal to said platen, spaced portions on said bundle being fixed to said core and armature respectively, the free length of said bundle between said spaced portions being such that said armature is movable toward and away from said core on said axis.

8. In an electromagnetic reciprocating portable sander, a housing having an open bottom, an electromagnetic core fixed within said housing, a coil for said core, an armature within said housing adjacent said core, a sandpaper platen secured to said armature and disposed below said housing, and means for supporting said armature comprising a pair of brackets on the armature disposed above and below said core and spaced therefrom, a first rod having spring-like qualities, a plurality of rods surrounding said first rod to form a compact bundle with the first rod at the center thereof, the axis of said bundle being normal to the plane of said platen, and aligned apertured portions carried by said core and said brackets, spaced portions of said bundle being disposed within said apertured portions, the diameters of said apertured portions being such that the spaced portions of said bundle are frictionally held against movement therein, the free portions of said bundle between said spaced portions being of such length that pivotal movement of said armature toward and away from said core is permitted on said axis.

9. In an electromagnetic reciprocating motor, a core having a pair of oppositely disposed U-shaped portions with a common central leg, a pair of electromagnetic coils disposed within said portions, a Z-shaped armature having end portions disposed adjacent the open ends of the U-shaped portions of said core so as to be attracted thereby, a pair of brackets forming the central portion of said armature, said brackets being disposed on opposite sides of the central leg of said core and spaced therefrom, and a support for said armature comprising a bundle of rods of spring-like quality, said rods having an intermediate portion fixed to the central leg of said core and end portions fixed to said brackets, the free portions of said bundle between said fixed portions being of such length as to permit pivotal movement of said armature toward and away from said core on a fixed axis.

10. In an electromagnetic reciprocating portable sander, a housing having an open bottom, an electromagnetic core fixed within said housing, said core comprising a pair of oppositely facing U-shaped portions having a common central leg, a pair of electromagnetic coils disposed within said U-shaped portions, a Z-shaped armature having end portions adjacent the open ends of said U-shaped core portions, upper and lower brackets forming the central portion of said armature disposed on opposite sides of the central leg of said core and spaced therefrom, a sandpaper platen secured to said lower bracket and disposed below said housing, and means for supporting said armature comprising a first rod of spring-like material, a plurality of rods of spring-like material surrounding said first rod to form a compact bundle with the first rod at the center thereof, the axis of said bundle being normal to the plane of said platen, and aligned apertured portions in said core and said brackets, spaced portions of said bundle being press-fitted within

said apertured portions so as to be fixed therein, the free portions of said bundle between said fixed portions being of such length as to permit movement of said armature toward and away from said core on said axis.

11. The combination according to claim 10, said rods being of reduced diameter in said free portions of the bundle.

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