United States Patent

[11] **3,558,939**

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[21] Appl. No. **854,677**
[22] Filed **Sept. 2, 1969**
[45] Patented **Jan. 26, 1971**

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[54] **MINIATURE VIBRATOR**
4 Claims, 3 Drawing Figs.

[52] **U.S. Cl.** **310/15,** 310/29
[51] **Int. Cl.** **H02k 33/02**
[50] **Field of Search** ..... 310/12-—17, 19, 21—24, 28, 29, 30, 32; 318/114

[56] **References Cited**

UNITED STATES PATENTS

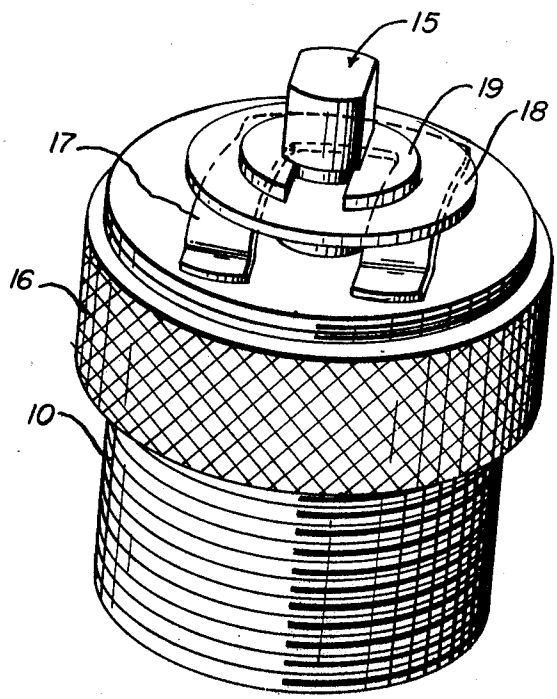
2,568,757	9/1951	Mesh	310/29X
3,116,428	12/1963	Blodgett et al.	310/15
3,248,580	4/1966	Smith	310/28

FOREIGN PATENTS

411,414 11/1966 Switzerland 310/29

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ABSTRACT: For inducing antifriction vibrations in precision instruments, a miniature electromagnetic vibrator is provided which includes a cylindrical side housing of magnetic material having an upper peripheral edge providing an annular percussion surface. A core of magnetic material is press-fit within the side housing and has a wire coil circularly disposed about a portion thereof. A cup-shaped top housing is threaded upon the upper end of the side housing. An armature has a disc-shaped striker portion disposed within the top housing, the striker portion having a diameter sufficient to span the percussion surface, and has a shank portion extending upwardly from the striker through an opening in the top housing. The shank is normally held in an elevated position by a spring to provide a clearance distance between the striker and percussion surface.



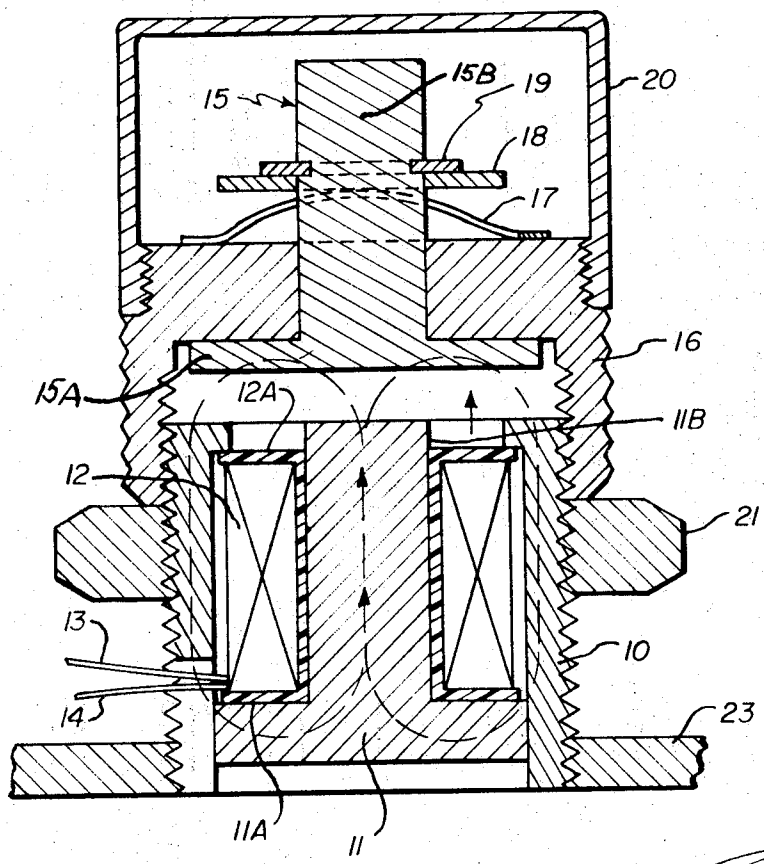


FIG. 2

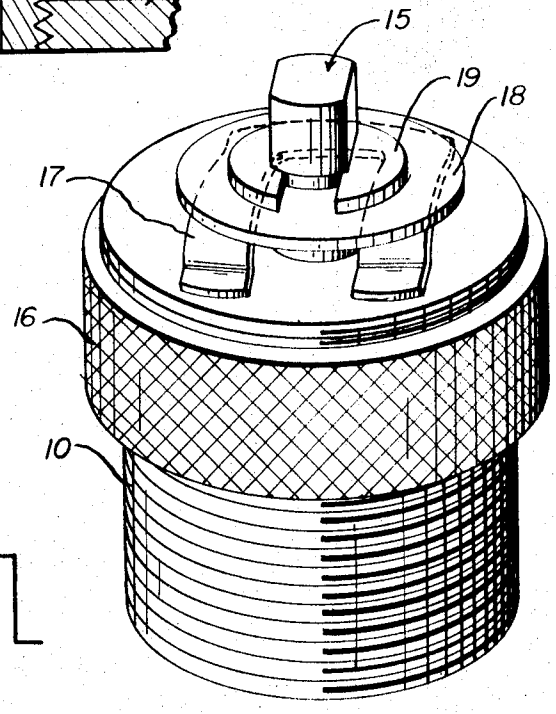


FIG. 1

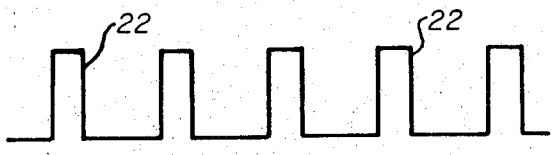


FIG. 3

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MINIATURE VIBRATOR

BACKGROUND OF THE INVENTION

The present invention relates to electromagnetic vibrators and particularly to a light weight, compact vibrator of simple and inexpensive construction for use with precision instruments in preventing friction binding of the delicate low force drive systems therein.

Numerous precision instruments, such as aircraft altimeters, depend upon substantially friction free operation of their drive systems to eliminate degradation of the instrument output. To be effective a vibrator, when mounted in an instrument, should provide an output force sufficient to remove the static friction of the system.

Existing vibrators have been found to be somewhat inefficient because their size limitations prevent their being mounted in the critical areas of the instrument mechanism where the vibration is most effective. Another disadvantage of existing vibrators for use with the precision instruments is that the magnetic path traversed by the magnetic flux includes a spring or hinge structure as an integral portion of such path causing the magnetic flux to become saturated or degraded in strength.

SUMMARY OF THE INVENTION

The primary object of the invention is to provide a vibrator of extremely compact size so that it can be placed in the critical areas of the instrument mechanism where the vibration is most effective.

A more particular object of the invention is to provide a vibrator characterized by the provision of a substantially solid magnetic path so that the magnetic flux does not become saturated or degraded in strength.

Another object is to provide a vibrator characterized by the provision of a direct force path for transfer of energy from the vibrating striker to the attachment base.

A further object is to provide a vibrator of inexpensive construction by utilizing a completely cylindrical arrangement of parts to achieve maximum efficiency and compactness, and to enable lower cost lathe production for all of the parts and eliminate need for milling except for the accessory milling operations usually encountered.

The vibrator of the present invention includes an elongated cylindrical base having a threaded bottom end portion for boltlike connection with the mechanism to be vibrated. The top end region of the base provides an annular edge serving as a percussion surface. Thus the base provides a direct force path for transfer of energy.

The core is of pedestal shape and is disposed internally of the base in press-fit engagement therewith. The core and base, being of magnetic material, thus provide a solid magnetic path.

The armature of the vibrator is of pedestal shape and includes a disc-shaped striker and a shank. A cup-shaped member providing a top housing is adjustably connected in nutlike fashion at the top end region of the base. The striker is disposed internally of the cup with the shank extending through an opening in the top face thereof. A spring, connected between the shank and top face normally urges the striker against the top face of the cup in predetermined spaced relation relative to the annular percussion surface. Upon energization of the stator, the striker impacts against the percussion surface, the shank being slidably guided by the opening in the top face.

The features and advantages of the invention are illustrated in the accompanying drawings which show structure embodying preferred features of the present invention and the principles thereof, and what is now considered to be the best mode in which to apply these principles.

BRIEF DESCRIPTION OF THE DRAWINGS

In the accompanying drawings forming a part of the specification, and in which like numerals are employed to designate like parts throughout:

FIG. 1 is a perspective view of a miniature vibrator in accordance with the present invention;

FIG. 2 is a sectional view of the miniature vibrator of FIG. 1; and

FIG. 3 is a timing diagram of the input DC voltage for energizing the stator of the miniature vibrator.

DETAILED DESCRIPTION

Turning now to the drawings, the vibrator is shown to include a tubular cylindrical base **10** of magnetic material. A pedestal-shaped core **11** of magnetic material is shown having a first diameter region **11A** disposed in internally press-fit engagement with the base **10** adjacent the bottom end region thereof. The core **11** further includes an upwardly extending reduced second diameter region **11B** terminating below the top edge of the base **10** to define an annular pocket within the base for the reception of an energizing coil or stator **12**.

The coil is shown being wound upon a bobbin **12A** of nonmagnetic material and having leads **13**, **14** at its lower end extending through a sidewall slot in the base **10** for connection to an energizing circuit which typically applies a train **22** of DC pulses at 50 millisecond intervals (FIG. **3**). The bobbin arrangement shown herein utilizes 2,700 turns of number 48 wire.

A generally cup-shaped member **16** comprising the vibrator top housing is shown in threaded nutlike engagement upon the upper end of the base **10** and is held in a predetermined position by a lock nut **21** to determine a clearance distance between the striking and percussion surfaces, as will be explained below.

An armature **15** of pedestal shape is shown having a disc portion **15A** disposed to span the upper end of the base **10** and normally impart vibration forces directly to the base without contacting the core. The armature **15** is shown to include a shank portion **15B** extending through and above the cup **16**, the shank having an external groove for receiving a snap ring **19** and one or more spacer discs **18** with a double-armed wave spring **17** being engaged in compression between the spacer discs **18** and the top face of the nonmagnetic cup **16**. The spring **17** normally holds the armature **15** elevated whereby the disc portion **15A** is urged against the inside end face of the cup **16**. The impact force between the striker surface and percussion surface can be adjusted by varying the number of spacers **18** which are used.

The vibrator is shown with the base **10** having a threaded bottom portion for boltlike connection in a tapped hole in a mounting plate **23** or other attachment member with a locktight or other adhesive being used to hold these parts against the vibration effects. A protective cap **20** is shown applied on the upper end of the cup **16** to enclose the exposed shank of the armature.

As is well known to persons skilled in the electrical arts, each time a DC pulse is applied to the energizing winding of the stator **12**, a strong magnetic flux field is set up through the core **11** and through the air space to the armature **15** and back through the base, **10**, thus drawing the armature **15** sharply against annular percussion surface at the upper end of the base **10** and transmitting a shock force directly through the base and into the attachment plate **23** which is connected to the portion of the drive mechanism desired to be maintained free of friction. When the pulse terminates, the spring returns the armature to its indicated raised position.

In a manufacture of the vibrator, the core **11** is first assembled in press-fit relation to the base **10**, with the upper end of the reduced diameter portion **11B** terminating short of the plane of the end of the housing, as stated previously. The connection wires **13**, **14** are fed downwardly into the annular mounting space between the core **11** and the base **10**, followed by the bobbin **12A** which is then seated in place as the connection wires are brought out through the side slot, with cement being used to secure the bobbin to the core. The lock nut **21** is then applied and approximately positioned upon the base **10**. The cup-shaped member **16**, with the armature **15** in

place, is threaded down onto the base until the armature is snugly gripped between the end wall of the cup-shaped top housing **16** and the percussion surface at the top end of the base. The cup **16** is then backed off a predetermined distance to establish the desired clearance distance for the armature and the lock nut **21** is turned snug against the end of the cup.

As stated above, the present vibrator is of extremely compact dimensions. In the embodiment disclosed herein for use in altimeters, the vibrator is about one-half inch in diameter and less than 1 inch in length. The normal clearance space between the disc portion **15A** of the armature **15**, comprising the striker surface, and the upper end of the tubular base **10** comprising the percussion surface, is about 0.018 inch. The compact size and method of mounting, as by now evident, permits the vibrator to be mounted at critical areas of instruments that heretofore have been inaccessible to conventional vibrators.

It will be noted that the cylindrical nature of the parts comprising the present invention materially reduces the costs of manufacture and that, while the vibrator can be easily and finely adjusted in the field, the vibrator is extremely simple to assemble thereby minimizing material handling costs.

Thus, while preferred constructional features of the invention are embodied in the structure illustrated herein, it is to be understood that changes and variations may be made by those skilled in the art without departing from the spirit and scope of the appended claims.

I claim:

1. A vibrator comprising a stator, an armature, structure providing a magnetic flux path intercepting the armature when the stator is energized, and means mounting the armature for reciprocating movement relative to the stator for effecting intermittent force producing impact of a striker against a percussion surface, characterized in that the structure providing the magnetic flux path includes an elongated cylindrical base for housing the stator and having a bottom end adapted for connection with the mechanism to be vibrated and an annular top edge region providing an annular percussion surface, and that the means mounting the armature includes a generally cup-shaped member in axially adjustable nutlike connection with the top region of the base whereby the clearance distance between the striker and percussion surface can be adjusted.

2. A vibrator according to claim **1** wherein said cup-shaped member includes a top face having a central opening therein, and further characterized in that said armature is of generally pedestal shape having a disc portion disposed internally of said member and a shank portion extending through said opening, said shank being spring mounted to said end face whereby said disc portion is normally urged against said top face, said disc portion being of a diameter sufficient to span said annular percussion surface.

3. A vibrator comprising a stator, an armature, structure providing a magnetic flux path intercepting the armature when the stator is energized, and means mounting the armature for reciprocating movement relative to the stator for effecting intermittent force producing impact between the armature and a percussion surface, said structure including an elongated cylindrical base of magnetic material and a pedestal-shaped core of magnetic material, said base having a threaded bottom end portion for boltlike connection with a mechanism to be vibrated and having a top edge region defining said percussion surface, said core having a first diameter portion disposed in internally press-fit engagement with the base adjacent the bottom end portion thereof and having reduced diameter portion extending upwardly from said first diameter portion and terminating below the plane defined by the top edge of the base to define an internal annular pocket within the base for receiving the stator, said means including a generally cup-shaped member in axially-adjustable nutlike connection with the base at the top edge region thereof.

4. A vibrator according to claim **3**, wherein the base, the first diameter portion of the core, and the cup-shaped member respectively comprise the vibrator housing side, bottom and top walls.