March 20, 1962 S. KARPCHUK 3,026,429

LOW FREQUENCY INERTIA-TYPE PICKUP

Filed Oct. 28, 1959

Fig. 1.

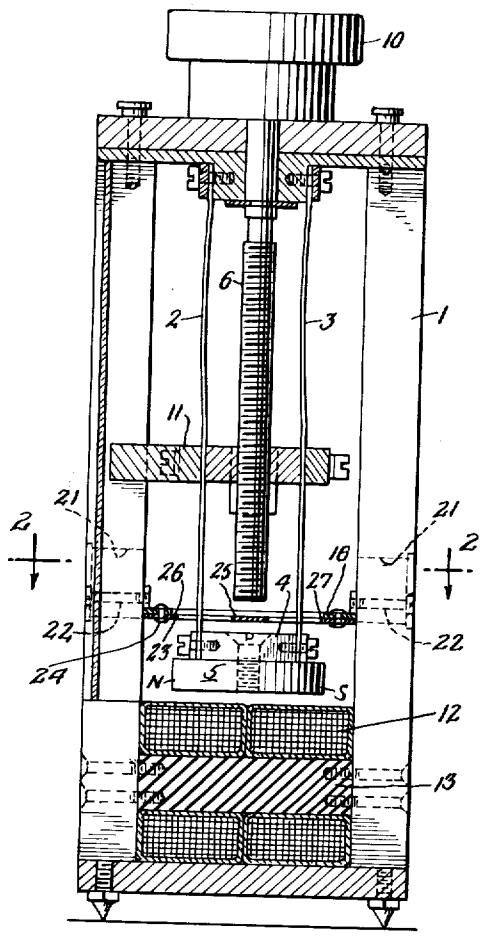


Fig. 2.

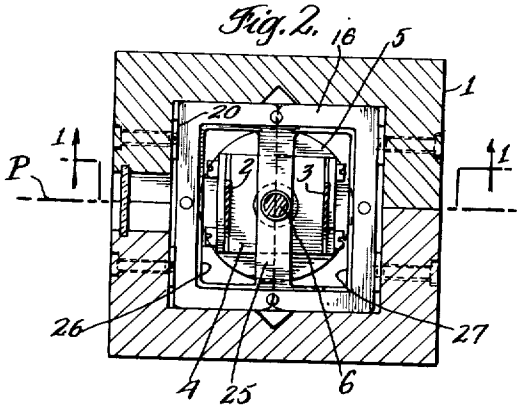


Fig. 3.

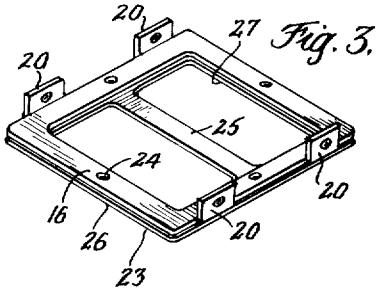


Fig. 4

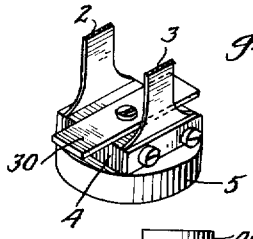


Fig. 5.

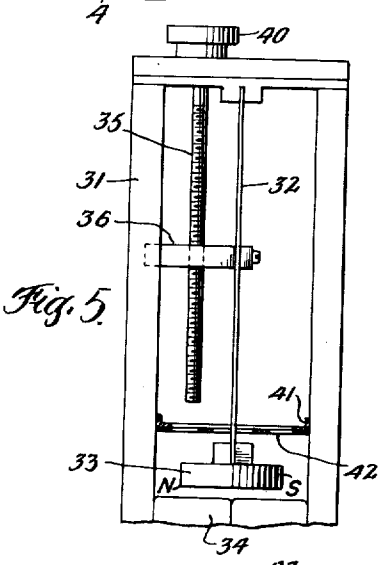
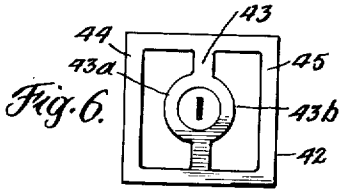


Fig. 6.



INVENTOR
Sylvester Karpchuk
BY
Symmetvedt & Lechner
ATTORNEYS

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LOW FREQUENCY INERTIA-TYPE PICKUP

Sylvester Karpchuk, Philadelphia, Pa., assignor to Tinius Olsen Testing Machine Company, Willow Grove, Pa., a corporation of Pennsylvania

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6 Claims. (Cl. 310—25)

This invention relates to vibration pickups and in particular relates to improvements in such pickups which adapt the same for use in both high and very low frequency ranges.

In my Patent 2,946,218, I have disclosed a tunable vibration pickup comprising a coil element and a permanent magnet which is suspended by a pair of springs which provide for relative motion between the coil and the magnet, the motion developing a signal or voltage in the coil. Means are provided for varying the effective vibrating lengths of the springs so that the pickup can be tuned to resonant frequency of the part with which it is being used.

While the pickup described above is designed for use over a broad band frequency range, the present invention provides for improvements in the same, particularly in extending use at very low frequency. In general, this is accomplished by mounting magnetic material over the magnet, the magnetic material being characterized by three sections, the interaction of which, with the poles of the magnet, provide for highly accurate and desirable operation at low frequencies and yet does not interfere with operation at the higher frequencies.

While in the pickup of my Patent 2,946,218 a pair of springs are used for suspending the magnet, the invention contemplates the use of a tunable single spring for suspending the magnet with a magnetic material mounted over the magnet and having three sections which interact with the magnet to produce the desired effect for low frequency operation.

The manner in which the invention is constructed will be apparent from the following description and drawings wherein:

FIGURE 1 is a vertical section of a two-spring tunable pickup incorporating the invention;

FIGURE 2 is a plan section taken along the lines 2—2 of FIGURE 1;

FIGURE 3 is an isometric view of an assembly having magnetic material provided with three sections;

FIGURE 4 is an isometric view of a magnet assembly;

FIGURE 5 is a vertical section of a single spring tunable pickup incorporating the invention; and

FIGURE 6 is a plan view of the magnetic material used in the pickup of FIGURE 5.

In FIGURE 1 the numeral **1** designates the housing of the unit which is constructed similarly as shown in my above-mentioned Patent 2,946,218 except for certain differences which will appear later. Secured to the top of the housing are a pair of strip-like springs **2** and **3** which are connected to a spacer **4** on which is mounted the magnet **5**. A screw **6** is rotatably mounted on the housing and is connected to a knob **10** by means of which the screw can be rotated. A nut **11** slidably mounted in the housing for up and down movement has slots which slidably interengage the springs **2** and **3**. The nut is also connected to the screw **6**. When the knob **10** is rotated the nut will be moved up or down depending on the rotation of the screw. The effect of this is to vary the effective vibrating lengths of the springs **2** and **3**, i.e., the parts of the springs which are below the nut. On the bottom of the housing is the coil assembly **12** which is preferably the air-core type. The non-magnetic insert **13** extends through the aperture in the coil and is fixed to the housing **1** so as to secure the coil assembly in position.

The springs **2** and **3** provide for relative motion as between the magnet and coil and this motion takes place in a vertical plane, for example, the plane P indicated in FIGURE 2. When the device is placed upon a member which is not vibrating the magnet and coil will assume the position as shown in FIGURE 1. For descriptive purposes this is termed the neutral position. With vibration the magnet may move from the neutral position to the left and then back to the neutral position and thence to the right and back to neutral to complete a full cycle of vibration. It will be understood of course, that in certain instances the magnet may, for all practical purposes, remain motionless while the frame and coil vibrate from neutral to the left and to the right. This, of course, produces the same effect as movement of the magnet.

The springs **2** and **3**, the spacer **4** and the securing screws all are preferably made of non-magnetic material.

Just above the magnet **4** there is mounted a frame **16**. As shown in FIGURE 3 the frame **16** is rectangular in shape and provided with ears **20** by means of which it is attached to the housing **1**. The housing is provided with a plurailty of slots **21** through which extend the screws **22**. By loosening the screws the frame **16** may be adjusted in a vertical direction and fixed in the desired adjusted position. The frame **16** and screws **20** are preferably of non-magnetic material.

The frame **16** carries the magnetic material **23** which may be secured to the same as by non-magnetic rivets **24**. As indicated, the magnetic material has a central section **25** and two outboard sections **26** and **27**.

The manner in which the magnetic material **23** effects operation of the magnet will be explained following. Assume first that the magnet is in the neutral position or as shown in FIGURE 1 and that the left-hand side is a north pole N and the right-hand side is a south pole S. The lines of flux from the magnet will cause the outboard section **26** to become a south pole and the outboard section **27** to become a north pole. The central section **25** will, for all practical purposes, be unpolarized. If the magnet is moved from the neutral position toward the right-hand side, the section **25** becomes a south pole and the section **27** becomes a stronger north pole. As the magnet starts to move toward neutral position, the repulsion between the south pole of the magnet and the south pole **25** tends to slow down the magnet. As the magnet approaches the neutral position the section **25** begins to change from south to north polarity and as the magnet passes just beyond the neutral position the center section **25** is completely reversed in polarity. As the magnet continues to move to the left the section **26** becomes a stronger south pole and the center section **25** becomes a stronger north pole. As the magnet moves back to neutral, the north pole of the magnet and north pole **25** repel and this tends to slow down the magnet.

In connection with the motion of the magnet from neutral to one side, say to the left side, it will be noted that the north pole N moves toward or closer to the outboard section **26** and away or farther from the central section **25**, while the south pole S moves toward or closer to the central section **25** and away or farther from the outboard section **27**.

In FIGURE 4 I have shown a magnet assembly wherein there is a piece of magnetic material secured to the spacer **4**. I have found this construction to be particularly useful for operation in the very low frequency ranges in that it augments the repulsion effects between the poles of the magnet and the poles set up in the magnetic material **23**. I believe the foregoing effect is due to the fact that the material **30** reduces the effect of the air gap between the magnet and the material **23**. In certain instances the material **30** may be angled to the path of relative motion.

This produces a smoother characteristic in the motion of the magnet.

In FIGURE 5 I have shown a single spring type pickup which is constructed similarly as the pickup of FIGURE 1 having a housing **31**, on the top part of which is a single spring **32** supporting the magnet **33** just above the coil assembly **34**. The screw **35** is rotatably mounted on top of the housing. The screw engages a nut **36** which is provided with a slot which slidably engages the spring **32**. As the screw is rotated by means of the knob **40**, the nut is moved up and down to vary the effective vibrating length of the spring **32**. Just above the magnet is mounted a frame **41** which is constructed similarly to the frame **16**. This frame carries the magnetic material **42**, the plan shape of which is shown in FIGURE 6. The magnetic material **42** has three discrete sections, namely, the central section **43** and the two outboard sections **44** and **45**. As is shown the central section **43** is split to portions **43***a* and **43***b*, the purpose of which is to accommodate the spring **32**.

I claim:

1. An inertia-type pickup having a low frequency response comprising: a housing; a permanent magnet; a coil connected with said housing and disposed below and adjacent said magnet to receive flux therefrom; means connected with said housing and supporting said magnet for vibratory motion from a neutral position to positions on opposite sides of neutral; and magnetic material connected with said housing, the magnetic material being characterized by a central section and two outboard sections to be polarized by movment of the magnet, the sections and magnet being located so that with motion of the magnet from its neutral position to one side, one pole moves toward one outboard section and away from the central section and away from the central section while the other pole moves toward the central section and away from the other outboard section.

2. An inertia-type pickup having a low frequency response comprising: a housing; two elongated strip-like, spaced-apart springs connected with the top of said housing and extending downwardly therefrom; a magnet connected with the lower end of said springs, the spring supporting said magnet for vibratory motion from a netural position to positions on either side of neutral; a coil connected with said housing and disposed below and adjacent said magnet to receive flux therefrom; and magnetic material connected with said housing and disposed over said magnet, the material being characterized by a central section extending between said springs and two outboard sections on opposite sides of said central section, the sections and magnet being located so that with motion of the magnet from its neutral position to one side, one pole moves toward one outboard section and away from the central section while the other pole moves toward the central section and away from the other outboard section.

3. An inertia-type pickup having a low frequency response comprising: a housing; a strip-like spring connected with the top of said housing and extending downwardly therefrom; a magnet connected with the lower end of said spring, the spring supporting the magnet for vibratory motion from a neutral position to positions on either side of neutral; a coil connected with said housing and disposed below and adjacent said magnet to receive flux therefrom; and magnetic material connected with said housing and disposed over said magnet, the material being characterized by a central section having two portions adjacent to and on opposite sides of said spring and two outboard sections on opposite sides of said central section to be polarized by movement of the magnet, the sections and magnet being located so that with motion of the magnet from its central position to one side, one pole moves toward one outboard section and away from the central section while the other pole moves toward the outboard section and away from the other outboard section, said spring extending between the two portions of said outboard section.

4. An inertia-type pickup having a low frequency response comprising: a housing; a magnet; a coil connected with said housing and disposed below and adjacent said magnet to receive flux therefrom; spring means connected with the top of said housing and extending downwardly therefrom; a magnet connected with the lower end of said spring means, the spring means supporting the magnet for vibratory motion from a neutral position to positions on either side of neutral; mechanism connected between said housing and said spring means and movable along the spring means to vary the effective vibrating length thereof; and magnetic material connected with said housing and disposed over said magnet, the material being characterized by a central section and two outboard sections on opposite sides of said central section to be polarized by movement of the magnet, the sections and magnet being located so that with motion of the magnet from its neutral position to one side, one pole moves toward one outboard section and away from the central section while the other pole moves toward the central section and away from the other outboard section.

5. A construction in accordance with claim 4 wherein said spring means comprises a single strip-like spring.

6. A construction in accordance with claim 4 wherein said spring means comprises a pair of strip-like springs.

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