

[54] ELECTRIC VIBRAPHONE

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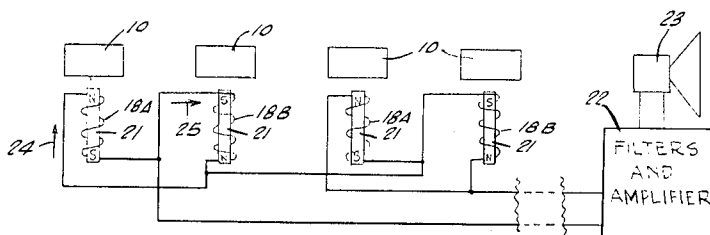
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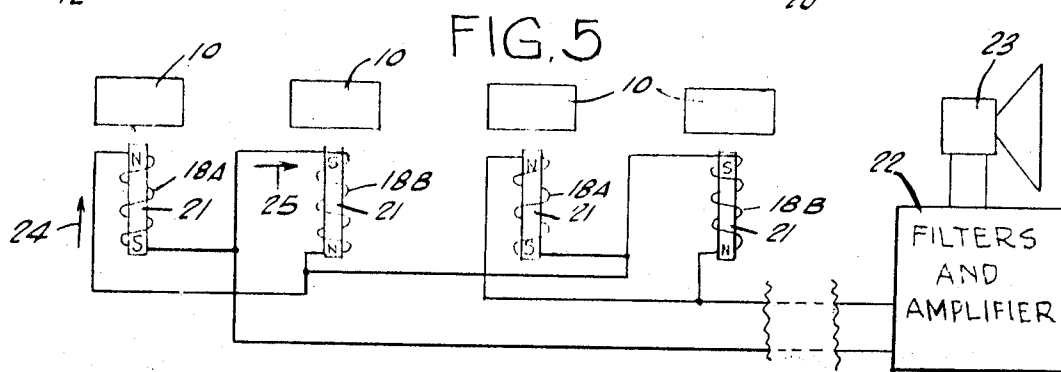
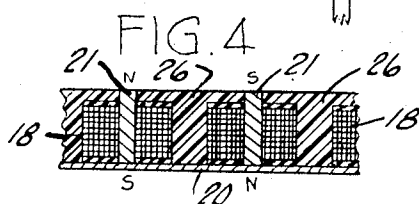
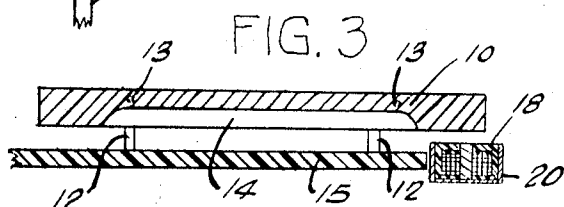
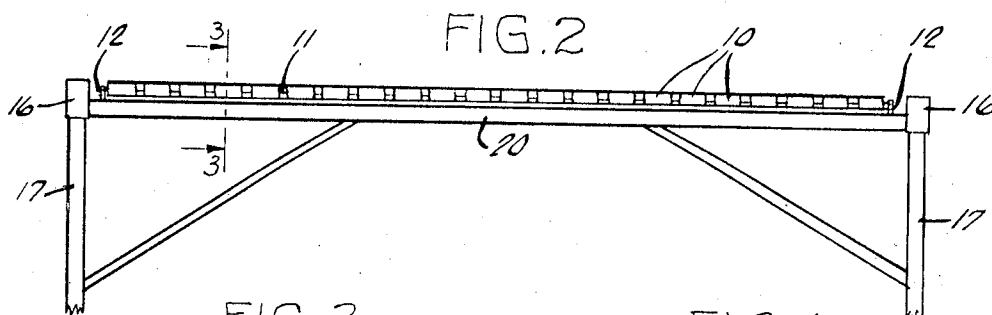
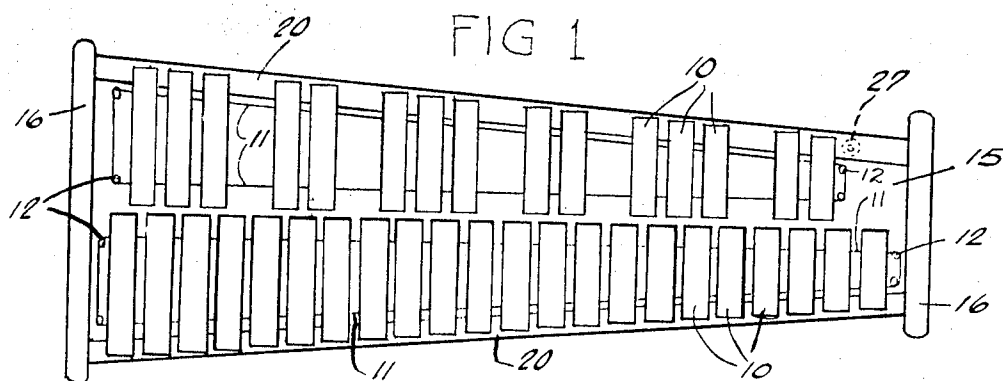
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ABSTRACT

A percussion musical instrument of the xylophone type having a plurality of aluminum alloy bars and played by striking the bars with mallets. No tubular resonators are required although they may be used. A magnetic pickup coil, with a permanent magnet core, is positioned under one of the ends of each bar and coupled to an amplifier and sonic transducer to reproduce musical notes. By alternately reversing the permanent magnet poles and connecting the pickup coils in pairs, noise, hum, and unwanted magnetic feedback is avoided.

5 Claims, 5 Drawing Figures





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ELECTRIC VIBRAPHONE

BACKGROUND OF THE INVENTION

Percussion musical instruments have been known for many years, the types which include a plurality of bars being used in orchestras and smaller instrumental groups. The glockenspiel has steel bars and produces a bell-like tone. The marimba and xylophone have wooden bars and produce a more mellow tone. In order to amplify the sound, the xylophone uses a plurality of hollow tubular resonators. The well known acoustical vibraphone is similar to a xylophone but uses aluminum bars and rotating discs in the upper portions of each resonator. A pulsating tone is produced but an electric motor is required to produce the disc rotation.

The present invention employs aluminum alloy bars to produce tones of exceptional purity. No resonators are necessary because the coupled amplified can be adjusted to produce considerable volume. No revolving discs or other mechanical tremolo means are necessary because the vibrato and tremolo effects may be added in the amplifier circuitry. The elimination of the resonator tubes and the revolving discs reduces the weight of the instrument and makes it more readily portable.

The amplifier and filter circuits used with the invention will not be described in detail because they are well known in the art.

One of the features of the invention is the array of pickup coils under the ends of the aluminum alloy bars. The windings of adjacent coils are reversed in direction so that the interaction between the magnetic fields of adjacent bars is reduced.

The magnetic feedback effects between the amplifier circuit and the pickup coils are practically eliminated by the reversed coil arrangements, generally termed a hum-bucking circuit.

Another feature of the invention is the elimination of tubular resonators and motorized discs, making the instrument more portable.

For a better understanding of the present invention, together with other details and features thereof, reference is made to the following description taken in connection with the accompanying drawings.

BRIEF DESCRIPTION OF THE FIGURES

FIG. 1 is a top view of the vibraphone, showing the arrangement of the bars and the channels which hold the pickup coils.

FIG. 2 is a partial side view of the instrument shown in FIG. 1.

FIG. 3 is a cross-sectional view of one of the bars, also a pickup coil. The section is taken along line 3—3 of FIG. 2.

FIG. 4 is a cross-sectional view, to a larger scale, of two of the pickup coils with their permanent magnet coils.

FIG. 5 is a wiring diagram showing how the pickup coils are connected.

DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring now to FIGS. 1, 2, and 3, the vibraphone comprises a plurality of resonant bars 10 arranged in a manner similar to the keys of a piano. The bars are supported by two stretched strings 11 held by pins 12. The strings pass through holes 13 (FIG. 3) permitting the bars to vibrate, when struck by a hammer, in their own free periods of vibration. Each bar is flat on its upper surface but contains a reduced section 14 in its under surface to enhance the tonal qualities. The bars 10 may be made of aluminum containing a magnetic substance. In a particular embodiment they are made of an aluminum alloy containing nickel and, because of the nickel content, are magnetic, having a permeability within the range of 5 to 30 for low-intensity magnetic flux. The pins 12 and other supports are mounted on a base plate 15 which is secured to end pieces 16. The instrument may be mounted on legs 17 or be supported on a table. A damping arrangement is generally employed to cut short the "ringing" time of the notes. Such a feature has not been shown in the drawings because it forms no part of the invention as claimed.

A plurality of pickup coils 18, one for each bar, are positioned in a channel support 20 which is placed under the ends of all the bars. Each coil 18 is wound around a permanent magnet 21 which is placed on end in the channel 20 with its upper end adjacent to the end of a bar 10. The coils are arranged in pairs, each pair including a first coil with its magnet having a north pole near the bar and a second coil with its magnet having a south pole near the bar. The two coils of each pair are connected to an amplifier in parallel and all the pairs are connected in series with each other. The ends of this circuit are then connected to an amplifier 22 (FIG. 5). The amplifier, in addition to amplifying the electric vibrations received from the coils, may contain filter circuits, and a low-frequency oscillator for producing vibrato and tremolo effects. The output of the amplifier is applied to a sonic transducer 23.

As shown in FIG. 5, the first coil 18A is wound in a clockwise direction, looking down from the bar 10, and the second coil 18B is wound in the reversed direction. The reversal of winding directions and the alternate placing of the magnetic poles has the effect of reducing hum and unwanted feedback between the coils and the magnetic components in the amplifier.

Since the bars are placed close together and since the coils must be connected to the same amplifier, there are two types of coupling between adjacent bars and coils. The first is the magnetic coupling between adjacent bars. When one bar vibrates and its end moves down, the magnetic lines of force are increased due to the decrease in airgap. This increase in flux causes an increase in flux in the adjacent bar and magnet core. The second coupling effect is the current coupling between coils since the coils are connected together. When the bar moves down, the change in magnetic flux causes a small current to flow in the direction indicated by the arrow 24. This current also flows in the second coil in the direction indicated by arrow 25. The result of the current in the second coil is to reduce the magnet flux in the airgap over the second coil 18B. In this manner the flux coupling and the current coupling cancel each other and the result is a pure tone when each bar is struck without side effects from adjacent bars.

As shown in FIGS. 3 and 4, the coils 18 and their cores 21 are surrounded by a potting compound 25 to hold them in place and protect them. This method of assembly is convenient but not necessary. FIGS. 1 and 2 show 22 bars in one array resulting in 11 pairs of pickup coils in one channel 20. The upper array, for sharps and flats, contains 15 bars and, to carry out the pair arrangement, a dummy coil 27 is placed to the right of the highest sharp in the other channel 20 or any other convenient position. This pickup coil performs no useful function except to nullify the hum and maintain uniform impedance in the system. While the series connection of all pickup pairs is the preferred circuit, it is obvious that other circuits combinations can be used.

From the above description it will be obvious that a novel instrument has been developed having no resonant tubes, no motorized discs, and therefore more readily movable from one playing area to another. The ranges of loudness, tremolo, and vibrato are all available in the amplifier circuitry.

Having thus fully described the invention, what is claimed as new and desired to be secured by Letters Patent is set forth by the following claims.

The embodiments of the invention in which an exclusive property or privilege is claimed are defined as follows:

1. A musical instrument adapted to drive amplification means, comprising a plurality of resonant bars arranged side by side and substantially within a plane, said bars having substantially flat surfaces which flex orthogonally to said plane when a bar is struck, and being made of an alloy of aluminum containing a magnetic substance; a pickup coil positioned in proximity to each of said bars, and having a permanent magnet core which is disposed perpendicularly to said plane, the permanent magnet cores of adjacent coils being oriented with opposite polarity, and said coils being in alignment with their

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ends in a plane substantially parallel to the plane of said bars; and circuit means connecting adjacent coils in pairs with each pair connected in parallel such that current flow within one coil of the pair will develop the opposite magnetic polarization in the other coil each pair of coils being serially connected to said amplification means.

2. A musical instrument as defined in claim 1, wherein the ends of each of said bars fall along a line extending from the end of the bars on the remote edges of said side-by-side arrangement, and wherein said coils are secured within a single support member that is disposed substantially in parallel with said line.

3. A musical instrument as defined in claim 1, wherein each

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coil is positioned at one end of its associated bar and establishes a primary magnetic circuit comprising only the end of said bar, the gap between the bar and said coil, and the permanent magnet core of said coil.

5 4. A musical instrument as defined in claim 1, wherein an uneven number of said bars are utilized, including an additional coil connected in parallel with the unpaired coil to form a further pair, said further pair being serially connected with all of the other pairs to said amplifying means.

10 5. A musical instrument as defined in claim 1, wherein said bars are made of an aluminum-nickel alloy having a permeability within the range of 5 to 30.

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