Jan. 10, 1950 E. A. GILBERT 2,494,438

PHONOGRAPH PICKUP

Filed May 31, 1946

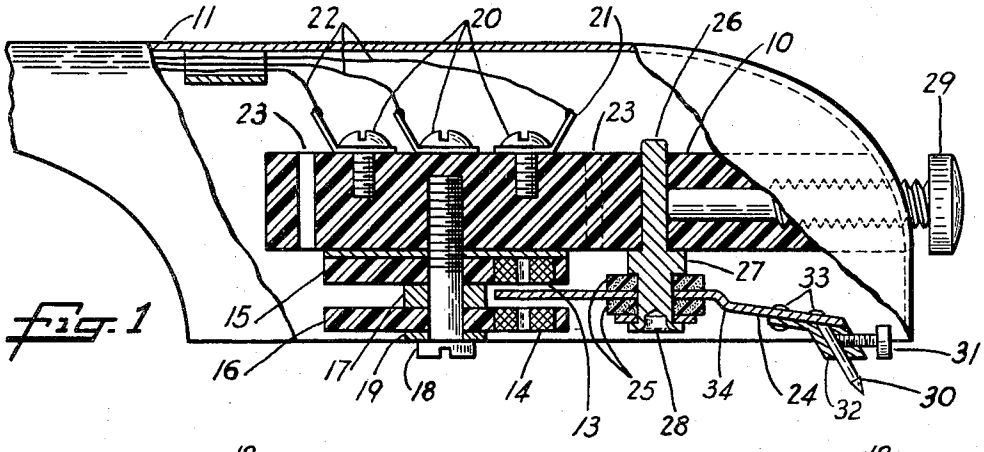


Fig. 1

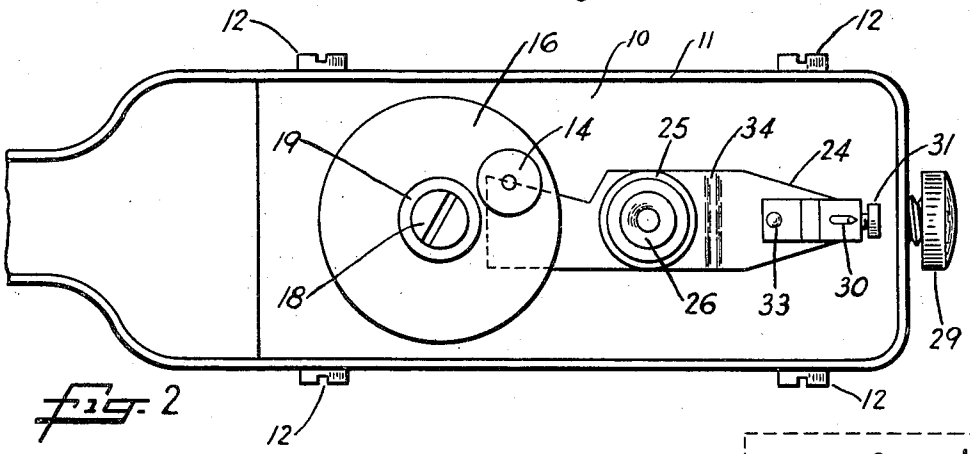


Fig. 2

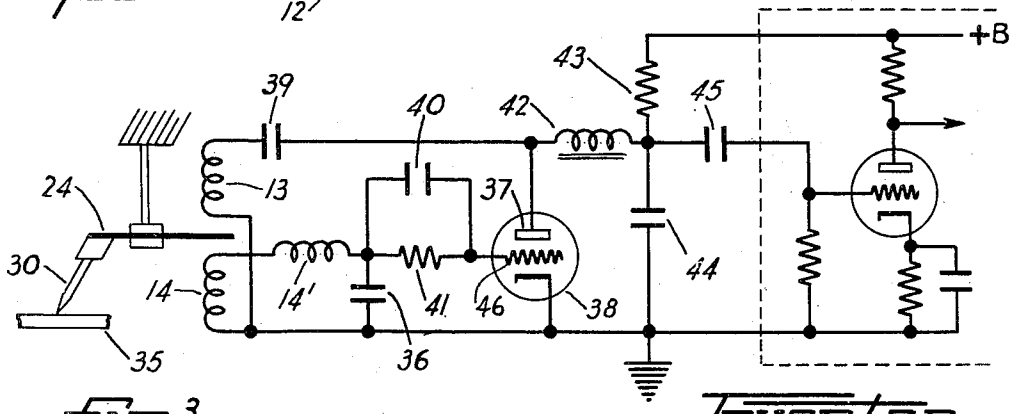


Fig. 3

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Patented Jan. 10, 1950 2,494,438

UNITED STATES PATENT OFFICE

2,494,438

PHONOGRAPH PICKUP

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Application May 31, 1946, Serial No. 673,476

3 Claims. (Cl. 179—100.41)

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This invention relates to a device for translating selected mechanical vibrations into corresponding electrical oscillations and more particularly to a novel phonograph pick-up for reproducing recorded sound waves with a minimum of scratch noises.

A recorded sound track comprises a spiral groove cut into the surface of a suitable disc, the depth of the groove being maintained as constant as is possible with the best available mechanical equipment. The edges of the groove consist of minute lateral undulations corresponding to the form, amplitude and frequency of the actual recorded sound waves. In reproducing the recorded sound it is essential that the pick-up device be capable of following those undulations which are substantially co-planar with the disc to the exclusion of all other vibrations likely to produce spurious noises from the loud speaker. In particular, scratch noises result when the needle point of the pick-up vibrates axially, that is, in a plane substantially normal to the disc, such vibration being caused by irregularities in the depth of the sound track, foreign particles imbedded in the disc, accumulated lint, etc.

To reduce the level of the scratch noise, phonograph pick-ups of the type contemplated by this invention are designed to exert a minimum pressure against the disc or record, the generally accepted pressure being approximately three (3) ounces. Yet, the pressure must be sufficient to compel the pick-up needle to follow each and every undulation of the recorded wave else the sound produced is not a faithful duplicate of the original.

Much effort has been directed toward the provision of a high quality pick-up having a minimum susceptibility to spurious vibrations. Needles have been made of non-metallic material, and special alloys having so called "soft" characteristics. Other needles are provided having a special shape intended to damp out axial vibrations of the needle while at the same time maintaining a maximum compliance to transverse vibrations. Further, photoelectric type pick-up devices have been proposed to eliminate direct contact between the pick-up and the record. I am not aware of any existing or proposed device that is recognized as an entirely satisfactory solution of the problem.

An object of this invention is the provision of a simple, compact and inexpensive arrangement for translating mechanical vibrations into electrical oscillations and including a member having a maximum compliance to transverse vibrations and a minimum compliance to axial or longitudinal vibrations.

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An object of this invention is the provision of a phonograph pick-up employing a conventional needle-point and including means interposed between the needle and the electrical circuit whereby spurious vibrations of the needle are prevented from affecting the reproduction of the desired sound waves.

An object of this invention is the provision of a phonograph pick-up comprising a needle, a metallic vane movable between spaced coils of an oscillator circuit, said needle secured to the vane by a resilient member pivoted for rotation in only one plane whereby the vane is free to follow transverse vibrations of the needle and is unaffected by axial vibrations of the said needle.

An object of this invention is the provision of a phonograph pick-up comprising a base, two axially displaced coils supported in fixed position relative to the base said coils being connected in an oscillator circuit, a resilient strip the inner end of which is disposed between the two coils and including means on the outer end for attaching a needle thereto, means pivotally securing the strip to the base, and resilient members clamping the strip in the region of the pivot area whereby transverse vibrations of the needle produce corresponding vibrations of the inner end of the strip in a plane parallel to that of the coils to thereby alter the voltage transfer ratio between the coils and the resilient members are effective to absorb or damp out axial vibrations of the needle.

These and other objects and advantages will be apparent from the following description of the invention when taken with the accompanying drawings. The drawings are for purposes of illustration and are not to be construed as defining the scope or limits of the invention, reference being had for this purpose to the appended claims.

In the drawings wherein like characters identify like parts in the several figures;

Figure 1 is a vertical, cross-sectional view of a phonograph pick-up made in accordance with my invention;

Figure 2 is a bottom view of the pick-up showing the relationship of the vibratory vane to the oscillator coils; and

Figure 3 is a circuit diagram showing the manner of converting mechanical vibrations into electrical oscillations.

Referring now to Figures 1 and 2, the individual components of the pick-up are carried by

the base 10 preferably made of an electrical insulating material and which is secured to a metal housing 11 by means of screws 12. Two electrical coils 13 and 14 are retained within insulator discs 15 and 16 respectively and are axially spaced apart by the bushing 17. A bolt 18 and flat washer 19 serve to fix the coils on the base 10. Threaded into the base 10 are screws 20 which serve to fasten the soldering terminals 21 to which the connection wires 22 may be soldered. Lead wires from the ends of the coils 13, 14 may also be soldered to the terminals by passing through holes 23 in the base.

A vibratory strip 24, preferably made of beryllium-copper, is clamped between two rubber washers 25 or the like. The stud 26 is provided with a shoulder 27 and an axial bore 28. By spinning over the end of the stud 26, the strip 24 and the washers 25 are clamped against the shoulder 27 resulting in a fairly rigid sub-assembly that is removably secured to the base 10 by the thumb screw 29. A conventional phonograph needle 30 is secured to the strip 24 by means of a thumb screw 31 that threads into the member 32 which is rigidly fastened to the strip by rivets 33 or in any other suitable manner.

The inner end of the strip 24 is disposed between the coils 13, 14 and preferably is so shaped that one edge of the strip lies in a plane bi-secting the coils when the strip is stationary i. e., not vibrating. The outer end of the strip is tapered and includes an offset section 34 that aids in damping out undesirable vibrations of the needle, as is explained in more detail hereinbelow.

While the drawing illustrates a unitary strip 24 of beryllium-copper it is apparent that the strip may be made of any material having suitable physical properties and variation of the mutual inductance between the coils 13 and 14 may be accomplished by attaching a vane or flag to the inner end of strip in any suitable manner. It is also pointed out that the shape of the vane, in the region of the coils, is not critical but in general it is good practice to shape the member to obtain the maximum variation in the magnetic lines of flux cutting the coils per unit displacement of the vibratory strip.

In actual use the point of the needle 30 follows the spiral groove of the record as the latter rotates. In so doing the needle vibrates in a complex manner in accordance with the minute undulations impressed into the record. Those vibrations corresponding to the recorded wave forms must be transmitted to the electrical circuit for faithful reproduction of the recorded sound. By reason of the manner in which the sound track is cut into the record the desired vibrations of the needle lie substantially in a plane parallel to that of the record. Axial or longitudinal vibrations of the needle are caused by variables such as minute imperfections in the material of which the record is made, foreign particles imbedded in the groove, variations in the depth of the groove, etc. These undesirable vibrations should be prevented from becoming effective in the electrical circuit as they result in what is known as scratch noises. My invention accomplishes this to a point wherein the level of the scratch noise is astonishingly low, it being conceded that the absolute and complete elimination of scratch noise is impossible in a pick-up of the type requiring direct contact with the surface of the record.

Transverse or lateral vibrations of the needle

30 produce a rotational motion of the strip 24 as the resiliency of the strip in this plane is substantially zero and the rubber washers 25 merely "give" or twist without retarding the rotation of the strip about the axis formed by the stud 26. Consequently, the inner end of the strip vibrates in a plane parallel to that of the coils 13, 14 thereby altering the voltage transfer between the coils, as is well known in the art. However, axial or longitudinal vibrations of the needle 30 are effectively damped out due to the resiliency of the strip 24 in this plane and the absorbing characteristics of the rubber washers 25. Consequently, such vibrations produce no motion of the inner end of the strip. Thus, it is apparent that a device made in accordance with my invention results in a high fidelity pick-up having a minimum susceptibility to spurious vibrations of the needle. It is recognized that the actual vibrations of the needle comprise components lying in all planes and while the functional explanation of my device has been described with respect to desired vibrations of a transverse or lateral nature and undesired vibrations of a longitudinal or axial nature certain vibrations occurring in intermediate planes may be transmitted to the inner end of the strip 24 in varying degrees. Inasmuch as the cross section of the sound groove is of approximate V shape most of such intermediate vibrations may be considered as desirable. Therefore, the total number of spurious vibrations effecting the transfer of voltage between the coils 13, 14 is only a very small percentage of the true, desired vibrations and the overall operation of my pick-up is of exceptionally high quality.

Figure 3 illustrates the electrical circuit employed in connection with my novel phonograph pick-up. Rotation of the record 35 imparts rotational vibrations to the needle 30 and results in mono-planar vibrations of the inner end of the strip 24. The coils 13, 14 form elements of a vacuum tube oscillator circuit of the tuned grid class and which is arranged to oscillate at radio frequencies in the region of 2 megacycles by proper design of the coils 14, 14' and the condenser 36. Coil 13 feeds energy from the plate 37 of the tube 38 to the tuned, grid coil 14. A condenser 39 by-passes radio frequency currents from the plate 37 to the coil 13 whereas the condenser 40 and associated resistor 41 charge to a peak voltage across the condenser 36 to limit the magnitude of the oscillations in the manner as pertains to tuned grid oscillators. A conventional load resistor 43 and a choke coil 42 are connected into the plate circuit. The by-pass condenser 44 has a reactance that is small compared to that of the resistor 43 at 10,000 cycles and, consequently, radio frequency currents are effectively by-passed to ground. On the other hand, audio frequency currents pass through the condenser 45 to the next amplifier stage represented by the circuit elements enclosed within the dotted line. The number of amplifier stages inserted between the oscillator and the loud speaker are determined by the sound level desired at the loud speaker.

The device operates as follows. Vibrations of the inner end of the strip 24 vary the mutual inductance of the coils 13, 14 at audio frequencies thereby producing corresponding variations in the transfer of radio frequency voltage between the said coils. Voltage variations induced in the coil 14 appear across the condenser 36 and are

of a magnitude of approximately .01 volt when the constants of the circuit are chosen to produce a normal transfer of 1.0 volts in the coil 14. These audio frequency, voltage variations across the condenser 36 produce corresponding variations of the bias on grid 46 and result in corresponding fluctuations of the plate current flowing through the resistor 43. The voltage drop across resistor 43 provides the control voltage on the grid of next amplifier stage and ultimately passes to the loud speaker.

Having now described one form of my high fidelity phonograph pick-up certain variations and modifications will be apparent to those skilled in the art. The specific form and construction of the various components of the device are subject to considerable latitude in design as is also the manner of mounting the components to form a practical, encased pick-up unit. Such variations are intended to fall within the scope and spirit of the invention as set forth in the following claims.

I claim:

1. A phonograph pick-up comprising a housing carrying a base, a stud extending downwardly from the base and substantially normal thereto, means securing the stud to the base and effective to prevent relative motion between the said stud and base, a vibratory strip having an inner section and an outer section, means pivotally securing the central section of the strip to the stud, a pair of electrical coils co-axially disposed adjacent to and on opposite sides of the inner section of the strip, means securing the coils in

fixed position relative to the base, a needle carried by the outer section of the vibratory strip, and vibration damping means engaging the central section of said strip and effective to absorb those vibrations of the strip corresponding to axial vibrations of the needle.

2. The invention as recited in claim 1, wherein the vibration damping means comprises a pair of resilient washers carried by the said stud, the individual washers being in contact with opposite surfaces of the vibratory strip.

3. The invention as recited in claim 2, wherein the vibratory strip is made of beryllium copper.

EVERETT A. GILBERT.

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