July 19, 1949. W. K. RIEBER 2,476,684

PHONOGRAPHIC TRANSDUCER

Filed Oct. 12, 1945

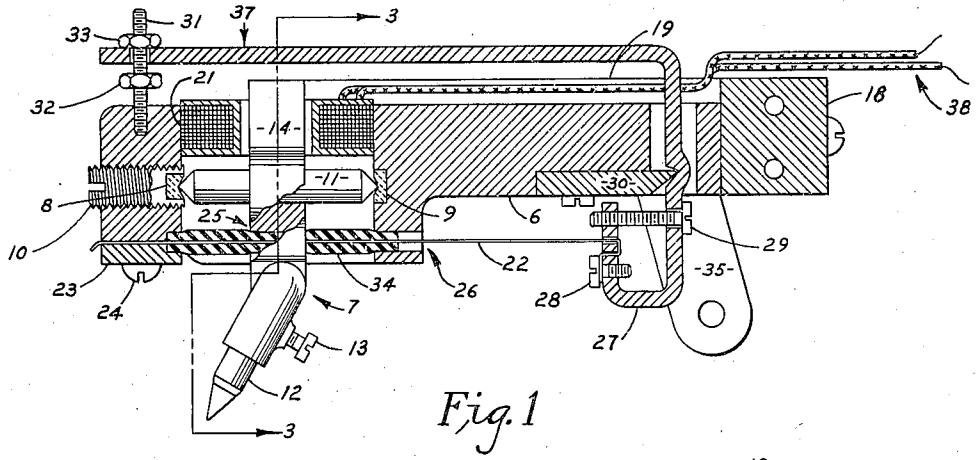


Fig. 1

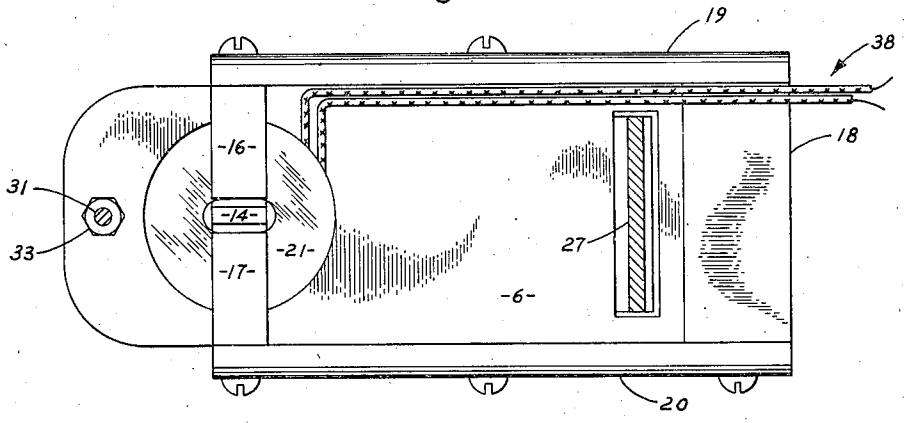


Fig. 2

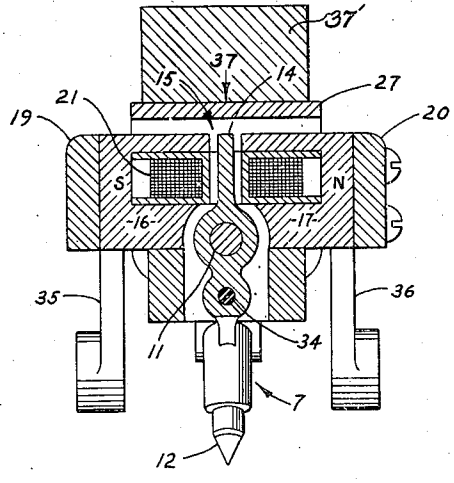


Fig. 3

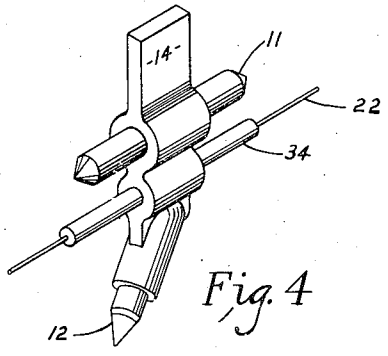


Fig. 4

INVENTOR.

William K. Rieber

Patented July 19, 1949

2,476,684

UNITED STATES PATENT OFFICE

2,476,684

PHONOGRAPHIC TRANSDUCER

William K. Rieber, Los Angeles, Calif.

Application October 12, 1945, Serial No. 622,061

13 Claims. (Cl. 179—100.41)

1

My invention relates generally to the translating means for converting mechanical vibration into pulsating or alternating electric current or the reverse of this, converting pulsating or alternating current into mechanical vibration.

My invention relates more particularly to such translating devices used in phonographic recording and transcribing equipment of the engraving or embossing class wherein an undulating groove is embossed or engraved in a moving record medium.

Several such translating means, which are reversible, are known in the art. Among such reversible means are the variable reluctance magnetic system and the piezo-electric crystal system.

In the present embodiment, my invention is shown employed in an electro-magnetic phonographic tone head which is adapted for use either as a sound recording head or a sound pick-up head.

For an understanding of my invention, it is well to consider now the factors and characteristics which should be variable in such a device in order to adapt it for either of the two above mentioned purposes. In this discussion, the following terms will hereafter be used to define the tone head and its functions: When used as a transducer for translating mechanical motion into electrical energy, the device will be called a "pick-up," and when used for the reverse purpose it will be called a "recording head." The two functions will be described as "playing back" and "recording" respectively and the apparatus employing the device will be referred to as a "transcriber" and "recorder" respectively.

Tone heads have been designed which are adaptable for use, both as pick-ups and recording heads, but in all such devices used previously the value of variable factors therein represent compromises between the best value for recording and the best value for playing back. However, to secure optimum efficiency, it is desirable to change the value of at least some of such variable factors when changing the function of the device from that of recording to that of playing back. Among such variable factors in a tone head of the variable reluctance magnetic type are the following: (1) the strength of the permanent magnetic field, (2) the mechanical stiffness or spring factor of the moving armature, (3) the mechanical damping, (4) the pressure of the recording stylus against the recording medium, (5)

2

the ability of the entire structure to "ride the groove" or "track."

It is desirable that all, or at least several of the factors listed above, be automatically and simultaneously changed by one simple adjustment which thus converts the device from the function of recording to the function of playing back or vice-versa.

I have found by experiment that the factors which it is most desired to change between functions are those of stylus pressure and stiffness and my invention deals therefore with these two variable factors.

It is one object of my invention to provide a sound translating head which is adaptable for use as a transducer, either to convert electrical pulsations into mechanical vibrations, when used in a recorder, or to perform the reverse of this function when used in a transcriber.

It is another object of my invention to provide a sound head of the class described in which the mechanical stiffness is dependent on the pressure which is applied to engage an engraving or embossing stylus with a record medium. These and other objects of my invention will appear in the following description of a preferred embodiment of my invention.

Briefly described, the device is of the variable reluctance magnetic type in which a stylus carrying armature moves in a magnetic field. Such motion of the armature results in electric current flow in a pick-up coil or, conversely, current in the coil produces motion of the armature.

In the illustrated embodiment, I prefer to use a stretched ligament as a spring for constraining the motion of the armature. In order to change the mechanical stiffness of the system, therefore, it is only necessary to increase the tension in the ligament. I provide a lever for this purpose which is so mounted in the tone head that when weight is added for the purpose of increasing stylus pressure such added weight also results in increasing the ligament tension.

For a more detailed description of the tone head embodying my invention, reference should now be had to the attached drawings wherein:

Fig. 1 is an elevational sectional view taken on a vertical plane passed longitudinally through the center of the tone head, with the parts in play-back position,

Fig. 2 is a partially sectioned plan view of the device shown in Fig. 1,

Fig. 3 is an elevational, partially sectioned view taken on the line 3—3 in Fig. 1 but with the parts in recording position, and

Fig. 4 is an isometric view of the armature portion of the device.

Referring now to the above drawings, a casting forms the frame 6 which supports the various members of an electromagnetic transducer. A stylus-carrying armature 7 constructed of ferromagnetic material is pivotally supported by the frame 6 in two jewel bearings 8 and 9, one of which 8 is held in an adjustment screw 10. A supporting pivot 11 is pressed into the armature which is thereby adapted for transverse swinging motion.

A jewel pointed embossing or engraving stylus 12 is supported in the lower end of the armature and secured therein by a set screw 13. Projecting upwardly from the armature at pivot 11 is a blade portion 14 of the armature which is substantially centrally located in a gap 15 between the upper arms of two U-shaped magnetic pole pieces 16 and 17, as best seen in Fig. 3. The two lower arms of the magnetic pole pieces 16 and 17 are brought into a point adjacent to the armature and near its pivot 11.

Magnetic flux is produced in the system by means of a permanent magnet 18 mounted to the back of the frame 6, flux being carried forward and into the pole pieces 16 and 17 by two flux conducting members 19 and 20. The magnetization of the permanent magnet 18 is such as to produce a south pole in the left hand pole piece and a north pole in the right hand pole piece as best seen in Fig. 3 and indicated by the letters N and S.

It will now be seen that as long as the armature 7, and hence the blade portion 14 thereof, remains in a substantially vertical position, as shown in Fig. 3, the magneto-motive forces thereon are balanced and no flux flows downwardly or upwardly through the blade portion. However, when the stylus is engaged with a moving sound record and caused to vibrate laterally thereby, the blade portion 14 of the armature will vibrate laterally in the gap 15, alternately approaching and receding from the pole pieces 16 and 17. Such vibration alternately changes the reluctance of the flux path through the armature blade 14 and hence an alternating flux passes therethrough. This alternating magnetic flux is converted into alternating electric current by means of a pick-up coil 21 mounted in the frame and between the arms of the U-shaped pole pieces and so positioned that the blade portion 14 of the armature passes therethrough.

Electric leads 38 are brought out from the coil 21 and may be connected to the input of an amplifier for the function of playing back, or the output of an amplifier for the function of recording. The method of making such connections is well known in the art and need not be shown here.

The process of mechanical, electrical transduction performed in this manner is reversible since alternating current flowing in the coil 21 will produce alternating magnetic flux in the blade portion 14 of the armature, thus causing it to vibrate in the gap 15 and thereby producing lateral vibration of the stylus point 12.

In order to maintain the armature 7 in a substantially vertical position, a stretched ligament 22 is provided which serves as a centering spring. This ligament 22 is secured at its forward end by a clamping plate 23 and screws 24 which clamp it against the main frame 6 and is stretched rearwardly, passing through a longitudinal hole 25 in the armature 7, and also through a hole 26 in a downwardly projecting portion of the frame. The ligament 22 is secured at its rearward end by passing through two holes in the lower end of an L-shaped lever member 27 and being clamped thereto by a screw 28. The lower end of the lever 27 is bent into a U shape and a screw 29 is provided for closing this U, thereby to adjust the initial tension of the ligament 22.

The L-shaped lever 27 is fulcrumed on a blade 30 which in turn is secured to the main frame 6.

The top arm of the lever 27 extends forwardly above the main frame and in adjustment screw 31 is provided in the main frame which projects upwardly through a hole in the forward end of the upper lever arm, as indicated in Fig. 1. Two nuts 32 and 33 are provided on this screw, one 32 below and one 33 above the lever arm 27. The nuts 32 and 33 form upper and lower stops, thus confining the motion of the forward end of the lever arm 27.

Damping of the armature motion is provided in the form of a sleeve 34 of rubber or similar material which passes over the ligament 22 and through the armature at the same point 25 as the ligament. The forward end of the damping sleeve 34 is secured by the clamping plate 23 and at its rearward end by being pressed into the hole 25 in the main frame 6.

Two lateral downwardly projecting arms 35 and 36 are provided on the rearward end of the main frame 6, and have journal bearings in the lower ends thereof, thereby to mount the entire structure for vertical swinging motion above a moving record medium.

The device described is adapted for the dual purpose of recording and playing back and operates as follows: In the condition shown in Fig. 1, the tone head is adapted to function as a pick-up, that is, when the stylus 12 is engaged with an undulating groove in a moving record, the lateral vibration of the stylus and hence the armature 7 produces correspondingly plusating electric current in the coil 21.

Now to convert the tone head for the function of recording, pressure is applied at a point indicated by the numeral 37 in Fig. 1, as for example by the addition of a weight 37' thereat as shown in Fig. 3 or by a downwardly thrusting spring. The added downward pressure first moves the upper arm of the lever 27 downwardly against the lower adjusting nut 32 thus rotating the lever counterclockwise about the fulcrum 30 and increasing the tension in the ligament 22. The increased pressure also acts downwardly through the adjusting nut 32, screw 31, frame 6, and armature 7 to exert additional downward pressure on the stylus 12 thereby to force it into the record medium for the purpose of embossing or engraving a groove therein. During the recording function, relatively greater magnetic flux strength must be produced in the blade portion 14 of the armature than during the play-back function, since during recording, it is necessary to deform the record medium. Greater magnetic flux strength in the armature tends to produce greater lateral excursions thereof during which the armature blade 14 would tend to strike the pole pieces 16 and 17. This tendency is overcome in the present embodiment by the aforementioned increased stiffness during the recording function.

The armature 7 and stretched ligament 22 if undamped would form an oscillating system in which sustained vibration would be possible and which would be alinear in its response to vary-

ing frequencies of alternating current in the coil 21. In order to prevent such resonance in the armature system, the damping sleeve 34 is provided which is so proportioned and of energy absorbing material such as to critically damp the armature motion.

It will be seen by those skilled in the art that it is the essence of my invention to provide in a phonographic transducer, a mechanical oscillator, the compliance factor of which is varied between the functions of recording and playing back and to so construct the transducer that the stiffness of the variable compliance is increased automatically when additional stylus pressure is produced. Various alternate methods of embodying my invention will be apparent and I do not mean to be limited to the embodiment disclosed herein but rather to the scope of the appended claims.

I claim:

1. In a dual purpose phonographic transducer: a supporting frame; a stylus carrying ferro-magnetic armature, pivotally mounted in said frame for laterally swinging motion therein; a stretched ligament connecting said armature to said frame and constraining said swinging motion; a damping sleeve of energy absorbing material surrounding said stretched ligament; a lever fulcrumed in said frame and moving in response to record engaging pressure of a stylus carried by said armature, one end of said lever being connected to said ligament whereby said stylus pressure responsive motion results in corresponding variation in said ligament tension; means for producing a permanent magnetic field surrounding said armature such that laterally swinging motion is accompanied by alternating magnetic flux flow in a portion of said armature; a coil surrounding said alternating magnetic flux-carrying armature portion, said coil so connected that current flow therein is accompanied by corresponding magnetic flux flow in said armature portion; and means for selectively connecting said coil to a source of alternating electric current or to a means for detecting such current.

2. In a dual purpose transducer: a supporting frame; an armature movably mounted in said frame; a spring connecting said armature and frame and under initial tension to constrain said armature movement; a movable member in said frame connected to said spring; means to selectively detect or produce mechanical vibration in said armature; an element in said armature adapted to selectively produce a sound record in a moving sound recording medium engaged therewith or to vibrate said armature in response to a moving sound record engaged thereto; and means to selectively apply pressure to said movable member to move the same whereby to increase the tension in said spring and simultaneously increase pressure of engagement of said element.

3. In a dual purpose transducer: a supporting frame; an armature movably mounted in said frame; a spring constraining motion of said armature; stylus means to selectively engage said armature with a source of mechanical vibrations or with a medium for recording such vibrations; a movable member in said frame connected to said spring; and means to selectively apply pressure to said member whereby to simultaneously increase tension in said spring and apply medium engaging pressure to said armature.

4. In a dual purpose transducer: a supporting frame; an armature movably mounted in said frame; stylus means to selectively engage said armature with a source of mechanical vibrations or with a medium for recording such vibrations; movable means in said frame resiliently connected to said armature; and means to selectively apply pressure to said movable means whereby to simultaneously decrease the mechanical compliance of said armature and apply medium engaging pressure to said stylus means.

5. In a dual purpose transducer: a supporting frame; an armature movably mounted in said frame; a spring connecting said armature and frame and under initial tension to constrain said armature movement; a movable member in said frame connected to said spring; means to selectively detect or produce mechanical vibration in said armature; an element in said armature adapted to selectively produce a sound record in a moving sound recording medium engaged therewith or to vibrate said armature in response to a moving sound record engaged thereto; means to selectively apply pressure to said movable member to move the same whereby to increase the tension in said spring and simultaneously increase pressure of engagement of said element; and adjustable means for limiting the motion of said movable means whereby to adjust the amount by which said spring tension is increased by said movable means.

6. In a dual purpose transducer: a supporting frame; an armature movably mounted in said frame; a spring constraining motion of said armature; stylus means to selectively engage said armature with a source of mechanical vibrations or with a medium for recording such vibrations; a movable member in said frame connected to said spring; means to selectively apply pressure to said member whereby to simultaneously increase tension in said spring and apply medium engaging pressure to said armature; and adjustable means for limiting the motion of said movable means whereby to adjust the amount by which said spring tension is increased by said movable means.

7. In a dual purpose transducer: a supporting frame; an armature movably mounted in said frame; stylus means to selectively engage said armature with a source of mechanical vibrations or with a medium for recording such vibrations; movable means in said frame resiliently connected to said armature; means to selectively apply pressure to said movable means whereby to simultaneously decrease the mechanical compliance of said armature and apply medium engaging pressure to said armature; and adjustable means for limiting the motion of said movable means whereby to adjust the amount by which said compliance is changed.

8. In a dual purpose transducer: a supporting frame having aligned bearings therein; a vibratory member pivotally mounted in said bearings; means in said frame to selectively vibrate or detect vibration in said vibratory member; stylus means fixed to said vibratory member and adapted to engage the same selectively with an external source of mechanical vibration or with a medium for recording such vibration; a compliance control member movably mounted in said frame; a pre-stressed spring connected between said control member and vibratory member and adapted to resist movement of said vibratory member; and means positioned and adapted to apply pressure to said compliance control member and frame whereby to increase the medium-engaging pressure of said stylus means and simultaneously to increase the resistance of said spring.

9. The construction of claim 8 further characterized in that said last-named means includes a weight adapted to rest on said control member.

10. The construction of claim 8 further characterized by having adjustable abutment members in said frame, positioned and adapted to limit the movement of said control member.

11. The construction of claim 8 further characterized in that said spring is a tensioned ligament.

12. The construction of claim 8 further characterized by having a body of energy-absorbing material engaged with said vibratory member whereby to damp the same.

13. The construction of claim 8 further characterized in that said compliance control member is a lever fulcrumed in said frame.

WILLIAM K. RIEBER.

REFERENCES CITED

The following references are of record in the file of this patent:

UNITED STATES PATENTS

Number	Name	Date
1,776,045	Rogers	Sept. 16, 1930
1,870,446	Foley	Aug. 9, 1932
1,883,100	Terrell	Oct. 18, 1932
2,173,051	De Madaler	Sept. 12, 1939
2,318,308	Harris	May 4, 1943