July 27, 1948. L. CHANAL 2,445,762

RECORD ENGRAVER SUSPENSION FOR SOUND TRACK REGISTERING MACHINES

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Fig. 1

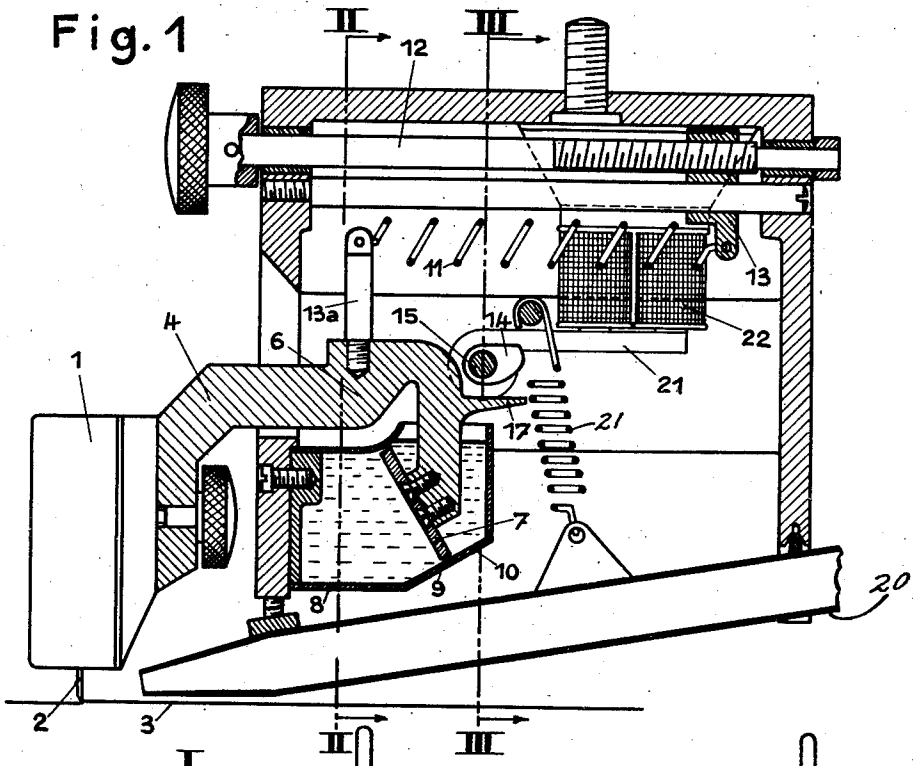


Fig. 2

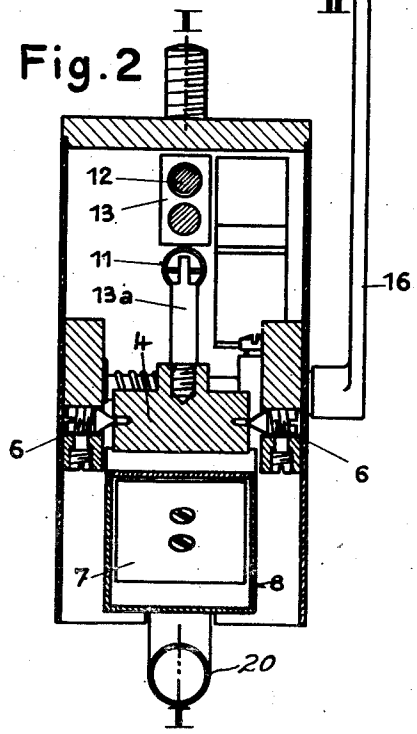
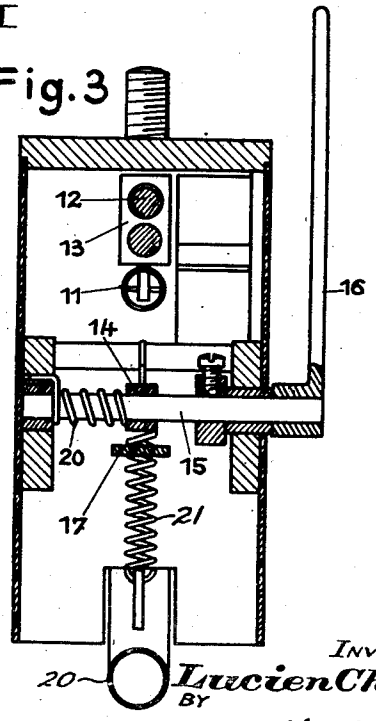


Fig. 3



INVENTOR
Lucien Chanal,
BY
Williamson & Groff
ATTORNEYS

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RECORD ENGRAVER SUSPENSION FOR SOUND TRACK REGISTERING MACHINES

Lucien Chanal, Annecy, France; vested in the Attorney General of the United States

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In Switzerland November 8, 1941

6 Claims. (Cl. 274—24)

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As is known, in a machine for registering a sound track on a disk-shaped record, the chisel or like tool carried by the engraver cuts into the record a furrow of triangular cross section whose apex angle is approximately equal to 90°. Such furrow should have a practically constant depth and width even when the record revolves in an imperfect plane. Therefore suspension means should be provided for the engraver so as to enable it closely to follow the motions of the record while keeping the tool applied with a given pressure upon the record for the purpose of cutting a furrow having the required depth. However, the cutting of the furrow produces a reactive stress which tends either to lift the tool off or to engage it more deeply depending upon the position of the engraver pivot with respect to the cutting position of the tool. Such reactive stress is the greater as the section of the cut chippings, i. e. the furrow depth is itself larger. Moreover, as the record surface is warped, it is necessary in order to obtain a furrow of uniform depth to arrange for the engraver to truly follow the up and down motions of the record. Since the tool must stand up almost at right angles to the record so as to cause the furrow to be correctly cut and since it can be assumed that the record never revolves in a perfect plane, pendular movements are unavoidably generated and gnawing of the engraver ensues. Instead of representing a helix, the furrow edge then represents a sinusoid.

An object of the present invention is to provide a new or improved suspension device for the engraver in a machine for registering a sound track on a record, said device being adapted to obviate the aforesaid disadvantages owing to the operative connection of the engraver-carrying arm with damping or cushioning means, said arm being arranged for free pivotal motion about an axis approximately parallel to the record surface and having a position relative to the cutting point so selected as to cause the cutting reaction to nullify the force which urges the tool against the record.

Another object of the invention is to provide a new or improved suspension device as aforesaid wherein the damping or cushioning means are so arranged as to cause the damping action on such up and down motions of the engraver-carrying arm as are produced by the record warping to vary in response to the height of the cutting point with respect to the height of the pivotal axis of the engraver-carrying arm, thereby preventing pendular motions from being initiated.

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A further object of the invention is to provide a new or improved suspension device as aforesaid wherein the engraver is left sufficiently free to follow the record throughout the up and down motions due to the unevennesses of its surface and at the same time applies a sufficient damping stress to the engraver unit twice per revolution to brake down to total elimination pendular oscillations as may be produced by reactive stresses due to the cutting action.

And a still further object of the invention is to provide a new or improved suspension device as aforesaid having a perfect efficiency due regard being paid to the fact that the engraver vibrations are similar to the Larsen or self excitation phenomenon and therefore require a fairly long time to reach a substantial amplitude, whereby as said time is much greater than the duration of half a revolution of the record between two maximum damping effects, the braking action can always occur quickly enough.

With these and such other objects in view as will incidentally appear hereafter, the invention comprises the novel construction and combination of parts that will now be described in detail with reference to the accompanying diagrammatic drawing illustrating a convenient embodiment of the same and forming a part of the present disclosure.

In the drawing:

Figure 1 is a sectional view of the entire device on the line I—I of Fig. 2.

Figure 2 is a sectional view on the line II—II of Fig. 1.

Figure 3 is a sectional view on the line III—III of Fig. 1.

Like reference characters designate like parts throughout the several views.

As illustrated, 1 is the engraver, 2 is the chisel or cutting tool carried thereby, 3 is the surface of the record to be engraved, 4 is the engraver-carrying arm pivoted between pointed bearings 5, 6 which are so adjusted as to hold the arm perfectly free to rock but devoid of play and sway.

The pivotal axis of the engraver-carrying arm 4 is substantially parallel to the record surface and its position with respect to the cutting point of the tool 2 is so selected as to cause the reaction of the cutting stress for the required depth of cut to nullify the torque due to the force which urges the tool against the record. Moreover, said axis is so arranged relative to the mass of the engraver-carrying arm 4 and engraver itself as to bring down the inertia of the unit to a low value, whereby the engraver 1 can follow the varia-

tions of height of the cutting point due to record warping.

The engraver arm 4 is operatively connected to a damping device. To that effect, the arm 4 carries at one of its ends one element of a damper comprising a board or panel 7 immersed in a mass of fluid (preferably a liquid) filling a container 8. Between the walls of the container 8 and the board 7 is left a throttled clearance which enables this board to follow the vertical motions of the engraver carrier 4 responsive to unevennesses due to warping of the record 3. The size of said clearance is calculated to match the desired degree of damping and the viscosity of the fluid in the container 8.

In order to permit the depth of cut of the tool 2 to be adjusted at will, a spring 11 is fastened to a lug 13a rigidly secured to the engraver-carrying arm 4. The tension of the spring 11 can be regulated by means of a threaded spindle 12 and a nut 13 fitted thereon. This spring 1 keeps the engraver arm 4 and thereby the tool 2 in their proper position with respect to the horizontal plane of the record.

A cam 14 fast upon a pin 15 forming one limb of a cranked lever 16 enables the engraver to be lifted off the work to inoperative position. By rotating the cranked lever 16 clockwise (as viewed in Fig. 1) the cam 14 is brought into engagement with a ledge 17 on the engraver arm 4 and raises the latter.

In order to automatically control the setting of the engraver into operation, there is coiled around the pin 15 a sufficiently strong spring 20 to rotate the cam 14 in a direction capable of lifting the engraver. For holding the engraver tool 2 upon the record 3 in proper cutting position, i. e. for maintaining the cam 14 in the illustrated position against the action of spring 20, a mechanical latch (not shown) or electromagnetic means as shown in Fig. 1 may be provided.

When the engraver 1 is in normal position (as shown in the drawing) to cope with an average record height, the damping board 7 extends at right angles to the walls of the container 8. At least one of the container walls such as the one designated by 10 is not parallel to the path described by the board edge during its motions but is so disposed with respect to said path as to cause the clearance between the board 7 and said wall to be minimum when the engraver 1 is in normal position. To that effect the wall 10 extends parallel to the plane which is tangent to the cylinder of revolution generated by the edge 9 of the board when the engraver is moved vertically along a generatrix corresponding to the position assumed by said board when the engraver is in normal position. It will be seen that when the engraver 1 is moved up or down from said position, the damping effect gradually dwindles down due to the increase in cross sectional area of the passage around the plate or disc 7.

It will be understood that as the warped record describes a complete revolution, the engraver 1 traverses its lowermost position once, its uppermost position also once and its normal position twice. Consequently the damping effect varies periodically, the duration of a period or cycle corresponding to the duration of half a revolution of the record. Moreover, the variations of the damping effect are such that when the engraver occupies its extreme positions (up or down) said effect is minimum while it is maximum when the engraver occupies its middle position. In other words, assuming the engraver to occupy those positions for which the damping effect is minimum, the engraver has a maximum of freedom, which enables the same to exactly follow the record unevennesses due to warping. Conversely, when the engraver occupies its middle position for which it can bear a larger damping effect since its motion is uniform when it traverses said position, the damping effect is maximum.

It will be seen from the foregoing that a device as above described leaves the engraver a sufficient degree of freedom to enable it to follow up and down the unevennesses of the record and that twice per revolution it applies to the assembly a sufficiently large damping effect to fully brake down those pendular oscillations which might be caused by the reactions due to the cutting action.

The efficiency of the assembly is fully satisfactory because the engraver vibrations are similar to a Larsen phenomenon and involve self excitement, i. e. require a fairly long time within which to reach a substantial amplitude. As such time largely exceeds the duration of half a revolution of the record which separates two maximum damping effects, the braking action always takes place quickly enough.

As an alternative construction, the manually operable cranked lever 16 may be preserved while the spring 20 is omitted.

Safety means are provided for preventing the engraver from remaining in cutting position as long as all steps necessary for effecting a registration have not been taken. Such means comprise in one embodiment as shown in Fig. 1 a double electromagnet 22 whose movable armature 21 is rigidly connected to the pin 15, the angular setting of said armature relative to the cam 14 being so provided that when this armature is held against the electromagnet or "stuck," the cam should be clear from the ledge 17.

The winding of the electromagnets 22 is energized only when all steps required for effecting a registration on a record have been fully taken, as set forth in my co-pending application Serial No. 463,571, filed October 27, 1942.

Therefore the engraver while being normally raised by the spring 20 is kept down only when the electromagnets 22 are energized and their movable armature 21 is held "stuck" against the action of said spring 20. Therefore the engraver can be brought into operative position only if the electric current flows through the electromagnet windings. As the switching on of said current into the magnets 22 is dependent upon the setting of the registering machine into service, no unskilful manipulation is possible.

Minor constructional details might be changed without departing from the scope of the subjoined claims.

For the purpose of carrying away material of the record which is removed by the engraver tool 2 I may provide a tube 29 adapted to be attached to an air suction means (not shown). This tube is normally held with its open end slightly above the record material by means of a spring 21 shown in Figs. 1 and 3.

What is claimed is:

1. In a sound track registering machine, a record engraver suspension device, comprising an engraver tool carrier, a frame adapted to be attached to a tone arm, a bearing in said frame adapted to pivotally suspend said carrier in said frame, the axis of said bearing being substantially parallel to the surface of the record, means for counteracting the reaction caused by the cutting stress exerted on said engraver tool carrier,

damping means operatively connected between said frame and said carrier, said damping means comprising a container and disc movable therein, the walls of said container forming a throttled passage around the disc, of varying cross sectional area along the path of movement of the disc to produce varying damping effects depending upon the extent of deviations of the engraver tool carrier from its normal position with respect to the plane of the record in such a manner that the damping effects on the carrier decrease gradually with increasing deviations from said normal position, thereby preventing initiation of pendular vibrations.

2. In a sound track registering machine according to claim 1, characterized by such a position of said bearing with respect to said carrier that the total inertia of the engraver tool and its carrier is small.

3. In a sound track registering machine according to claim 1, said damping means comprising in combination, a plunger associated with said engraver carrier and a container mounted in said frame, said container filled with a fluid and operatively connected with said plunger, said plunger being emersed and movable in said fluid.

4. In a sound track registering machine according to claim 1, said counteracting means including an adjustable spring member disposed and acting between said frame and said carrier, said spring means being adapted to vary said counteracting stress.

5. In a sound track registering machine, a record engraver suspension device, comprising an engraver tool carrier, a frame adapted to be attached to a tone arm, a bearing in said frame adapted to pivotally suspend said carrier in said frame, the axis of said bearing being substantially parallel to the surface of the record, said carrier being balanced and the position of said bearing with respect to the engraver tool point being such that the carrier counteracts the reaction caused by the cutting stress exerted on said engraver tool point, damping means operatively connected between said frame and said carrier,

said damping means comprising a container and disc movable therein, the walls of said container forming a throttled passage around the disc, of varying cross sectional area along the path of movement of the disc to produce varying damping effects depending upon the extent of deviations of the engraver tool carrier from its normal position with respect to the plane of the record in such a manner that the damping effects on the carrier decrease gradually with increasing deviations from said normal position, thereby preventing initiation of pendular vibrations.

6. In a sound track registering machine, an engraver carrying arm, means for pivotally supporting said arm on a horizontal axis between the ends of the arm, an engraver secured to one end of the arm, the opposite end of the arm being formed with a downwardly extending portion, a damping plate carried at the end of said portion and a fluid filled container into which said portion extends, the side walls of the container being so shaped as to form a throttled passage around the plate which varies in cross sectional area from point to point along the path of movement of said plate.

LUCIEN CHANAL.

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