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A. CRAMWINCKEL ET AL

METHOD AND DEVICE FOR MECHANICAL RECORDING

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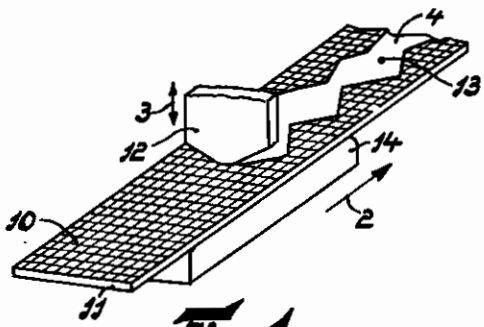

Fig. 1

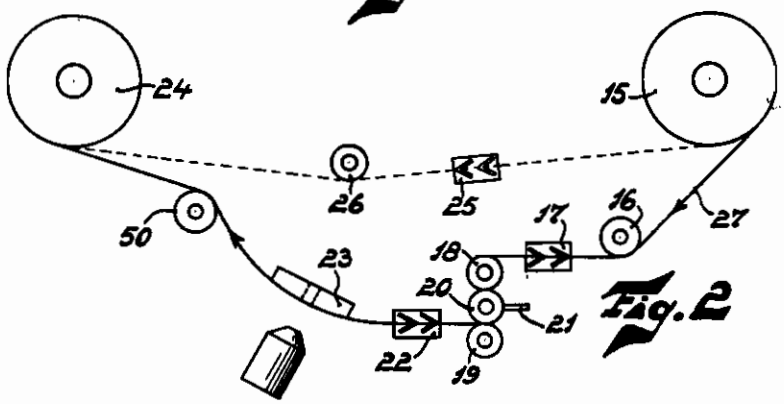

Fig. 2

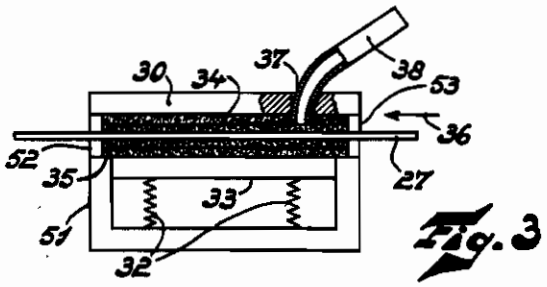

Fig. 3

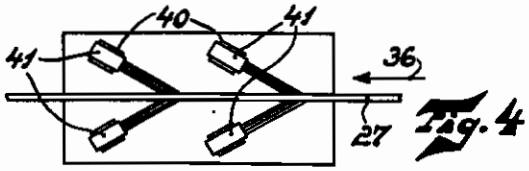

Fig. 4

INVENTORS
A. Cramwinckel and
C. J. Dippel

BY C. F. Wunderott

ATTORNEY

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METHOD AND DEVICE FOR MECHANICAL RECORDING

Arnaud Cramwinckel and Cornelis Johannes Dippel, Eindhoven, Holland; vested in the Alien Property Custodian

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Our invention relates to a method and device for mechanically recording a sound track which has depth variations and optically-reproducible width variations which are an enlargement of the depth variations.

As is well known dirt deposited on an optically-reproducible sound track, for instance dust, particles of film material, or the like, is largely responsible for a hiss during reproduction. It has been suggested to remove this dirt from both surfaces of the carrier at the area of the sound track before the sound track is optically scanned. It is also known that a deposit of dust on the light-sensitive emulsion prior to or during the formation of the photographic sound track deleteriously affects the recording and the quality of the track obtained and therefore the recording and subsequent development and fixation are usually carried out in rooms which are as free as possible from dust.

In photographic sound-recording it is primarily the emulsion surface of the carrier, i. e. the surface on which recording is effected, which should be kept free from any dirt which might intercept or diffuse the exposure light. Any dirt that may exist on the surface of the carrier remote from the exposure light, i. e. the exposed surface of the celluloid or acetyl cellulose supporting layer, has no influence during the photographical recording upon the quality of the sound record. During the reproduction only the particles of dirt which exist at the area of the track have an influence and these particles are responsible for only a small portion of the total hiss produced during the reproduction.

The term "recording surface" as used herein and in the claims is to be understood to mean the surface at which the sound track is located, and the term "supporting surface" is to be understood to mean the surface which bears upon the surface of a supporting member at the point of recording.

Although in photographic recording it is mainly desirable to remove the light-absorbing or light-diffusing dirt from the recording surface of the carrier, we have found that in mechanical recording of the above-mentioned type it is mainly desirable to remove both light-transmitting and opaque dirt from the supporting surface of the carrier prior to the formation of the sound track. More particularly, if only one surface of a carrier is cleaned and the carrier is wound on a reel, the cleaned surface would engage the other surface, and as the dirt would be attracted to the cleaned surface due to an electrostatic charge on the carrier. Thus, it would be necessary that cleaning be effected during the recording process i. e. after the carrier is unwound from the reel and immediately before recording.

We have found that the presence of dirt on the supporting surface of the carrier results in greatly interfering additional noise during reproduction of a mechanically-recorded track of the above-mentioned type, because a particle of dirt between the carrier and the supporting member causes a locally-raised position of the carrier. Thus, during the recording the cutting edge of the cutting tool penetrates locally to a greater depth into the carrier and consequently a supplementary width variation occurs opposite the particle of dirt.

Our invention is of particular importance in connection with methods of recording in which the width variations of the track are an enlargement of the depth variation, for instance recording of the type described in the U. S. Patent #1,919,116 to James A. Miller. In such methods of recording the amplitude of the width deformation caused by the presence of a particle of dirt between the supporting surface of the carrier and the surface of the supporting member would be several times the thickness of the particle.

If, in accordance with the above mentioned patent, the track is cut by means of a cutting tool having a V-shaped cutting edge of a large apical angle, for instance 1740, a particle of dirt having a size of about 20 microns may cause a local track widening of about 800 microns or 0.8 mm, which in the case of a neutral track width of 0.3 mm causes a decided local widening of the track which is audible during reproduction as an intense dull detonation. Because of width variations which are greatly enlarged with respect to the depth variations, the interfering influence of the presence of dirt in mechanical recording is much greater than in photographic recording. In fact in photographic recording particles of dirt between the carrier and its support are of practically no importance, i. e. the locally-raised position of the carrier causes substantially no variations in the shape of the light line in the emulsion. If particles of dirt are present in the path of the recording light, the interfering influence, insofar as they may intercept the light, depends only on their direct size.

We prefer to clean not only the supporting surface of the carrier but also to clean the re-

cording surface prior to the recording because once the track has been cut it is exceedingly difficult to remove any dirt that gets into the depressions of the track.

During mechanical recording of the track particles of the carrier disengage from the chips cut therefrom and these particles may deposit on both surfaces of the carrier and be pressed into the material of the carrier during the winding operation effected subsequent to recording. Because of this we prefer also to clean the carrier on both sides after the recording and in some cases even again before the winding operation.

We prefer to effect the cleaning by means of a cleaning device comprising a group of directed hairs, for example a strip of velvet or a brush. In this case the dirt slides between some of the said hairs and is retained, so that the cleaning device no longer readily disengages the dirt on to the film surface and is in addition capable of absorbing considerable dirt before being saturated.

If the carrier has been cleaned in the manner described above, any dirt that exists on the carrier and in some cases in the recording device is prevented from depositing on the carrier mechanical recording and re-winding. If the sound track is optically reproduced after the mechanical recording, it is advisable to subject the carrier to another cleaning operation prior to the optical reproduction in order to remove any dirt which may be deposited on the carrier during its passage along the guide rollers and guide surfaces.

In order that the invention may be clearly understood and readily carried into effect we shall describe the same in more detail with reference to the accompanying drawing, in which

Fig. 1 is a perspective view of a carrier and shows a cutting tool,

Fig. 2 is a diagrammatic view of a recording system comprising a plurality of cleaning devices,

Fig. 3 is a partly-sectionized side view of a cleaning device, and

Fig. 4 is a side view of a cleaning device according to another embodiment of the invention.

The carrier shown in Fig. 1 comprises a thin covering layer **10** of opaque material provided on a supporting layer **11** of a transparent material of good cutting properties. The carrier is moved at a constant speed in the direction of the arrow **2** over a supporting member **14**, which may be a stationary block as shown, or a rotating roller, while a cutting tool **12** is vibrated in the direction of the double-headed arrow **3** in accordance with the sound being recorded. The cutting tool **12**, which has a V-shaped cutting edge having a large apical angle, for instance an angle of about 174°, removes portions of the opaque layer **10** and of the cutting layer **11** to form in the carrier a sound track **4** having depth variations and width variations which are an enlargement of the depth variations.

If there is a particle of dirt **13** on the supporting surface of the carrier, i. e. the surface which bears upon the surface of the supporting member **14**, the carrier will be slightly raised locally from the surface of member **14**. As a result the thin covering layer **10** will be raised slightly at this point and the sound track at the location of the particle **13** will have a width greater than that which corresponds to the amplitude of the cutting tool. With a V-shaped cutting edge of the above mentioned angle, the width variations of the track are about 40 times the depth variations so that the deformation in the boundary of the track due to the particle **13** will be about 40 times the thickness of this particle.

It should be noted that the above difficulties occur not only when the track is surrounded by opaque portions, as shown, but also when the track is cut into a transparent layer and is then blackened. In the latter case the deformation causes a sharp projection of the blackened track.

The recording device diagrammatically shown in Figure 2 is used for recording a variable-depth and variable-width sound track in a carrier or tape **27**, which may be of the type shown in Fig. 1. The carrier **27** is unwound from an unwinding reel **15** and moves in the direction indicated by the arrows. More particularly, the carrier **27** passes over a guide roller **16**, through a cleaning device **17**, over a guide roller **18**, over a recording roller **20**, through a cleaning device **22**, through an optical scanning system **23**, over a roller **50** and onto a winding reel **24**. A roller **19** presses the carrier against roller **20**.

The recording is effected at roller **20** by means of a recorder **21** which may have cutting tool of the type shown in Fig. 1. As suitable recording devices, scanning devices and driving devices are well known in the art, further description or illustration of the same is believed to be unnecessary.

When carriers of non-conductive substance, such as carriers comprising a gelatin cutting layer carrier by a celluloid supporting layer, are unwound from an unwinding reel in a dry atmosphere, they receive an electrostatic charge which attracts many particles of dirt. Furthermore, dirt is deposited on the carrier at points at which it is carried for the purpose of guiding and at which the edges pass along flanges or plates, i. e. along the rollers **16** and **18**. To remove this dirt the cleaning device **17** is arranged in front on the point of recording i. e. so as to clean the carrier before the track is cut. As the electric discharges also exist on the carrier after cleaning and besides for other reasons dirt is deposited on the carrier, for example at the guiding points, this cleaning operation should be effected as short a time as possible before the recording of the track. The cleaning device **17** therefore is arranged as close as is constructionally possible in front of the recording device **21**. Because of the lack of space it is not possible to locate cleaning device **17** between the last guide roller **18** and the recording roller **20**, and this is why it is arranged after the next to the last roller **16**.

The cleaning device **17** cleans not only the supporting surface but also the recording surface of the carrier because the particles of dirt existing on the latter surface might enter the depressions of the cut track and influence the light during reproduction. Furthermore, it should be noted that due to the varying depth of the track it would be very difficult to remove such particles.

During cutting, the material removed is in the form of a continuous chip or shaving which is generally removed from the point of recording by suction. However, in practice small particles are disengaged from this shaving and might deposit on the carrier even after cutting. There is the danger that such particles, if they get between the carrier and the surface of the supporting member, or during winding between the turn of the coil, may be pressed into the material of the carrier. Because of this we prefer to repeat

the cleaning as soon as possible after the recording.

In the recording device of Fig. 2 the second cleaning member 22 is located after the recording roller 20 and the roller 19, and cleans both surfaces of the carrier. Thus, we ensure that before the optico-electrical reproduction for checking the recorded sound track is effected by means of the device 23, the carrier is made as free from dirt as possible on both surfaces. The cleaning member 22 is therefore arranged in front of the point of optical scanning 23. When the carrier is then wound on the winding reel 24 there is as little dirt as possible between the turns. If desired, cleaning may be affected again immediately before winding, i. e. by a cleaning device (not shown) located between reel 24 and roller 50.

We may further clean the carrier when it is rewound on the unwinding reel 15, which is generally of an interchangeable form. This cleaning operation is effected by a cleaning device 25 on the rewinding path (indicated by a dotted line) the carrier during which the carrier engages a guide roller 26. This cleaning operation may be effected on both sides of the carrier or on the supporting surface.

The cleaning devices 17, 22 and 25 of Fig. 2 may be of the construction illustrated in Fig. 3. The device shown in Fig. 3 comprises a housing 51 provided at its ends with two openings 52 and 53 for the passage of the carrier 27, which moves in the direction of the arrow 36. Within housing 51 and bearing upon the upper surface of the carrier 27 is a piece of velvet 34 while a second piece of velvet 35 engages the lower surface of the carrier and is pressed thereto by a pressing block 33 and two compression springs 32. The short, grouped hairs of the velvet 34 and 35, which extend substantially perpendicular to the surface of the carrier brush away the particles of dirt loosely-seated on the surfaces of the carrier. The width of the said strips is greater than the width of the carrier itself so that also the lateral sides of the latter are cleaned by the hairs.

If this brushing action is not sufficient to remove the dirt, for example because the adhesion of the dirt to the carrier is greater than the force that the hairs can exert on these particles of dirt, the adhesion of the cleaning member may be increased artificially by the addition of substances of greater adhesion, such as liquids and in some cases tacky or greasy liquids or greasy substances in general. As examples of such substances we may mention sulfonated recinusoil or olive oil. For this purpose, a feed tube 38 extends through an aperture 37 provided in the top of housing 51 near the point at which the carrier 27 enters the cleaning device. The aperture 37 extends at least throughout the width of the carrier and a small supply of the desired liquid or fat is passed through the tube 38 to the velvet and the surface to be cleaned. The substance applied is removed together with the dirt by the portions of the velvet strips remote from the aperture 37.

If cleaning is effected by means of a volatile liquid such as carbon tetrachloride with some alkohol and water, the recording surface of the carrier may also be treated in the above manner. The portion of liquid which is not removed in the further part of the cleaning members volatilizes from the track. Non-volatile liquids and fats can be used for cleaning only the supporting surface of the carrier but they have to be removed together with the dirt by means of a strip of velvet.

The cleaning member shown in Fig. 4, which preferably serves for dry cleaning, comprises four brushes 41 supported in carriers 40. The bristles of brushes 41 are not at a right angle to the surface of the carrier 27, as in the case of the hairs of the velvet in Fig. 3, but from an acute angle therewith. Furthermore, the bristles are in "anti-direction" with the direction of movement 36 of the carrier 27 i. e. they form an obtuse angle with the surface of the incoming carrier. The length of the bristles is of the order of magnitude of 10 mms. i. e. many times greater than that of the velvet, and therefore each bristle per se must be stiff in order that it may form an angle with the surface of the carrier in spite of the pressure of the bristles on the carrier, i. e in order that it may not become located in the plane of the carrier. The necessary pressure of the bristles on the surface of the carrier is procured by the resilience of the bristles themselves. With such a cleaning device the length of the bristles is greater than with the velvet, and therefore more dirt can be absorbed before the brushes are saturated and must be replaced. When replacement is necessary the bristles 41 can be withdrawn from the carriers.

Although we have described our invention in connection with specific examples and applications we do not wish to be limited thereto because obvious modifications will appear to one skilled in the art.

ARNAUD CRAMWINCKEL.
CORNELIS JOHANNES DIPPEL.