March 3, 1936. C. J. DIPPEL 2,032,741

MECHANICAL RECORDING

Filed Dec. 17, 1934

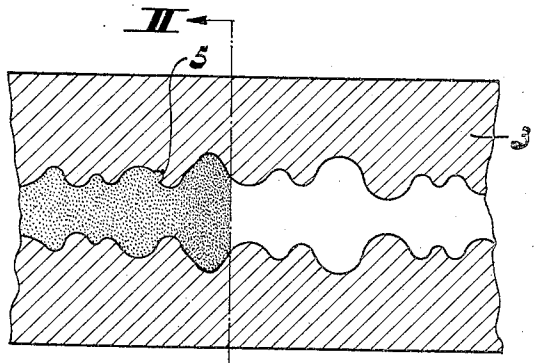


Fig. 1.

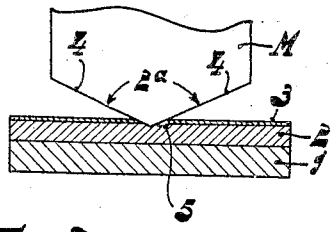


Fig. 2.

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MECHANICAL RECORDING

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6 Claims. (Cl. 274—43)

The present invention relates to carriers for use in the mechanical recording of vibrations and more particularly to carriers provided with gelatin layers.

I have found that when vibrations are mechanically recorded on a layer formed of gelatin, the properties of the vibration track are greatly dependent upon certain conditions of such a layer.

In my copending application Ser. No. 748,144, filed October 12, 1934, I have described a process whereby, by a suitable drying operation to give the gelatin layer a correct degree of dryness, a great improvement in its cutting properties can be obtained.

The measures which I describe in this application, form one condition, which has to be fulfilled in order to obtain gelatin with good cutting properties.

Further investigations, which I have made regarding the cutting properties of gelatin layers, have brought out the fact that the cutting properties of such layers, as well as the properties of the vibration tracks cut in same, depend in addition to the condition described in my former application, to a great extent upon the hydrogen ion concentration, i. e. pH value, of the colloidal solution from which the layer has been formed.

I have furthermore found that when the colloidal solution used has a pH value corresponding to that of the iso-electric point of the solution—i. e. to that point at which the solid colloidal particles possess no electric charge—the layer is difficult to cut and the surface of the track cut into such a layer has a frosted appearance. Furthermore, the surface of the track appears rough as compared with a clean-cut track, and the border lines are less clearly defined.

The difficulty in cutting manifests itself by the fact that when cutting such a frosted track the tool used for this purpose encounters a considerably higher cutting resistance than when cutting a clean-cut track. This increased cutting resistance requires greater power and also may cause considerable heating of the tool, with a resulting deterioration of its cutting edge. Even if a sapphire cutter is used for this purpose the heating has deleterious effects, for instance it may melt the cement by which the sapphire is secured to its holder, with the result that the sapphire becomes loosened.

Also, under such conditions the edge of the cutter is subjected to an abnormally high degree of wear, which in its turn deleteriously affects the quality of the recorded track.

If such a frosted vibration track is to be optically reproduced—and by optical reproduction is meant a photo-electric reproduction of the track, as well as a photographic copying of same—the frosted condition of the track surface, the decreased definition of the border lines of the track, the difficulties brought about by the increased cutting resistance, and possibly the loosening of the cutter, etc. will markedly affect the quality of the optical reproduction.

The above difficulties encountered with a track having such a frosted appearance when cut into a layer of gelatin formed of a colloidal solution having a pH value corresponding to the iso-electric point seem to be due to the tendency of the colloidal particles to separate out of the solution as a flocculent precipitate, when the pH value of the solution is at or about the iso-electric point and thus when these particles are substantially devoid of electrical charge.

This can be explained as follows: When the colloidal particles are charged, the charges are of a like polarity and cause them to repel each other, and to assume a definite distance from each other. However, at the iso-electric point, the colloidal particles, having no electric charge, no longer repel each other, but will be attracted in accordance with the general law of gravitation, and by such attraction will form smaller or larger conglomerates of particles; i. e., floccules which precipitate from the solvent. This precipitation of floccules in the case of gelatin having a pH value corresponding closely to its iso-electric point, can take place both during the gelatinization of the solution, as well as during the first stage of the drying, so that the finally formed layer exhibits, throughout its entire depth, a more or less granular structure.

While such a granular structure does not imply that the formed gelatin layer is non-coherent, nevertheless, its coherence is not uniform; i. e. the coherence between the parts of a given conglomerate, is much greater than the adherence between individual conglomerates. Because of this, when cutting, instead of removing the desired exact amounts of material, conglomerates may be removed which are greater or smaller than the amount of material desired to be removed.

In such gelatin solutions the iso-electric point corresponds, on the average, to a pH value of about 4.7.—The usual gelatin solutions of this type have pH values falling between 5 and 6, although some commercial gelatins have a pH value which falls slightly below the iso-electric point.

I have found that, irrespective of whether the pH value of the gelatin solution used falls below or above that of the iso-electric point, as long as this value does not materially differ from the latter value, the above drawbacks, which are the most pronounced at the iso-electric point, still persist to a marked degree.

The present invention is, therefore, based on the recognition that, to obtain satisfactory cutting properties of gelatin, it is necessary to use a colloidal solution whose pH value considerably differs from the pH value corresponding to the iso-electric point of the solution. Thereby to get good results the solution has to be either alkaline, i. e., having a pH value of 7 or more, or has to be strongly acidic, to an extent of having a pH value less than 4.

For pratical considerations, alkaline solution should preferably have a pH value between 7 and 10, and acidic solutions between 1 and 4. As a rule, for reasons later to be stated, properly acidified solutions give slightly better results than alkaline solutions.

In order that the invention may be clearly understood and readily carried into effect, it will be further described with reference to the accompanying drawing, in which:

Figure 1 is an enlarged top view of a film portion carrying a mechanically-recorded vibration track.

Figure 2 is a cross section through the film of Fig. 1, taken at II—II, and also shows the cutting tool while cutting the track.

The carrier shown in the drawing may consist of three superimposed layers. The base or supporting layer 1 is made of a suitable transparent material, for instance, of celluloid, while the second or cutting layer 2 is of gelatin. Layer 2 is the cutting layer into which the vibration track is cut and with which my invention is concerned. The top layer 3 is a comparatively thin opaque layer applied to layer 2 and may be of paint or dye, and offers a practically negligible cutting resistance. The tool used for the recording is shown as a chisel having two cutting edges 4—4 forming with each other an angle 2α. In practice the angle 2α has a value of about 174°, however for clarity a smaller angle is shown in the drawing. By moving the chisel perpendicularly to the surface of the carrier, in accordance with amplification of the vibration to be recorded, a vibration track is cut into the carrier, the width of which varies with the amplitudes of the vibration to be recorded, and are an amplification of the vertical movement of the chisel.

When cutting the vibration track the chisel removes portions of both layer 2 and layer 3, the layer 3 serving merely to provide a difference in the translucency of the track and of the background, so as to permit "optical reproduction".

The left side of Fig. 1 represents the appearance, as viewed under a microscope, of the track when the cutting layer 2 is made of a gelatin in which the pH value of the colloidal solution is at, or near, that corresponding to its iso-electric point. In this case the surface of the track has a rough and frosty appearance. Furthermore, particles 5 may be removed at the boundary line of the track, which causes the boundary line to be less definite.

The above difficulties can be eliminated by providing a cutting layer in accordance with the present invention, in which case a vibration track as shown at the right side of Figure 1 will be obtained, which track has a smooth surface and clearly defined boundary lines.

A layer according to the invention can be prepared, for example, as follows: 60 grams of purified iso-electric gelatin is soaked in 800 cc. of water, and the so-dissolved gelatin is heated to 45° C., and 10 cc. of a neutral sulphonated castor oil, for example, the preparation known commercially as "Turkonöl A", is added while the solution is agitated. The solution is then preferably filtered, after which it is given the proper pH value by the addition of an acidic or alkaline agent, for instance, by the addition of 35 cc. of 1 n Hcl. Such a solution will have a pH value between 2 and 2.5.—The solution is then poured out in the form of a thin layer on a suitable carrier, for example on a celluloid film. The above amount of solution suffices for the coverage of 1 sq. meter of celluloid, whereby a cutting layer of a thickness of 50 microns is obtained.

Instead of using hydrochloric acid other acids, for instance, acetic acid can be used; or if an alkali is at hand, such alkalies as, for instance a solution of caustic soda, caustic potash or spirit of sal-ammoniac can be added.

Although I mention above some acids and bases, which have proven useful for this purpose, I do not wish to be limited thereto.

While good results can be obtained by either rendering the colloidal solution alkaline or acidic, provided it is rendered sufficiently alkaline or acidic to considerably change its pH value from that corresponding to the iso-electric point, as a rule slightly better results are obtained with acids, which may be due to the fact that the large molecules of the iso-electric gelatin are hydrolized into smaller molecules without actually changing the general composition of the gelatin. This action is generally known and takes place, for instance, when a large molecule of cane sugar is hydrolized by an acid into smaller molecules e. g. glycose and fructose. This reduction in the size of the molecules may also contribute to the improvements of the cutting properties of the gelatin. However, the improvement in the cutting properties obtained, are obtained primarily because of operating away from the iso-electric point of the solution—thus preventing the formation of conglomerates of uncharged particles—which is evidenced by the fact that alkaline solutions in which no such reduction of the size of the molecules takes place, also give satisfactory results.

The addition of materials such as Turkey red oil is not for the purpose of influencing the pH value of the solution, but such addition improves the cutting property of the layer by other action. The addition of such materials as Turkey red oil has been specifically described in my copending application Ser. No. 746,010, filed September 28, 1934, now Patent No. 2,019,215.

While I have described my invention by means of specific examples, and in connection with specific applications, I do not wish to be limited thereto, but desire the appended claims to be construed as broadly as permissible in view of the prior art.

What I claim is:

1. A carrier for the mechanical recording of an optically-reproducible vibration track comprising a gelatin cutting layer whose pH value is considerably different from the pH value corresponding to the iso-electric point of the gelatin.

2. A carrier for the mechanical recording of

an optically-reproducible vibration track comprising a gelatin cutting layer whose pH value falls outside of the range formed substantially by the values 4 to 7.

3. A carrier for the mechanical recording of an optically-reproducible vibration track comprising a gelatin cutting layer whose pH value is 1 to 4.

4. A carrier for the mechanical recording of an optically-reproducible vibration track comprising a gelatin cutting layer whose pH value is 7 to 10.

5. A carrier for the mechanical recording of an optically-reproducible vibration track comprising a gelatin cutting layer whose pH value is 2 to 2.5.

6. As a material for a cutting layer for the mechanical recording of an optically-reproducible vibration track, a gelatin solution comprising an agent to radically change the pH value of the gelatin from that corresponding to its iso-electric point.

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