

May 16, 1933.

P. A. ROBBINS

1,909,504

PRODUCTION OF SOUND RECORDS

Filed Oct. 19, 1931

2 Sheets-Sheet 1

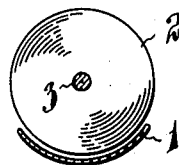
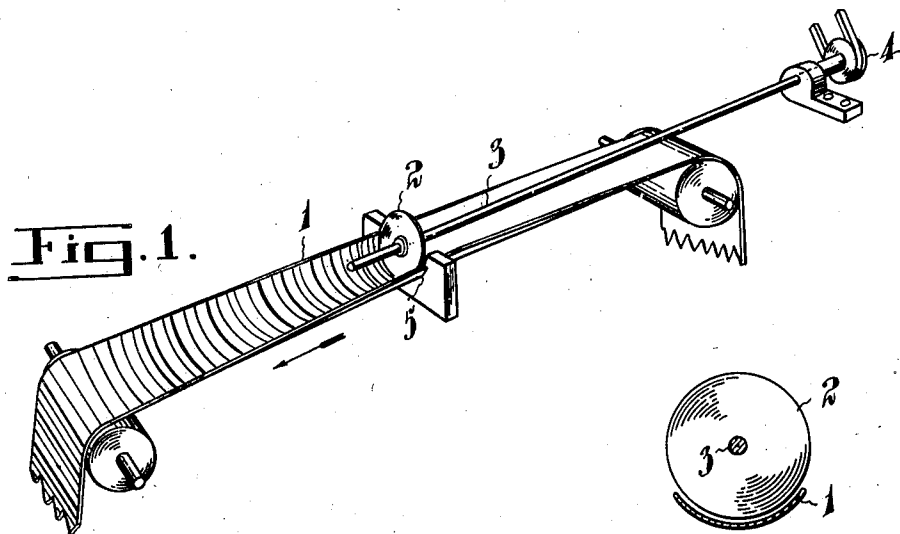


Fig. 2.

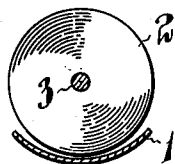


Fig. 3.

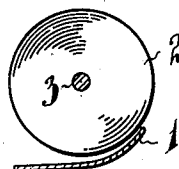


Fig. 5.



Fig. 6.

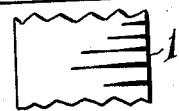
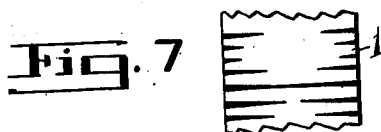


Fig. 8.



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2 Sheets-Sheet 2

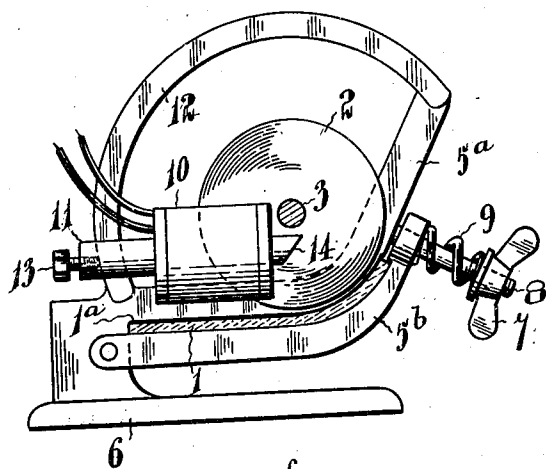


Fig. 9.

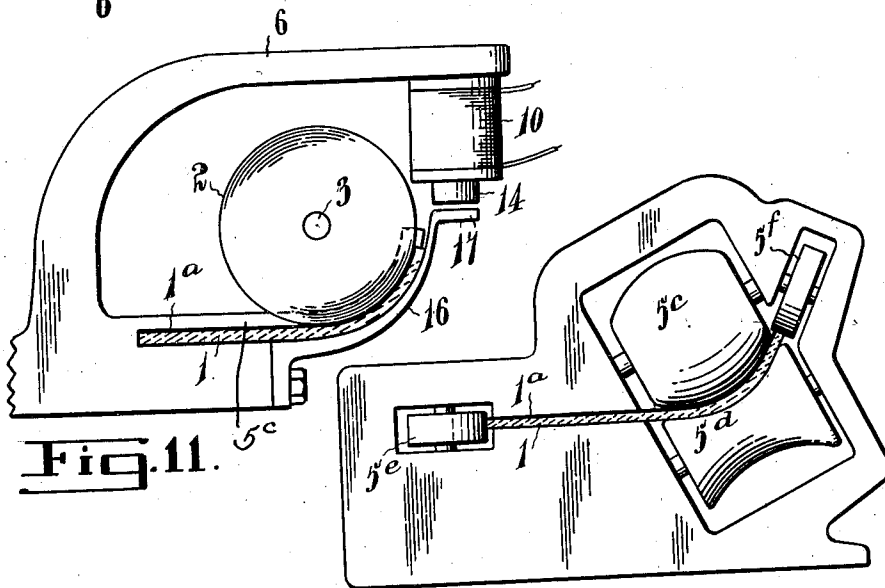


Fig. 11.

Fig. 10.

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UNITED STATES PATENT OFFICE

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PRODUCTION OF SOUND RECORDS

Application filed October 19, 1931. Serial No. 569,701.

This invention relates to a process of, and apparatus for, the production of sound records on films such as are employed in the moving picture industry. The ordinary method employed is substantially entirely photographic and is difficult, lengthy and expensive.

With the idea of cheapening the production inventors have proposed to carve records on films by means of rotating cutters which produce an engraved record of the hill-and-dale type requiring a stylus for reproduction, which is not satisfactory for combined picture and talking films.

In a previous application No. 445,782 dated April 19, 1930 I have disclosed a film provided with an opaque surface layer in which openings were cut by a vibratile rotating cutter, the record therefore being reproducible with the aid of light transmitted through or reflected from the film.

These previous engraving processes, however, have a common fault, since the contact between a circle and a plane is a point, a revolving cutter will only carve a narrow line of material from the surface of the film.

It follows then that only by engraving deeply can the width of this line be greatly increased and, owing to the thinness of standard films, deep carving is impracticable, as it destroys the strength of the film. Furthermore, with a film such as described in my previous application, it is necessary to remove patches of the opaque skin of varying area, and also undesirable to cut deep enough to weaken the film.

My object in the present invention, therefore, is to produce a film in which the engraved record is increased in its transverse dimensions without material increase in the depth of the engraving, whereby the record is much better adapted for reproduction, with the aid of transmitted light, than is a record produced as in my prior application herein before referred to.

I attain my object by imparting vibratory movements to a rotating cutter in a direction substantially normal to its axis, moving a flexible strip past the cutter in a direction longitudinal of its axis, and by bending the

strip transversely to a trough-like form to ensure arcs of contact between the cutter and strip which are long relative to the depth of the engraving.

The invention is hereinafter more specifically described and is illustrated in the accompanying drawings in which

Fig. 1 is a fragmentary perspective view illustrating the principle of the invention;

Fig. 2 a cross sectional detail of the cutter and film of Fig. 1;

Figs. 3, 4 and 5 cross sectional details showing various arrangements of the cutter and films;

Figs. 6, 7 and 8 plan views showing in an exaggerated manner the type of engraving produced respectively by the forms of the invention illustrated in Figs. 3, 4 and 5;

Fig. 9 a cross section of one form of the apparatus for vibrating the cutter and bending the film;

Fig. 10 a similar view of a modification of the bending apparatus; and

Fig. 11 a similar view showing a modification in which the film is vibrated instead of the cutter.

In the drawings like numerals of reference indicate corresponding parts in the different figures.

Referring particularly to Fig. 1, 1 is a film of flexible material, preferably such as moving picture films are based on. This film is assumed to be mounted to move from right to left in the direction indicated by the arrow, and in its course to pass the rotary cutter 2. This cutter is secured to the resilient shaft 3 suitably mounted and provided with the driving pulley 4. The film adjacent the cutter is bent to trough-like form by passing it through a guide illustrated diagrammatically at 5. If the cutter by sound waves is caused to move up and down by means such as illustrated in Fig. 9 and hereinafter described and if the curvature of the film is approximately the same as that of the cutting edge of the cutter and, further assuming that the film is within the range of vibration of the cutter, then a series of marks will be engraved on the film of the nature illustrated in this figure of the drawings. For the sake

of clearness the markings are shown in black on white, whereas if the surface layer is dark the markings would be lighter in shade.

In Fig. 2 I illustrate the film bent to substantially the same curvature as the cutter. The trough formed by the film being less than a semicircle and the direction of vibration being in the median plane of the trough then the marking will be substantially as shown in Fig. 1.

In Fig. 3 I show the film troughed to a radius slightly greater than the radius of the cutter. In this case the record will be of the form shown on the film illustrated in Fig. 6.

In Fig. 4 I show the film troughed to a radius slightly less than the radius of the cutter and the form of record thus produced is illustrated in Fig 7 of the drawings.

In Fig. 5 I show the film troughed at one edge only to a radius slightly less than the radius of the cutter, and in this case the record will be of the form shown in Fig. 8. In all these cases the records will vary in shape in accordance with sound waves, assuming that the cutter is vibrated in accordance with sound waves which, through suitable mechanism, have been caused to effect a vibratory movement of the shaft 3 carrying the cutter.

In Fig. 9 of the drawings I show apparatus arranged to suitably bend the film and to vibrate the cutter. In this case 6 is a suitable base over which is supported the cutter 2 on its shaft 3. This shaft will be supported, for example, as shown in Fig. 1 of the drawings. This base 6 carries the guide for the film, which comprises a stationary part 5^a and a hinged part 5^b. The hinged part 5^b may be adjusted relative to the fixed part by means of the wing nut 7, which is threaded on the threaded stem 8 connected with the fixed part of the guide 5^a and extending through an opening in the movable part 5^b. A coil spring 9 is positioned between the part 5^b and the wing nut. It is evident that by adjusting the wing nut 7 that any required resilient pressure may be exerted against the movable part of the guide to suitably hold the film in contact with the fixed part of the guide while making provision for yielding in case of unevenness in the thickness of the film. It will be necessary, of course, to have all parts of the guide contacted by the film highly polished and to carefully round all edges with which the film is liable to contact.

To vibrate the cutter I provide the electro-magnet 10, which is secured to a slide 11 movable on the arc-shaped guide 12 and adjustable as moved by means of the set screw 13. The pole 14 of the magnet is positioned close to the shaft 3, which will be made of paramagnetic material and serves as an armature for the magnet. When an undulatory current corresponding to sound waves is passed through the coils of the electro-magnet the shaft is vibrated in correspondence with such

sound waves and causes the cutter to vibrate to and from the film. As the latter is within the range of vibration of the cutter the film is marked as hereinbefore described. By adjusting the position of the magnet 10 on the guide 12 the vibration of the shaft 3 may be caused to occur in any direction in a plane substantially normal to the movements of the film and the type of record engraved by the cutter may thus be regulated with great precision. It will probably be found that the arrangement which causes the record to be engraved at one edge of the film (see Figs. 8 and 9 of the drawings) would be the most desirable in practice as in forming such records the motion of the cutter may be easily directed so as to avoid cutting too deeply into the film. In any case the maximum range of vibration of the cutter is easily determined by suitably proportioning the cutter shaft.

For reproduction by transmitted light, I prefer to form the film with a surface layer 1^a of a material which is either opaque or more or less impervious to light rays.

The engraving of the sound record trace may be so regulated that the markings forming the trace remove substantially only the surface layer and do not cut into and weaken the body of the film.

Owing, however, to the process of producing the record which I employ, the average length of the markings transversely of the film is very considerably greater than the depth.

While I have thus far described an apparatus in which the rotating cutter is vibrated toward and away from the film, it is obvious that the relative movement between cutter and film may be attained by vibrating the film toward and away from the cutter, and in Figure 11 I show an arrangement for accomplishing this latter movement.

As in the other drawings, 1 is the film, and 2 is the rotating disc cutter mounted upon the shaft 3. The film is shown is guided and bent to trough-like form beneath the guide 5^c which overlies the base 6.

A spring piece 16 of paramagnetic metal is attached to the base 6 as shown, the spring being curved to conform to the guide 5^c and to engage the outer side of the bent film. On the end of the spring a projection 17 serves as an armature to the electro-magnet 10, and as the flow of current through the magnet-coil varies, the armature 17 moves up and down in conformity with the current variations.

These movements of the armature cause the spring to bend slightly about its fixed base and each such movement forces the film against the cutter causing a record of the movement to be cut into the surface of the film.

In Fig. 10 of the drawings I illustrate an alternative method of guiding the film past

the cutter. Instead of the curved guide shown in Fig. 9 I employ a series of rollers 5°, 5^d, 5°, 5^t. The rollers 5°, 5^d effect the bending, while the rollers 5°, 5^t position the film transversely.

5 The cutting element may be of any desired form, for example, a fine grained corundum wheel. I contemplate operating the cutter at a speed above the acoustical limit of audition, so that any irregularity in the cutting
10 points will show in the record at such short time intervals that they will be beyond the range of audition.

It will be found that sound records produced in the manner hereinbefore described
15 will lend themselves admirably to reproduction by the methods described in application 445,782 hereinbefore referred to.

What I claim as my invention is:

1. Apparatus for producing a sound
20 record comprising a rotatable cutter mounted to vibrate in a direction normal to its axis; means for guiding a movable flexible record strip past the cutter within the range of its vibrations; and means for bending the strip
25 as it passes the cutter to give the cutter an arc of contact with the strip.

2. Apparatus for producing a sound record comprising a rotatable cutter mounted to vibrate in a direction normal to its axis;
30 means for guiding a movable flexible record strip past the cutter within the range of its vibrations; and means for bending the strip as it passes the cutter to a curvature approximating the arc of a circle of the same radius
35 as the circumference of the cutter.

3. Apparatus for producing a sound record comprising a rotatable cutter mounted to vibrate in a direction normal to its axis; and means for guiding a movable flexible
40 record strip past the cutter within the range of its vibrations comprising two spaced guide members and means for adjusting the space between them, the guide members being curved transversely to give the cutter an arc
45 of contact with the strip.

4. Apparatus for producing a sound record comprising a rotatable cutter mounted to vibrate in a direction normal to its axis; means for guiding a movable flexible record
50 strip past the cutter within the range of its vibrations; and means for bending the strip transversely to a trough-like form to ensure long arcs of contact between the cutter and the strip.

55 5. Apparatus for producing a sound record comprising a rotatable cutter mounted to vibrate in a direction normal to its axis; means for guiding a movable flexible record strip past the cutter within the range of its
60 vibrations; means for bending the strip transversely to a trough-like form; and means for varying the direction of vibration of the cutter in a plane substantially normal to the direction of travel of the said flexible
65 record strip.

6. Apparatus for producing a sound record comprising a rotatable cutter mounted to vibrate in a direction normal to its axis; means for guiding a movable flexible record
70 strip past the cutter within the range of its vibrations; means for bending the strip transversely to a trough-like form; and means for adjusting the device to cause the direction of vibration of the cutter to vary
75 relative to the cross sectional contour of the trough.

7. A sound record comprising a translucent film formed with a thin surface layer more or less impervious to light rays and having a sound record trace engraved therein, the
80 said trace comprising transverse markings cut in said film and having an average length transversely of the film considerably greater than their depth, the depth being sufficient to more or less entirely remove the surface
85 layer.

8. Apparatus for forming a sound record upon the surface of a flexible strip by means of a rotating cutter comprising means for moving the strip lengthways past the cutter;
90 means for forming a trough of the moving strip; a continuously rotating cutter revolving within the trough in a plane substantially at right angles to the axis of the trough; and means for causing momentary engagements
95 between the cutter and the inner surface of the trough in conformity with the undulations of sound waves.

9. Apparatus for forming a sound record upon the surface of a flexible strip by means of a rotating cutter comprising means for moving the strip lengthways past the cutter;
100 means for forming a trough of the moving strip; a continuously rotating cutter revolving within the trough in a plane substantially at right angles to the axis of the trough; and means for causing a vibratory movement of the film to and from the periphery of the
105 cutter.

Signed at Highland Park, Ill., this 12th
day of October, 1931.

PERCY A. ROBBINS.

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