April 30, 1935. R. EVANS 1,999,754

RECORDING AND PROJECTING SOUND ON FILM APPARATUS

Filed April 22, 1932

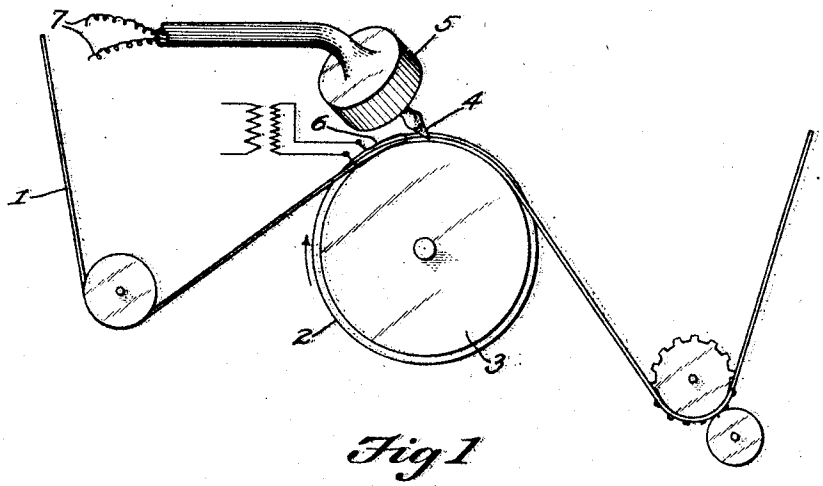

Fig 1

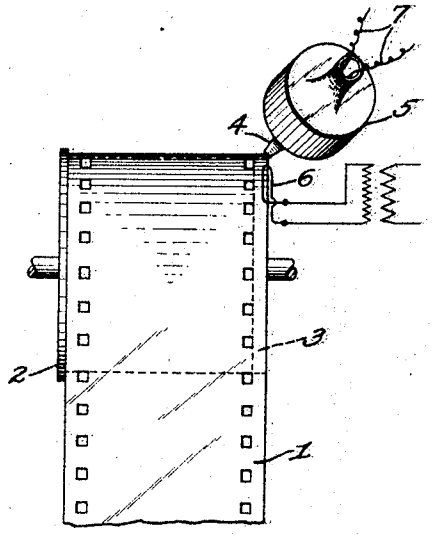

Fig. 2.

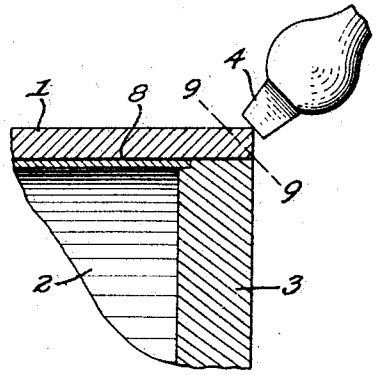

Fig. 3.

INVENTOR

Raymond Evans

Patented Apr. 30, 1935 1,999,754

UNITED STATES PATENT OFFICE

1,999,754

RECORDING AND PROJECTING SOUND ON FILM APPARATUS

Raymond Evans, Washington, D. C., assignor to Arthur M. Hyde, as Secretary of Agriculture of the United States of America

Application April 22, 1932, Serial No. 606,900

4 Claims. (Cl. 274—11)

(Granted under the act of March 3, 1883, as amended April 30, 1928; 370 O. G. 757)

The invention described herein may be manufactured and used by or for the Government for governmental purposes without the payment of any royalty thereon.

This invention relates to the art of mechanically recording sound on motion picture film, and has for its primary object the development of a system of sound recording and reproduction combining the advantage of automatic synchronism of sound and picture, inherent in the photographic sound-on-film system, with the simplicity and ruggedness of the separate disk-and-film system.

A further object of the invention is to make effective a simple and easily-operated sound-film system requiring simple and inexpensive mechanism for the reproduction of sound, applicable either to 35 or 16 millimeter film, and well-adapted for the economical presentation of talking pictures with portable equipment in the school, the home, or elsewhere, by non-professional operators.

A further object of the invention is to provide a sound-film system embodying a mechanical sound-track relatively free from danger of injury from ordinary sources of abrasion and from deposits of dust or oil, that are common sources of damage and of consequent distortion of sound in the use of sound-film with photographic sound-track.

A further object of the invention is provide a method of impressing on motion picture film a mechanical sound-track that does not partially sever a strip from the border of the film, yet at the same time is recessed when the film is normally rolled, so as to protect it from injury.

A further object of the invention is to make effective a sound-film system embodying the use of a simple pick-up such as is used in the separate disk and film system yet obviating entirely the danger of the needle or stylus "jumping the track", inherent in the disk system.

These objects are attained by impressing on motion picture film a mechanical sound record, similar to the original Edison "hill-and-dale" phonographic record, said record being cut at an angle on the edge of the positive film carrying the motion picture associated with the sound; and by reproducing said sound by the use of a simple pick-up unit and associated amplifier and speaker, similar in operation to the universally familiar phonograph pick-up.

Figure 1 is a diagrammatic outline of the essentials of the recording unit hereinafter described.

Figure 2 is a supplementary view of the recording drum as seen from a different angle from that of Figure 1.

Figure 3 is a very much enlarged cross-section of the film and stylus at the point of contact.

Similar numerals refer to similar parts throughout the several views.

The method I have chosen for carrying my invention into effect is as follows:

Film 1 (cellulose acetate or other slow-burning base) is driven at a uniform speed, emulsion side down, over freely revolving drum 2, which is flanged on one end and faced on the other end by a disk of fibre or other similar tough material 3 suitable to serve as an anvil to support film 1 under the impact of recording stylus 4. The length of drum 2 is such that the film runs with one edge flush with the face of fibre disk 3 when the other edge is running against the flange. Stylus 4 is a chisel-pointed tool of sapphire, agate or similar very hard material, driven by the armature of a floating recording assembly 5 responsive to a suitable system for amplifying the modulations of a sound current, bears against the exposed edge of film 1 with its edge at an angle of 45 degrees, more or less, to the exposed face of film 1, and with its mounting inclined with reference to the direction of movement of film 1 in accordance with standard phonographic construction. Thus stylus 4 rests against the exposed "corner" of the exposed edge of film 1. As film 1 is drawn over revolving drum 2 it passes under a red-hot wire 6, or other suitable heating element, designed to render the exposed edge of film 1 momentarily slightly plastic, and immediately thereafter passes under stylus 4 of recording assembly 5, vibrating up and down in accordance with the modulations of the sound current. Input voltage 7 and the pressure of stylus 4 on film 1 are balanced so as to obviate distortion through lack of contact due to jumping of recording unit 5. In other words, the stylus is "damped" by applying sufficient pressure to the cutting head to prevent the entire recording assembly 5 from bouncing clear of film 1, under the thrust of the stylus. Thus stylus 4 cuts on one "corner" of the exposed edge of film 1, a sine wave corresponding to the modulations of the sound current, full modulation lying between the vertex of the angle or "corner" against which stylus 4 rests and the line of maximum depth 9—9 to which stylus 4 can drive without penetrating the emulsion 8 on the opposite side of film 1 as illustrated by line 9—9 in Fig. 3 (rough-

ly plus or minus five mills, according to the angle at which stylus 4 is applied to film 1).

The record, or sine wave cut by stylus 4, is essentially a "hill-and-dale" phonographic record on the edge of film 1, and reproduction is effected by use of a suitable phonograph pick-up and associated, amplifier and speaker, the "needle" being a chisel-pointed sapphire or similar jewel and the film running over a properly mounted drum or roller, similar to that used in recording.

For this method the following advantages may be cited:

With zero modulation (silence) the "corner" of the edge of the film, properly smoothed by preparatory polishing (as, for example, by shaving and burnishing) offers the contact with the recording stylus most desirable from the standpoint of ground-noise reduction, since such contact minimizes friction, an important source of objectionable noise.

With minimum modulation (as in pianissimo passages in music) the "corner" of the film offers correspondingly small resistance to the impact of the stylus, thus facilitating faithful recording with low power, with consequent relative freedom from the distortion inherent in high amplification. When the modulated current is stronger and the stylus therefore tends to cut deeper into the film, the constantly-increasing cross section of the medium offers resistance that provides a damping effect desirable where a floating cutting head is used, as in this instance.

As compared with other possible positions for a mechanical sound track on film, the position here advocated has the following advantages:

The use of the edge of the film and a chisel-pointed stylus obviates entirely the danger of the stylus "jumping the track", inherent in both lateral-cut and hill-and-dale recording in a groove.

Edge-recording obviates the danger of cutting entirely through the film and thus shearing a strip from the border thereof, a danger inherent in any method involving the cutting of a groove sound-track on the border of the film between the edge and the sprocket holes, or elsewhere.

Edge-recording at an angle as specified permits the use of a positive anvil to support the film under the impact of the stylus, thus obviating the danger of distortion owing to buckling, difficult to avoid if the stylus drives with its edge parallel that of the film.

Edge-recording at an angle as specified permits full modulation in the smooth and dense cellulose base without allowing the stylus to penetrate to the tough and granular emulsion, which is not a suitable medium for use in recording.

Edge-recording at an angle as specified puts the sound track in a sheltered position, so that it is largely protected from accidental injury when the film is rolled normally, since the projecting emulsion, and more or less of the base it adheres to, serve as a guard, the track itself being recessed.

With reference to the complete system, covering both recording and reproduction, and involving, not only the features for which originality is claimed, but also several basic steps in mechanical recording and reproduction commonly known to the art, the following advantages are evident:

It combines automatic synchronism of sound and picture with the simplicity and certainty of response of the disk talking-picture system. Thus the reproducer is a relatively cheap and simple piece of mechanism; the pick-up is operated just as the universally familiar phonograph pick-up, has relatively greater output than has a photo-electric cell in ordinary talking picture practice, and hence can be used successfully with fewer stages of amplification.

This system combines automatic synchronism of sound and picture with relative freedom from injury to sound track from ordinary sources of abrasion and from deposits of dust or oil, common and serious sources of injury to the photographic sound track.

Because of the hardness of the medium in which the sound track is cut, the record may be played much more often without serious loss of quality in reproduction than either the standard disk or the photographic record.

To those skilled in the art it will be apparent that this system may be modified in detail and still accomplish the desired end, without departing from the spirit of my invention.

Having thus described my invention and the method of using it, I claim as new and useful and my own invention the following, for which I desire to secure Letters Patent:

1. A machine for making sound records on the corner of a film, means for feeding said film past a conventional recording mechanism activating a chisel-pointed stylus, substantially as described, said stylus disposed to the plane of the film surface in a plane at a transverse angle of incidence of substantially 45 degrees, said stylus thereby subjected to continuous contact with the corner of said film, in motion, a support for said film against the thrust of said stylus at the area of contact.

2. A method for mechanically recording sound on motion picture film, which comprises contacting of a motion picture film with a recording mechanism having a stylus connected thereto disposed to the plane of said film surface in a plane at a transverse angle of incidence of substantially 45 degrees and thus continuously contacting with said stylus said film on the corner and in such a position, and subjecting said film to the action of said stylus so positioned on the corner of said film.

3. A method for mechanically recording sound on motion picture film, which comprises subjecting a corner of a motion picture film to the action of a recording mechanism disposed to the plane of said film surface in a plane at a transverse angle of incidence of substantially 45 degrees.

4. A method of mechanically recording sound on motion picture film, in which a recording mechanism is used to drive a chisel-pointed stylus, held continuously in contact with one corner of said film, with said stylus centered on said corner in a plane inclined at an angle of substantially 45 degrees to the plane of the adjacent surface of said film, and pressing thus on said corner while said film is driven over an anvil member designed to support said film solidly under the thrust of the said stylus.

RAYMOND EVANS.