

Oct. 19, 1937.

J. R. KIEL

2,096,113

SOUND RECORDING AND REPRODUCING

Filed Sept. 19, 1935

3 Sheets-Sheet 1

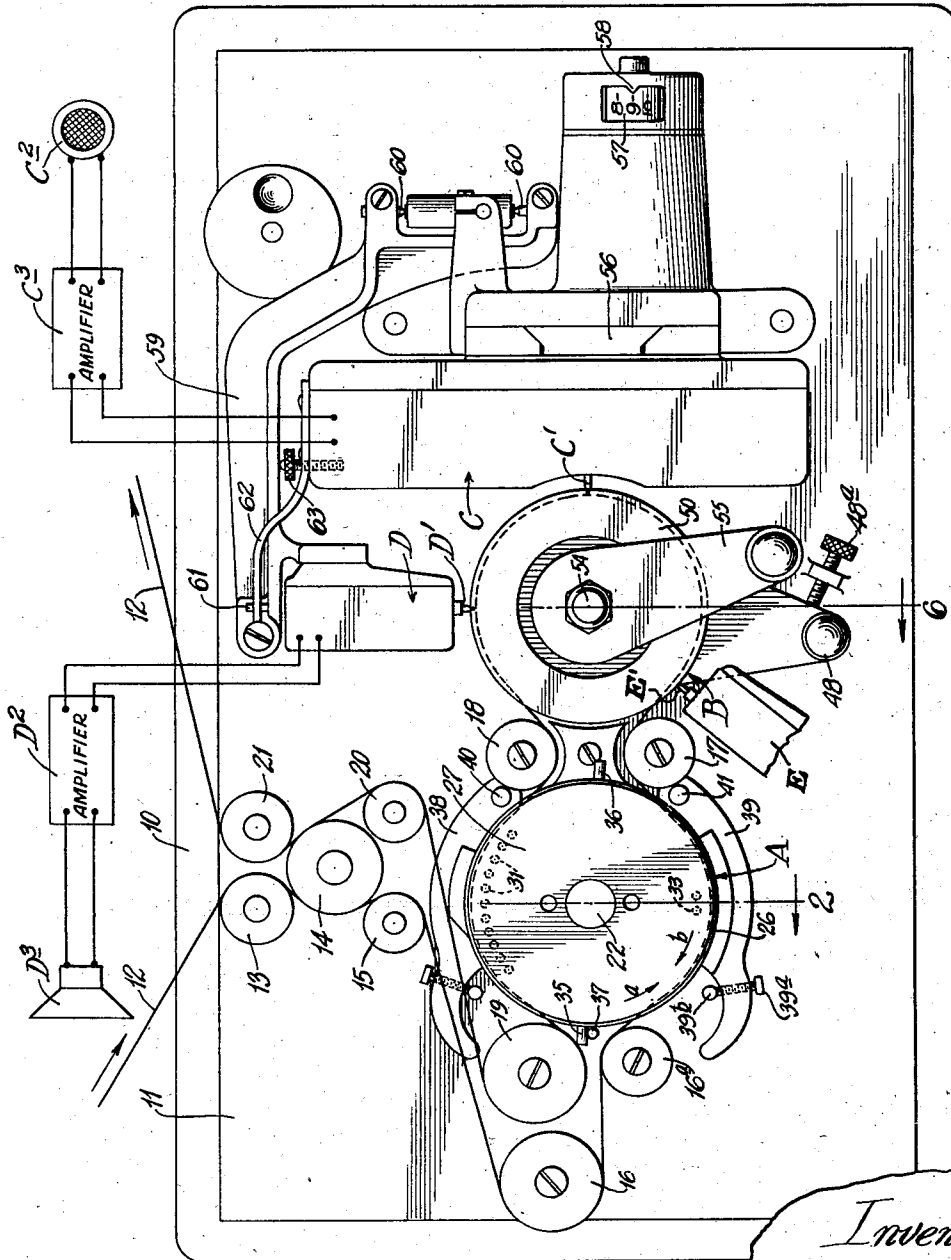


Fig. 1

Inventor:
John Ripley Kiel,
By *Cunning & Cunningham*
Attys.

Oct. 19, 1937.

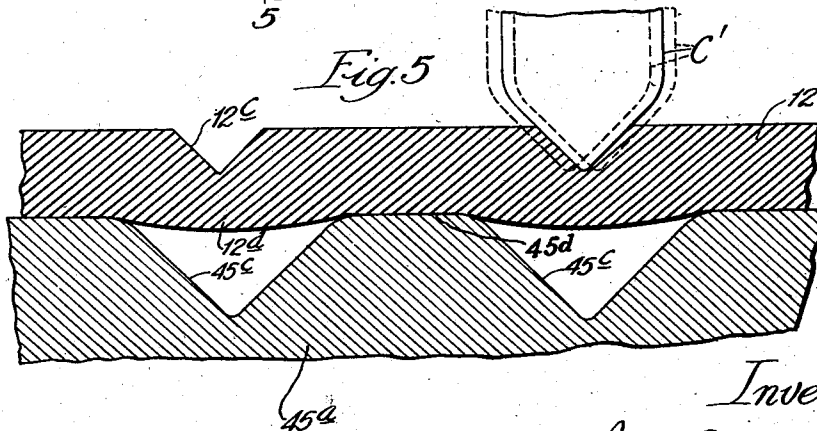
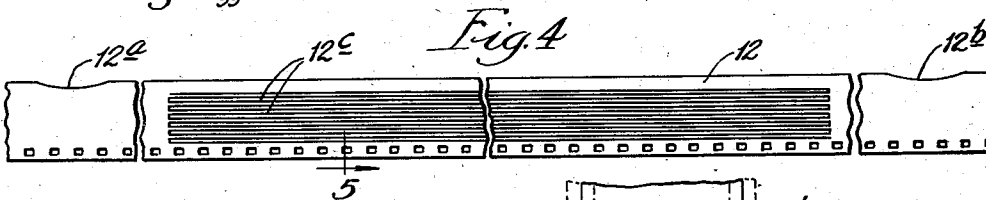
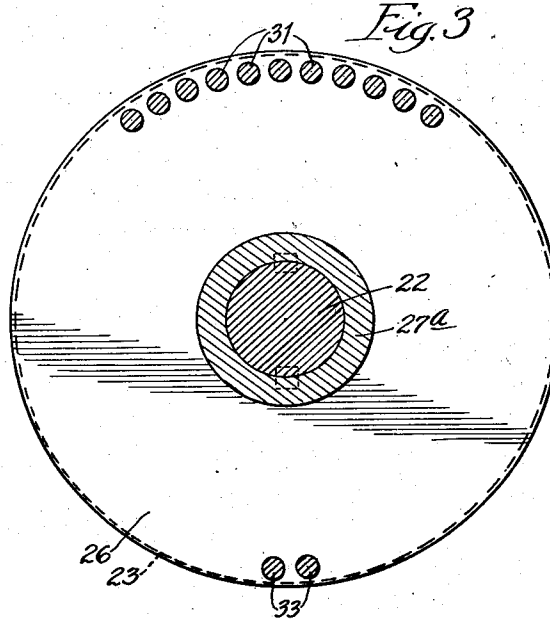
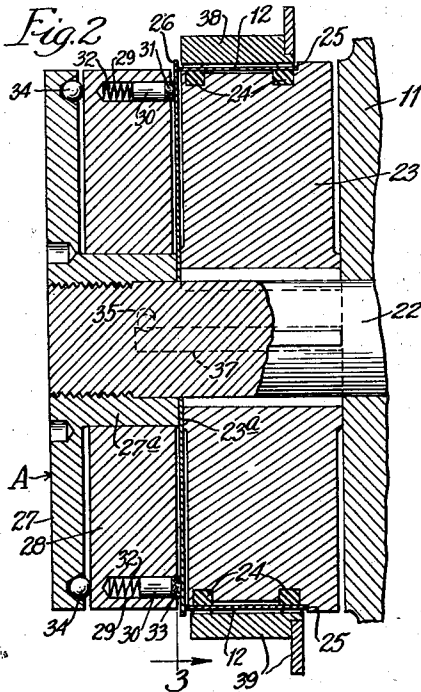
J. R. KIEL

2,096,113

SOUND RECORDING AND REPRODUCING

Filed Sept. 19, 1935

3 Sheets-Sheet 2



Inventor:
John Ripley Kiel,
By Banning & Banning
Attys.

Oct. 19, 1937.

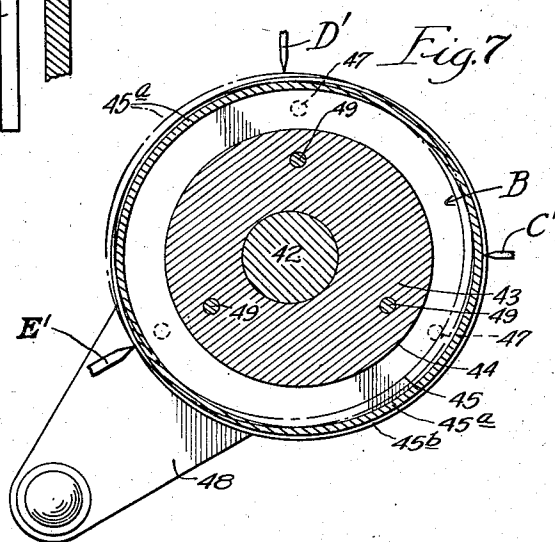
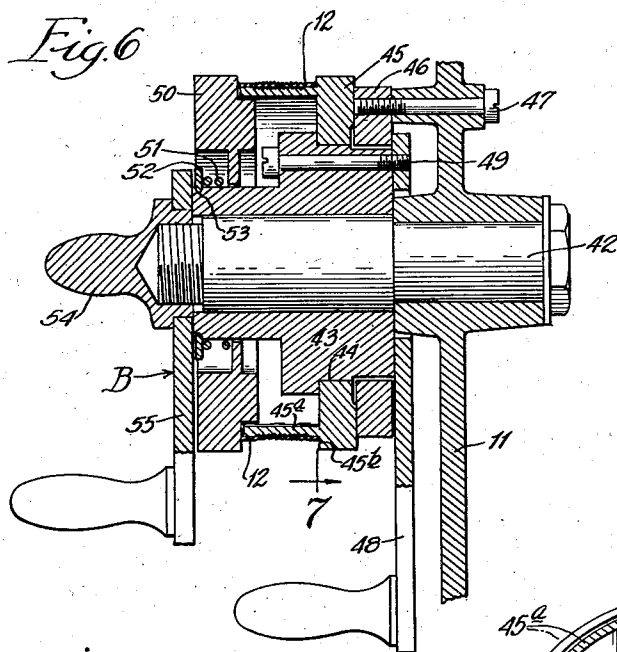
J. R. KIEL

2,096,113

SOUND RECORDING AND REPRODUCING

Filed Sept. 19, 1935

3 Sheets-Sheet 3



Inventor:
John Ripley Kiel,
By Banning & Banning
Attys.

UNITED STATES PATENT OFFICE

2,096,113

SOUND RECORDING AND REPRODUCING

John Ripley Kiel, Chicago, Ill., assignor to Ripley Corporation, Chicago, Ill., a corporation of Illinois

Application September 19, 1935, Serial No. 41,189

23 Claims. (Cl. 274—11)

An object of this invention is to provide an improved apparatus for recording sound by means of a groove on a long strip or ribbon, hereinafter referred to as a film, of a suitable permanently deformable material, whether coated or uncoated, and for reproducing sound therefrom.

Another object is to provide an improved film carrying a plurality of parallel grooves by which a continuous sound record is made reading in opposite directions in alternate grooves.

These and other objects, as will hereinafter appear, are accomplished by this invention which is fully described in the following specification and shown in the accompanying drawings, in which—

Figure 1 is a front elevation of a machine embodying this invention;

Fig. 2 is a partial enlarged vertical section on the line 2 of Fig. 1;

Fig. 3 is a vertical section on the line 3 of Fig. 2;

Fig. 4 is a front elevation of a strip of film having sound grooves produced by the recording apparatus;

Fig. 5 is an enlarged section of film on the line 5 of Fig. 4 and line 5 of Fig. 1, showing the stationary anvil beneath;

Fig. 6 is a partial enlarged vertical section on the line 6 of Fig. 1; and

Fig. 7 is a vertical section on the line 7 of Fig. 6.

This is a continuation in part of my pending applications Serial No. 659,538, filed March 3, 1933, showing a rigid, stationary support over which the film is slid at the point of recording, and Serial No. 685,145, filed August 14, 1933, showing a mechanism for propelling an endless film having a plurality of parallel sound grooves therein past a reproducer pick-up, together with means operated by notches on the sides of the film for controlling the movement of the film and for shifting the reproducer pick-up from one groove in the film to another. This film may be a flat elongated strip of cellulose acetate, cellulose nitrate, or other permanently deformable material, either with or without an emulsion, as for motion picture film, and with or without perforations for driving the film. The film shown has perforations but not an emulsion.

The embodiment illustrated comprises a cabinet 10 having a front panel 11, in front of which much of the recording mechanism is mounted. In general, a film 12, shown in Fig. 4, is wound at its two ends on two reels (not shown) which may be driven in any manner well known in this art so as to maintain the two ends of the film shown in Fig. 1 at a moderate degree of tension. That

portion of the mechanism forms no part of the present invention and hence is not illustrated.

As will later be described, this film feeds in one direction until the film is almost completely unwound from the first reel on to the second, when a reversal of the direction of the film causes it to rewind from the second reel back on to the first until the second reel is almost completely unwound, when the direction of the film is again reversed. A recording head C and a reproducer pick-up D are carried on the panel and are operably connected so as to move in and out, as will later be described, so that a recording stylus C' and an electric reproducer needle D' always lie in the same plane and the needle can operate in the groove just after it is formed, if so desired. At each reversal of the film the stylus and needle are advanced the spacing of one groove. Thus the reproducer needle adapted to operate in the groove previously formed can be connected to a suitable amplifier D² and head phones or to a loud speaker D³ to render audible the sound which has just been recorded, so that an observer can check the recording as it is done. Thus any error in recording can be instantly caught and, if desired, that portion of the recording can be retaken at once.

Thus the film 12 from the first reel (not shown) passes around idler rolls 13, 14, 15, 16 and 16^a, around the driving drum indicated generally as A, thence around an idler roll 17, then is slid around a preferably stationary recording drum or other arcuate anvil indicated generally as B, thence under idler roll 18, over the driving drum A, around idler rolls 19, 20, 14 and 21 to the second reel (not shown). The above mentioned rolls are all journaled on suitable pins or studs carried by the front panel 11. An electric recording head C having a recording stylus C' and an electric reproducing pick-up D having a reproducer needle D' are so mounted adjacent the recording drum that either the stylus or needle, or both, can be brought into engagement with a film passing around the drum.

The driving drum A will now be described in detail, as best shown in Fig. 2. A shaft 22 is journaled in suitable bearings in the cabinet 10 and in the front panel 11, and driven at an adjustable constant speed by any suitable source of power (not shown). This shaft has keyed thereon a driving drum 23 which has an outer cylindrical surface in which are mounted spaced friction bands 24, and has an annular shoulder 25. The film 12 engages the friction bands, which may be of rubber and preferably extend

slightly above the cylindrical surface of the drum for greater traction, and the film when pressed laterally against the shoulder 25 extends slightly beyond the outer edge of the drum opposite the shoulder.

A thin spring sheet metal disk 26 is pressed against a hub 23^a on the pulley by means of a hub 27^a on a nut 27 which is screwed on the threaded outer end of the shaft 22. The hub 23^a projects slightly farther than the overhanging portion of the film so that when no pressure is applied to the disk, it has a tendency to stand away very slightly from the film. A finger plate 28 is journaled on the hub 27^a and has along the upper edge a series of axially drilled holes 29, in each of which is placed a plunger 30 carrying a small leather finger 31 which is normally pressed against the outer surface of the disk 26 by means of an inserted spring 32. Two or more similar spring-pressed fingers 33 are placed at the opposite side of the finger plate. Friction between the finger plate 28 which, during recording is normally stationary, and the nut 27 which rotates, is minimized by means of suitable ball bearings 34. The finger plate is provided at its periphery with pins 35, 36 (Figs. 1 and 2) which are adapted to engage a stop 37 carried by the front panel.

It will be understood from the foregoing that when the shaft 22 is rotated in a counterclockwise direction (Fig. 1) the pin 35 will be brought into engagement with the upper side of the stop 37, and will remain in this position until the direction of motion of the shaft 22 is reversed. During this time the large number of fingers in the holes 29 press the spring metal plate 26 against the overhanging edge of the film which is held at the opposite side by means of the shoulder 25, so that it is driven in the direction indicated by an arrow *a*, thereby pulling the film around the recording drum, which will later be described. At the same time the fingers in the holes 33, shown at the bottom of the driving drum, give the film a slight amount of push so that it will not have a tendency to bind too much as it passes around the stationary recording anvil. Above and below the drum 23 are located arcuate shoes 38, 39 which are mounted on hinge pins 40, 41, respectively, and which are pressed by springs (not shown), the pins being carried by the front panel. These shoes are normally spaced a small distance from the film by means of adjusting screws 39^a which bear against pins 39^b in the front panel. These shoes prevent the film from buckling under the side pressure of the disk.

When the direction of motion of the shaft 22 is reversed to a clockwise direction as indicated by the arrow *b*, the finger plate 28 will be carried around with the shaft 22 and its associated parts until the pin 36 strikes the under side of the stop 37, during which time the finger plate will have made almost one-half a revolution. The large number of fingers in the holes 29 will then be at the bottom of the driving drum and will pull the film around the recording drum in the opposite direction, and the film will be taken from the right-hand or second reel (not shown) and fed on to the left-hand or first reel (not shown).

The recording anvil, shown in detail in Figs. 5, 6 and 7, is rotatably mounted upon a stud 42 carried by the front panel. On this stud is mounted an eccentric sleeve 43 which has a shouldered ledge 44 on which is mounted a stationary, rigid anvil member 45, which is retained against the shoulder by means of a ring 46 which is held in place by a series of screws 47 which

pass through the front panel. A shift lever 48 is secured to the sleeve 43 by means of screws 49, and has an adjustable stop screw 48^a by means of which the position of the lever 48 is regulated. The anvil 45 includes a thin annular anvil element 45^a which I find may advantageously be about .03" in thickness for faithful recording of high notes. The film-supporting annulus 45^a is slightly resilient in itself and yet rigidly mounted to preclude vibration, and said rigid mounting is preferably stationary by reason of the mechanical difficulty of obtaining vibrationless rigidity in a rotary mount.

The member 45 also has an outer shoulder 45^b. The film 12 passes around the thin anvil member 45^a and bears against the shoulder 45^b, the anvil being of such a breadth that the film overhangs it by about .01". A shoe 50 of considerable weight in the form of an annulus is pressed against the overhanging edge of the film by means of a spring 51 which abuts a split washer 52 seated in an annular slot 53 in the sleeve 43. The outer end of the stud 42 is threaded to receive a lock nut 54 which is provided with a handle 55 for easy operation. The mass of the shoe 50 is sufficient to insure the film remaining steady under the lateral vibration of the recording stylus.

At the side of the recording anvil is disposed the recording head C carrying the recording stylus C' which, as will later be described, is pressed firmly into the film and is vibrated laterally by electrical impulses imparted to the head by sounds received as by a microphone C² and amplified by an amplifier C³ in a well known manner, and serves to form a sound groove in the film as it passes beneath the stylus. The depth of the sound groove is regulated by the lever 48 and this lever by the screw 48^a.

Above the recording anvil is a reproducer pickup D carrying a reproducer needle D', preferably in line with the recording stylus. One function of the recording anvil is to move the film by means of the eccentric 43 into and out of contact with the recording stylus C'. For ordinary reproduction after the recording is done, the needle D' alone is in contact with sound groove of the film while the film is held out of contact with the stylus C'.

It will be understood from the description of the recording anvil that by moving the locking handle 55 so as to move it out of contact with the sleeve 43, the sleeve will be free to rotate on the shaft 42 and may be turned by means of the shift lever 48 from the full line position of Fig. 7, wherein the film 12 is in contact with the recording stylus to the dotted line position wherein the film is out of contact with the recording stylus. The anvil may be locked in either of these positions by means of the locking handle 55 which serves to press the anvil member 45 against the ring 46.

In Fig. 5 is shown greatly enlarged a partial cross section of the film 12 and the thin anvil element 45^a at the point of recording under the recording stylus C'. The anvil is provided with a series of notches, channels or depressions 45^c which are equally spaced, and which preferably extend entirely around the anvil at all points touched by the film. I find that for this purpose a lateral spacing of sixty-four depressions to the inch is very satisfactory. It is essential for good recording that the edges 45^c of the channels be rounded as shown. A mechanism (not shown) but substantially the same as that shown

and described in my co-pending application Serial No. 685,145, serves to move the recording head C outwardly a distance equal to the spacing of the depressions 45° at each actuation which is accomplished by means of reversing mechanism operated by two switches, one of which is actuated at a time by a cutout 12^a, near one end of the film, and the other by a cutout 12^b near the other end of the film.

This same mechanism serves to reverse the direction of rotation of the shaft 22 which then continues to propel the film in a given direction until the mechanism is again reversed and the recording head moved over to a position immediately over the next recording notch or depression 45°. Thus during recording the recording stylus is vibrated laterally, as indicated by the dotted lines of Fig. 5, and forms a V-shaped sound groove 12°. Beneath this groove a ridge 12^a is embossed on the opposite side of the film by the material displaced into the depression as the groove is formed.

The depression or channel may be of V-section or U-section, or variations thereof, it being important only that the capacity of the channel be such as readily to accommodate the ridge of material embossed therein by the recording stylus without contacting the apex of the ridge, and that the edges of the channel, slightly rounded, serve to support the film and define the overall width of the embossment. The width of the channel and of the embossed ridge will depend upon the thickness of the film to be employed and the depth and width of the cut or sound groove, the dimensions of the channel being a function of the film thickness and the sound groove width. Advantageously, the depression or channel may have a width substantially equal to that of the sound groove, plus the thickness of the film employed or a width slightly more than twice that of the groove. This precludes interference by the channel edges with the free displacement of the film material in the extreme amplitude range of the recording stylus.

The recording head is slidably mounted on a stationary guide 56 and carries an indicator mechanism 57 which is movable beneath a pointer 58 to indicate the depression in the anvil over which the stylus is operating.

The reproducer pick-up D is carried by an arm 59 which is mounted on pivots 60, and has a pin 61 in line with the reproducer needle D', the pin engaging an arm 62 on the recording head C. The arm 59 is supported by a screw 63 by means of which the needle D' is adjusted with respect to the anvil 45°. Thus any movement in or out of the recorder head causes a corresponding movement of the reproducer needle, thereby serving to keep the needle and stylus always over the same depression in the anvil. Thus at any time the anvil can be shifted by means of the shift lever 48 from the recording position to the non-recording position, or vice versa, the position of the anvil being fixed by the knurled nut 48^a which serves as a stop. By a suitable reversing mechanism (not shown) the film can be stopped and run backward to any given point and then fed in the same direction as that during which recording was previously done in order to play any portion of the record which has been made in the film.

The edges of the depressions are rounded and the surface of the anvil rolled or polished to reduce to a minimum the noise produced by a film sliding thereover. I have found that by thus

recording sound on a strip of film as it slides over a stationary arcuate anvil having a series of depressions therein, as shown, a record is produced which for fidelity of tone and freedom from foreign noise of all kinds is very much superior. In the apparatus as shown in Fig. 1, the reproducer needle D' lies in the record groove made by the recording stylus C' when the film is traveling around the anvil 45° in a counterclockwise direction. Thus the quality of the recording can be instantly checked by an operator listening to the recording as it is done. Thus any imperfections of recording can be instantly caught and that portion of the record can be repeated until it is satisfactory. A second reproducer pick-up may be used on the opposite side of the recording stylus, so that one pick-up needle can always be placed in the groove just after it is formed by the recording stylus. The pick-up E may be supported and held in contact with the film on the anvil in any well known manner and the output current may be amplified as in the pick-up D by means of a suitable amplifier.

It will be understood that one or more such sound grooves can be formed in the untreated or smooth face of a motion picture film, and the sound thus recorded will be synchronized with the picture by means of the sprocket holes therein in a well known manner.

Dragging or sliding the strip of film over the opposed convex face of the anvil will insure intimate contact between the two at the point of sound recording by reason of the relative movement between the two at such point whether or not the anvil be absolutely stationary.

I claim:

1. A film having a substantially V-shaped laterally-undulating sound groove in one face and a sharply defined embossed ridge in the reverse face opposite the groove, the embossed ridge being more than twice as wide as the groove.

2. Apparatus for forming a sound groove in a face of a film comprising a rigid, stationary support over which the film passes, means for sliding the film over the support at substantially a uniform rate, a recording tool adapted to be vibrated and to be pressed into the film to form a sound groove therein, the support having a depression opposite the recording tool and parallel to the direction of motion of the film to enable the tool to force the film into the depression so as to produce a ridge on the film opposite the sound groove, and means for preventing lateral motion at the point of recording.

3. Apparatus for forming a sound groove in a face of a film comprising a rigid, stationary support over which the film passes, means for sliding the film over the support at substantially a uniform rate, a recording tool adapted to be vibrated and to be pressed into the film to form a sound groove therein, the support having a depression opposite the recording tool and parallel to the direction of motion of the film to enable the tool to force the film into the depression so as to produce a ridge on the film opposite the sound groove, a shoulder at one side of the support, a shoe at the other side of the support, and a spring for pressing the shoe inwardly so as to firmly guide the film, to prevent its lateral movement at the point of recording.

4. The method of forming a substantially V-shaped laterally-undulating sound groove in a

strip of film comprising sliding the film over a rigid stationary support having a longitudinal depression formed therein, holding the film firmly against the support, pressing a vibrating recording tool against the film over the depression to form a sound groove in the film while the film passes over the depression, the depression having a width of more than twice that of the sound groove whereby as the recording tool vibrates across the depression, the material of the strip lying under the tool is embossed into the depression on the opposite side from the sound groove, and guiding the film at the recording point to prevent its lateral movement.

5. The method of forming a sound groove in a strip of film comprising sliding the film over a rigid stationary arcuate support having a longitudinal depression formed therein, pressing a vibrating recording tool against the film over the depression to form the sound groove therein while the film passes over the support, thereby embossing the material of the film into the depression on the opposite side of the film from the sound groove, and guiding the film at the recording point to prevent its lateral movement.

6. Apparatus for forming a sound groove in a face of a strip of film comprising a rigid, stationary, arcuate support over which the film passes, means for sliding the film over the support at substantially a uniform rate, a recording tool adapted to be vibrated and to be pressed into the film to form a sound groove therein as the film is moved, the support having a groove therein opposite the recording tool to enable the tool to emboss the film so as to produce a ridge on the film opposite the sound groove.

7. Apparatus for forming a sound groove in a face of a motion picture film comprising a rigid, stationary, arcuate support over which the film passes, means for sliding the film over the support at substantially a uniform rate, and a recording tool adapted to be vibrated and to be pressed into the film to form a sound groove therein, the support having a depression opposite the recording tool and parallel to the direction of motion of the film to enable the tool to force the film into the groove so as to produce a ridge on the film opposite the sound groove.

8. Apparatus for producing a sound record in a strip of suitable material comprising a sound-actuated vibratory tool, a rigid support disposed adjacent the tool and spaced therefrom, and having formed therein a depression in register with the tool, means to draw the strip over the support between the tool and the depression whereby to form a sound groove in one face thereof and to emboss the displaced material into the depression, the width of the depression definitely defining the width of the material embossed into the depression, and means to hold the strip against lateral movement of the vibratory tool.

9. Apparatus for producing a sound record in a strip of suitable material comprising a sound-actuated vibratory tool, a rigid, arcuate support disposed adjacent the tool and spaced therefrom, and having formed therein a depression in register with the tool, means to draw the strip over the support between the tool and the depression whereby to form a sound groove in one face thereof and to emboss the displaced material into the depression, the depression marginally defining and fixing the embossment as to width and itself of sufficient width and depth to permit lateral shifting therein of the medial portion of the em-

bossment under the action of the vibratory recording tool.

10. Apparatus for producing a sound record in a strip of permanently deformable material in the form of a sound groove, said apparatus comprising a rigid, arcuate support having a depression therein, a sound-actuated vibratory tool held rigidly in register with the depression in the support and at a substantially fixed distance therefrom, means for drawing the strips around the support at a uniform rate between the tool and depression to form a sound groove therein, and means for holding the strip against lateral movement at the point of recording, the width of the depression being a function of the sound groove width and of the sheet thickness.

11. Apparatus for producing a sound record in a strip of permanently deformable material in the form of a sound groove, said apparatus comprising a rigid, arcuate support having a depression therein, a sound-actuated vibratory tool held rigidly in register with the depression in the support and at a substantially fixed distance therefrom, means for drawing the strip around the support at a uniform rate between the tool and depression to form a sound groove therein, and means for holding the strip against lateral movement at the point of recording, the width of the depression being more than twice the width of the sound groove.

12. The method of forming an undulatory sound groove in a strip of permanently deformable material comprising moving the strip over a rigid support having a longitudinal depression formed therein, holding the strip firmly against the support, pressing a vibrating recording tool against the strip over the depression to form a sound groove in one face thereof and to emboss the material into the depression to form a ridge on the side opposite the sound groove, the depression having a width defining by contact the width of the embossment but sufficiently greater than that of the groove to accommodate the lateral shifting therein of the material embossed thereinto by the laterally vibrating tool.

13. Apparatus for forming a sound groove in a face of a strip of film comprising a rigidly mounted arcuate support over which the film moves, means for moving the film over the support at substantially a uniform rate, a recording tool adapted to be vibrated and to be pressed into the film to form a sound groove therein as the film is moved, the support having a depression therein opposite the recording tool to enable the tool to emboss the film so as to produce a ridge on the film opposite the sound groove, and means for preventing lateral movement of the film at said point.

14. Apparatus for forming a sound groove in a face of a strip of film comprising a rigidly mounted stationary, arcuate support over which the film slides, means for sliding the film over the support at substantially a uniform rate, a recording tool adapted to be vibrated and to be pressed into the film at any one of a plurality of laterally spaced points to form a plurality of sound grooves in the film parallel to each other and to the edges of the film as the film is moved, the support having a plurality of similarly spaced depressions therein opposite the recording tool to enable the tool to emboss the film so as to produce a plurality of ridges on the film opposite the sound grooves, and means for preventing the lateral movement of the film at said point.

15. Apparatus for forming a sound groove in a

face of a strip of film comprising a rigidly mounted stationary, arcuate support over which the film slides, means for sliding the film over the support at substantially a uniform rate, a recording tool adapted to be vibrated and to be pressed into the film at any one of a plurality of laterally spaced points across the film to form a plurality of sound grooves in the film parallel to each other and to the edges of the film as the film is moved, the support having a plurality of similarly spaced depressions therein opposite the recording tool to enable the tool to emboss the film so as to produce a plurality of ridges on the film opposite the sound grooves, and means for preventing the lateral movement of the film at said point, the depressions extending around the support at all points touched by the film.

16. Apparatus for forming a sound groove in a face of a strip of film comprising a rigidly mounted stationary, arcuate support having a thickness of about .03" over which the film slides, means for sliding the film over the support at substantially a uniform rate, a recording tool adapted to be vibrated and to be pressed into the film to form a sound groove therein as the film is moved, the support having a depression therein opposite the recording tool to enable the tool to emboss the film so as to produce a ridge on the film opposite the sound groove, and means for preventing lateral movement of the film at said point.

17. Apparatus for forming a sound groove in a face of a strip of film comprising a rigid, stationary support over which the film slides, means for sliding the film over the support at substantially a uniform rate, a recording tool adapted to be vibrated and to be pressed into the film to form a sound groove therein as the film is moved, the support having a depression therein opposite the recording tool to enable the tool to emboss the film so as to produce a ridge on the film opposite the sound groove, means for preventing lateral movement of the film at said point, a reproducer pick-up having a needle in alignment with the groove, and means for adjustably positioning the support so as to bring the film thereon selectively into or out of engagement with the recording tool, and means for moving the reproducer needle into and out of the groove.

18. Apparatus for forming a sound groove in a face of a strip of film comprising a rigid, stationary support over which the film slides, means for sliding the film over the support at substantially a uniform rate, a recording tool adapted to be vibrated and to be pressed into the film to form a plurality of sound grooves in the film parallel to each other and to the edges of the film as the film is moved, the support having a plurality of similarly spaced depressions therein opposite the recording tool to enable the tool to emboss the film so as to produce a plurality of ridges on the film opposite the sound grooves, means for preventing the lateral movement of the film at said point, a reproducer pick-up having a needle operably associated with the recording tool so as to operate in the groove made by the tool, means for positioning the support so as to move a film thereon into or out of engagement with the recording tool, means for advancing and retracting the reproducer needle into and out of the sound groove, an element carrying both the recording tool and the pick-up, and means for positioning the recording tool over any one of the depressions in the support.

19. Apparatus for forming a sound groove in

a face of a strip of film comprising a rigidly mounted stationary support over which the film slides, means for sliding the film over the support at substantially a uniform rate, a recording tool adapted to be vibrated and to be pressed into the film at any one of a plurality of laterally spaced points to form a plurality of sound grooves in the film parallel to each other and to the edges of the film as the film is moved, the support having a plurality of similarly spaced depressions therein opposite the recording tool to enable the tool to emboss the film so as to produce a plurality of ridges on the film opposite the sound grooves, and means for preventing the lateral movement of the film at said point, the edges of the depression being rounded and the surface of the support polished to reduce to a minimum the noise of the film sliding thereover.

20. A method of sound recording including the steps of inducing relative surface movement between a record strip of permanently deformable material and an arcuate support having a channel in its arcuate face, the strip being tensioned about the arcuate face of the support, whereby a drag and hugging contact of the strip with the support is maintained, and bringing a vibratory sound-actuated recording stylus into pressure engagement with the strip in line with the channel to emboss material displaced by the stylus into the channel.

21. A method of sound recording including the steps of inducing relative surface movement between a record strip of permanently deformable material and an arcuate support having a plurality of substantially parallel channels in its opposed face, the strip being tensioned about the arcuate face of the support, whereby a drag and hugging contact of the strip with the support is maintained, bringing a vibratory sound-actuated recording stylus into pressure engagement with the strip in line with one of the channels to emboss material displaced by the stylus into said channel, and bodily shifting the stylus into line with an adjacent channel to produce a second sound record groove adjacent and parallel to the first.

22. Apparatus for recording sound including an arcuate support having in the face thereof a channel, a sound-actuated vibratory recording stylus mounted above and in line with the channel, means to slide a strip of permanently deformable material over and in contact with the channeled face of the support beneath the stylus, the coating faces of the support and the strip having relative surface movement and the latter being tensioned about the curved face of the former, whereby a rearward drag and hugging action is imparted to the strip, means to impart by the stylus pressure upon the strip concurrently with the sound-actuated vibration of the stylus whereby to emboss the material of the strip into the channel to produce an undulatory sound groove in the upper face of the strip and the corresponding ridge upon the lower face.

23. Apparatus for recording sound including an arcuate support having in the face thereof a plurality of substantially parallel channels, a sound-actuated vibratory recording stylus mounted above and in line with one of the channels, means to slide a strip of permanently deformable material over and in contact with the channeled face of the support beneath the stylus, the coating faces of the support and the strip having relative surface movement and the latter being tensioned about the curved face of

the former, whereby a rearward drag and hugging action is imparted to the strip, means to impart by the stylus pressure upon the strip concurrently with the sound-actuated vibration of the stylus whereby to emboss the material of the strip into the channel to produce an un-

dulatory sound groove in the upper face of the strip and the corresponding ridge upon the lower face, and means to bodily shift the recording stylus laterally of the support and strip to bring the stylus into line with a different channel.

JOHN RIPLEY KIEL.