Feb. 25, 1936. C. N. BATSEL ET AL 2,031,813

PHONOPHOTOGRAPHIC APPARATUS

Filed Jan. 3, 1933

Fig. 1

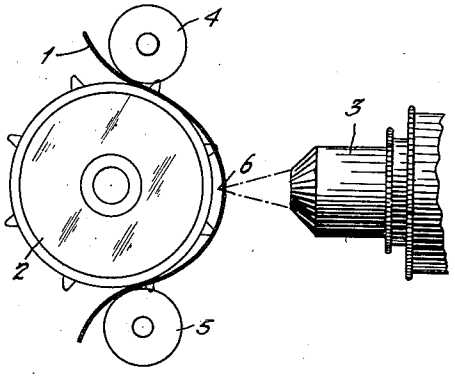


Fig. 2

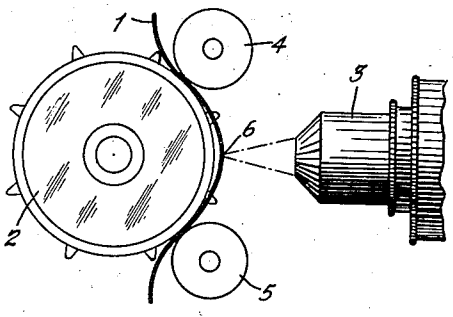
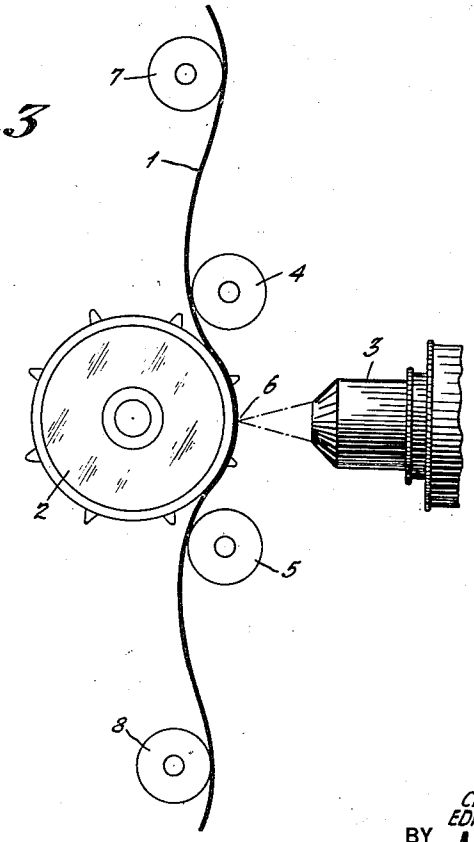


Fig. 3



INVENTORS
CECIL N. BATSEL
EDWARD W. KELLOGG
BY H. B. Grover
ATTORNEY

Patented Feb. 25, 1936 2,031,813

UNITED STATES PATENT OFFICE

2,031,813

PHONOPHOTOGRAPHIC APPARATUS

Cecil N. Batsel, Collingswood, and Edward W. Kellogg, Moorestown, N. J., assignors to Radio Corporation of America, a corporation of Delaware

Application January 3, 1933, Serial No. 649,936

7 Claims. (Cl. 271—2.3)

This invention relates to phonophotographic apparatus, and more particularly to the portion of such apparatus which serves to feed the film bearing the soundtrack area past the point at which sound is to be recorded or from which sound is to be reproduced.

Trouble has been experienced in the past in apparatus of this type in which film is carried on a sprocket past the point where the recording or reproducing light beam converges upon the film, by failure of the film to stay snugly in contact with the sprocket at the said point. We have found that this difficulty is due in part to the attempt to wrap the film around too great an arc of the sprocket, and in part to improper action of the loops of film on either side of the sound sprocket.

It has been the usual practice in the past in the construction of machines in which sound is recorded on a film or reproduced therefrom at a point on the circumference of the sprocket, to employ a large angle of wrap around the sprocket. This practice has been followed in part because of a theory that with a large number of teeth engaged the disturbance in the motion of the film when a tooth engages or disengages will be relatively less than would be the case with fewer teeth engaged. The reasoning on which this theory is based is questionable and our experiments have indicated that nothing is to be gained by the large angles of wrap which have hitherto been employed. In order to make the film lie tightly against the sprocket at the recording and reproducing point it has frequently been found necessary to subject the film to a certain amount of tension. Such tension, however, is objectionable, first, in that it wastes power, secondly, in that the tensioning means are apt to cause slight irregularities in the tension and thereby affect the speed of the sprocket, and thirdly because the engagement and disengagement of the teeth is accompanied by more disturbance if the film is under tension. It would, of course, be possible to hold the film against the sprocket by means of a shoe or roller opposite the point at which the sound is recorded or reproduced but a roller at this point would interfere with the optical system while a sliding shoe would cause objectionable friction and perhaps cause injury to the film. Rollers for holding the film against the sprocket are therefore placed above and below the optical system and it is especially important that the film touch the sprocket at the center of the arc.

Our invention comprises a new method and apparatus for maintaining the film snugly in contact with the surface of a drum or sprocket at the point opposite the optical system by so locating the rollers in relation to the said drum as to provide a suitable arc of contact between the film and the drum and in addition to so flex the film on either side of the arc of contact that the natural stiffness of the film tends to hold it positively against the drum. Our invention applies particularly to the case in which the drum is provided with teeth to engage perforations in the film thereby acting as a sprocket.

One object of the invention is to provide an improved means for causing the film to lie snugly against the sound sprocket when it passes the optical system.

Another object of the invention is to make it unnecessary to subject the film to any appreciable tension at the point where the film passes the optical system.

Another object of the invention is to provide means for utilizing the elasticity of the film itself for causing the film to lie against the sprocket or drum.

Another object of the invention is to insure that the film shall at all times remain in focus or at a constant distance from the optical system which converges light upon it.

Another object of the invention is to provide a structure which precludes any buckling of the film at the reproduction point.

The invention will be better understood from the following description when considered in connection with the accompanying drawing, and its scope will be pointed out in the appended claims.

In the drawing;

Fig. 1 shows a common arrangement of sprocket, rollers, and optical system, and illustrates the tendency of the film to loop away from the sprocket when the angle of wrap is too large.

Fig. 2 shows an improved arrangement with a favorable angle between the rollers, but in which adverse conditions in the film loops adjacent to the sprocket, may still cause the film to loop away from the sprocket.

Fig. 3 illustrates diagrammatically the construction of our apparatus and the position of a film passing therethrough.

Referring to Fig. 1, which illustrates a common condition the film 1 is carried by a sprocket 2 past an optical system 3, while the rollers 4 and 5, sometimes called pad rollers, hold the film against the sprocket. The optical system serves to bring a light beam to focus at a point 6 which is on the surface of the film provided the film is

against the sprocket. We have found that with the rollers 4 and 5 as far apart as shown in Fig. 1 the natural stiffness of the film causes it to tend to form a loop or stand away from the sprocket at the middle of the arc, but this tendency is very much less with small arcs of contact. We have obtained excellent results with arcs of about 90° and we found that difficulty begins to be encountered if the arc of contact exceeds about 120°. Fig. 1 shows the form which a film tends to take when the arc of contact is too large. The film 1 is held in contact with the sprocket 2 by the rollers, 4 and 5, but since the pressures exerted on the film by these rollers are substantially radial and the radii are nearly opposite, the forces have only a slight component to the left and there is little tendency to move the film toward the left. A loop of film squeezed on the two sides tends to form itself into a curve resembling an elipse more nearly than a circle with the maximum curvature at the mid-point. In taking such a form the film tends to loop away from contact with the sprocket at the mid-point. On the other hand, if the rollers which hold the film on the sprocket are separated by a small angle as shown in Fig. 2 the radial forces which they exert on the film have large components toward the left, thereby urging the film more strongly against the sprocket throughout the arc of wrap. Moreover, when the forces applied to the film are more nearly parallel, or more nearly horizontal as seen in Figure 2, there is far less tendency for the film to assume a curve having sharp curvature at the center.

In addition to locating the rollers, 4 and 5, in such positions that they provide a suitable angle of wrap we have found it desirable to employ another measure to insure the film lying against the drum at all times. If in Fig. 2 the film above and below the rollers, 4 and 5, is under no strain the film will touch the sprocket throughout the arc, but it not infrequently happens that the film loops are of such shape as to produce a slight longitudinal thrust. Under these conditions the natural tendency of the film to touch the sprocket throughout the arc may be offset by the effect of this thrust, which tends to lift the film off the sprocket at the point 6. It may also happen that the loops of film outside the rollers 4 and 5 of Fig. 2 are of such form that they cause the film to lie against the sprocket beyond the rollers, thereby increasing the effective angle of wrap and producing a condition similar to that shown in Fig. 1. We therefore employ additional means to limit the angle of wrap and furthermore to cause the film to be forced more strongly against the sprocket. We accomplish this by providing additional guides which may be rollers, 7 and 8, of Figure 3 or may be other guiding devices. These guides are so placed as to flex the film away from the sprocket. The bending of the film around the rollers, 4 and 5, causes it to press strongly against the sprocket in the region between the rollers, 4 and 5.

We find with this arrangement that the film at all times stays against the sprocket, that no tension on the film is required, and that the engagement and disengagement of teeth is accompanied by a minimum of disturbance.

The rollers, 4 and 5, may be made movable so that they can be moved away from the sprocket to permit threading or they may be fixed in location with sufficient spacing from the sprocket so that threading may be accomplished without moving the rollers. When there is appreciable space between the rollers, 4 and 5, and the sprocket, 2, the angle at the center of the sprocket subtended by the rollers 4 and 5 is considerably greater than the arc of actual film contact. Under these conditions it is not the angle subtended by the rollers but the angle of film contact which should not exceed 120°.

Having thus described our invention;

We claim:

1. The method of maintaining a film in contact with a supporting drum at an operational point comprising the step of flexing the film so that it is urged by only its own flatwise elasticity against the drum at the said operational point.

2. The method of maintaining a film at each side of the drum in contact with a supporting drum at an operational point comprising the step of flexing the film in a reverse curve so that it is urged by its own flatwise elasticity only against the drum at the said operational point.

3. In phonophotographic apparatus, a drum adapted to support and drive the film at the operational point, means adjacent to, but spaced from, the said drum for defining the path of the film approaching or leaving the said drum, and additional means on the side of said first means away from the said drum for defining a re-curved film path whereby said film is maintained firmly against said drum by its own flatwise elasticity only.

4. Film guiding apparatus comprising a drum for supporting the film at the operational point and a pair of guides positioned inwardly from said operational point for flexing the film around the said drum, the said guides being so positioned that the arc of contact between the film and the drum is less than 120°, and additional guides beyond the first said guides, for flexing the film in reverse curves around the first said guides, whereby said film is maintained against said drum at the operational point by its own flatwise elasticity only.

5. Film guiding apparatus comprising a film supporting drum, and means adjacent the said drum for flexing the film toward the said drum by its own natural stiffness only.

6. Film guiding apparatus comprising a drum for supporting the film at the operational point, and a pair of rollers spaced from the said drum and positioned inwardly from the said operational point for flexing the film around the said drum by its own natural stiffness alone.

7. In phonophotographic apparatus, a drum supporting one face of and driving the film at the operational point, means spaced from the said drum supporting the same face on the said film, and means between the said drum and the supporting means pressing against the other face of the said film and flexing the said film into contact with the drum and the first means through the natural stiffness only of the film.

CECIL N. BATSEL.
EDWARD W. KELLOGG.