July 16, 1940. L. DEWAN 2,207,722

SOUND REPRODUCING APPARATUS

Original Filed Jan. 26, 1935

FIG.1.

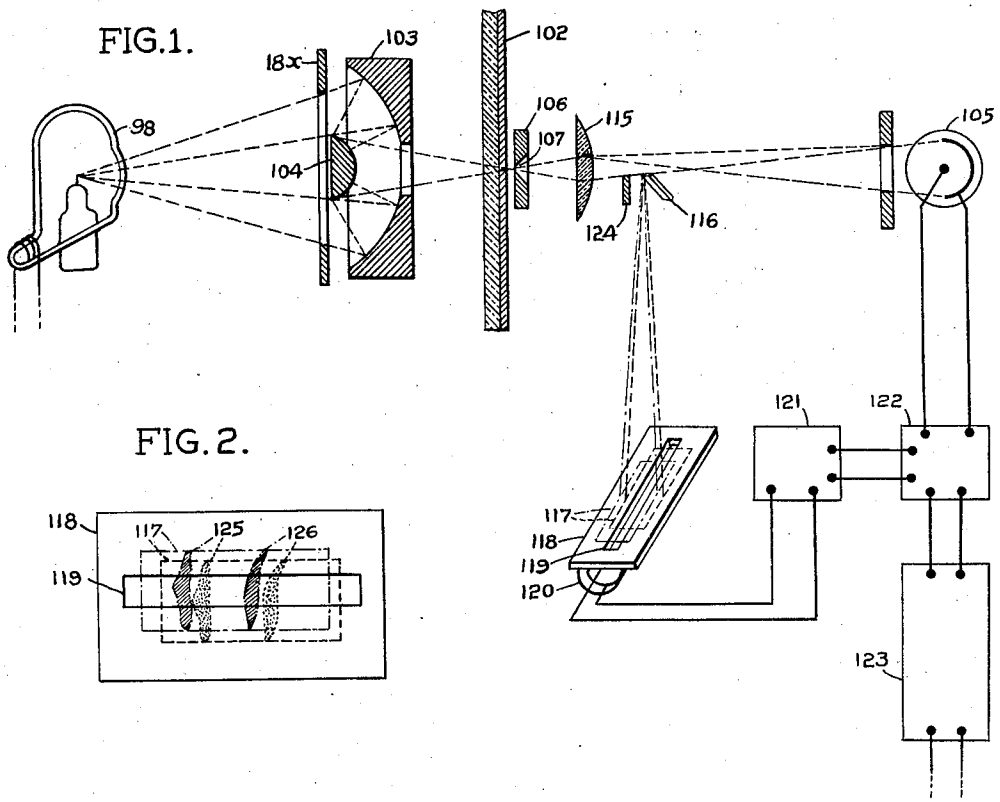


FIG.2.

FIG.3.

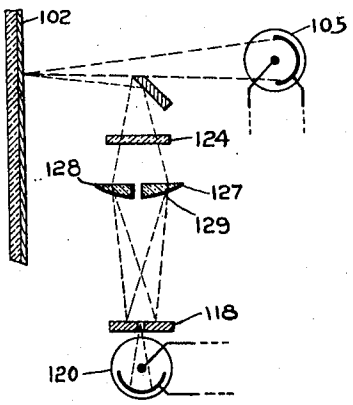
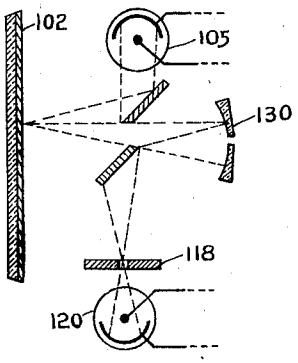


FIG.4.



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SOUND REPRODUCING APPARATUS

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Original application January 26, 1935, Serial No. 3,635, now Patent No. 2,165,236, dated July 11, 1939. Divided and this application August 19, 1938, Serial No. 225,689

7 Claims. (Cl. 179—100.3)

This application is a division of the application filed January 26, 1935, Serial No. 3,635, now Patent No. 2,165,236, of July 11, 1939.

This invention relates to improvements in sound reproducing apparatus, one object of the invention being the provision of means coordinated with the present type of photoelectric cell sound reproducing apparatus and its amplifying means to be actuated by the sound track control light beam, so that the effect therefrom is fed into the input of the photoelectric cell amplifier to produce an effect which tends to and does improve the sound from any particular sound track, and particularly where such track is scratched and/or dirty.

Another object of this invention is the provision of a device of this character which is readily attached to sound reproducing apparatus as an adjunct thereto, and without in any way affecting the present apparatus.

Still another object of this invention is the provision of an apparatus and a method, whereby are formed a plurality of superimposed laterally displaced images of the sound track so that the light of the images interfere and thus iron out as it were the irregularities in the sound track due to scratches and/or dirt thereon.

In the accompanying drawing:

Figure 1 is a diagramatic view of a complete sound reproducing apparatus with this invention shown therein.

Figure 2 is a diagram illustrating the effect produced with the apparatus as shown in Figure 1.

Figures 3 and 4 are diagrams illustrating mirror combinations to produce a like effect to that as shown in Figure 1.

Referring to the drawing, the numeral **98** designates generally an exciter lamp used in the sound reproducing apparatus, and its beam is projected through the open mask **18x**, upon the concaved mirror **103**, having a central opening, through which the reflected beam upon the semi-spherical mirror **104** directs the beam through such opening on to the sound track of the film **102**. This combination of concave and convex mirrors serves the purpose of an objective lens to concentrate a fine light slit on the sound track. The beam after being affected by the track is then passed through an aperture **107** in the second mask **106** and through the lens **115** on to the photoelectric cell **105**. This cell is connected to the input of the photoelectric cell amplifier **122**, which in turn is connected to the power amplifier **123** and to the loud speakers (not shown). This part may be of usual construction and similar to that now used in general practice.

In order that a sound track, which in usage becomes scratched and soiled, may be used and the scratch or ground noise to a great extent eliminated in the final sound reproduction, a part of the light after passing through the sound track portion of the film is caused to form an image that affects a separate photoelectric cell **120**. This latter cell is in the nature of a neutralizing or compensating means which being affected only by the ground noise and not by the sound in the track will act in such manner that when dust spots or scratches are present on the sound track their effect on the cell **105** will be eliminated without affecting the sound per se.

A mirror **116**, which is formed in two parts disposed at a small angle relative to each other, is positioned in the path of the light beam after its passage through the sound track to divert light therefrom and form two images **117**, displaced from each or relative to each other on the mask **118**, having a slit **119**, covered with ground glass. Behind this mask is positioned the photoelectric cell **120**, whose amplifier **121**, is so coupled through the grid of the first relay of the amplifier **122**, that the two photoelectric cells **105** and **120** act similarly or in unison on the amplifier **123**, except that the effect of the cell **120** is greater for an equal amount of light excitation by virtue of the amplifier **121**.

A monochromatic filter **124** is placed to filter the light beam in advance of the mirror **116**, so as to cause light of only one color to pass, red for example, so that the two images thus formed may be disposed as illustrated in Figure 2. It is assumed that a variable density track is being reproduced and the two images **117** of an oblong slit-like portion of the track are projected upon the slit **119**. It is also assumed that two spots **125** and **126** have just appeared on the slit as the sound track moves by. The relative position of the two parts of the mirror **116** is such that not only are the two images **117** displaced from each other laterally to an extent equal to the average diameter of the larger spots that usually occur in the sound track, but are also very slightly displaced in a direction at right angles to the other direction, so that fairly broad interference bands are produced, preferably parallel to the slit **119**. This slit **119** is made to lie in one of the dark bands where the two beams forming the images **117** totally interfere. Where there are no spots on the sound track the slit **119** is in darkness, regardless of the light variations due to recorded

sound since both beams of the images 117 interfere whether they are strong or weak, since they remain of equal intensity. If the spot 125 appears in the sound track and consequently in the images 117, the two areas formed by the spot 125, due to the displacement of the images 117, will each receive light from the luminous portions of each other's image, and since light from only one image is present in each area formed by the spot, there will no longer be interference in these areas and visible light results therein. The result of this, is that whenever a dark spot appears in the sound track, the tendency towards a temporary diminution of the output of the amplifier 123, caused by the dark spot is compensated for by the simultaneous appearance at the photoelectric cell 120 of light caused by this same dark spot.

No sound variations are transmitted from the photoelectric cell 120, due to the fact as before described of equal intensity of the images 117, when the sound track is uniform. Only disuniformity, such as spots, dust, etc., appear luminous through the slit 119, and cause the photoelectric cell 120 to neutralize the effect of these irregularities upon the amplifier 123.

If desired, the images 117 may be enlarged, either by means of having the mirror 116 be slightly convex, and therefore divergent, or by having a special lens or mirror to produce the images 117 at a longer distance therefrom. An astigmatic or cylindrical mirror or lens may also be introduced in the optical system, in order to greatly enlarge the images 117 in the direction of the width of the slit 119. More than one slit may be used, each slit being placed where a dark band of the interference pattern falls. If desired, the light from the sound track may reach the photoelectric cell 105 directly, without an image thereof being formed, and means may be employed for diverting a part of the light for the compensating or neutralizing photoelectric cell and forming the enlarged image required therefor.

In Figure 3 is shown such an arrangement, wherein a lens 127, made in two parts 128 and 129, forms the required image with an interference pattern. The formation of the two images is accomplished by displacement of the two halves of the lens at right angles to the plane of the drawing, and the interference pattern is produced either by separation of the two halves or by having one of the halves slightly thicker than the other, in which case the two halves should be at a slightly unequal distance from the mask 118, so that the two images produced shall both be perfectly focussed thereon. The lens 127 may be astigmatic in order to produce the broadening effect on the images 117 as already described.

If desired, a concave mirror may be used to produce the same results as lens 127. This is shown in Figure 4, where a concave mirror 130 is composed of two halves displaced in two directions. For example, the two halves may be at an angle with each other to produce the displacement which causes any spots on the sound track to appear double by means of the image formed by the mirror, and may be at slightly unequal distances from the mask 118 to produce the interference pattern. The interference pattern may also be produced in this case by slightly rotating the two halves on an axis passing centrally through the mirror at right angles to the split. In the use of either the mirror 130, the lens 127, or the mirror 116, the images produced thereby may be displaced laterally without causing any effect on the interference pattern.

This may be done in the case of the mirrors 116 or 130 for example, by providing a sufficient distance between the two halves thereof.

Instead of a lens such as 127, or a spherical concave mirror to produce the image or images of the sound track upon the screen 118, a cylindrical lens or mirror may be used if desired in such manner that an image of the sound track is produced on the screen 118 only in the lateral plane while the light in the longitudinal plane is allowed to diverge from the sound track and fall on the screen 118. The formation of the two images of the sound track to produce double images of the sound track irregularities laterally displaced may in this case be produced by causing the cylindrical lens or mirror used to be split with its halves at an angle in the lateral plane or by using a two-part reflector or refractor whose parts are also at a slight angle in the lateral plane. The rays diverging from the sound track in the longitudinal plane without being acted upon by the cylindrical lens mentioned may be caused to produce lateral interference bands parallel to the slit in the screen by dividing the beam into two portions and causing an overlapping thereof by means of a two-part plane reflector whose parts are at a slight angle in the longitudinal plane or by means of a suitable refractor similarly used. If desired the divergence of the beam from the sound track in the longitudinal plane can be somewhat modified and decreased by means of a cylindrical lens whose axis is in the lateral plane to cause the light rays to be less divergent longitudinally, and the beam divided into two halves at an angle in the longitudinal plane to produce overlapping areas on the screen 118. One of the halves may be retarded in light speed to an extent of suitable relation to the wave length of light used, to produce the width of interference band desired, by means of a plane transparent medium interposed in the beam path, or by having one-half of the cylindrical lens which modifies the beam in the longitudinal plane be thicker than the other half. It is possible in this feature to produce more than two laterally displaced images of the sound track in order to produce a more uniform effect and take care of the various sizes of irregularities.

Where variable area sound track is being reproduced, the images 117 on the slit 119 will vary in length simultaneously in accordance with the sound waves though this would not cause sound variations to affect the cell 120, due to the interference conditions described. The slit 119, and/or any other slits covered by the images 117 are placed in the very darkest portion of the dark bands of the interference pattern. If the images 117 are the result of a straight narrow analyzing aperture of the sound track, then, in cases where curved interference bands are produced, the slit 119 may be curved in conformity therewith since in that case the sound track will have been analyzed by the aperture mentioned rather than the slit 119.

From the foregoing description taken in conjunction with the drawing, the operation of the present invention and its modifications will be fully understood and its manifold advantages be fully appreciated, when it can be seen that with a soiled, spotted or scratched sound track, good sound can be produced, by the simple addition to the present sound reproducing apparatus of this neutralizing means.

What is claimed is:

1. The method in reproducing sound on film consisting in scanning the sound track, simultaneously selecting ground noise components from the scanned sound track by projecting the sound track in such a manner that sound wave images are decreased in visibility relative to ground noise images in the sound track and photoelectrically translating the scanning of the selected ground noise components, and applying said selected ground noise components simultaneously with the main sound effects to produce a compensatory action whereby the effect of the original ground noise upon the final sound reproduction is neutralized.

2. The combination with a sound on film reproducing apparatus including a film progressing mechanism, an exciter lamp, a photoelectric cell, and an amplifying system controlled by the cell, of neutralizing means consisting of means for projecting the scanning light passing through the track and for decreasing the visibility of sound waves relative to the extraneous interference carried by said track, and means for applying the modulations of the extraneous interference selected thereby to the amplifying system whereby the effect of said extraneous interference carried by the sound track is neutralized and reduced in the final reproduction of the sound in the system.

3. The combination as claimed in claim 2 wherein the neutralizing means includes an auxiliary photoelectric cell the output of which is connected to the amplifying system.

4. The combination as claimed in claim 2, wherein the neutralizing means includes a light deflecting means disposed in the light beam after it has passed through the sound track of the film, and an auxiliary photoelectric cell the output of which is connected to the amplifying system and which is in the path of the light after striking the light deflecting means.

5. The combination as claimed in claim 2, wherein the neutralizing means includes a light deflecting means disposed in the light beam after it has passed through the sound track of the film, an auxiliary photoelectric cell the output of which is connected to the amplifying system and which is in the path of the light after striking the light deflecting means, and a mask interposed between the cell and the light deflecting means to limit the light exposure upon the cell.

6. The combination as claimed in claim 2 wherein the neutralizing means includes means for producing light wave interference.

7. The combination as claimed in claim 2 wherein the neutralizing means includes means for producing a plurality of displaced super imposed images of the sound track.

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