

Oct. 22, 1935.

W. H. OFFENHAUSER, JR

2,018,315

SOUND REPRODUCTION

Original Filed Dec. 18, 1929 2 Sheets-Sheet 1

Fig. 2

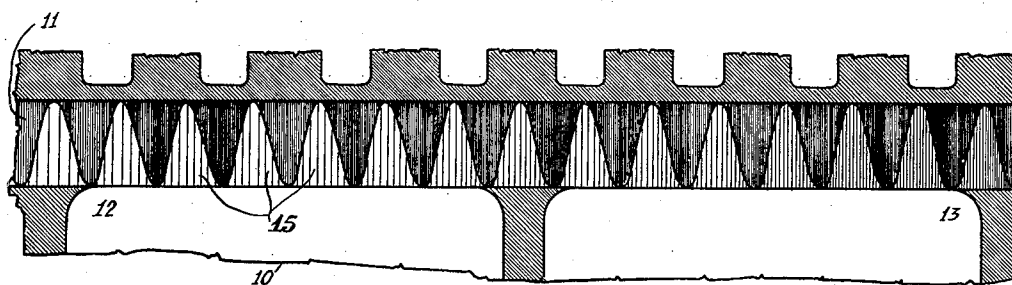
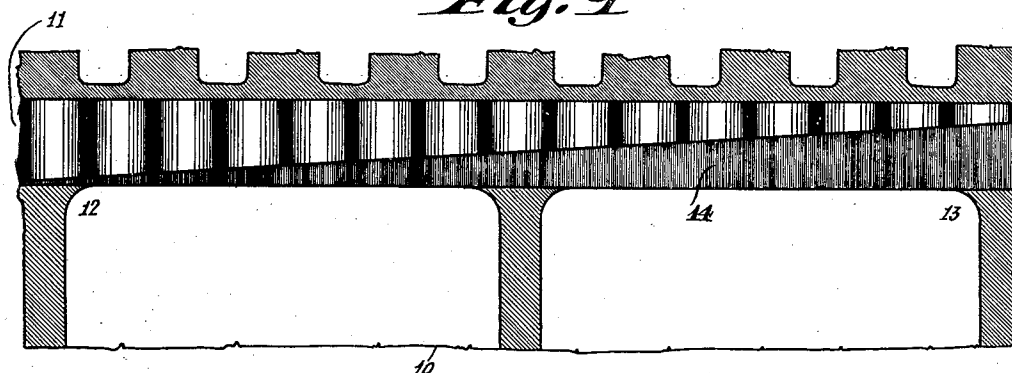


Fig. 1



INVENTOR
W. H. OFFENHAUSER JR.

BY

H. G. Grover
ATTORNEY

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Fig. 3

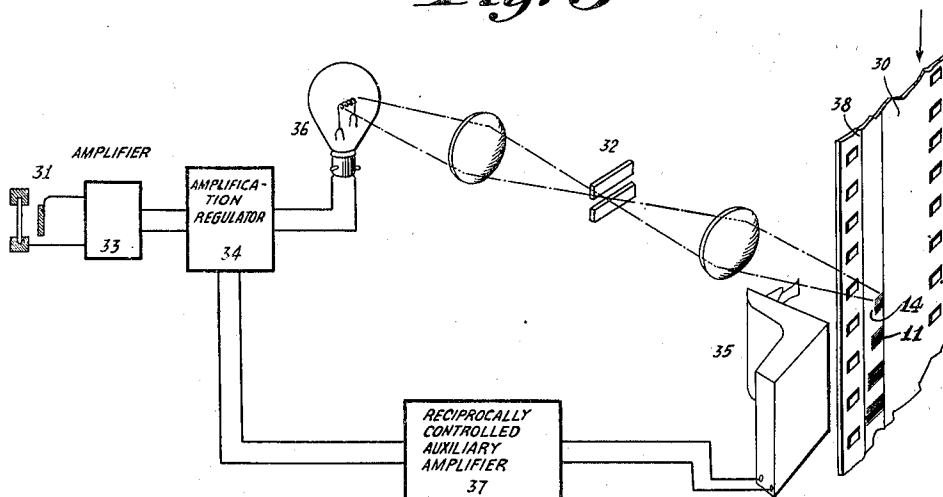
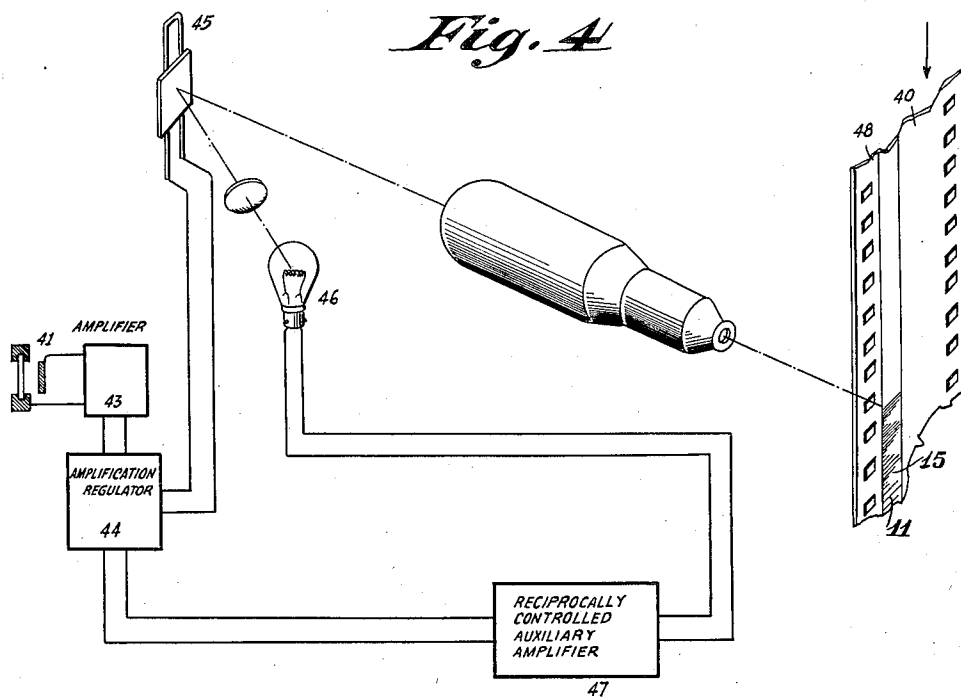


Fig. 4



INVENTOR
W. H. OFFENHAUSER

BY *H. S. Grover*
ATTORNEY

UNITED STATES PATENT OFFICE

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SOUND REPRODUCTION

William H. Offenhauser, Jr., New York, N. Y.,
assignor to Radio Corporation of America, a
corporation of Delaware

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414,878. Divided and this application April 2,
1931, Serial No. 527,322

3 Claims. (Cl. 274—41.6)

In the reproduction of sound recorded upon a moving film, a considerable number of difficulties are encountered. The particular difficulty with which this case is concerned is that with respect to change in volume, or more particularly, with respect to maintaining a proper ratio between the intended sound effects and the sound produced by irregularities in the film, and emulsion and dirt, which causes what is commonly referred to as ground noise.

In order to maintain the ratio of desired sound large with respect to the ground noise, it has been found impossible to produce the pianissimo effect with the same setting of the reproducing amplifiers as well as reproducing from the same film, the forte effect. It has, therefore, been necessary to provide some means for varying the amplification of the reproduced sound currents. In other words, the pianissimo must be recorded after greater amplification than the forte, and in reproduction the pianissimo must not be so much amplified.

Many means have been proposed for doing this, the simplest and most common of which is the simple manual variation of the amplification in reproduction. This has led to the improper sound reproduction of films due to the ignorance or lack of feeling of the operator and, in some cases, to the entire loss of proper effect, amounting almost to ruining what might otherwise be a good sound picture.

Later development has been the preparation of a cue sheet which enables the operator to set his amplification at exactly the right point for the various sounds of the film. This, however, requires absolute attention and does not permit small variations to take place frequently within the space of a scene. The result is, therefore, a little better than that produced by the undirected efforts of the control operator.

Mechanical and electro-mechanical means and methods have been proposed for accomplishing the desired result. These methods might be roughly divided into two classes: the first, in which an auxiliary record of some type is used to control the volume in reproduction; and the second class, the one into which the present invention falls, a type of record which will simultaneously control the tone as well as the full range of the volume of the sound. This latter method will be discussed fully hereinafter.

The type of control in which the auxiliary record is used falls roughly into two branches; the first, in which a simultaneously operated record is run, such as a volume control phonograph

record of the disc or film phonograph type, or even a perforated record similar to that used in a player piano; and the second class, in which the volume control record is incorporated on the same film with the sound record. The volume control record may take the form of either a photoelectric record from which the amplifier biasing potential may be obtained, or from which a control current to operate means for mechanically varying the amplifier bias is obtained. This control record incorporated in the talking moving film may also take the form of a mechanical record such as perforations or indentations of the film adapted to control a mechanical film control in an appropriate manner.

The present invention has no distinct bearing upon the foregoing briefly outlined methods of volume control. It, on the other hand, relates to the method of volume control in which a single sound record has incorporated therewith, features which enable the full control of volume as well as the control of tone. Another method falling into this same general class has been suggested. In this method, the mean audio current in reproduction is varied so that the light falling upon the photo cell is zero for low volumes as well as high volumes, with maximum sound impulses displacement. In this method, however, it is necessary in reproduction to have a special amplifier having some sort of a time lag device in order to control the gain control of the amplifier.

In the present method, the tone frequencies are recorded either as density variations or area variations at full modulation, and the volume is recorded as a variation in area or density respectively.

In reproduction the gain control of the reproducing device is set to give maximum amplification desired, and the control of volume would be automatically caused entirely by the total variation in the light transmitted through the film.

The process thus resides entirely in the recording in which the bias required to obtain a maximum modulation in recording the tone is adapted to control means for causing the appropriate area or density variations to produce the gain control variation of the record.

As an example, when the very heaviest tones being recorded, say, by the variable area method, the recorded tones would occupy the entire width of the sound track. In this case, the supposedly clear portion of the positive used in reproduction would be as clear as possible, and as the tones in the sound being recorded change from forte to pianissimo, this clear portion of the record

would be gradually shaded, completely covering up the ground noise inherent in it at the same time that the variable area feature of the record was maintained at full amplitude. The amount of amplification which was necessary to amplify the tones picked up from the sound being recorded to actuate the sound recording mirror at full amplitude would reciprocally reduce the intensity of the recording light so that in the positive, as the intensity of the reproducing sound changes from forte to pianissimo, the clear portion of the film which is indicative of the intensity of the recording light would change from the most brilliant to the least brilliant.

The operation, when a sound is recorded by variable density, is simply reversed, the intensity of the light varying on each cycle of the audio tone from maximum to minimum and the width of the record being controlled reciprocally in the same manner as was the intensity of the light in the first instance.

Having thus described my invention, attention is invited to the accompanying drawings in which;

Fig. 1 represents a record made in accordance with the method of my invention, in which the tone is controlled by variable density and the volume by variable area;

Fig. 2 is a record made in accordance with my invention in which the tone is controlled by variable area and the volume by variable density;

Fig. 3 is a schematic diagram illustrating the method of producing the record of Fig. 1; and

Fig. 4 is a schematic diagram illustrating the method of producing the record of Fig. 2.

Referring now more particularly to Fig. 1, there is shown a talking motion picture film 10 having a sound record portion 11 on the side thereof. This sound record is of the variable density type, and it will be observed that the record density changes from maximum density to minimum density for each cycle of the audio frequency. In order to control the actual volume, the effective area of the sound record is varied from the full width at the portion 12, where the tone is supposed to be forte, to minimum width at the portion 13, where the tone to be reproduced is supposed to be pianissimo, thus producing a volume control area 14. If a light is passed through the sound record 11 and permitted to fall upon a photoelectric cell, and the current thus produced is amplified and reproduced through suitable loud speaking devices, it is obvious that the fluctuations of current produced by the light falling upon the photoelectric cell in passing through the portion of the record 12 will produce the greatest possible variation in the loud speaker current, and, therefore, a sound of the greatest intensity; whereas when the light falling upon the cell is that passing through the record at the portion 13, the variations of current are fed to the loud speaker devices, and, therefore, the sound produced will be minimum. However, it is to be observed that the ratio of the sound current to the ground noise current is at all times maintained constant, that is, the dirt and grain irregularities affecting the light passing through the film at the portion 13 of the record, affects the total amount of light only by the same proportion that it does at the portion 12. In other words, with this record being passed through a sound reproducing apparatus, whereas the ground noise at the portion 12 will be considerable, the sound produced by the actual tone variations will be a great deal

more, or, there will be a high ratio between the tone and ground noise. At the portion of the record 13, there will be a very much diminished ground noise effect, and the total sound produced by the record will be also diminished, but they will both be diminished in approximately the same ratio.

Referring now more particularly to Fig. 2, the sound strip 11 of the film 10 is shown as a variable area record, and the normally clear portions 15 of the film are shown as varying in density from the least density at 12 to the maximum density at 13. The explanations with respect to the variations of the tone reproduced from this record are the same as the explanations with respect to Fig. 1. It is seen that whereas the fluctuations of light falling upon the photoelectric cell through the portion 12 of the record are maximum, and fluctuations caused by the light passing through the portion 13 are minimum, the ground noise effect at the portion 12 is maximum, whereas the ground noise effect at the portion 13 is minimum. The shading of the clear portion of the film may be arranged to keep this ratio approximately constant and is shown as near as possible to have the same occlusion of light as the occlusion caused by the narrowing of the film area of the film record of Fig. 1.

As above stated, in the reproduction from either of these two types of record, the light is simply passed through the sound record in the ordinary fashion and the reproduction is otherwise exactly the same as it is in the usual sound reproduction from a talking moving film, the only exception being that the amplification of the control apparatus is adjusted to give the maximum effect desired when a clear or full width portion, or a maximum volume portion of the record, is passing through the machine. The film then automatically controls the volume of reproduction entirely by controlling the amount of light falling upon the photoelectric device.

Briefly described, the methods of producing a film in accordance with this invention would be similar to that producing the variable area, and variable density record in common use at the present time. The variable area type as shown in Fig. 2 would probably be most easily produced using the present apparatus. Such an apparatus modified to produce the record of Fig. 2 is schematically illustrated in Fig. 4 to which attention is now invited. In this figure, the current picked up by the microphone 41 is suitably amplified at 43 and used to control the shutter or galvanometer 45 of the recorder in the usual manner, except that amplification regulator means 44 is provided to cause the shutter or galvanometer to operate it at a maximum amplitude at all times. Some such means are to be found in automatic volume control systems. Such regulator means for adjusting the current being recorded are shown in Fig. 2 of the patent to Sacia 1,623,756. The amount of gain control current necessary to cause maximum operation of the recording shutter or galvanometer would be used to reciprocally vary the intensity of the recording light so that when the sound being recorded was maximum and very little amplification was necessary to operate the recording shutter at maximum, the recording light 46 would be at full brightness, whereas when the sound being recorded is minimum and a great deal of amplification is necessary to cause the shutter to work at full capacity, the intensity of the light

would be decreased. The reciprocal amplifier 47 is used to supply the current to the recording light 46. The film 40 is the negative of the film shown in Fig. 2 and, therefore, the representations of light and shading are the opposite of those shown in Fig. 2.

The recording of the film shown in type 1 is practically as simple, as shown in Fig. 3. In this figure, the amplified recording current is used to control the intensity of the light 36 of the usual variable density type of recorder, and the amplification of the light fluctuations necessary to cause full fluctuation at all times is used to control the shutter 35 which serves to screen a portion of the image to produce the variations in the width of record 38 produced on the moving film 30. As shown a reciprocally controlled auxiliary amplifier 37 is used in order that the circuit of Fig. 3 may be the same as that of Fig. 4. In this case, the shutter is arranged to reduce the width of the sound track 38 to the least extent when the greatest amplification of the weakest signals being produced by the microphone 31 is taking place in the amplifier 34. Under these conditions, of course, the greatest amount of control current is used to regulate the maximum intensity of light 36 and therefore the least current flows to the shutter 35. It is obvious, however, that the reciprocally controlled amplifier 37 may be omitted and the shutter 35 arranged to give the least sound record width with the least input current representing therefore the least amplification of the input current by the amplification regulator 34.

While I have briefly outlined methods of producing the film of my invention, it is to be understood that I am not to be limited by any such

method of producing a film except as broadly set forth in the appended claims. I am therefore limiting my description of the method of recording to its essential elements, which are necessary to produce the record of my invention. I am similarly limiting the description of reproduction of my record it being understood that essentially my invention resides in the type of sound record and method, rather than in any specific apparatus.

Certain variations of either the recording or reproducing apparatus may be made which fall clearly within the scope of my invention, which it is my intention to define in the appended claims. It is to be understood therefore, that I am not to be limited to the specific embodiment shown and described for the purpose of illustration, but by the scope of my invention as set forth in the appended claims. By the term "sound record" in the following claims I refer to a record of sound, as distinguished from indicia of notes or a record of notes or individual notes to be reproduced such as are used on music rolls for automatic piano or organ actions.

I claim:

1. A talking motion picture record in which the sound is recorded as a variable density record, and volume is recorded by variations in the area of said record.
2. A talking motion picture record in which the sound tone is recorded as a constant amplitude variable density record and the volume is recorded as variations in the area of the record.
3. A film record comprising a sound-track in which the tone consists of a constant maximum amplitude variable density record and the volume consists of a variable area record.

WM. H. OFFENHAUSER, JR.