

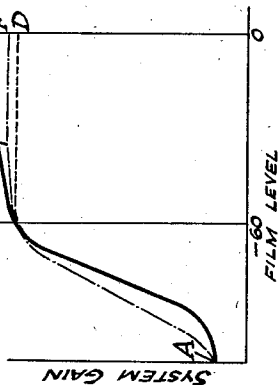
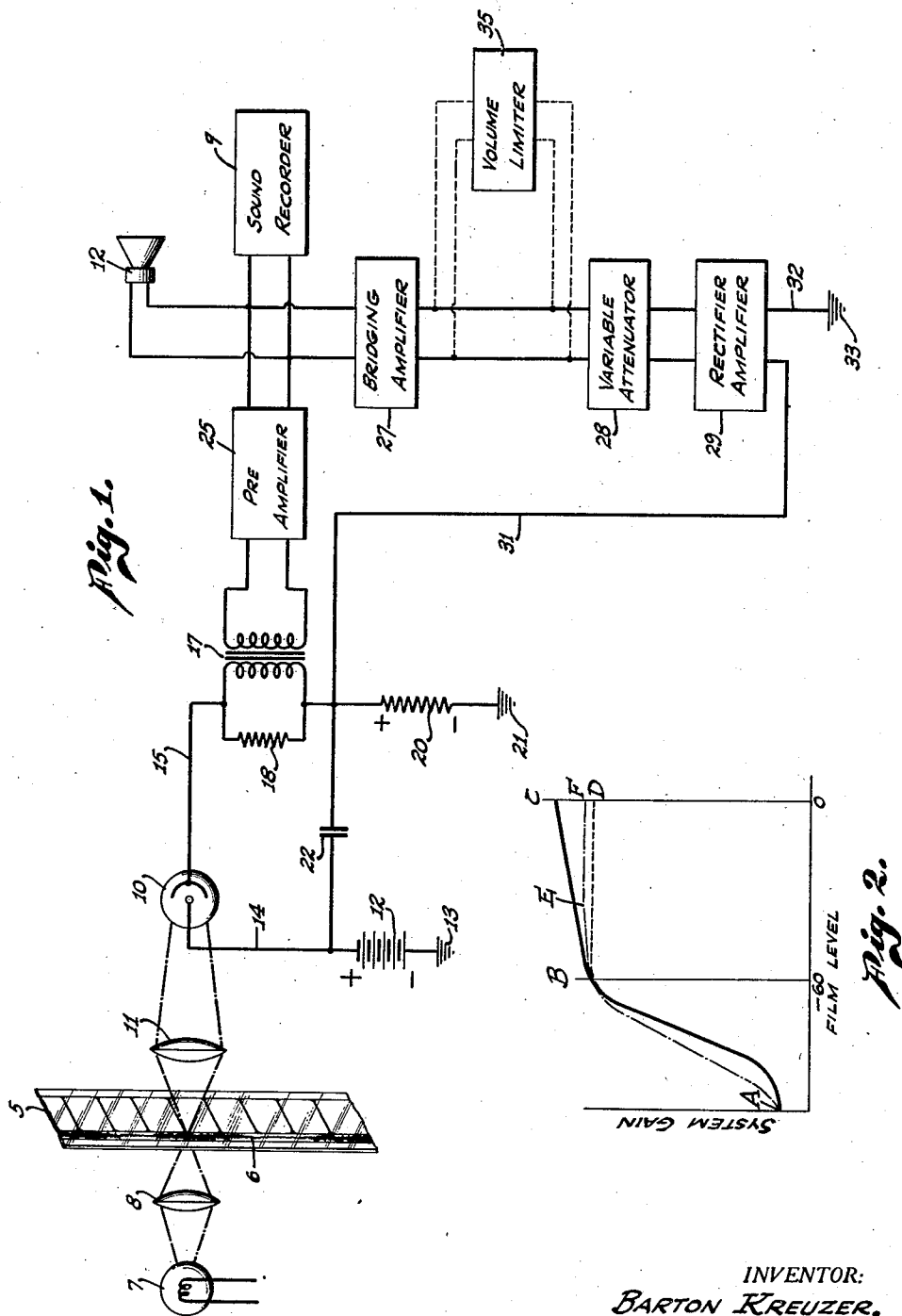
Oct. 20, 1942.

B. KREUZER

2,299,398

NOISELESS SOUND REPRODUCING SYSTEM

Filed April 30, 1941



INVENTOR:
BARTON KREUZER,
BY *Vol. R. G. G. G.*
ATTORNEYS.

UNITED STATES PATENT OFFICE

2,299,398

NOISELESS SOUND REPRODUCING SYSTEM

Barton Kreuzer, Los Angeles, Calif., assignor to
Radio Corporation of America, a corporation of
Delaware

Application April 30, 1941, Serial No. 391,050

9 Claims. (Cl. 179—100.3)

This invention relates to sound reproducing and recording apparatus and particularly to a method of and system for the rerecording and reproduction of sound.

It has been found that sound tracks appear to have a greater overall quietness and provide a better overall quality if the noise is suppressed or eliminated between the actual sound periods. For instance, in the case of dialogue there are periods of original silence between spoken phrases or sentences and between the conversations of two or more persons. If during these periods the reproduction of the sound record can be made absolutely or substantially silent, the quality of the sound is not only enhanced, but the dramatic effect or expression of the dialogue is improved. This means the substantial elimination of all sound at the loudspeakers usually caused by ground-noise. Such ground-noise may be produced by the lack of noise reduction on the film or by dirty or scratched film or by film graininess.

Noise reduction systems are well known wherein the signal to noise ratio is maintained high even during low amplitudes of the signal. In variable area systems this is accomplished by eliminating the light from the reproducing cell by blackening the areas of the sound track not occupied by the sound modulations, while in variable density systems, the average density of the film is increased as the signal amplitudes decrease. It is obvious, however, that these types of noise reduction systems cannot introduce absolute quiet at time of no signal because complete noise reduction is not practical between signals since a certain safety margin must be retained on the film to avoid the loss of the very low modulations and to prevent clipping. Thus, there is a certain noise level present at such times. However, even if such noise reduction systems did function to completely eliminate noise from the loudspeakers, it would not prevent extraneous light getting through to the photoelectric cell during the silent or no-signal periods due to dirt or scratches on the film.

The principal object of the present invention, therefore, is to improve the rerecording and reproduction of sound from sound records.

Another object of the invention is to eliminate the reproduction of sound during silent periods of a record.

A further object of the invention is to control the reproduction of sound in accordance with the signal level.

A further object of the invention is to reduce

the efficiency and effectiveness of a photoelectric cell during times of no-signal modulation.

A further object of the invention is to increase the effectiveness of a photoelectric cell during the impression thereon of light modulations to be reproduced.

Although the novel features which are believed to be characteristic of this invention are pointed out with particularity in the appended claims, the manner of its organization and the mode of its operation will be better understood by referring to the following description read in conjunction with the accompanying drawing forming a part thereof in which

Fig. 1 is a diagrammatic-schematic diagram of a rerecording system embodying the invention; and

Figure 2 is a graph illustrating the operation of the system of Fig. 1.

Referring now to Fig. 1, a film 5 has a sound track 6 which is to be reproduced and rerecorded on any suitable type of sound recorder 9. Light from a lamp 7 is directed on the sound track 6 by a lens 8 and then projected upon a photoelectric cell 10, such as an RCA 868 or 920, by a lens 11 in any well known manner. The photoelectric cell 10 is energized from a battery 12 over a circuit from ground 13, through battery 12, with the polarity as shown, over conductor 14, photoelectric cell 10, conductor 15, primary of audio coupling transformer 17 shunted by a resistance 18, control resistance 20, to ground 21. An alternating current circuit for the photoelectric cell 10 includes the by-pass condenser 22.

The output of the photoelectric cell 10 is impressed upon a preamplifier 25 through the transformer 17 and then upon the sound recorder 9 and monitoring loudspeaker 12. Bridged across the transmission circuit from the preamplifier is a bridging amplifier 27 feeding a variable attenuator 28 and a rectifier amplifier unit 29. The bridging amplifier 27 could also be connected across the input to amplifier 25. The load of the unit 29 is the resistance 20 connected over conductors 31 and 32 to respective grounds 21 and 33.

By the use of the bridging amplifier 27 and variable attenuator 28, the desired input level is impressed on the rectifier unit 29. The unit 29 may be the usual type of noise reduction unit employed in sound recording in which a rectifier and filter unit is employed, a typical unit being an RCA MI-3218. This unit can be of the exponential type wherein the ratio of signal level to D. C. output varies exponentially to provide the proper input-output relationship.

The output of the unit 29, as mentioned above, varies the voltage across the resistance 20 in accordance with the signal level. The adjustment of the system is such that when no signal is impressed upon the photocell 10, the output of the unit 29 produces a voltage across the resistance 20 slightly less than the polarizing voltage of the battery or other voltage supply 12. This insures that a small voltage of the correct polarity is supplied to the photocell 10. Thus, during a no-signal condition the transmission efficiency of the photocell 10 is extremely low. However, as soon as the signal on the film is impressed upon the photoelectric cell 10, sufficient signal passes to the unit 29 to reduce the voltage across the resistance 20 and thus increase the voltage upon the photocell 10.

The increase and decrease in voltage across the resistance 20, and, consequently, the increase and decrease in voltage upon the photoelectric cell 10 are extremely rapid over a small range of low signal levels, after which these voltages remain substantially constant. This action may be explained by referring to Fig. 2 wherein film level is plotted against the gain or amplification of the entire system. The solid curve ABC shows that between the film range of -60 db. and full-track modulation taken as zero db., the gain is not only higher than below the -60 db. level, but is substantially constant. The general shape of this curve is produced by the exponential action of the noise reduction unit, this action attenuating currents produced by any light variations caused by dirt or scratches appearing upon the sound track area of the film during periods of silence or periods of low modulations below -60 db. In the art of sound recording it has been found that modulations lying below this film level may be substantially eliminated inasmuch as any desired signal modulations to be recorded are maintained above this point so that the film signal range being utilized lies between -60 to zero db.

Thus, by the use of the invention in a rerecording system as illustrated the new sound track will not have thereon any undesired modulations caused by dirt, scratches or the graininess of the film being rerecorded between the true sound periods. When the invention is used in a system reproducing a film not rerecorded with the invention, then the same result is directly obtained. It is obvious, of course, that a "silent" track may be reproduced with the invention.

In dotted lines interposed between the bridging amplifier 27 and variable attenuator 28, is shown a volume limiter 35, this limiter being usable in the circuit if it is desired to flatten or maintain the system gain more nearly constant between the -60 db. level point and the zero db. level point, as shown by the dotted lines BD in Fig. 2. By the use of a volume limiter, such as an RCA broadcast limiter 96A, the combination characteristic ABD is obtainable. The dot-and-dash characteristic ABEF is obtainable by the use of an exponential rectifier-amplifier combination adjusted to run out of current at point E, thus limiting the system to a constant gain between points E and F. A linear rectifier-amplifier unit may also be adjusted to run out of current at point B, providing the ABD characteristic. Thus, almost any desired operating characteristic is obtainable.

With the above-described invention, therefore, it is possible to obtain substantially complete silence at the loud-speakers during no-signal pe-

riods either from film rerecorded or reproduced with a system embodying the invention, thus enhancing the overall reproduction and expression of the sound.

What I claim as my invention is:

1. A sound reproducing system comprising means for obtaining light variations corresponding to sound waves, means for translating said light variations into corresponding electrical currents, means for amplifying said currents, means for translating said amplified currents into sound waves, and means for controlling the efficiency of translation of said light variations into electrical currents by said electrical currents whereby light variations below a predetermined level are substantially eliminated from said current-to-sound translating means.

2. A sound reproducing system in accordance with claim 1 in which said last-mentioned means includes an electronic translator of said currents having a characteristic substantially flat over a predetermined range of amplitudes and comparatively steep over a lower range of amplitudes.

3. The method of rerecording a sound record from a film comprising generating electrical currents from a light beam varying in substantial accordance with the ratio of variation of a sound record and varying the efficiency of generation of said currents from said light beam to substantially prevent the generation of currents during the periods between occurrences of said sound record on said film.

4. The method of selectively varying the generation of currents from light variations comprising generating electrical currents in direct proportion to said light variations at a predetermined efficiency over a predetermined range of amplitudes of light variations and decreasing the efficiency of generation of electrical currents to substantially eliminate the generation thereof from light variations having amplitudes below a predetermined amplitude.

5. The method of selectively reproducing a sound record having modulations of different amplitudes comprising scanning said record to obtain light variations in accordance therewith, generating electrical currents from all light variations above a certain amplitude at a substantially constant efficiency, generating electrical currents from all light variations below said certain amplitude at a lower efficiency, and translating said currents into sound waves.

6. The method in accordance with claim 5 in which the efficiency of generation of said modulations below said certain amplitude decreases with decreases in amplitude of said modulations.

7. A sound reproducing system comprising a sound record having modulations of different amplitudes and periods of silence therein, means for obtaining light variations corresponding to said record, means for generating electrical currents with certain of said light variations, means for translating said currents into sound waves, and means connected intermediate said generating means and said translating means for deriving a voltage corresponding to the average value of said currents for varying the efficiency of generation of said electrical currents in accordance with the amplitudes of the modulations of said record.

8. A sound reproducing system comprising a sound record having modulations of different amplitudes and periods of silence therein, means for translating said modulations into electrical currents, means for translating said currents into sound waves, and means connected to and inter-

mediate said first-mentioned translating means and said second-mentioned translating means for varying the efficiency of said first-mentioned translating means in accordance with the amplitudes of the modulations of said record, said first-mentioned translating means comprising a photocell and said last-mentioned means including means for varying the polarizing voltage on said cell.

9. A sound reproducing system comprising a sound record having modulations of different amplitudes and periods of silence therein, means for translating said modulations into electrical currents, means for translating said currents into sound waves, and means connected to and inter-

mediate said first-mentioned translating means and said second-mentioned translating means for varying the efficiency of said first-mentioned translating means in accordance with the amplitudes of the modulations of said record, said first-mentioned translating means comprising a photocell and said last-mentioned means including means for decreasing the polarizing voltage on said cell at a rapid rate for decreases in amplitudes of said modulations within the lower range of said modulations and maintaining said polarizing voltage substantially constant for changes of amplitude of said modulations in the higher amplitude range of modulations.

BARTON KREUZER.