

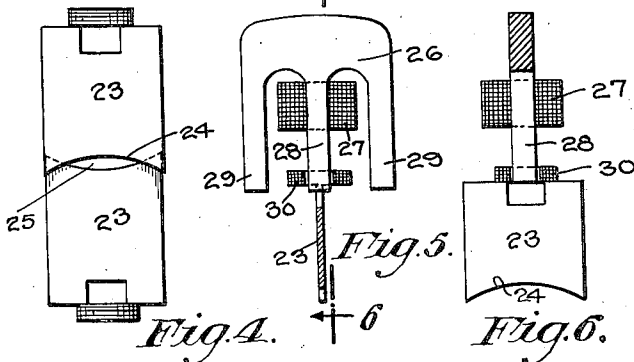
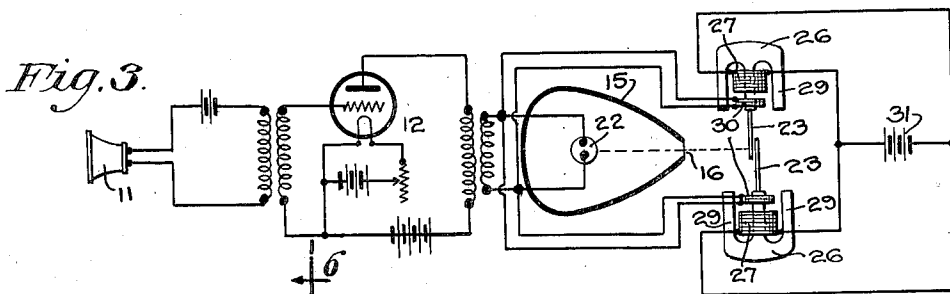
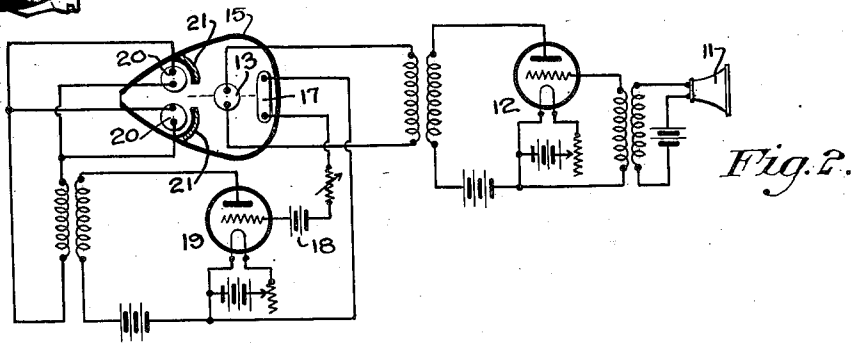
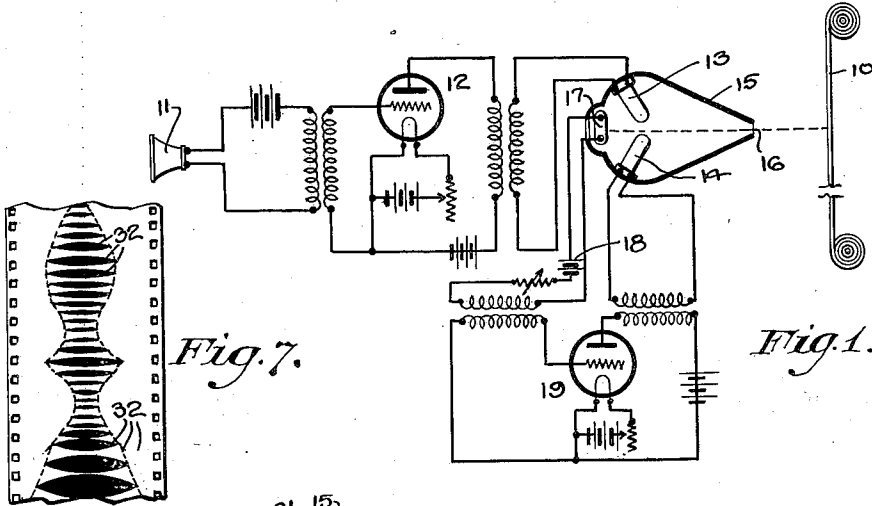
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B. KWARTIN

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REGENERATIVE SOUND RECORDING DEVICE

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Inventor:
Bernard Kwartin,
By Lem Edebo
Attorney.

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REGENERATIVE SOUND RECORDING
DEVICE

Bernard Kwartin, Brooklyn, N. Y.

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6 Claims. (Cl. 179—100.3)

This invention relates generally to improvements in the art of recording sound and more particularly to a regenerative sound recording device for recording sounds upon a photographic film.

It is among the principal objects of the present invention to provide a sound recording device which is operative to convert electrical current variations into corresponding light variations and which is capable of producing greater variations in the light intensity with a minimum of current amplification.

A still further object of the invention is the provision of a sound recording device including primary and secondary sources of light operative to conjointly produce light rays the intensities of which vary in accordance with the sounds as originally produced, the primary source being included in a microphone circuit from which it derives its energy and the secondary source being included in an electrically independent photo-electric cell circuit in which current variations are established in accordance with the variations in intensity of the primary light source.

Still another object of the invention is the provision of a sound recording device which has an increased range of sensitivity and sound shading capacity, which is adapted to regeneratively produce light fluctuations in fixed accordance with the initially produced sounds, and which is capable of recording the strongest and weakest sound effects without exaggerated amplification.

Still another object of the invention is the provision of an improved shutter arrangement for variably intercepting the light rays, this shutter arrangement being of such design and operable in such manner as to produce upon the photographic film a sound record in the form of a series of bands or striations of substantially elliptical form, both the major and minor axes of each of which increase or decrease accordingly as the intensity of the sound vibration is increased or decreased. The present arrangement for photographically recording sounds thus takes into account not only the intensity differences in the photographic representations of the sounds but also the differences in amplitude.

A still further object of this invention is the provision of an improved photographic record of sounds which consists of a series of longitudinally spaced bands or striations the longitudinal and transverse dimensions of which both increase or decrease in accordance with the variations in intensity of the sounds as originally produced. In other words it is among the aims

of this invention to produce a photographic record of sound vibrations which is characterized by the fact that the areas of the photographic representations of the respective sound vibrations vary in accordance with the changes in the intensities of said vibrations.

Other objects and advantages of the present invention will appear more fully hereinafter.

The invention consists substantially in the combination, construction, assembly and relative arrangement of parts, all as will be more fully hereinafter described, as shown in the accompanying drawing, and as finally pointed out in the appended claims. In the accompanying drawing, which is more or less diagrammatic and merely illustrative of the general principles of the invention:—

Figure 1 is a diagrammatic view showing an arrangement for photographically recording sounds upon a traveling film in accordance with the principles of this invention;

Figure 2 is a diagrammatic view of a slightly modified arrangement of the apparatus;

Figure 3 is a diagrammatic view showing an arrangement for photographically recording sounds upon a film in accordance with the principles of the present invention;

Figure 4 is an elevational view of a preferred form of cooperating shutters for producing the desired photographic representations of the sounds to be recorded;

Figure 5 is an enlarged view of one of the shutters shown in Figure 4 and its associated electromagnet;

Figure 6 is a view taken on the line 6—6 of Figure 5; and

Figure 7 is an enlarged fragmentary view of a photographic sound record obtained by using the shutter arrangement of Figures 3 and 4.

Referring now to the drawing and more particularly to Figure 1 thereof which shows an arrangement for photographically recording sounds upon a traveling film 10, it will be observed that the sounds which are to be recorded upon this film are initially received by a suitable microphone 11 or similar device which is adapted to convert the sound vibrations as originally produced into corresponding electrical current variations. These current variations, which are thus set up in the microphone circuit, may be suitably amplified, as at 12, preliminarily to energizing an actinic lamp 13 or other source of light capable of producing light rays of varying intensity. It will be understood, of course, that the intensity of the light rays which ema-

nate from the primary source of light 13 is entirely dependent upon and is in accordance with the current variations established in the microphone circuit 12.

5 Heretofore and prior to this invention it has been the usual practice to employ a source of light, such as an actinic lamp, which is energized by the current variations established in the microphone circuit. The results obtained
10 through the use of this single source of light have been far from satisfactory due to the fact that an exaggerated amount of amplification was necessary in order to obtain the required intensity of light. This not only necessarily entailed over-
15 loading of the actinic lamp, but it also considerably reduced the sensitivity of the lamp to current variation extending over a wide range. In other words, because of the exaggerated amplification necessary to produce light rays of maxi-
20 mum intensity corresponding to the strongest sound effect, it has been exceedingly difficult, if not entirely impossible, to produce light rays of such minimum intensity as are necessary to faithfully record those sounds of weakest or
25 finest character.

The present invention overcomes these difficulties heretofore encountered by employing a secondary source of light which is also capable of producing light rays of varying intensity.
30 Preferably, this secondary source of light is included in a circuit which is electrically independent of that which includes the primary source of light 13, this secondary source of light being designated in Figure 1 by the reference numeral
35 14. As appears quite clearly in Figure 1 both the primary source of light 13 and the secondary source of light 14 are suitably housed within a casing 15 having an opening 16 through which
40 are commonly projected the light rays emanating from both sources. Also housed within the casing 15 and adapted to be influenced by the light rays emanating from the primary source of light 13 is a photo-electric cell 17. This
45 photo-electric cell 17, which is connected to a suitable source of electrical energy 18, is included in any suitable type of amplifying circuit 19 for supplying a variable current to the secondary source of light 14. It will of course be apparent that the variations in intensity of the light rays
50 produced by this secondary source of light are in strict accordance with the variations in the light rays produced by the primary source of light 13. The light rays thus produced by the secondary source of light are added to those produced by the
55 primary source of light in such manner that the resultant light rays which are projected through the opening 16 of the casing 15 are of greater intensity than those which might have been produced solely by the primary source of light.

60 Inasmuch as the energization of the secondary source of light is dependent upon the light rays emanating from the primary source of light and only indirectly by the current variations established in the microphone circuit 12, it will be
65 apparent that the lamp 13 may be of much smaller capacity than in those cases where it is the sole source of light. On the other hand, the secondary source of light 14 may be of any desired capacity greater than that of the lamp 13, or any number of secondary sources of light may
70 be employed as is illustrated in Figure 2 wherein a pair of secondary lamps 20 are employed. If desired, the secondary lamp may be respectively provided with suitable reflectors 21 arranged for
75 the purpose of directing a more concentrated

light through the opening in the casing and upon the traveling photographic film.

It will be apparent that the arrangement just described affords what is in effect a regenerative sound recording lamp inasmuch as the light variations which are produced by the primary lamp
5 13 are reconverted into corresponding electrical variations, which latter variations after being suitably amplified are employed to energize the secondary lamp 14. The light variations thus
10 produced by the secondary lamp 14 are not only additive with respect to those produced by the primary lamp but are also employed to further influence the photo-electric cell 17, thereby still
15 further decreasing the resistance of this cell and causing the current in the secondary lamp circuit 19 to be increased proportionately as the resistance in the photo-electric cell is decreased. This cycle of operation continues until the resistance of the photo-electric cell has been reduced
20 to an irreducible minimum with the consequent result that a maximum flow of current is obtained for energizing the secondary lamp 14 of Figure 1 or the secondary lamp 20 of Figure 2.

The advantages of the present invention will be quite apparent inasmuch as it makes possible the photographic recordation of sound in such
manner that the nuances between sounds of strongest and weakest character are defined in
30 a manner not heretofore possible. Thus, where the sounds as originally produced are quite feeble in character, the primary lamp 13 which is of relatively small capacity, will produce light variations which are correspondingly feeble in character but which are nevertheless sufficiently
35 strong to influence the photo-electric cell 17 in such manner as to effect the energization of and so produce light rays from the secondary lamp 14 which, when added to the light rays produced by the primary lamp 13, are sufficient to produce
40 a faithful record upon the photographic film of these feeble sounds. One the other hand, when the sounds as initially produced are quite strong in character, the primary lamp 13 is correspondingly energized to produce light rays of strong
45 intensity which in turn strongly influence the photo-electric cell to produce strong light in the secondary lamp 14. The strong light effects so obtained in the lamps 13 and 14 are produced without energizing the primary light source to a degree beyond its capacity and without entailing any undue or exaggerated amplification in the energizing circuit for the primary lamp.

Referring now more particularly to Figure 3, it will be observed that a shutter arrangement has
55 been provided for variably intercepting the light rays which emanate from within the interior of the casing 15. These light rays may be produced either by means of an actinic lamp 22 which is variably energized in accordance with the initially produced sound variations in the usual manner well known in the art or by the regenerative principle as shown in Figures 1 and 2 hereinbefore. Arranged immediately in advance of the
60 opening 16 in the casing 15 are a pair of shutters 23, these shutters being movable in parallel planes and toward and away from each other. As more clearly appears in Figure 4 each of these shutters, which are preferably constructed of an opaque material, is provided with an arcuately
70 shaped inner end 24. By reason of this construction, it will be apparent that as these shutters are shifted toward or away from each other to effect a more or less overlapping relation between the curved inner ends thereof a greater or smaller
75

opening 25 of substantially elliptical form is afforded through which the light rays may pass for projection upon the photographic film.

Obviously, in order to obtain a faithful photographic representation of the sounds as initially produced, it is imperative that the shutters 23 operate in exact synchronism with the current variations established in the microphone circuit for energization of the actinic light source. In order to secure this synchronous actuation of the shutters 23, the latter are respectively secured to a pair of moving coils each of which tends to move when subjected to a fluctuating magnetic field. As appears quite clearly in Figure 3 each of the shutters 23 has operatively associated therewith an electromagnet 26 which is energized by the passage of an electric current through the stationary coil 27. The electromagnet is provided with a central core 28 upon which the stationary coil 27 is mounted and with a pair of outside poles 29 of opposite polarity. It will be understood that the passage of current through the coil 27 creates a strong magnetic field between the poles 29—29. Also surrounding the central core 28 of each electromagnet is a small movable coil 30 to which is suitably secured one of the shutters 23. Each of these coils 30 is connected in parallel with the light source 22 in such manner that this light source and both of the movable coils are simultaneously energized by the current variations which are set up in accordance with the sound vibrations as initially produced. Energy is supplied to the stationary coils 28 from a suitable source of supply, such as a battery 31.

It will be understood that current passing through the movable coils 30 render the same magnetic in consequence of which they tend to move within the magnetic field created between the poles 29 of the electromagnet. Inasmuch as the current value changes in these coils in accordance with the variations in the sound vibrations, there is produced a change in the magnetic field of each movable coil. Due to the reaction which takes place between the changeable magnetic field of the movable coil and the constant magnetic field of the stationary coil the former is set in motion and moves toward and away from the stationary coil in accordance with the current variations established in the microphone circuit. This movement of the coils 30 is imparted to the shutters 23 which are respectively secured to the coils with the result that a greater or less opening is provided between the proximate ends of the shutters through which the light rays emanating from the light source 22 may pass.

Inasmuch as both of the coils 30 are dependent for their energization upon the same current variations which are employed to energize the light source, irrespective of whether the latter is of the simple form shown in Figure 3 or the regenerative arrangement shown in Figures 1 and 2, it will be apparent that the shutters 23—23 will be caused to move away from or toward each other whereby to provide a substantially elliptical opening between the overlapping ends thereof the area of which varies in strict accordance with the current variations and the sound vibrations corresponding thereto. It will be understood of course that the proximate ends of the shutters 23—23 may be shaped other than as shown to produce a sound record which is comparable in every respect with that shown in Figure 5, as by providing V-shaped notches in the ends of the shutters

which together function to provide a diamond-shaped opening of variable longitudinal and transverse dimensions.

Figure 5 is an enlarged fragmentary view of a sound record such as may be produced by the arrangement shown in Figure 3 and wherein are employed the shutters illustrated in Figure 4. It will be seen that this record is made up of a series of longitudinally spaced bands or striations 32 each of which is of substantially oval or elliptical shape with the major axes thereof extending transversely of the film. It will further be noted that longitudinal and transverse dimensions of each striation (i. e. the minor and major axes thereof) vary accordingly as the value of the current supplied to the light source is varied. Thus, where the initially produced sound vibration is of great strength the longitudinal and transverse dimensions of the photographic record thereof are both greater than are the corresponding dimensions of the photographic record of a weaker sound vibration.

The advantages of the type of record shown in Figure 5 will be quite apparent inasmuch as it makes possible the recordation of sound effects upon the film which take into account the photographic representations of both the intensity and amplitude differences between the sounds. The result is the provision of a photographic record of sounds wherein the nuances between sound vibrations of greatest and weakest character are rendered larger, richer and clearer than has been possible heretofore.

It will be understood of course that various changes may be made from time to time in the arrangement and method herein shown and described without departing from the real spirit or general principles of the invention, and it is accordingly intended to claim the same broadly, as well as specifically, as indicated in the appended claims.

What is claimed as new and useful is:

1. In an apparatus for photographically recording sound vibrations, in combination, means responsive to the sound vibrations for converting the latter into corresponding electrical current variations, a light source arranged to be variably energized by said current variations for producing light variations corresponding to said sound variations, a pair of cooperating shutters arranged in advance of said light source and movable toward and away from each other, the inner ends of said shutters being relatively so arranged and complementally formed that upon movement of said shutters relatively to each other there is formed therebetween an opening variable in depth and in width, and means for effecting the movement of said shutters relatively to each other accordingly as the intensity of the said light source is varied.

2. In an apparatus for photographically recording sounds upon a photographic film, in combination, means variably responsive to sound variations for recording the same upon the film, light intercepting means arranged in advance of the film and provided with an aperture of variable width and depth, and means energizable commonly with said sound responsive means and movable in a fluctuating magnetic field for varying the width and depth of said aperture, the changes in said magnetic field being dependent upon said sound variations.

3. In an apparatus for photographically recording sounds, in combination, sound responsive means for converting the sounds into corre-

sponding electrical current variations, means variably energizable by said current variations for producing light rays of varying intensities, a pair of coating light intercepting screens complementally formed to provide an aperture of substantially biconvex form through which the light rays may pass, means for creating a constant magnetic field in the immediate vicinity of each of said screens, a pair of electromagnetic coils respectively located within said constant magnetic fields and secured to said screens, said coils being commonly energized by said current variations whereby to create changeable magnetic fields therein to vary the relative position of said screens and so change the effective dimensions of both the major and minor axes of said aperture.

4. In an apparatus for photographically producing a sound record upon a photographic film, in combination, a sound responsive device, a light producing element variably activated by said sound responsive device for recording the sounds upon a film, a pair of light intercepting shutters arranged between said light producing element and said film, the proximate ends of said shutters being complementally formed to provide an opening of greater width than depth and wherein the

depth gradually decreases in opposite directions from the center thereof, and means for varying the relative position of said shutters whereby to increase or decrease the effective dimensions of said opening as respects both the width and the depth thereof in accordance with the variations in the sounds as originally produced.

5. The method of producing a photographic record of sound vibrations which consists in passing a photographic film before a source of light which varies in intensity in accordance with the variations in said sound vibrations and simultaneously exposing to said light successive areas of said film which vary both in horizontal and vertical dimensions accordingly as the intensity of said light varies.

6. The method of producing a photographic record of sound vibrations which consists in passing a photographic film before a source of light the intensity of which varies in accordance with the variations in said sound vibrations and simultaneously exposing to said light successive areas of said film in each of which the length of the major and minor axes are both correspondingly increased or decreased accordingly as the intensity of said light is increased or decreased.

BERNARD KWARTIN.