July 14, 1942. W. V. WOLFE 2,289,893

SOUND RECORDING SYSTEM

Filed June 26, 1939

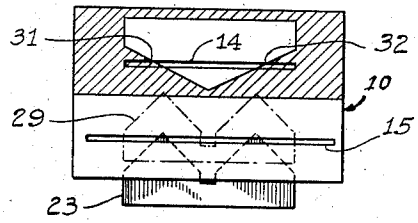


Fig. 5.

Fig. 1.

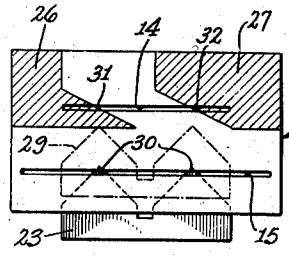
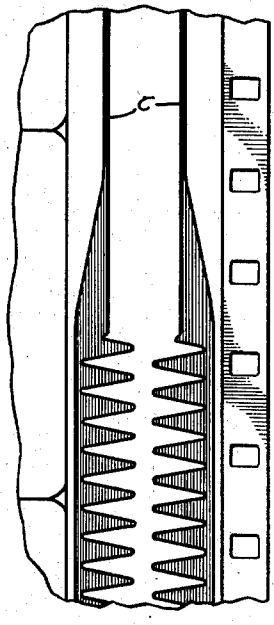


Fig. 2.

Fig. 3.



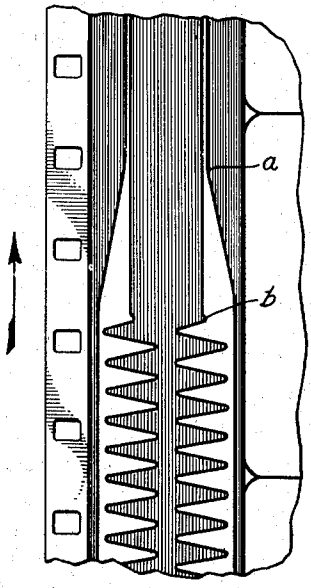


Fig. 4.

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SOUND RECORDING SYSTEM

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Application June 26, 1939, Serial No. 281,156

9 Claims. (Cl. 179—100.3)

This invention relates to sound recording systems and particularly to a system wherein an improved method of and means for obtaining noise reduction is provided.

In copending application Serial No. 168,173, filed October 9, 1937, there is disclosed a sound recording system capable of producing a reverse negative or direct positive sound record which is immediately available for reproduction with a high degree of fidelity. One of the important features of the invention described in this copending application is the provision of anticipatory noise reduction wherein the variations in the sound track produced by the average signal current or the envelope of the signal current are effective at a point on the film in advance of the point of application of the modulations. Ordinarily, in a variable area sound recording system, wherein a shutter or shutters are provided for controlling the unmodulated portion of the sound track, and a vibrating element such as a galvanometer mirror is employed for signal modulation, the shutters are actuated substantially simultaneously with the actuation of the galvanometer. Such a system may permit clipping of the peaks of the modulations particularly during the sudden application of high amplitude sounds due to the inability of the shutters to clear the track area for the modulations. By the use of the reverse negative or direct positive system disclosed in the above-mentioned copending application, it is possible to direct the light beam being modulated by the envelope currents at a point on a film in advance of the point of impression of the modulations so that the track area is prepared for the modulations.

The direct positive type of system, however, provides, after development, a positive record which has been produced without the use of a negative. Although this direct positive system has many advantages, one disadvantage thereof might be that there is no negative from which to make additional prints. In this case, if further positives or prints are desired, it is necessary to print a negative from the direct positive, from which the additional prints may be made, or rerecord to obtain the necessary negative as described in the copending application referred to above. The present invention provides a method of and system for first producing a negative or for directly producing a negative which embodies anticipatory noise reduction and from which any desired number of prints may be made by printing.

An object of the invention, therefore, is to improve the present systems of sound recording having noise reduction embodied therein.

Another object of the invention is to provide a recording system for introducing anticipatory noise reduction on a negative film.

A further object of the invention is to provide anticipatory noise reduction on a sound negative.

A further object of the invention is to produce a negative sound record which may be printed to a positive record having anticipatory noise reduction.

Although the novel features which are believed to be characteristic of this invention are pointed out with particularity in the claims appended herewith, 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—

Figure 1 is a diagrammatic view of the recording system embodying the invention;

Figure 2 is a diagram of the slit mask element of Fig. 1;

Figure 3 is a negative sound record produced with the system of Fig. 1;

Figure 4 is a sound record print made from the negative of Fig. 3; and

Figure 5 is a diagram of an aperture arrangement for producting a different form of track from that shown in Figs. 3 and 4.

Referring now to Fig. 1, light from a light source represented by a filament **5** is collected by a lens **6**, projected through an aperture mask **7** and then to a galvanometer mirror **8** by a lens **9**. The beam of reflected light pre-shaped by the aperture in mask **7** is projected to a slit mask **10** through a condenser lens **11** and a prism **12**. The mask **10** has a recording or modulation slit **14** and a noise reduction slit **15** therein (see Figs. 2 and 5). Light passing through the slit **14** is projected onto a film **17** through lenses **18**, while light passing through the slit **15** is projected on the film **17** through a deflecting prism **20** and lenses **21**.

A shutter vane **23**, operated by a motor **24**, is directly behind the noise reduction slit **15** to intercept the light passing to the film **17** through the slit **15**. The shutter **23** is actuated in accordance with the average value or the envelope of the currents being recorded and impressed on motor **24** as in the usual type of noise reduction system. It is understood, of course, that the usual type of electrical circuit may be employed for impressing the signal currents to be recorded

upon the galvanometer for vibrating the mirror 8 in accordance with the amplitude and frequency of the currents.

To explain the operation of the optical recording system shown in Fig. 1, reference is made to Fig. 2, which is a view of the slit mask 10 taken along the line 2—2 of Fig. 1. It is to be understood that the aperture of mask 7 produces what is known as a Class A sound track, although this form of track is not limited to this form of aperture, as described in the above-mentioned copending application. In Fig. 2, the slit mask 10 is shown as a rectangular plate having the elongated slit 14 for passing light in accordance with the amplitude and frequency of the sound waves being recorded, and the longer elongated slit 15 positioned below slit 14 for passing light in accordance with the envelope of the sound waves being recorded. The light beam from the aperture mask or plate 7 is shown on the plate 10 in the unshaded portions of the plate. In other words, the only portions of the plate 10 not receiving light are shown cross-hatched at 26 and 27.

There is also shown in Fig. 2 two positions of the shutter vane 23, the lower outlines being the no-signal position of the shutter, and the dot and dash outlines 29 showing the full-track modulation position of the shutter. Thus, the shutter vane 23 will take a position between these two limiting positions shown at 23 and 29 in accordance with the amplitude of the signal being impressed on the mirror 8. With the shutter 23 in the no-signal position, light will reach the film 17 over the entire sound track area except at the tip portions 30, which coincide with the shaded portions 26 and 27 at 31 and 32 to produce the zero traces, such as shown in Fig. 3 at *c*.

As disclosed in copending application Serial No. 168,173, referred to above, the type of recording system just described will produce what is called either a reverse negative or a direct positive Class A sound track immediately playable, after normal processing, in a sound reproducing machine. This type of record is shown in Fig. 4. This record has anticipatory noise reduction as shown by the distance between points *a* and *b*, since the light passing the noise reduction slit 15 impinges on the film 17 (running downwardly) at a point in advance of the impingement of the light modulations through slit 14 (see Fig. 1), although simultaneously with respect to time. The shutter 23 becomes active at the point *a* at the time the modulations begin at point *b*, and the sound track area is thus prepared in advance for the modulations regardless of their amplitude of initial impression.

However, the record produced is a print and it is necessary to make a negative, such as shown in Fig. 3, therefrom to provide additional duplicate prints.

With the present invention, however, such a sound negative may be obtained directly. This is accomplished by recording with the system of Figs. 1 and 2 upon an auto-positive film such as is now being manufactured by Eastman Kodak Co. and called "auto-positive." Thus, by direct recording and normal processing, a negative sound track having anticipatory noise reduction is produced. In this case, as shown in Fig. 3, the zero line traces *c* and the modulated portion of the track will be opaque and the remainder of the sound track area will be transparent so that it may be used for printing any number of prints having anticipatory noise reduction as shown in Fig. 4. The auto-positive film requires the normal commercial type of development, one type of developer being Eastman SD–12.

It is to be understood, of course, that a special reversal developing process may be applied to the usual type of film to produce a negative, but this method is not practical from a commercial standpoint nor does it result in as satisfactory a product.

Referring now to Fig. 5, this view is similar to Fig. 2, like parts being given identical numbers. The light beam in Fig. 5 has a lower rectangular portion and an upper triangular portion, and its vibrations are normal to the slits 14 and 15. This type of beam is obtained by only changing the mask 7 to one having the proper apertures, with the result that a standard duplex variable area track is produced having anticipatory noise reduction, as shown in Figs. 3 and 4. The form of this track will appear as shown in Figs. 3 and 4 except that the modulations will be in phase instead of 180° out of phase as shown. It is also to be understood that a unilateral or single edge track may be obtained by using a mask having a shape corresponding to one-half of the mask of Fig. 5. Thus, the invention is applicable to several types of sound tracks, the attendant advantages above-mentioned being applicable to each type.

I claim as my invention:

1. A variable area sound wave recording system which includes means for simultaneously making on an auto-positive emulsion stock a direct negative record of said sound waves and of the volume of said sound waves, and means adapted to position said volume record adjacent to and in advance of said wave record.

2. A sound wave recording system which includes means for simultaneously making on an auto-positive film a direct negative record of said sound waves and of the volume of said sound waves, and means adapted to position said records adjacent to and displaced longitudinally from one another, said volume record being positioned in advance of said wave record, said direct negative being printable to produce a positive record.

3. A sound wave recording system comprising means for making on an auto-positive film a direct negative sound record of said sound waves, and means for simultaneously making on said film a direct negative record of the volume of said waves, said record of the volume of said waves being displaced longitudinally from the record of said sound waves and in advance of said wave record.

4. The sound wave record producing method which includes light-impressing an auto-positive film in accordance with sound waves to be recorded to make a record thereof, and light-impressing said film in accordance with the volume of said sound waves to make a record thereof spaced longitudinally from the record of said sound waves, said volume record preceding said wave record.

5. The sound wave recording method which includes light-impressing an auto-positive film in accordance with said sound waves to make a record thereof, simultaneously light-impressing said film in accordance with the volume of said sound waves to make a record thereof spaced longitudinally from said record of said sound waves, said volume record preceding said wave record, and normally developing said film.

6. The method of obtaining a negative sound

record comprising exposing an auto-positive film as a direct positive record, and normally processing said exposed film.

7. The method of obtaining a negative sound record having anticipatory noise reduction comprising recording a signal on auto-positive film as a direct positive record with anticipatory noise reduction, and processing said film to a negative record of said signal.

8. The variable area sound wave recording method which includes modulating light corresponding to said sound waves to make an exposure for a direct positive record in which the noise reduction exposure precedes the sound wave exposure, and processing said exposure to produce a negative record.

9. The variable area sound wave recording method which includes exposing a film at one point with light modulated in accordance with the instantaneous variations of said sound waves, and at another point in accordance with the average value of the variation of said sound waves, said average value exposure preceding the instantaneous modulated exposure longitudinally of said film, and processing said film to produce a negative record of said sound waves.

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