June 25, 1940. H. J. HASBROUCK, JR 2,205,528

SOUND REPRODUCTION

Filed Feb. 5, 1935

Fig. 1

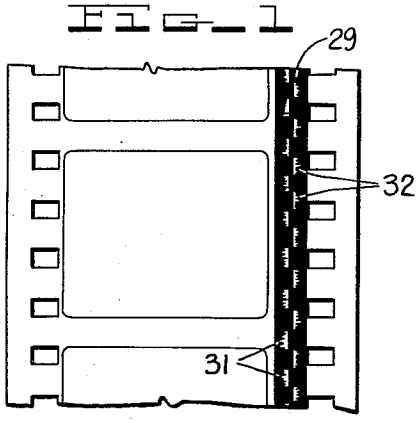


Fig. 2

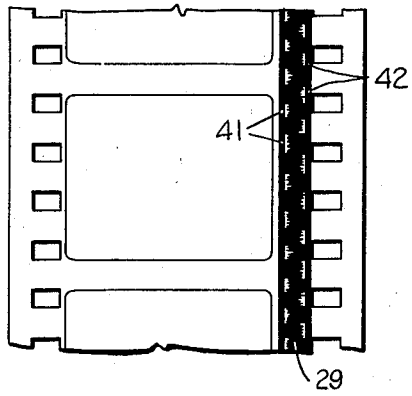


Fig. 4

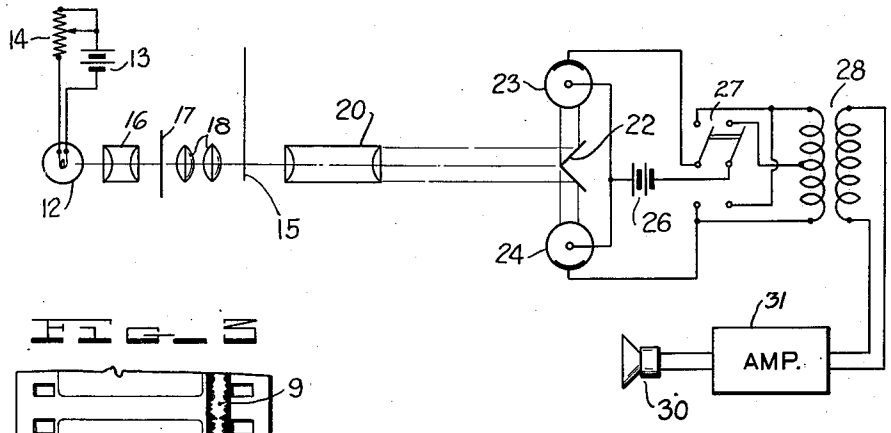


Fig. 3

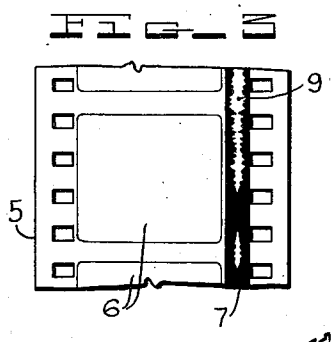
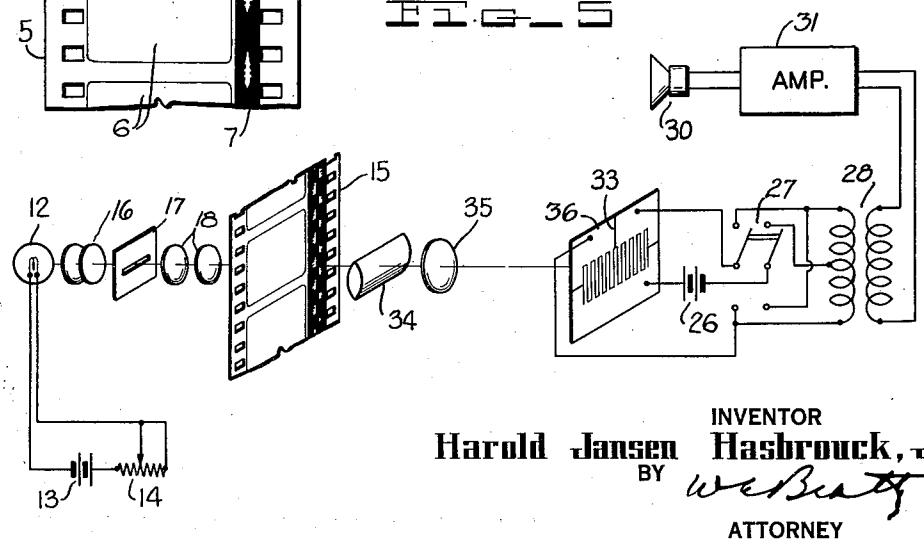


Fig. 5



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UNITED STATES PATENT OFFICE

2,205,528

SOUND REPRODUCTION

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Application February 5, 1935, Serial No. 5,014

2 Claims. (Cl. 179—100.3)

This invention relates to the reproduction of sound from records and particularly to the reproduction of sound from film records of the noise reduction type wherein the photographic positive print is transparent substantially only in portions corresponding to the sound modulations, any unmodulated transparent portion of the sound track being substantially absent, thereby preventing ground noises in the unmodulated portion.

A pioneer disclosure in the art of reproducing sound from records of the noise reduction type just mentioned is disclosed and claimed in U. S. patent to Adsit No. 1,291,702, patented January 21, 1919. As disclosed in this patent, the record to be reproduced has opposite components of the recording appearing in separate longitudinal portions of the sound track, these portions lying on opposite sides of the center line of the sound track. In other words, the displacements of the galvanometer mirror in one direction from its position of rest are recorded on one side of the center line and the displacements of the galvanometer mirror in the opposite direction are recorded on the opposite side of the same line.

As disclosed in Adsit Patent 1,291,702, separate light beams are projected through the separate sound track portions to produce currents which are combined in a push-pull circuit to reproduce the sound. To avoid distortion in reproduction, each record portion should modulate its own light beam and not the other, in order that current from the two modulated light beams may correspond to the separate record portions, whereby the actual sound is accurately reproduced. There may be several factors which cause distortion in reproduction such as the drift of the galvanometer mirror from its center position, lateral weaving of the film in the recording machine, film shrinkage, displacement of negative and positive records in the printing machine, lateral weaving of the positive film in the reproducing machine, and maladjustment of the scanning light and light sensitive cell with respect to the sound track.

Although the record which I provide differs from the type used in the Adsit system mentioned above, by having the opposite components or galvanometer displacements separated on opposite sides of the center line, which of itself aids in the elimination of distortion, the present invention provides a reproducing system, for double sound track records, which reduces to a minimum the above mentioned factors pertinent to reproduction which cause distortion of the reproduced sound. In Adsit, two light sensitive devices, each receiving light from one track component, are placed adjacent to the sound track portion of the film. The present invention contemplates separating the film from the light sensitive devices by an optical system which preferably magnifies the sound track thus providing a greater separation between the two images of the sound track components, and a greater latitude for adjustment and operation as above described. The invention further contemplates a reproducing system readily convertible to accommodate either records having a double track or records having a single track.

The features of the reproducing apparatus will be more fully understood by referring to the following description read in conjunction with the accompanying drawing in which:

Figs. 1 and 2 are sections of film having two modifications of the push-pull type of record.

Fig. 3 is a section of film having a single track type of record thereon.

Fig. 4 is a diagrammatic drawing of a reproducing system adaptable for either a single track or push-pull type of record, this system employing photo-electric cells, and

Fig. 5 is a second modification of a reproducing system employing a selenium cell as well as being adaptable to either the push-pull or single track record.

Referring now to Figs. 1 and 2 showing film sections, the sound track portions **29** have two tracks each made up of modulations **31** and **32** in Fig. 1 and modulations **41** and **42** in Fig. 2, these records having two tracks separated along parallel base lines. These records may be produced with the recording systems disclosed and claimed in my co-pending application S. N. 3,239 filed Jan. 24, 1935. Each track **31**, **32**, **41** and **42** corresponds to a certain displacement of the galvanometer mirror in a particular direction and for proper reproduction the beam of light modulated with each track must be kept separate and made to effect its own particular light sensitive device.

The film section **5** shown in Fig. 3 is of the single track type with picture portion **6**, sound track portion **7** and modulations **9**. With this type of track only a single photo-sensitive element is required, the element being affected solely by the modulations since at the time of no sound, no light reaches the element.

Referring now to Fig. 4 which illustrates a reproducing system suitable for any of the sound record types above described, a lamp **12** is main-

tained at a constant intensity from an energizing source 13 under control of a rheostat 14. The light rays from lamp 12 are collected with a lens system 16, projected on aperture plate 17, the aperture thereof being focused upon the sound track portion of film 15 by lenses 18. The emergent light from the film is projected by lens unit 20 upon a V-type mirror 22, which divides the light beam into two portions, one of which impinges upon a light to current translator such as photo-electric cell 23 and the other upon another light to current translator such as photo-electric cell 24. These cells are energized in a circuit having an energy source 26, a switch 27 and the primary of a transformer 28. The output of the transformer 28 is fed to an amplifier 31 connected to a current to sound translator such as a reproducing unit 30.

In operating the above system the lamp 12 is energized and the film 15 moved at the proper speed, say 90 feet per minute. If either type of film as shown in Figs. 1 and 2 is being reproduced the lens system and reflector 22 is so adjusted that the light through one track of modulations is impinged upon one of the photo-electric cells and the light through the other track is impinged upon the other photo-electric cell. Since there is a definite separation between the two tracks of modulations a certain amount of film weaving may occur without permitting either light beam to impinge upon the wrong cell. For the reproduction of the type of records of Figs. 1 and 2, the switch 27 is thrown in an upward position, which connects the cells 23 and 24 in a push-pull relationship with the transformer 28; that is, the common anode connection through energy source 26 is connected to the midpoint of the primary of the transformer 28 while the cathodes of the cells are connected to respective terminals of the primary. Each modulation in the separate tracks affects one particular cell and since these modulations are longitudinally displaced along the sound track portion, each cell is actuated successively in accordance with the modulations or transparent portions in each track. The current variations set up in transformer 28 are amplified in the amplifier 31 and reproduced at 30. It is to be understood that the lens unit 20 may magnify the light images and thus provide a greater separation between the tracks, at the mirror 22, thus decreasing the possibility of a light beam impinging upon the wrong cell.

To reproduce film of the type shown in Fig. 3 or any other single track record of either variable area or density, it is only necessary to manipulate the switch 27 from its upward position to its lower position. This manipulation connects the cells 23 and 24 in a parallel relationship, that is, the anodes are now connected through the source 26 to the upper terminal of the primary of the transformer 28 while the cathodes are now connected together to the lower terminal of the primary. With this connection the light falling on either cell will supplement the light falling on the other, this system operating in effect as a single cell arrangement. In this circuit arrangement, therefore, it is only necessary to throw the switch to either of its operating positions when records of different types are introduced in the system to efficiently reproduce them.

Referring now to Fig. 5 showing another modification of the reproducing system, the drawing shows the same light source, lens system and film as shown in Fig. 4 except in perspective. The systems differ, however, in the use of different types of optical systems between the film and photo-sensitive device which in this case is a selenium cell. This optical system comprises a cylindrical lens 34 and a spherical lens 35 which function to project an enlarged image of the sound track upon the selenium cell 36, this cell being of the type disclosed in U. S. Patent No. 1,948,766 patented February 27th, 1934. The cell 36 is a modified cell having a vertical trace 33 which divides the cell into three sections, thus adapting it for use in a push-pull system connected in the same manner as the two photo-electric cells of Fig. 4. The trace 33 corresponds to the forward edge of the V-type mirror 22, in providing a dividing line between the two sound track images.

The operation of the system in Fig. 5 is substantially identical with that of Fig. 4, the optical system, including the cylindrical lens 34 and the spherical lens 35 serving to elongate and widen the image of the sound track upon the grid of the selenium cell 33 for the purpose of providing a greater latitude for film weaving and also to produce a more efficient cell response. It has been found that if a certain light quantum falling on selenium cell 36 is reduced in intensity and spread over the entire grid of the cell, that the efficiency of the cell will be increased and distortion decreased.

The switch arrangement 27 is operated in the same manner as in Fig. 4 for accommodating either a single track or a double track film, that is, with the switch thrown in its upward position, the sections of the selenium cell 33 are connected in a push-pull relationship while with the switch in its lower position a parallel connection is made to the transformer 28. It has been found that the above optical systems and arrangements of photo sensitive elements eliminate or reduce many of the faults of reproduction listed above.

What is claimed is:

1. In a system for reproducing sound, a selenium cell having an electrode and a pair of electrodes interdigitated with said first electrode and separated by a trace, means for projecting a modulated light beam to completely cover at all times one member of said pair and a portion of said first electrode, and a second modulated light beam to completely cover at all times the other member of said pair and another portion of said first electrode, and a common circuit connected to all of said electrodes.

2. In a sound reproducing system, a sound recording, a selenium cell having three electrode portions, means for passing a light beam through said sound recording to said selenium cell, and an optical system including a cylindrical lens and a spherical lens in a series relationship between said sound recording and said selenium cell for increasing substantially the whole of the image of said sound recording to a size comparable with said selenium cell, and an output circuit connected to said electrodes.

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