

Sept. 27, 1932.

J. NEALE

1,879,423

SYSTEM OF SOUND RECORDING AND REPRODUCTION

Filed June 3, 1929

4 Sheets-Sheet 1

Fig 1.

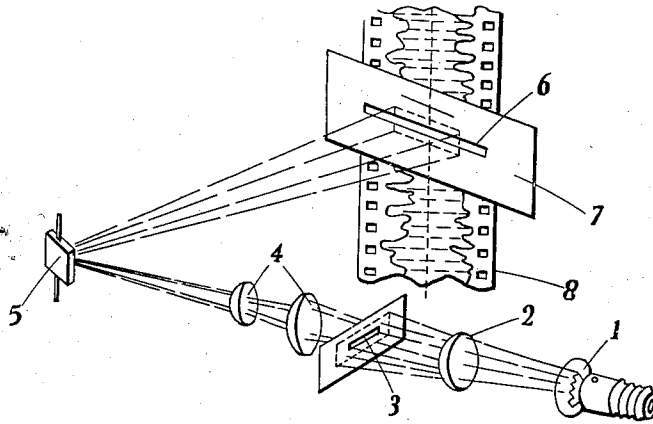
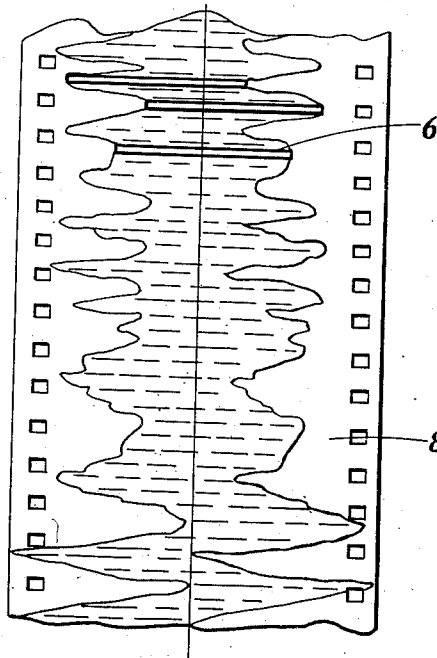


Fig. 2.



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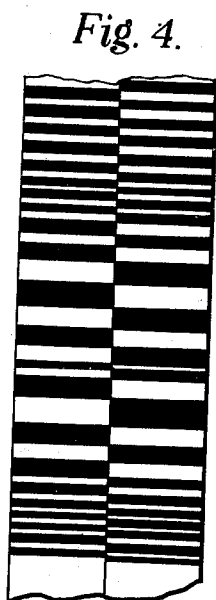
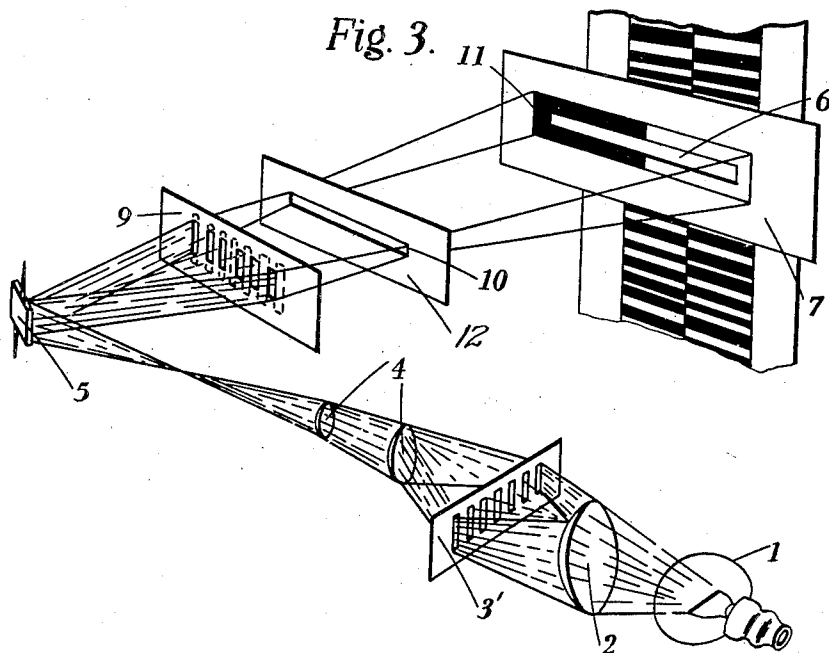
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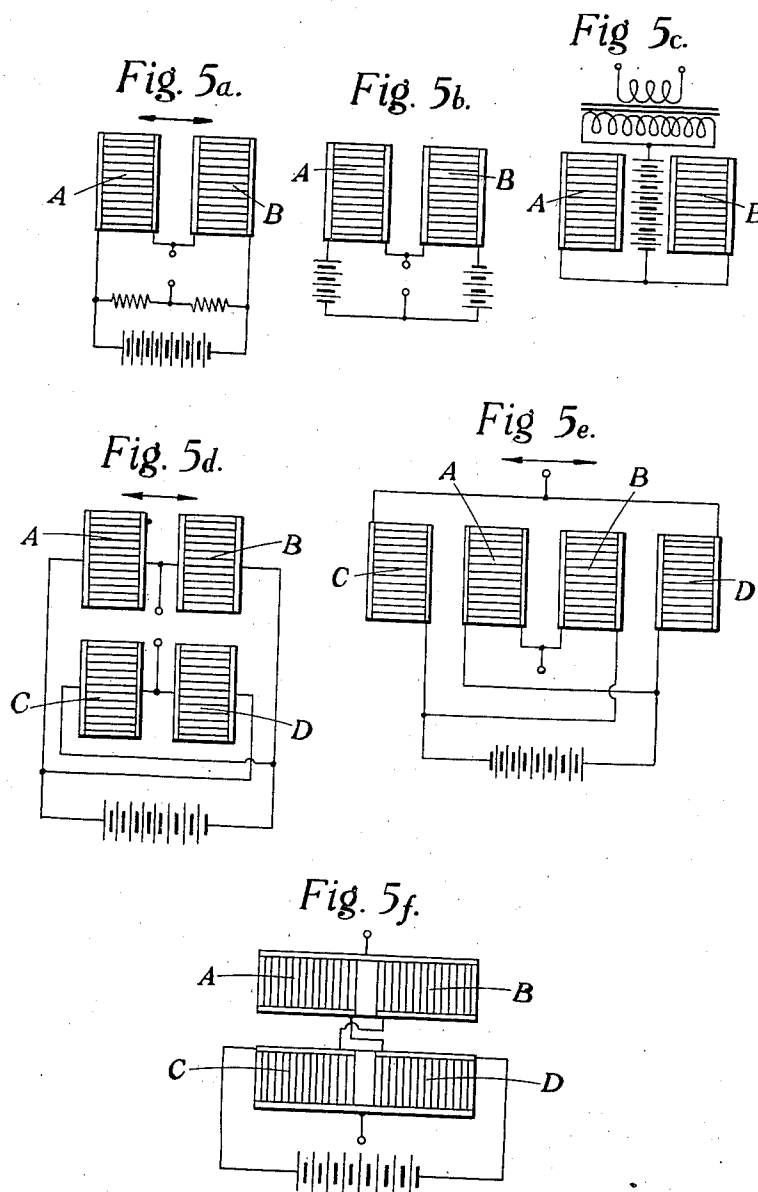
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4 Sheets-Sheet 3



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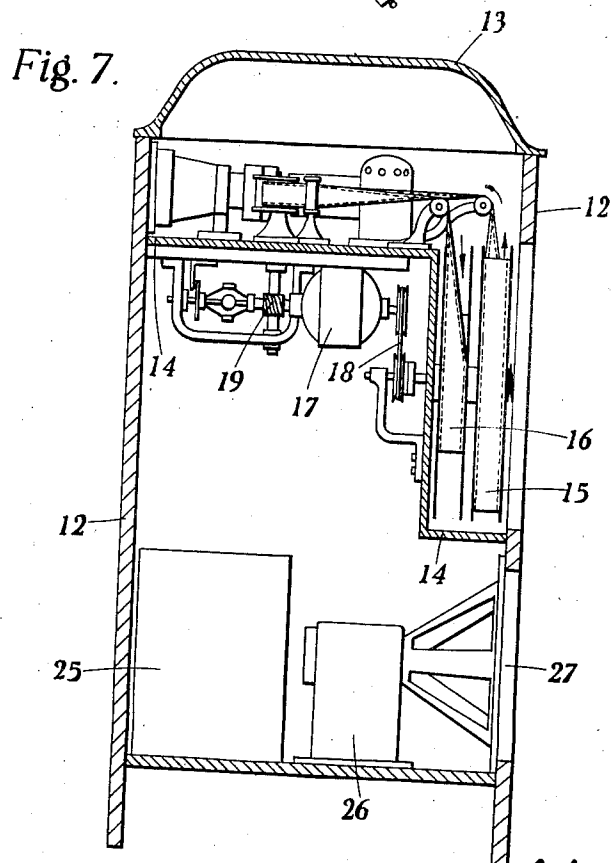
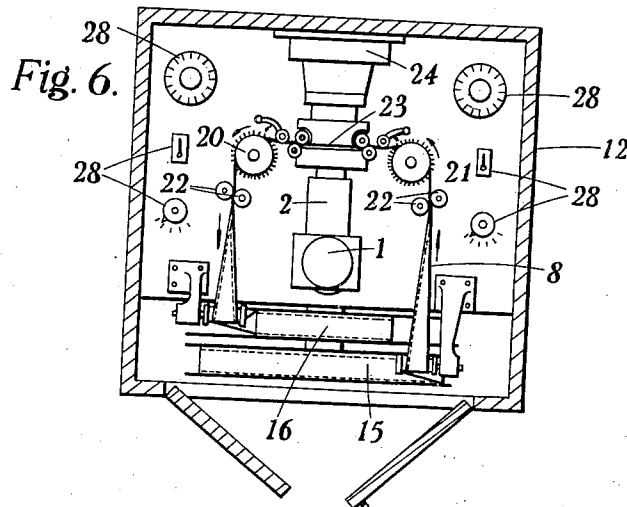
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SYSTEM OF SOUND RECORDING AND REPRODUCTION

Application filed June 3, 1929, Serial No. 368,038, and in Great Britain June 6, 1928.

This invention relates to an improved system of sound recording and reproduction.

According to the usual method of sound recording at present in use the individual sound vibrations are recorded in a single straight path in the direction of motion of the film, such vibrations being utilized to control the amount of light transmitted through the film either by variation of the total density or by the relative proportion of opaque to transparent area.

According to the present invention, however, I produce upon a film or like sensitive medium, for the purpose of sound recording, a double series of impressions complementary in the sense that the elements of each pair vary inversely to each other as regards their light controlling values. This double series forms two tracks located on opposite sides of a central neutral line and for purposes of sound reproduction I pass this dual record across one or more pairs of light-sensitive units connected in a balanced Wheatstone circuit.

In carrying out the invention for the purpose of sound recording, I preferably employ one of two methods, which are as follows:—

(1) A pivotal mirror may be used oscillated at right angles to the direction of travel of the film, and casting a rectangular beam of light across a masking slot of suitable size. This arrangement is more particularly applicable where it is desired to effect variations in the relative opaque and transparent areas.

(2) A pair of asymmetrical grids may be employed with or without a pivoted mirror to control the complementary light impressions. This arrangement is more particularly applicable where it is desired to effect variations of density.

In carrying out the invention for the purposes of sound reproduction, I also preferably employ one of two methods which are as follows:—

(1) Two light-sensitive surfaces may be employed positioned in a line located at right angles to the direction of travel of the film, each surface being influenced by one of the pair of complementary sound records, the

two light-sensitive surfaces being electrically connected to form opposite arms of a balanced Wheatstone bridge circuit.

(2) Four light-sensitive surfaces may be employed in a similar manner to the above in which case two will be positioned on each side of the central line and each pair will form two opposite arms of the Wheatstone circuit.

In the above cases light-sensitive surfaces may be individual light-sensitive devices, or may be individual light-sensitive areas of a single light-sensitive device. It would be possible to employ a further number of pairs of light-sensitive surfaces.

In one form of apparatus for reproduction I feed the film at suitable speed between an illuminant and the light-sensitive Wheatstone unit and place a loud speaker or amplifying device of known design in the "galvanometer" circuit of the latter.

The invention will now be described by way of example only with reference to the accompanying drawings, in which:—

Fig. 1 is a diagrammatic representation of a recording system of the variable area type, employing a pivoted mirror.

Fig. 2 represents the type of sound record produced by the apparatus depicted in Fig. 1.

Fig. 3 is a diagrammatic representation of a recording system of the variable density type employing a system of asymmetrical grids in conjunction with a pivoted mirror.

Fig. 4 represents the type of sound record produced by the apparatus depicted in Fig. 3. (Owing to limitation of line block printing process, half gradations are not shown.)

Fig. 5 represents various possible arrangements of the light-sensitive areas for use in conjunction with the apparatus described in Figs. 1, 2, 3 and 4 for reproducing purposes.

Fig. 6 represents diagrammatically in plan one form of reproducing apparatus.

Fig. 7 is a side elevation of the apparatus shown in Fig. 6.

Referring to Figs. 1 and 2 of the drawings, 1 is a source of light from which emerges a beam of light passing through a condenser 2 and a slit 3. The beam then passes through an optical focussing system 4 and falls in

rectangular form upon a mirror 5 vibrated and in synchronism with the sound impulses which are to be recorded. From the mirror the rectangular beam is reflected upon the limiting slot 6 in the mask 7 which extends across the film 8. The recording rectangle of light in the quiescent position of the mirror is centrally located with respect to the slot 6 and is preferably of half the width of the slot for maximum response. The sound record may be positioned at any convenient path in the width of the film, and it would be possible to divide the two complementary sound records, but should this be the case it would entail very accurate feeding of the film for reproduction to ensure that corresponding impressions registered simultaneously with the light-sensitive areas.

Fig. 2 shows an enlarged view of the type of sound record produced in this manner. It should be noted that in this type of record the sound record is uniformly opaque and the sound values are substantially represented by the amplitude of the curve ordinates.

Referring to Figs. 3 and 4 the beam from the lamp 1 after passing through the condenser 2, falls upon a grid 3' and thence, after passing through the optical system 4 falls upon the vibrating mirror 5. The separate small bars of light so produced are then reflected upon a second grid 9 and the light passing through the second grid proceeds through a slot 10 in the mask 12 to the limiting slot 6 in the mask 7. The image of the slot 10 on the member 7 is indicated by 11 and completely covers the actual limiting slot 6. The slots in the grids 3 and 9 are so arranged respectively that when the slots on one side of the centre line are in register those on the other are out of register, and at the quiescent position the slots on both sides are at half register.

Fig. 4 shows the type of sound record produced with the apparatus described with reference to Fig. 3. This record is of the type in which the sound impressions are of varying density, and it will be noticed that the corresponding impressions on either side of the centre line are complementary in light and shade values. In the quiescent position of the mirror the corresponding impressions are of equal value. It would, of course, be possible to provide two actual grids one of which is mechanically moved from the source of sound.

In Fig. 5 are shown various arrangements of the light-sensitive surfaces which are to be affected during reproduction from the films previously recorded in either of the methods described. These surfaces are all arranged to form parts of a Wheatstone bridge or other balanced circuit. In Figures 5a, 5b and 5c two light-sensitive surfaces only are employed, while in figures 5d, 5e and 5f four light-sensitive surfaces are provided

forming the four arms of a Wheatstone bridge circuit.

Referring now to Figs. 6 and 7 the mechanism is contained within an external cabinet 12 with a pivotal lid 13. Within the casing partitions 14 are conveniently arranged as may be desired to carry the various components of the apparatus. The film 8 passes from the frictionally-damped drum 15 through the apparatus and so back to the take-up drum 16. The latter is driven from a constant speed motor 17 through the friction drive 18 and the motor 17 also drives through skew gearing 19, the driving sprockets 20 and 21 with which the film engages. Tensioning and guide rollers 22 are provided where necessary.

The lamp is suitably enclosed and directs a beam of light through the optical system 2 on to the film 8 as it passes through the usual optical gate 23. Light passing through the film is then directed on to the light-sensitive system 24. The latter controls the current passing to the amplifier 25 which in turn actuates the loud speaker 26, which is directed towards the sound apertures 27. Suitable controls 28 are provided for the regulation of the instrument in a manner which will be understood to those skilled in the art.

Having now particularly described and ascertained the nature of my said invention, and in what manner the same is to be performed, I declare that what I claim is:—

1. A method of sound recording consisting in passing a beam of light through a slit, reflecting it from a vibrating mirror, passing it through a limiting slot in a mask and receiving it on a light-sensitive surface to form two complementary tracks thereon on opposite sides of a central neutral line.

2. A method of sound recording consisting in passing a beam of light successively through a condenser, a mask having a slit therein, and an optical focussing system, reflecting said beam from a mirror, vibrated in synchronism with the sound impulses to be recorded, passing said beam through a slotted mask and receiving it on a light-sensitive surface to form two complementary tracks on opposite sides of a central neutral line.

3. A method of sound recording and reproduction, consisting in projecting a beam of light through a slotted mask, reflecting it from a mirror vibrating in synchronism with the sound impulses to be recorded, passing it through a mask having a limiting slot, receiving it on a light-sensitive surface to form two complementary tracks thereon on opposite sides of a central neutral line, reproducing said beam of light by passing said tracks between a source of illumination and a pair of light-sensitive devices included in a balanced sound reproducing circuit.

4. A method of sound recording and re-

production consisting in projecting a beam of light through a slotted mask, reflecting said beam of light from a vibrating mirror, passing it through a mask having a limiting slot therein, receiving it on a light-sensitive surface, and reproducing said beam of light by passing said surface between a source of light and a pair of light-sensitive devices included in a balanced sound reproducing circuit.

5 5. A method of sound recording consisting in projecting a beam of light successively through an apertured plate and an optical focussing system, receiving it on a vibrating mirror, reflecting it from said mirror through
10 a second apertured plate co-operating asymmetrically with said first apertured plate, and receiving said beam on a light-sensitive surface to form two complementary tracks
15 disposed on opposite sides of a central neutral line, said apertured plates being so arranged that when the slots on one side of the centre line are in register those on the other side are out of register, and at the quiescent
20 position the slots on both sides of the centre line are at half register.

25 6. A method of sound recording consisting in projecting a beam of light successively through a condensing lens, a grid, and an optical system to change said beam to a grid of light, receiving said light-grid on a mirror
30 vibrated in synchronism with the sound impulses to be reproduced, reflecting said light-grid from said mirror through a second grid, co-operating asymmetrically with said first
35 grid, and through a slotted mask, and receiving said light-grid on a light-sensitive surface to form two complementary tracks thereon disposed on opposite sides of a central neutral line.

40 7. A method of recording and reproducing sound, consisting in projecting a beam of light successively through a grid and optical system to change said beam to a grid of light, receiving said light-grid on a vibrating mirror,
45 reflecting said light-grid from said mirror and passing it onto a light-sensitive surface successively through a second grid co-operating asymmetrically with the first grid and through a slotted plate, to form two complementary tracks on said surface on opposite
50 sides of a central neutral line on said film, and reproducing said light-grid by passing said surface between a source of light and a plurality of light-sensitive devices forming
55 a balanced electrical circuit and positioned in a line at right angles to the direction of movement of the surface.

In testimony whereof, I have signed my name to this specification at London, England, this 29th day of April, 1929.

JOHN NEALE.