

Dec. 21, 1937.

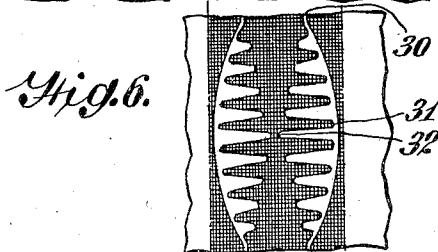
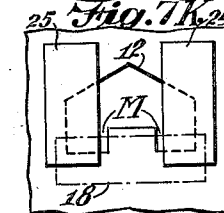
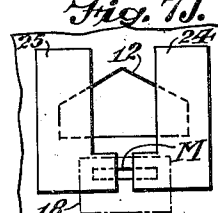
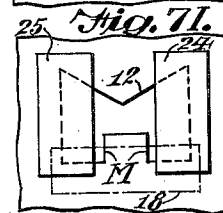
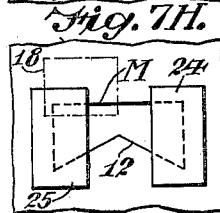
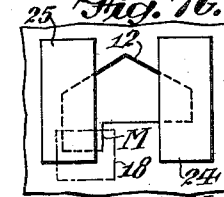
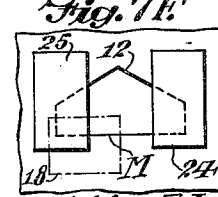
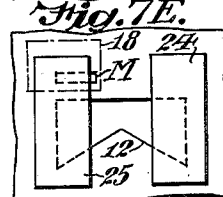
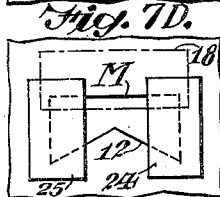
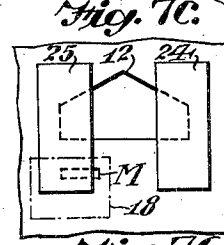
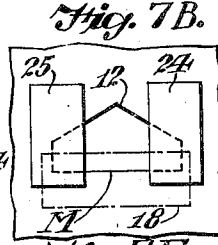
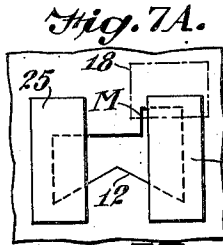
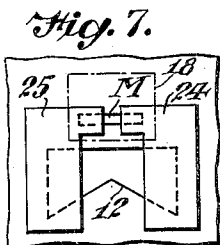
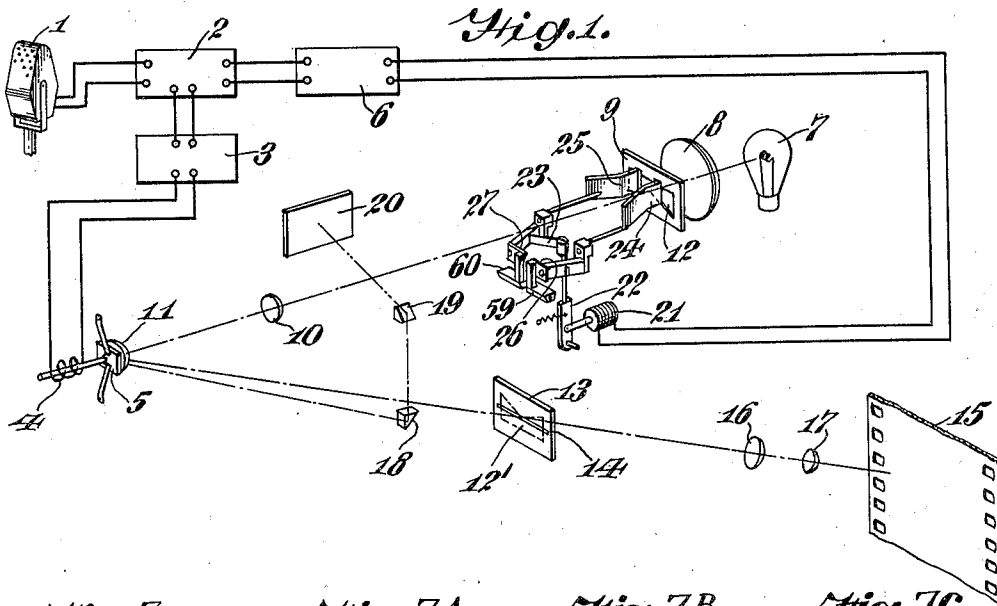
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2,102,778

PHOTOPHONOGRAPHIC APPARATUS

Filed May 29, 1936

2 Sheets-Sheet 1



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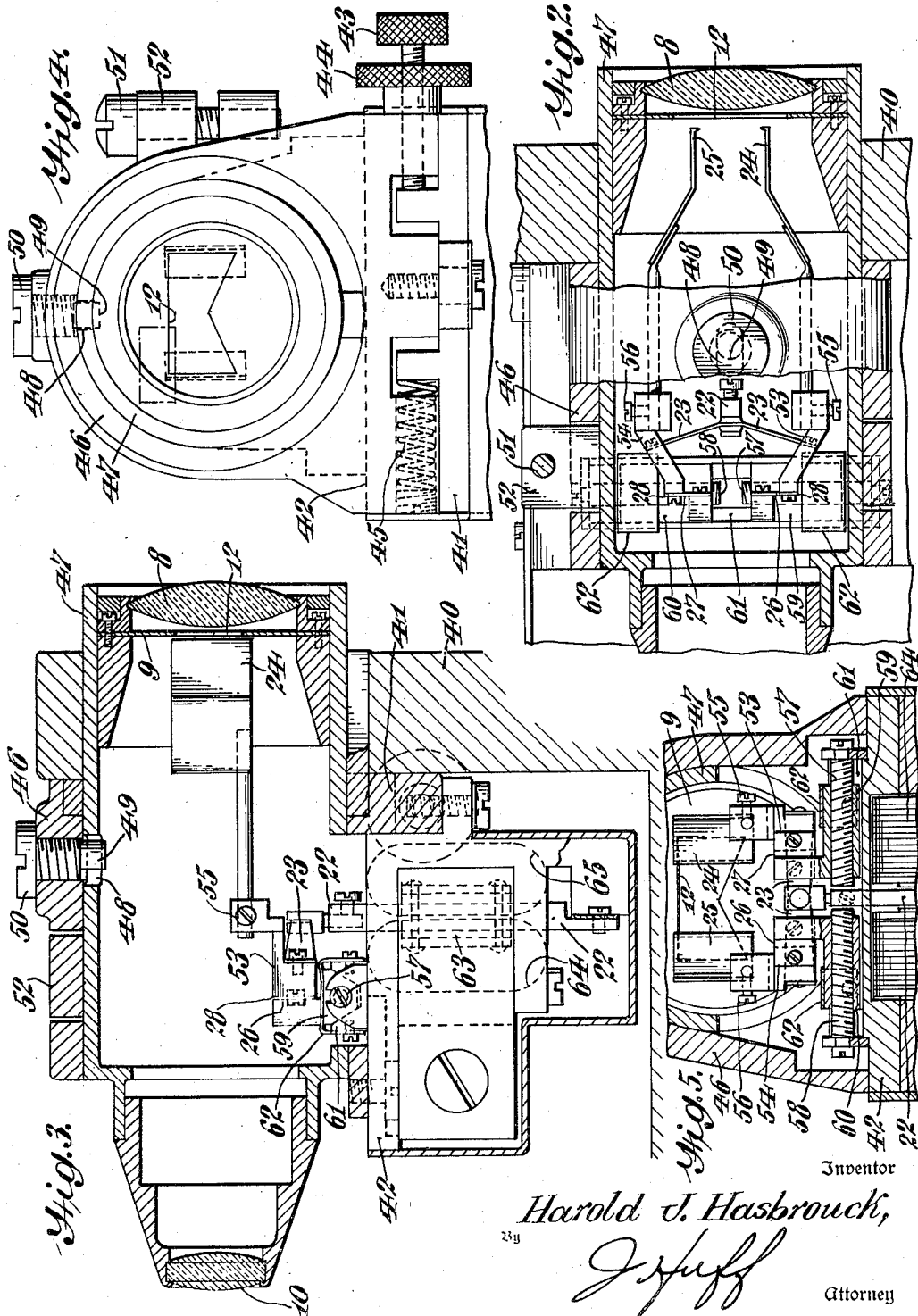
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PHOTOPHONOGRAPHIC APPARATUS

Filed May 29, 1936

2 Sheets-Sheet 2



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UNITED STATES PATENT OFFICE

2,102,778

PHOTOPHONOGRAPHIC APPARATUS

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Application May 29, 1936, Serial No. 82,418

8 Claims. (Cl. 179—100.3)

The present invention relates to sound recording apparatus and more particularly to sound recording apparatus of the type adapted to record sound photographically upon film.

5 The recording of sound on film by what is known as the variable area method has been known for a number of years and is described, for example, in Fritts Patent No. 1,203,190. In the reproduction of the earlier variable area
10 sound records, as well as variable density sound records, there is produced what is known as "ground noise" due to imperfections in the film and to noise produced in the photocell. In the case of these earlier films the volume of this
15 noise was constant as the average light transmission was constant. Accordingly, such noise was very objectionable at low volumes of reproduced sound. It was proposed, for example, in Robinson Patent No. 1,854,159 to reduce the
20 transparent area of the positive film at low sound amplitudes thereby decreasing the ground noise as the volume of sound was decreased and correspondingly improving the quality of the sound at low amplitudes.

25 It was proposed in McDowell Patent No. 1,855,197 to use a shutter in the sound recorder to cover, and thereby render transparent, the unused portion of the sound negative, which in turn rendered the corresponding portion of the
30 positive film opaque in order to reduce ground noise. My invention is an improvement on the said McDowell apparatus.

One object of my invention is to provide a sound record which is symmetrically arranged in
35 relation to the sound track area.

Another object of my invention is to provide an improved ground noise reduction shutter.

40 Another object of the invention is to provide an attachment for conventional recording apparatus which will serve to convert it to produce my improved record.

Another object of my invention is to provide an improved monitoring means for photophono-
45 graphic recorders.

Other and incidental objects of my invention will be apparent to those skilled in the art from a reading of the following specification and an inspection of the accompanying drawings in which:

50 Fig. 1 is a schematic representation of a sound recording apparatus built in accordance with my invention,

Fig. 2 is a horizontal section through my improved optical system and shutter arrangement,

55 Fig. 3 is a vertical section thereof,

Fig. 4 is an end view looking from the right hand side of Figs. 2 and 3,

Fig. 5 shows details of the construction,

Fig. 6 shows a positive print of my improved sound record,

5 Figs. 7 to 7I show various shapes of apertures and arrangements of monitoring apertures which may be used.

Referring first to Fig. 1, the sound recording microphone is indicated at 1 and the microphone
10 amplifier at 2. From this microphone amplifier a portion of the current is fed to the main recording amplifier 3, which in turn actuates the galvanometer 4, thereby causing the galvanome-
15 ter mirror 5 to oscillate about a horizontal axis.

A portion of the output from the amplifier 2 is fed to the ground noise reduction amplifier 6, which may be constructed in accordance with the said McDowell patent. This amplifier 6
20 amplifies the current fed to it, then rectifies the amplified current and passes the rectified current through a low pass filter, thus providing a variable direct current output, the instantaneous
25 value of which corresponds to the average value of the sound input to the galvanometer. Such a current is commonly termed an envelope current, as it corresponds to the envelope of the sound waves.

In the recorder, light from an exciter lamp 7 is passed through a condenser lens 8 and an aperture 9 to the lenses 10 and 11. These lenses 10
30 and 11 concentrate the light on the galvanometer mirror 5 and also serve to focus an image of the aperture 12 in the plate 9 on the slit plate 13. This slit plate is provided with a narrow
35 slit 14 which serves to select the desired portion of the image 12', which is then focused on the film 15 by the lenses 16 and 17. As shown in the drawings, the aperture 12 is in the form of
40 an elongated rectangle with two triangular extensions on one side and a smaller rectangular extension on the other side. When this aperture is imaged on the plate 13, as indicated at 12', the triangular portions fall on the slit 14 and pro-
45 duce two areas of illumination of the slit. When the galvanometer mirror 5 is oscillated about a horizontal axis, these triangular areas move up and down across the slit 14, thereby causing the slit to intercept portions thereof of different
50 lengths and correspondingly producing two separated sound records, each corresponding to the sound being recorded. Light from the rectangular extension in the aperture 12 is deflected by the prism 18 and is again reflected by the prism
55 19 onto the screen 20, where the movement of

this portion of the spot of light permits the operator of the apparatus to see the manner in which the galvanometer is operated.

Current from the ground noise reduction amplifier 6 is passed to a magnetic means 21, which may be of any desired type, where it is caused to deflect a movable member 22 in accordance with the amplitude of the envelope current. As the member 22 is deflected it pulls upon a flexible resilient member 23, thereby causing the shutters 24 and 25 to move about the pivots 26 and 27 against the tension of the spring 28. It will be apparent that the amplifier unit 6 may be so connected as to cause an increase in the envelope current when there is a decrease in the output of the amplifier 2, thereby causing the shutters 24 and 25 to be moved toward each other and masking off a corresponding portion of the aperture 12. Alternatively, the shutters 24 and 25 may be mechanically adjusted to remain in their most nearly closed position and when there is an increase in output from the microphone 1, the output from the amplifier and rectifier 6 would then be so connected as to cause the shutters 25 to be opened by the increasing current.

I prefer, however, to have the shutters mechanically adjusted so that when their circuit is open they are in the position shown in Fig. 1; to adjust the amplifier and rectifier 6 so that when the circuit is closed, the shutters 24 and 25 are pulled to their closed position when there is no input; and when modulation is applied to the amplifier 2, and the rectifying amplifier 6 to cause the current through the magnetic means 21 to decrease, thereby permitting the shutters to open in accordance with the amplitude of the sound to be recorded. It will be apparent that the selection of any one of these three methods can be accomplished by merely a reversal of connections either between amplifier 2 and the rectifying amplifier 6, between amplifier 6 and the magnetic means 21, or of magnetic means 21 to the arm 22. Similarly, if it is desired to cause a decrease in the output of the amplifier 6 or an increase in the output of the amplifier 2, it is necessary that the output of the amplifier 2 increase the negative grid bias in the rectifying amplifier 6, while to produce the opposite result, the connections are so made as to cause a decrease in the grid bias.

The aperture plate 9 is located quite close to the shutters 24 and 25 and when the shutters are in the closed position, i. e. when there is no sound being recorded, each covers approximately one-fourth of the aperture 12. When the image of this covered aperture is projected on the slit plate 13, only narrow tips of the image 12' coincide with the slit, thereby producing only a very narrow record such as indicated at 30 in Fig. 6. When, however, modulation is applied to the amplifier 2, the shutters 24 and 25 are withdrawn toward the position shown in Fig. 1, a distance corresponding to the amplitude of the sound to be recorded, and when the shutters are completely withdrawn, for recording maximum amplitude, the image 12' on the slit plate 13 presents the appearance shown in Fig. 7. It will be apparent that when the image 12' is moved vertically by oscillation of the mirror 5 it will swing between two extreme positions, in the lowermost position only the tops of the triangles of the image coinciding with the slit and producing a very narrow record portion, as indicated at 31, and at the uppermost position substantially the entire slit being filled with light, thereby producing

the peaks indicated at 32 in Fig. 6. As a consequence of the described movement of the shutter in accordance with the modulation, a negative record will be produced from which a positive may be printed having the appearance shown in Fig. 6, from which it will be apparent that the record has an outer envelope corresponding with the envelope of the voice currents and an inner outline corresponding with the sounds themselves, the outer envelope being produced by the shutter and the inner outline being produced by the galvanometer. It will be apparent that each of the halves of this record corresponds with the McDowell record but that two records are symmetrically arranged with relation to the sound track, thereby preventing the cutting off of peaks at high amplitudes if the reproducing aperture is slightly out of alignment by preventing the cutting out of the sounds under similar circumstances at extremely low amplitudes which might follow with such sound records, as for example that of Hanna Patent No. 1,888,724.

The shutter mechanism includes a base member 40 which may be the base of the recorder. Upon this base member is mounted a support member 41 on which the portion of the optical system including the condenser 8, the lens 10, and the intervening shutter mechanism is mounted. On this is mounted an appropriate carriage 42. As shown in Fig. 4, this carriage is mounted for lateral movement on the member 41, being shifted by the screw 43 provided with the jam nut 44 and being held firmly in position by the compression spring 45 which produces a pressure opposing that exerted by the screw 43. This carriage 42 includes a cylindrical upper portion 46 in which the barrel 47 of the optical system is fitted.

In order to position the optical system with the aperture 12 accurately parallel to the slit 14, the optical barrel is slitted at 48 and into this slit is fitted an eccentric pin 49 on a screw 50. It will be apparent that rotation of the screw 50 will cause the pin 49 to move laterally of the member 46 and to thereby rotate the barrel together with the aperture plate 9. The barrel may not only be rotated but may be slid longitudinally within the limits prescribed by the slots 48 and it can then be clamped in place by the screw 51, which passes through the slit ring 52 and which forms a portion of the member 46.

As shown in Fig. 2, the shutters 24 and 25 are hinged on the springs 26 and 27. These shutters 24 and 25 are adjustably secured on the arms 53 and 54 by the screws 55 and 56 in order that they may be adjusted to the proper distance from the aperture plate 9. It will be apparent that although the ends of the shutter blades must clear the aperture plate 9, they must, at the same time, be so close thereto that a properly focused image of the edges of the shutters will be formed on the slit plate 13 in the same focal plane with the image of the aperture 12. The individual shutter blades are adjustable laterally by means of screws 57 and 58 as shown in Fig. 5, these screws passing through V-shaped blocks 59 and 60, Figs. 3 and 5, which are held into the correspondingly shaped slideway 61 by the spring members 62. It will be apparent that rotating the screws 57 and 58 will shift the blocks 59 and 60 longitudinally in the guideway, thereby shifting the pivots of the shutters and correspondingly shifting the opposite ends of the shutter blades in the opposite direction to the movement of the pivots.

As described in connection with Fig. 1, a re-

silent member 23 is connected from the arm 22 to the arms supporting the shutters and when this arm is actuated by the magnets the shutters are pulled closer together or moved farther apart, as the case may be.

In the preferred form of the invention, as shown in Figs. 2 to 5, the arm 23 is provided with a rectangular armature 63 as shown in dotted lines in Fig. 3, and moves in a plane passing through the axis of the lenses between the poles of the pairs of magnets 64 and 65. The coils of the several magnets 64 and 65 are connected to the ground noise reduction amplifier 6 and in such a manner that the pairs of poles longitudinally of the device are of opposite polarity, thereby causing movement of the arm 23 in accordance with the energization of the magnets and correspondingly moving the ends of the shutters 24 and 25.

As shown in Fig. 7 at A to L the aperture in the plate 9 may be of many different shapes. In whichever form of aperture I use, however, I provide either an auxiliary aperture or an extension of the main recording aperture either in length or width or an extension only of a portion of the aperture which passes a portion of the beam not used in recording, these extensions or areas being indicated at M in each of these figures. This auxiliary aperture or extension of the main aperture is made of an appropriate size and shape for projection onto the monitoring screen 20 and it is so located in relation to the shutters 24 and 25 that it will be changed in size an amount corresponding to the change in size of the main aperture when the shutters 24 and 25 or one of them is actuated. For example in Figs. 7a, c, e, and k the size of the monitoring aperture is determined by both shutters in 7b, d, f, g, h and i. It is determined by one shutter only while in Figs. 7j and l, two monitoring apertures are provided, each similarly affected by one shutter. In these figures, the outline of the prism 18 is shown as it would appear from the mask.

I claim as my invention:

1. In a ground noise reduction shutter system for sound recorders, a symmetrical pair of movable shutters, spring means supporting said shutters in a predetermined position, and means for moving said shutters from said position.

2. Apparatus of the class described comprising means for forming a spot of light increasing in width from the middle to both ends, a slitted member for selecting a narrow line of light from said spot, a galvanometer for vibrating said spot across said slitted member in accordance with sound waves to be recorded, a pair of shutters

for masking the ends of said spot in accordance with the volume of the sound to be recorded and means for adjusting the position of said shutters.

3. Apparatus of the class described comprising means for forming a spot of light increasing in width from the middle to both ends, a slitted member for selecting a narrow line of light from said spot, a galvanometer for vibrating said spot across said slitted member in accordance with sound waves to be recorded, a pair of shutters for masking the ends of said spot in accordance with the volume of the sound to be recorded, means supporting said shutters, means for adjusting said shutters in relation to said supporting means and means for adjusting the position of said supporting means.

4. Photo-phonographic apparatus including an aperture plate for defining the shape of a beam of light, said aperture plate being provided with an aperture for a monitoring beam adjacent the recording beam.

5. Apparatus of the class described comprising means for forming a spot of light tapering in width from the middle to both ends and having a smaller rectangular extension, means for selecting a narrow line of light from said spot, means for vibrating said spot across said selecting means in accordance with sound waves to be recorded and means for directing the light from said rectangular extension to a monitoring screen.

6. Sound recording apparatus including an optical system adapted to direct a beam of light to a galvanometer, the said optical system including a mask having an aperture provided with one side tapered from its middle to its ends and with another side having a rectangular extension.

7. Apparatus of the class described comprising means for forming a spot of light increasing in width from the middle to both ends and having a smaller rectangular extension, means for selecting a narrow line of light from said spot, means for vibrating said spot across said selecting means in accordance with sound waves to be recorded, and means for masking the ends of said spot and said extension in accordance with the volume of the sound to be recorded.

8. Sound recording apparatus including an aperture plate having a recording aperture and a monitoring aperture and masking means for covering the recording aperture inversely in accordance with the volume of the sound to be recorded and simultaneously and similarly covering the monitoring aperture.

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