

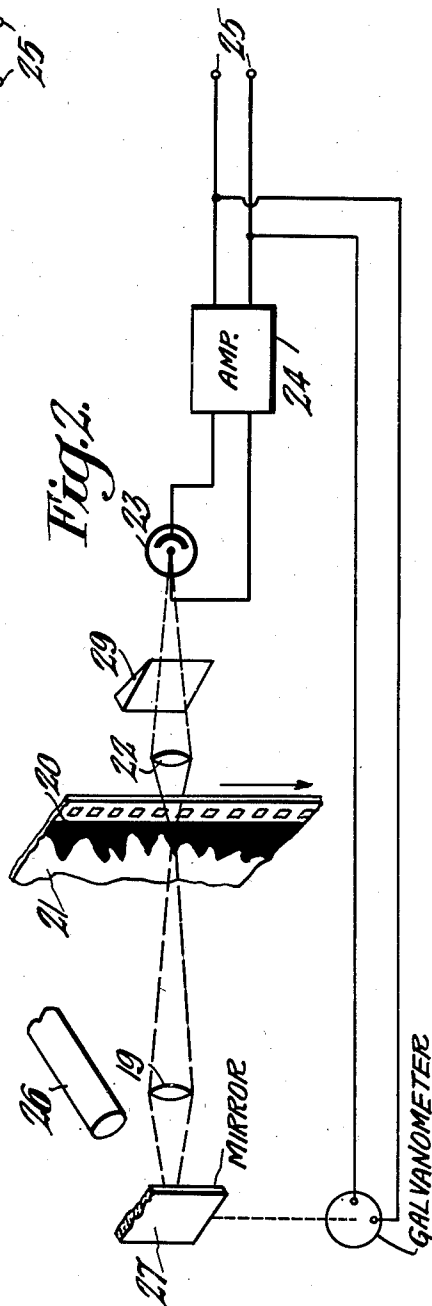
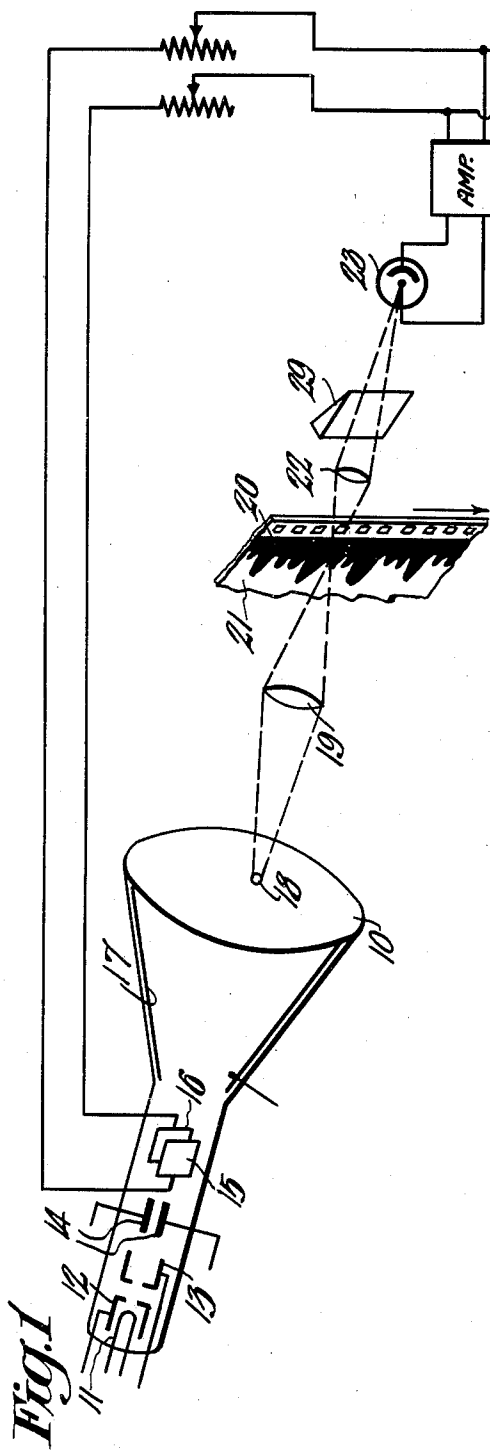
March 29, 1949.

J. R. COONEY

2,465,849

SOUND REPRODUCING DEVICE

Filed April 10, 1944



INVENTOR.
John R. Cooney
BY *CD Miska*
ATTORNEY

UNITED STATES PATENT OFFICE

2,465,849

SOUND-REPRODUCING DEVICE

John R. Cooney, Waldoboro, Maine

Application April 10, 1944, Serial No. 530,415

4 Claims. (Cl. 179—100.3)

1

This invention relates to reproducing devices such as are utilized to produce an electrical effect which varies in accordance with the contour of a boundary between different areas which may constitute parts of a sound record, a map, a specimen to be examined or the like. In each case, the electrical effect (current, voltage or frequency) may be utilized to reproduce the examined figure on the same or a different scale or to produce other effects such as the reproduction of the recorded sound.

The invention is put into effect by means of a small beam of radiant energy, such as light, which has its position controlled by the contour of the boundary between the different areas so as to be maintained automatically at the boundary line. As the position of this line changes, the resulting electrical effect varies in magnitude and this variation is utilized both to keep the beam always at the boundary line and to produce whatever other effect may be desired.

Thus, if the boundary is between adjacent transparent and opaque areas, the beam is produced by a cathode ray tube, a galvanometer or the like, and is applied through suitable optical units to the boundary. That part of the beam passed by the transparent areas is applied through suitable optical units to a photo-electric device and the resulting current is amplified by any suitable type of amplifier such as an electron multiplier or the like. Output from this amplifier is supplied to the device to be operated and is also fed back to the beam producing device in a manner to cause the beam to follow the boundary as it is moved transversely of the beam.

If the beam producing means is a cathode ray tube, for example, the connections between the amplifier and the deflecting electrodes of the tube may be such that the beam is driven toward the darker area when more than half of the beam reaches the photo-sensitive device and vice versa. Likewise, when a galvanometer is utilized to produce the beam, the connections between the amplifier and operating coil of the galvanometer are such as to maintain a substantially equal division of the light beam between the opaque and transparent areas. This, of course, also applies to other types of beam producing means which may be utilized to maintain the beam at the boundary line whether such means involve the use of light or other forms of radiant energy.

The invention has for its principal objects the provision of an improved apparatus and method of operation for producing an electrical effect dependent on the position of a boundary between different areas; the provision of improved means for reproducing sound from a sound record or for re-recording sound from one record to another; the provision of improved means for transferring various types of figures from one scale

2

to another, and the provision of improved means for minimizing background noise during the reproduction of sound from a sound record.

The invention will be better understood from the following description considered in connection with the accompanying drawings and its scope is indicated by the appended claims.

Referring to the drawings:

Figure 1 illustrates a first embodiment of the invention utilizing one form of cathode ray device as the beam producing means, and

Figure 2 illustrates a second embodiment wherein the beam is controlled by a galvanometer.

The apparatus of Figure 1 comprises a cathode ray device 10 which includes the usual electron gun or beam producing means 11—12—13, the vertical deflectors 14, the horizontal deflectors 15—16, and a second anode 17. The device 10 also has at its enlarged end a fluorescent screen through which a small spot of light 18 is produced on the end of the tube where the beam impinges on the screen. It is desirable that this spot be very small (of the order of one thousandth of an inch). To this end the device may be provided with such additional focusing means as are required to produce a spot of the desired character and proportions. Moreover the cathode ray may be biased to any desired position which may be assumed to be the normal position of the beam for any predetermined signal condition.

The light spot 18 is projected through an optical system, shown as a lens 19, to the boundary between an opaque area 20 and a transparent area 21 which are shown in the form of a variable width sound track. The part of the light passed by the area 21 is projected through optical means, shown as a cylindrical lens 22 to a photo-sensitive device 23. The device 23 may be an RCA 931 phototube or the equivalent. Such a tube is capable of responding to a brightness of 10^{-5} candlepower. The light from a spot of a fluorescent screen having an area of the order of 1 mil is sufficient to produce such candlepower. There may be interposed between the lens 22 and the device 23 a light wedge, a grated filter, or the equivalent (indicated as 29), which functions to detect the audio impulses recorded on the record 20—21.

The resulting electrical effect is applied to the input of an amplifier 24 which supplies its output through terminals 25 to a loud speaker, a sound recorder or other type of utilization device.

Also connected to the amplifier output are the horizontal deflectors 15—16 of the device 10. The vertical deflectors 14 may be omitted or may be subjected to a constant potential for restraining the movement of the spot 18 to a straight line transversely of the record strip 20—21.

With the spot 18 in its illustrated position, its light is focused at a point on the boundary be-

tween the areas 20 and 21. As the record strip moves downwardly in the direction indicated by the arrow, more than half of the light of the beam tends to be cut off by the opaque area 20, thus reducing the output potential of the amplifier 24 and applying to the deflector 16 a potential whereby the spot is moved slightly to the left. If the spot tends to move too far to the left, more than half of the light of the spot reaches the photo-sensitive device 23, the output voltage of the amplifier is increased and the deflector 16 is subjected to a voltage whereby an equal division of light between the areas 20 and 21 is restored.

Movement of the beam transversely of the strip 20—21 is utilized to produce an electrical effect dependent on the contour of the boundary between the two areas. This effect is due to variation in the position of the beam at the variably transparent member 29. It is evident that this movement of the beam across the member 29 is an action which is much slower than the small and very rapid movements which result from unequal division of the light between the areas 20 and 21 and are utilized to restrain the beam to this boundary line. As a result of this difference in the character of the two movements, they are substantially independent of one another.

In the case of a sound record, the position of the beam transversely of the record strip varies with the amplitude of the recorded sound and the amplifier output is properly modulated due to the linear variation in the light transmission of the member 29. In the case of a map or other figure, the amplified output may be utilized to operate a stylus or other device by which the figure is reproduced on any desired scale.

The modification of Figure 2 differs from that of Figure 1 in that a spot of light produced by an optical system 26 is applied to the reflector 27 of a galvanometer and is reflected through a lens 19 to the boundary between the areas 20 and 21. As is well known, the mirror 27 may be biased to any desired position mechanically, or otherwise. The operating coil 28 of the galvanometer is connected to the output of the amplifier 24. As previously described, the beam is so regulated that it is divided in substantially equal proportions between the opaque and transparent areas.

The operation of the galvanometer involves the inertia of moving parts and for this reason is better adapted to the tracing of boundaries which change direction at a relatively slow rate. Where the contour of the traced boundary changes rapidly, better results are achieved with the device of Figure 1, which is substantially instantaneous in its action. In either case, there is produced an electrical effect which is dependent on the position of the boundary and is readily utilized to produce a result proportional to the extent of one or the other of the areas. In the case of sound reproduction, there is realized the important advantage that background noise is minimized due to the small area of the record illuminated.

The important feature of the present invention, of course, is the provision of electronic means whereby a beam of radiant energy is made to follow the boundary between surfaces of different beam transmitting characteristics. By focusing the radiant energy on a small spot on the boundary the ratio of signal to noise is substantially improved with respect to prior art de-

vices which apply the radiant energy to a substantial area of the sound record whereby imperfections in the entire area establish undesired responses.

I claim as my invention:

1. In a device for reproducing sound, the combination of a sound record having transparent and opaque areas defined by a boundary which varies in accordance with said sound, means for applying a beam of light to said record, means responsive to the light transmitted through said record for maintaining said applied beam at said boundary, and means for reproducing said sound in response to the transmitted light.

2. In a device for reproducing sound, the combination of a sound record having transparent and opaque areas defined by a boundary which varies in accordance with said sound, means for applying a beam of light to said record, means including a galvanometer responsive to the light transmitted through said record for maintaining said applied beam at said boundary, and means for reproducing said sound in response to the transmitted light.

3. In a device for reproducing sound, the combination of a sound record having transparent and opaque areas defined by a boundary which varies in accordance with said sound, a cathode ray device having means for applying a beam of light to said record and means for controlling the position of said beam, means responsive to the light transmitted through said record for applying to said position control means a potential whereby said beam is maintained at said boundary, and means for reproducing said sound in response to the transmitted light.

4. In a device for reproducing sound, the combination of a sound record having transparent and opaque areas defined by a boundary which varies in accordance with said sound, means for applying a beam of light to said record, means including a light sensitive device arranged to produce a control potential dependent on the light transmitted through said record, means responsive to said control potential for moving said beam toward said transparent area in response to decrease in said transmitted light and to move said beam toward said opaque area in response to increase in said transmitted light, and means for reproducing said sound in response to the transmitted light.

JOHN R. COONEY.

REFERENCES CITED

The following references are of record in the file of this patent:

UNITED STATES PATENTS

Number	Name	Date
1,765,029	Murray	June 17, 1930
2,113,184	Sperti	Apr. 5, 1938
2,121,211	Padva	June 21, 1938
2,124,030	Douden	July 19, 1938
2,172,313	Young	Sept. 5, 1939
2,199,071	Gale	Apr. 30, 1940
2,206,547	Gerlach	July 2, 1940
2,261,644	Cockrell	Nov. 4, 1941
2,262,354	Cates	Nov. 11, 1941
2,268,097	Underhill	Dec. 30, 1941
2,274,530	Collins	Feb. 24, 1942
2,331,337	Meyer	Oct. 12, 1943
2,347,084	Cooney	Apr. 18, 1944
2,363,502	Collins	Nov. 28, 1944
2,414,666	Poulson	Jan. 21, 1947