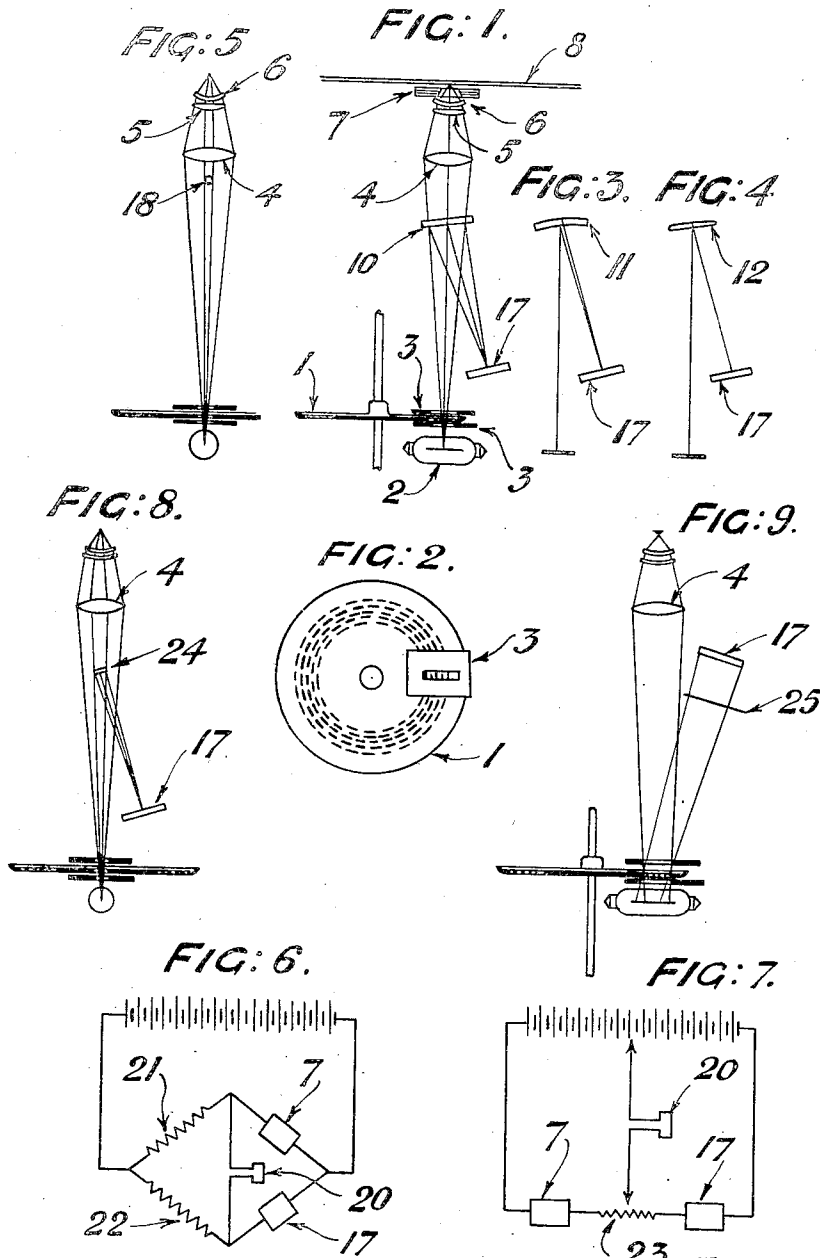


A. BARR, W. STROUD AND E. E. F. D'ALBE.
OPTOPHONE.

APPLICATION FILED NOV. 26, 1919.

1,350,954.

Patented Aug. 24, 1920.



Inventors.
Archibald Barr.
William Stroud
Edmund Edward Fournier d'Albe
By *J. Walter Fowler* Atty.

UNITED STATES PATENT OFFICE.

ARCHIBALD BARR AND WILLIAM STROUD, OF ANNIESLAND, GLASGOW, SCOTLAND,
AND EDMUND EDWARD FOURNIER D'ALBE, OF LONDON, ENGLAND, ASSIGNORS TO
BARR AND STROUD, LIMITED, OF GLASGOW, SCOTLAND.

OPTOPHONE.

1,350,954.

Specification of Letters Patent.

Patented Aug. 24, 1920.

Application filed November 26, 1919. Serial No. 340,745.

To all whom it may concern:

Be it known that we, ARCHIBALD BARR and WILLIAM STROUD, subjects of the King of Great Britain and Ireland, and both of
5 Caxton street, Anniesland, Glasgow, Scotland, and EDMUND EDWARD FOURNIER D'ALBE, a subject of the King of Great Britain and Ireland, and of 10 St. James Terrace, Regents Park, London, N. W., 8,
10 England, have invented new and useful Improvements in Optophones, of which the following is a specification.

In an optophone as hitherto constructed by one of the present applicants, a series
15 of intermittently luminous dots, having different frequencies of intermission, within the range of ordinary musical notes, is projected upon a printed page to be read by a blind person, by means of the ear. The
20 dots, which lie in a line at right angles, or nearly so, to the line of printing, are caused to pass along the line with a more or less uniform motion, either by moving the page or by moving the optical system. The light
25 reflected from the page is received on a sensitive tablet composed of a substance, the electrical conducting properties of which alter under the action of light, such for example as selenium, placed in circuit with
30 a battery (or other source of current), and a telephone, with the result that when a dot is received on a black portion of the printed surface, the telephone is silent as regards the sound corresponding to the
35 periodicity of that dot, whereas when it falls upon a white portion a musical note is produced in the telephone of a frequency corresponding to that of the intermissions of the dot. The effect thus produced may
40 conveniently be termed "white sounding".

The improvement, which is the subject of the present invention, consists in reversing the action above referred to, so as to produce silence when the whole of the series of
45 dots falls upon a white surface, and on the other hand, to produce a sound composed of the frequencies of all the luminous dots which fall upon a black surface. The effect thus produced may conveniently be termed
50 "black sounding" because the black letters themselves cause sounds to be produced varying with the shapes of the letters as the dots pass along the line and a blind person identifies the letters by these sounds instead of

identifying them by means of the sounds
55 produced by the white interstices in and between the letters.

A "black sounding" effect, according to this invention, can be obtained by exposing
60 simultaneously two sensitive tablets to the intermitted light, one (hereinafter referred to as the primary tablet) being exposed to the intermitted light from the white portions of the paper surface, the other (hereinafter referred to as the secondary tablet) being con-
65 tinuously exposed to the intermitted light, and connecting the two tablets with a telephone and battery in such a way that the effect of the intermittent light on one tablet
70 balances the effect of the intermitted light on the other when a white surface is exposed and so produces silence in the telephone in that case. Thus no sound (or very little sound) is produced in the telephone until
75 one or more of the luminous dots falls upon a black (or a comparatively non-reflecting) surface of the printed page. When one or more of the dots falls on a black portion of the page the balance between the actions of the two tablets is destroyed and is not re-
80 stored until a white portion of the surface of the paper is again presented to receive the whole series of luminous dots. The balance between the actions of the two tablets may be obtained by any of the electrical methods
85 hitherto used for producing a zero current in one element of a network of conductors of variable resistance. The two tablets may, for example, be inserted in two branches of
90 what is known as a Wheatstone bridge arrangement and balanced by adjusting two other resistances so as to produce a zero current in the branch containing the telephone. As another example of means for producing
95 the desired effect, the two tablets may be inserted in series in the circuit of a battery consisting of several cells, and the telephone terminals may be connected on the one hand to the wire joining the two tablets, and on
100 the other hand to a junction between two cells, or sets of cells, of the battery, the connection being made at such part of the battery as will cause no current or very little current to pass through the telephone when
105 white paper is exposed to the dots.

In any of these electrical devices the primary tablet will be exposed to the light diffusely reflected from the page, and the sec-

ondary tablet will be exposed to a small portion of the intermitted light carried off at some point before it reaches the paper. This may be done by partial reflection of the
 5 main beam of light on to the secondary tablet, or by inserting the secondary tablet into the main beam so that it intercepts a portion of the light, the amount of which could be varied at will. The required balance
 10 when white paper is exposed may further be adjusted in a variety of ways. For example, the intensity of the light that is to fall upon the secondary tablet may be increased or reduced by varying the effectiveness of a reflector which takes up a part of
 15 the intermitted light, or by varying the distance of the secondary tablet, or by varying the obliquity at which the light falls upon the secondary tablet, or again by interposing a semi-transparent substance between the light
 20 and the secondary tablet.

Examples of construction will now be shown in connection with the drawings in which Figure 1 is a sectional elevation of
 25 the optical and certain mechanical parts of one form of optophone. Fig. 2 is a plan of the mechanical parts shown at the lower portion of Fig. 1. Figs. 3 and 4 are elevations illustrating alternative modifications
 30 of a part of the optical system, while Figs. 5, 8 and 9 are sectional elevations illustrating different methods of exposure for the secondary tablet. Figs. 6 and 7 are diagrams illustrating alternative arrangements
 35 for the electrical circuits.

In Fig. 1 there is shown a disk 1 (shown in plan in Fig. 2) which can be set in rapid rotation by means (say) of an electrical motor. This disk has a series of perforations, usually equally spaced, in (say) five
 40 concentric circles, the number of perforations being different in each circle just as in an ordinary acoustical siren. Below the disk 1 is placed an incandescent lamp 2 with straight filament arranged radially. Above and below the disk we may place
 45 screens 3 with radially placed slots, although either or both of these may be dispensed with. 4 is a converging lens, while 5 and 6 are additional converging lenses for producing a very small image of the incandescent filament at the top surface of a glass
 50 plate 8 upon which the printed page is laid face downward, the lines of words being perpendicular to the paper in Fig. 1. Between 6 and 8 there is placed the primary tablet 7, in which an aperture is formed to enable the light to pass through, and, when
 55 a printed page is in position on the glass plate 8, be reflected from the white portions of the page angularly downward onto the top surface of tablet 7, the top surface being the only part of the tablet accessible to light. Thus, with the tablet 7 connected in
 60 series with a source of current and a tele-

phone, an instrument comprising these parts only would constitute a "white sounding" optophone.

According to the present invention, in the method illustrated at Fig. 1 we insert a
 70 concave lens 10 in the main beam of intermitted light in an oblique attitude, so arranged that light reflected from the surface of 10 is directed to fall on a secondary tablet 17. In Fig. 3 the concave lens 10 is
 75 replaced by a concave-convex lens 11, the surfaces being such that light reflected from both surfaces can be utilized in the formation of the image, while in Fig. 4 a plano convex lens 12 is shown acting by reflection
 80 from its upper surface. It is not necessary that an image of the filament shall be formed upon 17 unless the size of the sensitive portion of the tablet is comparable with the dimensions of the source of light. 85
 If the sensitive portion of the tablet 17 has fair dimensions there may be no need to form a real image. In such a case the lens 10, 11 or 12 may be replaced by a plane plate
 90 of glass.

In the case of Fig. 5 there is no attempt
 to form a real image upon the secondary tablet which is there represented as in the form of a cylindrical rod 18 with selenium
 upon a portion of its surface, say in the form of a longitudinal band between two
 95 longitudinal conducting strips. The rod 18 may be arranged capable of angular adjustment, say, about its axis, whereby the light may be caused to fall more or less obliquely on the sensitive portion, so as to obtain variations in the magnitude of the effect produced by the light, such variations being utilized in the process of balancing
 100 the electrical effects of the two tablets.

Fig. 8 shows another arrangement for the illumination of the secondary tablet 17. In this case a mirror of small transverse dimensions 24 (which may be completely opaque, and may be flat or curved) picks up
 110 a portion of the beam and reflects it on to the secondary tablet 17.

In Fig. 9 another arrangement is shown in which the secondary tablet 17 is illuminated by portions of the intermitted light
 115 that would not enter the main optical system of the instrument. A semi-transparent screen 25 may be interposed to cut down the amount of light and may be used for adjusting the effectiveness of the light upon the
 120 secondary tablet 17 so as to effect the required balance when the main beam falls upon a white surface.

The primary and secondary tablets are connected in electrical circuits associated
 125 with a telephone in some suitable manner, for example, in the manner shown in Fig. 6 or that shown in Fig. 7. In these figures, 20 designates a telephone, 7 the primary and 17 the secondary tablet.

The balancing of the effects of the intermitted light upon the two tablets 7, 17, so far as their effects on the telephone 20 are concerned, may further be effected, partially or wholly, by variation in the electrical resistance of the circuits.

In Fig. 6 there is represented an ordinary Wheatstone bridge circuit in which the electrical effects of the tablets 7 and 17, when placed in position in the optophone and exposed to the intermitted light, are balanced by adjustment of one or other or both of the resistances 21, 22. Fig. 7 shows an alternative arrangement of circuit in which the balancing is effected roughly by shifting one terminal of the telephone 20 along the cells of the battery, while the fine adjustment is effected by shifting the other terminal over the resistance 23 until a balance is obtained.

We claim:—

1. An optophone having means by which a series of intermittently luminous beams having different frequencies of intermission are produced, a primary and a secondary sensitive tablet each composed of a substance the electrical conducting properties of which alter under the action of light, means for supporting a printed page, the printed page having light reflecting and comparatively non-reflecting surface portions, means for projecting continuously onto the secondary tablet portions of the light of the whole series of beams, means for projecting onto the surface of the paper intermittently luminous dots of the whole series, the primary tablets being arranged to receive the light reflected from the paper, a source of electricity, two circuits one containing the primary tablet the other the secondary tablet, and a telephone, for the purposes set forth.

2. An optophone having means by which a series of intermittently luminous beams having different frequencies of intermission are produced, a primary and a secondary sensitive tablet each composed of a substance the electrical conducting properties of which alter under the action of light, means for supporting a printed page, the printed page having light reflecting and comparatively non-reflecting surface portions, means for reflecting continuously onto the secondary tablet portions of the light of

the whole series of beams, means for projecting onto the surface of the paper intermittently luminous dots of the whole series, the primary tablet being arranged to receive the light reflected from the paper, a source of electricity, two circuits one containing the primary tablet the other the secondary tablet, and a telephone, for the purposes set forth.

3. An optophone having means by which a series of intermittently luminous beams having different frequencies of intermission are produced, a primary and a secondary sensitive tablet each composed of a substance the electrical conducting properties of which alter under the action of light, means for supporting a printed page, the printed page having light reflecting and comparatively non-reflecting surface portions, a lens or lenses for projecting continuously onto the secondary tablet portions of the light of the whole series of beams, means for projecting onto the surface of the paper intermittently luminous dots of the whole series, the primary tablet being arranged to receive the light reflected from the paper, a source of electricity, two circuits one containing the primary tablet the other the secondary tablet, and a telephone, for the purposes set forth.

4. An optophone consisting of a lamp, a plate of glass, an optical system located between the lamp and the plate of glass, the axis of the optical system being normal to the surface of the plate of glass, a rotatable disk located near the lamp having concentric circles of perforations arranged to intersect the light entering the optical system, a primary tablet located between the optical system and the plate of glass having an aperture for the light directed by the optical system to pass through and having sensitive surface accessible to light presented toward the face of the plate of glass, a secondary tablet located outside the optical system, means located between the optical system and the disk for reflecting light onto the secondary tablet, a source of electricity, two circuits one containing the primary tablet the other the secondary tablet, and a telephone, for the purposes set forth.

ARCHIBALD BAER.

WILLIAM STROUD.

EDMUND EDWARD FOURNIER D'ALBE.