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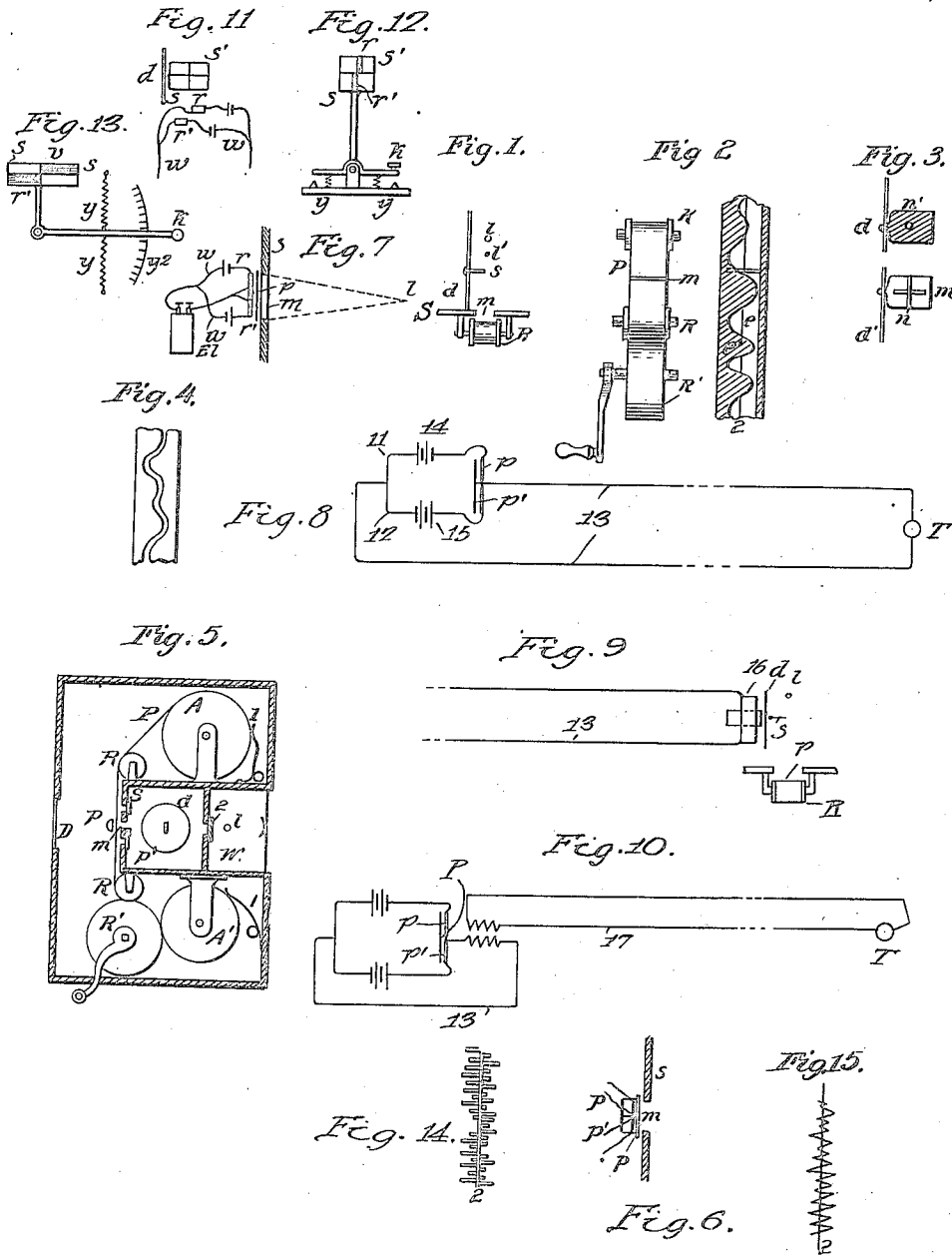
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MEANS FOR PRODUCING, CONTROLLING, AND UTILIZING ELECTRIC CURRENTS.

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1,213,616.



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MEANS FOR PRODUCING, CONTROLLING, AND UTILIZING ELECTRIC CURRENTS.

1,213,616.

Specification of Letters Patent. Patented Jan. 23, 1917.

Original application filed October 22, 1880, Serial No. 19,313. Divided and this application filed June 22, 1912. Serial No. 705,351.

To all whom it may concern:

Be it known that CHARLES EDGAR FRITTS, now deceased, but formerly a citizen of the United States residing at Oneonta, in the county of Otsego and State of New York, did invent a new and useful Improvement in Means for Producing, Controlling, and Utilizing Electric Currents, of which the following is a specification.

This invention relates to recording variations or pulsations in sounds, light, or electrical currents, in a permanent or tangible form, and reproducing the same at will, not merely at the instrument alone, but also at any other instrument suitably connected therewith,—and not merely in their original forms, but also changed as may be desired.

It consists in the application of photography and electricity for recording and reproducing such variations or pulsations, by the aid of a diaphragm or equivalent device capable of vibrating under those influences, and particularly under the influence of sounds, as hereinafter fully set forth. I have therefore termed it a photo-phonographic method and apparatus.

In a co-pending application Serial No. 19,313, filed October 22, 1880, of which this application is a division, I have fully shown and described means for recording, reproducing, transmitting and utilizing various pulsations and variations in sound, electricity, magnetism, etc.

In the present application I have shown so much of the apparatus as is necessary for a complete understanding of the invention herein claimed, reference being made to said co-pending application for further details.

My present invention relates particularly to the production and utilization of alternating currents produced by variation in resistance of two parts of a circuit, these parts being preferably branches of the same circuit. I make use of a pattern or record for controlling the direction and character of the current flowing in the circuit, and thus it is possible to get any desired wave form and to vary it as desired.

The novel features of the invention will

be apparent from the following description taken in connection with the accompanying drawings.

In the drawings: Figure 1 is a view partly broken away showing a speaking diaphragm carrying a shutter, a source of light and a roller carrying a sensitive strip exposed to said light through an opening controlled by said shutter. Fig. 2 shows at the left a plan view of the sensitive strip and rollers and at right an enlarged plan view of a portion of the strip having the photographic record thereon. Fig. 3 shows two forms of shutter mounted on diaphragms which may be used in carrying out my invention. Fig. 4 is a plan view of a strip having thereon a sinusoidal record produced by the shutter shown in Fig. 3. Fig. 5 is a vertical sectional view of one form of apparatus arranged for making the negative or pattern and moving it along by hand in carrying out my invention. Fig. 6 shows two selenium cells arranged for exposure through a single opening to produce alternating current. Fig. 7 is similar to Fig. 6 showing the electrical connections more clearly. Fig. 8 is a diagrammatic view of a circuit and translating device connected directly to the two variable resistances. Fig. 9 is a diagrammatic view of a translating device adapted to make a record of the pulsations in the circuit. Fig. 10 is a view similar to Fig. 9, a circuit receiving induced current from the controlling current having the variable resistances. Fig. 11 is a view of a divided shutter and two selenium bars for producing alternating current. Fig. 12 shows a modified form of divided shutter mounted as a key. Fig. 13 is a view of another arrangement. Fig. 14 shows a record view made by using one of the divided form of shutter. Fig. 15 shows a record such as will be produced by the upper shutter shown in Fig. 3.

In carrying out the present invention an electric circuit is provided with means therein which react to light, such as a selenium bar or cell so that under the influence of varying light the current flowing in said circuit will be varied. The current thus va-

ried may be conducted by wire to any instrument or place and there converted into sounds or utilized for any other purpose. The light reaching the selenium cell may be controlled by a pattern or record having recorded thereon variations in light, and as explained in original application 19,313 that pattern may be formed in various ways to represent various phenomena, such as sound waves, or it may consist of arbitrary predetermined signals. It is preferably made photographically and is so arranged and moved as to vary the light reaching the selenium cell in accordance with the forms on it. It may be in the shape of a negative strip passing across a slit or opening in a casing, the selenium being exposed to the light passing through it and through said slit. When the light is entirely cut off from the selenium, its resistance is so great that the current is (or may be) wholly prevented from passing through it. Thus the pattern can produce intermittent or undulating currents corresponding to the curves or forms upon it. In order to produce alternating currents, I arrange the selenium in two parts or sections, each section adapted to send whatever current penetrates it through the circuit in a positive direction. As the pattern allows one section to be exposed and lighted up, a current will be sent through the circuit in one direction, and vice versa; and in either case the strength of the current will be governed by the amount of light transmitted by the pattern. Any desired variations can thus be produced in electrical currents by using a suitable pattern. These currents can be utilized on the spot, or can be sent through the circuit to a distance, and, if desired, can be there repeated and sent on in a manner well known to electricians, and finally utilized in a telephone or electrical receiver of any kind.

It will be seen by reference to Fig. 6 that two selenium bars p and p' are placed behind a narrow slit m long enough to cover the length of the two bars and each bar is inclosed and protected from all light except that which passes through the slit. A record or negative strip P is fed past the slit m transversely, thus varying the light which reaches the bars in accordance with the forms on it. Each bar has proper wires to conduct the current through it, which are so connected up that each bar directs the current which flows in it through the line in an opposite direction, and their resistances are such that no current (or a very slight one) flows through either of them as long as they are kept in the dark. But immediately that the negative strip admits light to either bar, its resistance is lessened, and the current flows through that bar to the line, or to the primary coil of an inductorium which sends the induced current to line, or

to any other device, as the case may be,—the strength of the current being in proportion to the length of the bar thereby exposed to the light. The electrical connections are as more fully shown in Fig. 7, or they may be arranged in any other suitable or well known manner. The longer the transparent part of the strip or signal, the more of the bar is lighted up, and the stronger the current which flows through it. When the other bar is illuminated, the same effect is produced, but the current is sent through the line or circuit in the opposite direction,—all of which will be readily comprehended and effected by electricians.

The arrangement above described may be used with proper patterns or negatives for producing alternating currents or undulating currents of alternately opposite polarity. The two cells are arranged end to end with their approximating ends at the central line of the pattern strip so that one cell or bar is opposite one half of the slit m and the other bar or cell opposite the other half. Each cell is arranged to send whatever current flows through it in a direction opposite to that of the current from the other cell, in any well-known or suitable manner and each may be supplied with its current from different ends or sections of the same battery or from separate batteries, as shown in Figs. 6 and 7 where the two sections of the selenium are inserted in derived circuits or branches of the main circuit $w w$. In either case, the electric current is arranged to flow through the selenium by proper conducting wires and the varying quantity of light which falls upon the selenium will correspondingly vary the current flowing through it, as is well known to electricians.

In Fig. 7 P represents the pattern or strip moving past the slit m in the partitions S and r and r' represent the two sections of the slit with the sectional current-controlling device arranged behind it—each section when lighted sending a current of opposite polarity through the circuit E' represents any suitable translating device for utilizing the current transmitted and l represents a source of light.

In Fig. 8 the two selenium bars $p p'$ are shown in the branch circuits 11 and 12 of the main circuit 13 and batteries or other sources of electricity 14 and 15 are placed in the branch circuits so connected as to tend to send current in opposite directions. A translating device T is placed in the main circuit.

Fig. 9 shows a translating device for utilizing the current variations in the main circuit 13 consisting of an electro-magnet 16 operating to vibrate a diaphragm d carrying a shutter s which controls the passage of light from a source l to a photo-sensitive strip P carried by the rollers R .

In Fig. 10 the circuit 13 controlled by the selenium bars $p p'$ induces current in a second circuit 17 which has in it a translating device T.

Mechanism which may be used in producing the negatives or patterns used to control the light passing to the two selenium bars is shown in Figs. 1, 2, 3, 5, 12 and 13 and some of the records produced are shown in Figs. 4, 14 and 15. The mechanism will be first described with reference to the production of sound records or negatives.

In making the negatives, the sound to be recorded is caused to impinge upon a vibrating diaphragm, which is properly damped and arranged, as will be readily understood by those versed in telephony. To the center of the diaphragm d , Fig. 1, is fixed a vertical screen or shutter s of mica or other light and stiff material being attached by its center and the outer corners rounded off a little to prevent their contact with the diaphragm during its backward vibrations, or to the left. It projects out at right angles to the plane of the diaphragm and is made opaque to prevent the passage of any light through it. Fig. 1 is a vertical plan view; s is the shutter, d the diaphragm, l is a powerful light throwing a beam of nearly parallel rays across the screen or partition S, which has a long narrow slit m in it, through which the light passes and strikes the prepared surface, which in this case is represented as a strip of sensitized paper, fed at a regular speed over the rollers R R. As the diaphragm shutter s normally stands its edge shuts the light off from one half of the slit and in vibrating it covers up more or less of the strip according to the extent of the vibrations. The paper strip being carried along behind the slit m , Fig. 2, the edge of the shutter will describe a curved line at the junction of the part e' ; not acted upon by the light, and e , which is acted upon; and by proper treatment the latter may be dissolved away or otherwise made transparent in any well known way, as will be at once understood by photographers.

If, instead of an opaque shutter on the diaphragm, there is left a vertical transparent strip across said shutter, the light will reach the paper strip behind the screen only through the intersection of the two slits in front of it, forming merely a square spot of light, as shown by Fig. 3 at the intersection of the two slits n and m . The vertical slit on the mica should make the light beam of about the same width as the stationary horizontal slit in the screen. As the diaphragm vibrates and the paper is moved along, we produce (after dissolving out the parts exposed to light, blacking the rest, soaking in oil or otherwise rendering it transparent) a narrow, transparent curve

on the paper strip, as represented in Fig. 4. Instead of the vertical strip, we may use a transparent spot at the point which will fall on the center of the stationary slit when the diaphragm is still, as seen at n on the upper shutter shown in Fig. 3. This also makes a negative strip, like Fig. 4.

Fig. 5 illustrates an apparatus which may be used in making the negative or record strip, and in the particular form shown the light reaching the strip is controlled by sound pulsations. It will be understood, however, that a similar structural arrangement may be used in making records by manual control of the light. At A is a roll of the prepared negative strip wound upon a bobbin which is mounted in journal bearings in any convenient way. This strip may be of any suitable thin and flexible material which may be strong fine paper, but what is known as paper parchment is preferred, although many other substances may be used. It should be covered with a thin film made very sensitive to light by any of the instantaneous processes employed in photography, although a dry process will be most convenient with this form of negative. After being properly coated and sensitized, it should be carefully dried, rolled up, and protected from light or damp until ready to use it. It may be thus coated and sensitized either before or after being cut up into strips of width suitable for use, but in the latter case, care must be taken in the cutting not to disturb the adhesion of the film to the strip. A suitable width is $\frac{1}{2}$ or $\frac{3}{4}$ inch and the length will, of course, be governed by convenience or the choice of the operator.

The roll A is free to turn, being held only by the spring 1 pressing upon it sufficiently to prevent it from turning faster than the strip is needed. From A the strip passes over the flanged rollers R R, Figs. 1, 2 and 5; at R' is a rubber-faced roller which presses the paper strip between itself and R tightly enough to prevent the slipping of the strip. It also fits between the flanges of the roller enough to carry that along with it. If desired, it can also press lightly on the roller A' to assist in rewinding the strip upon it. To this roller can be applied the power which feeds the strip along before the slit m in the screen or partition S. For experiment or common telegraphic purposes a crank may be attached to the roller R' or R, as shown in Fig. 5, or the strip may be otherwise fed by hand. But when accuracy is required, some motor should be employed which will give the negative a perfectly uniform and known rate of speed. These are not new and need not be described, as they form no part of my invention. The motor may be attached to or contained in the box or frame of the phonograph or

otherwise connected as preferred. The strip being thus fed along at a uniform speed it is wound upon a second roller A' or may simply be fed loosely into the bottom of the box or case of the phonograph after exposure to the varying light. It will now remain unchanged if kept from light and damp, for days or even weeks, or, on the other hand, it may be at once developed, intensified, fixed, or otherwise treated to render the image permanent,—according to the process employed or the effect desired. All of which will be at once understood by those versed in photography, who will be enabled from the foregoing description to readily make a negative strip having the characteristics required and will probably prefer the gelatino-bromid process. If the paper seems to have a greasy nature, it may, before applying bromid emulsion, be coated with four per cent. solution of white of egg to which sufficient chrome-alum has been added to give it a slight bluish tinge. This will insure the film adhering perfectly. But it will seldom be required if a good quality of paper or parchment is used. These strips being fixed, they may be treated and used in different ways. The parts acted upon by light may be made transparent and the rest blacked and rendered more opaque and the strip used by transmitting light through it; or the strip may be left opaque and used by reflected light—in which case the parts acted upon by light should be made as white or brilliant, and those not acted upon as black and absorbent of light as possible, all of which can be done by any one out of many well known ways, and detailed directions are not necessary. For example, a strip to be used by transmitted light may have the dark parts blacked with carbon-ink, flexible black varnish, or otherwise, and the lights rendered transparent by dipping in castor oil thinned with absolute alcohol.

The finished strip being again wound upon the wheel or roller A and properly arranged in the phonograph, we can reproduce the original variations in the first beam of light in another beam of light, by feeding the strip before the slit *m* at the same speed as when making the negative and throwing the beam of light through it as it passes the slit. To do this, the diaphragm *d* with its shutter is removed—the upright frame which holds it being arranged to slide on a foot-piece which fits in grooves so that it may be slid into its place for use, or moved back out of the way, as desired. The square chamber which contained the diaphragm is now empty or free and allows the light *l* to shine unobstructed across it to and through the slit *m* onto and through the strip which is rapidly fed before it, whereby the light which passes through the strip is

varied in precisely the same manner as the original beam of light was varied by the shutter on the diaphragm *d*, *i. e.*, the greater the proportion of the strip which is transparent, the longer the beam of light which is passed through it, and vice versa (see Fig. 2). This light can now be used to produce corresponding variations or pulsations in sound, electric currents, magnetic attractions, etc., as desired.

By arranging the diaphragm *d* or its shutter *s* to be operated manually, feeding the strip slowly and vibrating the shutter in a manner similar to that used in sending Morse signals the result would be a strip with transparent lines across it. The shutter can, of course, be actually arranged on a sort of key and be vibrated manually before the slit *m* to intercept the light properly. Fig. 11 shows this device adapted for producing alternating currents. The parts *s* and *s'* are opaque, the rest of the shutter transparent. The black bodies *r* and *r'* represent the two sections of the slit *m* which are normally covered or protected by the opaque portions *s* and *s'*. But when the key *K* is operated to move the shutter to the right it uncovers the section *r*, and vice versa, thus producing the pattern precisely as already described, only it is now done manually instead of automatically. By arranging the shutter like Figs. 3 and 13, to be moved in both directions from the center and to different distances for the different letters or signals, a strip like Fig. 14 would be made. Fig. 13 shows the key or lever *K* for moving the shutter, the proper distances being indicated by the scale y^2 . The springs *y y* keep it normally in its central position and when moved to either side it uncovers one of the sections of the slit *m* precisely as described for Fig. 12 and the further the key is turned on its central pivot the more of the slits or openings are uncovered by the shutter and the greater the length of the beam of light allowed to pass through to the sensitive surfaces behind the slit. Or the pattern strip could be punched out or otherwise produced by hand in the manner now practised for automatic telegraphing. Such a strip prepared in either way can then be run through the instrument at almost unlimited speed and the signals will be perfectly produced by the light being varied during its passage through the strip and then falling on two selenium bars or strips or other current-controlling devices arranged behind the slit *m*, producing correspondingly varying currents, which are then sent over the line or other currents induced by them sent instead to another phonograph or to one of my telephones or other apparatus, as shown at *EZ* in Fig. 7, where *P* is the pattern or strip moving past the slit *m* in the partitions, *S*, and *r* and *r'* represent the two sections of

the slit with the sectional current-controlling device arranged behind it—each section, when lighted, sending a current of opposite polarity through the circuit.

5 A pattern like that shown in Fig. 4 and also one like that shown in Fig. 15 can be made by the use of a shutter like that shown in Fig. 3 where a single spot of light passes to the negative and is vibrated laterally as
10 the strip moves.

A strip or pattern like that shown in Fig. 14 will produce an alternating current whose changes of strength and polarity will be sudden or instantaneous for each
15 section of the cell will be at once lighted for the whole length of the signal or form on the strip then as suddenly shut off from all light, and the other cell or section will be lighted and operated by the form on the
20 opposite half of the pattern strip. A pattern like Figs. 2, 4 and 15, however, produces the changes of strength and polarity gradually. When designed to be used with a divisional selenium cell, they should, of
25 course, be made by a divisional shutter on the diaphragm, as shown in Fig. 12. In using such a shutter to produce negatives, it should be arranged so that the central vertical line or division of the shutter will fall
30 on the central line of the slit m , which should also be made preferably in two parts in different planes, as shown by the position of r and r' in Figs. 12 or 13. When arranged
35 as in Fig. 12, the opaque part s of the shutter stands between the light and the part r' of the slit and s' covers up the slit r , as will be understood from Fig. 13, where the parts
40 are so arranged. Now, when the shutter vibrates to the right, s' uncovers more or less of slit r , and when moving to the left, the part r' of the slit is similarly exposed by the removal of s . The sensitive surface
45 being fed down past the slit, a pattern is produced like Fig. 2 but with the two halves independent, and possibly, dissimilar,—each corresponding to the movements of its own half of the shutter. By now moving this pattern (when finished) past the slit again
50 after arranging a sectional selenium cell behind it with each section of the selenium behind the corresponding section of the cell (and the shutter being now moved back out of the way) we shall produce alternating
55 currents whose variations in strength and polarity will correspond to the original vibrations of the shutter and, therefore, of the force which moved it—the principle involved in making and using the pattern being
60 precisely the same as already described.

Having thus described the invention what is claimed is:

1. The combination with two sources of electricity and a circuit connected thereto,
65 branch conductors in said circuit, each having one of said sources oppositely connected

therein, and a conductor the resistance of which is affected by light included in each branch circuit.

2. The combination with two sources of electricity and a circuit connected thereto,
70 branch conductors in said circuit, each having one of said sources oppositely connected therein, each branch conductor including a selenium cell.

3. The combination with a source of electricity and a circuit connected thereto,
75 two branch conductors in said circuit each including an oppositely connected section of said source of electricity and a conductor the resistance of which is affected by light,
80 and a translating device affected by the relative currents flowing in said branch conductors.

4. The combination with a source of electricity and a circuit connected thereto,
85 of branch conductors in said circuit each including an oppositely connected section of said source of electricity and a selenium section, said selenium sections being adjacently
90 mounted, and means for supplying variable light to said selenium sections.

5. The combination with sources of electricity and a circuit associated therewith, of
95 branch circuits connecting opposite poles of said sources of electricity to one terminal of said circuit, a selenium conductor in each branch circuit, and means for supplying
100 varying light to said selenium conductors.

6. The combination with sources of electricity and a circuit associated therewith, of
100 branch circuits connecting opposite poles of said sources of electricity to one terminal of said circuit, a selenium conductor in each branch circuit, and means for supplying
105 varying light to said selenium conductors increasing and diminishing alternately and reciprocally to impress upon said circuit an
alternating current.

7. The combination with sources of electricity and a circuit associated therewith, of
110 branch circuits connecting opposite poles of said sources of electricity to one terminal of said circuit, a conductor the resistance of which is affected by light in each branch
115 circuit, a source of light, and a movable record constructed to control and vary the rays from said light supplied to said conductors to vary the amount and direction of
current impressed upon said circuit.

8. The combination with a source of electricity and a circuit associated therewith, of
120 branch circuits connecting opposite poles of said source of electricity to one terminal of said circuit, adjacently located selenium
125 conductors in said branch circuits, a source of light, and a movable record translucent in degrees to control the degree and alternation of light admission to said selenium
conductors.

9. The combination with a source of elec- 130

tricity and a circuit associated therewith, of
 branch circuits connecting opposite poles of
 said source of electricity to one terminal of
 said circuit, adjacently located selenium con-
 5 ductors in said branch circuits, a source of
 light, and a record translucent in degrees
 upon successive portions and movable before
 said selenium conductors to vary and cut off
 the light with respect to each selenium con-
 10 ductor alternately.

10 10. The combination with an electric cir-
 cuit, of two selenium cells adjacent to each
 other and each connected with said circuit
 and a source of electricity arranged to direct
 15 current in said circuit in opposite directions,

means for excluding light from said cells
 except on one face, an elongated flexible rec-
 ord strip having successive portions trans-
 lucent in degrees and movable across said
 face with part overlapping each cell, and 20
 means for passing light through said strip
 to said cells modified by said record strip.

In testimony whereof I affix my signature
 in presence of two witnesses.

JOSEPHINE H. FRITTS,

*Administratrix of the estate of Charles Ed-
 gar Fritts, deceased.*

Witnesses:

GEORGE L. GIBBS,

FRANCES E. FRITTS.