

Nov. 1, 1927.

1,647,652

H. J. MURRAY

ELECTRIC CURRENT AFFECTING DEVICE

Original Filed Sept. 15, 1921 2 Sheets-Sheet 1

Fig. 1.

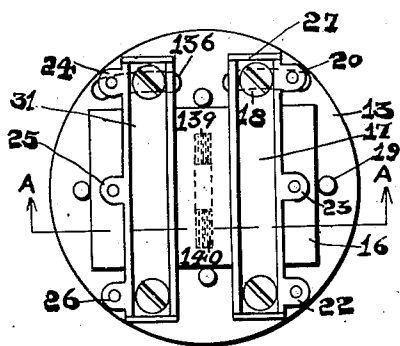


Fig. 2.

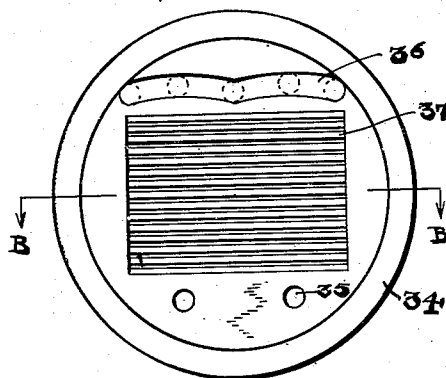


Fig. 3.

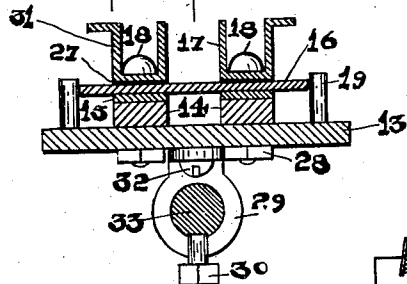


Fig. 4.

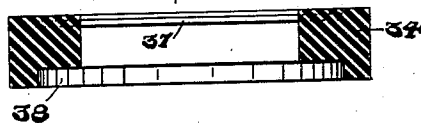


Fig. 5.

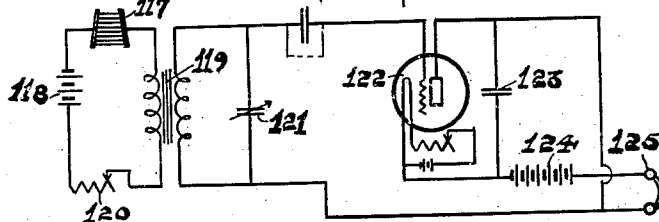


Fig. 6.

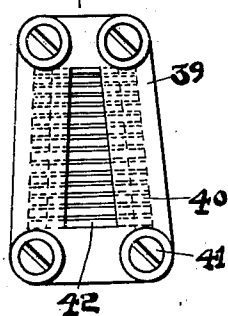


Fig. 7.

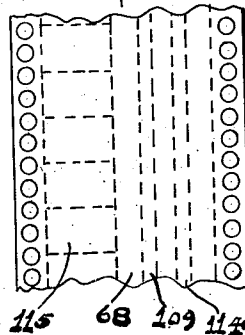
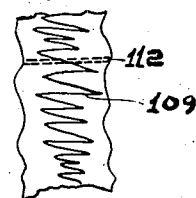


Fig. 8.



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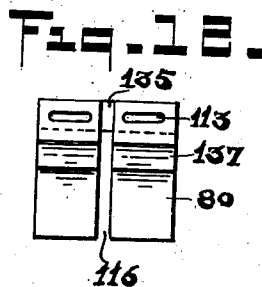
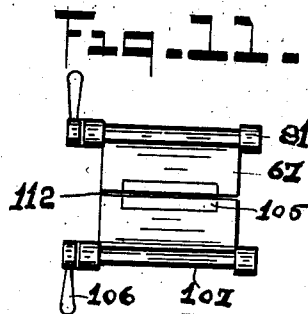
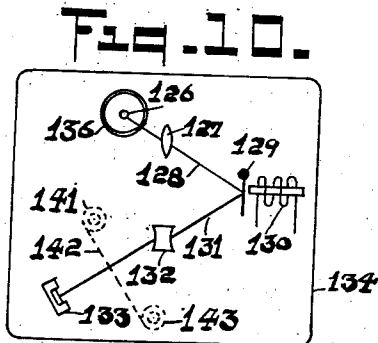
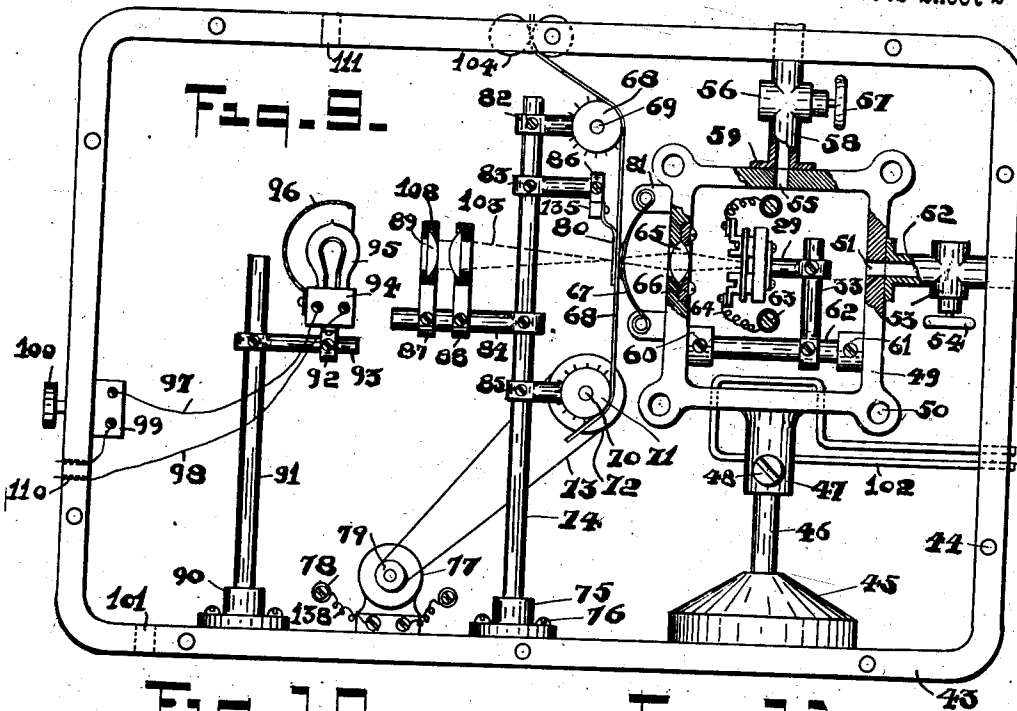
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ELECTRIC CURRENT AFFECTING DEVICE

Original Filed Sept. 15, 1921 2 Sheets-Sheet 2



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UNITED STATES PATENT OFFICE.

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ELECTRIC-CURRENT-AFFECTING DEVICE.

Application filed September 15, 1921, Serial No. 500,938. Renewed July 21, 1926.

My invention relates in general to the variation of electric current by means of a light sensitive resistance changing element.

One of the general objects of my invention is to provide a device which may be used to vary current in an electric circuit in synchronism with the movement of a beam of light.

A further object of my invention is to provide a simple device which may vary current in an electric circuit in desired synchronism with the relative movement of a beam of light or other radiant energy of approximately constant area, color, and intensity.

The application features for a general object the providing of means for affecting the current in an electric circuit by the action of light on a light sensitive resistance changing element constituting a portion of said circuit.

This application has for additional objects the providing of means including a light sensitive cell designed to be affected by the action of energy radiations of approximately constant amount, intensity, or area. The said means in addition permit the said radiations to impinge on the surface of the said element thereby to vary its resistance in accordance with a desired movement of the said radiations.

Still another object of the invention is to provide means for affecting an electric current so as to electrically reproduce and amplify light recorded sound waves.

Various other objects and advantages of the invention will be in part obvious from an inspection of the accompanying drawings and in part will be more fully set forth in the following particular description of one form of mechanism embodying my invention, and the invention also consists in certain new and novel features of construction and combination of parts hereinafter set forth and claimed.

In the drawings:—

Figure 1 is a plan view of a variable area light sensitive cell.

Figure 2 is a bottom view of a light sensitive variable area cell composed of a plurality of light sensitive resistance changing conductors.

Figure 3 is a vertical sectional view taken at A—A in Figure 1.

Figure 4 is a vertical sectional view taken at B—B in Figure 2.

Figure 5 is a plan view of a fixed area light sensitive cell.

Figure 6 is a diagrammatic view of an amplifying circuit including a light sensitive cell.

Figure 7 is a portion of a light sensitive film such as usually employed in connection with motion picture machines but widened to record one or more sound records in addition to the usual photographs.

Figure 8 shows a greatly enlarged view of a light recorded sound record.

Figure 9 shows a vertical plan and partially sectional view taken through a mechanism containing casing, enclosing a preferred embodiment of the invention mounted on an adjustable support and also means for providing desired light and moving sound records.

Figure 10 is a diagrammatic view of the embodiment of the invention in a simple photophone.

Figure 11 is a plan view of the variable area device shown in drawing Fig. 10.

Figure 12 is a plan view of the ray limiting device shown in drawing Fig. 10.

In the following description and in the claims, parts will be identified by specific names for convenience of expression, but they are intended to be as generic in their application to similar parts as the art will permit.

Referring to the embodiment of my invention as disclosed in Figures 1 and 2, there is shown a disc shaped base of fibre or other insulating material 13. Secured to the base 13 by means of suitable screws 18 and nuts 28 are two sets of adjustable resistance terminal holding means consisting of insulating strips 14, yieldable pads 15 preferably made of felt, contact strips preferably made of lead and the terminal holding strips 17 and 31.

Positioned between 15 and 27 is the light affected resistance changing element 16 preferably in the form of a smooth sheet and consisting of selenium. The element 16 is positioned by the locating pins 19. The adjustable terminal holding members 17 and 31 are made of current conducting material of comparatively high or low resistance as desired due to requirements hereinafter de-

scribed. It is to be noted that each of the terminal members 17 and 31 have a plurality of circuit connection portions as 20, 22, 23 and 24, 25, 26.

5 A bracket clamp 29 is firmly secured to the base 13 by means of the screws 32 and is adjustably secured to the adjusting post 33 by means of set-screw 30.

10 The slots 136 in the base 13 are provided so that the terminal members 17 and 31 may be rotated about the lower screws 18 as an axis.

15 In operation it will be understood that the said cell may be included in an electric circuit by any combination of the said connection portions so that current will flow in either direction through the element 16 and from one terminal member to the other.

20 The dotted areas as 139 and 140 shown on the surface of the element 16 (Figure 1) represent portions intercepting light rays. The two said portions and the dotted connecting lines may be taken to represent the maximum movement of a beam of light on the 25 exposed active surface of the element 16 while current is flowing through same. It is evident that as long as the terminal strips 17 and 31 are of comparatively low resistance and the said light remains approximately constant in area, color, intensity, and 30 position, no appreciable change in resistance of the element 16 will occur. If the said light be caused to move in effect as indicated in Figure 1 no appreciable change in resistance will occur except due to the low resistance of the terminal holders 17 and 31.

35 However, if one or both of the members 17 and 31 together with the said attached parts are rotated in either direction about 40 the lower screws 18 as an axis then the exposed active surface or area of the element becomes trapezoidal in form. When the top screws 18 are properly tightened down on the terminal members 17 and 31 by means 45 of the nuts then suitable contactual relation will be effected by the terminal members and the said element because of the channel form of the said members.

50 The relatively soft current conducting contact strips 27 will tend to prevent warping and will be pressed against the surface of the said element 16.

55 Under these conditions it is evident that the total resistance of the element 16 will vary according to the relative position of the said light interception by the said element, the form of the active area of the said element, and the combination of circuit connecting portions used to include the said element in an electric circuit.

60 Such action would be in accord with well known and accepted laws of computing resistance values.

65 If the said light is caused (in effect) to move over the said surface of the element

in an imaginary straight line from top to bottom (with reference to Fig. 1) then the current change in the circuit of which the element 16 may be a portion will of course be changed accordingly.

70 By causing the terminal member 31 to have a relatively high resistance and the terminal strip 17 to have a relatively low resistance it is evident that the said current variation can be affected as desired in magnitude, form, and frequency. For example 75 if the said circuit as shown by Fig. 6 includes 24 of the high resistance member 31, the said element 16, and 23 of the low resistance terminal member 17, and the area of the said exposed and active surface of element 16 is that of a trapezoid wider at the 80 top than at the bottom (with reference to Fig. 1) the following action will occur as the said light beam is moved in effect over the active surface of the element 16 toward 85 the narrow base of the said trapezoidal area the resistance of the said cell as a unit will decrease. As the said light is moved toward the wider base the total resistance will increase 90 proportional to the movement of the light.

95 If the rate of movement is increased the change of resistance will be accordingly accelerated. If the light is oscillated with the speed of voice or sound waves as desired 100 then the said resistance and consequently the said current will be varied according to the said light oscillations.

105 By employing a light wave of approximately constant intensity, color, area, and suitable oscillation period, the current in the said circuit may be variably affected by varying the said area and the resistance of the terminal members 17 and 31.

110 If the circuit includes 25, 16, and 23 and both of the said terminal members are of comparatively high resistance and disposed in parallel then the change of current will be greatest when the said light is impinging on the surface of the element 16 at approximately the center or in a line connecting 25 and 23 as shown by Fig. 1. The said change will decrease on movement in effect of the light in a direction from the center in either 115 direction.

120 Therefore the oscillations of the current change will be double the rate of oscillation of the said light beam if the circuit includes the ends of the high resistance terminals because the variation would twice be zero and twice a maximum for each oscillation of light. Hence the form and frequency of the said current may be varied at will.

125 By changing the form and area of the element 16 or a plurality of elements co-actively associated, the specific resistance of the said members, the intensity area and color of the said light, etc. unlimited current variations in form, magnitude, and frequency may be 130 obtained when the element 16 is a portion

of an electric circuit having a source of power and the said light is moved in effect over the exposed surface of the said element. It is understood that any form of radiant energy may be substituted for the said light.

The insulating base 13 is held by the clamp 29 as previously described and by moving 29 about 33 the angle of incidence of the said light against the said surface may be varied as well as the relative position of the said element and therefore the form of the said current variation may be changed for any given light oscillation as desired.

By affecting the movement of the said light, its intensity, color, and area the said form will of course be further affected.

In Figure 2 we have an embodiment of the invention which employs a plurality of light sensitive resistance changing conductors 37 arranged in parallel and separately insulated by positioning same in the moulded form 34 preferably made of bakelite. This form is provided with holes 35 designed to receive lower screws 18 and also provided with radial openings 36 arranged to receive upper screws 18 of Fig. 1.

The element 16 and the pins 19 in Figure 1 may be replaced by the form 34 and conductors 37 of proper dimensions to fit over the base 13.

When the terminal members 17 and 31 are rotated and secured as previously described we again form a trapezoidal area or a rectangular one as desired but composed of a plurality of light sensitive conductors in parallel both physically and electrically.

Accepted laws regarding conductance and resistance of current conductors disposed in parallel electrically indicate that any change of resistance in one or more of the said conductors varies the total conductance and resistance of the said conductors. Hence if we affect the resistance of one of the wires 37 as shown in Figure 2 we will affect the total resistance of the circuit of which they may be a part when placed on the said insulating base in Fig. 1 as described above.

Of course if the wires 37 were all of the said length and of the same resistance then affecting any one of the said wires to the same extent would affect the total to the same extent, but as the area is trapezoidal in form each conductor has a different resistance value than an adjacent one.

In other words we will have a tapering resistance and the movement of the said light in certain directions across the said conductors will vary the resistance of each conductor to approximately the same extent, but will vary the total resistance in proportion to the extent of its movement in either direction.

The conductors 37 may be arranged in any desired combination of sizes, lengths, specific resistances in order to secure desired

results, as for example they may be arranged so as to secure a variation according to the sine law etc.

In Figure 5 we have a fixed light affected resistance changing cell, composed of a plurality of preferably tellurium conductors 42 having portions moulded into an insulating form 39 preferably of bakelite. The said conductors are connected electrically by means of connecting strips 40 which end in contactual relation with the binding posts 41 constituting means for introducing the said cell into an electric circuit.

Figure 6 consists of a diagrammatic view of an organization of current means for varying current by means of the conductors in Figure 2 and designated as a cell 117 in series with a source of current 118, variable resistance 120, and a winding of transformer 119. The remainder of the organization consists of a standard amplifying set including a vacuum tube having a filament 122 the necessary condensers 121, batteries 124, etc., and one or more receivers 125. It is understood that any suitable arrangement for amplifying current may be used in connection with the cell 117 which is merely a diagrammatic form of an embodiment of my invention.

I have described the effect of a relative movement of the said beam of light in one form of my invention, and I will also describe one form of means for causing (in effect) the said relative movement of light also included in one embodiment of my invention.

It is admitted that causing a reflected beam of light to oscillate due to the vibrations of a diaphragm magnetically actuated or otherwise is old in the art. It is also old to cause the said beam to affect the resistance of a selenium cell or other light affected substances. In addition the art reveals methods of recording the oscillations of a beam of light on a moving photographic surface also means for amplifying current variations.

My invention requires the use of one or more of the above known means more or less improved and arranged for a complete embodiment.

In one form of my invention I employ a beam of light and a continuously moving photographic film to produce the oscillated light as hereinbefore described. By the use of my invention in connection with one or more of the above known means a great improvement is made in the practical and useful reproduction and amplification of light and sound records.

When the invention is used in connection with a current amplifier as shown by Fig. 6 the device is admirably suitable for use in connection with a talking and moving picture machine and it will be described in con-

nection with such a device but it will be readily appreciated that the invention is not so limited, but may be utilized wherever an electric current may be affected to electrically reproduce and amplify desired waves of light or sound.

Referring to Figure 7 I show a portion of film 68 sufficient in width to include the usual picture space 115 and also spaces 109 and 114 designed to receive a plurality of light recorded sound records. It is obvious that two or more films may be employed. One for the pictures and the others for the said sound records.

In Figure 8 is shown a magnified portion 109 of the said light recorded sound record assumed to be found in the spaces 109 and 114 of Figure 7. The record portion or section of 109 included between the dotted lines 112 of Figure 8 will permit the said light to pass through the film because of the transparency of the said light affected portion of the said film. Hence as the said film is moved infinitesimal portions of the sinusoidal line 109 moving between the lines 112 will for an instant permit the said light to pass. The result (in effect) will be a beam of light moving or oscillating similar to the said sinusoidal line.

If this moving beam of light is permitted to impinge on the surface of the said element as shown in Fig. 1 and previously described then the sound or energy waves represented by the sinusoidal line 109 in Fig. 8 will be electrically reproduced and amplified as desired as shown in Fig. 6.

In Fig. 9 there is shown a mechanism containing casing 43 provided with an air tight cover (not shown) fastened to the said casing by suitable screws which fit into the drillings 44. This casing contains a support rod 46 having a heavy slidable base 45. Mounted on the said rod is a second smaller casing 49 designed to resist pressure both inside and out and adjustably supported to the said rod 46 by means of a set screw 47 and the clamp 48 attached to 49. An air tight cover (not shown) closes 49 and is fastened to same by means of bolts passing through the openings 50. Opening 51 and 55 are designed to admit gas, air etc. into the said casing or remove same by means of the pipes 58 and 62, valves 53 and 56, and hand wheels 54 and 57. The said openings may also be used to create a vacuum in the said enclosure. A system of circulating pipes 102 are designed to bring heated or cooled liquid to the interior of the said casing 40 and thereby raise or lower the temperature of its interior. Adjustably mounted on adjusting post 33 is the light affected resistance changing cell as shown in one embodiment by Figures 1 and 3, or Figures 2 and 4. The said post 33 is in turn adjustably secured to the horizontal rod 62 by the

sliding clamp of 33. The rod 62 is securely fastened to projections of the casing 49 by means of set screws 60 and 61.

The said cell is suitably connected to an exterior circuit of which it may be a portion by means of the insulated conductors 64 and insulated terminals 63 passing through the walls of the casing 49 so as to make same air tight under pressure or vacuum.

A suitable lens 65 is suitably positioned in a desirable opening of the casing 49 so as to prevent cracking due to the bolted element 66.

Also contained in the interior of the enclosure formed by the casing 43 is a portion or all of a movable previously exposed and developed film as shown by Figure 7 properly guided and positioned by the wheels 68 and 71. These said wheels are adjustably mounted on shafts 69 and 70 respectively adjustably positioned by clamp collars 82 and 85 on supporting post 74. If desired the film may be entirely contained in the said enclosure by replacing the wheels 68 and 71 by suitable spools. In either case the said film may be actuated by motor 77, pulley 79, belt 73, and power wheel 72 attached to 71 by means of rotatable shaft 70.

Suitable power may be delivered to the said motor 77 by means of conductors 138 suitably connected to insulated terminals 78 and an external source of power. The supporting post 74 is securely fastened to casing 43 by means of floor clamp 75 and bolts 76.

Integral with and projecting from the casing 49 are two support ears 81 designed to properly support and position the variable area elements 67 as shown on Figure 11. These said elements have a rotatable hinged portion 107 formed about tight fitting pins turning in openings of the said ears 81 so as to be stationary except when moved by the adjusting handles 106 or by other suitable means. Due to these area varying elements the space as indicated by 112 on Figure 8 and included between the dotted lines may be varied as required. Raised portions 105 are designed to cause the said film to move smoothly and closely over the elements 67 and to permit fine adjustment due to the possible thinness of the material used.

Adjustable clamp 83 attached to supporting rod 74 by means of a set screw in turn adjustably positions clamp 86 which supports the light limiting members 80 by means of bracket 135 as shown on Figure 12. The slots 113 permit the movable members 80 to be moved relative to each other in order to vary the width of the space 116 formed by such movement. The members 80 are preferably designed to be yieldable due to the curved portion 137 and the said por-

tion may be formed so as to give suitable pressure against the film 68.

Also adjustably supported by supporting rod 74 is lens rod 84 in turn adjustably supporting clamp members 87 and 88 ending in lens holders 108 in which are suitably mounted condenser lenses 89. A third support rod 91 also secured to the casing 43 by means of floor flange 90 and suitable bolts is used for supporting the source of light 95, reflector 96, socket 94, and socket clamp 92 attached to adjusting rod 93 by a set screw.

Openings having insulating bushings 110 admit current conductors 97 and 98 which supply a variable current to the filament of 95 due to the variable rheostat 99 and the handle 100.

Openings 101 and 111 are also provided in the wall of the said casing to permit desired ventilation.

It is assumed that the film 68 may be a portion of film used in a motion picture machine designed to receive a film similar to that shown on Figure 7 or two separate films as hereinbefore mentioned. In such event two or more sets of pulleys 104 may be used to guide the said film in or out of the said casing 43.

The operation of the elements shown on Figure 9 may be described as follows.

Desired light is produced by passing current through the filament 95 of proper strength. This light is suitably collected by the condensers 89 when properly adjusted and caused to converge as rays 103 which may focus at a point adjacent the surface of the film 68. The light limiting members 80 prevent the said ray impinging on the said film except at a desired area, as for instance the maximum width of the record 109 as shown on Figure 7.

The opening 112 formed by the space 139 between the edges of the variable aperture member 67 may be considered at right angles to the opening 116 between the light limiting members 80. Hence if the film were removed the said light would be permitted to pass through the rectangular opening formed by the two said spaces. But in operation the said film is moving between the said members and only the light affected sound record will permit light to pass through the said film. One dimension is fixed by the opening and the other dimension will vary with the width of the said record. Assuming that the record 109 of Figure 8 may be represented for the sake of description by a sinuous line of approximately constant width it is evident that the transparent portion included in the said area will in effect reciprocate at right angles to the direction of movement of the said film 68.

It is also evident that the portion of light passing through the said transparent por-

tion due to the said reciprocation will in effect become an oscillating beam of light passing on to lens 65 in diverging lines.

The said lens 65 is assumed to be of such suitable form as to cause the said light to again converge and impinge on the surface of the said light affected resistance changing element as shown in Figures 1 and 3, or 2 and 4, and hereinbefore described.

By adjusting the relative positions of condenser lenses 89 it is apparent that the point of focus may be varied with respect to the surface of the said film.

In addition the adjusting means supporting the said cell will allow movement relative to the lens 65 and thereby vary the intensity and area of the said light at the instant of impinging of the said light on its active area. In some operations it will be possible to eliminate the lens 65 and permit the light to strike the cell directly after passing through the said film. By rotating the said cell in a horizontal plane about the post 33 the light may be permitted to impinge on the said surface at an angle. By employing all the adjusting means herein described many variations of the effect of the said light on the said surface may be obtained. Hence the resistance of the said light affected element may be varied and the current of the circuit of which it may be a portion also varied as indicated by the diagrammatic connections as shown by Figure 6. In addition this variation may be effected faithfully in synchronism with the said moving sound records recorded on a moving film, and by means of a suitable receiver reproduced into audible sound waves.

Due to the adjusting means herein described the amplitude, frequency, pitch and therefore overtones and harmonics of the audible vibrations produced by the said receiver may be produced and varied relative to the said sound record on the said moving film. Furthermore these variations may be amplified to the extent desired and transformed into audible sound waves by receiver 125 as shown on Figure 6.

Figure 10 indicates a diagrammatic assembly of the elements required for amplifying current waves by an embodiment of my invention as shown on Figure 5. A source of light 126 is suitably placed in a reflecting enclosure 136 so formed as to emit a beam of light 128. A lens 127 is employed to concentrate the said beam on a preferably hinged diaphragm 129 actuated preferably by a suitable core in turn actuated by winding 130, but, of course, the said diaphragm may be vibrated by any other desired means. The said beam 128 is reflected by 129 as an oscillating beam 131 through lens 132. The lens 132 may be arranged to change the color of the moving beam 131 or it may focus it on the moving

"light wave" record 142. When suitably enclosed as shown and described in Fig. 9 this record or so-called film will be affected by the movement of the said beam 131 to record its movement thereby when suitably treated as is known in the art. Or the film 142 may be removed and an element 133 more specifically shown by Fig. 1 may be positioned in the path of the said beam. 10 131. It is understood that the light affected element 133 forms a portion of an electric circuit as shown by Fig. 6. By changing the form of the said element 133 the current in the circuit of which 133 may be a portion 15 may be affected variably with reference to the movement of the said diaphragm 129 and hence the current in the windings 130. In other words the current in the circuit of which 133 is a portion (as in Fig. 6) may be decreased as the current in 130 increases, 20 or any instantaneous relation may be obtained by suitable design and adjustment.

It should also be evident that if the said film 142 is bent or curved when the record 25 is made that the variation from the true light oscillation may be rectified by suitable design of the element 133.

This diaphragm reflects and oscillates the said beam 131 so that same will pass through 30 the lens 132. The lens 132 may converge or diverge the said light rays as desired and permit same to impinge on the surface of the said element or cell as shown by 133. It is of course possible to employ the cell shown by Figure 1 instead of the one shown 35 by Figure 5.

This embodiment of my invention is shown and described merely to indicate one of the many possible applications of my invention. 40 It is evident that by proper design the cell may be employed in organizations constituting such devices as an oscillator, rectifier, detector, relay, a photoelectric condenser, a photoelectric impedance, voltage 45 regulator, and in fact any device depending on the variation of current for its proper action.

While I have shown and described and have pointed out in the annexed claims certain novel features of my invention it will be understood that various changes in the form and details of the device illustrated, such as providing means for multiplying the number of elements in co-operative arrangements 55 may be made.

A plurality of light sources, means for attaching the device to a moving picture machine, providing elements with curved surfaces etc. could have been shown.

60 It is also obvious that various other changes, omissions and substitutions in the particular form of invention illustrated and in its operation may be made by those skilled in the art without departing from the spirit of my invention. 65

Having thus described my invention I claim:

1. In a device of the class described, the combination of an adjustable terminal element, a plurality of light affected resistance 70 changing conductors arranged in parallel, and a second adjustable terminal element, fastening means for maintaining the said terminal members and the said conductors in proper contactual relation thereby to cause 75 the said conductors to become of desired lengths electrically as the said terminal members are adjusted, and means for supporting the said terminal members and the said conductors. 80

2. In a light affected resistance changing cell, the combination of a resistance portion constituting a terminal holder, a light affected portion constituting a plurality of light affected conductors arranged in parallel 85 so that the resistance of each successive conductor is more or less than the preceding one, and a second resistance portion also constituting a terminal holder, means for adjusting the said holders whereby the rate of 90 successive change in conductor resistance may be varied at will.

3. In a device of the class described, the combination of a plurality of light affected resistances constituting conductors, and 95 means for positioning and securing the said conductors between adjustable holding terminals whereby the said conductors may be given a desired tapering resistance when in an electric circuit in parallel. 100

4. In a device of the class described, the combination of a plurality of light susceptible resistance changing conductors, each having a given normal resistance, means for placing the said conductors in an electric 105 circuit in parallel electrically so that the said resistances may be varied at will in progression so as to taper electrically from one side to the other whereby the said circuit will vary in its total resistance according to the 110 movements of a beam of light of approximately constant intensity and approximately constant area, and also in accordance with the said tapering resistance.

5. In a device of the class described, the combination of a plurality of light affected conductors arranged in parallel and having a total normal resistance such as to be varied by the same amount of light impinging on different equal areas of the said conductors, and manual means for adjusting and 120 varying the said normal resistance.

6. In a light affected cell, the combination of a plurality of light affected resistance changing conductors of various lengths and 125 resistance values arranged in a desired combination electrically, and adjustable terminal means for varying the total resistance so that a moving beam of light of approximately constant area and strength will additionally 130

ally affect the total resistance.

7. An energy ray affected resistance changing element designed to form a part of an electric circuit, adjustable terminal supporting members variable so as to vary the area and shape of the active portion of the said element and thereby vary the resistance change caused by the movement of a constant ray of energy over the said portion, means for securing the said terminal members in a desired relative position, and means for supporting the said terminal members and said element.

8. A light susceptible resistance changing device, including a light susceptible element consisting of a plurality of light susceptible conductors arranged in parallel, adjustable contact terminals designed to support and position the said conductors so as to cause the said conductors to have desired resistance values individually and as a whole, means for securing the said contact terminals in different desired relative positions whereby the resistance of the said conductors may be varied, and means constituting a pressure resisting container containing a gas and designed to admit a beam of light to the said light susceptible element when positioned therein to additionally vary its resistance.

9. In a device of the class described, the combination of means including a light sensitive portion positioned between two adjustable terminal elements, said portion shaped by said terminals so that its total resistance will be changed by the impinging of an oscillating beam of light, and means constituting a pressure resisting container having a light entering portion and containing the above named means and a temperature controlling means.

10. A resistance changing device consisting of a light affected area formed by a plurality of light affected conductors and rendered sensitive electrically by the movement of a beam of light of constant intensity and area across equal portions of its said sensitive area, adjustable contact means for changing the form and size of the said area, and means for securing said contact means thereby to firmly variably position the said conductors.

11. A current changing device including a light susceptible element formed by a plurality of light susceptible conductors arranged in parallel electrically and having a total resistance depending on the relative position of a beam of light on certain equal portions of its said susceptible area, means constituting a pressure resisting container, arranged to enclose the said element and suitably admit the said beam of light and means for supporting and adjusting the said susceptible element and its associated mem-

bers so that the said beam may impinge on the desired portions of the said area while in the said container.

12. In a device of the class described, the combination of a plurality of light susceptible resistance changing conductors held in parallel electrically, adjustable means for varying the resistance of the said conductors so that each conductor will have a different effective normal resistance from all the others so that the total normal resistance of the said conductors will vary when any combination of the said conductors intercept the same amount of light.

13. In a light sensitive current varying device, the combination of two adjustable portions constituting holder terminals, a light sensitive conductor in sheet form position between said portions thereby to have its active area varied by the adjustment of the said portions therewith, said portions each provided with a plurality of connecting means thereby to introduce the said conductor into operative connection with a circuit organization.

14. In a light affected current changing device, the combination of a plurality of contact terminals, a plurality of light sensitive conductors arranged in parallel electrically so as to permit the said terminals to slide along the said conductors and thereby unequally change the individual resistance of each of the said conductors, and a plurality of circuit connecting points arranged along the said terminals so as to permit selective connection to an external circuit.

15. A resistance changing current varying transmitter including a portion consisting of a contact terminal with lugs and a yieldable conducting strip, a light affected portion, and a second portion consisting of a contact terminal with a plurality of lugs and a yieldable conducting strip, means including an insulated base for supporting and holding the above named portions so that the said terminal portions can be adjustably moved over the surface of the said light affected portion, thereby to change its area and form, and means comprising a container designed to admit desired light to the surface of the said light affected portion and maintain a desired temperature condition around same.

16. A current varying cell consisting of a resistance changing portion affected by energy rays, a plurality of contacting portions in series electrically with the said ray affected portion, means for adjusting the said contacting portions, and means for cooling the above named portions.

Signed at New York city in the county of New York and State of New York this 14th day of September, A. D. 1921.

HOWARD J. MURRAY.