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W. H. ECCLES ET AL

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METHOD OF AND MEANS FOR CONTROLLING LIGHT

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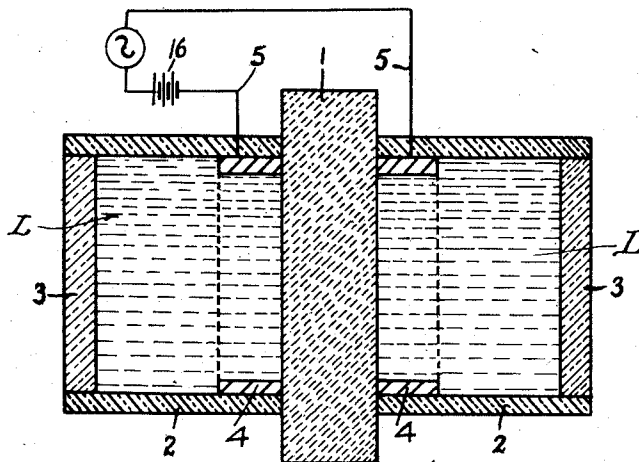


FIG. 1.

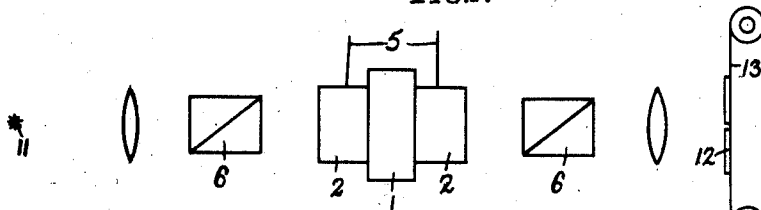


FIG. 2.

FIG. 4.

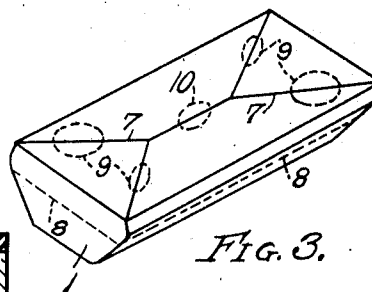
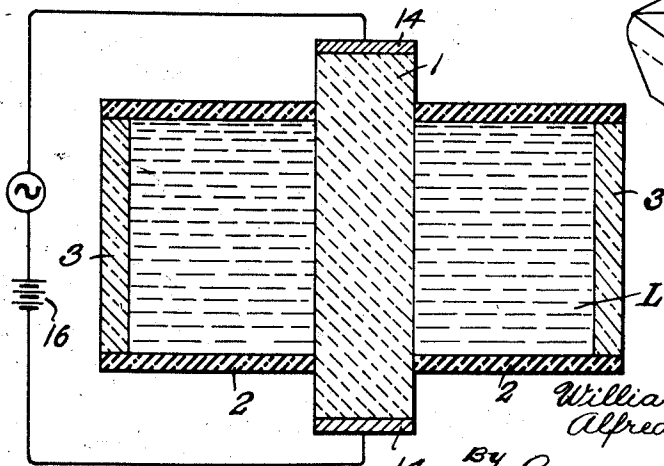


FIG. 3.

Inventors.

William Henry Eccles and
Alfred Whitaker.

By Cameron, Kerkam and Sutton.
Attorneys.

UNITED STATES PATENT OFFICE

WILLIAM HENRY ECCLES, OF LONDON, AND ALFRED WHITAKER, OF WEST DRAYTON, ENGLAND, ASSIGNORS, BY MESNE ASSIGNMENTS, TO RADIO CORPORATION OF AMERICA, OF NEW YORK, N. Y., A CORPORATION OF DELAWARE

METHOD OF AND MEANS FOR CONTROLLING LIGHT

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The present invention relates to means for controlling the intensity of a beam of light in accordance with electrical oscillations.

It is known that certain bodies have the property, when subjected to electro-static stress, of becoming doubly refracting or, if they are initially doubly refracting, of having this property modified in degree. This effect has been utilized in light cells, known as Kerr cells, for controlling the intensity of a beam of light in accordance with electrical oscillations. The light is passed through two polarizing devices between which is arranged the electro-statically influenced body. The degree of extinction of the light passing through the system is thus varied in accordance with the electrical variations impressed upon the device. It has also been proposed to utilize, as the body subjected to electro-static stress in modulating a beam of light, a piezo-electric crystalline body, alternating voltages being applied to the body to cause it to oscillate. One disadvantage which is experienced in using this arrangement, or any known form of Kerr cell, in making a photographic record of sounds is that the rotation produced is, in the main, proportional to the square of the applied voltage and, to only a small extent, directly proportional to the applied voltage. It has been discovered by Pockels that certain acentric crystals, which exhibit the Kerr or second order effect, also exhibit another effect which is of much greater magnitude than the second order effect and which is a first order effect, that is to say an effect in which the resultant change in illumination is directly proportional to the applied voltage. This effect will be referred to as the Pockels effect. According to the present invention, the intensity of a beam of light is modulated by passing the light through a material in which the Pockels effect preponderates over the second order effect, voltage variations being applied to the material. The relation between the applied voltage and the change in illumination produced is therefore substantially linear. Rochelle salt has, for example, been found to be suitable.

The invention is illustrated in the accompanying drawing in which

Fig. 1 is a view in sectional elevation of a cell in accordance with the invention.

Fig. 2 is a diagram illustrating the application of the invention to the recording of sound.

Fig. 3 is a view of a crystal suitable for use in connection with the present invention, and

Fig. 4 is a view, similar to Fig. 1, of a modified form of our invention.

Referring to Fig. 1, a piece 1 cut from a single crystal of Rochelle salt, preferably in a manner to be described later, is mounted between two co-axial cylinders 2 of insulating material, the ends of these cylinders being closed with glass discs 3. Upon the inside of each of these cylinders is arranged an annular ring 4 of conducting material, connecting wires 5 being taken from each of these rings through the insulating tubes to the outside. The conducting rings 4 act as the electrodes of the device. The space within the two tubes is filled with some feebly conducting liquid L which does not dissolve the crystal, such, for example as alcohol. The parts of the device may be fixed together in any suitable manner.

It will be noted that the lines of electro-static force, when a difference of potential is maintained between the two electrodes 4, will run approximately parallel to the axis of the tubes 2 and that this direction is parallel also to the direction in which light, passing in through one glass disc and out through the other, is transmitted through the cell.

In the alternative device illustrated in Fig. 4, the electro-static lines of force are at right angles to the direction of the light. The crystal 1 is, in this case, arranged between two parallel conducting plates 14, the light being transmitted in a direction parallel to the surfaces of these plates.

In using cells of this type for controlling the intensity of a beam of light, the cell may be arranged, as shown in Fig. 2, between two polarizing devices 6, and the potential variations, which are to be converted into changes of intensity of the beam of light, are applied to the two electrodes through the conductors 5. The light from source 11 passes through the system 6, 1, 6 and falls through a suitable

slit 12 upon a photographic film 13. The degree of extinction of the light beam will thus be varied in accordance with the applied potentials.

5 The light used, may, if desired, be monochromatic. Either a polarizing direct voltage may be provided in circuit with the normal working electrodes, such as a battery 16, or, alternatively, auxiliary electrodes (not shown) may be employed for obtaining a polarizing electro-static stress. The polarizing electro-static stress may be in the same or in a different direction from the varying electro-static stress. If desired, the whole or part of the light may be caused, by suitable optical means, to traverse the cell repeatedly in such direction as to augment the effect.

20 The electrical variations applied to the electrodes of the cell, for example in recording sound, may be either electrical variations corresponding to the acoustic vibrations or they may be high frequency oscillations modulated with the acoustic vibrations.

25 Fig. 3 illustrates the preparation of a suitable crystal of Rochelle salt. The crystal from which the working material is to be cut should be one exhibiting the surface marking indicated at 7, which is known as the "hour-glass" structure. The crystal is cut along a plane indicated by the dotted lines 8 and the lower part is rejected. The pieces which will best serve for light modulation are those within the dotted lines 9 and 10, the pieces 9 being, if anything, preferable.

35 We claim:

1. The method of controlling the intensity of a beam of light by means of a material exhibiting the Pockels effect which consists in passing said beam of light through said material along an axis in which the Pockels effect preponderates over the second order effect and applying voltage variations to said material.

45 2. The method of controlling the intensity of a beam of light by means of a material exhibiting the Pockels effect and in accordance with voltage variations which consists in passing said beam of light in succession through a polarizing device, along an axis of said material in which the Pockels effect preponderates over the second order effect, and a second polarizing device, said voltage variations being applied to said material.

55 3. The method as claimed in claim 1 wherein said voltage variations are in the form of modulated high frequency oscillations.

4. The method as claimed in claim 1 wherein said voltage variations are in the form of modulated high frequency oscillations and wherein said high frequency oscillations have a frequency corresponding substantially to the natural frequency of said material or to a harmonic thereof.

65 5. The method as claimed in claim 1 where-

in a steady direct voltage is superposed upon said voltage variations.

6. The method as claimed in claim 1 in which said material is a crystal of Rochelle salt.

7. In apparatus for controlling the intensity of a beam of polarized light, the combination of a crystal, means for directing said beam of light therethrough, and means for applying a variable voltage thereto, said crystal being a section of a crystal of the type exhibiting hour glass marking and being cut adjacent said marking.

8. In apparatus for controlling the intensity of a beam of polarized light, the combination of a crystal, means for directing said beam of light therethrough, and means for applying a variable voltage thereto, said crystal being of the type exhibiting hour glass marking and being so disposed that said light beam is passed through said crystal adjacent said marking.

9. In apparatus for controlling the intensity of a beam of polarized light the combination of a Rochelle salt crystal, means for directing said beam of light therethrough, and means for applying a variable voltage thereto, said crystal exhibiting hour glass marking and being so disposed that said light beam is passed through a portion of said marking.

10. The method of controlling the intensity of a beam of light by means of a crystal exhibiting the Pockels effect which consists in passing said beam of light through said crystal along an axis in which the Pockels effect predominates over the second order effect and applying voltage variations to said crystal.

11. The method of controlling the intensity of a beam of light by means of a Rochelle salt crystal wherein the Pockels effect is exhibited which consists in passing said beam of light through said crystal along an axis wherein the Pockels effect predominates over the second order effect and applying voltage variations to said crystal.

12. The method as claimed in claim 1, wherein said voltage variations correspond to acoustic vibrations.

In testimony whereof, we have signed our names.

WILLIAM HENRY ECCLES.
ALFRED WHITAKER.