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LIGHT VALVE

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Fig. 1

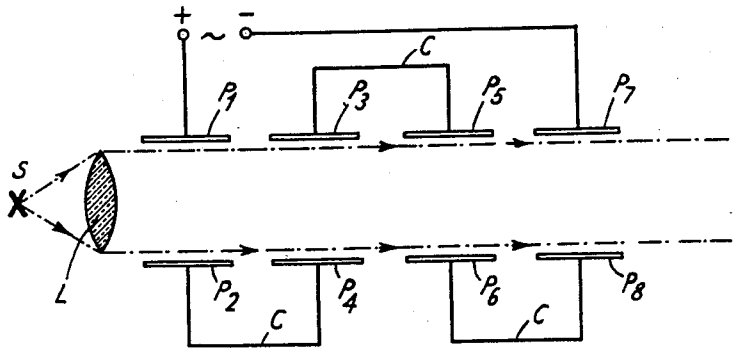
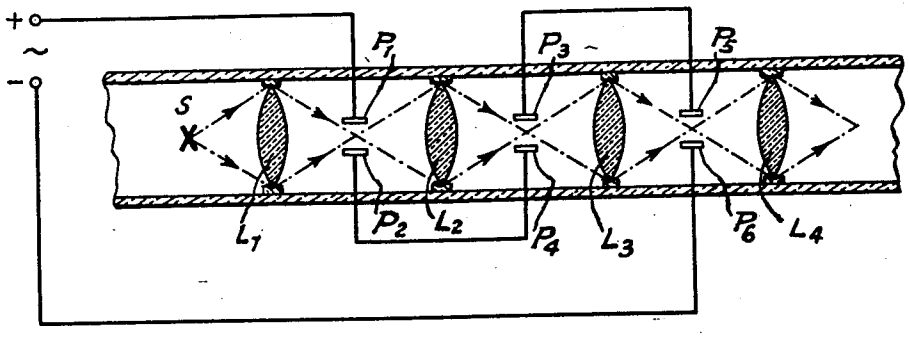


Fig. 2



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LIGHT VALVE

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2 Claims. (Cl. 88—61)

This invention relates to television and like apparatus and more particularly to apparatus including electro-optical translating devices of the Kerr cell or similar type.

One of the difficulties met with when electro-optical translating devices of the Kerr cell or similar type are employed to translate electrical variations of relatively high frequency into variations of light intensity—for example where a Kerr cell is employed to translate into light variations television signals transmitted in a high definition system wherein a large number of scanning lines is used per picture—is that the inter-electrode or self-capacity of the cell tends to bye-pass the higher frequencies. This difficulty becomes very serious in known multi-electrode Kerr cells for in these known multi-electrode arrangements the plates of each individual element (i. e. each pair of plates) are in parallel with those of the others consequently the total capacity of the Kerr cell will be equal to the effective capacity of each pair of plates multiplied by the number of pairs.

The principal object of the present invention is to meet this disadvantage and to provide an improved Kerr or similar cell of reduced inter-electrode or self-capacity.

According to this invention a Kerr or similar cell arrangement comprises a plurality of pairs of electrodes connected in series with one another and the incoming signals to be converted into variations of light intensity are applied between the end plates of the whole series. With this arrangement the inter-electrode capacity of each pair of plates is caused to be in series with those of the other pairs, and accordingly the total effective capacity of the whole multi-electrode system will be much reduced.

The invention is illustrated in the accompanying drawing in which Fig. 1 shows schematically one embodiment of our invention; and

Fig. 2 shows schematically a modification of an embodiment of our invention.

Referring to Fig. 1 a Kerr cell comprises four pairs of electrodes P_1 P_2 P_3 P_4 P_5 P_6 P_7 and P_8 (any number of pairs may be provided but four are shown as an example) the electrodes of each pair being opposite one another and the said pairs being arranged side by side so that there are four electrodes P_1 P_3 P_5 P_7 in one straight line and four P_2 P_4 P_6 P_8 in another parallel straight line. The usual nitrobenzene or other dielectric filling (not shown) is provided and the light to be modulated in accordance with electrical signals is projected from a source represented at S and, after being rendered parallel by a suitable condenser lens arrangement represented in Figure 1 by a simple lens L is projected as a parallel beam between the electrodes of the pairs, the said light beam passing first through one pair P_1 P_2 of electrodes then through the next P_3 P_4, then through the next P_5 P_6 and so on. The chain lines in Figure 1 represent the light path. The signals to be converted into light variations are applied between the end electrodes of the four which are in one straight line (i. e. between electrodes P_1 and P_7 in Figure 1) and the remaining electrodes are interconnected as shown by connectors C so that there is a series circuit through the whole Kerr cell as follows:—from one terminal of the course of incoming signals, through the self-capacity of the first pair P_1 P_2 of electrodes, then through an internal connection C in the cell to the electrode P_4 of the second pair of electrodes, then through the self-capacity of the second pair P_3 P_4 of electrodes, then through an internal connection C in the cell to one electrode P_5 of the third pair P_5 P_6 of electrodes, then through the self-capacity of the third pair P_5 P_6 of electrodes, and so on. Preferably the Kerr cell is physically as well as electrically a single cell; that is to say, there is preferably a single envelope (not shown) containing a nitrobenzene filling appropriate to all of the electrodes, the said electrodes being in the common envelope. This arrangement has the advantage that light losses at refracting surfaces are minimized but obviously it is possible to carry the invention into effect by providing a series of separate cells whose electrodes are interconnected as above described to obtain the series self-capacity effect.

In the modified arrangement represented in Figure 2 the light beam passed through the succession of pairs of plates is not a parallel beam but is brought to a focus between each pair of plates. The necessary lenses for effecting this focusing may, if desired, be incorporated in a single envelope (not shown) with the nitrobenzene and all the associated electrodes. For example, as shown light from the source S may be focused by a lens L_1 to a point between the electrodes of the first pair P_1 P_2 and between the first and second pair of electrodes there may be provided a second lens L_2 which again focuses the light to a point between the electrodes of the second pair P_3 P_4 there being a similar lens L_3 between the second and third pairs of electrodes adapted to focus the light to a point between the electrodes of the third pair P_5 P_6 and so on. In Figure 2 only three pairs of electrodes are shown.

Cells in accordance with this invention may be constructed to operate satisfactorily with quite small applied signal voltages. The voltage necessary to produce the required phase difference δ in a multi-electrode Kerr cell is given by the formula:—

$$\delta = \frac{KE^2L}{d^2}$$

where K is a constant, E is applied voltage, L is length of light path, and d is the distance between plates.

As will be apparent from a consideration of this formula δ may be made large for a given value of E either by increasing L or decreasing d. In the ordinary known multiplex or multi-electrode type of Kerr cell d is made small, but in cells in accordance with the present invention L is made large since its value is the sum of the light paths through the separate "cell elements" (this term is used here to denote the individual pairs of electrodes and their associated di-electric filling) and accordingly the required voltage E to give a predetermined phase difference may be made quite small.

In a specific form of Kerr cell which has been successfully employed experimentally, the envelope is a straight tube about 6'' long and about 1'' in diameter and the arrangement is like that shown in figure 2. At each end of the tube is a lens and two further lenses are provided at distances of about 2'' from the two ends of the tube, these further lenses being supported by suitable supports fitted to the inside of the tube. The four lenses are mounted in such manner that their focal points are all in the same straight line which straight line is the axis of the tube. For convenience in construction the two lenses at the ends of the tube are made large enough to act as closure members for the said tube.

Midway between each successive pair of lenses is a pair of electrodes. The said electrodes and the lenses are so constructed and arranged that the first end lens focuses incoming parallel light to a focal point between the electrodes of the first pair while the next lens has one focus also at this point and another at a point between the electrodes of the second pair . . . and so on. When the cell is in use parallel light is passed through the lens at one end of the tube whence it is brought to a focus between the electrodes of the first pair, the next lens serving to bring the light which has passed between the electrodes of the first pair to a focus between the electrodes of the second pair, and so on, a parallel beam of signal modulated light emerging from the lens at the other end of the tube. Two external connections passing through the wall of the tube are provided one external connection being made to one electrode of the pair nearest one end of the tube and the other external connection being made to the opposite electrode of the pair of electrodes adjacent the other end of the tube. Internal connections within the tube are made between the remaining electrode of the first pair and one electrode of the second pair and also between the other electrode of the second pair and one electrode of the third pair so that the inter-electrode capacities of the three pairs of electrodes are put in series with one another by the internal connections.

Having now particularly described and ascertained the nature of our said invention and in what manner the same is to be performed we declare that what we claim is:—

1. A Kerr cell arrangement comprising a plurality of pairs of electrodes connected only in series with one another, means for passing light successively between the plates of the pairs whereby the electrostatic capacity of the cell is reduced and means for applying electrical signals to be converted into light variations across the series of plates.

2. A Kerr cell having an envelope a plurality of pairs of plates within said envelope, the plates of each pair being opposite one another and the said pairs being side by side so that one half of said plurality of plates lie substantially in one plane and the other half of said plates in a substantially parallel plane, electrical interconnections only between said plates so that the inter-electrode capacity of each of said pair is in series with the inter-electrode capacities of the other pairs whereby the electrostatic capacity of the cell is reduced and means to apply electrical signalling energy to the whole cell.

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