

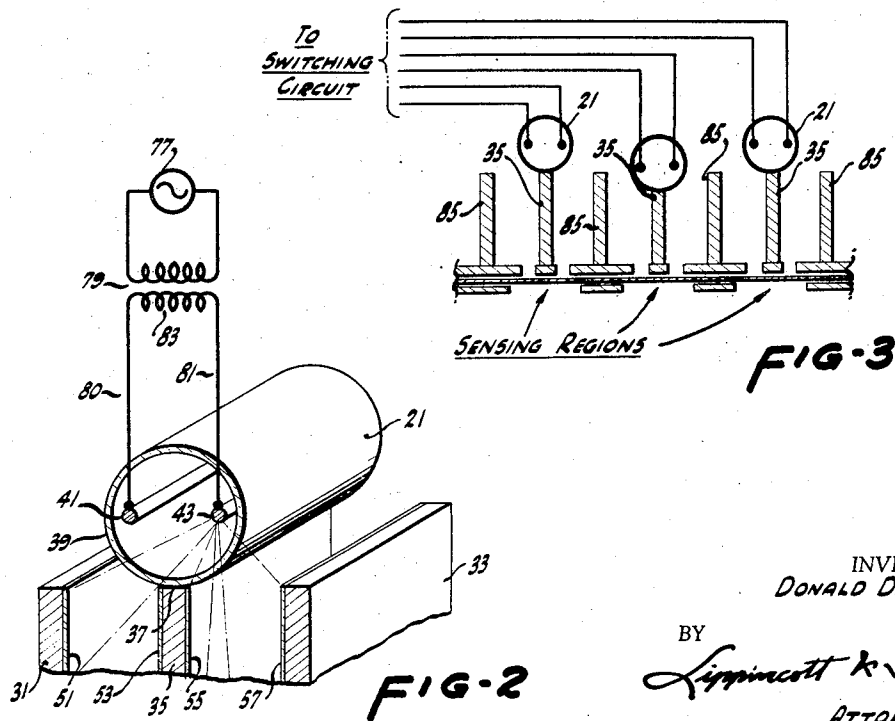
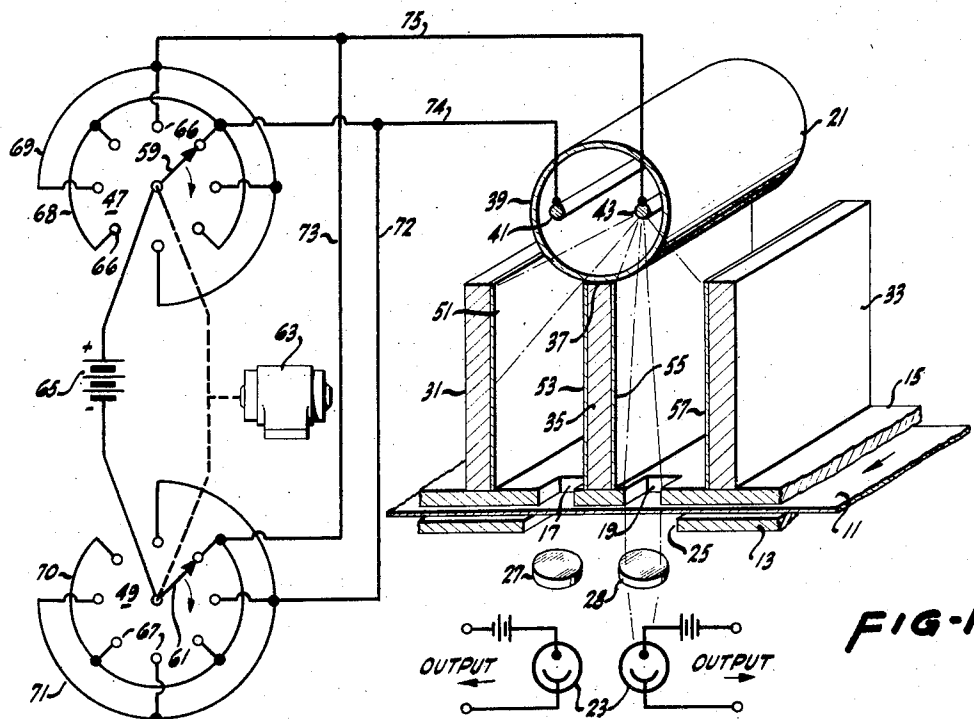
Feb. 3, 1959

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2,872,589

OPTICAL READING DEVICE

Filed Jan. 11, 1957



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OPTICAL READING DEVICE

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Application January 11, 1957, Serial No. 634,603

8 Claims. (Cl. 250—217)

This invention relates to sensing apparatus and is directed particularly to a sensing device capable of operating to sense a multiplicity of marked or perforated positions on various forms of tabulating and punched cards arranged to be moved relative to the component.

Where cards or other record media on which a great deal of information is often to be placed and where a determination or sensing thereof is to be provided by either directing a light beam through the record medium or reflecting a light beam therefrom, difficulties are frequently experienced because of the limited space available for the installation. Frequently this necessitates the use of an extremely small light source and is attended by difficulties of arrangement and connection within the limited space, with the end result of complication and accuracy reduction because of fluctuating light values and levels from one lamp to another and because of the difficulty of arranging lamps at the same distances from the record-bearing medium so that even if the lamps operate uniformly, the light path and the effective light in the medium will vary.

According to the present invention, the difficulties have been reduced substantially by the arrangement in a suitable platen, adjacent to which the record-bearing medium is adapted to be moved, of a plurality of sensing apertures. The apertures are preferably divided into pairs by baffle elements arranged to extend outwardly from the platen at either side of each pair of sensing apertures. The pairs of sensing apertures which are segregated and separated by the baffle elements are then further divided by a dividing barrier arranged also to extend outwardly from the platen in a direction substantially parallel to the baffles but from a point between the pair of apertures confined between the adjacent baffles. A suitable glow discharge lamp having a plurality of elongated electrode elements is then supported substantially adjacent to the outer edge of the barrier with one of the elongated electrodes located on one side of the barrier center and the other elongated electrode located upon the other side of the barrier center. This location is such that a direct uninterrupted light path exists between the elongated electrode of the lamp which lies on one side of the barrier to the platen aperture which is located upon the same side of the barrier.

The barrier, however, extends outwardly from the platen for such distance that it forms a masking element with respect to any direct light passing from an elongated electrode of the light-producing lamp lying on one side of the baffle center to the aperture on the other side of the baffle. Consequently, if the glow discharge lamp is positioned with the electrodes extending parallel to the surface of the platen and this lamp is excited in a way whereby the electrodes thereof are made alternately positive and negative relative to each other, the glow discharge light originates from a region within the tube confined to one electrode to the exclusion of the other electrode. Then, by the effect of the solid dividing barrier between adjacent sensing apertures of the pair, the developed light is switched alternately from one to the other of the aper-

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tures at the frequency of source excitation. The source excitation may be produced either by direct or alternating current but is caused to shift relatively rapidly from one source to the other. Whatever light is directed through the apertures or reflected therefrom, as varied by the record-bearing medium passing relative to the apertures, will then cause a response from a light-responsive element associated with the apertures and permit the detection of varying intensity of light caused by the marks or openings on the record medium in the sensing positions.

With the record-bearing medium carrying indicia extending laterally to cover more space than occupied by a single pair of apertures the platen may be provided with a series of apertures extending generally laterally thereacross. These apertures are then divided by baffle elements into pairs, each of which pairs is then divided by the central barrier in accordance with the plan hereinabove described.

Where space requirements dictate, the barrier elements may extend outwardly from the platen alternately for slightly different distances in order that the light-producing tubes may be more or less nested with respect to each other, and still provide the same shielding as regards adjacent sensing apparatus.

In accordance with the foregoing, it becomes an object of this invention to provide sensing apparatus wherein records moved relative thereto may be explored and the information contained thereon recovered by apparatus functioning with greater simplicity and stability than heretofore obtainable.

Another object of the invention is that of providing sensing apparatus particularly usable for recovering information from either punched or marked cards supplied to the exploring medium by an arrangement more compact, more efficient, and more foolproof than that theretofore known.

Other objects of the invention are, of course, those of providing sensing apparatus particularly adapted for installation in limited area spaces where the effective illumination may be made substantially constant.

A further object of the invention is that of providing sensing apparatus wherein the light directed to the various sensing positions strikes from the same angle and from substantially the same distance.

Other objects of the invention are those of simplifying the design and mechanics of the structural operation of the testing component more efficiently and primarily in a way by which the operating life is extended and further, to reduce production costs by reducing the number of components required.

Still other and further objects will become apparent from a reading of the following description of a preferred form of the invention considered in conjunction with the several figures of the drawing, wherein:

Fig. 1 is an exemplification of an exploring and sensing mechanism for alternately sensing between a pair of apertures beneath which the record medium is moved with the switching being D. C. controlled;

Fig. 2 is a view generally similar to that shown by Fig. 1, designed particularly for A. C. operation; and

Fig. 3 is an extremely schematic showing presented for the purpose of illustrating the application of the invention of Figs. 1 and 2 to multiple-aperture platen, whereby simultaneously a plurality of record designations may be translated from the record medium.

Referring now to the drawings for a further understanding of the invention, a record strip such as the conventionally represented card 11 is arranged to be moved and to come between guide surface 13 and platen 15 in its motion. The platen 15, in the illustrated example of Fig. 1, is provided with a plurality of apertures or sensing positions 17 and 19 through which light origi-

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nating in the conventionally represented source 21 is adapted to be directed to fall upon suitable light-translating elements such as the schematically represented phototubes 23. The guide surface 13 is provided with a large opening 25 preferably spanning the region between a pair of adjacent apertures 17 and 19, and any light passing through the apertures 17 and 19 is then directed by the schematically represented lenses 27 and 28 into the phototubes 23 at the sensing positions.

There extends outwardly from the surface of the platen 15, and arranged generally as a cantilever element secured thereto, a pair of baffles 31 and 33. These baffles are located on the platen so as to include the pair of apertures 17 and 19 between their inner and most closely adjacent surfaces. A barrier 35 is also held to extend outwardly from the surface of the platen 15 in a direction substantially to parallel the baffles and to extend outwardly from the platen for generally and approximately the same distance as the baffles. The light-producing element or tube 21 is arranged to be supported substantially adjacent to the outer edge 37 of the barrier 35. The tube 21 may, if desired, be one of the commercially known types, such as the NE-2A neon bulbs. It may be supported independently of the barrier 35 and adjacent thereto, or, where desired, may be permitted to rest upon the outer edge 37 of the barrier.

The light-producing tube 21, thus of a glow-discharge variety, has an outer glass wall constituting the envelope 39 which is thus rested upon the barrier edge 37 or held in close proximity thereto. Within the tube envelope 39 two elongated electrode elements 41 and 43 are positioned. These electrodes extend lengthwise of the tube 21 within the envelope 39 and are thus arranged when positioned so as to extend in directions generally parallel to the barrier wall surface. The electrodes 41 and 43, when the tube 21 is appropriately positioned relative to the outer edge 37 of the barrier 35, are then held so one is at one side of the barrier 35 while the other is at the other side of the barrier. As the arrangement has been shown the electrode 43 is at the right side of the barrier 35, looking at Fig. 1, and a direct optical path exists between this electrode and the aperture 19. Similarly, the electrode 41 is at the opposite side of the barrier 35, and a direct optical path exists between it and the aperture 17. However, as indicated, the light which emanates from within the region of glow discharge when exciting voltages are applied between the electrodes 41 and 43 so that electrode 43 is positive with respect to electrode 41 the glow discharge will take place in the region immediately adjacent to the electrode 41 and the resultant light will be directed through the aperture 19 and the message section of the record 11 instantaneously associated therewith to influence in accordance with the light transmission within the sensing region the phototube 23 shown to the right. If now the potential of the electrodes 41 and 43 changes so that electrode 41 is made positive relative to the electrode 43, then the emanating light will be directed through the space between the baffle 31 and the barrier 35 and fall through the aperture 17 to control the current flow through the left-hand phototube 23. Suitable switching, as conventionally indicated by the switching elements 47 and 49 later to be described in further detail, is provided.

In the case where the light developed is centered in the region of the electrode 43, for instance, it is directed through the space between the baffle 33 and the barrier 35 into the aperture 19, but the light which emanates laterally and which passes beyond the upper left-hand edge of the barrier 35, for instance, strikes the inner side wall of the baffle 31. This inner wall 51, like each wall 53 and 55 of the barrier, and the inner wall 57 of the baffle 33, is coated or covered with a light-absorbing substance which prevents light striking the same from being readily reflected into an aperture located in the space between the inner wall of the baffle and the adjacent wall to the barrier. It thus becomes apparent that the light de-

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veloped in the region of the electrode 43, for instance, will pass directly to the aperture 19 on the same side of the baffle, but that the baffle itself will serve as a mask from direct rays reaching the aperture 17 on the opposite side and the opaque coating on the walls of the formed compartment will prevent reflected light from passing through to the aperture.

Similar conditions arise with respect to light generated in the region of the electrode 41 by reason of its relative potential with respect to the electrode 43 and it being held at a potential whereby light is produced by glow discharge in the region of the electrode 41.

Referring now to the switching elements 47 and 49, these comprise the switch arms 59 and 61 adapted to be simultaneously rotated under the control of a suitable prime mover, conventionally represented at 63, with the common drive indicated by the dash line, suitable means to rotate the elements in the same direction are not herein indicated due to the obvious nature thereof. The switch arms 59 and 61 connect at opposite (that is, the plus and minus) terminals of a voltage source 65 with one of the switch arms 59 contacting a series of contact points 66 as it rotates and the other switch arm 61 contacting a series of similar contact points 67 with rotation. Alternate contact points 66 and 67 of the two switching units 47 and 49 are electrically connected together, as indicated, so that adjacent contact points are connected to separate electrical lines. Thus, on the switch unit 47 the first, third, fifth and seventh of the assumed eight contact points connect to the conductor ring 68, while the even numbered contact points two, four, six and eight connect to the conductor ring 69.

On the lower switch 49 (as shown) the alternate contact points 67 connect to one or the other of the conductors 70 and 71, respectively, each forming a conductor ring. The conducting rings 68 and 71 are electrically connected by a conductor 72, while the conducting rings 69 and 70 are similarly connected by a conductor 73. The arrangement provides that the conducting ring 68 connects with the conducting ring 71 by a conductor 72. Then, the joint connection of these elements by way of the conductor 74 establishes a connection to one of the electrodes 41 of the glow discharge tube 21. Similarly, the conductor 75 connected to the outer ring 69 of the contactors of switch 47 and to the inner ring 70 of switch contacts 67 of switch 49 by the conductor 73 is connected to electrode 43 of the lamp 21 by conductor 75.

In this manner it can be appreciated that with the potential source 65 being connected with its positive terminal poled toward the switch arm 59 and its negative terminal poled toward the switch arm 61, rotating the switch arms of the switches 47 and 49 in the angular direction indicated whereby the switch arm 59 makes contact with a contact point 66 connected to the conducting ring 68 while the switch arm 61 of the switch 49 makes contact to a contact point 67 connected to the conducting ring 70 of the switch 49. The connection then established is such that switch arm 59 will supply the positive potential through conductor 74 to the electrode 41, while the negative potential of the source 65 will be supplied via the switch arm 61 and the contactor 67 through conductor 75 to the electrode 43 of the glow discharge device 21.

When the switch arms move under the control of the prime mover 63 to contact the next succeeding contact point, moving clockwise, it is apparent that the connection of the source 65 to electrodes 41 and 43 is reversed and the positive potential of the source 65 is then supplied through the switch arm 59 to a contact point 66 and the conducting ring 69 and conductor 75 to the electrode 43, while at this time the electrode 41 is connected to the negative terminal of the source 65 by way of the conductor 74, the conductor 72, the outer ring 71 of the switch 49 and the switch arm 61 contacting with a contacting point 67 connected to the outer conducting ring 71. It is

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thus apparent that as the switch arms of switches 47 and 49 move in sequence from one to another of the contact points, as the arrangement is shown, the potential applied to the electrodes 41 and 43 of the glow discharge tube 21 progressively changes between positive and negative at the electrodes.

For many conditions, it is desirable to provide A. C. switching of the electrodes with respect to each other in order particularly to provide a rapid change in the point of origin of the produced light. To this end the form of the invention illustrated by Fig. 2, while generally similar to that shown by Fig. 1, is so arranged that the tube electrode elements 41 and 43 are excited from the conventionally represented source of alternating current 77, arranged to feed its output, for instance, through the transformer 79 into the leads 80 and 81 connected respectively to the electrodes 41 and 43. Thus, by connecting the leads 80 and 81 to opposite ends of the transformer secondary winding 83 the potential maintained between the electrodes 41 and 43 is changed at the frequency of the source 77 so that when light is developed within the tube it will alternately originate in the region of one or the other of the electrodes and will pass to one of the apertures 17 or 19 (not shown by Fig. 2) in the manner already explained.

In the illustrated form of the invention as shown diagrammatically by Fig. 3, the applicability of the teachings provided by the structures of Fig. 1 or 2 is carried over to use in a system wherein a multiplicity or plurality of generally adjacently positioned apertures are arranged in the platen adjacent to which the recorded information is passed. Then, by providing, as indicated, baffle elements 85 separated each from the other by two adjacent apertures and by extending in the region between two adjacent apertures a barrier outwardly from the platen, the teachings above suggested with respect to light selection may be carried out, it being appreciated, of course, that in this use opposite sides of each baffle will be coated or covered with light absorbents. Alternate baffle elements 85 may, if so desired, project outwardly from the platen for greater distances, as shown in Fig. 3, so that the light-producing means 21 supported adjacent thereto are arranged in staggered planes.

In the form of the invention used with a multiplicity of apertures, it will be appreciated that the indicia placed upon the record medium passed adjacent to the platen can be obtained with approximately one-half the number of light-generating tubes heretofore utilized. The switching then can be arranged in any desired sequence or each tube may be separately controlled.

The showing of Fig. 3 is completely schematic in view of the detailed showings of Figs. 1 and 2.

Having now described the invention, what is claimed and desired to secure by Letters Patent is the following:

1. A sensing device comprising a platen having a pair of adjacent sensing apertures therein across which a marked record element is adapted to be moved, a barrier divider extending outwardly from the platen in a direction normal thereto, a light-producing tube supported with its tubular wall substantially adjacent to the barrier at its outer end, said light-producing tube having a pair of electrode elements therein so supported and arranged relative to the barrier that the electrode elements are carried at opposite sides of the barrier center so that each electrode element is located in a direct optical path relative to the aperture located upon the same side of the barrier and so that the barrier interrupts a direct light path between tube electrodes and apertures on opposite sides thereof, means to excite the light-producing tube alternately to initiate illumination in a region confined generally to the immediate area of one electrode to the exclusion of the other electrode whereby light from the light-producing tube alternately reaches each aperture of the pair at the selected switching rate, and means to sense the light penetrating each aperture.

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2. A sensing device comprising a platen having a pair of adjacent sensing apertures therein before which a marked record element is adapted to be moved, a barrier divider extending outwardly from the platen as a cantilever from a location substantially centered between the most closely adjacent edges of the apertures, a light-producing glow discharge tube having its tubular wall supported substantially adjacent to the free edge of the cantilever barrier, said glow-discharge tube having a pair of electrode elements within the envelope and spaced relative to each other and adapted with the tube positioning to be located on opposite sides of the barrier at substantially like distances from the barrier center so that a direct optical path is provided between the tube electrode and the aperture located on like sides of the barrier, means to sense the light penetrating each aperture when directed along the direct optical path from the tube to the aperture and means to excite the light-producing element at a selected excitation frequency alternately to develop light in the region adjacent to one or the other of the two electrode elements so that light passes from the electrode to one or the other of the apertures and is masked from the other by the barrier.

3. A sensing device comprising a platen having a pair of adjacent sensing apertures therein before which a marked record element is adapted to be moved, a barrier divider extending outwardly from the platen in a direction normal thereto from a region substantially centered between the most closely adjacent edges of the apertures, a light-producing tube having its tubular wall supported substantially adjacent to the edge of the barrier most remote from the platen, said tube having a pair of electrode elements spaced relative to each other and adapted with said tube positioning to be located on opposite sides of the barrier at substantially like distances from the barrier center so that a direct optical path is provided between the tube electrode and the aperture located on like sides of the barrier, a pair of baffle elements also extending outwardly from the platen in directions substantially parallel to the barrier from positions to locate the apertures between the inner baffle wall and the adjacent barrier wall so that light passing along the path from an electrode to the aperture on the same side of the baffle is laterally confined to the light chamber provided between the baffle and the barrier, means to sense the light penetrating each aperture when directed along the optical path thereto, and means to excite the light-producing element at a selected excitation frequency whereby light is alternately developed in the region adjacent to one or the other of the two electrode elements so that light passes from the electrode to one or the other of the apertures and is masked from the other by the barrier.

4. A sensing device comprising a platen having a pair of adjacent sensing apertures therein across which a marked record element is adapted to be moved, a barrier divider extending outwardly from the platen as a cantilever from a location substantially centered between the most closely adjacent edges of the apertures, a light-producing glow discharge tube having its tubular wall supported substantially adjacent to the free edge of the cantilever barrier, said glow-discharge tube having a pair of electrode elements within the envelope and spaced relative to each other and adapted to be located on opposite sides of the barrier at substantially like distances from the barrier center so that a direct optical path is provided between tube electrodes and the aperture on like sides of the barrier, a pair of baffle elements also extending outwardly as cantilevers from the platen in directions substantially parallel to the barrier from positions to locate the apertures between the inner baffle wall and the adjacent barrier wall so that light passing along the path from an electrode to the aperture on the same side of the baffle is laterally confined to the light chamber provided between the baffle and the barrier, means to

sense the light penetrating each aperture when directed along the optical path thereto, and means to excite the light-producing element at a selected excitation frequency to make the electrodes alternately positive and negative polarity whereby light is alternately developed in the region adjacent to that one of the two electrode elements instantly the more positive so that light passes from the region of the positive electrode to the aperture optically alined therewith and is masked from the other by the barrier.

5. The device claimed in claim 4 comprising, in addition, a light absorbing coating on the baffle wall faced toward the dividing barrier between the apertures.

6. Sensing apparatus comprising a platen having a plurality of substantially adjacent sensing apertures therein across which a marked record element is adapted to be moved, a plurality of baffle elements extending outwardly from the platen and arranged to separate the apertures into adjacent pairs, a plurality of barriers also extending outwardly from the platen in a direction substantially parallel to the baffles, the said barriers being arranged substantially midway between each pair of baffles to locate one aperture of each pair separated by barriers on either side of its associated baffle, a plurality of light-producing tubes each having a pair of elongated electrodes, one said light-producing tube being supported substantially at the end of each barrier and arranged so that the elongated electrodes are spaced one on each side

of the adjacent barrier and in direct optical path with the aperture included in the platen between the barrier and its adjacent baffle, means to sense the light penetrating each aperture when directed along the direct optical path from the tube elongated electrode to the therewith alined aperture, the said barrier providing for masking light from the electrode elements to the platen apertures located on opposite sides thereof, and means for exciting the light-producing tube in cyclic fashion alternately to produce light confined to the region of one or the other of the elongated electrodes, whereby light is directed from a single light-producing tube alternately and cyclically shifted between the individual apertures of the pair between adjacent baffles.

7. The apparatus claimed in claim 6 wherein alternate barriers project outwardly from the platen for greater distances so that light-producing means supported adjacent thereto are arranged in staggered planes.

8. The apparatus claimed in claim 7 comprising, in addition, a light-absorbing surface on the baffle and barrier elements to prevent light reflection from the walls thereof to the apertures.

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