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ELECTRICAL SELECTIVE SIGNALING SYSTEM

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2 Sheets-Sheet 1

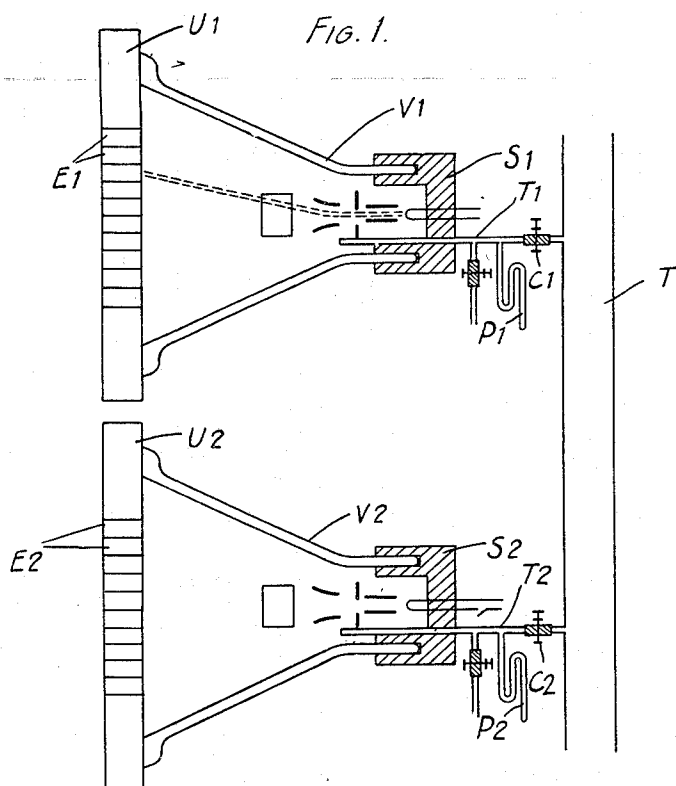
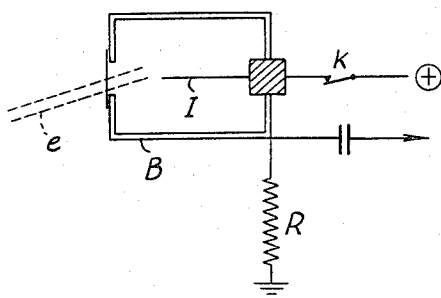


FIG. 2.



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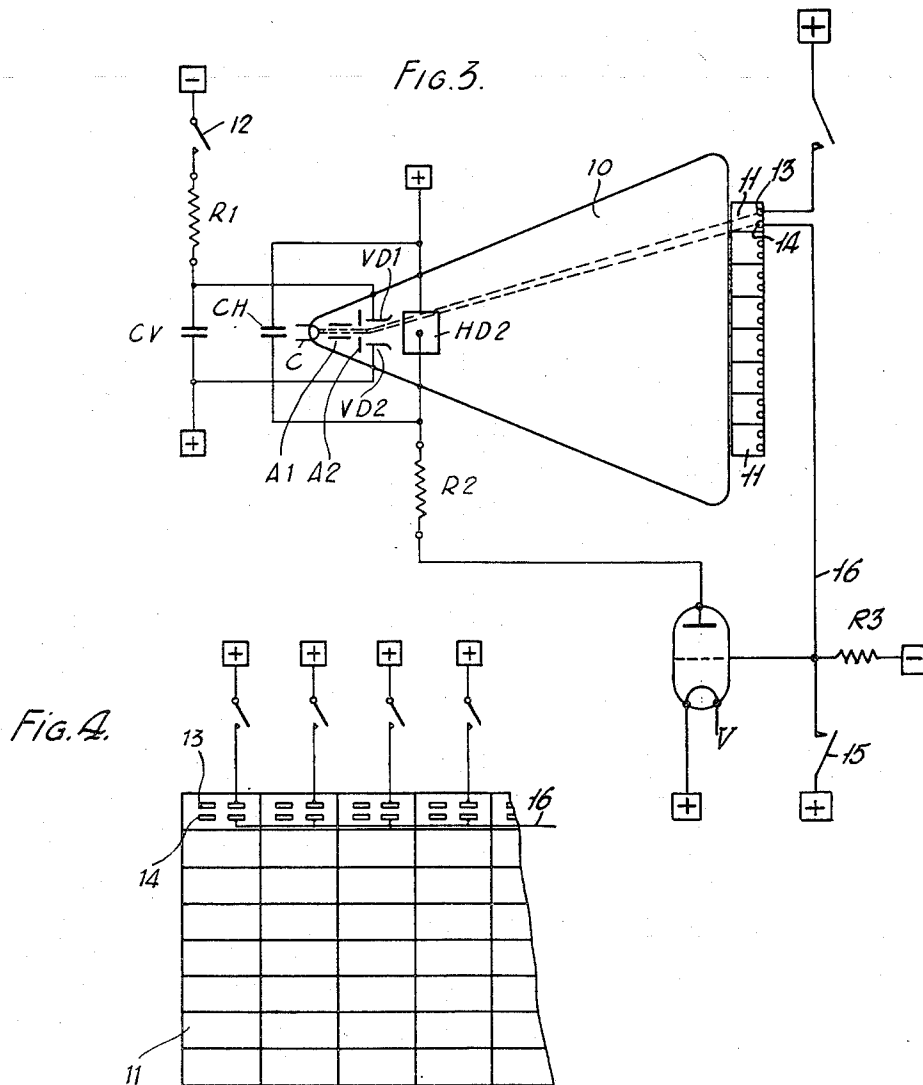
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2 Sheets-Sheet 2



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ELECTRICAL SELECTIVE SIGNALING
SYSTEM

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14 Claims. (Cl. 179—27.52)

The present invention concerns improvements in or relating to electrical selective signaling systems and in particular to electric switches for use therein.

It has already been proposed to use as a selecting means in such systems a beam of electrons which is deflected to fall on one of a number of electrodes whereby a particular line associated with the electrode may be selected. Alternatively it has been proposed to use a beam of light which is deflected to fall on one of a number of photosensitive elements.

An object of the present invention is to provide an improved easily detachable unit of elements sensitive to an impinging beam.

A further object of the invention is to provide improved arrangements for mounting selector switches utilising a beam for selecting a particular line or element.

According to one feature of the invention in which a beam is adapted to be selectively controlled to affect directly or indirectly one of a plurality of elements, the elements are mounted in a unit detachable from the beam source.

According to a second feature of the invention in an electric switch in which a beam is adapted to be selectively controlled to affect directly or indirectly one of a plurality of elements forming a unit the unit being adapted to be attached to a vessel surrounding the beam, the vessel is arranged to jack into a support thereby permitting of easy removal and replacement.

According to a third feature of the invention in a telephone or like system of the kind employing cathode ray tube switches for the setting up of connections, the cathode beam is adapted to be controlled so as to be directed to the appropriate one of a number of elements in a unit mounted separately from but adjacent to or in contact with the tube.

According to a fourth feature of the invention in an arrangement for controlling the setting of a switch which is adapted to be set by the application of varying potentials thereto, the charge of a condenser is adapted to be varied in accordance with the number of times an impulsing contact is operated to control the potential to be applied to the switch and the setting thereof.

According to a fifth feature of the invention in an arrangement for controlling the setting of a switch which is adapted to be set by the application of varying potentials thereto, the charge of a condenser is adapted to be varied each time the switch is set to a position corresponding to a

line which is not in a particular condition (e. g. calling or idle condition) to cause the switch to be set on to an adjacent line until the line in the particular condition is found.

The invention is described with reference to two embodiments shown in the accompanying drawings comprising Figures 1, 2, 3 and 4, of which

Fig. 1 shows schematically two cathode ray tubes used as switches in a telephone system,

Fig. 2 shows schematically one of the cells in the bank of a cathode ray switch,

Fig. 3 shows a modification using photoelectric cells in conjunction with the cathode ray tube, and discloses schematic circuits for operating the tube as a selector switch, and

Fig. 4 is a partial front view of the photoelectric cell bank of Fig. 3.

In the first embodiment shown in Fig. 1 two selector switches are shown forming part of an automatic telephone system. The selectors comprise a cathode ray tube of which the cathode, focusing tubes and deflecting plates are attached to the support S1, S2. Into this support a conical vessel V1, V2 which may be of glass or any other suitable material (e. g. moulded insulating material or even metal) is jacked. The units U1, U2 contain elements E1, E2 respectively sensitive to an electron beam. The deflection of the electron beam so as to impinge on one of these units will be described later in connection with Fig. 3.

In the support S1, S2 is provided a tube T1, T2 which leads to a central tube T through which all the selectors may be continuously evacuated; each selector is provided with a pressure gauge P1, P2 which may have an associated alarm circuit to be closed when air gets in to the selector so that the pressure rises above a certain value. Cocks C1, C2 are provided for shutting out any selector so that it will not affect the vacuum in the others.

The cells E1, E2 may consist simply of hollow vessels each having a hole through which the electrons of the beam may be collected. In this case if the beam is allowed to fall on a single cell only the arrangement is suitable for a single wire connection to a subscriber. Alternatively, an arrangement such as that shown in Fig. 2 may be used which also amplifies the current in which a potential is applied between the case B of the element and a central pin I which is led out through an insulating stopper. When an electron beam e enters the cell which may contain air at normal or reduced pressure or else

some suitable gas, a discharge occurs and a considerable potential arises across the resistance R. The output may be smoothed out if the electron beam is to be modulated for speech transmission. In this case a two wire circuit is provided. In order to provide a "private" conductor it could be arranged for the beam to cover two elements one of which would be used in the manner indicated in connection with Fig. 3 and described in more detail with reference to the second embodiment. Otherwise the connection to the centre pin might be used as a private conductor by providing a contact *k* controlled by a relay operated when the associated line is busy.

Instead of the elements described above the electron current may be amplified by electron multiplier units of the kind in which a single electron impinging on a metallic surface gives rise to a shower of electrons which may be received by a further surface. In this case too by arranging that a beam shall cover two units the normal facilities of a two wire circuit and a "private" line used for denoting busy conditions etc. may be provided for.

In Fig. 3 a further embodiment is shown in which a sealed cathode ray tube 10 is used as the selector in association with a unit comprising a number of beam sensitive units 11. The cathode ray tube is fitted with the usual cathode C and pairs of vertical and horizontal deflecting plates VD1 and VD2, HD2 and HD1 (behind HD2 in drawings) respectively. These deflecting plates can of course be arranged outside the tube, the tube being fitted into them when required. In addition there are provided the anodes A1 and A2 which may be respectively in the known form of a cylinder and disc for the purpose of directing and focusing the stream of the electrons from the cathode into a narrow beam which is projected on to a flat screen at the end of the tube. The screen is of the kind such that wherever the electron beam impinges against the screen a spot of light is produced. Thus for example a fluorescent screen might be used or a screen in the form of a thin metal plate which is heated locally by the electron beam so as to give off light.

The flat screen of the tube is placed in position against what may be termed a bank 11 which is assumed to carry in the present example ten rows of ten pairs of photoelectric elements used as the beam sensitive units, these of course being affected by the electron beam only indirectly through the intermediary of the screen. The beam would then have to be normally biased to one of the corners of the bank. It is possible, however, to use the selectors as a selector switch of much larger capacity and with the beam normally central 4 banks could be made accessible with the possibility of selecting one of these before the tube is brought into use. It is assumed that the electron beam is of small intensity and that if a fluorescent screen is used it is provided with enough fluorescent material for the tube to have a considerable life in spite of the wearing out of the tube due to the continued action of the electron beam. An end part view of the bank 11 is shown below the side view in order that the general layout of the photo-electric elements may be appreciated. Each photo-electric element consists of two electrodes such as 13 and 14 treated in accordance with known principles in such a manner that the resistance between the electrodes varies in

accordance with the amount of light falling on the element.

The elements are grouped in pairs, each pair being separated by means of a screen made up for example on the honeycomb principle so that when light falls on one pair of elements there will be no appreciable light leakage to an adjacent pair.

One method of operating the device will now be described and it will be assumed that it is operating as a selector switch in an automatic telephone system.

Impulses from a subscriber's dial or other source will operate the contacts 12 and so charge the condenser CV through the resistance R1 to a certain voltage in accordance with the number of impulses received. This condenser communicates its voltage to the vertical deflecting plates VD1 and VD2 to which it is connected so that the electron beam generated in the normal way by the cathode of the tube 10 will be arranged to step vertically in synchronism with the impulsing of the contacts 12. As a result the light spot on the screen will be positioned opposite the row of photoelectric elements corresponding to the number of impulses dialled. It will be understood that before reception of a train of impulses, the electron beam will occupy a position on the screen to the left of and below the first row of elements as seen from the front. It will be necessary to arrange that there be no leakage from the condenser as otherwise it would not be possible to maintain the electron spot stationary. It could be arranged however, that the potentials of the deflection plates are maintained at the potentials reached by means of some automatic feed arrangement.

The invention is not limited to the use of condensers for transforming the impulses into potentials; instead a series of potentials could be provided one of which is selected in accordance with the incoming impulses.

If for example the device is to be used for the purpose of what is known as a group selector, it is generally required that in response to the first digit a particular group of outlets shall be selected and this is usually after vertical movement of the switch, while an automatic horizontal movement must then be performed in search of a free outlet in the group selected. This action could be performed by arranging that after the vertical movement an automatic horizontal step will be performed in accordance with normal practice on two motion group selectors, and the light spot will then cover the first pair of elements in the selected level. This may be accomplished by transitorily applying positive battery to the grid of valve V, for example by momentarily closing contact 15 after the vertical movement has been completed. The grid normally has sufficient negative bias to prevent any current flow in the plate circuit of the valve, but the application of a positive bias to the grid causes the valve to pass current and charge the condenser CH via resistance R2. This condenser is connected across the horizontal deflecting plates HD1 and HD2, and the voltage now applied will cause the beam to swing to and cover the first pair of elements.

The left hand element of each pair of elements will, in this instance, be connected in circuit with the outgoing line to a subsequent selector, while the right hand element of each pair will be utilised as a so-called "private" or "control" element.

If the first outlet on the level selected is free

it will be understood that the contact in circuit with the "private" element will be open and no circuit will be completed to step the beam onto the next pair of elements. Speech and/or signaling may now take place over the line and this may be effected by modulating the electron beam by means of a suitable intensity control cylinder connected round the cathode of the tube, the bias voltage of this cylinder being varied in accordance with the received voltages from the preceding switch, or else the intensity of the beam may be varied in some other way in accordance with the impressed signal as by providing a further control electrode in the path of the electrons to act in the same manner as the control grid of an ordinary thermionic valve.

Should the outlet connected to the first pair of elements be engaged, the upper electrode of the associated "private" element will be connected to a positive battery over a contact of a busy relay. Hence when the light spot illuminates the "private" element the resistance is lowered and the positive battery extends to the grid of the valve V which normally has sufficient negative bias to suppress any anode current flow. The application of a positive bias to the grid causes the valve to pass current and so again charge the condenser CH via the resistance R2. The voltage now applied to the horizontal deflecting plates HD1 and HD2 will cause the beam to swing from the first pair of elements on the level to the second pair. If these are also engaged a further pulse of current will be delivered to the condenser CH so as to repeat the stepping-on process and the operation will continue until a pair of elements connected to a free outlet is found.

If all outlets are busy it could be arranged to return a "busy" signal to the calling party, to research the level or to step-on to another level of outlets and search over this level.

Where the device is to operate as a "connector" or "final selector" both the vertical and horizontal movements will be effected by dialling. In this case the condenser CH will not be connected to the plate of a valve V as shown, but instead will be connected to a charging circuit substantially identical to that shown for condenser CV, in which circuit it will be charged in steps in the same manner as has already been described for condenser CV.

Again both vertical and horizontal movements may be automatic as in the case where the device shall operate as a finder switch. In this instance a calling line will be marked with a particular potential or absence thereof and vertical and rotary hunting will take place for the marked outlet. The finding operation might be performed by providing an extra set of vertically disposed elements over which the spot of light would travel during the automatic vertical motion. A particular one of these level marking elements would mark the level on which the calling line was situated, and the spot of light would then cut into the level and sweep horizontally until it reached the pair of elements associated with the calling line when the movement would be arrested and the line marked busy.

The device finds particular application for the purpose of digit absorption and it is only necessary for a photo-electric element to cause the operation of a relay or other device which would discharge the impulse receiving condenser involved, for the desired result to be achieved.

The invention is not limited to the particular vertical and rotary movement described, and obviously the beam could be made to move initially in a horizontal direction until a desired vertical level is reached and then could step vertically either automatically or under control of dialled impulses. Also it might be arranged to have some other form of movement, for example movement in a spiral.

Owing to the great hunting speed obtainable with a switch of the above described type the number of outlets catered for need only be limited by the number of beam sensitive elements which can be placed against the end of the tube.

The bank of photo-electric elements together with other banks of elements which may be multiplied thereto will preferably be rigidly mounted on a rack in the same manner as the banks of ordinary electromagnetic telephone switches, and the mounting of the cathode ray tube will be arranged on the jack-in principle so that the tube may be readily removed and replaced.

By this arrangement a standard known form of cathode ray tube can be utilised and the problem of providing a large number of contacts or electrodes in the end wall is avoided.

The devices described are not limited to one electron stream but envisage the use of a plurality of streams acting either independently or in unison in the same vessel. These streams may operate on either common or independent banks of beam sensitive elements.

The device lends itself to other forms of control as well as impulsing, for example the position of the beam may be controlled by the value of resistance inserted in the condenser charging circuits, while variation in the capacity included in this circuit could also be utilised to control the electron stream.

The invention is not limited in application to the particular embodiment described and reasonable modification may be made as desired without exceeding the scope of the invention. The arrangement described does not endeavour to include all the fine points involved in operating and controlling selecting mechanisms, particularly in regard to automatic telephone systems where a fast operating, noiseless and anti-microphonic selecting mechanism is particularly desirable, but it merely serves to indicate the basic principles from which a highly efficient selective signaling system may be developed by one skilled in the light current signaling and television art.

I claim:

1. In a telephone system, a switch having therein a bank of line terminals, means in said switch for producing a cathode ray, means for directing said ray at any of said terminals thereby to enable a connection to be extended over the line associated with that terminal, means for characterizing one of said terminals, and means controlled by said ray if same is directed at said one terminal for causing said directing means to move said ray, thereby to direct it at a different one of said terminals.

2. In a telephone system, a switch having therein a bank of line terminals divided into groups, means in said switch for producing a cathode ray, means for moving said ray in one direction to select a particular group of said terminals, means controlled by said ray for then moving said ray in a different direction to direct said ray at a particular terminal in said particular group,

thereby to enable a connection to be extended over the line associated with said particular terminal.

3. In combination, a discharge tube, means for producing a cathode ray in said tube, means for directing said ray, thereby to cause same to occupy different positions in said tube, means individual to each of said positions for characterizing that position in different ways at different times, and means controlled by said ray if same is caused by said directing means to occupy any one of said positions at a time when that position is characterized in a particular way for controlling said directing means thereupon to move said ray away from said one position, said ray effective to remain in any one of said positions which it is caused to occupy at a time when that position is characterized in a different way.

4. In combination, a discharge tube, means for producing in said tube a cathode ray adapted to occupy at least three different positions in turn, means individual to each of said positions for characterizing that position in different ways at different times, and means controlled by said ray if said ray occupies any one of said positions at a time when that position is characterized in a particular way for moving said ray to the next one of said positions, said ray effective to remain in any one of said positions which it occupies at a time when that position is characterized in a different way.

5. In combination, a discharge tube, means for producing a cathode ray in said tube, means for initiating a linear scanning operation of said ray, a field of electrodes in the path of said ray, means for marking certain of said electrodes, and means controlled by said ray for sustaining said scanning operation of said ray only so long as said ray encounters marked electrodes in the course of scanning.

6. In combination, a discharge tube having an electrode field, means for marking any one of the electrodes in said field, means for producing a cathode ray in said tube, and means for scanning said field with said ray in search for the marked electrode therein and, responsive to said ray encountering said marked electrode, halting said scanning operation and maintaining said ray stationary in the position in which it encountered said electrode.

7. In combination, a series of at least three light sensitive cells, illuminating means for actuating the different ones of said cells at different times, and means controlled by each of said cells when actuated by said illuminating means for causing said illuminating means then to actuate the next one of said cells in said series.

8. In combination, a discharge tube, means for producing a cathode ray in a certain position in said tube, means for moving said ray step by step for a variable number of steps from said certain position, thereby to move said ray to a second position, means for then moving said

ray step by step for a variable number of steps from said second position, thereby to move said ray to a third position, a first plane in which said ray lies throughout said movement from said certain position to said second position, and a second plane in which said ray lies throughout said movement from said second position to said third position, said second plane being transverse to said first plane.

9. In a combination as claimed in claim 8, a device actuated a variable number of times at will and effective to control, in accordance with the number of times it is actuated, the number of steps which said ray is moved in one of said planes.

10. In combination, a discharge tube, means for producing a cathode ray in a particular position in said tube, means for moving said ray step by step in a certain direction from said position, said last means including a different device cooperating with said ray upon each step to cause said ray to take the next step, and means for disabling any one of said devices, thereby to cause said movement of the ray to stop after any number of steps have been taken.

11. In combination, a series of three or more electrodes, means for producing a cathode ray, means for directing said ray at any one of said electrodes, means controlled over each electrode responsive to said ray being directed at that electrode for controlling said directing means to move said ray, thereby to direct it at the next electrode of said series, said last means comprising the sole effective means for moving said ray.

12. In combination, a discharge tube, means for producing a cathode ray in a particular position in said tube, means for moving said ray from said particular position a variable distance to a second position and for then moving said ray from said second position a variable distance to a third position, a first plane in which said ray lies throughout said movement from said particular position to said second position, and a second plane in which said ray lies throughout said movement from said second position to said third position, said second plane being transverse to said first plane.

13. A combination as claimed in claim 12, wherein the distance which said ray is moved in one of said planes is controlled by said ray.

14. In combination, a group of elements arranged in parallel rows, each row containing a plurality of said elements, means for producing a cathode ray, means for moving said ray along a substantially straight path adjacent the ends of said rows to a position opposite the end of any desired row, and means for then moving said ray from said position over a substantially straight path along said desired row to select any desired element in that row and, when said ray reaches said desired element, for halting said ray and maintaining it stationary over that element.

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