

June 28, 1938.

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2,122,102

ELECTRIC SIGNALING SYSTEM

Filed Feb. 27, 1936

2 Sheets-Sheet 1

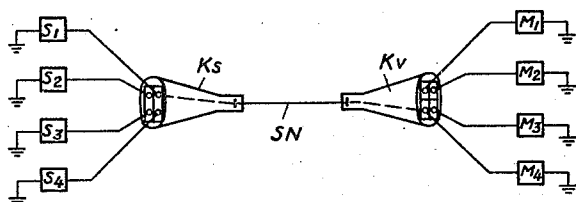


Fig. 1.

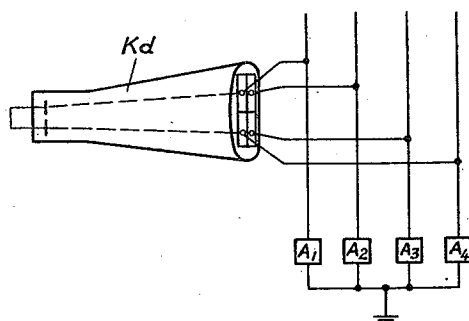


Fig. 2.

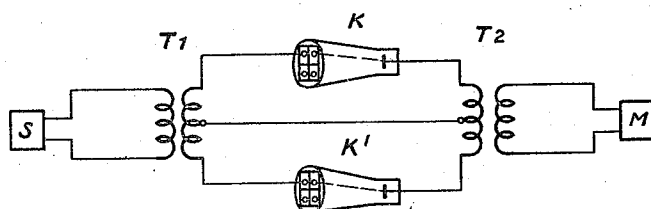


Fig. 3.

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2 Sheets-Sheet 2

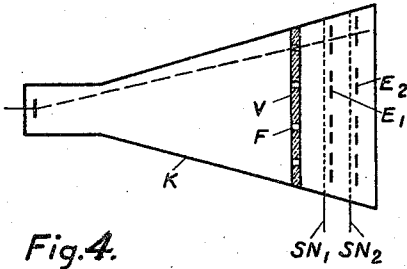


Fig. 4.

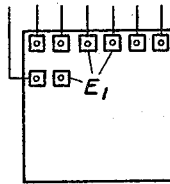


Fig. 5.

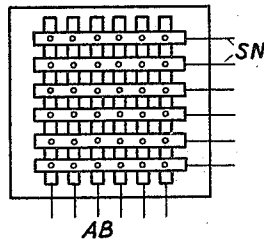


Fig. 6.

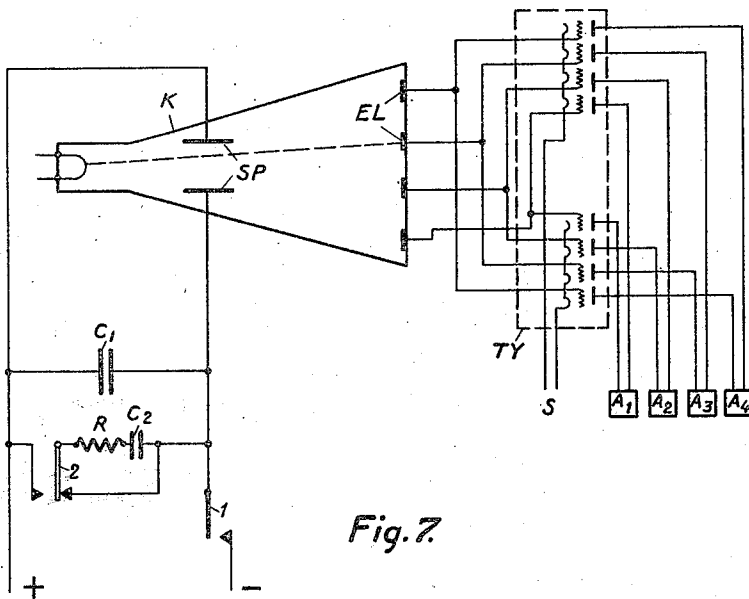


Fig. 7.

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2,122,102

ELECTRIC SIGNALING SYSTEM

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8 Claims. (Cl. 179—27.52)

The present invention relates to electric signaling systems. More particularly the invention relates to electric signaling systems of the kind in which a certain one of a plurality of senders shall be automatically put into electric connection with a certain one of a plurality of receivers. The invention has for its object to provide improved arrangements for establishing the connection.

It has been previously proposed to use as a substitute for mechanical selectors in the establishing of such a connection a selector the wiper of which consists of a ray of light. This arrangement is, however, expensive both as regards costs of installation and operation since the ray of light must be modulated in order to be able to transmit speaking currents. Furthermore, it is known to actuate from a sender by means of a directable ray of energy a definite one of a plurality of receivers whereby connection between sender and receiver is established. This principle is in certain cases advantageous but has not hitherto been realized in an embodiment capable of competing with mechanical selectors. According to the present invention the signaling system comprises controllable electron or discharge paths by the aid of which the desired connection is established and maintained. The invention renders possible the provision of some very simple and reliable arrangements.

The invention will now be described more closely with reference to the accompanying drawings showing arrangements which can be employed in various kinds of signaling systems but which for the purpose of explaining their operation have in certain cases been described as forming parts of an automatic telephone system. In the drawings,

Figure 1 shows in principle the use of a cathode ray tube in a system comprising finders, cord circuits and final selectors;

Figure 2 shows an example of the employment of a tube having two beams of cathode rays;

Figure 3 illustrates a two-wire connection over cathode ray tubes;

Figures 4, 5, and 6 show an example of a tube for use in a system according to the invention in which tube a beam of cathode rays ignites a discharge path between contacts connected to the sender and to the receiver;

Figure 7 illustrates an example of an arrangement in which the charging of a grid by the thermionic ray causes a discharge between cathode and anode in a thyatron type tube and thus a connection between a cord circuit and a subscriber.

In Figure 1 is shown a signaling system, for instance, a telephone plant in which two cathode tubes K_s , K_v are connected with their cathodes over a cord circuit SN, the tube K_s operating as a finder and the tube K_v as a final selector.

Each tube is constructed in known ordinary

manner. A voltage applied between the cathode and an anode in the tube (not shown) accelerates and concentrates the thermionic current from the cathode in known manner so that part of the current continues past the anode and strikes on the wall V. The beam of electron rays can be controlled laterally and in elevation in a manner known per se by means of deflector plates or magnets. The contacts of K_s are connected with senders S_1 — S_4 and the contacts of K_v are connected with receivers M_1 — M_4 . When a sender S_1 desires communication with a receiver M_4 there is at S_1 applied a voltage to the line which voltage characterizes the contact in K_s with which S_1 is connected. Means can also be provided for letting the same voltage cause a searching movement of the cathode ray in K_v which movement can be continuous, if desired, the cathode ray then sweeping over the contacts as in a mechanical finder employed in automatic telephone systems. The ray controlling arrangements are so devised that, as soon as the ray is directed towards the contact marked with the particular potential, they bring the ray to stop. The calling sender becomes in this manner connected with the cord circuit SN. Impulses from S_1 now actuate deflector plates in K_v so that the ray in said tube is directed towards the contact in K_v with which the desired receiver is connected whereby the desired connection between S_1 and M_4 is established.

Figure 2 illustrates the principle of a connection in which two rays having different functions are produced in a common cathode ray tube K_d . One of the rays is arranged as a finder traversing the contacts whereas the other ray is arranged as a selector. The subscriber's stations A_1 — A_4 which act both as senders and as receivers can thus be connected together similarly as in a connection according to Figure 1 with multiplied sender and receiver circuits. If, for instance, A_2 is to be connected with A_3 the finder ray is set on the contact corresponding to A_2 whereafter the selector ray is set by means of selector impulses transmitted from A_2 on the contact corresponding to A_3 .

In the schematic drawings described above the lines have been shown as single wire lines and a return has been provided through the indicated earthing of the sender and of the receiver. In practical embodiments the lines are usually made as two-wire lines and are as in ordinary automatic telephone systems brought to the selector arrangements in multiple.

In the connection according to Figure 3 there is shown in principle an example of how a two-wire connection can be established according to the invention. The two tubes K and K' respectively included in each of the line branches are in this case arranged as finders. A contact in

the screen of one of the tubes is over the secondary winding of a transformer T₁ connected with the corresponding contact of the other tube, the primary winding of the transformer being connected to the sender S. In corresponding manner the cathodes are mutually connected over one winding of a transformer T₂ the other winding of which is connected to a receiver M. The midpoints of the windings connected to the tubes are connected together. The part of the line containing the cathode ray tubes is thus connected to the two other parts of the line through the transformer. It is hereby rendered possible to transform to a higher value the characteristic impedance for the part of the line containing the tubes and to connect the direct current circuits of the tubes across the midpoints of the transformers without influencing the signaling circuit. A transformation of the characteristic impedance is generally necessary since the resistance in the cathode rays is rather great even when evacuated special tubes are employed.

In the above described connection the cathode ray is used in the same manner as a wiper in mechanical selectors and finders so that for instance in the transmission of speech the speaking currents flow over the cathode ray. However, there are also other possibilities according to the invention. In Figures 4 and 5 a tube is shown by means of which a connection is established in such a manner that the cathode ray causes a discharge between two contacts in a discharge path between which the connection is established, the ray thus bringing about the connection without forming part thereof. The tube shown in Figure 4 in longitudinal section is intended to be used in connection with cord circuits. The tube is by means of a wall V divided into two chambers one of which contains the cathode and is evacuated as an ordinary cathode ray tube and the other one of which is gas filled as in a glow discharge lamp. In the wall V which for example can consist of glass there are provided windows F which let through the cathode ray, the windows consisting for instance of thin metal foils. In the gas filled chamber there are arranged two contact groups SN₁, E₁ and SN₂, E₂. One of the contact groups consists on the one hand of a metal net (or a perforated metal plate) SN₁ connected to one branch of the cord circuit and on the other hand of contacts E₁ provided with apertures and connected each to one of the two conductors in a plurality of subscriber's lines. The second contact group consists in similar manner of a net or the like SN₂ connected to the other conductor of the cord circuit and of contacts E₂ each connected to the second conductors in the subscriber's lines. Figure 5 shows the contacts E₁ arranged on a plate of insulating material. The windows in the wall V and the holes in the nets SN₁ and SN₂ and in the contacts E₁ and E₂ are so positioned behind each other that the cathode ray can pass through the same. When the tube is connected as a finder, selector or the like, there is applied such a voltage between SN₁ and E₁ and between SN₂ and E₂ that as soon as the cathode ray is directed through a window F and passes the contacts a discharge takes place between SN₁ respectively SN₂ and that contact V₁ respectively V₂ through the hole of which the ray passes. Through this discharge the respective contact E₁ is connected with SN₁ and the respective contact E₂ with SN₂. The distance between E₁ and SN₁ and between E₂ and SN₂ should be small

as compared with the distance between different E₁ or E₂ contacts in order that the discharge shall not spread from one discharge path to an adjacent one. Walls of insulating material between the different contacts can also be provided for protecting against such a spreading of the discharge.

If the cathode ray tube according to Figures 4 and 5 is used as a finder, for example in an automatic telephone system, only those contacts E₁, E₂ which correspond to the calling subscriber are given through the call the voltage in relation to SN₁ or SN₂ respectively required for initiating a discharge, the two paths under tension being ignited as soon as the ray performing a searching movement over the contact rows reaches the contacts in question. If, on the other hand, the tube is to be used as a selector the ray is moved by means of selector impulses so that it is directed through the desired contacts and causes discharge between them. Preferably the ray is normally extinguished and the voltages on the deflector plates controlling the direction of the ray supplied to the deflector plates before the ray is lighted. The ray is thereafter lighted for a moment and causes the desired discharge. The ray can thereafter be used to bring about other connections. This can be the case for instance in a contact construction according to Figure 6 where the contacts for six cord circuits SN consist of horizontal metal bands, as shown on the drawings, the two conductors of each cord circuit being connected with two metal bands positioned behind each other in analogy with SN₁ and SN₂ in Figure 4. The correspondence to the contacts E₁, E₂ consists of vertical metal bands, and two bands positioned behind each other can be said to correspond to a row of contacts E₁ and a row of contacts E₂ respectively. To each such pair of bands is connected a subscriber's line. In said construction a multiple is obtained in the tube proper.

In the arrangement according to Figure 7 is shown an example of another possibility of letting the ray bring about a connection between two contacts by igniting a controllable electron path. In this case mutually insulated contacts EL are arranged on the screen K of the tube. To each such contact are connected two grids in a tube TY of thyratron type, one grid forming part of a group of electrodes the cathodes of which are connected with one of the cord circuits, and the other grid being included in a corresponding manner in a group in which the cathodes are connected to the other conductor in the cord circuit. To two mutually connected grids correspond two anodes connected with a subscriber A₁-A₄. In connection with Figure 7 there is also shown an example of a connection for controlling the thermionic ray by means of impulses. Across the deflector plates SP is connected a condenser C₁. The condenser is connected with one of its plates to the positive terminal of a source of current and can be connected with its other plate over a normally open relay contact 1 to the negative terminal of the source of current. A condenser C₂, which is small as compared with the condenser C₁, can be shunted to the last mentioned condenser in series with a resistance R by means of a relay contact 2 which in its position of rest short circuits the condenser and the resistance. By closing the contact 1 for a moment and thereafter permitting it to go back to its position of rest the condenser C₁ and the deflector plate SP are charged to a voltage which brings the

cathode ray back to its original position. If thereafter the contact 2 is actuated, for instance by an incoming selector impulse, so that it occupies its left hand position part of the charge on C₁ is transferred to C₂ and the voltage across the deflector plates falls one step. If voltages and capacities are suitably selected it is possible by means of a selector impulse to bring the ray to move exactly the distance between two contacts. Between every impulse the condenser C₂ discharges over the contact 2 in the right hand position of the latter. According as the voltage across C₁ falls due to the discharges over C₂ the change in voltage for each impulse decreases and consideration must be given to this condition in dimensioning the elements included in the arrangement.

A cathode ray can also be used according to the invention to initiate and control in other manner a discharge between the contacts to be connected together. As is well known a circuit subjected to thermionic radiation emits secondary electrons. This phenomenon can be utilized according to the invention in such manner that the cathode ray is directed towards one of the contacts while the other contact is so positioned that the secondary emission will strike thereon. Through a suitable selection of the material of the first mentioned contact and through a suitable mutual positioning and a proper shaping of the two contacts it is possible to cause the current of secondary electrons to become so strong that a satisfactory connection between the contacts is produced.

The electron path by the aid of which the connection is established, for instance according to the principle illustrated in Figures 1 to 3, can be designed in a plurality of different ways. Thus the thermionic tube can be provided with a grid which after the thermionic ray has been directed to the desired contact controls the intensity of the current as in an ordinary three electrode tube, one subscriber being connected with the grid and the cathode and the other with its contact acting as an anode and the cathode. In this construction it is possible through an amplifying action to compensate for the damping which for example according to the construction shown in Figure 3 is caused by the high resistance of the ray. An inconvenience in said arrangement is, however, that it can be designed only for one direction of speech wherefore it is necessary in using the same to provide a similar selector (or finder respectively) for the other speaking direction in analogy with the two amplifiers in a two-wire repeater.

I claim:—

1. In a communicating system in combination a number of conductors, a discharge tube, a set of electrodes in said tube, said electrodes being connected each to one of said conductors, means for producing a cathode ray in said tube, means for directing said ray in different directions against the set of electrodes, and means for selecting one of said directions and for fixing the direction of the ray in the selected position so as to establish electric connection between different electrodes, said electrodes being connected with control grids in discharge paths of thyatron type in such a manner that upon irradiation of an element the resistance of the thyatron discharge paths controlled through the corresponding grid drops from a very high value to a low value, senders and receivers con-

nected to said thyatron discharge paths being then connected with each other.

2. In a communicating system in combination a number of conductors, a discharge tube, a set of electrodes in said tube, said electrodes being connected each to one of said conductors, means for producing a cathode ray in said tube, means for deflecting said ray in different directions so as to cause scanning movement of the ray over said set of electrodes and means under the control of potentials on said electrodes for stopping said scanning movement in a selected position of the ray so as to establish electric connection between different electrodes.

3. In a communicating system in combination a number of conductors, a discharge tube, a set of electrodes in said tube, said electrodes being connected each to one of said conductors, means for producing a cathode ray in said tube, means for directing said ray in different directions, and means for producing discharge between different electrodes under the influence of said ray so as to establish electric connection between said electrodes.

4. In a communicating system in combination a number of conductors, a discharge tube, a set of electrodes in said tube, said electrodes being connected each to one of said conductors, means for producing a cathode ray in said tube, means for directing said ray in different directions and means for producing glow discharge between different electrodes under the influence of said ray so as to establish electric connection between said electrodes.

5. In a communicating system in combination, a discharge tube, a cathode, sets of apertured electrodes arranged in different transversal planes in said tube, each electrode being disposed in longitudinal alignment with one electrode of each of the other sets, a number of conductors connected to the electrodes in said sets of electrodes, means for producing a cathode ray in said tube, and means for directing said ray selectively against the apertures of the electrodes so as to establish electric connection between electrodes of different sets.

6. In a communicating system in combination, a discharge tube, a set of apertured electrodes in said tube, a second set of electrodes disposed each behind one of said apertured electrodes, a number of conductors connected to the electrodes in said sets of electrodes, means for producing a cathode ray in said tube, and means for directing said ray selectively against the apertures of the electrodes of said first set so as to establish electric connection between an electrode of the first set and the appertaining electrode of the second set.

7. In a communicating system in combination a discharge tube, a set of electrodes within said tube, means for producing a cathode ray in said tube, means for directing said ray in different directions, and means for producing discharge between different electrodes under the influence of said ray, a number of said electrodes being connected in common with a cord circuit and other of said electrodes being connected each with a telephone subscriber's line.

8. A system according to claim 5, characterized in that a number of said electrodes are mutually in metallic connection and are formed by a metal net.

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