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BY A. P. C.

P. M. G. TOULON
PICTURE TRANSMISSION SYSTEMS
Filed Oct. 28, 1936

Serial No.
108,062
6 Sheets-Sheet 1

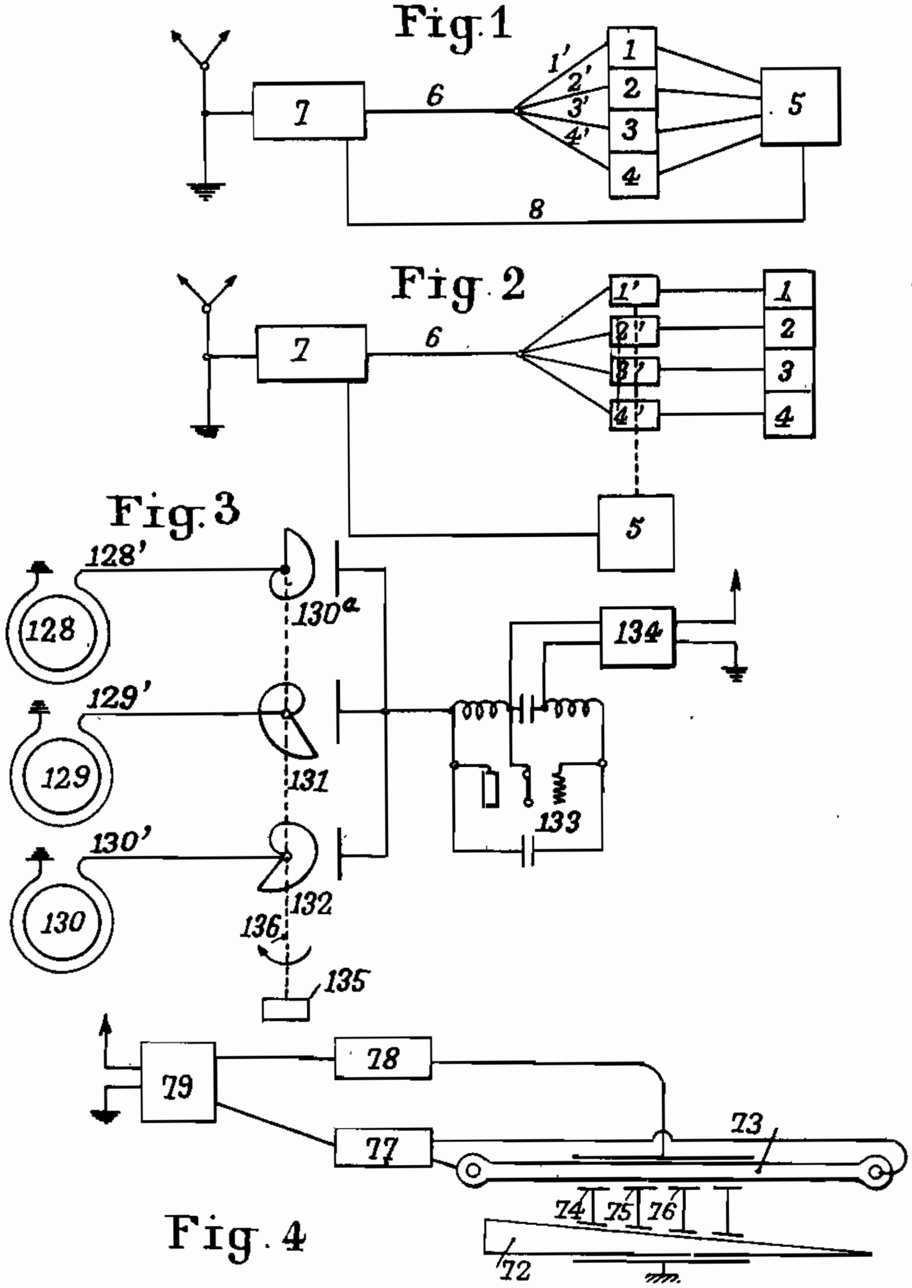

Fig. 1

Fig. 2

Fig. 3

Fig. 4

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Fig. 5

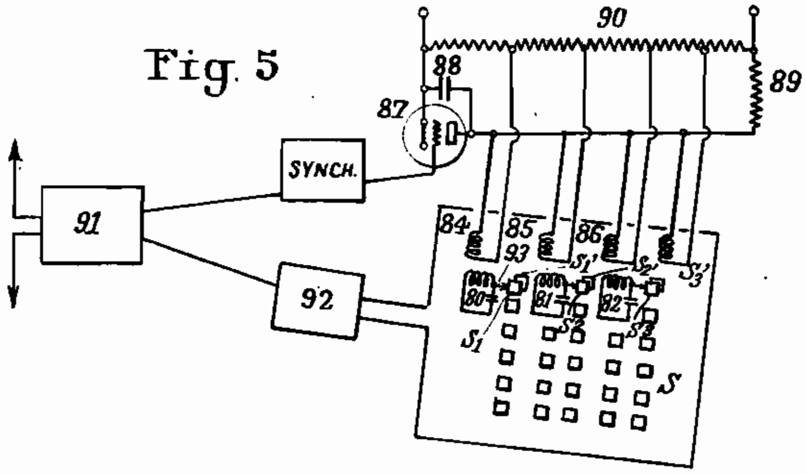

Fig. 6

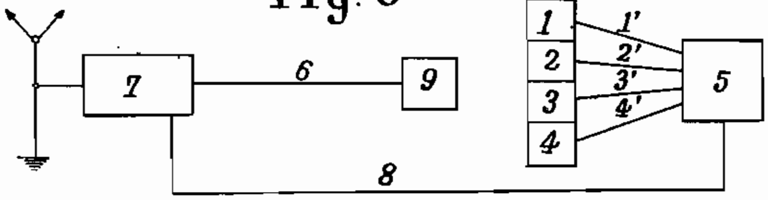

Fig. 7

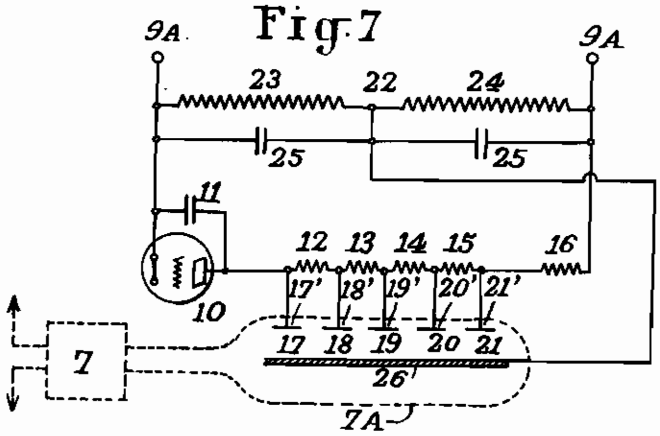

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Fig. 8

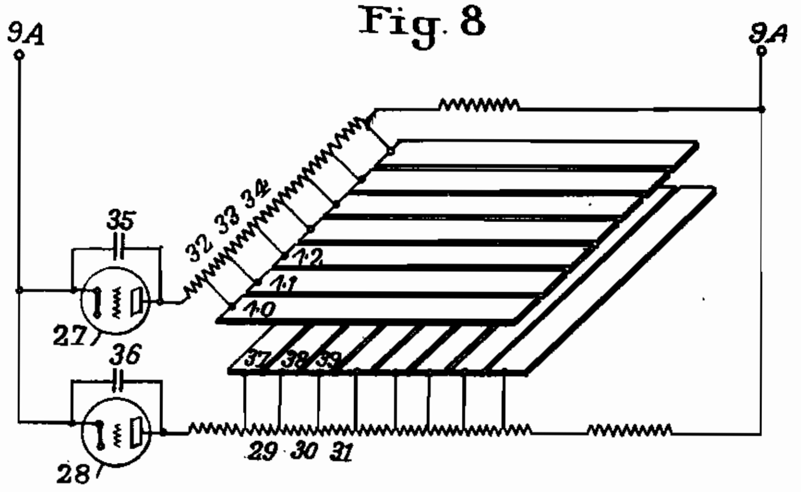
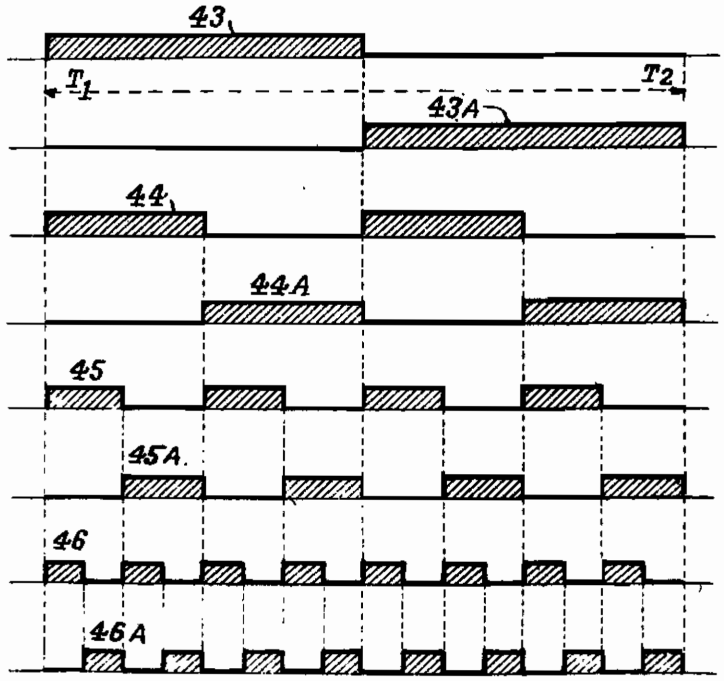


Fig. 9



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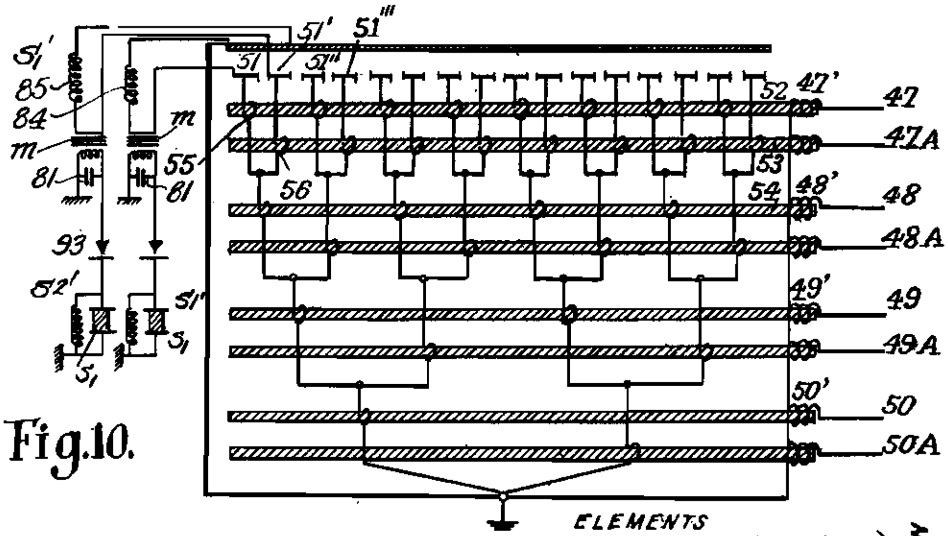

Fig.10.

Fig 11

ELEMENTS

1st DISTRIBUTION

LINE 47+LINE 47A	1	0	1	0	1	0	1	0	1	0	1	0	1	0	1	0
LINE 48+48A	1	1	0	0	1	1	0	0	1	1	0	0	1	1	0	0
LINE 49+49A	1	1	1	1	0	0	0	0	1	1	1	1	0	0	0	0
LINE 50+50A	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0
RESULT	4	3	3	2	3	2	2	1	3	2	2	1	2	1	1	0

2nd BISTRIBUTION

0	1	0	1	0	1	0	1	0	1	0	1	0	1	0	1
1	0	0	1	1	0	0	1	1	0	0	1	1	0	0	1
1	1	1	0	0	0	0	1	1	1	1	0	0	0	0	1
1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	1
3	3	2	3	2	2	1	3	2	2	1	2	1	1	0	4

3rd DISTRIBUTION

1	0	1	0	1	0	1	0	1	0	1	0	1	0	1	0
0	0	1	1	0	0	1	1	0	0	1	1	0	0	1	1
1	1	0	0	0	0	1	1	1	1	0	0	0	0	1	1
1	1	1	1	1	1	0	0	0	0	0	0	0	0	1	1
3	2	3	2	2	1	3	2	2	1	2	1	1	0	4	3

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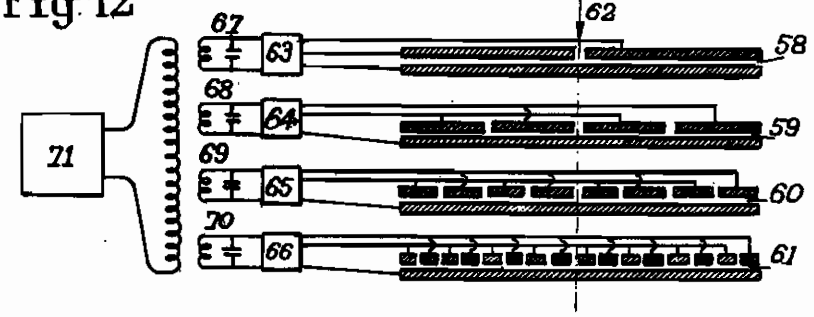
Fig. 12



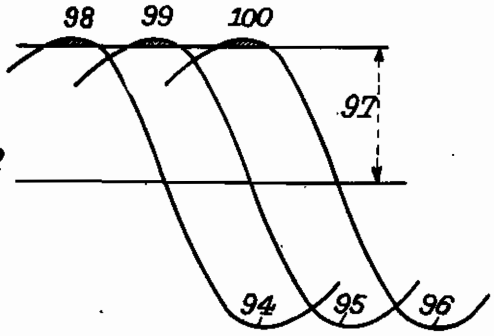


Fig. 13

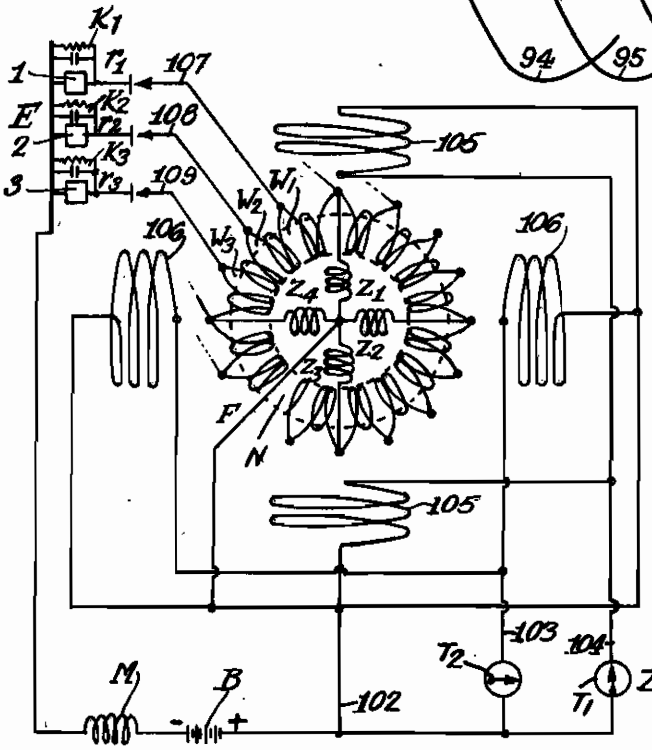


Fig. 14

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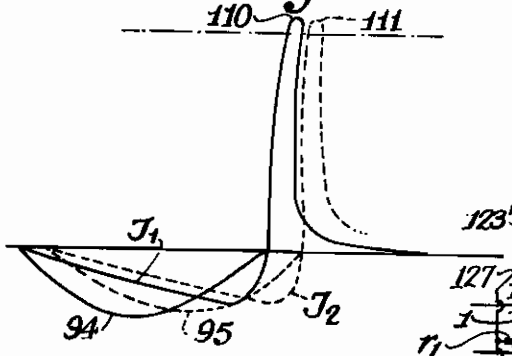
Fig.15.



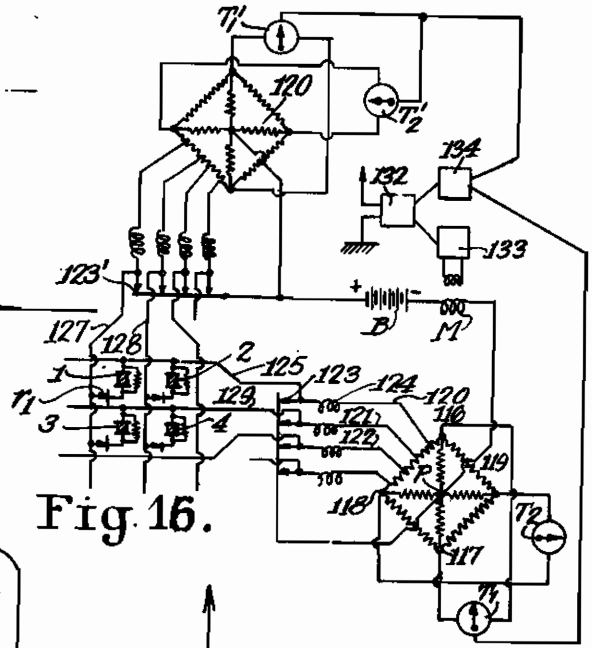
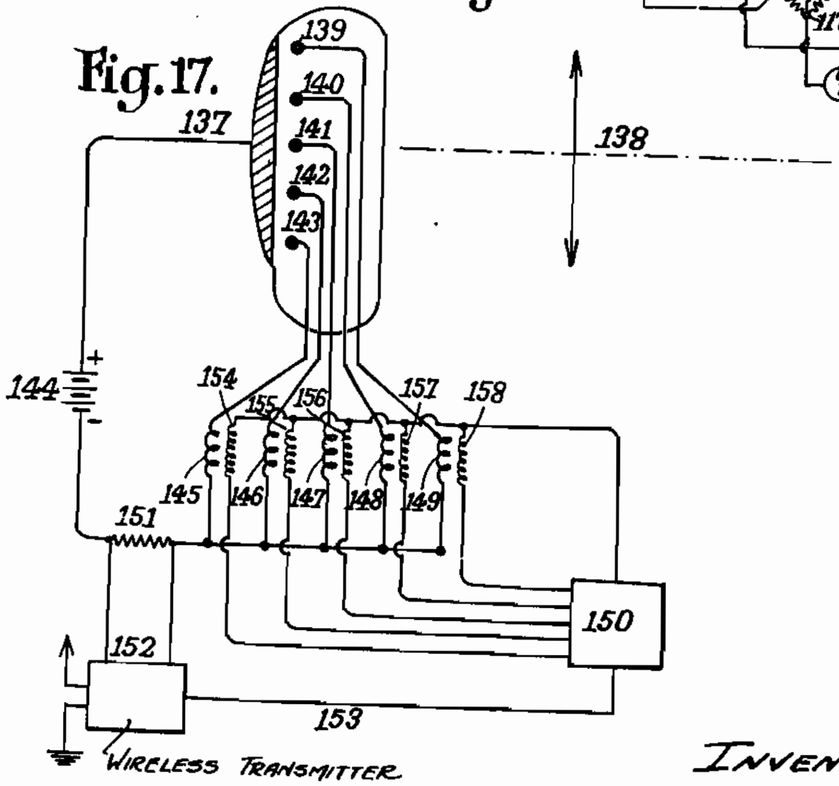


Fig.16.

Fig.17.



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ALIEN PROPERTY CUSTODIAN

PICTURE TRANSMISSION SYSTEMS

Pierre Marie Gabriel Toulon, Puteaux, France; vested in the Alien Property Custodian

Application filed October 28, 1936

The invention has for object a new method of exploration adapted for the transmission to a distance of images of moving or stationary objects which is applicable to transmission as well as to reception.

In the television systems hitherto known, the scanning was ensured either by a rotating mechanical member (collector) or by a moving electronic beam. According to the invention, the exploration of a device having multiple elements, separated or contiguous, is effected without it being necessary to make use of such moving connecting members.

The scanning according to the invention is ensured in such a manner that the characteristic of each element or of the electric circuit which is associated therewith varies in regard to time and that, consequently, the element comes into action periodically (for instance, once during the total time of exploration of a complete image). The multiple elements will generally be arranged side by side and will form a continuous or multicellular surface or line. The device scanned may form part of the electric vision circuit, and in this case all the elements will be inserted simultaneously in the circuit; this device may also play the part of an optical distributor. In the former case, the modification of the characteristics of the elements consists, for instance, in variation of their sensitivity or of the sensitivity of the electric circuits which are connected to these elements.

The scanning may also be ensured by the combination of several superposed multi-cellular devices (such as lines or surfaces), the elements of which receive a different sensitisation.

The modification of characteristics of each element or of the electric circuit which is associated therewith may be effected either mechanically or electrostatically or electromagnetically, or by an auxiliary voltage or current or, alternatively, an auxiliary high-frequency wave, etc. This modification may be the consequence of, or alternatively may consist in, either a variation in tuning of the element or of its circuit or a change in the mean potential of the element. This modification may take the form of a variation of the mechanical, electrical, magnetic, optical properties etc., of the element or of its circuit. The modification of the sensitivity of the element or of its circuit may be obtained mechanically; preferably, it is ensured electrically, starting from a distribution of current or of auxiliary voltages (distributor) in which the value of the current or the voltage, its form or its direction, ensures the distribution between the elements. The distribution of the sensitivity of the elements may be effected in sequence or may be effected in any other manner, for instance, by missing a line of exploration (interlacing scanning) or, alternatively, by passing from one point to another, distant from the former and located on the same line or on a different line etc.

The distribution of the auxiliary current (playing the part of distributor) may be obtained, for instance, by means of thyratron releasers or, alternatively, by means of a transformer having a rotating field etc. This distribution may also be complex, that is, may be effected by the addition of several voltages proceeding from different lines. It may also be effected in such a manner that the modification of an element initiates the modification of the element which follows it and may, moreover, react on the element which precedes it.

The element of the device scanned (or its circuit) may be constructed in such a manner that the effect produced on it is prolonged.

The object and the mode of execution of the invention will be more readily understood from the accompanying drawings which illustrate several particular cases by way of example.

Fig. 1 illustrates the general diagram of an exploring system in accordance with the invention, in which all the elements of the circuit are excited simultaneously by the vision current, and sensitised successively by a distributor.

Fig. 2 diagrammatically illustrates a modification of Fig. 1, according to which the sensitisation is effected by the action on the transmission lines connecting the receiver to the elements.

Fig. 3 illustrates an application of the diagram according to Fig. 2. In order to ensure the transmission, use is made of high frequency, the resonance conditions of lines being modified.

Fig. 4 is another application of the scanning according to Fig. 2, according to which the characteristics of lines are statically varied owing to the use of a tube containing rarefied gas, the dielectric constant of which is modified.

Fig. 5 is another modification of the application of scanning according to Fig. 2.

This figure shows how the successive sensitisation of the circuits associated with the various elements of the surface can be effected with the aid of a magnetic field. This figure also illustrates a connection which owing to the use of a rectifier associated with a circuit offering a certain time constant, allows of prolonging the duration of the response of the electro-optical element, after its excitation, and of extending it particularly over the whole of the period which elapses between two consecutive scannings.

Fig. 6 illustrates the general diagram of another modification of the invention in which the surface with multiple elements only performs an optical distributing function while an additional device receives the modulation.

Fig. 7 illustrates the application of the principle of scanning according to Fig. 6 to the scanning of the various elements of a line.

This figure shows how it is possible to obtain a transparent spot which is displaced in sequence on an opaque line.

Fig. 8 illustrates the application of the same method to the scanning of an entire surface by means of two releasers.

Figs. 9, 10 and 11 relate to an improved method of distribution of the distribution current (construction of a distributor).

Fig. 9 illustrates in function of time the form of the voltages in the different wires which feed the distributor.

Fig. 10 illustrates the principle of the cabling of the different wires constituting the distributor and allowing, owing to the form of the voltages described with reference to Fig. 9, of varying the sensitivity of the various elements of a line in the course of time.

Fig. 11 is a diagrammatic table, in which is illustrated the addition of the different voltages furnished by the various wires which conduct the current to the distributor. This table explains why the cabling of Fig. 10 traversed by currents according to those of Fig. 9, ensures the scanning of the line.

Fig. 12 shows the application of a principle analagous to those described with reference to Figs. 9, 10 and 11, but in the case where use is made of several electro-optical elements superposed optically and each supplied by a single distribution of current.

Fig. 13 illustrates in function of time a distribution of polyphase current which permits another type of static distributor to be constructed.

Fig. 14 illustrates the diagram of construction of a transformer having a rotating field which permits the polyphase voltage of the static distribution described with reference to Fig. 13 to be obtained.

Fig. 15 illustrates another form of phase-displaced voltage obtained by the use of an induction coil and a rectifier, these voltages being intended, as in the previously mentioned arrangements, to ensure the successive distribution of the conductivity of the various elements.

Fig. 16 illustrates a method of construction of a static scanning device employing distributor voltages according to Fig. 15.

Fig. 17 represents an application of the invention to transmission, in which the entire image of the object to be transmitted is projected onto a photosensitive surface.

All these figures are only given by way of example and in order better to understand the new method of scanning which forms the object of the invention, but it is obvious that this method may be applied in a very large number of other ways, not only for television (transmission or reception) but also for other uses (remote control automatic communication etc.).

Fig. 1 diagrammatically illustrates the application of the exploring system which forms the object of the invention, to a television receiver in which the scanning device receives the modulation at the same time. This device is formed by a very large number of elements 1, 2, 3, 4 etc. forming the screen and on which the image of the subject televised, is produced. By the term "an element," there should be understood, in particular, any body of small dimensions, of which the brightness, transparency, position, index of refraction or the rotatory power in polarised light etc. varies as a function of the electric field or magnetic field, or of the voltage etc. which is applied to it or the current which traverses it. The vision currents received by the station 7 are applied through the line 8 to the different branches (lines 1', 2', 3', 4') terminating at each of the elements. The exploration is ensured by the static scanning of the device 1—4, obtained by successively varying the sensitivity of these elements by means of a distributing member 5. The function of the distributor is to render all the elements of the device except one insensitive to the modulation at each moment, and to displace continuously on the surface the position of the active element. This distributor is synchronised with the transmission through the line 8.

Fig. 2 illustrates a method of scanning, for reception, in which the same references are employed to denote the same elements as in Fig. 1. This diagram only differs from the diagram of Fig. 1 in that the distributor 5 modifies the characteristics 1', 2', 3', 4' associated with the elements 1, 2, 3 and 4 and the scanning of these elements is thus ensured by the successive sensitisation of these lines. All these lines are permanently connected, for example, by the common line 8, to the receiving station 7 for receiving the image signals, but at each moment one line only is rendered sensitive to the image current and then conveys this current towards the element at which this line terminates. The distributor 5 may be operated mechanically, but preferably this distributor will be constructed in a static form. The rectangles 1', 2', 3', 4' diagrammatically represent the variable part of the line, the term "line" denotes either the line strictly speaking, between the element and the station, or any circuit inserted in this line.

Fig. 3 illustrates the application of the scanning system, the principle of which has been described with reference to Fig. 2, to a television receiver comprising three elements 128, 129, 130 forming a multi-elementary screen, on which the image appears. These elements are, for instance, electric discharge tubes (neon) which are illuminated under the action of a magnetic field produced by a solenoid surrounding them, such as 128', 129', 130'. These elements thus translate the electrical image impulses into luminous impulses. The image currents are received by the station diagrammatically illustrated at 134. They modulate a high-frequency generating tube 133. The high-frequency wave so produced is simultaneously and permanently applied to all the electric lines 130ª—128', 131—129' and 131—130'. Each line comprises a variable condenser (130, 131, 132 respectively). These variable condensers are driven by a common shaft 136 operated by a suitable motor 135 which serves as distributor.

The scanning of the screen, that is, the illumination of the neon tubes and their modulation, in synchronism with the transmitting station is ensured, according to the invention, by this motor 135 playing the part of distributor which simultaneously modifies the tuning of the different lines 128'—130ª, 129'—131 and 130'—132. Arrangements are made so that the condensers are displaced with respect to one another, so that at each moment only one of the lines becomes sensitive owing to its tuning to the frequency of the oscillator 133. The other lines, being detuned, do not cause any transmission of modulation to their respective elements. The high-frequency wave thus penetrates into only one of the lines, for instance, the line 128'—130ª, at a given moment. This wave produces in the solenoid 128' a high-frequency magnetic field, the intensity of which corresponds to the brightness of the point of the image transmitted at the given moment. The high-frequency magnetic field, in turn, causes the illumination of the tube 128 placed in the interior. Thus, without resorting to any commutation between the receiver and the elements, owing to the periodic sensitisation of the circuits which are connected to the elements, it is possible to transmit the brightness of a definite point of the transmitted object to a geometrically corresponding element of the receiving station.

Fig. 4 shows how the different elements of the surface can be successively sensitised by the use of an electrostatic field, and how it is possible to apply the modulation at the same time, that is, control the luminosity as a function of the vision current received. In this figure, in order to ensure the distribution use has been made of a modification of the dielectric power by resorting to tubes of rarefied and ionised gas serving as dielectric.

It is known that the dielectric constant varies with the intensity of the auxiliary current traversing the tube; this current rendered variable in the course of time acts as a static distributor by automatically sensitising an electric circuit associated with each element of the line.

At 72 there is illustrated the explored line, the elements of which are formed by piezo-electric quartz crystals of different thickness forming a single block of wedge shape but which may also be separated and capable therefore of entering into resonance for different wave-lengths. At 73 there is illustrated a tube capable of being ionised and to which are applied the electrodes such as 74, 75, 76 etc. connected to the different elements of the quartz. The ionisation of the tube is effected in a progressive manner with the aid of a thyration releaser 77 which furnishes voltage of sawtooth form. The modulation currents picked up by a wireless station 79 are applied to a heterodyner 78 which electrostatically excites all the elements of the line 2. However, at a given moment, the transmission can only act on a single element owing to the fact that each element only enters into resonance for a determined value of ionisation of the tube, depending upon the current furnished by the releaser which plays the part of the static distributor.

The quartz entering into resonance plays the part of an electro-optical element (when it is placed behind a polariser) and allows a quantity of light to pass which reproduces the image.

In the above example, a single transmission line is illustrated. Of course, several ionised tubes may also be arranged in succession and it is thus possible to effect the exploration of a very large number of elements.

Instead of employing a dielectric of which the specific inductive power varies for ensuring the effect of sensitisation, the scanning may also be effected by varying the inductance of the circuit, for instance, the permeability of a magnetic core as shown in Fig. 5. In this figure it is also shown how it is possible to maintain the effect produced on the element by the modulation current during the whole of the time which elapses between the two consecutive scannings, for example, by means of a small auxiliary rectifier associated with the element offering a certain time constant.

According to this construction, each element of the surface S, the elements being represented by small rectangles S_1, S_2, S_3, is associated with an oscillatory circuit such as 80, 81, 82. The inductance coil of each of these circuits is mounted on a magnetic core, the permeability of which may be varied by saturating it owing to the passage of a current in an auxiliary winding such as 84, 85, 86 etc. The distribution of auxiliary current forming a distributor varies the tuning of each of these circuits successively and therefore has the effect of "sensitising" the elements at the suitable moment. A releaser allows of successively neutralising the current in each of the coils 84, 85, 86 etc. This releaser comprises the thyratron 87 associated with the condenser 88 and the resistance 89. A potentiometer 90 suitably constructed and connected to the continuous current supply of the releaser allows of distributing the voltages to each of the coils 84, 85 etc. The grid of the thyratron 87 is controlled by the synchronisation current proceeding from the wireless station 91. The modulation is transmitted to a heterodyner 92 which simultaneously excites all the oscillatory circuits, but only a single element is at each moment employed, namely, that which is sensitised. The high-frequency voltage successively appears in each of the auxiliary circuits at the moment when they are sensitised, with an amplitude which corresponds to the modulation. This voltage is rectified by individual copper oxide rectifiers such as 83, and charges the capacity, the plates of which are formed by the two electrodes S_1 and S_1' of the electro-optical element. This charge has the effect that the optical modification which the element has undergone, owing to the action of the modulation current, continues during the whole of the time which elapses between two successive scannings. The discharge of this capacity occurs very slowly owing to a certain leakage in the element.

This method allowing of prolonging the effect produced by the modulation on the characteristics of the electro-optical element, by means of a rectifier supplying a circuit offering a certain time constant, applies not only to the circuit connection of Fig. 5 but to all the circuit connections employing a device having multiple elements operated successively by the vision modulation.

Moreover, use may be made of the rectifier adapter to apply the modulating voltage to the elements, in order to ensure at the same time its sensitisation for a definite voltage of the distributor. It is sufficient, for this purpose, to arrange, for instance, the circuit of the element, rectifier included, in such a manner that it becomes conductive only when the voltage of the distributor is applied to it. The modulation voltage will be introduced in series with the former. The same circuit connection may also be applied to the instantaneous subjection to the modulation voltage of the whole of the line comprising several elements which come into operation successively owing to a second distributor.

Fig. 6 illustrates a modification of the application of the invention; the vision currents received by the station 7 are applied to a device 9 transforming them into light of a variable intensity. The scanned multiple device 1, 2, 3, 4 serves here only to transform this light into an image, which is ensured owing to the distributor 5, synchronised by the line 8, which has the effect of successively modifying the optical properties of the elements 1 to 4, that is, modifying either their transparency or their reflecting power. Of course, this arrangement also applies to transmission, in which case 9 will be a photo-electric cell and the device 1—4 will play, for instance, the part of a shutter between the object and the cell.

As is illustrated in Fig. 7, it is possible to ensure, for instance, the transparency of the various elements of a line and thus to effect an entirely static scanning by making use of the electro-optical elements such as those which have been employed in Fig. 1 and by employing a releaser for controlling these various elements.

In this figure there is illustrated at 9*bis* the continuous current supply which feeds the thyratron 10 of the releaser. At 11 there is illustrated its condenser and at 12, 13, 14, 15, 16 are illustrated the fractions of the resistance which determines the period of release. It is known that such a connection (or any other similar releasing device employed in television) allows of obtaining a voltage represented in the course of time by a curve of sawtooth form. The different electro-optical elements are designated by 17, 18, 19, 20, 21 and their juxtaposition constitutes the line to be explored. These elements are connected between the sections 12, 13, 14, 15, 16 of the abovementioned resistance through the intermediary of the electrodes 17', 18', 19', 20', 21'. The extremities of these sections are brought to progressively increasing and variable potentials, as a function of time, when the releaser operates.

A common electrode 26 is connected to the centre point 22 of a potentiometer 23, 24, which fixes the mean potential of the continuous current supply. If necessary, the condensers 25 are introduced, which prevent any alternating component from appearing at the potentiometer 23, 24; the electro-optical elements 17, 18 etc. possess the remarkable property of becoming transparent only if the voltage between their electrodes is zero; this property is obtained, for example, by producing a very weak transverse field which orientates in a permanent manner crystals polarising the light; use may also be made of any other device sensitive to the electrical impulse and modulating the light. At a given moment, this difference of potential between 26 and any one of the electrodes 17'—21' is zero, while all the other elements present appreciable differences of potential. In order to fix the ideas, let us assume that at the beginning of the release (lower part of the sawtooth curve) the voltage between 17' and 26 is zero; the corresponding elements will then be transparent. On the other hand, the voltage between 18' and 26 will be, for instance, 10 volts, between 19' and 26, 20 volts etc; the corresponding elements will thus be opaque.

Some time afterwards, the element between 17' and 26 will become opaque; on the other hand, the element 18 will become transparent in turn and so on. The releaser thus plays the part of distributor which successively and periodically renders transparent the various elements of the line. In this way, the successive transparency of all the elements is obtained, and this is displaced in a progressive manner from one extremity to the other of the line. This method of scanning may be employed, for instance, for exploring a cinematographic film by projecting this film line for line on to the scanning device having multiple elements, and by collecting the light which this band allows to pass on a photo-electric cell.

Fig. 8 shows that the above principle can very easily be applied to the scanning of an entire surface. In this figure there are shown at 27 and 28 the two thyratrons constituting the line and image releasers, similar to those of which use is being made at present in television receivers having a Braun tube. However, instead of causing the voltage produced by the releaser to act on the deflecting plates of the electronic tube as is customary, the ends of the resistances 29, 30, 31 etc. on one hand and 32, 33, 34 etc. on the other are connected to rectilinear bands, such as 37, 38, 39 etc. extending in one direction and 40, 41, 42 etc. in the perpendicular direction, these bands constituting two plane electrodes facing one another. At a given moment, the different bands of the same electrode are brought to definite potentials defined by the intensity of the current which traverses the resistance. These potentials determine the electrostatic field in the space enclosed between these two electrodes. At each moment, only a single element of this space is found for which the electric field is zero, namely, that which is delimited by the two perpendicular bands which, at the moment under consideration, are at the same potential, whereas the field in all the other elements is not zero. Gradually as the releasers function, the element in which the field is zero is displaced progressively over the surface, and as the two releasers have different frequencies, the element of zero field is displaced along a line and progresses by one line to the following until the surface is scanned. In the space between the two electrodes, an electro-optical substance is placed which possesses the properties already described in the device of Fig. 1.

This system of scanning of a surface may be employed for the reception of television according to the diagram of Fig. 6; the function of the static scanning device is entirely analogous to that which would be performed by a Nipkow disc placed in front of a modulated electric discharge lamp.

The devices described in reference to Figs. 7 and 8 may also be applied to the receiving circuit of Fig. 1.

In this case, the electric distribution which has just been described will play the part of a static distributor which has for effect the successive sensitisation of the elements 1—4, that is, their subjection to the conditions such that they respond to the electrical image impulses which are also applied to these elements. For instance, use may be made of the electro-optical elements formed by a large number of small crystals energised by a Brownian movement. The voltages applied to these elements by the distributor direct the crystals in a definite direction and thus render the elements insensitive to the modulation by the image currents. At a given moment, a single element, as has been described in connection with Figs. 7 and 8, is under the zero voltage of the distributor. Its crystals, therefore, will not be directed and this element will therefore not be blocked. It will translate the electric image impulse into a luminous impulse which will correspond to the brightness of the geometrically corresponding point of the subject televised. In Fig. 7 there is shown in dotted lines the station

7 receiving the electrical image impulses, and by 7*bis* a loop connected to this station and simultaneously submitting all the elements 17 to 21 of the screen to the magnetic field corresponding to the image impulses. Each element is thus submitted to the static voltage of the distributor, applied between its electrodes, for instance, 17′ and 26, and to the magnetic modulation field. It is only when this static voltage passes through zero that the element becomes sensitive to the magnetic field and reproduces a point of the image.

The arrangement of the above-described distributor presents the disadvantage of not being very precise; the total voltage of the releaser being limited, only a very small fraction of this voltage is provided between each consecutive element, in order to pass from the transparency to their opacity, if the number of elements is increased. The precision of the system may be much improved and the necessary voltages may be reduced by employing the following means:

Instead of applying to the different elements of the line (or of the surface) to be scanned, voltages which at a given moment are distributed in an order increasing in a regular manner, the voltage of the "distributor" is obtained by means of several distribution wires independent of one another, and there are applied to these different wires voltages variable in the course of time, which allows, as will be shown by the following example, of reducing the voltage on the element. By suitably choosing the voltages of the elementary wires, it is possible to achieve the result of applying to only one of the elements a total voltage of zero, and it also is possible to modify the different voltages of the wires in such a manner that this result is produced successively in the course of time for each of the elements.

Figs. 9, 10 and 11 explain this improved method of distribution of the distribution current. In the example illustrated in Fig. 10, it has been assumed that the number of elements (51*a*, 51*b*, 51*c* etc.) of the line to be explored is 16. Use has been made of a distributor comprising four independent pairs of distribution wires. These pairs are designated by 47 and 47*bis*, 48 and 48*bis*, 49 and 49*bis*, 50 and 50*bis*.

Fig. 9 illustrates as a function of time the form of the voltages applied to each of the wires which feed the distributor. In this figure, the abscissa T_1—T_2 represents the time which elapses between the two consecutive scannings of any one of the elements of the surface. The voltage applied to the first wire 47 which feeds the coil 47′ is represented by the curve 43. The inverse of the voltage 43 which feeds the wire 47*bis* and its coil is represented by the curve 43*bis*. The voltage applied to the second wire which feeds its coil 48′ is represented by 44, and its inverse which feeds the wire 48*bis* by the curve 44*bis*. By 45 there is represented the voltage furnished to the third wire 49 which feeds the coil 49′ and by 45*bis* its inverse which feeds the wire and the coil 49*bis* etc. All these coils magnetise the cores 52, 53, 54 etc. of transformers on which are selected the different individual distributions which constitute the distributor. The successive elements of the line explored such as 51*a*, 51*b*, 51*c* are brought to a potential with respect to earth by means of a distributing cabling which is shown in Fig. 10 and which is fed by the above-described cores. The elements of even rows, such as 51*a*, 51*c* etc., are fed by the core 52, while the elements of odd rows such as 51*b*, 51*d* etc. are fed by the core 53. By other means, the secondary windings such as 55 and 56 which feed the first two elements 51*a* and 51*b* are connected to one another, and the potential of their junction point is modified by the action of the core 54 and so on. The voltage of each of the elements of the line such as 51*a*, 51*b*, 51*c* etc. results from the addition of the voltages furnished individually by the different wires 47, 47*bis*, 48 and 48*bis*. As is shown in Fig. 9, the frequencies of currents which feed the different wires are sub-multiples of one another. It will be shown that at each moment, only one of the elements of the line explored possesses a zero voltage and that the voltage applied to all the other elements is different from zero. For this purpose, there have been illustrated in the table of Fig. 11 the first three successive distributions of the voltages during scanning (that is, during the exploration of the first three elements of the line). The voltage of each secondary winding 55, 56 etc. has successively a zero or a unitary value (Fig. 9), which is represented in the table by 1 or by 0 and the voltage applied to each element has been totalled. In the last line of each table, the location corresponding to the active element at the moment under consideration, that is, that which is transparent while all the others are opaque, has been framed. It is clear from this table that a continuous scanning is obtained if frequencies which are sub-multiples of one another are applied to the different wires. In the above-mentioned examples, the successive variation of the transparency of the device scanned is obtained. This result may find television applications in installations of the type described in Fig. 6. The action on the elements may have as result also the variation of their power of reflection or any other optical modification and may be employed for receiving an image transmitted to a distance.

Moreover, these circuits may be employed for providing the television installation described in Fig. 1. It is sufficient for this purpose to transmit the modulation simultaneously to all the elements. This transmission may be effected by the distributing member itself.

The distributing circuit connection of Fig. 10 may be simplified by combining the cores 52 and 53 into a single core and by winding the secondaries 55 and 56 in opposite directions.

In the example chosen a particularly simple case has been described where a line is explored and use has been made of a linear division system, but it is evident that the same principle can be applied to the scanning of a surface. Instead of the binary division system it is evident that any geometrical progression whatsoever may be employed.

This geometrical distribution may be effected by circuits other than that forming the object of Fig. 10, provided that they fulfill the following conditions; the elements of the line or surface scanned are distributed in groups, each of them into sub-groups and so on, and the whole of the elements of each group, then of each sub-group, is fed by an individual distribution of current, these different distributions of current having frequencies which are sub-multiples of one another.

Instead of employing a single row of electro-optical elements, to which the sum of several elementary voltages is applied, several optical elements may, on the contrary, be placed one behind the other, and a single voltage may be applied to each of them. Thus the equivalent of a mechanical shutter is statically obtained, the vanes of which would be of different dimensions and which would be movable with different speeds.

Fig. 12 illustrates this modification. At 58, 59, 60 and 61 are shown the four lines of optical element arranged one behind the other and traversed at the same time by the luminous beam 62. The lines 63, 64, 65, 66 feed electrodes in the form of grids, which act on the elements.

The dimensions of these electrodes vary from one line to the other according to a geometric progression; in particular, the length of the electrode of the line 79 is half of that of the line 59. The distributor wires are associated, for instance, with oscillatory circuits such as 67, 68, 69, 70 receiving their energy originally from a common multi-vibrator 71. This multi-vibrator furnishes lines 63—66 with voltages similar to those of Fig. 9.

Instead of employing a releaser comprising a thyratron for obtaining the voltage of the static distributor (that is, for ensuring the blocking and the successive sensitisation of the elements), it may again be obtained originally from, for example, a polyphase transformer.

In Fig. 13 there is illustrated the form of the voltages furnished by such a distributor as a function of time and in Fig. 14 a cabling of the phase-multiplying transformer furnishing these voltages. On the image-modulating voltage there is superposed a negative polarising voltage which is capable of modifying the sensitivity. At 94, 95, 98 there is shown a certain number of alternating voltages displaced with respect to one another, which are furnished by a phase-multiplying transformer, and serving to sensitise the different elements of a line. On these alternating voltages there is superposed a continuous voltage 97, which allows of successively sensitising each element in a very short interval of time, such as that shown in hatching at 98, 99, 100 etc. Each element is associated with a rectifier and its sensitisation takes place as soon as the polarisation voltage exceeds a certain value, starting from which the rectification may be effected.

Fig. 14 shows, in a receiver, a cabling system which allows of obtaining different voltages in a very simple manner and if necessary in a sealed tube. Through the glass wall V of this bulb there pass, for example, four conductors 101, 102, 103, 104 fed by two triodes T_1 and T_2 furnishing a distribution of polyphase currents. These conductors feed two coils 185 and 186 perpendicular to one another and arranged on a core N. This core carries a continuous winding similar to the armature of a Gramme ring, which winding furnishes the different polarisation voltages necessary for feeding the wires of the distributor 107, 108, 109 etc. terminating at the elements arranged between the electrodes S_1, S_2, S_3 and a common electrode E. In the lead of each element there is inserted a rectifier R_1, R_2, R_3. The winding is so arranged so as to comprise an accessible neutral point P (such as is the case in the Dolive-Dobrovolosky generators). This neutral point is connected by a wire F to the terminal 102 which serves at the same time as return lead for the coils 105 and 106. The modulation (that is, the image current) is introduced by the coil M between the wires 101 and 102. The wire 101 is connected to the electrode E common to all the elements. Moreover, a polarising battery B is inserted in the wire 101. This battery polarises the circuit of each rectifier (R_1, R_2, R_3) so as to prevent any current from passing (voltage 97 of Fig. 13), and the image currents received in M therefore cannot act on the electro-optical elements. The voltages of the Gramme ring (94, 95, 96, Fig. 13) are superposed on the blocking voltage 97 and neutralise it periodically (point 98, 99, 100). At these moments, the rectifier allows the modulating current to pass, which acts on the element.

The arrangement described with reference to Figs. 13 and 14 presents the drawback that the moment of sensitisation of each element is not sufficiently precisely defined, as the continuous sinusoids of voltage (98 for example) which sensitise the elements are tangent to the straight line 97. A better precision can be obtained in the definition of the moment of the sensitisation, by producing a voltage of very short duration at the moment when the sinusoid cuts the X-axis.

Fig. 15 illustrates, as a function of time, the instantaneous voltage applied to the different elements in this way and Fig. 16 represents the corresponding cabling of the elements. Moreover, Fig. 16 differs from Fig. 14 in that the different voltages, displaced in phase with respect to one another are obtained, not by means of a Gramme ring, but by means of a simple potentiometric arrangement. The over-voltage obtained is utilised by a rectifier which discharges in series to an inductance coil. As Fig. 15 shows, voltages 110, 111, 112 of very short duration are obtained and displaced with respect to one another with the aid, for example, of an individual copper oxide device and an inductance in series on each element. In Fig. 16 there are illustrated at 116, 117, 118, 119 the current tappings of a circular potentiometer serving to distribute the voltage between the different elements. At 120, 121, 122 etc. there are illustrated the current tappings selected on this potentiometer, which each feed a rectifier (for example, 123) through an inductance coil (for example, 124).

The instantaneous over-voltage (which is produced successively at each of the rectifiers, as is shown in Fig. 15) is employed to effect the distribution of the voltages between the bands 125 through the condensers (for example, C_1). A second similar distributor 126 ensures the distribution between the bands 127 perpendicular to the former bands. As has been described in connection with the circuits of the preceding figures, this installation allows of successively sensitising the elements included between these two planes of bands.

Fig. 17 illustrates the application of the invention to transmission. The lens 138 forms on the cathode of a photo-electric cell an image of the subject televised. Opposite this cathode there is arranged a large number of elementary anodes 139, 140, 141, 142, 143 which are permanently connected to the transmitting station 152. According to the invention, the electronic image forming on the cathode is scanned, without employing a moving electronic beam, but by successively sensitising all the points of the cathodic surface. To this end, each of the elementary anodes is connected to a circuit comprising a polarising battery 144 serving for "blocking" this anode, and the coil such as 145, 146, 147, 148, 149 into which may be introduced an auxiliary voltage which neutralises the effect of the battery 144 at the moment when the element must be sensitised.

This sensitising voltage is obtained originally from the distributor 150 and by means of the coils 154, 155, 156, 157, 158.

It is thus possible to obtain a photo-electric current which at each moment corresponds to the electronic transmission of the element of the surface of the cathode situated opposite the anode, and as the distributor successively sensitises the various elements, the current collected at the terminals of the resistance 151 in the output circuit corresponds successively to the tint of the various points of the image explored by the distributor. This modulation is introduced into the wireless apparatus 152, which may also transmit the synchronising signal furnished by the distributor 150 and suitably conducted through the transmission line 153.

Instead of causing the modulation to act on a system of wires which is independent of distribution (Figs. 1 and 2) or on a lamp placed behind the distributor (Fig. 6), the distributor itself may also be employed for directing the modulation. This result may be obtained, for instance, by employing electro-optical elements, the sensitivity of which is not linear and in which the modulating voltage cannot influence the operation of the distributor.

It is possible to reduce the voltage applied to the electro-optical elements and serving either to sensitise them or to block them, by making use of bodies which do not follow Ohm's law in combination with the electro-optical elements. The use thereof is particularly interesting in the case of the circuit arrangement of Fig. 7, as it permits of considerably reducing the continuous exciting voltage applied to the electro-optical elements (voltage between 17' and 26 or 16' and 26 etc.) An increased resistance is introduced into each of the wires 17'—18' etc. which will be arranged in series with the body in question, placed in parallel with the electro-optical element. This body must be chosen in such a manner that the voltage drop at its terminals does not substantially exceed a limiting value which must be equal to or greater than the blocking voltage of the element. Thus the greatest part of the voltage is absorbed by the resistance and the voltage applied to the electro-optical element included between zero and this limiting value may be chosen sufficiently low. As the body in question, use may be made, for example, of an electrolytic solution; this may be the electro-optical element itself.

In order to ensure the sensitisation and the blocking of the different elements or their circuits, use may be made of the following means. Each element, by being sensitised, causes the desensitisation of the element which immediately precedes it and initiates the sensitisation of the element which immediately follows it. Thus, the elements are sensitised in sequence and the complicated circuit arrangements described above (such as releasers, distributors with numerous elements) are avoided.

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