

April 9, 1935.

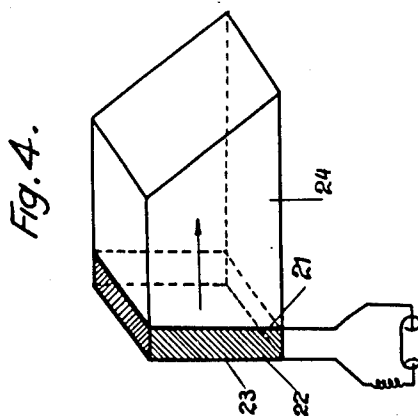
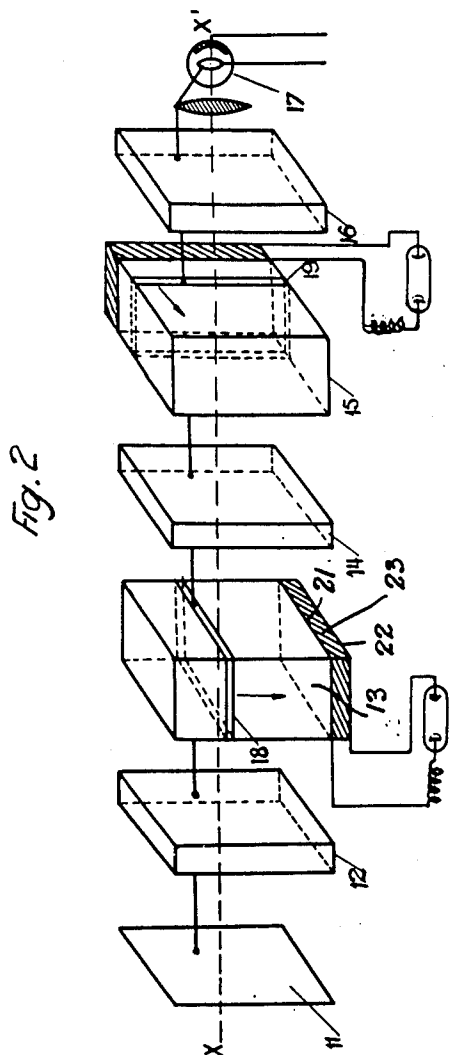
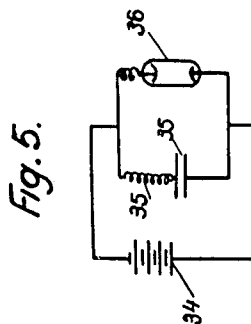
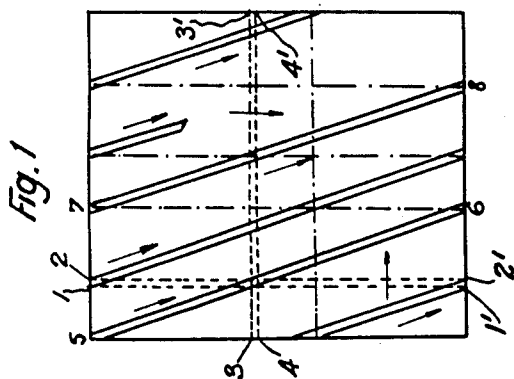
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1,997,371

PICTURE TRANSMITTING DEVICE

Filed June 25, 1930

5 Sheets-Sheet 1



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PICTURE TRANSMITTING DEVICE

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5 Sheets-Sheet 2

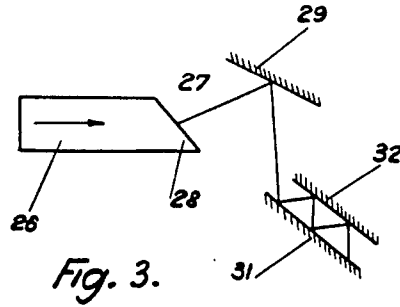


Fig. 3.

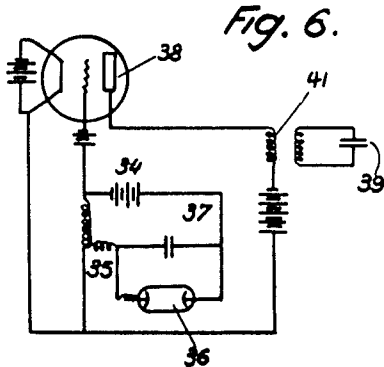


Fig. 6.

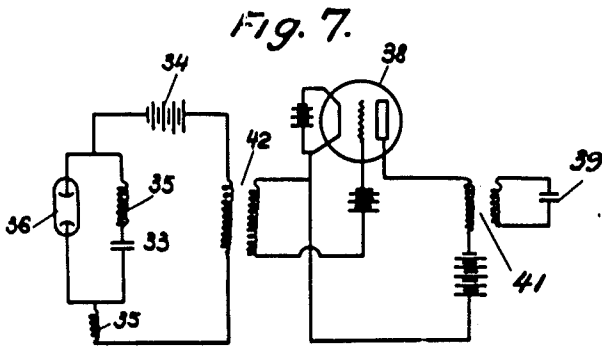
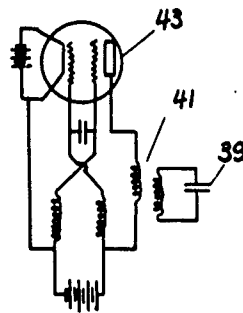


Fig. 7.

Fig. 8.



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5 Sheets-Sheet 3

Fig. 9.

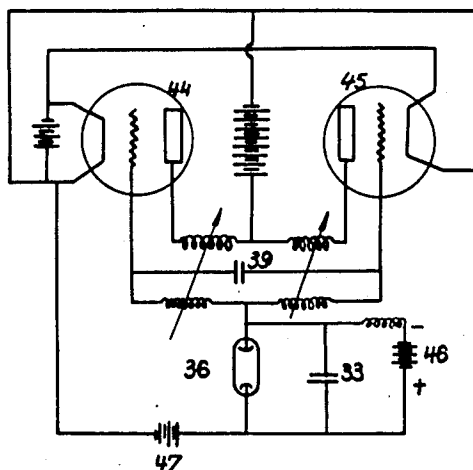
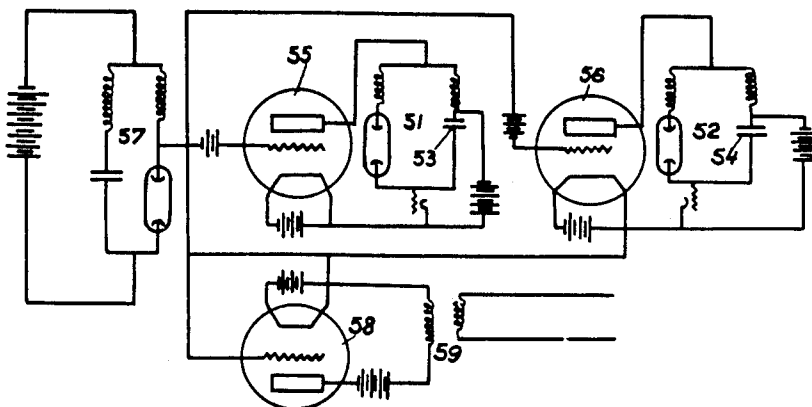


Fig. 17.



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1,997,371

PICTURE TRANSMITTING DEVICE

Filed June 25, 1930

5 Sheets-Sheet 4

Fig. 10

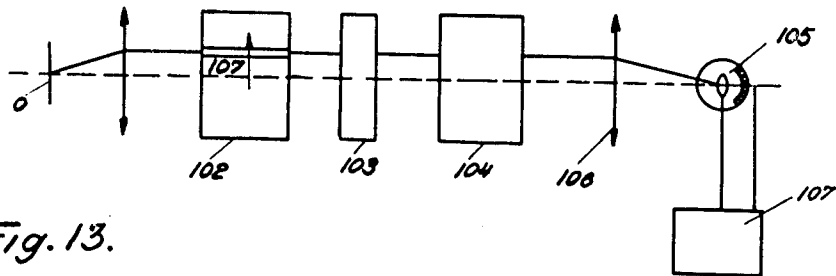


Fig. 13.

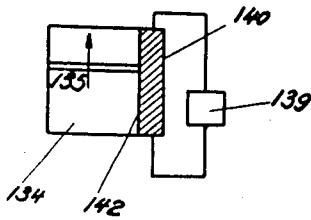
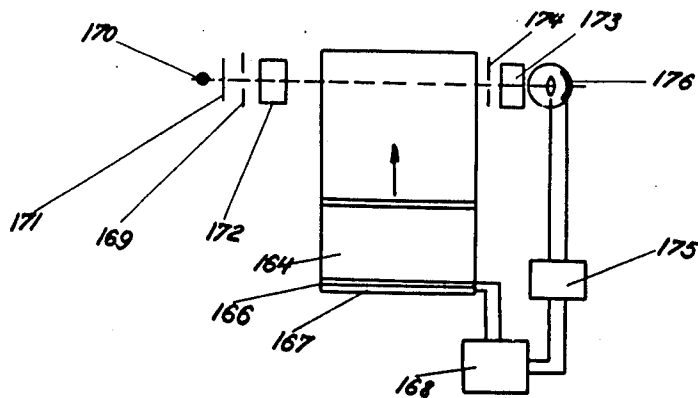


Fig. 19.



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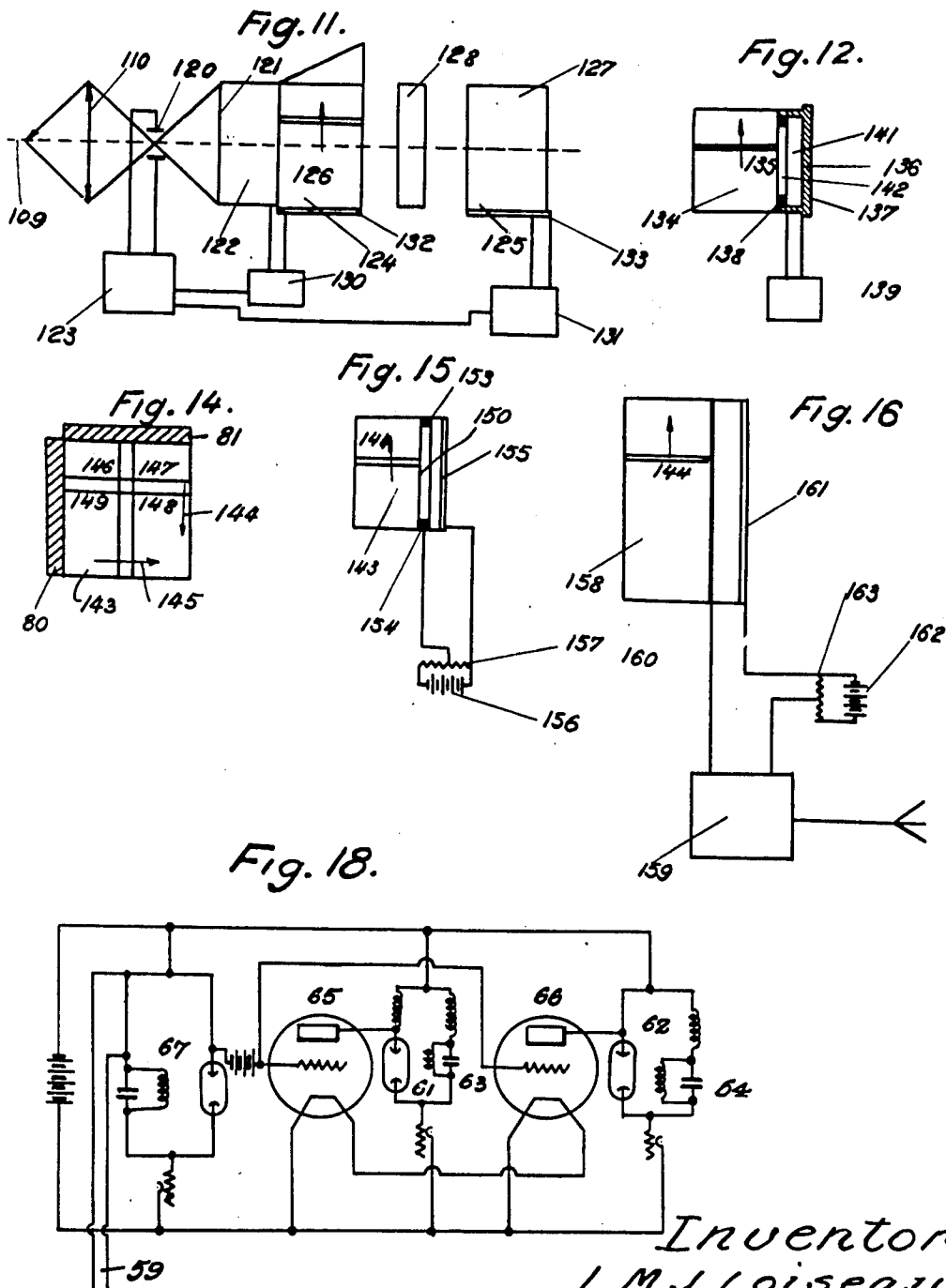
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1,997,371

PICTURE TRANSMITTING DEVICE

Filed June 25, 1930

5 Sheets-Sheet 5



UNITED STATES PATENT OFFICE

1,997,371

PICTURE TRANSMITTING DEVICE

Louis Marie Jean Loiseau, Paris, France

Application June 25, 1930, Serial No. 463,762
In France July 1, 1929

9 Claims. (Cl. 178-6)

The present invention relates to devices for the electric distant transmission of pictures; it concerns more particularly the means for exploring a picture and recomposing the same respectively at the transmitter and the receiver television stations.

It is known that most of the known devices of this sort comprise mechanical parts, such as discs provided with slots turning at very high speeds at the transmitter and the receiver stations, in order to scan synchronously the picture and the screen on which the picture is to be reproduced, by a beam of light whose intensity is modulated according to the illumination of the various points of the picture to be transmitted. These mechanical devices present various drawbacks the most serious of which being the difficulty of attaining the very high speeds necessary for instance for a moving picture (cinematographical) transmission, and also that of obtaining a perfect synchronism between the two stations.

In order to obviate these drawbacks, it has already been proposed to make use, for the decomposing and the recomposing of the picture, of certain transparent bodies whose optical properties vary when they are subjected to mechanical deformations. The above devices are based upon the following principle, which is schematically illustrated by Figure 1 of the joined drawings:

Between the picture to be transmitted and the photoelectric cell of the transmitter (or between the lamp whose light is modulated and the projection screen of the receiver), a device equivalent to two screens provided with slots and moving in two directions normal to one another is interposed, in such a manner that the light rays which have passed through the two windows can reach the cell or the screen. If 1, 1' and 2, 2' are the edges of one of the slots, and 3, 3' and 4, 4' the edges of the other slot, it is obvious that only the rays that have passed through the surface limited by 1, 1'-2, 2'-3, 3'-4, 4' can reach the cell, and it will be understood that if these slots are caused to pass in front of the picture at convenient time intervals and at convenient speeds, all the points of the picture can be explored in succession along the inclined lines such as 5-8, 7-8, etc.

In the known devices of the kind where the slotted screens are replaced by bodies with variable optical properties, two light controlling parts are interposed in the path of the light, each of these parts being constituted by a pile of laminae of a transparent piezoelectric body perpendicular to the image and to the screen, the laminae of the two piles being, moreover, perpendicular to

one another. By appropriate means these laminae are excited in succession with alternating currents, being thereby caused to vibrate successively at their natural frequency. Under the effect of the mechanical deformations due to these vibrations, the laminae become double refracting, and by means of appropriate supplementary parts, such as polarizers or analyzers, only the beam of light which has passed through two laminae vibrating, simultaneously reaches the photoelectric cell.

According to the present invention, instead of using a transparent body whose various layers are caused to vibrate in succession at their natural frequency, a continuous transparent and homogeneous body is employed, and by applying to one of its faces, at regular time intervals, an elastic disturbance of short duration, for instance a compression or an impact, narrow zones of mechanical deformation are set up which travel at regular time intervals through the transparent body thereby modifying the optical properties of the body.

It is necessary to well understand that the natural vibration frequencies of the various layers traversed by the zone of deformation do not play any part in this device, the phenomenon used being in all points similar to the propagation of a sound wave in a limited medium, or to that of a deformation propagated along a stretched cord on the free end of which a sudden impulse is impressed.

The speed with which the zone of deformation will travel depends only on the transparent body utilized, and more particularly on its coefficient of elasticity and on its density, whereas the width of this zone depends only on the duration of the disturbance applied to one of the faces of the body. Thus it is seen, that by a convenient choice of the transparent body and of the means enabling the creation of an elastic perturbation, an exploration of the picture is obtained, which may be as rapid and as fine as desired.

One may, of course, without departing from the invention, utilize any transparent, solid, liquid or gaseous body provided that its optical properties vary when it is deformed; one may, likewise, select any one of the variable optical properties, as the elliptical polarization, the rotational polarization, the variation of the index of refraction and the like.

By way of example, there are illustrated in the accompanying drawings various forms of the invention.

Fig. 1 is a diagram illustrating the principle of operation of the device, as described above.

Fig. 2 is a diagrammatic view of a transmitter or receiver.

Fig. 3 represents a device preventing the reflexion of the elastic waves.

Figs. 4 to 9 represent electrical devices enabling the creation of an elastic perturbation on one of the faces of the transparent body.

Figs. 10 and 11 represent diagrammatically a transmitter and a receiver in a simplified form of realization.

Figs. 12 and 13 represent another simplification of the transmitter.

Figs. 14 and 15 represent respectively in transverse section and in elevation, a transmitting device comprising one transparent medium only.

Fig. 16 represents a receiving device realized in the same manner as the above transmitter.

Figs. 17 to 19 represent devices providing synchronization between the transmitter and the receiver stations.

Fig. 2 shows a device applicable to the transmitter station; by means of an appropriate optical device, a picture of the object it is desired to transmit is formed on the screen 11 in such a way that the picture emits rays parallel to the line X X', these luminous rays passing through a polarizer 12 for instance a nicol, and then through a parallelopiped 13 transparent to the light waves, and in which the elastic waves 18 travel in the direction of the arrows, then an analyzer 14, and afterwards a second parallelopiped 15 similar to the first, and lastly a second analyzer 16. After having left the device, the rays are concentrated on the photoelectric cell 17.

The polarizers and analyzers are placed in such a manner that the analyzer 14 normally extinguishes the rays of light which have been polarized by 12 and have traversed the body 13. If an elastic disturbance is produced, for instance a compression or a shock of very short duration, on the upper face of the body 13, an elastic wave 18 will be set up, which would travel downwards at a speed of 5.500 metres per second if the body is quartz, this speed depending only upon the nature of the body, and the thickness of the deformed zone depending upon the duration of the elastic perturbation thus set up. In the inside of the zone 18, the optical properties of the body will be modified. The body will acquire, for instance, the property of transforming light polarized linearly by 12 in light polarized elliptically, with the consequence that the rays that have traversed the zone 18 will no longer be extinguished by the analyzer 14. Thus it is seen that the wave 18 has played the part of a horizontal slot moving downward at the fixed speed of 5.500 metres per second for quartz, a result which could not easily be attainable with purely mechanical arrangements.

The analyzer 16 is disposed so that it normally extinguishes the light or the light rays that have traversed the zone 18 and the analyzer 14; if then one produces in the body 13 a disturbance that is propagated horizontally in the direction indicated by the arrow, by submitting one of the lateral faces of the body to an elastic perturbation, it is seen that the phenomena will again be set up: the zone of perturbation 18 will now play the part of a vertical slot travelling horizontally, and finally only the beam of light having passed through the zones 18 and 19 will not have been extinguished at its exit from the analyzer 16 and will sensitize the photoelectric cell 17.

A similar system is used at the receiver for scanning the whole of the surface of the detector (screen or sensitive plate) by means of a beam of light whose intensity is modulated, for instance by means of a Kerr cell or a neon or similar tube acting as source of light, the modulation being carried out by the current from the photoelectric cell 17.

It is known that the deformation waves travelling in elastic media are reflected and refracted at the surfaces separating two media in exactly the same way as light waves, the index of refraction being equal to the ratio of the speed of propagation in the two media. In these conditions, when an elastic wave such as 18 passes through the transparent body 13 and reaches the face opposite to the face from which it has been issued, it has a tendency to be reflected on this second face and return back again thus creating, by interference with the next elastic wave and by renewed reflection on the emitting face, a very complex state of deformation which is very detrimental to the desired result. In order to obviate this disadvantage and in order to have, at any instant, only one elastic wave travelling inside the transparent body in one direction only, with no reflection, provision is made, according to the invention, at the exit of the transparent body, for another adjacent elastic medium, the exit face of the transparent body being preferably given such a direction, that the angle which it forms with the direction of propagation of the elastic wave is the angle of total reflection. Thus in the device schematically represented in Figure 3, the face of separation 28 between the transparent media 26 travelled through by the elastic wave in the direction of the arrow, and an adjacent medium 27, forms with the said direction or propagation an angle such that the elastic wave is entirely refracted and passes into the medium 27. The medium 27 is limited by a body 29 absorbing and reflecting the elastic wave in a direction such that this wave does not meet the transparent body 26; the wave is preferably directed towards other absorbing and reflecting surfaces such as 31, 32, in order to be damped by successive reflections and absorptions.

Various mechanical or elastic means may be imagined for producing on one of the faces of the transparent body a perturbation giving rise to an elastic wave. In the preferred form schematically represented in Figure 4, a condenser is used whose armatures 21, 22 are connected to an appropriate electric circuit, one of the armatures 21 being fixed to the plane face of the transparent body 24 where the elastic wave has to be emitted. In these conditions, if the condenser is progressively charged and then suddenly discharged, this discharge has the effect of suddenly decompressing the dielectric, and this sudden expansion of the dielectric 23 is transmitted to the transparent body where it gives rise to a narrow zone of compression travelling in the direction of the arrow. In order to obtain a strong disturbance, it is preferable to choose as dielectric, a matter whose modulus of elasticity is as small as possible.

If the electrical circuit into which the condenser is discharged is oscillating, the discharge is also oscillating and the zone of mechanical deformation travelling through the transparent body will be constituted, not by one zone of compression alone, but by a succession of narrow alternative zones of compression and decompression, constituting a real train of waves limited

by two planes. This will be a detriment to the successful operation of the device because, by a convenient choice of the constants of the electrical circuits used, things may be arranged so that the total duration of each oscillating discharge is sufficiently short in order that the deformation due to the train of waves will not be too large.

In the case of an oscillating discharge, one may, in order to obtain disturbances of large amplitude, take as dielectric a body whose natural frequency is equal to that of the oscillating discharge; in this case, the dielectric may advantageously be constituted by a lamina of a piezo-electric crystal. Of course, only the dielectric of the condenser is set in vibration in this case, whereas the transparent body only undergoes deformations during the passage of the elastic wave passing through it.

A great number of arrangements may be imagined in order to obtain, at regular time intervals, short periodic or aperiodic discharge of a condenser that is progressively recharged during the intervals separating two successive discharges, some of these arrangements using relaxation circuits will be described below by way of example.

With the device of the Figure 5, the condenser 33 is charged by the battery 34 through induction coils or resistances such as 35 suitably adjusted: It is discharged through a neon lamp 36. The adjustment of the various elements of the circuit allows the loading period and the time between two successive loadings to be given the desired values.

In the device of Figure 6, an auxiliary condenser 37 inserted in the grid circuit of a three-electrode tube 38, is charged by means of a battery 34 through suitable induction coils or resistances 35 and is unloaded through the neon lamp 36. The condenser 39 acting upon the transparent body is controlled by the anode circuit, for instance through the transformer 41; or through a resistance or an induction coil shunted by the condenser 39. This arrangement allows the amplification of the current provided by the lamp 38 to be made use of.

In the arrangement of Figure 7, the relaxation circuit comprising the auxiliary condenser 33, the resistances or induction coils 35, the charging battery 34 and the neon lamp 36, is coupled through the transformer 42 to the grid circuit of the three-electrode tube 38 whose anode circuit acts, for instance through the transformer 41, on the condenser 39 which sets up the disturbances that travel through the transparent body.

Lastly Figure 10 shows how it is possible to use for the same purpose a four-electrode tube 43 for constituting the relaxation circuit. One could also use, instead of this tube, two three-electrode tubes like in Abraham's multivibrator.

Figure 9 represents an arrangement particularly adapted for producing a train of waves similar to that due to an oscillating discharge; the two tubes 44 and 45 mounted as oscillators, give rise to oscillating variations of potential in the condenser 39 acting upon the dielectric.

These oscillations cannot, however, be produced normally by reason of the negative potential given to the grids by the battery 46. When the auxiliary condenser 33 charged by this battery, is discharged through the neon lamp 36, the latter becomes conductive and the grids are connected through it to the feeding battery and biased by the battery 47. Oscillations are set

up, but only last as long as the lamp 36 remains lit.

The above diagrams are given by way of example; they may be modified or replaced by others allowing similar results to be obtained, without departing from the invention.

The arrangement represented as a whole in Figure 2 and described at the beginning of the description may be considerably simplified. One may, first, take for the transparent body 13, a body acting at rest (i. e. in the absence of deformations) as polarizer; in this case, the polarizer 12 becomes useless, provided that the transparent body 13 and the analyzer 14 be disposed in such a manner with respect to one another that the analyzer 14 extinguishes all the light rays passing through the body 13 in the absence of an elastic wave. Similarly, by choosing for the body 15 a body which is such that it may serve as analyzer, one may do away with the analyzer 16 provided the parts 15 and 14 are placed conveniently with respect to one another.

Figures 10 and 11 respectively represent a simplified transmitter and a simplified receiver as explained. The emitter comprises an optical system 0, designed to protect the image in parallel light rays, two transparent bodies 102 and 104 inside which elastic waves travel in two directions normal to one another, these bodies being separated by the analyzer 103, a lens 106 concentrating the light leaving the device, on to the photoelectric cell 105, and a device 107 in which the carrier wave is modulated by the current of the cell 105.

The receiver comprises a source of light 109, an optical system 110 concentrating the beam of light on to a Kerr cell 120 modulating the intensity of this beam under the action of the current which it receives from the receiver of wireless waves 123. A lens 121 transforms the light whose intensity is modulated and which comes from the device 120, into a beam of parallel rays 122. The two transparent bodies 124, 125 inside which travel the elastic waves 126, 127 are separated by the analyzer 128; the displacement of the elastic waves is controlled by devices 130, 131 which will be described later, connected to the receiver 123 and ensuring the synchronism of the travelling of the elastic waves at the emitter and at the receiver. The beam of light thus modulated by the emitter current, comes out of the transparent body 125 and sweeps a screen on which the picture is reproduced.

The transmitter system may further be simplified by uniting the sensitive cell and the medium 105 into one sole element. In this way it is possible to suppress the optical system 106 (Figure 10) and increase the optical efficiency of the system.

Figure 12 shows the corresponding transmitter comprising an airtight space 141 empty or filled with a gas at a suitable pressure. One of the walls is constituted by the surface 142 of the second transparent body 134 in which the elastic wave 135 travels; an electrode 136 of the cell is constituted for instance by potassium supported on a plate 137, the other electrode being in the form of a ring fixed to the face 142 of the transparent medium 134. Instead of using a photoelectric cell, one may also use a photo-resistant cell, for instance a selenium cell. Figure 13 shows such a device. In this device 140 is a selenium plate applied against the face 142 of the transparent medium 134 and connected to

the transmitter 139. 135 is the elastic wave travelling inside the medium 134.

Figures 14 to 16 illustrate a form in which the media 102 and 104 and the analyzer 103 of Figure 10 are united and in which the cell is fixed to the medium in which the elastic waves travel, as in the case of Figure 12 or 13. This new device comprises neither the use of polarized light nor that of an analyzer.

In order that the light shall act upon a photoelectric cell, it is necessary that the difference of potential between the electrodes, i. e. that the electric field inside the medium exceeds in algebraical value a certain given value. The device of the Figures 14 and 15 is based on this fact.

The device according to these figures comprises a piezoelectric body 143 whose electrical axis is set and inside which the elastic waves travel in two directions making with each other a certain angle, for instance a right angle, and crossing one another over a small surface 146, 147, 148, 149 (Figure 14), these waves being set up by means of two condensers 80, 81 fixed, by one of their armatures, respectively to two lateral faces at right angles of the transparent body 143. A photoelectric material is placed on the external surface 150 of the piezoelectric medium 143 which may, if desired, be covered by a metal layer constituting an electrode sufficiently thin to be transparent to light. If such a layer does not exist, the electrode which replaces it may be constituted, as shown on the figure, by a ring 153, 154 of convenient form surrounding the surface 150. The other electrode 155, parallel to 150, is covered with a matter which is sensitive to light, for instance potassium, sodium or the like. These electrodes are connected to suitable parts such as a battery and a potentiometer 156 and 157.

The adjustment of the device is carried out in such a way that:

(1) In the absence of elastic waves in the medium 143, the cell does not give out any current (the "darkness current" relative to the electric field existing between the two electrodes 153, 155 being neglected);

(2) The field between the electrodes is higher than the lower working limit only in the region 151, 152, 153, 154 where the two elastic waves cross each other; in front of this region common to the two waves, the field is, indeed, stronger due to the piezoelectric charge developed in this place on the face 150 of the transparent body under the effect of the resultant mechanical deformation produced by the two elastic waves. The cell therefore produces a current that corresponds only to the quantity of light passing through the surface 151, 152, 153, 154. This small surface element sweeps the whole of the surface of the picture to be transmitted, due to the displacement of the waves 144 and 145, thus producing the emission of the picture.

At the receiver, the apparatus used is similar to the one just described in relation with the transmitter. It is represented on Figure 16. In this arrangement one piezoelectric medium 158 is traversed by two elastic waves at right angles 144 and 145, as represented in the transverse section of Figure 14; the current, transmitted by wire or by wireless waves, is amplified by 159 which is connected to two electrodes 160 and 161 comprising between them a medium such as a rare gas under reduced pressure capable of being illuminated under the action of an electric field when the latter rises over a certain value.

The electrode 160 is on the surface of the piezoelectric medium 161 which may be metallized.

The medium 158 being piezoelectric, the field in front of the region 146, 147, 148, 149, intersection of the two elastic waves 144, 145 is higher than in the other regions comprised between 160 and 161, due to the charge developed on the surface 160 under the effect of the mechanical deformation produced in this region by the two elastic waves. The two electrodes 160 and 161 are connected to a regulating device, such as a battery and a potentiometer 162 and 163 which enables the system to be adjusted in the following manner:

(1) The field E_1 produced by means of the potentiometer in the absence of a wave has a value such, that when the field E_2 is produced by the two elastic waves in a tube of force whose section is 146, 147, 148, 149, $E_1 + E_2$ is insufficient to produce the luminescence of the gas inside this tube.

(2) If x is the field produced between the two electrodes 160—161 by the current coming from the transmitter after having been amplified in 159, $E_1 + E_2 + x$ is higher than the field-strength causing the illumination of the gas. The sensitivity of the system is, therefore, increased by increasing the field E_1 as far as possible.

By causing the surface element, intersection of the two displacement waves to travel over the whole surface 160 in synchronism with the movement of the elastic waves of the transmitter, all the volume elements occupied by the gas are illuminated in succession, and this, with intensities proportional to the current transmitted from the transmitter, so that the various illumination of all the points of the picture at the transmitter station are well rendered, and the picture conveniently reproduced. Thus it is seen that the cell of this device plays at the same time the part of the source of light and that of the Kerr cell of Figure 11.

It should be remarked that the surface of intersection of the two waves does not necessarily present a uniform charge if the zone of transformation is constituted, as indicated above, by a train of waves, but the above result is still obtained, because, in certain points, the field exceeds the limit of ionization in the transmitting apparatus.

It is also seen that the simplified arrangement of Figures 14 to 16 may be utilized at the receiver or at the transmitter, even when the device at the other station is not similar to the one described, but is according to the embodiment represented by Figure 2.

In order to increase the sensitivity of the transmitting and receiving apparatus, an auxiliary electric or luminous radiation may be used whose effect will add to that of the light or to that of the electric field.

One of the difficulties in the realization of television apparatus is the maintenance of synchronism between the transmitter and the receiver stations. With the means at present available for radiotelegraphic or radiotelephonic transmissions, it is found that synchronism between the two stations may be maintained with sufficient precision during the interval necessary for the beam of light to explore once the totality of the picture, and that it is sufficient, after each exploration, to perform a correction in order to re-establish the synchronism, in the same way as this is done in numerous telegraphy apparatus, in order that the errors at the end of each exploration shall not be allowed to accumulate

and finally produce serious deformations of the transmitted picture.

It is obvious that things could also be arranged in such a way that the electric current acting upon the condenser that produces the deformation in the transparent medium of the transmitter shall be transmitted to the receiver where it also controls the device producing the corresponding disturbance.

Figs. 17 and 18 show, also schematically and by way of example, the devices permitting after each sweeping, for instance at each $1/18$ th of a second to stop for a very short time, for instance $1/100$ th of a second, the devices producing the disturbances, both at the transmitter and at the receiver, these devices beginning their operation again simultaneously, the effects of the slight discrepancies in the movement of the exploring and the reproducing beam, produced during the previous exploration being thus rendered ineffective on the next exploration.

In Fig. 17 which represents schematically the essential part of a transmitting station, the circuits 51 and 52 comprise condensers 53 and 54 each one of which acts upon one of the transparent bodies, such as those represented in 13 and 15 on Figure 1, neon lamps and induction coils or resistances, these relaxation circuits being inserted in the anode circuits of the tubes 55 and 56; the grids of these tubes are connected to a third relaxation circuit 57, also containing a condenser and a neon lamp, adjusted in such a manner that its condenser is discharged after each sweeping of the picture, for instance after every $1/18$ th of a second, the duration of the discharge being very short, for instance $1/100$ th of a second. During this discharge, the potential of the grids of the tubes 55 and 56 attains a value such that the neon lamps of the circuits 51 and 52 remain lit and that, consequently, the operation of these circuits is interrupted. As soon as the neon lamp of the circuit 57 is out, things will be again in their original state and the condensers of the circuits 51 and 52 will simultaneously start being charged, even if, at the end of the previous period there has been a slight time-lag of one condenser with respect to the other, time-lags which would have otherwise accumulated during the successive charge and discharge periods of the condensers. The arrangement provides, as it is seen, a sort of return to zero device; in order that this return to zero shall be produced at the same moment at the receiver, the circuit 57 acts upon the grid of a third tube 58 coupled in any suitable manner, for instance by means of transformers 59 with the radio or other transmitter ensuring the communication between the two stations in the case of wireless transmission, or with the line connecting the television emitting station with the radio (or other) transmitter.

The receiver is provided with a device similar to the preceding, for instance that represented in Figure 18; it comprises two circuits 61 and 62 each of which contains a condenser 63 or 64 acting on one of the transparent media, these circuits being fed by the anode currents of the tubes 65 and 66, the grids of which are controlled by the circuit 67 also comprising a neon lamp and a condenser. This circuit is adjusted so as to be acted upon and to act in turn on the grids only when it receives through the line 59 the current corresponding to the current emitted at the receiver by the tube 58.

These diagrams have been represented only

for the sake of example and may be very considerably varied; one could also use for synchronizing, currents obtained mechanically by means of tuning forks, rotating contacts and the like.

The synchronization may also be obtained by using a device in which the gas lamps, for instance neon lamps, constituting part of the relaxation systems producing the elastic waves, and the synchronizing system of the said lamps act by their light emission directly on the transmitting photoelectric cell. One may also send, without any additional intermediate part, currents to the receiver, which are directly utilized for producing elastic waves synchronously with those of the transmitter, or for synchronizing only the special synchronizing cell. Figure 19 shows a device of this type.

In this Figure 19, 164 is the medium in which is propagated the wave 165 emitted for instance under the action of a condenser formed by a semi-conductor 166 in contact with a conductor 167. This arrangement forms a condenser of very small thickness excited by a relaxation device 168. The device of automatic emission of the wave comprises a slot 169, a source of light 170 emitting a beam of rays which are rendered parallel by the optical system 171, and placed in such a way that the rays are parallel to the plane of the elastic wave 165; these rays are polarized by means of the polarizer 172 and analyzed by the analyzer 173, placed after the slot 174 and set at right angles with the polarizer 172 in order to extinguish normally the rays issuing through 174. In front of the analyzer is disposed a photoelectric cell 176 connected to an amplifying device 175 and to the relaxation system 168 arranged in such a way that an impulse of current before the cell 176 brings about the emission of an oscillation in 168 and consequently the emission of an elastic wave in the medium in which it travels. The operation of the device will be easily understood.

When a first elastic wave is emitted, it arrives at a certain moment in front of the source of light 170, it modifies the light on its course, causes the appearance of light beyond the analyzer 173. This light penetrates inside the photoelectric cell 176 thus producing the emission of the next elastic wave through the intermission of 175. The time interval separating two successive elastic waves therefore depends on the distance separating the beam of rays passing through the slot 169 from the lower face of the transparent body where the elastic wave is emitted. This interval of time may be adjusted very simply and with great precision by adjusting the position of the slot 169. An adjustment carried out once and for all will suffice.

The current producing the emission of each elastic wave may just as well be emitted by the cell serving for the transmission of the current corresponding to the illumination of the various points of the picture, since, at the moment when the current producing the emission of an elastic wave is sent out, no illumination signal is being transmitted and consequently there cannot be any interference between these two sorts of currents.

What I claim is:

1. In an apparatus for the electric transmission of pictures or the like, a light controlling device for decomposing and recomposing the picture, comprising a body in the form of a rectangular transparent, continuous, homogeneous parallelepiped, having in all its points the same physical

properties in its normal state, and optical properties changing in the same manner in every volume element submitted to a same mechanical stress, means for causing the rays of light to fall perpendicularly on one face of said body, and means for applying to one of the lateral faces, parallel to the rays of light, an elastic disturbance in such a manner that it gives rise to a wave motion of plane elastic waves travelling through said body and creating mechanical stresses in the interior of the movable zone occupied by the said wave.

2. In an apparatus for the electric transmission of pictures or the like, a light controlling device for decomposing and recomposing the picture, comprising a body in the form of a rectangular transparent, continuous, homogeneous parallelepiped, having in all its points the same physical properties in its normal state, and optical properties changing in the same manner in every volume element submitted to a same mechanical stress, means for causing the rays of light to fall perpendicularly on one face of said body, and means for subjecting one of its lateral faces, parallel to the rays of light, to a series of alternate displacements during very short time intervals separated by equal time intervals, so as to produce in the body narrow zones of mechanical deformation constituted by elastic waves with two fronts (the fore front and the aft front) limiting the deformed movable zone, travelling one after the other through the body, remaining parallel to the said face and producing on their passage mechanical stresses.

3. In an apparatus for the electric transmission of pictures or the like, a light controlling device for decomposing and recomposing the picture, comprising one after the other on the path of the rays of light two bodies in the form of rectangular parallelepipeds, these bodies being transparent, continuous, homogeneous, having in all their points in their normal state the same physical properties, and optical properties changing in the same manner in every volume element submitted to a same mechanical stress, means for causing rays of light to fall perpendicularly on one face of each body, said faces being parallel to one another, means for subjecting, during very short intervals of time separated by equal time intervals, one of the lateral faces parallel to the rays of light, these two faces being perpendicular to one another, to a series of small alternate displacements in order to create, in each of the two bodies, a wave motion of plane elastic waves with two fronts (fore and aft front) limiting the deformed zone, travelling one after the other through each one of the bodies in two directions respectively normal to one another and producing on their passage mechanical stresses, means for extinguishing the rays of light passing through the said transparent bodies outside of the movable zones of deformation.

4. In an apparatus for the electric transmission of pictures or the like, a light controlling device for decomposing and recomposing the picture, comprising in succession on the path of the rays of light, a polarizer, two bodies in the form of rectangular transparent, continuous, homogeneous parallelepipeds, having normally the same physical properties in all their points and capable, under the effect of an interior stress, of polarizing elliptically plane polarized light, means for causing rays of light to fall perpendicularly to one face of each body, these two faces being parallel to one another, means for applying to one of the lateral faces of each one of the bodies parallel to the rays of light, said faces being perpendicular to one another, a series of elastic disturbances during a very short time at equal intervals of time, in order to form, in each one of the transparent bodies, two narrow zones of mechanical deformation constituting plane elastic waves limited by two planes parallel to the disturbed faces of each body and travelling in two directions respectively perpendicular with respect to one another, an analyzer placed between the two transparent bodies in a manner such that it extinguishes the polarized rays of light traversing the first body outside of the movable mechanical zone of deformation, a second analyzer placed after the second prismatic transparent body, in a manner such that it extinguishes the polarized rays of light traversing the second body outside the zone of mechanical deformation travelling through it.

5. In an apparatus for the electric transmission of pictures or the like, a light controlling device for decomposing and recomposing the picture, comprising one after the other on the path of the rays of light two bodies in the form of rectangular, transparent, continuous and homogeneous parallelepipeds, having normally in all their points the same physical properties, and optical properties changing in the same manner in every volume element submitted to a same mechanical internal stress, means for causing rays of light to fall perpendicularly on one of the faces of each one of the bodies, these faces being parallel to one another, two plane condensers constituted by a dielectric and two armatures, means for charging progressively these condensers and for realizing, at equal time intervals, an oscillating discharge, means for fixing each one of these condensers to a lateral face, parallel to the rays of light, of each one of the transparent bodies, these faces not being parallel to one another, in such a manner that the successive compressions and expansions of the dielectric due to the oscillating discharge are transmitted to the face of the transparent body on which is fixed the condenser, in order to produce a succession of narrow zones of mechanical deformation travelling through the said bodies, means for extinguishing the rays of light traversing at every instant these bodies outside of the movable zones of deformation travelling through them.

6. In a device for the electrical transmission of pictures or the like, a transmitting station comprising a light controlling device for decomposing the picture, consisting in a piezoelectric body in the form of a rectangular continuous, transparent, homogeneous parallelepiped having in all its points the same physical properties, and optical properties changing in each volume element submitted to a same mechanical stress, means for causing the light to fall normally to one face of the body, a photoelectric cell constituted by an air-tight space adjacent to the exit face of the rays of light traversing said body, on this face a layer of metal sufficiently thin to be transparent constituting the anode, on the wall of the cell opposite this face, a layer of substance emitting electrons under the effect of light and constituting the cathode, two condensers each constituted by two metal armatures and a dielectric, means for charging progressively these condensers and for obtaining, at regular time intervals, an oscillating discharge, means for fixing one of the armatures of one of the condensers to one lateral face, parallel to the rays of light, of the piezoelectric

7. In an apparatus for the electric transmission of pictures or the like, a light controlling device for decomposing and recomposing the picture, comprising one after the other on the path of the rays of light two bodies in the form of rectangular transparent, continuous, homogeneous parallelepipeds, these bodies being transparent, continuous, homogeneous, having in all their points in their normal state the same physical properties, and optical properties changing in the same manner in every volume element submitted to a same mechanical stress, means for causing rays of light to fall perpendicularly on one face of each body, said faces being parallel to one another, means for subjecting, during very short intervals of time separated by equal time intervals, one of the lateral faces parallel to the rays of light, these two faces being perpendicular to one another, to a series of small alternate displacements in order to create, in each of the two bodies, a wave motion of plane elastic waves with two fronts (fore and aft front) limiting the deformed zone, travelling one after the other through each one of the bodies in two directions respectively normal to one another and producing on their passage mechanical stresses, means for extinguishing the rays of light passing through the said transparent bodies outside of the movable zones of deformation.

tric body, means for fixing one of the armatures of the other condenser on a second lateral face of the piezoelectric body, parallel to the rays of light, but perpendicular to the first, in such a manner that the successive compressions and depressions of the dielectrics due to the oscillating discharges are transmitted to the corresponding lateral faces of the transparent body in order to produce elastic waves with two fronts travelling in a direction parallel to these faces in directions perpendicular to one another, means for applying a biasing potential to the anode of the cell, this potential being lower than the limit of operation of the cell, means for adjusting the amplitude of the oscillating discharge in such a manner that the potential resulting on one hand from the charge developed on the piezoelectric body under the effect of the elastic waves and, on the other hand, from the biasing potential, is such that the stream of electrons passes only between the cathode and the portion of the anode which is common at any instant to two trains of movable elastic waves, when this portion is sufficiently illuminated.

7. In an apparatus for the electric transmission of pictures or the like, a receiving station comprising a device for receiving and amplifying the modulated current from the transmitter, a device for recomposing the picture, comprising a piezoelectric body in the form of a rectangular continuous, homogeneous parallelepiped, two condensers constituted each by two metal armatures and a dielectric, means for charging progressively these condensers and for obtaining, at regular time intervals, an oscillating discharge, means for fixing one of the armatures of one of the condensers on one lateral face of the piezoelectric body, means for fixing one of the armatures of the other condenser on a second lateral face of the piezoelectric body perpendicular to the first, in such a manner that the successive compressions and expansions of the dielectric due to the oscillating discharges are transmitted to the corresponding lateral faces of the transparent body in order to produce the trains of elastic waves travelling in directions parallel to these faces, an air-tight space filled with gas at a suitable pressure, adjacent to one face of said piezoelectric body perpendicular to the two said lateral faces, on this face and the wall opposite the space filled with gas, a metal layer sufficiently thin to be transparent, means for connecting the receiving device to these metal layers, means for applying a biasing potential to one of the layers and means for adjusting the amplitude of the oscillating discharge of the condensers in such a manner that the potential resulting on one hand from the electric charge developed on the face of the piezoelectric body under the effect of the passage of the elastic wave and on the other hand from the biasing potential is such that the illumination of the gas takes place only in front of the portion common to the two elastic waves when a poten-

tial coming from the transmitter is applied between the two metal layers acting as electrodes, this potential serving for modulating the illumination of the gas.

8. In an apparatus for the electrical transmission of pictures or the like, a light controlling device for decomposing and recomposing the picture, comprising a transparent, continuous, homogeneous body, having normally in all its points the same physical properties, and whose optical properties change in the same manner in every volume element submitted to a same mechanical stress, means for causing the light to fall perpendicularly to one of the faces of the said body, means for applying to one lateral face of this body, parallel to the rays of light, at regular time intervals, during a very short time, a series of successive elastic disturbances, in such a manner as to produce a wave of mechanical deformation travelling through this body in a direction normal to said lateral face, and producing mechanical stresses in the interior of the movable zone occupied by the said wave, a medium placed against that one face of each transparent body which is opposed to the disturbed face emitting the elastic wave, the plane surface of separation between said medium and the transparent body making with the direction of propagation of the elastic wave an angle of total refraction, in this second medium absorbing surfaces disposed so as to reflect the elastic waves, each reflection damping the waves.

9. In an apparatus for the electrical transmission of pictures or the like, a light controlling device for decomposing and recomposing the picture, comprising, on the path of the rays of light, a body in the form of a rectangular transparent, continuous, homogeneous parallelepiped, having normally in all its points the same physical properties, and optical properties changing in the same manner in every volume element submitted to a same mechanical stress, a condenser constituted by two armatures and a dielectric, a neon lamp connected in parallel with this condenser, adjustable means for progressively charging said condenser until the difference of potential between its armatures is sufficient to produce the illumination of the neon lamp, means for producing an oscillating discharge at the moment this potential has been attained, means for fixing one armature of the condenser on one face of said transparent body in such a manner that the successive compressions and expansions of the dielectric during each oscillating discharge, are transmitted to the face of the transparent body to which is fixed the condenser, in order to produce a narrow zone of mechanical deformation travelling through the said body, and means for extinguishing the rays of light traversing the transparent body outside of the movable zone of deformation.

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