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METHOD OF AND APPARATUS FOR PICTURE TRANSMISSION

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METHOD OF AND APPARATUS FOR
PICTURE TRANSMISSION

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My invention relates to a method of, and appa-

ratus for, picture transmission, particularly for
television.

It has already been proposed in this art to

provide a so-called glow-cathode lamp panel,
broken or broken on the receiver side. The panel
consists of a series of glow lamps or glow tubes
comprising a plurality of glow gaps so arranged
that each lamp is coordinated to a given element
of the picture.

It is an object of my invention to increase the
light intensity of the transmitted picture. To this
end and in accordance with my method, I

effect after-glowing of the several lines after
the controlling current impulse has ceased, so
that the line which has been excited by the sig-

nalling impulse retains its intensity for a certain
predetermined length of time.

Preferably I so perform my method that the
series of lamps in the lines which continue to glow
are quenched before the new impulse arrives.

For example, in reducing my invention to prac-
tice I connect an initial lighting voltage prefer-
ably in parallel with the several lines of glow
lamps. This bias voltage alone is not sufficient
for ignition of the lamps since ignition should
actually be produced or effected by the arriving
current impulses which are distributed to the
several lines. When the glow dis-
charge once occurs it continues until it is
quenched by a special glow quenching means be-
fore a new control impulse arrives.

When, for instance, the picture is explored or
keyed fifteen times per second on the sender side,
a new distribution of light and dark must occur
on the receiver side after each fifteenth of a sec-

ond. Consequently, the arrangement may be
such that after one fifteenth of a second the control
current for all glow lines is cut out at the
same time, and immediately cut in again so that
a fresh ignition of the several elements of the
picture is effected by the new impulses.

When the complete system is quenched at the
same time, as described, the intensity is different
in the several elements of the picture as the lines
that had been ignited first glow longer than those
ignited later. Preferably, therefore, the several
elements of the picture are quenched in a se-
quential manner a short time before the arrival
of the new signal impulse. Obviously initial
voltage is provided in this case as well.

The problem of quenching and reigniting the
glow lamps in this manner may be solved in va-
rious ways, for instance, by means of a selector
operator with a given lag with respect to the
selector which cuts in the several elements. The
auxiliary ignition by a synchronous distributor
may be brought to act on the several glow lines
by inductive means or by auxiliary electrodes.

It is another object of my invention to improve
a picture obtained. The picture usually ob-
tained is merely a black and white reproduction
without mezzo tones, but I have found that the
mezzo or half tones may be obtained by igniting
the darker elements of the picture at a slower
rate in proportion to their darkness.

For instance, if the complete picture is analyzed
or keyed eighteen times per second, I control
the apparatus in such a way that the lines corre-
sponding to the lightest parts of the picture are ignited at the
maximum rate of eighteen per second. Those
lines on the receiving panel corresponding to the
darker parts of the transmitted picture are ignited
at correspondingly lower rates, say nine or six
times per second, and for the darkest elements
of the transmitted picture no ignition will occur
in the receiver glow lamps.

The principle of this variation in the ignition
period is that the rate of ignition for the several
glow lines of the board is proportioned to the
lightness or darkness of the picture elements so
that when the receiver panel is viewed the im-
pression of a toned picture is obtained.

In reducing this invention to practice I provide
means for effecting a rhythmic variation of the
sensitivity of the transmitting part. When a
photo cell is employed at the sender end, suitable
means, for instance, periodic optical screening,
may be provided in such a manner that only the
lightest parts of the picture obtain sufficient con-
trol voltages for the signals to be transmitted
under all conditions, while the less light parts do
so only when the screening of the light from the
photocell is less, and the still darker elements at
a still less intense screening. In this manner
signals of equal intensity are transmitted but less
frequently from the several parts of the picture,
as a function of the periodically varied screening,
and the ignition of the several glow lines of the
board occurs at various intervals.

The above explanation is given only as an ex-
ample for illustrating the principle. In practice
it is preferable not to vary periodically the light
intensity which serves for controlling but to vary
the amplifiers so that, for instance, their sensitiv-
ity is varied periodically by regulating the initial
voltage.

An apparatus of this kind may be arranged as
follows:
The intensifiers or relays which emit the send-

...
ing impulses only operate when the saturating current is flowing in the anode circuit of an electrode tube. The result is that the initial grid voltage is varied in this tube, the saturating current will occur at various intensities of the grid voltage which in turn is controlled by the parts of the picture. By periodically regulating the sensitivity of such a tube, that is, by varying periodically the grid voltage, signals will be emitted at any keying for the lightest parts and consequently at minimum sensitivity of the tube, while the darker parts are able to emit signals only at the periods of increased sensitivity.

An example selected above, 18 complete picture signals will be emitted from the lightest parts of the picture per second and 18 complete ignitions will be effected per second. Nine signals only will be emitted from a given half tone, six from a tone that is darker still, and none from the darkest parts of the picture during the same time interval.

An arrangement of this type may obviously be varied in many ways without departing from my invention. For instance, the resistance to leakage may be varied, or any other of the factors influencing the amplification or sensitivity of an electrode tube, may be influenced periodically. The transmitting part, the sensitivity of which is varied periodically, need not necessarily be on the sending side, as assumed in the example specified, but may also be on the receiving side. When the picture is transmitted from the sending side by modulation of a carrier impulse in proportion to the difference in intensity, the impulses received are of various intensities in proportion to the lightness of the parts of the picture concerned. Consequently the transmitting part of variable sensitivity may be employed in this case as well and therefore the number of ignitions per second may be varied in proportion to the intensity of the parts of the picture.

In the accompanying drawing an apparatus in which my method may be performed is illustrated diagrammatically by way of example.

The system illustrated is a sender of the normal television type in which the elements of the picture are transmitted synchronously with the splitting-up on the receiver side in that succession which results from the arrangement of the surface lamps of the panel board on the receiver side. The panel board may, for example, be provided with fifty lines of fifty lamps each, corresponding to 2500 surface units of the picture, and then it may be assumed, for example, that the said 2500 surface elements are transmitted 18 times per second. For convenience of illustration, only a minor part of the lamp equipment has been shown, to wit, five lamps each from the first three rows numbered 1 to 5, 51 to 55, and 101 to 105, but it will be obvious as to how the remaining lamps may be connected.

According to my invention, each lamp is equipped with an anode 6, a cathode 7 and an auxiliary electrode 8. The lamps produce a glow in consequence of a glow discharge at the cathode 7. If the lamp is filled with neon the glow appears to be of an almost transparent nature. The discharge is adapted to be controlled without lag, as required by the object of this invention.

Numerical 23 represents a source of direct current of such voltage that it cannot of itself effect a discharge between the anode 6 and the cathode 7. It is possible to maintain a discharge between the cathode and anode after an igniting voltage has been conducted to the cathode 7 past the auxiliary electrode 8. When the igniting current ceases current will continue to flow from the source 23 past the anode 6 and the cathode 7, and a resistance 9 in series with each lamp of the board, until this principal circuit is broken by the rotary change-over switch 13, 14.

All of the auxiliary electrodes 8 and other parts are connected to the receiving amplifier, of which the last tube is shown at 11, at a rate which is determined by synchronous operations. The rotary change-over switch 10 for keying the picture at the sender. The ignition-change voltage which is supplied by a transformer in the anode circuit is consequently closed in succession across the several lamps of the board. It will only be present, however, when on the sender side a part of the picture of corresponding lightness is keyed, and will not be present when the part is dark. All lamps of the panel board which are coordinated with the elements of the picture which are also dark in the picture at the sender will not glow while all lamps which correspond to light elements in the picture will produce a glow discharge. All receiver lamps which are ignited in this manner and which have thus become light elements of the received picture will continue to glow due to voltages supplied from source 23, until the rotation of the rotary change-over switch 13, 14 interrupts their main circuit by the movement of a rotary insulating part 15 in the rotary part 14 moving past the segment connected with the particular line of lamps. It follows that the change-over switch 13, 14 rotate at the same speed as the commutator 10, and eighteen times per second when the picture is transmitted at that particular rate. The lamps of the board are quenched in complete rows or lines at the same time, and not separately by the change-over switch 13, 14. This is preferable for amplifying the switch 13, 14 as compared with an arrangement which breaks the circuit of each separate lamp. The small graduation of the tinging of the picture which is the result of the simplification in switching is imperceptible.

To obtain intermediate tones the ignition voltage is varied periodically. This has the advantages that special expedients in connection with the sender are not required so that the sender is able to operate quite quantitatively with respect to the transmission of variations in the tone by the photo cell. The variation of the amplification on the receiver side is achieved by designing the last amplifier tube 11 (the variation may as well be effected by another tube or in the coupling between tubes) as a space-charging grid tube, that is, a tube which contains a space-charging grid 21 in addition to the control grid 22. The voltage for the space grid 21 is tapped at a potentiometer 20 and varied by a rotary switch or distributor 16 which upon its rotation cuts in three distinct steps of voltage as will be understood by those skilled in the art. The switch 16 rotates at a definite rate with respect to the switches 10, 13, and 14, and, in the present case, not at 18 revolutions per second but at six, that is, at one third the speed of the switches 10, 13, 14. Consequently, for the reddish-yellow color of a picture, that is, within one-sixth of a second, the voltage at the space grid 21 is changed three times and thereby the ignition voltage supplied by the transformer 12 for the lamp panel or board is also varied. Now if at a given point in the picture to be transmitted the element is very light while the switch 16 performs one revolution, the signal received will be very strong and will be sufficient.
for all three voltages of the space grid for generating at the transformer a sufficient ignition voltage for the lamp concerned. When the element is less light the lamp will not be ignited for the lowest space grid voltage so that the lamp will be ignited only twice during three transmissions of the picture. If the element is darker the lamp is ignited only a single time during each revolution of the switch, that is, during three transmissions.

In this manner the lightness or varying intensities of light and shadow on the elemental areas of the picture surface is graded in four distinct stages, which may be very light, light, dark and very dark, corresponding to three, two, one, or no ignitions of the glow lamps for each three transmissions within one-sixth of a second.

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

1. A system for reproducing transmitted pictures by igniting a cluster of glow lamps arranged on a panel board in a sequential manner in accordance with received signal energy impulses varying in intensity by values proportional to the varying intensities of light and shadow on elemental areas of a transmitted picture, the method of producing half-tone effects in the received picture which consists in maintaining the glow from each of the glow lamps for a predetermined time period after the cessation of signalling impulses producing the initial glow, and in changing the number of ignitions of each of the lamps per unit time period in accordance with the intensity of light and shadow of elemental areas of the original picture to be represented by the coordinated lamps.

2. The method of reproducing transmitted pictures which consists in sequentially producing glow discharges along predetermined lines in a reproducing panel in accordance with received signalling impulses, in maintaining the glow produced for a substantial portion of the time interval between successive signalling impulses, and in varying the number of ignitions for each unit area of the reproduced picture within a predetermined time period in accordance with the varying intensity of light and shadow on the transmitted picture.

3. The method of reproducing pictures which consists in sequentially igniting a series of glow lamps by a series of current impulses of intensities varying in proportion to the varying intensities of light and shadow on elemental areas forming the transmitted picture, in maintaining the glow produced for a predetermined time period between successive signalling impulses for like picture areas, and in reducing the number of ignitions of the lamps per unit time interval in accordance with decreasing light intensities on elemental areas of the transmitted picture areas.

4. A method of recording pictures with a series of glow lamps arranged in a plurality of adjacent lines which consists in sequentially igniting the glow lamps of each of these lines in accordance with received signalling impulses varied in accordance with the intensity of light and shadow on elemental areas of a transmitted picture represented by the glow lamps, in maintaining the ignition of said lamps after ignition by the received signalling impulses, in quenching the glow from each of the lamps a predetermined time interval prior to the arrival of successive signalling impulses representing like areas of the picture, and in varying the number of ignitions of each of the lamps within a given time in accordance with the varying tone intensity of the particular elemental picture area represented by each of the lamps.

5. A method of recording transmitted pictures with a series of glow lamps arranged in a plurality of adjacent lines which consists in sequentially igniting the series of glow lamps of each of the series of lines in accordance with received signalling impulses varied in intensity in proportion to the varying intensities of light and shadow on elemental areas of a transmitted picture coordinated with and represented by each of the glow lamps, in maintaining the glow from said lamps for a substantial portion of the time interval between successive signalling impulses for like elemental areas of the picture, and in varying the number of ignitions of each of the lamps per unit time period in accordance with the varying light and shadow intensity of the particular picture area represented by each of the lamps.

6. A system for reproducing transmitted picture impulses which includes a plurality of glow lamps arranged in a line for line manner on a panel board, means for sequentially igniting each of said glow lamps in accordance with received signalling impulses, means for maintaining the glow in each of said lamps for a predetermined portion of the time interval between successive signalling impulses for igniting each of said lamps, and means for varying the number of ignitions of said lamps per unit period of time in accordance with the varying intensities of signal impulses representing varying intensities of light and shadow of the transmitted picture.

7. A system for reproducing transmitted pictures and the like which includes a plurality of glow lamps arranged in a plurality of adjacent lines corresponding in position to and coordinated with elemental areas of a transmitted picture, means for sequentially igniting each of said glow lamps in accordance with received signalling impulses, means for maintaining the glow in each of said lamps for a predetermined time period following the ignition due to signalling impulses, means for quenching each of said glow lamps in a line for line manner a predetermined time prior to the arrival of signalling impulses corresponding to the elemental areas represented by each of said glow lamps, and means for varying the time rate of illumination by each of said glow lamps in accordance with the intensity of light and shadow on elemental areas of the transmitted picture represented by each of said glow lamps.

8. A system for reproducing television transmitted pictures and the like which includes a plurality of glow lamps arranged to form a predetermined number of lines each composed of a predetermined number of lamps representing predetermined elemental areas of a transmitted picture, means for maintaining a biasing potential on each of said lamps of a value insufficient to produce ignition but sufficient to maintain ignition after ignition is once started, means for igniting each of said lamps in a sequential manner in accordance with received signalling impulses, means for quenching said lamps in a line for line manner a predetermined time prior to the arrival of signalling impulses corresponding to the elemental areas of the transmitted picture represented in accordance with received signalling impulses, and a space charge control amplifying tube for varying the number of ignitions of each of said lamps per unit period of time in accordance with the varying intensity of light and shadow on elemental areas of the picture.
transmitted picture represented by each of said glow lamps.

9. A system for reproducing television transmitted pictures and the like which includes a plurality of glow lamps arranged to form a predetermined number of lines each composed of a predetermined number of lamps representing predetermined elemental areas of a transmitted picture, means for maintaining a biasing potential on each of said lamps of a value insufficient to produce ignition but sufficient to maintain ignition after ignition is once started, means for igniting each of said lamps in a sequential manner in accordance with received signalling impulses, means for quenching said lamps in a line for line manner a predetermined time prior to the arrival of signalling impulses corresponding to the elemental areas of the transmitted picture represented by each of said lamps, and a space charge control amplifying tube for producing half-tone effects in the received picture by varying the rate of ignition of each of said lamps in accordance with the varying intensity of light and shadow on elemental areas of the transmitted picture represented by each of said glow lamps.

10. A system for reproducing transmitted pictures comprising means for receiving signals representing the varying intensities of light and shadow on elemental areas of a transmitted picture, a series of glow lamps arranged in panel formation, means for igniting said glow lamps in a sequential manner in accordance with received energy impulses, and means for varying the number of ignitions of each of the glow lamps within predetermined time periods in accordance with the intensity of the light to be represented by each of the elemental areas of the transmitted picture as determined by the received signals.

11. In a television system for reproducing transmitted pictures, a series of glow lamps each coordinated with elemental areas of the transmitted picture, means for igniting said lamps in a sequential manner in accordance with received signal energy impulses varying in intensity by values proportional to the varying intensities of light and shadow on elemental areas of the transmitted picture, and means for changing the number of ignitions of each lamp per unit of persistence of vision in accordance with the light intensity to represent each of the elemental areas of the transmitted picture by each of the individual lamps.

12. The method of producing half-tone pictures which comprises sequentially comparing a series of received signal energy impulses with a series of predetermined standards, and sequentially producing light energy of constant brilliance and of variable period in accordance with the differences between the transmitted signals and the predetermined standard.