

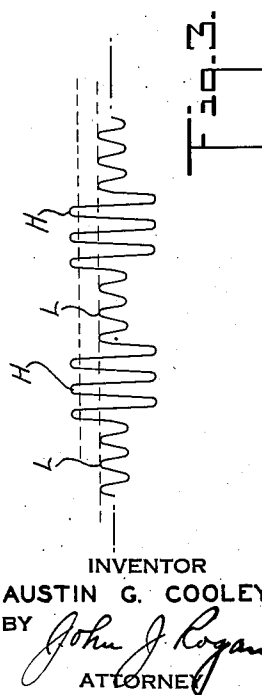
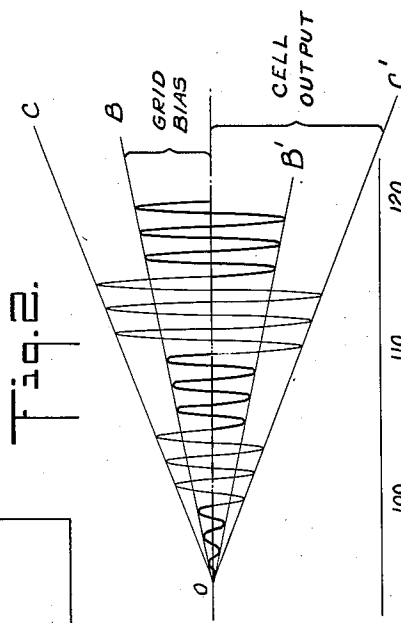
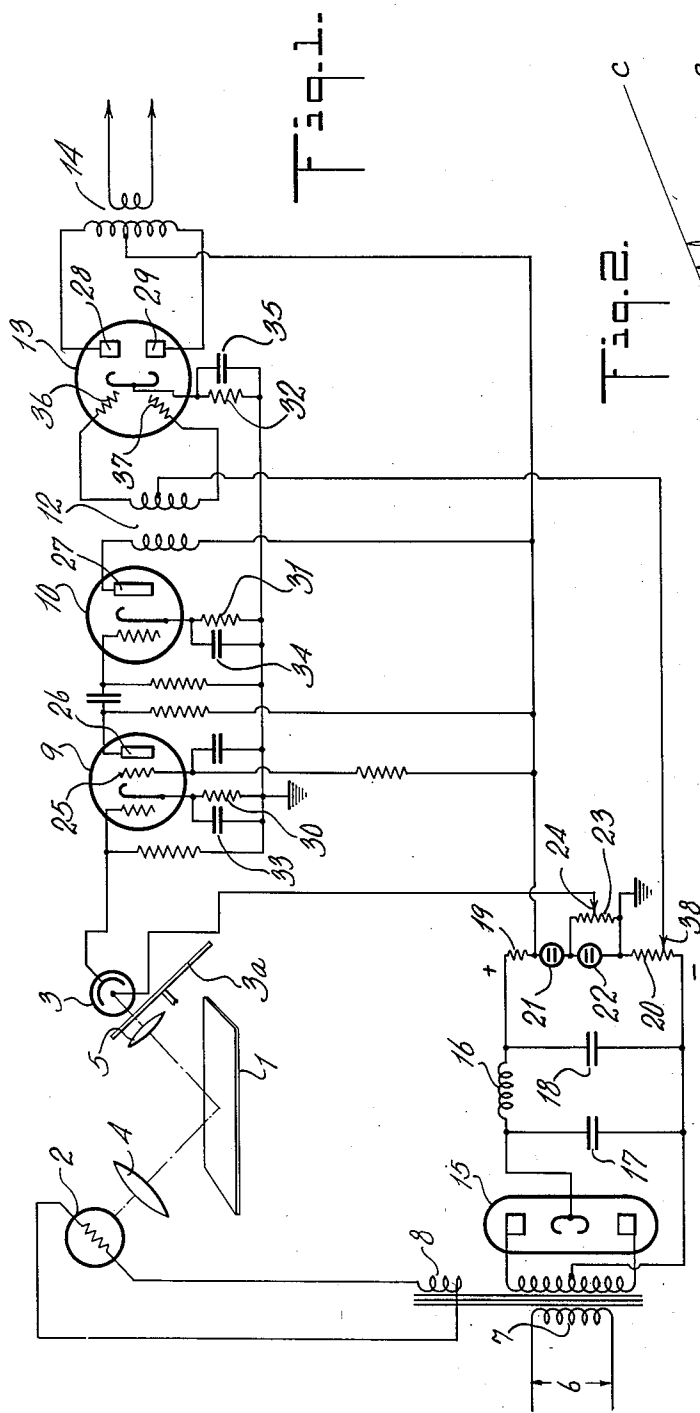
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ELECTRO-OPTICAL SIGNALING SYSTEM

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ELECTRO-OPTICAL SIGNALING SYSTEM

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12 Claims. (Cl. 178—7.1)

This invention relates to signaling systems and more especially to systems of the electro-optical type such as used in telefacsimile, telegraph and the like.

A principal object of the invention is to provide an improved light-photoelectric cell translator wherein the effects of variations in line voltage feeding the light source are compensated for.

Another principal object is to provide a transmitter for telegraph type signals such as "black" and "white" facsimile signals, wherein signal discrimination is a function of signal amplitude, and wherein the variations of the supply voltage for an exciter lamp controlling the generation of the signals, are prevented from interfering with the proper signal discrimination.

Another principal object relates to a light source-photoelectric cell translator and amplifier, wherein the light source is excited from commercial supply lines and the level of the amplified output is automatically adjusted in a predetermined ratio and is correlated to the departure of the said light source from a normal degree of brightness.

A feature of the invention relates to a power supply arrangement for a light source-photoelectric cell controlled amplifier, and having a novel form of voltage divider to compensate for abnormal variations in light source brightness.

Another feature relates to a system of recording signal conditions wherein one signal condition is represented by certain minimum wave amplitude and another signal condition is represented by a certain maximum signal amplitude, and wherein discrimination of signals is dependent upon a predetermined ratio between said amplitudes, the system being controlled by a light source and photoelectric cell amplifier and having special compensating means to prevent "background" noise or the like from interfering with the proper recording of the signal conditions even though the power supply to the light source should depart from a normal value.

A further feature relates to an improved line voltage compensating arrangement for a photoelectric cell controlled amplifier.

A further feature relates to a novel form of voltage divider.

A still further feature relates to the organization, arrangement and relative proportioning of parts which cooperate to provide an improved telegraph signal recording system such for example as a system for recording marking and spacing signals.

Other features and advantages not specifically

enumerated will be apparent after a consideration of the following detailed descriptions and the appended claims.

While the inventive concept is capable of utility and is adapted to a wide variety of signal transmitters, it finds its primary utility in systems of the type wherein the signals are of the marking and spacing type such as used in telegraph, facsimile and like apparatus. In one aspect the invention is in the nature of an improvement in the type of system disclosed in application Serial No. 397,513, filed June 11, 1941, now Patent No. 2,328,056, granted August 31, 1943. Inasmuch as the invention is concerned mainly with a photoelectric cell controlled amplifier and power supply therefor, only those parts of a telegraph system are shown and described as are necessary to teach one familiar with the art how to practice the invention. Accordingly, in the drawing,

Fig. 1 is a composite schematic-circuit diagram embodying features of the invention.

Figs. 2 and 3 are wave diagrams explanatory of the operation of Fig. 1.

There is described in application Serial No. 397,513, filed June 11, 1941, a system for recording facsimile subject matter in the form of "black" and "white," e. g., ordinary printed or written matter. In such a system, the "white" areas to be recorded are represented for example by signals above a predetermined minimum amplitude; while the "black" areas are represented by the absence of signals or by signals below said minimum amplitude. In such a system, the signal discrimination between "black" and "white" is a function of the ratio of the two signal amplitudes. One of the main advantages of such a "ratio" system is that the amplifiers can be adjusted so that the effects of the "background" noise in the amplifier or associated equipment can be substantially eliminated or suppressed so far as its effect on the recording is concerned. This is particularly true in those systems where the "marking" signal (e. g., a "white" area signal) is only effective when the signal amplitude is above a certain minimum value. The maintenance of the proper minimum ratio between the mark signal and the background noises or between the mark signal and the space signal, if a space signal is being transmitted, is very important in recording correct copy of "black" and "white" subject matter. Various methods of securing the desired ratio are known to the art, including for example many well-known methods of level and volume control in the signal ampli-

fier. However, I have found that even when these conventional volume controls are employed, there is still a possibility of false recording should the exciter lamp or its equivalent, vary in brightness during signal recording. This is especially true in the case of photoelectric cell controlled amplifiers wherein the exciter lamp is energized directly from the commercial supply lines which lines may be subject to voltage changes. Consequently with such known arrangements, if the level of the amplifier is adjusted for a given normal brightness of the exciter lamp to produce a certain A. V. C. signal, the rate at which the A. V. C. signal varies may not be sufficient to compensate for the rate of variation of brightness or the effect of such variation of brightness on the recorded copy. In other words, the law of variation of the A. V. C. may not be properly correlated to the law of variation of the exciter lamp brightness versus supply voltage variation. I have devised a novel form of level control and voltage divider for such systems whereby the rate or percentage of variation of the A. V. C. on the output level of the amplifier can be matched or correlated to the variations in exciter lamp brightness so that false recording of blacks and whites is substantially eliminated.

Referring to Fig. 1, there is represented by the numeral 1 a subject matter to be transmitted, and merely for illustration this subject matter may be in the form of a tape or web on which the intelligence is printed or written. The tape or web is adapted to be scanned in successive elemental areas as is well-known in the facsimile transmission art, and for purposes of simplicity, the scanning mechanism is omitted from the drawing. Associated with the scanning mechanism are the usual exciter lamp 2 and the photoelectric cell 3 with their respective optical systems 4 and 5. The electric signal from the cell 3 is in the known way a function of the light and shade characteristics of the successive elemental areas of the subject matter on tape 1 and the brightness of lamp 2. The lamp 2 is steadily energized by the current from the supply line 6 through transformer primary 7 and its step-down secondary 8. The brightness of lamp 2 is therefore a function of the line voltage and is adjusted so that its normal brilliancy is such that in cooperation with cell 3 it gives the required ratio of the response corresponding respectively to the black and white areas of the subject matter. Preferably, the light which reaches the cell 3 is interrupted by a rotating light chopper 3a whereby the response of the cell consists of a pulsating current of regular frequency having its amplitude modulated in accordance with the shade characteristics of the subject matter 1.

The response of cell 3 is amplified in any suitable electron tube amplifier which, in the drawing is shown as of the three-stage type wherein the amplifier tube 9 of the first stage is a resistance-condenser coupled to the amplifier tube 10 of the second stage. The second stage is coupled through transformer 12 to the output or push-pull stage 13. The output signal of stage 13 is then applied to transformer 14 to control any well-known form of telegraph or facsimile reproducer either locally or at a distance, it being understood that the recorder scans its recording surface in synchronism with the scanning of subject matter 1 as is well-known in the art.

The power for the various stages of the amplifier and for the cell 3 is derived from line 6 through the power transformer and full-wave rec-

tifier 15. The rectified voltage is smoothed out by any suitable filter comprising for example inductance 16 and shunt condensers 17, 18. The resultant smoothed D. C. is applied across a voltage divider which, according to the invention, consists of three sections in series. Two of these sections are constituted of resistors 19, 20, the voltage drops across which vary with the total load current drawn by the amplifier; while the third section comprises a pair of gaseous type voltage regulator tubes 21, 22, of any well-known type, which have the property of maintaining a constant voltage drop thereacross for variations in the variable voltage on line 6.

For the purpose of supplying a steady D. C. potential to the anode of cell 3, a potentiometer resistance 23 is connected across tube 22 and the adjustable arm 24 is connected to the anode of the cell. The high D. C. voltages for the screen-grid electrode 25 and for the plate electrodes 26, 27, 28 and 29, are taken off between the resistor 19 and tube 21. It will be observed that the cathodes of the tubes are returned to ground through their respective grid bias resistors 30, 31, 32, and their shunt condensers 33, 34 and 35, and that the junction between resistor 20 and tube 22 is likewise returned to ground. The control grids 36 and 37 of push-pull tube 13 are returned to ground through the arm 38 which is adjustable along resistor 20. Consequently, the grid-bias voltage of tube 13 is a function of the normal plate current of this tube which flows through resistor 32, and is also a function of the IR drop through the voltage divider resistance 20. I have found that by properly proportioning the values of resistors 19 and 20, with respect to the potential drop across tubes 21 and 22, it is possible to maintain the proper ratio between space and mark signals in the output of tube 13 so that the proper discrimination therebetween is maintained at all times and this discrimination is substantially independent of a comparatively wide change of brightness in lamp 2 resulting from a change of voltage on line 6.

As one possible explanation of this compensation, reference may be had to Figs. 2 and 3.

In Fig. 3, there are shown two signal conditions plotted against time, wherein the high amplitude waves H represent the response of cell 3 when a white area of subject 1 is being scanned, while the low amplitude waves L represent the response when a black area is being scanned. In order that there may be a proper discrimination in the record, it is necessary that there be a definite minimum difference between the black and white signals since otherwise the background noise or the like may reach into the region of the white signal amplitude. Furthermore, if the lamp 2 should increase in brightness, it may cause the normal cell response corresponding to black to be increased sufficiently to prevent proper discrimination between the black and white signals.

Since the recorder controlled by tube 13 must be rather sharply discriminating to the two amplitudes corresponding respectively to "white" and "black," it is necessary that the ratio of the two signal amplitudes be maintained constant even though the brightness of lamp 2 should accidentally vary. This relation is illustrated in Fig. 2 wherein the abscissae may represent voltage applied to lamp 2 and the ordinates may represent "cell response." The line OB represents the law of change of bias on grid 36 with a change in line voltage, and line OB' represents

the law of change of bias on grid 37 with change of line voltage. Thus, it will be seen that as the line voltage drops, the cell response drops because the brightness of lamp 2 is lowered. At the same time, the negative bias applied to grids 36 and 37 through resistor 20 is decreased in value, with a corresponding increase in the output of tube 13. In Fig. 2, the signal at any given lamp voltage corresponding to a black area is represented by the heavy black waves, while the signal for a white area is represented by the light or thin waves. Since for proper recording it is desirable to maintain a uniform fixed ratio between the white and black signal responses, the law of change of cell output for variable line voltages, with respect to the law of change of grid bias must be substantially uniform as represented by the lines OB—OC and OB'—OC'. This can be effected by properly proportioning the resistors 19 and 20 with respect to the voltage drop across tubes 21 and 22 and by adjustment of arm 38. As an illustrative example, it may be assumed that the plates of tube 13 are operated at a normal plate voltage of 300 volts; that the system is designed to operate with a normal voltage on the line 6 of 110 volts, and that for this condition the total voltage developed across 19, 21, 22 and 2, is 350 volts. Then the resistors 19 and 20 can be proportioned so that the drop across resistor 19 is for example 30 volts and the drop across resistor 20 is 20 volts, and therefore there is a steady voltage across tubes 21, 22 of 300 volts. Under this condition, a maximum of 20 volts negative bias can be applied to grids 36 and 37 by arm 38. If the line voltage should drop so that the total voltage across the voltage divider is only 325 volts, the drop across tubes 21 and 22 will still be 300 volts, leaving a balance of 25 volts to be divided between resistors 19 and 20. By proper proportioning of these two resistors therefore, the necessary law of change in drop across resistor 20 to compensate properly for the law of change in brightness of lamp 2 can be achieved. The same applies if the line voltage should rise above 110 volts.

It will be understood that if desired, the total grid bias applied to grids 36 and 37 may be such that the respective plate circuits of tube 13 pass current only when the marking or white signal amplitude H (Fig. 3) is applied. Consequently, the recording device will be operated to reproduce a "mark" signal or to reproduce a "white" area only in the region when the amplified cell response is between the lines OB and OC (Fig. 2). Consequently, the bias OB can be automatically adjusted so as to eliminate from the output of tube 13 the background noise which would be represented by the area between OO' and OB or between OO' and OB'.

While in the foregoing description, reference has been made to "white" and "black" areas, it will be understood that these are used in a relative sense and would include respectively dark and light areas, or areas which have a sufficient contrast in shade to be considered different for the purpose of signal production and transmission.

While one specific embodiment has been disclosed, it will be understood that various changes and modifications may be made therein without departing from the spirit and scope of the invention.

What I claim is:

1. In a system of the type employing an elec-

tron tube amplifier controlled by a light source-photoelectric cell combination, a source of voltage for energizing the light source, a voltage divider energized from said voltage source and connected to the electrodes of said amplifier, said voltage divider comprising a constant voltage section connected in series with a variable voltage section, and a connection from said variable voltage section to the control grid of said amplifier to vary the bias of said control grid in a predetermined law with respect to the law of change in brightness of said light source when the line voltage changes.

2. In a system of the type employing an electron tube amplifier controlled by a light source-photoelectric cell combination, a source of voltage for energizing the light source, a voltage divider energized from said voltage source and connected to the electrodes of said amplifier, said voltage divider comprising a pair of resistors whose IR drop varies in accordance with the load current of the amplifier and in series with said resistors a constant voltage device, means for applying the constant voltage across said device to the output electrode of said amplifier, and means to bias the grid of said amplifier from the voltage developed across one of said resistors.

3. In a signaling system of the type employing an electron tube amplifier controlled by an exciter lamp and photoelectric cell combination, a source of voltage for said lamp which source is subject to undesirable voltage variations, a D. C. voltage divider energized from said source, and having one section constituted of a variable IR drop resistor and another section constituted of at least one gaseous type voltage regulator tube, a connection from said voltage regulator tube for supplying a constant D. C. voltage to an output electrode of said amplifier, a connection from said resistor to the input control electrode of said amplifier, said resistor being proportioned so that the negative bias applied to said input electrode varies automatically in direct ratio to the variation of brightness of said lamp.

4. A system according to claim 3 in which said amplifier tube is also provided with a self-biasing arrangement whereby its grid is self-biased negatively in proportion to the average plate current flowing therethrough.

5. In a signaling system of the type employing an electron tube amplifier controlled by an exciter lamp and photoelectric cell combination, a power supply for said lamp, a self-biasing arrangement for the grid of said tube whereby said grid is negatively biased in accordance with the average plate current of said tube flowing therethrough and substantially independent of a wide range of variations in said power supply source, and another biasing arrangement for the grid of said tube whereby said grid is negatively biased in proportion to a change in brightness of said lamp.

6. In a signaling system of the type employing an electron tube amplifier controlled by an exciter lamp and photoelectric cell combination, a power supply circuit for said amplifier, said power supply circuit being fed from a supply line which is subject to undesirable voltage variation, means to energize said lamp substantially directly from said supply line, means to supply D. C. power derived from said line to said amplifier, the last-mentioned means including a voltage divider comprising at least one gaseous type voltage regulator tube connected in series with a variable IR drop resistor and with the point of connection between said regulator tube and said resistor connected to

ground, means to connect the output electrodes of said amplifier across said regulator tube, and means to connect the control grid of said amplifier tube to a point on said resistor whereby the total negative bias on said control grid varies in constant ratio to the variation in brightness of said lamp.

7. In a signaling system of the type wherein signals of two different amplitudes are transmitted to reproduce respectively two different signal conditions, e. g., marking and spacing, an exciter lamp, a photoelectric cell and means for varying the excitation of said cell from said lamp to produce said two signal conditions, an electron tube amplifier for said cell, and means to maintain a constant ratio between the two signal conditions in the output of said amplifier over a comparatively wide range of variation in brightness of said lamp, the last-mentioned means including a voltage supply for the amplifier having a section which is stabilized to remain uniform in voltage under different amplifier loads and another section which varies in voltage in accordance with the amplifier load, and means to adjustably connect said other section to the control grid of said amplifier tube.

8. A system according to claim 7 in which a potentiometer resistance is connected across said stabilized section, and a connection is provided from said potentiometer resistance to the anode of said cell.

9. A system according to claim 7 in which said amplifier tube is also provided with a grid self-biasing circuit which applies a negative grid bias to the grid in proportion to the average output current of said tube flowing therethrough.

10. In combination a lamp, a power supply line connected to said lamp, a voltage divider, a rectifier and filter connected between said line and said voltage divider, said voltage divider having two variable IR drop resistors connected in series with a gaseous type voltage regulator tube, at least one of said resistors being connected between the said regulator tube and the negative side of the rectifier, a voltage tap between said regulator tube and the positive side of the rectifier, and a ground connection on the negative side of said voltage regulator tube.

11. In combination, a photoelectric cell, an electron tube amplifier for said cell, a power supply circuit for said cell and amplifier, a voltage divider across said circuit, said voltage divider comprising a pair of gaseous type voltage regulator tubes connected in series with a resistance, means to connect the plate-cathode circuits of said amplifier across said pair of regulator tubes, means to connect the control grid-cathode circuit of said amplifier tube across said resistance, and means to connect the anode-cathode circuit of said cell across one of said regulator tubes.

12. In a system of the type employing an electron tube amplifier controlled by the combination of a photoelectric cell and a light source fed from a supply voltage, means to compensate for undesirable variations in brightness of the light source comprising grid bias means for the amplifier tube, and means to control said bias means jointly in accordance with the brightness of said light source and in accordance with the voltage applied to said light source.

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