Oct. 31, 1961 OSAMU NAKAGAWA ET AL 3,006,992

ELECTRONIC STENCIL CUTTER

Filed May 9, 1960

Fig. 1.

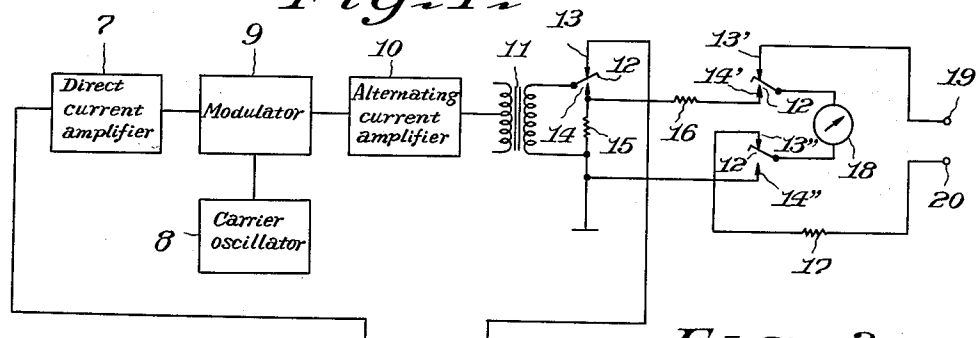
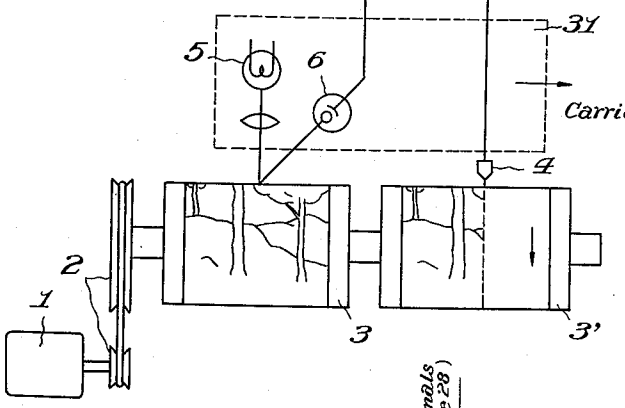


Fig. 3.



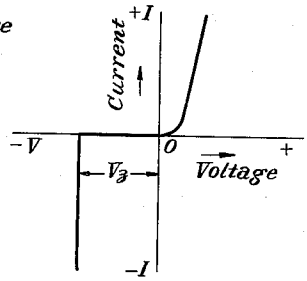


Fig. 2.

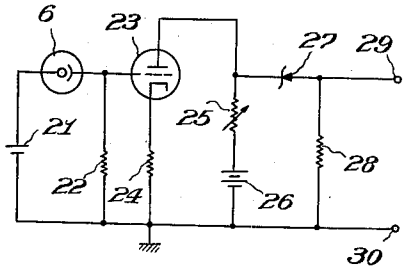
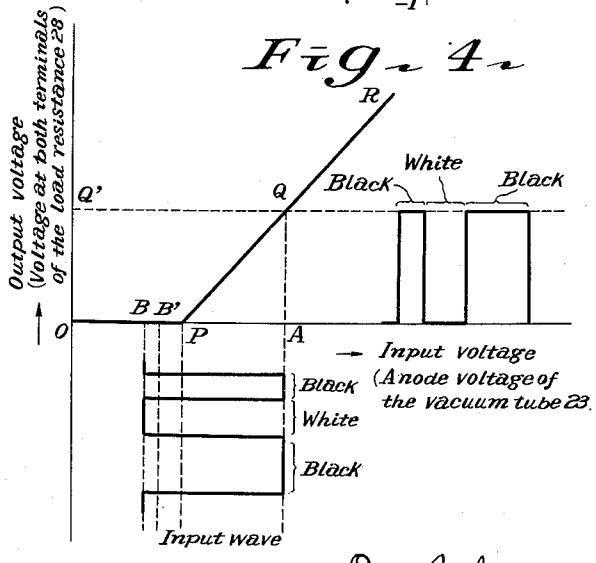


Fig. 4.



Osamu Nakagawa
Makoto Saito
INVENTORS

BY George B. Oliverett
Atty.

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ELECTRONIC STENCIL CUTTER

Osamu Nakagawa and Makoto Saito, Setagaya-ku, Tokyo-to, Japan, assignors to Tokyo Kokukeiki Kabushiki Kaisha, Tokyo, Japan

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1 Claim. (Cl. 178—6.6)

This invention relates to electronic stencil cutters, and more particularly it relates to an electronic stencil cutter having a new and improved, direct-current amplification circuit and output regulation circuit.

In the conventional electronic stencil cutters, photoelectronic amplifier tubes are used in the photoelectric conversion parts, but in such cutter apparatuses, high voltage has been necessary for the power supply of the photoelectronic amplifier tubes. The conventional state of the art, however, has been such that, in spite of the provision of stabilizing devices in this high-voltage power supply, the degree of stability of the cutter apparatuses with respect to voltage variation of the electric power source has been poor.

It is an essential object of this invention, with profitable consideration of the abovementioned disadvantage of conventional apparatuses, to provide a new and improved, electronic stencil cutter which operates in a stable manner irrespective of fluctuations in the electric power source.

It is another object of this invention to provide such an electronic stencil cutter, as stated above, of greatly simplified construction with the use of ordinary photoelectric tubes.

The details of the invention and the manner in which the foregoing as well as other objects and advantages of the present invention may best be achieved will be understood more fully from a consideration of the following detailed description of one representative embodiment of the invention, taken in conjunction with the accompanying drawing, in which the same members are designated by the same numerals, and in which—

FIG. 1 is a schematic circuit diagram showing the essential elements for an explanation of the principle of one embodiment of the present invention;

FIG. 2 is a circuit diagram of one example of a direct-current amplifying circuit to be used with the embodiment of FIG. 1;

FIG. 3 is a graphical representation showing the voltage-current characteristic of the Zener diode (constant-voltage diode) used in the embodiment of FIG. 1;

FIG. 4 is a graphical representation for describing the operation of the Zener diode circuit used in the embodiment of FIG. 1.

Referring to FIG. 1, the essential, mechanically moving component of the apparatus comprises a transmitting drum **3** having an original script wrapped therearound and a receiving drum **3'** having a stencil wrapped therearound, said drums being driven by an electric motor **1** through a reduction gear train **2**. The transmitting drum **3** is provided with a suitably disposed photoelectric reading device composed of an exciter lamp **5** for the light source and a photoelectric tube **6**. The receiving drum **3'** is provided with a suitably disposed recording stylus **4**.

Said photoelectric tube **6**, exciter lamp **5** and recording stylus **4** are supported by a scanning carriage **31**, the construction and operation of said carriage being omitted, because said construction and operation are well-known. Said photoelectric tube **6** and recording stylus **4** are connected electrically to the electrical circuit of the apparatus, which comprises a direct-current amplifier **7**, a carrier oscillator **8**, a modulator **9**, an alternating-current amplifier **10**, an output transformer **11**, a key **12** with sets of contacts (**13**, **14**), (**13'**, **14'**), and (**13''**, **14''**), a dummy load **15**, an alternating-current voltmeter **18**, resistances **16** and **17** for the multiplier of the voltmeter, and terminals **19** and **20** for measuring the voltage of the commercial power source, said elements of the circuit being electrically connected as indicated in FIG. 1.

The principle of operation of the embodiment as illustrated in FIG. 1 may be described as follows. The transmitting and receiving drums **3** and **3'** are driven to rotate at a rotational speed of from 200 to 300 revolutions per minute by mechanical power supplied by the electric motor **1** through the reduction gear train **2**. The exciter lamp **5** emits a light beam which is projected onto an original script wrapped around the drum **3**. The resulting reflected light beam, the intensity of which varies according to the original script, is converted by the photoelectric tube **6** into a photoelectric current, which is conducted into the direct-current amplifier **7**, where it becomes a direct-current signal corresponding to the black and white of the original script and is amplified. The output of this amplifier is conducted to the modulator **9**. Since a carrier wave is supplied by the carrier oscillator **8** to the said modulator **9**, the said carrier wave is modulated by the said direct-current signal corresponding to the black and white of the original script, whereby a modulated output is generated. Said output is conducted to the alternating-current amplifier **10** the output of which is supplied to the output transformer **11**.

If, as a supposition, the moving contacts of the key **12** are contacting, respectively, their contacts **13**, **13'**, and **13''**, the output voltage of the transformer **11** will be impressed on the recording stylus **4** through the contact **13**, and signal receiving and recording will be effected on the drum **3'**. At the same time, since the alternating-current voltmeter **18** will then be connected, through the contacts **13'** and **13''**, respectively, and the resistance **17** for the multiplier, to the terminals **19** and **20** for measuring the voltage of the commercial power source, the said alternating-current voltmeter will indicate the power source voltage.

If, on the other hand, the moving contacts of the key **12** are contacting, respectively, their contacts **14**, **14'**, and **14''**, the output voltage of the output transformer **11** will be impressed on the dummy load **15** through the contact **14**. At the same time, since the alternating-current voltmeter **18** will then be connected, through the contacts **14'** and **14''** of the key **12** and the multiplier resistance **16**, to the two terminals of the dummy load **15**, it will be possible to measure the output voltage impressed on the dummy load **15**. Thus, by switching a single key, it is possible to use a single voltmeter as a power source voltmeter and as an output voltmeter.

A further understanding of the invention may best be gained from the following detailed description of a direct-current circuit which may be used as an important part of the present invention. In direct-current amplification, in general, the degree of modulation is seriously impaired by such influences as the zero point shifting of the vacuum tube current, due to fluctuation in the power source. In the particular case of such apparatus as an electronic stencil cutter, since a high degree of modulation is required, a general type of direct-current amplifying circuit is unsuitable for use. Consequently, in the conventional art, complex, direct-current regeneration methods, such as the clamping method, have been used. In the case of the present invention, in the light of the above-described points, a Zener diode (constant-voltage diode) is used in the direct-current amplifying circuit, and the constant-voltage characteristic of the reverse-direction voltage of the Zener diode is utilized to remove the detrimental influences due to such effects as photoelectric tube dark current and zero-point shifting of the vacuum tube

current from the direct-current output, whereby it is made possible to obtain an output with a degree of modulation which is constantly 100 percent.

FIG. 2 shows the details of one embodiment of the direct-current amplifying circuit of the invention, which comprises an electric power source 21 for supplying the plate voltage of the photoelectric tube 6; a load resistance 22 of the photoelectric tube 6; a vacuum tube 23 for direct-current amplification; a cathode resistance 24; a variable resistance 25 for the plate resistance of the vacuum tube 23; an electric power source 26 for the plate of the vacuum tube 23; a Zener diode 27; a load resistance 28; and output terminals 29 and 30 of the direct-current amplifying circuit. As will be seen in FIG. 2, the plate of the vacuum tube 23 and the load resistance 28 are joined by the Zener diode 27.

FIG. 3 shows a graph of the voltage-current characteristic of the Zener diode 27. It indicates that, if the voltage is gradually increased in the reverse direction, the reverse current will be practically zero until a certain voltage V_z (Zener voltage) is reached, and if the said voltage is exceeded, the reverse current will increase suddenly, but the voltage of the two terminals of the Zener diode will remain constant at V_z. Accordingly, the input-output characteristic of the Zener diode circuit for the case in which, in the circuit arrangement of FIG. 2, the voltage of the two terminals of the plate resistance 25 is made the input voltage, and the voltage generated on the two terminals of the load resistance 28 is made the output voltage, will be as indicated by the curve OPQR of FIG. 4. Here, the input voltage is the reverse voltage of the Zener diode, and OP corresponds to the Zener voltage V_z. Accordingly, in case the plate voltage of the vacuum tube 23 does not exceed V_z, the output voltage of the load resistance 28 will be zero; and, in case said plate voltage exceds V_z, an output voltage will be developed at the load resistance 28. Furthermore, the line PQR of FIG. 4 will be approximately a straight line.

When the illuminated portion of the original script wrapped around the transmitting drum 3 is black, practically no reflected light from the said script enters the photoelectric tube 6. Accordingly, the voltage across the terminals of the photoelectric tube 6 and load resistance 22 is zero, and the grid potential of the vacuum tube 23 becomes zero. The plate voltage of the vacuum tube 23 in this case is taken as OA in FIG. 4. Next, when the original script is white, the light beam reflected from the said script enters the photoelectric tube 6; a photoelectric current flows and causes a voltage drop across the load resistance 22; the grid of the vacuum tube 23 assumes a positive potential; and the plate current increases. As a result, a voltage drop is created across the plate resistance 25, and the plate voltage decreases. The plate voltage of the vacuum tube 23 in this case is taken as OB in FIG. 4. Therefore, the plate voltage of the vacuum tube 23 varies from OA to OB in FIG. 4 in accordance with the black and white of the original script, and the amount of this variation is indicated by AB. By adjusting the variable resistance 25 in FIG. 2, the absolute value of OB only can be varied while AB of FIG. 4 is held approximately constant. Now, if the value of OB is selected to be somewhat lower than that of the Zener voltage OP, even if the value of OB is caused to fluctuate somewhat as shown by OB' by such effects as the zero point shift of the vacuum tube current, no output power will be developed at the load resistance 28 since said value of OB is less than the Zener voltage. Only the part of AP which corresponds to the black of the original script appears as a direct-current output voltage at the load resistance 28, that is, this is OQ' in FIG. 4. For this reason, the direct-current output voltage which is developed at the load resistance 28 is a maximum when the original script is black and becomes zero when the said script is white. By imparting such a direct-current output, picture signal on the moduator 9 to modulate a carrier wave, an alternating-current, modulated output of 100-percent degree of modulation is obtained.

The method of eliminating the ground color in the case where the ground color of the original script differs greatly may be described as follows with reference to FIG. 4. For the case when the ground color of the original script is white, let the plate voltage corresponding to this white, of the vacuum tube 23, be represented by OB, and the plate voltage corresponding to the black portion of the original script be represented by OA in FIG. 4. Now, let it be supposed that, if the ground color of the said script is not white but of a slightly gray color, the plate voltage would be slightly higher than in the case of white so as to be represented by OB' in FIG. 4. Let it be further assumed that the moving contacts of the key 12 in FIG. 1 are in contact with their respective sides 14, 14' and 14'', whereby the alternating-current output voltage created at the dummy load 15 is caused to be indicated by the alternating-current voltmeter 18. Then if the variable resistance 25 in FIG. 2 is so adjusted that the indication of the alternating-current voltmeter 18 will be zero when the light from the exciter lamp strikes the ground color of the original script, the voltage OB' corresponding to the ground color of the original script in FIG. 4 being less than the Zener voltage OP, the ground color of the original script will, in effect, be eliminated. Thus, by adjusting the variable resistance 25 of FIG. 2 in such a manner that the voltage OB' corresponding to the ground color of the original script will always be less than OP, that is, that the indication of the alternating-current voltmeter 18 will be zero, it is possible to eliminate the ground color of any original script.

As described above, in the apparatus of the present invention, it is possible, by switching a single key, to use a single, alternating-current voltmeter as a power source voltmeter and as an output voltmeter. Furthermore, by using a Zener diode in the direct-current amplifying circuit, it is possible to connect the said direct-current amplifying circuit directly to a modulator, whereby a modulated output which always has a 100-percent degree of modulation can be derived. Thus, it is possible, to accomplish, in an extremely easy manner, direct-current amplification of picture signals, which, heretofore, has been considered to be difficult. The apparatus of the present invention has further advantages in that it is almost completely unaffected by such factors as fluctuations of the auxiliary, power source and light source systems, dark current of the photoelectric tube, and variations in the properties of the paper material of the transmitting, original script; in that its frequency characteristics are good; in that its construction and electrical circuits are simpler than those of conventional apparatuses of this type, whereby its cost of manufacture can be relatively lowered; and in that its operation and maintenance are extremely easy.

While we have described a particular embodiment of our invention, it will, of course, be understood that we do not wish our invention to be limited thereto, since many modifications and applications may be made. For example, it is obvious that it is possible to obtain the same results as indicated in the drawing by using the invention in an electrical facsimile-transmitting device. We, therefore, contemplate by the appended claim to cover all such modifications as fall within the true spirit and scope of our invention.

What we claim is:

An electronic stencil cutter, comprising in combination; motor means; a transmitting-receiving drum assembly driven by said motor means, the transmitting portion of said drum assembly being adapted to receive thereon an original script, the receiving portion of said drum assembly being adapted to receive a stencil upon which said original script is to be reproduced; exciter lamp means for projecting a light beam onto said original script; a photoelectric tube disposed so as to receive a light beam reflected from said original script; a photo-

electric tube load across the output of said photoelectric tube, said reflected light beam thus furnishing a direct current signal through said photoelectric tube across said load, the signal intensity varying with the intensity of said reflected light beam; a direct current amplifying tube, including a cathode, anode and grid, said grid being connected to said photoelectric tube to amplify the direct current signal generated across said photoelectric tube load; a plate excitation source for said direct current amplifying tube including a plate load; a Zener diode including a diode load connected between the plate and plate load of said direct current amplifying tube; a carrier signal oscillator; a modulator connected to the output circuit of said diode impressing upon the carrier signal provided by said oscillator said amplified varying reflected signal; an alternating current amplifier connected to the output circuit of said modulator amplifying said modulated alternating current signal; an output transformer having a primary connected to the output circuit of said alternating current amplifier; a recording stylus connectable to

said transformer secondary; a dummy load connectable across said transformer secondary; alternating current power source terminals; an alternating current voltmeter; and, gang switching means having decks, switching in the one position a first deck to connect said transformer secondary and said stylus and a second deck placing said voltmeter across said alternating current power source terminals, and switching in the second position said first deck to connect said dummy load across said transformer secondary output, and said second deck placing said voltmeter across said dummy load.

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