

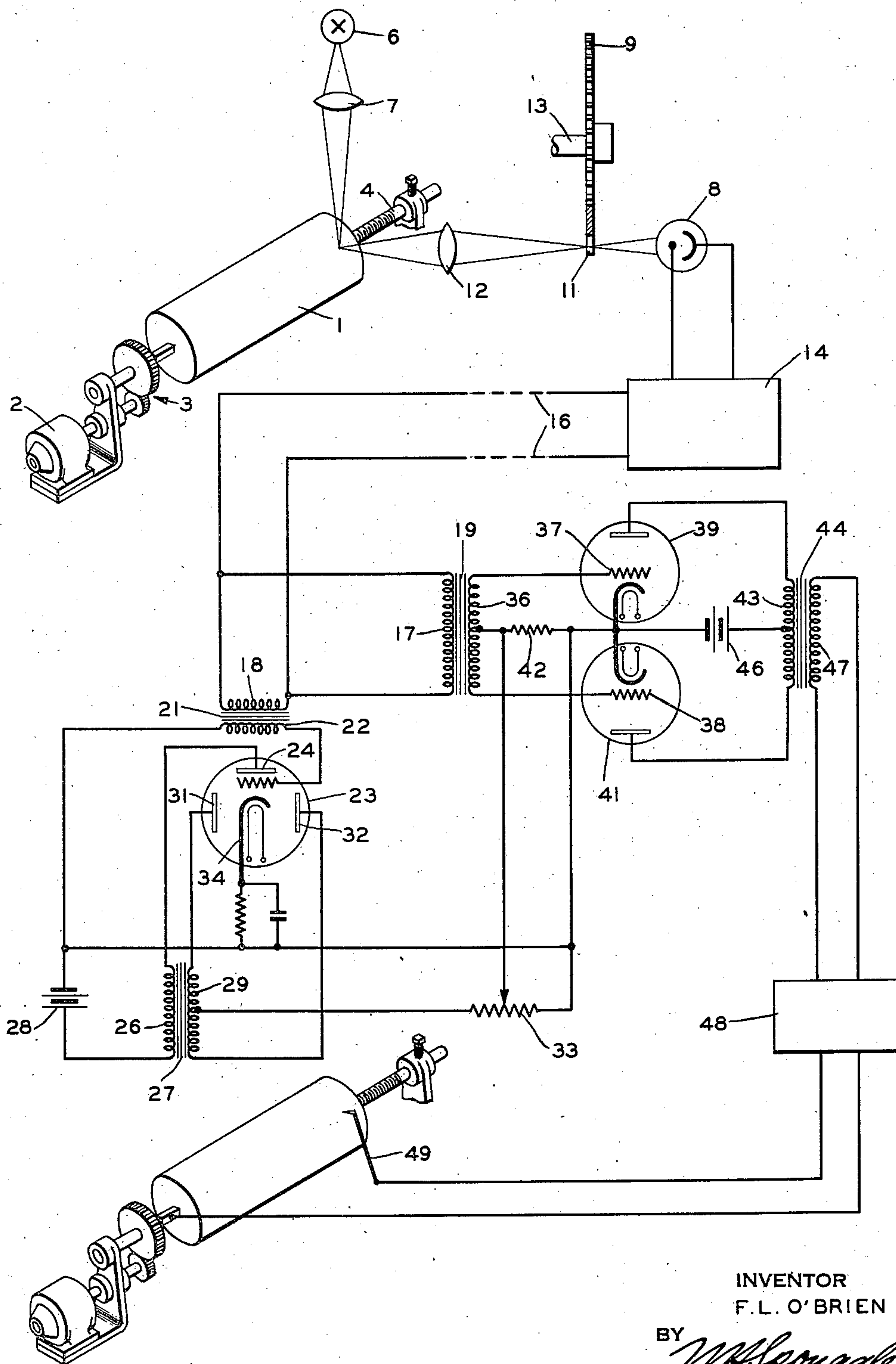
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FACSIMILE SIGNAL INVERTER

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FACSIMILE SIGNAL INVERTER

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This invention relates to the art of signaling and more particularly to signaling by means of amplitude modulated alternating currents.

In certain types of facsimile telegraph systems a relatively high frequency train of oscillations is modulated in amplitude at a relatively low frequency in accordance with tone values of the subject matter being scanned. One form of a scanning device employs a light sensitive element such as a photoelectric cell to control the carrier modulation in accordance with the quantity of light reflected from the subject matter onto the photoelectric cell. Thus, an elemental area from which a large quantity of light is reflected is represented by signals having a relatively large amplitude and, conversely, a relatively dark elemental area is represented by signals having a relatively small amplitude. Such signals may be employed to record on a photographic film or equivalent recording means for the purpose of obtaining a negative copy of the scanned subject matter. However, in order to obtain a positive copy or an exact reproduction of the scanned subject matter it is necessary to make a positive print from the film or other recording means.

In order to eliminate this additional step the facsimile signals representative of the scanned subject matter may be inverted. Numerous signal inverting systems have been proposed heretofore for inverting the signals as they are generated at the transmitter, but it is not always convenient to employ such apparatus because of the fact that skilled operators may not be available at the transmitting point to make the necessary adjustments. Also, it is often desirable to effect the simultaneous recording of facsimile signals to obtain both a negative and a positive copy of the transmitted subject matter. For the foregoing reasons and also because it may be more feasible to locate the signal inverting apparatus at the receiving point where the recorded copy may be used as a guide in making the necessary adjustments, it is desirable that means be provided for inverting the facsimile signals at the receiving station. It is also advantageous, in employing apparatus which is used for such a purpose at a point remote from the transmitting station, to maintain the apparatus in exact synchronism with the generator of the signals. In this way, any variation in the frequency of the modulated carrier wave is compensated for in the signal inverting apparatus.

Hence it is the primary object of the invention to provide novel means for inverting facsimile

telegraph signals subsequent to the generation thereof.

Another object of the invention resides in the provision of means for operating facsimile signaling apparatus in exact synchronism with the signal generator.

Still another object of the invention is to provide means for generating direct current modulated in accordance with the facsimile signals and for combining the generated direct current with the facsimile signals in a manner to produce other signals modulated inversely to the facsimile signals.

A further object of this invention is to provide means for deriving from the facsimile signals a direct current modulated in accordance with the facsimile signals.

Other and more specific objects of the instant invention will appear in the following description of the invention taken in conjunction with the accompanying drawing, the single figure of which shows the circuit arrangement of a facsimile telegraph system embodying an illustrative form of the novel facsimile signal inverting apparatus.

In its general aspect the invention contemplates the derivation from amplitude modulated facsimile signals of a modulated direct current. The facsimile signals are impressed upon the input circuit of a thermionic amplifier. Also the modulated direct current is connected to the input circuit of the amplifier in a manner to oppose the facsimile signals. Thus, the modulated direct current constitutes a bias modulation for the amplifier and is sufficiently large when the facsimile signals are at a maximum so that the facsimile signals are given a very small amplification. When the facsimile signals are small in amplitude, the bias provided by the modulated direct current is also sufficiently small to provide a relatively large amplification of the facsimile signals. Thus, the amplifier serves to produce signals in its output circuit which are modulated inversely in amplitude to the generated facsimile signals.

The invention is disclosed and described in conjunction with a facsimile telegraph system employing an optical scanning device. It will be understood that the instant invention is not limited to the specific combination of instrumentalities disclosed herein but may be practiced in combination with substantially any form of facsimile scanning apparatus. Referring to the drawing, the subject matter to be scanned may be conveniently mounted on a drum 1. The drum

is rotated at a suitable speed by means of a driving motor 2 which is connected thereto by means of a coupling device 3. Axial movement of the drum 1 is produced by a suitable means 4 so that the entire field of the message may be scanned. Light from a source 6 is concentrated by means of a lens 7 upon the surface to be scanned and is reflected into a photoelectric cell 8 or equivalent device. The spot of light which is projected upon the surface of the cylinder or drum 1 is thus caused to traverse the cylinder in a longitudinal direction as the cylinder rotates by reason of the axial movement thereof. The light which is reflected from the surface of the subject matter being scanned and which is incident upon the photoelectric cell 8 is interrupted by a shutter or light chopper 9. The shutter may be in the form of a disc as illustrated which is provided with a series of equally spaced openings or notches 11 adjacent its outer edge. In cases where the reflected light is to be interrupted, a lens 12 serves to bring the reflected light beam to a focus substantially in the plane of the disc 9 so that it may pass through openings 11 successively. The disc 9 is mounted upon a rotatable shaft 13 which may be driven in any suitable manner from the motor 2 or, if desired, from a separate source of mechanical power. The number of openings in the disc and the speed of rotation of the shaft may vary within wide limits depending upon the desired rate of scanning, the constants of the communication circuit employed between the transmitting and receiving stations and other factors. The output appearing across the terminals of the photoelectric cell 8 is of such a character that a negative copy of the scanned subject matter will be reproduced by the usual recorder employed in facsimile systems of this nature.

In cases where it is desired to make a positive record from facsimile signals generated as described, a signal inverter is employed, a novel form of which comprises the subject matter of the instant invention. Subsequent to the generation of the facsimile signals modulated in accordance with the tone values of the subject matter scanned the signals may be amplified by means of a suitable amplifier 14 and transmitted over a pair of line conductors 16. At the receiving station the line conductors are terminated in windings 17 and 18 of transformers 19 and 21 respectively. The modulated facsimile signals are reproduced by induction in the winding 22 of transformer 21 which is connected to the input circuit of a thermionic device 23. The output circuit of the tube 23 includes an anode or plate 24, the winding 26 of transformer 27 and a source of plate potential 28.

The modulated alternating current signals amplified by the tube 23 are reproduced inductively in the winding 29 of transformer 27. The terminals of this winding are connected respectively to plates 31 and 32 of the tube 23. The winding 29 is provided with a tap intermediate its terminals and which is connected to one terminal of a potentiometer 33, the other terminal of which is connected to the cathode 34 of the tube 23. Thus, by this arrangement the alternating current signals are rectified and appear across the potentiometer 33 as a direct current potential modulated in accordance with modulations of the facsimile signals. It has been found convenient to include the amplifier and the rectifier in one envelope. However, it will be obvious to those skilled in the art that separate tubes may

be provided for these purposes without departing from the spirit of the invention.

The facsimile signals which are impressed upon the winding 17 of transformer 19 are inductively reproduced in the winding 36 of this transformer. The terminals of the winding 36 are connected to the control grid elements 37 and 38 of a pair of amplifying tubes 39 and 41 respectively. The midpoint of the transformer winding 36 is connected through a resistance 42 to the respective cathodes of the tubes 39 and 41. The output circuits of the pair of amplifying tubes are connected differentially through a winding 43 of a transformer 44 and include a common source of current 46. This arrangement of a pair of vacuum tubes is well known in the art as a push-pull connection, the operation of which need not further be described.

The modulated direct current derived from the facsimile signals is connected across the resistance element 42 and in a manner to produce a negative bias upon the input circuits of the tubes 39 and 41, which is in opposition to the facsimile signals impressed upon the input circuits. Thus, it may be seen that when the amplitude of the facsimile signals is large, a relatively large negative bias is applied to the amplifying tubes 39 and 41 so that the facsimile signals are given a minimum of amplification. However, when the amplitude of the generated facsimile signals is small, the bias which is applied to the tubes is also small since it is derived from the facsimile signals. Consequently, the small amplitude facsimile signals are given a relatively large amplification. In this manner the facsimile signals are effectively inverted. The inverted signals are reproduced in the winding 47 of transformer 44 and may be amplified if desired by means of an amplifier 48 and applied to the recording apparatus.

The recording apparatus as disclosed herein is substantially similar to the transmitting apparatus previously described with the exception that, instead of the optical scanning instrumentalities, the apparatus is provided with a stylus 49 by means of which recording may be effected electrically in a manner well known in the art. Thus, it is seen that by employing the signal inverting apparatus described, the recording apparatus functions in such a manner that marks are made on the recording medium having tone values varying between white and black in accordance with the variation in the current amplitude of the signals impressed upon the recording stylus 49.

The nature of the invention may be ascertained from the foregoing description of an illustrative embodiment, it being understood that changes in the invention herein disclosed may be made within the scope of what is claimed without departing from the spirit of the invention.

What is claimed is:

1. In a facsimile telegraph system, means for generating signaling current modulated in amplitude in accordance with the amount of light reflected from elemental areas of the scanned subject matter, a vacuum tube arrangement to amplify a small portion of said signaling current energy without changing the amplitude ratio of components thereof, means for rectifying said amplified current, and a second vacuum tube arrangement for combining in the input circuits thereof said signaling current and said rectified current in opposition to amplify said signaling current with the amplitude ratio of components

thereof inverse to the amplitude ratio of components of the generated signaling current.

2. In a facsimile telegraph system, means for generating alternating current modulated in amplitude in accordance with the amount of light reflected from elemental areas of the scanned subject matter, two amplifiers, means for impressing said alternating current upon said amplifiers simultaneously, means including a first one of said amplifiers for amplifying a small portion of said alternating current energy, a rectifier for said amplified energy and means including connections between said rectifier and the second one of said amplifiers to vary the degree of amplification of said second amplifier in inverse proportion to the generated alternating current to produce alternating current modulated in amplitude inversely to said generated alternating current.

3. In a facsimile telegraph system, means for generating alternating current facsimile signals modulated in amplitude in accordance with tone values of subject matter, a rectifier for translating said facsimile signals to direct current modulated in accordance with said signals, a pair of vacuum tubes, each having input and output circuits, means for impressing said modulated direct current symmetrically upon said input circuits to vary the negative bias of said tubes concurrent with and in proportion to the amplitude of said facsimile signals, means for impressing said facsimile signals oppositely upon said input circuits to excite said tubes alternately, and means connected differentially to said output circuits to translate the combined output of said tubes into alternating current recording signals modulated in amplitude inversely to said generated facsimile signals.

4. In a facsimile telegraph system utilizing amplitude modulated alternating current signals, signal inverting apparatus comprising, a thermionic amplifier, a rectifier, a utilization circuit, means for impressing said modulated alternating current signals simultaneously upon said amplifier and said rectifier, means including said rectifier for negatively biasing said amplifier constantly in proportion to the instantaneous amplitude of said signals whereby said signals are amplified in inverse proportion to the amplitude of said facsimile signals, and means for impressing said amplified signals upon said utilization circuit.

5. A facsimile telegraph system comprising, means for generating alternating current facsimile signal energy modulated in amplitude in accordance with tone values of subject matter, an amplifier having input and output circuits, means for rectifying one portion of said facsimile

signal energy to obtain direct current energy proportional in amplitude to said facsimile signal energy, means for combining in simultaneous opposition in the input circuit of said amplifier another portion of said facsimile signal energy and the corresponding direct current energy derived from said one portion of said facsimile signal energy to produce in the output circuit of said amplifier signals having amplitudes inversely related to the amplitude of said facsimile signal energy, and means for recording the inverted signals.

6. A facsimile telegraph system comprising, means for generating alternating current facsimile signals modulated in amplitude in accordance with tone values of subject matter, means for amplifying said signals, means controlled by said signals for producing a direct current varying in magnitude in proportion to the instantaneous amplitude of said signals, means utilizing said direct current to negatively bias said amplifying means whereby said signals are amplified in inverse proportion to the amplitude of the facsimile signals, and means for recording said inversely amplified signals.

7. In a facsimile telegraph system, means for generating alternating current facsimile signal energy modulated in amplitude in accordance with tone values of subject matter, a rectifier for demodulating one portion of said facsimile signal energy, an amplifier tube having a control grid responsive to another portion of said facsimile signal energy, and circuits interconnecting said rectifier and said grid to utilize said demodulated facsimile signal energy as a variable negative bias for said grid, said bias constantly varying in direct proportion to the amplitude of said facsimile signal energy to vary constantly the amplification factor of said amplifier in inverse proportion to the amplitude of said facsimile signal energy whereby the amplified signal energy is modulated in amplitude inversely to said facsimile signal energy.

8. In a facsimile telegraph system, means for generating amplitude modulated alternating current energy constituting facsimile signals representative of scanned subject matter, an amplifier, means including said amplifier for amplifying one portion of said signal energy, means for rectifying another portion of said signal energy, and means for utilizing said rectified signal energy as a bias for said amplifier to vary the degree of amplification thereof inversely to the amplitude of the facsimile signals whereby the amplified signal energy is modulated in amplitude inversely to said facsimile signals.

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