

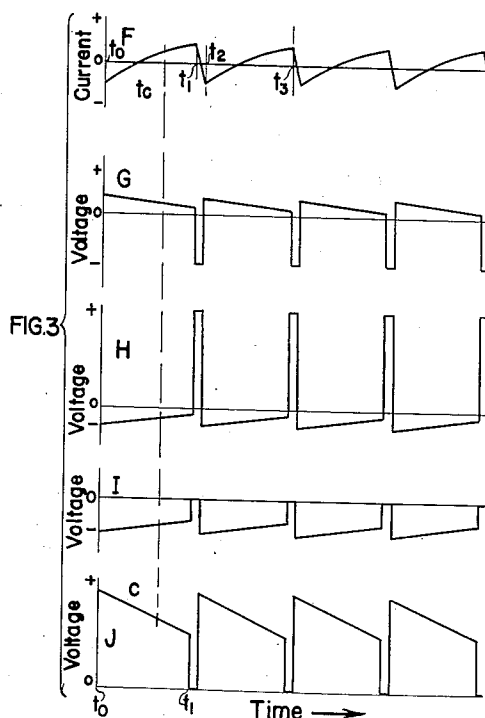
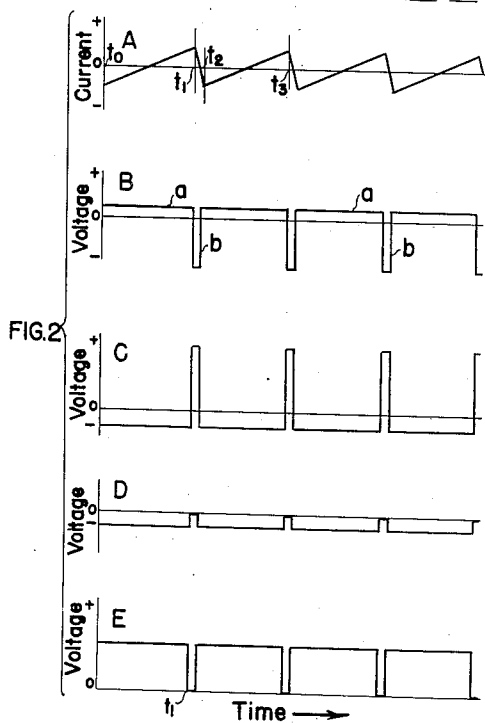
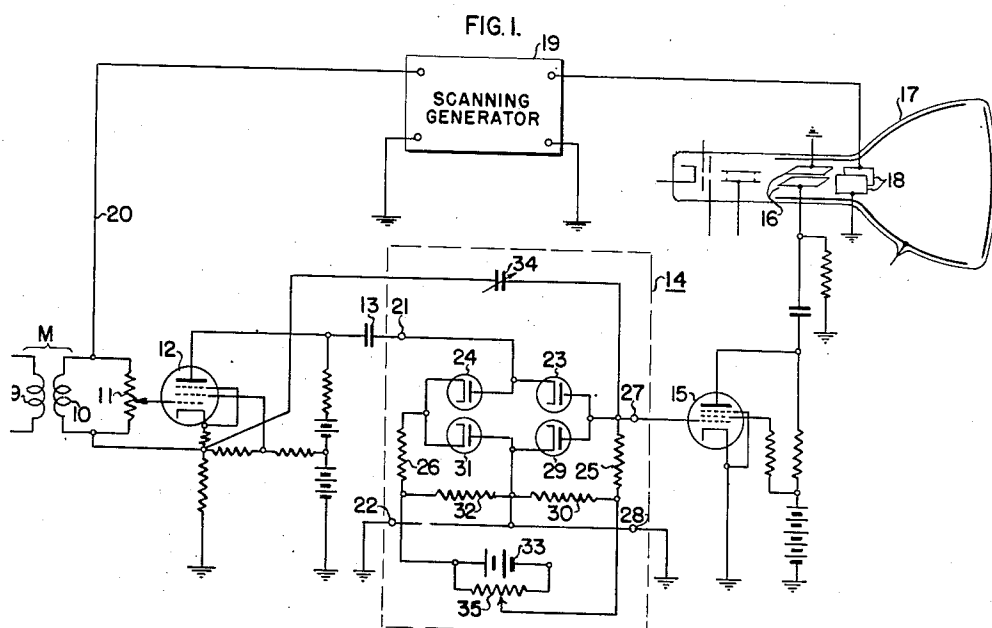
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RECTIFIER SYSTEM

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2,347,529

RECTIFIER SYSTEM

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The present invention relates to rectifying systems and, particularly, to rectifying systems adapted to separate out, with accurate preservation of wave form, complete half-cycles of an alternating voltage applied to the system. While the invention is of general application, it is particularly suited for use in a system for indicating the wave slope of saw-tooth scanning currents commonly used in television systems and will be described in that connection.

In conventional television systems, the television image is transmitted by the method of transmission of a continuous signal representative of successive image elements. To reproduce the transmitted image with fidelity, it is essential that the positioning of the multiplicity of elements in the received image be exactly the same as in the original televised image. To this end, signal-generating and image-reproducing tubes of the cathode-ray type are used respectively at the transmitter and receiver and the cathode-ray beams of the transmitting and receiving tubes are, in general, deflected in synchronism with each other at substantially constant velocity, the deflections in both the transmitting and receiving tubes being in two directions normal to each other to produce a raster or pattern of parallel scanning lines. Successive incremental portions of each line of the reproduced pattern at the receiver correspond to successive elements of the televised image at the transmitter, whereby the complete pattern of lines together form the television image at the receiver.

The constant-velocity deflection of the cathode-ray beams of the transmitting and receiving cathode-ray tubes is accomplished in one form of television system by a deflecting field produced by a scanning wave of saw-tooth wave form. Such a wave changes in one sense at a constant rate over a relatively long trace interval during the formation of one line of the pattern of lines and changes in the opposite sense at a greater rate during a relatively short retrace interval. Since the rate of change of the saw-tooth wave determines the velocity of deflection of the cathode-ray beam, it is essential that the wave have a constant rate of change during the trace interval; that is, that the saw-tooth wave have uniform slope during such interval.

In some cases, a definite departure from uniform slope of the saw-tooth scanning wave may be desired to compensate for geometric relations in the cathode-ray tubes, as to compensate for differences in the degree of curvature of the transmitter and receiver cathode-ray tube

screens. Thus, it is desirable to be able to indicate visually such wave slope in a simple and effective manner to facilitate the design and adjustment of the saw-tooth wave generator. Mere inspection of a reproduced television image is not adequate. Nor is it always adequate merely to reproduce the scanning wave on the screen of an oscilloscope, since slight variations in the wave slope are not easily detected by visual inspection and especially is this true of the relative magnitudes of such variations.

It has been proposed in accordance with one prior art arrangement that the slope of a scanning wave be indicated by inserting a small pickup coil within the magnetic field of the deflecting coil to be used with the cathode-ray tube and then to observe the voltage induced in the pickup coil, which is proportional to the wave slope. Since only the slope during the trace interval is important from the standpoint of image reproduction, the relatively large voltage pulse produced during the short retrace interval is removed by a clipping or limiting system and the voltage pulse produced during the trace interval is subsequently amplified and reproduced on the screen of an oscilloscope. A linear saw-tooth scanning current and resulting magnetic field produce a voltage of rectangular wave form in the pickup coil. Departures of the reproduced voltage pulse from a rectangular wave form indicate departures from linearity or uniformity of slope of the saw-tooth current during the scanning interval. This indicating system has a disadvantage that the axis of the original voltage induced in the pickup coil is lost by the action of the clipping system and it is, therefore, difficult to determine its correct position. The arrangement consequently is not well adapted for ascertaining exact values of the magnitude of changes of slope of the scanning wave.

It has been proposed in accordance with another prior art arrangement that a pickup coil be used as in the arrangement described above and that the relatively large voltage pulse induced in the pickup coil during the retrace interval be removed by the use of a rectifier, the relatively smaller voltage pulses induced during the trace interval being subsequently amplified and reproduced on the screen of an oscilloscope. While this arrangement is relatively simple, a rectifier has inherent capacitive admittance in a direction opposite to that of its normal conductivity, whereby a portion of the voltage pulse produced during the retrace interval is coupled into the pulse amplifier and is reproduced with distortion on the oscillo-

scope screen. The reproduction of such portion of the voltage pulse of the retrace interval effectively shifts the indication of the axis of the reproduced voltage pulses, thereby to introduce inaccuracies in measurements made from the reproduced pulse wave form of the magnitude of changes of slope of the saw-tooth scanning wave.

If a rectifier system is to derive only complete half-cycles of one polarity of an alternating voltage applied thereto, it is necessary that the input circuit coupled to the rectifier have negligible resistance to direct current. This condition is difficult to fulfill where the rectifier system is fed from an amplifier, it being necessary in this event that the high unidirectional potential of the amplifier output circuit be isolated from the rectifier system by the use of an intervening coupling transformer or coupling condenser. In such a case, the impedance of the rectifier system tends to distort the wave form of the voltage delivered to the rectifier system from the amplifier so that the wave form effectively loses the identity of the equal-area axis of the alternating voltage wave applied to the rectifier system.

It is an object of the present invention, therefore, to provide a rectifier system particularly suitable for use in a system for accurately indicating the slope, and the magnitude of changes thereof, of a saw-tooth scanning wave, over the trace interval, while avoiding one or more of the disadvantages and limitations of the prior art indicating systems of this nature.

It is a further object of the invention to provide a rectifier system which uniformly loads an input circuit connected thereto with uniform conductance over each complete cycle of an alternating voltage applied to the input circuit, whereby the rectifier system presents a uniform resistance to the input circuit for either symmetrical or unsymmetrical wave forms of alternating voltage applied thereto and retains the wave axis undisturbed by the rectifying action of the system.

It is an additional object of the invention to provide a rectifier system wherein the effect in the rectifier output circuit of the undesired inherent capacitive admittance of rectifier devices included in the system is greatly reduced, whereby the wave form of the voltage derived by the rectifier system accurately corresponds to complete half-cycles of one polarity of the alternating voltage applied to the system.

In accordance with the invention, a rectifier system for deriving half-cycles accurately corresponding to half-cycles of an alternating voltage applied thereto comprises an input circuit adapted to have applied thereto said alternating voltage and rectifier means having effective initial conduction potentials which are negligible relative to the applied voltage and including a pair of rectifier devices coupled to the input circuit individually to conduct complete half-cycles of applied voltage of opposite polarities and having individual resistive load networks. The devices and their respective load networks have equal effective values of resistance with respect to the input circuit for the respective half-cycles of applied voltage conducted thereby. An output circuit is coupled to the load network of only one of the rectifier devices for deriving therefrom only complete half-cycles of one polarity of the alternating voltage.

In accordance with a preferred form of the invention, a rectifier system of the type described comprises a pair of rectifier devices, each having

undesired capacitive admittance in a direction opposite to that of its normal conductivity. There is provided means including a unidirectionally-conductive device connected in circuit with the load network to which the output circuit is coupled for reducing the effect in the output circuit of the undesired capacitive admittance of the rectifier device associated therewith.

For a better understanding of the present invention, together with other and further objects thereof, reference is had to the following description taken in connection with the accompanying drawing, and its scope will be pointed out in the appended claims.

Referring now to the drawing, Fig. 1 is a circuit diagram, partly schematic, of a complete saw-tooth current wave-slope indicating system embodying the invention; Fig. 2 is a graph comprising curves representing voltage variations occurring at certain points in the indicating system of Fig. 1 when the scanning wave has uniform slope during the scanning interval and is used as an aid in explaining the operation of the invention; and Fig. 3 is a graph comprising curves representing corresponding voltage variations which occur when the scanning wave has nonuniform slope during the scanning interval.

Referring now more particularly to Fig. 1, there is represented schematically a complete indicating system embodying the present invention in a preferred form. The system comprises an input circuit including a pickup winding 10 adapted to be inserted within the magnetic field of a winding 9 which may be the deflecting winding of a cathode-ray tube, not shown. The pickup winding 10 is connected to a potentiometer 11, a selectable portion of which is coupled to the input circuit of a vacuum-tube amplifier 12. The output circuit of the amplifier 12 is coupled through a condenser 13 to the input circuit of a rectifier system 14 embodying the invention and described in more detail hereinafter, the output circuit of which is coupled to the input circuit of a vacuum-tube amplifier 15. The output circuit of amplifier 15 is, in turn, coupled to the deflecting electrodes 16 of an oscilloscope 17. The oscilloscope 17 additionally includes a pair of deflecting electrodes 18 normal to the electrodes 16 to which there is applied a scanning potential of saw-tooth wave form from a scanning generator 19. A synchronizing circuit of the scanning generator 19 is coupled by a conductor 20 to the pickup winding 10, whereby the scanning potentials of the generator 19 are developed in synchronism with the potentials induced in the pickup winding 10.

It will be understood that the apparatus just described may, with the exception of the rectifier system 14, be of a conventional construction and operation, the details of which are well known in the art, rendering detailed description thereof unnecessary. Considering briefly the operation of the indicating system as a whole, and neglecting for the moment the operation of the rectifier system 14 presently to be described, scanning currents of saw-tooth wave form flowing through the winding 9 from a source, not shown, induce in the pickup winding 10 an alternating voltage of rectangular pulse wave form comprising relatively large amplitude negative pulses during the retrace interval and relatively small amplitude positive pulses during the trace intervals. For the purpose of simplifying the description of the operation, and while the expressions are not strictly accurate since the in-

duced pulse voltage has an unsymmetrical wave form, the portion of the induced voltage wave on the positive side of the equal-area axis will hereinafter be referred to as the "positive half-cycles" while the portion of the induced voltage on the negative side of the axis will be referred to as the "negative half-cycles." Additionally, all references to positive and negative half-cycles will be with reference to the half-cycles of the input induced pulse voltage regardless of any reversal of phase which the induced voltage may undergo at one or more points in the system. The pulse voltage induced in winding 10 is applied to amplifier 12 and after amplification therein is applied to rectifier system 14 which removes the large amplitude negative half-cycles to derive in the output circuit of the rectifier system the relatively low amplitude positive half-cycles representative of the slope of the input current wave during the trace interval. The positive half-cycles of the amplified pulse voltage are applied to amplifier 15 and, after further amplification therein, are applied to the deflecting electrodes 16 of the oscilloscope 17 to deflect the cathode ray of the oscilloscope 17 in a first direction. The cathode ray is deflected in a second direction normal to the first direction by the deflecting electrodes 18 which are energized by the scanning potential applied thereto from the scanning generator 19, the operation of the latter being synchronized by the pulse voltage induced in pickup winding 10. Consequently, the wave form of the positive half-cycles of voltage induced in the pickup winding 10 is reproduced on the fluorescent screen of oscilloscope 17. The value of the reproduced wave at any point is a measure of the slope of the saw-tooth current wave at a corresponding point in the cycle.

Referring now more particularly to the portion of the system embodying the present invention, the rectifier system 14 is one for deriving half-cycles accurately corresponding to half-cycles of an alternating voltage applied thereto. It comprises input circuit terminals 21, 22 and rectifier means having effective initial conduction potentials which are negligible relative to the applied voltage and including a pair of like rectifier devices 23, 24 which are coupled to the input circuit individually to conduct complete half-cycles of the applied voltage of opposite polarities. The rectifier devices have individual resistive load networks comprising resistors 25, 26, respectively, of equal value but high in relation to the resistances of the rectifier devices 23, 24 in their respective directions of conductivity. The sums of the resistances of the rectifier devices 23, 24 and their respective load resistors 25, 26 are equal in the directions of conductivity of the devices, whereby the parallel combination of the devices and their load networks present to the input circuit of the rectifier system 14 substantially uniform resistance for all values of the instantaneous voltage applied to the input circuit from amplifier 12, that is, throughout each complete cycle of the applied alternating voltage and for different amplitudes thereof. The rectifier system includes an output circuit which is coupled to the load network of only one of the rectifier devices for deriving therefrom only complete half-cycles of one polarity of the alternating voltage. This circuit comprises terminals 27, 28 which are coupled to the load resistor 25 through a resistor 30 of relatively small value. Each of the rectifier devices 23, 24 has inherent undesired capacitive admittance in a direction

opposite to that of its normal conductivity. To reduce the effect in the output circuit of the rectifier system of the undesirable capacitive admittance of rectifier device 23, there is provided a unidirectionally-conductive device 29 which is coupled with polarity opposite to that of rectifier device 23 in shunt to the load resistor 25 through the resistor 30 of relatively small value. Similarly, to avoid the effect in the rectifier system input circuit of the undesired capacitive admittance of rectifier device 24, there is provided a second unidirectionally-conductive device 31, similar to device 29, which is coupled with polarity opposite to that of rectifier device 24 across the load resistor 26 through a resistor 32 of equal value equal to resistor 30. The rectifier devices 23, 24 and the unidirectionally-conductive devices 29 and 31 are all preferably of the thermionic vacuum-tube type with indirectly heated equipotential cathodes, so that the cathode of each has an initial electron-emission potential, the polarity of which is in a direction aiding the normal conductivity of the device. This causes the rectifier devices to have an initial conduction potential which may be appreciable with relation to the amplitude of the applied alternating voltage. The electron-emission potential and other factors, such as contact potential and space-charge effects which are inherent in tubes of this nature, cause the resistance of such a tube in the direction of its conductivity to vary with the current flowing therethrough and this current, in turn, is dependent upon the instantaneous value of voltage applied to the tube and the resistance of its load network. Thus, the input voltage-output current characteristic of such tubes is nonlinear over the range of values of instantaneous voltage applied to the tube. The effect on the input circuit 21, 22 of the nonlinear operating characteristic of the devices 23, 24, 29, and 31 is substantially eliminated by a unidirectional-bias potential applied across the resistors 30 and 32 from a voltage divider 35 across which is connected a source of battery or unidirectional potential 33 and which serves to make the effective initial conduction potentials across the rectifier devices negligible relative to applied alternating voltage amplitudes of even small values.

The magnitude of the unidirectional potential applied across the resistors 30 and 32 is so proportioned, by adjustment of the voltage divider 35, with relation to the load networks comprising resistors 25, 26 and the operating characteristics of the devices 23, 24, 29, and 31 that the latter devices and the load networks present substantially uniform resistance to the input circuit 21, 22 for both small and large values of instantaneous voltage applied to the input circuit.

A portion of the pulse current in the cathode circuit of amplifier 12 is conducted through an adjustable neutralizing condenser 34 to the load resistor 25, this current having such phase relationship that it is effective further to reduce in the output circuit of the rectifier system the effect of the undesired capacitive admittance of the rectifier device 23.

In considering the operation of the circuit just described, and referring to Fig. 2, it will be assumed that a scanning current of saw-tooth wave form represented by curve A flows through the winding 9. This saw-tooth current induces in the pickup winding 10 a pulse voltage represented by curve B having positive half-cycles *a* of relatively small amplitude and negative half-cycles *b* of relatively large amplitude. A portion of the volt-

age induced in the pickup winding 10 is selected by adjustment of the potentiometer 11 and is applied to the input of amplifier 12, the potentiometer 11 preferably being adjusted to apply to the amplifier the maximum voltage which the latter is able to repeat without distortion. Any distortion of the amplified voltage undesirably shifts the axis of the pulse wave. The pulse voltage is thus amplified by amplifier 12 to develop in the output circuit thereof a pulse voltage represented by curve C.

The amplifier pulse voltage C is applied to the input circuit of the rectifier system 14 where it is rectified by the rectifier devices 23 and 24 to derive across the load resistors 25 and 26 pulsating unidirectional voltages corresponding to the original positive and negative half-cycles, respectively, of the applied voltage. Since the individual rectifier devices 23 and 24 are effectively coupled without a biasing potential across the input circuit of the rectifier system 14 because the voltage derived from source 33 is relatively very small, the initial voltage applied to each of the rectifier devices is in the region of marginal conduction thereof. By the region of marginal conduction is meant the region in which any substantial voltage change in one sense will render one of the rectifier devices conductive, whereas the device will not be conductive as a result of a similar change in voltage in the other sense. The inherent capacitive admittances of the rectifier devices 23 and 24 are compensated by the respective unidirectionally-conductive devices 29 and 31 which nearly short-circuit the respective load resistors 25, 26 insofar as the reverse currents through the respective rectifier devices 23, 24 are concerned. Thus, the wave forms of the voltages derived across the respective load resistors 25 and 26 accurately correspond to the wave forms of corresponding complete half-cycles of the voltage applied to the rectifier system. The voltage derived across the load resistor 25 is represented by curve D and is applied through the output circuit of the rectifier system to the input circuit of amplifier 15 where it is amplified to develop in the output circuit of the amplifier a voltage having the wave form represented by curve E. The wave form of this voltage is reproduced on the fluorescent screen of the oscilloscope 17.

The portion of the saw-tooth scanning current corresponding to the trace intervals is represented by the intervals t_0-t_1 , t_2-t_3 etc., of curve A of Fig. 2. Since the wave form of the scanning current is assumed to be linear, that is, of uniform slope, during these intervals, the tops of the wave reproduced on the screen of the oscilloscope 17 are flat as indicated by curve E. Conversely, the flat top of the wave form of the voltage reproduced by the oscilloscope 17 is an indication that the saw-tooth current has uniform slope during the trace intervals.

If it is assumed that the wave form of the saw-tooth scanning current flowing through the winding 9 has non-uniform slope during the trace intervals, as represented by curve F of Fig. 3, curves G, H, I, and J of Fig. 3, respectively, represent the wave form of the voltage induced in pickup winding 10, that developed in the output circuit of amplifier 12, that derived from the output circuit of the rectifier system 14, and that reproduced on the fluorescent screen of the oscilloscope 17. From curve J it will be apparent that the saw-tooth scanning current has changing slope from the beginning to the end of the trace

intervals. Since the minimum amplitude of curve J accurately corresponds to the axis of the voltage induced in the pickup winding 10, and represented by curve G, the amplitude of any point, as the point c, on curve J is a direct measure of the wave slope of the saw-tooth scanning current at a corresponding point t_c in the scanning cycle. The wave slopes of the scanning current at all points in the trace intervals are thus readily and accurately determined from the wave form of the voltage reproduced on the screen of the oscilloscope 17.

As previously stated, the unidirectionally-conductive device 29 nearly short-circuits the load resistor 25 with respect to the reverse current through rectifier device 23 resulting from its inherent capacitive admittance. The device 29 has a small internal resistance in its conductive direction so that, were it not for the neutralizing current conducted through the condenser 34, a small undesired voltage would be developed across the load resistor 25 by the negative peaks of the voltage induced in pickup winding 10. The neutralizing current conducted to the load resistor 25 through the neutralizing condenser 34, however, is of the proper phase to oppose that conducted thereto through the undesired capacitive admittance of the rectifier device 23 and is effective to oppose such small undesired voltage, thereby to reduce the effect of the internal resistance of the device 29 in its conductive direction and the effect in the output circuit of the undesired capacitive admittance of the rectifier device 23. Thus, the neutralizing current aids the unidirectionally-conductive device 29 in reducing to a minimum the voltage developed across the load resistor 25 by current resulting from the inherent capacitive admittance of the rectifier device 23. As a result, the minimum amplitude of the pulsating unidirectional voltage developed across the load resistor 25 accurately corresponds to the axis of the pulse voltage induced in pickup winding 10.

Either or both of the unidirectionally-conductive device 29 and the neutralizing circuit comprising the condenser 34 are effective to reduce in the rectifier system output circuit the effect of the undesirable capacitive admittance of the rectifier device 23.

As illustrative of a specific embodiment of the invention, the following information is given for the embodiment of the invention shown in the drawing:

Frequency of scanning wave.....cycles.....	60
Retrace time.....period.....	0.01 to 0.1
Rectifier device 23 and unidirectionally - conductive device 29.....	Type 6H6 double diode
Rectifier device 24 and unidirectionally - conductive device 31.....	Type 6H6 double diode
Resistor 25.....	megohm..... 1
Resistor 26.....	do..... 1
Resistor 30.....	ohms..... 1000
Resistor 32.....	do..... 1000
Condenser 34.....	micro-microfarads..... 17-18
Potential of battery 33.....	volts..... 1½

From the foregoing description of the invention, it will be evident that a rectifier system embodying the invention presents to an amplifier preceding the system the equivalent of a constant high resistance to half-waves of both polarities of the alternating voltages in the output of the amplifier. This has the advantage that it is easy to develop across this effective high resistance a

high voltage and the amplifier consequently has high gain. Additionally, the net direct current through the rectifier system is zero and there is, therefore, no tendency to develop in the input circuit of the rectifier system any unidirectional potential which would cause the loss of the identity of the equal-area axis of the alternating voltage applied to the rectifier system.

While there has been described what is at present considered to be the preferred embodiment of this invention, it will be obvious to those skilled in the art that various changes and modifications may be made therein without departing from the invention, and it is, therefore, aimed in the appended claims to cover all such changes and modifications as fall within the true spirit and scope of the invention.

What is claimed is:

1. A rectifier system for deriving half-cycles accurately corresponding to half-cycles of an alternating voltage applied thereto comprising, an input circuit adapted to have applied thereto said alternating voltage, rectifier means having effective initial conduction potentials which are negligible relative to said applied voltage and including a pair of rectifier devices coupled to said input circuit individually to conduct complete half-cycles of applied voltage of opposite polarities and individual resistive load networks for said devices, said devices and their respective load networks having equal effective values of resistance with respect to said input circuit for the respective half-cycles of applied voltage conducted thereby, and an output circuit coupled to the load network of only one of said rectifier devices for deriving therefrom only complete half-cycles of one polarity of said alternating voltage.

2. A rectifier system for deriving half-cycles accurately corresponding to half-cycles of an alternating voltage applied thereto comprising, an input circuit adapted to have applied thereto said alternating voltage, rectifier means having effective initial conduction potentials which are negligible relative to said applied voltage and including a pair of rectifier devices coupled to said input circuit individually to conduct complete half-cycles of applied voltage of opposite polarities and individual resistive load networks for said devices, the sums of the resistances of said devices and their respective load networks being equal in the respective directions of conductivity of said devices, whereby said devices and said load networks present to said input circuit substantially uniform resistance throughout each complete cycle of said alternating voltage, and an output circuit coupled to the load network of only one of said rectifier devices for deriving therefrom only complete half-cycles of one polarity of said alternating voltage.

3. A rectifier system for deriving half-cycles accurately corresponding to half-cycles of an alternating voltage applied thereto comprising, an input circuit adapted to have applied thereto said alternating voltage, a pair of rectifier devices coupled to said input circuit individually to conduct half-cycles of applied voltage of opposite polarities and having individual resistive load networks, the sums of the resistances of said devices and their respective load networks being equal in the respective directions of conductivity of said devices, whereby said devices and said load networks present to said input circuit substantially uniform resistance throughout each complete cycle of said alternating voltage, each

of said devices having undesired capacitive admittance in a direction opposite to that of its normal conductivity, an output circuit coupled to the load network of only one of said rectifier devices for deriving therefrom only complete half-cycles of one polarity of said alternating voltage, and means connected in circuit with said one load network for reducing the effect in said output circuit of the undesired capacitive admittance of said one rectifier device during the half-cycles of the other polarity.

4. A rectifier system for deriving half-cycles accurately corresponding to half-cycles of an alternating voltage applied thereto comprising, an input circuit adapted to have applied thereto said alternating voltage, a pair of rectifier devices coupled to said input circuit individually to conduct half-cycles of applied voltage of opposite polarities and having individual resistive load networks, the sums of the resistances of said devices and their respective load networks being equal in the respective directions of conductivity of said devices, whereby said devices and said load networks present to said input circuit substantially uniform resistance throughout each complete cycle of said alternating voltage, each of said devices having undesired capacitive admittance in a direction opposite to that of its normal conductivity, an output circuit coupled to the load network of only one of said rectifier devices for deriving therefrom only complete half-cycles of one polarity of said alternating voltage, and means including a unidirectionally-conductive device connected in circuit with said one load network for reducing the effect in said output circuit of the undesired capacitive admittance of said one rectifier device during the half-cycles of the other polarity.

5. A rectifier system for deriving half-cycles accurately corresponding to half-cycles of an alternating voltage applied thereto comprising, an input circuit adapted to have applied thereto said alternating voltage, a pair of like rectifier devices coupled to said input circuit individually to conduct half-cycles of applied voltage of opposite polarities and having individual resistive load networks of equal value, the sums of the resistances of said devices and their respective load networks being equal in the respective directions of conductivity of said devices, whereby said devices and said load networks present to said input circuit substantially uniform resistance throughout each complete cycle of said alternating voltage, each of said devices having undesired capacitive admittance in a direction opposite to that of its normal conductivity, an output circuit coupled to the load network of only one of said rectifier devices for deriving therefrom only complete half-cycles of one polarity of said alternating voltage, and means including a unidirectionally-conductive device connected in circuit with said one load network for reducing the effect in said output circuit of the undesired capacitive admittance of said one rectifier device.

6. A rectifier system for deriving half-cycles accurately corresponding to half-cycles of an alternating voltage applied thereto comprising, an input circuit adapted to have applied thereto said alternating voltage, a pair of rectifier devices coupled to said input circuit individually to conduct half-cycles of applied voltage of opposite polarities and having individual resistive load networks, the sums of the resistances of said devices and their respective load networks being equal in the respective directions of conductivity

of said devices, whereby said devices and said load networks present to said input circuit substantially uniform resistance throughout each complete cycle of said alternating voltage, each of said devices having undesired capacitive admittance in a direction opposite to that of its normal conductivity, an output circuit coupled to the load network of only one of said rectifier devices for deriving therefrom only complete half-cycles of one polarity of said alternating voltage, and means including a unidirectionally-conductive device connected in shunt with said one load network for reducing the effect in said output circuit of the undesired capacitive admittance of said one rectifier device.

7. A rectifier system for deriving half-cycles accurately corresponding to half-cycles of an alternating voltage applied thereto comprising, an input circuit adapted to have applied thereto said alternating voltage, a pair of rectifier devices coupled to said input circuit individually to conduct half-cycles of applied voltage of opposite polarities and having individual resistive load networks, the sums of the resistances of said devices and their respective load networks being equal in the respective directions of conductivity of said devices, whereby said devices and said load networks present to said input circuit substantially uniform resistance throughout each complete cycle of said alternating voltage, each of said devices having undesired capacitive admittance in a direction opposite to that of its normal conductivity, an output circuit coupled to the load network of only one of said rectifier devices for deriving therefrom only complete half-cycles of one polarity of said alternating voltage, and means including a pair of unidirectionally-conductive devices individually connected in circuit with said load networks for reducing the effect in said input and output circuits of the undesired capacitive admittance of said rectifier devices.

8. A rectifier system for deriving half-cycles accurately corresponding to half-cycles of an alternating voltage applied thereto comprising, an input circuit adapted to have applied thereto said alternating voltage, a pair of rectifier devices coupled to said input circuit individually to conduct half-cycles of applied voltage of opposite polarities and having individual resistive load networks, the sums of the resistances of said devices and their respective load networks being equal in the respective directions of conductivity of said devices, whereby said devices and said load networks present to said input circuit substantially uniform resistance throughout each complete cycle of said alternating voltage, each of said devices having undesired capacitive admittance in a direction opposite to that of its normal conductivity, an output circuit coupled to the load network of only one of said rectifier devices for deriving therefrom only complete half-cycles of one polarity of said alternating voltage, and means for conducting to said one load network an alternating current of phase to oppose that conducted to said one network by the undesired capacitive admittance of said one rectifier device for reducing the effect in said output circuit of the undesired capacitive admittance of said one rectifier device.

9. A rectifier system for deriving half-cycles accurately corresponding to half-cycles of an alternating voltage applied thereto comprising, an input circuit adapted to have applied thereto said

alternating voltage, a rectifier device coupled to said input circuit and having a resistive load network, said device having undesired capacitive admittance in a direction opposite to that of its normal conductivity, an output circuit coupled to said load network for deriving therefrom only complete half-cycles of one polarity of said alternating voltage, and means including a unidirectionally-conductive device connected in circuit with said load network for reducing the effect in said output circuit of the undesired capacitive admittance of said rectifier device.

10. A rectifier system for deriving half-cycles accurately corresponding to half-cycles of an alternating voltage applied thereto comprising, an input circuit adapted to have applied thereto said alternating voltage, a pair of rectifier devices coupled to said input circuit individually to conduct half-cycles of applied voltage of opposite polarities and having individual resistive load networks, the sums of the resistances of said devices and their respective load networks being equal in the respective directions of conductivity of said devices, an output circuit coupled to the load network of only one of said rectifier devices for deriving therefrom only complete half-cycles of one polarity of said alternating voltage, and a source of unidirectional potential connected in circuit with said devices with a polarity to oppose the conductivity thereof and having a magnitude so proportioned with respect to said load networks and the operating characteristics of said devices that said rectifier devices and their load networks present substantially uniform resistance to said input circuit for all values of instantaneous applied voltage.

11. A rectifier system for deriving half-cycles accurately corresponding to half-cycles of an alternating voltage applied thereto comprising, an input circuit adapted to have applied thereto said alternating voltage, a pair of rectifier devices coupled to said input circuit individually to conduct half-cycles of applied voltage of opposite polarities and having individual resistive load networks, the sums of the resistances of said devices and their respective load networks being equal in the respective directions of conductivity of said devices, each of said devices having undesired capacitive admittance in a direction opposite to that of its normal conductivity, an output circuit coupled to the load network of only one of said rectifier devices for deriving therefrom only complete half-cycles of one polarity of said alternating voltage, a unidirectionally-conductive device connected in circuit with said one load network for reducing the effect in said output circuit of the undesired capacitive admittance of said one rectifier device, and a source of unidirectional potential connected in circuit with said devices with a polarity to oppose the conductivity thereof and having a magnitude so proportioned with respect to said load networks and the operating characteristics of said devices that said devices and said load networks present substantially uniform resistance to said input circuit for all values of instantaneous applied voltage.

12. A rectifier system for deriving half-cycles accurately corresponding to half-cycles of an alternating voltage applied thereto comprising, an input circuit adapted to have applied thereto said alternating voltage, a pair of rectifier devices coupled to said input circuit individually to conduct half-cycles of applied voltage of opposite polarities and having individual resistive

load networks, the sums of the resistances of said devices and their respective load networks being equal in the respective directions of conductivity of said devices, each of said devices having undesired capacitive admittance in a direction opposite to that of its normal conductivity, an output circuit coupled to the load network of only one of said rectifier devices for deriving therefrom only complete half-cycles of one polarity of said alternating voltage, means including a pair of unidirectionally-conductive devices individually connected in circuit with said load networks for reducing the effect in said

input and output circuits of the undesired capacitive admittances of said rectifier devices, and a source of unidirectional potential connected in circuit with said devices with a polarity to oppose the conductivity thereof and having a magnitude so proportioned with respect to said load networks and the operating characteristics of said devices that said devices and said load networks present substantially uniform resistance to said input circuit for all values of instantaneous applied voltage.

HAROLD A. WHEELER.

CERTIFICATE OF CORRECTION.

Patent No. 2,347,529.

April 25, 1944.

HAROLD A. WHEELER.

It is hereby certified that error appears in the printed specification of the above numbered patent requiring correction as follows: Page 4, second column, line 9-10, for "accuraatly" read --accurately--; line 65, for "17-18" read --17-80--; and that the said Letters Patent should be read with this correction therein that the same may conform to the record of the case in the Patent Office.

Signed and sealed this 14th day of November, A. D. 1944.

Leslie Frazer

(Seal)

Acting Commissioner of Patents.

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