

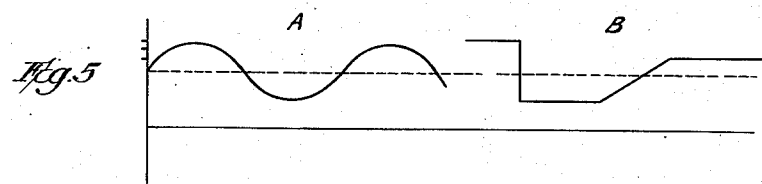
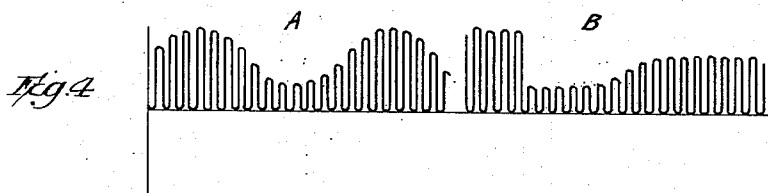
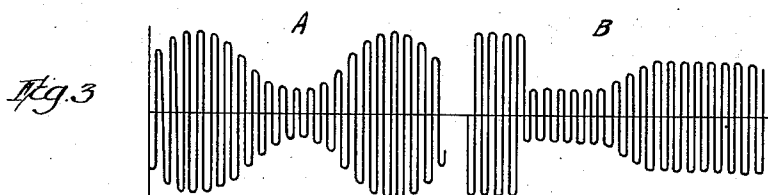
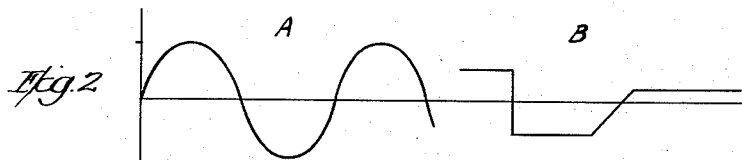
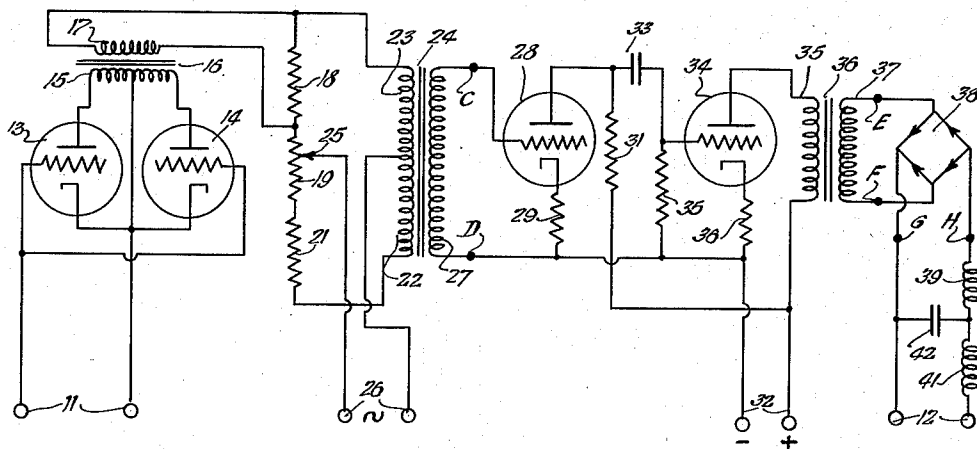
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AMPLIFIER SYSTEM

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Fig. 1



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AMPLIFIER SYSTEM

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11 Claims. (Cl. 179—171)

My invention relates to amplifier systems and more particularly to an amplifying system for direct currents or alternating currents.

Heretofore whenever it was desired to obtain amplification of direct currents or relatively low frequency alternating currents this was done by using direct-coupled amplifiers. In such amplifiers the grid of one vacuum tube is connected to the plate of the preceding tube so that changes in a direct current potential on the grid of the input tube will be amplified by the system. Such amplifiers are used for low frequency alternating currents whenever it is desired to eliminate the phase distortion which would be produced if the usual type of alternating current amplifier were utilized. Many direct-coupled amplifiers however, particularly when used for amplifying direct currents or low frequency alternating currents, have several disadvantages. One disadvantage results from the fact that small changes in the filament, plate, and grid supply voltages will produce erroneous indications in the output circuit. Still another disadvantage is the nature of the plate and filament supply voltages that are required. Accordingly it would be highly desirable to provide an amplifying system capable of amplifying direct or alternating voltages or currents with a high degree of wave form reproduction without introducing errors caused by changes in voltage of the source supplying the power to the amplifying system. Furthermore it would be desirable to provide an amplifying system which would operate to amplify direct currents or alternating currents from substantially zero to an upper limit which would be determined only by the physical limits of the component parts used in the amplifying system.

Therefore it is an object of my invention to provide an improved amplifying system for direct current or alternating current which has a high degree of wave form reproduction.

Another object of my invention is to provide an apparatus for and a method of amplifying direct or alternating current without introducing errors whenever the power source for the amplifying system varies in voltage.

Still another object of my invention is to provide in an amplifying system means for modulating an alternating current in accordance with direct or alternating current which is to be amplified.

In accordance with my invention it is possible to overcome the above mentioned disadvantages of the prior art by providing an amplifying system in which a generated alternating current is modulated in accordance with the direct current or alternating current to be amplified, the modu-

lated current is then amplified and subsequently demodulated to produce a current having a high degree of wave form reproduction corresponding to an amplification of the current to be amplified.

Other and further objects of my invention will become more readily apparent by reference to the following description taken in connection with the accompanying drawing wherein Figure 1 is a circuit diagram of a preferred embodiment of my invention; Figure 2 at A and B shows alternating and direct current voltages which are to be amplified; Figures 3 and 4 are explanatory of certain operations occurring within the amplifier; and Figure 5 illustrates the fidelity of wave form reproduction obtained by my invention.

Referring to Figure 1 of the drawing, there is shown a preferred embodiment of an amplifying system constructed in accordance with my invention which has an input circuit 11 and an output circuit 12. The input circuit 11 is connected between the grids and cathodes of a pair of vacuum tubes 13 and 14 the anodes of which are connected to the outer extremities of a mid-tap winding 15 of a transformer 16. The two control electrodes or grids of the tubes 13 and 14 are connected to the one side of the input circuit 11. The mid-point of the transformer 15 and the two cathodes of the tubes 13 and 14 are connected to the other side of the input circuit 11. A second transformer winding 17 of the transformer 16 is connected across an impedance 18. The impedance 18 is connected in a circuit having an impedance 19 provided with a sliding contact, an impedance 21, and transformer winding portions 22 and 23 of a transformer 24. The impedances 18, 19 and 21 together with the transformer windings 22 and 23 comprise a bridge circuit. One diagonal of the bridge extends from the common juncture of the windings 22 and 23 to an adjustable contact 25 on the impedance 19. Between this adjustable contact 25 and the common juncture of the windings 22 and 23 there is impressed an alternating current by means of a pair of the conductors 26. The alternating current supplied by the conductors 26 is preferably obtained from an alternating current generator having a frequency higher than the frequency of any current which is to be amplified and which would be connected to the input circuit 11. The transformer windings 22 and 23 which comprise two legs of the bridge adjacent one diagonal of the bridge are coupled to the transformer winding 27 of the transformer 24. The transformer winding 27 is connected to the input of a vacuum tube 28, which is provided with a cathode resistor 29. The anode of the vacuum tube 28 is connected through a plate resistor 31 to a suitable source of plate voltage obtained from

across the conductors 32. The output of the plate or anode of the vacuum tube 28 is coupled through a coupling capacitor 33 to an input circuit of a vacuum tube 34 which has a grid circuit coupling resistor 35 and a cathode resistor 36. The anode of the vacuum tube 34 is connected through primary winding 35 of a transformer 36 to the conductors 32 which supply plate potential to the vacuum tubes 28 and 34. A second transformer winding 37 of the transformer 36 is connected to a suitable full wave rectifier which may comprise a bridge rectifier such as shown. The output of the full wave rectifier 38 is connected through a filter circuit having a pair of series inductors 39 and 41 and a filter capacitor 42, to the output terminals 12.

By referring to Figures 2, 3, 4, and 5 in connection with Figure 1, the operation of the amplifying system will become readily apparent. If it is assumed that it is desired to amplify alternating current such as shown at A in Figure 2, this voltage appearing on the control electrodes of both of the vacuum tubes 13 and 14 will produce a variation in the effect of the impedance 18 which is a portion of one leg of a bridge circuit. Since the alternating current source connected to the terminals or conductors 26 supplies to the bridge circuit alternating current which appears across the leg of the bridge including the impedance 18, there will appear in winding 17 of transformer 16 alternating current potentials which energize the transformer winding 15 so that alternating current voltages will appear between the cathodes and anodes of the vacuum tubes 13 and 14. The vacuum tubes 13 and 14 are so selected or arranged that they will operate as half wave rectifiers. While by proper selection of vacuum tubes which will operate in the manner corresponding to Class B amplifiers, the circuit may be as shown, it will readily be appreciated that other vacuum tubes may be caused to operate in a similar manner by inserting between the cathodes and the mid-tap of the transformer winding 15 a suitable plate voltage. Since the vacuum tubes 13 and 14 will operate as half wave rectifiers, the transformer 16 is loaded during each half cycle of the alternating current appearing across the transformer 17. This loading of the transformer winding 17 changes the effect of the impedance 18 in one leg of the bridge. Thus the variation of the impedance 18 will be one which corresponds to a function of the plate resistance of the vacuum tubes 13 and 14. This variation in plate resistance is determined by the voltage appearing across the input circuit 11.

In the absence of any input voltage appearing across the circuit 11, the bridge is balanced by means of the adjustable contact 25 operating on the impedance 19. Any variation of the position of the adjustable contact 25 from the point of balance will cause a constant amount of the alternating current supplied from the alternating current generator by the conductor 26, to appear across the transformer winding 27. By such an arrangement therefore it is possible to control the percentage of modulation of the alternating current supplied to the bridge by the conductors 26. Therefore if it is assumed that the input circuit 11 is being supplied with an alternating potential or alternating current corresponding to that shown in Figure 2A, there will appear across the terminals CD of the transformer winding 27 an alternating current which is represented by Figure 3A. The alternating current voltage appearing across the terminals EF or across the trans-

former winding 27 will also correspond to the representation shown in Figure 3A, if it is assumed that the ordinates now have a greater value than heretofore. This current which is now passed through the full wave rectifier 38 will then produce current across the terminals GH corresponding to the representation shown in Figure 4. This in turn is transmitted through the filters to the output terminals where the resultant current will be that represented in Figure 5.

If now it is assumed that it is desired to amplify a direct current which corresponds to the representation shown in Figure 2B, the alternating current potential appearing across the terminals CD and the terminals EF will be represented by curves similar to that shown in Figure 3B. The output of the rectifier 38 for such voltage will then be represented by the curve shown in Figure 4B. After passing through the filters the voltage appearing across the output terminals 12 is that represented by Figure 5B.

It is to be understood that the amplifying system shown in Figure 1 is suitable for amplifying currents and voltages and that the terms alternating current and direct current have been used in the description and explanation in a broad sense so as to distinguish between two different types of currents or voltages which may be amplified by the system.

From the above description and explanation of the amplifying system it will be seen that in effect this system comprises a source of alternating current having a frequency higher than that of any signal which is to be amplified, means for modulating such alternating current, an amplifier, a demodulator, and a filter. Due to the fact that the amplification is accomplished by the use of modulated alternating current having a high frequency as compared to the very low frequency of the input signal, the system operates with high stability so that any variations in the voltage of the source of power supplying filament or plate voltage will have substantially no detrimental effect on the signal appearing across the output circuit. The frequency range over which the system will operate is determined by the selection of the components and hence it is apparent that the system will amplify direct current, and alternating current beginning just above zero to any desired frequency value. By selection of proper tubes and other components the degree of amplification may be readily determined regardless of how low in intensity the signal or current to be amplified may be.

While for the purpose of illustration and description there has been shown a preferred embodiment of an amplifying system constructed in accordance with my invention, it is to be understood that I do not wish to be limited thereto since obviously modifications may be made in the circuit arrangements and in the instrumentalities employed without departing from the spirit and scope of my invention as set forth in the appended claims.

What I claim as new and desire to secure by Letters Patent of the United States is:

1. A direct current or alternating current amplifying system comprising a bridge connected at diagonal points to a source of alternating current having a frequency higher than the frequency of any alternating current to be amplified, an impedance element connected in one leg of the bridge, means including a vacuum tube rectifier for varying the effect of said impedance element in accordance with the current to be amplified, an

amplifier having its input connected to adjacent legs of said bridge, and a rectifier connected to the output of said amplifier.

2. A system for amplifying direct or alternating currents comprising a bridge connected at diagonal points to a source of alternating current having a frequency higher than that of any alternating current to be amplified, means including a controlled vacuum tube rectifier for varying the effect of an impedance element connected in one leg of said bridge in accordance with the current to be amplified, an amplifier connected across the other diagonal of said bridge, and a rectifier connected to the output of said amplifier.

3. A system for amplifying direct or alternating currents comprising a bridge, a source of alternating current having a frequency higher than the frequency of any current to be amplified, said source being connected to one diagonal of said bridge, an amplifier connected to the other diagonal of said bridge, a rectifier connected to the output of said amplifier, a vacuum tube rectifier connected to the impedance of one leg of said bridge so that the impedance thereof will vary in accordance with the variations of plate resistance of said tube, and an input circuit for said tube for receiving direct or alternating currents to be amplified.

4. A system for amplifying direct or alternating currents comprising a vacuum tube full wave rectifier having an input circuit for receiving direct or alternating currents to be amplified, a bridge connected at one diagonal to a source of alternating current having a frequency higher than that of any current to be amplified, means connected between said vacuum tube and one leg of said bridge whereby the impedance thereof will be varied in accordance with variations in the plate resistance of the tubes of said rectifier, an amplifier connected to the other diagonal of said bridge, and a rectifier connected to the output of said amplifier.

5. A system for amplifying direct or alternating currents comprising a bridge connected at diagonal points to a source of alternating current having a frequency higher than the frequency of any current to be amplified, an impedance element connected to one leg of said bridge, means including a full wave controlled vacuum tube rectifier for varying the effect of said impedance in accordance with the current to be amplified, and an amplifier having its input circuit energized from two legs of said bridge adjacent said diagonal.

6. The combination in a system for amplifying direct or alternating currents comprising a bridge connected at one diagonal to a source of alternating current having a frequency higher than that of any current to be amplified, and means for varying the impedance in one leg of said bridge in accordance with the current to be amplified, said means including a pair of vacuum tubes each having a control electrode, a transformer having a mid-tapped winding connected between the anodes and cathodes of said tubes and another winding connected to said leg of said bridge, and an input circuit for the current to be amplified connected between said control electrodes and said cathodes.

7. In a system for amplifying direct or alternating currents, means for controlling the amplitude of alternating current supplied from a source having a frequency higher than that of any current to be amplified, a bridge circuit hav-

ing one diagonal connected to said source, an output circuit energized from two legs on said bridge adjacent said diagonal, and means for varying the impedance of another leg of said bridge in accordance with the current to be amplified comprising a transformer having one winding connected to said latter leg and another winding connected between the anodes and the cathodes of a pair of vacuum tubes each having a control electrode, and a circuit connected to cathodes and said control electrodes for receiving current to be amplified, said cathodes being connected together, and said control electrodes being connected together.

8. A direct current or alternating current amplifying system comprising a bridge connected at one diagonal to a source of alternating current having a frequency higher than the frequency of any alternating current to be amplified, an alternating current amplifier connected to the other diagonal of said bridge, a rectifier connected to said amplifier, an inductance having a plurality of windings, one of said windings being connected across one leg of said bridge, and means connected to another winding of said inductance for passing therethrough a direct current proportional to the current to be amplified thereby to proportionally vary the effect of said inductance on said bridge.

9. A direct current or alternating current amplifying system comprising a bridge connected at one diagonal to a source of alternating current having a frequency higher than the frequency of any alternating current to be amplified, an alternating current amplifier connected to the other diagonal of said bridge, a rectifier connected to said amplifier, an inductance having a plurality of windings, one of said windings being connected across one leg of said bridge, the other of said windings comprising a mid-tapped winding, a pair of vacuum tube rectifiers each having an anode, a cathode and a control electrode, said anodes being connected to the outer terminals of said other winding, said cathodes being connected to the mid-tap of said winding, and an input circuit connected between said cathodes and both control electrodes.

10. A system for amplifying direct or alternating currents comprising a bridge connected at one diagonal to a source of alternating current of a frequency greater than that of any alternating current to be amplified, an amplifier connected to the other diagonal of said bridge, an inductance having a plurality of windings, one of said windings being connected to one leg of said bridge, a full wave controlled vacuum tube rectifier connected across another winding of said inductance, and means for controlling the conductivity of said rectifier in accordance with the current to be amplified.

11. A direct or alternating current amplifying system having a bridge, a source of alternating current connected to one diagonal of said bridge, an amplifier connected to the other diagonal of said bridge, a transformer having one winding connected to one leg of said bridge, said transformer having a second winding provided with a midpoint, a pair of grid controlled vacuum tubes having their cathodes connected to the midpoint of said winding and their anodes each connected to one terminal of said winding, means connecting said grids together, and an input circuit for the current to be amplified connected between said grids and said cathodes.

FREDERICK K. FLOYD.