March 2, 1926. H. A. AFFEL 1,574,779

TRANSLATING CIRCUITS

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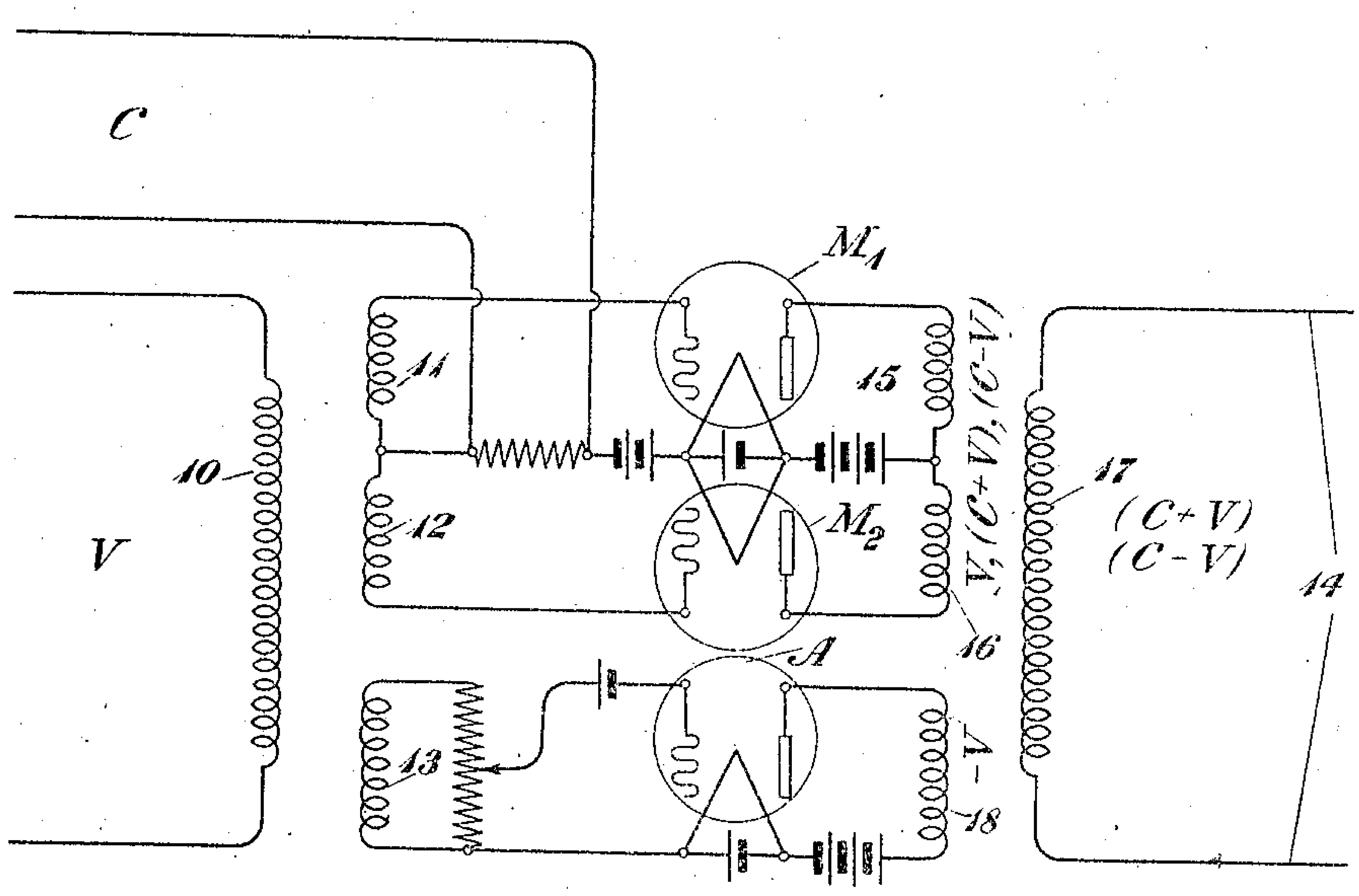

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TRANSLATING CIRCUITS.

Application filed October 5, 1921. Serial No. 505,529.

To all whom it may concern:

Be it known that I, HERMAN A. AFFEL, residing at Brooklyn, in the county of Kings and State of New York, have invented certain Improvements in Translating Circuits, of which the following is a specification.

This invention relates to translating circuits, and more particularly to translating circuits adapted to suppress certain components resulting from the translating operation.

Where a balanced type of vacuum tube modulator is employed for the purpose of modulating carrier currents in accordance with signaling or voice currents it is possible to suppress in the output circuit either the unmodulated carrier component or the modulating signal current. It is not possible by means of balanced type of circuit to suppress both the carrier component and the modulating component. This is for the reason that the balanced circuit is so arranged that the tubes are connected cumulatively with respect to one of the input currents—that is, the carrier or the modulating current—but is connected to operate differentially with respect to one of the other input current. If, for example, the circuit is arranged so that the tubes act cumulatively with respect to the modulating current, even though the tubes may be adjusted for the greatest modulating effect by operation upon the lower curved portion of the characteristic curve, the linear amplification components of the curve will still be present to a sufficient extent to allow considerable amplification of the modulating frequency.

One of the objects of the present invention is to balance out by auxiliary means the component transmitted through the modulator by reason of this straight amplification effect in the modulation circuit. This may be done, for example, by passing a certain amount of the input modulating energy through an auxiliary vacuum tube circuit in which the adjustment is such that the operation is mainly that of amplification, the amplified energy of the modulating frequency being applied to the output circuit in such a way as to oppose the energy due to the amplifying effect of the tubes.

The above object, as well as other objects of the invention, may be attained by means of various organizations, an example of which is set forth in the following description and illustrated in the single figure of the accompanying drawing.

Referring to the drawing, M_1 and M_2 designate the modulating vacuum tubes connected in a duplex balanced circuit of the general type disclosed in the United States patent to John R. Carson, No. 1,343,307 of June 15, 1920. In accordance with the principles of said patent the carrier frequency c may be applied to the common path of the two grid circuits so that this frequency will be balanced out so far as the output circuit of the tubes is concerned. The voice or other signaling frequency v is serially applied to the two grid circuits through the transformer primary 10 and secondaries 11 and 12. As explained in said patent to John R. Carson, the modulating or voice frequency v and the two side frequencies $c + v$ and $c - v$ will appear in the output circuit. The carrier frequency c will not appear owing to the balanced relation of the tubes. The modulating or voice frequency v will always appear if applied to the modulating circuit for the reason that it is impressed upon the two grids in series and no balancing action takes place.

While it is true that the tubes will be adjusted to work upon the lower curved part of the characteristic curve in order to emphasize the modulating characteristics of the tubes, some amplifying effect will still be present. In order to neutralize the component v with respect to the outgoing circuit 14, which is associated with the output sides of the modulating tubes M_1 and M_2 through the primary windings 15 and 16 and secondary winding 17, an auxiliary tube A is provided. This tube has its input circuit associated with the source of modulating energy through a winding 13 inductively arranged with respect to the winding 10. Its output circuit is associated with the outgoing circuit 14 through a winding 18 inductively connected with the winding 17. The tube A is arranged to operate upon the straight or amplifying portion of the characteristic curve, and its amplification constant is so adjusted that the energy of frequency v applied to the input circuit of the tube will appear in the output circuit with the same amplitude as the energy appearing in the output circuit of the modulator due to the amplifying effect of the modulating tubes. By properly poling the transformer windings the amplified energy from the tube A will be equal in magnitude but opposite in sign to the amplified energy of modulating frequency in the output circuit of the modulator. Consequently the component of frequency v will be prevented from passing to the circuit 14 and only the side frequencies $c+v$ and $c-v$ will be present in said circuit.

The general action above described may be considered as a method in which two translating devices are employed, one operating in such a manner that its characteristic is chiefly non-linear, so that the modulating action predominates; the other translating device operating in such a manner that its characteristic is chiefly that of an amplifier, that is, linear; the connections being so arranged that the linear components remaining in the circuit of the first translating device, whose action is desired to be essentially non-linear, are balanced out by proper adjustment of the linear components of the circuit of the second translating device. The resultant action in the combined translating circuit is therefore more purely non-linear than that obtainable by the use of the first circuit alone.

It will be obvious that the general principles herein disclosed may be embodied in many other organizations widely different from those illustrated without departing from the spirit of the invention as defined in the following claims.

What is claimed is:

1. In a translating system in which two translating devices are employed, one having a characteristic which is chiefly non-linear and the other having a characteristic which is chiefly linear, the method of transmission which consists in subjecting energy to the action of the device whose characteristic is chiefly non-linear, thereby producing in the output of said device energy components due to its non-linear characteristic and other energy components due to the linear component of its characteristic, and subjecting a portion of the energy applied to said first mentioned translating device to the action of the translating device having the linear characteristic, the amount of energy so subjected being of such value as to produce translated energy equal in value to the components resulting from the linear action of said first translating device, and impressing the translated energy upon a transmission medium carrying said components resulting from the linear action of said first translating device but in opposite phase relation thereto.

2. In a translating system in which a translating device is employed, having a characteristic which is chiefly non-linear, the method of transmission which consists in subjecting energy to the action of said device whose characteristic is chiefly non-linear, thereby producing in the output of said device energy components due to its non-linear characteristic and other energy components due to the linear component of its characteristic, and in suppressing the energy components due to the linear action by applying to a transmission medium carrying said components an amount of the subjected energy equal in value to said components due to the linear action of the translating device, the energy thus applied to the transmitting medium being opposite in phase to the energy to be suppressed.

3. In a translating system employing a balanced modulator circuit in which two translating devices having chiefly non-linear characteristics are associated with certain input frequencies applied differentially with respect to the translating devices, and other input frequencies applied cumulatively with respect to the translating devices whereby the output current contains modulated component corresponding to said second mentioned input frequencies, but no component corresponding to said first mentioned input frequencies, the method of suppressing said first mentioned output component which consists in applying to a transmission medium carrying said unsurpressed components energy of the corresponding input frequency or frequencies, said applied energy being equal in amount and opposite in phase to said unbalanced component in the output of the modulator circuit.

4. In a translating system employing a translating device having a linear characteristic and a balanced modulator circuit in which two translating devices having chiefly non-linear characteristics are associated with certain input frequencies applied differentially with respect to the translating devices, and other input frequencies applied cumulatively with respect to the translating devices whereby the output current contains modulated component corresponding to said second mentioned input frequencies, but no component corresponding to said first mentioned input frequencies, the method of suppressing said first mentioned output component which consists in subjecting energy of the corresponding input frequency or frequencies to the action of the translating device having a linear characteristic, the amount of energy so subjected being of such value as to produce translated energy equal in value to the unbalanced modulator components, and impressing the translated energy upon a medium carrying said unbalanced components but in opposite phase relation thereto.

5. In a translating system, a balanced modulator circuit comprising a pair of

translating devices, a source of input energy applied differentially with respect to said devices, another source of input energy applied cumulatively with respect thereto, an outgoing circuit upon which the output energy of the modulator is applied, and means to impress upon said outgoing circuit, independently of said modulator, energy from said cumulatively applied source, said means translating the energy from said source without substantial change in wave form.

6. In a translating system, a balanced modulator circuit comprising a pair of translating devices, a source of energy applied differentially with respect to said translating devices, and another source of energy applied cumulatively with respect thereto, whereby the output energy of the modulator will contain a component corresponding to the latter source but no component corresponding to the former source, an outgoing circuit upon which the output energy of the modulator is impressed, and means for impressing upon said outgoing circuit, independently of said modulator, energy from said cumulatively applied source, with such amplitude and phase relation as to neutralize the effects of the component of the output current of the modulator corresponding to said cumulatively applied source, said means translating the energy from said source without substantial change in wave form.

7. In a translating system, a balanced modulator circuit comprising a pair of translating devices, a source of energy applied differentially with respect to said translating devices, and another source of energy applied cumulatively with respect thereto, whereby the output energy of the modulator will contain a component corresponding to the latter source but no component corresponding to the former source, an outgoing circuit upon which the output energy of the modulator is impressed, an auxiliary translating device, means to apply a portion of the energy from said cumulatively applied source to said auxiliary translating device for translation without substantial change in wave form, and means to apply the output energy of said auxiliary translating device upon said outgoing circuit in such phase relation as to neutralize the effects of the component of the output current of the modulator corresponding to said cumulatively applied source.

8. In a translating system, a modulating device comprising a translator whose characteristic is chiefly non-linear, a source of energy applied differentially with respect to said translator and a source of energy applied cumulatively thereto, so that a component will be present in the output current of the translator corresponding to said last mentioned source, but no component will be present corresponding to the first mentioned source, an auxiliary translator whose characteristic is chiefly linear, means to impress energy from said second mentioned source upon said last mentioned translator, an outgoing circuit, means to impress the output energy from said modulator upon said outgoing circuit, and means to impress the energy from the translator having the linear characteristic upon said outgoing circuit in opposite phase relation to the component of the modulator current corresponding to the source applied cumulatively with respect to the translator having the non-linear characteristic.

9. In a translating system, a modulator, including two translating devices having chiefly non-linear characteristics, said translating devices being arranged in a balanced circuit, a source of energy applied differentially to said translating devices, and a second source of energy applied cumulatively with respect to said translating devices, whereby the output current of the modulator will include a component corresponding to said second mentioned source, but no component corresponding to the first mentioned source, an auxiliary translating device having a linear characteristic, means to impress upon said last mentioned translating device energy from said second source, an outgoing circuit, means to impress the energy of the output current of the modulator upon said outgoing circuit, and means to impress energy from the translating device having the linear characteristic upon said outgoing circuit in opposite phase relation to the component of the output current of the modulator corresponding to the second source.

In testimony whereof, I have signed my name to this specification this 21st day of September 1921.

HERMAN A. AFFEL.