Dec. 24, 1935. F. A. COWAN 2,025,158

MODULATING SYSTEM

Filed June 7, 1934

FIG. 1

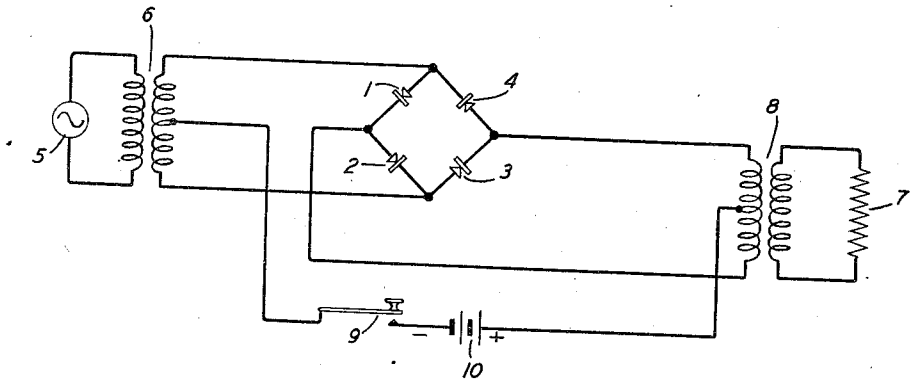
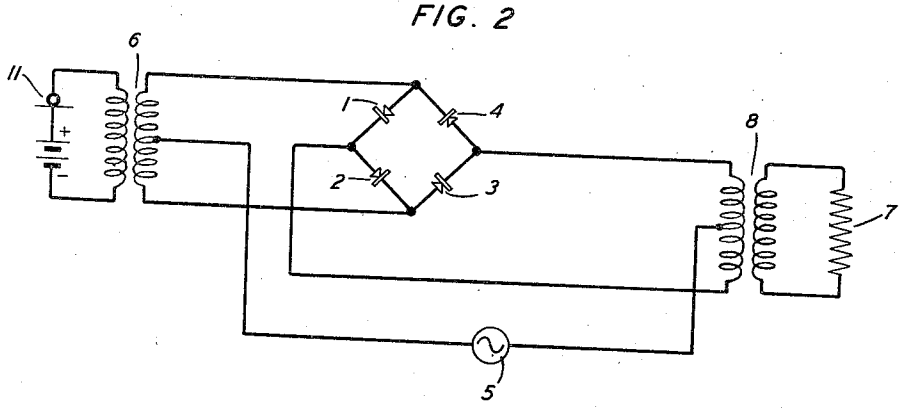


FIG. 2



INVENTOR
F. A. COWAN

BY

ATTORNEY

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MODULATING SYSTEM

Frank Augustus Cowan, New York, N. Y., assignor to American Telephone and Telegraph Company, a corporation of New York

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This invention relates to modulating systems and more particularly to modulating systems in which a plurality of undesired currents are suppressed in the load circuit.

The main object of the invention is to increase the simplicity and economy of modulating systems.

Another object is to improve the degree of suppression of the carrier and of unwanted currents in various portions of the system.

United States Patent No. 1,855,576, issued April 26, 1932 to C. R. Keith, shows a modulating system which provides for the suppression of harmonics and certain other classes of modulation products in addition to the carrier and impressed signals in the load circuits, thereby transmitting substantially sidebands alone. Features of Keith's system include the provision of three mutually conjugate circuit branches and the adaptability of the system for simultaneous use as a modulator and a demodulator. His arrangement utilizes balanced transformers, eight critically adjusted windings in all being required, together with four rectifiers which serve as modulating elements. In the present state of the art, transformers are expensive, particularly if the windings are balanced.

In accordance with this invention, I connect four rectifiers in a novel bridge arrangement with which only two transformers, including a total of four balanced windings, are required to provide a circuit possessing all the above mentioned advantages. The number of components in my circuit is reduced to a virtual minimum, with the result that great simplicity of design is effected and the cost is low.

The invention will be more fully understood from the following detailed description and the accompanying drawing of which,

Figs. 1 and 2 represent two different embodiments of the invention.

In Fig. 1, reference characters 1, 2, 3 and 4 indicate the ratio arms of a bridge network, comprising rectifying elements all having their best conductivity in one direction around the closed loop in which they are joined. These rectifying elements may be of the copper oxide type or may be diode vacuum tubes. A carrier current generator 5 is connected to one diagonal of the bridge through an input transformer 6 having a divided secondary winding. In the other diagonal of the bridge a load circuit 7 is connected by means of an output transformer 8 having a divided primary winding. A telegraph key 9 and a battery 10 are connected between the division points of the respective transformer windings.

In the operation of the system of Fig. 1, when key 9 is open the alternating current from source 5 flows into the bridge but is not transmitted to the output circuit, assuming that the ratio arms are properly balanced, as for example, when they comprise substantially identical elements. During one-half cycle the current flows mainly in rectifiers 1 and 2 and during the other half cycle in rectifiers 3 and 4, but there is substantially no voltage induced across transformer 8. When key 9 is closed, with the battery 10 poled as shown, a direct current flows from the battery, in two parallel circuits as follows: (1) through the upper part of the primary of transformer 8, rectifier 4, and the upper part of the secondary of transformer 6; (2) through the lower part of the primary of transformer 8, rectifier 2, and the lower part of the secondary of transformer 6. At the same time the battery impresses a blocking potential across the two remaining rectifiers. The conducting rectifiers 2 and 4 present a low impedance while the blocked rectifiers 1 and 3 present a high impedance to the alternating current from source 5. Consequently, the bridge is unbalanced, permitting alternating current to pass from the source to the load. Moreover, the similarity of the rectifiers insures equal currents through the two portions of each divided winding. By using windings having two equal parts the currents therein may be balanced out with with respect to their effects, upon the circuits connected to the respective transformers. In other words, currents from the battery do not induce voltages either across the load or across the generator 5, the key and battery acting merely as a means to control the transmission of energy from the generator to the load. The arrangement may serve for example as a carrier telegraph transmitting system. The symmetry of the circuit insures that the generator shall not induce any appreciable voltage across the keying circuit. Usually the particular polarity of the battery is not material.

It is evident from the foregoing description that the system of Fig. 1 may be adjusted in such manner that it will possess three pairs of mutually conjugate branches. The bridge diagonals are conjugate to each other and each diagonal is in turn conjugate to the keying circuit. It is apparent also that the three external circuits, namely the alternating current or carrier source, the control or keying circuit, and the load may be rearranged in any desired permutation as

regards the particular circuit branch each occupies.

Fig. 2 shows a telephone transmitter 11 connected to transformer 6 and the generator 5 placed between the midpoints of the divided transformer windings. Otherwise, the arrangement is identical with that in Fig. 1. This system operates as a radio or carrier modulator system the carrier wave being supplied by the generator 5. Because of the balance of the divided windings of transformers 6 and 8 the carrier wave is not transmitted either to the load 7 or the source 11. By its biasing action on the rectifier elements, however, an intermittent flow of the signal current through the system from the source to the load is permitted. There is thus established in the load 7 a modulated high frequency current corresponding to the signal current subjected to reversals at the carrier frequency rate. This, as is well known, represents a modulated carrier wave with the carrier component suppressed. For the best operation of the system the amplitude of the carrier wave should be large compared with that of the signal wave.

The arrangement is especially useful in signal inversion schemes for promoting secrecy, such as in Kendall Patent 1,571,010 of January 26, 1926. In these systems, it is usual to invert the frequencies of the signal components. The inverted band may lie partly or wholly within the same frequency range as the original signal. It is then important to keep any uninverted signal from reaching the load. Further, it is desirable to suppress the carrier. The system of the invention suppresses the uninverted signal, the carrier, and all their harmonics, as well as certain of the combination products incidental to modulation.

What is claimed is:

1. A modulating system comprising a rectifier bridge, an input transformer with a divided secondary winding, said winding being connected across one diagonal of the bridge, an output transformer with a divided primary winding, said primary winding being connected across the other diagonal of the bridge, and connections to the respective division points, the rectifiers being so poled that said connections together with the two remaining transformer windings constitute three mutually conjugate circuit branches.

2. A modulating system comprising four rectifiers connected together in a closed loop each with its best conductivity in the same direction around the loop, a network including said rectifiers and having three mutually conjugate branches, and a signal source, a carrier source and a load circuit connected respectively in the said three branches.

3. A modulating system comprising four rectifiers joined in series-aiding relation in a closed loop or bridge, an input transformer with divided secondary winding connected across one diagonal of the bridge, a carrier source connected to the primary of said input transformer, an output transformer with divided primary connected across the other diagonal, a load circuit across the secondary of the output transformer, and a signal source bridged between the division points of the two transformers.

4. A modulating system comprising four rectifiers connected together in series-aiding relation in a closed loop or bridge, a signal source connected in one diagonal of the bridge, a load circuit connected in the other diagonal, a carrier source, and means to connect said carrier source to the bridge in conjugate relation both to the signal source and to the load circuit.

5. A modulating system comprising four rectifiers joined in series-aiding relation in a closed loop or bridge, an input transformer with divided secondary winding connected across one diagonal of the bridge, a signal source connected to the primary winding of the input transformer, an output transformer with divided primary winding connected across the other diagonal, a load circuit across the secondary of the output transformer, and a carrier source bridged between the division points of the two transformers.

FRANK A. COWAN.