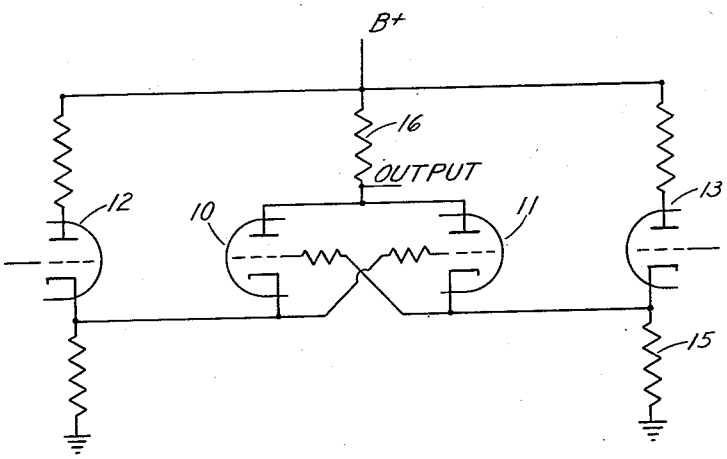
Sept. 11, 1951 H. W. KOHLER 2,567,214

COMBINING CIRCUITS

Filed Aug. 20, 1945



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Patented Sept. 11, 1951 2,567,214

UNITED STATES PATENT OFFICE

2,567,214

COMBINING CIRCUITS

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Application August 20, 1945, Serial No. 611,680

4 Claims. (Cl. 250—27)

(Granted under the act of March 3, 1883, as amended April 30, 1928; 370 O. G. 757)

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The invention described herein may be manufactured and used by or for the Government for governmental purposes, without the payment to me of any royalty thereon.

This invention is in electrical apparatus and particularly is a circuit for effectively adding two electrical signals.

Relay-operated devices for combining mark-space signals (Teletype, for example) to provide privacy or economy are well known (see the patent to Vernam, No. 1,310,719). The signals handled by such apparatuses, however, are composed of bauds on the order of twenty milliseconds in length, and, when much higher frequencies are desired to be handled—two to three millisecond bauds, for instance—relay operation cannot be depended upon, and reliance must be placed on electronic circuits.

The principal object of this invention is to provide novel electronic means for combining two high frequency mark-space signals.

Other objects will be apparent from a reading of the following specification and claims.

The single drawing is a schematic diagram of the electronic circuit of my invention.

Referring to the drawing, 10 and 11 represent two halves of a high-mu double triode. Elements 10 and 11 are intended to be either on or off during the entire length of a baud and may be a part of or controlled by two Eccles-Jordan circuits. A low-mu double triode, comprising triode sections 12 and 13, is provided; the intelligence signal is applied to the grid of section 12 and the keying signal to the grid of member 13. It will be understood that corresponding bauds of the two signals will be equal in length, and, commonly, all bauds will be of equal length.

Two suitable tubes may, of course, be used in place of each of the double triodes, and in the description to follow the halves of the two double triodes may be referred to as tubes.

The cathodes of tubes 12 and 13 are connected to the cathodes of tubes 10 and 11, respectively, and thus the cathode potentials of all tubes are determined essentially by the plate currents of tubes 12 and 13.

Assuming that plate current is flowing in tube 12 while none is flowing in tube 13, the cathode of tube 10 is then at some positive potential with respect to ground, as is the grid of tube 11. The cathode of tube 11 is at a smaller positive potential with respect to ground due to plate current flowing in the latter tube and through cathode resistor 15 of tube 13. As a result, tube 10 is cut off while tube 11 is conducting, and a certain

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voltage drop—depending upon the values of the various components of the circuit—is developed across plate resistor 16.

Obviously, if tube 13 is conducting and tube 12 is cut off, tube 11 will in turn be cut off while tube 10 will conduct and the voltage drop across resistor 16 will be the same as before. These two conditions represent the addition of an on and an off signal, it being apparent that it makes no difference in the result whether the intelligence signal contains a marking baud and the keying signal a spacing baud during a particular time interval, or vice versa.

Should both tubes 12 and 13 be cut off, this representing a case where both intelligence signal and keying signal contain off or spacing bauds, the grid-cathode potentials of tubes 10 and 11 are essentially zero, and the voltage drop across resistor 16 is twice as large as before described. Similarly, when both tubes 12 and 13 are conducting, the grid-cathode potentials of tubes 10 and 11 are substantially zero.

The expressions "mark-space" and "on-off," and their elements, have been used interchangeably herein. Generally, of course, an on-off signal is utilized in communications of the nature here involved, but other two-level signals are possible and can be combined following the principles of this invention. In the claims, therefore, the expression "mark-space signal" or the like should be considered to define all usable two-level signals.

One specific embodiment of the invention has herein been described and shown. Many modifications will suggest themselves, however, to those skilled in the art as, for example, the substitution of pentode tubes for the high-mu triodes 10—11. For the true scope of my invention, therefore, reference should be had to the appended claims.

I claim:

1. A circuit of the nature described including a first tube and a second tube each tube having a cathode, a plate, and a grid element, a third tube and a fourth tube each having a cathode, means for applying a mark-space signal to said third tube, means for applying another mark-space signal to said fourth tube, means connected to all of said tubes for biasing the same to make the said third and fourth tubes conductive responsive to the applied mark-space signals and for making the said first and second tubes conductive responsive to the outputs of said third and fourth tubes, means interconnecting the cathodes of said first and third tubes and the

grid element of said second tube, and means for interconnecting the cathodes of said second and fourth tubes and the grid element of said first tube.

2. A circuit of the nature described including a first tube and a second tube each tube having a cathode, a plate, and a grid element, a third tube and a fourth tube each having a cathode, means for applying a mark-space signal to said third tube, means for applying another mark-space signal to said fourth tube, means connected to all of said tubes for biasing the same to make the said third and fourth tubes conductive responsive to the applied mark-space signals and for making the said first and second tubes conductive responsive to the outputs of said third and fourth tubes, means interconnecting the cathodes of said first and third tubes and the grid element of said second tube, means for interconnecting the cathodes of said second and fourth tubes and the grid element of said first tube, a common plate resistor for said first and second tubes, and means for taking the output of the circuit across the said resistor.

3. A circuit of the nature described including a first high-mu triode and a second high-mu triode, a first low-mu triode and a second low-mu triode, means for supplying a mark-space signal to one of said low-mu triodes, means for supplying another mark-space signal to the other of

said low-mu triodes, means connected to all of said triodes for making the said low-mu triodes conductive responsive to said mark-space signals, and the high-mu triodes conductive responsive to said low-mu triodes, means for interconnecting said triodes to maintain at substantially like potentials the cathode of one of said low-mu triodes, the cathode of one of said high-mu triodes, and the grid element of the other of said high-mu triodes, on the one hand, and, on the other hand, the cathode of the other of said low-mu triodes, the cathode of the other of said high-mu triodes, and the grid element of the said one of said high-mu triodes.

4. A circuit of the nature described including a duplex tube, each half thereof having a cathode, a plate, and a grid element, a common circuit for the plates of said tube, a first means responsive to a mark-space signal for supplying a signal to the cathode of one-half of said tube and the grid element of the other half thereof, a second means responsive to another mark-space signal for supplying a signal to the cathode of the other half of said tube and the grid of said one-half, and biasing means connected to said tube for conditioning said halves of said tube for conduction responsive to said supplied signals.

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No references cited.