Feb. 7, 1950 H. B. SMITH 2,496,317

COMBINING CIRCUIT

Filed Dec. 24, 1946

FIG. 1

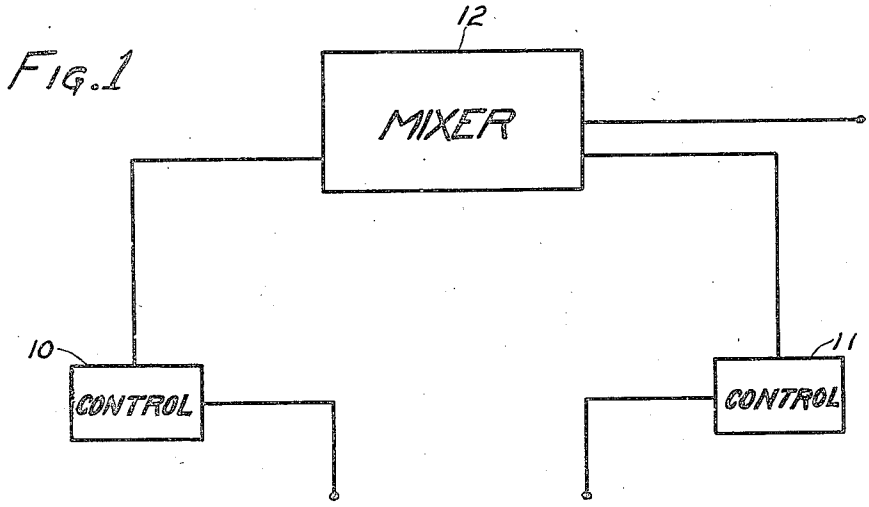
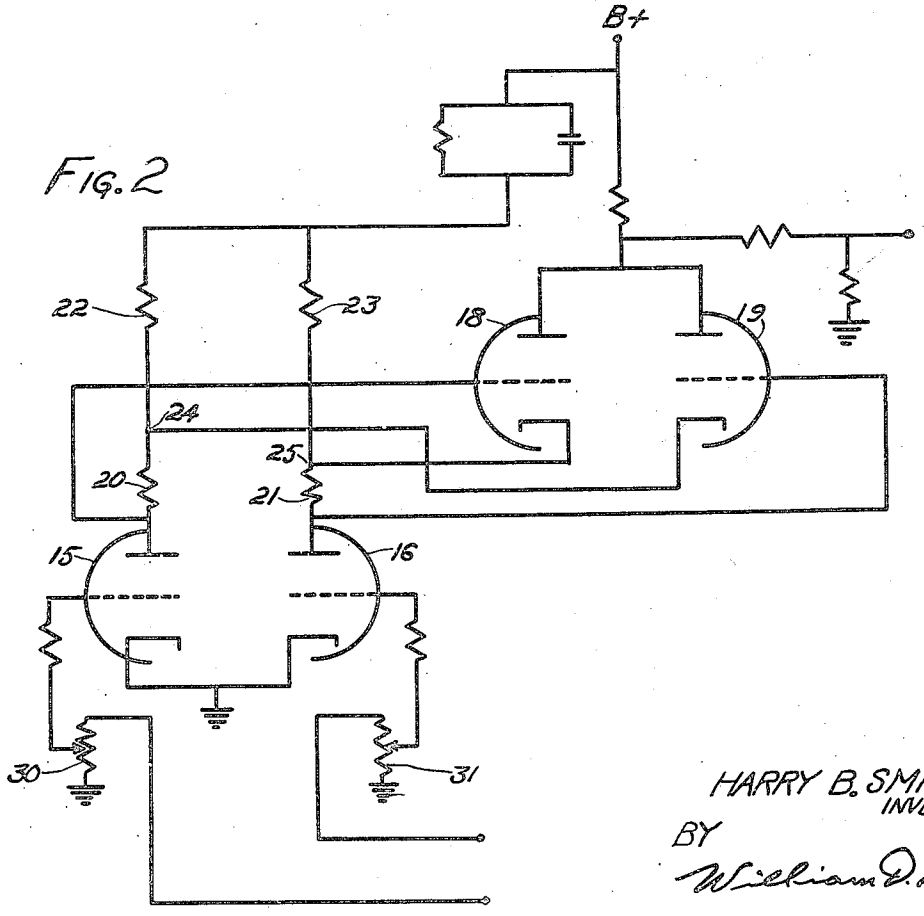


FIG. 2



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COMBINING CIRCUIT

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2 Claims. (Cl. 250—27)

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This invention is in electrical apparatus and more particularly is a novel mixing or combining circuit.

The primary object of the invention is to provide a circuit for combining two Baudot electrical signals to obtain a third Baudot type signal, the combining being in accordance with the so-called Vernam rule (see the patent to Vernam, No. 1,310,719). According to this rule, the following results may be obtained by adding two Baudot signals ("+" representing a marking signal and "—", a spacing signal).

+ − + −	+ − + −
+ − − +	+ − − +
+ + − −	− − + +

Another object is to provide a circuit for combining two electrical signals and indicating a similarity or difference in their amplitudes.

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

In the drawings:

Figure 1 is a block diagram illustrating the basic features of the invention; and

Figure 2 is a schematic diagram of the mixer stage of Figure 1.

It will be understood that the invention is primarily concerned with mark-space or on-off signals, and it is to such signals that reference will be made in the following description, although signals of any two desired levels may be combined.

With reference to the drawings and especially to Figure 1, control stages 10 and 11 are identical and may herein be considered to comprise any means for supplying on-off or two-level signals of the Baudot type. If speeds of the order of those encountered in telegraph work are to be handled, the control stages may conveniently operate with standard perforated tapes and relays. At higher speeds, tubes will be employed. The signals are combined in mixer stage 12.

According to Figure 2, the mixer stage includes two tubes 15 and 16 (which may be enclosed in a single envelope), these serving as switching tubes for the mixer proper. High-mu triodes are shown, but high-gain pentodes may be employed. Tube 15 is biased in such fashion that one signal from its control stage 10 (a marking signal, for example) is more positive than its grid bias, whereas the other signal (spacing) is less positive than said grid bias. Tube 16 is similarly biased with respect to the signals from its control stage 11.

The output of tube 15 is taken from the plate and is used to control one half of the mixer proper

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(tube 18), and a signal, similarly taken from tube 16 and fed to the grid of tube 19 (the other half of the mixer), is used to control the latter-mentioned tube.

The two switching stages 15 and 16 are identical so that plate resistors 20 and 21 are of like value as are resistors 22 and 23. The result is that under conditions of no signal the voltage at the plate of tube 15 equals that at the plate of tube 16 while the voltage at point 24 equals that at point 25. At no signal, therefore, the cathodes of tubes 18 and 19 are equally more positive than their grids by amounts represented by the drops across resistors 20 and 21. The value of resistor 22 is so proportioned with respect to the value of 20, and that of 23 with that of 21, that regardless of the degree of conductivity of switching tubes 15 and 16, the voltage drops across plate resistors 20 and 21 are sufficient to hold mixing tubes 18 and 19 cut off.

Similarly, if spacing signals are applied simultaneously to tubes 15 and 16, the voltage drops across resistors 20 and 21 will be equal and, while smaller than before, still not small enough to raise the grids of tubes 18 and 19 above cut off.

In either case, the output of the mixing circuit remains at the same figure, fixed by the values of the various circuit components.

If, however, a marking signal is applied to the grid of tube 15 while a spacing signal is applied to the grid of tube 16, the voltage drop across resistor 20 is larger than at no signal while the drop across resistor 21 is smaller than at no signal. Consequently, the voltage at the plate of tube 15 is smaller, that is to say, less positive than the voltage at the plate of tube 16, and tube 19 (with its cathode less positive and its grid more positive than normally) will conduct to saturation. Conversely, if switching tube 16 conducts while a spacing signal is applied to tube 15, mixing tube 18 conducts while tube 19 remains cut off. In either case, the output of the mixing circuit assumes a new value, lower than before.

The circuit illustrated can readily handle not only mark-space signals but signals of randomly varying amplitudes as well. In the latter case, it will be desirable to calibrate the output of the mixer stage. If necessary, the input signals can be stepped down through potentiometers 30 and 31.

For delicate comparisons, a high-stability, high-gain amplification stage can be direct-coupled into each control stage.

The foregoing description is in specific terms, and many modifications will readily suggest

themselves to those skilled in the art. For the true scope of the invention, therefore, reference should be had to the appended claims.

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.

I claim:

1. In a circuit of the nature described, a first switching tube having a plate, a second switching tube having a plate, means for applying input signals one to each switching tube, a plate voltage supply for said tubes, similar voltage dividing means between each plate and said supply, two substantially similar mixing tubes having cathodes and control electrodes, grid biasing means for said first mixing tube including a tap on one of the voltage dividers, and means including a tap on the other voltage divider for biasing the grid of said second mixing tube, a tap on said one voltage divider at a point more positive than the first mentioned tap on said voltage divider for supplying the cathode of said second mixing tube, a tap on said other voltage divider at a point more positive than the first mentioned tap thereon for supplying the cathode of said first mentioned mixing tube, and a common output for said mixing tubes.

2. An apparatus of the nature described, including a first switching tube having a plate and a control electrode, a second switching tube having a plate and a control electrode, means for applying one signal to the control electrode of one of

said switching tubes and for applying another signal to the control electrode of the other of said switching tubes, plate voltage supply circuits for said switching tubes each of said circuits including voltage dividing means, a first mixing tube, and a second mixing tube each of said latter tubes including a cathode, a control electrode, and a plate the plates of said mixing tubes being tied together to provide a common output for said mixing tubes, means for tapping the cathode of one of said mixing tubes and the control electrode of the other of said mixing tubes to one of said voltage dividers thereby to maintain the last-mentioned cathode at a constantly higher potential than the last-mentioned control electrode, and means for tapping the cathode of the other of said mixing tubes and the control electrode of the first-mentioned mixing tube to the other of said voltage dividers thereby to maintain the last-mentioned cathode at a constantly higher potential than the last mentioned control electrode.

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The following references are of record in the file of this patent:

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