Oct. 14, 1952 J. BOISVIEUX ET AL 2,614,247

PULSE MODULATING SYSTEM

Filed Dec. 22, 1948

FIG. 1.

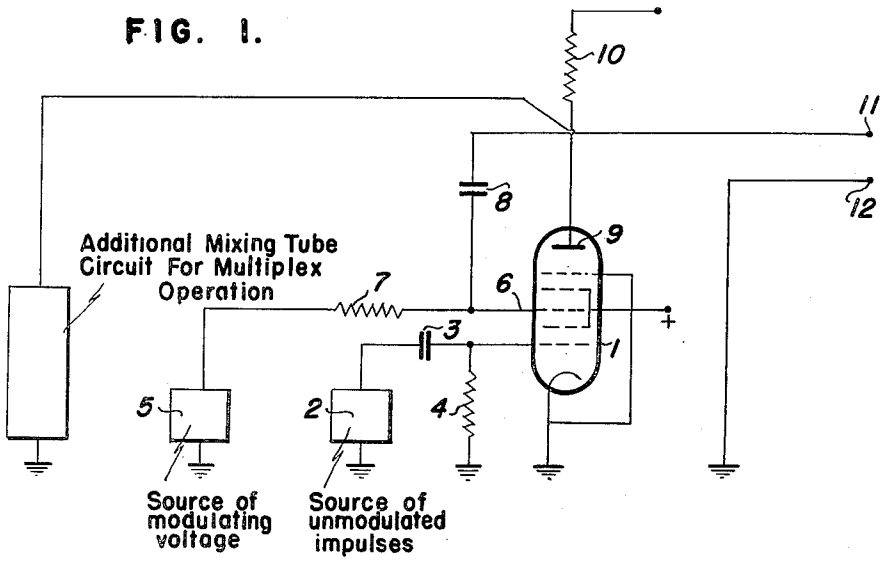
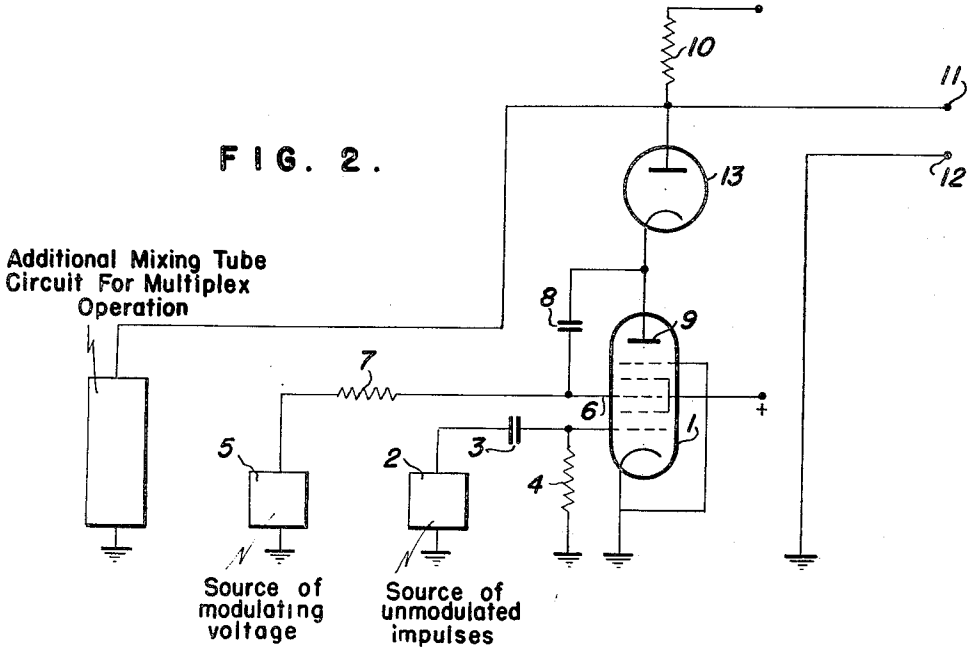


FIG. 2.



INVENTORS

J. Boisvieux and J. Chaumeron

BY Ben. J. Chromy

their ATTORNEY

Patented Oct. 14, 1952 2,614,247

UNITED STATES PATENT OFFICE

2,614,247

PULSE MODULATING SYSTEM

Jacques Boisvieux, Nogent-sur-Marne, and Jacques Chaumeron, Paris, France, assignors to Societe Francaise Sadir-Carpentier, Paris, France, a corporation of France

Application December 22, 1948, Serial No. 66,644
In France December 26, 1947

6 Claims. (Cl. 332—64)

1

Our invention has for its object the amplitude modulation of impulses and it covers more particularly the production of impulses the amplitude of which is a linear function of the modulating voltage within the total range of variation of the letter, said amplitude being capable of sinking to zero.

A method in current use heretofore for producing such a modulation consists in sending unmodulated impulses to the controlling grid of a pentode tube, the suppressor grid of which receives the modulating voltage in addition to a suitable negative bias. It is thus possible to obtain an amplitude modulation of the impulse but the amplitude of the impulse is not in this case a linear function of the modulating voltage, chiefly because the characteristic curve of a pentode is not linear when the anode current approaches zero; as a matter of fact, said characteristic curve is such that the anode current is a function of the voltage of the suppressor grid when the other electrodes are submitted to unvarying voltages. Moreover this method implies the necessity of providing a negative bias to the suppressor grid, which is a drawback in many cases.

According to the present invention, it is possible to use in this case a multi-grid tube such as a hexode or a tube having a number of grids higher than that generally used in frequency changing tubes.

The unmodulated impulse is applied to one of the control grids, say the first grid while the modulating voltage is applied to the second or control grid.

Accompanying drawings show respectively in Figs. 1 and 2 two embodiments of our invention given by way of example and by no means in a binding sense.

In Fig. 1, 1 designates the hexode tube used. The cathode of this tube is grounded and the screening grids are brought to suitable positive voltages. Similarly the suppressor grid, if such a grid is used, is brought to a suitable constant voltage; it may for instance be connected for this purpose with the cathode. The source of unmodulated impulses is shown at 2 and the impulses are fed to the first grid through the condenser 3, said grid being grounded through the resistance 4. The impulses are applied here again in their positive direction. Their amplitude is at least equal to the cut off voltage of the tube that is to the absolute value of the negative voltage that it is necessary to apply to said grid for cutting off the anode current of the tube.

2

The time constant of the system 3—4 is considerably higher than the duration separating two consecutive impulses fed by the source 2.

It is a known fact that under such conditions, the action of the grid cathode current is such that during the interval separating two impulses, the grid of the tube is brought to a value less than the cut off value, said grid assuming a potential practically equal to that of the cathode at the moment of the passage of the impulses, this being the usual well known effect of peak detectors. The consequence is that, whatever may be the amplitude of the pulses fed by the source 2 provided they are higher than the above mentioned cut off voltage, the tube is locked between the impulses as the grid is brought to the potential of the cathode only at the moment of the passage of the impulses so as to release the tube at this moment and only at this moment.

The modulating voltage provided by the source of positive voltage 5 which varies slightly as a function of time and that may reach the value zero, is applied to the second controlling grid of the tube 1 so as to amplitude modulate the impulses produced by said tube as a function of the instantaneous voltage of said supply 5.

According to an important feature of our invention, an improved linearity of the impulses is obtained through a feedback system inserted between the supply 5 and the second controlling grid 6. This feedback includes a resistance 7 inserted between the source 5 and the grid 6 and a condenser 8 inserted between the anode 9 of the tube 1 and the point connecting the grid 6 with the resistance 7.

10 designates the load resistance inserted in the anode circuit, said resistance being connected through its end opposed to the anode with a high voltage source that is not illustrated.

The impulses provided at the output of the tube 1 are supplied to the output circuit connected at a point between the anode 9 and the resistance 10, to the terminals 11 and 12.

The feedback arrangement described operates as follows:

The above disclosure shows that the tube is locked during the intervals between the successive impulses and is capable of feeding current only at the moment of the passage of the latter.

At this moment the voltage at the point between the anode 9 and the resistor 10 drops suddenly by reason of the instantaneous drop in voltage through the resistance 10; this drop in voltage is transmitted almost integrally through the condenser 8 to the grid 6 because the re-

sistance 7 is of a high value compared to the internal resistance of the source 5.

Calculation shows that if the product of the internal resistance of the tube 1 and the slope of the curve, giving the anode current of the tube as a function of the variation in potential of the grid 6, is substantially greater than 1, the voltage of the grid 6 at the moment of the passage of the impulse, which voltage is due both to the action of the resistance 7 and condenser 8 and to the voltage it has received from the source 5 immediately before, is such that the drop in voltage across the resistance 10 is precisely equal to the value of the modulating voltage applied to the grid 6 at the moment of the arrival of the impulse, in spite of the curvature of the characteristic curve of the tube. This provides an impulse that is a linear function of the instantaneous modulation voltage provided by the source 5; it is even apparent that this linear function is reduced to equality. Consequently for a zero voltage of the source 5, the impulse obtained is wiped out.

In order to avoid any substantial modification in the voltage of the grid 6, while the impulse is being transmitted, the condenser 8 is given a sufficient capacity for the time constant of the system 7—8 to be high with reference to the duration of said impulse.

An important application of the invention is that wherein several systems of the type illustrated in Fig. 1 are used, for providing a multiplex communication. The simplest manner of proceeding in this case consists in inserting several tubes in parallel with the common anodic resistance 10, said tubes receiving unmodulated impulses that are staggered as to time and separated modulating voltages, whereby there is collected across the terminals 11—12 the desired train of impulses, while a supplementary member may provide the synchronising impulse. In such an arrangement, the following drawback appears:

The condenser 8 is in this case loaded not only through the impulse of the tube to which it is connected but also through the impulses of all the tubes inserted in parallel; consequently it cannot discharge with sufficient rapidity between two consecutive impulses of the train of impulses and the result is that at the beginning of the passage of an impulse through the tube considered, the voltage of the grid 6 is not exactly that of the source 5 which leads to cross-talk or interaction between the different channels of the multiplex communication system.

Fig. 2 shows a modification of the arrangement that removes this drawback. The elements already shown in Fig. 1 play the same part and have received the same reference number. Thus the anodes of all the tubes such as 1 are connected in parallel with the lower end of the resistance 10.

Now according to a further feature of our invention, there is connected between the resistance 10, common to all the tubes, and each of the tubes, such as 1, a diode 13, the anode of which is connected to the resistance 10 and the cathode to the anode of the tube 1. The condenser 8 is connected to a point between the cathode of diode 13 and the anode of tube 1. There is thus inserted in series with the high voltage anode source, in addition to the resistance 10 and tube 1, the diode 13. By reason of the presence of such a diode, it is apparent that the negative impulses produced in the resistance 10 by tubes other than the tube 1 considered, are without any action on the condenser 8 of said tube 1 as the diode 13 prevents their passage. This removes completely the above mentioned drawback.

Obviously, the diode 13 may be replaced by rectifiers and many other details may also be changed without widening unduly the scope of our present invention as defined in accompanying claims.

Our invention is applicable in particular to advantage to different measuring systems operating through impulses.

What we claim is:

1. A mixing tube circuit adapted to provide amplitude modulation impulses in linear relationship with modulating voltages, comprising a mixing tube having a plurality of grids, means for feeding unmodulated impulses to one of said grids, means for feeding a modulating voltage to a second one of said grids and a feedback system coupling said second grid with the anode of said tube to produce the aforesaid linear relationship.

2. A mixing tube circuit adapted to provide amplitude modulated impulses in linear relationship with modulating voltages, comprising a tube having a plurality of grids, means for feeding unmodulated impulses to one of said grids, means for feeding a modulating voltage to a second one of said grids and a feedback system coupling said second grid with the anode of said tube, said feedback system including a resistance in series with said last mentioned grid and a capacitor connected to provide a connection between said last mentioned grid and said anode to produce the aforesaid linear relationship.

3. In a mixing tube circuit adapted to provide amplitude modulated impulses in linear relationship with modulating voltages, comprising a mixing tube having a first grid and a second grid and an anode, a source of unmodulated impulses, connections for connecting said source to said first grid, said tube being biased to cutoff and the amplitude of said impulses being such as to overcome said bias and permit current to flow through said tube, a source of modulated impulses connected to said second grid and a feedback system connected to the anode of said tube and to said second grid, said feedback system comprising a resistor-capacitor circuit having a time constant that is high compared to the duration of the individual impulses of said second source, said feedback system functioning to produce a linear relationship between the amplitude modulated impulses in the output of said tube and the voltage of said modulated impulse source.

4. In a mixing tube circuit adapted to provide amplitude modulated impulses in linear relationship with modulating voltages, comprising a mixing tube having a first grid and a second grid and an anode, a source of unmodulated impulses, a resistor-capacitor circuit having a time constant considerably greater than the duration separating two consecutive impulses of said source, connections for connecting said resistor-capacitor circuit between said source and said first grid, said tube being biased to cutoff and the amplitude of said impulses being such as to overcome said bias and permit current to flow through said tube, a source of modulated impulses connected to said second grid and a feedback system connected to the anode of said tube and to said second grid, said feedback system functioning to produce

linear relationship between the amplitude modulated impulses in the output of said tube and the voltage of said modulated impulse source.

5. In a mixing tube circuit adapted to provide amplitude modulated impulses in linear relationship with modulating voltages, comprising a mixing tube having a first grid and a second grid and an anode, a source of unmodulated impulses, a resistor-capacitor circuit having a time constant considerably greater than the duration separating two consecutive impulses of said source, connections for connecting said resistor-capacitor circuit between said source and said first grid, said tube being biased to cutoff and the amplitude of said impulses being such as to overcome said bias and permit current to flow through said tube, a source of modulated impulses connected to said second grid and a feedback system connected to the anode of said tube and to said second grid, said feedback system comprising a resistor-capacitor circuit having a time constant that is high compared to the duration of the individual impulses of said second source, said feedback system functioning to produce a linear relationship between the amplitude modulated impulses in the output of said tube and the voltage of said modulated impulse source.

6. In a mixing tube circuit adapted to provide amplitude modulated impulses in linear relationship with modulating voltages, the combination of a tube having a plurality of grids and means for feeding to one of said grids unmodulated impulses and further means for feeding a modulating voltage to a second one of said grids and a feedback system coupling the said second grid with the anode of said tube, said tube having a characteristic such that the product of the internal resistance of said tube and the slope of the anode current curve with reference to the variations in potential of said last mentioned grid is substantially greater than 1.

JACQUES BOISVIEUX.
JACQUES CHAUMERON.

REFERENCES CITED

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

UNITED STATES PATENTS

Number	Name	Date
2,248,549	Schlesinger	July 8, 1941
2,278,159	Wheeler	Mar. 31, 1942
2,462,111	Levy	Feb. 22, 1949

FOREIGN PATENTS

Number	Country	Date
388,756	Great Britain	Feb. 28, 1933