

April 8, 1947.

G. A. MORTON ET AL

2,418,521

IMPULSE MEASURING DEVICE

Original Filed Jan. 21, 1943

Fig. 1.

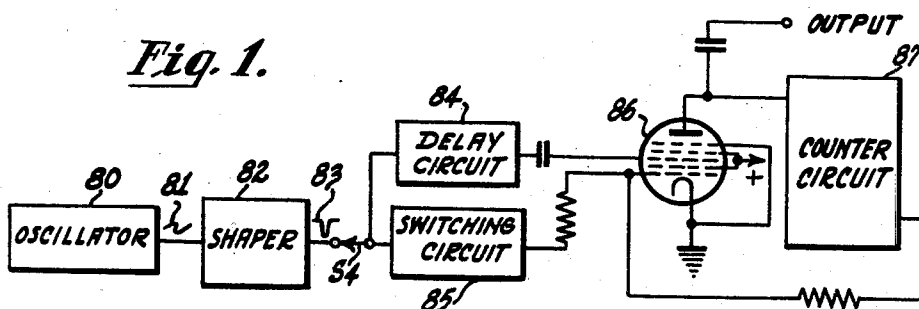
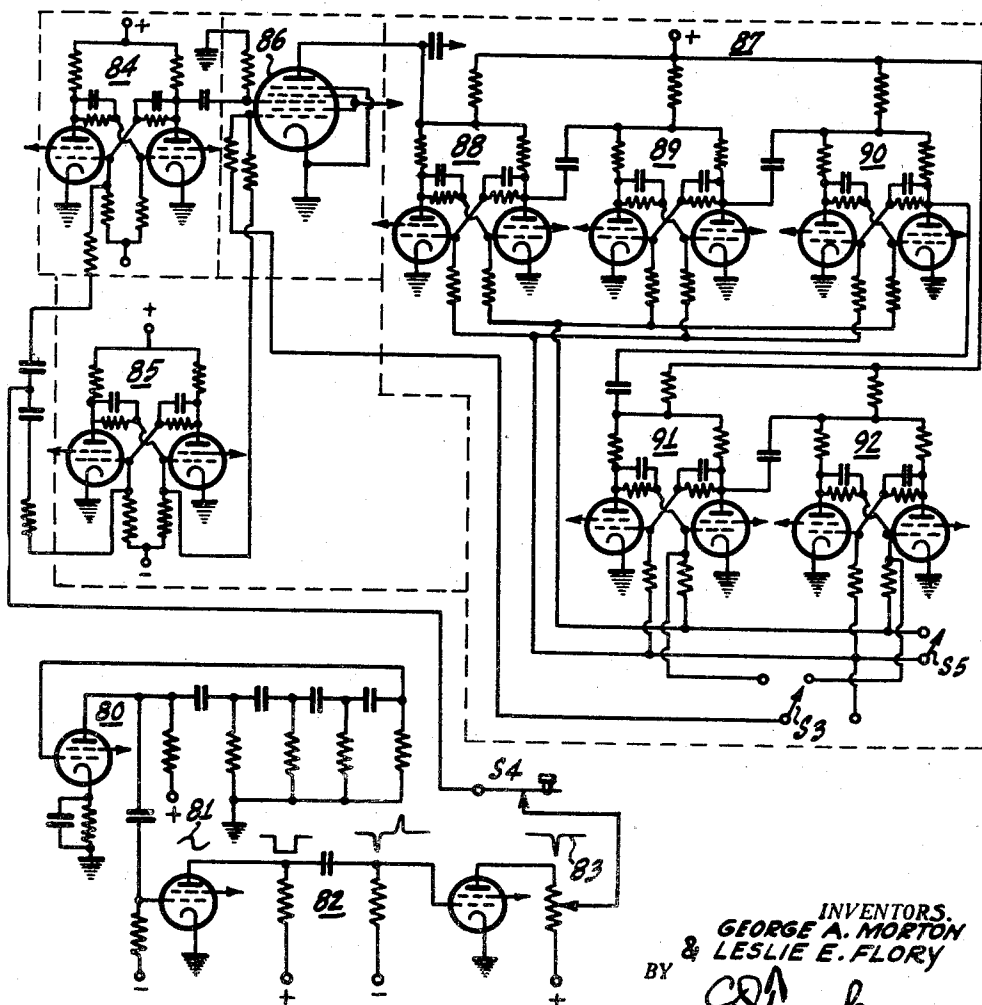


Fig. 2.



INVENTORS,
GEORGE A. MORTON
& LESLIE E. FLORY
BY *CD Huska*
ATTORNEY

UNITED STATES PATENT OFFICE

2,418,521

IMPULSE MEASURING DEVICE

George A. Morton and Leslie E. Flory, Princeton, N. J., assignors to Radio Corporation of America, a corporation of Delaware

Original application January 21, 1943, Serial No. 473,146, now Patent No. 2,404,047, dated July 16, 1946. Divided and this application January 8, 1945, Serial No. 571,880

5 Claims. (Cl. 177-353)

1

This invention relates to impulse measuring devices such as are utilized to transmit a predetermined number of electrical impulses from a continuously operating constant frequency oscillation generator to a utilization circuit.

The present application is a division of our application Ser. No. 473,146, filed January 21, 1943, now U. S. Letters Patent 2,404,047, granted July 16, 1946, which relates to an electronic computer or number multiplying device of which the impulse measuring device of the present invention may form a part.

The basic circuit utilized in adapting the invention to the various circuits to be described is the well known "trigger" circuit of the general type described in "Theory and Application of Vacuum Tubes," by Herbert J. Reich. In one of its simplest forms, this trigger circuit includes two triodes in which the grid of the first triode is coupled to the anode of the second triode through a network comprising a parallel connected resistor and capacitor, and the grid of the second triode is similarly coupled to the anode of the first triode through a similar coupling network. The cathodes of both triodes are grounded, either directly, or through suitable cathode resistors. Grid and anode potentials are applied to the respective electrodes through separate resistors. If desired, a gaseous discharge tube may be connected across one of the anode resistors to indicate circuit operation.

In operation, if a negative voltage is applied to the grid of the first triode, the anode current of the triode will be reduced and the anode potential will become more positive. Due to the connection through the coupling resistor, the grid potential of the second triode will become more positive, causing an increase in the anode current of the second triode, with a resultant decrease in the second triode anode potential. This decrease in anode potential will, in turn, cause the grid potential of the first triode to become more negative. This action will continue until the anode current of the first triode is cut off. The first triode will remain cut off, and the second triode will remain conducting, until a positive potential is applied to the grid of the first triode or a negative potential is applied to the grid of the second triode. In either latter instance, the tube operating conditions will be reversed and the first triode will become conducting and the anode current of the second triode will be cut off.

One of the features of the instant invention is the utilization of such trigger circuits in cas-

2

cade arrangement, whereby a predetermined change in the polarization or activization of one triode of the trigger circuit will generate a pulse to trigger or activate a succeeding trigger circuit in the cascade arrangement. As many trigger circuits as desired may be connected in cascade.

The present invention has for its principal object the provision of an improved apparatus and method of operation whereby predetermined numbers of electrical impulses are transmitted from a continuously operating constant frequency source to an electronic computer or other utilization device.

The invention will be better understood from the following description considered in connection with the accompanying drawings and its scope is indicated by the appended claims.

Referring to the drawings:

Figure 1 is a block diagram of a preferred embodiment of the invention, and

Figure 2 is a wiring diagram of this embodiment.

Fig. 1 provides a general means for deriving a predetermined number of stepping pulses in rapid succession upon application thereto of an initial starting voltage.

A source of oscillations 80, of waveform 81, is connected through a pulse shaping circuit 82 to provide sharply defined negative pulses 83. These negative pulses are then applied simultaneously, through a switch 84, to a delay circuit 84 and a switching circuit 85, such as a multivibrator. The switching circuit, in response to the initial negative pulse applied thereto, provides a positive bias potential to unblock an amplifier 86. After the amplifier 86 is unblocked, the delayed pulses are applied through the delay circuit 84 to the amplifier input circuit. The output circuit of the amplifier is next applied to an electronic counter 87, which may be of the general type described in the copending U. S. application of Leslie E. Flory, Serial No. 467,032, filed November 28, 1942, in which any predetermined number of pulses applied thereto will provide a control potential when the counter is filled. When the desired number of pulses are counted, the control potential derived from the counter is applied to the amplifier to bias off the amplifier anode current. Thus a predetermined number of pulses may be delivered to a load circuit connected to the amplifier output circuit. The number of pulses may be controlled by changing the electronic counter as described in the copending Flory application. The circuit may be cleared for a succeeding operation by disconnecting or

3

stopping the oscillation source, and by returning the counter to its initial operating condition.

As hereinafter explained in connection with Fig. 2, the delay circuit 84 may be a conventional slideback trigger circuit having grid resistors of different values such that it has only one stable operating condition. The values of these grid resistors are so related that the slideback trigger circuit (1) maintains its unstable operating condition long enough to permit the switch 85 to put the amplifier 86 in a conducting condition but (2) returns to its stable operating condition before the second or next successive pulse applied from the pulse shaper 82. Each time the slideback trigger circuit returns to its stable operating condition, the second control grid of the amplifier 86 is made more positive and a counting pulse is applied to the counter 87.

Fig. 2 provides a specific circuit for the operation generally described in Fig. 1. The oscillator 80 is of the conventional R-C type. Its output circuit is connected through the conventional pulse shaping circuit 82 to provide the discrete negative pulses 83. The negative pulses are then simultaneously applied to key the switching multivibrator 85 which is a symmetrical trigger circuit of the type described heretofore, and to key the slideback trigger circuit 84 which provides the required delay for the pulses applied to the second control electrode of the amplifier tube 86. A positive bias potential is derived from the switching multivibrator 85 which has its current conductivity changed from its left to its right side in response to actuation thereof by the initial negative pulse. This positive bias potential is applied to the first control electrode of the amplifier tube 86 to unblock the tube for amplification of the delayed pulses. The minimum delay time of the slideback trigger circuit 84 must be sufficient to allow the switch 85 to put the amplifier 86 in a conducting condition. This is necessary to prevent the delayed pulse being applied to the amplifier before the amplifier is in condition to pass it.

The maximum delay time must be short enough to allow the delay circuit 84 to resume its normal stable operating condition before the next succeeding pulse is applied. Thus each time the delay circuit 84 returns to its stable operating condition with its left side conducting, a pulse is applied through the amplifier 86 to the counter 87.

The anode circuit of the amplifier 86 is connected to the electronic counter 87 which includes the trigger circuits 88, 89, 90, 91, 92 connected to provide a control potential when a predetermined number of pulses have been counted. In the particular circuit disclosed, operation of the switch s3 will provide a control pulse for either six or fourteen applied pulses from the amplifier 86. The control potential is derived from the movable element of the switch s3 and applied to the first control electrode of the amplifier 86 to block the tube anode current. The number of pulses required for the control potential depends upon the particular trigger circuit connected to the movable elements of the switch s3. The predetermined number of pulses are then derived from the amplifier anode circuit and applied to the utilization circuit.

The pulse generator may be cleared by opening the switches s4 and s5. Opening the switch s4 removes the source of oscillations from the counting circuit, while opening the switch s5 changes the bias on all trigger circuits of the

4

electronic counter, to restore the counter to any predetermined initial count. It should be understood that the essential difference between the counter of Fig. 2 and the counter circuit disclosed in the copending Flory U. S. application referred to heretofore, is that in the instant device the initial count is provided by reversed bias means in one or more predetermined trigger circuits, (in this instance, trigger circuit 89), while feedback means are provided in the copending application.

All trigger circuits may be cleared, after each multiplying operation is completed, by applying a high negative control electrode bias simultaneously to all binary 1 tubes in the manner which is described, for example, in the copending application mentioned heretofore, or by removing the grid bias from the binary 0 tubes.

It should be understood that the particular circuits described are merely illustrative of one means for accomplishing the invention. Many of the individual circuits may be modified, and the coupling and control circuits varied in accordance with accepted engineering practice, without deviating from the spirit and scope of the invention.

We claim as our invention:

1. A circuit for generating a predetermined number of voltage pulses which includes a source of oscillations, a blocking amplifier, means responsive to said oscillations for initially unblocking said amplifier, means responsive to said oscillations for delaying said oscillations until said amplifier is unblocked and for applying said delayed oscillations to said amplifier, an electronic counter, means for applying said delayed and amplified oscillations to actuate said counter, means for deriving a control potential from said counter when a predetermined number of oscillations have been counted thereon, means for applying said control potential to block said amplifier, and means for deriving said pulses from said amplifier.

2. A circuit for generating a predetermined number of voltage pulses which includes a source of oscillations, a blocking amplifier, means including a trigger circuit responsive to said oscillations for initially unblocking said amplifier, means responsive to said oscillations for delaying said oscillations until said amplifier is unblocked and for applying said delayed oscillations to said amplifier, an electronic counter, means for applying said delayed and amplified oscillations to actuate said counter, means for deriving a control potential from said counter when a predetermined number of oscillations have been counted thereon, means for applying said control potential to block said amplifier, and means for deriving said pulses from said amplifier.

3. A circuit for generating a predetermined number of voltage pulses which includes a source of oscillations, a blocking amplifier, means including a trigger circuit responsive to said oscillations for initially unblocking said amplifier, trigger circuit delay means responsive to said oscillations for delaying said oscillations until said amplifier is unblocked and for applying said delayed oscillations to said amplifier, an electronic counter, means for applying said delayed and amplified oscillations to actuate said counter, means for deriving a control potential from said counter when a predetermined number of oscillations have been counted thereon, means for applying said control potential to block said am-

5

plifier, and means for deriving said pulses from said amplifier.

4. A circuit for generating a predetermined number of voltage pulses which includes a source of oscillations, a blocking amplifier, means including a trigger circuit responsive to said oscillations for initially unblocking said amplifier, trigger circuit delay means responsive to said oscillations for delaying said oscillations until said amplifier is unblocked and for applying said delayed oscillations to said amplifier, an electronic counter comprising a plurality of trigger circuits, means for applying said delayed and amplified oscillations to actuate said counter, means for deriving a control potential from said counter when a predetermined number of oscillations have been counted thereon, means for applying said control potential to block said amplifier, and means for deriving said pulses from said amplifier.

5. Apparatus of the type described in claim 1 including bias means for clearing said electronic

6

counter and said unblocking means after each derivation of said pulses.

GEORGE A. MORTON.
LESLIE E. FLORY.

REFERENCES CITED

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

UNITED STATES PATENTS

Number	Name	Date
2,373,134	Massonneau	Apr. 10, 1945
2,158,285	Koch	May 16, 1939
2,310,105	Michel	Feb. 2, 1943
2,332,300	Cook	Oct. 19, 1943

FOREIGN PATENTS

Number	Country	Date
485,703	British	May 24, 1938
355,705	British	Aug. 24, 1931