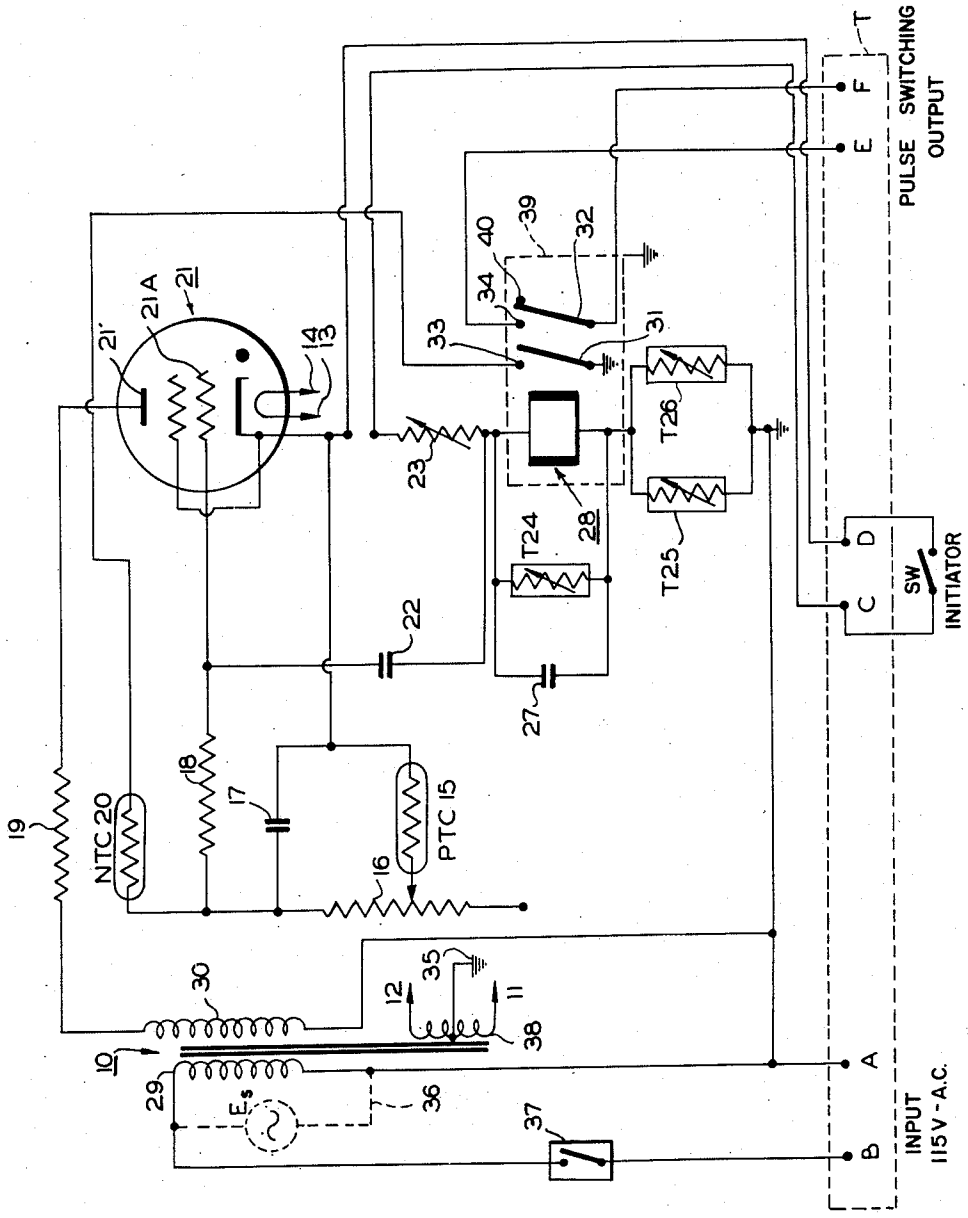
April 15, 1958 F. A. OBLOY 2,831,130

ELECTRONIC PULSING DEVICE

Filed March 16, 1956




INVENTOR

FELIX A. OBLOY

BY Frank H. Hanmore

ATTORNEY

United States Patent Office 2,831,130 Patented Apr. 15, 1958



2,831,130

# ELECTRONIC PULSING DEVICE

Felix A. Obloy, Rancho Santa Fe, Calif, assignor to Bill Jack Scientific Instrument Co., Solana Beach, Calif., a corporation of California

Application March 16, 1956, Serial No. 572,088

14 Claims. (Cl. 307—132)

One object of my invention is to provide a pulsing device or pulse switch generator having a high degree of stability.

Another object is the provision of a pulse switch generator whose switch repetition rate is substantially constant under wide variations of ambient temperature and power source conditions.

An additional object of this invention is to produce a pulse switching device wherein the switching time interval and repetition rate remain constant under a substantial range of temperature and input voltage variations.

More specifically, it is an object of the present invention to provide a precision timer or switching device utilizing a pulse shaping and timing generator having a gaseous electronic discharge device in combination with temperature and current responsive devices in a novel circuit.

In particular it is an object of my invention to devise a gas tetrode electronic switching device of precision stability having both temperature-responsive and current-responsive resistance means.

With the foregoing and other objects in view the invention resides in the combination of parts and in the details of construction set forth in the following specification and appended claims, certain embodiments of which are illustrated in the drawing which is a circuit diagram including the details of a preferred embodiment of the electronic pulse switch device in accordance with my invention.

Considering the figure in detail, the circuit of the switching device may be conveniently assembled in a "plug-in" package as is well known in the art and may be provided with external contacts indicated at terminal block T. As indicated by the drawing legends, contacts AB are to be connected to an alternating current power source of 115 volts nominal potential at a frequency of 50 to 1000 cycles; contacts CD may be connected to an external initiating switch SW; and the times pulse switching output may be taken off at contacts EF.

The input voltage from contacts AB is applied to primary winding **29** of transformer **10** through switch **37**. This is shown schematically as a voltage of magnitude $E_s$ supplied by the generator **36** indicated in dotted outline. The cathode heater **13**, **14** of gas tetrode **21** is energized from terminals **11**, **12** of secondary winding **38** of transformer **10**, which winding is center-tapped to ground at **35** as indicated. Anode potential is applied at plate **21**$^1$ of the tetrode **21** through a current limiting resistor **19** from transformer secondary winding **30**. Secondary **30** is optionally a step-up winding which raises the applied anode potential approximately 20 precent above the input source $E_s$ to insure positive action of the circuit of load relay **28** which controls the timed switching cycle.

Load relay **28** is a double-pole double-throw type whose contacts are shown in unenergized position. This relay is connected in the cathode circuit of tetrode **21** through a path which may be traced from the tube cathode through



terminal contacts CD when bridged by the time cycle initiating switch 'SW," thence through resistor **23** to the positive lead of relay **28**, with the circuit completed through the relay winding and resistors **T25**, **T26** to ground.

The grid circuit of the gas tetrode switching device includes temperature compensating resistors **20** and **15**. Resistor **20** has a negative resistance coefficient, while resistor **15** has positive resistance coefficient, to effect calibration accuracy despite ambient temperature changes. One end of resistor **20** is connected to load relay terminal **33** which is cyclically grounded at contact **31** during operation of the device, while the opposite end of this resistor connects to the tetrode grid through grid limiting resistor **18**. The grid is returned to the cathode through a resistance capacitance voltage divider network made up of "calibration" potentiometer **16**, condenser **17**, and temperature compensating resistor **15**.

The resistance capacitance combination of condenser **22** and variable resistor **23** controls the pulse duration or pulse cycle for the grid bias of tube **21**, which effectually determines the cyclic switching rate at output terminal contacts EF, as will be more fully explained hereinafter when the operation of the complete circuit of the invention is described. One end of condenser **22** is directly connected to the tetrode grid, and the opposite end thereof connects to resistor **23** as shown.

It will now be noted that the winding of load relay **28** is shunted by a parallel combination of condenser **27** and resistor **T24**, and the lower end of such winding is grounded through resistors **T25**, **T26** which are connected in parallel. Resistors **T24**, **T25** and **T26** are of the type which demonstrate a non-linear resistance characteristic with respect to applied current, and may be of the variety generally designated as "Varistors" which may be compounded with thyrites or other known media to eflect such non-linear characteristics.

The non-linear resistance elements are utilized as a means of compensating for current variations and thus serve to stabilize the pulsing cycle of the circuit within voltage differentials of plus-and-minus-15 percent from the normal 115 volt input valve. This compensation effect has been found to be an essential factor in attaining a highly precise switch timing cycle according to my invention. Timing intervals of precision accuracy may be maintained under severe variations of input potential values for either sustained or varying conditions of under-voltage or over-voltage.

As previously mentioned, the pulse width duration of the output switching cycle is basically determined by the values of condenser **22** and resistor **23**. However, it is to be noted that this pulse width value may be influenced by the resistance capacitance time constant of the parallel combination of the winding of load relay **28** and condenser **27**. The varistor **T24** which is shunted across this latter combination stabilizes the effect of induced potential surges created due to the inductive action of the relay winding when the current therethrough collapses, and thus prevents any undesired timing cycle variations.

The manner in which this invention operates to provide a precision timed pulse switching rate may be explained as follows. With switch **37** closed, the external "initiating" contacts of switch SW connected across contacts CD, and an adequate alternating current potential source applied at AB, within approximately ten seconds load relay **28** will be energized due to current flow through tetrode **21**. This current flow will have taken place due to the fact that the tube cathode has been raised up to emitting temperature by the heater voltage from secondary **38**, while at the same time recurrent positive swings

of potential have been applied to the tetrode plate 21' by transformer winding 30, until a gas discharge or conduction between the plate 21' and the cathode occurs. Also during this period the tetrode control grid 21A has built up a high negative biasing voltage across condenser 17.

When load relay 28 is energized, contacts 31 and 33 are closed which provides a momentary negative grid bias potential on control grid 21A through grid resistor 18. Since the plate 21' of tetrode 21 is energized from an alternating current source, plate current flow will stop within one half-cycle of applied plate voltage when the grid has attained a bias value below cutoff.

When load relay 28 is energized the output contacts 32, 34 provide an isolated switching pulse at contact terminals EF. As shown in the figure, this switch pulse will be a circuit closing pulse. If a circuit opening pulse is required, the contact E may be connected to relay contact 40 rather than to contact 34. Relay 28 and the contacts thereof may be shielded if necessary, as indicated in dotted outline at 39.

When plate current flow ceases relay 28 opens, the high negative grid bias dissipates from condenser 17, and the tetrode 21 will remain deionized and non-conducting until condenser 17 discharges to a value sufficient to permit plate current flow to be reinitiated. Thus, repetitive switch cycling action is obtained.

It should be noted that resistors T25 and T26 are parallel connected. I have found experimentally that this is a preferable expedient which effects a high degree of stable operation despite variations in applied input voltage. Greater stability is achieved with this parallel connection than by the use of a single varistor of equivalent resistance value. I believe that this may be explained as being due to a compensating action within the resistors, whereby non-uniform current vs. resistance characteristics are cancelled out or otherwise compensated.

It will be apparent to those skilled in the art that various changes may be made in the circuitry from that of the preferred embodiment which I have shown in the drawing, and that further uses for such a pulsing device may be contemplated. For example, the invention may be used in cascade multiple circuit switching operations by the simple expedient of providing a plurality of such devices in a series chain. Thus the output switch pulse from contacts EF of a first unit could be connected to the initiating contacts CD of a second unit, and so on. Accordingly, the scope of the invention is to be construed as indicated in the appended claims.

I claim:

1. A pulse timing generator including an electron current switching device and temperature responsive stabilizing means therefor.

2. A pulse timing generator including an electron current switching device and current responsive stabilizing means therefor.

3. A pulse timing generator including an electron current switching device, first means to stabilize said device for temperature variations, and second means to stabilize said device for current variations.



4. A stabilized pulse switch generator including, in combination, an electron discharge device, first circuit means to apply operating potentials to said device, second circuit means cyclically energized by said device, and stabilizing means associated with at least one of said circuit means.

5. A Stabilized pulse switch generator according to claim 4 in which said stabilizing means is temperature responsive.

6. A stabilized pulse switch generator according to claim 4 in which said stabilizing means is current responsive.

7. A stabilized pulse switch generator according to claim 4 in which said last-named means stabilizes for both temperature and current variations.

8. A pulsing device for determining recurrent timing intervals including electron discharge means having at least an input circuit and an output circuit, a source of potential, connections between said source and said discharge means such that current flow is established in each circuit for at least a portion of such recurrent intervals, and temperature responsive means to regulate said current flow.

9. A pulsing device for determining recurrent timing intervals including a voltage operated current switching device, first means to stabilize said device against ambient temperature variations, and second means to stabilize said device against voltage variations.

10. A pulse interval timing apparatus including an electronic discharge device having an input circuit and an output circuit, temperature variation compensating means included in said input circuit, and current variation compensating means included in said output circuit.

11. A pulse switch generator of the gaseous relaxation type including circuit means to compensate for temperature and input power variations.

12. A pulse switch generator according to claim 11 wherein such compensating circuit means include resistance elements.

13. An electronic pulsing device comprising, in combination, a gas tube having at least a grid, an anode and a cathode, a source of operating potentials associated with said tube, a timing network including resistance and capacitance means connected to the grid of said tube, the resistance means of said timing network compensating for temperature variations, and a pulse output circuit including resistance and capacitance means connected to the cathode of said tube.

14. The pulsing device of claim 13 wherein the resistance means of said output circuit compensates for variations of operating potentials.

**References Cited** in the file of this patent

UNITED STATES PATENTS

| | | |
|---|---|---|
| 2,532,508 | Menkhaus | Dec. 5, 1950 |
| 2,684,448 | Nilles | July 20, 1954 |