

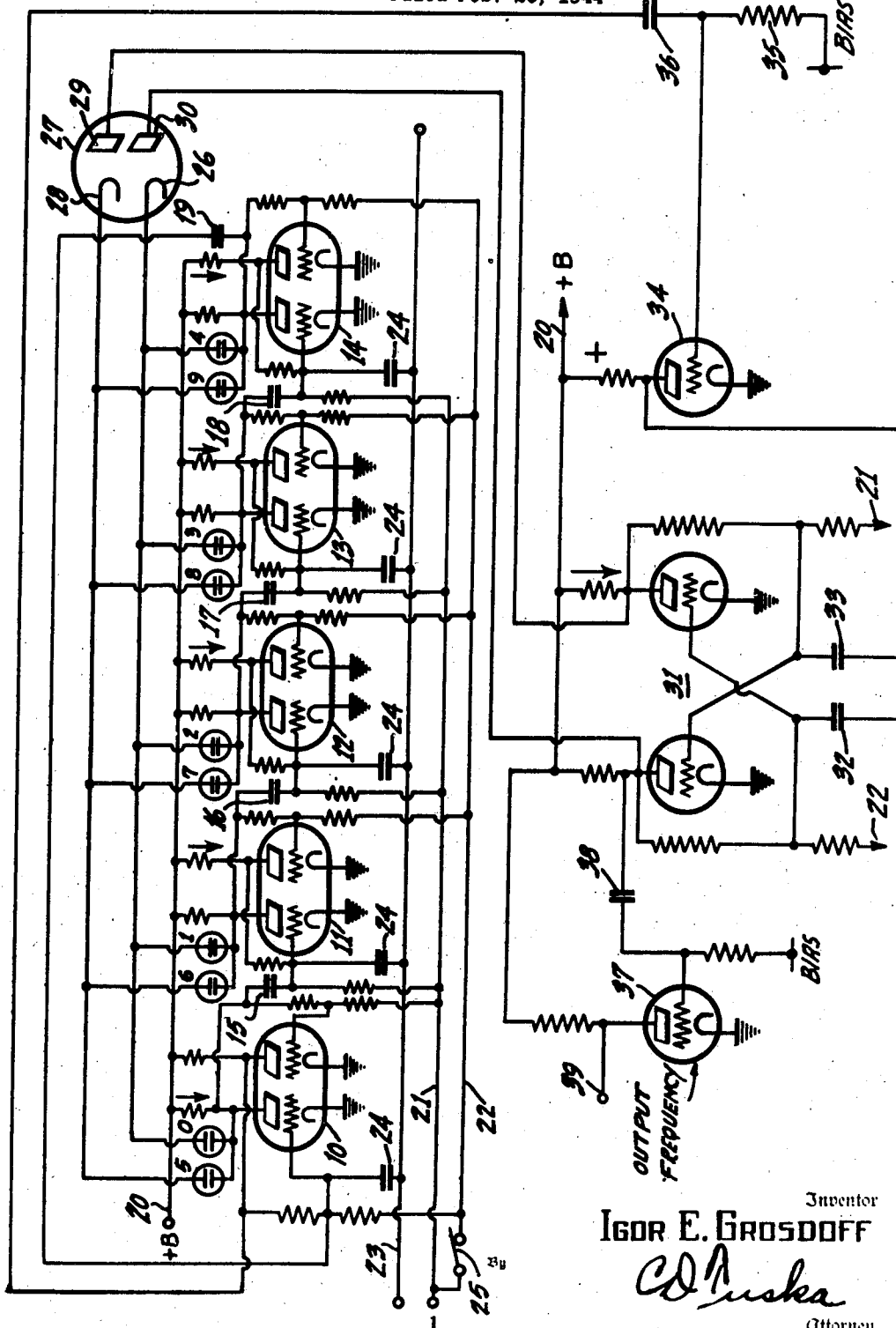
March 2, 1948.

I. E. GROSDOFF

2,436,963

ELECTRONIC COUNTING CHAIN WITH DECIMAL INDICATORS

Filed Feb. 26, 1944



Inventor
IGOR E. GROSDOFF

CD Muska

Attorney

UNITED STATES PATENT OFFICE

2,436,963

ELECTRONIC COUNTING CHAIN WITH
DECIMAL INDICATORSIgor E. Grosdoff, Princeton, N. J., assignor to
Radio Corporation of America, a corporation of
Delaware

Application February 26, 1944, Serial No. 523,968

3 Claims. (Cl. 235-92)

1

This invention relates to electronic registers, and has for its principal object the provision of an improved apparatus and method of operation whereby an output frequency which is a submultiple of the input frequency is produced with less parts than those heretofore utilized for the purpose.

Electronic registers heretofore utilized have usually required the provision of a trigger unit for each digit of the number involved in the computation. This requirement is avoided by the present invention which includes one half the trigger units heretofore required. This reduction is made possible by the provision of a switch of the trigger type which functions to interchange the anode potentials of a pair of diodes through which the various indicators of the trigger units are controlled. For example, if five such units are connected in a closed loop, the switch interchanges the potentials of the diode anodes as each count of five pulses is completed and different indicators are utilized for alternate cycles of five counts. Associated with the trigger type switch is also an output tube which is controlled by this switch to deliver a negative pulse to an output terminal for each count of ten, i. e. for every ten impulses applied to the input terminals of the closed loop of five trigger units. While the apparatus has been utilized as applied to the decimal system, it is apparent that it is also applicable to other numerical systems.

Important objects of the invention are the provision of a closed loop of trigger units which are used successively with different indicators to register a number of input pulses which is a multiple of the number of units, and the provision of an improved means of deriving from such loop an output frequency which is a submultiple of the input frequency.

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

The single figure of the drawing is a wiring diagram of a register which includes five trigger units connected in a closed loop or chain so as to deliver a negative pulse each time its cycle of operation is completed.

This computer includes trigger units 10 to 14 which are coupled together through capacitors 15 to 19. Each of these units has right and left hand electron discharge elements each including a cathode, an anode and a control grid for controlling the conductivity of the element. The grids and anodes of these units are cross-con-

2

nected in a well known manner so that (1) only one element of the unit becomes conducting at a time and (2) current conductivity is transferred from one element to the other in response to the application of a positive pulse to the grid of a nonconducting element or the application of a negative pulse to the grid of a conducting element. The anodes of the various elements are connected to a positive bus through separate anode resistors and the cathodes are grounded.

Bias potential is applied to the various grids through buses 21 and 22. Input pulses are applied to the left hand grids of the various units through a bus 23 and the capacitors 24. A reset switch 25, which is closed during normal operation of the computer, is temporarily opened to establish a standby or starting condition with current in the left hand side of the unit 10 and in the right hand sides of the units 11 to 14 and unit 31. It will be noted that opening of the switch 25 disconnects the right hand grid of the unit 31 from the negative bus 21 thus permitting this grid to assume a more positive potential.

Pairs of indicating means 5-0, 6-1, 7-2, 8-3 and 9-4 are each connected to an anode of a different one of the trigger units for indicating which element of the unit is conducting. It will be noted that the indicators 0, 1, 2, 3 and 4 are connected to a cathode 26 of a duodiode 27 and that the indicators 5 to 9 are connected to the other cathode 28 of the duodiode.

The anodes 29 and 30 of the duodiode 27 are connected respectively to the left and right anodes of a trigger unit 31 which has its grids coupled through capacitors 32 and 33 to the anode of a triode 34. The grid of the tube 34 has its bias potential applied through a resistor 35 and is coupled through a capacitor 36 to the right hand anode of the unit 10. An output tube, shown as a triode 37 is coupled through a capacitor 38 to the left hand anode of the unit 31. Plate potential is applied to the anodes of this unit 31 through the usual anode resistors.

The operation of the register is readily understood assuming that it starts with current flowing in the left side of the unit 10 and the right sides of the units 11 to 14 and 31 as indicated by the arrows. Under these conditions, the indicator 0 is lighted because its lower terminal is connected to the conducting anode of the unit 10 which is at a potential more negative than that of the non-conducting left anode of the unit 31 to which the upper terminal of the indicator 0 is connected through the diode element 26-30. The indicator 5, however, is not lighted

for the reason that its upper terminal is connected through the diode element 28—29 to the conducting and therefore more negative right anode of the unit 31. The other indicators are not lighted because their cathodes 28 and 26 are at substantially +B potential which is just as positive or more positive than the potentials applied to the anodes 29 and 30 from the anodes of the unit 31.

The application of the first negative input pulse to the bus 23 functions to transfer current from the left to the right side of unit 10 thereby producing a positive pulse which is transmitted through the capacitor 15 to the left grid of the unit 11 and causes current to be transferred to the left side of the unit 11. Under these conditions, the indicator 1 is lighted but the indicator 8 is not lighted for reasons explained in connection with indicators 0 and 5. This process continues from unit to unit around the loop so long as input pulses are applied to the bus 23 as indicated by the following tabulation:

Multivibrator No. and side drawing current

Pulse No.	10	11	12	13	14	31	Lamp Lighted
Standby.....	L	R	R	R	R	R	0
1.....	R	L	R	R	R	R	1
2.....	R	R	L	R	R	R	2
3.....	R	R	R	L	R	R	3
4.....	R	R	R	R	L	R	4
5.....	L	R	R	R	R	L	5
6.....	R	L	R	R	R	L	6
7.....	R	R	L	R	R	L	7
8.....	R	R	R	L	R	L	8
9.....	R	R	R	R	L	L	9
10.....	L	R	R	R	R	R	0
11.....	R	L	R	R	R	R	1
	R	R	L	R	R	R	

At the end of each cycle, however, a positive pulse is applied through the capacitor 36 to the grid of the tube 34 thereby increasing the current of this tube and producing a negative pulse at the grids of the unit 31. The effect of this negative pulse is to transfer current from the right to the left side of the unit 31. When this occurs, the potentials of the anodes 29 and 30 are interchanged so that the indicators 5, 6, 7, 8 and 9 are successively lighted during the next cycle of operation at the end of which the potentials of the anodes 29 and 30 are again interchanged and a negative pulse is applied to the terminal 39.

The present invention thus affords a ready means of deriving pulses at a frequency one tenth that of the input pulse frequency with a minimum of required trigger units.

I claim as my invention:

1. The combination of a plurality of trigger

units coupled together to form a closed loop and each having a pair of electron discharge elements, a pair of diode elements, switching means connected to apply different potentials to the anodes of said diodes, a plurality of indicators arranged in pairs each of which pairs has one pair of its terminals connected together to one anode of a different trigger unit and has the other pair of its terminals connected separately to the cathodes of said diode elements, and means responsive to completion of the operating cycle of said loop for operating said switching means to interchange the potentials of the anodes of said diodes.

2. The combination of a plurality of trigger units coupled together to form a closed loop and each having a pair of electron discharge elements, a pair of diode elements, switching means connected to apply a more positive potential to the anode of one of said diode elements and a more negative potential to the anode of the other of said diode elements, a plurality of indicators arranged in pairs each of which pairs has one pair of its terminals connected together to an anode of a different one of said trigger units and has the other of its terminals connected separately to the cathodes of said diode elements, and means responsive to completion of the operating cycle of said loop for operating said switching means to interchange the potentials of the anodes of said diodes.

3. The combination of a plurality of trigger units coupled together to form a closed loop and each having a pair of electron discharge elements, a pair of diode elements, switching means connected to apply different potentials to the anodes of said diodes, a plurality of indicators arranged in pairs each of which pairs has one pair of its terminals connected together to an anode of a different one of said trigger units and has the other of its terminals connected separately to the cathodes of said diode elements, means responsive to completion of the operating cycle of said loop for operating said switching means to interchange the potentials of the anodes of said diodes, and means for deriving a negative output pulse in response to alternate operations of said switching means.

IGOR E. GROSDOFF.

REFERENCES CITED

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

UNITED STATES PATENTS.

Number	Name	Date
1,972,941	Lewis	Sept. 11, 1934
2,310,105	Michel	Feb. 2, 1943
2,348,016	Michel	May 2, 1944
2,349,810	Cook	May 30, 1944