

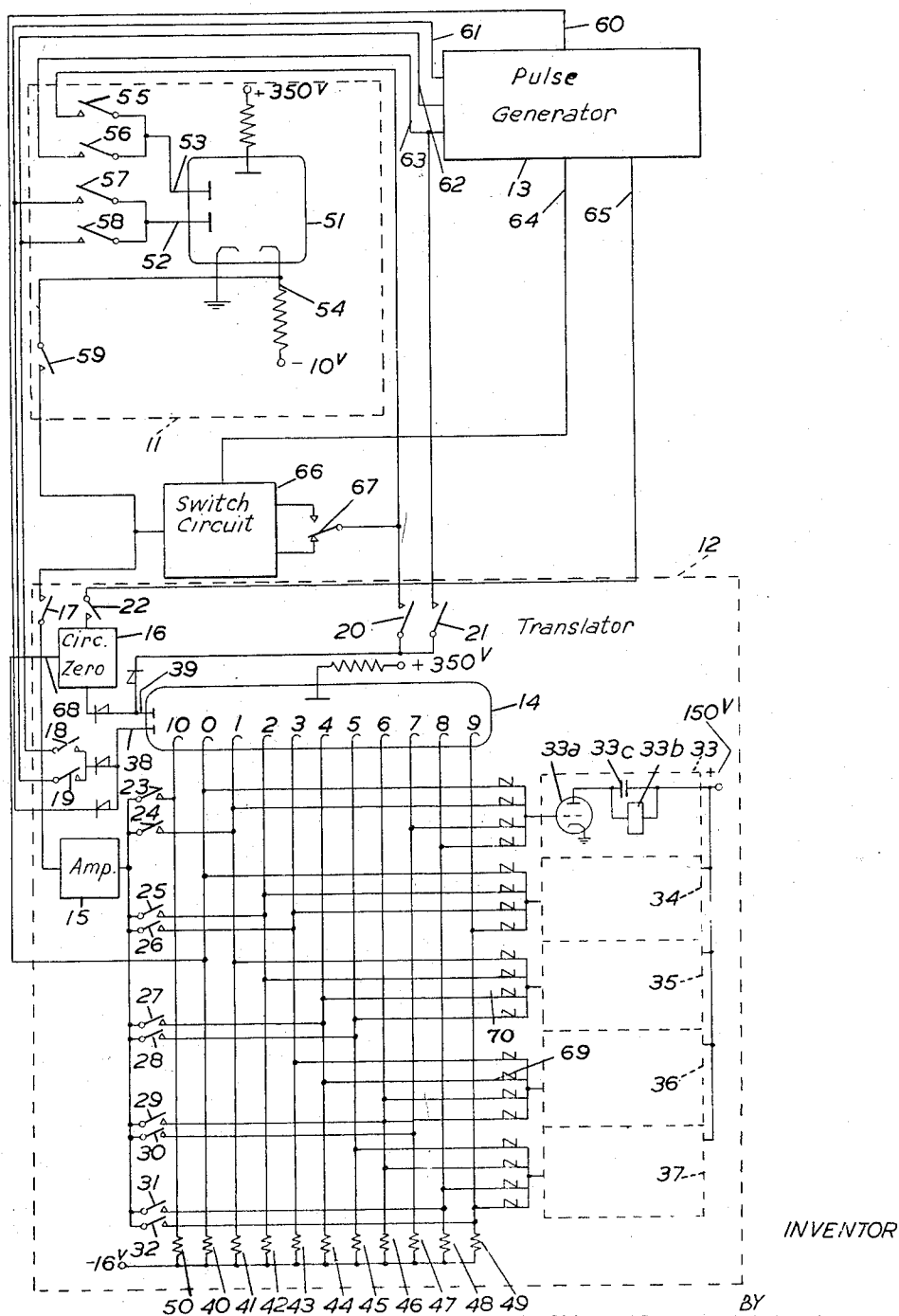
Dec. 29, 1953

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2,664,555

MULTIELECTRODE GASEOUS-DISCHARGE TUBE CIRCUITS

Filed Feb. 21, 1952



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Patented Dec. 29, 1953

2,664,555

UNITED STATES PATENT OFFICE

2,664,555

MULTIELECTRODE GASEOUS-DISCHARGE TUBE CIRCUITS

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Application February 21, 1952, Serial No. 272,852

Claims priority, application Great Britain
February 23, 1951

5 Claims. (Cl. 340-168)

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This invention relates to electrical circuit arrangements using multi-cathode gaseous-discharge tubes. Circuits according to the invention have applications in electronic calculating machines.

Multi-cathode gaseous-discharge tubes, sometimes referred to as cold cathode counting tubes or polycathode glow tubes, have been described in the literature including an article "Polycathode glow tube for counters," by J. J. Lamb and J. A. Brustman (Electronics, McGraw-Hill Publishing Company, November 1949, pages 92-96), an article "The dekatron—a new cold cathode counting tube," by R. C. Bacon and J. R. Pollard (Electronic Engineering, vol. 22, No. 267, May 1950, pages 173-177) and an article "Multicathode gas-tube counters," by G. H. Hough and D. S. Ridler (Electrical Communication, vol. 27, No. 3, September 1950, pages 214-226).

It is the purpose of this invention to provide an electrical circuit by which information may be recorded by moving the discharge in a multi-cathode gaseous-discharge tube (a store) and by which information may be extracted from such a store. The process of recording is hereinafter referred to as "translating in" and the process of extraction is referred to as "translating out." The information to be translated in may be of a form represented, for example, by the perforation on a punched paper tape or by the setting of electrical switches and information translated out may be made to appear as a record on a punched paper tape or it may be fed to an electrically operated typewriter.

The circuit of the invention comprises a pulse generator, first switch means to direct a pulse train from the generator to move the discharge in either one or the other of first and second multi-cathode gaseous-discharge tubes, second switch means associated with the output cathode of the first tube to switch pulses occurring after the discharge reaches the output cathode to move the discharge in the second tube, means associated with the main cathodes of the second tube to mark any one of said cathodes to switch pulses via said second switch means occurring after the discharge reaches the marked cathode to move the discharge in the first tube, and identifying means associated with the main cathodes of the second tube, to identify the cathode on which the discharge comes to rest.

Apparatus embodying the invention will now be described with reference to the accompanying circuit diagram.

The circuit comprises a storing unit 11, a "translator" 12 and a pulse generator 13. The translator consists of a multi-cathode tube 14, an

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amplifier 15 for the pulses taken from the cathodes 0-10 of the tube 14, a "circulate zero" circuit 16 for circulating the discharge in the tube 14 on to the cathode 0, various switches 17-32 and output circuits 33-37. Load resistances 40-50 are associated with cathodes 0-10 respectively. The tube 14 has first and second guide cathode groups 38 and 39. Each output circuit 33-37 comprises a triode amplifying valve such as 33a, a relay such as 33b in the anode circuit of the valve, and a condenser 33c to give the relay 33b a slow release characteristic. The contacts associated with the relays (33b etc.) are used to feed signals to an electrically operated typewriter or to a tape-perforator in a well known manner.

The storing unit 11 may be regarded as typical of a large number of similar units used in an electronic calculating machine. A cascade of such units may be used to store the digits of a multi-digit number. The unit 11 consists of a multi-cathode tube 51, provided with first and second guide cathode groups 52 and 53 and output cathode 54 and, also in the unit 11, a series of switches 55-59. The storing unit 11 may be used as a receiving store (for translating in) or as a sending store (for translating out).

The pulse generator 13 is provided with a series of connections 60-65 for the transmission of pulse trains to various parts of the circuit.

A switch circuit 66 is provided which, in conjunction with tubes 14 and 51, is used for transfer operations between the tubes in the manner indicated in the co-pending patent application Serial No. 272,312 dated February 19, 1952. The switch 57 is provided to establish "add" or "subtract" conditions between the tubes.

The operation of the circuit is now described, by way of example, for the simple operation of translating a count of 4 into the storing unit 11 and the subsequent operation of translating out this count.

The circuit is first set for "translating in." This involves momentarily operating switch 22 so that the discharge in tube 14 is circulated to cathode 0 by pulses from the generator 13 connected to the first and second guide cathodes 38, 39; the pulses to the first guide cathode being transmitted by way of connection 60, and the pulses to the second guide cathode being transmitted by way of connection 65 and circuit 16. A connection 68, between the "circulate zero" circuit 16 and cathode 0, is used to provide a signal when the discharge reaches that cathode and so stop the circulation of the discharge. Switch 29 is operated by a relay associated with the contacts of a tape reader to select cathode 6; switch 17 is operated to associate this cathode with switch circuit 66

by way of the amplifier 15, switches 18 and 21 are operated to direct a train of ten pulse pairs to circulate the discharge in tube 14 from cathode 0 to cathode 10 and switches 55 and 57 operated in the store 11 to prepare a circuit to operate tube 51. When in the course of this circulation the discharge alights on cathode 6 a pulse is transmitted from that cathode by way of switch 29, amplifier 15 and switch 17 to operate the switch circuit 66, so that the pulses fed to it by connection 64 are diverted by way of switch 67 (in the "add" position) and switch 55 to the second guide cathode 53 of tube 51, to pair with pulses in connection 61 from the pulse generator 13 to the first guide cathode 52, by way of switch 57, of tube 51. The discharges in tube 14 and 51 then move in synchronism, i. e. the discharge in tube 14 moves four steps (from cathode 6 to cathode 10) and the discharge in tube 51 moves four steps. This completes the operation of translating in a count of "4."

For translating out this count of "4" the switches operated for translating in are restored and switches 56, 58, 59, 20 and 19 are operated and switch 22 is then operated momentarily. Ten pulse pairs from the pulse generator 13 are led by way of connections 62 and 63 to circulate the discharge in tube 51 so that an output pulse is generated at the cathode 54 of tube 51, on receipt of the sixth pulse pair, to trigger the switch circuit 66 to divert four pulses of a synchronous train of ten pulses from the generator 13 by way of connection 64 and switches 67 and 20 to the second guide cathode to tube 14. These four pulses pair with pulses in connection 61 to first guide cathode 38 to move the discharge in tube 14 by four steps to rest on cathode 4. The presence of a discharge on cathode 4 energises output circuits 35 and 36 by way of connections 70 and 69 respectively. The relay contacts associated with the relays of these output circuits are used to operate a tape-punching machine, the count of four being identified by a code combination of the third and fourth holes punched in a "five hole" line.

The relationship between tube 14, switch circuit 66 and tube 51 in the operation of translating in is similar in form to that disclosed in the co-pending application Serial No. 272,312, dated February 19, 1952, which describes a transfer circuit comprising a receiving tube (tube 14), a switch operated by a control pulse (switch circuit 66) and sending tube (tube 51). In the operation of translating out, tube 51 becomes a receiving tube and tube 14 becomes the sending tube.

An electronic calculating machine embodying the present invention may comprise a number of multi-digit stores and a selector, such as combinations of relay contacts, for selecting those stores according to orders given to the machine so that numbers may be translated in or out or have arithmetical operations performed upon them. The number in any store may be a number on which it is required to perform arithmetical operations or it may represent an order, coded say as a two digit code, which will be called upon in the course of operation of the machine to decide further operations of the machine. An order stored in numerical form may be translated out to the form given by output circuits 33-37 and used to instruct the calculating machine further. With an order stored in numerical form, it is a straight-forward process to add a number to the store so that the order is altered thus providing

for a sequence of operations in which the instructions to the machine are amended during its operation according to a preconceived scheme.

We claim:

1. A circuit comprising a pulse generator, first switch means to direct a pulse train from the generator to move the discharge in either one or the other of first and second multi-cathode gaseous-discharge tubes, second switch means associated with the output cathode of the first tube to switch pulses occurring after the discharge reaches the output cathode to move the discharge in the second tube, means associated with the main cathodes of the second tube to mark any one of said cathodes to switch pulses via said second switch means occurring after the discharge reaches the marked cathode to move the discharge in the first tube, and identifying means, associated with the main cathodes of the second tube, to identify the cathode on which the discharge comes to rest.

2. A circuit comprising a first multi-cathode gaseous discharge tube having means for deriving a potential from the output cathode thereof when the discharge arrives at that cathode, a second multi-cathode gaseous-discharge tube having means associated with each main cathode operated when the discharge comes to rest on the cathode, and means associated with the main cathodes for deriving a potential when the discharge arrives at a selected cathode; a first switch means for feeding a pulse train to move the discharge in either of the multi-cathode tubes and switch means for feeding pulses synchronous with pulses in said train and following either of said derived potentials to move the discharge in both multi-cathode tubes.

3. A circuit according to claim 1 wherein said means associated with each main cathode operated when the discharge comes to rest on the cathode comprises an electronic valve connected to feed current through slow-to-operate electromagnetic relay.

4. A circuit according to claim 1 wherein said means associated with each main cathode operated when the discharge comes to rest on the cathode comprises two detectors the input to each of which is common with connections from other main cathodes so that any cathode is identified by a characteristic combination of two detectors.

5. A circuit comprising a first multi-cathode gaseous discharge tube having means for deriving a potential from the output cathode thereof when the discharge arrives at that cathode, a second multi-cathode gaseous-discharge tube having means associated with each main cathode operated when the discharge comes to rest on the cathode, and means associated with the main cathodes for deriving a potential when the discharge arrives at a selected cathode; a first switch means for feeding a pulse train to move the discharge in either of the multi-cathode tubes, and change-over switch means for, on the one hand, feeding pulses synchronous with pulses in said train and following, on the other hand, feeding pulses synchronous with pulses in said train and preceding, either of said derived potentials to move the discharge in both multi-cathode tubes.

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No references cited.