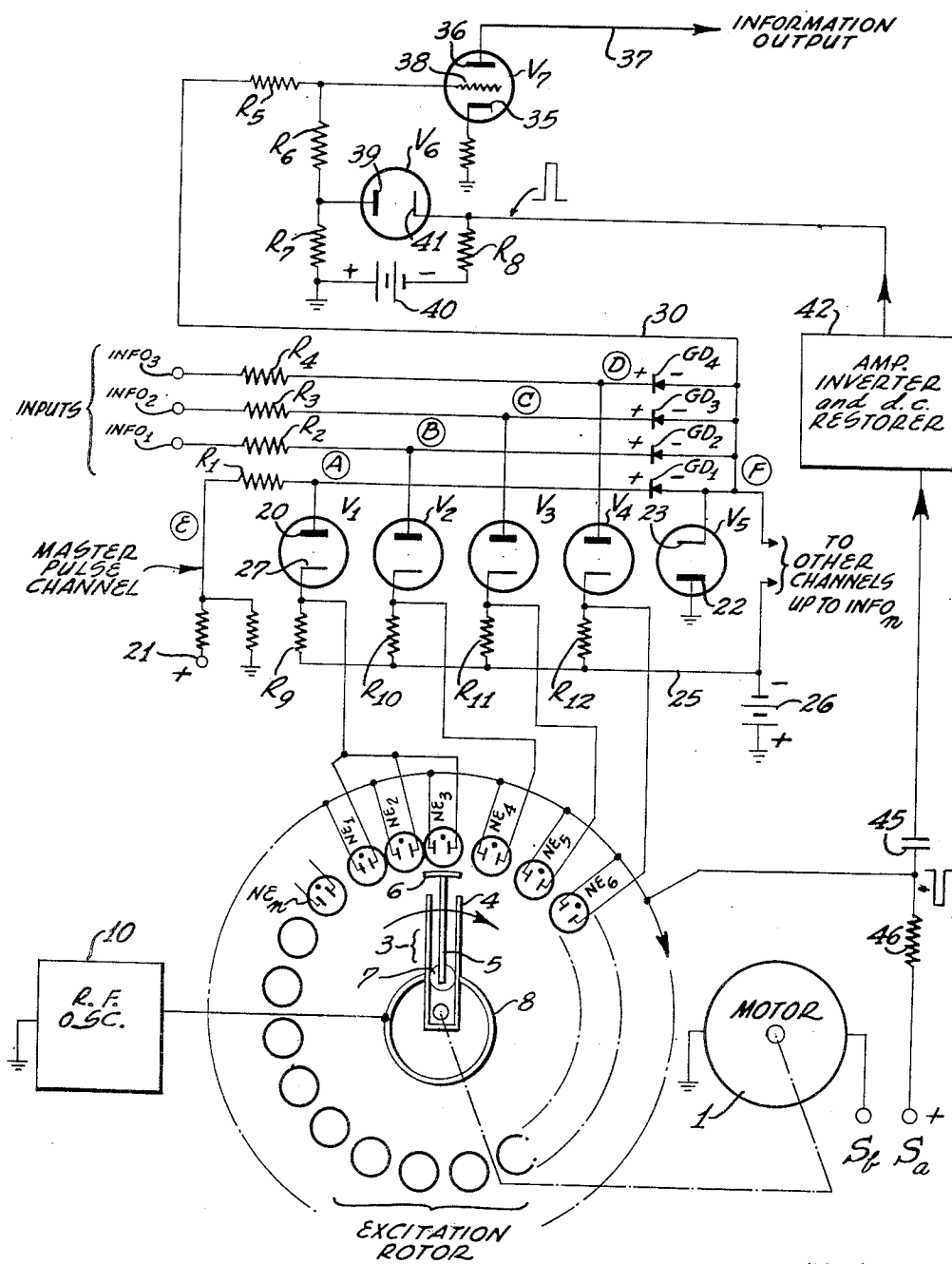


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HIGH-SPEED COMMUTATOR

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HIGH-SPEED COMMUTATOR

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This invention relates to a means and method of commutating a large number of information channels into one common lead for the purpose of transmitting information out of these information channels on a single carrier.

Among the objects of the invention are:

To provide commutation at a high rate;

To provide a commutator without brushes or commutator segments;

To provide commutation without physical contact of circuit controlling elements;

To provide commutation by ionic control of gaseous discharge tubes;

And to provide a relatively simple high speed commutation device.

The above objects are accomplished in the present invention by the utilization of a radio frequency field to excite a plurality of gaseous discharge lamps arranged so that a high speed rotor distributing this field excites or ionizes each lamp consecutively until the commutation cycle is completed. When each lamp is ionized by the R. F. field, the lamp passes a direct current, developing a voltage that is used to operate a gating circuit.

Referring to the single figure which shows diagrammatically the present invention as applied to a telemetering circuit, a motor 1 is connected to rotate an excitation rotor 2 having an arm 3. Arm 3 comprises a shield 4 carrying an arm electrode 5 ending in an excitation tip 6 tangent to the circle of rotation of the arm 3.

Arm electrode 5 is connected through a suitable brush 7 and stationary ring 8 to a radio frequency oscillator 10, this oscillator being adapted for continuous excitation of tip 6.

Positioned concentrically in a circle around arm 3 and just outside the circle of rotation of tip 6 are a plurality of two electrode cathode glow tubes NE₁, NE₂, etc. Up to 40 of such tubes, well known in the art and usually filled with neon, can readily be utilized for example.

Several of these neon tubes, for example three adjacent tubes NE₁, NE₂ and NE₃, have one electrode thereof (cathode) connected in parallel to a gate diode V₁, the anode 20 of which is energized through resistance R₁ and positive potential line 21. The anode 20 of tube V₁ is also connected to ground through a germanium diode GD₁ and a diode V₅, this latter diode having its anode 22 connected to ground, with its cathode 23 connected to the negative side of germanium diode GD₁.

A bias line 25 is provided, energized by a bias

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source 26 providing a bias to the cathode 27 of gate V₁ through cathode resistance R₃.

As will be seen later, the three glow tubes NE₁, NE₂ and NE₃ combine to produce a synchronizing pulse once per revolution of arm 3.

The other glow tubes NE₄ to NE_n are respectively connected to information channels INFO₁ to INFO_n, respectively, through respective gate diodes V₂ . . . V_n, and also respectively through germanium diodes GD₂ to GD_n to a main channel line 30. Each of the gate diodes V₂, V₃ . . . V_n is biased from bias 26 through bias line 25 and through respective bias resistors R₁₀ . . . R_n in the same manner as described for gate diode V₁.

Main channel line 30 is led through an input resistor R₅ to the grid 38 of a triode amplifier tube V₇, and the combined channel output is taken from the anode 36 of this triode V₇ by an output line 37.

Grid 38 of triode V₇ is also fed by an anode 39 of a bias diode V₆ through bias resistor R₆, this latter diode being shunted by a bias cell 40 in series with a resistance R₇ on one side and resistance R₈ on the other. The junction between R₇ and cell 40 is grounded. The cathode 41 of bias diode V₆ is connected to the output of an amplifier, inverter, and D. C. restorer 42, the input of which is connected to all of the other electrodes (anodes) of the glow tubes NE₁ to NE_n through an isolating capacity 45. These latter anodes are also energized from a positive potential source S_a through limiting resistor 46. (Motor 1 is energized from source S_b.)

The operation of the above described commutator is as follows:

Diode tubes V₁, V₂, V₃, V₄, etc. are connected to information channels INFO₁, INFO₂ . . . INFO_n and master pulse channel 30. When these diodes conduct, they effectively short out the information voltage through series resistors R₁, R₂, R₃, R₄, etc., one in each channel. The bias 26 voltage is connected to the cathode 27 of the gating diodes V₁ . . . V_n to bring all of these cathodes below ground potential insuring that the points A, B, C, D, etc. will be at ground potential or lower, with maximum information voltage.

Each neon NE₁, NE₂, etc. is connected to the positive D. C. potential source S_a, which has a potential lower than the extinguishing voltage of the lamps. When any neon lamp NE₁ . . . NE_n is ionized by the R. F. field upon close approach thereto of the energized tip 6, this lamp conducts current, thereby developing a voltage

across the related resistor in the group $R_9 \dots R_n$ connected in the cathode circuits of the diode gates V_1, V_2, V_3 , etc.

Considering the arm 3 to be rotating clockwise and in a position to ionize NE_1 , a voltage will be developed across R_9 . This voltage raises the cathode 27 of gate V_1 to be sufficiently positive so that the gate tube V_1 cuts off, thereby permitting the voltage at point E to develop a voltage on the grid 38 of the amplifier tube V_7 through the germanium diode GD_1 and resistor R_5 . Lamps NE_1, NE_2 and NE_3 are mounted physically so close together so that the field on tip 6 ionizes lamp NE_2 before lamp NE_1 extinguishes, and lamp NE_3 is ionized before lamp NE_2 extinguishes. With this arrangement an output pulse three times the width of an information pulse is generated and creates a master synchronization pulse once per revolution of the excitation rotor.

Lamps NE_4, NE_5, NE_6 and the rest of the neon lamps in the commutation cycle are physically spaced so that each lamp extinguishes before the next lamp ionizes, thereby providing a time separation between the gating of each information channel.

When the excitation tip 6 ionizes lamp NE_4 , a voltage is developed across cathode resistance R_{10} which causes gate diode V_2 to cut off, thereby allowing the information voltage at information channel $INFO_1$ to develop a voltage at the grid of amplifier tube V_7 . As each neon lamp is ionized in turn, the information in terms of voltage on the associated $INFO$ channel is gated and fed to the amplifier tube V_7 . This process continues until all the $INFO$ channels have been gated, at which time the excitation tip is again in a position to cause the master synchronization pulse to be generated.

The germanium diodes GD_1, GD_2, GD_3, GD_4 , etc. are connected so that a positive information voltage at points A, B, C and D will have a low impedance path to the grid 38 of amplifier tube V_7 , but will see a high impedance back into any other information channel. Diode V_5 is connected to conduct when a negative voltage appears at point F. A negative voltage at point F would be present when points A, B, C, D, etc. are negative during the time the gating diodes V_1, V_2 , etc. are conducting. This is caused by the fact that germanium diodes do not have an infinite back impedance. Since the anode 22 of diode V is connected to ground, any negative voltage that would be present at point F is reduced to an insignificant value.

Bias diode V_6 and bias cell 40 are connected so that normally bias diode V_6 provides a current path through resistors R_7 and R_8 , thereby developing a negative voltage on the end of resistance R_7 presented to grid 38 of amplifier tube V_7 . This negative voltage across resistance R_7 puts a negative voltage on the grid 38 of amplifier tube V_7 through a voltage divider consisting of resistances R_6, R_5 and the diode V to ground. Since resistance 46 is connected in series with the voltage supplied to the neon lamps $NE_1 \dots NE_n$, each time a lamp conducts, a negative voltage is developed across resistance 46. This voltage is fed to the input of the amplifier, inverter and D. C. restorer 42 which causes a positive voltage to be developed across resistance R_3 each time a neon lamp NE fires to gate a channel. This positive voltage across resistance R_3 raises the cathode 41 of bias diode V_6 above ground high enough so that it stops conducting, thereby removing the negative voltage across re-

sistance R_7 . This action allows the grid 38 of tube V_7 to go to a positive potential proportional to the information voltage being gated. By adjusting the resistance of resistance R_7 , the amplitude of the channel synchronizing pulse can be set to any desired percentage of the maximum information voltage.

Summing up the operation of the synchronizing pulse circuits, just above described, it can be said that each time an information channel is gated, the grid of amplifier tube V_7 rises from a preset negative value to ground when a channel with zero information is gated or to a positive value proportional to the information voltage when a channel with information voltage present is gated.

The R. F. oscillator 10 used to ionize the neon lamps $NE_1 \dots NE_n$ is conventional and need only supply enough R. F. field at tip 6 for proper ionization and excitation of the neon lamps.

Motor 1, which turns the excitation rotor, is preferably a constant speed motor turning at approximately 15,000 R. F. M. for example, depending on the desired commutation frequency. When 40 information channels are used, for example, these channels can all be sampled 250 times per second, a sampling speed not at present known to be practical with any mechanical commutator.

While in order to comply with the statute, the invention has been described in language more or less specific as to structural features, it is to be understood that the invention is not limited to the specific features shown, but that the means and construction herein disclosed comprise a preferred form of putting the invention into effect, and the invention is, therefore, claimed in any of its forms or modifications within the legitimate and valid scope of the appended claims.

What is claimed is:

1. A commutating device comprising a rotor having a conducting area thereon adapted to be energized to produce a field extending beyond said rotor, and a plurality of gaseous discharge tubes positioned in an area adjacent the arc of said area whereby as said area is rotated said tubes will be serially exposed to the field extending from said area without contact therewith.

2. A commutating device comprising a rotor having a conducting area, means for rotating said rotor to cause said area to describe an arc, means for energizing said area while rotating with high frequency energy to provide a field around said area extending beyond said area, a plurality of gaseous discharge tubes positioned in an arc adjacent the arc described by said area with each of said tubes positioned to be influenced by the field on said area as said area is rotated, and means for energizing said tubes at a potential below the burning potential thereof, whereby as said area is rotated said tubes will ignite to pass current only when in the field of said area.

3. Apparatus in accordance with claim 2 wherein at least a portion of said tubes are spaced with relation to the extent of said field so that an ignited tube will extinguish before the next tube is ignited.

4. Apparatus in accordance with claim 2 wherein at least a portion of said tubes are spaced with relation to the extent of said field so that an ignited tube will remain ignited until the next tube is ignited.

5. Apparatus in accordance with claim 2 wherein a plurality of information channels are pro-

vided each with a gate, each of said gates being connected to be opened or closed in accordance with the ignition and extinction of one of said tubes, and a common output line connected to said gates.

6. Apparatus in accordance with claim 2 wherein a portion of said tubes are spaced with relation to the extent of said field so that an ignited tube will remain ignited until the next tube is ignited, the remainder of said tubes being more widely spaced so that an ignited tube will extinguish before the next tube is ignited.

7. Apparatus in accordance with claim 6 wherein a single gate is connected to be controlled by the condition of said closely spaced tubes, a plurality of energized information channels each provided with a gate, said latter gates being connected to be respectively controlled by said wider spaced tubes, and a common output line connected to said gates whereby a relatively long energy pulse followed by a succession of shorter energy pulses will be present in said common output line as said area is rotated.

8. The method of commutation which comprises energizing a plurality of cold cathode gaseous glow discharge tubes at a potential just below the burning voltage thereof, and serially exposing said tubes to a high frequency electrical field sufficient to ionize each tube, when exposed, to the extent that the exposed tube will pass current.

9. The method of commutation which comprises continuously energizing a plurality of cold cathode gaseous glow discharge tubes at a potential just below the burning voltage thereof, and serially exposing said tubes in a predetermined repeating order to a high frequency electrical field sufficient to ionize the exposed tube, only, to the extent that it passes current to develop a voltage for electronic gating purposes.

10. A commutating device comprising a plurality of cold cathode gaseous glow discharge tubes positioned in adjacent locations, an electrical radiator member, means for energizing said radiator member with radio frequency oscillations to produce an electrical field extending beyond said radiator member, and means for moving said radiator member past said tubes in a predetermined cycle whereby said tubes are serially exposed to said extending field to cause said tubes to conduct only when exposed to said field.

11. A commutating device comprising a plurality of gaseous discharge tubes positioned in predetermined relation, an electrical radiator member adapted to be energized to produce a radio frequency field extending beyond said radiator member, and means for continuously mov-

ing said radiator member in a path adjacent said tubes to serially expose said tubes to said radio frequency field in a predetermined cycle, whereby as said field is moved said tubes may be ignited to pass current only when exposed to said field.

12. A commutating device comprising a plurality of gaseous discharge tubes positioned in a predetermined relation, an electrical radiator member adapted to be energized to produce a radio frequency field extending beyond said radiator member, means for energizing said tubes at a potential lower than the burning potential thereof, and automatic mechanical means connected to said radiator member to move said member in cyclic manner past said tubes to expose each of said tubes to said radio frequency field, whereby said tubes will ignite to pass current only while exposed to said radio frequency field.

13. A commutating device for cyclicly applying electrical information in a plurality of information inputs to a single output line, which comprises a plurality of gaseous discharge tubes positioned in predetermined relation, an electrical radiator member adapted to be energized to produce an oscillating field extending beyond said radiator member, circuit means for constantly energizing said tubes at a potential just below the burning potential thereof, a plurality of normally conducting gate means respectively connected at one side thereof to a control point in each conducting circuit of said tubes where a potential change occurs during conduction of its respective tube, the other side of each gate means connected respectively to said information inputs, each said gate means being open to short out its respective input when its respective discharge tube is non-conducting, a rectifying diode connected to the junction of each of said information inputs and its respective gate means, the other sides of said rectifying diodes connected directly to said output line, and means for moving said radiator member in a continuous cyclic manner past said tubes to serially expose said tubes to said field, whereby each time a tube is so exposed it is caused to conduct current and produce a voltage closing its respective gate, thereby allowing the potential of its respective information input to pass through its respective rectifying diode and appear on said output line.

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