June 1, 1937. A. B. DU MONT 2,082,327

CURRENT GENERATOR AND CONVERTER

Filed March 25, 1935

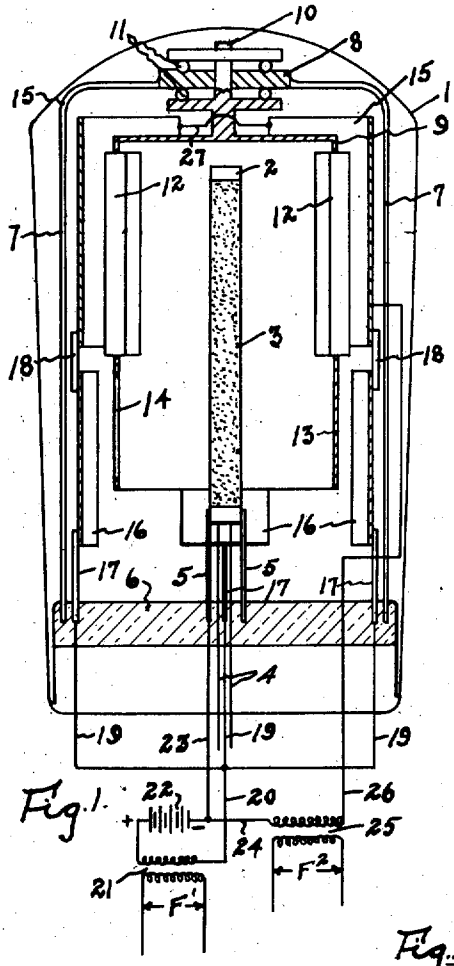


Fig. 1.

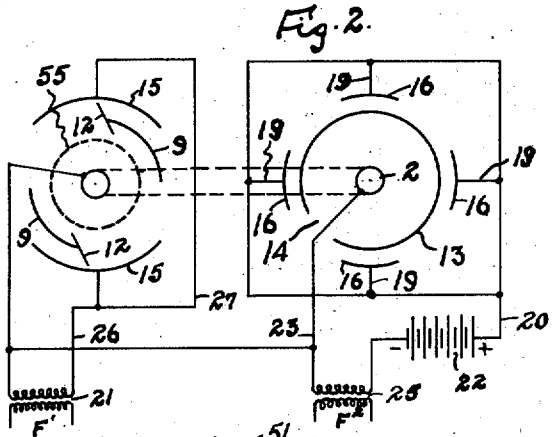


Fig. 2.

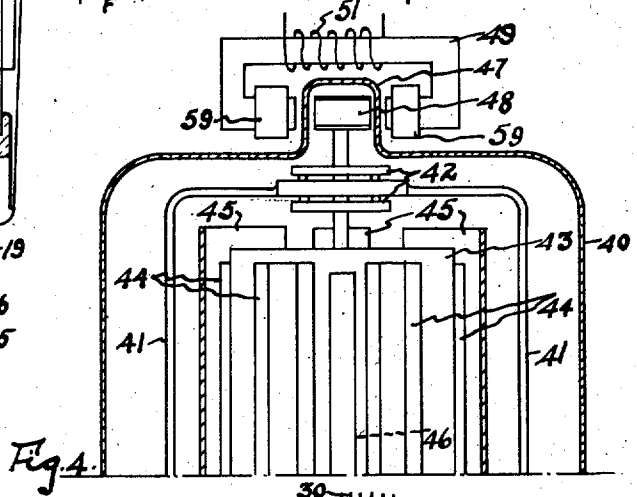


Fig. 4.

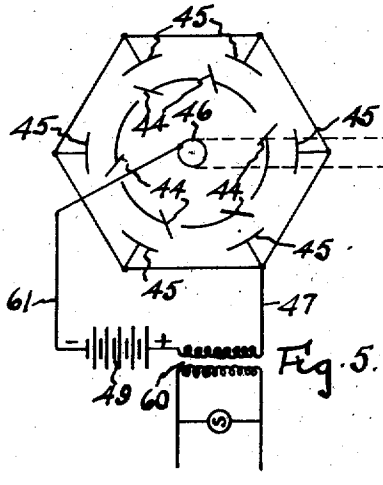


Fig. 5.

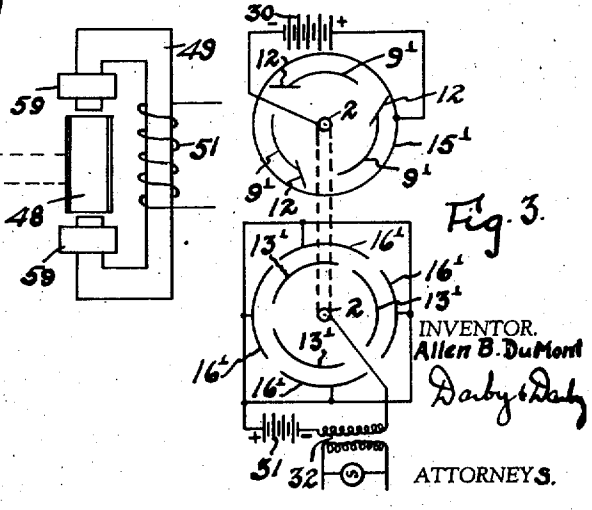


Fig. 3.

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UNITED STATES PATENT OFFICE

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CURRENT GENERATOR AND CONVERTER

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Application March 25, 1935, Serial No. 12,852

10 Claims. (Cl. 250—27.5)

This invention relates to space discharge devices and particularly to means for utilizing an electronic or ionic stream to effect mechanical movement.

An object of this invention is to provide means for utilizing an electronic or ionic stream in the production of currents of any desired wave shape or frequency.

Another object of the invention is to provide means for utilizing an electronic or ionic stream to effect switching or commutating action.

A still further object of this invention relates to means operated by an electronic or ionic stream for converting a current from one characteristic into a current having a different characteristic.

An additional object of the invention relates to an electron discharge device having therein a member adapted to be driven by an electronic or ionic stream produced between a pair of cooperating electrodes and another pair of electrodes adapted to have the electronic stream therebetween varied by rotation of said member.

A still further feature of the invention relates to an electron discharge device having an electron emissive cathode and a pair of anodes common to said cathode, together with a pair of movable members rotatable as a unit between said pairs of electrodes.

A still further and additional object of the invention is to provide an electron discharge device with means for producing an electron stream, together with a pair of members adapted to move transversely with relation to the stream, one of said members having applied thereto current of one frequency and the other of said members controlling generation of currents of different frequency.

Another object of this invention is to provide a novel type of synchronous motor driven converter deriving its motive power mainly from the kinetic energy of a moving electronic or ionic stream.

This invention resides substantially in the combination, construction, arrangement and relative location of parts, all as will be described in greater detail in the following specification.

In the drawing,

Figure 1 is a vertical, central, cross-sectional view with some parts in elevation of a frequency changer in accordance with this invention;

Figure 2 is a schematic development of this device;

Figure 3 is another schematic development thereof showing an arrangement for converting direct currents into alternating currents;

Figure 4 is a vertical, central, cross-sectional view with some parts in elevation of the upper portion of a device in accordance with this invention for generating currents; and

Figure 5 is a schematic development of this device.

This application is a continuation in part of my co-pending application Serial No. 425,025, filed January 31, 1930 and issued as Patent No. 1,999,407 on April 30, 1935.

The device illustrated in Figure 1 comprises an evacuated envelope 1 of any desired shape or configuration to serve as an enclosure for the parts of the mechanism to be described. While the envelope is shown as having the shape usually employed for audions, it will be understood that any other shape may be employed.

The envelope is provided with the usual reentrant stem and press 6 from which the various parts are supported. As illustrated, the source of electrons is an indirectly heated cathode which may be made in accordance with many known forms but which has been illustrated as comprising a central rod of insulating material which supports a heater which may either lie in bores therethrough or be directly embedded therein. The central rod is enclosed within a tight-fitting metal sleeve 2, upon the surface of which has been deposited, in accordance with well known principles, an electron emissive coating 3 which becomes active when heated. It is, of course, within the scope of this invention to employ a directly heated type of cathode comprising an emissive body which is directly heated by the passage of current therethrough, in accordance with well known principles. At 4 are the wire leads for the heater or filament which pass through the press and externally of the vessel and may be energized in accordance with well known principles from any suitable current source (not shown). The cathode structure is supported from the press by means of a pair of rods or wires 5 which are conductively secured to the metal sleeve 2 in any suitable manner and are embedded in the press as shown. With this arrangement the cathode is supported centrally of the vessel.

At 7 are a pair of rods or supports embedded in the press and extending upwardly towards the top of the vessel and into horizontal portions which terminate at a bearing plate or support 8. At 9 is the rotor which is provided with a vertical central shaft 10 for rotatably mounting the rotor

from the plate 8 by means of the ball thrust bearings 11. The rotor 9 comprises a metal cylinder which may take a number of forms in accordance with this invention. As illustrated in the drawing, it consists of a continuous cylinder supported from the top end by the shaft 10 so as to rotate on an axis coincident with the axis of the cathode. The upper portion of the rotor is provided with windows or openings extending longitudinally thereof and having mounted at one edge of each window a vane 12. The vanes are positioned so as to be preferably, but not necessarily, at an angle of approximately 45° with a radius from the cathode. In accordance with this invention the vanes 12 may be formed by simply punching out the metal of the cylinder to simultaneously provide a window having the vane 12 integral with the cylinder and along one edge of the opening. The lower portion 13 of the cylinder 9 is continuous with the exception of a single window in the form illustrated, as shown at 14. Supported adjacent the upper portion of the rotor 9 and opposite the vanes 12 are the sectors 15 made of metal and forming the anodes of the device. In the form illustrated there are but two of these sector-like anodes which are positioned on the circumference of a circle concentric with the cathode. Mounted below the anodes 15 are additional anodes 16 positioned opposite the portion 13 of the rotor. In the form illustrated there are four of these anodes 16, which are of sector-like form and are mounted on the radius of a circle concentric with the cathode. The anodes 16 are supported from the press by means of the rods 17 and the anodes 15 are in turn supported from the anodes 16 by means of any suitable construction, as, for example, the insulating spacers 18 which interconnect them.

The anodes 16 are all electrically connected together by means of the wires 19 to a common wire 20 which terminates at one terminal of the secondary of the transformer 21 through the current source 22. The primary of transformer 21 may be energized from any suitable current source, such as an alternating current of a particular frequency. The other terminal of the current source 22 is connected by wire 24 to one terminal of the primary of the output transformer 25. Wire 24 is connected by wire 23 to the cathode sleeve by way of a supporting rod 5. The other terminal 26 of the primary of transformer 25 is connected by wire 26 to one of the anodes 15. The two anodes 15 are electrically connected together, as illustrated at 27.

The relation of the parts to the circuit combination employed is schematically shown in Figure 2. While the motor portion of this device is shown employing two anodes 15 and two windows and vanes 12 and the converter portion is shown employing four anodes 16 and a cylindrical rotor 13 having a single window 14, it will be understood by those skilled in the art that the ratio of the number of windows in one set to those in the other will be determined by the desired ratio of frequency change.

When a frequency F' is impressed upon the primary of transformer 21 the anodes 15 will have impressed thereon alternately positive and negative potentials. With the cathode active emiting electrons it will be apparent that for the positive halves of the wave, the anodes 15 being positive at that time, the electrons will be attracted from the cathode thereto at increasing velocity. These electrons may reach the anodes by passing through the windows in the upper portion of the rotor 9. By reason of the position of the vanes the electrons will strike them and cause the cylinder 9 to revolve. The anodes 16 are maintained at a positive potential by reason of their connection to the direct current source 22. Thus as the window 14 in the portion 13 of the rotor moves into alignment successively with the anodes 16 a current will flow from the cathode to the anode. This will, of course, be an interrupted direct current, which in travelling through the primary of transformer 25 will be repeated in the secondary as an alternating current of the frequency F_2. For example, assuming the frequency of the supply F' is 60 cycles per second then with the structure illustrated the rotor 9 will revolve synchronously at a rate of about 1800 R. P. M. Consequently, there will be generated in the primary of transformer 25 a current having a frequency of 120 cycles per second, since four impulses will flow between the cylinder anode sectors 16 and the cathode for each revolution of the rotor. Consequently, the frequency F_2 will have twice the frequency of the source F'.

It will be obvious that any other frequency ratio may be generated by designing the number of anode sectors and rotor slots in the proper ratio. It will also be clear that instead of using X anode sectors and Y windows for the lower or generating portion the proper frequency may be generated by employing Y anode sectors and X windows. Furthermore, the slots or windows may be designed so as to "cut off" the electron streams in either a sinusoidal manner or in any other manner, depending upon the wave shape desired for the generated currents. While the window or slot 14 in the lower part of the rotor is shown without a vane, it will be apparent that a vane may be attached thereto and the device will then be reversible if the frequency to be changed is applied to transformer 25.

The circuit of Figure 3 is similar to that of Figure 2 with the exception that a direct current source is employed to operate the motor portion of the device. In this case the anode 15' is shown as a continuous cylinder which is maintained at a positive potential by connection to the direct current source 30. The negative terminal of this source is connected to the cathode 2. The motor portion 9' of the rotor is shown as having three windows and three vanes. It is obvious that the rotor will revolve continuously since electrons will travel from the cathode to the anode and in striking the vanes cause rotation thereof. The lower portion of the device comprises, as before, the anode sectors 16' and the rotor sectors 13', which in this case are formed by providing four windows. The anode sectors 16' are all connected to the positive side of a current source 31 which is connected at its other terminal through the primary 32 of an output transformer. The other terminal of this primary is connected to the cathode 2.

When the rotor revolves it will be apparent that although the device is energized by direct current alternating current will be produced in the secondary of the transformer 32. Thus the device may be employed as a current converter as well as a frequency changer. As will be apparent from the foregoing description, the form of structure of Figure 3 is basically like that of Figures 1 and 2. A common cathode is employed, separate sets of motor and generator anodes are employed, and a single rotor is employed having motor and generator portions.

A still further modification is illustrated by Figures 4 and 5. In this case, instead of employing an electron stream to cause the rotor member to revolve it is connected to and driven by a synchronous motor. In this case, as illustrated in Figure 4, the evacuated envelope is shown at 40, within which is supported, by means of the rods 41 from the press not shown, a rotor 43 by means of the ball thrust bearing 42. The rotor 43 is in this case provided with six windows and vanes 44. The anodes 45, of which there are six, are supported concentrically around the rotor and the central cathode 46 as before from the press. The rotor 43 and the anodes 45 comprise the generator portion of the device. The motor operation is, as illustrated, of a different construction. The rotor of the synchronous driving motor is shown at 48 secured to the upper end of the shaft which supports the rotor 43. The rotor 48 fits within an extension 47 of the envelope 40. Supported outside of the envelope is the stator 49 which is shaped to provide a pair of poles radially opposite the rotor 48.

At 59 are illustrated the starting coils commonly employed with such a motor. The stator is energized by means of a stator winding 51 which is energized from any suitable alternating current source to cause operation of the motor in accordance with well known principles. It is noted, of course, that this illustration is diagrammatic and that any suitable form of synchronous driving motor may be employed. The circuit connections are diagrammatically illustrated in Figure 5. In this case all of the anodes 45 are connected together and by means of a wire 47 to the primary of a transformer 60, the other terminal of which is connected to the positive terminal of a direct current source 49. The negative terminal of this source is connected by wire 61 to the cathode 46. When the synchronous motor is energized it will cause the rotor 43 to revolve so that electrons will periodically flow through the windows to the positive anodes 45. The result will be to produce an alternating current in the secondary of transformer 60.

The velocity of electrons impinging upon the movable member may be increased or controlled by means of a control electrode similar to the grid of a vacuum tube which is interposed between the cathode and the rotor or between the rotor and the anode or both. This control electrode is maintained at a suitable positive potential with respect to the cathode or at any other suitable potential to reduce space charge effects, back emission effects and the like, as are well known in the art of electron discharge devices. The use of such a grid has been illustrated by way of example in Figure 2 at 55. A similar grid or control electrode can, of course, be used with the other forms of the device as illustrated. If desired, the input alternating potential may be impressed on the grid rather than the anodes 15 or 15' or on both to assist the synchronous operation of the device. For example, a source of positive potential may be interposed between the anodes 15 and the cathode and an alternating current potential impressed upon the grid which will act to synchronize the device and cause operation similar to the arrangement of Figure 2 without the use of a grid.

From the above description it will be apparent to those skilled in the art that the principles of this invention may be applied in many physical forms, and I do not, therefore, desire to be strictly limited to this illustrated disclosure but rather to the scope of the appended claims.

What I seek to secure by United States Letters Patent is:

1. An electric converter including a rotor, a cathode, a pair of anodes cooperating with said rotor and cathode, one of said anodes serving to control the rotation of said rotor, the other anode serving to control the conversion of electric currents.

2. In combination, an electron emitting cathode, a pair of anodes, electrons flowing between said cathode and each of said anodes when energized, and means including a slotted rotor operated by the stream of electrons flowing to one anode for controlling the stream of electrons flowing to the other anode.

3. A frequency changer including an electron emitting cathode, a first anode, electrons flowing from the cathode to the anode when an alternating current is impressed across said anode and cathode, a second anode, and means including said second anode and said cathode for controlling the generation of an alternating current.

4. A frequency changer comprising a source of emitted electrons, a rotor having sets of openings for the free passage of electrons, one set of openings for controlling the rotation of said rotor and the other set for controlling the generation of an electric current and a plurality of anodes surrounding said rotor.

5. A frequency changer according to claim 4 in which one set of openings is provided with means adapted to be acted upon by electron impacts.

6. In combination an evacuated envelope, a single source of emitted electrons within said envelope, a member mounted for rotation within said envelope, means located outside said envelope for rotating said member across the path of said electrons and a pair of longitudinally aligned anodes positioned to receive electrons from said source.

7. A device, comprising an evacuated container, a cathode within the container, a rotor surrounding the cathode, a pair of anodes exterior to said rotor, and a second pair of anodes exterior to said rotor, said rotor having openings therein to expose the cathode to said anodes.

8. A device comprising an evacuated container, a cathode within the container, a rotor surrounding the cathode, anodes surrounding the rotor and arranged in two groups, and a control electrode interposed between the cathode and the rotor.

9. A frequency changer tube comprising an evacuated vessel, a pair of sets of anodes, the anodes of one pair being spaced from the other pair, a common source of electrons, and a slotted member rotatably mounted between the electron source and all of said anodes.

10. A frequency changer comprising an electron emitting cathode, a plurality of anodes and a rotor interposed between the cathode and anodes, said rotor having a plurality of members for controlling the flow of electrons from said source to said anodes, said rotor being movable by electron impact.

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