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1,983,172

MODULATING SYSTEM

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Fig. 1.

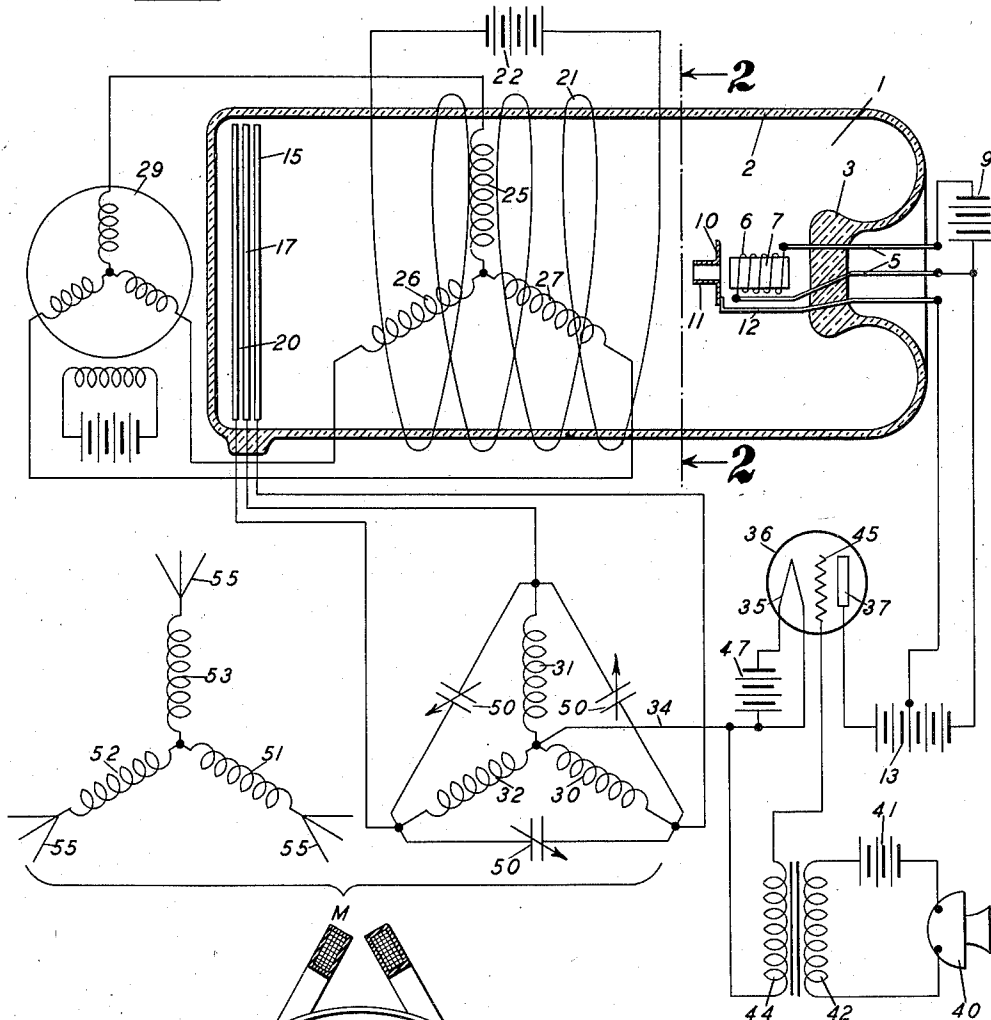
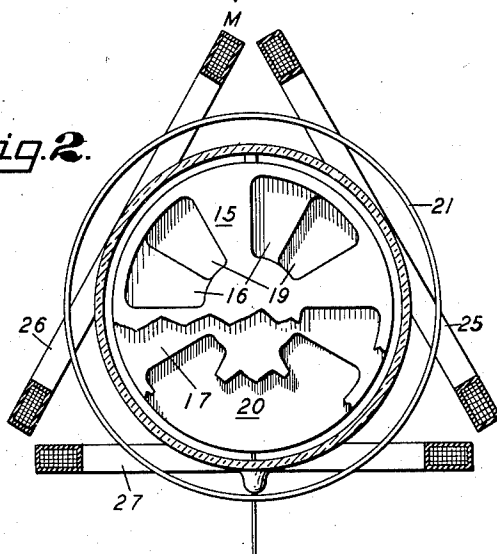


Fig. 2.



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MODULATING SYSTEM

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Application December 21, 1931, Serial No. 582,274

3 Claims. (Cl. 179-171)

My invention relates to modulating systems, and particularly to methods of modulating the output of cathode ray frequency converters or generators of the types described in the copending application of A. H. Brolly, Serial No. 574,292 and my copending applications, Serial Nos. 574,260 and 574,262, all filed November 11, 1931.

Among the objects of my invention are: to provide a method of producing a modulated polyphase alternating current; to provide a method of converting a modulated direct current into a modulated alternating current of either single or polyphase; and to provide a method of modulating a frequency converter system of the type described at a low level and to a moderate degree, in order that the output of such a converter may be utilized to modulate a second converter of the same type at a high level and high degree as is described in my copending application, Serial No. 582,275 filed simultaneously with this application.

Other objects of my invention will be apparent or will be specifically pointed out in the description forming a part of this specification, but I do not limit myself to the embodiment of my invention herein described, as various forms may be adopted within the scope of the claims.

Referring to the drawing:

Figure 1 is a diagram, partly schematic, of the apparatus and circuit utilized in a modulating system embodying this invention.

Figure 2 is a transverse sectional view of a cathode ray frequency converter tube utilized in this invention, the plane of projection being on the line 2-2 of Figure 1.

The frequency converter to which this invention primarily applies comprises a vacuum tube including an electron-emitting cathode and one or more anodes, at least one of which is provided with a plurality of openings therein. A source of direct current, connected between the cathode and the anode, supplies the energy for a beam of cathode rays, means preferably being provided for concentrating or focusing this beam so that it is clearly defined. Means are provided for deflecting the beam across the openings in the anode, so that the flow of current from cathode to anode is cyclically interrupted a plurality of times in each deflecting cycle.

Broadly considered, the modulating system of this invention comprises varying the direct current supplied to the cathode ray beam to modulate this beam in the manner that it is desired that the alternating output of the tube shall be modulated. The impulses then flowing in the output circuits of the device follow in intensity the variations of the

input, and the tube therefore becomes a source of modulated alternating current of the type desired. In a preferred construction, where a plurality of anodes are used, each anode is connected to one branch of a polyphase output circuit, and the beam in its deflection passes successively across the various anodes. The polyphase alternating currents thus supplied are modulated in precisely the same manner as the single phase output would be.

The frequency converter shown in the drawing is substantially the same as that illustrated in my copending application, Serial No. 574,262 above mentioned, and is indicated by the general reference character 1. It comprises a glass envelope 2 having a stem 3 in one end thereof, the stem carrying supply leads 5 for energizing a heating coil 6. A cylindrical internal emitting cathode 7 within the heating coil is raised to the proper temperature by currents from a battery or other source 9.

Closely adjacent the cathode, and also mounted on the stem, is an annular auxiliary anode 10 having a short collar 11 surrounding its central opening. This anode is supported by a lead 12 which connects to an intermediate tap on a battery 13, whose negative end connects to the cathode.

Mounted in the opposite end of the tube are a plurality of disk-shaped anodes. The foremost of these anodes 15 is provided with a plurality of equally spaced sector-shaped openings 16. In the converter described, which is designed for three-phase operation, the openings 16 are twice the width of the bars which separate them. The second anode 17 is also provided with openings 19 of half the width of the openings 16, and the third anode 20 is without openings. It will therefore be seen that a beam of cathode rays traveling at a constant rate in a circular path around the axis of the tube will fall successively and for equal periods upon each of the anodes.

The tube is surrounded by a solenoid 21, through which a direct current from a source 22 flows to focus or concentrate the beam. This focusing coil is shown schematically in Figure 1, in order that the drawing may not be unduly complicated, the actual disposition of the coil being indicated in Figure 2.

Three deflecting coils 25, 26 and 27 are equiangularly disposed about the tube in planes parallel to the tube's axis. These coils are also shown schematically in Figure 1 and their actual disposition indicated in Figure 2. Each of these coils forms a branch of a three-phase circuit

which is excited by a generator 29. The coils are shown star-connected, but may be equally well connected in delta.

The three anodes 15, 17 and 20 connect respectively to the terminals of three star-connected coils 30, 31 and 32, a neutral lead 34 connecting from these coils to the filament 35 of a vacuum amplifying tube 36. The plate 37 of this tube connects to the positive terminal of the battery 13. A microphone 40 is connected in series with a battery 41 and the primary 42 of a transformer whose secondary 44 connects from the lead 34 to the grid 45 of the tube 36. The filament of this tube is shown as supplied by a battery 47. The grid 45 may be negatively biased in the usual manner, but since the primary function of this tube is current amplification and low impedance in the tube is therefore desired, it is frequently advisable to operate the tube with zero or even with positive bias as is shown.

The operation of the device is as follows:

The battery 13 supplies a current which is carried by electrons, emitted from the cathode and accelerated by the auxiliary anode 10, to the three main anodes 15, 17 and 20. The electron beam or cathode ray beam thus generated is concentrated by the magnetic field of the coil 21, and is deflected in a circular path by the rotating polyphase magnetic field from the coils 25, 26 and 27. The beam thus sweeps over the openings in the anodes 15 and 17, flowing successively and for equal periods first to anode 15 and through the coil 30, then to anode 17 and through the coil 31, and finally to anode 20 and through the coil 32, after which the cycle is repeated. From the junction of the three output coils the electron flow continues from the filament 35 of the tube 36 to the plate 37 and hence back to the battery. The magnitude of this current flow is, however, regulated by the potential on the grid 45 derived from the microphone 40. The interrupted current flow in the coils 30, 31 and 32 must, of course, follow in magnitude the variations in the electron flow or cathode ray current.

The wave form due to the interrupted current in these coils will not, in general, be sinusoidal, but by tuning the coils with the condensers 50 the irregularities in wave form will be very largely smoothed out. The three coils may form the primary of a radio frequency transformer having secondary coils 51, 52 and 53,

whose coupling to the primary coils is indicated by the bracket M. The polyphase secondary coils may supply a polyphase antenna system 55, arranged and spaced to generate a rotary-polarized radio wave as is described in my copending application, Serial No. 439,054, filed March 26, 1930.

I claim:

1. A polyphase frequency converter and modulator comprising a vacuum tube having a cathode therein, a plurality of anodes each having a plurality of spaced openings therein and angularly displaced within said tube to receive successively a beam of cathode rays from said cathode, means for deflecting said beam across said anodes, a plurality of star-connected inductors connected to said anodes respectively, a potential source connected between said cathode and the common terminal of said inductors, and means for varying the current supplied by said source at a modulating frequency.

2. A polyphase frequency converter and modulator comprising a vacuum tube having a cathode therein, a plurality of anodes each having a plurality of spaced openings therein and angularly displaced within said tube to receive successively a beam of cathode rays from said cathode, means for deflecting said beam across said anodes, a plurality of star-connected inductors connected to said anodes respectively, a potential source connected between said cathode and the common terminal of said inductors, a vacuum tube having a cathode and an anode connected in series with said source, and a control electrode for varying the impedance thereof.

3. A polyphase frequency converter and modulator comprising a vacuum tube having a cathode therein, a plurality of anodes each having a plurality of spaced openings therein and angularly displaced within said tube to receive successively a beam of cathode rays from said cathode, means for deflecting said beam across said anodes, a plurality of star-connected inductors connected to said anodes respectively, a potential source connected between said cathode and the common terminal of said inductors, a vacuum tube connected in series with said source to modulate the current supplied thereby, and means for controlling said last-mentioned vacuum tube at a modulating frequency.

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