Sept. 1, 1936. R. CRÄMER 2,053,133

RECTIFICATION OF ALTERNATING CURRENTS

Filed July 17, 1933

Fig. 1.

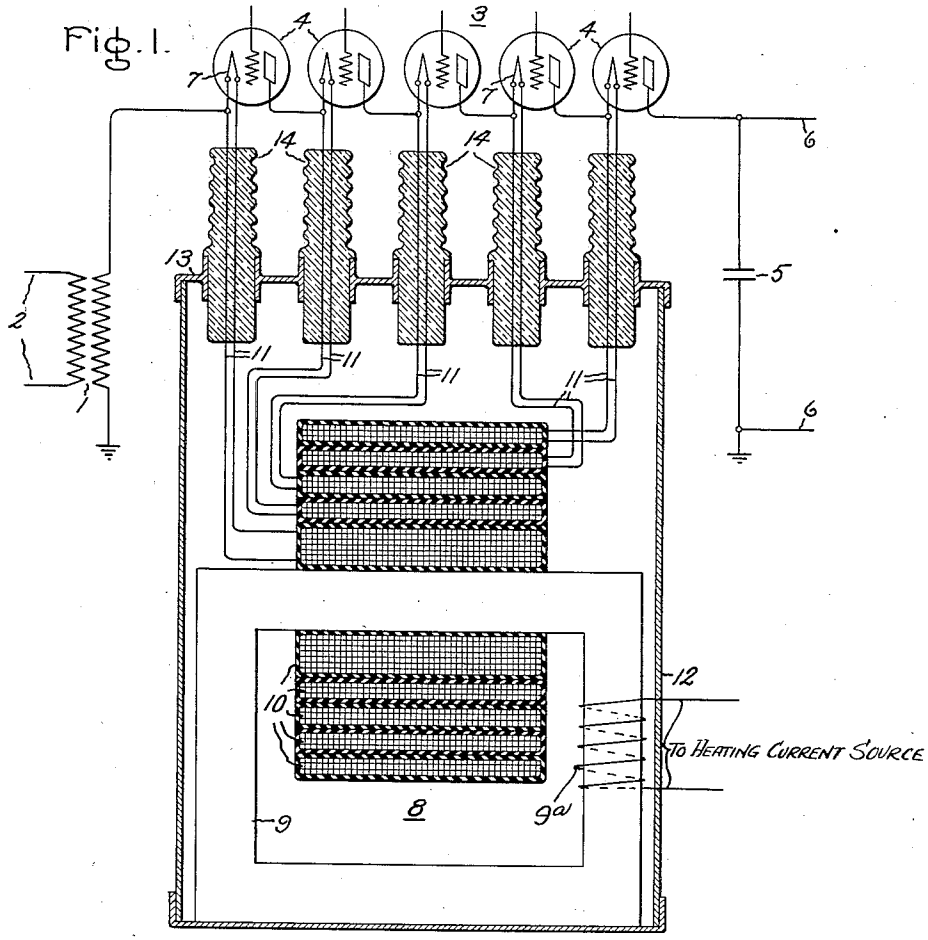


Fig. 2.

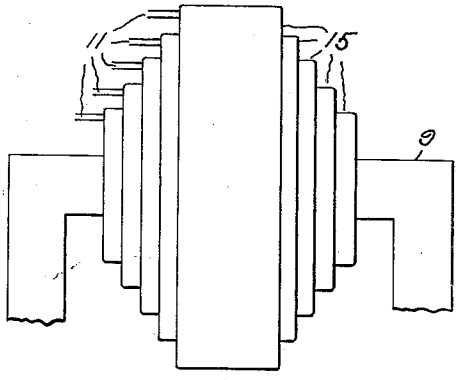
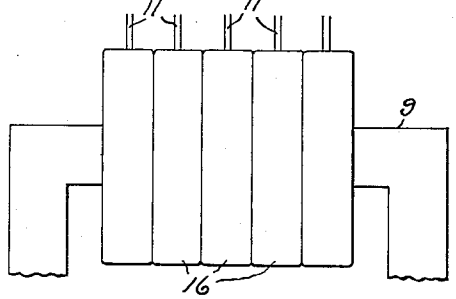


Fig. 3.



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RECTIFICATION OF ALTERNATING CURRENTS

Richard Crämer, Berlin-Steglitz, Germany, assignor to General Electric Company, a corporation of New York

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In Germany August 9, 1932

1 Claim. (Cl. 175—363)

My invention relates to the rectification of alternating currents, particularly to the rectification of high-potential alternating currents by means of a plurality of series-connected discharge devices or tubes of the hot-cathode type, and has for its principal object to provide simplified means for supplying heating current to the cathodes and for controlling the potential distribution in the series of discharge devices.

The rectification of high-potential alternating current by means of thermionic valves or discharge tubes of the hot-cathode type is well known. When, however, several valves are connected in series for the production of especially high potentials difficulties are encountered due to the fact that the heating current for the cathodes must be supplied from current sources which are at high potentials differing one from another. For heating the cathodes various sources of current have been used heretofore, such as storage batteries insulated one from another, or separate heating transformers which were required to be correspondingly highly insulated from each other and from ground, or separate generators arranged to be insulated from each other and ground and to be driven by means of insulating shafts. Further, in all the above cases, to insure a uniform potential distribution throughout the system of series-connected discharge devices, condensers of adequate capacity have been required arranged in parallel with the discharge devices.

In accordance with my invention these difficulties are overcome by the provision of a common heating transformer for all of the series-connected tubes instead of the separate means, heretofore employed, for each tube, the arrangement being such that at the same time special condensers for controlling the potential distribution in the series of tubes may be dispensed with. To this end, the common heating transformer is provided on its core with as many mutually independent secondary coils as there are tubes in the series, and the several coils are insulated from each other.

In order to obviate the use of the special condensers hereinbefore mentioned, in accordance with my invention the relative capacities of the secondary coils are utilized to provide the required uniform potential distribution in the series of tubes. If desirable the capacity of the insulators, or insulating bushings, which are commonly associated with the connecting leads between the heating transformer coils and the tubes may also be utilized for this purpose.

In a preferred arrangement the secondary coils are arranged concentrically, such arrangement being particularly effective when the several coils are graded or stepped in length in the manner of the usual disposition of the insertions or laminations of condenser-type bushings.

In other cases I have found a construction to be advantageous in which a series of disk-shaped secondary coils mounted one over another on the transformer core is provided instead of the concentrically arranged coils above mentioned.

It is of advantage to connect the secondary windings to the tubes in the same order as that of the corresponding tubes of the series since in this manner the insulation between contiguous pairs of coils may be substantially the same throughout the series of coils.

The series of tubes may be built up, together with the above described cathode heating transformer, into a unit which may then be entirely independent of the high-potential input transformer, the potential from which is to be rectified by the series of tubes.

My invention will be better understood from the following description when considered in connection with the accompanying drawing and its scope will be pointed out in the appended claim.

Referring to the drawing, Fig. 1 is a semi-diagrammatic representation of a rectifier system in which my invention has been embodied, and Figs. 2 and 3 illustrate modifications of the cathode heating transformer included in the system shown in Fig. 1.

In Fig. 1 a rectifying apparatus in which a cathode heating means in accordance with my invention is employed comprises an alternating current high-potential input transformer 1 the primary of which is connected to an input circuit 2. High-potential alternating current to be rectified is supplied to a series 3 of space discharge devices or valve tubes 4 and the resulting unidirectional current is supplied from the tubes to a condenser 5 the terminals of which are connected to a direct-current output circuit 6.

The heating current supply means for the cathodes 7 of the tubes comprises in accordance with my invention a single heating transformer 8 having a core 9 upon which are mounted a primary winding 9a connected to a suitable source of heating current, and a plurality of secondary heating windings 10 insulated from each other and each connected through leads 11 to a different one of the cathodes 7. These secondary windings are, in the embodiment of the invention

shown in Fig. 1, concentrically arranged and so dimensioned that they each produce a potential of the proper value for the heating of the corresponding cathode, and that they conduct the cathode current without overheating.

The heating transformer 8 is mounted within a container or tank 12. The leads 11 connecting the secondary heating windings 10 to the corresponding cathodes 7 pass through and are insulated from the cover 13 by means of bushings 14.

It is a particular feature of my invention that the coils 10 are so disposed with reference to each other that during the current blocking period of the alternating potential impressed on the series of tubes 4, or period during which the potential impressed on the anodes is negative, the required uniform potential distribution throughout the tube series is established in accordance with the relative capacities of the windings 10, thereby rendering unnecessary the provision of special condensers associated with the series of tubes. To the capacities of the windings 10 may be added if necessary the capacities of the bushings 14.

Since the capacities of the several windings 10 in Fig. 1 increase, in proceeding from the core 9 outwardly, as the diameter of the windings, it is preferable to reduce the axial length of the windings progressively from the core outwardly, as shown in the graded or stepped form of secondary windings 15 illustrated in Fig. 2.

An alternative arrangement of the transformer coils is illustrated in Fig. 3, wherein the secondary coils 16 are of disk form adjacently disposed on the core 9.

For the purpose of producing large currents in accordance with the present invention, it is advantageous to employ hot cathode devices of the arc discharge type, i. e. devices having a hot cathode and at the same time filled with a gas or vapor at a suitable pressure. In order to permit the output direct current to be conveniently regulated it is preferable to employ devices of the above character which are grid controlled.

What I claim as new and desire to secure by Letters Patent of the United States, is:

A rectifying system comprising a plurality of electric discharge devices of the hot-cathode type connected in series and each including a cathode and an anode, means to impress an alternating potential on said anodes, a transformer having a core and a plurality of windings adjacently disposed thereon each adapted to supply cathode heating current for a different one of the discharge devices, said windings being insulated from and electrically independent of one another, a container for said transformer, a plurality of separate pairs of leads to connect said windings to the corresponding cathodes, a plurality of bushings to insulate said leads from the container, and means comprising said windings and said bushings to provide without capacitance means external to said windings and bushings sufficient capacitance between contiguous devices of said series of devices to cause uniform potential distribution throughout said series of devices during the current blocking periods of said alternating potential.

RICHARD CRÄMER.