

UNITED STATES PATENT OFFICE.

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ELECTRON-DISCHARGE DEVICE.

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The present invention relates to improvements in electron discharge devices such as audion tubes; primarily employed in radio communication.

5 The primary object of the invention is to provide an improved tube of this character which is susceptible of being incorporated into various electrical circuits of radio apparatus; thus permitting of a wide range of use for the tubes and for experimental purposes.

10 A further object of the invention is to provide an improved type of audion tube, formed with remote spaced groups of terminal points, and with one of said groups of terminals arranged for current conducting engagement with the usual contacts of standard triode audion tube sockets.

15 A still further object of the invention resides in the novel manner of mounting the electrode elements of the tube, so as to permit of proper functioning of certain of said electrodes when all electrodes are not required, and permitting of all of the electrodes functioning simultaneously should the incorporation of the tube into a specific type of radio apparatus require functioning of all of the elements.

20 A still further object of the invention resides in the particular construction of an audion tube having a plurality of electrodes, certain of which may be heated and thus function as a filament or glower; may act as grid elements; or employed merely for the purpose of conducting a current through the tube, without necessarily being heated to any appreciable degree.

25 Other objects and advantages of the invention will be apparent during the course of the following detailed description, taken in connection with the accompanying drawing, forming a part of this specification, and in which drawing,

30 Figure 1 is a central longitudinal sectional view of my improved tube, showing certain portions thereof in elevation.

35 Figure 2 is an enlarged transverse sectional view taken on the line 2—2 of Figure 1, and

40 Figure 3 is a further enlarged fragmentary perspective view of the supporting column illustrating the manner of mounting the electrode elements within the tube.

Referring to the drawing in detail, and wherein similar reference characters designate corresponding parts throughout the several views, the letter A may designate an evacuated vessel having a base B attached to its lower portion, and a cap C attached to its upper portion. D designates a supporting column for mounting of the various electrodes designated generally by the letter E.

Referring first to the vessel A, which is preferably made of glass, the same is formed with a tubular body portion 5 having its lower portion tapering inwardly in conical formation as at 6, and then abruptly outwardly for forming an annular sealing shoulder 7 about the axially disposed opening 8 in the lower end of the tube. The upper end of the tubular body 5 tapers inwardly in dome shaped formation as at 9 for forming an annular opening 10 at the upper end of the tubular body 5, of less diameter than the lower opening 8 but lying in axial alignment with the opening 8.

The base B which may be of usual construction, embodies the usual annular metal shell 11 having a terminal supporting block 12 secured therein in any suitable manner, and as by way of example as shown, by pressing a portion of the shell into an annular groove 13 formed in the block 12. Rigidly mounted in the supporting block 12, which is formed of suitably hard insulating material, are the four tubular terminal prongs 14 which project from the lower surface of the block as in the usual construction of standard triode valves. These prongs 14, as is well known, are intended for contact with independent spring contact members carried by the standard type of tube socket. The shell 11 is secured about the base of the vessel A in the usual manner as by a suitable cement shown at 15.

Referring now to the cap C, which is intended for positioning over the upper end of the vessel; the same comprises an annular shell 16 secured to the upper end of the tubular body portion 5 as by a suitable cement 17. Secured within the shell 16, and preferably flush with the upper edge of the shell, is a terminal post supporting block 18 which may be held in position within the shell as by pressing an annular portion of the shell

into an annular groove 19 formed in the supporting block. Rigidly mounted in spaced relation to one another in the block 18, are a plurality of hollow terminal binding posts 20 having externally threaded portions 21 projecting upwardly from the top surface of the block. It may here be stated that these hollow binding posts 20, as well as the tubular prongs 14, form communicating passageways opening inwardly of the respective supporting blocks of the members 14 and 20. A binding nut 22 is threaded upon each threaded portion 21 of the posts 20; and it is preferred that a washer portion 23 be disposed about each post 20 in contact with the upper surface of the block 18 for co-acting relation with each binding nut 22.

Referring particularly to the supporting column D which is preferably made of glass, the same is intended for co-axial positioning within the tubular vessel A with its opposite terminal end portions engaging opposite ends of the vessel A in a manner for supporting the column co-axially of the vessel. The base or flaring stem portion 24 of the column D terminates at its upper end in a triangular shaped press portion 25 forming radially extending press arms 26 so radially spaced from the axis of the column as to permit of free passage of the column upwardly through the opening 8 of the tubular body 5 in assembling of the device. Extending upwardly in parallel relation to one another from the outer end of each arm 26, are bridge posts 27 terminating at their upper ends in the outer ends of radially extending press arms 28 of a triangular shaped press portion 29, arranged in opposed relation to the press portion 25. Extending from the press portion 29, and co-axially of the base portion 24, is a tubular stem portion 30 closed at its end adjacent the press portion 29, and being of less diameter than the diameter of a circle scribed about the bridge posts 27. The upper or open end of this stem portion 30 tapers inwardly at an abrupt angle for forming a reduced annular seat portion 31 for engaging the wall of the annular opening 10 formed in the upper end of the tubular body 5. Thus it will be seen that when the column D is inserted into the tubular body 5, that the ends of the column will seat at opposite ends of the body in a manner for efficiently supporting the column co-axially within the body. Disposed within the tubular stem portion 30, and communicating with the interior of the tube as at 32, is a tube 33 which may be employed for evacuating the tube in any well known manner.

Referring now to the electrodes E, all of which are intended to be supported upon the column D; one of said electrodes, which

may be termed a filament or electron emitting electrode, consists of a straight fine gauge tungsten wire 34 supported axially of the column D by co-acting supports 35 and 35', embedded in aligned press arms 26 of the spaced apart press portions 25 and 29 respectively. Secured at one end in electrical contact with the lower support 35, is a lead wire 36 having its opposite end connected to the tubular prong 14^a; while the upper support 35' has a lead wire 37 secured thereto and extending through the tubular stem portion 30 for connection with the hollow terminal binding post 20^a. Embedded in aligned press arms 26 of the spaced press portions 25 and 29 are sealing conductors 38 and 39 carried by the press portions 25 and 29 respectively. These conductors 38 and 39 serve as terminals for an electrode 40 wound in spiral triangular formation with the convolutions supported in equal spaced apart relation by metal hook shaped members 41 embedded in equal spaced apart relation in each bridge post 27, and all of which hooks 41 preferably extend an equal distance in a general direction toward the axial center of the column D. Secured to the lower conductor 38 is a lead wire 42 which extends through the stem 24 for connection with the prong 14^b; while the upper conductor 39 has a lead wire 43 extending through the tubular stem 30 for electrical connection with the hollow terminal binding post 20^b. A third set of sealing conductors 44 and 45, embedded in other aligned press arms 26 of the press portions 25 and 29 respectively, are intended to act as opposite terminals for an electrode 46 of similar formation as that of the electrode 40. The electrode 46 which is spirally wound in a like direction as that of the electrode 40 has its convolutions supported upon certain of the metal hooks 41 at points midway between the hook members which support the electrode 40. Thus it will be seen that the convolutions of each electrode extend in a triangular spiral path at a point midway of the convolutions of the companion triangular electrode, by reason of the equally spaced positioning of the hook members 41. Secured in electrical contact to the lower conductor 44, is a lead wire 47 which extends through the stem 24 for connection with the prong 14^c; while the upper conductor 45 has a lead wire 48 extending through the tubular stem 30 for electrical connection with the hollow terminal binding post 20^c. It will here be noted that each of the electrodes 34, 40 and 46, complete a circuit through the tube from their respective contact prongs 14 to their respective terminal binding posts 20. The electrodes 40 and 46, which may be termed grid elements, may therefore be caused to act as grids, or may be heated in a like manner as the filament termed electrode 34.

The fourth electrode 50, which may be termed the plate, is in the form of an equilateral triangle in cross section, and is intended to be supported about the bridge posts 27 by three supporting arms 51 embedded at their lower ends in the radially extending press arms 26. The longitudinally extending portions of the arms 51, about which the angular portions of the plate 50 may be clamped as illustrated in Figure 3, are disposed in longitudinal radial alignment outwardly of their respective bridge posts 27 so as to dispose the inner angularly disposed faces of the plate in parallel spaced relation to the straight line sides of the triangular convolutions of the electrodes 40 and 46. A lead wire 52 is connected at one end to one of the supporting arms 51, and passes through the stem 24 for connection at its opposite end to the hollow contact prong 14^a. It is preferred, but not absolutely essential, that the electrodes 34, 40 and 46, be spaced equal distances from one another, and the electrodes 40 and 46 spaced the same distance from the plate 50.

In assembling of the device, and to which careful consideration has been given to the structural design of the various elements, it will be apparent that the electrodes 34, 40 and 46, may first be mounted upon the column D, and then plate 50 slid over the small tubular stem portion 30 for attachment to the supporting arms 51. By so forming the stem portion 30 of a reduced size from that of the stem portion 24 permits of the plate 50 being shaped into triangular formation before being placed in position upon the column, thus avoiding possibility of injury to the column as would be apt to occur if the plate was directly formed into triangular formation about the column. The column may then be inserted through the larger opening 8 of the tubular body 5; which opening is of a size large enough to freely permit passage of the plate 50, until the flaring stem 24 seats in the annular sealing shoulder 7, and at which time, the annular seat portion 31 at the opposite end of the column will snugly engage the wall of the reduced opening 10. The column may then be sealed at both ends to the tubular body 5 as by fusing with a flame in the ordinary manner; and the vessel then evacuated in any well known manner through the tube 33. The base B and cap C may then be cemented at opposite ends of the tube, with their respective lead wires projecting through the hollow prongs 14 and hollow binding posts 20 carried by the base B and cap C respectively. The projecting portions of the lead wires may then be cut off flush with the outer ends of the hollow bodies 14 and 20 through which they extend, and then be secured in position as by soldering at 60 in the well known manner.

It will be apparent that an audion tube so constructed will be capable of a wide range of use in various circuits of radio apparatus, since such construction permits of employment of the tube into a circuit either as a diode, triode, or as a four element valve. It will also be apparent that by so constructing the base of the tube as to permit of the tube being inserted into a standard type of socket for triode, valves, that no specially constructed support will be required for mounting of the tube. By so mounting in the cap C; a number of terminal binding posts having electrical connection with certain of the electrodes E, it will be seen that terminals of various electrical circuits may be detachably secured to any of the binding posts for creating various electrical effects within the tube in accordance with the specific circuit in which the tube is being incorporated as a part.

While in the example shown, the number of electrodes within the tube has been limited to four, it is to be understood that certain of the electrodes may be dispensed with; as well as more electrodes added should the occasion ever arise to make such changes.

From the foregoing description of this invention it will be apparent that an audion tube of novel application into radio circuits has been provided; embodying novel features of construction for assembling of the tube elements; and embodying novel and efficient supporting means for the various electrodes of the tubes.

Various minor changes may be made to the specific form of the invention herein shown and described, without departing from the spirit of the invention, or the scope of the following claims.

I claim:

1. An electron discharge device comprising an evacuated vessel, a column having hollow neck portions formed at each end thereof, supported in the vessel by the neck portions, press portions formed at the inner end of each neck portion, bridge posts connecting said press portions, an assembly of independent electrodes supported intermediate said press portions and having lead wires passing through each press portion and its adjacent hollow neck portion to independent conductors externally of the vessel, and a single electrode disposed about said assembly of electrodes and connected with an external conductor.

2. An electron discharge device comprising an evacuated vessel, a column having hollow neck portions formed at each end thereof, supported in the vessel by the neck portions, press portions formed at the inner end of each neck portion, bridge posts connecting said press portions, supporting members arranged on said bridge posts in spaced relation to one another, an assembly

- of independent electrodes arranged between said press portions with certain of the electrodes supported by said supporting members, and all having lead wires passing through each press portion for connection with external conductors, and a single electrode disposed about said assembly of electrodes and connected with an external conductor.
3. An electron discharge device comprising an evacuated vessel, a column having hollow neck portions formed at each end thereof, supported in the vessel by the neck portions, bridge posts connecting said neck portions, supporting hooks arranged in equal spaced relation on each bridge post, an electrode supported in a spiral manner on the supporting hooks, a second electrode extending axially of the first mentioned electrode, and a third electrode disposed about said first and second electrodes and supported by said column, all of said electrodes having electrical connection with external conductors.
4. An electron discharge device comprising an evacuated vessel, a column supported at its opposite ends within said vessel and embodying terminally disposed neck portions, a plurality of bridge posts connecting said neck portions, equally spaced apart supporting hooks carried by each bridge post and extending toward a common center forming the axis of said column, electrodes supported in a spiral manner on the supporting hooks, an electrode supported axially of the spirally supported electrodes, and an electrode disposed about said bridge posts and consequently all of said aforementioned electrodes, all of said electrodes having connection with external conductors.
5. An electron discharge device comprising an evacuated vessel, a column supported at its opposite ends within said vessel and embodying terminally disposed neck portions, bridge posts arranged in triangular formation, connecting said neck portions, equally spaced apart supporting hooks carried by each bridge post and all extending toward a common center forming the axis of said column, electrodes wound in spiral formation on the supporting hooks with the convolutions of one electrode disposed in equal spaced relation between the convolutions of its companion spiral electrodes, an electrode supported axially of the spirally supported electrode, and an electrode disposed about all of the aforementioned electrodes, all of said electrodes having independent lead wires for connection with external conductors.
6. An electron discharge device comprising an evacuated vessel, a column supported at its opposite ends within said vessel and embodying terminally disposed neck portions, a plurality of bridge posts connecting said neck portions, equally spaced apart supporting hooks carried by each bridge post and extending toward a common center forming the axis of said column, electrodes supported in a spiral manner on the supporting hooks, a second electrode extending axially of the first mentioned electrode, and a third electrode disposed about said first and second electrodes and supported by said column, all of said electrodes having electrical connection with external conductors.
7. In an electron discharge device embodying an evacuated vessel having a standard four pronged base portion; a plurality of electrodes supported in the vessel, independent lead wires connecting each electrode with a respective prong of the standard base portion, a cap secured to the vessel in spaced relation from the base portion and serving as means for supporting a number of binding terminal posts, and independent lead wires extending from each binding post and connected with certain of the electrodes whereby certain of the electrodes may be heated by passing of a current through the electrodes.
8. In an electron discharge device comprising a tubular body having openings at opposite ends thereof of unequal diameters, a support for the electrodes thereof comprising terminally disposed neck portions adapted for respective seating engagement at the openings in the body portion, press portions at the inner end of each neck portion, and bridge posts connecting the press portions for supporting certain of the electrodes.
9. In an electron discharge device comprising a tubular body open at both ends, a support for the electrodes thereof comprising a column having terminally disposed neck portions adapted for sealing relation at opposite ends of the tubular body, press portions at the inner ends of each neck portion formed with radially extending press arms, and bridge posts extending from the outer ends of the press arms of one press portion to the press arms of the other press portion.
10. An electron discharge device comprising a tubular body having the opening at one end thereof of less diameter than the opening at the opposite end of the body, a column having terminally disposed neck portions of unlike sizes, adapted for insertion into the tubular body with the smaller neck portion adapted for seating in the smaller

opening of the tubular body and the larger neck portion seating in the larger opening of the tubular body, press portions formed at the inner end of each neck portion, a plurality of bridge posts connecting the press portions, electrodes supported by the column at a point intermediate the press portions thereof, and means for connecting certain of the electrodes with external conductors for permitting when desired, of more than 10 one of the electrodes being heated by a current passing therethrough.

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