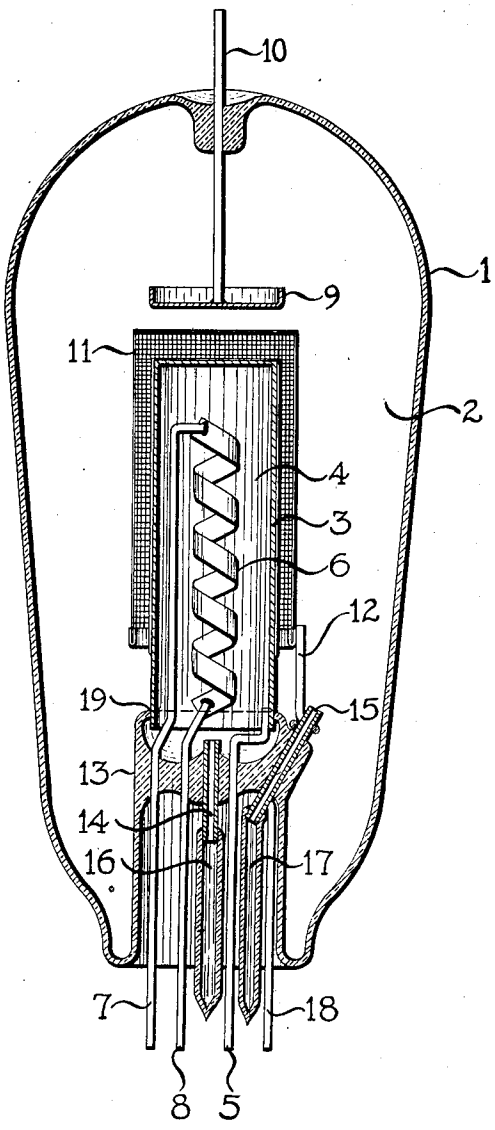
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ELECTRON TUBE

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ELECTRON TUBE

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This invention relates to electron tubes with indirectly heated cathodes.

An object of the invention is to provide an improved heater for the cathode.

Another object is to prevent undesirable discharge between the heater and other elements in the tube.

Another object is to provide a heater which can be operated at high voltages without danger of discharge between various parts of the heater itself, such discharge being often the result of ionization of the gas surrounding the heater.

Another object is to provide separate exhaust connections for the heater space inside the cathode and the outer space of the tube surrounding the cathode.

Another object is to provide exhaust connections which can be applied in an easy and reliable manner.

Another object is to provide a combined exhaust connection and leading-in conductor.

Other objects and advantages of the invention will hereinafter appear.

Electron tubes with indirectly heated cathodes in which the heater is hermetically separated from the discharge space surrounding the cathode are known in the art but as manufactured at present such heaters are usually introduced from the outside of the vessel, the cathode itself forming a part of the evacuated space and separating the latter from the outer atmosphere and the heater. Such heaters are therefore exposed to atmospheric attacks and are thus subject to slow disintegration.

It has therefore been proposed to also evacuate the space surrounding the heater but this has proved to be difficult and unsatisfactory because it was necessary to either provide at one end of the tube two separate exhaust connections for the space inside and outside of the heater respectively which was difficult with the old methods or to provide separate exhausts at opposite ends of the tube. The latter is objectionable since the tube very often requires bombardment by high frequency discharges during the exhaustion process and when the exhausts are arranged at opposite ends of the tube it is impossible to slide the high frequency energizing coil over the tube.

The present invention obviates these disadvantages and provides for certain additional advantages which will be pointed out hereafter.

The accompanying drawing illustrates a tube exemplifying the invention.

Referring to the drawing, 1 is an evacuated vessel of glass or other vitreous material enclosing a vacuum space 2 with a cathode 3 which in turn encloses a second evacuated space 4. As illustrated, the cathode 3 consists of a metal or other suitable air-tight material. It is provided with a leading-in wire 5 and is heated by radiation and possibly by convection by means of a heater 6, the latter being supplied with current through the leading-in wires 7 and 8. The heater 6 is thus mounted in an evacuated space which is separate and distinct from the outer evacuated space.

The outer evacuated space 2 contains the anode 9 which is provided with a leading-in wire 10 and the grid 11, the latter being mounted on a support 12 which also serves as a conductor for the grid.

In order to permit the exhaustion of the two evacuated spaces, provision has to be made to connect them with suitable vacuum pumps by means of conduits which are sealed off after the evacuation has proceeded to the desired degree. The exhaust connection to the outer evacuated space 2 could easily be made by any of the well known methods but the exhaustion of the inner space 4 presents difficulties because the base of this inner space has to be closed off by a press 13 which retains and anchors the leading-in wires 5, 7 and 8.

The press 13 is normally formed by heating a glass tube to the melting temperature of the glass after the introduction of the leading-in wires and squeezing the tube until it welds into a compact mass. It would obviously be very difficult to maintain open a laterally exhaust conduit in the press by such an operation.

The present invention obviates the aforementioned difficulty by providing exhaust conduits of a material which retains its rigidity at the welding temperature of the glass. The material is also of such a nature that it is wetted by the glass, in other words, that it forms a weld with the latter, and its coefficient of expansion must be of the same order as that of the glass so as not to set up any undue strains in the glass upon cooling or the conduit material must be sufficiently flexible and ductile that while strongly adhering to the glass it will yield sufficiently upon changes of temperature as not to induce dangerous strains in the weld. The conduits and the necessary leading-in wires and other parts are assembled in a suitable holder in the desired position relative to each other and the press is then formed in the usual manner.

In the drawing, the metal conduits 14 and 15

leading respectively into the inner and outer evacuated spaces are sealed into the press. The conduits may be extended downwardly by means of glass tubes 16 and 17 respectively to facilitate the connection of the respective spaces to the evacuating pumps and to permit their sealing off when desired. The conduits are sealed into the press in any well known manner and are treated for this purpose the same as the leading-in wires 5, 7 and 8. It is preferable to use nickel for these exhaust conduits and to employ the type of nickel seal in accordance with the co-pending application by Fritz, Serial No. 539,314, of May 22, 1931. The conduits may be employed for conducting current to one or the other element of the tube and they also serve as supports for such elements. In the drawing, the inner end of conduit 15 serves as an anchorage for the grid support 12 and has attached to its outer end the leading-in wire 18 which latter thus becomes the supply wire for the grid 11.

In manufacturing the discharge device, the cathode 3 is first sealed to a glass tube of suitable diameter to form a gas tight seal as indicated at 19 whereupon the heater 6 with its leading-in wires 7 and 8, as well the leading-in wires 5 and 18, the exhaust conduits 14 and 15 and the glass tube 16 are inserted. The press is then made in the manner aforedescribed. The anode may be mounted as indicated in the drawing or it may be supported from the base of the tube in a well known manner in which latter case the leading-in wire 10 is, of course, also passed through the press 13.

As will be apparent the exhaust conduits constructed in accordance with this invention are much more solidly and reliably attached to the vacuum vessel than the exhaust conduits known in the past and they thus permit of easier and more expeditious handling of the tube during manufacture. Further, the attachment of exhaust conduits in accordance with the present invention involves none of the special precautions and difficulties attendant upon the manufacture of the older types of exhaust conduits. In accordance with the present invention the exhaust conduits are treated and attached in the same manner as the leading-in wires.

By separating the outer vacuous space of the discharge device, which space may contain mercury or another gas, from the inner space in which the cathode heater is placed by the wall of the cathode itself, high efficiency in the transmission of heat to the cathode is obtained. The construction permits the mounting of the heater in a vacuum and thus the use of high voltage heaters without danger of ionization between the terminals of the heater which would be destructive. It is also possible, where desirable, to have different gases of any desired pressure in the inner and outer evacuated spaces.

Where gas is used the gas and the pressure of the gas in the inner chamber are selected so as to prevent the flow of a discharge current between the heater and the cathode 3. Such gas, when used, also serves to improve the heat transmission from the heater to the cathode and thus prevents excessive temperature of the former and its slow evaporation.

It is not absolutely necessary that the cathode wall be impervious to all gases, but it may be made of such material and thickness that gas of one kind can penetrate from one space to the other, while other gases or vapors are simultaneously prevented from so penetrating.

What we claim as new and desire to secure by Letters Patent is:

1. A gas tight electron discharge tube comprising a plurality of non-communicating compartments, energy translating elements arranged within said tube in different compartments, a glass portion for said tube forming a stem, and exhaust tubes for the several compartments forming passages through said stem for independent exhaustion of said compartments and comprising a material which is rigid at the melting temperature of the glass.

2. In a gas tight electron discharge tube, in combination, a vessel having a plurality of non-communicating compartments, energy translating elements located in different compartments, a glass portion for said vessel forming a stem and metallic exhaust tubes for the several compartments forming passages through said stem and providing independent exhaust connections for said compartments.

3. In a gas tight electron discharge tube, in combination, a vessel having a plurality of non-communicating compartments, a glass portion for said vessel forming a stem energy translating elements of which certain are located in one compartment and certain in another compartment, electrodes for conducting current to certain elements inside said compartments and metallic exhaust tubes for the several compartments forming passages through said stem and providing independent exhaust connections for said compartments.

4. In an electrical discharge tube, in combination, two separate non-communicating compartments, a plurality of electrodes in one compartment, including an electron emitting cathode, a heater in the other compartment, said second compartment being evacuated and containing an attentuated gas to prevent discharge between said heater and said cathode, a glass portion for said tube forming a stem, said stem having embedded therein separate exhaust conduits for the two compartments forming passages through said stem and comprising material which is rigid at the melting temperature of the glass.

5. In an electrical discharge tube comprising a vessel divided into a plurality of non-communicating compartments, one of said compartments containing a plurality of electrodes including a cathode, said cathode having one surface exposed to the interior of said one compartment and another surface exposed to the interior of another of said compartments, a heater within the latter compartment for heating said cathode, said latter compartment being evacuated and containing an attenuated gas to prevent discharge between said heater and said cathode, a glass portion for said tube forming a stem, said stem having embedded therein separate metallic exhaust conduits for the several compartments forming passages through said stem and providing exhaust connections for said several compartments.

6. In an electrical discharge tube, in combination, two separate non-communicating compartments, a plurality of electrodes in one compartment, including an electron emitting cathode, a heater in the other compartment, said second compartment being evacuated, a glass portion for said tube forming a stem, said stem having embedded therein separate exhaust conduits for the two compartments forming passages through

said stem and comprising material which is rigid at the melting temperature of the glass.

7. In an electrical discharge tube comprising a vessel divided into a plurality of non-communicating compartments, one of said compartments containing a plurality of electrodes including a cathode, said cathode having one surface exposed to the interior of said one compartment and another surface exposed to the interior of another of said compartments, a heater within the latter compartment for heating said cathode, said latter compartment being evacuated, a glass portion for said tube forming a stem, said stem having embedded therein separate metallic exhaust conduits for the several compartments forming passages through said stem and providing exhaust connections for said several compartments.

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