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INDIRECTLY HEATED CATHODE

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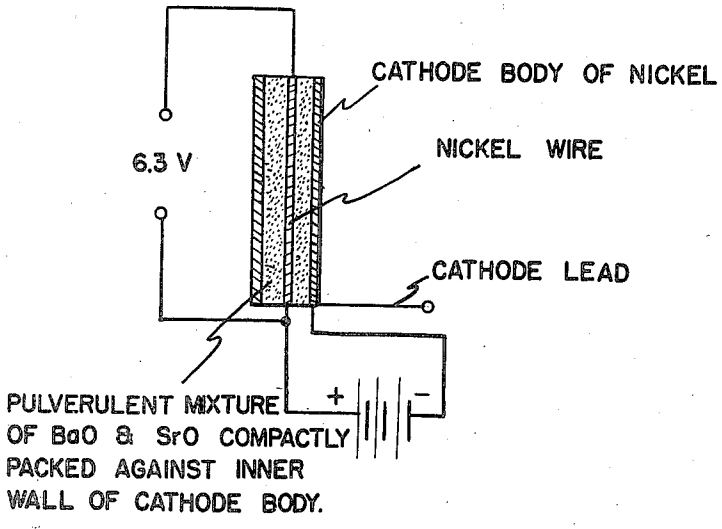

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INDIRECTLY HEATED CATHODE

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1 Claim. (Cl. 250—27.5)

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The invention relates to a method of manufacturing an indirectly heated cathode, to a cathode manufactured by this method and to a circuit arrangement comprising such a cathode.

It is known to manufacture an indirectly heated cathode by arranging a rod-shaped conductor consisting, for example, of molybdenum, tungsten, chromium nickel or nickel within a tubular body of molybdenum, tungsten, nickel or similar material, by filling the intervening space with insulating material such as magnesia, alumina, or thoria and by hammering and drawing the whole of it thus obtained until a body of the desired dimensions is obtained. This composite body can only be used as a cathode after the outside has been coated with electron-emitting material, for example with barium oxide or strontium oxide.

Besides, it has been proposed to utilize a directly heated cathode consisting of an internally hollow tubular element, for example, of nickel which is filled with an electron-emitting metal, more particularly with caesium. Upon heating such a cathode the metal would diffuse from the interior to the outside and ensure there a satisfactory emission.

The invention relates to an indirectly heated cathode and to a method of manufacturing such a cathode, in which an emitting substance is present in the interior and during operation diffusion to the outside takes place, owing to which the emission is brought about. According to the method of the present invention, the starting point is formed by a tubular body within which one or more conductors are arranged, if desired, with the interposition of one or more further tubular elements; then the remaining space is filled with one or more compounds of the alkaline- or alkaline earth metals, whereupon the whole of it thus obtained is given the desired dimensions and/or the desired shape by mechanical operations such as hammering, drawing and rolling.

The material present in the interior, which is preferably composed of oxides of the alkaline- or alkaline-earth metals, more particularly of barium oxide and/or strontium oxide, acts at the same time as insulation between the heating element and the cathode body; it also acts as filling material in the drawing operation and finally as emitting material during the operation. It has been found that also with the use of these non-metallic substances a satisfactory diffusion takes place through the wall of the cathode body.

We thus obtain an indirectly heated cathode

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which is directly suitable for use without the outside of the tubular body being coated with emitting material so that this cathode can be employed with great advantage in tubes wherein a low alternating current resistance of the emitting layer is desired, for example for tubes in receiving and transmitting installations for ultra-short waves. It may also be advantageously employed in high-voltage transmitting tubes. With a cathode according to the invention the advantages inherent to an indirectly heated cathode are combined with those offered by a cathode which has no emitting material on the outside of the cathode body whilst the insulation between the heating element and the cathode body simultaneously performs three functions. When due to the heating of the heating element present within the cathode, the latter is raised to a high temperature, emitting material diffuses through the outer casing to the exterior where it forms an extremely thin emitting layer. This diffusion is probably greatly simplified owing to the fact that, in consequence of the method used, i. e. the hammering and drawing of a body of comparatively large dimensions, a very great compactness of the material present in the interior is obtained; only thus is a satisfactory diffusion possible, even with compounds in the interior of the cathode.

With a cathode according to the invention it is, however, very easy to form further emitting metal by applying during the operation of the cathode, in accordance with a determined mode of realisation, a uni-directional voltage between the heating element and the cathode body so that electrolysis of the insulating oxide takes place and alkaline- or alkaline-earth metal is isolated on the inside of the cathode body, which quantities of metal easily diffuse through the wall and may act on the outside as emitting materials. The voltage to be utilized in this case may be of the order of magnitude of a few volts.

The invention will be explained more fully with reference to one practical example wherein a method of manufacturing an indirectly heated cathode according to the invention is described. According to this method, the starting point is formed by a tube which consists, for example, of nickel or copper and which has a diameter of 8 mms. and a wall thickness of 0.5 mm. Into this tube are inserted two wires consisting of nickel and having a thickness of about 1 mm. These wires are set firmly relatively to the surrounding tube and then the remaining space is filled, which takes place, for example, in vacuo, with a pul-

verulent mixture of barium oxide and strontium oxide, the tube being shaken during and also a short time after the filling operation. The whole thus obtained is then hammered until an appreciable increase of length is obtained and then it is drawn and/or rolled until the desired dimensions are obtained.

The single figure of the drawing shows in section a tubular cathode body which may be constructed for example, of nickel. Positioned within the cathode body are heater wires, which may also be of nickel. An alkaline-earth oxide compactly fills the space between the wires and the cathode body. A unidirectional source of voltage applies a potential between the wires and the cathode body, the positive side of the battery being connected to the nickel wires and the negative side of the battery being connected to the cathode body. A source of voltage for the heating of the nickel wires is also shown.

I claim:

An electron discharge tube system comprising an electron discharge device having a cathode comprising a tubular conductive body, a conductive heater element within said body, and a pulverulent alkaline earth oxide compactly filling the space between said body and said element, means connecting said cathode body to the negative terminal of a unidirectional source of voltage, and means connecting said heater element to the positive terminal of said unidirectional source of voltage.

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