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# UNITED STATES PATENT OFFICE

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## CATHODE

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2 Claims. (Cl. 176—126)

This invention relates to cathodes for luminous tubes and electron-discharge devices.

In this art various devices employing electropositive metals have been described. These metals e. g. sodium, potassium, lithium, caesium, calcium, barium, etc. have low cathode drops and are good electron emitters and have been described as coatings for or adjuncts to heavy metals or metalloids e. g. copper, nickel, carbon, etc. They have however the serious drawback that they are volatile. Tubes with cathodes coated or provided with such metals may be started easily but during operation of the tube, particularly an arc-discharge tube in which the discharge current is relatively high, the electropositive metal volatilizes and migrates from the heavy metal or metalloid. Thereupon the cathode drop increases, due to ionic bombardment, to that corresponding to the normal cathode drop of the heavy metal or metalloid and the utility of the low cathode drop electropositive metal is destroyed.

In the art relating to an arc-discharge between electrodes in an atmosphere of rare gas, it has therefore been the practice to employ cathodes coated or provided with non-volatile thermionic material e. g. oxides or salts of electropositive metals e. g. barium oxide, nitrate, chloride, etc. and corresponding compounds of calcium, strontium, etc. and/or activated decomposition products thereof. Such compounds are good emitters so long as they are maintained at a suitable emissive high temperature and being of a non volatile nature, do not migrate from the cathode for that reason. Cathodes of this character have certain disadvantages. It has been the practice to employ an external circuit to supply the heat for emission. This is a waste of energy so far as light production in a gas discharge tube is concerned and therefore lowers efficiency. Moreover unless precaution is taken to heat the cathode to an emitting temperature before applying discharge potential to the tube the thermionic material is eroded by ionic bombardment. Consequently for an automatically operated commercial lamp, automatic means has to be employed to heat the cathode and to delay the application of discharge potential and/or auxiliary starting means such as a high frequency discharge, high inductive "kick" etc. until the thermionic material becomes emissive.

Such structural requirements, complications and losses of efficiency have hitherto militated strongly against the commercial advance of the luminous or luminescent tube particularly of the arc-discharge type which operates at low voltages of the order of 110 to 220 volts.

One object of the present invention is to provide a cathode free from these defects.

Described broadly, I take advantage of what formerly was a fatal limitation to the use of caesium and other volatile electropositive electron emitters and I produce a combination having a new function. This is broadly done in the following manner:

I place a body or surface of volatile electropositive electron-emissive material e. g. caesium, potassium, sodium, lithium, etc. (preferably caesium) in heat-exchange relation to a body or surface of thermionic material e. g. activated oxides and/or salts or oxides of barium and/or other alkaline earth metals.

When this combination is used as a cathode it behaves as follows according to the theory which I believe to be correct and which at least explains the observed phenomena and facts: the caesium or its equivalent has a low cathode drop even when cold, i. e. it is a good cold electron emitter. Therefore a tube containing a rare gas together with a cathode so provided "strikes" i. e. becomes operative as an arc-discharge device at low voltages of the order of 110 to 220 volts and the arc-current concentrates on the caesium thus protecting the cold thermionic material against erosion due to bombardment. The caesium preferably has some heat conductive material as a support or carrier. As the arc current continues to play upon the caesium its temperature rises and the caesium volatilizes progressively and migrates away from the cathode which accordingly receives ionic bombardment in ever increasing intensity. Soon the carrier for the caesium gets highly heated. In the meantime however this heat is being transmitted to the thermionic material and emission from that source begins. Eventually the part of the cathode provided with caesium becomes such a poor emitter that the arc current (which seeks the point of greatest emission) shifts to the thermionic material and the tube operates with the thermionic material as chief or sole cathode constituent.

Thus my cathode might be characterized as a sort of duplex cathode comprising both thermionic material and volatile electropositive metal in combination, the electropositive metal acting as an automatic means of protecting the thermionic material against erosion during the starting of the tube and as a means of providing easy

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LUMINOUS TUBE AND CIRCUIT

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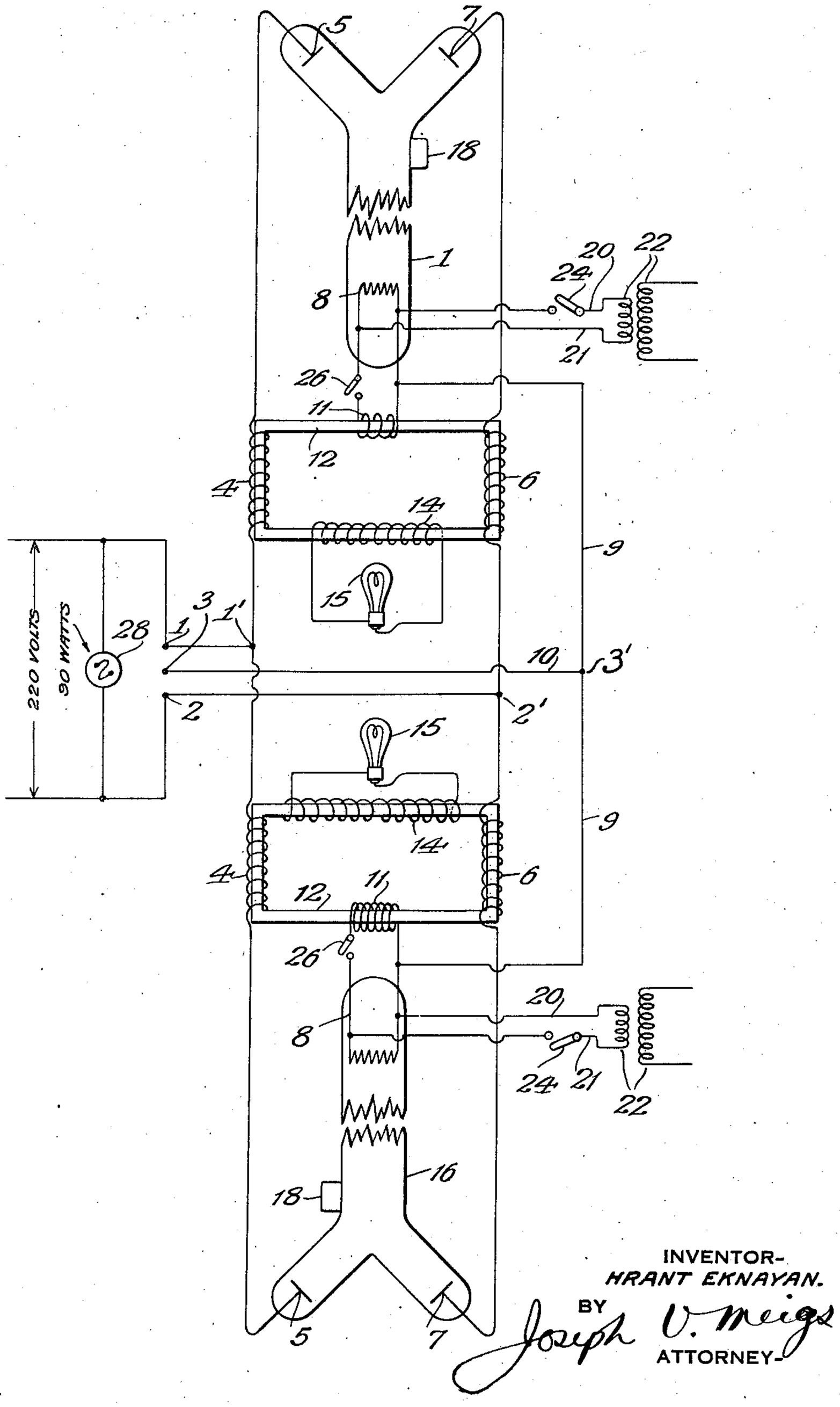


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