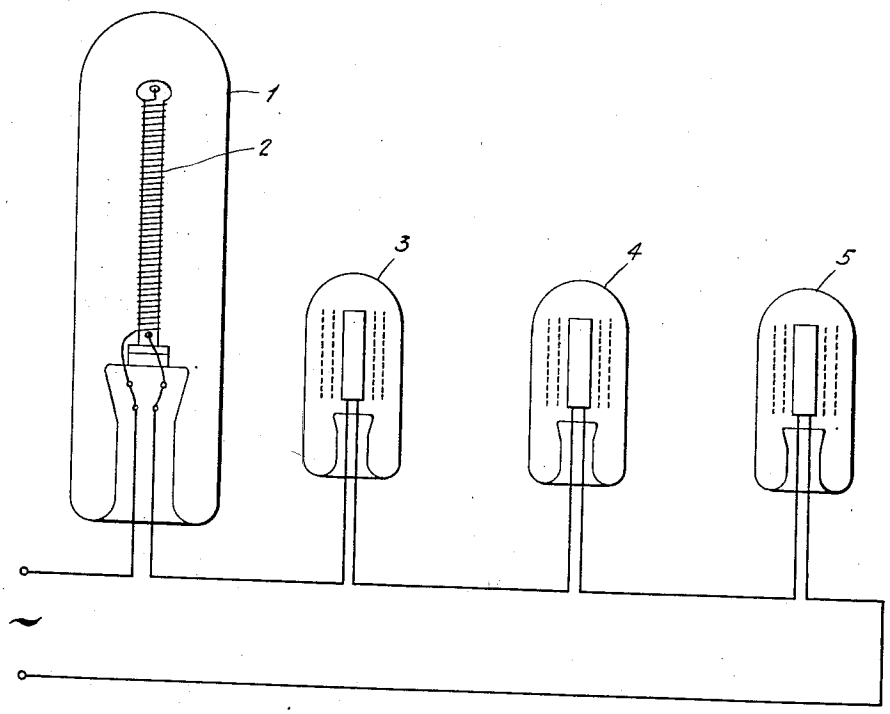
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CIRCUIT AND SERIES RESISTANCE FOR INDIRECTLY HEATED CATHODES

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CIRCUIT AND SERIES RESISTANCE FOR INDIRECTLY HEATED CATHODES

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2 Claims. (Cl. 201—67)

The present invention is concerned with radio apparatus and more particularly with such apparatus employing thermionic tubes having indirectly heated cathodes.

The invention has for its main object to reduce the time of heating of indirectly heated cathodes (i. e. cathodes having an insulated filament within a ceramic tube provided with a nickel or copper sleeve as carrier for the emitting oxide layer). In order to accomplish this, without the use of reverse-switching means, in such circuits for single or several indirectly heated cathodes connected in series, which at normal operating temperature consume together only a part of the line or input voltage available, there is used in accordance with the invention, a series resistance dimensioned and suited for a high end temperature, and which is formed of material having a positive temperature coefficient of resistance. This resistance device is suitably provided with such thermal inertia, that it remains at first relatively cold at the beginning of the heating period. The voltage drop across it thus is essentially reduced, and the voltage applied to the heating elements of the individual indirectly heated cathodes is therefore essentially increased over the final state, reached after complete heating. In this manner the transformation of energy at the cathodes is temporarily increased and therefore the time of heating reduced.

The series resistance may be produced for instance in the shape of a bulb, having a tungsten wire within the evacuated or gas-filled inner space, and which is suitably mounted on a heat resisting, non-conducting, and heat removing base, or a highly effective thermic conduction is provided therefor in another physical manner. The dimensioning of the thickness and length of the wire and of the conduction or radiation as well as the heat capacity of the entire structure is such that the tungsten wire remains at first comparatively cold as a result of the cooling by its support or surroundings respectively, so that its resistance is therefore comparatively small. If, for instance at operating temperature the total consumption of the indirect cathodes placed in series, is 70 volts, while the line furnishes 220 volts, the series resistance after the heating period is completed, must absorb 150 volts. In the cold state, a 5 to 10 times smaller resistance, is thus easily attained, i. e. at the instant of the switching-in the series resistance at first, has such a high conductivity that an essential excess current is supplied to the receiving tubes, and which accelerates the heating of the cathodes.

Due to the excess current, the temperature of the series resistance will also increase more rapidly, and its voltage drop finally will reach the final value of 150 volts, while the voltage at the cathodes will drop to 70 volts. The invention is also applicable to individual cathodes of tubes connected in parallel; in this case, a single series resistance is possibly used, after which the heating line is branched off to the cathodes. The figure shows an embodiment of the invention by way of example. Herein is 1 the bulb, containing the series resistance 2 of the shape of a helix or double helix and mounted on a ceramic support of suitable dimensions. The thermic contact with the latter can be augmented by covering the tungsten wire with suitable layers such as aluminum-oxide, establishing at the same time the heat conducting connection. The cathodes schematically represented, of the receiving or amplifying tubes 3, 4, 5 are placed in series to the series resistance.

I claim:

1. An improvement in signalling apparatus and the like of the type provided with at least one electronic tube having an indirectly heated cathode and a cathode heating circuit and wherein the cathode heating circuit is provided with means for connection thereof to a source of current, said improvement comprising a resistance structure connected in said heating circuit, said structure comprising a wire resistance element composed of a material having a positive temperature coefficient of resistance, said wire being wound around a ceramic mass, said resistance wire being provided with an outer coating of a good heat conducting material for establishing good heat transfer between the wire resistance and the ceramic mass, said filament and ceramic mass being enclosed within an envelope, said ceramic mass and resistance wire being proportioned with respect to each other so that the heat capacity of the entire structure delays for an appreciable period of time the full effect of the resistance in said circuit whereby an abnormal voltage is applied to the cathode heating circuit at the beginning of the heating period, said voltage dropping to normal at the end of said period of delay.

2. An improvement in signalling apparatus and the like of the type provided with at least one electronic tube having an indirectly heated cathode and a cathode heating circuit which is provided with means for connection thereof to a source of heating current; said improvement comprising a variable resistance device connect-

ed in the heating circuit said device including a wire resistance element composed of a material having a positive temperature coefficient of resistance and provided with an outer coating of a material having good heat conducting properties, said wire being wound in the form of a helix tightly around a supporting post composed of ceramic material, means for connecting said wire resistance element in series in said heating circuit, an envelope for enclosing said wire resistance and ceramic support, said ceramic support and resistance element being proportioned with respect to each other so that the heat capacity of the entire structure delays for an appreciable period of time the full effect of the resistance in said circuit whereby an abnormal voltage is applied to the cathode heating circuit at the beginning of the heating period, said voltage dropping to a normal value at the end of said period of delay.

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