Patented Nov. 21, 1950 2,530,686

UNITED STATES PATENT OFFICE

2,530,686

CURRENT REGULATOR TUBE

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No Drawing. Application January 14, 1946, Serial No. 641,180. In the Netherlands July 24, 1941

Section 1, Public Law 690, August 8, 1946
Patent expires July 24, 1961

1 Claim. (Cl. 201—63)

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With devices consisting of a closed envelope which contain an incandescent body adapted to be electrically heated and consisting substantially of iron such as gas-filled current-regulator tubes designed for keeping a current constant upon variation of an operating voltage, the length of life of the incandescent body is, when comparing large numbers, very irregular . This seems to be connected with the irregular temperature distribution which occurs in the incandescent body in such cases and due to which distribution there may locally occur a transition from α-iron into γ-iron, which transition is attended with deformation of the incandescent body. These phenomena are particularly prominent if the incandescent body consists of thin wire and they are highly dependent on the current wave-form and on the frequency, as well as on the number of times of switching on and off.

It has now been found that the length of life of the incandescent body can be improved by the use of alloy constituents which reduce the γ-region.

The elements which enter into account as such alloy constituents are known in metallurgy and are mentioned, for example, in the publication by Wever in "Archiv für Eisenhüttenwesen," vol. II, 1928–1929, page 746.

Since the point of the transition from α-iron into γ-iron (Ac_3-point) is located in the neighbourhood of 906° C. and since the invention is intended particularly for applications wherein, by closing and breaking the circuit, this transition point is repeatedly passed, it could be expected, especially since elements such as zirconium and chromium considerably lower the transition point, that the undesired deformation might only be suppressed by utilizing the alloy constituents according to the invention in such quantities that transition from α-iron into γ-iron cannot occur.

It has been found however, that even in much smaller quantities the said elements may have a retarding effect on the transition from α-iron into γ-iron and thus counteract the undesired deformation of the incandescent body. This is of particular importance with current-regulator tubes and similar applications wherein it is advantageous that the properties of pure iron, more particularly, those which are connected with the current-voltage characteristic curve, should be substantially retained.

According to literature, elements such as silver and bismuth do not alloy with iron. However, after measuring the temperature coefficients of

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the resistance of materials formed with the aid of the latter elements it seems, that it must be assumed that with these elements there exists all the same a slight possibility of alloying in the sense of the invention. In accordance therewith the desired improvement of the length of life is therefore also obtained, for example, by the addition of silver. In view thereof the above-mentioned definition of the elements which enter into account, in accordance with the invention, for use as alloy constituents should be considered to include also those elements of which any possibility of alloying with iron in the sense of the invention may be assumed to exist from measurements of the temperature coefficient of the resistance.

According to the invention, in connection with the use as an incandescent body, those elements may be utilized as alloy constituents which do not vaporize in a harmful manner when the incandescent body is being loaded. Very satisfactory results are obtained, more particularly, with the elements beryllium, aluminium, titanium, zirconium, tin, phosphorus, vanadium, chromium, molybdenum, tungsten and silver.

With the use in current-regulator tubes filled with an inert gas of high thermal conductivity such as hydrogen, it is furthermore important in this connection that the requirement must be satisfied that the current-voltage characteristic curve should exhibit a substantially flat course, for example, that upon variation of the operation voltage in a ratio of at least 1 : 2 the current should not vary by more than 10%. It has been found that such a result can be obtained with the above-mentioned alloy elements.

If, for example, out of pure iron and tungsten rods containing an atomic percentage of tungsten of about 0.5% are made by metal-ceramic agency we obtain, after the said rods have been worked up into wire of about 35 μ, a material suitable for current-regulator tubes.

Some 100 current-regulator tubes constituted by a tubular bulb and having a length of about 11 cms. and a diameter of about 4 cms. and having mounted therein a wire with a length of about 125 cms. were made with the aid of this material, said bulbs being filled with hydrogen at a pressure of about 5 cms. Under conditions of practical operation all these tubes sustained more than 10,000 switching-on and-off operations. With an equal number of tubes of similar construction but provided with a wire of pure iron the number of switching operations was very irregular and varied from about 200 to 5000

with an average of about 4000. Considered over a large number, the length of life of regulator tubes manufactured with the aid of the said alloy has become, due to the application of the invention, not only more regular but, in addition, has also considerably increased.

It has previously been proposed to increase the length of life of iron-hydrogen resistances by adding small quantities of non-metallic substances which impede the recrystallisation of the incandescent body, as is also usually done in the manufacture of incandescent lamps. However, by this step the above-mentioned phenomenon of deformation is not counteracted and the obtained improvement of the length of life is not so considerable as is the case according to the invention.

What I claim is:

A current regulator tube comprising a sealed envelope, an inert gas within said envelope, a current carrying body within said envelope, said body comprising iron and an atomic percentage

of tungsten of .5% alloyed with said iron said body retaining substantially the current-voltage characteristic of pure iron.

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