

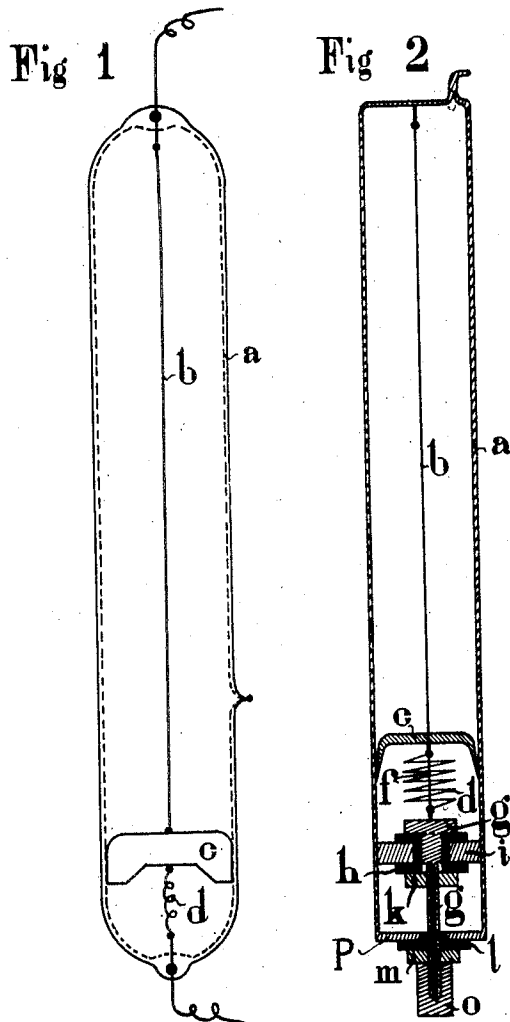
No. 853,492.

PATENTED MAY 14, 1907.

H. BECK.

PROCESS AND DEVICE FOR CONTROLLING ELECTRIC CIRCUITS.

APPLICATION FILED JAN. 27, 1906.



Witnesses

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PROCESS AND DEVICE FOR CONTROLLING ELECTRIC CIRCUITS.

No. 853,492.

Specification of Letters Patent.

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Application filed January 27, 1906. Serial No. 298,131.

To all whom it may concern:

Be it known that I, HEINRICH BECK, a civil engineer, and a subject of the German Emperor, and residing at Meiningen, Duchy of Saxe-Meiningen, part of the German Empire, have invented certain new and useful Improvements in Processes and Devices for Controlling Electric Circuits, of which the following is a specification.

My present invention has reference to a regulating resistance for the purpose of being included in the circuit of electrical apparatuses of any kind.

The new regulating resistance may for instance be employed in arc-light-circuits. My new resistance is characterized by being based upon the principle that a thin wire which consists of a material having a high temperature coefficient, is employed as a resistance and is kept in a stretched position in the interior of a tube which has been evacuated or which is filled with indifferent gases. Among the materials possessing a high coefficient of temperature iron is to be considered in the first place. Upon being heated to a high temperature an iron wire or a wire made from any other suitable material will present a higher resistance to the electric current than at a low temperature.

Hence, if the tension is increased in an apparatus circuit in which this kind of resistance is included, the said apparatus will consequently be fed with current of a higher strength, and the regulating resistance will therefore be heated to a higher temperature. In view of the regulating resistance possessing the property of presenting a higher resistance to the passage of the current at an increased temperature, the tension will, however, decrease in the apparatus circuit very soon. Thus, for instance, if the tension existing between two arc-light-lamps burning with 9 amperes, amounts to 80 volts, while the total tension or voltage in the circuit amounts to 110 volts altogether, the ballast resistance should amount to 3.3 ohms. If however for some reason, the pressure or tension at both lamps is reduced to only 60 volts altogether, the strength of the current, when an ordinary resistance of 3.3 ohms is made use of, would be immediately increased to 15 amperes, so that the loss of pressure in the ballast resistance would now amount to 50 volts. If however an iron resistance of 3.3 ohms is used, the resistance, all other conditions being equal, is increased

in consequence of the increased heating to such an extent, that the required loss of pressure of 50 volts will already be obtained with about 10.5 amperes. Hence the resistance of the iron wire has been automatically increased from 3.3 to almost 4.8 ohms. Similar conditions prevail in the case of variations of the pressure or tension occurring in the system. Furthermore the injurious decrease of resistance which is due to the consumption of the carbons by burning, is compensated by the use of a suitable iron resistance. This is of great importance, in view of this loss of tension or pressure amounting up to 8 volts in the case of long carbons.

The characteristic feature of this invention as compared with other controlling and regulating devices for adjusting the resistance of electric arc light lamps, is the fact that in the new arrangement, herein described, it is not the resistance of the arc of light, which is balanced in the case of variations of the arc light resistance, and also the fact that not only the variations of resistance which are produced gradually by the consumption by burning, but also the suddenly occurring variations of resistance which are compensated or balanced automatically. However, in order to produce good results the combination with an iron resistance is of particular importance. Thus for instance, if an electric current, the strength of which is slowly increased, is made to pass through an iron wire of a certain definite length, a different value of the resistance is found for each value of current, the loading of the wire being specifically strong. In an iron wire, which presents a resistance of 1.5 ohms to current of 3 amperes, by actual measurements the value of 1.7 ohms could be found with 5 amperes and of 1.9 ohms with 6 amperes and 2.3 ohms with 7 amperes and of 2.7 ohms with 8 amperes and of 6.1 ohms with 10 amperes. By then causing the current to pass in the reverse order through the same values, the same values for the resistance are obtained as in the case of the progressive increase of the strength of the current, provided the wire is in the open air and provided it is not excessively strong. When it is desired, to produce great variations of resistance, the wire should be loaded to a high specific strength and it should be heated up to about red heat. On account of the considerable oxidation, produced at

this temperature, and on account of the variation of resistance of the resistance material consequent thereon, and of iron in particular, the use of strongly loaded resistances for the purpose of annihilating certain quantities of energy is excluded in the open air. The resistance wire has therefore been inclosed in form of a spiral wire in evacuated receptacles or in receptacles filled with indifferent gases and in this manner working has been successful with small strengths of current. In the case of more considerable strengths of current however in the wire resistances of the kind mentioned entirely different values for the resistance are obtained for decreasing values of the current, as compared with those values corresponding to increasing values of the current. The reason for this behavior is the fact that heat is stored up in the resistance wire itself and in the parts situated near to the said wire or surrounding the same. The stored-up amount of heat is not conducted away quick enough, so that, when the strength of the current decreases, the temperature and consequently also the ohm-resistance of the resistance material will decrease at a slower rate than the current itself, so that in consequence thereof, a different value of resistance for the same value of current and at decreasing strength of current is found, as compared with increasing strength of current. This action becomes particularly noticeable when red heat is reached. If for instance, in the case of current strength increasing up to about 9 amperes, the wire resistance is heated up to red heat at 7 amperes, red heat will still be prevailing under ordinary conditions, when the strength of the current is decreased to 6 amperes. The energy which has been annihilated in the resistance, will be approximately equal in both cases.

In accordance with this invention the resistances are arranged in such a manner, that, when the strength of the current is decreased, as nearly as possible the same values for the resistance are obtained, as in the case of increasing strength of current. This is accomplished by reducing the heat capacities of the resistance to the lowest degree, so as to avoid the before mentioned storing-up of heat and the thereby ensuing unfavorable action of the resistance wire. With this end in view, the mass of the resistance wire will be kept as low as possible, that is to say, it is made as thin as possible and provision is also made for the conveying off of the heat in such a manner, that the wire is capable of annihilating as much energy as possible, before it is brought up to red heat or before it exceeds the admissible limit of glowing heat. These conditions will be fulfilled most conveniently by stretching the wire in a free and disengaged condition and out of contact with masses which

are liable of storing-up heat, that is to say it is not laid in spiral windings in the interior of a glass vessel or the like, which is either evacuated or filled with an indifferent gas such as hydrogen. The spiral windings of the resistance wire are not recommendable for the reason, because a change of the relative position of the several spiral windings in relation to each other would take place when the wire is heated and in particular in the case of rather great strength of current, the said change of position in its turn being liable to cause the windings that are close together, to become more highly heated, resulting in a twisting of the resistance body or even the short-circuiting of some of the windings. The stretched-out, straight wire will give off the excess of heat the more quickly, the more care is taken to enable the receptacle surrounding the wire of storing-up as little heat as possible, which object can be attained by increasing the surface or by imparting to it a convenient shape or size in any suitable manner. The difference of temperature between the walls of the receptacle and the wire, which has been heated up to red heat, should be as high as possible. In order to take into account the extending of the wire occurring when the freely stretched-out wire is heated, and in order to always retain the said wire for its whole length in a central position at the interior of the receptacle and at the same distance from the walls of the receptacle, one end of the resistance wire is kept stretched-out by a weight in accordance with my invention; or the same purpose may be accomplished by springs acting upon one or both extremities of the said wire. By this means the uniform cooling of the wire for its entire length is also insured and short-circuiting or breaking of the walls of the receptacle is prevented. When it is desired to use special supports for the wire, a very small heating capacity should be imparted to the said supports.

A form of construction of the resistance in accordance with this invention and suitable for an electric arc lamp of 9 amperes consists of four tubes of moderate size, two of which are arranged in parallel series.

Upon the accompanying drawing the subject matter of my invention is shown in two forms of construction.

Figure 1 illustrates in longitudinal elevation a regulating resistance, arranged in the interior of a glass-tube; Fig. 2 showing a regulating resistance in section, arranged in a metal tube.

In the tube shown in Fig. 1, a straight, single iron wire *b* is stretched out in the interior of a glass-tube *a*, the wire being loaded at its lower end by a weight *c*, so as to be kept in a stretched condition. The lower terminal *d* for the admission of the current

is movable and is made of material of good conductivity. It will be at once apparent, that the weight *c* may be replaced by one or several springs made of material of good conductivity and this form of construction has therefore not been shown on the drawing.

In the form of construction, shown in Fig. 2, the iron wire *b* is arranged in the interior of a metal tube *a*, the walls of which have a thickness of about 0.2 millimeters. The walls of the tube are preferably blackened at the inside and on the outside, in order to effect a better absorption of heat and a better radiation to the surrounding atmosphere. In this form of construction also the resistance wire *b* is kept taut by a weight *c*, which may also be replaced by a suitable combination of springs. *d* is the spiral wire for the admission of current into the resistance wire *b* and *f* is a piece of thread which is intended to prevent swinging of the weight during transportation. The spiral wire for the admission of current is secured at its lower end to a metal screw *g*, so as to constitute electrical connection, a disk *i* which fits snugly in the tube *a* being secured to the metal screw by means of a nut *k* and insulated therefrom by means of the insulating pieces *h*. The stem of the screw *g* projects through the bottom cover *p* of the tube and is insulated therefrom at the outside by an insulating collar *l*. Onto the outer free end of the screw *g* the connecting contact piece *o* and the nut *m* are secured by suitable screw threads. The space between the closely fitting disk *i* and the cover *p* is preferably filled with oil or with mercury in order to produce a better tightening in relation to the upper part of the tube *a* which has been evacuated or which is filled with indifferent gases. In the case of mercury being used as a tightening material the screw *g* and the nut *k* are inclosed in insulating material. In the form of construction shown in the drawing, one of the terminals is formed by the metal tube itself. In accordance with the strength of the current several tubes of certain length are connected to each other.

What I claim and desire to secure by Letters Patent of the United States is:—

1. An electric regulating resistance for apparatus circuits, a resistance wire, consisting of material with a high coefficient of temperature and kept stretched-out in a tube, the tube being evacuated or filled with indifferent

gases, means for maintaining the wire in a stretched condition, substantially as described and for the purpose set forth.

2. An electric regulating resistance for apparatus circuits, a resistance wire of material with a high coefficient of temperature, being stretched out in a tube, the tube being thin-walled and being of metal and being evacuated or filled with indifferent gases, means for keeping the wire in a stretched condition, substantially as described and for the purpose set forth.

3. An electric regulating resistance for apparatus circuits, a resistance wire of material with a high coefficient of temperature, being stretched out in a tube, the said tube being of metal and being thin-walled, means for keeping the wire in a stretched condition, a connecting screw, projecting from the tube and insulated therefrom, substantially as described and for the purpose set forth.

4. An electric regulating resistance for apparatus circuits, a resistance wire of material with a high coefficient of temperature, being stretched out in a tube, the said tube being of metal and being thin-walled, means for keeping the wire in a stretched condition, a connecting screw, projecting from the tube and insulated therefrom, a disk fitting snugly in the said tube and insulated from the above mentioned connecting screw and arranged in the interior of the tube, a closely fitting cover at the lower end of the tube, means in the space between the cover and the closely fitting disk in the interior of the tube for the purpose of tightening the tube, substantially as described and for the purpose set forth.

5. An electric regulating resistance for apparatus circuits, a resistance wire of material with a high coefficient of temperature, being stretched out in a tube, the tube being thin-walled and being of metal and being blackened at the inside and at the outside and being evacuated or filled with indifferent gases, means for keeping the wire in a stretched condition, substantially as described and for the purpose set forth.

In witness whereof I have hereunto set my hand in the presence of two witnesses.

HEINRICH BECK.

Witnesses:

ALMA LARK,
BERTA HAMMANN.