July 12, 1938. H. BECK 2,123,645

ARC LAMP WITH AUTOMATIC REGULATION OF THE NEGATIVE ELECTRODE

Filed July 16, 1937

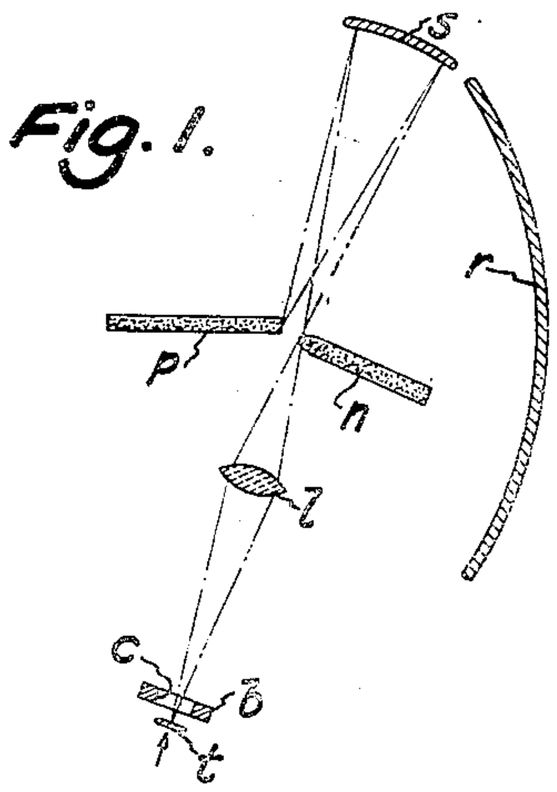

Fig. 1.

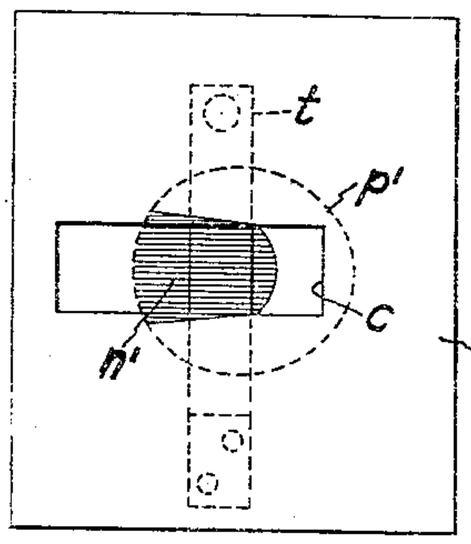

Fig. 2.

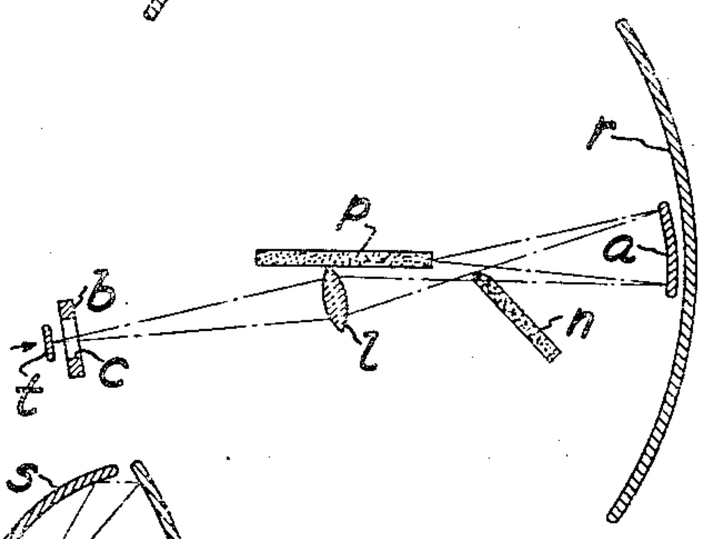

Fig. 3.

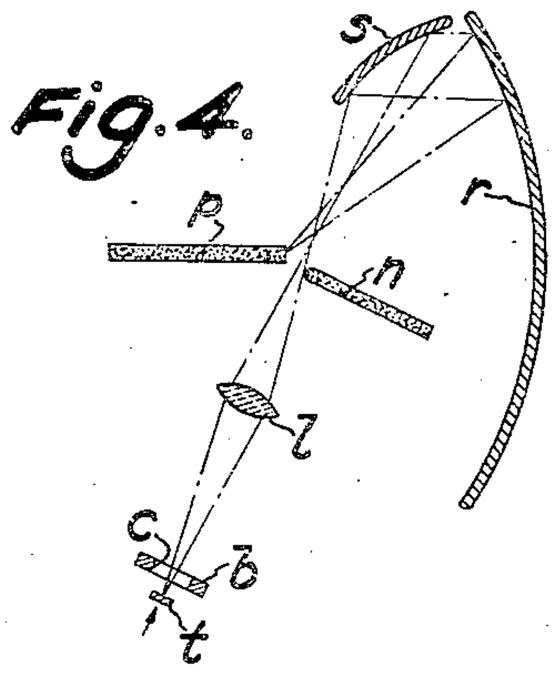

Fig. 4.

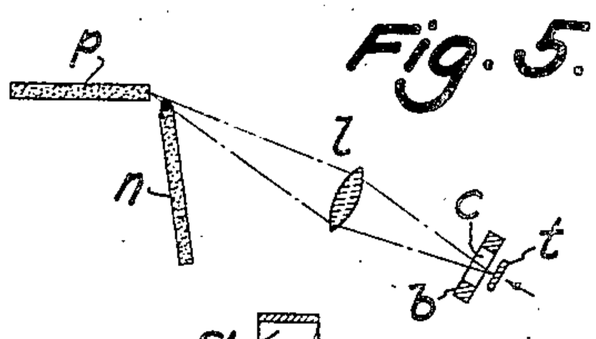

Fig. 5.

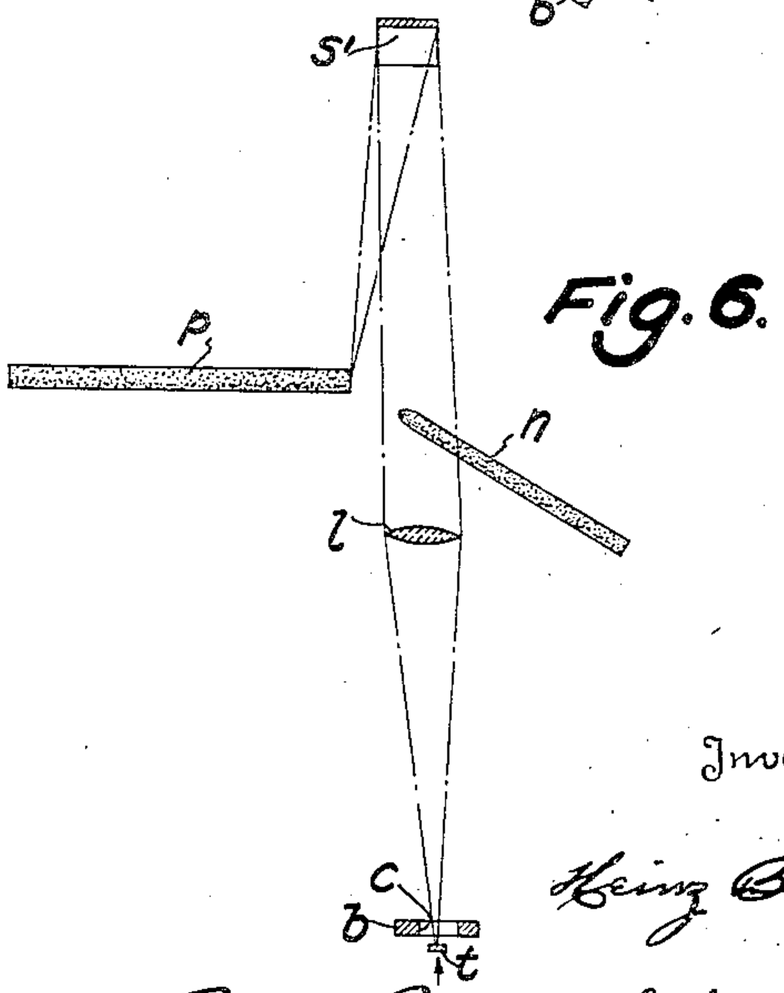

Fig. 6.

Inventor:

Heinz Beck,

By Potter, Pierce & Scheffler,

Attorneys.

Patented July 12, 1938

2,123,645

UNITED STATES PATENT OFFICE

2,123,645

ARC LAMP WITH AUTOMATIC REGULATION OF THE NEGATIVE ELECTRODE

Heinz Beck, Bremen, Germany

Application July 16, 1937, Serial No. 154,065
In Germany April 28, 1936

8 Claims. (Cl. 176—71)

The thermostatic regulation of the positive electrode of arc-lamps, especially of high-efficiency lamps such as used in lights, presents, as is known, essential advantages, particularly as regards the simplicity, the accurateness and the reliability of the respective adjusting arrangements. It seems desirable to apply the same principle to the negative electrode in order to obtain also a regulation of the arc to constant length. Such a manner of regulation presents over the regulations used hitherto, viz. with respect to constant current, voltage or resistance, further essential advantages, in that these latter manners of regulation respond in an undesired manner to every slight disturbance and give, therefore, rise to unsteadiness of the arc.

The object of the present invention is to overcome the hitherto experienced difficulties in the automatic regulation of the negative electrode; it renders possible to regulate the negative electrode by means of a thermostatic means in a highly sensitive and perfectly reliable manner.

The gist of the invention resides therein that by a suitable optical means either the radiation of the positive crater of an arc-lamp or another radiation is so conducted to a control device sensitive to light, such as a thermostat, that the burning end of the negative electrode of the arc-lamp casts a shadow on the control device. As the negative electrode is consumed, the shadow of the negative electrode tip is withdrawn from the control device, whereupon the respective device commences to respond.

The method of operation and advantages of the invention will be apparent from the following specification when taken with the accompanying drawing in which:

Fig. 1 is a sectional view through an arc lamp embodying the invention, the view being taken substantially on a longitudinal plane through the electrodes;

Fig. 2 is an enlarged elevation of baffle and control devices of Fig. 1; and

Figs. 3 to 6, inclusive, are sectional views, similar to Fig. 1, illustrating modifications of the invention.

In the drawing, the reference characters *p*, *n*, identify the positive and negative electrodes, respectively, of an arc lamp associated with the reflector *r* of a search light. The specific mounting of the arc lamp and mirror in the search light casing forms no part of this invention and such details are therefore omitted from the drawing. In accordance with this invention, an auxiliary concave mirror *s* is supported by appropriate means, not shown, on the search light casing in position to reflect rays from or an image of the positive electrode crater upon the tip of the negative electrode *n*. A radiation sensitive control device *t*, such as a thermostat, a thermo-electric couple, a photocell or a photosensitive resistance is located in the path of the reflected radiation from the positive crater, but at a point more remote from the mirror *s* than is the electrode *n*. A diaphragm *b* having an opening *c* is positioned in front of the control device *t* which, as illustrated, is an electric switch having a thermally responsive movable contact of strip form, and means such as lens *l* is provided to form an image of the electrode tip on the control device *t*.

As shown in enlarged scale in Fig. 2, the described optical system concentrates the radiations from the positive crater on the portion of the diaphragm *b* that lies within the dotted line circle *p'*. The tip of the negative electrode *n*, when properly adjusted, extends into the path of the radiations and casts a shadow *n'*, Fig. 2, within the brightly illuminated area or image of the positive crater. The width of the opening *c* of diaphragm *b* is somewhat less than the width of the shadow *n'*, and the control device *t* is thus shielded from the heat of the reflected image of the positive crater so long as the tip of the negative electrode is in normal position. The shadow *n'* recedes as the negative electrode burns down, thus exposing the control device to the reflected radiations, and the resultant bending of the control strip closes the switch contacts to actuate or to accelerate the feed mechanism for the negative electrode. The shadow *n'* moves towards the right, Fig. 2, as the electrode *n* is fed forward, and the electrode feed continues until the control device *t* is again shaded. The sensitiveness of the regulation is very great, in fact, equal to the regulation obtained by the known positive thermostatic method. The light emitted by the negative crater and the glowing tip of the carbon is not disturbing owing to its slight intensity. The regulation sensitiveness is greatest if the shadowy picture is produced perpendicularly to the axis of the negative carbon. Anyhow, the regulation will still suffice if the radiation coming from the mirror *s* falls upon the electrode *n* under an angle considerably smaller than ninety degrees.

In the case of the negative electrode being disposed at a slight inclination position relatively to the crater *p* there is then also such a position of the mirror *a* possible as that shown in Fig. 3, in which the auxiliary mirror *a* is mounted in the

medium zone of the search-light mirror *r*. Eventually also the radiation reflected by this zone of the mirror *r* can directly be used or this mirror is suitably ground in its middle portion in order to increase the intensity of the light falling upon the electrode *n*, the shadow of which latter is then again cast upon the thermostat by suitable optical means.

Instead of shadowing the thermic strip continually by the electrode *n* and to make it respond by means of a radiation, said strip can normally be exposed to full radiation. If in such a case the negative electrode is continually fed forward with a speed higher than its normal consumption, then the electrode casts after some time a shadow entering into the radiation falling upon the strip *t* whereby the bending thereof becomes diminished. Owing hereto, the thermostat commences to respond and delays the movement of the carbon or stops it entirely. After the carbon has been consumed, in which case the shadow has disappeared, the normal forward feed commences again and the operation proceeds as before.

In the further example shown in Fig. 4, the radiation coming directly from the crater *p* is not cast upon the negative electrode by means of an auxiliary mirror, such as *s*, but the radiation of the positive crater reflected by the search-light mirror *r* is cast by said mirror upon the negative electrode *n* and upon the thermostat to produce a shadow of the negative electrode on the thermostat, as already described.

If the negative electrode is arranged at a sharp angle relative to the positive one it is also possible to project an image of the negative electrode as a shadow of the radiation coming directly from the positive crater, as is shown in Fig. 5. Casting the shadow of the negative electrode *n* upon the strip *t* is preferably effected by a condensing lens *l*. Anyhow, the arrangement illustrated in Fig. 5 permits likewise to cast the shadow of the electrode *n* directly upon the thermostat. Under circumstances the arrangement can be simplified in such a manner that for casting a shadow of the electrode *n* upon the strip *t* the lens of the positive thermostatic control can be used.

The described mounting of the auxiliary mirror *s* on the search-light casing will result in faulty regulation if, as is frequently the case, the search-light includes means for adjusting the arc lamp with respect to the mirror *r* to control the spread or focus of the search-light beam. An arrangement as shown in Fig. 6 may be used in such cases to avoid a manual resetting of the optical system at each adjustment of the arc lamp within the search-light casing. This construction makes use of a cylindrical mirror *s'* which reflects the radiation of the positive crater in the form of an extended long strip upon the negative carbon, along the axis thereof. When then the lamp is shifted relatively to the auxiliary mirror, and if the focal line of the cylindrical mirror lies parallel to the axis of the positive carbon, radiation will always reach the negative carbon tip under the same angle of incidence.

The principle employed in the present invention, viz. causing a thermostat to respond to the action of a shadow of a negative electrode, is maintained also if a source for the radiation producing that shadow not the positive crater but another source is used, the radiation of which is projected by means of a suitable arrangement of the members concerned upon the negative electrode and thence upon the thermostat by means of a lens.

I claim:

1. An arc-lamp with automatic regulation of the negative electrode, comprising, in combination with said electrode, a device sensitive to the radiations emitted by the crater of the positive electrode, optical means transmitting radiations from the positive electrode crater to said device along a path into which the tip of the negative electrode extends, whereby a shadow picture of the negative electrode tip is formed on said device.

2. An arc-lamp with automatic regulation of the negative electrode, comprising, in combination with said electrode, a thermostat, a source of radiations, and optical means cooperating with said source to cast a shadow of the tip of the negative electrode upon said thermostat.

3. An arc-lamp with automatic regulation of the negative electrode, comprising, in combination with said electrode, a thermostat sensitive to the radiation emitted by the crater of the positive electrode, and an auxiliary mirror reflecting radiations of the positive electrode crater to the tip of the negative electrode, and optical means cooperating with said mirror to form a shadow of the negative electrode tip upon said thermostat.

4. An arc-lamp as specified in claim 3, further comprising the feature that the auxiliary mirror is concave.

5. An arc-lamp as specified in claim 3, wherein said mirror has a cylindrical shape and is so positioned that the radiation is cast onto the negative electrode in the shape of a strip extending along the axis of the same.

6. An arc-lamp with automatic regulation of the negative electrode, comprising, in combination, with said electrode, a source of radiations, a device sensitive to radiations emitted by said source, a diaphragm arranged ahead of said device, and optical means for transmitting radiations from said source to said diaphragm along a path in which is located the tip of the negative electrode, said diaphragm having an opening therethrough to permit only the passage of a strip of light extending along the longitudinal axis and of less width than the shadow cast by the electrode tip on said diaphragm.

7. An arc-lamp with automatic regulation of the negative electrode, comprising, in combination with said electrode, a source of radiation, a thermostat sensitive to the radiations emitted by said source, a diaphragm arranged ahead of said thermostat, and optical means cooperating with said source of radiation to produce on said diaphragm and thermostat a shadow of the tip of the negative electrode.

8. An arc-lamp with automatic regulation of the negative electrode comprising, in combination with said electrode, a source of radiations, a control device sensitive to said radiations, means for transmitting radiations from said source to said control device along a path into which the tip of the negative electrode extends, whereby the position of the tip of the negative electrode controls the transmission of radiations from said source to said control device.

HEINZ BECK.