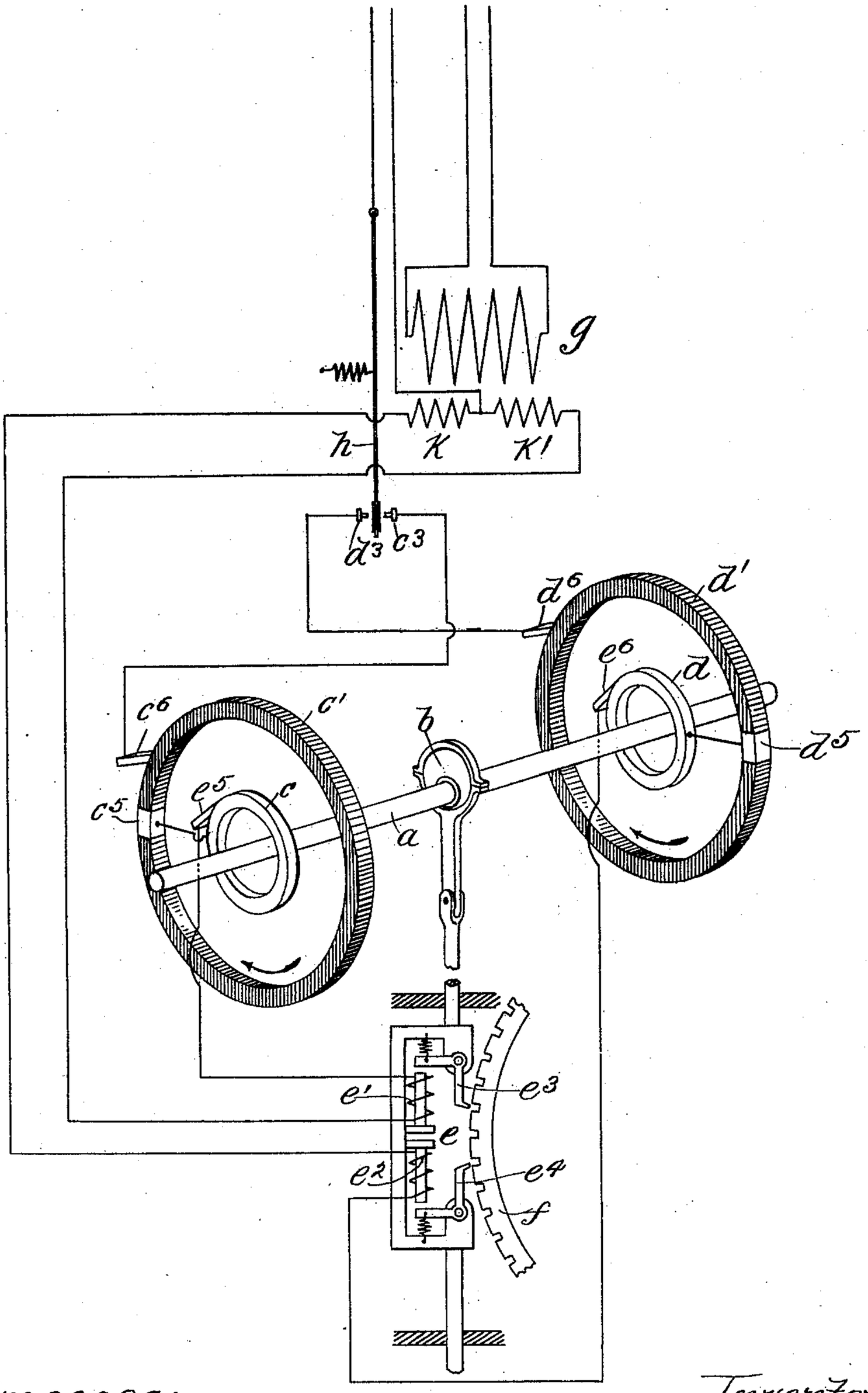
(No Model.)

E. W. G. C. HOFFMANN.

AUTOMATIC DEVICE FOR ELECTRIC CURRENT REGULATION.

No. 567,982. Patented Sept. 22, 1896.



Witnesses:
S. N. C. Darner.
A. D. Laurence.

Inventor:
Ernst W. G. C. Hoffmann,
By Burton Brown
Attorneys.

UNITED STATES PATENT OFFICE.

ERNST WILHELM GUSTAV CARL HOFFMANN, OF CHARLOTTENBURG, GERMANY, ASSIGNOR TO THE SIEMENS & HALSKE ELECTRIC COMPANY OF AMERICA.

AUTOMATIC DEVICE FOR ELECTRIC-CURRENT REGULATION.

SPECIFICATION forming part of Letters Patent No. 567,982, dated September 22, 1896.

Application filed April 17, 1896. Serial No. 587,947. (No model.) Patented in Germany February 28, 1891, No. 60,150.

To all whom it may concern:

Be it known that I, ERNST WILHELM GUSTAV CARL HOFFMANN, a citizen of Germany, residing at Charlottenburg, Prussia, Germany, have invented certain new and useful Improvements in Automatic Devices for Electric-Current Regulation; and I do hereby declare the following to be a full, clear, and exact description of the invention, such as will enable others skilled in the art to which it appertains to make and use the same, and for which Letters Patent have been granted in Germany, No. 60,150, dated February 28, 1891.

My invention relates to an improvement in an automatic device for electric-current regulation.

The object of my invention is to provide means for securing in the regulating-relay a firm sparkless contact, and thereby prevent all injury caused by arcing and insure certainty of action for the regulating device.

In an application for Letters Patent filed by E. W. G. C. Hoffmann and J. H. F. Goerges April 17, 1896, Serial No. 587,951, is described an electric-current-regulating device consisting of two electromagnetic clutches given a reciprocating movement by an eccentric mounted upon a continuously-revolving shaft, which are adapted to engage with teeth provided upon the periphery of a wheel controlling the regulating resistance. The said clutches are actuated by means of a relay, which is in turn operated by the current to be regulated.

In the operation of the above device it has been found that in the use of the ordinary type of double-contact relay, provided with a single spring and coil, a considerable amount of sparking is constantly present at the contact-points of the relay, caused by the necessarily slight force with which the contact is made. When the relay is adjusted for regulating small variations of current, the contact is made with less and less force and the relay becomes more uncertain in its action. The slightest tendency of the relay-arm toward vibration by reason of disturbing influences will be apt to cause a momentary break or interruption of the circuit at the contact-points, and injurious sparking and uncertain regulation may ensue.

The device of the present application avoids these objectionable features in its operation. It consists of two auxiliary coils provided in the relay and oppositely wound, which coils, respectively, operate in conjunction with and in opposition to the solenoid of the relay and contacts provided upon the revolving shaft of the regulating device for operating either of the auxiliary coils by closing the circuit through the said coil and the corresponding relay-contact.

Referring to the drawing accompanying this application, which is a diagrammatic view of the regulating relay and device in connection with the improvements of the present application, the shaft a, continuously revolving in the direction indicated by the arrows, has keyed upon it eccentric b and the contact-rings c c' and d d', all of which are insulated one from another.

The connecting-rod of eccentric b imparts vertical movement to the clutch device e, which carries the electromagnets e' and e^2 and clutches e^3 and e^4, actuated, respectively, by the magnets to engage with the toothed wheel f as current is supplied to the one or the other of the said magnets, thereby controlling the direction in which the wheel f is turned. Connected with the said wheel and governed by its rotation is the contact for varying the regulating resistance whereby the normal current is maintained. The current to be regulated passes through the solenoid g of the relay in shunt-circuit, and, by means of a spring adjustment opposing the magnetic force of the solenoid, the contact-arm h is regulated to remain midway between the contact-points c^3 and d^3 as long as the normal current is maintained. These contacts c^3 d^3 are respectively connected to the brushes c^6 d^6, which bear upon the rings c' and d', respectively. These rings are constructed of some insulating material with a small contact c^5 and d^5 inserted in each, which are respectively connected to the contact-rings c and d. The contacts c^5 and d^5 are at the opposite diameters of the rings c' and d' and so placed

with regard to the eccentric as to make contact with their respective brushes alternately when the clutch device is either at the top or bottom of the stroke. The brush e^5 is connected with the upper magnet e' and brush e^6 with the lower magnet e^2. The auxiliary coil k, wound differentially, so as to oppose the action of relay-solenoid g, is connected with the circuit through the magnet e^2, and auxiliary coil k', wound cumulatively to assist the relay-magnet, is connected with the magnet e'. Connected to each of the auxiliary coils is the current-supply wire, the opposite terminal thereof being in connection with the relay-arm h.

The operation of the device is as follows: When any variation takes place in the current flowing through the solenoid g, the magnetic effect thereof correspondingly varies and the contact-arm is actuated to engage with one or the other of the contact-points c^3 d^3. Assuming that the current has fallen below the normal, the spring connected to the relay-arm will thereupon overcome the influence of the solenoid, so that the arm h will be drawn into contact with point d^3. However, the circuit is not complete until the shaft a revolves so that the contact d^5 also is in engagement with brush d^6. Thus all arcing will occur at the contact d^5, as the circuit is opened and closed there; but the parts will be kept clean and bright by reason of the friction between the brush and contact. By arrangement of the position of the eccentric and ring d' upon the shaft the contact between the brush d^6 and contact d^5 cannot occur until the clutch device is at the lowest position of its stroke. Current then flows through the coil of magnet e^2, which is energized and actuates the clutch e^4 into engagement with toothed wheel f during the upward stroke of the clutch device. The circuit through magnet-coil e^2 is broken by the further revolution of the shaft a, the clutch, however, remaining frictionally engaged with the wheel f until the upward stroke is finished, when a spring provided for that purpose serves to withdraw the clutch. If sufficient resistance has not thus been cut out of circuit, the clutch continues similarly to engage the wheel at each upward movement until the normal current is once more established. When contact is made between the brush d^6 and contact d^5, current flows through the electromagnet e^2 to the auxiliary coil k, which serves further to weaken the magnetic effect of the relay-solenoid g, and the contact-arm h is pressed against the point d^3 in firm sparkless contact by the spring opposing the said solenoid. If, on the contrary, the current has risen above the normal, the same action occurs in the second circuit through contact-point c^3, contact c^5, ring c, magnet-coil e', and the auxiliary coil k', so that more resistance is cut in by the revolution of the wheel f by the clutch e^3 in the opposite direction, that is, actuated when the clutch device is making its downward stroke. In each instance the relay contact-arm h is pressed firmly into contact either with the point c^3 or d^3 by action of one or the other of the auxiliary coils operating in conjuntion with or in opposition to the magnetic force of the relay-magnet g, thereby preventing injurious sparking or uncertain action of the relay.

Having described my invention, what I claim as new, and desire to secure by Letters Patent, is—

1. In a relay, the combination with the main magnetic relay-coil, of auxiliary coils oppositely wound to respectively assist and oppose the main relay-coil, a relay contact-arm adapted to be influenced by the said main and auxiliary coils, whereby the said arm is actuated to engage with contacts provided on the said relay; substantially as described.

2. The combination with a relay provided with auxiliary coils to respectively assist and oppose the main relay-coil, of a circuit opening and closing device adapted to connect one or the other of the said coils in circuit; substantially as described.

3. In an automatic electric regulating device, the combination with a relay having auxiliary coils wound respectively to assist and oppose the action of the main relay-coil, the said relay-coil being adapted to close the regulating-circuits extending to the relay, of means for opening and closing the circuit through either of the auxiliary relay-coils, whereby the relay-contacts are brought into close engagement, substantially as described.

4. The combination with the main magnetic coil of a relay, of auxiliary coils respectively wound differentially and cumulatively to oppose and assist the said main coil, a contact-arm adapted to be moved by the said coils into firm engagement with the relay contact-points, a spring acting upon the said contact-arm in opposition to the main relay-coil, contact rings and brushes adapted to connect one or the other of the said auxiliary coils in circuit, whereby the said contact-arm may be brought into engagement with one or the other of the relay-contacts with the desired force and circuit completed therethrough; substantially as described.

5. In an automatic electric regulating device, the combination with the relay thereof, of auxiliary coils k' k' wound to act upon the relay-arm h respectively in conjunction with and in opposition to the relay magnet-coil g, contact-rings c c' and d d' insulated one from another and mounted upon the revolving shaft a of the regulating device and adapted to open and close the circuit respectively through the contact-point c^3 and auxiliary coil k, or the contact-point d^3, and auxiliary coil k', to the regulating device; substantially as described.

6. In an automatic electric regulating device, the combination with the main relay-coil g, of the auxiliary coils k k' wound respectively differentially and cumulatively to

thus oppose and assist the said coil g, a relay contact-arm h actuated by the said coils and adapted to engage with one or the other of the relay contact-points d^3 c^3, electromagnetic clutches e' e^2 adapted to respectively actuate a rack-bar controlling a regulating arm or lever, step by step in one direction or the other, contact-ring c connected in series by the brush e^5 with electromagnetic clutch e' and auxiliary coil k', contact-ring d connected in series by the brush e^6 with electromagnetic clutch e^2 and auxiliary coil k, contacts c^5 and d^5 respectively connected with the rings c' and d', brushes c^6 and d^6 respectively connected with relay contact-points c^3 and d^3, the said brushes being adapted to engage respectively with contacts c^5 and d^5, thereby closing one or the other of the circuits above described, when the relay-arm is moved into engagement with one or the other of the relay contact-points; substantially as described.

In testimony whereof I affix my signature in the presence of two witnesses.

ERNST WILHELM GUSTAV CARL HOFFMANN.

Witnesses:
PAUL ROEDIGER,
JULIUS LINGLER.