No. 782,450. PATENTED FEB. 14, 1905.

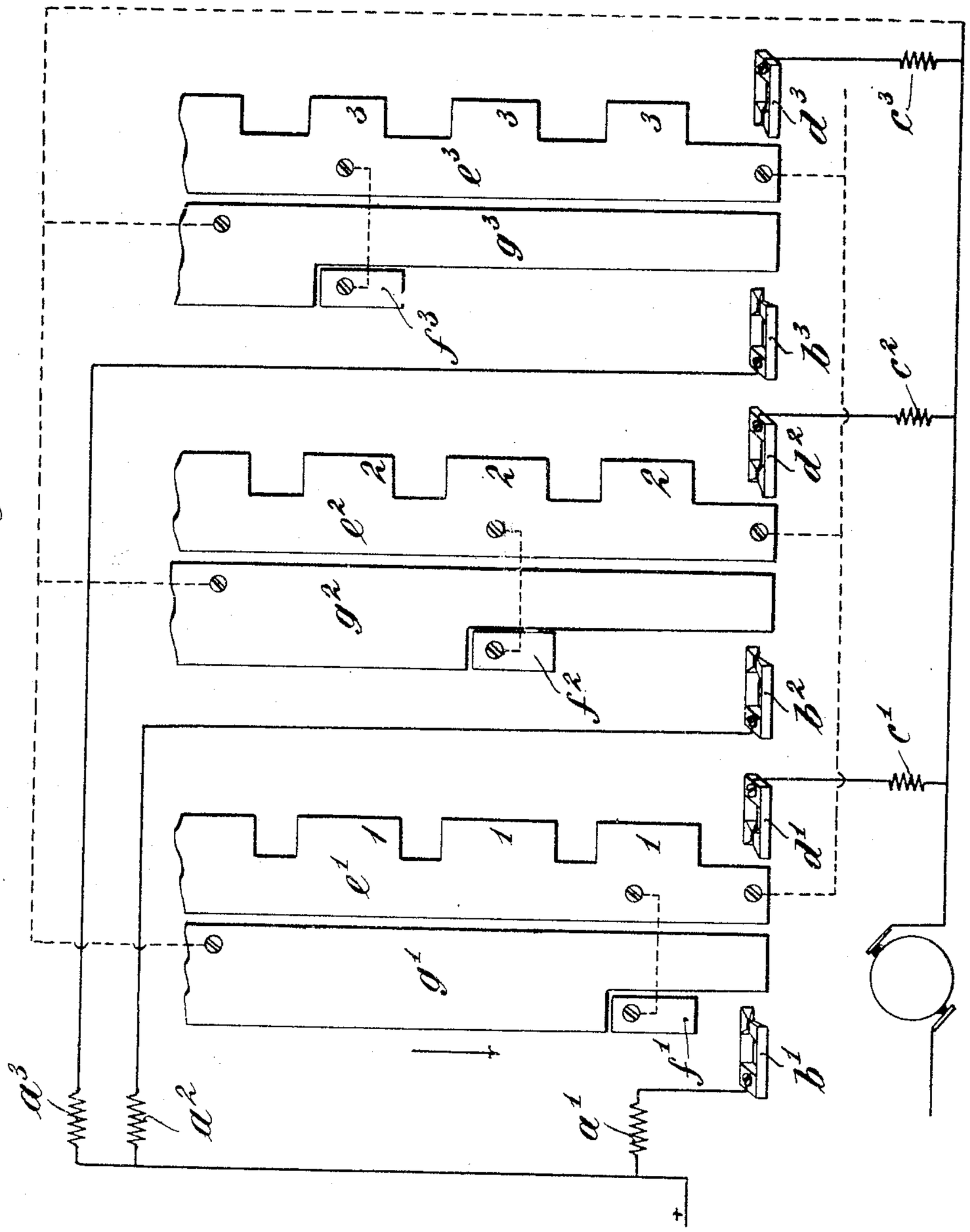
H. VON KRAMER.

ELECTRIC CONTROLLER.

APPLICATION FILED JAN. 21, 1904.

3 SHEETS—SHEET 1.

Fig. 1



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3 SHEETS—SHEET 2.

Fig. 2

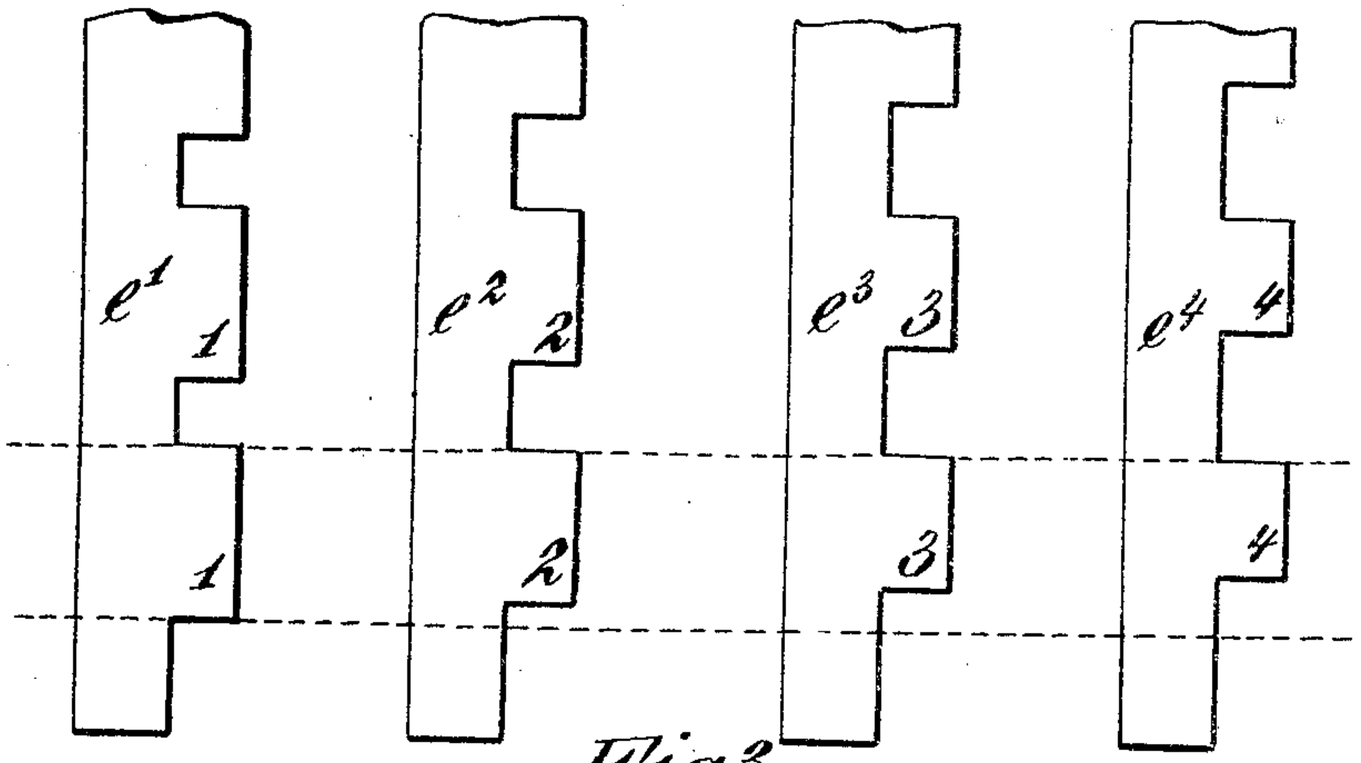
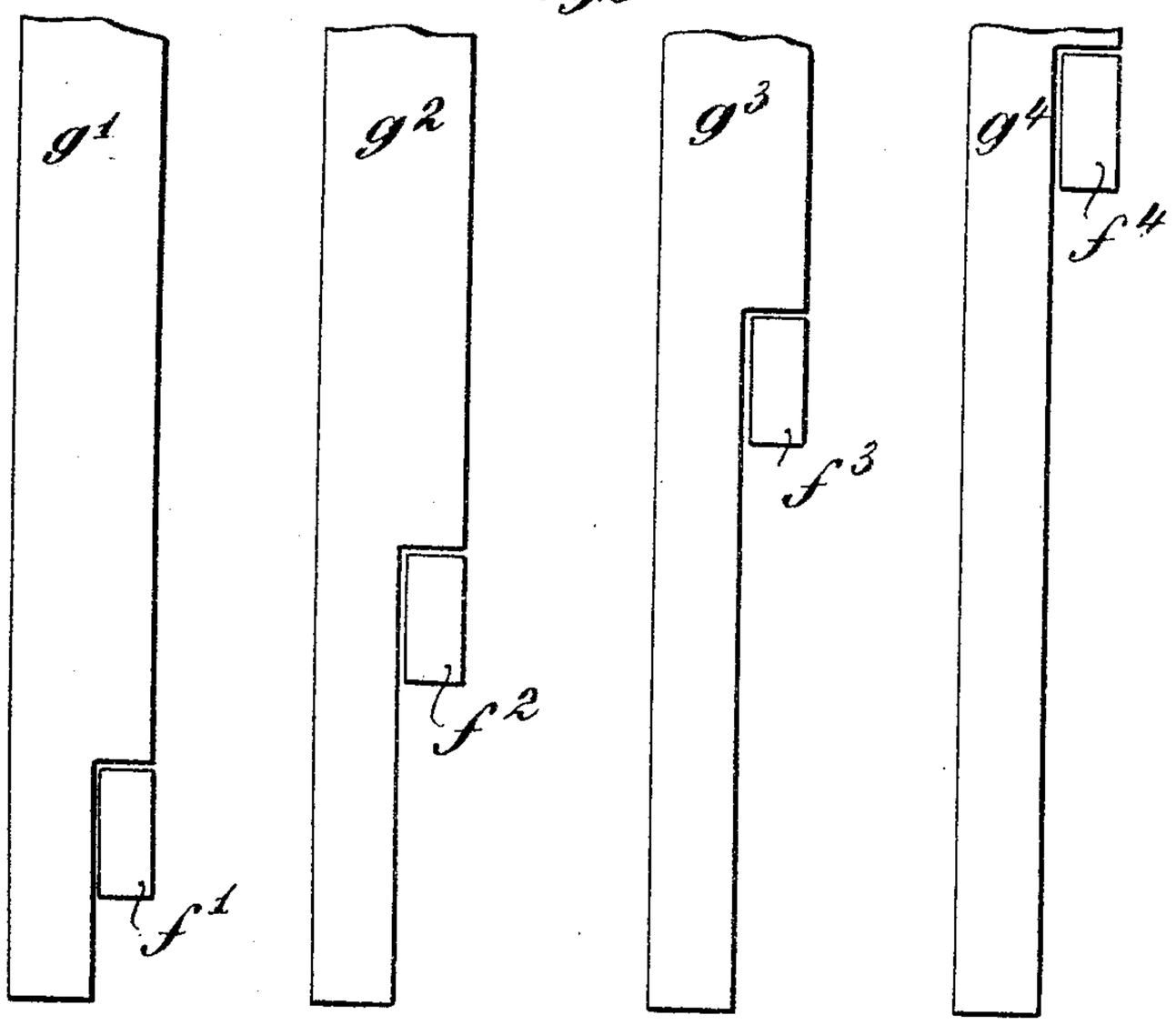


Fig. 3



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3 SHEETS—SHEET 3.

Fig. 4

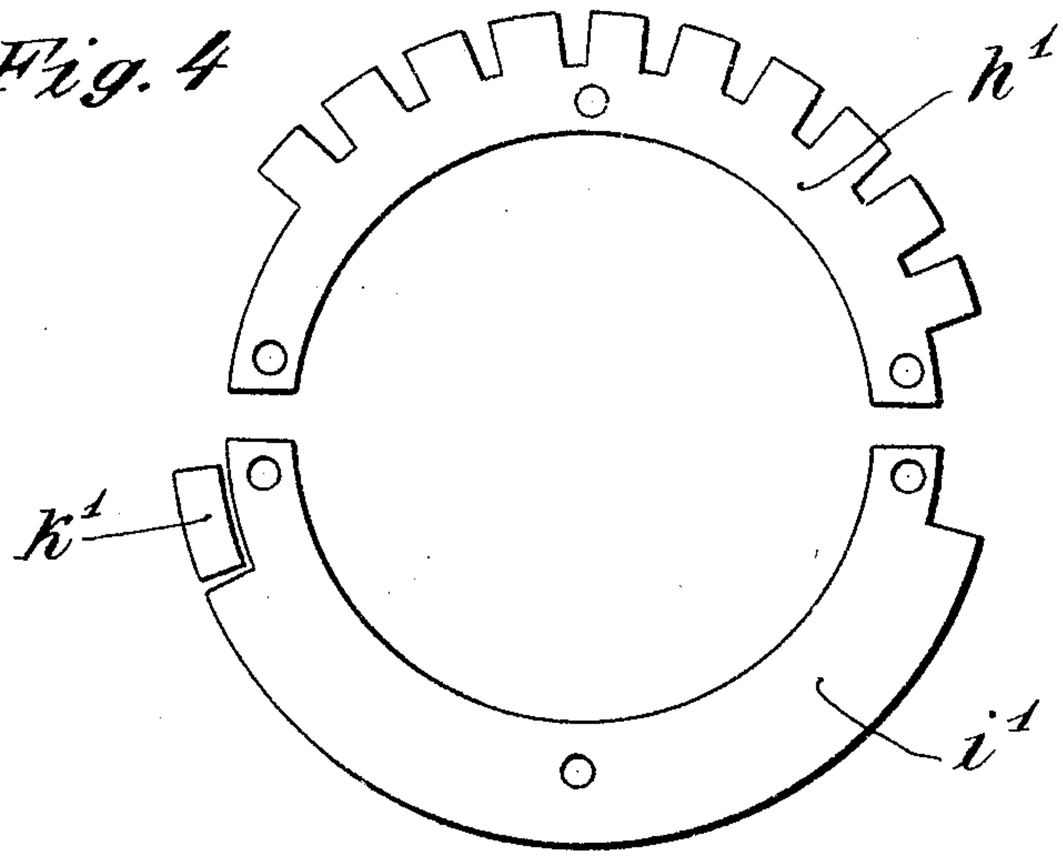
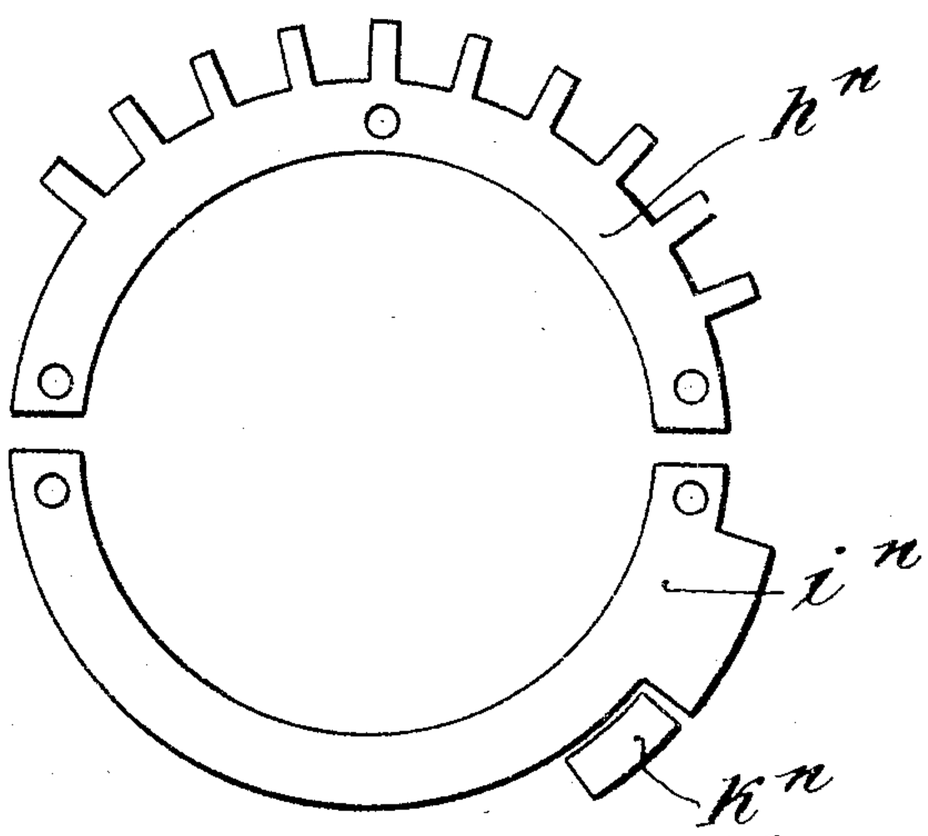


Fig. 5



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No. 782,450. Patented February 14, 1905.

UNITED STATES PATENT OFFICE.

HANS VON KRAMER, OF BATH, ENGLAND.

ELECTRIC CONTROLLER.

SPECIFICATION forming part of Letters Patent No. 782,450, dated February 14, 1905.

Application filed January 21, 1904. Serial No. 190,057.

To all whom it may concern:

Be it known that I, HANS VON KRAMER, a subject of the German Emperor, and a resident of Lower Weston, Bath, in the county of Somerset, England, (whose postal address is 41 Newbridge Hill, Lower Weston, Bath, England,) have invented certain new and useful Improvements Relating to Electric Controllers, of which the following is a specification.

My invention relates to an electric controller for starting and regulating electric machinery or increasing or decreasing the current strength of an electric circuit; and the object of my controller is to switch on or off in very fine and sensitive stops in order to avoid sparking or arcing on the contacts under whatever conditions the controller works.

In order to increase or decrease the ohmic resistance of an electric circuit, I switch electricity-resisting materials of certain units into the circuit and add or deduct in parallel to the same similar resistance units. Before, however, I switch on or off any such unit of a certain large dimension I connect in series with this said large resistance-step a number of small resistance-steps, all of them of various units, and I then gradually short-circuit these small resistance-steps until the current in the large step has actually reached its exact amount. In this moment I add this large resistance-step into the circuit without a spark. The small steps are of such dimensions that when in series with the large step they can be short-circuited very gradually without arcing or sparking on the contacts by which they are operated. The controller has a number of contacts for the large resistance-steps and also one set of contacts for the small resistance-steps which are each time placed and short-circuited in series with every one of the large resistance-steps whenever the latter are to be inserted parallel under each other into the circuit in question. In switching off a large step the same operation takes place in the opposite way. The number and the ohmic resistance of the small steps is so chosen that according to the prevailing voltage of the circuit it is the highest when the first small step is in series with a large step, and by switching on the second small step the total resistance of the large step in series with the first plus the second small step decreases slightly, and by switching on the third small step the total resistance of the large step in series with the first plus the second plus the third small again decreases, and so on. If, for instance, the first large step has ten ohms and the voltage of the circuit is one hundred volts, I would choose ten small steps, of which the first step has ninety ohms. Consequently the large step in series with the first small step would have ten ohms plus ninety ohms, equal one hundred ohms, the passing current being only one ampere. The first plus the second small step in series with the large step must give a total of fifty ohms, when the strength of the current will be two amperes. The first plus the second plus the third small step in series with the large step must give a total of 33.33 ohms, when the strength of the current will be three amperes. The next (fourth) total resistance would be twenty-five ohms, when the strength of the current will be four amperes, and the fifth total resistance would be twenty ohms for a current strength of five amperes, and so the total resistance would be gradually less until a total current strength of ten amperes is reached. This is the case when the small resistance-steps have been short-circuited. By this regulation the amperes would rise from one to two to three to four amperes, &c., and each step would mean one hundred additional watts only, which small amount of electricity would not injure the contacts which open and close each step.

With this system no electromagnetic spark-extinguisher is any further required.

After these explanations I will now describe my invention with reference to the drawings accompanying this my complete specification, in which—

Figure 1 represents, for example, a diagram of electric connections. Fig. 2 represents collector-bars for the small steps forming parts of a controller. Fig. 3 represents collector-bars for the large steps, equally forming parts of the controller; and Figs. 4 and 5 represent circular collector-segments for a rotatory controller.

In the plan of electric connections repre-

sented diagrammatically in Fig. 1 it is assumed that the controller is to work with three large resistance-steps a', a^2, and a^3, connected with the three contacts b', b^2, and b^3, respectively, and with three small resistance-steps c', c^2, and c^3, connected with the three contacts d', d^2, and d^3, it being presumed that these three small resistance-steps c' c^2 c^3 are sufficient for switching on or off any of the three large resistance-steps a', a^2, and a^3 without producing any sparking or arcing on their respective contacts. The collector-bars e', e^2, and e^3, the number of which is equal to that of the small resistance-steps c', c^2, and c^3, are provided with notches to form the teeth 1 1, 2 2, and 3 3. As is shown at Fig. 2, the teeth 1 1 of the first collector-bar e' are a little longer than those 2 2 of the second collector-bar e^2, which in turn are a little larger than those 3 3 of the third collector-bar e^3. (In Fig. 2 more than three collector-bars are shown in order to better illustrate the varying length of the teeth of the several collector-bars.) The three collector-bars e', e^2, and e^3 are electrically connected with the three small auxiliary collector-bars f', f^2, and f^3, respectively, or they may be made in one piece with the latter. These auxiliary bars f', f^2, and f^3 are insulated from the three collector-bars g' g^2 g^3 for the three resistance-steps a' a^2 a^3, and they are arranged in a special manner with reference to the teeth of the other three collector-bars e' e^2 e^3. The three sets of the collector-bars e' g', e^2 g^2, and e^3 g^3 are in any known manner combined with the aid of insulating materials to form a controller which can be moved in any known manner either in the direction of the arrow in Fig. 1 or in the opposite direction. It is important that the touch between the lowermost tooth 1 of the collector-bar e' and the contact d' should occur simultaneously with the touch between the auxiliary bar f' and the contact b', and it is hereby assumed that the auxiliary bar f' is moved, in conjunction with the collector-bar g', in the direction of the arrow in Fig. 1. On moving these parts farther in the direction of the arrow the auxiliary bar f' should first leave the contact b' before the tooth 1 of the collector-bar e' leaves the contact d'.

The manner of operating the controller will now be obvious from Fig. 1. When assuming that the contacts b' b^2 b^3 and d' d^2 d^3 be stationary and that the collector-bars e' e^2 e^3 and g' g^2 g^3, with the auxiliary bars f' f^2 f^3, be moved in the direction of the arrow, then first the lowermost tooth 1 of the first collector-bar e' will touch the contact d' and at the same time also the auxiliary bar f' of the first collector-bar g' will touch the contact b', so that the first small resistance-step c' will be placed in series with the first large resistance-step a'. On further moving the collector-bars the lowermost tooth 2 of the second collector-bar e^2 will touch the contact d^2, when the two small resistance-steps c' and c^2 will be placed in series with the first large resistance-step a'. Afterward also the lowermost tooth 3 of the third collector-bar e^3 will touch the contact d^3, so that the three small resistance-steps c' c^2 c^3 are now placed in series with the first large resistance-step a'. On all the collector-bars moving still farther in the direction of the arrow the first auxiliary bar f' will leave the contact b', whereupon the first collector-bar g' will touch the contact b'. Simultaneously with this contact or immediately afterward the contact is broken between the three lowermost teeth 1 2 3 of the three collector-bars e' e^2 e^3 and the contact-pieces d' d^2 d^3. The first large resistance-step a' is now switched on. After a while the same series of occurrences described above will take place with reference to the following teeth 1 2 3 of the three collector-bars e' e^2 e^3, so that on establishing a contact between the second collector-bar g^2 and the second contact b^2 the two large resistance-steps a' and a^2 will be switched on. In a similar manner the third large resistance-step a^3 can be switched on by still further moving all the collector-bars, so that first the three small resistance-steps c' c^2 c^3 are equally placed consecutively in series with the third large step a^3, and then a contact is established between the third collector-bar g^3 and the third contact b^3.

It is evident that the number of the small resistance-steps c' c^2 c^3 may be inserted at leisure and in correspondence therewith, also that of the collector-bars e' e^2 e^3, and in accordance with size of the large resistance-steps.

It is evident that by moving the controller in the other direction—*i. e.*, in a direction opposite to that of the arrow in Fig. 1—the three large resistance-steps can be switched off in the reversed order.

Instead of making the collector-bars straight they may also be made semicircular, as is represented by Figs. 4 and 5. Such collector-segments form parts of a rotatory controller. The multitoothed collector-segment h' in Fig. 4 is for the first small resistance-step and corresponds to the straight collector-bar e' in Fig. 1, while the simple collector-segment i' with the auxiliary bar k' is for the first large resistance-step and corresponds to the straight collector-bar g' with the auxiliary bar f' in Fig. 1. Fig. 5 shows the multitoothed collector-segment h^n with narrower teeth for the last small resistance-step and the collector-segment i^n with the auxiliary-bar k^n for the last large resistance-step. The intermediate collector-segments are shaped conveniently and in a manner which requires no further explanation.

The several collector-segments are combined with the aid of insulating material in any known manner to form a controller which can be operated conveniently.

The electric controller described so far can

be varied in many respects without deviating from the spirit of my invention.

What I claim, and desire to secure by Letters Patent, is—

An electric controller comprising a plurality of collector-bars, each having a series of teeth, and adapted to engage a series of contacts, connected with resistance-steps, a second set of collector-bars adapted to engage consecutively with another set of resistance-steps, by means of contacts, and a plurality of auxiliary bars adapted to place the first-mentioned steps in series with the last-mentioned steps, substantially as described.

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

HANS VON KRAMER.

Witnesses:

FRIEDRICH VON KRAMER,

HANS GROTSCH.