C. KRAMER.

MOTOR CONTROL SYSTEM.

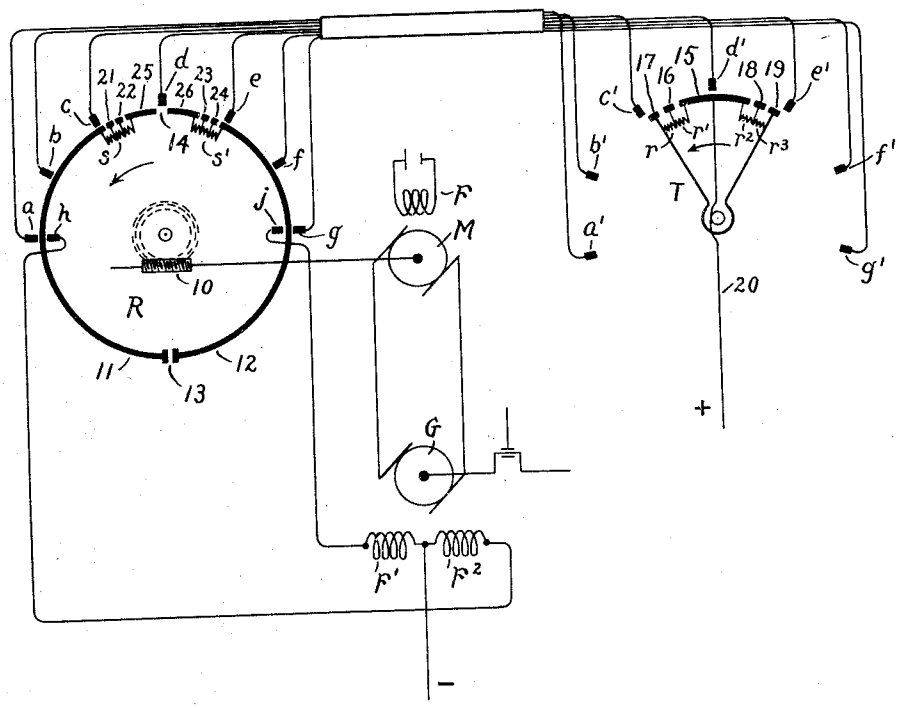
APPLICATION FILED JUNE 3, 1912.

Patented Oct. 29, 1912.

2 SHEETS—SHEET 1.

1,042,693.

Fig. 1.



WITNESSES:

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2 SHEETS—SHEET 2.

Fig. 2.

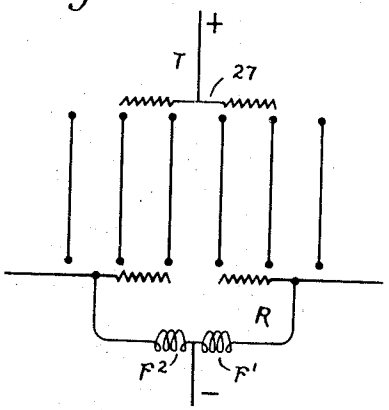


Fig. 3.

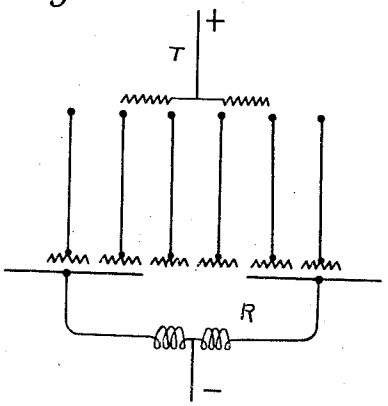


Fig. 4.

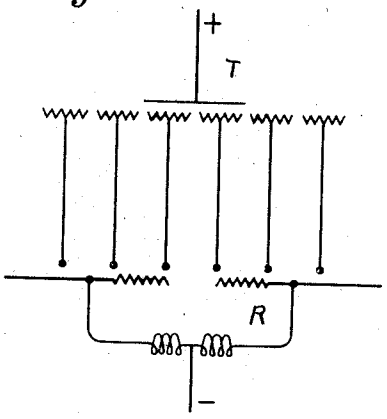
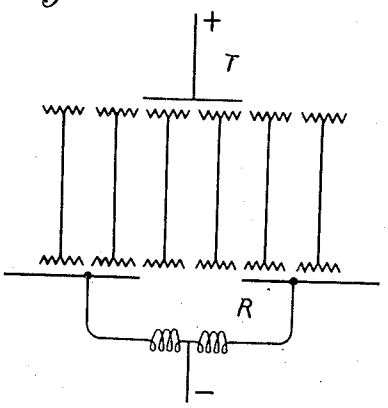


Fig. 5.



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UNITED STATES PATENT OFFICE.

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MOTOR-CONTROL SYSTEM.

1,042,693. Specification of Letters Patent. Patented Oct. 29, 1912.

Application filed June 3, 1912. Serial No. 701,119.

To all whom it may concern:

Be it known that I, CHRISTIAN KRÄMER, a subject of the Emperor of Germany, residing at Berlin, Germany, have invented certain new and useful Improvements in Motor-Control Systems, of which the following is a specification.

This invention relates to devices for controlling electric motors and has for its object the provision of means whereby an electric motor may be controlled from a remote point in a simple and reliable manner.

My invention relates more specifically to the control of motors which are employed for operating rudders, searchlight projectors and the like, the object being to provide means whereby the movement of the transmitting mechanism in the hands of an operator at a remote point will be reproduced at the motor. Devices of this kind have been commonly used, but some of them have the objection that a large number of conductors are necessary between the transmitting and receiving stations in order to obtain an equal number of control positions. The transmitting and receiving stations are frequently long distances apart and the provision of a large number of conductors is not only inconvenient, but also expensive.

One of the objects of my invention, therefore, is to reduce the number of conductors, at the same time insuring accurate and efficient control throughout a large number of control points.

Other objects and purposes of my invention will appear in the course of the following specification in which I have shown my invention embodied in concrete form for purposes of illustration.

Referring to the drawings illustrating one form of my invention, Figure 1 is a diagrammatic view showing my complete device; and Figs. 2, 3, 4 and 5 represent diagrammatically various modifications in the arrangement of the transmitting and receiving mechanisms.

Referring first to Fig. 1, T represents the transmitting device moved by hand or otherwise, and R represents the receiving device which is connected to the device to be rotated. In the drawing I have shown a Leonard system of motor control, although my arrangement is in no sense limited to this particular control system. A generator G, which may be driven in any desired manner, feeds the motor M having a field winding F. The generator G is provided with two differential field windings F′ and F² and the direction of rotation of the motor will depend upon the relative excitation of these two field windings. The receiving device proper consists of a drum driven from the motor by a worm gearing 10. This drum is shown diagrammatically only and in its essential elements consists of two contact bars 11 and 12 insulated from each other. In the drawing I have shown these bars separated by an air space at 13 and 14. Around the surface of the contact bars 11 and 12 are a plurality of brushes, a, b, c, d, e, f and g, which are connected respectively with brushes a', b', c', d', e', f' and g' on the transmitting device T. These brushes correspond to the main positions which will be assumed by the mechanism. The transmitting device consists of an arm provided with an elongated contact 15 of sufficient length to bridge any consecutive two of the brushes with which it coöperates. On each side of this contact are two auxiliary contacts 16, 17, and 18, 19 forming the terminals respectively of resistance sections r, r', r^2, and r^3. These contacts are spaced from the main contact 15 as shown on the drawing so that when the main contact is in the central position, the last contacts 17 and 19 will not quite engage the brushes c' and e'. Contact 15 is connected with the positive side of the line through the wire 20. When the transmitting device T is moved to any position, as, for instance, into engagement with the brush c', that is, so the brush c' engages the contact 15 at its central point, the receiving device R will likewise move one step since the current will pass from the positive side of the line to brush c', thence to brush c and brush h connected with the field F² of the generator. The winding F′ is not in circuit, since the brush d' is not connected with the line. The generator will therefore drive the motor in a direction to drive the contact drum of the receiving device in the direction of the arrow. When the brush c reaches the space 14, the circuit will be broken. In like manner, when the transmitting device is moved so that its contact 15 assumes a central position on any of the main brushes the receiv-

ing device will move correspondingly. It will be noted that in order to obtain these seven positions seven conductors are necessary between the transmitting and the receiving devices. In order to increase the number of positions without increasing the number of conductors, I have provided the intermediate or auxiliary contacts 21, 22, 23 and 24 on the controller corresponding to the contacts 16 to 19 on the transmitting device. These contacts 21 to 24 are connected with the resistances s and s' so as to divide the resistances into three sections. These sections are equal in value to the sections of resistance r and r' and preferably are equal to each other in value. The resistances s and s' are thus connected at one end to the contact bars 11 and 12 and at the other end are connected to contacts 25 and 26. These contacts 25 and 26 are of a length substantially equal to the distance between the contacts 25 and 26 and their corresponding contact bars 11 and 12. With this arrangement it will be seen that if the transmitting device instead of being moved a full step is only moved a slight amount, say for instance, to the left until the contact 17 engages the brush c', the result will be as follows: Current will pass from the positive side of the line through the two resistance sections r, r', brush c', thence to brush c and field F^2. No current will flow through the brushes d' d since they are not in circuit and the field winding F' will therefore not be energized. This will cause the controlling drum of the receiving device to move in the direction of the arrow until the brush c rests on contact 21 and the brush d rests on contact 26. In this position the circuit will be divided, one circuit being from brush d', brush d, through the resistance s' to the brush j, field F', while the other passes through the two sections of resistance r and r' and one section of the resistance s to field F^2. The sections of resistance of the transmitting and receiving devices being equal and there being three sections in series with each of the fields F and F', a balanced condition will ensue and the motor will stop. In like manner when the transmitting device is moved another step, as, for instance, until the brush c' engages contact 16, there will be in circuit with the field F^2 one section of resistance r' and one section of resistance s. On the other hand, there will be in series with the field F' all of the resistance s' since the brush b still remains on contact 26. This will cause an unbalanced condition whereby the controller will again be rotated in the direction of the arrow until another section of resistance is cut into the field F^2. This will happen when the brush c engages the contact 22. When the transmitting device is moved so that its contact 15 engages both brushes c and d' a balanced condition ensues, since the resistance s' will then be in series with the field F' and the resistance s will be in series with the field F^2. It is thus possible to obtain three intermediate steps between each main step. In other words, with the seven conductors extending between the transmitting device and the receiving device I am able to transmit twenty-one positions.

In Figs. 2 to 5, I have shown modifications of Fig. 1. In Fig. 2 the movable member of the transmitting device T consists of a contact 27 which spans two of the brushes and having a resistance at each end. The movable member of the transmitting device therefore covers four brushes. On the receiving device the movable member consists of two resistances which are separated by a space equal to the space between the brushes. Windings F' and F^2 are connected as shown. By moving the transmitting device step by step, it will be obvious that the receiving device will be correspondingly moved, in accordance with the mode of operation described with reference to Fig. 1.

In Fig. 3 the arrangement is somewhat different, in that the resistance of the receiving device is not attached to the movable member. The arrangement of the transmitting device is the same as in Fig. 2, but in the receiving device the resistance is attached centrally to each brush.

In the device shown in Fig. 4 the operation is similar to that of Fig. 2 with the exception that in the transmitting device the resistance is fixed instead of operating with the movable member.

Fig. 5 shows an arrangement which is similar to Fig. 3 with the exception that the resistance in the transmitting device is fixed instead of being mounted on the movable member. In this case the resistances of both the transmitting and receiving devices are stationary.

It will be seen that I have provided a simple and efficient arrangement whereby movement of the control member in the hands of the operator will be transmitted to the receiving station so that a large number of positions may be obtained through a relatively small number of conductors.

While I have described my invention as embodied in concrete form and as operating in a specific manner in accordance with the patent statutes, it should be understood that I do not limit my invention thereto, since various modifications thereof will suggest themselves to those skilled in the art without departing from the spirit of my invention, the scope of which is set forth in the annexed claims.

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

1. The combination with an electric motor

and a controller therefor driven by the motor, of a transmitting device provided with contacts constituting main positions, connections whereby a movement of the transmitting device to any one of said main positions causes the motor to drive the controller to a corresponding position, resistances associated with both the transmitting device and the controller connected to effect the operation of the motor and having contacts constituting auxiliary positions, and connections whereby a movement of the transmitting device to an auxiliary position causes the controller to assume a corresponding position.

2. The combination with an electric motor, of a controller therefor driven by the motor having a plurality of resistance sections for affecting the operation of the motor, transmitting mechanism having a plurality of resistance sections arranged to be connected in circuit with the resistance on the controller, and connections whereby a movement of the transmitting mechanism affects the resistance associated therewith to cause a corresponding movement of the controller which movement in turn affects the resistance associated with the controller to stop the motor.

3. The combination with an electric motor, of a generator for supplying current thereto having differential field windings, a resistance for each field winding, a controller for said resistance driven by the motor and arranged to vary one resistance without varying the other when moved in each direction, transmitting mechanism including a variable resistance, and connections whereby a movement of the transmitting mechanism varies the field of the generator to drive the motor until the controller is moved correspondingly to energize the differential fields equally and oppositely and stop the motor.

4. The combination with an electric motor, of a generator for supplying current thereto having differential field windings, a resistance connected with said field windings, a controller therefor driven by the motor, transmitting mechanism including a resistance controlling member, and connections whereby a movement of the transmitting mechanism causes the resistance associated therewith to be inserted in the field windings of the generator and energize the same unequally to drive the motor until the control member is moved a corresponding step to energize the field windings equally and oppositely to stop the motor.

5. The combination with a dynamo electric machine having differential field windings, a resistance controlling member driven thereby and connected with said field windings, a resistance varying transmitting mechanism, and connections whereby a movement of the transmitting mechanism causes field excitation of the dynamo electric machine for driving the controlling member through a corresponding movement which energizes the differential field windings equally and oppositely and stops the movement of the controlling member.

6. The combination with a dynamo electric machine having differential field windings, a resistance in circuit with each of said field windings, a controller therefor driven by said machine to vary the resistance in steps, transmitting mechanism provided with equal resistance steps, and connections whereby a movement of the transmitting mechanism through one step causes unbalancing of the differential windings to drive the controlling member a corresponding step to balance the windings and stop the member.

7. The combination with a dynamo electric machine having differential field windings, a resistance controller driven thereby having a sectional resistance in one field winding and an equal resistance for the other field winding, transmitting mechanism provided with resistance in series with said sectional resistance divided into sections equal in value to the sections of the controller, and connections whereby a movement of the transmitting mechanism places resistance sections in series with the field winding with which they are associated having a total resistance which is different from the resistance in the other field winding to cause a movement of the controlling member, said connection causing a corresponding movement of the controller to render the resistance in the two field windings the same so as to stop the movement of the controller.

8. The combination with a dynamo electric machine having differential field windings, a section of resistance for each winding one being variable when the controller is moved in one direction from the off position and the other when it is moved in the opposite direction, transmitting mechanism provided with two resistances one in series with each of said sections of resistance and divided into sections equal to those on the controller, and connections whereby a movement of the transmitting mechanism in either direction connects one of the resistances associated therewith in series with the corresponding resistance on the controller and one of the fields to balance the field windings, said connections being such that the movement of the controller caused by such unbalancing will bring the field to balanced condition.

9. The combination with an electric motor, of a generator for supplying current thereto having differential field windings, a resistance for each field winding, a controller for connecting one resistance in series with each field and arranged to vary one

resistance when moved in one direction from the off position and in the other direction when moved in the opposite direction, transmitting mechanism comprising similarly arranged resistance having sections of value equal to those on the controller, and connections whereby movement of the transmitting mechanism causes unbalancing of the field resistances which in turn causes the controller to be moved to balanced position.

In witness whereof, I have hereunto set my hand this 14th day of May, 1912.

CHRISTIAN KRÄMER.

Witnesses:

RICHARD NEUMANN,

WALTHER REINHARDT.