Dec. 1, 1942. F. E. RICH 2,303,499

RHEOSTAT

Filed Sept. 15, 1939 2 Sheets-Sheet 1

Fig. 1.

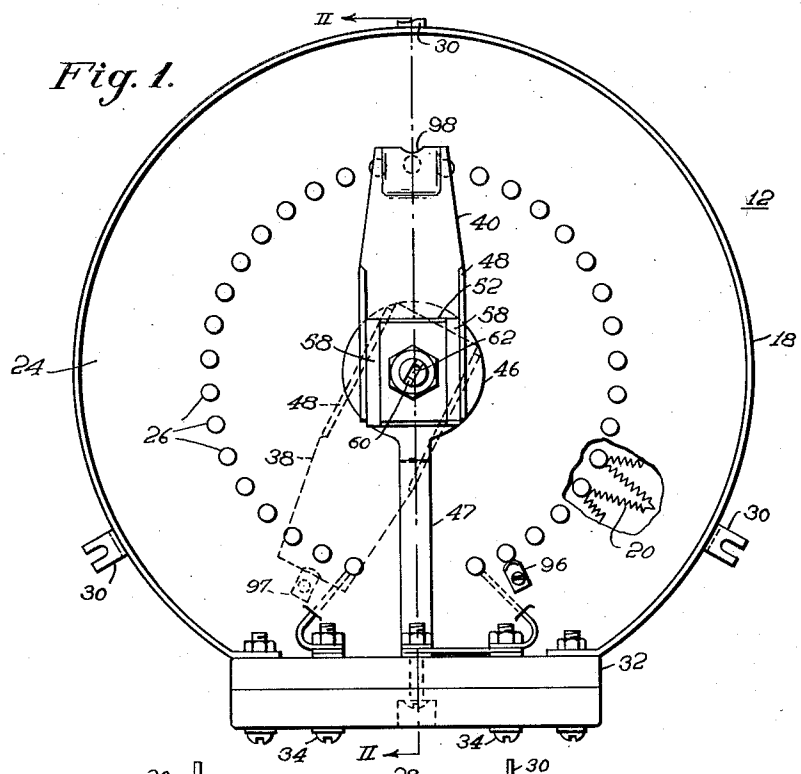
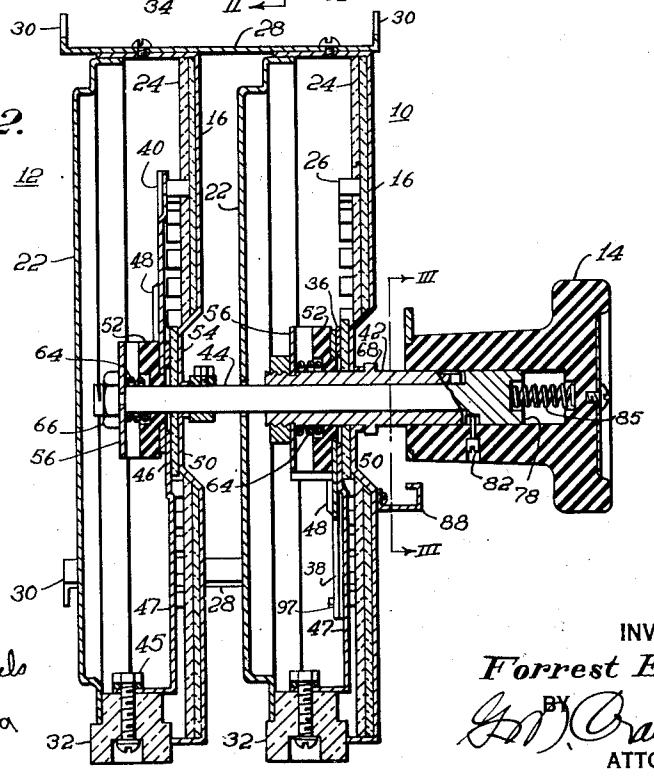


Fig. 2.



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Filed Sept. 15, 1939 2 Sheets-Sheet 2

Fig. 3.

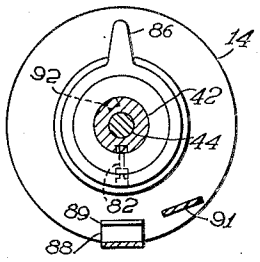


Fig. 4.

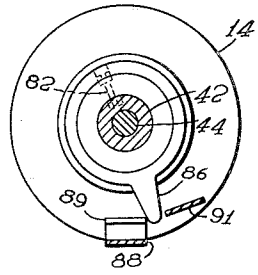


Fig. 6.

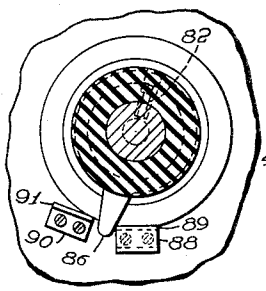


Fig. 5.

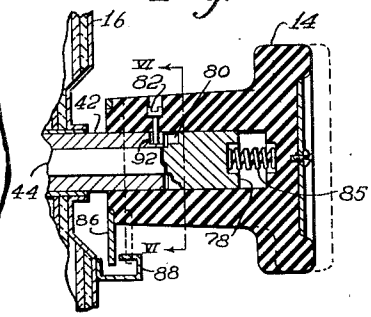


Fig. 7.

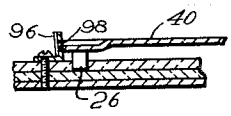
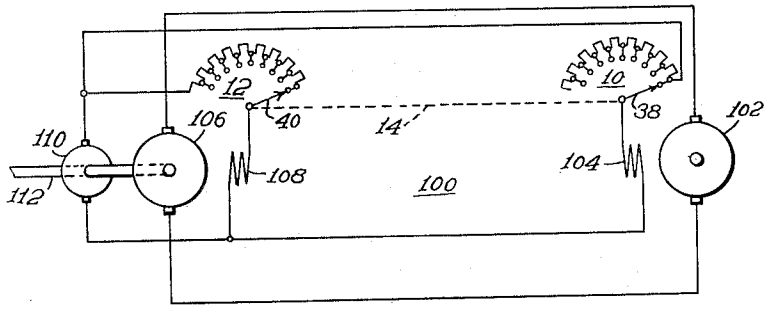


Fig. 8.



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UNITED STATES PATENT OFFICE

2,303,499

RHEOSTAT

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Application September 15, 1939, Serial No. 295,002

3 Claims. (Cl. 201—48)

My invention relates generally to rheostats, and it has reference, in particular, to multiple unit rheostats.

Generally stated, the object of my invention is to provide an improved rheostat construction, which is simple and inexpensive to manufacture, and is positive in operation.

More specifically, an object of my invention is to provide for so operating a multiple unit rheostat, having a plurality of rheostat units, that operation of the units may be effected only in a predetermined sequence.

An important object of my invention is to provide for interlocking a plurality of rheostat units so as to provide for a predetermined sequence of operation of the said rheostat units.

A further object of my invention is to provide a simplified method of speed control of a motor in a variable voltage system, by utilizing a multiple unit rheostat having a rheostat unit for controlling the generator voltage and another rheostat unit for controlling the voltage applied to the field winding of the motor, with a single operating handle for effecting operation of the said rheostat units in a predetermined sequence.

Yet another object of my invention is to provide for operating a plurality of rheostat units by means of a common handle which is normally operatively connected for actuating one of said rheostat units, and is actuable only after a predetermined degree of operation of the said one rheostat unit to be disconnected from the said one rheostat unit and operatively connected to another of the rheostat units for effecting operation thereof, in a predetermined sequence.

Other objects will, in part, be obvious and will, in part, appear hereinafter.

In practicing my invention, a plurality of rheostat units may be so associated that a common operating handle, which is normally operatively connected to one of the said rheostat units for actuating the said one rheostat unit, may be actuated after a predetermined degree of operation of the said one rheostat unit to be operatively connected to another of the said rheostat units for operating the said other rheostat unit throughout its entire operating range, without effecting further operation of the first-mentioned of said rheostat units. In this manner, two or more rheostat units may be operated so as to insure a predetermined sequence of operation thereof, without requiring complicated and expensive interlocking means to prevent operation thereof in the wrong sequence, and the units may be operated throughout their entire operating range, thus permitting fine adjustment thereof in any position.

Thus, for example, when it is desired to control the speed of a motor in a variable voltage system over a wide range, it may be desirable to operate both a generator field rheostat and a motor field rheostat so as to vary both the voltage applied to the motor armature by the generator, and the voltage applied to the field winding of the motor. In order to secure satisfactory operation of the motor over the entire range of speed control, it is essential for stable operation of the motor to operate it with a full field when operating on reduced voltage, and to first increase the speed of the motor by increasing the generator voltage. Then, for a further increase of the motor speed, the field of the motor may be weakened by reducing the voltage applied to the field winding of the motor through operation of the motor field rheostat. When reducing the speed of the motor, it is likewise necessary to reduce the motor speed by first operating the motor field rheostat to increase the voltage applied to the motor field winding and strengthen the motor field, and then secure further reduction in the motor speed by operating the generator field rheostat to reduce the voltage applied to the motor. In such an application, a rheostat embodying the features of my invention provides a simple and effective method of insuring the desired sequence of operation of the generator and motor field rheostats, and is of great value in preventing improper control of the motor speed.

For a more complete understanding of the nature and scope of my invention, reference may be had to the following detailed description, taken in connection with the accompanying drawings, in which:

Figure 1 is a view, in end elevation, of a rheostat embodying the principal features of my invention;

Fig. 2 is a longitudinal sectional view of the rheostat of Fig. 1 taken along the line II—II;

Fig. 3 is a cross-sectional view taken along the line III—III of Fig. 2;

Fig. 4 is a cross-sectional view taken along the line III—III of Fig. 2, showing the handle in the transfer position;

Fig. 5 is a partial view, in section, showing the rheostat with the handle actuated for operating the second of the units;

Fig. 6 is a view along the line VI—VI of Fig. 5 showing the stop members;

Fig. 7 is a sectional view showing details of the contact arm retaining member; and

Fig. 8 is a schematic diagram of a variable voltage motor control system, illustrating an application of my invention.

Referring particularly to Figs. 1 and 2 of the drawings, the reference numerals 10 and 12 denote, generally, a pair of rheostats of any suitable type well-known in the art, and which are associated for operation by a common operating handle 14, which is adapted to effect a predetermined sequence of operation thereof.

The rheostat units 10 and 12 may be of the same general construction comprising, for example, a housing which may consist of a substantially flat front plate 16 which is provided with a circumferential rim 18, and a removable cover plate 22 for enclosing the housing. A resistance element 20, such as shown in the broken out portion of Fig. 1, may be positioned in the housing in any suitable manner, being, for example, embedded in a layer of vitreous enamel 24, or the like, which may be fused to the inner surface of the front plate 16 so as to secure the resistance element 20 and suitable projecting contact members 26, which are connected thereto, in fixed relation to the face plate, so that they are insulated therefrom. The rheostat units 10 and 12 may be connected to each other in any suitable manner, such as, for example, by means of the metal strips 28, which may be attached to the peripheral rim 18 of the casings at spaced intervals, and which may, if desired, be provided with feet 30 for mounting the rheostat units.

In order to provide for making electrical connections to the rheostat units, suitable terminal blocks may be provided therefor by cutting away portions of the peripheral rims 18 of the casings, and attaching blocks 32 of insulating material thereto for supporting terminal screws 34, to which the ends of the resistance elements 20 may be connected. In order to make a suitable sliding contact with the contact members 26, the rheostat units 10 and 12 may be provided with rotatable contact arms 38 and 40 which are disposed to be actuated by the coaxial operating shafts 42 and 44, respectively. Suitable means, such as the collector rings 46 may be provided for making contact with the contact arms 38 and 40 and may, for example, be connected to suitable terminal members 45 on the terminal blocks 32 by means of connectors 47, so that the desired connections may be thereby made to the contact arms.

The contact arms 38 and 40 may be of any suitable construction, comprising, for example, substantially flat conductive strips, having upturned edge portions 48, and provided with openings 50 at one end, substantially larger than the shafts 42 and 44, and through which the shafts may pass. Suitable means, such as the insulating blocks 52, may be provided for mounting the contact arms on the shafts. The blocks 52 have openings therethrough for receiving the operating shafts 42 and 44 and projecting boss portions 54 on one side which may be positioned in the openings 50 of the contact arms to insulate them from the shafts.

Relative movement of the insulating blocks 52 and the shafts 42 and 44 may be prevented in any suitable manner, such as, for example, by providing key plates 56 which may be recessed between the upstanding side portions 58 of the insulating blocks 52, and keyed to the shafts 42 and 44, respectively, by suitable means, such as shown in Fig. 1, wherein the projecting lugs 60 of the key plate 56 project into a slot 62 in the shaft 44. The contact arms 38 and 40 may be biased against the contact members 26 to insure good electrical contact therewith by means such as the springs 64, which may be interposed between the key plates 56 and the insulating blocks 52, and nuts 66 which may be threaded onto the ends of the shafts 42 and 44 to draw the shoulder portion 68, and a suitable collar 70 against the face plates 16 of the rheostat units.

In order to effect operation of the rheostat units 10 and 12 in a predetermined sequence, suitable means may be provided whereby the common operating handle 14 may be operatively connected to the shafts 42 and 44 for individually actuating the rheostat units only in the desired predetermined sequence. For example, the shaft 44 may be provided with an enlarged end portion 78 having an axially disposed peripheral slot 80 positioned therein on the face adjacent the end of the shaft 42, which may be tubular, in order that the shaft 44 may pass therethrough. Suitable means, such as the pin 82 may be provided on the handle 14 to project into the central bore 84 thereof, and into the slot 80 in the head portion of the shaft 44. The handle 14 may thereby be normally operatively connected to the shaft 44 for operating the contact arm 40 of the rheostat unit 12, and a spring 85 may be provided for biasing the handle 14 to this position.

Referring principally to Figs. 2, 3, 4, 5 and 6 of the drawings, it will be seen that suitable stops may be provided for engaging a pointer 86 attached to the handle 14. For example, a stop member 88 may be provided for engaging the pointer 86 when the handle 14 is operatively connected to the shaft 44 of the rheostat unit 12, having an inturned stop portion 89, so that the pointer 86 may clear it when the handle is actuated axially for operating the second rheostat. Thus the pointer 86 will engage the stop portion 89 in both the minimum and maximum operating positions of the rheostat unit 12. An additional stop member 90 may be provided, having an upturned stop portion 91, which is adapted to engage the pointer 86 in its minimum and maximum operating positions only when the handle 14 is operatively connected to the shaft 42 for operating the rheostat unit 10.

Referring particularly to Figs. 3, 4, 5 of the drawings, it will be seen that the end of the tubular shaft 42 of the rheostat unit 10 may be provided with an axially disposed slot 92, which is so positioned as to be opposite the axial slot 80 in the head portion of the shaft 44, when the contact arm 38 of the rheostat unit 12 has been operated to a predetermined position, such, for example, as the position of minimum resistance thereof, as shown. Means such as the L-shaped resilient stop or retaining member 96 shown in Fig. 7 may be provided for engaging a groove 98 in the end of the contact arm 40, for retaining the contact arm in this position, and insuring against accidental movement therefrom.

By pressing inwardly on the handle 14 when the rheostat unit has been operated to a predetermined, or transfer position, which in this instance is shown as the position of minimum resistance, against the spring 85, the pointer 86 may be disengaged from the inturned stop portion 89 of the stop member 88, and the pin 82 may be moved axially from its position in the axial slot 80 in the head portion of the shaft 44, into the axial slot 92 of the shaft 42, as illustrated

particularly in Fig. 5 of the drawings, wherein the handle 14 is shown in full in the actuated position, and in the original position by the dotted outline. The handle 14 may then be rotated to actuate the contact arm 38 of the rheostat unit 10 to any desired position throughout its entire operating range, without effecting any movement of the contact arm 40 of the rheostat unit 12.

In order to effect subsequent operation of the contact arm 40 of the rheostat unit 12, it is first necessary to return the contact arm 38 of the rheostat unit 10 to its original, or transfer position, which, for the purpose of illustration, has been shown as the position of minimum resistance, though it will be realized that with different applications, this relation of the rheostat units may be otherwise. When the handle 14 is rotated so that the pointer 86 is returned to the transfer position, against the stop portion 91 of the stop member 90, the handle may then be actuated axially so that the pin 82 is moved back into the slot 80, operatively connecting the handle with the shaft 44 for operating the rheostat unit 12. The contact arm 38 may be retained in the transfer position by a stop or retaining member 97 similar to that for the contact arm 40, and positioned as shown in Figs. 1 and 2.

If it is desired to operate more than two rheostate units in a predetermined sequence, suitable provision may be made so that when the contact arm of the second rheostat unit has been operated to a predetermined position, the handle may be actuated axially, and operatively connected to the operating shaft of still another rheostat unit, in a similar manner, so as to provide for the operation thereof in a predetermined sequence relative to the other rheostat units.

Referring particularly to Fig. 8 of the drawings, the reference numeral 100 may denote generally a variable voltage control system wherein a motor 102 having a field winding 104, is adapted to be energized from a source of variable voltage, such as the generator 106, which is provided with a field winding 108. As therein illustrated, the field windings 104 and 108 may be energized from a separate source, rather than from the generator, such, for example, as the exciter 110, which may be driven from the same shaft 112 that drives the generator, and to which any suitable motive means may be connected.

The rheostat unit 12 may be connected in series circuit relation with the field winding 108 of the generator, for varying the voltage applied to the motor 102, and the rheostat unit 10 may be connected in series circuit relation with the field winding 104 of the motor for varying the strength of the motor field.

Thus, in order to vary the speed of the motor, initially, the handle 14 may be operated to vary the position of the contact arm 40 of the generator field rheostat unit 12. By rotating the handle 14 counter-clockwise the resistance in series with the generator field may be decreased, increasing the voltage applied to the motor 102, and thus increasing the speed thereof, while the motor field is maintained at full strength, since the handle 14 is normally operatively connected for operating the rheostat unit 12. When the contact arm 40 of the rheostat unit 12 reaches the limit of its travel, so that the pointer 86 engages the stop portion 89, the handle 14 may then be pressed inwardly against the spring 85, so as to be operatively connected for operating the rheostat unit 10 upon further rotation thereof. The rheostat unit 10 may then be operated to increase the resistance in the field circuit of the field winding 104 of the motor 102, for any further increase of motor speed.

In order to decrease the speed of the motor, the handle 14 must be first operated to return the contact arm 38 of the rheostat unit 10 to its original or transfer position, before the handle can be actuated so as to be operatively connected for operating the rheostat unit 12, to reduce the motor speed by reducing the generator voltage. In this manner, the sequence of operation of the generator and motor field rheostat units is predetermined, and they can only be so operated that the motor will operate on reduced voltage only after the full motor field strength has been restored. Thus undesirable unstable operating conditions of the motor are effectually avoided.

From the above description, and the accompanying drawings, it will be realized that I have provided a simple and effective manner for controlling the operation of a plurality of associated rheostat units in a predetermined sequence. Furthermore, I have, in the manner hereinbefore explained, greatly facilitated speed control of motors over a wide range of speeds, by reducing the possibilities of unstable operation thereof through inadvertent operation of the generator and motor field rheostats in the wrong sequence in a variable voltage motor control system, while utilizing the full available operating range of the rheostat units so as to permit relatively smooth adjustment of speed in a large number of steps.

While the invention has been illustrated and described principally in connection with the speed control of a motor in a variable voltage motor control system, and for the purpose of illustrating the invention in the simplest manner only a pair of single rheostat units have been shown, the invention is not thereby intended to be limited to such application, or such combination, and it is to be understood that the particular construction illustrated may be modified readily to provide for operating more than two units in a definite sequence. Likewise, in practicing my invention, any number of units may be operated at once, instead of the single units shown.

Since certain changes may be made in the above description, and different embodiments of the invention may be made without departing from the scope thereof, it is intended that all the matter contained in the above description or shown in the accompanying drawings, shall be considered as illustrative, and not in a limiting sense.

I claim as my invention:

1. The combination of a rheostat unit having a hollow operating shaft with an axially disposed peripheral slot adjacent one end, an additional rheostat unit having an operating shaft extending through the hollow shaft of the first-mentioned rheostat unit, a portion of the shaft of the second mentioned rheostat unit having an axially disposed peripheral slot on the face immediately adjacent the end of the hollow shaft positioned in a predetermined relation to the slot in the end of the hollow shaft, and a handle for said rheostat units slidably positioned on said shafts having a projection normally disposed in the peripheral slot of the shaft of one of the said rheostat units for operating the said one rheostat unit, said handle being axially actuable to project the said projection into the peripheral slot of the other of the said shafts for ef-

fecting operation of the other of the rheostat units.

2. A multiple unit rheostat comprising, a pair of coaxially alined rheostat units having rotatable contact arms mounted on coaxially positioned operating shafts, a common operating handle supported by one of the shafts, said handle being rotatable with respect to both of said shafts and movable axially thereof to different operating positions, an operating mechanism for connecting the handle to one of the shafts only in one axial operating position and to the other shaft only in the other axial operating position including opposed coaxial clutch means on the shafts and a pin positioned transversely of the shafts operatively associated with the handle effective to prevent axial movement of the handle from one axial operating position to the other except when the shafts are relatively positioned in a predetermined angular relation, and stop means effective to prevent rotation of the handle in one direction when the shaft connected thereto is in the predetermined angular relation with the other shaft.

3. A multiple unit rheostat comprising, a pair of coaxially related rheostat units having movable contact arms actuated by coaxially disposed shafts, a common handle supported by one of the shafts being rotatable relative thereto and movable axially thereof to a pair of different operating positions, operating means to connect the handle to one of the shafts in one operating position and to the other shaft in the other operating position including opposed clutch means on the shafts and a pin positioned transversely of the shafts and being operatively associated with the handle to prevent axial movement of the handle from one operating position to the other until the shafts are positioned in predetermined angular relation to each other, stop means preventing rotation of the handle in one direction past a position in which the predetermined angular relation of the shafts occurs, and additional stop members preventing movement of the disconnected shaft from said position while the handle is connected to the other shaft.

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