

L. BRADLEY.
SPEED REGULATOR FOR ELECTRIC MOTORS.
APPLICATION FILED MAR. 3, 1913.

1,066,580.

Patented July 8, 1913.

3 SHEETS—SHEET 1.

Fig. 2.

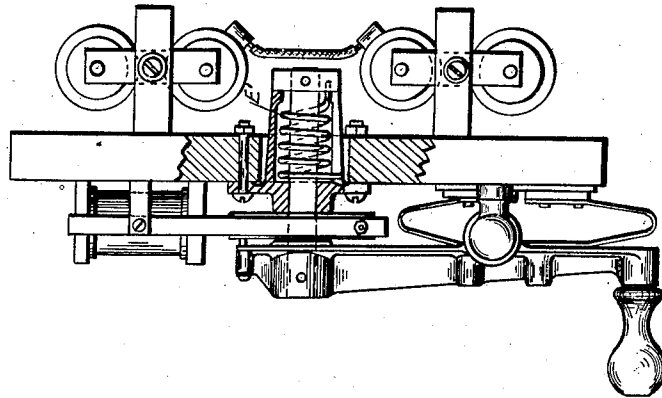
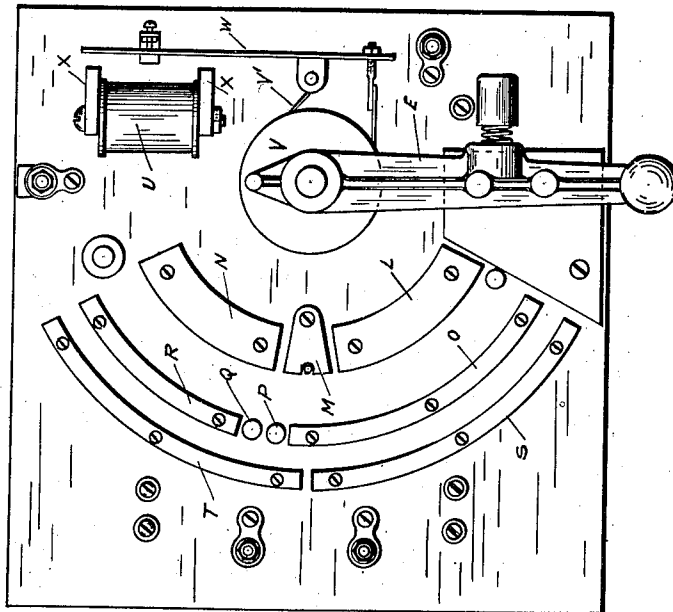


Fig. 1.



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3 SHEETS-SHEET 2.

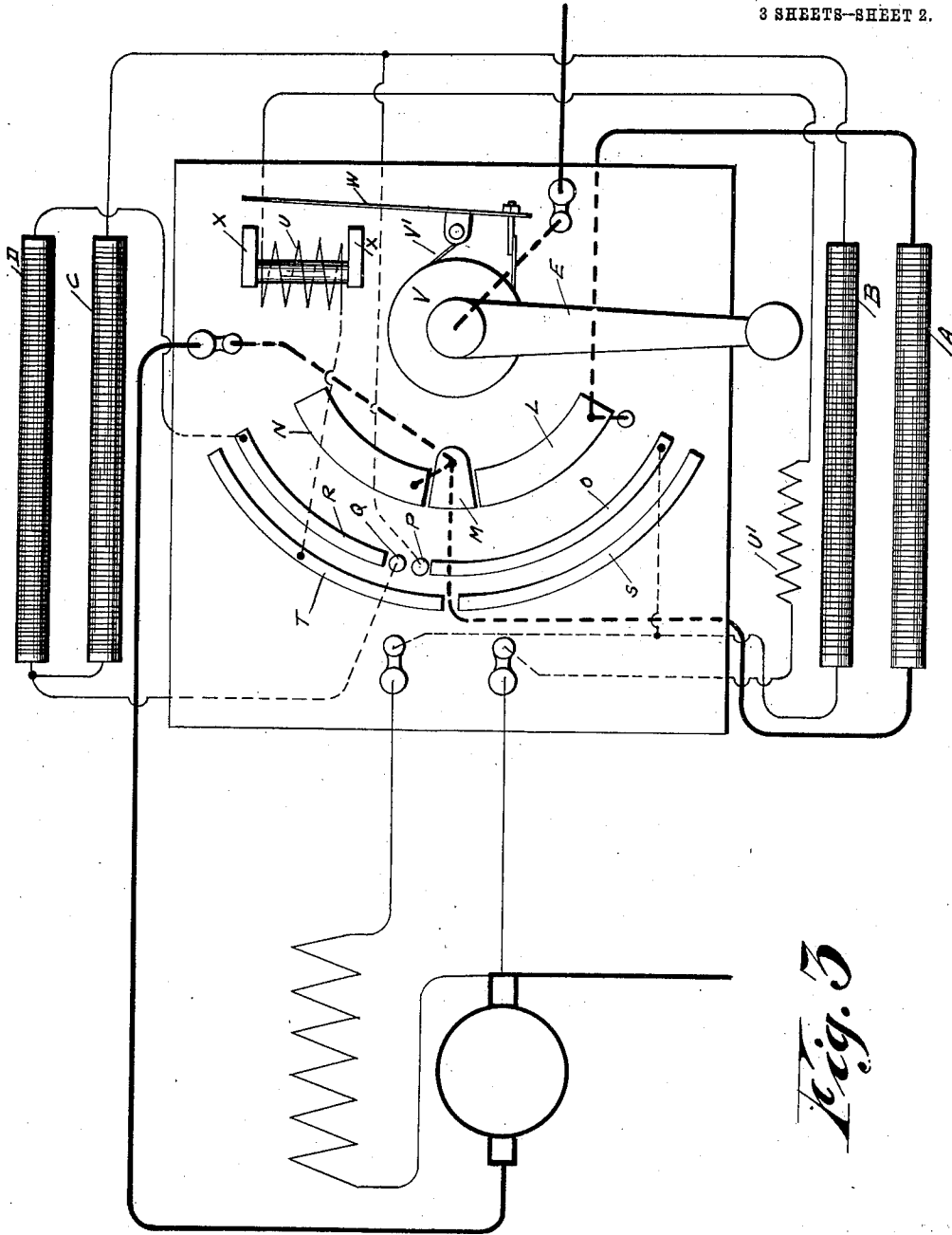


Fig. 3

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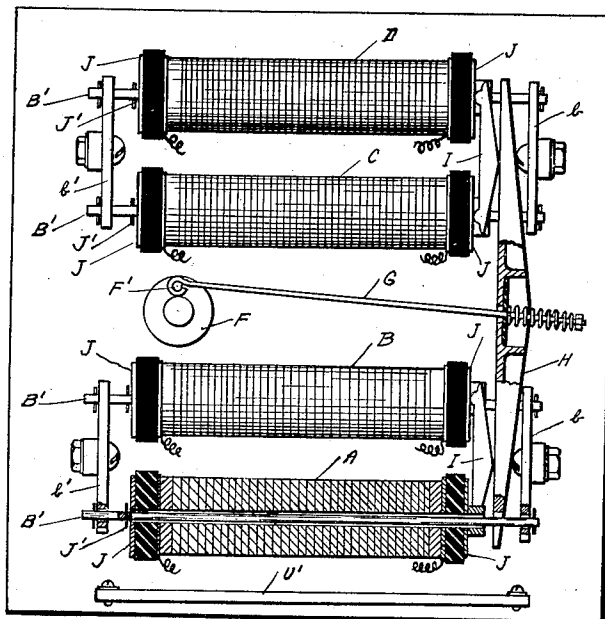
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Fig. 4



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UNITED STATES PATENT OFFICE.

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SPEED-REGULATOR FOR ELECTRIC MOTORS.

1,066,580.

Specification of Letters Patent.

Patented July 8, 1913.

Application filed March 3, 1913. Serial No. 751,973.

To all whom it may concern:

Be it known that I, LYNDE BRADLEY, a citizen of the United States, residing at Milwaukee, county of Milwaukee, and State of Wisconsin, have invented new and useful Improvements in Speed-Regulators for Electric Motors, of which the following is a specification.

The objects of my invention are to provide an improved motor starter having means for controlling both the armature and field circuits, not only by adding or subtracting resistance units to secure step by step variations, but by employing compressible resistance members or units which permit of gradual variations in the resistance of the individual members, whereby units at maximum compression and minimum resistance may be introduced into the field circuit of the motor and the compression subsequently reduced to gradually increase the resistance; also to provide means whereby the actuating member upon which such resistance variations depend, will be automatically retained (at least in one stage of its movement) at any point of manual adjustment during power (current) maintenance and returned either to the point of greatest compression when the current is interrupted, or past that point to position of cut out; also to provide means whereby the effect of a given adjustment upon the field is kept constant notwithstanding temperature variations in the units.

In the drawings Figure 1 is a front elevation of a compound speed regulator embodying my invention. Fig. 2 is a side view part in section with frame omitted. Fig. 3 is a diagram of the electrical connections. Fig. 4 is a rear elevation showing the resistance varying pressure columns.

Like parts are identified by the same reference characters throughout the several views.

The resistance members A, B, C and D consist of carbon columns similar to those shown and described in my former patent, Number 815317, dated March 13th, 1906.

In the present construction, the operating lever E, (Fig. 1), actuates crank disk F (Fig. 2), and the rotary movement of the crank F' is transmitted to apply a varying pressure upon the columns through link rod G, bar H and equalizer bars I, the latter having their end portions in bearing contact with end caps J. The lever E normally

occupies a substantially vertical position. As it swings upwardly to and past the horizontal position, it moves successively over contacts L, M and N of the armature circuit; also over segment O and contacts P, Q and R of the field circuit, and also over dead segment S to contact T of the circuit of the release magnet, presently described. A spring E' restores the lever to normal position when not otherwise held in another position of adjustment.

The current is introduced through the lever E. When the lever connects with contact segment L, the armature circuit is from lever to segment L through armature resistance column, (assumed to be column A in Fig. 3), armature, and from armature to line. The field circuit is simultaneously established from lever to segment O, thence directly to field and to line. As lever E moves upwardly, the pressure upon the carbon columns is gradually increased as crank F' swings to line of centers, whereupon the pressure is at maximum. Meanwhile lever E moves from segment L to contact M to short circuit armature resistance column A at maximum pressure and minimum resistance, the armature having by this time acquired speed. The continued movement of lever E then makes contact successively with contact buttons P and Q and contact segment R to successively introduce the resistance columns B, C and D into the field circuit while their resistance is substantially at minimum. A continued movement of lever E over segment R will then progressively increase the resistance in all three columns, since crank F' will have passed the line of centers from crank through the axis of crank disk rotation and the connection of rod G with bar H and the pull upon bar H will therefore be relieved as the crank moves in this direction.

Preparatory to switching in the initial field resistance by the movement of lever E to button P, the lever E moves from dead segment S to segment T, whereupon a circuit will be established from lever to segment T, thence to no voltage release coil U and to the line through resistance U'. The lever is provided with a drum V, oscillating over its pivotal axis, and a band brake V' is bound upon this drum by an armature W which is attracted to the poles X of the release coil when the latter is energized. This sets the brake with sufficient

energy to hold lever E in any position of adjustment along segment T, against the tension of spring E'. But in case of an interruption of the current, spring E' operates to immediately restore lever E to normal position.

It will be observed that the no voltage release coil is operative only after lever E has moved to segment T. Prior to that time, if the lever is manually released, the spring E' will instantly restore it to normal. But when the armature resistance column is cut out and the field resistance switched in, the coil is effective to hold the lever at any desired point of adjustment, and the speed of the motor can be very accurately controlled by merely varying the pressure upon the columns without introducing additional units. This statement, however, assumes that the resistance of the columns A, B, C and D will be uniform in any given position of lever adjustment, and it is therefore necessary to take into account the heat generated in the columns themselves, whereby there is a tendency to decrease the resistance automatically after the lever has been brought to the desired position of adjustment. The cap J at one end of each column opposite the end at which the lever pressure is applied, is caused to bear against a stop J' carried by a rod B' which extends through the column and connects with a fixed abutment b. The unconnected ends of the rods B' beyond the stops J' are provided with suitable guide bearings at b'.

The rods B' are electrically insulated from the disks or other members composing the columns. They are formed of a material which expands when heated, and since these rods are exposed to the heat electrically generated in the columns, it is obvious that as the heat increases, the rods will lengthen. The extent to which the rods will lengthen with each added degree of heat depends upon the character of the material employed, and by using proper alloys, it is possible to provide rods which will expand and reduce the pressure upon the columns in such proportion to the increased heat that the resistance of said columns will remain substantially constant. The decrease in electrical resistance of each column, due to heat, will thus be compensated by an increased electrical resistance therein due to a reduction in pressure by the lengthening of the rod B'. It is therefore possible to adjust the controller lever E for a desired speed immediately after starting the motor, and no further manual adjustments are required in order to maintain such speed.

The apparatus above described may be termed a compound speed regulator. In one stage of operation of this regulator, a variable armature resistance is secured by varying the pressure upon a resistance column,

the pressure being relieved and the resistance raised to maximum automatically whenever the lever employed for effecting the compression is released. In the other stage, the pressure upon the columns starts at maximum with the armature resistance column cut out and the field resistance column switched in. In this stage the actuating member starts at maximum compression and minimum resistance, and moves against the tension of its own retracting spring in a direction to reduce the pressure and increase the resistance in the field circuit, and so far as this stage of operation is concerned, the compression means is held at any desired stage of compression so long as the release magnet is energized, and swings automatically to the point of greatest compression when released by said magnet. The fact that the operating lever or compressing means moves past the point of greatest compression to its normal position with the compression reduced, is of no importance so far as the field circuit is concerned since the resistance in the field circuit is wholly cut out when the lever passes said point of greatest compression on its return to normal.

I claim—

1. The combination with an electric motor, of means for introducing a compressible resistance column into the circuit of the motor field under high compression and subsequently gradually reducing said compression.

2. The combination with an electric motor, of a set of compressible resistance units, an actuator movable from a position of initial low compression through a stage of high compression to a final stage of low compression of said units, and switch mechanism for connecting one of said units in the armature circuit of the motor during the initial stage of low compression, and also adapted to cut out such unit and connect units successively into the field circuit of the motor during the stage of high compression.

3. The combination with an electric motor, of a set of compressible resistance units, an actuator movable from a position of initial low compression through a stage of high compression to a final stage of low compression of said units, and switch mechanism for connecting one of said units in the armature circuit of the motor during the initial stage of low compression, and also adapted to cut out such unit and connect units successively into the field circuit of the motor during the stage of high compression, each of said units having a thermally expansible member and means for utilizing the expansion and retraction of said member to vary the pressure upon such unit, said member being composed of a material adapted by its expansion and contraction to offset the effect

of various temperatures upon the conductivity of the unit.

4. In combination with an electric motor having a field and an armature, a compressible resistance medium in series with said field, means for varying the pressure on said resistance medium, a release magnet adapted to hold said compression means at any stage of its action, and means for moving said compression means to its position of greatest compression when released by said magnet and then cutting out the resistance medium from said field.

5. In an electric current controller, the combination of a compressible resistance medium and means for varying the pressure on said medium, an electromagnet adapted to resist the action of said compression means when said electromagnet is energized.

6. In an electric current controller, the combination of a compressible resistance medium and means for varying the pressure on said medium, an electromagnet adapted to resist the action of said compression means when said electromagnet is energized, and means for switching the resistance medium into circuit with the field of an electric motor at the stage of greatest pressure and subsequently reducing said pressure with the resistance medium in circuit with said field.

7. In an electric current controller, the combination of a compressible resistance medium and means for varying the pressure on said medium, an electromagnet adapted to resist the action of said compression means when said electromagnet is energized, means for switching the resistance medium into circuit with the field of an electric motor at the stage of greatest pressure and subsequently reducing said pressure with the resistance medium in circuit with said field, and means for cutting out said magnet and also the resistance in sequence in case the current is interrupted.

8. In an electric current controller, the combination of a compressible resistance medium, means for varying the pressure on said medium, a release magnet adapted to retard the action of said pressure means during one stage of its movement, and means adapted to return said compression means to its initial position when released by said magnet.

9. In an electric current controller, the combination with a set of compressible resistance columns, a motor having an armature adapted to be connected in circuit with one of the columns, and its field adapted to be connected in circuit with another of said columns, a lever for applying pressure to the columns, a magnetic brake controlling said lever in one stage of its movement, and means for utilizing the lever to set said magnetic brake, said lever being arranged to

move in either direction through a stage of increasing compression to a stage of decreasing compression, whereby the resistance of said columns may be decreased to a connecting and disconnecting point and subsequently increased.

10. In combination with an electrical circuit, a set of compressible resistance columns, a movable actuating member for connecting and disconnecting said columns in said circuit at the stage of greatest pressure, said actuating member being adapted to move through a stage of decreasing compression at both sides of the stage of greatest pressure, means for automatically restoring the actuating member to normal position, and a magnetic brake adapted, when energized, to prevent the operation of the restoring means during one of said stages.

11. In combination with an electrical circuit, a set of compressible resistance columns, a movable actuating member for connecting and disconnecting said columns in said circuit at the stage of greatest pressure, said actuating member being adapted to move through a stage of decreasing compression at both sides of the stage of greatest pressure, means for automatically restoring the actuating member to normal position, and a magnetic brake adapted, when energized, to prevent the operation of the restoring means during one of said stages, together with means for automatically varying the pressure upon said columns in accordance with variations in temperature and in such proportions as to maintain a constant electrical resistance for any given position of the actuating member.

12. In combination with an electric motor having a field and an armature, a compressible resistance medium in series with said field, means for varying the resistance by varying the pressure on said resistance medium, a release mechanism adapted to hold said compression means at any stage of its action, and means for returning said compressing means in the direction of increased compression when released by said mechanism.

13. In combination with an electric motor having a field and an armature, a compressible resistance medium in series with said field, means for varying the resistance by varying the pressure on said resistance medium, a release mechanism adapted to hold said compression means at any stage of its action, and means for returning said compressing means in the direction of increased compression when released by said mechanism, together with means for maintaining a constant electrical resistance in said medium under varying temperatures thereof.

14. In combination with an electric motor having a field and an armature, a compressible resistance medium in series with said

field, means for varying the pressure on said resistance medium, a release magnet adapted to hold said compression means at any stage of its action, and means for moving
5 said compression means to its position of greatest compression when released by said magnet.

15. In combination with an electric motor, a compressible resistance medium in series
10 with the field of said motor, means for varying the resistance by varying the pressure on said resistance medium, and means for moving said compressing means in the direction of increased compression during the initial
15 part of its movement toward normal position.

16. In combination with an electric motor, a compressible resistance medium in series with the field of said motor, means for manually varying the resistance by varying
20 the pressure on said resistance medium, and thermo means for automatically regulating said pressure in accordance with the temperature of said medium to secure a constant resistance regardless of temperature changes
25 in any given position of manual adjustment.

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

LYNDE BRADLEY.

Witnesses:

LEVERETT C. WHEELER,
IRMA D. BREMER.