

**No. 624,719.**

Patented May 9, 1899.

**T. VON ZWEIGBERGK.**  
**CONTROLLER.**

(Application filed Feb. 20, 1899.)

(No Model.)

**2. Sheets—Sheet 1.**

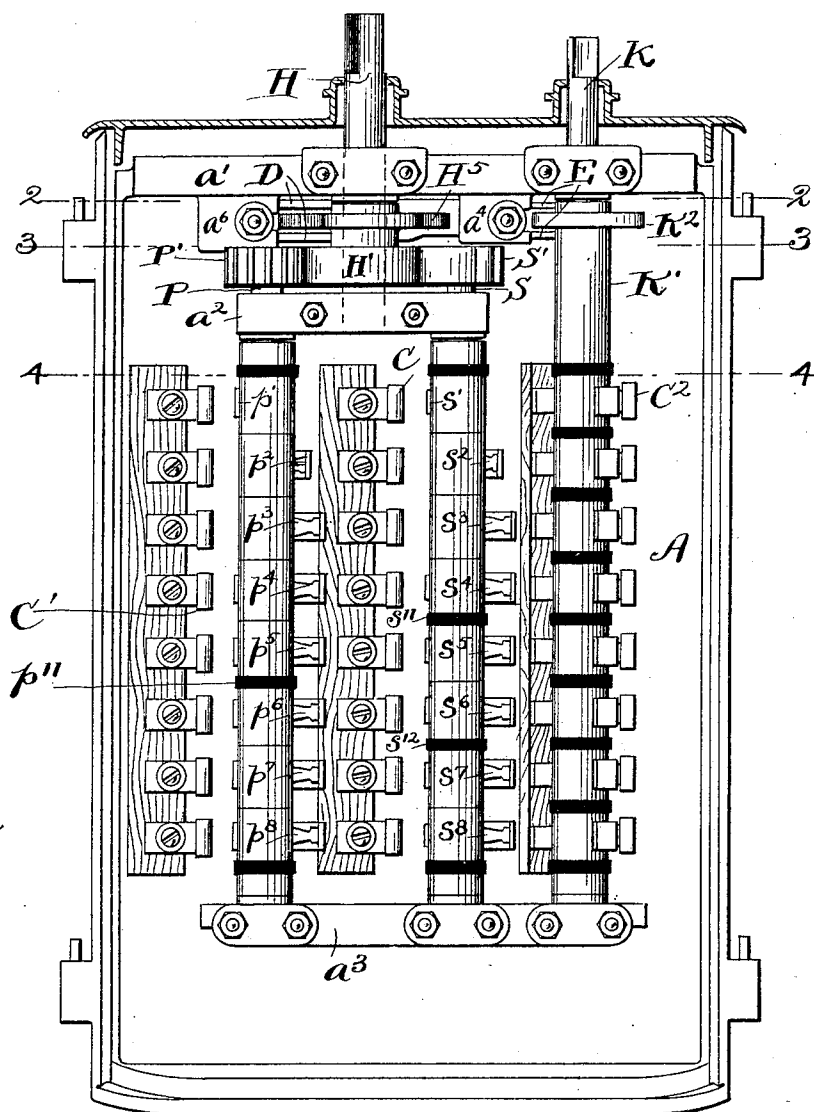
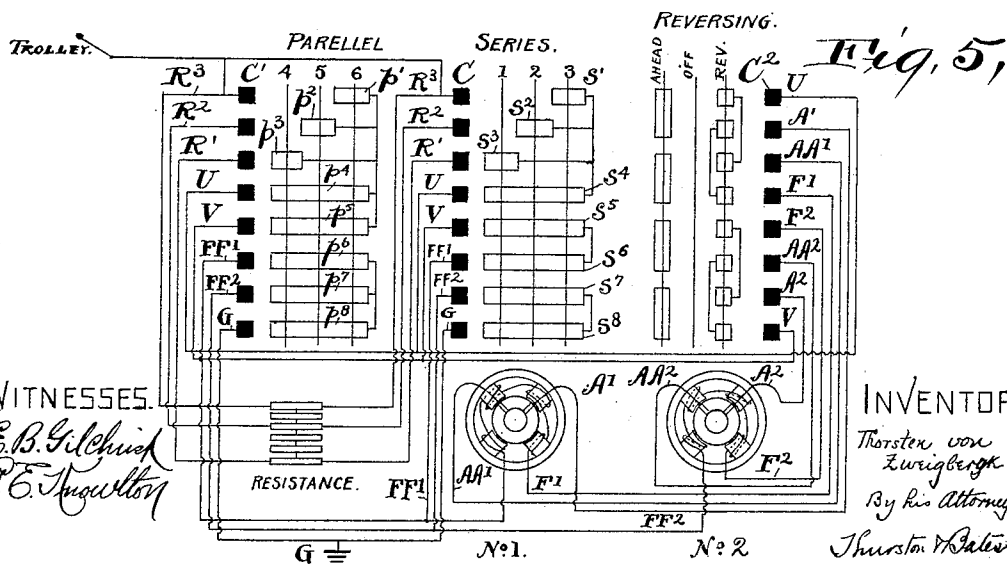
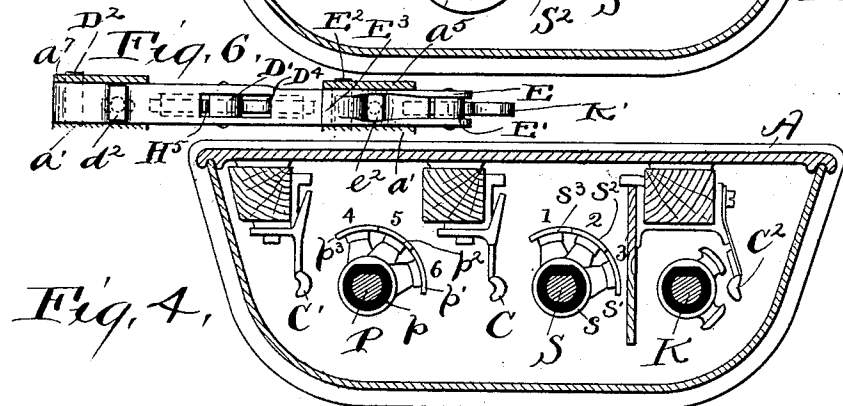
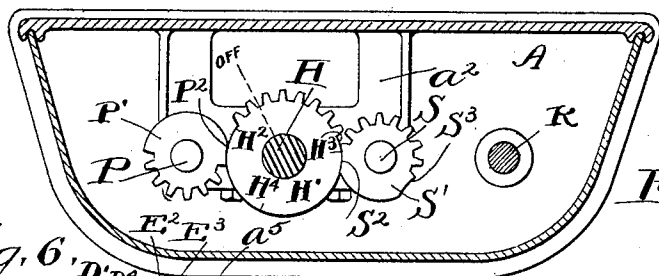
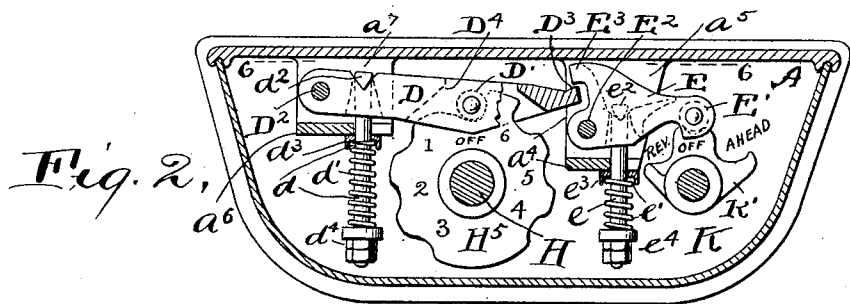


Fig. 1.

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# UNITED STATES PATENT OFFICE.

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## CONTROLLER.

SPECIFICATION forming part of Letters Patent No. 624,719, dated May 9, 1899.

Application filed February 20, 1899. Serial No. 706,240. (No model.)

*To all whom it may concern:*

Be it known that I, THORSTEN VON ZWEIGBERGK, a subject of the King of Sweden and Norway, residing at Cleveland, in the county of Cuyahoga and State of Ohio, have invented a certain new and useful Improvement in Controllers, of which the following is a full, clear, and exact description, reference being had to the accompanying drawings.

My invention is for an efficient and novel form of controller adapted to govern motors by connecting them in series or parallel and cutting out resistance, its object being to segregate the controller-segments onto two separate shafts, a series and a parallel, adapted to be operated in succession by one lever or handle. Thus the disadvantages which have hitherto attended the construction of single-cylinder series parallel controllers are avoided.

The invention consists in part in the combination of a series rheostatic governing-cylinder, a parallel rheostatic governing-cylinder, an operating-lever, and a suitable connection between the lever and the two cylinders such that the movement of the lever may operate the two cylinders successively, either cylinder being locked out of use when the other is in use.

Another feature of my invention is a very simple and efficient interlocking mechanism between the governing part of the controller and the reversing-switch, which prevents the operation of the reversing-switch when the current is on and the operation of the governing-cylinders when the reversing-switch is at the off position.

The specific form of my controller shown in the drawings, which is the best embodiment at present known to me, is also of my invention.

In the drawings, Figure 1 is a front elevation, partly sectional, of my controller, the front casing and the operating-handles being removed. Figs. 2, 3, and 4 are horizontal sections of the controller, taken on the lines 2-2, 3-3, and 4-4, respectively, of Fig. 1. Fig. 5 is a diagram illustrating the connections and electrical operation of the controller; and Fig. 6 is a rear elevation of the interlocking mechanism between the reversing-switch and the governing part of the controller, being a

vertical section on the line 6-6 of Fig. 2 looking toward the front of the controller.

Referring to the parts by letters, A represents the frame of the controller. Projecting forward from the back of this frame are the webs  $a^1$   $a^2$   $a^3$ , which, with suitable cap-plates secured to them, constitute the bearings for the different shafts of the controller. The series cylinder and the parallel cylinder are constructed exactly alike, except in the electrical grouping of the contact-segments caused by interposed insulating-washers between hubs of consecutive segments.

S represents the shaft of the series cylinder, and P that of the parallel cylinder, each of these shafts being journaled in the bearings  $a^2$   $a^3$ . Surrounding these shafts are insulating-sleeves  $s$   $p$ , around which are the hubs of the contact-segments  $s^1$  to  $s^8$  and  $p^1$  to  $p^8$ . On the series cylinder the segments  $s^1$  to  $s^4$  are electrically connected together in one group, the segments  $s^5$  and  $s^6$  in another group, and the segments  $s^7$  and  $s^8$  in the third group, the separation being caused by the interposed insulating-washers  $s^{11}$  and  $s^{12}$ . On the parallel cylinder the segments  $p^1$  to  $p^5$  are electrically connected into one group and the remaining segments into a second group, the two groups being separated by the insulating-washer  $p^{11}$ .

Secured to the upper ends of the shafts S and P are the gears S' and P', which mesh with the gear H' on a shaft H, which is journaled in the bearings  $a^1$  and  $a^2$ , and has at its upper end a definitive shape which the operating-lever is adapted to engage. The gears H', S', and P' are constructed in a peculiar shape to attain the desired result, which is that the rotation of the gear H' from the off position shall first rotate the gear S' and then become disengaged from that gear and rotate the gear P', the gears S' and P' each remaining locked when the other is moved.

I accomplish the above result in the following manner: The gear-teeth on the gears P' and S' extend only part way around the circumference, preferably about half-way, and the gear H', which is of larger diameter than the other two, has only sufficient gear-teeth to engage with the teeth on either of the other gears. Beyond the gear-teeth on the gear H' that gear continues its periphery H<sup>4</sup> smoothly

and (except at  $H^2$  and  $H^3$ , near the end of the gear-teeth, where the radius is less) concentrically, and the surfaces of the gears  $P'$  and  $S'$ , which are adapted to engage with such concentric surface of the gear  $H'$ , is concaved, as shown at  $P^2$  and  $S^2$  and  $S^3$ . As these surfaces are adapted to fit snugly against the smooth surface  $H^4$  of the gear  $H'$ , the gears  $P'$  and  $S'$  thereby become locked.

Fig. 3 shows the parts in the off position, the position of the operating-handle being indicated by the broken center line. As that handle is moved in a right-hand direction the teeth on the gear  $H'$  mesh with the teeth on the gear  $S'$ , and the surface  $H^3$  of decreasing radius releases the gear  $S'$ , and the rotation following brings the segments carried by the series cylinder into engagement with the contact-fingers, which are electrically connected with the motors, resistance, and reversing-switch.

In the form shown in the drawings three series positions are provided, which couple the motors in series with the whole resistance, with a part of the resistance, and without any resistance, respectively. These positions are numbered 1, 2, and 3 in the diagram. The right-hand rotation of the operating-handle after the third position is reached causes the series cylinder to pass out of contact entirely with the contact-fingers  $C$ , and thereafter the surface  $S^3$  comes into engagement with the smooth surface  $H^4$  of the gear  $H'$ , (the surfaces  $H^2$  allowing it to pass,) and the gear  $S'$  becomes locked. Thereafter the teeth of the gear  $H'$  mesh with the teeth of the gear  $P'$ , and a continued rotation turns the parallel cylinder through the positions shown in the diagram as 4, 5, and 6, connecting the motors in parallel with the whole resistance, with part of the resistance, and without any resistance, respectively, the contact-segments on the parallel cylinder engaging with the contact-fingers  $C'$ , which are connected in the same manner as the contact-fingers  $C$ . When the current is to be shut off, the operating-handle is moved in the left-hand direction and the gear  $P'$  is rotated back about half a rotation until the surface  $P^2$  engages with the concentric surface  $H^4$  of the gear  $H'$  and becomes locked, and thereafter the teeth on the gear  $H'$  engage with the teeth on the gear  $S'$  and rotate it back into the position shown in Fig. 3, in this position both cylinders being locked.

$K$  represents the shaft of the reversing-switch, which is journaled in the bearings  $a'$   $a^3$  and carries a series of segments, one longitudinal row of which is individually insulated and alternately connected, the other row of which overhangs the hubs of consecutive segments without contacting with them. This construction is a usual one for reversing-switches and operates to establish the connections between the armatures and fields of the motors in either of two directions, accord-

ing to which longitudinal row of segments is in contact with the contact-fingers  $C^2$ .

Secured to the shaft  $K$ , preferably by being formed integral with a sleeve  $K'$ , surrounding the shaft, is a notched indicator-plate  $K^2$ , which is adapted to normally hold the shaft in its off, ahead, or reverse positions by reason of the roller  $E'$ , carried by the lever  $E$  and engaging with notches in the indicator-plate. This roller is drawn toward the plate by the rod  $e$ , at the rear end of which is formed a "knife-edge" head  $e^2$ , which stands within a recess  $E^5$  in the rear side of the lever and engages with the front wall of the recess. The spring  $e'$  surrounds the rod  $e$  and bears at its inner end against a washer  $e^3$ , which lies against the front side of a web  $a^4$ , integral with the web  $a'$  and extending downward therefrom. The force of the spring  $e'$  is adjusted by the nuts  $e^4$ , screwing onto the front end of the rod  $e$ . The web  $a^4$  is integral at its lower end with the web  $a^5$ , which extends horizontally backward and joins the back plate of the frame. The pin  $E^2$ , on which the lever  $E$  is journaled, takes into the two horizontal webs  $a'$  and  $a^5$ .

Secured to the shaft  $H$  is the indicator-wheel  $H^5$ , taking into an opening  $D^4$  in the lever  $D$ , and engaging with the roller  $D'$ , carried by that lever. This lever is journaled on the pin  $D^2$ , carried by the horizontal webs  $a'$  and  $a^7$ , and is drawn toward the indicator-wheel by a spring  $d'$ , surrounding and giving a thrust to rod  $d$ , which has on its rear end knife-edges  $d^2$ , engaging the lever  $D$ , the spring  $d'$  being adjustably confined between the washer  $d^3$  against the front of the web  $a^6$  and the nuts  $d^4$ . The lever  $D$  has at its extreme end toward the lever  $E$  a toe  $D^3$ , which when the parts are in the off position stands in front of a toe  $E^3$  on the lever  $E$ . In this position the operating-handle on the shaft  $H$  cannot be moved, for the increasing radius of the detent-wheel  $H^5$  must force the lever  $D$  rearward, and its toe  $D^3$ , engaging with the toe  $E^3$ , prevents this. When, however, the reversing-switch is thrown to either the ahead or the reverse position, the roller  $E'$  comes into a notch in the indicator-plate  $K'$  of less radius, and the toe  $E^3$  thus moves away from the toe  $D^3$  sufficiently to clear it. Now if the current is turned on by the rotation of the shaft  $H$  the lever  $D$  is moved rearward, and the toe  $D^3$  comes opposite the end of the toe  $E^3$ , and thus standing in the path of that toe prevents the movement of the lever  $E$ , and hence the rotation of the reversing-switch. It will thus be seen that the same levers which carry the rollers for the indicator-wheels also constitute this interlocking mechanism, which is a very simple, cheap, and satisfactory arrangement.

The electrical operation of the controller need not be specifically described, but will be apparent from Fig. 5, wherein  $R^3$   $R^2$   $R'$  represent the lines to the governing resistance;

U and V, lines from the governing-cylinders to the reversing-switch; F F' and F F<sup>2</sup>, lines from the field of the first and second motors, respectively, to the governing-cylinders; G, the line to the ground, and A', A A', F F<sup>2</sup>, A A<sup>2</sup>, and A<sup>2</sup>, the lines from the reversing-switch to the armature and field of the two motors. The connection of the contact-fingers C and C' are exactly the same, and those of the contact-fingers C<sup>2</sup> are a usual arrangement for reversing-switches.

Having described my invention, I claim—

1. In a controller, in combination, two governing-cylinders, one adapted to couple motors in series, the other adapted to couple motors in parallel, an operating-lever, and a suitable connection between the lever and the two cylinders such that the movement of the lever in one direction from the off position may operate the cylinders successively, substantially as described.

2. In a controller, in combination, two governing-cylinders, one adapted to couple motors in series the other adapted to couple motors in parallel, an operating-lever, and a suitable connection between the lever and the two cylinders such that the movement of the lever may operate the cylinders successively, and means for locking either cylinder when the other is at an operative position and for locking both cylinders when they are both off, substantially as described.

3. In a controller, in combination, a series rheostatic cylinder, a parallel rheostatic cylinder, an operating-shaft, a gear on said shaft, gears on the cylinders with which the gear on the shaft may mesh, there being means for causing the disengagement of the gear on the shaft from that on the series cylinder, and the engagement with that on the parallel cylinder in the movement from the series to the parallel positions, substantially as described.

4. In a controller, in combination, a series cylinder, and a parallel cylinder, each having a segment of a gear secured to it, an operating-shaft, a segment of a gear secured to it, the teeth on the last-mentioned gear engaging in the movement from off position first with the teeth on the gear of the series cylinder and by movement in the same direction after passing out of engagement therewith engaging with the teeth on the gear of the parallel cylinder, substantially as described.

5. In a controller, in combination, a series cylinder, and a parallel cylinder, gears S' and P' secured thereto, an operating-shaft H, a gear H' secured thereto, said gear H' having teeth for but a portion of its circumference, each of the gears S' and P' having a surface which is adapted to engage with the surface of the gear H' beyond the teeth thereon and be locked by such engagement, substantially as described.

6. In a controller, the gear H' having teeth for a portion of its periphery and having a concentric smooth surface H<sup>4</sup> beyond said teeth and surfaces H<sup>2</sup> and H<sup>3</sup> of smaller radius near the ends of the gear-teeth, the two gears P' and S' having teeth which are adapted to engage successively with the teeth on the gear H', said gear S' having two concave surfaces S<sup>2</sup> S<sup>3</sup> at either extremity of its teeth which are adapted to engage with the concentric surface H<sup>4</sup> and lock the gear S' in either of two positions, and the gear P' having the surface P<sup>2</sup> which is adapted to engage with the surface H<sup>4</sup> and lock the gear P' when the gear S' is locked in one of its positions, in combination with means for rotating the gear H', and controlling-cylinders adapted to be rotated by the gears S' and P', substantially as described.

7. In a controller, a shaft H adapted to operate a governing-controller, a notched indicator-plate H<sup>5</sup> secured to said shaft, a lever D, a roller D' carried by said lever, a spring drawing said roller toward the indicator-plate, in combination with a shaft K adapted to operate the reversing-switch, an indicator-plate K' carried thereby, a lever E, a roller E' carried by said lever and adapted to engage with the indicator-plate K', said lever E having a toe E<sup>3</sup> which when the reversing-switch is at the off position stands behind and prevents the movement of a lever D, the end of the lever D when the lever E allows it movement being moved by the indicator-plate H<sup>5</sup> when turned to an operative position, opposite the end of the toe E<sup>3</sup> and in the path thereof, whereby the reversing-switch is locked, substantially as described.

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

THORSTEN VON ZWEIFBERGK.

Witnesses:

ALBERT H. BATES,

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