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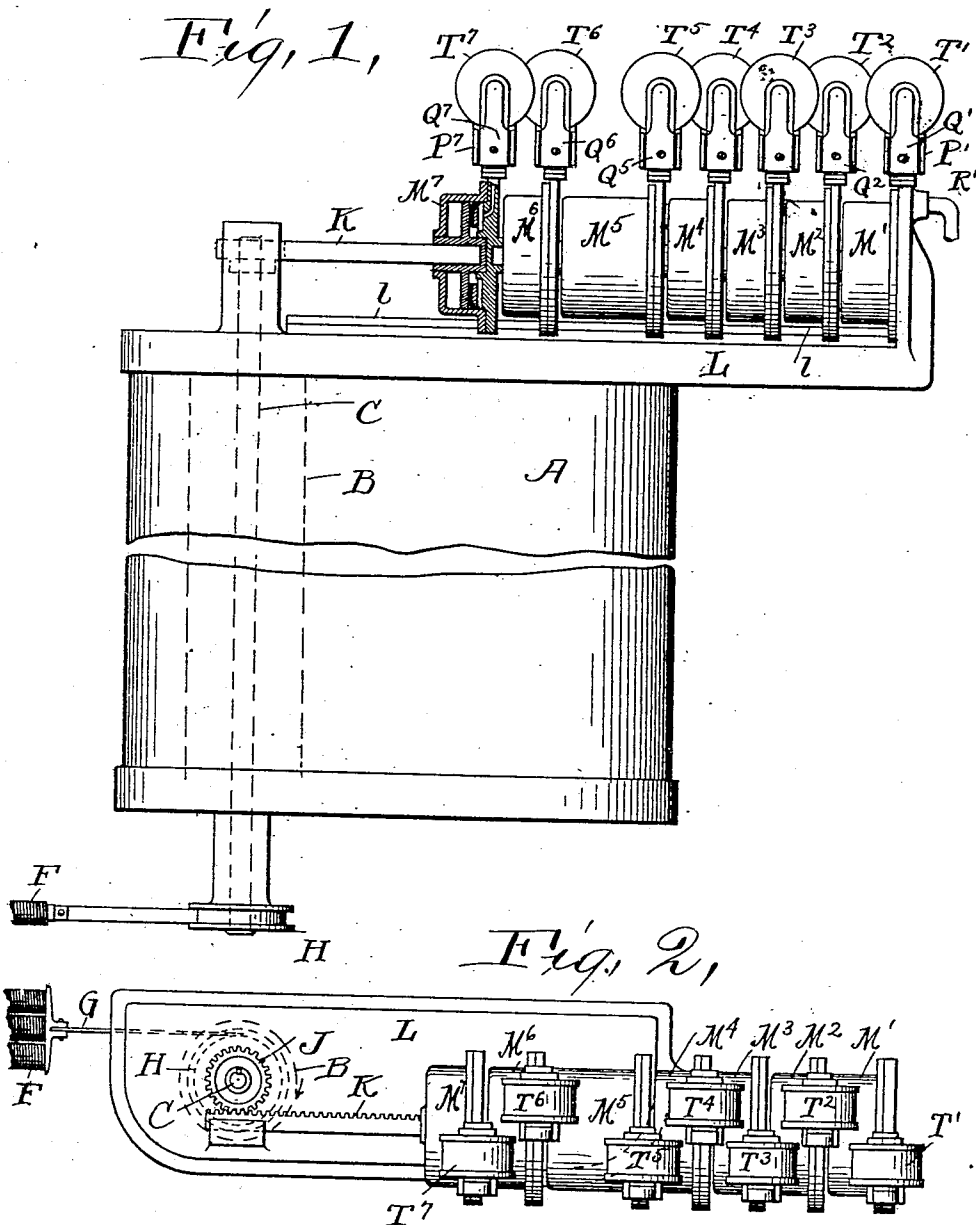
Patented Jan. 21, 1902.

T. VON ZWEIFBERGK.
CONTROLLING SYSTEM.

(Application filed July 8, 1901.)

(No Model.)

4 Sheets—Sheet 1.



Witnesses.
E. B. Gilchrist
H. M. Kase

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Thorsten von Zweigbergk,
By his Attorneys,
Thorsten & Bates.

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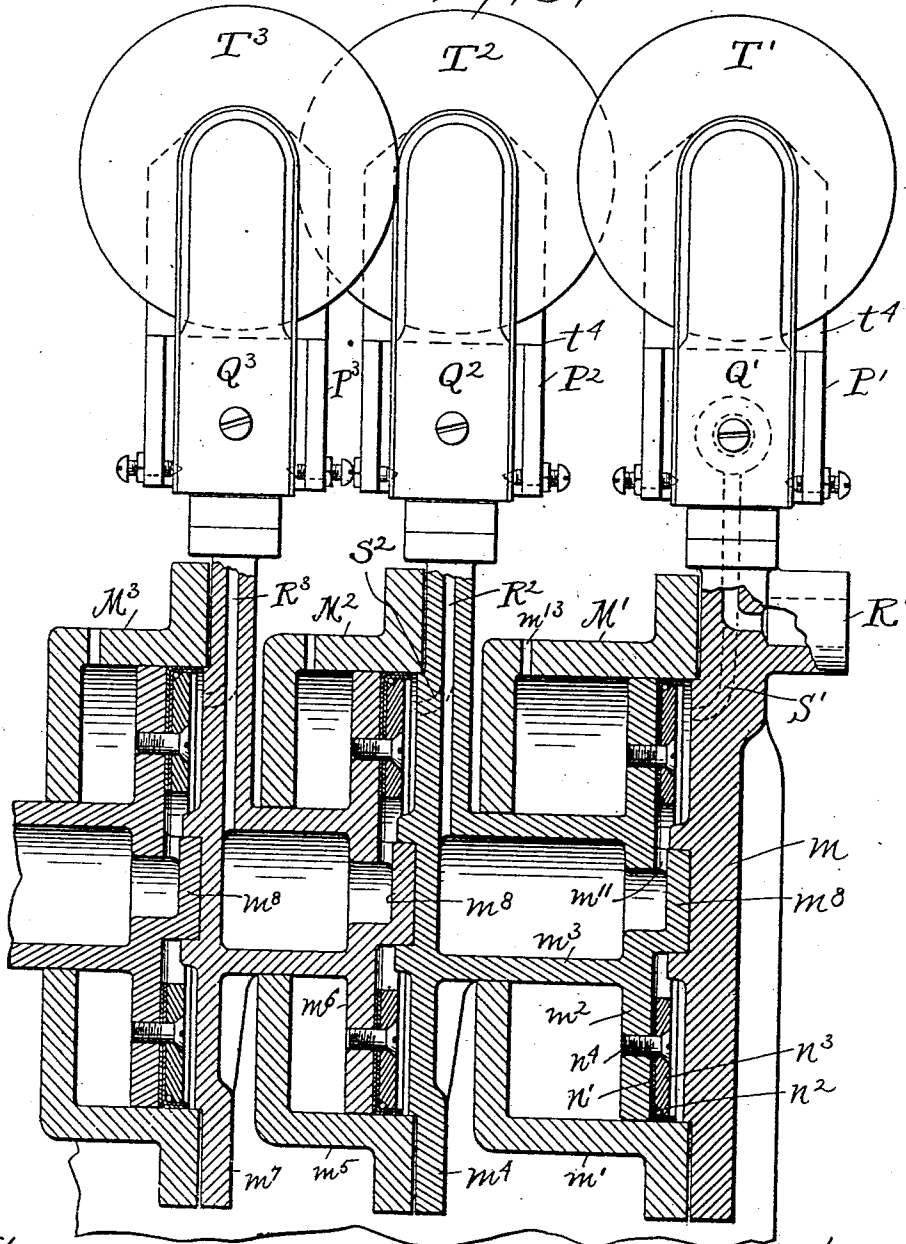
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4 Sheets—Sheet 2.

Fig. 3,



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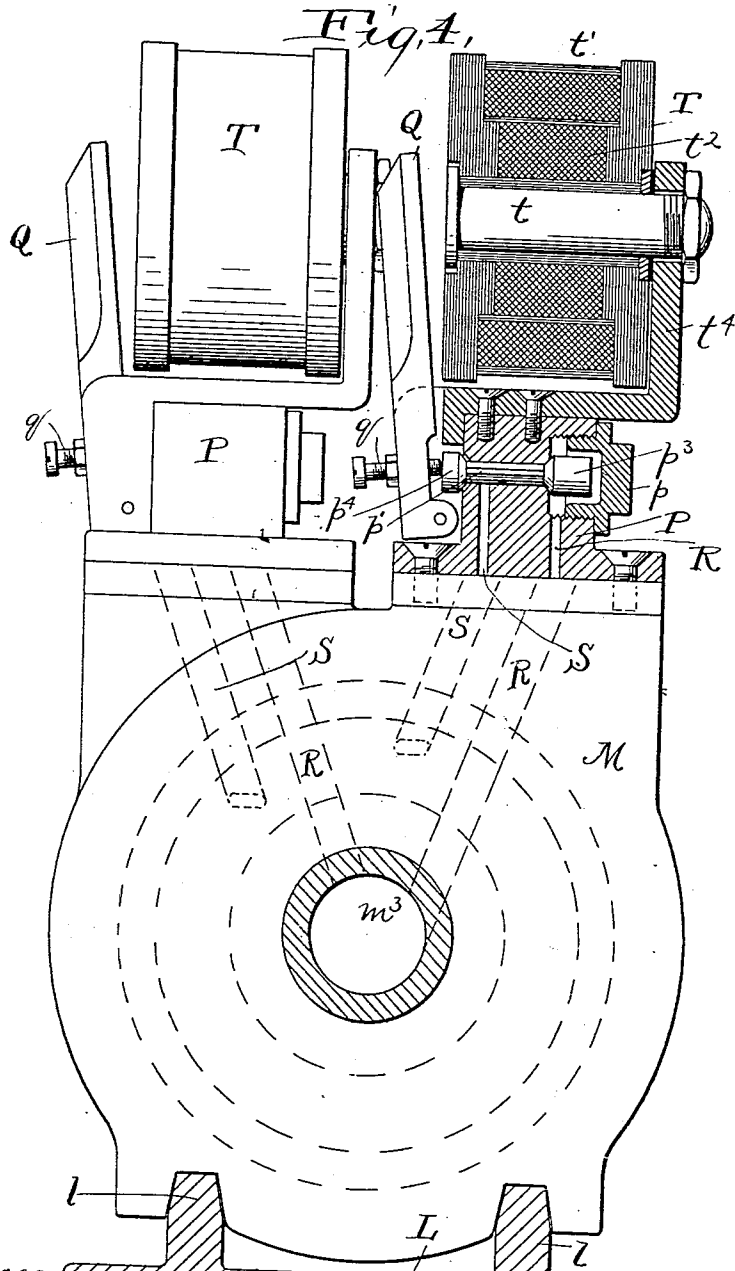
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4 Sheets—Sheet 3



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4 Sheets—Sheet 4.

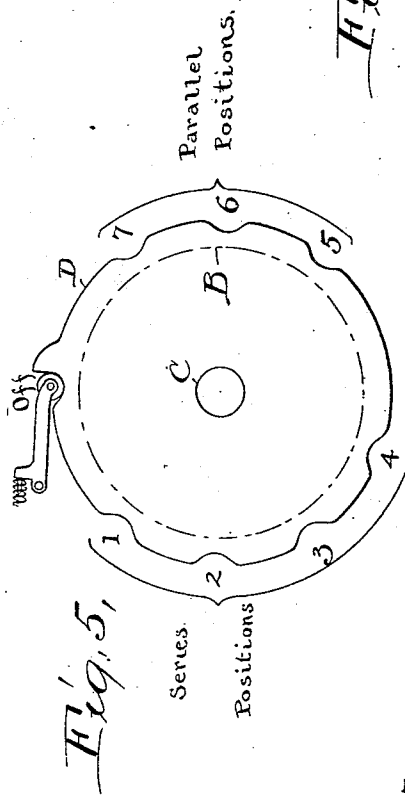
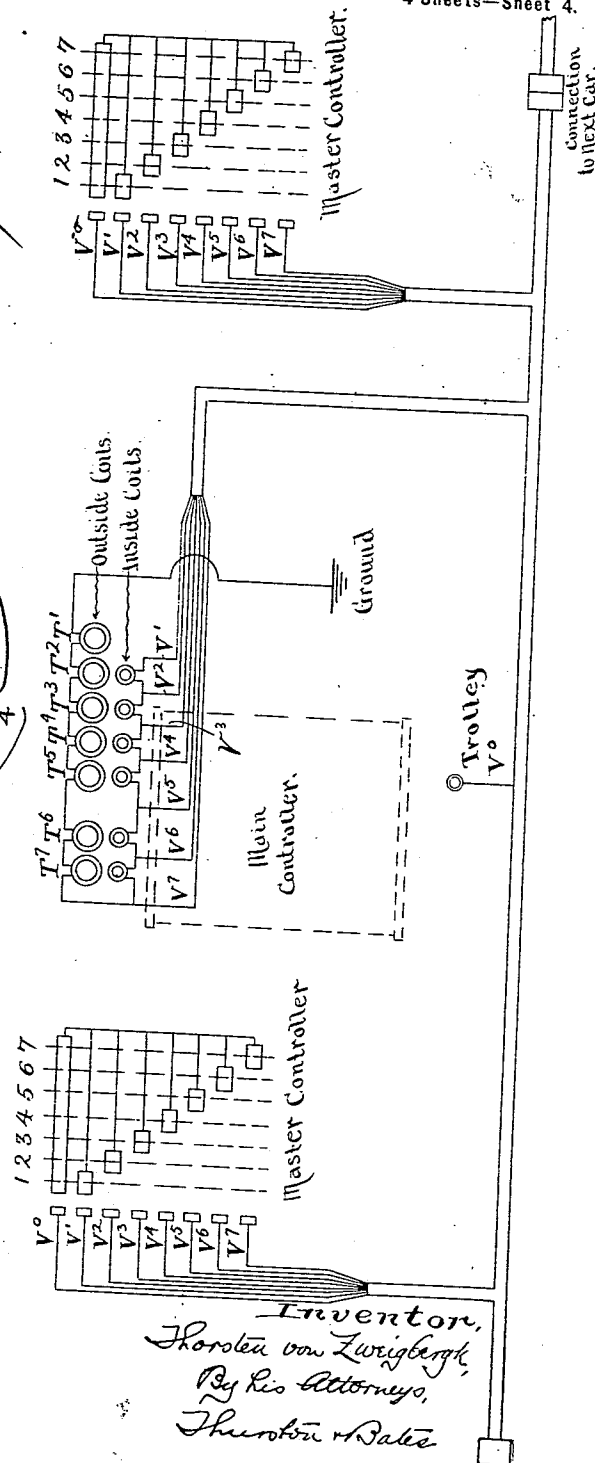


Fig. 6,



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UNITED STATES PATENT OFFICE.

THORSTEN VON ZWEIGBERGK, OF PRESTON, ENGLAND.

CONTROLLING SYSTEM.

SPECIFICATION forming part of Letters Patent No. 691,692, dated January 21, 1902.

Application filed July 8, 1901. Serial No. 67,418. (No model.)

To all whom it may concern:

Be it known that I, THORSTEN VON ZWEIGBERGK, a citizen of the United States, residing at Preston, in the county of Lancaster, England, have invented a certain new and useful Improvement in Controlling Systems, of which the following is a full, clear, and exact description, reference being had to the accompanying drawings.

10 The object of this invention is to provide simple and efficient mechanism for operating a controller by means of compressed air governed electrically by one or more master-controllers, the result being that the main controller, located where most convenient—on a train, for example—may be operated with very little manual power from the most desirable point or points.

15 To operate the necessary air-valves, I have provided a system of magnets so arranged and connected that their sluggishness is overcome, whereby they respond with the desired rapidity.

20 The invention consists of the means I employ to attain the above ends, broadly, and also more particularly as hereinafter described. It includes the arrangement of individual mechanisms, each adapted to move the controller one notch, and the movements aggregating to move the controller from notch to notch continuously, as desired. It includes the arrangement of the magnets, the valves and passages, and various features of construction, all of which will be definitely set out in the claims.

25 The drawings clearly illustrate my invention as applied to a main controller of suitable form. The controller box or casing is shown and the controller-barrel indicated diagrammatically.

30 Figure 1 is a side elevation of such controller-box having my operating mechanism. Fig. 2 is a plan of the same. Fig. 3 is an enlarged side elevation, partly in section, of a portion of my operating mechanism, the section plane being somewhat distorted and passing through the main air-passages. Fig. 4 is an end elevation, partly sectional, of the operating mechanism. Fig. 5 is a diagram illustrating the positions of the controller-barrel, and Fig. 6 a diagram illustrating the

wiring and connections of the magnets and the master-controllers.

In the reference-letters on the drawings it is to be noted that the capital letters with numeral exponents refer to the corresponding individuals of a series designated generically by the same letter without the exponent.

35 As shown in the drawings, A represents a usual controller box or casing, in which the main controller cylinder or barrel B is contained, mounted upon the rotatable shaft C. These parts may be of any proper construction.

40 Fig. 5 shows a usual indicator-wheel D rigid with this shaft and a spring-pressed roller engaging the same, this conventional representation illustrating the different movements of the controller which the mechanism shown is adapted to cause. It may be employed or not, as desired.

45 A spring F, connected by a strap G to a drum H on the lower end of the shaft C, brings the controller cylinder or barrel to the off position whenever so allowed by the air-controlled mechanism. At the upper end of the shaft C is a pinion J, engaged by a rack K. The air-cylinders operate to shove this rack to the left, rotating the controller-barrel as desired against the action of the spring F, which returns the barrel when the air-pressure is released.

50 There are a series of pneumatic mechanisms (generically designated M,) there being as many individuals in the series as there are active positions of the controller. Thus the drawings show seven mechanisms M' to M', corresponding to four series and three parallel positions of the controller. The first of these mechanisms M', at the extreme right, is rigid. All the others are adapted to be moved bodily. The piston of each cylinder is rigid with the body of the cylinder next to the left, so that when the cylinder at the extreme right is actuated it moves the other six cylinders a distance of one unit. When the next cylinder M' is actuated, it moves the remaining five cylinders one notch farther, and so on. The piston of the final cylinder is connected with the rack K, so that the controller-barrel is driven from notch to notch as the pistons are

successively actuated. The stroke of the pistons is proportional to the distance between the notches or stopping positions of the main controller.

5 Describing the air-cylinders and pistons more specifically, the first cylinder M^1 is rigid with the frame of the mechanism, which, as shown, is also the top plate L of the controller-box. This cylinder is composed of the
10 vertical plate m , rising from the plate L , and the cylindrical hood m' , secured thereto. Slidable within the cylindrical interior of the hood is the piston m^2 , which has the hollow rigid piston-rod m^3 . Rigid with the outer end
15 of this piston-rod is the plate m^4 , which forms the back of the cylinder M^2 and with the hood m^3 constitutes that cylinder. The piston m^6 of this cylinder is rigidly connected with the plate m^7 , constituting the back of the cylinder M^3 , and so on. All of the cylinders except the first one, M^1 , are guided to slide on
20 suitable rails l , rigid with the frame of the mechanism. The pistons are properly packed by suitable means, that shown being a flexible packing n^1 , backed by a wire ring n^2 and an annular clamping-plate n^3 , held to the pistons by screws n^4 . A central boss m^5 , extending rearward from each piston, normally engages the face of the cylinder-back, preventing lost motion. Associated with each
30 cylinder is a valve box or casing $P, P',$ to P^7 , within which is a valve, about to be described, adapted to govern communication between the passages to or from the corresponding cylinder. In the first cylinder one of these passages R^1 leads from the main air-supply to the valve-box P^1 and the other, S^1 , leads to the cylinder M^1 . The chamber on the rear side of the piston m^2 is connected by a passage-way m'' with the interior of the piston-rod
40 m^3 , and from this interior leads the passage R^2 within the plate m^4 to the second valve-box P^2 . From this valve-box a passage S^2 leads to the interior of the second cylinder M^2 , the passage R^3 leads from this cylinder to the next valve-box, and so on. Now if the passages R^1 and S^1 are coupled together by the valve air is admitted from the main supply to the rear side of piston m^2 and all the cylinders
50 M^2 to M^7 are moved to the left a distance equal to the stroke of the piston m^2 , and this through the rack K rotates the controller-barrel from the off position to position No. 1. Thereafter if the valve in the box P^2 is also opened the air passes from the passage-way R^2 to the passage-way S^2 and drives the piston m^6 to the left. This shoves all the cylinders M^3 to M^7 , inclusive, to the left one notch, further rotating the controller-barrel to position No. 2, and so on. It will thus be seen that if an air-pressure is maintained in the passage-way R^1 it is simply necessary to open the valves in the boxes $P^1, P^2,$ &c., successively and maintain them open to rotate the
65 controller-barrel through its successive steps. Suitable vents m^{13} in the various cylinders prevent any back pressure on the front side

of the pistons. By having each movable cylinder receive its air from the preceding cylinder the necessity of a flexible air-hose to
70 each cylinder is obviated, and the main air connection at R^1 may be rigid.

The valves and passages in the boxes P are arranged so that when they close the pipes $R^1, R^2,$ &c., they open the exit-pipes $S^1,$ &c.,
75 to the atmosphere, whereby, with the controller in any operative position, if the valves are moved to their normal position the admission of compressed air is shut off and the entrained air is allowed to escape and the spring
80 F brings the controller-barrel toward the off position, returning the corresponding cylinders accordingly.

The valves which control the above-described operation are best shown in Fig. 4,
85 where the valve-boxes P will be seen to be castings, having the passages R and S connected through a cross passage-way, which is occupied, though not filled, by the valve-stem
90 p^1 . On opposite ends of this stem are the heads p^3 and p^4 . The former of these is adapted to engage and close a seat connecting the cross passage-way with the passage R . The latter may close an oppositely-facing seat between the passage S and the outer air. The
95 two heads are thus really a pair of alternately-seating valves, though it is convenient to speak of them with the stem as a "valve." The air-pressure in the pipe R normally maintains the valve p^3 against the former seat,
100 preventing communication between the pipes R and S , while the valve p^4 is free from its seat, connecting the passage S with the outer air. A screw-cap p allows convenient access to the valves.
105

An armature-lever Q is suitably pivoted and carries an adjustable screw q , which is adapted to bear against the valve-head p^4 . The normal position of these parts is as shown in Fig. 4, the pressure on the valve-head p^3
110 maintaining that head in its seat, as shown. When the governing-magnet T , however, is energized, its magnetized core t draws the armature Q toward it, moving the valve so that the head p^4 seats in its seat, shutting off communication from the passage S to the outer
115 air, but coupling that passage with the passage R by means of the free space around the stem p^1 . It will thus be seen that when the magnet T^1 is energized the piston in the
120 cylinder M^1 is moved, which moves the main controller to position 1. Thereafter when the magnet T^2 is also energized the piston in the cylinder M^2 is actuated and the controller-barrel is rotated to position 2, and so on.
125 Thus the controller may be governed as desired from any point by a master-controller which electrically governs the energization of the magnets.

The magnet T , it will be observed, has an
130 outer winding l' and an inner winding l'' , these windings having the same number of ampere-turns, but being connected in relatively opposite directions, whereby if the cur-

rent flows through both windings the magnetization is nil.

The magnets T are governed by a master-controller of the simple type illustrated in the diagram Fig. 6. There the governing-current comes from the line V^0 , which is a shunt from the main line governed by the main controller, and in the different positions of the master-controller this line V^0 is connected successively with the lines V^1 , V^2 , V^3 , and so on. Of these lines the first, V^1 , leads in series through the inside coil of all the magnets except the first (there being no inside coil for that magnet) and then leads in series through the outside coils of all the magnets. The line V^2 leads through the inside coils of all the magnets except the first and second and through the outside coils of all the magnets, and so on, the line V^7 leading simply through the outside coils of all the magnets.

In operation when the master-controller is turned to position No. 1 the governing-current passes along line V^1 and through both coils of all the magnets except the first, and hence neutralizes all the magnets T^2 to T^7 , but actuates the magnet T^1 , and this through the valve, as explained, causes the rotation of the controller-barrel to position No. 1. When the master-controller is turned to position 2, all the magnets are neutralized except the first and second. This maintains the valve in the box P^1 open and also opens the valve in the box P^2 , moving the controller-barrel to position 2, and so on. In the final position, 7, all of the inside coils are cut out, and hence all of the outside coils are active and all the valves are held open and the controller-barrel is maintained in position No. 7. The object of this peculiar arrangement of double-coiled magnets is to lower the self-induction to a minimum. I put as few turns as possible in each magnet, which relieves the strain on the insulation and enables the magnets to operate more rapidly. This neutralizing effect prevents in the first movement the self-induction of any coil except the first, due to the bucking effect of magnets T^2 to T^7 , inclusive, the self-induction of these magnets being practically nothing. In going from notch No. 1 to notch No. 2 the only self-induction will be that of the outer coil of T^2 and from notch No. 2 to notch No. 3 that of outer coil T^3 , and so on. By this arrangement it will be seen that the self-induction for each notch is dependent only on the turns in one coil, and this self-induction may be kept very low. The magnets will therefore operate more rapidly than if they were connected in parallel, which would require considerably more turns and finer wire. There will also be less strain on the insulation of the coils when opening and closing the magnetic circuits, which is of great importance in the construction of shunt-coils for the comparatively high potential which the main line supplies.

I claim—

1. The combination of a main controller, a series of pneumatic mechanisms one for each active position, and electric means for controlling said series of mechanisms, substantially as described.
2. A plurality of pneumatic mechanisms connected in series whereby the effect of each mechanism is added onto that of the preceding mechanism, and a controller connected with said mechanisms and adapted to be actuated thereby, substantially as described.
3. The combination of a plurality of pneumatic mechanisms connected in series whereby the effect of each mechanism is added onto that of the preceding, means for controlling the admission and exit of air from said mechanisms, a controller connected with said mechanisms and adapted to be moved consecutively from position to position thereby, and a spring operating to return said controller when air-pressure is released, substantially as described.
4. The combination of a main controller, a series of pneumatic mechanisms each connected to move said controller from one stopping position to the next, said mechanisms aggregating their movement to move the controller past several stopping positions, and a master-controller for governing said pneumatic mechanisms, substantially as described.
5. The combination of a series of pneumatic mechanisms each adapted to move bodily the remainder of the series on one side thereof and a controller connected with the last mechanism of the series whereby the sum of all the strokes of the different mechanisms move the controller to the last position while any intermediate position thereof is caused by the sum of all the strokes of the mechanisms between such intermediate position and the off position, substantially as described.
6. The combination of a controller, a series of independently-movable mechanisms connected in series with each other, mechanism connecting the last of the series with the controller, each of said series moving bodily the remainder of the series which are on that side toward which said connection with the controller is made, whereby the movements of the individuals of said series aggregate to move the controller through consecutive positions, and a master-controller for governing said movable mechanisms, substantially as described.
7. The combination of a series of pneumatic mechanisms each adapted to move bodily the remainder of the series and a controller connected with the last mechanism of the series whereby the sum of all the strokes of the different mechanisms move the controller to the last position while any intermediate position thereof is caused by the sum of all the strokes of the mechanisms between such intermediate position and the off position, a master-controller having a position for each of said mechanisms, and magneto-electric mechanism

ism controlled thereby for governing said pneumatic mechanisms, substantially as described.

8. The combination of a controller, a series of pneumatic mechanisms for operating the same, each mechanism having a cylinder and plunger, the plunger of one cylinder being connected to the adjacent cylinder and the final plunger being connected with the controller, and means for governing the air admitted to said cylinders, substantially as described.

9. The combination of a series of independently-movable pneumatic mechanisms, each mechanism including a cylinder and a piston, the piston of one cylinder being connected to the cylinder adjacent, there being passages adapted to admit operating fluid onto the rear sides of said pistons, substantially as described.

10. The combination of a series of independently-movable pneumatic mechanisms, each mechanism including a cylinder and a piston, the piston of one cylinder being connected to the cylinder adjacent, there being passages adapted to admit operating fluid onto the rear sides of said pistons, and an electric controller connected to the piston of the final cylinder, and means for admitting air to the different cylinders successively, substantially as described.

11. The combination of a main controller, a series of pneumatic mechanisms adapted individually to move the same each one position, said mechanisms being connected to convey aggregate movements, magnets for governing the individual mechanisms, and a master-controller connected with said magnets and in the first position actuating the first magnet, in the second position the first and second magnets, the third position the first, second and third magnets, and so on, substantially as described.

12. The combination of a series of cylinders, pistons therein, the piston of one cylinder being connected with the body of the next cylinder, there being air-passages leading to and from each cylinder, a valve or valves for controlling said passages, a series of magnets for controlling said valves, and a master-controller connected to operate in the first position the first magnet, in the second position the first and second magnets, in the third position the first, second and third magnets, and so on, substantially as described.

13. The combination of a series of independently-movable pneumatic mechanisms, each mechanism including a cylinder and a piston, the piston of one cylinder being connected to the cylinder adjacent, there being passages adapted to admit operating fluid onto the rear sides of said pistons, and a rotatable controller-barrel, a gear-wheel connected therewith, and a rack meshing with said gear and connected to the last piston in the series, and means for controlling the admission of

air to said cylinders successively, substantially as described.

14. The combination of a series of independently-movable pneumatic mechanisms each mechanism including a cylinder and a piston, the piston of one cylinder being connected to the cylinder adjacent, there being passages adapted to admit operating fluid onto the rear side of said pistons, a movable controller, a connection between the final piston in the series and such controller for moving it consecutively from one active position to the next, a spring tending to return said controller, and means for controlling the admission of air to said cylinders successively, substantially as described.

15. The combination of a series of cylinders, pistons therein, each piston being connected by a hollow piston-rod with the adjacent cylinder, a passage-way carried by the adjacent cylinder leading from said hollow piston-rod, a passage-way leading also to the interior of said adjacent cylinder, a valve adapted to couple said two passage-ways or maintain them disconnected, and electric means for operating said valve, substantially as described.

16. The combination of a series of cylinders, pistons therein, each piston being connected by a hollow piston-rod with the adjacent cylinder, a passage-way in the wall of the adjacent cylinder leading from said hollow piston-rod, a passage-way in said wall leading also to the interior of said adjacent cylinder, there being an admission-passage between two passage-ways, and there being an exit-passage from that passage-way which leads to the interior of the cylinder, and valve mechanism for alternately opening or closing said admission and exit passages, substantially as described.

17. The combination of a series of cylinders having pistons therein, the piston in one cylinder being connected to the body of the adjacent cylinder whereby each piston when it moves will bodily shift all of the cylinders at the forward side thereof, means for admitting air onto the rear side of the pistons and for releasing said air, magnets for operating such means, a controller, and a connection between the same and the forward piston, substantially as described.

18. The combination of a series of cylinders having pistons therein, the piston in one cylinder being connected to the body of the adjacent cylinder whereby each piston when it moves will bodily shift all of the cylinders at the forward side thereof, means for admitting air onto the rear side of the pistons and for releasing said air, a controller, and a connection between the same and the forward piston, the first or rearward cylinder being stationary and the others all movable along a suitable guideway, substantially as described.

19. The combination of a main controller, a

series of pneumatic mechanisms, each adapted to move individually and shift bodily the mechanism at the forward side thereof, a connection between the extreme forward mechanism and the controller, whereby the controller is moved through consecutive positions, each movable pneumatic mechanism receiving its operating-air through a connection with the preceding mechanism, substantially as described.

20. The combination of a series of cylinders having pistons therein, the piston in one cylinder being connected to the body of the adjacent cylinder whereby each piston when it moves will bodily shift all of the cylinders at the forward side thereof, the rearmost cylinder being stationary and the others movable, means for admitting air onto the rear side of the pistons and for releasing said air, each of said movable cylinders receiving its air through the preceding cylinder, a controller, and a connection between the same and forward piston substantially as described.

21. The combination of a series of cylinders, pistons therein, the piston of one cylinder being connected with the body of the next cylinder by a hollow piston-rod, an air-passage through the body of each cylinder from the piston-rod connected therewith, and another air-passage leading to the interior of the cylinder and discharging on the rear side of the piston therein, and an air passage-way from such rear side to the interior of the piston-rod which is in that cylinder, and a valved passage-way adapted to couple together said two passages, substantially as described.

22. The combination of a series of cylinders, pistons therein, the piston of one cylinder being connected with the body of the next cylinder by a hollow piston-rod, an air-passage through the body of each cylinder from the piston-rod connected therewith, and another air-passage leading to the interior of the cylinder and discharging on the rear side of the piston therein, an air passage-way from such rear side to the interior of the piston-rod which is in that cylinder, valves governing a passage-way adapted to couple together said two passage-ways, a series of magnets for controlling said valves, and a master-controller connected to operate in the first position the first magnet, in the second position the first and second magnets, and so on, substantially as described.

23. The combination of a main electric controller, a plurality of operating mechanisms connected in series whereby the movement of each mechanism is added onto the movement of an adjacent one, said mechanisms being connected with the main controller to operate it, a series of individual magnets for governing the movements of said mechanisms, said magnets being adapted to be connected in series on a shunt from the main circuit of the main controller, means for neutralizing any of said magnets, a master-controller, and suitable electric connections whereby in the

first active position all of said magnets are in circuit but all except the first are neutralized, in the second position all except the first two neutralized, and so on, substantially as described.

24. The combination of a plurality of mechanisms connected in series whereby the movement of each mechanism is added onto the movement of an adjacent one, a series of individual magnets for governing the movement of said mechanisms, means for neutralizing any of said magnets, a master-controller which in the first active position connects in all of said magnets but neutralizes the effect of all except the first thereof, in the second position neutralizes the effect of all except the first two, and so on, substantially as described.

25. A plurality of mechanisms connected in series whereby the movement of each mechanism is added onto the movement of an adjacent one, a series of individual magnets for governing the movements of the mechanisms, means for neutralizing any of said magnets, a master-controller which in the first active position connects in all of said magnets but neutralizes the effect of all except the first thereof, in the second position neutralizes the effect of all except the first two, and so on, combined with a main controller connected with said mechanisms and having stopping positions the distance between which is proportional to the individual throw of the mechanisms, substantially as described.

26. A series of magnets wound with two coils, a master-controller, and such connections between the controller and said coils that said controller throughout all active positions directs the current in series through all of one set of coils, and in series through various of the other set of coils in the opposite direction around the magnet, said controller in its different positions cutting out successively these last-mentioned coils, combined with a series of mechanisms whose movements aggregate and which are governed by said magnets, substantially as described.

27. The combination of a series of magnets wound with two coils, a master-controller, such connections between the controller and said coils that said controller throughout all active positions directs the current in series through all of one set of coils, and in series through various other sets of coils in the opposite direction around the magnet, said controller in its different positions cutting out successively these last-mentioned coils and thus actively energizing an increasing number of coils of the other set, the difference between the number of the two sets of coils which are inserted at any position being equal to the number of that position, and a main controller connected to move from position to position for each magnet actively energized, substantially as described.

28. The combination of a series of pneumatic mechanisms each adapted to move the

adjacent mechanism and thereby continuously separate themselves and communicate an aggregate movement, a valve for governing each mechanism of the series, a magnet for controlling each valve, all of said magnets except the first having a double winding, and a master-controller for governing said magnets adapted in the first position to direct the current through all of one set of windings and through the additional windings in opposite direction thus neutralizing all magnets except the first, and then in successive positions successively cutting out said neutralizing-winding thereby energizing a continuously-increasing number of said magnets, substantially as described.

29. The combination of a controller, a series of mechanisms each adapted to move the controller from one notch to the next, and the aggregate movement of said mechanisms acting to move the controller corresponding distances, electromagnets, each adapted to govern one of said mechanisms, said magnets having a coil connected in series and all except the first having an additional coil in the opposite direction also connected in series, and a master-controller adapted to direct current through all of said coils in series and then consecutively cut out said additional coils, substantially as described.

30. The combination with a controller, a plurality of mechanisms connected therewith and successively connected in series, each mechanism being adapted to move the con-

troller one notch and the movements of the mechanisms aggregating to move it through several notches, a series of electromagnets for controlling said mechanisms, each of said magnets being wound by a direct coil, and all but the first by a relatively reversed coil in addition, and a master-controller adapted in each active position to direct current through all of said direct coils in series, and the first position through all of said reversed coils also and then in successive position to continuously cut out the reversed coils, substantially as described.

31. In a controller, in combination, a series of pneumatic cylinders, pistons of one cylinder connected with the cylinder adjacent whereby each piston may move all the cylinders, valves for controlling the inlet and outlet of air of each cylinder, magnets for controlling said valves, each of said magnets except the first being wound in two directions, and a master-controller connected to direct current in each position through all of the coils which every magnet has, and also to direct current in series through those coils which the first magnet has not and in successive positions to successively cut out these latter coils, substantially as described.

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

THORSTEN VON ZWEIGBERGK.

Witnesses:

R. MILLS ROBERTS,
JOHN BLACK.