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F. B. COREY.

SYSTEM OF MOTOR CONTROL.

APPLICATION FILED OCT. 1, 1904.

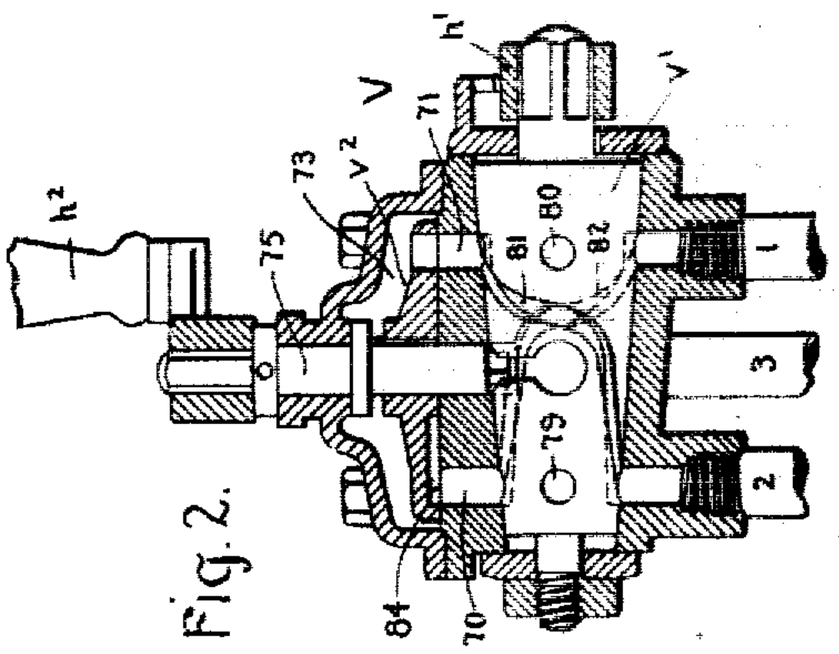

Fig. 2.

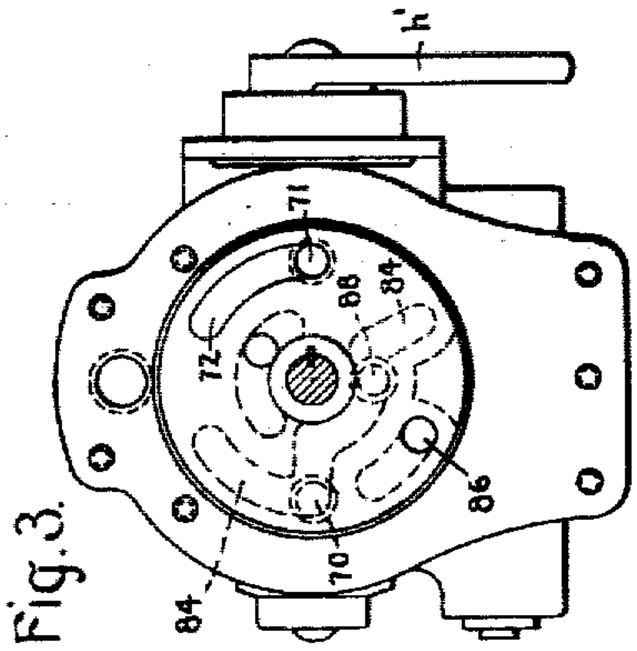

Fig. 3.

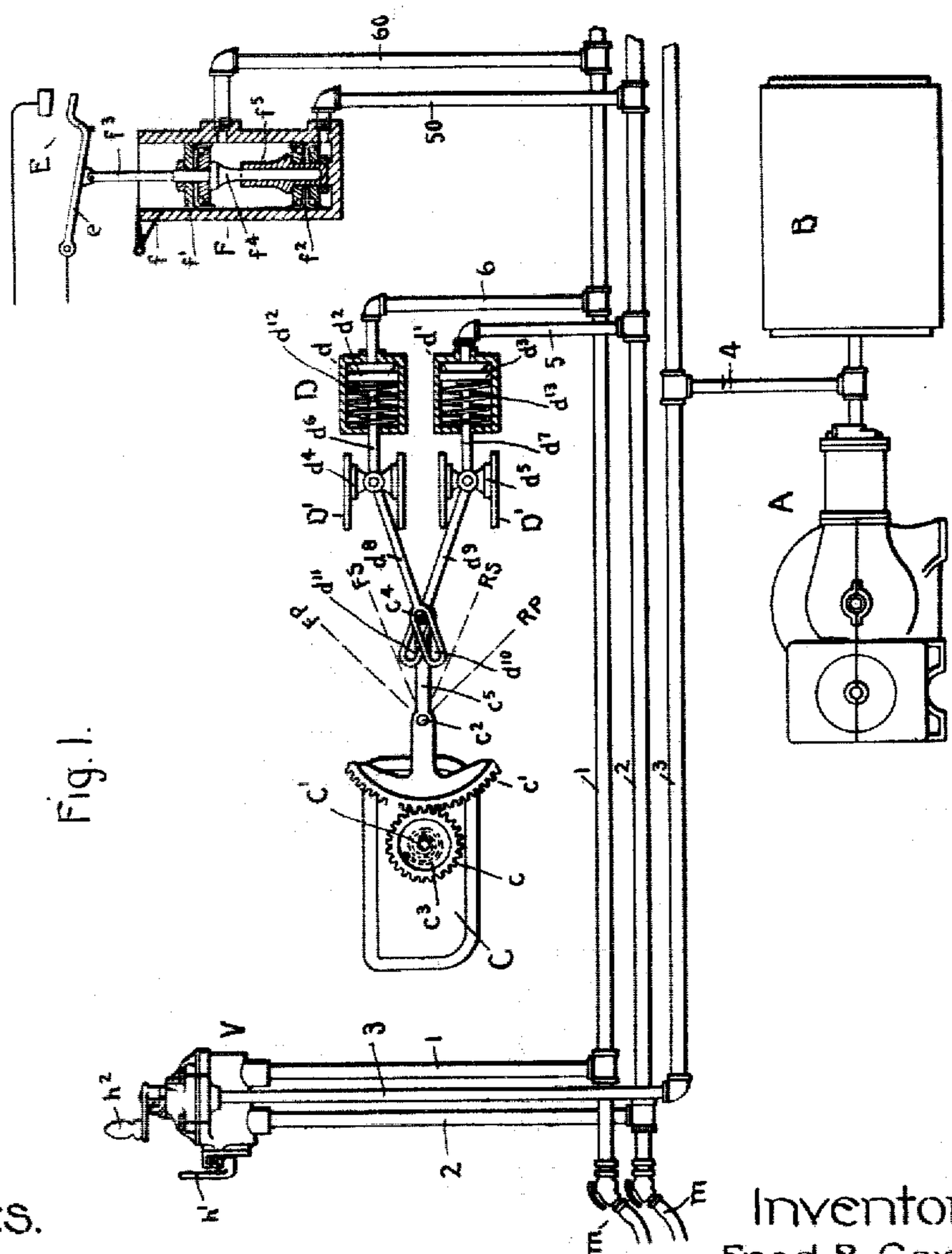

Fig. 1.

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UNITED STATES PATENT OFFICE.

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SYSTEM OF MOTOR CONTROL.

No. 811,766. Specification of Letters Patent. Patented Feb. 6, 1906.

Application filed October 1, 1904. Serial No. 226,754.

To all whom it may concern:

Be it known that I, FRED B. COREY, a citizen of the United States, residing at Schenectady, county of Schenectady, State of New York, have invented certain new and useful Improvements in Systems of Motor Control, of which the following is a specification.

The present invention relates to systems of control, and more particularly to electropneumatic systems of train control, in which the motor-circuits of the several cars of a train are controlled pneumatically from one or more points on the train.

In one of its aspects the present invention relates to improvements in the system of control shown in Patent No. 763,046, granted June 21, 1901, on an application filed by me. In the patented system the use of train-wires is avoided and only two train-pipes are used; but since one of the objects of that system is to prevent the starting of the car or train until pressure has been applied to both pipes the mechanism employed is not of the simplest form, and, furthermore, for the same and other reasons the compressed fluid is not employed in the most economical manner, for instead of serving at all times to operate the controller it is at times employed simply to actuate auxiliary devices preparatory to the application of the actual moving forces.

The present system also contemplates the use of two train-pipes, but connected to a novel and simple form of pneumatic operating means for the motor-controller of each car, the arrangement being such that pressure in either pipe will move each controller to one of its running positions, and pressure in the other will continue the movement of the controller to another position, the direction of movement of the car or train being determined as in the aforesaid patent by the order in which pressure is applied to the train-pipes.

The present invention is carried out by utilizing for each car a single controller of the type which when rotated in one direction controls the motor connections for forward movement and when rotated in the opposite direction controls the connections for running in the reverse direction, and associating therewith duplicate operating devices either of which will place the controller in full series position, where it remains until the actuation of the other device, which will then continue the rotation of the controller to its parallel position.

One of the principal features of my present invention lies in the peculiar form of operating device for the controllers, which enables these movements to be accomplished, each operating device consisting, preferably, of a pair of pistons or diaphragms mounted in suitable chambers and so connected together and to the controller that their successive operation in one order or the other serves to move the controller to its extreme forward or reverse running position. The chambers in which the pistons or diaphragms are mounted communicate directly with the train-pipes, thereby obviating the use of all valve mechanism except that in the motorman's valve for governing the admission and release of compressed fluid to the train-pipes.

In the present system by thus adding together the successive strokes of the piston or diaphragm neither need have a stroke more than half as great as in the patent heretofore referred to, and by doing away with all valves and stops the construction is greatly simplified and the compressed fluid is employed in the most efficient manner, since the train-pipe pressure serves always as a primary moving force instead of acting simply to trip or operate some auxiliary device for rendering some other moving force effective.

In another of its aspects the present invention relates to a simple and compact device for operating the circuit-breaker in an electropneumatic control system when pressure is admitted to any one of a plurality of pipes.

Further objects of the present invention will appear in connection with the following description thereof.

The present invention is illustrated in the accompanying drawings, in which—

Figure 1 represents diagrammatically a portion of a car equipment embodying my improvements, and Figs. 2 and 3 are detail views showing a convenient form of motorman's valve for use in connection therewith.

Similar reference characters will be used through the specification and drawings to denote like parts.

C represents a controller on one of the cars of the train, and this may be either a master-controller for controlling the motor-controllers of the individual cars or it may be a motor-controller of the ordinary type, it be-

ing necessary, however, that the controller be of the character in which the motor connections for forward movement are produced by a rotation of the controller in one direction, and the motor connections for reverse movement are made upon turning the controller in the opposite direction. The controller is operated by means of the pneumatic arrangement D, which will be hereinafter described and which constitutes one of the principal features of the present invention.

An air-compressor A of any suitable type compresses air or other fluid and stores it in a reservoir B, and from this reservoir the compressed fluid is admitted at the proper times to the pneumatic controller-operating means D through the intervention of a motorman's valve V. The valve V is connected to the reservoir through pipe 3 and a branch pipe 4 and admits the compressed fluid from pipe 3 to the pipes 1 and 2, which are in turn connected to the operating-cylinders d and d' of the controller-actuating apparatus by means of the branch pipes 6 and 5. The pipes 1 and 2 extend from end to end of the car and are provided at each end with couplings m for connecting the pipes of several cars together. The valve V, which is the motorman's valve, is preferably provided in duplicate, one on each end of the car, whereby the car may be operated from each end.

The controller-shaft C′ is provided with a gear-wheel c, which meshes with a segmental rack c', pivoted at c^2. In Fig. 1 the parts are shown in their normal or "off" positions, and the gear-wheel c then engages with the rack c' at or about its center. Upon oscillating the rack in one direction the forward motor connections are secured. Upon turning it in the opposite direction the motors are properly connected for moving the car or train in the reverse direction. Suitable springs c^3 are connected to the controller-shaft or to gear-wheel c in order to turn the controller to its off position whenever the restraining influence ceases.

Within each of the cylinders d d' is mounted a piston or diaphragm d^2 d^3, respectively, and these pistons or diaphragms are connected to the cross-heads d^4 d^5 by the stems d^6 d^7, the cross-heads being adapted to reciprocate in suitable guides D′. Pivotally secured to the cross-heads d^4 d^5 are a pair of links or arms d^8 d^9, respectively, the outer ends of these arms being provided with elongated slots d^{10} d^{11}. A pin c^4 passes through the slots d^{10} d^{11} and into an arm c^5, extending from the rack c'. The parts are so arranged that when the pistons d^2 d^3 are in their retracted positions the controller is in its off position and the pin c^4 rests within the inner ends of the slots d^{10} d^{11}.

Assuming that the parts are in the position shown and it is desired to move the car in the forward direction, air is admitted into the pipe 2 and from thence through the branch pipe 5 into the cylinder d', the piston d^3 being thereupon moved outwardly and carrying with it the stem d^9. Since the pin c^4 rests within the inner end of the slot in this arm and the arms d^9 and c^5 are at an angle to each other, the rack will be swung about its pivot, so as to move the controller to its forward series position, where it will remain as long as the conditions remain unchanged. When it is desired to move the controller to its parallel position, air is admitted to the pipe 1 and from thence through the branch pipe 6 into the cylinder d, whereupon the piston d^2 is forced outwardly and the segment is given a further movement in the same direction—namely, to its forward parallel position. When it is desired to stop the motors, air is exhausted from both pipes and the pistons d^2 d^3 are forced backwardly by means of springs d^{12} d^{13}, or by gravity where the cylinders are arranged vertically, and the controller is brought to its off position by means of the springs c^3. If, on the other hand, it is desired to reverse the motors in order to move the car or train in the reverse direction, air is admitted first to the pipe 1 and then to the pipe 2, whereupon the segment is again moved through two successive steps by the pistons, which, however, are operated in the reverse order, thereby moving the segment in the opposite direction and giving reverse series and reverse parallel positions to the controller.

The present invention may well be employed in connection with a controller of the type illustrated in Patent No. 764,480 to J. B. Linn, granted July 5, 1904, in which case upon the successive operation of the pistons the movement of the controller to its forward series position will cause the motors to be connected in series for moving the car forwardly and the resistance to be automatically cut out in order to accelerate the motors, and its movement to its parallel position will cause the motors to first be connected in parallel with all resistance and the resistance to be subsequently cut out step by step. The controller in this instance merely closes relay-circuits. If a controller of the ordinary type is employed wherein more than two sets of contacts are progressively closed in the controller, a suitable damping or checking device may be employed in connection with the controller in order to prevent a too rapid progression of the contacts as the operating-segment is moved to its final series and parallel positions. I have also illustrated a pneumatically-operated circuit-breaker E, the operating means F for which comprises a cylinder f, within which are arranged a pair of pistons or diaphragms f' and f^2, located at some distance apart. Pipes 60 and 50, corresponding to the pipes 6 and 5, connect the train-pipes 1 and 2, respectively, with the chambers

beneath the piston f' and the piston f^2, these parts being so designed that whenever pressure is admitted to either of the pipes 1 or 2 the circuit-breaker will be closed before either of the pistons d^2 or d^3 is operated, or at least not later than the operation of the pistons. The pistons or diaphragms f' f^2 may be operatively connected together with the circuit-breaker in various ways. In the embodiment illustrated the piston or diaphragm f' is connected with the switch member e by means of a stem f^3, and a projection f^4 from this same stem projects downwardly into a bearing within a boss f^5, forming part of the piston or diaphragm f^2. Consequently when compressed fluid is admitted beneath the piston or diaphragm f' it is moved upwardly independently of the piston or diaphragm f^2, thereby avoiding the retarding effect which the lower piston would influence when compressed fluid is admitted beneath the piston or diaphragms f^2, both pistons or diaphragms are moved upwardly together; but since the chamber between the two pistons or diaphragms remains unchanged in volume the sole retarding effect of the piston or diaphragm f' is a negligible quantity—namely, that due to its weight. The sliding connection between the two pistons or diaphragms is preferably made of such a length that the parts do not become disengaged in operation, and thereby each piston or diaphragm serves as a guide for the other.

The particular construction of the motorman's valve V forms no part of the present invention; but in Figs. 2 and 3 I have illustrated valve mechanism suitable for use in connection with the apparatus which I have described. This valve consists in the main of a plug-valve v', which determines into which pipe 1 or 2 pressure shall be admitted, and a disk valve v^2, which admits compressed fluid from the pipe 3 into the train-pipes when valve v' is properly set and which exhausts the compressed fluid from the train-pipes. The two valves are operated by means of handles h' h^2, respectively. When it is desired to move the car or train in the forward direction, the valve v' is turned to the position illustrated in Fig. 2, connecting the pipe 2 by means of a peripheral groove or port 81 with the port 71 in the valve-casing. Thereupon when the disk valve is moved to the position indicated in Figs. 2 and 3 compressed fluid will pass from the chamber 73, which is connected directly with the source of compressed-fluid supply, through the pipe 3, through the ports 72, 71, and 81, to the pipe 2, operating the piston d' in the manner previously described and moving the controller to its final series position. Upon moving the disk valve in a clockwise direction to its second position the port 86 registers with the passage 70 in the casing and the compressed fluid is then free to flow through the ports 86 and 70 and through the second peripheral passage or port 82 in the plug-valve to the pipe 1, thereby operating the pistons d^2 and moving the controller to its final parallel position.

The port 72 is in the form of an elongated slot, so that as the disk valve is moved to cause the pipe 1 to be energized the pipe 2 still remains in communication with the source of fluid-supply. When it is desired to return the controller to its off position, the disk valve is moved to its off position, thereby closing communication between the chamber 73 and the pipes 1 and 2 and bringing these pipes into communication with the undercut passage-way 84. (Shown in part in Fig. 2 and in dotted lines in Fig. 3.) This passage-way is placed in open communication with the atmosphere by means of the port 88, (shown in dotted lines in Fig. 3,) and the compressed fluid is free to escape to the atmosphere, thereby releasing the pistons d^2 and d^3 and permitting them to be retracted.

If it is desired to operate the car or train in the reverse direction, the plug-valve is initially placed so that the ports 79 and 80, which extend through the body of the plug-valve, connect the pipes 2 and 1, respectively, with the passages or ports 70 and 71. Thereupon when the disk valve is moved to the position shown air will first be admitted to the pipe 1 and thereafter to the pipe 2, causing the controller to be moved step by step in the reverse direction.

While I have described my invention as embodied in the best form now known to me, I do not limit the present invention to the structural details illustrated, since in its broader aspects the present invention may be embodied in various forms. Furthermore, the mechanisms for operating the controller and the circuit-breaker are not confined to those uses alone, since they may be employed to advantage in other apparatus.

Having described my invention, I claim as new and desire to protect by Letters Patent of the United States—

1. In combination, a controller and a plurality of operating devices therefor acting thereon in succession, the direction of movement of the controller being determined by the order in which said operating devices are actuated.

2. In a system of motor control, a switch for determining the direction in which current passes through the motors and for controlling the series and parallel motor connections, a plurality of operating devices therefor acting thereon in succession to produce successively series and parallel motor connection, the order in which said operating devices are actuated determining the direction of rotation of the motors.

3. In a system of motor control, a switch for determining the direction of passage of

current through the motors and for controlling the series and parallel motor connections, duplicate operating devices, acting successively upon the switch to produce the series and parallel connections of the motors, the order in which said operating devices are actuated determining the direction of the flow of current through the motors.

4. In a system of motor control, a controlling-switch for determining the direction of flow of current through the motors and for controlling the series and parallel connections of the motors, a pair of pneumatically-actuated devices associated with each switch for operating the same, two pipes communicating with said pairs of operating devices, and means for connecting said pipes successively with a source of compressed-fluid supply.

5. In a system of motor control, a controlling-switch, a pair of pneumatically-actuated devices associated with said switch for operating the same, two train-pipes communicating with said pair of operating devices, and means for energizing said train-pipes successively, the order in which the train-pipes are energized determining the direction of movement of the car or train.

6. In a system of motor control, a controller, a pair of operating devices associated with said controller, and means for actuating said operating devices successively, the direction of movement of the train being determined by the order in which said operating devices are actuated.

7. In a system of motor control, a controller, a pair of operating devices for said controller, their successive operations serving to move the controller respectively to series and parallel positions and the direction of movement of the train being determined by the order in which said controller-operating devices are applied.

8. In a system of motor control, a motor-circuit, a controller therefor, a pair of operating devices for the controller, either of said operating devices serving to move the controller to series position and the other to move it to parallel position, the direction of movement of the train being determined by the order in which the operating devices are applied.

9. In a system of motor control, a motor-controller, a pair of operating devices for said controller, either of said operating devices serving to move it to series position and the other to move it to parallel position, the direction of movement of the car or train being determined by the order in which the operating devices are applied, and means for controlling said operating devices from a single point.

10. In a system of control, a motor-circuit and an oscillating controller therefor, a pair of pistons or diaphragms, chambers in which said pistons or diaphragms are mounted, means for admitting compressed fluid to said chambers in succession and connection between said controller and the piston or diaphragms such that the controller is oscillated in one direction or the other, according to the order in which compressed fluid is supplied to said chambers.

11. An oscillating driven member, a pair of reciprocatory driving members therefor and connections between the driven member and the driving members such that the driven member is oscillated in one direction or the other depending upon the order in which said driving members are applied.

12. An oscillating driven member, a pair of reciprocatory driving members arranged to operate in succession upon said driven member to give it successive movement in the same direction, and connections between said driving and driven members whereby the reversal of the order in which the driving members are operated reverses the direction in which the driven member is oscillated.

13. In combination, an oscillating driven member, a pair of reciprocatory driving members, a slotted link pivoted to each driving member, and a projection from the driven member extending through the slots in said links.

14. In combination, an oscillating driven member, a pair of reciprocatory driving members having paths of movement on opposite sides of the axis of the oscillating members, a slotted link pivoted to each driving member, and a projection from the driven member extending through the slots in said links.

15. In combination, an oscillating driven member, a pair of reciprocatory driving members having paths of movement on opposite sides of the axis of the oscillating member, a slotted link pivoted to each driving member, and a projection from said reciprocatory member extending through the slots in said links and located near the inner ends of said slots when the parts are in their inoperative positions.

16. In a control system, a circuit-closing switch, a plurality of superimposed pistons or diaphragms operatively related thereto, a plurality of pipes, and operative connection between said pistons and said pipes whereby pressure in either pipe moves a piston to close said switch.

17. In a control system, a circuit-closing switch, a chamber, a plurality of pistons or diaphragms associated therewith and operatively related to said switch, a plurality of pipes opening into said chamber upon corresponding sides of said pistons or diaphragms, and means for admitting compressed fluid to said pipes.

18. In a control system, a circuit-closing switch, a chamber, a plurality of independent

pistons or diaphragms associated therewith one of which pistons or diaphragms is operatively related to said switch, a stop for limiting the movement of the pistons or diaphragms toward each other, and means for admitting compressed fluid to either of said pistons or diaphragms.

In witness whereof I have hereunto set my hand this 16th day of September, 1904.

FRED B. COREY.

Witnesses:
BENJAMIN B. HULL,
HELEN ORFORD.