(No Model.) 3 Sheets—Sheet 1.

E. H. DEWSON, Jr.

PNEUMATIC CONTROLLER.

No. 524,542. Patented Aug. 14, 1894.

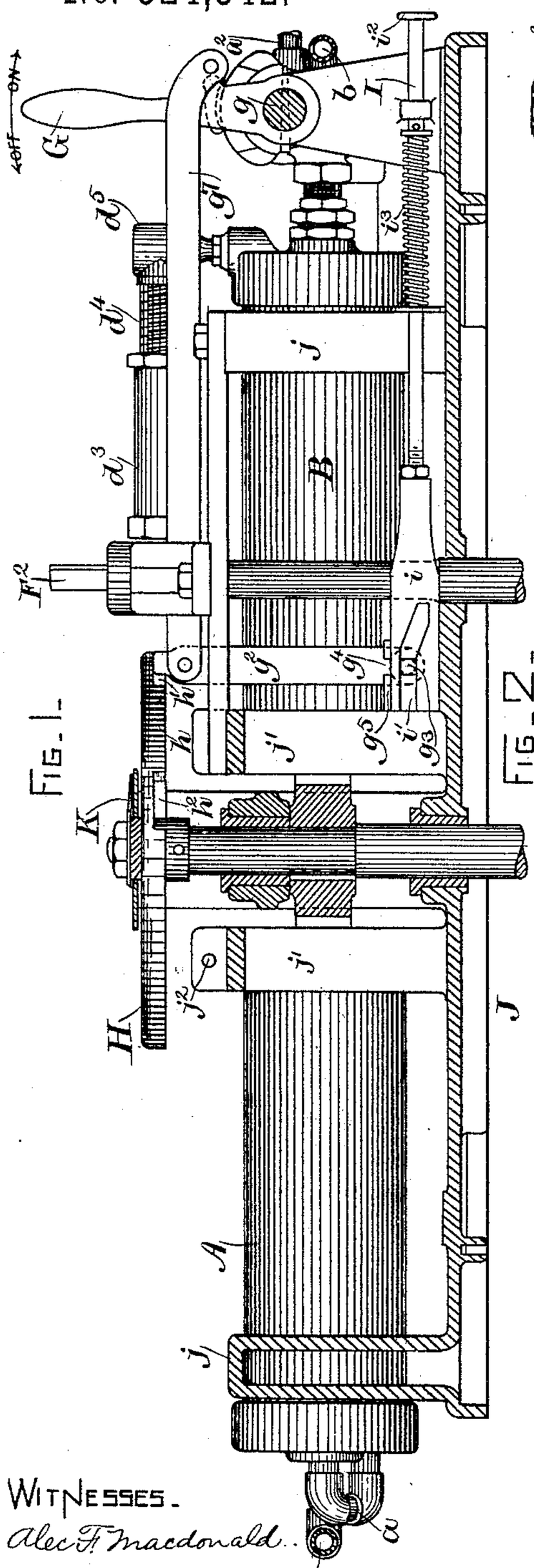

FIG. 1.

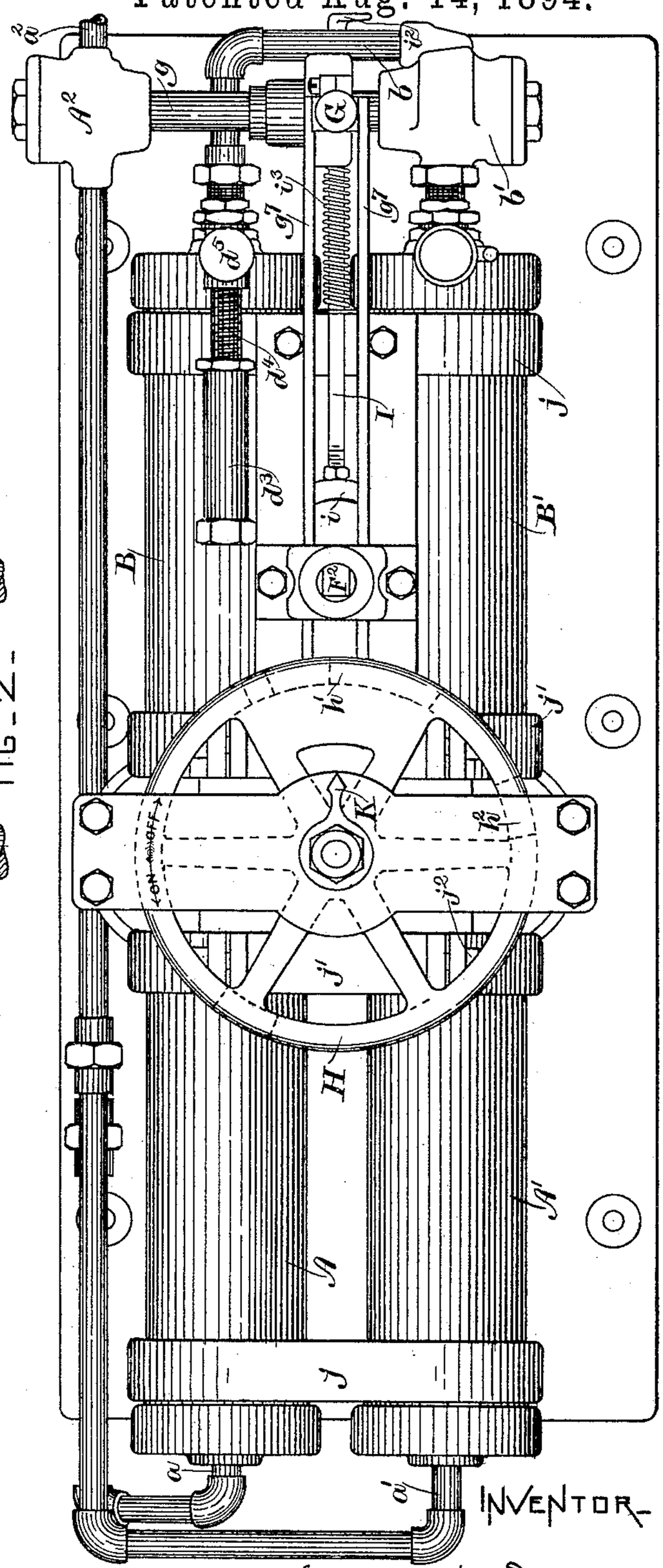

FIG. 2.

WITNESSES.

Alec F. Macdonald.

A. L. Rice

INVENTOR.

Edward H. Dewson Jr.

By Bundy & Blodgett

Attys.

(No Model.)

3 Sheets—Sheet 2.

E. H. DEWSON, Jr.

PNEUMATIC CONTROLLER.

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FIG. 3.

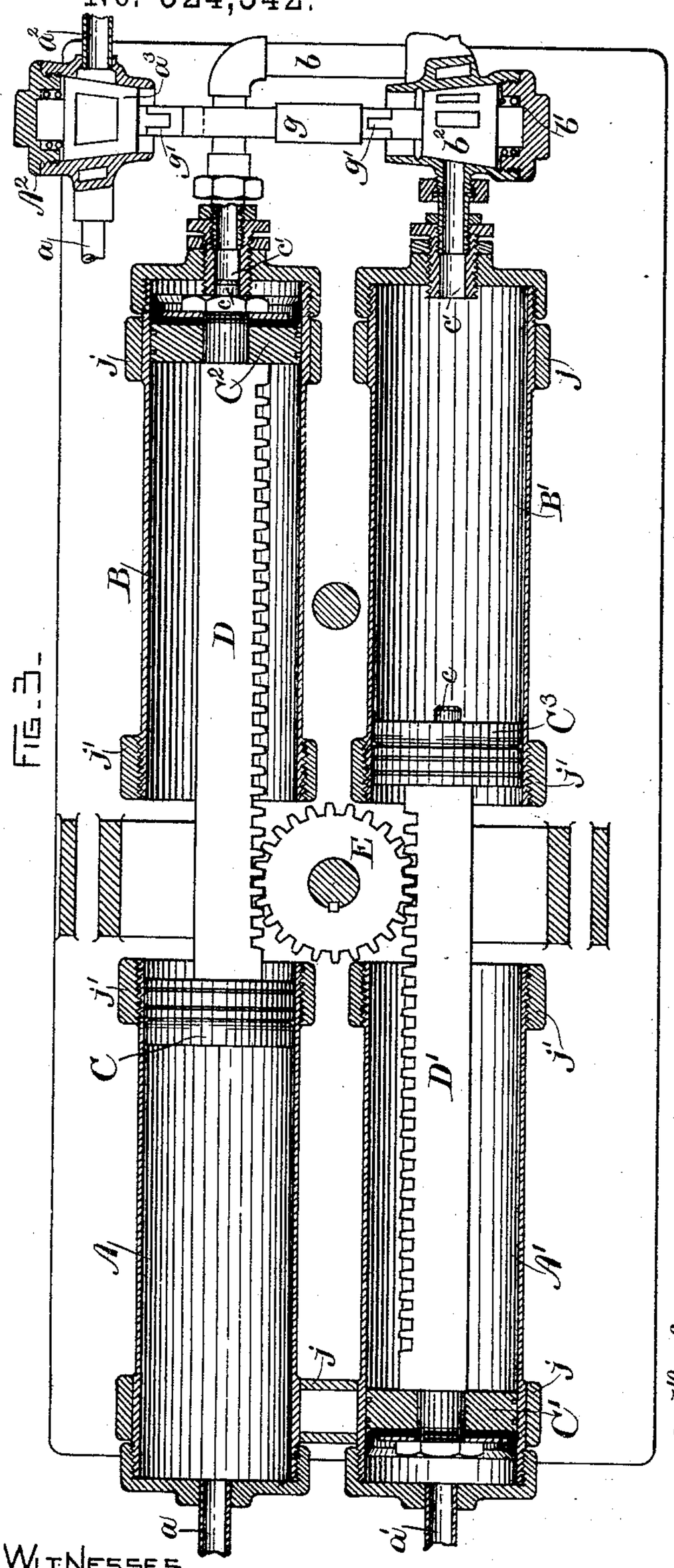


FIG. 6.

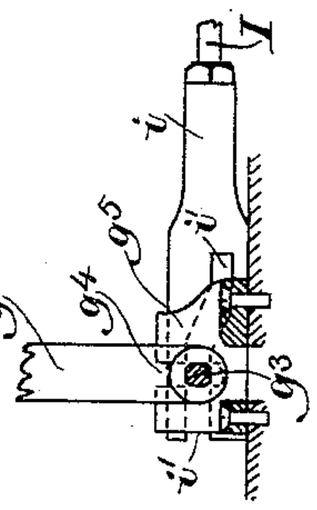


FIG. 5.

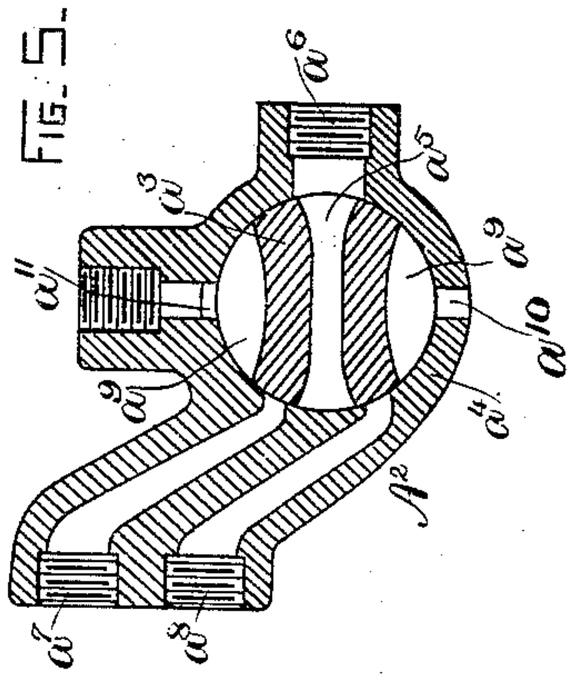
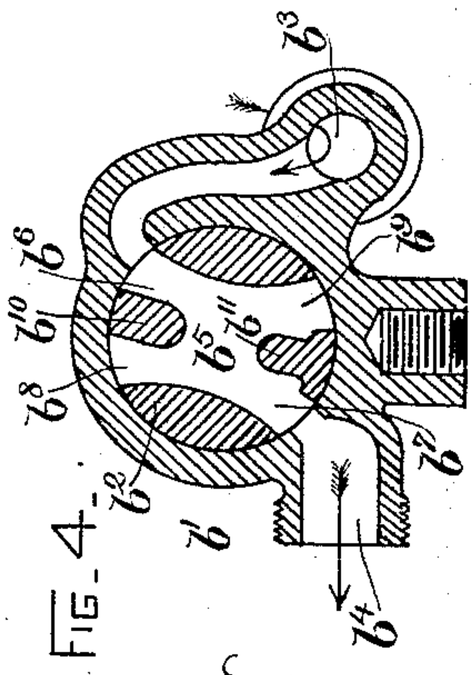


FIG. 4.



WITNESSES.

Alec F. Macdonald.

A. L. Orne

INVENTOR.

Edward H. Dewson.

By Bentley & Blodgett

Attys.

(No Model.) 3 Sheets—Sheet 3.

E. H. DEWSON, Jr.

PNEUMATIC CONTROLLER.

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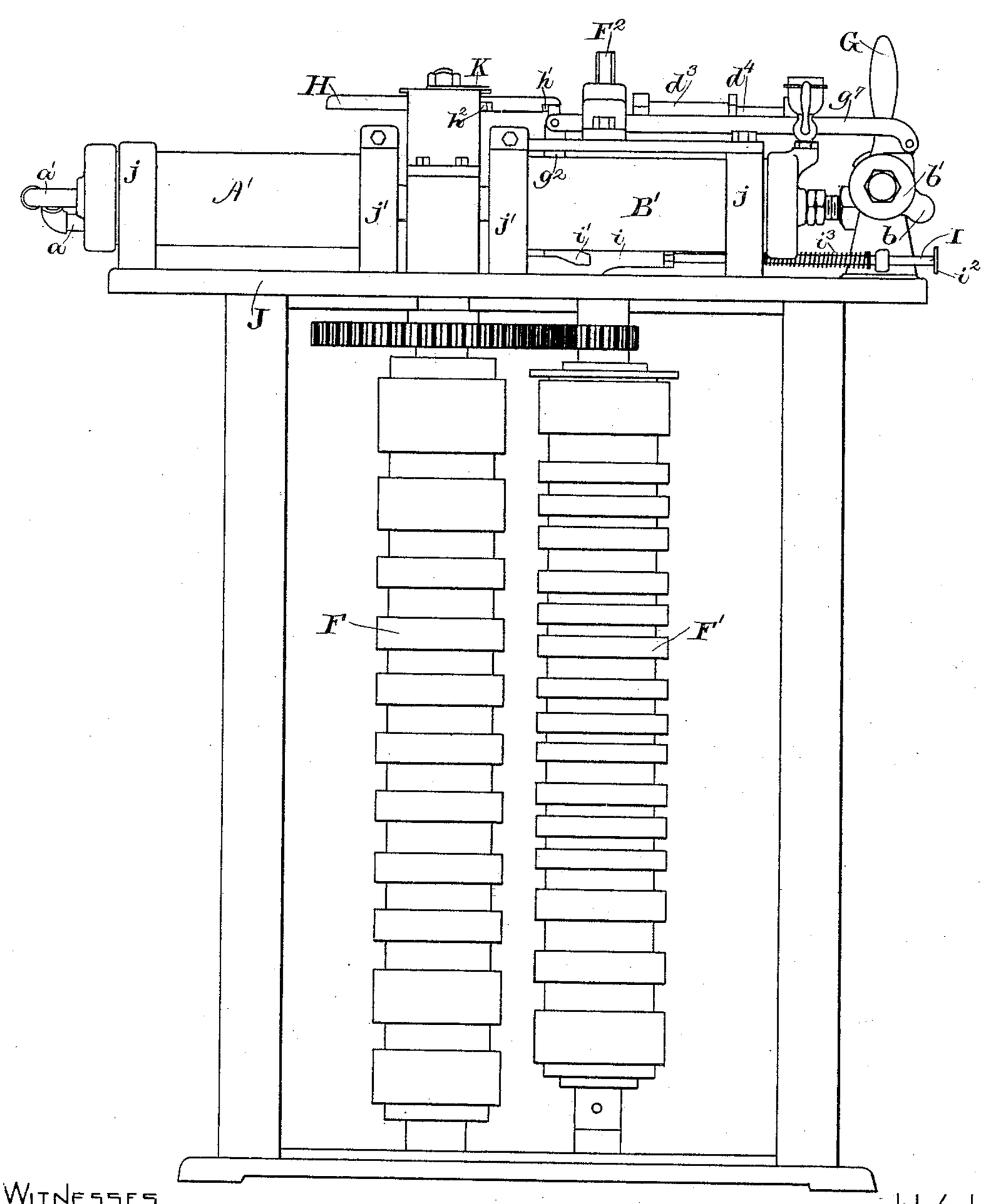
FIG. 7.



WITNESSES.
Alec F. Macdonald.
A. D. Shine

INVENTOR.
Edward H. Dewson Jr.
By Bentley & Bradforth
Atty's.

UNITED STATES PATENT OFFICE.

EDWARD H. DEWSON, JR., OF LYNN, MASSACHUSETTS, ASSIGNOR TO THE GENERAL ELECTRIC COMPANY, OF NEW YORK.

PNEUMATIC CONTROLLER.

SPECIFICATION forming part of Letters Patent No. 524,542, dated August 14, 1894.

Application filed July 13, 1893. Serial No. 480,411. (No model.)

To all whom it may concern:

Be it known that I, EDWARD H. DEWSON, Jr., a citizen of the United States, residing at Lynn, in the county of Essex and State of Massachusetts, have invented certain new and useful Improvements in Pneumatic Controllers, of which the following is a specification.

My invention relates to a pneumatic device for operating mechanism such as a rheostat, switch, or other controller for electric motors, where it is essential to actuate the mechanism in either direction with rapidity and accuracy. It is especially designed for use in connection with series-parallel controllers for electric locomotives, and is shown and described as applied thereto, although it is obvious that it might be used in many other connections.

In a previous application, filed April 7, 1893, Serial No. 469,859, I have described and claimed a similar apparatus designed for the same purposes, and my present invention consists in a new and useful improvement thereon.

In carrying out my invention I provide two cylinders open at one end placed parallel to each other, each containing a piston carrying one end of a rack, said racks meshing respectively with opposite sides of a pinion at the open ends of said cylinders and between the two. These cylinders are connected respectively by pipes to a source of fluid pressure, such as compressed air, and a valve is provided whereby such pressure is admitted to either cylinder and by the same action of the valve the pressure medium is allowed to exhaust from the other. Directly opposite to the said pressure cylinders are two other open ended cylinders parallel to each other and having their open ends turned toward the open ends of the pressure cylinders. These cylinders are also provided with pistons carrying the other ends of the racks above mentioned, said racks forming connecting rods between the pistons in opposite cylinders. These second cylinders serve as a damping or retarding device and through them power is transmitted from one pressure piston to the other. The said cylinders are connected together by a pipe leading from their closed ends and contain oil or other slow-flowing fluid, which in passing through the connecting pipe from one cylinder to the other will afford some resistance to the piston acting upon it, and prevent unduly sudden and rapid motion of the system.

The operation of the apparatus is briefly as follows. The air-pressure valve is turned by means of a hand-lever so as to let the air flow into one of the pressure cylinders while the other is permitted to exhaust. The piston in the cylinder to which pressure is thus admitted moves outwardly under said pressure carrying the rack with it and pushing the piston at the other end thereof into the oil cylinder opposite. Through the oil the pressure is transmitted to the piston in the other oil cylinder and thence by the other rack to the piston in the other pressure cylinder opposite thereto, said piston thus being moved into its cylinder while the other piston is being pushed out as aforesaid. When the valve is reversed the pistons move in the opposite direction and the two racks acting in opposite directions on opposite sides of the pinion co-operate in moving said pinion in one direction or the other as pressure is admitted to one or the other of said cylinders. Through the pinion is operated the mechanism to which the device is applied.

Mechanical means for further controlling the movement of the pinion in response to the pressure admitted through the valve are provided and operated by the same lever which controls the valve. These and further details will be fully set forth in the following description, reference being made to the accompanying drawings, in which—

Figure 1 is a vertical cross section of the apparatus. Fig. 2 is a top plan view of the same. Fig. 3 is a horizontal cross section through the middle of the cylinders. Figs. 4 and 5 are details showing the valves in cross section. Fig. 6 is a detail showing a safety or emergency device hereinafter described, and Fig. 7 is an elevation of the apparatus showing conventionally a series parallel switch operated thereby.

Like letters represent like parts throughout.

Referring to Fig. 3 the open-ended air cylinders A A′ are respectively connected by the

pipes a, a', to the three-way cock A^2, shown in cross-section in Fig. 5, which is adapted to close both of said pipes or to connect either one of them to a suitable source of pressure through the pipe a^2. In Fig. 5 the said cock is shown as closed, and if it is desired to admit pressure to the cylinder A, the valve a^3 is turned to the left in the valve seat a^4 so that the passage a^5 connects the inlet a^6, in which the pipe a^2 is threaded, to the outlet a^7 in which the pipe a is threaded, while the outlet a^8 in which the pipe a' is threaded is connected through the space a^9 to the exhaust port a^{10}. In this position pressure is admitted to cylinder A while the exhaust in cylinder A′ is permitted to escape. By turning the valve to the right the action is reversed, the cylinder A′ being connected to the source of pressure while the cylinder A is connected to the exhaust-port a^{11}. Opposed to the above-described air cylinders are two similar cylinders B and B′ connected together by the pipe b and the cock b' shown in cross section in Fig. 4. The cock b' is simply a shut off cock, and its function will be hereinafter described. Each of the said cylinders A, A′, B, B′ is provided with a piston C, C′, C^2 and C^3 respectively, the piston C in cylinder A being connected by the rack D to the piston C^2 in the cylinder B; and the piston C′ in cylinder A′ being connected by the rack D′ to the piston C^3 in cylinder B′. The cylinders B and B′ contain oil or other suitable slow-flowing fluid, the object of which is to retard and render uniform the speed of action of the pistons.

The action of the apparatus is as follows: Upon pressure being admitted to the cylinder A′ the piston C′ is forced to the right, carrying the rack D′ and the piston C^3. As the said piston C^3 is forced into cylinder B′ the oil therein is forced through the pipe b and cock b' into cylinder B, acting on the piston C^2 and driving the rack D to the left, while the piston C is forced into cylinder A, the air in which is free to exhaust through the port a^{11} as above described. Upon reversing the cock A^2, the opposite action takes place and the rack B is driven to the right while the rack D′ is driven to the left. The said racks D and D′ mesh with opposite sides of the pinion E, so that the two acting in opposite directions co-operate in rotating the pinion in one direction. The said pinion E is keyed to the shaft of the main switch cylinder F which is geared to the rheostat cylinder F′, Fig. 7, the whole switch mechanism, therefore, being driven by said pinion. It is not deemed necessary to describe the said switch mechanism in detail, since it forms the subject of a pending application of W. H. Knight and J. W. Darley, Jr., and is briefly described in my pending application, Serial No. 469,859, above referred to.

The general action of my apparatus is substantially as above set forth, and the means of operating and controlling the same are as follows: Referring to Figs. 1 and 2, the operating handle G is keyed to a shaft g which carries at one end the air valve a^3 and at the other end the oil valve b^2 as best shown in Fig. 3. The said shaft g is provided with universal joints g' so that any slight strain or displacement of the pipes or cocks may be taken up thereby and compensated for without straining the valves or causing them to bind in their seats.

It is essential in the operation of a series-parallel controller for electric motors that the switch cylinder be stopped only at certain predetermined positions, or running positions, as they may be called, since otherwise a detrimental bridging of contacts may ensue causing destructive arcs. It is obviously necessary, therefore, that the operator be provided with means for determining these positions, and I have so arranged my apparatus that it is impossible to close the pressure cock and stop the apparatus except at such predetermined running positions. A safety device, however, is added whereby the switch can be reversed at any time if it is necessary to stop suddenly. This will be more fully described hereinafter. To attain these desired ends a double bar g^7 is attached to the operating handle G, and said bar g^7 extends longitudinally along the apparatus and is pivoted at its outer end to the upper end of an upright bar g^2 which rests in turn on a pivot g^3 at its lower end, so that its said upper end is free to oscillate with the longitudinal movement of the double bar g^7. The said pivot g^3 is laterally held in vertical slots g^4 in the upright pieces g^5, best shown in Fig. 6, provided for that purpose. The said pivot is supported however in the horizontal slot i' in the slide i, forming the safety device above mentioned, the action of which will be hereinafter described. The top of the rod g^2 forms a stop for the wheel H, which is keyed to the shaft which carries the pinion E and switch cylinder F and revolves therewith. The said wheel H is provided with a thin flange h upon its periphery, and said flange is provided with slots h' h^2, &c., at intervals, through which the rod g^2 may pass, as shown in Fig. 1. That is to say, when the apparatus is in its normal condition, with the motors out of circuit and the locomotive or device the operation of which is to be controlled at rest or out of action, the pressure and oil cocks are closed, the lever G is in the intermediate position shown in Fig. 1, and the rod g^2 is engaged by the slot h'. If now it is desired to start the mechanism, the lever is pulled to the right, so actuating the valve A^2 as to admit pressure to the cylinder A′ and rotate the pinion E and wheel H from right to left. This movement of the lever pulls the rod g^2 also to the right, out of line with the periphery of wheel H, thus releasing the said wheel and allowing it to turn from right to left with the pinion.

When the wheel H begins to rotate, the flange h obviously prevents any further move-

ment of the bar g^2 and consequently of the operating lever and valves. When however, the said wheel has rotated in this direction until the slot h^2 is opposite the rod g^2 the lever G can then be returned to its normal or central position, shutting off the pressure and pushing the rod g^2 into the said slot h^2, thereby holding said wheel and the switch F controlled thereby in its first running position. The action can then be repeated and the wheel stopped at any subsequent slot in the same manner. If now it is desired to reverse the switch, it becomes necessary to cause the pinion to rotate in the opposite direction, which is done by pushing the lever G to the left, thus reversing the cock A^2 and admitting pressure to the cylinder A. Such a movement of the lever G is further communicated, as before, to the arm g^2, pushing said arm to the left so that it passes through the slot h', h^2, or other slot, as the case may be, and clears the flange h on its inner side so that the wheel is free to rotate until stopped by returning the lever to its normal vertical position, thus closing the cocks and bringing the arm g^2 into the desired slot after the wheel has rotated to the proper point.

If for any reason it becomes necessary to suddenly reverse the direction of the switch cylinder F, while the wheel H is traveling in its forward direction and that portion of the flange h between any two of said slots is opposite to the arm g^2 thus preventing the operation of the pressure cock, some means must be provided whereby the said arm g^2 can be immediately thrown out of engagement with said flange h, so that the lever G will be free to move in either direction. For this purpose the movable piece or slide i is provided having a slot i' in which the pin g^3 rests as hereinbefore described. The said slot i' is downwardly inclined at its inner end so that by pushing the slide i inwardly toward the rod g^2, the said rod g^2 is drawn downward by the pin g^3 in the said slot i', so that the upper portion of said rod is brought below the flange h, and is free to move backward and forward with the lever G. The slide i is bolted to a rod I having a handle i^2 convenient to the operator, and a spring i^3 holds said slide in its normal position, so supporting the rod g^2 that said rod may be engaged by the slots in the flange h. The said slide i is intended as a safety device for use in emergencies, and does not form one of the normal operating parts of the device, the said spring i^3 restoring the parts to their normal condition as soon as released by the operator.

The function of the cock b' in the pipe b which connects the oil cylinders B and B', which has not thus far been described, is to check or render inoperative the piston system in the four cylinders, until after the cock A^2 is operated to admit pressure to either cylinder. That is to say, the valve b^2 on the shaft g, is so arranged with relation to the valve a^3 on the same shaft, that it keeps the pipe b closed until after pressure is admitted to the proper cylinder, so that the piston in said cylinder is under full pressure before it is permitted to move. This insures the promptness and evenness of action essential to the device. The said cock b' is shown in section in Fig. 4. The ports b^3 and b^4 are connected together by the passage b^5 in the valve b^2. This passage has four openings so that when the valve b^2 is oscillated by the lever G connection is made between the ports by the branches b^6 and b^7 as shown in the drawings, or by the branches b^8 and b^9, or is closed when in an intermediate position by the solid portions b^{10} and b^{11}.

The pistons C^2 and C^3 which travel in the oil cylinders B and B' are provided at their inner ends with projections c, adapted to enter and fit into the couplings c' at the end of the cylinder, through which the oil is forced into the pipe b. The said couplings c' project a little into the cylinder, and as the stem c enters therein it gradually stops the flow of oil from the cylinder, and the oil remaining between the ends of the said couplings and the end of the cylinder acts as a cushion to stop the piston at the end of the stroke.

A small cylinder d^3 having a threaded stem d^4 is screwed into the cup d^5 at the end of cylinder B. This acts as an adjustable oil reservoir, forming in effect a means of changing the capacity of the cylinder B and is adapted to take up the leakage of oil during a day's use of the apparatus, for example, but is not intended to effect any great amount of adjustment, since the oil cylinders should be properly charged and leakage taken care of at the end of each trip or such period as may be found necessary.

The cylinders and other parts are all mounted in suitable castings J, which may be of any desired shape and design. I prefer to support the cylinders at their outer or closed ends in the hollow cast supports j, which are bored to receive them, while at their inner ends they are screwed into split collars j' threaded for the purpose, said split collars being drawn together by bolts j^2 after the cylinders are screwed in place.

A stem F^2 integral with the shaft of cylinder F' is provided projecting above the apparatus, and adapted to receive a suitable handle for manual operation, in the event of the pneumatic device being rendered inoperative by accident or otherwise.

A pointer K, turning with the wheel H, serves to indicate to the operator the position of the switch or device which he is operating.

It is to be noted that my arrangement of parallel open-ended cylinders placed in pairs opposite to each other entirely obviates the necessity of guides or ways for the driving racks which are supported by the pistons themselves in the cylinders.

The source of pressure operating this device may be an air-tank charged by a pump operated by the same motor which the device is intended to control, or by a separate mo-

tor, or by any other suitable means. Where air brakes are used, the same source of pressure may be utilized for both brakes and controller.

While my invention as above set forth, is clearly applicable for use in operating any kind of a controller, it is especially adapted for use with series-parallel controllers for electric locomotives, where the controller mechanism is heavy and complicated and not readily operated by hand.

My device is compact and symmetrical, absolute in its action, and occupies as little space as is practicable for a device of this nature, having the requisite power and accuracy.

I do not, however, limit myself to the exact construction herein set forth, since it is obvious that almost endless modifications in the arrangement of the device might be made without departing from the spirit of the invention. It is, of course, not essential that no more or no less than two pressure cylinders be employed, or that said cylinders be open at one end, or that they be parallel, since the same results could be obtained without these limitations; and the same may be said of the damping or transmitting cylinders. Nor is it necessary that the movement of the controller should be transmitted to the switch or other device to be controlled by means of a rack and pinion, since it is manifest that any other form of gearing could be readily adapted for the purpose.

What I claim as new, and desire to secure by Letters Patent, is—

1. A pneumatic device comprising pressure cylinders and transmitting cylinders substantially as described, pistons in said pressure cylinders respectively connected to pistons in said transmitting cylinders, non-elastic or incompressible fluid acting as the transmitting medium between said transmitting cylinders, and a cock for controlling the passage of said fluid from one of said transmitting cylinders to another.

2. A pneumatic device, comprising pressure cylinders and pistons therein co-operating through a fluid transmitter, means for putting said cylinders at will in communication with a source of pressure, and a cock for said fluid transmitter controlling the action of said pistons and opened to permit movement thereof only after said cylinders have been put into communication with said source of pressure, as set forth.

3. The combination with a controller for electric currents, of an actuator therefor, operated by an attendant, for moving said controller into and stopping it at predetermined positions, and a stop or lock for said actuator preventing it from being stopped when once in motion except in one or another of the said predetermined positions.

4. The combination with an electric switch or similar device, of a pneumatic controller therefor comprising a cylinder piston and gearing actuated thereby to set the said switch in motion, a lever or like means for controlling the supply of compressed air or other fluid under pressure to the said pneumatic controller, and a stop preventing the movement of said lever except when the said switch is in certain predetermined positions.

5. The combination with an electric switch or similar device, of a pneumatic controller therefor, and a stop comprising one member moving with the said switch and a second member moving with an operating lever or means for governing the said pneumatic controller, the said members being so related to each other that the movement of said operating lever is prevented except when the said switch is in certain predetermined positions.

6. The combination with an electric switch or similar device, of a pneumatic controller adapted to actuate the same, a stop normally locking the operating parts of said pneumatic controller, and preventing the operation thereof except when said switch is in certain predetermined positions, and means for preventing such locking of the said controller at will.

7. A device for operating electric switches or other controllers, comprising a source of fluid pressure, open-ended cylinders connected by separate pipes to said source of pressure, pistons in said cylinders, racks carried by said pistons meshing respectively with opposite sides of a pinion common to both, whereby a movement of one of said pistons communicates a movement to said pinion, and a consequent movement to the other piston in the opposite direction, and a cock whereby either of said pipes may be opened to an exhaust port while the other is open to said source of pressure, as described.

8. A device for operating electric switches or other controllers, comprising two parallel open-ended cylinders A and A′ connected respectively to a common source of pressure through separate pipes and a cock adapted to admit pressure to either at will, pistons in said cylinders, racks carried by said pistons and carrying at their outer ends other pistons moving in the corresponding parallel open-ended cylinders B and B′, a pipe connecting said cylinders B and B′, slow-flowing fluid within said cylinders B and B′ free to flow from one to the other through said pipe whereby a movement of one rack is transmitted to the other rack thereby setting up a movement thereof in the opposite direction, said slow-flowing fluid acting both as a transmitting and retarding medium, a pinion between said racks and engaged thereby on opposite sides respectively, and means for operating said cock at certain predetermined positions of said pinion, substantially as described.

9. A pneumatic reciprocating device comprising pressure cylinders and power transmitting cylinders substantially as described, a three-way valve mounted on a shaft and

adapted to admit pressure to either pressure cylinder or cut it off from both, a two-way valve also mounted on the said shaft adapted to open or close communication between the power-transmitting cylinders, an operating lever keyed to said shaft whereby both of said valves are simultaneously operated, the said pressure-valve being so adjusted that it is completely opened before the transmitting valve is opened to allow the system to move, and mechanical means also operated by said operating lever, whereby the operation of said valves is prevented except at certain predetermined positions of the moving system, as set forth.

10. In a pneumatic device comprising a source of pressure and means for utilizing the same to drive mechanism, substantially as described, a stop-device for determining the consecutive resting points of the driven mechanism consisting of a wheel rotated thereby and co-operating therewith, a flange on the periphery of said wheel, slots in said flange at predetermined intervals, a bar adapted to be thrown into said slots as they come opposite the same during the rotation of said wheel, thereby preventing further rotation of said wheel, and a lever connected to said bar for the operation thereof, said lever being adapted to also control the direction and duration of action of the actuating pressure at the same time, as set forth.

11. In a pneumatic device comprising a source of pressure and means for driving therewith a switch or controller, substantially as described, a stop-device for determining the consecutive resting points of said switch or controller consisting of a wheel rotated thereby and co-operating therewith, a flange on the periphery of said wheel, slots in said flange at predetermined intervals, pressure valves for setting the device in motion in either direction or stopping the same, a bar movable with said pressure-valves and oscillating between opposite sides of said flange when such oscillation is permitted by said slots during the rotation of said flange, said bar being so adjusted with relation to said pressure valves that it is engaged by opposite sides of said flange during the rotation thereof in opposite directions respectively and by the edges of said slots when the valve is shut off, so that said valve can be normally operated only at intervals determined by said slots during the rotation of the wheel, an operating lever for said valve, and a safety device comprising separate means whereby said bar can be withdrawn from engagement with said flange permitting the operation of the pressure-valve for the reversal of the mechanism at any point regardless of said determining slots, substantially as described.

12. In a pneumatic device comprising a source of pressure and a piston driven thereby, a controlling device consisting of a three-way cock for admitting pressure to either side of said piston or shutting it off altogether, a wheel rotated by said piston, a flange on the periphery of said wheel, a slot in said flange, a bar pivoted at its lower end so that its upper end is movable across the line of said flange but normally resting in said slot, an operating lever for said cock, a connection between said lever and said bar whereby said bar is moved out of said slot to one side or the other of said flange when said cock is turned in one direction or the other by said operating lever, thereby permitting said wheel to rotate and temporarily preventing further operation of said lever, other slots in said flange which consecutively come opposite said bar as said wheel rotates so that said lever can again be operated at predetermined positions of said wheel, a slide at the lower end of said bar having a beveled slot in which said bar is pivoted so that a longitudinal movement of said slide will lower said bar until it is entirely out of engagement with said flange, whereby said lever is rendered operative at any time, and a handle for operating said slide independently of the other parts of the apparatus, all substantially as described and for the purpose set forth.

13. In a pneumatic controller, a damping device comprising two cylinders closed at one end and open at the other, a pipe connecting the closed ends thereof, a reciprocating piston in each of said cylinders actuated by the controller mechanism, and slow-flowing fluid in said cylinders adapted to flow through the said connecting pipe from one cylinder to the other whereby a movement of one of said pistons is transmitted to the other piston, the resistance of said fluid in flowing through said pipe acting to retard the movement of the driving piston, as described.

14. In a damping or retarding device, the combination with a piston or plunger opposed in its movement by fluid in a cylinder or chamber, of means for compensating for leakage from said chamber, substantially as and for the purpose set forth.

15. In a damping or retarding device, the combination with a piston or plunger opposed in its movement by fluid in a cylinder or chamber, of an auxiliary chamber connected to the main cylinder or chamber and provided with a means of adjusting its capacity; whereby the auxiliary chamber compensates for leakage from the main cylinder or chamber.

16. The combination with two or more valves arranged in line with one another, of a common operating shaft extending between said valves, and means for varying the line of said shaft, whereby undue strain upon the valves is avoided, if they are accidentally displaced from their line position, as set forth.

17. In a damping or retarding device substantially as described, an auxiliary cylinder d^3 having a threaded stem d^4, adapted to be screwed into the cup d^5 connected to the large cylinder B, whereby slight leakage of the

fluid comprising the transmitting and retarding medium of the device may be compensated for, as set forth.

18. In a pneumatic reciprocating device having pressure cylinders and retarding cylinders substantially as described, the combination with a three-way valve A^3 through which said pressure cylinders are connected to a source of pressure, of a valve b^2 through which said retarding cylinders are connected together, a common shaft g on which both of said valves are mounted, universal joints g' in said shaft, and an operating lever G keyed to said shaft and adapted to oscillate the same and thereby simultaneously operate the said valves, substantially as described.

19. In a pneumatic reciprocating device comprising a source of pressure, pistons adapted to be driven in one direction or the other thereby, and retarding fluid caused to flow through a narrow orifice by the action of said pistons, the combination with an oscillating three-way valve a^3 adapted at one extreme of oscillation to cause pressure to drive said pistons in one direction and at the other extreme of oscillation to cause pressure to drive said pistons in the opposite direction and in an intermediate position to intercept said pressure so that said pistons remain stationary, of a two-way oscillating valve b^2 adapted at either extreme of oscillation to permit the flow of said retarding fluid and in an intermediate position to prevent said flow, a common shaft on which said valves are mounted, an operating lever keyed to said shaft, and an adjustment of said valves such that in the intermediate position both valves are closed but by oscillation in one direction or the other pressure is admitted through valve a^3 before said retarding fluid is permitted to flow through valve b^2, as and for the purpose set forth.

20. In a pneumatic device comprising a source of pressure adapted to actuate a driven mechanism in one direction or the other, and a wheel, slotted flange and bar movable across the line of said flange whereby said driven mechanism when once started can be stopped or reversed only at predetermined intervals, as described, a safety device comprising a slide i having an inclined slot i' in which said bar is pivoted, and an operating handle for moving said slide so that said bar is engaged by said inclined slot and withdrawn from engagement with said flange, as and for the purpose set forth.

In testimony whereof I have hereunto set my hand this 6th day of July, 1893.

EDWARD H. DEWSON, JR.

Witnesses:
E. B. RAYMOND,
JAS. RILEY.