(No Model.) 5 Sheets—Sheet 1.

E. H. DEWSON, Jr.

PNEUMATIC CONTROLLER.

No. 524,541. Patented Aug. 14, 1894.

FIG. 1.

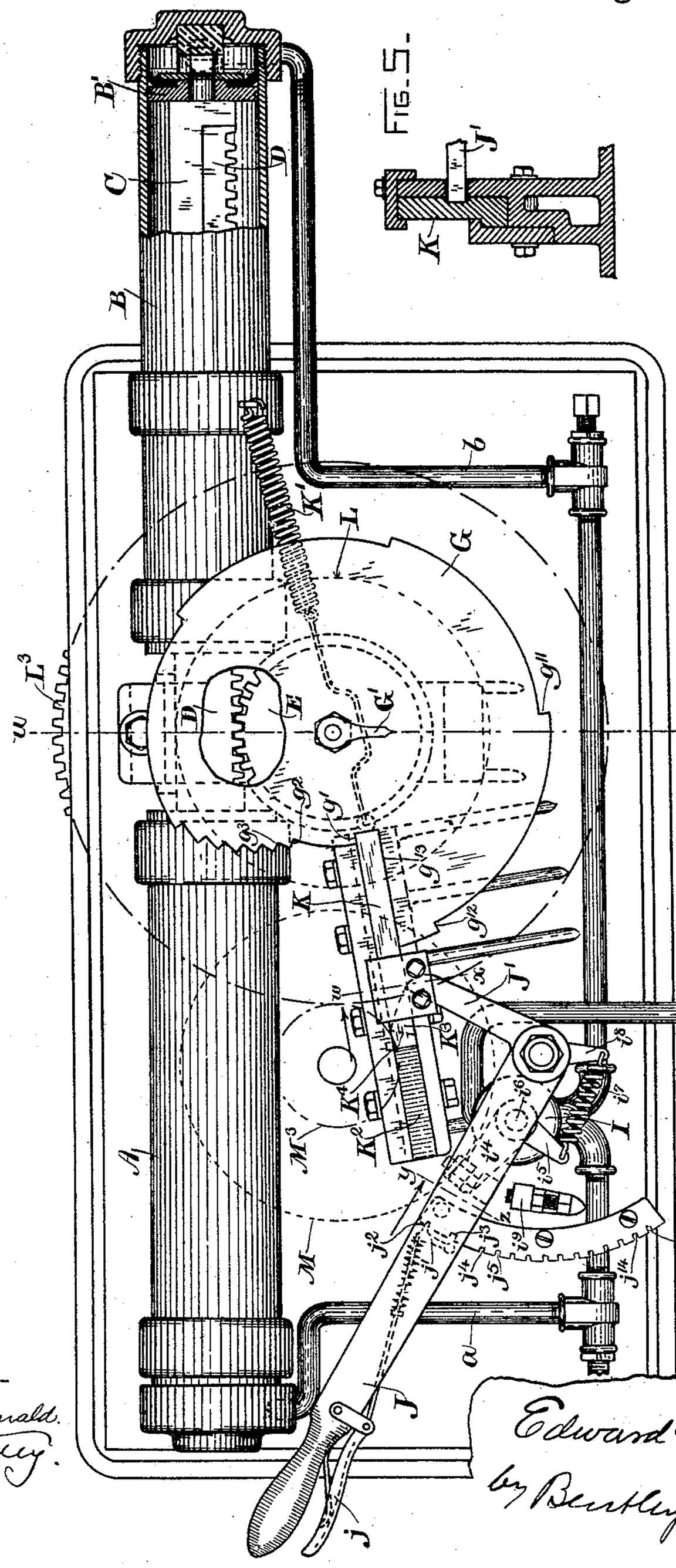

FIG. 5.

WITNESSES.

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(No Model.) 5 Sheets—Sheet 2.

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PNEUMATIC CONTROLLER.

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FIG. 2.

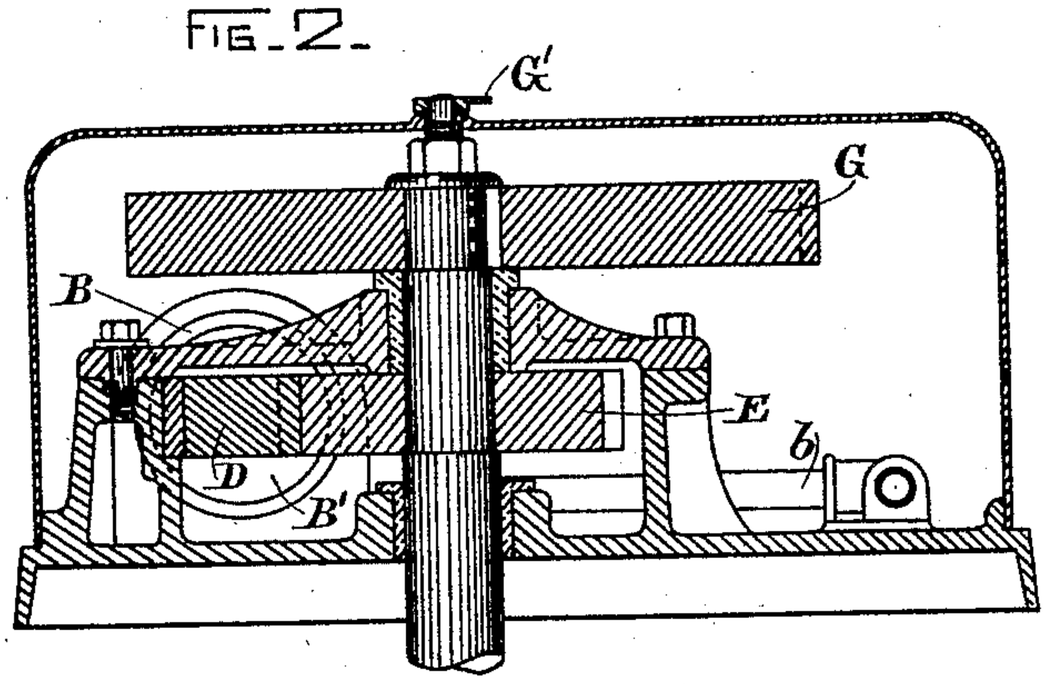


FIG. 3.

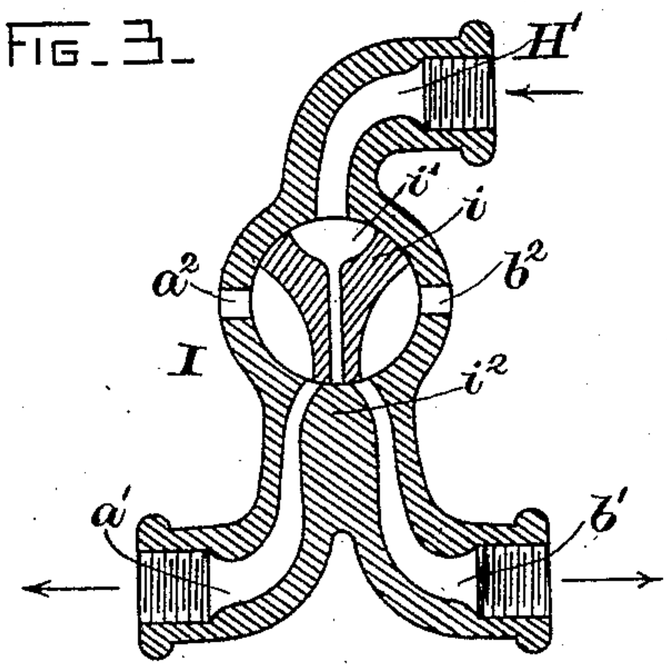


FIG. 6.

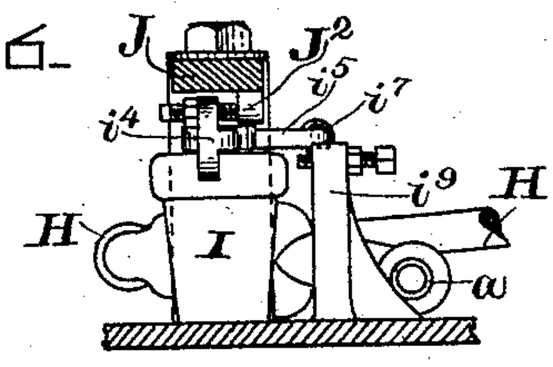
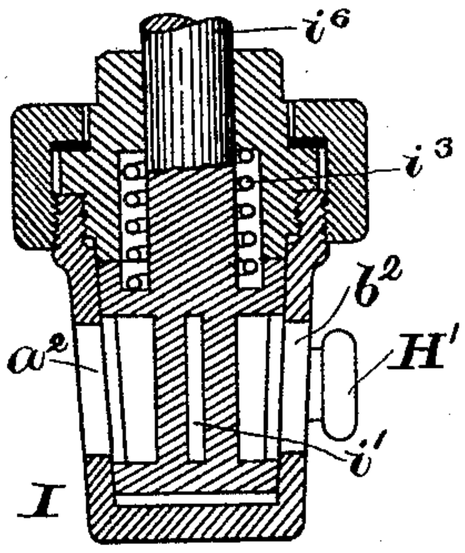


FIG. 4.



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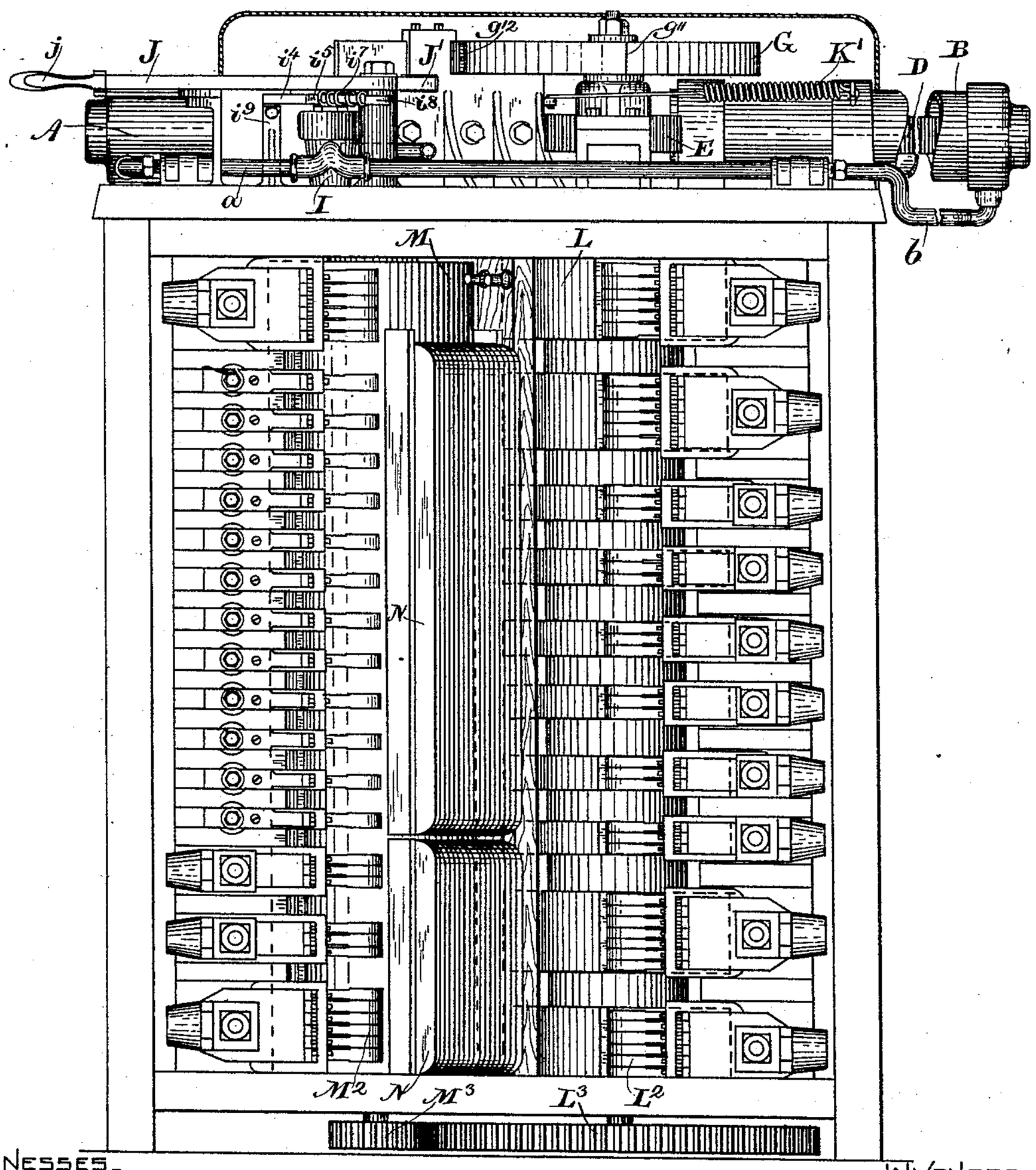
PNEUMATIC CONTROLLER.

No. 524,541. Patented Aug. 14, 1894.

FIG. 7



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(No Model.)

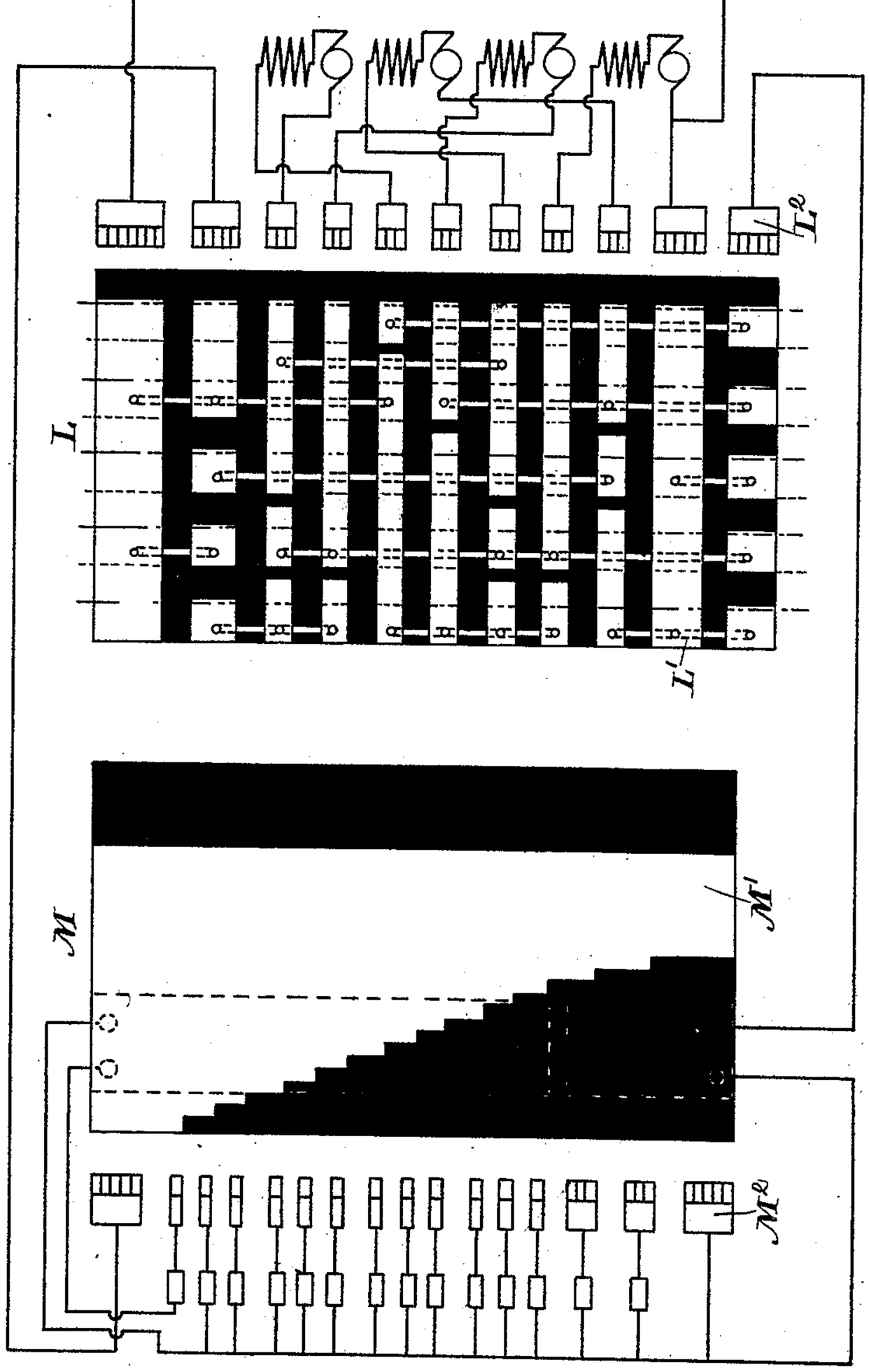
5 Sheets—Sheet 4.

E. H. DEWSON, Jr.

PNEUMATIC CONTROLLER.

No. 524,541. Patented Aug. 14, 1894.

FIG. 6.



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(No Model.) 5 Sheets—Sheet 5.

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PNEUMATIC CONTROLLER.

No. 524,541. Patented Aug. 14, 1894.

FIG. 10.

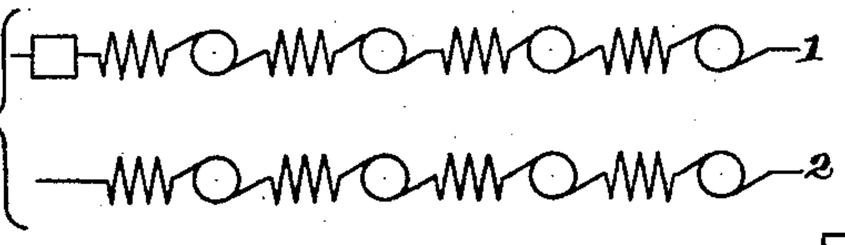


FIG. 11.

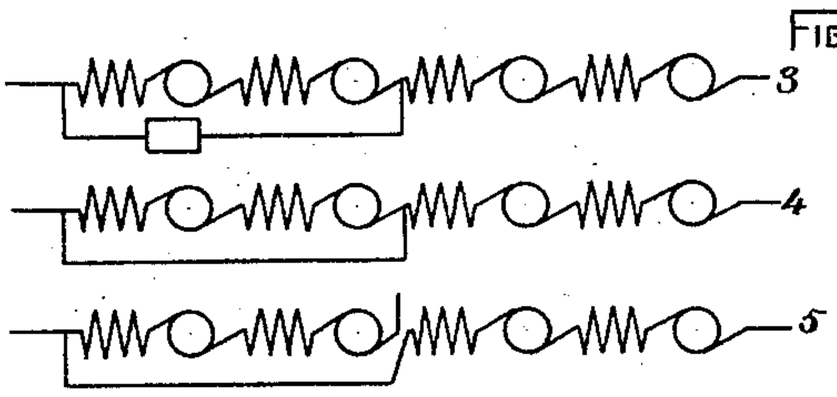


FIG. 12.

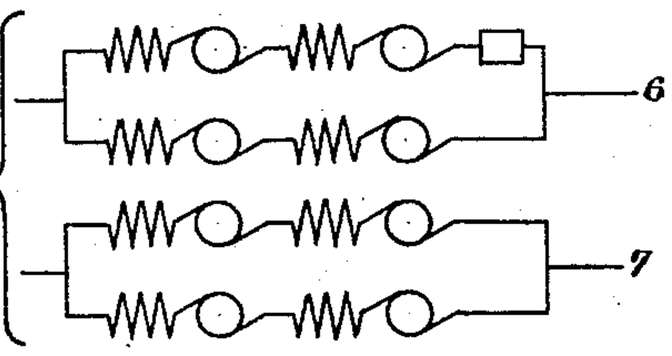


FIG. 13.

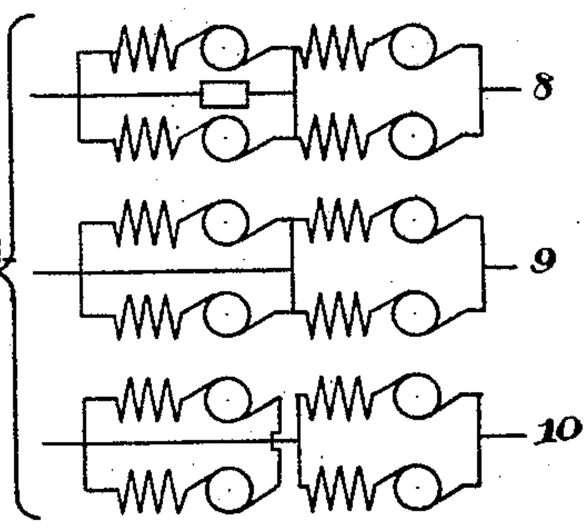


FIG. 14.

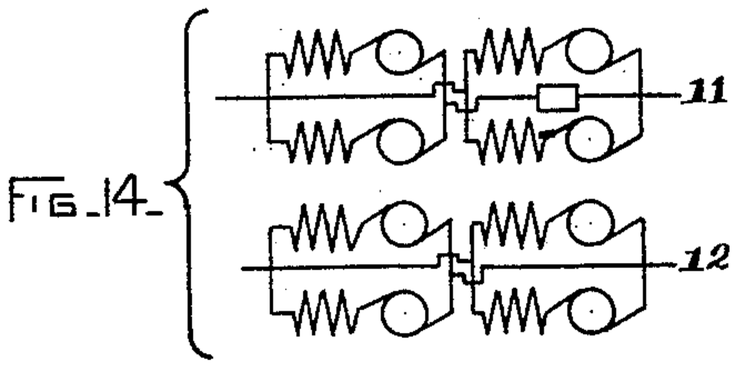
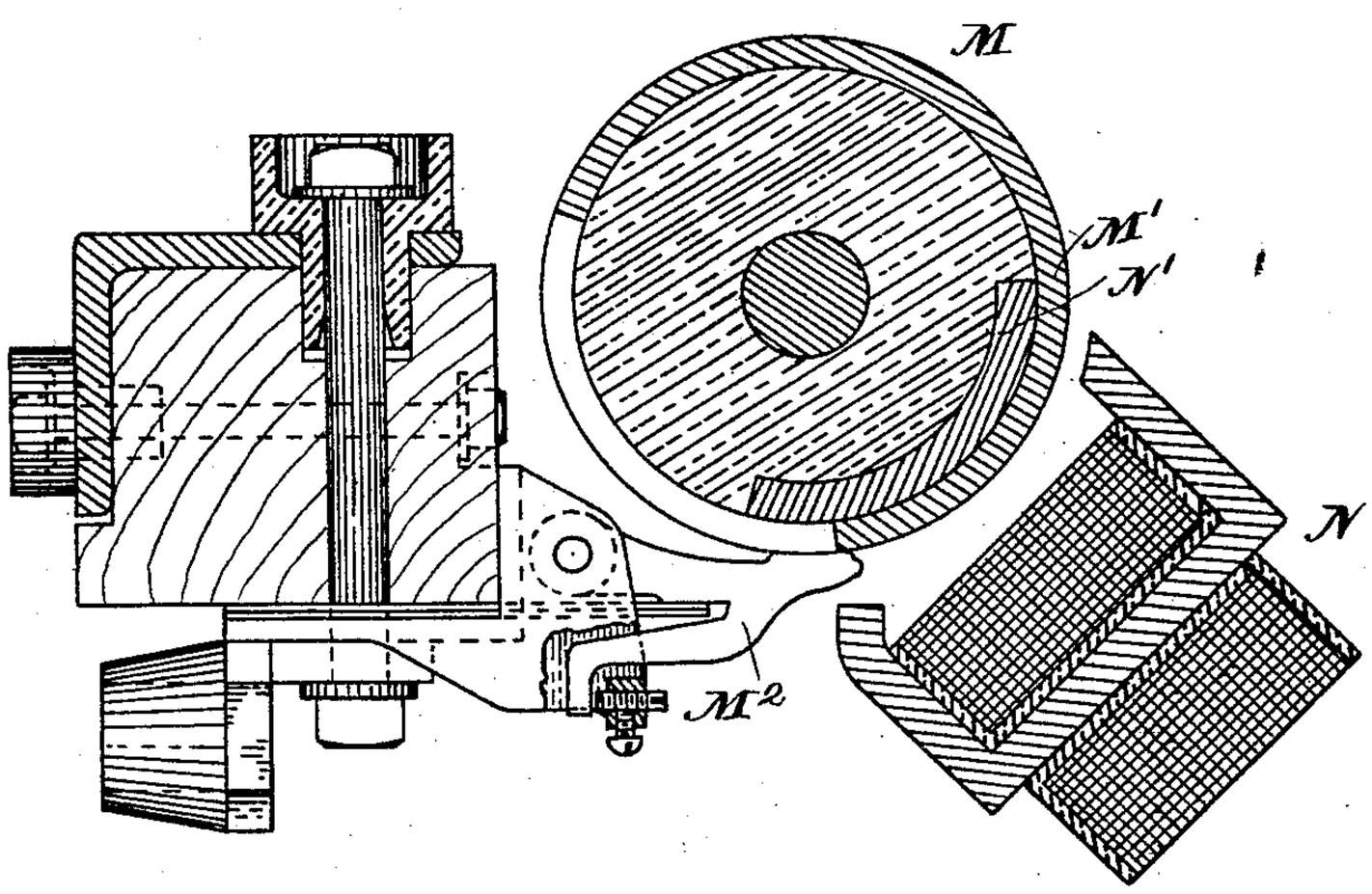


FIG. 9.



WITNESSES.
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UNITED STATES PATENT OFFICE.

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PNEUMATIC CONTROLLER.

SPECIFICATION forming part of Letters Patent No. 524,541, dated August 14, 1894.

Application filed April 11, 1893. Serial No. 469,859. (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, county of Essex, State of Massachusetts, have invented certain new and useful Improvements in Pneumatic Controllers, of which the following is a specification.

My invention relates to pneumatic or fluid-pressure controllers, and I have devised it especially with a view to its application to electric locomotives, although it might be equally well applied to other devices where an oscillatory or to and fro movement can be used.

In this specification and the accompanying drawings, I have shown and described my apparatus as applied to a switch for controlling electric locomotives having a plurality of motors, by changing the connections of the several motors through various steps from series to parallel and introducing resistance into the circuit at each change of connections to prevent arcing. This switch is fully described and claimed in an application for Letters Patent recently filed by Walter H. Knight and John W. Darley, Jr., and forms no part of the present invention, which relates only to means for operating such a switch or similar device.

In carrying out my invention I provide a cylinder or cylinders with a piston or system of pistons therein, and connections through which fluid pressure may be brought to bear on either side of the said piston or pistons causing a movement thereof in either direction at will. I prefer, however, on account of certain mechanical advantages hereinafter set forth to use two open ended cylinders, having their open ends opposed to each other, with a piston in each, the two pistons being connected together by a rod. Since I prefer this form, I have shown it in the accompanying drawings, and will refer more particularly to it in the following description, it being understood, however, that a single cylinder might be arranged so as to form a substantial equivalent for the two shown. These cylinders are respectively connected to a common source of fluid or gas under pressure, air being the most suitable medium, through independent pipes and a three-way cock, whereby the air or fluid may be admitted to either at will, so that the pistons and connecting rod will be forced from the cylinder into which the pressure medium is introduced toward the opposed cylinder, the movement of the rod in one direction or the other being thus controlled by the manipulation of the three-way cock. The movable rod carries a rack or other suitable gearing device whereby the switch cylinder is rotated. The switch cylinder has a stop-wheel rotating with it on the same axis consisting of a disk having its periphery cut away so as to form shoulders adapted to be engaged by a stop acting thereon and actuated by the same lever which controls the three-way cock between the source of pressure and the pipes leading to the cylinders. The said lever is provided with a catch traveling over a notched scale corresponding to the position of the stop or locking device aforesaid so that by placing the lever at the proper notch the stop-wheel and switch cylinder rotating therewith may be arrested at any desired point. The lever normally rests on the second notch in which position the cock is closed to both pipes. The first forward step of the lever (viz. from the second into the third notch) operates the cock so that pressure is brought to bear on the piston which operates the mechanism in its forward direction; at the second step the stop is moved so that the cylinder may rotate until brought up by the stop in its new position; at the third step the stop is again moved so that the cylinder may rotate a little further, and so on, the valve remaining in the same position, so that the operating piston is constantly under pressure. When it is desired to reverse the operation the lever is quickly brought back to the extreme end of the notched scale namely to the first notch, thereby reversing the valve and rotating the cylinder in the opposite direction.

The apparatus and mode of operation will now be more fully explained, reference being made to the accompanying drawings in which like letters represent like parts.

Figure 1 is an elevation of the apparatus with a portion cut away to show the rod and rack carried by the pistons and the pinion actuated thereby. The switch cylinders are also shown in dotted lines. Part of one of the air cylinders is in section to show the

piston. Fig. 2 is a cross section of the same on the line u, v, Fig. 1. Figs. 3 and 4 are sectional views of the cock. Figs. 5 and 6 are details in cross section on lines w, x, and y, z, of Fig. 1 respectively. Fig. 7 is a view of the apparatus applied to a series-parallel switch set forth in the application of Knight and Darley aforesaid. Fig. 8 is a development of the switch cylinder, to which I have shown my device as applied, with the contacts thereon, and the fixed contacts engaged thereby showing how the various combinations are effected by the revolution of the cylinder. Fig. 9 is a cross-section of a portion of the switch showing the resistance cylinder and blow-out magnet and Figs. 10, 11, 12, 13 and 14 are diagrams showing the circuit of four motors as affected by the switch.

Referring to Fig. 1, A and B are open-ended cylinders in line with each other having their open ends opposed to each other, and each is provided with a piston, the two pistons being connected together by a rod. A portion of the cylinder B is cut away, showing the piston B′ and the connecting rod C which carries the rack D. Meshing with the rack D is the pinion E to which is imparted a rotary motion in one direction or the other as the piston rod moves between the cylinders. This pinion carries with it the main switch cylinder L and the stop-wheel G the function of which will be hereinafter explained. In order to operate the rod, a suitable pressure medium such as compressed air is introduced to one cylinder or the orher through the pipes a and b respectively, by a pipe H communicating with a source of supply, and a three-way cock I connecting the pipe H to the pipe a or b as desired. The construction of the said cock is clearly shown in Figs. 3 and 4 in which i is the valve provided with a port i' having a wide mouth to receive air from the inlet H′ and a narrow opening which may be opposed, as the valve is turned, to the outlet a', to the closed portion i^2 or to the outlet b'.

a^2 and b^2 are exhaust ports for the discharge of air from the pipes a and b respectively; that is when air is admitted to cylinder A by turning the cock to the outlet a', the air from cylinder b exhausts through pipe b and port b^2 as the piston moves into said cylinder B.

i^3 is a spring which holds the valve in close contact with its seat.

To operate the valve, arms i^4 and i^5, (Fig. 1,) are radially attached to the shaft i^6 thereof, the former adapted to be engaged by a projection J^2 (Fig. 6) on the main operating lever J, and the latter acted on by a spring i^7 between it and some fixed part of the apparatus, as i^8. A projection i^9 is provided, against which the arm i^4 is normally held by said spring i^7 when not engaged by the lever J. In the position of the valve corresponding to said normal position of said valve arm i^4, pressure is admitted to the cylinder B, which tends to rotate the pinion E and the stop-wheel G from right to left and thus start the switch cylinder and the mechanism controlled thereby. The rotation of the stop-wheel, however, is at this stage of the operation prevented by a stop K hereinafter described, which is operated by the lever J, but not so operated until after the valve is opened to the cylinder B, a further movement of the lever being required after the valve is in its normal position aforesaid, to actuate the said stop K and release the stop-wheel. The said stop-wheel G consists of a disk having its periphery radially cut into at predetermined intervals so as to form, as it were, a consecutive series of integral concentric segments increasing in length of radius from the starting point of rotation, so that the periphery of the disk is made up of a series of concentric arcs terminated respectively by the shoulders g', g^2, &c. These shoulders are adapted to be engaged as the disk rotates in its forward direction by a stop K consisting of a bolt or bar spring-pressed against the periphery of the disk. A spring K′ for this purpose is shown in Fig. 1 attached to a ring or projection on cylinder B.

The stop K travels in a grooved track K^2 radial to the periphery of the stop-wheel and is shown in the drawings in its normal position, namely against the periphery of the stop-wheel and engaged by the shoulder g' whereby the said stop-wheel is held stationary in its initial position. A slot K^3 (shown in dotted lines Fig. 1) is provided near the outer end of said stop, whereby the arm J′ of the lever J is free to engage with the portion K^4 of the stop K and draw said stop away from the stop-wheel as the lever J is pushed down. A reverse movement of the lever, however, is not communicated to the stop so that its movement in the other direction is entirely dependent upon the spring above described. The lever J is provided with a supplementary handle j controlling a catch j' adapted to engage successively with the notches j^2 j^3 j^4, &c., each of which corresponds to a predetermined position of the switch cylinder as will now be described. Assuming the lever to be in such a position that the catch j' is in the notch j^3 (in which position the valve I is closed) let it be moved to the next position with catch j' in notch j^4. The valve, following the lever through the action of its spring i^7, is then open to the pipe b and pressure is brought to bear on the piston B′. The arm J′ however has not yet acted on the stop K but is in contact with portion K^4 ready to move the stop at the next step. The lever J is now in a neutral position between the valve and the stop, both of which are in their normal positions and substantially acting against one another so that pressure is at hand to rotate the cylinder as soon as the removal of the stop K from engagement with shoulder g' will admit of such movement. The lever is then pushed down until the catch j' is in the notch j^5, thus withdrawing the stop K from the shoulder g' and permitting the cylinder to rotate until stopped by the shoulder g^2 coming in contact

with the stop K, it being understood that the valve is constantly open to cylinder B during the further movement of the lever in this direction. The next stop brings the shoulder g^3 into contact with the stop K, after due rotation of the cylinder, and so on around to g^{12} which is the limit of positive rotation of the stop-wheel. The segment between g^{12} and g' forms a long shoulder g^{13}, which engages the stop K when the cylinder has completed its rotation in its backward direction and reaches its initial position after a reversal of the valve as shown hereinafter. Since the operating lever is so arranged that the valve must be in a position to admit pressure to the piston B′ before the stop K can be operated at all, it is obvious that the action of the switch will be sudden and rapid, and that said switch will be firmly and positively held at the desired position determined by the position of the lever and stop, by the pressure constantly tending to rotate it and the stop acting against the pressure to prevent rotation. In its application to an electric switch this is an important feature, since it is essential that the changes of connection be made rapidly and absolutely without the possibility of resting in an intermediate position where a destructive arc might be playing unknown to the operator.

When it is desired to reverse the switch and stop the motor the operation is as follows: The lever J is quickly brought back to the position shown in Fig. 1 of the drawings with the catch j' in notch j^2, thereby engaging the arm i^4 of the valve and turning said valve to admit pressure to the pipe a, when the cylinder will begin to rotate in the opposite direction, while the stop K under the action of its spring will pass from one shoulder to another of the stop-wheel like a pawl on a ratchet without affecting the rotation of said stop-wheel. Suppose for example the lever is in the last position (notch j^{15}) and the stop K against the shoulder g^{12}. When the lever is drawn back to the first position, air is admitted to cylinder A rotating the stop-wheel from left to right. When the shoulder g^{11} reaches the stop, the latter under the action of its spring drops over said shoulder to the surface of the next and the stop-wheel continues to rotate until it reaches its normal position between the shoulder g' and the long shoulder g^{13} on the opposite side of the segment which forms shoulder g^{12}. The cylinder is now held by the stop K so that it cannot rotate in either direction until said stop is operated again by the lever J; and the motors are out of circuit.

If it is desired to reduce the speed of the motors by stopping the switch cylinder at any intermediate position when rotating in its backward direction (from left to right) the lever is quickly brought to the position shown in the drawings, and the cylinder allowed to rotate in its backward or negative direction until just after the desired point is reached, when the lever may be returned to the proper notch j^2, reversing the direction of rotation of the cylinder and setting the stop K so as to engage the desired portion of the stop-wheel. Suppose, for example, the stop is at g^{12} and it is desired to move the switch one step back. The lever is moved as just described to notch j^3 and held there until the indicator G′ which may be provided with a suitable scale on the casing of the device, although it is not shown in the drawings, shows that the shoulder g^{11} has passed the stop, and then the lever is quickly moved to notch j^{14}, when the cylinder is reversed and stopped at g^{11}.

It is of course obvious that the stop-wheel G may be arranged in any manner suitable for the work it has to do; that is the cuttings may be so spaced that the cylinder will travel any predetermined distance at each step in the regulation. Notches or teeth moreover might be substituted for the shoulders shown in the drawings by slightly modifying the arrangement of the operating lever. In the present instance it will be noted that as the cylinder begins to rotate it travels a very short distance at each step, but after it has completed about a fifth of its revolution a considerable distance is traversed at one movement of the lever. The reason for this is that it would be unsafe to take the first steps in controlling electric motors suddenly, while after the motors have attained a considerable rate of speed, so that counter-electro-motive force is being developed, it is possible to change connections rapidly. This is fully set forth in the application of Knight and Darley above referred to. It is obvious, however, that the same principle would apply to any other source of motive power in overcoming the inertia at starting.

The special advantage of a pneumatic controller of this kind is its absolute accuracy in obeying the movement of the lever and the certainty that the switch will be in precisely the position indicated by the lever, while a mechanically operated switch is liable through looseness of gearing or other cause, to fail in the accuracy of action required in this work. The pressure medium may be easily obtained by means of a compressing pump operated by a small motor in the same circuit with the locomotives; and if an air brake is to be used the same source can be made to supply both brake and controller.

The apparatus embodied in my invention, comprising two open ended cylinders with a connecting-rod reciprocating between them is simple and compact. The cylinders themselves afford a support and guide for the rod, obviating the need of special guides or ways for the same, as would be necessary with a double-headed cylinder. The valve arrangement also is simple and effective, admitting as it does a constant supply of the pressure medium to the working cylinder during the "step-up" movement of the switch cylinder

controlled by the operating lever and step-by-step device described, without the possibility of being accidentally shut off, since it is independent of the operating lever when once opened.

The switch or controller for the operation of which I have especially designed my pneumatic device herein set forth, is illustrated in Figs. 7 to 14 of the drawings, and may be briefly described as follows: It consists of two cylinders, L and M, the cylinder L carrying a series of contacts L′ engaged by brushes L^2 connected to the terminals of the motors, so that by its rotation the motors may be connected up in various ways; and the cylinder M carrying a single contact M′ connecting as it rotates with a series of rheostat terminals M^2, so as to bring more or less resistance into circuit to prevent arcing while the changes of connection are being made. The two cylinders are geared together, so that the cylinder M or rheostat cylinder, makes five revolutions, while the cylinder L, or switch cylinder, makes only one, whereby the same resistance is used five times during one complete change in the connections of the motors. The rheostat cylinder is so adjusted that by its rotation the full resistance afforded by the rheostat is in circuit at the beginning of a change of motor connections and decreased gradually until the change is effected, when no resistance is left in circuit. A blow-out magnet N is provided for the purpose of extinguishing any arc that may be formed at the contacts, and in order to render said magnet more efficient a plate of iron N′ is placed within the cylinder M and underneath the contact plate thereon forming an armature for said magnet when the said cylinder is in the position where the action of the magnet is required, said plate or armature completing the magnetic circuit.

The drawings show the general construction of the apparatus clearly enough for the purposes of the present application, and it is not deemed necessary to go into a more detailed description. Fig. 7 illustrates the switch with my pneumatic controlling device applied thereto, and indicates plainly the manner in which the main or switch cylinder L is rotated by the pinion E and controlled in its rotation by the stop-wheel G, as hereinbefore described, and also shows the connection between the two switch cylinders through the gear-wheels L^3 and M^3. The general arrangement of the motor and rheostat connections and the blow-out magnet may also be readily understood from this figure. Figs. 10 to 14 show in diagram the changes in connections of the four motors as applied to which this switch is shown; first, all in series with a resistance; second, in series with no resistance, (both of said stops being shown in Fig. 10;) third, two motors short-circuited through a resistance and the remaining two in series; fourth, the same, with the resistance cut out of the short circuit; fifth, two motors open-circuited and the remaining two in series (the third, fourth and fifth steps being shown in Fig. 11); and so on to the last step in Fig. 14 where all four motors are connected in parallel, it being unnecessary to trace the intermediate stages.

While I have stated that my pneumatic device herein set forth may be used with switches of any kind, or even rheostats, it is of especial value in connection with switches of the kind set forth in the application of Knight and Darley above referred to, and herein shown and briefly described, inasmuch as these switches when used to establish different groupings of a number of large railway motors, are of necessity very complicated and require an exactitude of operation which can be attained only with a powerful mechanical controller or operating device such as I have herein shown.

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

1. In a pneumatic controller, a cylinder, a piston therein geared to the switch or other device to be operated, a valve controlling the admission of air or other fluid under pressure to said cylinder, a stop adapted to control the movement of said switch, and a common lever which first operates said valve and then actuates said stop to control the movement of the switch.

2. In a pneumatic controller, actuated by constantly acting pressure, a step-by-step device comprising a rotating disk co-operating in its movement with the switch to be controlled, shoulders on the periphery of said disk, a stop consisting of a bolt or bar radial to said disk, and means whereby said bar may be caused to engage with any of said shoulders and hold the switch in the position desired, substantially as described.

3. In a pneumatic controller actuated by constantly acting pressure, a step-by-step device comprising a rotating disk co-operating in its movement with the mechanism to be controlled, and having its periphery made up of a series of arcs to its own center of rotation, the said arcs increasing in length of radius from the starting point of forward rotation, whereby a series of shoulders g, g', g^2, &c., are formed thereon, and a stop consisting of a bolt or bar adapted to be moved to and fro in a direction radial to said disk so as to engage with any of said shoulders at will to stop said disk and the mechanism controlled thereby in any of a number of positions predetermined by the arrangement of the shoulders on the disk.

4. In a pneumatic controller actuated by constantly acting pressure in either direction, a step-by-step device consisting of a rotating disk co-operating with the mechanism to be controlled, said disk being limited in its forward movement by mechanical means manually controlled, but free to move in the reverse direction if so actuated, until it reaches its initial position, or until it is stopped and

again actuated in its forward direction by a reversal of the actuating pressure.

5. In a pneumatic device for operating motor controllers a source of substantially constant pressure, a piston actuated thereby, a valve controlling the pressure medium and determining the direction of movement of the said piston, a regulating or step-by-step device for limiting and controlling the movement of said piston, and common means for operating said valve and step-by-step device as described.

6. In a pneumatic device comprising a cylinder and reciprocating piston, a three-way valve controlling the admission of pressure to said cylinder, said valve being normally held open by a spring to admit pressure to one side of said piston, a step-by-step device substantially as described adapted to limit the movement of said piston after said valve is in its normal position aforesaid, and a lever operating said step-by-step device after said valve is in said normal position and adapted by a reverse movement to close and then reverse the valve without acting on the step-by-step device.

7. In a pneumatic device actuated by a reciprocating piston, the combination with a valve for admitting pressure to said piston to operate the same, of a step-by-step device substantially as described, limiting and determining the movement of the said pneumatic device, and an operating lever whereby said valve and step-by-step device are co-operatively controlled.

8. In a pneumatic device actuated by a reciprocating piston, the combination with a valve for admitting pressure to one side or the other of said piston to operate the same in either direction, of a step-by-step device substantially as described limiting and determining the movement of the said pneumatic device in one direction but not in the other, and an operating lever whereby said valve and step-by-step device are co-operatively controlled.

9. The combination with a three-way cock for operating a pneumatic reciprocating system, of a step-by-step device substantially as described for controlling and limiting the movement of said system, and common means for operating said cock and said step-by-step device as set forth.

10. The combination with a three-way cock for operating a pneumatic reciprocating system, of a step-by-step device substantially as described for controlling and limiting the movement of said system in one direction but not in the other, and common means for first operating said cock so that pressure is admitted to said system before said system is released by said step-by-step device, and afterward operating said step-by-step device to release and control the further movement of said system, substantially as set forth.

11. The combination with a three-way cock for operating a pneumatic reciprocating system, of a step-by-step device substantially as described for controlling and limiting the movement of said system, a cylinder geared to said system and rotated thereby carrying electric contacts on its surface whereby the terminals of a plurality of electric motors are variously connected and the power and speed of said motors thereby controlled, and common means for manually operating said valve and said step-by-step device as set forth.

12. The combination with a double open-ended cylinder having co-operating reciprocating pistons actuated by fluid pressure in said cylinders, of a rack carried by said pistons, a pinion meshing therewith, and a cylinder rotating with said pinion and carrying electrical contacts whereby the connections of a plurality of motors are varied as and for the purpose described.

13. The combination with two open-ended cylinders having their open ends opposed to each other, of a reciprocating system comprising a piston in each cylinder and a connecting rod between said pistons, the whole of said reciprocating system being supported and guided by said cylinders, and operated in one direction or the other by pressure admitted to said cylinders respectively, and a rack carried by said connecting rod whereby the reciprocating movement thereof is translated and utilized.

14. The combination with a switch or similar device to be operated, of a cylinder, a reciprocating piston therein, a valve controlling the admission of fluid pressure to said cylinder, gearing between said piston and said switch, a stop acting on a series of shoulders moving with said switch to control the extent of movement thereof, and a common operating device for said valve and said stop.

15. The method of pneumatically controlling an electric switch or similar device, which consists in first subjecting the said device to air pressure tending to actuate it, and then controlling mechanically the movement of the switch due to said pressure.

16. The method of controlling an electric switch or similar device, which consists in first subjecting said device to air pressure tending to actuate it in one direction, said device being mechanically locked until after said air-pressure is caused to act thereon, then unlocking said device and regulating the consequent movement thereof, and finally reversing the direction of the said pressure whereby the device is actuated in the opposite direction until restored to its normal position.

17. The method of controlling an electric switch or similar device, which consists in first subjecting said device to air pressure tending to actuate it in a forward direction, then mechanically releasing and controlling the consequent movement of said switch, then reversing the direction of action of said pressure so as to actuate said switch in a backward direction, and finally causing said switch

to rest in the desired intermediate position by again reversing the direction of action of said pressure so as to stop the backward movement of said switch and again actuate it in its forward direction, and then mechanically controlling its movement in said forward direction as before.

In witness whereof I have hereunto set my hand this 7th day of April, 1893.

EDWARD H. DEWSON, JR.

Witnesses:
H. J. LIVERMORE,
ALEC F. MACDONALD.