No. 702,931. Patented June 24, 1902.

F. L. DODGSON & M. CORRINGTON.

PNEUMATIC RAILWAY SWITCH AND SIGNAL APPARATUS.

(Application filed Oct. 26, 1901.)

(No Model.) 7 Sheets—Sheet 1.

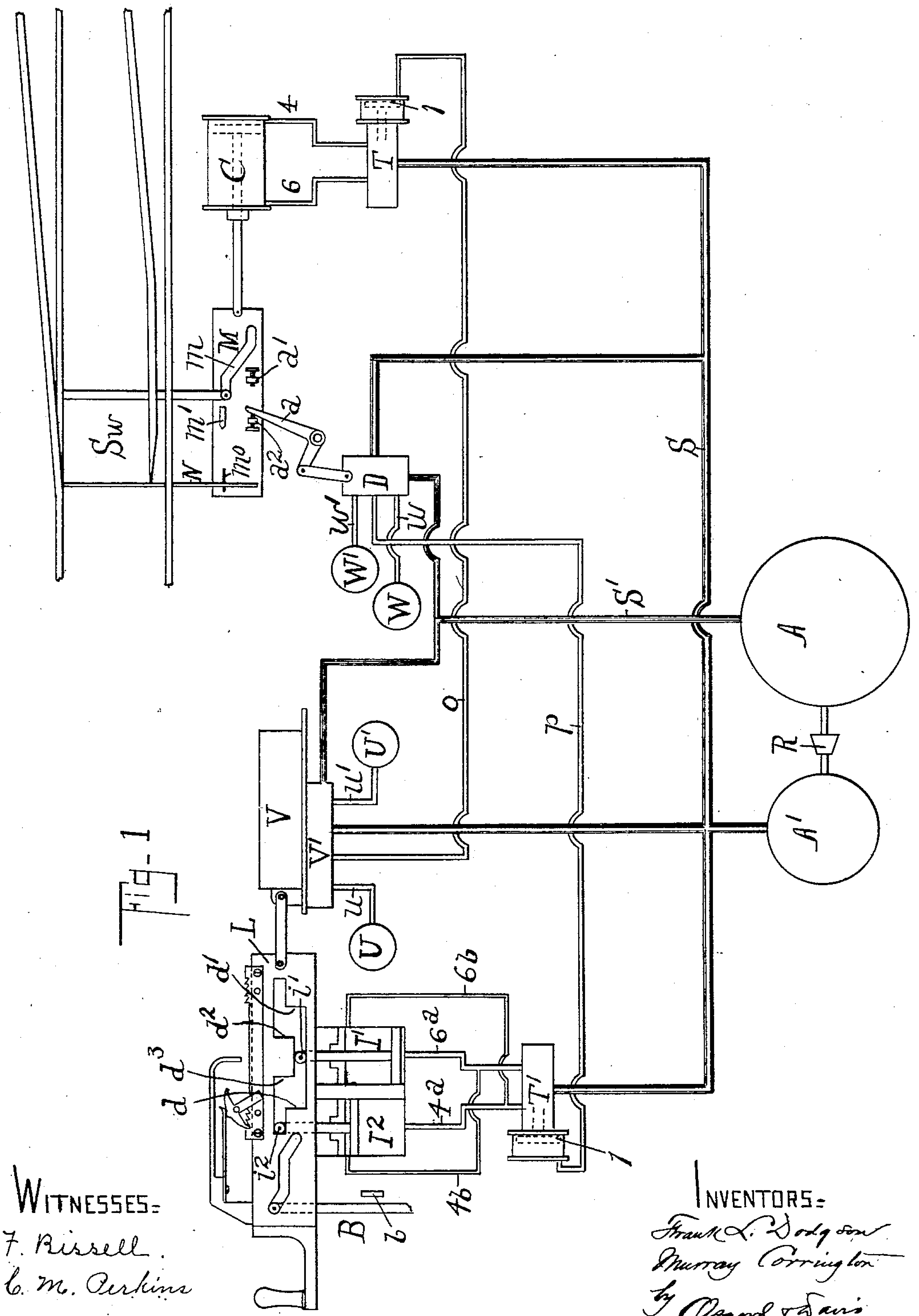


Fig. 1

WITNESSES:
F. Russell.
C. M. Perkins

INVENTORS:
Frank L. Dodgson
Murray Corrington
by Osgood & Davis
Attys

THE NORRIS PETERS CO., PHOTO-LITHO., WASHINGTON, D. C.

No. 702,931. Patented June 24, 1902.

F. L. DODGSON & M. CORRINGTON.

PNEUMATIC RAILWAY SWITCH AND SIGNAL APPARATUS.

(Application filed Oct. 26, 1901.)

(No Model.) 7 Sheets—Sheet 2.

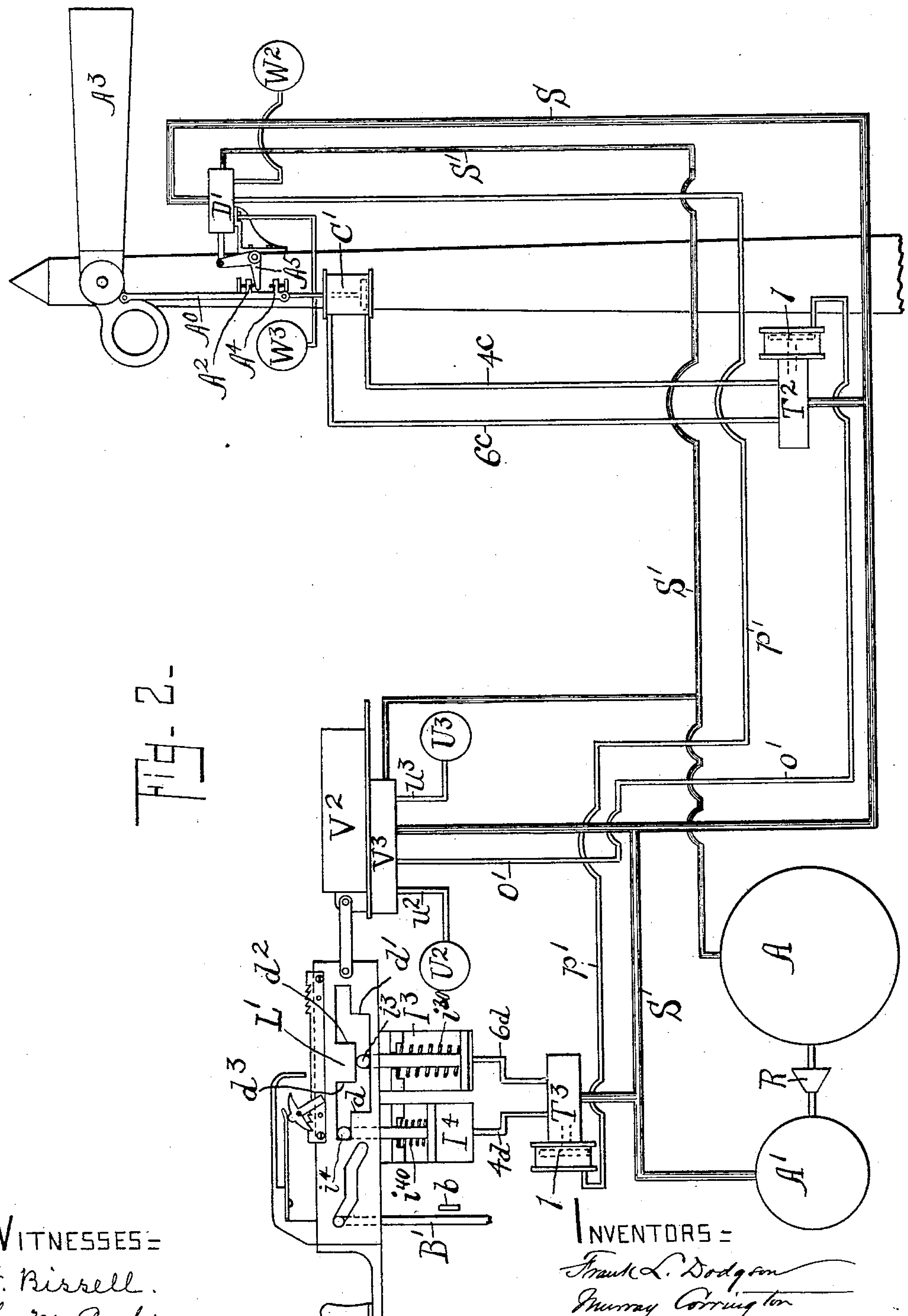


FIG. 2.

WITNESSES:
F. Bissell.
C. M. Perkins.

INVENTORS:
Frank L. Dodgson
Murray Corrington
by Osgood & Davis Attys

THE NORRIS PETERS CO., PHOTO-LITHO., WASHINGTON, D. C.

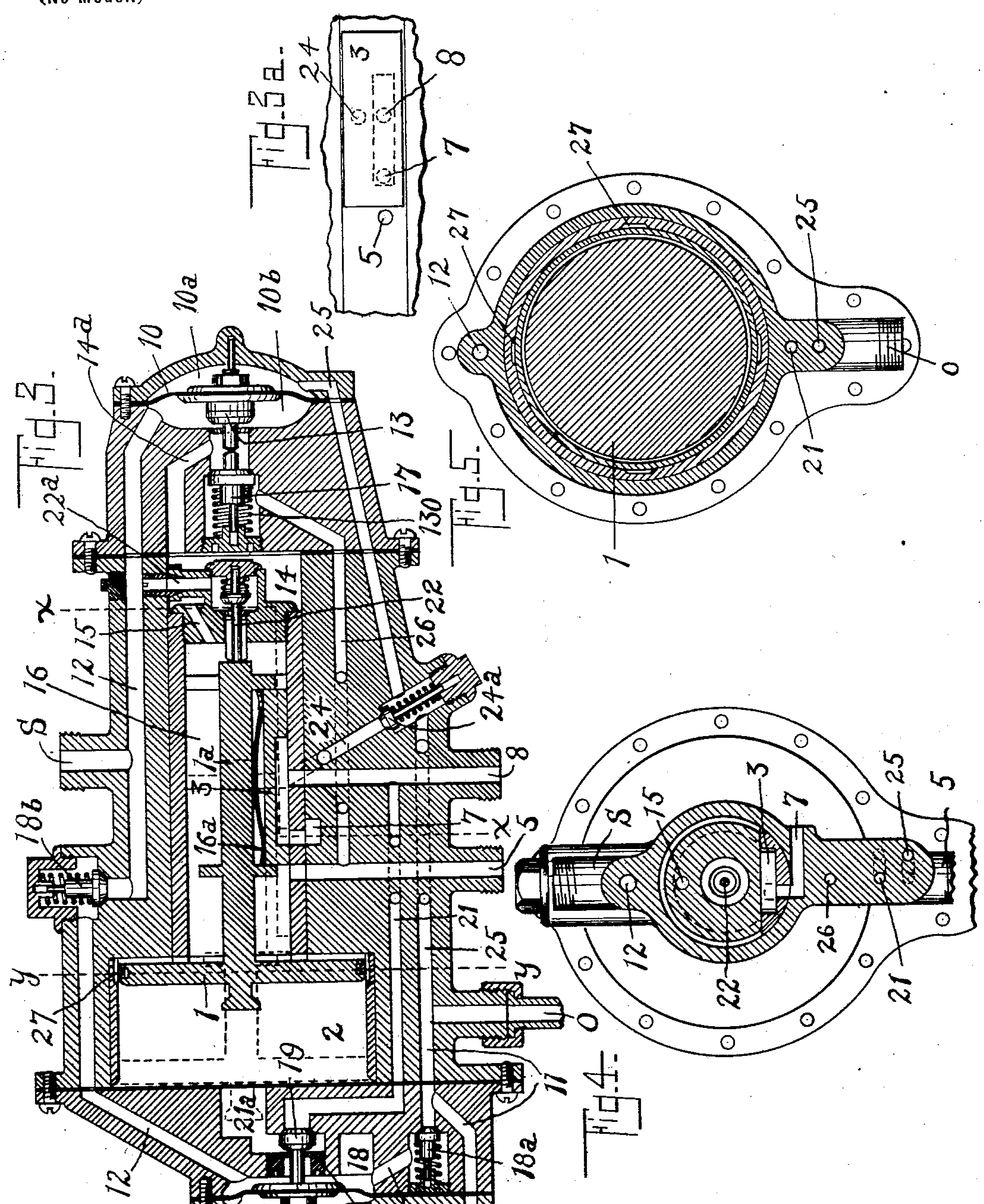
No. 702,931. Patented June 24, 1902.

F. L. DODGSON & M. CORRINGTON.

PNEUMATIC RAILWAY SWITCH AND SIGNAL APPARATUS.

(Application filed Oct. 26, 1901.)

(No Model.) 7 Sheets—Sheet 3.



WITNESSES_

C. M. Perkins.

F. Bissell

INVENTORS_

Frank L. Dodgson

Murray Corrington

by Osgood & Davis Attys

THE NORRIS PETERS CO., PHOTO-LITHO., WASHINGTON, D. C.

No. 702,931. Patented June 24, 1902.

F. L. DODGSON & M. CORRINGTON.

PNEUMATIC RAILWAY SWITCH AND SIGNAL APPARATUS.

(Application filed Oct. 26, 1901.)

(No Model.) 7 Sheets—Sheet 4.

Fig. 6.

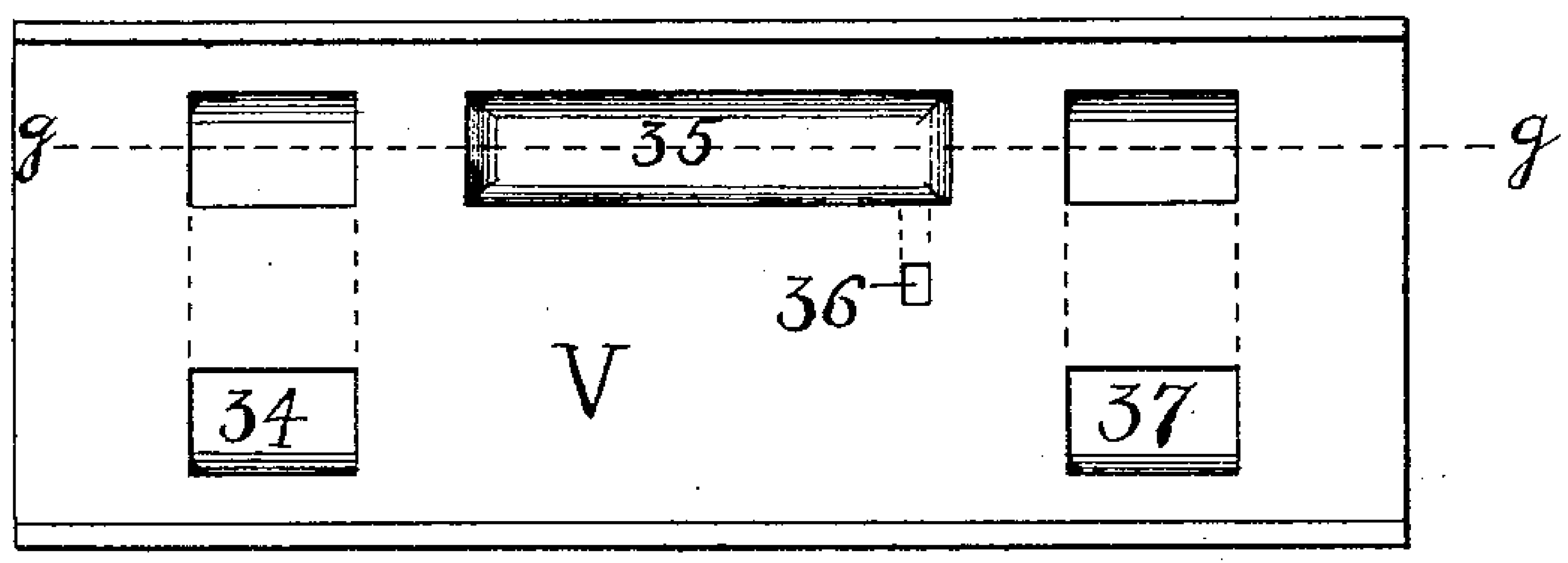


Fig. 7.

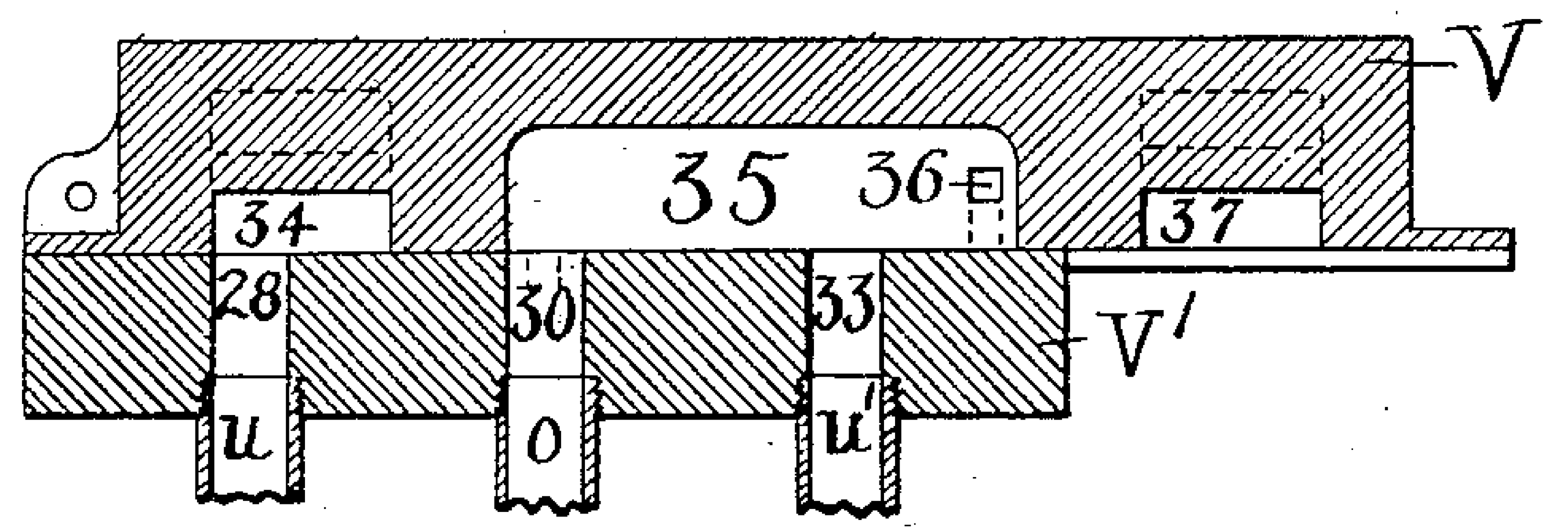


Fig. 8.

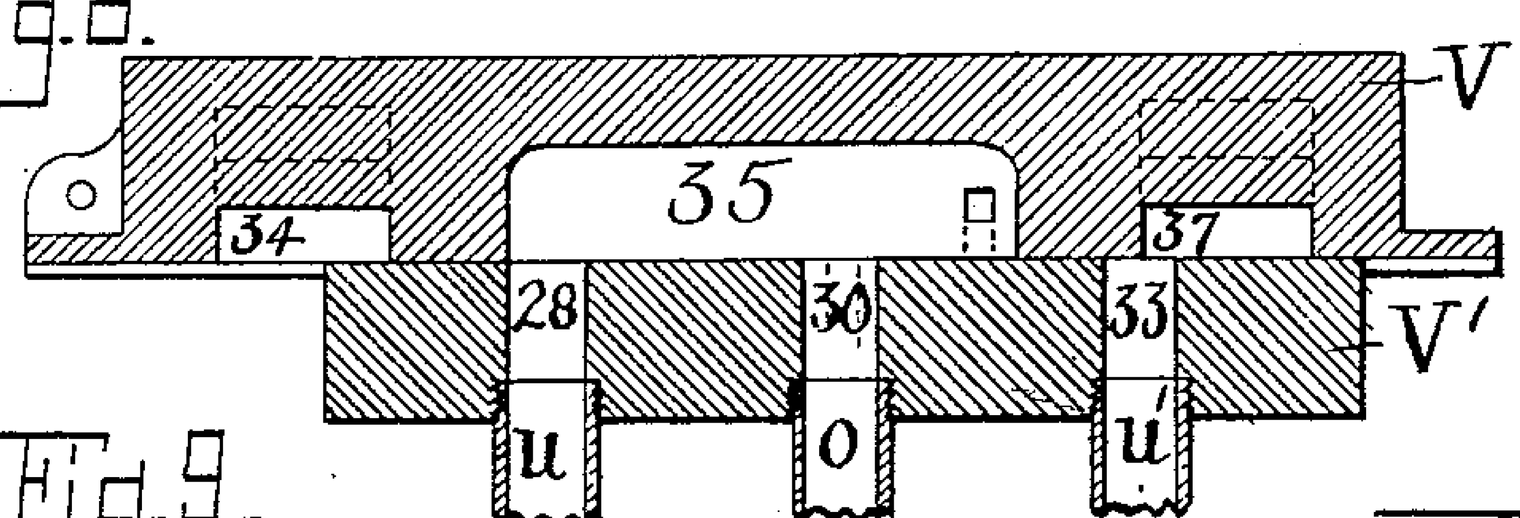


Fig. 9.

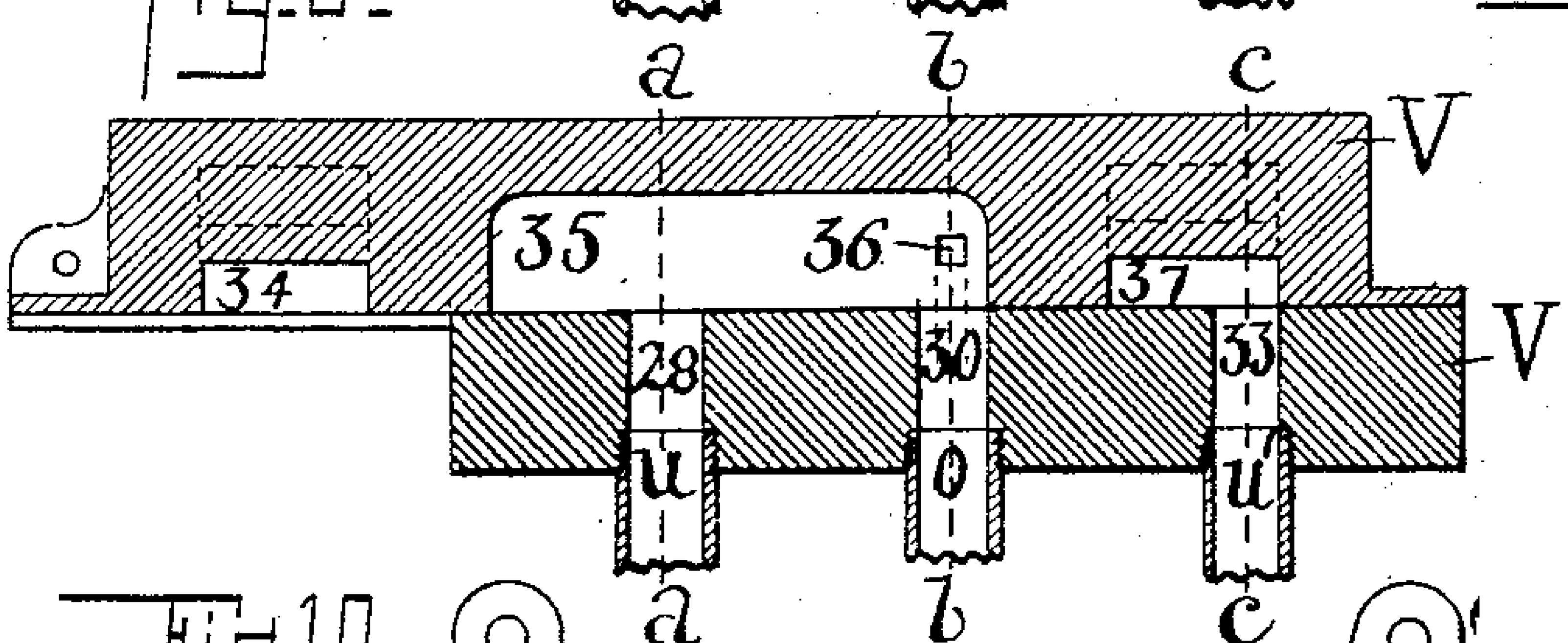


Fig. 11.

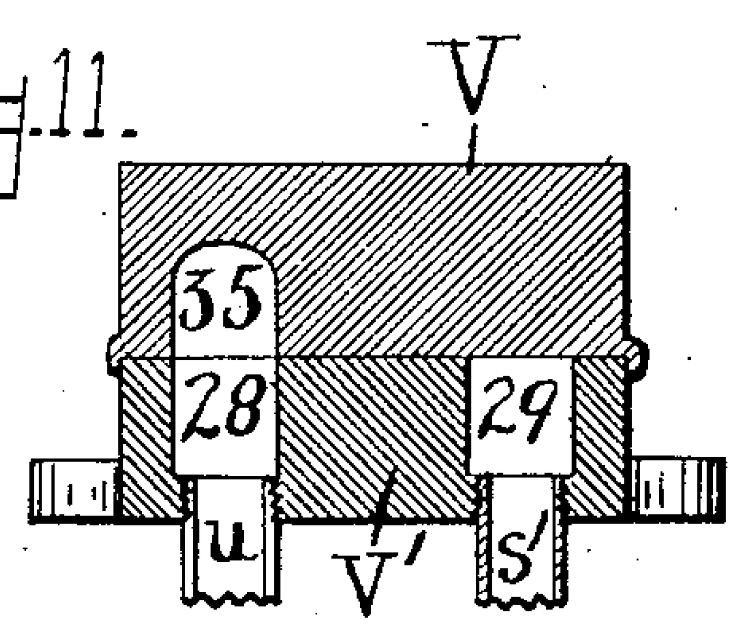


Fig. 10.

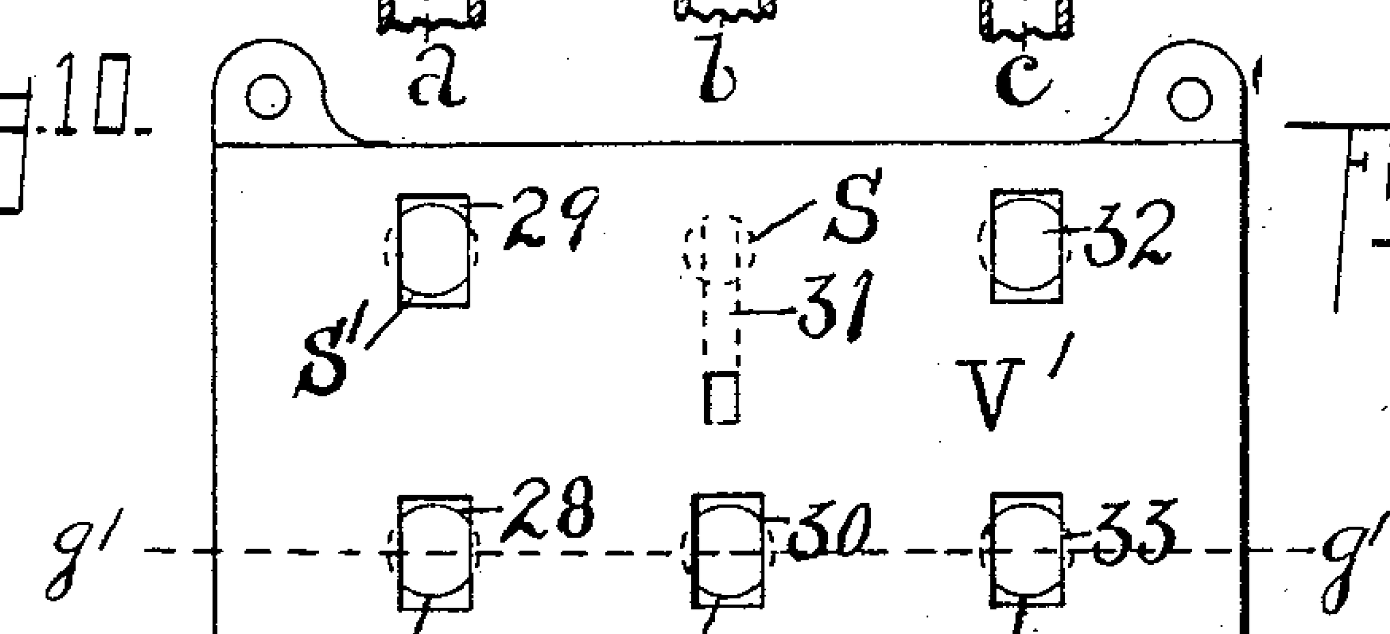


Fig. 12.

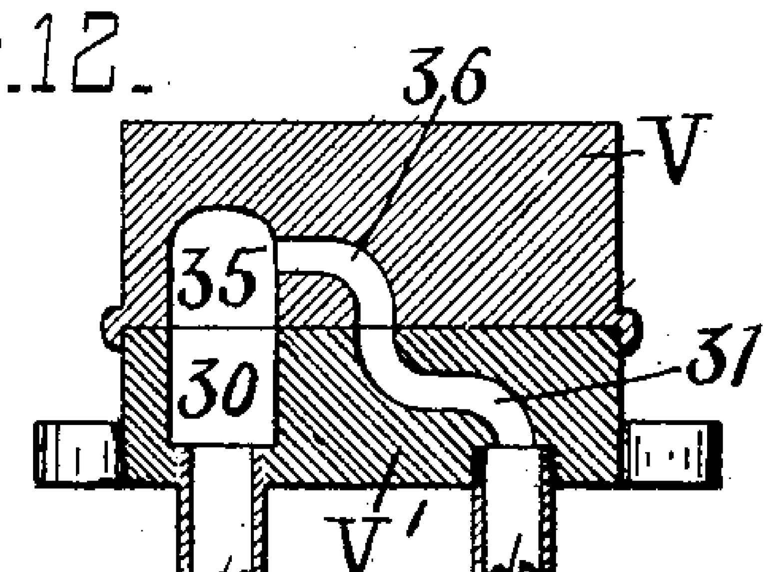
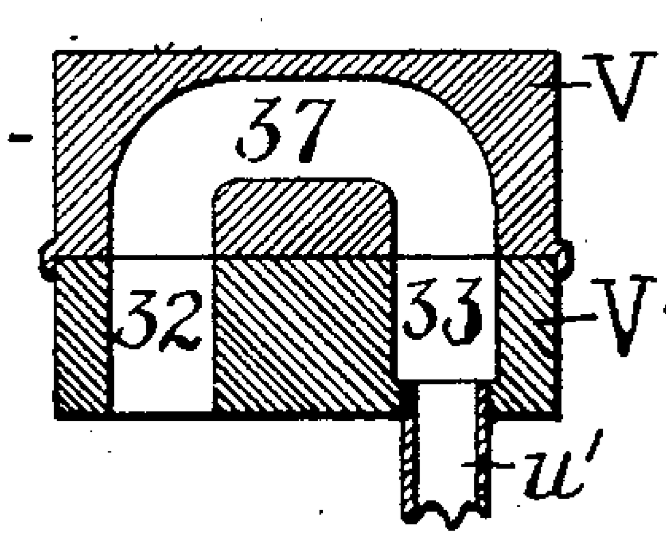


Fig. 13.



WITNESSES:
F. Bissell
C. M. Perkins.

INVENTORS:
Frank L. Dodgson
Murray Corrington
by Osgood & Davis
Attys.

THE NORRIS PETERS CO., PHOTO-LITHO., WASHINGTON, D. C.

No. 702,931. Patented June 24, 1902.

F. L. DODGSON & M. CORRINGTON.

PNEUMATIC RAILWAY SWITCH AND SIGNAL APPARATUS.

(Application filed Oct. 26, 1901.)

(No Model.) 7 Sheets—Sheet 5.

Fig. 14.

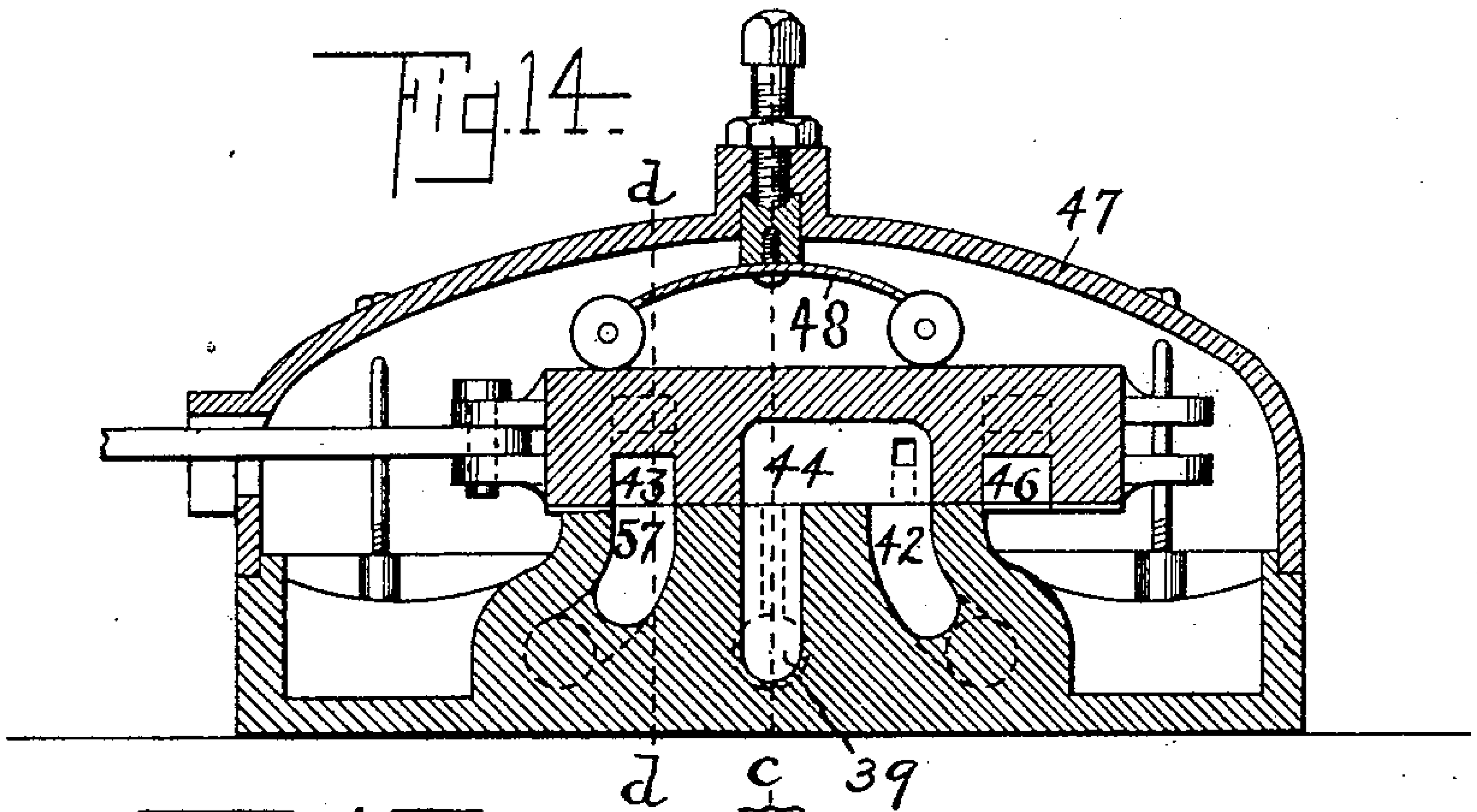


Fig. 15.

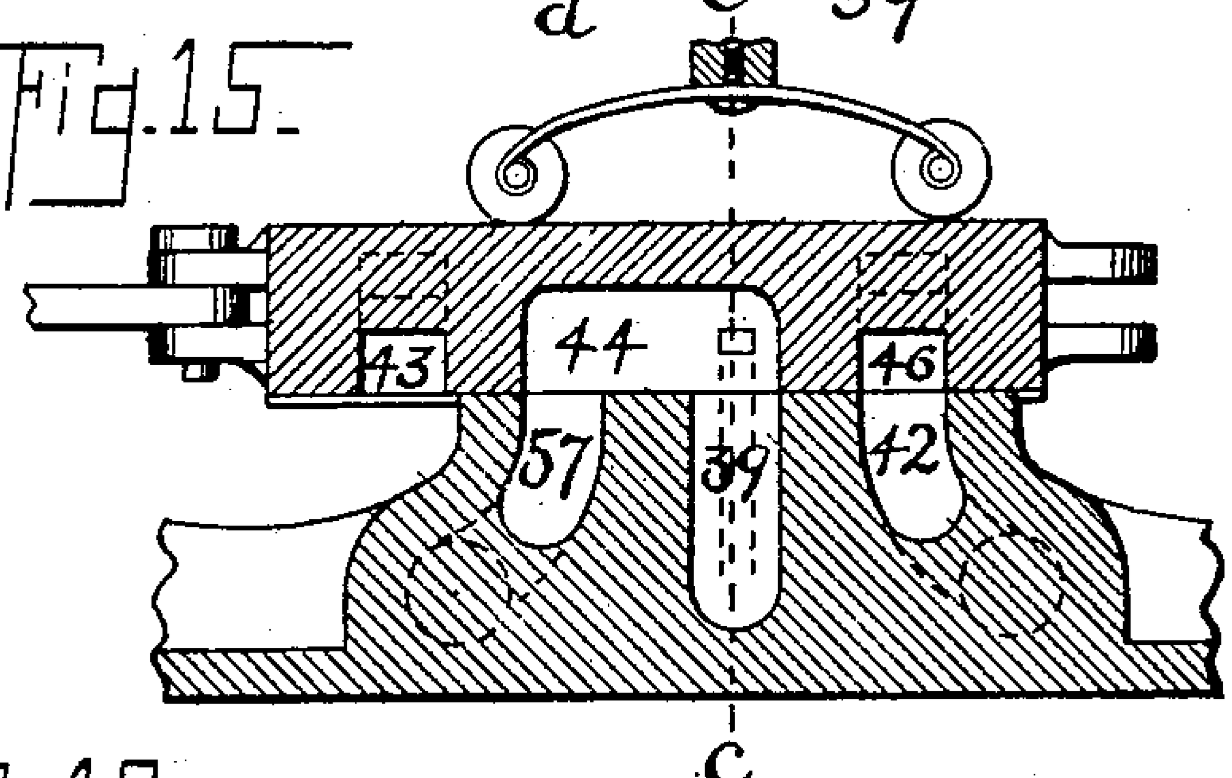


Fig. 16.

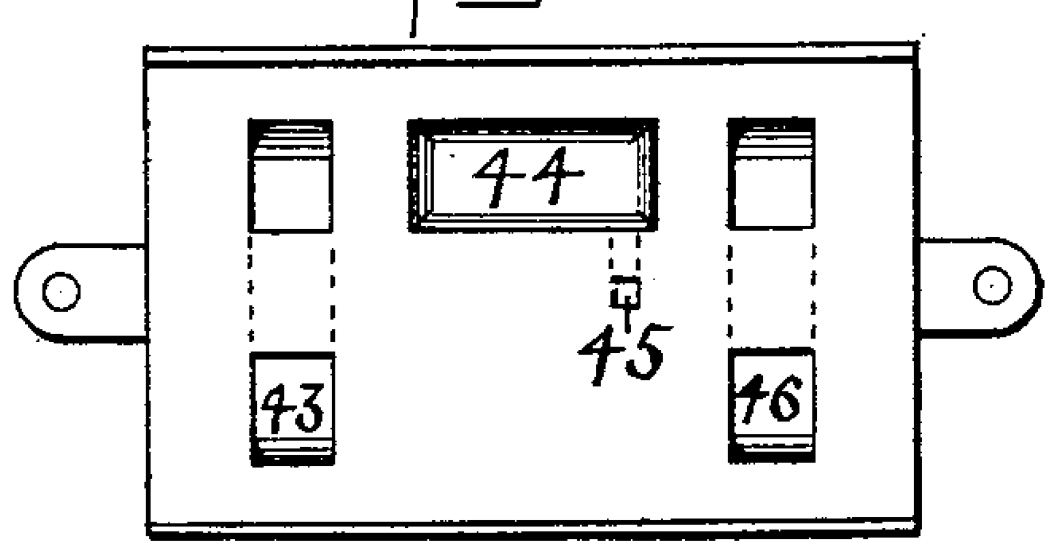


Fig. 18.

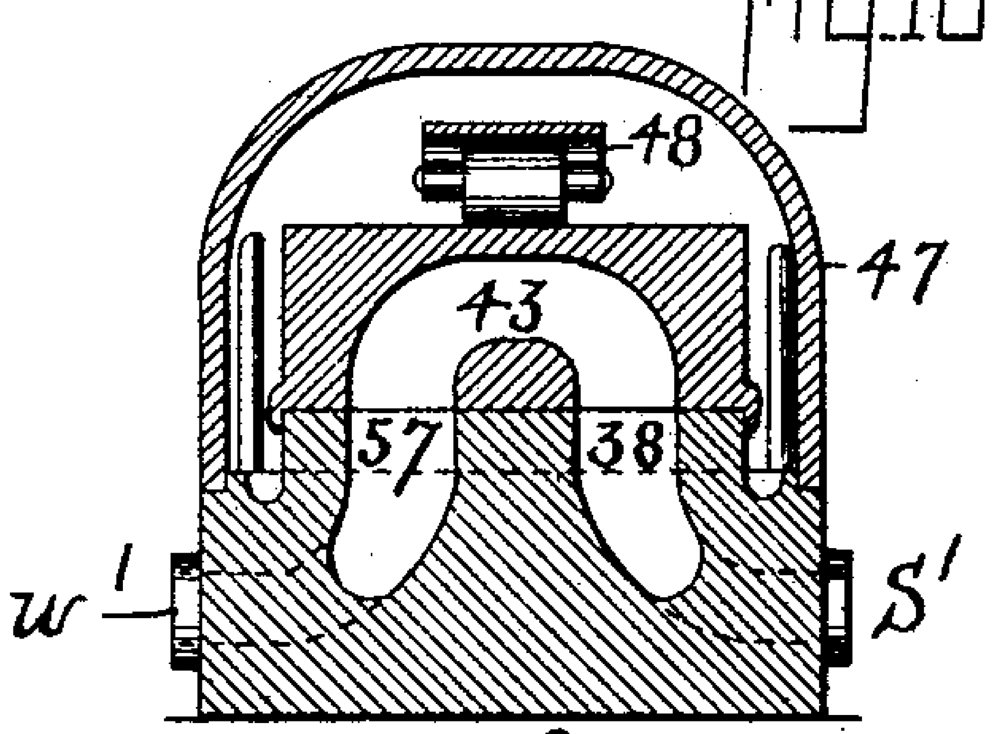


Fig. 17.

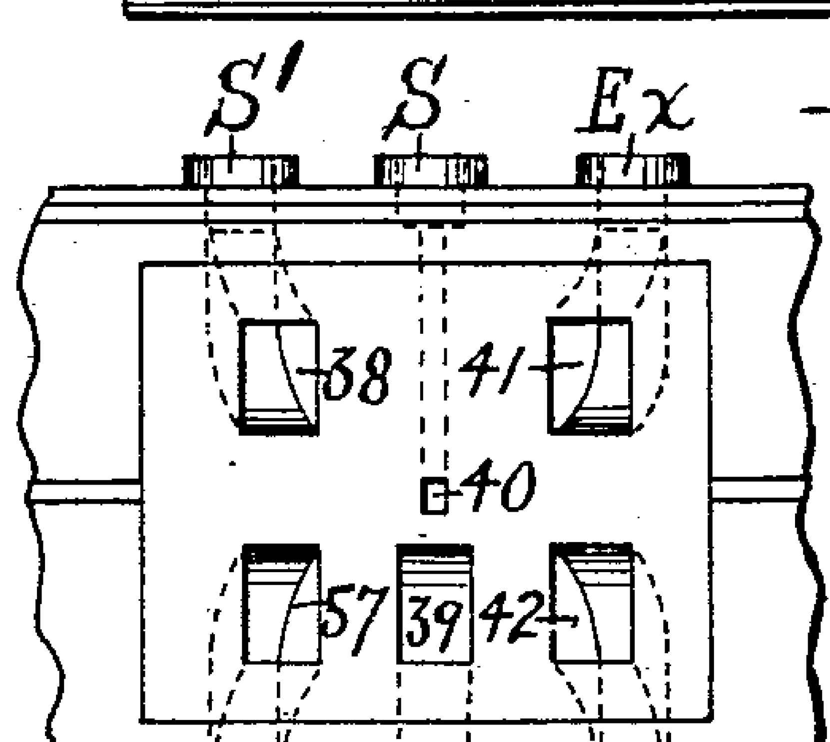
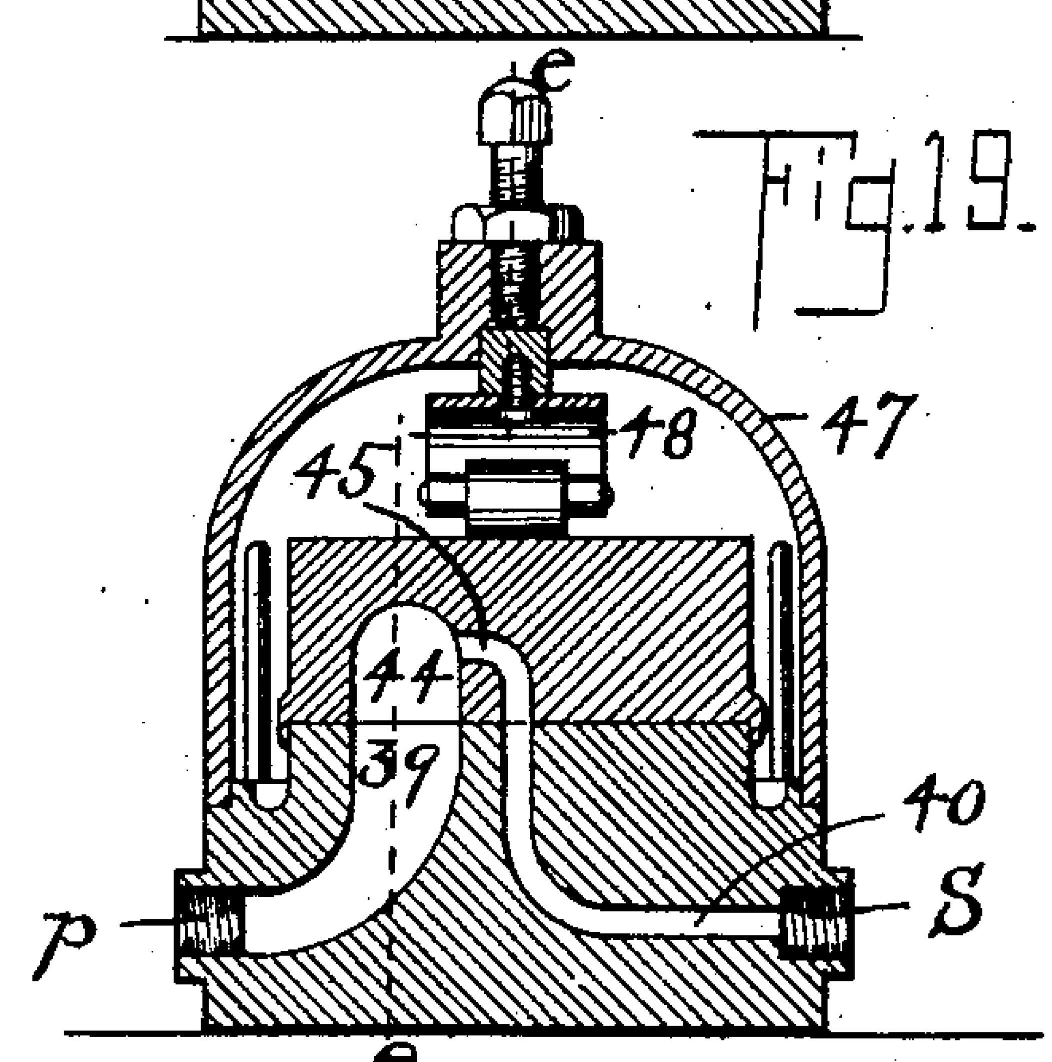


Fig. 19.



WITNESSES:
F. Bissell.
C. M. Perkins.

INVENTORS:
Frank L. Dodgson
Murray Corrington by Osgood & Davis, Attys

THE NORRIS PETERS CO., PHOTO-LITHO., WASHINGTON, D. C.

No. 702,931. Patented June 24, 1902.

F. L. DODGSON & M. CORRINGTON.

PNEUMATIC RAILWAY SWITCH AND SIGNAL APPARATUS.

(Application filed Oct. 26, 1901.)

(No Model.) 7 Sheets—Sheet 6.

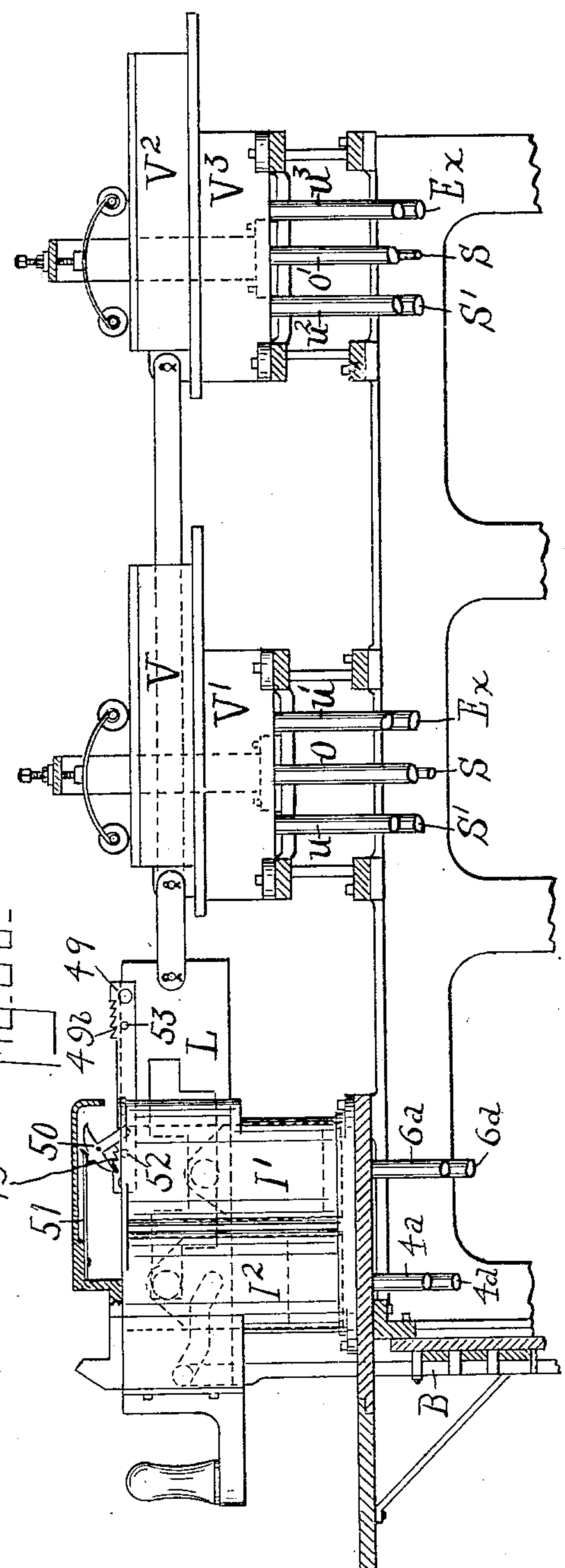


Fig. 20

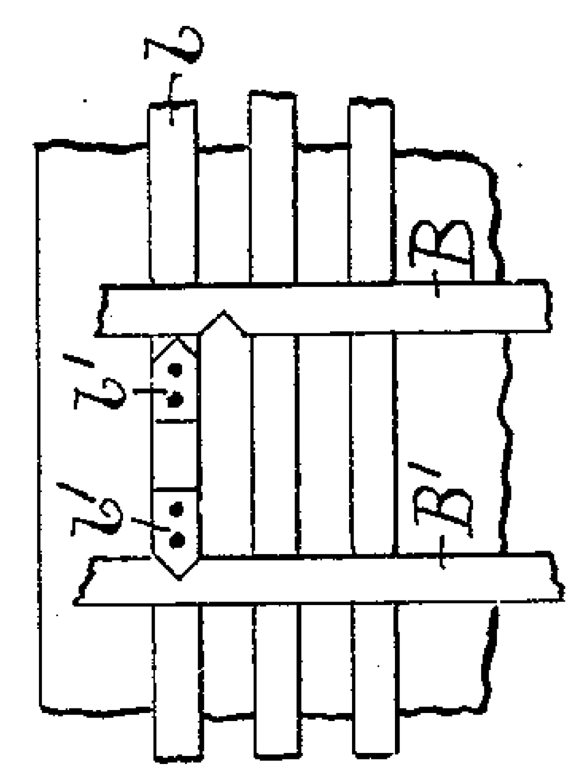


Fig. 21

WITNESSES:
F. Bissell.
C. M. Perkins.

INVENTORS:
Frank L. Dodgson
Murray Corrington
by Odgood & Davis
Attys

No. 702,931. Patented June 24, 1902.

F. L. DODGSON & M. CORRINGTON.

PNEUMATIC RAILWAY SWITCH AND SIGNAL APPARATUS.

(Application filed Oct. 26, 1901.)

(No Model.) 7 Sheets—Sheet 7.

Fig. 22.

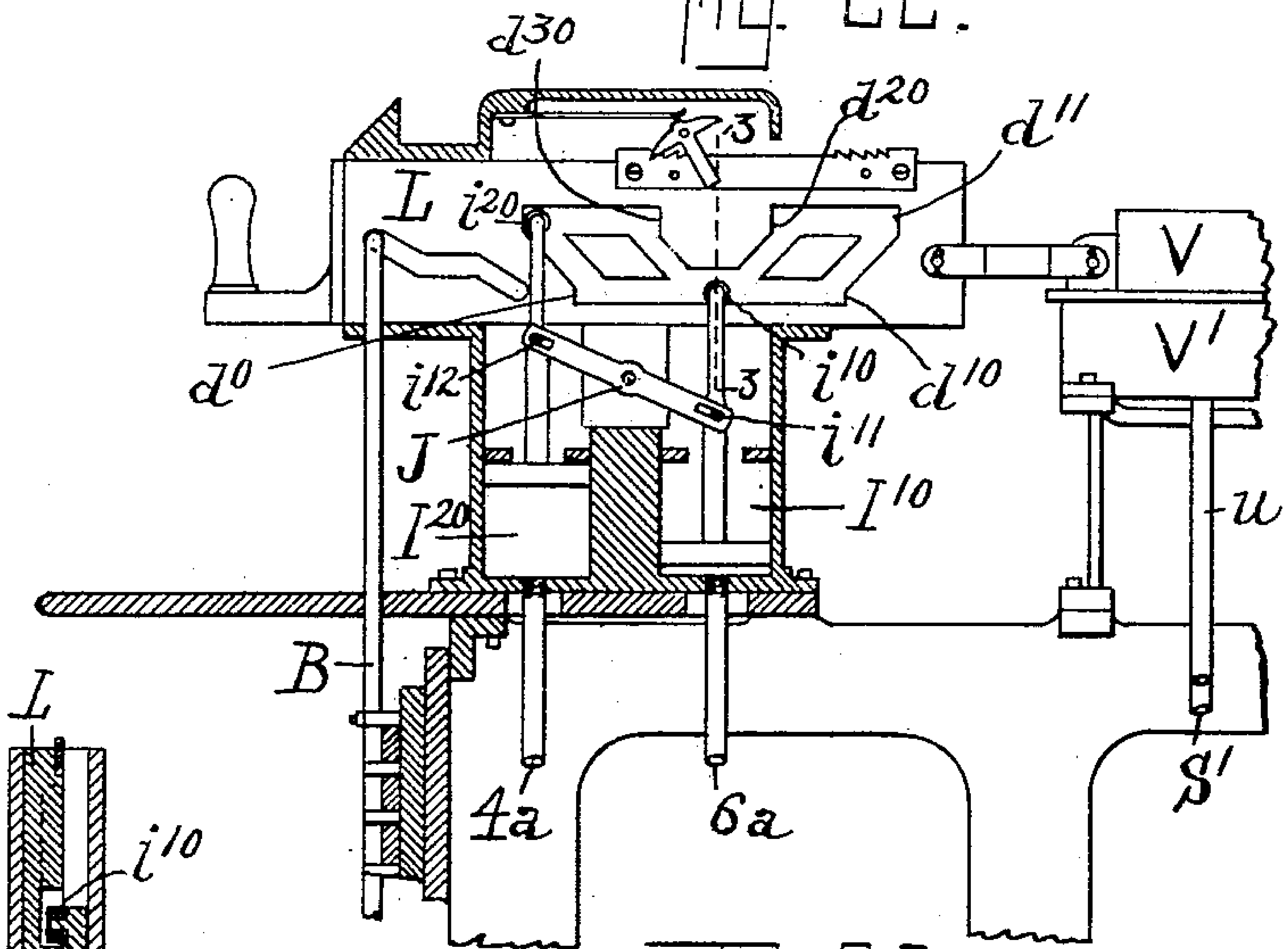


Fig. 24.

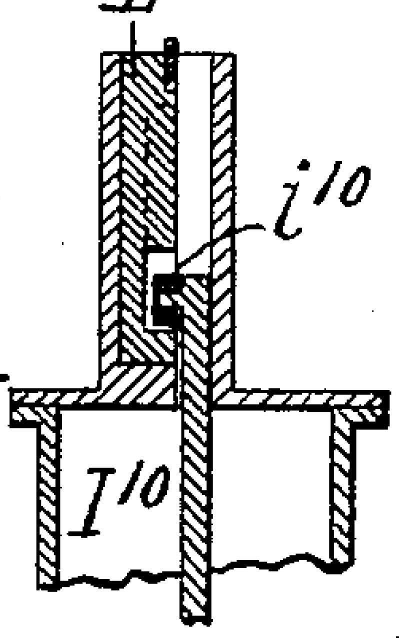
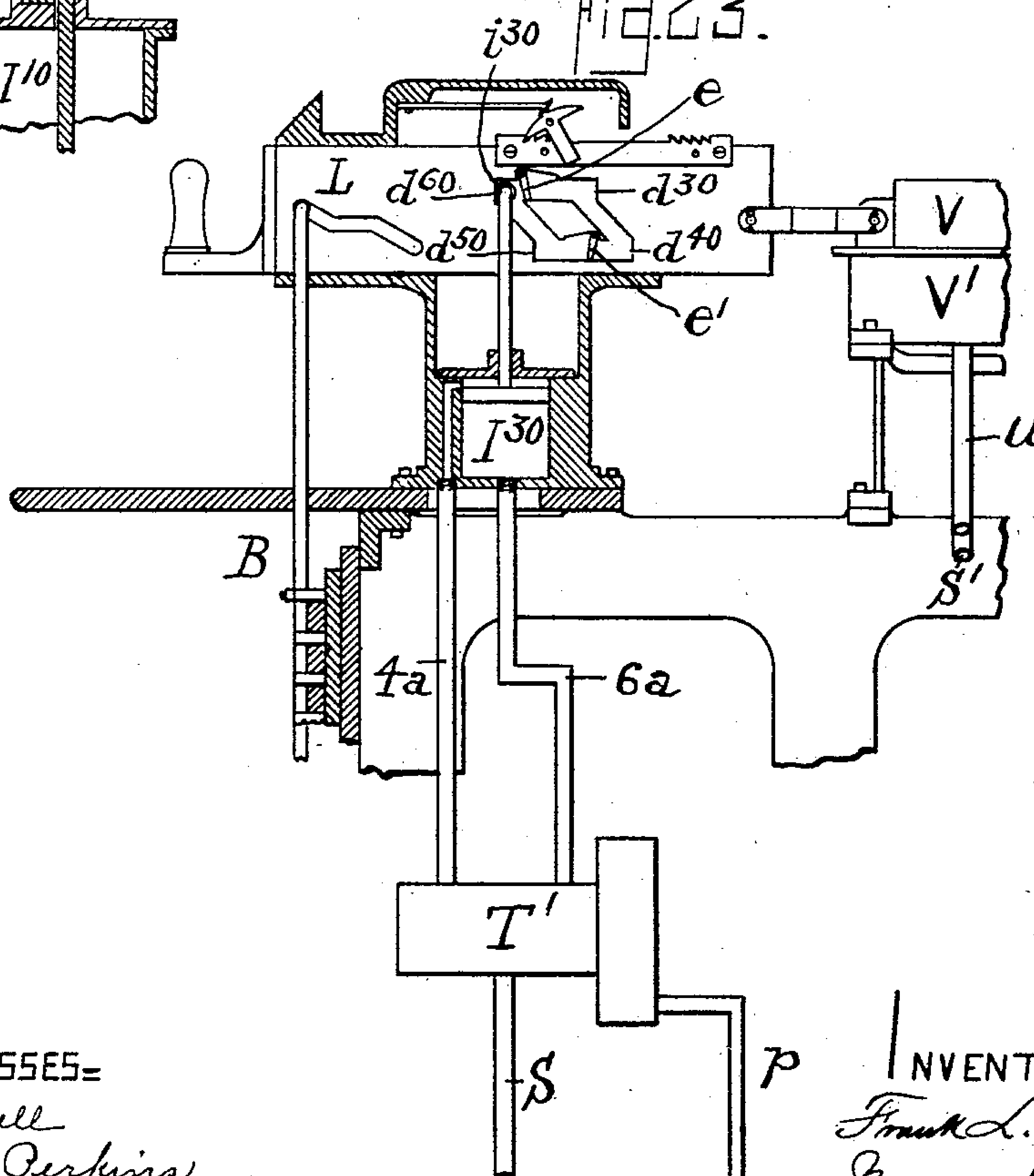


Fig. 23.



Witnesses=

F. Bissell

C. M. Perkins.

Inventors=

Frank L. Dodgson

Murray Corrington

by Osgood & Davis, Attys.

UNITED STATES PATENT OFFICE.

FRANK L. DODGSON, OF ROCHESTER, AND MURRAY CORRINGTON, OF NEW YORK, N. Y., ASSIGNORS TO INTERNATIONAL PNEUMATIC RAILWAY SIGNAL COMPANY, OF ROCHESTER, NEW YORK, A CORPORATION OF WEST VIRGINIA.

PNEUMATIC RAILWAY SWITCH AND SIGNAL APPARATUS.

SPECIFICATION forming part of Letters Patent No. 702,931, dated June 24, 1902.

Application filed October 26, 1901. Serial No. 80,107. (No model.)

To all whom it may concern:

Be it known that we, FRANK L. DODGSON, of the city of Rochester, and MURRAY CORRINGTON, of New York city, State of New York, have invented certain new and useful Improvements in Pneumatic Railway Switch and Signal Apparatus, of which the following is a specification.

This invention is designed to operate interlocked railway switches and signals by means of compressed air, whereby mechanism controlled by valves in the cabin may admit pressure to the cylinder working the switch or signal, and the position of said switch or signal is indicated by variation of pressure in a fluid-column extending to the cabin upon completion of a switch or signal movement, said indication imperatively controlling the lever-stroke and the interlocking.

In the switch and signal system hereinafter described there are two separated stations connected by an operating fluid-column and by a return fluid-column, both contained in suitable piping. One of the stations is a motor-station, comprising the switch or signal, as the case may be, devices for controlling pneumatic indications by the return-column to the operating-station, and motor mechanism controlled through said operating-column for operating the switch or signal. The other station is the operating-station (usually an operator's cabin) comprising devices for controlling said operating-column and devices controlled by said return-column for effecting certain results, hereinafter particularly described. A system of air-supply is also hereinafter described.

In the system as described in the United States Patent No. 647,483 one operating-pipe for each direction of movement of the switch or signal and one indicating-pipe for each ultimate position of these parts was employed. In the case of the signal one of the indicating-pipes was omitted, as it was not considered necessary to indicate the safety position of the signal.

In the present improvement only one operating-pipe is necessary for movement of the switch or signal in both directions, and only one indicating-pipe is necessary to indicate both positions of the switch or signal. A further distinction is that in the system described in the patent the air was exhausted from the cylinders and operating-pipes upon the completion of the entire cycle. In the present system the pipes are constantly under pressure. Movement and indication in one direction is obtained by reducing pressure in the operating or indicating pipes, respectively, below a mean pressure, and movement and indication in the other direction is obtained by increasing the pressure in these pipes above said mean pressure.

Figure 1 represents a diagrammatic view of the complete switch-movement with its operating-lever, the pipe connections, valves, and air-supply. Fig. 2 is a diagrammatic view of the signal-movement, showing the corresponding parts. Fig. 3 is a longitudinal section of the valve employed as a motor-valve for admitting air to either side of the switch and signal cylinders and also as a return-valve for operating the indicating-cylinders in both the switch and the signal mechanism. Fig. 3ª is a plan of the slide-valve and its seat contained in the valve shown in Fig. 3. Fig. 4 is a cross-section of this valve on the lines *x x*, Fig. 3. Fig. 5 is a cross-section on the line *y y*, Fig. 3. Fig. 6 is an inverted plan view of the machine-valve. Figs. 7, 8, and 9 are longitudinal sections through this valve and its seat on the lines *g g g' g'* of Figs. 6 and 10, showing three positions of the said valve and the correspondence of the ports. Fig. 10 is a plan view of the seat of the machine-valve, showing the ports. Figs. 11, 12, and 13 are cross-sections on the lines *a a*, *b b*, and *c c*, respectively, of Fig. 9. Fig. 14 is a longitudinal section of the indication-valve and its seat, together with the casing therefor at both switch and signal, showing said valve in one extreme position. Fig. 15 is another section of the indication-valve and its seat, showing the valve in the other extreme position. Fig. 16 is an inverted plan view of the slide of the indication-valve. Fig.

17 is a plan view of the same valve-seat. Figs. 18 and 19 are sections on the lines $d\ d$, Fig. 14, and $c\ c$, Fig. 15, respectively. Fig. 20 is a side elevation of the interlocking machine with the valves and levers complete. Fig. 21 is a view of part of the interlocking board, showing the interlocking tappets and locking-bars between the levers. Figs. 22 and 23 are elevations, partly in vertical section, of modifications; and Fig. 24 is a section on the line 3 3 of Fig. 22.

Referring now to Fig. 1, S*w* represents the switch; M, the motion-plate, through which said switch is moved and locked in its two positions and the indication-valve D actuated.

C is the motor or switch cylinder, and T the motor-valve through which pressure is admitted to and exhausted from either end of said cylinder. In the cabin there is another valve T', (herein called the "return-valve,") identical in construction with the motor-valve T, which is actuated by variations of pressure in an air-column in a pipe extending from the switch to the cabin for transmitting the indication in such a manner that pressure is admitted to either one of the two indication-cylinders I' or I^2. The lever L slides in a horizontal plane, carrying with it the machine-valve V, by which the admission of air into the operating-pipe is controlled. The interlocking bar B is actuated by a slot in the said lever, as usual. The motion-plate M will move the switch into either position by means of the slot m and will lock it in either position by the projections m' m^0 on the said plate, which enter notches in the switch-locking bar N, as is explained more in detail in the patent referred to.

The switch and its lever L are shown in the normal position. In this position there is air at the mean pressure in the left-hand end of the cylinder C, in the lower end of the indication-cylinder I^2, in the upper end of the indication-cylinder I', in the operating-pipe o, in the indication-pipe p, and in the valves T and T'. To reverse the switch, the lever is moved to the left until the roller i^2, attached to the piston of the indication-cylinder I^2, abuts against the shoulder d^3 and the roller i' of the indication-cylinder I' abuts against the shoulder d' of the locking and indicating slot in said lever. By this movement in a manner which will be explained farther on pressure is increased in the operating-pipe o, moving the motor-valve T to such a position that air is exhausted from the left-hand side of the cylinder C and is admitted from the main supply S to the right-hand end of said cylinder, moving the piston and reversing and locking the switch. Just before the end of this movement the right-hand lug a' on the motion-plate striking against the angle-lever a will move the indication-valve D in such a manner that pressure in the indication-pipe p is decreased, moving the return-valve T' to its other extreme position, exhausting the air from the lower end of the indication-cylinder I^2 and admitting air to its upper end, admitting air into the lower end of the cylinder I' and exhausting air from its upper end, thus permitting the roller i^2 of the descending piston of I^2 to move away from the shoulder d^3 and the roller i' of the ascending piston of I' to rise above the shoulder d' and permitting a completion of the movement of the lever to its extreme left-hand position, which causes the interlocking bar B to complete its downward stroke. When this position has been reached, the pressures in o and p are equalized to the mean pressure.

In order to overcome friction of the piston in a single-acting indication-cylinder, as shown in Fig. 2, a spring i^{30} i^{40} is employed, that tends to force the piston downward. The spring must be strong enough to depress the piston when the pressure under it is exhausted and must be weak enough to yield to the pressure employed for lifting the piston. To put the switch again to normal, the cycle of operations is precisely the same, except that it is reversed and the pressure in the pipe o is reduced and that in the pipe p is increased and the corresponding mechanical parts come into action. The movement of the signal A^3, Fig. 2, is exactly the same. The cylinder C' moves the signal in both directions, and indication is sent to the cabin for both positions of the signal by the indication-valve D', and the signal is actuated directly by the piston of its cylinder instead of being moved through a motion-plate. The lugs A^2 A^4, which act upon the lever A^5 of the indication-valve, are placed conveniently upon the connecting-rod A^0, between the cylinder-piston and the signal-arm.

In the position of the parts shown in Fig. 2 there is air at mean pressure in the upper end of the cylinder C', in the indication-cylinder I^4, in the operating-pipe o', in the indicating-pipe p', in the motor-valve T^2, and in the return-valve T^3. The indication-cylinder I^3 and the lower end of the cylinder C' are connected to the exhaust through the valves T^3 and T^2, respectively. To set the signal to "safety," the lever L' is moved to the left until the roller i^4 of the indication-cylinder I^4 abuts against the shoulder d^3 and the roller i^3 of the indication-cylinder I^3 abuts against the shoulder d' of the locking and indicating slot in said lever. By this movement the valve V^2 is shifted on its seat V^3, whereby pressure is increased in the operating-pipe o' and moves the motor-valve T^2 to such a position that air is exhausted from the upper portion of the cylinder C' and is admitted from the supply S' to the lower end of the cylinder under the piston, thus lifting the piston and depressing the blade A^3 from the normal horizontal or "danger" position to the angular or "safety" position. Just before the end of the upward movement of the piston the lug A^2 strikes the lever A, moves the indication-valve D' to such a position that pressure in the indicating-pipe

p' is decreased, thus moving the return-valve T^3 to a new position, whereby air is exhausted from the cylinder I^4, permitting the piston thereof to descend, assisted, if necessary, by a spring i^{40}, and removing the roller i^4 from abutment against the shoulder d^3, and at the same time the new position of the return-valve T^3 admits air in the cylinder I^3, lifts the piston thereof against the force of the spring i^{30}, and causes its roller i^3 to rise above the shoulder d', thus permitting completion of the movement of the lever to its extreme left-hand position, which sets the interlocking bar B′ at its lowermost position. When this last position of the parts is reached, the pressures in the pipes o' and p' are equalized automatically to the mean pressure.

To return the signal to the horizontal or danger position, the cycle of operations is the reverse of that just described, the pressure in the pipe o' is reduced and that in the pipe p' is increased.

In the following description it will be assumed that the normal position of the signal is the horizontal one indicating "danger."

The construction of the motor and return valves is shown in Figs. 3, 3^a, 4, and 5. The valve has a valve-body of suitable shape containing a piston chamber or cylinder 2 at one end thereof, a piston 1 moving in said chamber, and equalizing-passages 27 in the cylinder-wall at one end of the cylinder, whereby a connection is made between those portions of the cylinder on both sides of the piston whenever the piston is in the proper position, and when the piston moves away from said position the said connection through the equalizing-passages 27 is cut off. The piston may have a stem 1^a, extending into a chamber 16 in the valve-body, and to this stem or to the piston is attached a slide-valve 3. A spring 16^a or other suitable means is employed to hold the slide-valve 3 properly seated. The chamber 16 has two passages from its right-hand end in Fig. 3, one of which, 22^a, connects with the supply S through a passage 12 and is controlled by a spring-operated valve 22, having a portion against which the stem 1^a abuts in order to open said valve against the pressure of its spring, thus connecting the chamber 16 with the supply S when the piston 1 is in its extreme right-hand position. Another port 15 through the end wall of the chamber 16 is connected with a chamber 14 outside of said end wall. Still farther to the right in Fig. 3 is a diaphragm-chamber in which is a diaphragm 10, dividing said chamber into two parts, one of which, 10^a, is at the extreme end of the whole valve and the other of which, 10^b, communicates with the chamber 14 by a passage 14^a. A valve 13 moves with the diaphragm 10, and the diaphragm and valve are normally pressed in one direction (toward the right in Fig. 3) by a spring 130. Operated by the spring 130 and the diaphragm 10 is another valve 17, facing in the opposite direction to the valve 13. The valve 13 opens and closes a connection between the chamber 10^b and the chamber 14, while the valve 17 opens and closes a port 26, connecting the port 5 with said chamber 14. The chamber 16 has a seat for the slide-valve 3, into which there are two ports 5 and 8, and between them an exhaust-port 7, leading out through the side of the valve-casing, as shown in Fig. 4. The shifting of the slide-valve 3 is adapted to connect the port 8 with the exhaust when the port 5 communicates with the chamber 16 and to connect the port 5 with the exhaust when the port 8 connects with said chamber. The valve 3 also opens or closes, according to the position of the piston 1, a port 24, leading from the chamber 16 to a port 25, and is controlled also by a check-valve 24^a, adapted to permit only outflow of air from the chamber 16. At the other end of the valve-body is a diaphragm-chamber divided into two parts by a flexible diaphragm 9, one of which parts 18 is on the inner or right-hand side of the diaphragm, while the other part 9^a is on the left-hand or outer side of said diaphragm. The diaphragm is pressed normally toward the right by a spring 90 and operates a valve 19, that controls the connection of a passage 21^a, leading to the left-hand end of the cylinder, either with a passage 20, communicating with the chamber 18, or with a passage 21, leading to the port 8. The chamber 9^a communicates constantly with the operating-pipe connection 11 of the valve. The chamber 18 also communicates with said operating-pipe connection 11 through a short passage 18^c, controlled by a spring-operated check-valve 18^a, that permits air to enter the chamber 18, but prevents the outflow of air from said chamber through the check-valve. The operating-pipe o connects with the passage 11, which communicates by a passage 25 with the chamber 10^a on the right-hand side of the diaphragm 10. The chamber 18 also connects by a passage 12 with the chamber 10^b on the left-hand side of the diaphragm 10, and the supply S is connected with this passage 12. A check-valve 18^b is adapted to permit air to flow from the supply S into the chamber 18 and to prevent the contrary flow. The piston operating the attached slide-valve 3 occupies one of two extreme positions at the respective ends of the cylinder and is moved in one direction by reducing the pressure in the operating-pipe o below a mean or normal pressure, while the piston is moved in the other direction by increasing the pressure in said operating-pipe above said mean or normal pressure. When said slide is in the extreme right-hand position, as shown in Fig. 3, a passage is open between the supply-pipe S and the pipe 4, Fig. 1, leading to one end of the cylinder C through the port 5, while the pipe 6, Fig. 1, leading to the other end of the cylinder, is connected to the exhaust 7 through the port 8. In the other extreme position of the slide 3 the pipe 6 and port 8 are connected with the supply S, and the pipe 4 and port 5 can exhaust through the port 7. Movement of the piston 1 and slide 3 toward the left is produced by decreasing below a mean pressure the air-pressure on the left-hand side of the piston 1 and movement of the piston toward the right by increasing above said mean pressure the pressure on the left-hand side thereof. After the piston has come to a state of rest the pressure on both sides of it is equalized. The pressures are controlled by means of the diaphragms 9 and 10 and the valves attached thereto. In the position of the parts as shown, and assuming that equalization has taken place, all the pipes, ports, and chambers, with the exception of port 8 and pipe 6, are under the same pressure, which we shall designate the "mean" pressure. Communication is open between the supply S and the port 5 through the port 12, the valve 13, the chamber 14, the port 15, and chamber 16. Another passage is also open from the supply S to the chamber 16 through the passage 22^a and the check-valve 22, which last is held open by the end of the piston-stem 1^a. To obtain movement of the piston 1 and of the slide 3, pressure in the operating-pipe *o* and in the passages 11 and 25 and in the chambers 9^a and 10^a is reduced below the mean to a pressure which we shall designate the "lower" pressure and by means which will be described later. The reduction of pressure in the chamber 10^a will not affect the position of this diaphragm nor of the valves 13 and 17, however, as the said diaphragm has reached the limit of its movement in that direction, and the mean pressure exists in the chamber 10^b on its left-hand side, and this position of the diaphragm is supported by the pressure of the spring 130, which assists in holding the valve 13 open and the valve 17 closed. This reduction of pressure will take place also in the chamber 9^a on the left-hand side of the diaphragm 9; but it cannot take place on the right-hand side thereof because of the check-valve 18^a. When reduction below said mean pressure has taken place to a sufficient degree, the mean pressure in the chamber 18 will cause the diaphragm to move toward the left, overcoming the action of the spring 90 and causing the valve 19 to close the passage 20 and to open the chamber 2 to the port 21 through the port 21^a. The air at the mean pressure, which was in the cylinder 2 on the left-hand side of the piston, now can pass into the said port 21, which leads into the port 8 and through this port into the exhaust 7. The pressure will then fall on the left-hand side of the piston, and as the mean pressure still exists in the chamber 16 the piston and its valves will be moved immediately to their extreme left-hand positions, connecting the port 5 to exhaust and the port 8 with the chamber 16. The parts will now be in the position shown in dotted lines and before another movement can take place the pressure must equalize again. The valve 3 in the positions shown in full lines closed the port 24; but in this new position the said port is uncovered and is placed in communication with the chamber 16, which in turn is in communication with the normal supply S through the port 12, valve 13, chamber 14, and port 15. Therefore air under the mean pressure can pass the check-valve 24^a into the passage 25 and the operating-pipe *o* and also into the chamber 10^a through said passage 25 and into the chamber 9^a through the passage 11. It can also equalize at the left of the piston 1 through the ports 8, 21, and 21^a, the valve 19 being open for the moment, and also through the passages 24 and 25 past the check-valve 18^a into the chamber 18, as well as through the passage 12 past the check-valve 18^b. In this manner the pressure at all these points will be brought up to the mean again, so that the diaphragm 9 has the same pressure on both sides. The spring 90 thereupon will cause the valve 19 to reassume the position shown in full lines in the drawings, and then the mechanism is ready for another operation. To return the piston 1 and its valves to the original position, the pressure is increased in the operating-pipe somewhat above the mean or normal pressure to a pressure that we shall designate the "higher" pressure. This will not affect the position of the diaphragm 9. The higher pressure will act on both sides of the said diaphragm directly from the port 11 and through the check-valve 18^a; but the excess of pressure produced by the spring 90 will keep the diaphragm in its position. The increase of pressure, however, will take place also in the port 25, and therefore on the right-hand side of the diaphragm 10, causing the valve 13 to close and the valve 17 to open. The check-valve 22 is closed when the piston begins this return movement. The supply S is cut off from the chamber 16 as both valves 13 and 22 are closed. The air confined in said chamber will be exhausted, however, through the port 15, the chamber 14, the valve 17, the port 26, the port 5, and the port 7. Thus there will be a reduction of pressure in the chamber 16 and in the cylinder on the right-hand side of the piston and an increase of pressure on its left-hand side through 11, 18^a, 18^c, 18, 20 and 21^a, thus forcing said piston and its valve back to the original position and cutting off the port 24. In this original position the equalizing-ports 27 connect the chamber 2 with the chamber 16. The valve 22 has been opened by the abutting of the piston-stem against it, and the chamber 16 is in communication with the supply at the mean pressure. Equalization therefore will take place between the higher pressure in the pipe *o*, passages 11 and 25, and said mean pressure in the chambers 16, 14, and 10^b through the passages 18^c, 20, 21^a, chamber 2, the ports 25 and 12, and ports 27. The check-valve 18^a will not close until all the pressures have equalized at the mean pressure. It will be understood that the volume of air under the higher pressure necessary to operate the mechanism is so small as compared to the volume of the constant supply of air under the mean pressure that this equalization will not affect such mean pressure perceptibly. As soon as this equalization has taken place the spring 130 will cause the valve 17 to close and the valve 13 to open and the mean-pressure supply, beside going past the valve 22, can go through the port 15, as formerly set forth. Thus it will be seen that reduction of pressure in the operating-pipe *o* (see Fig. 1) will place the valve in such a position that the supply S is in communication with the pipe 6, whereas increase of pressure in said pipe will place this valve in such a position that communication is open between the supply and the pipe 4. In a similar manner a reduction of pressure in the indicating-pipe *p* (see Fig. 1) will open communication between the supply S and the pipes 6^a and 4^b, leading to the indication-cylinders I′ I^2 for one alternate operation, and increase of pressure in *p* will cause this supply to connect with the pipes 4^a and 6^b, leading to said cylinders for the other alternate operation. In each case the pipe not in communication with the supply will be connected to exhaust.

Referring, again, to Fig. 1, the manner in which the increase and reduction of pressure in the operating and the indicating pipes is obtained will now be set forth.

There is a supply-tank A, which is fed from any suitable source of compressed-air supply and contains air under the said higher pressure. Another tank A′ contains air under the said mean pressure and may be fed from the tank A through a suitable reducing-valve R. A supply-pipe S from this tank A′ leads to the valves T and T′, to the machine-valve seat V′, and to one side of the seat of the indication-valve D at the switch. Another supply-pipe S′ leads from the tank A to the machine-valve seat and to the indication-valve. Suitable small tanks U U′ and W W′, the purpose of which will be explained presently, are connected to the seat of the machine-valve V and to the indication-valve D through pipes *u u′* and *w w′*, respectively. The operating-pipe *o* leads from the machine-valve seat V′ to the motor-valve T, and the indicating-pipe *p* leads from the indication-valve D to the return-valve T′.

The machine-valves V, Fig. 1, and V^2, Fig. 2, and their seats V′ and V^3 are identical in construction and have identical tanks and connections. The following description is based on the valve V. Fig. 7 shows the position of the machine-valve V corresponding to its position in Figs. 1 and 2. In the valve-seat V′, as shown in Figs. 7, 8, 9, and 10, are ports 28, 29, 30, 31, 32, and 33. The port 28 is connected with the pipe *u* and therefore with the tank U. The port 29 is connected with the higher-pressure supply S′. The port 30 is connected to the operating-pipe *o*. The port 31 connects with the mean-pressure supply S. The port 32 connects to exhaust to the atmosphere, and the port 33 is connected to the pipe *u′* and the tank U′. The slide of the valve has the port 34, which can connect ports 28 and 29, and the longitudinal port 35, which can connect 30 with either 28 or 33. A supplemental passage from the port 35 to a small port-opening 36 can connect a corresponding port 31 in the valve-seat with the ports 28 and 30. (See Figs. 9 and 12.) The port 37 can connect 32 and 33. (See Fig. 13.) In the position shown in Figs. 1 and 7 ports 28 and 29 are in communication with each other. Therefore tank U is being filled with air under the higher pressure. The ports 30 and 33 are connected, so that the pipe *o* is under the same pressure as the tank U′. The other ports are closed. The first movement of the lever and slide until stopped by the rollers i^2 *i′* on the indication-pistons abutting against the shoulders d^3 *d′* will bring the valve to the position shown in Fig. 8. In this position the port 29 is shut off, 28 and 30 are connected through the port 35, and the port 33 (and consequently the tank U′) will be exhausted to atmospheric pressure through the ports 37 and 32. As the tank U, and consequently the pipe *u*, are under the higher pressure the pressure in the operating-pipe *o* will be increased. This will cause a movement of the motor-valve T in the manner hereinbefore described, a consequent movement of the switch-cylinder piston, and a reversal of the switch itself. Thereupon the indication-valve D will be moved to another position and a release of the locking of the lever through the indication-cylinders will take place in a manner described hereinafter. The movement of the lever toward the left in Fig. 1 can now be completed, bringing the machine-valve into the position shown in Fig. 9. In this position the port 36 registers with the port 31, therefore connecting 28 and 30 with the mean-pressure supply S. This port 36 therefore helps to restore mean pressure in the tank U and also in the operating-pipe *o*, equalizing the valve T. Port 33 and the tank U′ remain connected to exhaust, and the parts are ready for a movement in the opposite direction. The slide of the valve is now at its extreme left-hand position, as shown in Fig. 9, the lever L also is at its extreme left-hand position, the roller *i′* is in that horizontal portion of the slot in the lever opposite the upper part of the shoulder d^2, and the roller i^2 is in the lower portion of said slot under the projection formed by the shoulders d^2 and d^3. (See Fig. 1.) In order to return the switch, the operation is as follows: Upon pushing the lever toward the right from the position just described until the rollers *i′* i^2 abut against the shoulders d^2 and *d* the slide takes such a position that the ports 30 and 33 are connected by the longitudinal port 35, and at the same time the ports 29 and 28 are connected through the cross-port 34. The tank U will fill with air at the higher pressure. The tank U′ during the previous operation has been exhausted to atmospheric pressure, as described. In the present position of the parts air from the operating-pipe o at the mean pressure will flow into the tank U′ through the ports 30, 35, and 33, filling said tank and reducing the pressure in the operating-pipe below the mean pressure. This reduction of pressure in the operating-pipe will cause a movement of the motor-valve T, as explained above. The switch will be brought back again to normal, the indication-valve D will be shifted, and the return-valve T′ will be operated, so that the relative positions of the indication-pistons will be changed, the roller i^2 rising and the roller i' descending, whereupon the lever and slide may be shifted farther to the right into the positions shown in Figs. 1 and 7. In this position of the slide the piston of the motor-valve T and its attached slides are in the position shown in dotted lines in Fig. 3, and the mean pressure is restored in the tank U′ and in the operating-pipe o through the motor-valve T by means of the uncovered port 24 in said valve.

The indication-valve D is shown in Figs. 14 to 19, inclusive. This valve is similar in construction to the machine-valve, but has only two operative positions, which are shown in Figs. 14 and 15, respectively. The section Fig. 15 corresponds to that position of the indication-valve shown in Fig. 1. In the valve-seat the port 57 communicates with the pipe w' and the tank W′, port 38 communicates with the higher-pressure supply S′, port 39 communicates with the indicating-pipe p, port 40 communicates with the mean-pressure supply S, port 41 communicates with the exhaust, and port 42 communicates with the pipe w and the tank W. In the slide the port 43 can connect ports 57 and 38, port 44 can connect 57 and 39 or 39 and 42, the small port 45 can connect 39 with the mean-pressure supply S through the port 40, and the port 46 can connect the ports 41 and 42 and consequently can connect the tank W with the exhaust. Upon a reversal of the switch the lug a' on the motion plate strikes the bell-crank lever a at the end of the movement and shifts the indication-valve D, so that it assumes the position shown in Fig. 14. In this position the port 43 connects the ports 57 and 38, and therefore fills the tank W′ with air at the higher pressure. The indicating-pipe p will be connected with the tank W through the port 44. This tank has been exhausted already, so that the pressure in the indicating-pipe will be reduced by air flowing out of it into said tank. This reduction will cause a movement of the return-valve T′, (see Fig. 1,) which movement will open 4^a to exhaust and allow air to enter 6^a, unlocking the lever and permitting a completion of the stroke. The indication-valve remains in its position. Upon putting the switch again to normal the indication-valve D at the end of its return stroke will take the position shown in Fig. 15. In this position the indicating-pipe p will be placed in communication with the higher-pressure tank W′ through the port 44, and therefore an increase of pressure will take place in this indicating-pipe, causing a reverse movement of the return-valve T′ and exhaustion of the pipe 6^a and supply to the pipe 4^a. In this position the port 45 will register with the port 40 and will assist in raising the pressure in the pipe p to the mean pressure. It must be understood that the port 40 is so small in comparison with the ports 39 and 57 and with the size of the tank W′ that an increase of pressure in the indicating-pipe p sufficient to operate the return-valve T′ can be obtained before equalization will take place through the supply S and the ports 40 and 45. The indication-valve is protected by a cover 47, and the slide is held in place by a spring 48 with any ordinary form of adjustment. The construction and functions of the indication-valve D′ at the signal are identical with those of the valve just described.

The movement of the signal is precisely similar to that of the switch. Assuming the normal position to be shown in Fig. 2, the lever L′ is pulled to the left until the rollers i^4 i^3 on the indication-pistons abut against the shoulders d^3 d'. This movement sets the machine-valve V^2 so as to place the pipe u^2 and the tank U^2 in communication with the operating-pipe o', thereby increasing pressure in the operating-pipe and moving the motor-valve T^2 to connect the supply S with the lower side of the cylinder C′, putting the signal to "safety" and at the same time exhausting air from the upper side of the said cylinder. Just before the signal reaches its extreme position the indication-valve D′ is moved to the right, thereby placing the indicating-pipe p' in communication with the exhaust-tank W^2, thereby lowering the pressure in the indicating-pipe p', which sets the return-valve T^3 so as to connect the indication-cylinder I^3 with the supply and to exhaust the cylinder I^4, unlocking the lever and permitting completion of the movement toward the left. Restoration of pressures will take place in the same manner as above described in connection with the switch. To put the signal back again to "danger," these operations are reversed.

Fig. 20 shows a detail of the machine with the valve, the indication devices, and an interlocking bar. The stroke-completing attachment is also shown more in detail in this figure. This attachment to the operating-lever L is for the purpose of compelling a completion of the stroke thereof when once begun in the original direction. It consists of a ratchet-bar 49, having two sets of oppositely-facing teeth 49^a and 49^b at a distance from each other and a clear space between them. A double pawl 50 is pivoted to a stationary part and is held in either one of two positions by a spring 51. This pawl is tilted into either of said two positions at the two extreme ends of the stroke by the studs 52 and 53, attached to the lever L. If a movement is begun in the direction toward the left of the drawings, the pawl will ride over the teeth 49^a, permitting said movement, but not its reversal. When the lever has reached the end of its stroke, the pin 53 will strike the tail of the pawl, reversing it and bringing it into engagement with the teeth 49^b at the other end of the ratchet-bar. The clear space between the sets of teeth will, however, permit of a partial free movement of the lever until the first tooth will strike against the pawl. This free movement is sufficient to permit the switch to be reversed after it has been thrown in one direction, but the pawl will prevent completion of the stroke in the reverse direction, even after indication. If a wrong movement has been made and the switch is held by the detector-bar or the error is realized in time to correct it, it may be corrected so far as the switch is concerned, and the strain can be taken off the detector-bar or the switch can be brought back into the correct position; but the danger of so manipulating the air-currents that the position of the lever will not correspond to that of the switch is avoided by alternately putting in and taking out air through the machine-valve, because no indication can be had and the cycle must be first completed, according to the original intention—that is to say, the switch must be moved and the indication must be received in the cabin, so that the pawl will be reversed.

As another means for preventing an improper movement of the lever we place in the slot and adjacent to the positions of the roller in the angles adjacent to the faces d^{50} and d^{40} pawls or dogs e e', which tilt and permit the roller to pass when the lever moves in the proper direction, but which rest against a side of the slot in order to block and prevent improper return of the lever past the roller. For instance, the roller may tilt the pawl e and pass it, and the pawl falls into place immediately behind the roller, whereupon the lever cannot return past the roller. This device accomplishes substantially the same result as the tilting pawl 50 and the ratchet-plate 49, hereinbefore described.

In Fig. 21 is shown a portion of an ordinary interlocking board of the Saxby and Farmer type, in which B is the switch-tappet, B' is the related signal-tappet, b is a locking-bar, and b' b' are locking-dogs.

Fig. 22 shows an elevation, partly in section, of a modified form of the operating-lever and its indication-cylinders. Two single-acting cylinders I^{10} and I^{20} are operated by pressure in the pipes 4^a and 6^a, as in the apparatus hereinbefore described. Each cylinder has a piston provided with a proper piston-stem, which bears a pin or roller i^{10} or i^{20}, adapted to run in slots in the lever L. As shown in Fig. 24, the slots are cut into the lever L from one side only, and the pin or roller i^{10} or i^{20} extends into the slot sidewise from the piston-stem. The two piston-stems are connected by a small walking-beam J, pivoted at its center to a stationary part of the mechanism and connected by slots in its ends with pins i^{11} i^{12} upon the piston-stems. Hence when one piston rises the other must descend, and vice versa. The slot or slots in the lever L are provided with stop-faces analogous to the shoulders in the lever L, shown in Figs. 1 and 2. Each roller i^{10} or i^{20} runs around in a slot pertaining to it and does not traverse the same path in the backward and forward movements of the lever, as in the previously-described example of this invention.

In Fig. 22 the parts are shown in positions similar to those shown in Fig. 1. If now the lever L is pulled to the left, it can move until the roller i^{20} strikes the face d^{30} and the roller i^{10} strikes the face d^{10}. At this position a return indication from the switch or signal causes admission of air-pressure into the cylinder I^{10} through the pipe 6^a and the pipe 4^a is connected with the exhaust. Consequently the piston in the cylinder I^{10} will rise along the diagonal portion of the slot above the face d^{10} until it rests in the right-hand upper angle d^{11} of the rhomboidal slot. At the same time the roller i^{20} must have descended from its original position down the diagonal portion of the slot to the right-hand lower corner of the left-hand rhomboid. This movement must have caused a motion of the lever L toward the left, completing the stroke of the lever in that direction. In order to reverse the switch or signal, the lever is now pushed toward the right from the position last described until the stop-face d^{20} abuts against the roller i^{10} and the roller i^{20} is against the stop-face d^0. Now a return indication from the switch or signal causes admission of pressure through the pipe 4^a and the pipe 6^a is exhausted, whereby the piston in the cylinder I^{10} will descend and that in I^{20} will rise, causing movement of the lever toward the right and a completion of its stroke, in which position the parts will be situated as shown in Fig. 22. In the form shown the two slots for the two rollers i^{10} and i^{20} are each rhomboidal in plan, and the two rhomboids are set symmetrically with reference to the line 3 3 of Fig. 22 and are connected with each other, with their lower sides in line. By this means single-acting cylinders may be used, and when the piston of one is operated by pressure the piston of the other is returned to place without the use of a spring.

In Fig. 23 another form of this device is shown employing a double-acting piston I^{30}, having the pipes 4^a and 6^a, connecting the return-valve T' with the upper and lower ends of the cylinder, respectively. The pin or roller i^{30} on the end of the piston-stem rests in a rhomboidal slot having the stop-faces d^{30} and d^{50}, exactly as in the slot shown in Fig. 22. These stop-faces are on two diagonally opposite angles of the rhomboid, and on the other two opposite angles of the rhomboid are stop-faces d^{40} and d^{60}. If the lever L is pulled toward the left, the roller i^{30} remains stationary while it is in the horizontal portion of the slot extending to the face d^{60} and until the face d^{30} strikes the roller and stops the lever. If the upper end of the cylinder I^{30} is now connected to pressure and the lower end to exhaust, (as occurs upon the return indication from the switch or signal,) the piston will descend, the roller will run down the diagonal portion of the slot from d^{30} to d^{40}. As the roller runs down the lever will be forced toward the left and the stroke of the lever and of the valve V will be completed. For the reverse operation the lever is pushed toward the right and the roller i^{30} runs along the horizontal portion of the slot from d^{40} to d^{50} until the lever is stopped by the face d^{50}. A return indication of the switch or signal now resets the return-valve T′, puts pressure in 6^a and exhausts 4^a, and consequently the piston rises and the roller runs upward along the diagonal slot from d^{50} to d^{60}, which forces the lever still farther toward the right and completes the stroke thereof in that direction. For a single roller or pin the rhomboidal slot in each case has two parallel portions in lines of the lever-stroke and two parallel diagonal portions connecting the two parallel portions.

The motor and return valve above described and shown in Figs. 3 to 5 is a fluid-pressure-distributing device containing a distributing-valve, (such as the slide-valve 3,) which determines the distribution of the compressed air from a single source of fluid-pressure supply S through a single fluid-pressure-supply port, to different fluid-pressure conductors, through different port connections, such as 5 and 8, by means of variations of pressure introduced into the distributing device through a single fluid-pressure-controlling port, such as *o*. This distributing device is particularly adapted to use with fluid-pressure motors, except with one single-acting motor.

Of course a double-acting motor is an equivalent of two coöperating single-acting motors.

This mechanism is applicable not only to switches and signals, but also to railway-gates, bridge-locks, and similar railway appliances.

What we claim is—

1. In a fluid-pressure-distributing device, a distributing-valve, a single source of fluid-pressure supply, which is to be distributed by the valve to different fluid-pressure conductors, a cylinder and a piston for operating said distributing-valve, a single operating-pipe, and means for connecting one side of said cylinder to the atmosphere when pressure is increased in the operating-pipe, and means for connecting the opposite side of the cylinder to the atmosphere when pressure is reduced in the operating-pipe, substantially as described.

2. In a fluid-pressure-distributing device, a distributing-valve, a single source of fluid-pressure supply which is to be distributed by said valve, a cylinder and a piston for operating said valve, a single controlling or operating pipe for the valve, two diaphragms, and valves operated by said diaphragms for controlling the admission of air to and from the two ends of the cylinder, substantially as described.

3. The combination, with a motor mechanism, of a fluid-pressure-distributing device, a distributing-valve, a single source of fluid-pressure supply which is to be distributed by said valve to different fluid-pressure conductors for operating the motor mechanism, a cylinder and a piston for operating said distributing-valve, a single operating-pipe for said valve, means for causing increase of pressure in said pipe above the normal, to operate the valve in one direction, means for causing decrease of pressure in said pipe below the normal to operate the valve in the other direction, and means for equalizing the pressure to the normal after each operation, said latter means being inoperative until after the valve has completed its movement, substantially as described.

4. In a fluid-pressure-distributing device, a single fluid-pressure-supply port, an exhaust-port, a single fluid-pressure-operating port, separate port connections for different fluid-pressure conductors, a distributing-valve, and means for operating said distributing-valve by variations of pressure in said operating-port to connect one of said port connections with the supply and another with the exhaust when pressure is increased at the operating-port and for reversing these connections when pressure is decreased at said operating-port, substantially as described.

5. In a fluid-pressure-distributing device, a single fluid-pressure-supply port, an exhaust-port, a single fluid-pressure-operating port, separate port connections for different fluid-pressure conductors, a distributing-valve, means for operating said distributing-valve by variations of pressure in said operating-port to connect one of said port connections with the supply and another with the exhaust when pressure is increased at the operating-port and for reversing these connections when pressure is decreased at said operating-port, and means for equalizing the pressure at the operating-port with that in the supply, after the valve has been operated to produce either of said connections, substantially as described.

6. In a fluid-pressure-distributing device, a single fluid-pressure-supply port, an exhaust-port, a single fluid-pressure-operating port, separate port connections for different fluid-pressure conductors, a distributing-valve, means, comprising a cylinder and piston, for operating said distributing-valve by variations of pressure in said operating-port to connect one of said port connections with the supply and another with the exhaust when

pressure is increased at the operating-port and for reversing these connections when pressure is decreased at said operating-port, means for equalizing the pressure at the operating-port with that in the supply, after the valve has been operated to produce either of said connections, means for connecting the cylinder on either side of the piston with the exhaust when operating-pressure is let into the cylinder on the opposite side of the piston, and means for equalizing the pressures on the opposite sides of the piston after an operation of the valve including cutting off the connection with the exhaust, substantially as described.

7. In a fluid-pressure switch or signal mechanism, a motor at the switch or signal, a single fluid-pressure supply for the motor, a fluid-pressure-distributing device for causing movement of said motor in either direction according to its position, a controlling mechanism in the tower, a single pipe between the controlling mechanism and the distributing device, means for reducing pressure in said pipe through the controlling mechanism, and means for producing an increase of pressure in said pipe through said controlling mechanism, said distributing device assuming one operating position when pressure is reduced in the operating-pipe and assuming another operating position when it is reduced in said operating-pipe, substantially as described.

8. In a fluid-pressure-distributing device, a casing, a supply-inlet port, two outlet-ports, an operating-port therefor, a distributing-valve, and means for causing said distributing-valve to take one position when pressure is decreased in said operating-port and the opposite position when pressure is increased in said operating-port, and means for causing the pressure in the operating-port to equalize with that in the supply, after the valve has moved to either extreme position, substantially as described.

9. In a fluid-pressure switch or signal mechanism, a motor at the switch or signal, a distributing device comprising a valve for distributing compressed air from a single supply-pipe to either of two fluid-pressure conductors to said motor, a manually-operated operating mechanism in the operating-station, a single fluid-pressure-operating pipe between the operating mechanism and the distributing-valve, means for reducing pressure in said operating-pipe through the operating mechanism, and means for producing an increase of pressure in said operating-pipe through said operating mechanism, means for causing said distributing-valve to take one distributing position when pressure is reduced in the operating-pipe and to take another distributing position when pressure is increased in the said operating-pipe, and means for causing the pressure in the operating-pipe to return to its normal pressure after the distributing-valve has assumed either of its extreme positions, substantially as described.

10. In a fluid-pressure switch or signal mechanism, a motor mechanism for said switch or signal, a distributing device comprising a valve for distributing compressed air from a single supply-pipe at a mean pressure to either of two fluid-pressure conductors to said motor, a single fluid-pressure-operating pipe from the operating-station to said distributing device, means in said device for causing it to assume either of two different positions by reduction or increase of pressure in the operating-pipe, a manually-operated operating-valve in the operating-station, a fluid-pressure supply under mean pressure, a second fluid-pressure supply under greater pressure, said second fluid-supply being connected to said operating-valve, two tanks connected to the seat of said operating-valve, said operating-valve having ports whereby one of these tanks may be connected to the high-pressure supply or to the operating-pipe and the other tank may be connected to the operating-pipe or to the atmosphere, substantially as described.

11. In a fluid-pressure switch or signal mechanism, a motor mechanism for said switch or signal, a distributing device comprising a valve for distributing compressed air from a single supply-pipe at a mean pressure to either of two fluid-pressure conductors to said motor, a single fluid-pressure-operating pipe from the operating-station to said distributing device, means in said device for causing it to assume either of two different positions by reduction or increase of pressure in said operating-pipe, a manually-operated operating-valve in the operating-station, a fluid-pressure supply under mean pressure, a second fluid-pressure supply under greater pressure, said second fluid-supply being connected to said operating-valve, two tanks connected to the seat of said operating-valve, said operating-valve having ports whereby one of these tanks may be connected to the high-pressure supply or to the operating-pipe and the other tank may be connected to the operating-pipe or to the atmosphere, branches from said mean-pressure-supply pipe to the seat of the operating-valve, said operating-valve having ports for connecting said branch supply with the operating-pipe at certain definite positions of said operating-valve, substantially as described.

12. In a railway switch or signal apparatus, the combination of a double-acting fluid-pressure motor mechanism for setting the switch or signal into its different positions, fluid-pressure supply for actuating the motor mechanism, a single fluid-column extending to the motor-station from an operating-station, means at the operating-station for causing variation of pressure in said column, and valve mechanism at the motor-station actuated by said variation of pressure for con-

trolling the operation of the motor mechanism by fluid-pressure in its movements in both directions, substantially as described.

13. In a railway switch or signal apparatus, two reciprocating fluid-pressure-operated mechanisms, fluid-pressure supply for actuating one of them, two fluid-columns extending between the positions of said two mechanisms, a valve device adjacent to each mechanism actuated by a variation of pressure in one of said columns for controlling the operation of its operated mechanism in both directions by fluid-pressure, manually-operated mechanism for causing variation of pressure in one of said columns, and a valve device controlled in correspondence with the movement of said last-mentioned operated mechanism for causing variation of pressure in the other column, and a valve device actuated by said last-mentioned variation of pressure for controlling the operation of its operated mechanism, substantially as described.

14. In a railway switch or signal apparatus, the combination of fluid-pressure motor mechanism for the switch or signal, fluid-pressure supply under mean pressure for actuating the motor mechanism, a second fluid-pressure supply under a different pressure, a single operating fluid-column extending to the motor-station from an operating-station, a valve device at the motor-station actuated by variation of pressure in said column for controlling the operation of the motor mechanism in both of its directions by fluid-pressure, operating mechanism at the operating-station for causing said variation of pressure in the operating-column, comprising controlling devices whereby the said variations of pressure are exactly controlled, and a connection and ports from said mean-pressure supply for connecting the operating-pipe therewith at certain positions of the operating mechanism, substantially as described.

15. In a fluid-pressure switch or signal mechanism, a manually-operated lever in the operating-station, an indicator-cylinder to act upon the lever, a stop-roller carried by the piston of said indicator-cylinder, said lever having a slot in which the roller is guided, said slot having two parallel portions offset from each other and at right angles to the axis of the indicator-cylinder, thus forming two shoulders against one of which the roller abuts when the piston in the cylinder is in one position and against the other one of which shoulders the roller abuts when the piston is in another position, substantially as described.

16. In a fluid-pressure switch or signal apparatus, a manually-operated lever having a slot or groove with two portions arranged diagonally across said lever and two other portions connecting said diagonal portions, a reciprocating mechanism having a part extending into said slot or groove, whereby said part moves around in said slot and the lever may be moved in part by hand and in part by said reciprocating mechanism, substantially as described.

17. In a fluid-pressure switch or signal apparatus, a manually-operated lever having a slot or groove with two portions substantially in lines of movement of the lever and two diagonal portions connecting the former two portions, a cylinder and piston, and a controlling device actuated by the piston and operating in said groove or slot, whereby the movement of the lever may be made in part independent of the piston and in part by the piston, substantially as described.

18. In a fluid-pressure switch or signal apparatus, a manually-operated lever having a slot or groove with two portions substantially in lines of movement of the lever and two diagonal portions connecting the former two portions, a cylinder and piston, and a controlling device actuated by the piston and operating in said groove or slot, whereby the movement of the lever may be made in part independent of the piston and in part by the piston, and stop-faces in said groove or slot whereby the lever is stopped at certain points until said piston is moved, substantially as described.

19. In a fluid-pressure switch or signal mechanism, a manually-operated operating-lever, an indicator-cylinder having a piston carrying a pin or roller adapted to run in a slot in said lever, the said slot having two parallel portions in lines of movement of said lever, and two substantially parallel diagonal connecting portions whereby the movement of the pin or roller in one direction in one of said diagonal portions shifts the lever in one direction and the movement of the pin or roller in the other diagonal portion in the other direction shifts the lever in its opposite direction, substantially as described.

20. In a fluid-pressure switch or signal mechanism, a manually-operated operating-lever, an indication-cylinder having a piston carrying a pin or roller adapted to run in a slot in said lever, the said slot having two parallel portions in lines of movement of said lever, and two substantially parallel diagonal connecting portions whereby the movement of the pin or roller in one direction in one of said diagonal portions shifts the lever in one direction and the movement of the pin or roller in the other diagonal portion in the other direction shifts the lever in its opposite direction, and stop-faces at ends of said first-mentioned parallel portions whereby the lever is stopped until the piston is moved to carry the roller or pin away therefrom, substantially as described.

21. In a switch or signal mechanism, a manually-operated operating-lever, a reciprocatory mechanism carrying a pin or roller adapted to run in a slot in said lever, the said slot having two parallel portions in lines of movement of said lever and two substantially parallel diagonal connecting portions where-

by the movement of the pin or roller in one direction in one of said diagonal portions shifts the lever in one direction and the movement of the pin or roller in the other diagonal portion in the other direction shifts the lever in its opposite direction, substantially as described.

22. In a switch or signal mechanism, a manually-operated operating-lever, a reciprocatory mechanism carrying a pin or roller adapted to run in a slot in said lever, the said slot having two parallel portions in lines of movement of said lever and two substantially parallel diagonal connecting portions whereby the movement of the pin or roller in one direction in one of said diagonal portions shifts the roller in one direction and the movement of the pin or roller in the other diagonal portion in the other direction shifts the lever in its opposite direction, and stop-faces at ends of said first-mentioned parallel portions whereby the lever is stopped until said reciprocatory mechanism is moved to carry the pin or roller away therefrom, substantially as described.

23. In a switch or signal mechanism, a manually-operated operating-lever, a reciprocatory mechanism carrying a pin or roller adapted to run in a slot in said lever, the said slot having two parallel portions in lines of movement of said lever and two substantially parallel diagonal connecting portions whereby the movement of the pin or roller in one direction in one of said diagonal portions shifts the lever in one direction and the movement of the pin or roller in the other diagonal portion in the other direction shifts the lever in its opposite direction, means controlled by said operating-lever for actuating the switch or signal and means controlled by the switch or signal for actuating said reciprocating mechanism, substantially as described.

24. In a switch or signal mechanism, a manually-operated operating-lever, a reciprocatory mechanism carrying a pin or roller adapted to run in a slot in said lever, the said slot having two parallel portions in lines of movement of said lever and two substantially parallel diagonal connecting portions whereby the movement of the pin or roller in one direction in one of said diagonal portions shifts the roller in one direction, and the movement of the pin or roller in the other diagonal portion in the other direction shifts the lever in its opposite direction, stop-faces at ends of said first-mentioned parallel portions whereby the lever is stopped until said reciprocatory mechanism is moved to carry the pin or roller away therefrom, means controlled by said operating-lever for actuating the switch or signal and means controlled by the switch or signal for actuating said reciprocatory mechanism, substantially as described.

25. In a railway switch or signal apparatus, the combination of fluid-pressure motor mechanism for the switch or signal, fluid-pressure supply for actuating the motor mechanism, a single fluid-column extending to the motor-station from an operating-station, means at the operating-station for causing variation of pressure in said column, and valve mechanism at the motor-station actuated by said variation of pressure for controlling the operation of the motor mechanism in both of its movements by fluid-pressure, and means for automatically equalizing the pressure in said column to a selected pressure after each operation of said valve mechanism, substantially as described.

In witness whereof we have hereunto set our hands this 23d day of October, 1901.

FRANK L. DODGSON.
MURRAY CORRINGTON.

Witnesses to signature of Frank L. Dodgson:

C. M. PERKINS,
F. BISSELL.

Witnesses to signature of Murray Corrington:

MAUCE. SPILLANE,
CHARLES W. STRONG.