

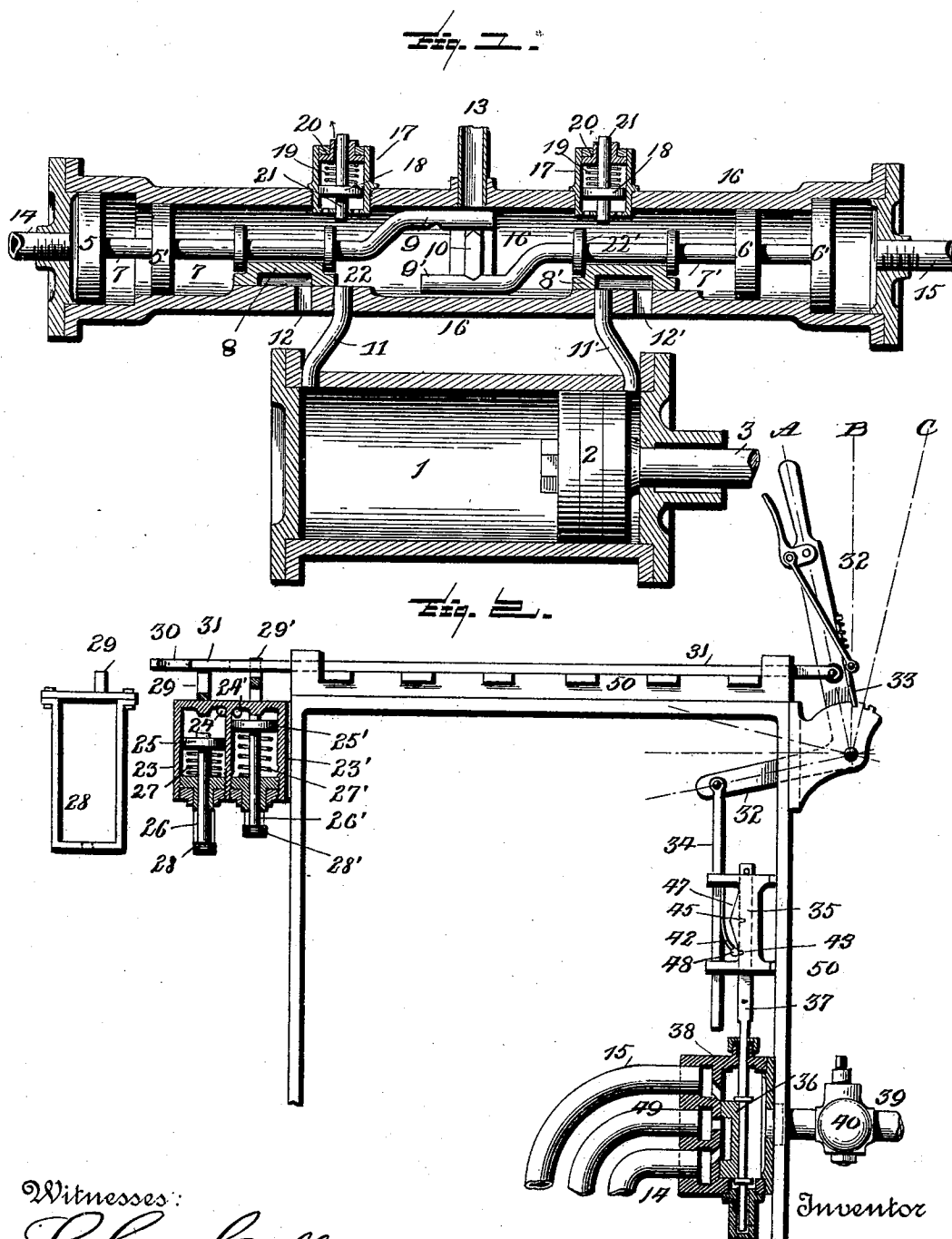
(No Model.)

4 Sheets—Sheet 1.

J. W. THOMAS, Jr.
PNEUMATIC SYSTEM OF AND APPARATUS FOR HANDLING RAILWAY
SWITCHES.

No. 520,812.

Patented June 5, 1894.



Witnesses:

L. C. Hills
Ewell, Dix

Inventor
John W. Thomas Jr.
by *Marshall Bailey*
his Attorney

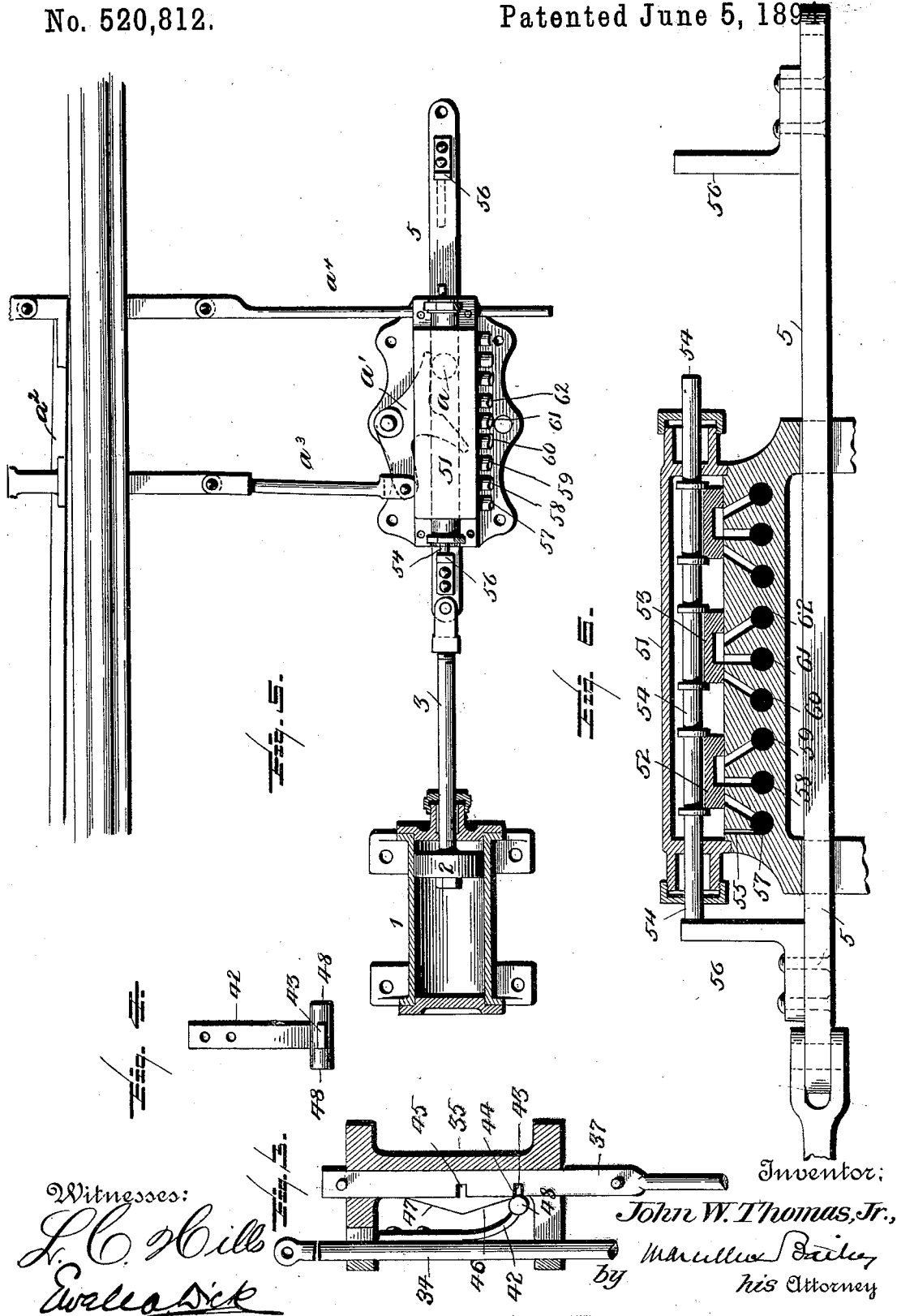
(No Model.)

4 Sheets—Sheet 2.

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Witnesses:

L. C. Hill
E. A. Dick

Inventor:

John W. Thomas, Jr.,

Marshall Bailey
his Attorney

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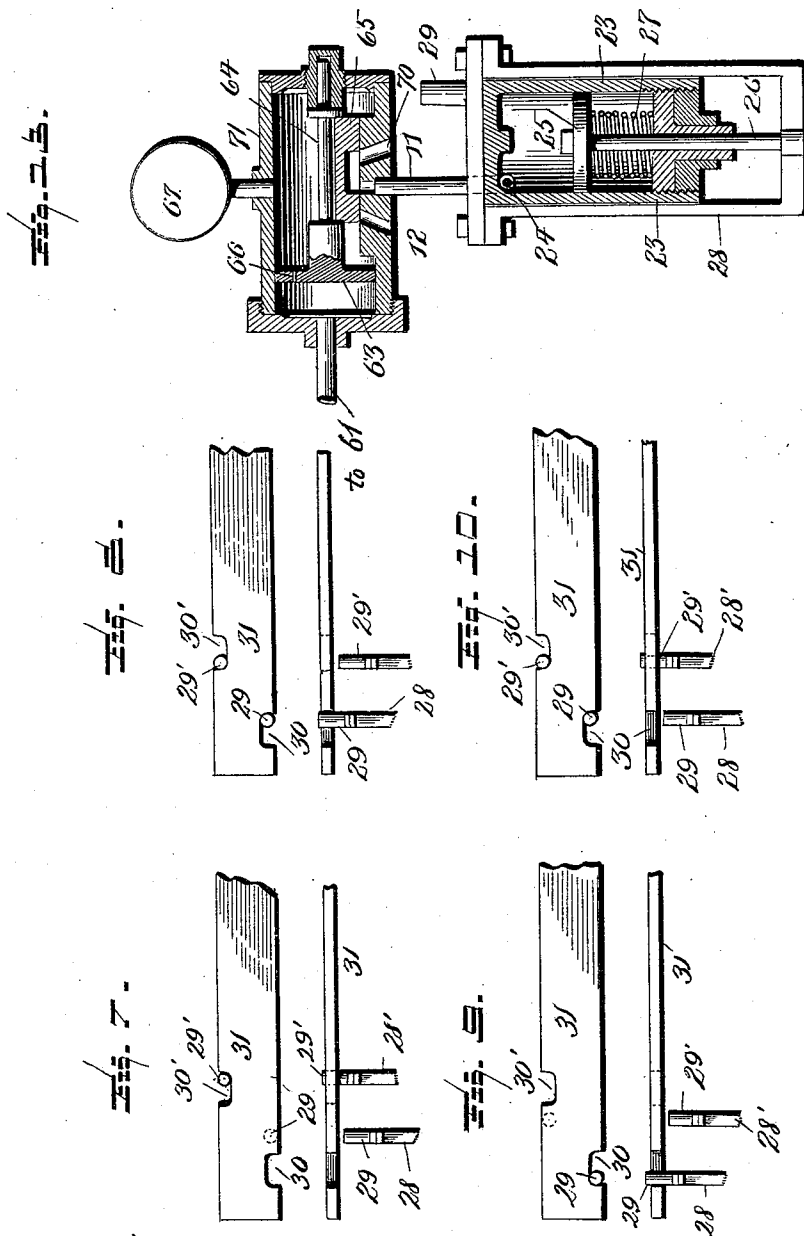
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J. W. THOMAS, Jr.

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4 Sheets—Sheet 4.

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Fig. 22.

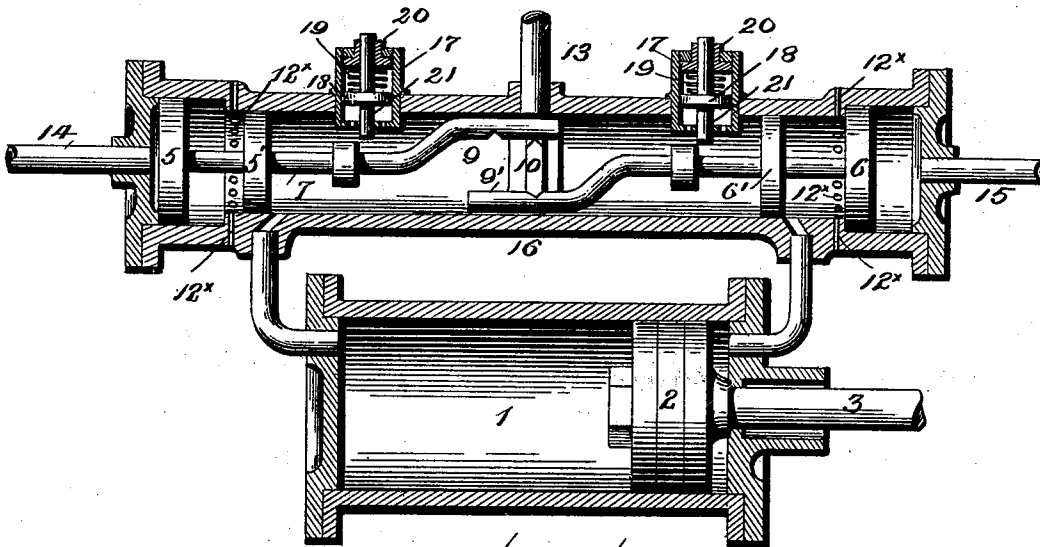
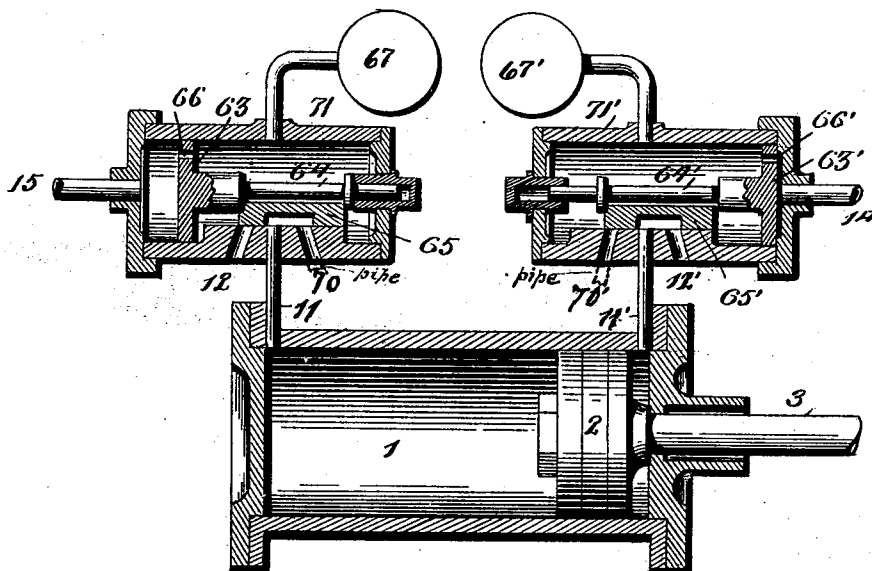


Fig. 23.



Witnesses:

L. C. Hills
E. W. Dike

Inventor
John W. Thomas, Jr.,

by Marcellus Bailey
his Attorney

UNITED STATES PATENT OFFICE.

JOHN W. THOMAS, JR., OF NASHVILLE, TENNESSEE.

PNEUMATIC SYSTEM OF AND APPARATUS FOR HANDLING RAILWAY-SWITCHES.

SPECIFICATION forming part of Letters Patent No. 520,812, dated June 5, 1894.

Application filed February 24, 1894. Serial No. 501,399. (No model.)

To all whom it may concern:

Be it known that I, JOHN W. THOMAS, JR., of Nashville, in the State of Tennessee, have invented a certain new and useful Pneumatic System of and Apparatus for Handling Railway-Switches, of which the following is a specification.

My invention is directed mainly to the handling of railway switches; but in some of its features it is applicable to the handling of railway signals as well.

The main and controlling feature of my invention is the manipulation of the valve or valves admitting air to and exhausting it from the working cylinder of a railway switch by means of two pneumatic pistons (of either the differential or the equalizing type as hereinafter described) each actuated independently of the other by means of separate and distinct controlling pipes both of which contain air at more than atmospheric pressure at all times—the pistons being subjected, on the sides opposite those on which the controlling pipes are located, to air pressure opposing that in the controlling pipe, and being actuated and controlled in their movements by alternately and at proper times reducing the pressure in the controlling pipes below, and restoring it to, the maximum.

The object which I have in view, and which is attained by the foregoing method of handling the valve or valves, is to insure speed, and certainty in the operation of the parts, as well as immunity from accident.

The invention resides also in the pneumatic appliances constituting what I term the indicator mechanism, employed by me to indicate to the operator in the tower whether the switch has responded properly to the movement of the switch operating lever, and to restrain that lever from motion to an extent sufficient to unlock the signal mechanism until after the switch has properly responded; it also resides in a valve mechanism controlled by the movement of the switch, for changing the currents of air by which the indicator mechanism is operated; and it further resides in other details which will be developed in the course of the following specification.

To enable others skilled in the art to understand and use my invention I will now proceed to describe more particularly and in detail the

manner in which the same is or may be carried into effect, by reference to the drawings accompanying and forming part of this specification.

In the accompanying drawings—Figure 1 is an axial section of the working, or switch-actuating, cylinder and the valve mechanism for controlling the supply of compressed air to said cylinder. Fig. 2 is a sectional side elevation of the operating lever (located in the tower) and the parts connected therewith through the agency of which the movement of the switch is controlled. Fig. 3 is a vertical section enlarged of the mechanism through which the operating lever is caused to intermittently engage the controlling valve. Fig. 4 is a face elevation of the spring device which engages the stem of said valve. Fig. 5 is a plan (with the working cylinder in section), and Fig. 6 is a longitudinal vertical section of the valve mechanism operated by the movement of the piston rod of the working cylinder. Figs. 7, 8, 9, and 10, are views respectively in plan and side elevation of that end of the tappet of the operating lever which engages the indicator or locking pin—showing the same in the different positions they assume during the operation of throwing the switch. Figs. 11 and 12, are axial sections of modified forms of the valve mechanism for the working cylinder. Fig. 13 is a like section of a modified arrangement of the indicator cylinder and parts connected therewith.

1 is the working cylinder; 2 is its piston (suitably packed); and 3 is the piston rod through the agency of which the switch is operated. The means employed for this purpose may vary; one known arrangement of mechanism is shown in plan in Fig. 5, comprising the reciprocatory bar 5 pinned to the outer end of the piston rod and provided with a pin a which engages and works the crocodile jaw lever a' pinned to some suitable base, and connected to the switch points a^2 by a suitable connection a^3 . The same bar 5 through suitable intermediary a^4 also works the switch lock. I attempt no detailed description and illustration of these parts however, inasmuch as they form no part of my invention and are well known to those skilled in the art.

The working cylinder is provided with ports

11, 11', one at each end, which by suitable passages or pipes communicate with like ports in the valve chest 16. This chest is also provided with two exhaust ports 12, 12', and with
 5 a supply pipe 13 through which air from the main compressed air supply enters the chest. The ports 11, 12 are controlled by a D slide valve 8, which is actuated by a differential piston 5, 5', the slide valve being held between collars on the stem of the differential
 10 piston; the ports 11', 12', are controlled by a like slide valve 8', which in like manner is connected to and actuated by a differential piston 6, 6'. In one head of the valve chest
 15 is an inlet 14 and in the other and opposite head of the chest is an inlet 15. Inlet 14 by a pipe communicates with a like numbered port 14 in the chest 38, controlled by a slide valve 36, (Fig. 2,) connected to the switch operating lever 32 in the tower. Inlet 15 by an
 20 independent pipe communicates with the like numbered port 15 of the valve chest 38 in Fig. 2. In chest 38 is an exhaust port 49 between the ports 14 and 15. This port 49
 25 is designed to be closed by a relief or pop valve set so as to blow off at any desired predetermined pressure—say above fifty pounds to the square inch, if the normal pressure in the controlling pipes and valve chest is, as I
 30 prefer it should be, sixty pounds to the square inch. Compressed air from the main supply enters the chest 38 through a pipe 39 controlled by a reducing valve 40. In the system I have adopted, while I work with sixty
 35 pounds pressure in the controlling pipes 14, 15, yet for certain reasons hereinafter explained I prefer that the main supply from which this air is drawn shall be at eighty
 40 pounds pressure to the square inch, and I therefore employ the reducing valve 40 to bring down the pressure to sixty pounds.

In the position of parts shown in Figs. 1 and 2, the controlling valve 36 is so located as to bridge the ports 49, 14, and to uncover
 45 the port 15. Thus air at sixty pounds pressure enters through inlet 15 of valve chest 16 (Fig. 1) and acting against the larger head of the differential piston 6, 6', overcomes the counter pressure of say eighty pounds exerted upon the smaller head of the piston, and
 50 forces it to the left bringing its slide valve 8' in position to bridge the ports 11', 12', and consequently opening the exhaust to the right hand end of the working cylinder. At the same time pressure upon the larger head
 55 of the other differential piston 5, 5', is reduced to say fifty pounds by reason of the inlet 14 at that end of the valve chest 16 being in communication with the exhaust or relief port 49 (Fig. 2), and consequently the
 60 superior pressure upon the smaller head of the differential piston 5, 5', forces it to the left, thus uncovering the port 11, and permitting compressed air at full pressure (eighty
 65 pounds) to enter the left hand end of the working cylinder, with the effect of forcing the piston 2 to the right. To reverse, the

controlling valve 36 is shifted to bridge ports 49, 15, and uncover port 14. The effect is to
 70 reduce pressure to fifty pounds at inlet 15 and to increase it to sixty pounds at inlet 14 with the result of shifting the differential pistons in Fig. 1, so that the valve 6, 6', will now
 75 (by the slide valve 8') admit compressed air to the right hand end of the working cylinder through uncovered port 11', while valve 5, 5', (by the slide valve 8) will bridge ports 11, 12, thus opening the left hand end of the
 80 cylinder 1 to the exhaust, and consequently causing the piston 2 to move to the left. Under this arrangement it will be noted that the valves which admit air to and exhaust it from the working cylinder are subjected to main-
 85 tained compressed air pressure from both sides, and are operated by means of two controlling pipes—one for each valve—by the
 90 alternate increase and diminution of pressure in which the valves are shifted—both of these pipes containing at all times air at more than atmospheric pressure.

My reason for having a high air pressure—say eighty pounds—in the main supply pipe, and reducing it to a maximum of sixty pounds in the controlling pipes 14, 15, is that practice has demonstrated that after the partial
 95 exhaust to fifty pounds pressure in the same pipe will be restored to sixty pounds more rapidly, than if the pressure in the main supply pipe were no greater than the maximum pressure in the controlling pipes, and therefore
 100 the valves for admitting and exhausting air from the working cylinder will be shifted more quickly.

In the practical working of this system under the conditions above indicated, fractures
 105 in the pipe line of the controlling pipes 14, 15, may occur, as for example in the pipe 15, in Fig. 1, which for the time being happens to be the high pressure pipe. The consequent leakage might result in such a reduction of pressure in that pipe as to cause the
 110 now superior eighty pounds pressure within the chest 16 to force valve 6, 6', to the right. To guard against movement of either one of the differential pistons from this cause I prolong their stems 7, 7', into tappets 9, 9' which
 115 extend on opposite edges of a transversely sliding dog 10, adapted to enter a notch in one or the other of the tappets and thus to lock it (and consequently its valve) against
 120 movement. The tappet 9' is thus locked in Fig. 1, and cannot be unlocked until the other piston 5, 5', and consequently the tappet 9, first move to the right far enough to bring the notch in that tappet opposite the dog—
 125 which movement of course cannot take place until pressure is restored to normal in the controlling pipe 14 of the differential piston 5, 5'. Again it may happen that pressure in the interior of the chest 16 delivered through
 130 main supply 13 will chance to fall so much below eighty pounds as not to be able to resist the pressure in pipe 14, although that pressure, under the conditions supposed in

Fig. 1, has been reduced to fifty pounds. In this event the valve 5, 5', would, by the superior pressure exerted through pipe 14, be forced to the right, thus opening the right hand end of the working cylinder to the exhaust and at the same time unlocking the tappet 9' of the other valve 6, 6'. If under these conditions the pressure in pipe 15 should by any chance fall so as not to be able to resist the internal pressure in the valve chest, the differential valve 6, 6', would move to the right, thus opening the air supply to the right hand end of the working cylinder, with the result of shifting the switch. In order to guard against any such contingency I provide for each piston valve a retaining pin 21, attached to a piston 18 in a cylinder 17 set in the valve chest 16 with its inner end communicating with the interior of said chest. The piston 18 is inwardly pressed by a spring 19, the stress of which is regulated by an adjusting nut 20. The adjustment is such that when main supply pressure in the interior of the chest is normal, it will suffice to push up the piston 18 against the force of its spring far enough to carry the pin 21 out of the path of the collar or flange 22, or 22', on the stem of the differential valve 5, 5', or 6, 6'. As soon however as pressure falls below normal the pin 21 drops behind the collar, in position to prevent any inward movement of that valve (in this instance valve 5, 5') which is for the time being the low pressure or exhaust valve, and the tappet 9 of which locks the dog 10 into engagement with the other tappet 9'. There should be in each of the adjusting nuts 20 an aperture to permit the escape to the atmosphere of any air which may happen to leak through between the piston 18 and its cylinder.

The valve 36 (Fig. 2) is operated, as before said by the operating lever 32. This lever is provided with a suitable latch 33, to engage a stationary notched quadrant by which it can be held in any one of the three positions A, B, C; and it is connected as customary to the tappet 31 of an interlocking apparatus by which all levers for operating signals which give the right of way to a train over the switch, are locked until the switch is fully thrown. For this reason the connection between the operating lever 32 and its valve 36 must be such that the valve will be moved its entire throw during the first half of the movement of the lever 32 in either direction, and remain stationary during the remainder of the stroke, thus permitting the lever sufficient movement, after the valve is thrown, to shift the interlocking tappet far enough to unlock the signal levers controlled by it; and for the same reason there must be combined with the interlocking tappet means whereby its movement to this extent is prevented until it is certain that the switch has been fully thrown or shifted. The means last referred to will be presently described.

I will now describe the mechanism by which

the operating lever after throwing its valve permitted further movement while the valve remains at rest. Various mechanical devices may be employed for the purpose. The mechanism shown in the drawings (Figs. 2, 3, and 4) is that which I now prefer.

The tappet 31 is supported by and slides in suitable guides on the table 50. The shorter arm of the operating lever is pinned to the end of a connecting rod 34, which passes through guideways (in which it can slide or move lengthwise) in a frame or casting 35, bolted to the side of the table 50. In this same frame or casting is a guideway for the end of the stem 37 of valve 36. In this stem are two notches 44, 45, and connection is established between rod 34, and the stem 37, by a dog 43, carried by the rod, which enters one or the other of the notches in the valve stem. So long as the parts are thus connected, the stem and rod will move together as one. But manifestly in order to admit of the independent further movement of the operating lever after the valve has been thrown, the connection between the rod 34 and the valve stem must be, not permanent, but temporary and intermittent. To this end I attach the dog 43, to the end of a bowed spring arm 42, fixed at its other end to the rod 34. This arm is provided at the end which carries the dog, with laterally projecting bosses 48, which run upon double inclines 47, 46, the apex or highest point of the incline being midway of its length—which length is equal to the traverse of the rod 34 occasioned by the full stroke of operating lever 32. And the distance between the notches in the valve stem is equal to one half of this distance—as indicated in Fig. 3.

In the position of parts shown in the drawings the dog 43 is engaged with the notch 44, and the operating lever is at one extreme of its movement, in its A position. In throwing it over to its C position the operation is as follows: This movement of the lever through the connecting rod 34 also moves the valve 36. As the bosses 48 move over the incline 46, the dog 43 is gradually withdrawn from the notch 44 and, as the apex or highest point of the incline is reached, finally quits and is disengaged from the notch—thus releasing the valve 36 from the control of the lever. By this time however, the valve has been fully thrown. All this is accomplished by the time the operating lever reaches its B position, thus leaving the remainder of the movement from B to C to effect the full movement of the interlocking tappet 31. By the time the operating lever reaches its C position, the dog 43, has traveled down the other incline 47, and has reached and engaged the other notch 45 in the valve stem, which notch by the previous movement of that stem was brought to position to meet the dog 43 at this time. Thus on reaching its C position the operating lever is once more in connection with the valve. In throwing the lever back

from C to A position, the same sequence of operations takes place. By the time the lever reaches B, the valve will have been thrown, and the dog 43 will have been disengaged from the notch 45, thus leaving the lever free to move from B to A without further influencing the valve. On returning to A position, the parts reassume the position indicated in Fig. 2.

I now pass to a description of the instrumentalities by which the operating lever in being thrown from one extreme of its movement to the other is prevented from passing beyond its B or middle position until the switch has been fully thrown. These instrumentalities are illustrated in Figs. 2, and 5 to 10 inclusive. The tappet 31, as seen in plan view in Figs. 7 to 10, has in it two longitudinal slots or recesses 30, 30'—one in each edge. In conjunction with these slots are provided the indicator pins 29, 29'—pin 29 working in conjunction with slot 30, and pin 29' working in conjunction with slot 30'. These pins are so arranged that when the one is up, the other is down, and they are actuated thus to move by pneumatic appliances controlled by or from the switch in the manner hereinafter described. It will be sufficient for the present to say that, as shown in Fig. 2, each pin is connected by an oblong rectangular frame 28, or 28' (shown detached in elevation on the left of Fig. 2) to the stem 26, or 26' of a piston 25, or 25', adapted to move up and down in a cylinder 23, or 23', and upwardly pressed by a spring 27, or 27', or weight or any other suitable instrumentality for the purpose, so as to project the pin into its appropriate slot in the tappet. Compressed air delivered into the cylinder through an inlet 24, or 24', will at proper times by its superior pressure depress the piston and so lower the pin out of engagement with the tappet. The two cylinders 23, 23' are secured to the table, and each frame 28 or 28', straddles and moves in guides on the exterior of its cylinder.

The parts are shown in normal position in Figs. 2 and 7. The pin 29 is down and under the solid portion of the tappet. The pin 29' is up and in the end of its slot 30' nearest to the operating lever.

To shift the lever from its A to its C position, the lever first moves from A to B—the length of the slot 30' permitting this limited movement—at the end of which the pin 29' will be at the far end of the slot 30', and the pin 29 will be opposite to or just under the near end of its slot 30. This movement of the lever from A to B should suffice as already explained to throw over the switch. If the switch is not fully thrown over, the pins will remain *in statu quo*, and further movement of the lever toward its C position will be prevented by the locking action of the pin 29'. But if the switch is fully thrown over, then, by the action of valve shifting mechanism to be presently described, compressed air will be exhausted from over pis-

ton 25 of cylinder 23 through port 24, and will be supplied to cylinder 23' through port 24', and consequently the pin 29' will drop and the pin 29 will rise as indicated in Fig. 8. With the parts in this position the operating lever is free to be moved to C—the tappet, when the lever reaches this point, occupying the position shown in Fig. 9. In returning the lever from C to A, its movement from C to B will bring the parts to the position shown in Fig. 10—provided of course the switch has been fully thrown; and further movement of the lever from B to A will be permitted—the parts, when the lever again reaches A position appearing as in Figs. 2 and 7. This result is reached, as already indicated, by alternately and at proper intervals decreasing and increasing the air pressure over the pistons 25 and 25'. The manner in which I attain the result is as follows—referring more particularly to Figs. 5 and 6: The rod 5, which is pinned to the piston rod 3 of the main cylinder 1 (Figs. 1 and 5) has more throw than is needed to handle the switch. In other words the reciprocatory rod 5 moves farther in each direction than is required for handling the switch. This excess of movement I avail of to operate the valve mechanism by which the supply of compressed air to the indicator cylinders is controlled—the arrangement being such that the operation cannot take place until after the switch has been fully thrown. The arrangement of mechanism for this purpose is as follows: Immediately above the rod 5, and fixed in a stationary position so that the rod can slide beneath it, is the valve chest 51, supplied with slide valves 52, 53, which either can be cast in one piece, or can be made separate as shown, in which latter event they will be held between collars or flanges on a piston rod 54, ends of which project out from opposite ends of the chest through suitable stuffing boxes. I remark at this point that to the right of valve 53 there is represented still another valve which has no designating numeral. This particular valve together with the passages (unmarked) controlled by it, are placed in the chest 51 for convenience, but have no close relation to the present invention, being merely instrumentalities in the nature of what may be termed a pneumatic “selector,” for operating the pneumatic pistons of two signals, one or the other of which will be operated according to the position of the switch; they form part of another application for Letters Patent in my name of even date herewith, for an improved pneumatic signal system and apparatus, and requires no description here.

The valve 52, operates in connection with ports 57, 58, 59—57 communicating with the main compressed air supply; 58 (through a suitable pipe) with the opening 24', in cylinder 23' over piston 25' (Fig. 2); and 59 with an exhaust controlled by a properly set pop or relief valve. The valve 53 operates in connection with similarly arranged ports 60, 61,

62, of which 60 communicates with an exhaust controlled by a properly set pop or relief valve; 61 (through a suitable pipe) with the opening 24 in cylinder 23 over piston 25; and 5 62 with the main compressed air supply. In practice one pop or relief valve will serve both ports 59 and 60. The arrangement is such that when the one valve is in position to put the main supply in communication with 10 its indicator cylinder, the other valve will be in position to open the other indicator cylinder to the exhaust. From one of the main supply ports—in this instance port 57—there leads a permanently open by-pass 55 to the 15 interior of the valve chest 51—the latter thus being constantly supplied with compressed air, for the purpose of balancing the valves. The shifting of the valves is effected by means of two knockers 56, carried by the rod 5, and 20 located one beyond each end of the valve stem 54.

The position of parts represented in Fig. 6 is that occupied by them when the switch is normal, and the lever 32 in the tower is in the position shown in Fig. 2. Valve 52 is in 25 position to put its exhaust port 58 in communication through port 59 with indicator cylinder 23', thus permitting the indicator pin 29' to rise, while valve 53 is in position 30 to put its compressed air supply port 62 in communication through port 61 with indicator cylinder 23, thus causing the indicator pin 29 to drop.

It will be borne in mind that, as hereinbefore stated, the rod 5 has more movement 35 than is needed to throw the switch.

In reversing or throwing over the switch the operation of the parts in question is as follows: By movement of the operating lever 40 32 from its A to its B position, air is admitted to the switch operating cylinder in a direction to cause the rod 5 to move to the left. The knocker 56 on the right hand end of the rod is such distance away from the valve stem 54, that the rod 5 can certainly move at 45 least the full distance required to throw the switch before the right hand knocker meets the end of the valve stem. Indeed I prefer that this rod 5 should move considerably farther than is needed to throw the switch before either knocker meets and shifts the valve stem—the shifting of the valve stem taking place say only during the last half inch of the movement of the rod 5. At any rate it 55 is only after the switch has been fully reversed and locked, that the right hand knocker 56, meets the valve stem 54, and the remainder of the movement of the rod is just sufficient to cause the knocker to shift the valves 52, 60 53, the former now supplying compressed air to its cylinder 23', and the latter partly exhausting the air from its cylinder, thus causing the indicator pin 29 to rise, and the pin 29' to descend, to the position represented in 65 Fig. 8. In this way, it will be seen that the indicator pins 29, 29' are so controlled by the pneumatic mechanism, the operation of which

is directly dependent upon that of the switch throwing devices, that the switch operating lever 32 in moving from A to C or vice versa, 70 cannot get beyond its B position until after the switch has been fully thrown and set.

The operation of the system as a whole has been sufficiently indicated in the course of the foregoing specification, and needs no further 75 description.

It will be noted that in this system the manipulation of the valve admitting air to and exhausting it from the working cylinder of the switch is controlled by two controlling 80 pipes—one for each valve or set of valves—both of which contain air at more than atmospheric pressure at all times, these pressures being variable within limits—that in the one rising, as that in the other is reduced— 85 and acting to oppose more or less the air pressure exerted in the contrary direction upon their respective valves. These conditions I believe to be essential to the practical operation of the system, and involves much 90 more than a mere duplication of the controlling devices.

At first sight it might be imagined that, for example, one half of the valve operating mechanism and one of the controlling pipes 95 in Fig. 1 might be dispensed with, and the admission of air to and its exhaust from the cylinder might be controlled by a single valve (8 for instance) through its two ports 12, 11, and a third port answering to 11' 100 placed on the side of 12 opposite to that on which port 11 stands. But in any such arrangement with one controlling pipe only the switch is very liable to fly over. If for example the controlling pipe should burst while 105 maximum pressure was on it, the switch would at once fly over. So also would it, if the controlling pipe were at minimum pressure and the main supply pipe leading to the valve chest should spring a leak sufficient to reduce the 110 pressure in the chest below that in the controlling pipe. Of course the latter contingency might be avoided if the valves were worked at such low pressures as that minimum pressure would be 0. But it is very necessary to work 115 at high pressure in order to handle switches with the requisite rapidity. If for example maximum pressure were ten pounds and minimum 0, it would take about twice as long to operate the switch for the reason that at 120 these low pressures air will flow more slowly than it will at high pressures. In fact experience has demonstrated that no switch or signal system in which all the air in the controlling pipe is exhausted at any stage of the 125 operation can be made to work successfully as to speed. To the attainment of speed, maintained high pressure, with as little variation as practicable between the maximum and minimum pressures, is requisite; and no 130 such system involving, as has heretofore been the case so far as I know, the use of one controlling pipe only, can be made really secure against the switch flying over, for the one

move or the other of the switch must be directly dependent upon reduction of pressure in the controlling pipe, and it does not matter whether the reduction be occasioned 5 designedly or by accident—the result will be the same.

Working at the pressures which, as hereinbefore indicated I prefer to work at, it requires a reduction of ten pounds pressure in the controlling pipes 14, 15 in order to properly handle the switch by means of the mechanism shown in Fig. 1. By eliminating however the slide valves 8, 8', and to this extent 15 the switch with a seven pound reduction of pressure.

A plan by which the valves 8, 8', can be dispensed with is illustrated in Fig. 11. The smaller pistons 5' and 6' of the differential 20 pistons are themselves used to control the ports by which air is exhausted from and admitted to the working cylinder; and the exhaust opening or openings 12^x in each case (corresponding in function to the ports 12, 12' 25 in Fig. 1) are located in that part of the valve chest which is embraced between the larger and smaller pistons or heads of each differential piston. In other respects the arrangement does not differ from that shown in Fig. 30 1. So too I can, and have, dispensed with differential pistons, using in lieu thereof equalizing pistons—that is to say pistons each of which has in it, or in that portion of the valve chest which it traverses, a port through which 35 air can gradually pass from one side of the piston to the other in order to finally equalize the pressure on both sides after it has been reduced from, or restored to, the maximum on the side of the controlling pipe. An arrangement 40 for this purpose is represented in Fig. 12. In this arrangement the equalizing pistons are shown at 63, 63'. Each is contained in a chest or compartment 71, 71', distinct from and non-communicating with the other; and each has a valve stem 64 or 64', connected to a slide valve 65 or 65'. Valve 65 45 controls ports 11, 12, similar to those in Fig. 1, and also (unlike the arrangement shown in Fig. 1) a port 70 that communicates with the main compressed air supply. Valve 65' controls 50 similar ports 11', 12', 70'. In the outer head of the one valve chest 71 is the controlling pipe 15, and in the like head of the other chest 71' is the controlling pipe 14. In each 55 piston is an equalizing port 66, or 66', through which air can gradually pass from one side to the other of the piston according to the preponderance of pressure so as to finally equalize the pressure on both sides of the 60 piston. The air capacity of the chests is preferably increased by reservoirs 67, 67'—one for each chest.

With the parts in the position represented in Figs. 12 and 2 respectively, then, if they 65 were operating together, the controlling pipes 14 and 15, of Fig. 12, would lead to the like designated ports in Fig. 2. This would be

the position of parts when the switch was normal—pipe 15, chest 71, and reservoir 67 70 containing air at say sixty pounds pressure, and pipe 14, chest 71' and reservoir 67' containing air at say fifty pounds pressure. The air from the main supply for the working cylinder through ports 70, 70', will be at eighty 75 pounds pressure. To reverse the switch, pressure is reduced in the pipe 15, and as this reduction takes place faster than air can pass through the equalizing port 66 from the reservoir 67, the piston 63 will be forced to the 80 left by the superior pressure on its reservoir side thus closing the supply and opening the exhaust to the left hand end of the working cylinder. At the same time pressure in pipe 14 is restored to maximum more quickly than 85 air can feed through the equalizing port 66' of piston 63', and consequently that piston will also be forced to the left, thereby closing the exhaust and opening the supply to the right hand end of the working cylinder. The 90 pressure in the chest 71 now begins to equalize until it is reduced to fifty pounds on each side of the piston 63, like equalization takes place in the chest 71', until the pressure there upon each side of the piston is sixty pounds.

In some instances, as for example when the 95 switches are a considerable distance from the tower containing the switch operating lever and the indicator pins, the equalizing arrangement just described can be used to great advantage in connection with the indicator cylinder for the purpose of hastening the action 100 of the indicator and thus rendering it practicable to handle the parts more quickly.

Fig. 13 represents one of the indicator cylinders and an equalizing piston and chest 105 thus combined—the cylinder is supposed to be the indicator cylinder 23 of Fig. 2, and the equalizing piston, a piston similar to 63 of Fig. 12. Similar reference numerals in these figures represent corresponding parts. Fig. 110 13 therefore needs no detailed explanation further than to say that the inlet 24 of the indicator cylinder 23, communicates with the supply port of the equalizing chest, and the head of that chest with the port 61 of the 115 valve chest in Fig. 6. In this way I am enabled for the purpose of operating the indicator to take compressed air from the main supply at a point in close proximity to the indicator. This arrangement permits of all the 120 air being exhausted out of the indicator cylinders, thus allowing the spring or its equivalents to force up the locking pin more quickly.

While the differential piston and the equalizing piston hereinbefore described are specifically different types of pneumatic piston, 125 yet for the purposes of my invention and in the connection in which I use them they are the equivalents one of the other.

I have represented the indicator pistons as 130 influenced on the reverse side by a spring, but in lieu of spring pressure, I can use air pressure, whether constant or intermittent, or a weight or other appliance.

I remark in conclusion that I am aware that it is not new in a general sense to take the air for the working cylinder from the main supply at a point in proximity to the cylinder, through the agency of pneumatically operated valve mechanism, controlled from a distance through the agency of air by some mechanically operated lever or like appliance; nor is it broadly new to admit air to and exhaust it from the working cylinder by means of a differential piston valve mechanism. Both of these features broadly considered I understand to be old and public property.

I desire further to remark that in my equalizing piston arrangement, the compressed air for the working cylinder is taken from the main supply at a point in proximity to the cylinder, and that the main supply is in direct communication with the working cylinder by way of the D slide valve controlled by the piston—no part of the air from the controlling pipe being used in the working cylinder.

The use of an equalizing piston mechanism on the indicator cylinder, as illustrated in Fig. 13, is applicable whether that indicator be used in connection with a switch lever, as herein described, or a signal lever as in my companion application of even date herewith for pneumatic system of an apparatus for handling railway signals.

What I believe to be new herein and of my own invention is as follows:

1. The method of manipulating or working the valve or valves admitting air to and exhausting it from the working cylinder, which consists in subjecting each of two pneumatic pistons to the action of a column of compressed air separate and distinct from that which acts on the other, and delivered through controlling pipes, one for each piston, containing air at more than atmospheric pressure at all times, the pistons being subjected, on the sides opposite those on which the controlling pipes are located, to air pressure opposing that in the controlling pipes, and being actuated and controlled in their movements by alternately and at the proper times reducing and restoring the pressure in the controlling pipes, substantially as hereinbefore set forth.

2. The combination of the two pneumatic pistons, the controlling pipes one for each piston, the operating lever, the valve actuated thereby and connections substantially as described between said controlling pipes and the ports controlled by said valve, whereby the one controlling pipe is placed in communication with the exhaust when the other is in communication with the source of compressed air supply, substantially as and for the purposes hereinbefore set forth.

3. The combination with the operating lever and its tappet, of the valve for regulat-

ing pressure in the controlling pipes, and means substantially as described whereby said valve is intermittently and automatically connected to and disconnected from the lever during the throw of the latter, substantially as and for the purposes hereinbefore set forth.

4. In combination, the operating lever and its slotted tappet, the two indicator pins, and pneumatic appliances for operating said pins connected to and controlled in their action by the movement of the switch; whereby one or the other of the pins is caused to engage and lock the tappet before the lever completes its full throw in either direction until after the switch has been fully shifted, substantially as hereinbefore set forth.

5. The indicator pins, and the reciprocatory pistons therein to which said pins are severally connected, in combination with the switch, the slide valve mechanism connected to and operated by the switch, and controlling two sets of ports one for each indicator cylinder and connections whereby when one indicator cylinder is opened to its air exhaust or reducing port, the other is opened to its air supply or pressure port, and vice versa.

6. The combination of the reciprocatory rod 5, the valve shifting knockers thereon, the valve mechanism actuated by said knockers at or near the conclusion of the movement of the rod in either direction, the indicator cylinders and mechanism, and connections between the same and the valve mechanism, substantially as and for the purposes hereinbefore set forth.

7. In combination with the valve chest or case and the controlling pipes, the two pneumatic pistons provided with notched stems and the transversely sliding dog arranged between said stems and operating to lock and release each stem alternately at the times and in the manner substantially as hereinbefore set forth.

8. The equalizing piston, its chest and controlling pipe, in combination with the valve operated by said piston, and the ports controlled by said valve, the supply port having direct communication with a source of compressed air supply and being closed at all times by the valve from communication with the compressed air received in the chest through the controlling pipe.

9. The equalizing piston mechanism, in combination with the indicator cylinder and appliances, substantially as and for the purposes hereinbefore set forth.

In testimony whereof I have hereunto set my hand, before two subscribing witnesses, this 16th day of February, 1894.

JOHN W. THOMAS, JR.

Witnesses:

EWELL A. DICK,
ROBT. W. COX.