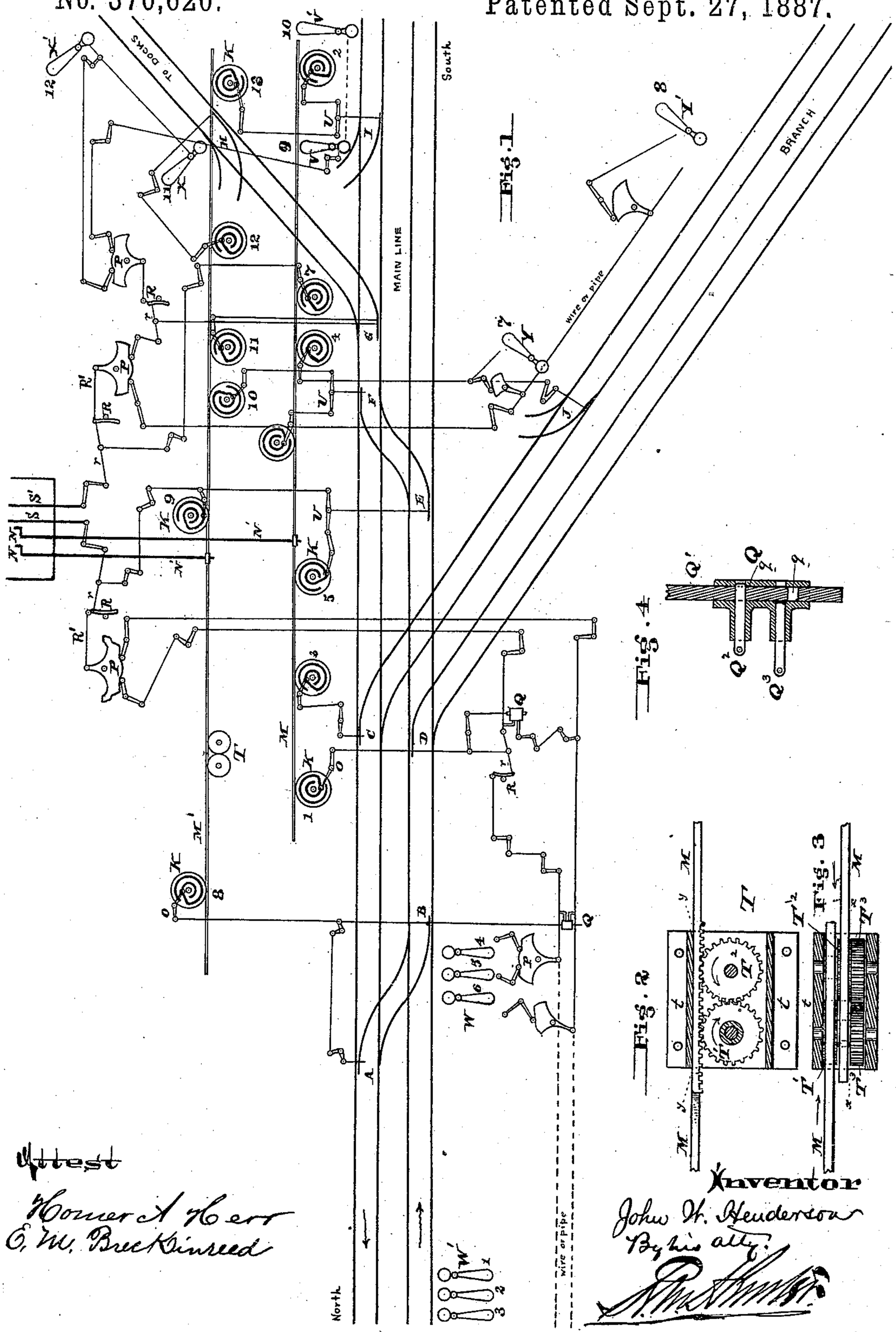
(No Model.)

2 Sheets—Sheet 1.

J. W. HENDERSON.

SWITCH AND SIGNAL.

No. 370,620. Patented Sept. 27, 1887.



Attest

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(No Model.) 2 Sheets—Sheet 2.

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Fig. 5

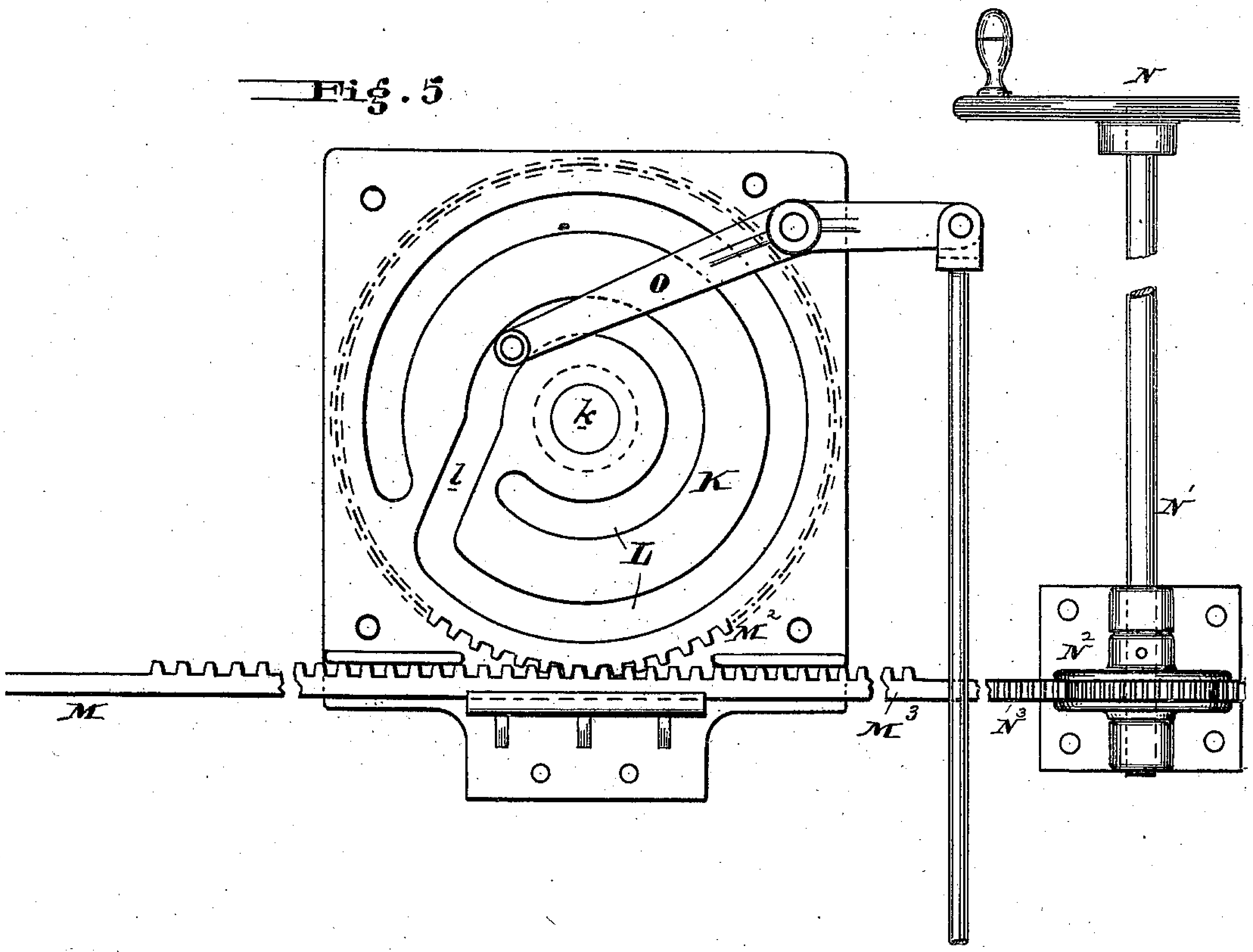
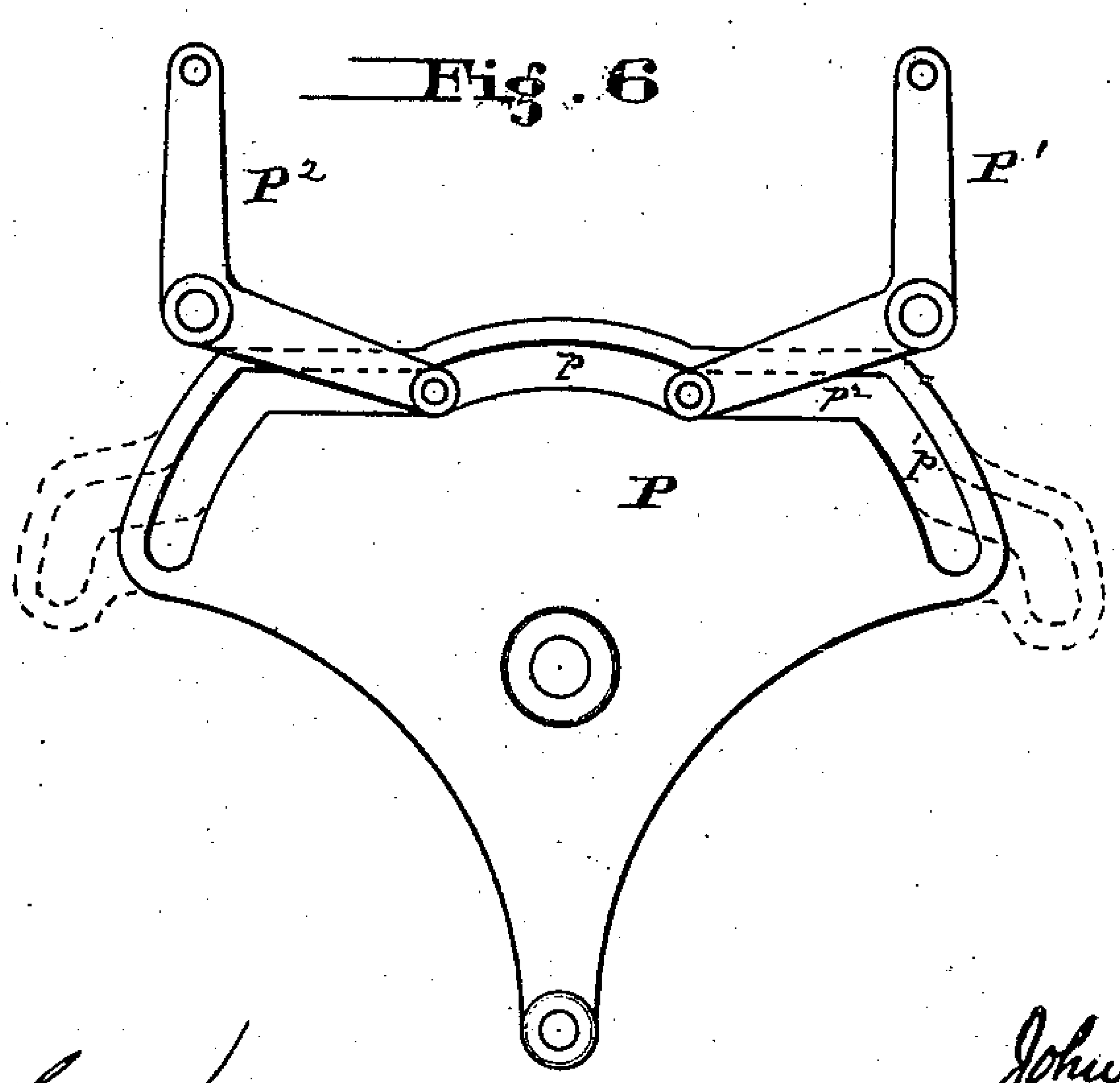


Fig. 6



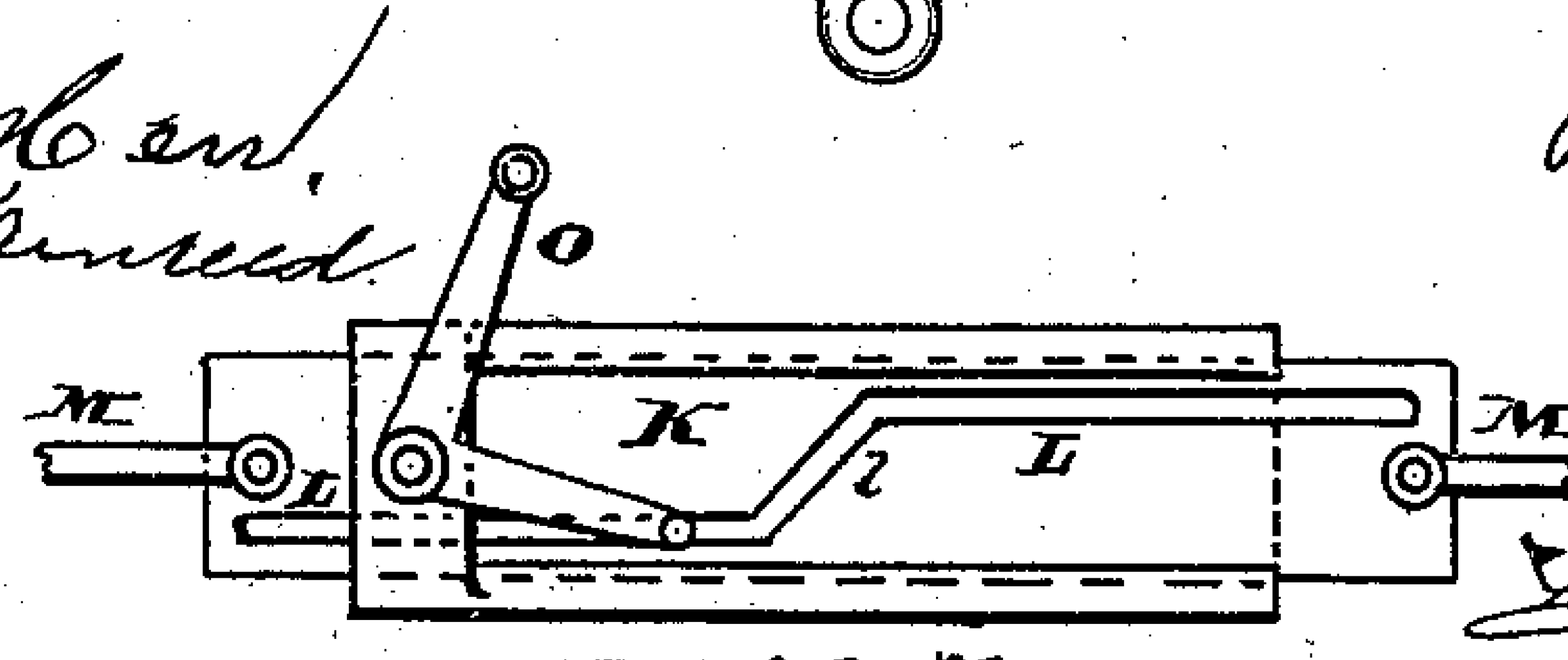


Fig. 7

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UNITED STATES PATENT OFFICE.

JOHN W. HENDERSON, OF PHILADELPHIA, PENNSYLVANIA.

SWITCH AND SIGNAL.

SPECIFICATION forming part of Letters Patent No. 370,620, dated September 27, 1887

Application filed September 29, 1885. Serial No. 178,530. (No model.)

To all whom it may concern:

Be it known that I, JOHN W. HENDERSON, of the city and county of Philadelphia, and State of Pennsylvania, have invented a new and useful Improvement in Switches and Signals, of which the following is a specification.

My invention has reference to operating switches and signals for railroad purposes; and it consists in certain improvements in interlocking mechanism for switches and signals, by which a large number of switches and signals may be operated with a limited number of levers, all of which are fully set forth in the following specification, and shown in the accompanying drawings, which form part thereof.

In carrying out this invention I provide a series of cams each having actuating parts and coupled together by an operating rod or mechanism, and so arranged that the said cams operate their levers in a predetermined order, and said levers are arranged to operate the switches, and, if desired, I also provide suitable mechanism by which the proper signal of a series is caused to be operated with a movement of a signal-lever common to a large number of signals.

In the drawings, Figure 1 is a plan view of a railway in which main line, branches, cross-overs, and throw-offs are provided, the object being to show a complicated arrangement of tracks, and thereby illustrate how with only four levers or their equivalent the same number of switches and signals may be actuated and with the same facility of movements that require 20 levers when constructed as now in common use for simple interlocking. Fig. 2 is a sectional plan view, on line *x x*, Fig. 3, of a compensating mechanism for the line-rods, pipe, or tubing. Fig. 3 is a sectional elevation of same on line *y y*. Fig. 4 is a sectional plan view of one of the locks. Fig. 5 is an enlarged plan view of one of the switch-operating cams, its connections, and operating mechanism. Fig. 6 is an enlarged plan view of the cams for operating one of two switches or signals with a single line of pipe and single lever; and Fig. 7 is a modified construction of cam for operating the switches or signals, in this case being made to slide or reciprocate in place of rocking or rotating.

In the arrangement of tracks shown in Fig. 1 trains may be run in the following ways: North and south bound main line; north-bound main line and south-bound branch; north and south bound branch; south-bound main line and north-bound from docks; south-bound to docks; north-bound from docks and south-bound branch. Trains may be shifted in the following ways: North-bound main line cross-over A B to south-bound main line; north-bound main line cross-over F E to south-bound main line; north-bound branch cross-over A B to south-bound branch; north-bound branch cross-over A B to south-bound main line; docks to cross-over F E to south-bound main line; docks to cross-over F E, run to D, then south-bound branch; docks to cross-over A B, then south-bound main line; docks to cross-over A B to south-bound branch. To accomplish these movements it requires seven switches and, for absolute safety of the train having the right of way, three throw-offs, making ten switches, all of which are operated by simply two levers or cranks, and with such a certainty that no mistake can possibly occur.

Before going into the details of the manipulation of these switches and their necessary signals I will describe the construction of a cam mechanism which I prefer to use in performing the operations, and will also mention other cams that might be used, one of which is shown in Fig. 7.

Referring to Fig. 5, K represents a cam-disk pivoted to a bed-plate at *k*, and having the two concentric cam-grooves L, connected by the actuating-groove *l*, the said disk being provided with gear-teeth M^2, which mesh with the rack M^3 on the actuating-line rod M, which may be reciprocated or moved longitudinally by any suitable mechanism, that shown being well adapted to the purpose, and consisting of the crank-wheel N, which would be located in the tower, the shaft N′ extending therefrom to the line-rod M, and provided with a pinion, N^2, adapted to mesh with a rack, N^3, on the line-rod M. As shown, one-eighth of a revolution of the cam-disk K will cause the groove *l* to shift the lever O from the inner concentric groove to the outer one, and vice versa, and during the remaining seven-eighths of the revolution, be the lever O in the inner or outer groove, it will remain stationary or in a locked position. The crank-wheel N and its connection might be of such proportion that a single

revolution thereof will cause the cam-groove *l* to move a sufficient distance to throw the lever from the inner to the outer concentric groove, or vice versa. If we have a series of these cam-disks K, all meshing with the line-rod M, but having their actuating parts *l* set with a different angular advance, it will be seen that the levers O will be operated at different times and with a different number of revolutions of the crank N, beginning at the starting-point and operating in a predetermined order, and it is self-evident that the crank may be rotated in either direction, causing the levers to be thrown from the inner concentric groove to the outer one, or vice versa. There are a large number of cam-movements which might be constructed to perform the same operations as the one described in Fig. 5 without departing from my invention. For a limited number of movements the one shown in Fig. 6 is well adapted, and the straight or reciprocating cam shown in Fig. 7 can be used for a large number of movements. These cam mechanisms are an essential feature of this application, whether arranged to work the switches and signals directly or indirectly through the cams P or their connecting mechanism, the construction of which has been fully set forth in a pending application of mine, filed April 11, 1885, and Serial No. 161,904.

The levers O may be arranged to actuate the switches directly, or they may be connected to levers U, in which case there are two cams, K, to operate one switch, which is connected to lever U in the center. Levers *o* of the cams are connected to the free ends of lever U. As shown in Fig. 1, the cross-over E F and the throw-off I are operated in this manner, the necessity for which construction being that in complicated arrangement of tracks two or more lines of pipes or rods, M M′, are required, in which case it follows that certain switches must be operated with the actuation of either of said lines of pipes or rods to accomplish some of the movements or manipulations of the trains, hereinbefore set forth. These cams K, while shown in all instances but one as actuating switches, or switches and signal mechanism combined, may indirectly actuate the latter alone, if desired, as is shown in the case of cam No. 7.

S and S′ are two actuating-rods extending from the tower and operate the signals through the agency of the links R, radius bars or rods *r*, cams P, and their connecting rods and levers, substantially in the manner set forth in the application hereinbefore referred to, only in that case the radius bars or rods *r* were shifted in the links by the switches directly or an auxiliary line of pipe and connections, while in this case the said radius-bars are shown as being actuated in some instances by the switches directly and in some cases by the cams K; but it will be noticed that where only one cam P is interposed between the actuating rod or lever and the signal or its cam located directly at the post thereof the radius-bar is actuated by a cam, K; but where there are two of said cams P (see right-hand side of Fig. 1) the radius-bar of the first of said cams will be actuated by one of the cams K, while the radius-bar of the second of said cams is actuated by a switch, (in this instance switch G, as the second cam would be required to actuate the home and distant signals X X′ on the branch to docks.)

In this application I do not make any specific claim to the cams P and their connections; but to enable a more clear understanding of the operation of these cams I will briefly describe their construction.

The cam P is provided with three concentric parts, *p p*, connected by the actuating parts p^2. (See Fig. 6.) These cams actuate levers P′ and P^2, and if the cam P is pushed in one direction lever P′ will be actuated and P^2 will remain stationary; or if it be pushed in the other direction the lever P^2 will be actuated and the lever P′ will remain stationary. To move the cam P in either direction the link R is provided, it being pivoted at the middle and connected at one end by a rod, R′, with an arm on the said cam P, and the said link is shifted or oscillated by the radius-bar *r*, which is actuated by one of the signal lines or levers S S′. If the radius-bar *r* be in the upper end of the link and then be thrust toward the link, then the lever P^2 will be operated. If, however, it be thrown to the lower end of the link and then moves toward the link, the lever P′ will be operated, and this link, as hereinbefore specified, may be moved up or down in the link either by the cams K or by the switches. In complicated arrangements, such as shown in Fig. 1, one of the levers (P^2, for instance) is shown as actuating a second radius-bar, or in turn operates a second cam, P, the levers P′ P^2 of which are adapted to actuate the home and distant signals X X′ of the road to dock and the home and distant signals V V′ on the north-bound main line.

Q represents locks, which consist (see Fig. 4) of a sliding bar, Q′, having apertures *q*, through which the bolts Q^2 and Q^3 are adapted to pass one at a time, the holes *q* being so located that both bolts cannot be shot at the same time. The bars Q′ are actuated by the switches or signals, and the bolts are operated by other switches or signals actuating levers, rods, or cables directly or indirectly, as the interlocking (not performed by the cam and other mechanisms) may require. In Fig. 1 only two of these locks Q are shown, for simplicity's sake; but more would be necessary in actual practice in the present track system. These two, however, are thought to be sufficient for illustration, and a description of the ones, Q, connected with the facing-point switch D and the rods actuating signals W, and also with the cross-over A B and signals W, will suffice to clearly show their functions.

The switches being set, as shown, for "main line clear," if lever should be pulled once the

proper home signal W, as determined by the links R and radius-bar *r*, would be pulled to "safety." Now, this signal must be so interlocked with the switch D and cross-overs A B and E F that before they can be moved the signal must be again set at "danger." This is the function of the lock Q, because when the signal is set at "safety" the bar Q^2 passes through a slot in Q′ and locks it so that the switch cannot be thrown until the signal is again at "danger." The lock Q for E F is not shown to save complication of drawings. If the locks Q were not used and an attempt were made to throw the switch D or E back to main line before the signal was returned to "danger," the radius-rod *r* would prevent the movement by jamming on the links R; but the use of the lock Q is of course preferable, so that no attempt can be made to move the switch until the signal is returned to "danger." The second movement of lever S will set the distant signal to "safety." It is not only used to interlock switches and their signals, but also for interlocking switches. In the track system before us it might be necessary to interlock the switches A C by a lock-box, Q, so that C could not be set to branch when A was set for cross-over, &c.

The following is a brief description setting forth how the railroad shown in Fig. 1 may be manipulated to accomplish the various movements of trains set forth in the first part of this specification, and, as the selection of tracks has been made most complicated for the purpose of showing the great adaptability of the apparatus, it will be convincing that the amount of movements from a very small number of levers can be made almost infinite and at the same time be absolutely interlocking in their action, so that no signal or switch can be used without first setting all the other switches and signals in the proper manner to prevent collision.

All switches being set as shown in the drawings, in which the north and south bound trains main line have right of way, the switches may be operated in the following manner: A single movement of the line-rod M to the right will close the switch D by cam 1, setting south-bound main line for branch, and this movement also operates the radius-bar *r*, so that when the signal-lever S is operated one movement the proper one of the home signals W will go to "safety," and when signal-lever S is operated one movement more the proper one of the distant signals W′ will go to "safety" and the locks Q will be locked by first movement, so that the said switch cannot be shifted until the signals are again set to "danger." The signals being all at "danger," another movement of said line M to the right will then close the switch C by cam 3 setting north-bound main to branch and also leaving the south-bound main line to branch, and still one movement more, making three in all, will set throw-off I for throw-off, and throw-off J to branch, leaving the road clear for trains moving south or north bound on the branch over switches C and D. Now, returning all switches to their original positions, one movement of the rod M to the right will operate cam 1, setting the switch D to branch, and three movements of rod M′ to the right will set throw-off I, close switch G to docks, and set throw-off H so that a train on south-bound main line may go south-bound on the branch and a train can go north-bound from docks. Returning all parts to their original positions, four movements of line M′ to right will by cam 13 set throw-off I on north-bound main line, by cam 11 close switch G to docks, by cam 12 set throw-off H to docks, and by cams 9 and 10 close cross-over E F, so that a train moving south-bound on the main line may cross over at E F and pass to docks.

The foregoing will explain how trains may be run upon the tracks, as shown, and I will now explain some manipulations by which trains may be shifted with the cross-overs, switches, and throw-offs when arranged as illustrated.

All parts being returned to their original positions, one movement to the left of line M′ will operate cam 8 and set cross-over A B. Returning again to their original positions, one movement to the left of line M will operate cams 5 and 6 to cross-over F E. Again returning, four movements to the right of line M will operate cam 1 to close switch D to branch, cam 3 to close switch C to branch, cam 2 to set throw-off I, cam 4 to set throw-off J, and now the train from branch may run north of A and stop, and then line M′ is given one movement to the left, closing cross-over A B, allowing the train to pass to south-bound branch. If the switches D and C to the branch are closed, as before, by the line M being given four movements to the right, it will also follow that the cam 2 will operate to set the throw-off I, cam 4 to set throw-off J, and the trains may run north of A. Then bring all parts to their original position and then give line M′ one movement to the left, which will operate cam 8 and close the switches A and B to cross-over, and now the train may run south of B on the main line. The throw-off I and H being set, switch G to docks closed, and E F to cross-over by four movements to the right of line-rod M′, then trains run north of E on south-bound main line from docks. Then the switches are returned to the normal; or the train can run south-bound on main line. Four movements to the right of line-rod M′, throw-off I will be set by cam 13, switch G to docks will be set by cam 11, throw-off H will be set by cam 12, cross-over E F will be closed by cams 9 and 10. Then trains may run north of D. Then bring all parts to their normal position, and give line M one movement to the right, and switch D to branch will be closed by cam 1, and the train can go south-bound on branch. Three movements to the right of line-rod M′ will set the throw-off I by cam 13, close switch D to docks by cam 11, set throw-

off H by cam 12, and now the trains run north of A. Then bring all parts to the normal, and give line-rod M′ one movement to the left, which will set A B to cross-over. The train can now proceed south-bound on main line. Three movements to the right of line M′ will set throw-off I by cam 13, close switch G to docks by cam 11, set throw-off H by cam 12. Then the trains run north of A. Then bring all parts to their normal positions; then move line M′ one movement to the left, setting cross-over A B by cam 8; then give line M one movement to the right to close switch D to branch by cam 1, and the train can go south-bound on branch, &c.

The foregoing will show the facility with which trains may be shifted.

Line-rod M will with each consecutive movement to the left operate the following parts: One movement to the left will set E F to cross-over; one movement to the right sets D for branch; two movements set D and C for branch; three movements set D and C for branch and I for throw-off; four movements to the right set D and C for branch I for throw-off, and J for branch, and cam 7 to move radius-rod *r*. One movement to the left for line-rod M′ sets A B for cross-over; one movement to the right sets I to throw-off; two movements to the right set I to throw-off and G to docks; three movements to the right set I to throw-off, G and H to docks; four movements to the right set I to throw-off and G and H to docks and E and F to cross-over.

Lever S operates signals 1, 2, 3, 4, 5, and 6, according as the switches and throw-offs and ground-locks may determine, and lever S′ operates signals 7, 8, 9, 10, 11, and 12, according as the switches and throw-offs and ground-locks may also determine. The first movement operates the home and the second the distant signals.

The lines M and M′ being required to operate with great exactness, it becomes necessary where they are very long to use compensators T, to allow for expansion and contraction, and the form of compensator which I prefer is shown in Figs. 2 and 3, in which *t* is the frame or case, and is provided with gears T' T^2 T^3, the gears T^3 of which mesh with each other and the gears T' and T^2 mesh, respectively, with the two ends of the several line-rods M M′, which are provided with racks. Any form of compensator may be used, if desired, and as many as wished may be put upon each of the lines M and M′.

While I prefer the construction shown, it is self-evident that the lines M and M′ may be operated in any other manner than by gearing, and that instead of the rotary cams K they may be made to reciprocate as shown in Fig. 7, or their equivalent.

Having now described my invention, what I claim as new, and desire to secure by Letters Patent, is—

1. A switch or signal, in combination with a rotating cam-plate having two concentric circular cam parts of different diameters connected by an actuating cam part occupying but a very small arc of the full throw of a cam-plate, and a lever or connecting-bar provided with an extension or projection into the cam part and during the rotation of the cam-plate traversing each of the concentric parts and their connecting cam part, whereby but a small portion of the full throw of the cam-plate is required to operate the switch or signal, and in which the circular parts of the cams act as lugs for the said lever in its extreme positions, and means to rotate said cam-plate through an arc of more than one hundred and eighty degrees, substantially as and for the purpose specified.

2. A series of switches or a series of signals, or both, in combination with two or more cam-plates having their actuating parts arranged with respect to entirely different and isolated switches or signals, so that they are not brought into actuating position at the same time, and a line-rod to actuate said cam-plates simultaneously, whereby a continued movement in one direction will actuate said switches and signals in a predetermined order, substantially as and for the purpose specified.

3. Two or more cam-plates having actuating cam parts so arranged that two or more of said cam parts come into operating position at different times, a line-rod to simultaneously actuate all of said cam-plates, a series of switches or a series of signals, or both, and connecting mechanism, by which a continued movement in either direction will actuate said switches or signals at different times, substantially as and for the purpose specified.

4. Two or more cam-plates having actuating cam parts, in combination with line rod to actuate said plates simultaneously, a series of switches or a series of signals, or both, and connecting mechanism, the cams on said plates being so formed that a continued movement in either direction will actuate certain switches or signals and lock the others in position, substantially as and for the purpose specified.

5. Two cam-plates having actuating cam parts, in combination with a line-rod to actuate said cam-plates in either direction, a series of switches or a series of signals, or both, and connecting mechanism, the said cam parts on the two plates being set to operate at different times, whereby a movement of the line-rod in one direction will actuate one switch or signal through its cam-plate, but not the other, and vice versa, substantially as and for the purpose specified.

6. Two cam-plates having actuating parts and locking parts, in combination with a line-rod to actuate said cam-plates in either direction, a series of switches or a series of signals, or both, and connecting mechanism, the said cam parts on the two plates being set to operate at different times, whereby a movement of the line-rod in one direction will actuate one switch or signal through its cam and lock the

other, and vice versa, substantially as and for the purpose specified.

7. The combination of cam-plates K, having locking parts L of sufficient length to admit of continued simultaneous movement of one plate while the others operate in succession thereto, and actuating cam parts 1, with a switch or signal and connecting mechanism, substantially as and for the purpose specified.

8. The combination of cam-plate K, having gear M^2, locking parts L, and actuating cam part 1 with a line-rod, M, having rack M^3, a switch or signal, and connecting mechanism, substantially as and for the purpose specified.

9. Two or more cam-plates having actuating cam parts so arranged that two or more of said cam parts come into operating position at different times, a line-rod to simultaneously actuate all of said cam-plates, switches, or signals, and connecting mechanism by which a continued movement in either direction will actuate said switches or signals at different times, and a compensator located in the line-rod between said cam-plates to prevent any relative change in the actuating cam parts thereof if said rod should expand or contract, substantially as and for the purpose specified.

10. The combination of a switch or signal with two cam-plates and connecting mechanism, whereby either cam-plate may be operated independently of each other to actuate said switch or signal, substantially as and for the purpose specified.

11. The combination of a switch, cam-plate K, connecting-levers, a cam, P, link R, radius-rod *r*, a rod connecting the switch with said radius-rod, suitable signals operated by said cam-plate P, and mechanism to operate the cam-plate and the radius-rod, substantially as and for the purpose specified.

12. The combination of a switch, two cam-plates, K, connecting-levers, radius-rod *r*, link R, a lever to move said radius-rod, cam-plate P, lock Q, having sliding bar Q′, furnished with holes *g* and worked by said switch, and bolts Q^2 Q^3, worked alternately by said cam P, according as to whether the rod *r* is shifted up or down in the link R by one of said cam-plates K, substantially as and for the purpose specified.

13. The combination, in a railway signal or switch apparatus, of the line-rod and a take-up consisting of racks and gear-wheels T′ T^2 T^3, arranged substantially as shown, substantially as and for the purpose specified.

14. Two cam-plates having actuating cam parts, in combination with independent means to actuate each of said cam-plates, switches or signals, connecting mechanism between said switches or signals and cam-plates, whereby the cam parts actuate the same, and a suitable lock device, substantially as described, and actuated by one of said cam-plates or its switches or signals to prevent action of the other cam-plate, substantially as and for the purpose specified.

15. The combination of two cam-plates, K, independent mechanism to actuate either of said cam-plates independently of the other, and switch or signal, and lever U, connected in the middle to said switch or signal, and connecting mechanism actuated by the cam-plates and respectively operating upon each end of the lever U, substantially as and for the purpose specified.

16. The combination, with the home and distant signal, each provided with a cam-plate connected to a common line of pipe or cable, whereby the first movement to said pipe or cable operates the home signal, and the second movement in the same direction operates the distant signal, substantially as and for the purpose specified.

In testimony of which invention I hereunto set my hand.

JOHN W. HENDERSON.

Witnesses:
R. M. HUNTER,
ANDREW ZANE, Jr.