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W. W. SLATER & H. C. BARNES.

PNEUMATIC ELECTRIC CIRCUIT CONTROLLING AND INTERLOCKING APPARATUS.

No. 481,430. Patented Aug. 23, 1892.

Fig. 2.

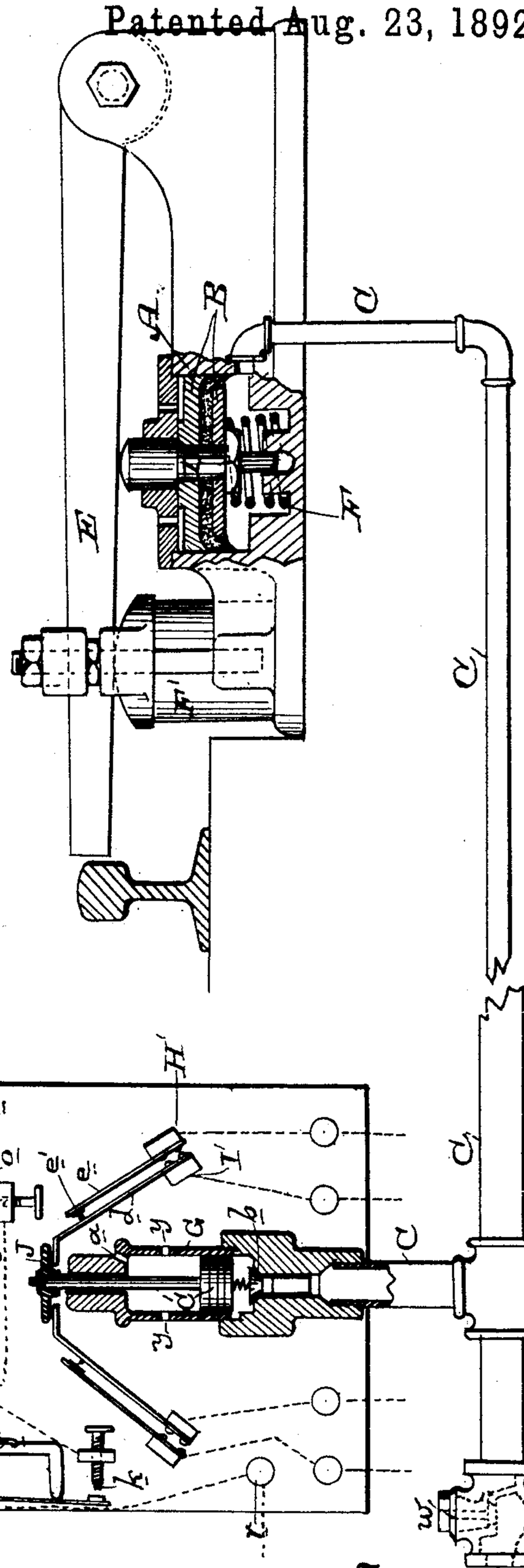

Fig. 1.

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(No Model.) 2 Sheets—Sheet 2.

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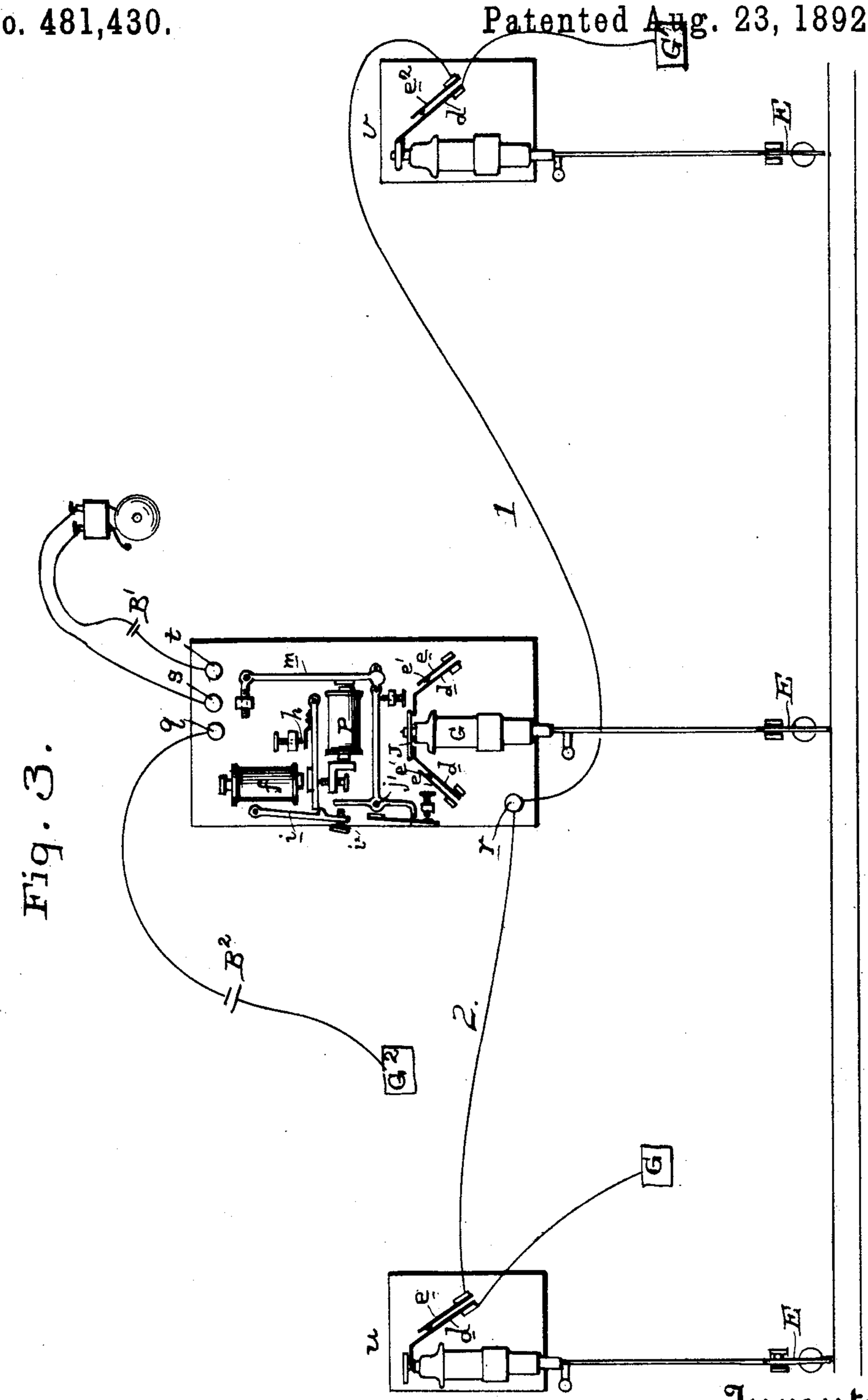

Fig. 3.

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UNITED STATES PATENT OFFICE.

WILLIAM W. SLATER AND HARRY C. BARNES, OF OAKLAND, CALIFORNIA.

PNEUMATIC ELECTRIC-CIRCUIT-CONTROLLING AND INTERLOCKING APPARATUS.

SPECIFICATION forming part of Letters Patent No. 481,430, dated August 23, 1892.

Application filed October 24, 1891. Serial No. 409,743. (No model.)

To all whom it may concern:

Be it known that we, WILLIAM W. SLATER and HARRY C. BARNES, citizens of the United States, residing at Oakland, Alameda county, State of California, have invented an Improvement in Pneumatic Electric-Circuit-Controlling and Interlocking Apparatus; and we hereby declare the following to be a full, clear, and exact description of the same.

Our invention relates to a circuit-controlling apparatus which we term a "pneumatic electric-circuit-controlling and interlocking apparatus."

It consists in certain details of construction, which will be more fully explained by reference to the accompanying drawings, in which—

Figure 1 is a view showing the arrangement of a pneumatic electric-circuit-controlling device. Fig. 2 is an enlarged view of the pneumatic track-instrument. Fig. 3 is a view of the pneumatic electric-circuit-controlling device as applied to a railway to operate one or more signals.

The object of our present invention is to dispense with all electrical circuits in the rails and all underground wiring. This is accomplished by the use of a pneumatic track-instrument, which consists, substantially, of a lever acting upon a diaphragm which fits within a chamber, the lever being acted upon by the wheels of a passing train so as to depress the diaphragm within the chamber as each wheel passes over it and produce a vibration or pulsation of the air through a pipe to the point where the electro-pneumatic mechanism is to be actuated by this column of air. The diaphragm and lever are immediately returned by a spring after each depression by the wheels, so that there will be a constant reciprocation and corresponding pulsation of air in the conducting-pipes while the train is passing. This movement or pulsation of the air may be produced by any diaphragm movable within a chamber and a suitable connection between the diaphragm and the wheels of a passing train either directly or by depressing a portion of the track itself as the train passes. In the present case we have shown a piston movable within a cylinder to illustrate the operation.

A is a cylinder suitably fixed with relation to the track, having a piston B packed and moving air-tight within it, with valves or any suitable means for admitting air to the space below the piston when it is raised, as shown by the check-valve *w*, and a pipe C, through which the air is transmitted to the point where the vibrating column is employed to actuate the electro-pneumatic portion of the apparatus. The piston B has a piston-rod D, which serves as a guide and projects slightly through the top cover of the cylinder, where it is acted upon by a lever E, suitably fulcrumed with relation to the cylinder and the track, and having its free end project so that the wheels of any passing train will successively depress the lever, and acting through it upon the piston-rod and piston will set a column of air in motion through the pipe C.

F is a spring situated below the piston, acting to return it and the lever after each depression by the passing wheels.

F′ is a heavy rubber spring under the lever to prevent the movement of the mechanism, except when a train is passing. By these means whenever a train passes this instrument it will set a column of air into motion in the pipe C. This pipe C is made of any suitable or desired length, extending to the point most convenient for locating the electro-pneumatic contact-instrument. This instrument is placed, preferably, as near as is convenient to the track-instrument and above-ground.

The means for operating the contact-instrument may be similar to the means above described for setting the column of air into vibration. It is here illustrated by the piston, movable within a cylinder.

The pipe C connects with a cylinder G, having a piston C′ reciprocating therein, the piston-rod extending through the top, and a valve *b* in the bottom, through which air is admitted below the piston and by which it is prevented from returning. The piston is fitted loosely enough so as to move freely and allow the air to pass its periphery gradually, so that when once lifted it will slowly descend as the air passes its periphery, and escapes at an opening *a* in the top of the cylinder, the valve *b* not allowing the air to escape in the opposite direction. Openings *y* are made in

the sides of the cylinder, which allow the escape of any excess of pressure when the piston has reached its highest point.

e is a spring-arm connected, as shown at H′, with one of the poles of a battery, and *d* is an elastic arm connected at I′ with the other pole. The arm *d* extends to a point beneath an adjustable nut or plate J upon the upper end of the piston-rod of the piston C′, and when this piston is in its normal position at the lower end of the cylinder the nut J rests upon the inner end of the arm *d*, and thus draws this arm away from the arm *e*, so that no contact will be produced at the contact-point *e*′. As soon, however, as the piston is forced up by the movement of the column of air previously described it will allow the arm *d* by its elasticity to rise until contact is formed with the arm *e* at the point *e*′, and the circuit will thus be completed. This contact is constantly maintained while the train is passing. It will be manifest that the contact-instrument may also be used to break a circuit which is normally closed by placing the spring *d* above the spring *e*. The electrical circuit thus closed or opened may be used to operate any electrical signaling device or mechanically-controlled interlocking relay, on which such device depends. It may be also used to mechanically move an arm or lever to lock or unlock an interlocking relay by means of the upward movement of the piston.

To operate a signal or bell to protect a road-crossing on a single track, we use three track-instruments, two contact-instruments, as above described, and an electro-pneumatic interlocking relay, which is described as follows: On a suitable base is fixed an electro-magnet *f*, which when energized lifts the fulcrumed arm *g*, making contact at *h* and completing a local circuit, which actuates a signal or bell, as shown by the dotted lines, from the contact-point *h* and the fulcrum of the lever *g* to the binding-posts *s* and *t*, and thence to the bell or signal, which is not shown. An arm *i*, fulcrumed at the upper end and swinging by gravity, has a projecting latch *i*′, which engages the end of the lever *g* when the latter is lifted, so that when *g* has made the contact with *h* it will be maintained until the latch *i*′ is withdrawn from the end of the lever *g*. A T-shaped lever *j* is fulcrumed at *j*′. In its normal position the lower end of the cross or T arm, which is bent outward, holds open a contact at *k* and at the same time the horizontal arm closes a contact at *l*. When the lever *j* is lifted, the upper arm of the T or cross-bar strikes the adjusting-screw i^2, which passes through the lower end of the swinging latch-lever *i* and withdraws the latch, thus allowing the lever *g* to fall (the magnet *f* being de-energized) and the contact at *h* is broken. The same movement of the lever *j* allows the contact to be made at *k* and breaks the contact at *l*. An arm *m*, suspended at the upper end and swinging by gravity, has projecting lugs or latches upon the opposite sides of its lower end, one a short distance above the other, and when the lever *j* is lifted the right-hand latch on the lever *m* engages the pin *n* on the outer end of the lever *j*, and thus hooks the latter up, holding it mechanically in that position. When *m* is drawn toward the left sufficiently to disengage its latch from the pin *n*, the lever *j* will drop a short distance, and a pin *o* upon the lever *j* is engaged by the latch upon the opposite side of the lever *m*, not allowing lever *j* to complete its fall until *m* is released and swings to its normal position. This movement of *m*, which disengages *n*, is produced by an electro-magnet *p*, which when energized pulls the arm *m* in that direction, and when de-energized it releases *m* and allows it to swing back to its normal position. This disengages *o* and allows *j* to fall, as before described.

The pneumatic apparatus before described is applied to this relay as follows: The upward movement of the lever *j* is produced by the upward movement of the piston C′ in the cylinder G. Its piston-rod passing out through the top of the cylinder strikes the bottom of the lever *j* and raises it to the point where it is latched by *n*, as before described. The circuit in the relay is from the binding-post *q* through the electro-magnet *f*, contact *l*, and lever *j* to the post *r* when *j* is down, or from *q* through the electro-magnet *p* and the contact *k* to the post *r* when the lever *j* is up.

These instruments are wired or connected as follows: from the post *s* to the bell or signal mechanism, and thence to the battery B′ and to the post *t*; from the ground G^2 to the battery B^2, and thence to the post *q*, and from the post *r* to the spring *e* of a contact-instrument *u*. This contact-instrument is connected by a pipe with a track instrument, as previously described, so that the train from that direction would first actuate it, and making the contact at the point *e* connection would be made through *r*. A similar line connects the post *r* with the spring e^2 of another contact-instrument *v*, and this in turn is connected by a pipe with a second track instrument, which a train from the opposite direction would first actuate. From the contact-springs of each of these instruments *u* and *v* connection is made with the ground, the contact being normally broken in each case, as previously described, by the levers *e* and *d* and the piston within the air-cylinder of the instrument.

The operation will then be as follows: The first wheel of a train passes over the end of a lever of the track-instrument upon that side, and by means of the pipe connecting the cylinder of this instrument with a contact-instrument—as, for instance, the one shown at *u*. This compresses the air under the piston of the track-instrument and produces a pulsation of air through the pipe, lifting the valve *b* and the piston C′ within the cylinder G. This releases the spring *d*, allowing it to make contact

at e' at the beginning of the upstroke of the piston C′. This stroke is long enough so that the piston cannot fall sufficiently low to again break contact until the whole train has passed, because succeeding wheels will give impulses fast enough to keep the piston raised and its weight off of the arm d. A check-valve w in the supply-pipe allows the supply of atmospheric air for these impulses and the valve b confines the air under the piston C′, so that it can only fall slowly. Consequently there is but one making and breaking of contact at e' for the whole train. The train having thus made contact at e', the circuit is complete from ground G^2 through the post q, electro-magnet f, contact l, arm j, post r, line-wire 2, contact e, and ground G, thence returning to battery B^2 through the ground. This energizes the electro-magnet f, lifts the arm g, and makes contact at h, which completes a local circuit between the binding-posts s and t. This actuates the bell or other signal. When the train has passed and the contact e' is again broken, the electro-magnet f is de-energized, but the contact h remains closed, because the arm g is hooked up by the latch i', as before described. The bell or signal thus continues in action until the train reaches the track-instrument, which is connected with the relay. Then the piston C′ in the relay is forced upward and lifts the arm j, which forces out the latch i', as before described, releasing the arm g, which falls and breaks the contact at h, thus cutting off the actuating power from the bell or signal. The arm j, having been thus lifted, is held up by the hook at the lower end of the arm m, as previously described, and the contact l is broken and k is closed until the train reaches the last track-instrument, which will make contact at e^2 in the instrument V. This completes a circuit from ground G^2, battery B^2, through the post q, electro-magnet p, and contact k, post r, line-wire 1, contact e^2, and ground G′, returning thence to battery B^2 through the ground. The electro-magnet p, being thus energized, attracts the arm m, and after the train has passed this last track-instrument m is again released and allowed to swing back to its normal position, thus dropping the pin o from its supporting-latch and allowing the lever j to fall, which leaves the relay in its normal condition ready for the passage of another train. It will be evident that a train passing in the opposite direction will produce the same effects and will actuate the bell or signal when it reaches the first track-instrument, will stop the bell or signal when it reaches the middle track-instrument, which is placed on the road-crossing, and will unlock the relay when it has passed the last track-instrument.

In Fig. 1 the contacts e' are virtually parts of two separate contact-instruments placed for convenience on the same base with the relay and operated by the same track-instrument and small piston that raises the arm j of the relay. These are for actuating a relay for a succeeding signal or bell and for unlocking a relay for a preceding signal or bell. When the circuit and relay are employed upon double tracks on which trains pass in but one direction, they will be simpler, but one electro-magnet and two arms being necessary in such cases; but it will be manifest that the operation is essentially the same.

It is sometimes necessary to give an engineer a signal at certain points to look out for danger or for other purposes. In such a case the mechanism above described opens a valve in an air-supply pipe and sounds a whistle, which is situated near the track so that the engineer cannot fail to hear it.

Having thus described our invention, what we claim as new, and desire to secure by Letters Patent, is—

1. In a railway-signal, the combination, with an electro-pneumatic contact-instrument and actuating mechanism, as shown, of a track-instrument consisting of a vertical cylinder, a piston moving therein, a spring by which the piston is held normally in the upper part of the cylinder, a piston-rod extending through the top of the cylinder, a lever fulcrumed by the side of the track, resting upon the top of the piston-rod, with its movable end so disposed that it is depressed by the successive wheels of a passing train, and an inwardly-opening valve by which air is admitted into the pipe connecting with the lower part of the cylinder when the piston rises, said pipe leading from this track-cylinder to the cylinder of the electro-pneumatic contact-instrument, substantially as herein described.

2. In a railway-signal, the track-instrument consisting of a vertical cylinder with piston, piston-rod, actuating-lever, and returning-spring, a pipe connecting the cylinder with a second cylinder upon a relay or contact-instrument adjacent to the track-instrument, a piston moving in the second cylinder, the piston-rod of which extends through the top of the cylinder, elastic contact-arms d and e, which are normally separated by the position of the piston at the bottom of the cylinder and the contacts are made when the piston is raised, and an electro-magnet f and mechanism whereby a local circuit is completed and a bell or signal actuated, substantially as herein described.

3. A pneumatic track-instrument actuated by passing trains, a chamber with a piston and rod, a pipe connecting the track-instrument with the chamber, whereby the vibration of a column of air is communicated from the track-instrument to the chamber to move the piston therein, and the locking and unlocking mechanism of an interlocking relay, mechanically actuated by the movement of the piston, substantially as herein described.

4. In a railway-signal, a track-instrument consisting of a vertical cylinder with piston, piston-rod, actuating-lever, and returning-spring, a pipe connecting the cylinder with a second cylinder upon a relay or contact-in-

strument adjacent to the track-instrument, a piston moving loosely in the second cylinder so as to allow the air to gradually escape past it, while itself falls by gravitation when the air-supply ceases, elastic contact-arms situated above the cylinder, an attachment upon the upper end of the piston-rod to engage one of the arms and hold them out of contact when the piston is at the bottom of the cylinder and to allow contact to be made when the piston rises, an electro-magnet and mechanism whereby a local circuit is completed when these contacts are made and a signal or alarm is actuated, and a mechanism by which the local circuit is maintained and the signal continued during a period after the actuating force has ceased, substantially as herein described.

5. In a railway-signal, an apparatus consisting of the two connected air-cylinders, contact-arms, and mechanism whereby contact between said arms is produced, as shown, a local circuit and signal, with a mechanism by which the latter is actuated when the contact is made and the circuit is maintained and the signal continued after the actuating force has ceased, and a mechanism by which the circuit is automatically cut off at the end of the time and the parts returned to their normal position, substantially as herein described.

In witness whereof we have hereunto set our hands.

WILLIAM W. SLATER.
HARRY C. BARNES.

Witnesses:
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