(No Model.) 3 Sheets—Sheet 1.

J. W. STEELE.

RAILWAY SIGNAL.

No. 498,864. Patented June 6, 1893.

Fig. 1.

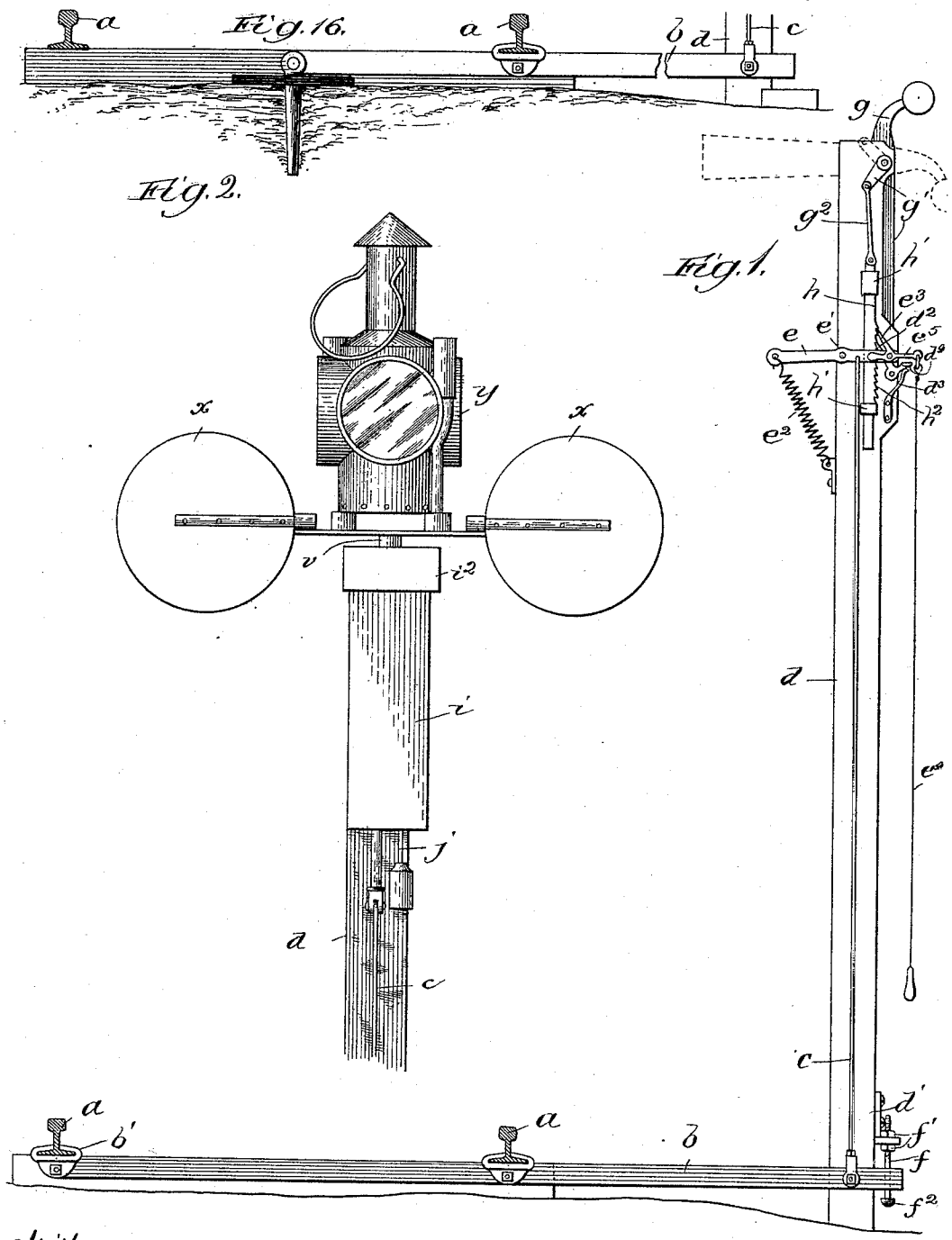

Fig. 2.

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(No Model.) 3 Sheets—Sheet 2.

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Fig. 3.

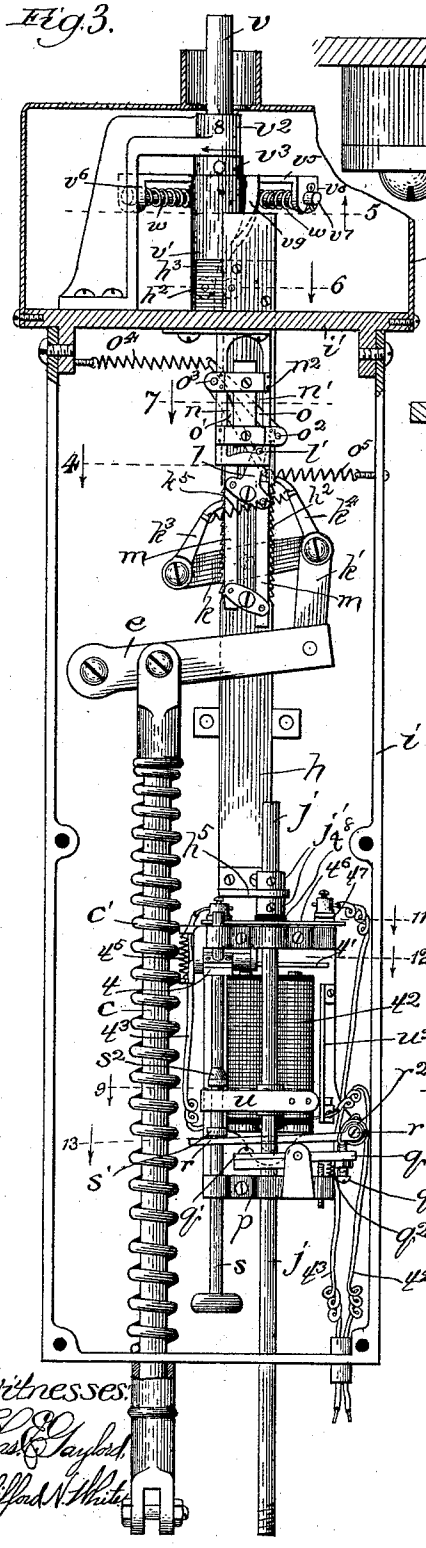


Fig. 4.

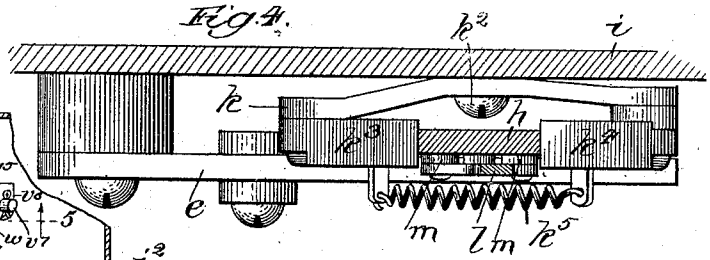


Fig. 5.

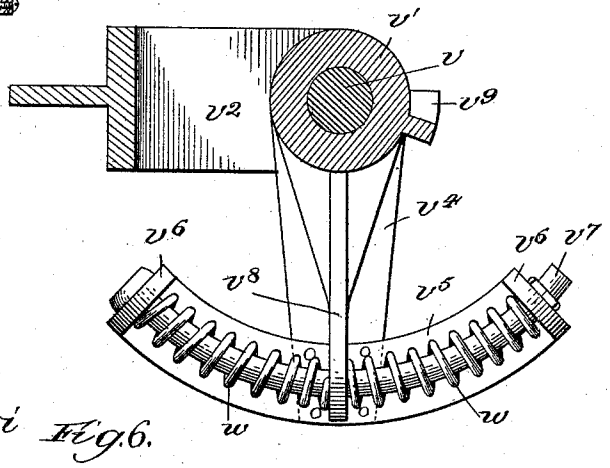


Fig. 6.

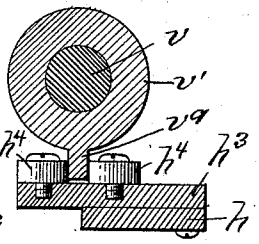


Fig. 7.

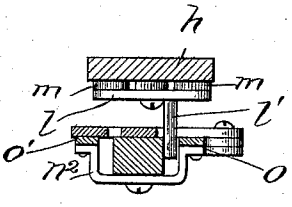
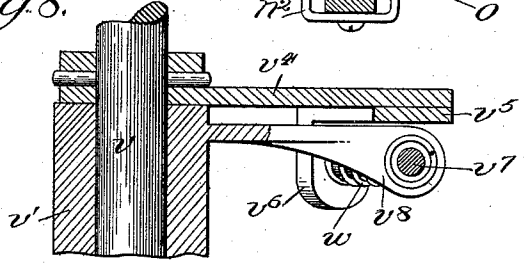


Fig. 8.



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RAILWAY SIGNAL.

No. 498,864. Patented June 6, 1893.

Fig. 9.

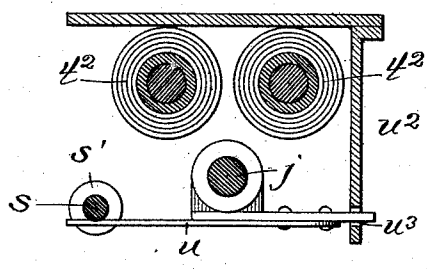


Fig. 14.

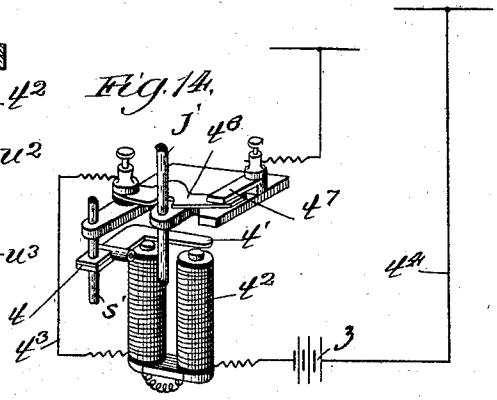


Fig. 10.

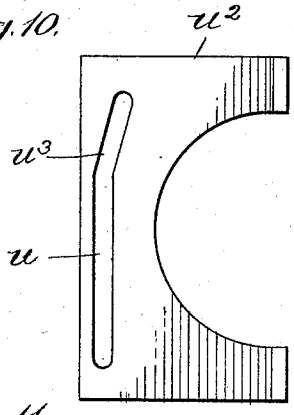


Fig. 15.

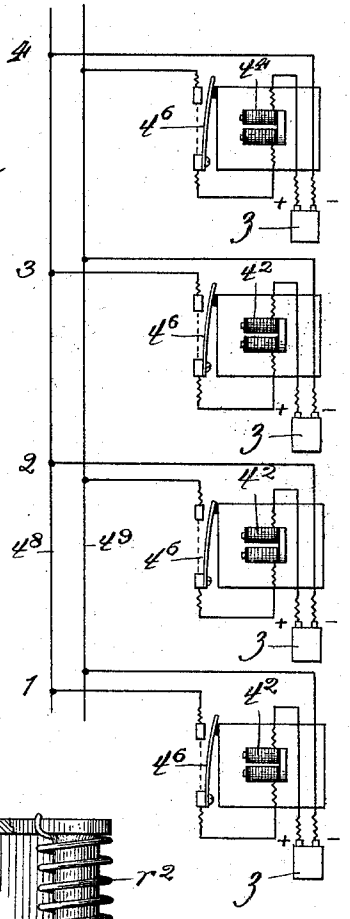


Fig. 11.

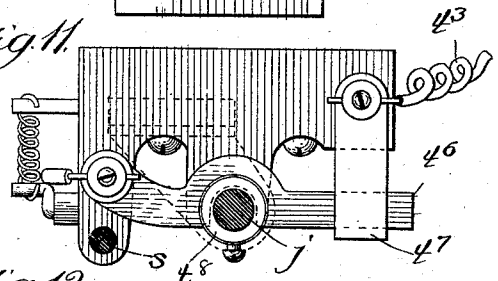


Fig. 12.

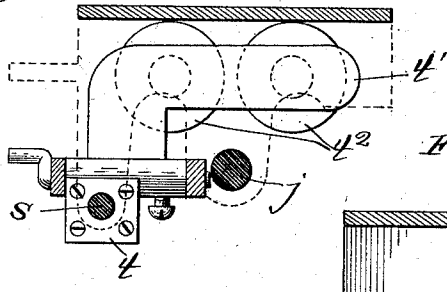
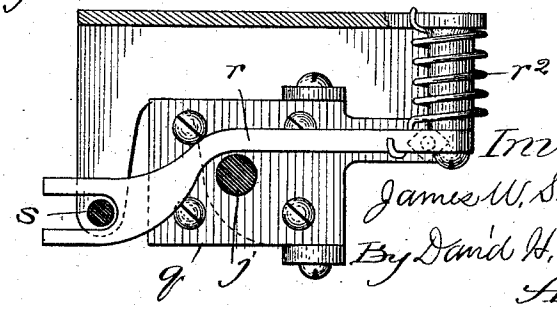


Fig. 13.



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UNITED STATES PATENT OFFICE.

JAMES W. STEELE, OF CHICAGO, ILLINOIS.

RAILWAY-SIGNAL.

SPECIFICATION forming part of Letters Patent No. 498,864, dated June 6, 1893.

Application filed October 5, 1891. Serial No. 407,771. (No model.)

To all whom it may concern:

Be it known that I, JAMES W. STEELE, of Chicago, in the county of Cook and State of Illinois, have invented certain new and useful Improvements in Railway-Signals, of which the following is a full, clear, and exact description, reference being had to the accompanying drawings, forming a part of this specification, in which similar letters and numerals of reference in the different figures designate like parts.

It is a recognized principle among railway builders, that a road-bed should be so constructed as to permit the rails and ties to yield vertically more or less during the passage of a train. For obvious practical reasons, this has been found to be essential;—and all road-beds are constructed in accordance with this principle.

The primary object of my invention is to utilize the spring of the rails upon the road-bed, caused by the passage of a train, to actuate a semaphore. A secondary object is to provide means for limiting the movement of the part attached to the rails and communicating with the mechanism in direct and immediate connection with the semaphore, so as to prevent injury to said mechanism. It is my purpose thirdly, to provide, in conjunction with the track connections, an automatic semaphore operating device which may be so sonstructed as to actuate a semaphore or signal as the result of an indefinite number of varying impulses imparted to the rails by the passage of a locomotive or train, and to enable said impulses to be continued indefinitely after the semaphore has been thrown or the signal displayed, without causing injury to or producing any effect upon the operating mechanism. It is my purpose finally, to provide a simple and effective means for electrically releasing a semaphore at a given station as the result of the passage by the next succeeding station of a locomotive or train and the setting of the signal thereat at danger, regardless of the direction in which the train is moved;—all of which I accomplish substantially in the manner hereinafter more particularly described and claimed.

In the drawings Figure 1, represents a transverse, sectional view of a railway track showing a semaphore adjacent thereto, together with my improved means for operating the same. Fig. 2, is an enlarged elevation of a modified form of a signal adapted for night and day use. Fig. 3, is an enlarged detail view showing the interior of the box or case upon the semaphore post and the mechanism inclosed therein for operating the semaphore. Fig. 4, is an enlarged sectional view thereof taken upon the line 4—, Fig. 3. Fig. 5, is an enlarged sectional view taken upon the line 5—, Fig. 3, viewed from beneath, as indicated by the arrow there shown. Fig. 6, is a sectional view in plan taken upon the line 6— Fig. 3. Fig. 7, is a like view taken upon the line 7, Fig. 3. Fig. 8, is a vertical sectional view in detail, taken upon the line 8—, Fig. 3, viewed in the direction of the arrow there shown. Fig. 9, is a transverse sectional view in plan taken upon the line 9, Fig. 3. Fig. 10, is a side view in detail of the slotted plate which guides the arm intended to raise the releasing rod. Fig. 11, is a sectional plan view taken upon the line 11—, Fig. 3. Fig. 12, is a like view taken upon the line 12, Fig. 3. Fig. 13 is a like view taken upon the line 13—, Fig. 3. Fig. 14 is a perspective view in detail of a portion of the releasing device, showing the electric circuit in diagram. Fig. 15, is a diagram view showing the manner of making the electrical connections with a series of signals, and Fig. 16, is a transverse sectional view of a railway track showing a detail view of a modified feature of said invention.

Referring to said drawings, *a* Fig. 1, indicates the rails of a railway track which are supported upon ties in the usual manner.

Extending beneath the track and being by preference, rigidly attached to the rails by means of suitable clamps *b'*, is a bar *b*, preferably made of steel, the free end of which is connected by means of a rod *c*, to a lever *e*, pivotally mounted at *e'* upon a post *d*. The lever *e*, is held in a normal position and under resilient tension, preferably by means of a spring e^2, one end of which is attached to said lever as shown, and the other to a lug upon the post *d*. The alternate depression and rise of the rails *a* serve to move the bar *b*,—thereby in turn actuating the lever *e*, for the purpose hereinafter stated. It is obvious that the "throw" of said lever may be in-

creased or diminished by varying the point at which the rod c, is connected therewith.

As too great a movement of the bar b, is liable to injure the semaphore-operating mechanism, or interfere with its proper action, I prefer to limit the downward movement of the outer end of said bar by introducing a stop thereunder, which is accomplished preferably as follows: A bracket d', is rigidly attached to the post d, to which is adjustably secured by means of lock-nuts f', a bolt f, which is passed loosely through the end of the bar b, and is provided with a head f^2, adapted to engage with said bar. An equivalent therefor is indicated in Fig. 16. Should the rails a be depressed more than usual by an excessively heavy weight, the bar b, may spring sufficiently to conform to such depression.

Journaled in suitable bearings at the top of the post d is a partially counterpoised semaphore arm g, which normally hangs in a vertical position. A crank-arm upon its axis enables it to be raised to a horizontal position as indicated in dotted lines in Fig. 1, from which it falls to its normal place when released, as hereinafter stated. The crank g', is connected by means of a pitman g^2, to a vertical bar h, which is loosely secured in guides h' h', and is provided with ratchet teeth h^2, as clearly shown in Fig. 1. A gravity pawl e^3, is loosely mounted upon the end of the lever e and is adjusted to engage with the ratchet-teeth upon the bar h. A cord e^4, attached to an arm e^5 formed upon said pawl enables the latter to be disengaged from the ratchet. A secondary pawl d^2 is loosely pivoted upon the post d and arranged to engage with said ratchet. A spring d^3, in engagement with an arm upon said pawl, serves to hold the latter in normal engagement with said ratchet, while an arm d^4, integral with the pawl d^2, is arranged to project beneath the arm e^5, but at such a distance therefrom that the movement of the pawls in riding over the ratchet teeth, will not cause the arm e^5 to be brought into contact with the arm d^4. Upon pulling the cord e^4, both of said arms are depressed and both pawls may be released from engagement with the ratchet.

The operation of said device is as follows: Assuming the respective parts to be in normal positions, as shown in Fig. 1, the passage of a locomotive or locomotive and train, depresses the rails a during the passage of each truck; but the resiliency of the rails causes them to spring back to a normal position as soon as the load is removed. The bar b, is, therefore depressed with each movement of the rail, which causes the lever e to vibrate; and with each upward movement of the pawl e^3, the bar h is lifted and held in place by the pawl d^2. As the device is adjusted so that when the semaphore arm is raised to a horizontal position the pawl e^3, will act upon the lowermost tooth, a continuation of the vibrating impulses only causes the pawl e^3, to slide back and forth upon a smooth surface, and hence the semaphore arm remains stationary as indicated in dotted lines, until both pawls are released, when said arm falls to its normal position.

In the construction which I have described, the semaphore may be released by hand at the station, or it may be mechanically or electrically connected with a distant station and released at will; but I prefer to release it automatically by the passage of a train; and as I also prefer a construction adapted to day and night use, in which the semaphore swings or turns horizontally instead of vertically, I recommend the construction shown in Figs. 2 to 14 inclusive, which I will now describe.

Rigidly mounted upon the post d is a frame or case i, Figs. 2, 3 and 4, within which is inclosed the mechanism which is interposed between the bar b and the semaphore, and is intended to operate the latter. The rod c, Fig. 3, is intended to be connected directly to the bar b, either by extending the same thereto, as shown in Fig. 1, or by a secondary rod or connection. Said rod c, is attached directly to the lever e which differs slightly from that shown in Fig. 1, in that it extends in one direction only from the pivotal point, and the rod c and lever e are held normally in given positions by means of a spiral spring c', the expansion of which is intended to lift said rod.

The bar h, shown in Fig. 1, is also represented in a modified form in Figs. 4, 5, 6 and 7; said bar passing loosely through a slot in a plate i' at the top of the case i, which forms a partial guide therefor. The lower end of the bar h is adjustably attached to a rod j, Figs. 2 and 3, which is connected to an automatic clutch and releasing mechanism as hereinafter described.

Attached to the lever e is a link k', Fig. 3, which is loosely attached to a cross-bar or lever k, Figs. 3 and 4, which is, in turn, pivoted at its middle, as indicated in dotted lines in Fig. 3, and shown at k^2, Fig. 4,—to the back of the case i. Upon the ends of the lever k are pivoted pawls k^3 k^4 respectively, which are connected with each other by means of a spiral spring k^5—thereby serving to normally hold said pawls in engagement with ratchet teeth h^2 h^2 upon opposite sides of the bar h.

Loosely pivoted to the bar h is a T shaped lever l, Figs. 3, 4 and 7, to two arms of which are pivoted straight bars m m, better shown in Fig. 3, which are also pivoted to a cross-bar m', loosely attached at its middle to the bar h. The bars m m and their connections, therefore, form a device similar to a parallel ruler, the outer edges of which fall within the lines describing the outer edges of the bar h, when the pivoted cross-bars are in an oblique position as shown in Fig. 3; but when said cross-bars are placed horizontally, or substantially so, the outer edges of the bars m m are flush with or project slightly beyond the points of the ratchet-teeth h^2, thereby serving

to prevent the pawls k^3 k^4 from engaging with said teeth.

To the upwardly projecting arm of the lever l is rigidly attached a pin or stud l', Figs. 3 and 7, which projects outwardly therefrom and passes loosely into guide-slots n n' formed in a stationary frame n^2 rigidly attached to and depending from the plate i', in front of the bar h.

Lever arms o o', Fig. 3, are loosely pivoted at points o^2 o^3 upon opposite sides and at the bottom and top respectively, of the frame n^2 and the free ends of said arms, one projecting upwardly and the other downwardly, are attached to spiral springs o^4 o^5 secured respectively to opposite sides of the case, so as to draw said lever arms obliquely across said frame n^2 in opposite directions. The pin l' is adapted to be engaged by said arms in turn, and to be moved laterally thereby in one or another direction according as it is at the bottom or top of the frame; and the lateral movement of said pin controls that of the bars m. The bar h is raised from its normal position as shown in Fig. 1, by the reciprocating action of the pawls k^3 k^4.

Rigidly secured within the frame i is a secondary frame p, Fig. 3, through bores in which the rod j is loosely passed.

Pivoted in bearings upon the frame at one side of the rod j is a disk q, upon which is secured a hardened-steel plate q' through a bore in which the rod j is projected. A spring q^2 causes the plate to impinge upon the rod j which is thereby clamped and prevented from sliding downwardly, although it is free to be moved in an opposite direction. A lever r, is provided at r' and arranged when its free end is depressed, to bear against a set-screw q^3 in the end of the clamping-plate q, and release the latter from its engagement with the rod j. A spring r^2, serves normally to raise the lever r, out of engagement with the set-screw q^3.

A rod s, preferably weighted at its lower end, is secured loosely in bearings in the frame, and is provided with a shoulder s', adapted to engage with the lever arm r. The upper portion of the rod s is projected through a bore in a clamping-plate t, the axis of which is preferably in a plane at right angles to that of the plate q. Upon the opposite side of its axis from the rod s, is an armature t', which is in operative proximity to an electro-magnet t^2, the terminals t^3, t^4 of which are connected with a source of electricity. A spring t^5, serves to hold the armature away from the magnet and to cause the plate t' to clutch the rod s, and prevent it from falling down.

An arm or cross-bar u, is attached to the rod j, one end of which is adapted to engage normally with a shoulder s^2, upon the rod s, while the other is passed loosely into a vertical slot u', formed in the plate u^2. The upper portion u^3, of the slot is inclined backwardly (see Fig. 10) so as to throw the opposite end of the bar u out of engagement with the shoulder s^2, when the rod j is raised to its full height,—thus enabling the rod s to fall, when released, as hereinafter stated.

Interposed in the circuit of the wire t^3, is a metallic spring t^6, intended to form a circuit-maker and breaker, and to press against a shoulder t^7 (Figs. 3 and 11) for the purpose of closing the electric circuit.

Collars j' j', are attached to the rod j, between which is secured an arm h^5, for connecting the rod j and bar h, with each other.

Between the lower collar j' and the spring t^6, is inserted a disk t^8, of insulating material, which is normally in contact with said spring and serves to depress it and thus hold the circuit broken; but as soon as the bar h, is lifted by the action of the ratchet mechanism, the spring t^6 is brought into contact with the shoulder t^7,—thus closing the line of the electric circuit at that point; but as the circuit remains broken at the next succeeding station, as hereinafter set forth, the magnet t^2 is not excited.

I will now describe the semaphore mechanism which is actuated by the devices above set forth, after which I will proceed to specify the manner in which the signals are operated automatically from one station to another in a block-system. A vertical shaft v, Figs. 2, 3, 5, 6 and 8, is loosely secured in bearings arranged within an upper case i^2, one of said bearings consisting of a bracket v^2, rigidly attached to said plate, while the other is formed in the plate itself. A sleeve v', is loosely attached to said shaft, between which and the bracket v^2, is interposed a collar v^3, which is rigidly secured to said shaft by means of a pin as shown in Figs. 3, and 8. Projecting from the collar v^3, is a rigid arm v^4 to which is attached a curved plate v^5 having depending lugs v^6 at its respective ends through which is passed a rod v^7, which rod also passes loosely through a bore in the end of a radial arm v^8 formed upon the sleeve v'. Buffing springs w w are interposed upon the rod v^7 between the lugs v^6 and the arm v^8. A spiral flange v^9, Figs. 3, 5, and 6 is formed upon the sleeve v' and adapted to engage with friction rollers h^4 h^4, better shown in Fig. 6, and indicated in dotted lines in Fig. 3, which are attached to a plate h^5 secured rigidly to the bar h. Upon the upper end of the shaft v, is mounted a day and night signal consisting preferably of the disks x, and lantern y, Fig. 2, which are adapted to rotate in a vertical plane to the extent of ninety degrees, in the usual manner. The raising of the bar h, and the consequent action of the friction rollers upon the spiral flange v^9, serves to rotate the signal as stated, to indicate "danger,"—while the descent of said bar reverses it. To avoid breakage as a result of the too sudden movement of the signal, I interpose the buffing springs w, which yield in both directions and relieve the shock.

In order the more clearly to illustrate its

working, I have shown a perspective view of a portion of the releasing device in Fig. 14, with its electrical connections, while in Fig. 15, a diagram is shown indicating a series of stations, and illustrating the manner in which the electric circuits are run. In order to prevent confusion, I have shown two line wires t^8 t^9, though it is obvious that in lieu of one of them a ground connection may be made;—and in actual practice it is my purpose to employ the latter method. The springs t^6, at each station in the diagram, may be assumed to be the equivalent of the spring so designated in the other figures. I have numbered the stations from one to four inclusive, and have shown a battery z in circuit at each station. It will be observed that the connections with the wires t^8 t^9, are reversed with respect to the polarity at each station. At station 1, the positive line is run to the wire t^8, and the negative to its companion, while at station 2, the reverse is true; and so on throughout the series,—the polarities alternating between the respective line wires, or what would be the same, and preferably in practice,—viz: alternating between the line and ground respectively. It should be borne in mind that the circuit at each station is normally open, as indicated in said diagram view.

Having thus described the various parts of my invention I will now explain the operation—first, of the mechanism of a single signal and finally of the series as a whole. Upon the passage of a train as stated, the rails a and bar b are depressed by each successive truck—thereby producing a series of reciprocating movements of the rod c;—and as the lever e and ratchet mechanism are so adjusted as to utilize the minimum movement of the rails, it is obvious that a greater movement thereof will cause the pawls to pass over several teeth of the ratchet at once; and with each reverse movement or recoil of the rail, the bar h will be lifted correspondingly. Hence it is obvious that the track movement may vary in degree and yet accomplish the same result. The double action of the pawls as arranged in Fig. 3, enables the bar h, to be lifted with twice the rapidity that it would be by the construction shown in Fig. 1. As the bar h is lifted, the bar j, is clutched by the opposite pawl, and thus prevented from falling back. In the meantime the rod s is raised by the arm u and clutched in like manner by the clutch t. As soon as the rod j has begun to rise, the spring t^6 is released, and pressing against the arm t^7, closes that portion of the normally open circuit; but the circuit as a whole, is still open by reason of the normal position of the circuit closing spring t^6 at the next succeeding station. It will be seen that the arms of the part l, which are connected with the bars m, m, are not at right angles but oblique to the part in which the pin l' is inserted, and hence, when the pin l' is in the slot n', at the right, as shown, the bars m are drawn in so as to expose the ratchet teeth h^2; but as soon as the pin l', is thrown into the slot n, the bars m are projected beyond the ends of the ratchet teeth, and hence the pawls k^3 k^4 are disengaged therefrom;—thus leaving the bar h free to fall as soon as the clutch q, is released. This action of the bars m takes place as soon as the bar h reaches the upward limit of its movement, when the pin l' is thrown over to the slot n by the action of the arm o. The elevation of the bar h, serves to revolve the shaft v and hence sets the signal at "danger." Upon the arrival of the train at the next succeeding station, the signal is mechanically set at "danger" in like manner; but in doing so, the circuit closing spring t^6, at said second station is released at the very beginning of the movement, thereby completing the electric circuit between that and the preceding station. As soon as this is accomplished the magnets t^2 at both stations are excited and the armature t' is drawn thereto, thereby releasing the clutch t at the first station, (before it is possible to place the signal at the second station fully at danger,) when the rod s, falls until the shoulder s' strikes the lever-arm r, which, acting upon the pivoted plate or clutch q, tilts it and in turn releases the rod j which falls to its normal position, reverses the semaphore and opens the electric circuit by again depressing the spring t^6. The secondary signal is then set to danger by the continued action of the train, which passes on to the third station, when the action described is repeated and the signal at the second station is released, while the third is set to danger, and so on throughout the series.

It will be observed that no tripping mechanism upon the track or elsewhere is required to close the electric circuit, and that no signal is thrown to "danger" by electric action. The throwing of the signal is, in each case, entirely mechanical; while, as an incident thereto, the electric device is merely employed to release the set signal behind it. This releasing mechanism may be made very delicate, and yet, by reason of the peculiar construction of the clutches, the corresponding leverage in connection therewith and the impact or blow of the first rod to release the clutch upon the second, the action is rendered positive and certain, while the weight which may be sustained and released by the clutch mechanism may be varied indefinitely without rendering the action of the machine uncertain or in any way influencing the battery power required to effect the initial release.

A further advantage of my improved system is that by it I am not only enabled to dispense with relays and other complicated electrical devices, but require only a minimum battery force to actuate my release. Moreover, by my system, a factor of safety is provided in that two batteries instead of one, are always in the circuit at the time it is closed; and as these batteries are constantly chang-

ing as the circuits are changed, the chances are always in favor of successful action. As an illustration of this statement, assuming a train to start at station 1, toward station 2, (Fig. 15,) the signal at station 1 is set at danger, and when station 2 is reached the circuit is closed with the batteries at both stations. This insures the release of the signal at station 1. Upon the arrival at station 3, the batteries at 2 and 3 are brought into circuit,—and so on throughout the series;—a new battery being added and one omitted at each station;—and this regardless of the direction in which the train is moving.

From actual experience I have found that the variation in the extent of the depression of the rails is immaterial, as the action of the machine is the same whether this movement be great or small; but I prefer to limit the movement of the end of the track-bar in the manner stated, or in some equivalent way, to prevent injury to the mechanism. This feature is especially desirable upon what is commonly known as a "dirt" road-bed,—or one in which but little or no ballast is employed. Said semaphore actuating mechanism may be placed horizontally if desired by employing springs to throw the rods in the releasing mechanism to normal positions,—in which case the manner of connecting the reciprocating bar with the semaphore, would, of course be modified; but I prefer the arrangement as shown.

Having thus described my invention, I claim—

1. The combination with a railway track of a reciprocating rod mounted upon a stationary support, a horizontal bar connected with the track and said reciprocating rod respectively, a spring for sustaining said rod in a normal position, a longitudinally movable bar having a series of ratchet teeth thereon, a lever attached to said reciprocating rod, a cross-bar pivoted to the frame and having one end loosely connected with said lever, pawls upon said cross-bar arranged to engage said ratchet teeth, a clutch mechanism for grasping and holding said longitudinally movable bar when in an abnormal position, means for disengaging said pawls when said bar is moved abnormally to its full limit, a semaphore in operative connection with said longitudinally movable bar, an electro-magnet having its armature in operative connection with said clutch, a source of electricity in normal open circuit with said magnet, and means for closing said circuit, substantially as shown and described.

2. The combination with a railway track and intermediate positive connections, of two or more semaphores or signals, means as specified for mechanically and consecutively setting said signals to "danger," automatic clutches in connection with said signals for holding the same in abnormal positions respectively, tripping or releasing devices for releasing said clutches, electro-magnets having their armatures in operative connection with said clutches, electrical connections between said magnets, a source of electricity, and a normally open circuit-making and breaking device at each of said stations, whereby the mechanical setting to "danger" of a secondary signal by the passage of a train, may enable the electric circuit to be automatically closed between the two signals and actuate the electric releasing mechanism of the preceding signal, substantially as shown and described.

3. The combination with a railway track of a plurality of signals, means, as described, for mechanically setting them to danger, an electrical releasing device at each station, separate sources of electricity corresponding in number to the number of the stations, a circuit closing device at each station, means for holding the same open while the signal is in its normal position, and electrical connections, the polarities of which are alternated in consecutive order, substantially as shown and described.

4. The combination with a series of railway signals and means for automatically setting the same by the passage of a train, of a like series of normally open circuit-closers, a like series of batteries, the polarities of which are alternated in consecutive order, and a like series of electro-magnets in electric circuit, having their armatures in operative connection with releasing devices, said circuit closing devices being self acting, and arranged to be released simultaneously with the setting of the signal, substantially as shown and described.

5. The combination with a railway track of a series of mechanically actuated signals, a series of mechanical clutches for retaining the same in an abnormal position when mechanically set, a series of electrical releasing devices in operative connection respectively with said clutches, a series of batteries, the polarities of which are alternately reversed with respect to the circuit connections thereof, and a series of automatic circuit closers in operative connection with the semaphore actuating mechanism, whereby said circuit closers may be permitted to act consecutively, and the mechanical setting of a given signal by the passage of a train may serve to release the preceding one in whichever direction the train is caused to move, substantially as shown and described.

6. The combination with the rails of a railway track and a signal of a bar arranged horizontally beneath said rails and extending laterally from the track, said bar being rigidly attached to each of said rails, means for actuating said signal by a series of impulses, and means for connecting said signal operating mechanism with the projecting end of said bar, substantially as shown and described.

7. The combination in a semaphore operating device, of a lever in operative connection with the railway track, movable pawls con-

nected with said lever, a sliding bar having ratchet-teeth thereon for actuating the semaphore, means for causing said pawls to engage with said ratchet teeth, parallel bars connected with said sliding bar and means for moving said bars laterally with each upward and downward movement of said sliding bar, whereby said pawls may be permitted to or prevented from effecting an engagement with said ratchet-teeth, substantially as shown and described.

8. The combination with the bar *h*, having a double ratchet thereon, of the bars *m m*, pivoted upon cross-bars as described, pawls k^3 k^4, means for actuating the same, and means for obliquely tilting the cross-bars upon which said bars *m m* are pivoted, substantially as set forth.

9. The combination with the ratchet-toothed bar *h*, and the pawls k^3 k^4, of the bars *m m* pivoted upon cross-bars which are in turn pivoted to the bar *h*, lever *l*, pin *l'*, a stationary frame having slots or guides *n n'*, therein, pivoted arms *o o'*, and springs o^4 o^5, substantially as described.

10. The combination of the sliding rod *h*, means for reciprocating the same, a semaphore pivotally mounted upon a vertical axis, arm v^4 rigidly attached to the pivotal shaft, a curved plate v^5 having spring buffers thereon, sleeve *v'* having a rigid arm v^8, in operative connection with said buffers and a spiral flange v^9 arranged to engage with friction rollers upon the bar *h*, substantially as described.

In testimony whereof I have signed this specification, in the presence of two subscribing witnesses, this 29th day of September, 1891.

JAMES W. STEELE.

Witnesses:
D. H. FLETCHER,
A. L. FLETCHER.