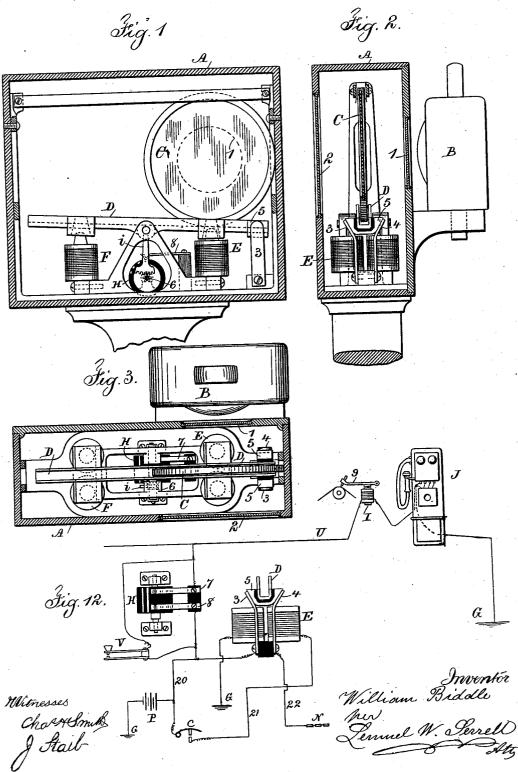
(No Model.)

4 Sheets-Sheet 1.

## W. BIDDLE. TRAIN SIGNAL.

No. 560,293.

Patented May 19, 1896.



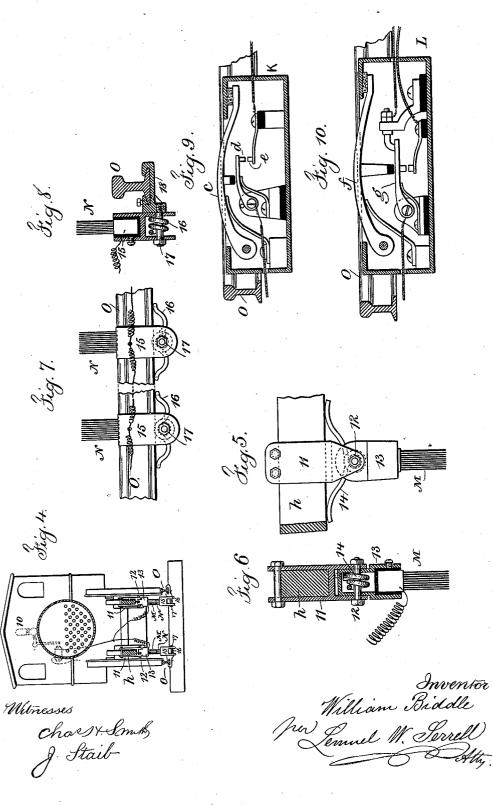
4 Sheets-Sheet 2.

(No Model.)

# W. BIDDLE. TRAIN SIGNAL.

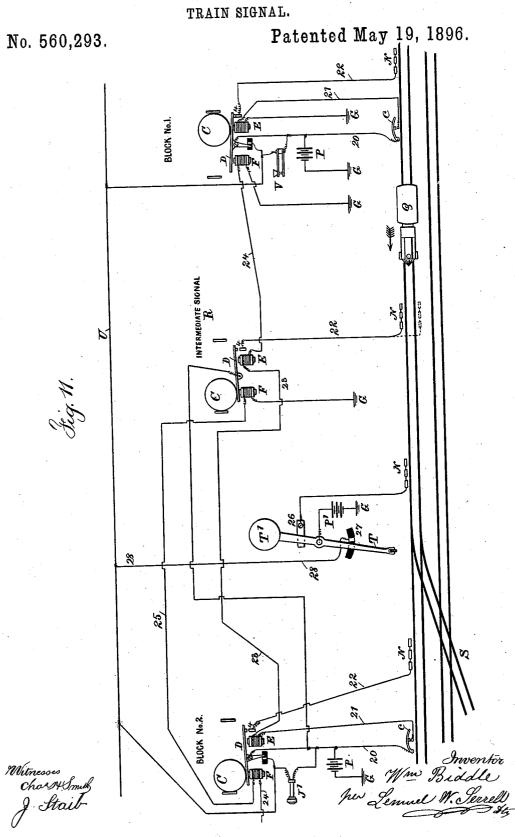
No. 560,293.

Patented May 19, 1896.



(No Model.)

No. 560,293.



W. BIDDLE.

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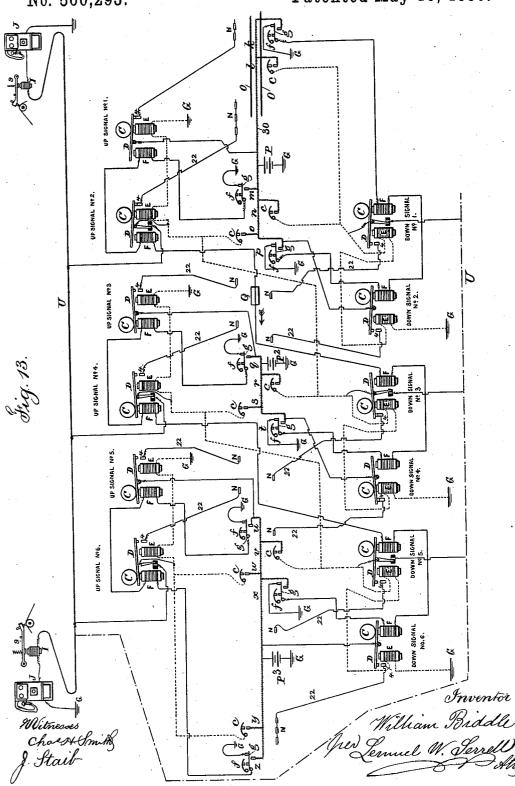
(No Model.)

W. BIDDLE. TRAIN SIGNAL.

No. 560,293.

Patented May 19, 1896.

4 Sheets-Sheet 4.



ANDREW B.GRAHAM, PHOTO-LITHO, WASHINGTON, D.C.

# UNITED STATES PATENT OFFICE.

#### WILLIAM BIDDLE, OF BROOKLYN, NEW YORK.

#### TRAIN-SIGNAL.

### SPECIFICATION forming part of Letters Patent No. 560,293, dated May 19, 1896.

Application filed March 22, 1894. Serial No. 5C4, 577. (No model.)

#### To all whom it may concern:

Be it known that I, WILLIAM BIDDLE, a citizen of the United States, residing at Brooklyn, in the county of Kings and State of New York, 5 have invented an Improvement in Train-Signals, of which the following is a specification. The object of this invention is to actuate block-signals upon a railway electrically and in such a manner that as the train passes along 10 a signal isset at "danger," and when the train reaches the next block-signal to set the same to "danger" a block-signal in the rear is returned to "safety," and in connection with the said block-signals an intermediate signal is 15 also employed and arranged in such a manner as to give an automatic alarm upon the train in either the engine-cab or in one of the cars,

and this system is available with two or more tracks and also with one track in which trains 20 are permitted to run in opposite directions, so that the possibility of collision is reduced to

a minimum. In the drawings, Figure 1 is an elevation of

- the signal with the case in section. Fig. 2 is 25 a cross-section of the same. Fig. 3 is a plan view with the case in section. Fig. 4 is an illustration of the locomotive and the circuitclosing brushes upon the same. Fig. 5 is an elevation of the circuit-closing brush on the
- 30 locomotive, and Fig. 6 a cross-section of the same. Fig. 7 is a side view, and Fig. 8 a cross-section, of the circuit-closing brush on the track. Fig. 9 is an elevation, with the case in section, of the circuit-closing lever
- 35 acted upon by the wheels of the train for making and breaking a single circuit. Fig. 10 is a similar view of the lever for switching the current from one circuit into another. Fig. 11 is a diagram illustrating the electric con-
- 40 nections for one track on a double-track railway. Fig. 12 is a diagram of the circuit-closing devices at an end station, the parts being in larger size than in Fig. 11. Fig. 13 is a diagram of the connection adapted to use 45 upon a single track in which the trains run

in different directions. The signal-box which I prefer to employ, and which is well adapted to the present im-

provements, is represented in Figs. 1, 2, and 50 3, in which A shows a case or box of suitable size with openings 1.2 through the same and

these openings is the lantern B, which is removable, as usual, and within the box A is the rolling signal C, usually composed of a 55 metal ring containing a colored celluloid or glass, such as red or blue, and the bottom edge of this rolling signal is upon the grooved armature-lever D over the electromagnets E and F, which may be made to act upon arma- 60 ture-blocks, or solenoid-cores may be con-nected to such armature-lever D, so that when the electromagnet E is energized the lever D will be swung into the position shown in Fig. 1 and the signal C will be rolled into line with 65 the openings 1 and 2 to give the signal of "danger," and when the electromagnet F is energized, the lever D will be moved, so that it is inclined in the opposite direction, and the signal C will be rolled away from the open- 70 ings 1 and 2 to indicate "safety."

Adjacent to one end of the armature-lever D are the circuit-closing springs 3 and 4, (represented in Fig. 12,) and the circuitwires are connected to these springs and they 75 are insulated from each other, but the insulated block 5 upon the lever D closes the cir-cuit between 3 and 4 when the signal C is rolled to "danger" for the purposes herein-80 after set forth.

The movement of the lever D is made use of for indicating upon the line running to the despatcher's office or central station the designation of the station where the signal is changed, and with this object in view I 85find it convenient to employ a rack-arm i, connected with the lever D and acting upon the pinion 6 of the circuit-wheel H, in which circuit-wheel there are contact-blocks closing the circuit between the springs 7 and 8, so 90 that when the lever D is moved the wheel H is rotated, and by its contact-blocks a signal is sent over the line to the central station or despatcher's office indicating the number or location of the place where the signal is set 95 to "danger," and in this electric circuit running from the line to the despatcher's office an electromagnet I is located to actuate a time-signal lever 9, having any desired char-acter of stamping device by which the time 100 can be denoted on a strip of paper and also the number of the station from which the signal is sent in, so as to keep a record at the in which glasses are inserted, and behind | despatcher's office of the movements of the

respective trains, and it is advantageous to place in the circuit a telephone instrument J, which may be made use of in any ordinary manner to communicate with the engineers 5 of the respective trains or with the distant stations, and I have represented a telephonereceiver J' at the block-signal No. 2, Fig. 11, and it is to be understood that Fig. 12 illus-

trates in detail the connections provided at 10 the sending-station or despatcher's office des-ignated as "block No. 1" on Fig. 11. I remark that in the diagrams I have represented insulating material and circuit-closing bars in connection with the rack-arm i in place of 15 representing the circuit-wheel H for the pur-

poses of illustration.

At the proper places along the line boxes K and L are placed, the boxes K each having a circuit-closing lever c, that is depressed by 20 the action of the passing wheel upon the locomotive or car, and in so doing closes the spring-contacts dein such box K, such springcontacts being in the electric circuits herein-

after mentioned, and in the boxes L there 25 are levers f, acted upon by the passing wheel to move the spring-switch g and change the electric circuit from one wire to another, and these boxes K and L are employed in the manner hereinafter described.

I provide in the cab of the engine, in the 30 caboose, or upon one or more of the cars any suitable audible signal, such as an electric bell or a steam-whistle, (illustrated by the dotted lines 10, Fig. 4,) and upon the vehicle, 35 preferably upon one of the equalizing-bars, a

portion of one of which is represented at h in Figs. 5 and 6, contact-brushes are supported, as shown at M, and it is advantageous to employ the straps 11 for securing the pivot-pin

40 12 to the equalizer-bar h and to support upon the pivot-pin 12 the box 13, into which are se-cured the contact-brushes M, and in the upper part of the box 13 and around the pivotpin 12 is a coiled spring 14, the ends of which

45 passout through openings in the top of the box and rest against the under side of the equalizer-bar h, and these springs press against the metal of the box 13 adjacent to the openings through which the springs pass outwardly, so

50 that the box 13 and the contact-brushes M are free to swing in either direction upon the pivot 12, and the coiled spring 14 acts to return the brushes to their normal positions and also allows the brushes to yield without injury in

55 case of contact with any foreign substance. The brushes M are insulated, as illustrated in Fig. 6, and the wire therefrom passes to the electric bell or signal 10, and the circuit can be closed through the metallic parts of the 60 engine or wheels and to the track and thence to the ground. Hence when the brushes M come in contact with a device that is in an electric circuit, the other end of which is grounded, the bell or whistle 10 will be 65 sounded in the engine or upon the vehicle and give a signal, and with this object in view the

support adjacent to the track and in line with the brushes M upon the vehicle, so that the circuit will be closed by the brushes M rub- 70 bing over and in contact with the brushes N, and these brushes N are insulated, as illustrated in Fig. 8, and each brush is set in a box 15 and provided with a coiled spring 16 around the pivot-pin 17, which projects as a 75 fixture from a clip 18, attached to one end of the track-rails O, so that each brush N may yield by the contact therewith of the brush M, and the electric-circuit wires are connected with the brushes N and to the block system 80 of signals, as hereinafter described.

I have represented batteries or other sources of electric energy at P at the block No. 1 and the block No. 2, and for the purposes of illustration an engine is shown at Q, Fig. 11, and 85 it is presumed to be traveling upon one of the two tracks in the direction indicated by the arrow.

The operations of the parts thus far described will be understood upon reference to 90 the diagram Fig. 11, and, presuming that the engine has started from the depot or despatcher's station at block No. 1, the circuit has been closed by the wheel acting upon the lever c in the box K and the current from the 95 battery P has passed by the wire 20, lever c, wire 21, through the electromagnet E to ground G, and by energizing the magnet E the signal C is rolled to "danger," and as the engine Q passes along and approaches the in- 100 termediate signal R the brushes M on the engine come in contact with the brushes N at the side of the track, and if the signal C is at "safety" no current will pass from N to M and no audible signal will be given in the 105 cab; but if the intermediate signal is at "danger" the circuit will be closed between 3 and 4, so that a current will pass from the battery P, Fig. 12, through 3 and 4 , Fig. 12, through 3 and 4 and the wire 22 to N, and thereby an audible signal will be given 110 through the brushes to the engineer in the cab or on any other part of the train. It is, however, presumed that the circuit is broken between 3 and 4 and the intermediate signal R is at "safety" and the train proceeds to 115 the block No. 2, Fig. 11, and should a signal at block No. 2 be at "danger" and the engineer not observe the same an audible signal will be given in the cab by the brushes at N, as aforesaid, such brushes being located 120 at a sufficient distance from the block-signal No. 2 to allow for the train being stopped to avoid a collision.

If the signal C is at "safety" when the locomotive reaches the block No. 2, the wheel 125 of the locomotive acts upon the lever c and closes circuit from the battery P through 20, c, and 21, energizing the magnet E to set the signal C to "danger," and the current passes by the wire 23 to the magnet E at the inter- 130 mediate station R and sets the signal C at the intermediate station to "danger," and thence the current passes by the wire 24 to contact-brushes N are located upon a suitable | the magnet F at block No. 1 and thence to

the ground, so as to return the signal C at block No. 1 to "safety," and when in the course of travel the engine reaches the third block-signal the current passes in the man-

block-signal the current passes, in the man-5 ner before described, by the wire 24 to the magnet F at block No. 2 and thence by the wire 25 to the magnet F at the intermediate station R to return the signal at both the intermediate station R and the block No. 2 to 10 "safety."

I have represented in Fig. 11 a track-turnout S, at the junction of which with the main track a switch is placed, as usual, and at T, I have indicated the switch-lever with its 15 usual indicating-disk T', and it is presumed

- to usual indicating-disk T', and it is presumed that this lever is moved by hand and there is a battery at P' connected to the switch-lever, and there is a contact 26, with which the switch-lever T engages to close the circuit to
- 20 the brushes N when the switch is open to the turnout or siding. Hence the brushes N will give an audible signal in the cab of the engine as the engine passes by and its brushes M contact with the brushes N.
- 25 When the switch coincides with the main track, the circuit to the brushes N is broken between the switch-lever T and the contact 26. At 27 I have represented a circuit-closer,
- which is advantageously a wheel to give a
  3° signal by its rotation similar to the circuitwheel H, and this circuit-closer 27 is connected by the wire 28 to the main-line wire U, which passes to the despatcher's office. Hence whenever the switch T is moved a current passes
  35 from the battery P' through T, 27, and 28, to
- 35 from the battery P' through T, 27, and 28, to the despatcher's office, and a record is made by the electromagnet I upon the paper and also by the time-signal lever 9, so as to indicate both the place where the switch is moved and
- 4° the time when that movement takes place, thus placing the switches within the knowledge of the train-despatcher and also giving an audible signal in the cab of the engine whenever a switch is set to divert a train
  45 upon the siding or turnout.

I have represented at V a finger-key in a circuit running around the circuit-closing wheel H, which finger-key may be provided at the different stations or only at the de-

- 5° spatcher's office and will allow for Morse characters being sent upon the line U from the battery P whenever desired, and inasmuch as the telephone J is in the main circuit with the line U and the receiving instrument J' is
- 55 also in a branch from the main line U telephonic communications can be had from the despatcher's office to the respective block-signal stations.

In the diagram Fig. 13 I have represented 60 the devices before described with reference to a single track, and in order to avoid confusion the positions of the track-rails are illustrated at O O only, and the position of the engine is illustrated at Q, such engine being

65 presumed to be traveling upon the single track in the direction of the arrow, and it is also to be understood that the dotted line U

at the bottom of Fig. 13 is the main-line wire U, (shown by full lines at the top of said Fig. 13,) the connections being thus illustrated to 70 avoid confusion which would result from the crossing of the wires, and the positions of the magnets E and F are the reverse on one side of the track to what they are on the other side of the track, because it is presumed that the 75 signals will be so placed that the engineer will only regard the signals at the right side of the track. Hence the signals at one side of the track will be observed when going in one direction and those on the other side of the 80 track will be observed when going in the other direction.

For convenience let it be understood that in describing the movements of the trains the following terms are made use of: The "up train" 85 is presumed to be going in the direction indicated by the arrow at the locomotive by Q, and the signals for the up train are indicated by the range of signals in the upper part of Fig. 13. The expression "down train" is applied to a train moving in the opposite direction to the arrow, and the expression "down signals" is applied to the range of signals in the lower part of Fig. 13.

I have indicated on Fig. 13 circuit-closing 95 devices at k l m n o p q r s t u v w x y z, and it is to be understood that the distance between any two of these places is to be greater than the length of any train, and presuming now that the train passes the circuit-closer  $f_{100}$ at k, in so doing the current from P passes along the wire 30, which may be buried, and through the spring-lever g to the first down magnet F, setting the signal to "safety," and from there the current passes through the 105 second down magnet, and thence to the circuit-closer at p to the ground. When the train passes over the circuit-closer c at l, the current from P passes by 30 c and by the wire indicated by dotted lines to the first 110 down magnet E, and thence through the second down magnet E to ground, changing the down signals to "danger." When the train reaches the contact f at m, the current passes from P through g and to the magnet F of the 115 first up signal, setting the signal thereof to "safety," and from there the current passes through the magnet F of the second up signal, setting that to "safety," and thence the cur-rent passes to the magnet F of the third down 120 signal, setting that to "safety," and thence to the magnet F of the fourth down signal, setting that to "safety," and thence through the spring g of the circuit-closer at t and to the ground. When the train reaches the circuit-125 closer c at n, the current passes from the battery P through c and through the electromagnet E of the first down signal without changing it, as the same is set to "danger," and thence it passes through the electromag- 130 net E of the second down signal, setting the same to "danger," and thence to the ground. When the train reaches the circuit-closer cat o the current from the battery P passes

through the circuit-closer c and thence through the electromagnet E of the second up signal, setting the same to "danger," and thence the current passes through the electro-5 magnet E of the first up signal, setting the same to "danger," and thence to the ground, and simultaneously the current divides by the branch leading to the electromagnet E of the third down signal, setting the signal to 10 "danger," thence to the electromagnet E of the fourth down signal, setting the same to "danger," and thence to the ground; and when the train passes the circuit-closer f at p the spring g is moved to make contact with the wire 30 15 for the current to pass from the battery P through 30 g to the electromagnet F of the second down signal, and thence through the electromagnet F of the first down signal, and thence through the spring G of the circuit-20 closer at k to the ground, and the train having passed the place marked p, and being at the position indicated by Q and traveling in the direction indicated by the arrow, the signals at the first and second down stations are 25 at "safety" and at "danger" at the first and second up signals, and the signals in front of the train at Q are at "safety," as indicated at the third and fourth up-signal stations, but the signals upon the third and fourth down 30 signals are at "danger," as indicated, so that a train coming in the opposite direction to the train at Q is arrested by said danger-signals at the right of the track as such train might be coming down toward the train at Q. As the 35 train proceeds from the point Q it comes into contact with the circuit-closer at q, and the current from the battery P<sup>2</sup> passes through the  $\operatorname{spring} g$ , and thence to the electromagnet F of the up signal 3, which is already at "safety," 40 and it goes also through the electromagnet F at the fourth up station, and thence through the electromagnet F of the fifth down station and through the electromagnet F of the sixth down station, thence by the spring g at x to 45 the ground, which leaves the distant down signals 5 and 6 at "safety;" but when the train reaches the circuit-closer c at r the current passes from  $P^2$  through c and divides, and part of the current passes back through the 50 magnet E of the second up signal and through the magnet E of the first up signal to the ground, but does not change the position of those signals; but the other branch of the current passes through the electromagnet E 55 of the third down signal, which is already at "danger," and also through the electromagnet E of the fourth down signal, which is already at "danger," without moving any of these sig-nals; but when the train reaches the circuit-60 closer c at s the current from  $P^2$  passes through c and through the electromagnet E of the fourth up signal and through the electromagnet E of the third up signal to the ground, changing both of these signals from "safety" 65 to "danger," and the current also divides and

passes to the electromagnet E of the fifth down | thence to the ground at u, setting the up signal, and thence through the electromagnet | nals at 5 and 6 from "danger" to "safety,

E of the sixth down signal to the ground, changing both of these signals from "safety" to "danger." When the train passes the cir- 70 cuit-closer f at t, the current from  $P^2$  passes through the spring g, thence through the electromagnet F at the fourth down signal and through the electromagnet F at the third down signal, changing these two signals from "dan- 75 ger" to "safety," and thence it passes to the electromagnet F of the second up signal and through the electromagnet F of the first up signal and through the spring g at m to the ground, changing the first and second up sig- 80 nals from "danger" to "safety;" but the down signals at 5 and 6 remaining at "danger" stop any train coming in the opposite direction. When the train reaches u and acts upon the circuit-closer f, the spring g closes the circuit 85from the battery  $P^3$  through g and through the electromagnet F at the fifth up signal and through the electromagnet F at the sixth up signal, and thence to the ground at z; but the up signals at 5 and 6 are not moved, as they 90 are at "safety," and when the train reaches the circuit-closer c at v the current from  $P^3$ passes through c and through the electromagnet E at the fifth down signal and through the electromagnet E at the sixth down signal to 95 the ground, but does not change these sig-nals, which are already at "danger;" but the current divides and passes through the electromagnet E at the up signal 4 and through the electromagnet E at the up signal 3 and 100 thence to the ground, changing these signals from "safety" to "danger," and when the train reaches the circuit-closer c at w the current passes from P<sup>3</sup> by c and through the electromagnet E of the sixth up signal, changing 105 the same from "safety" to "danger," and thence through the electromagnet E of the fifth up signal, changing the same from "safety" to "danger," and when the train reaches the circuit-closer f at x the spring g is 110 moved, and the current passes from the battery  $P^{3}$  through g, and then  $\bar{c}e$  through the electromagnet F at the sixth down signal and through the electromagnet F at the fifth down signal, and thence through the electromagnet 115 Fof the fourth up signal and through the elec-tromagnet F of the third up signal, and thence through the spring g at q to the ground, setting these up signals 3 and 4 from "dan-ger" to "safety," and when the train reaches 120 the circuit-closer c at y the current passes from the battery P<sup>3</sup> through c and through the electromagnet E of the sixth up signal, chang-ing the same from "safety" to "danger," and also through the electromagnet E at the 125 fifth up signal, changing the same from "safety" to "danger," and thence to the ground; and when the train reaches the circuit-closer f at z the current passes from  $P^3$ , by the spring g, and through the electromag- 130 net F at the sixth up signal and through the electromagnet F at the fifth up signal, and thence to the ground at u, setting the up sig-

so that the line is free for the train to pass in either direction. I have shown in connection with this Fig. 13 the brushes at N, near the respective circuit-closers, and these brushes 5 act to give an audible signal in the cab of the locomotive or upon the train, as before mentioned, whenever either of the signals is at "danger" if the engineer should run past the visual signal without stopping, because at 10 each signal the armature-lever D, when at

"danger," closes the circuit from the battery, through the springs 3 and 4, to the track contact-brushes N, near that signal; and it will be observed upon reference to Fig. 11 that

- 15 when the train passes block No. 2 the battery P at that block is connected with the armature-lever D at the intermediate signal R, and hence the current passes through the said armature to the track-brush N at this
- 20 intermediate signal R, and the same connections are illustrated in Fig. 13, but the brushes N are so placed as to indicate that they are passed over by the engine before reaching the visual signal with which they are connected.
- It will be observed that the respective sig-25 nals are not detrimentally affected by the passage of numerous wheels over one circuitcloser, because the current would thereby be simply pulsated without changing the signal,
- 30 neither are such signals changed by the passage of a second train over the circuit-closer, and the registering mechanism is not brought into action except when a signal is moved from "danger" to "safety," or the reverse.
- 35 Hence there is no confusion of signals at the despatcher's office or central station; and it is advantageous to make use of registering devices at both ends of the line, as indicated in Fig. 13, so that the movements of the trains
- 40 are clearly and definitely noted, and upon long lines one or more intermediate stations may be provided, or despatcher's offices, as usual in railways, so that the information furnished reduces the risk of collisions to a minimum,

especially in view of the fact that the same 45 circuit can be used for a telephone or for Morse system of communication between one despatcher's office and another, and the signals being set automatically by the passing trains the responsibility of observing those signals 50 devolves upon the engineer, and the audible signal given in the cab lessens the risk of collision in foggy weather or in consequence of carelessness on the part of the engineer in observing the visual signals.

At the intermediate station R, Fig. 11, and at the locomotive, Fig. 4, I have represented two sets of circuit-closing brushes N in line with each other and adjacent to the respective rails, so as to increase the reliability of 60 the audible signal.

I claim as my invention—

1. The combination in an electric signal, of an armature-lever, a rolling signal upon the armature-lever, two electromagnets for giv- 65 ing motion to the armature-lever and to the signal, a circuit-closer or wheel operated by the armature-lever, and electric-circuit connections to the central station or train-despatcher's office for indicating the movements 70 of the respective signals automatically, substantially as set forth.

2. In an electric train-signal apparatus a brush of conducting material, insulating material around such brush and a stationary 75 pivotal support for the same, in combination with springs acting in both directions to return the brush to a normal position, and a similar brush upon the engine standing in reverse position so that the points of the brush- 80 wires rub against each other and yield as the traveling brush moves over the standing brush, substantially as specified.

Signed by me this 17th day of March, 1894. WILLIAM BIDDLE.

Witnesses:

GEO. T. PINCKNEY, A. M. OLIVER.

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