(No Model.) 3 Sheets—Sheet 1.

T. A. B. PUTNAM.

Electric Danger Alarm for Railways.

No. 243,619. **Patented June 28, 1881.**

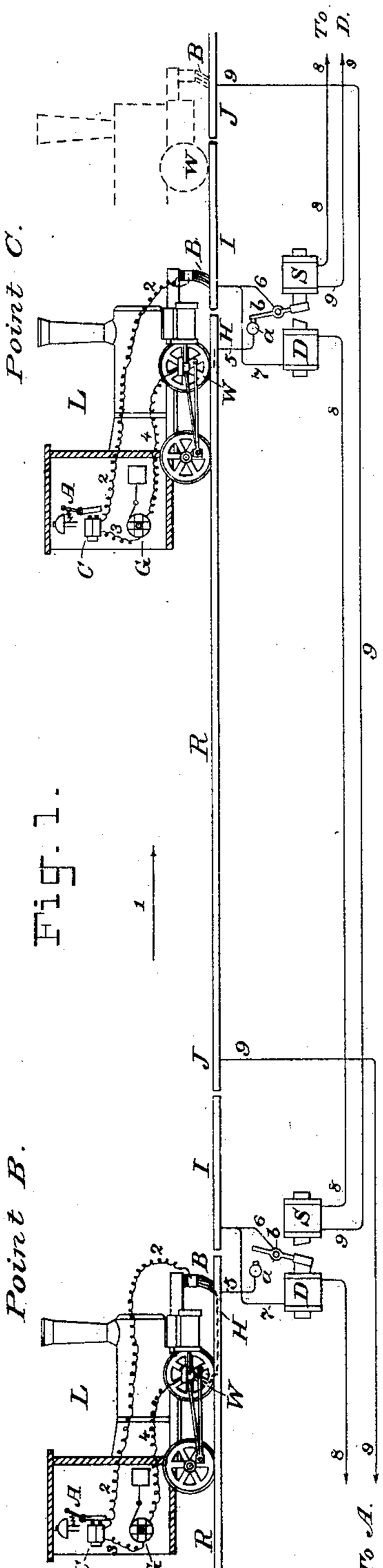

Fig. 1.

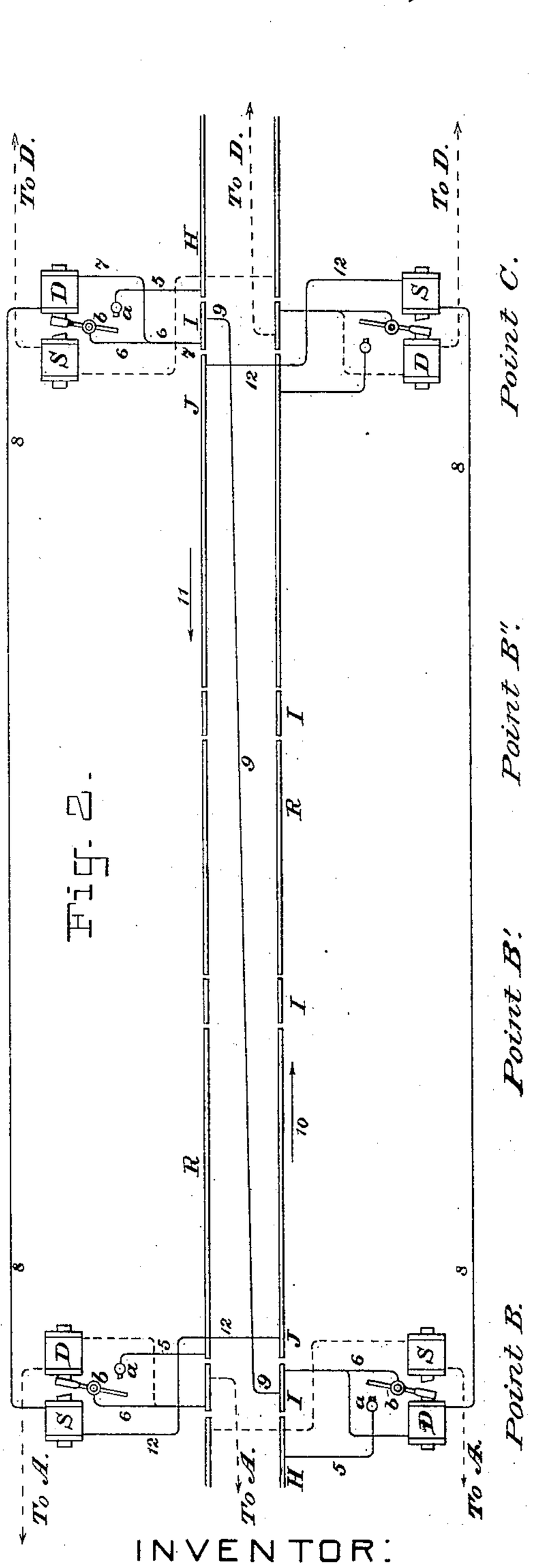

Fig. 2.

ATTEST:

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Geo. Bairdon

INVENTOR:

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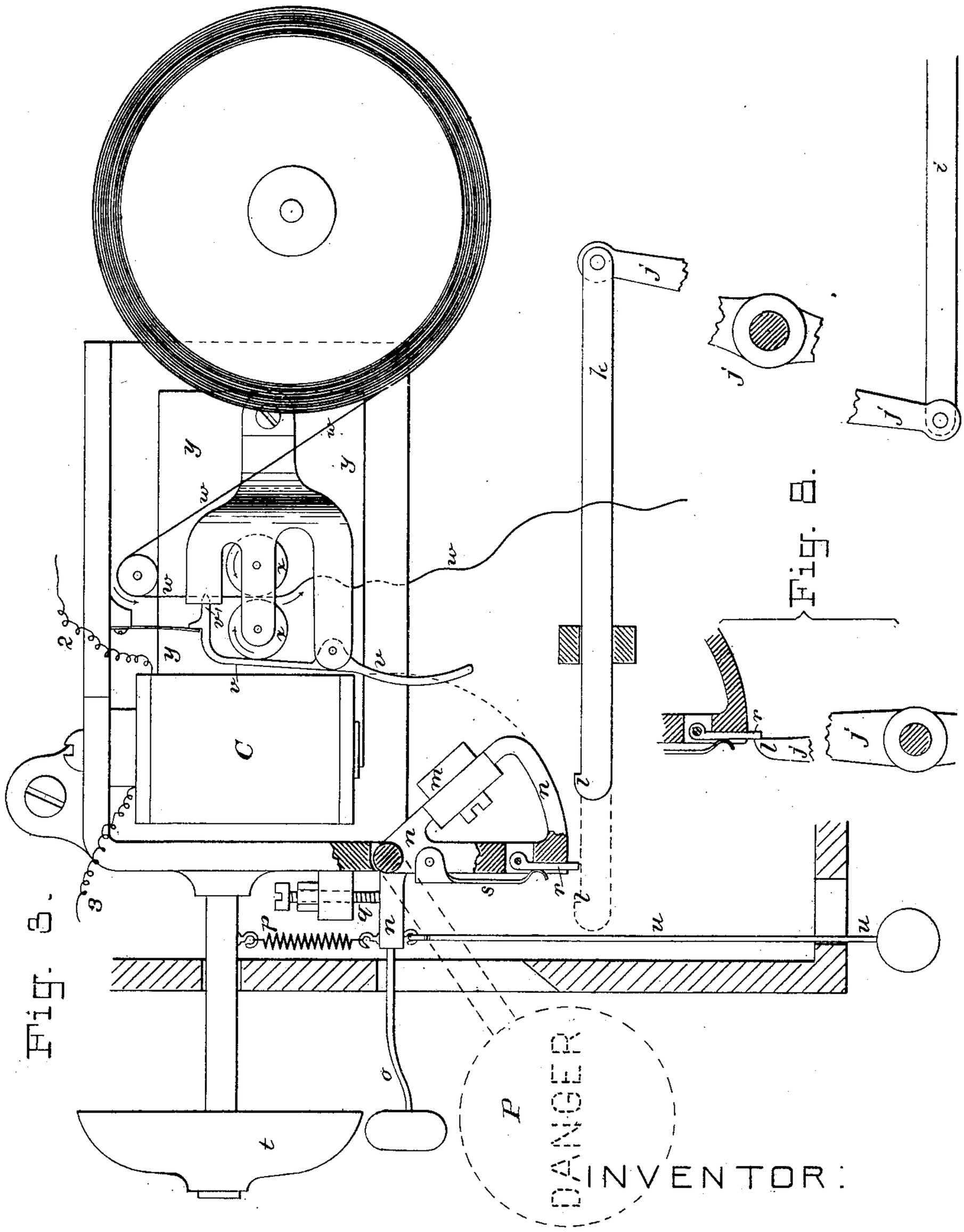
(No Model.) 3 Sheets—Sheet 2.

T. A. B. PUTNAM.

Electric Danger Alarm for Railways.

No. 243,619. **Patented June 28, 1881.**



ATTEST:
E. B. Bolton
Geo. Bairstow

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(No Model.)

3 Sheets—Sheet 3.

T. A. B. PUTNAM.

Electric Danger Alarm for Railways.

No. 243,619. Patented June 28, 1881.

Fig. 5.

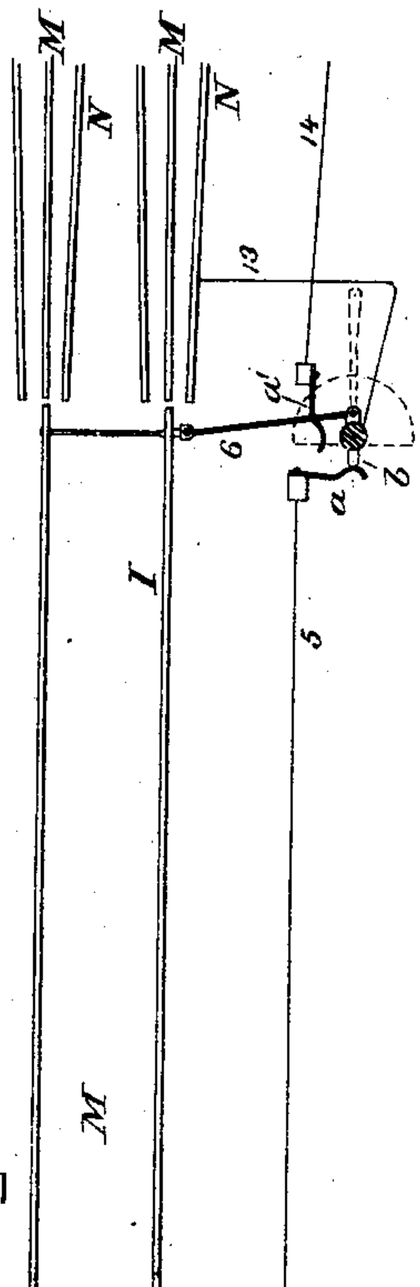


Fig. 8.

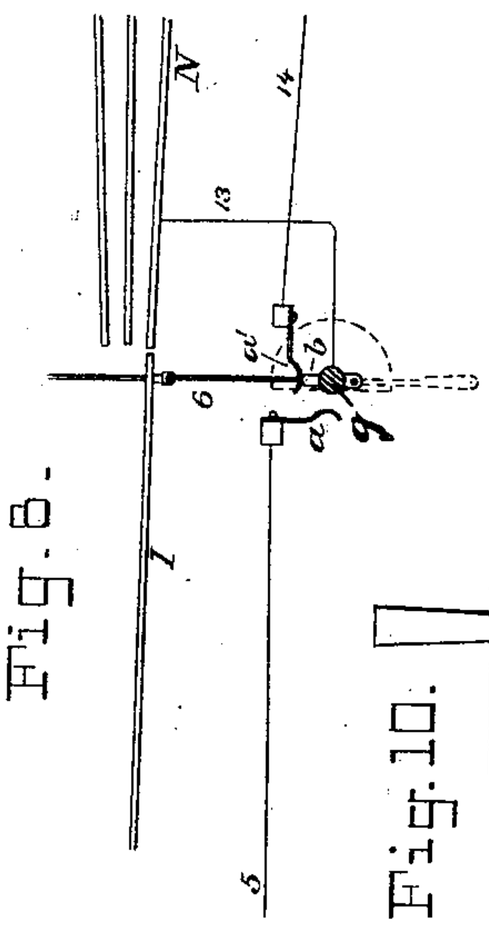


Fig. 10.

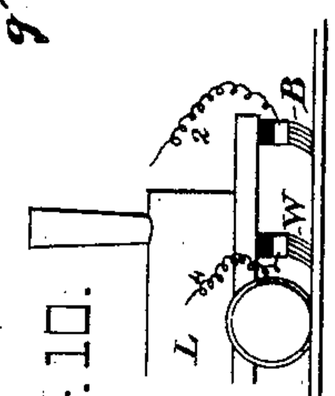


Fig. 4.

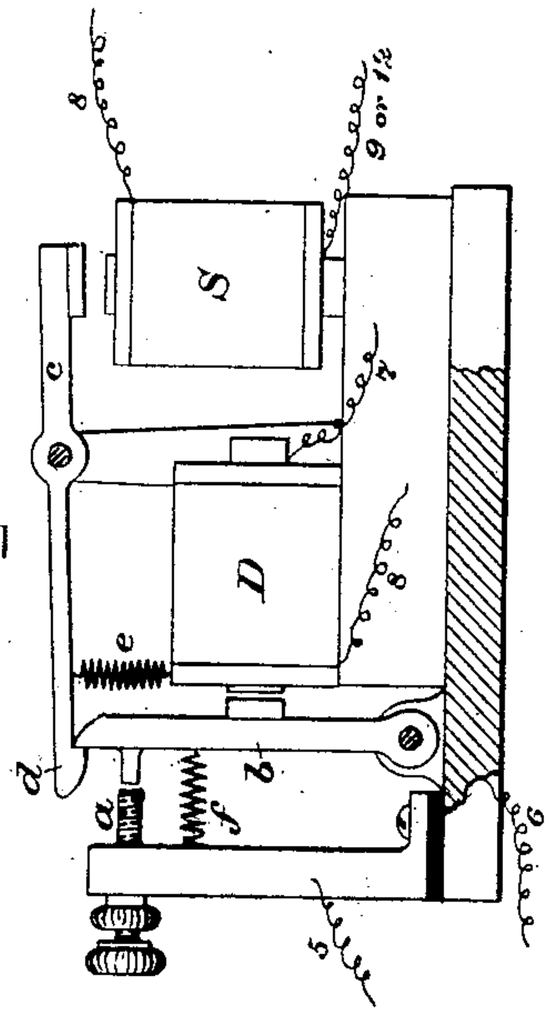


Fig. 7.

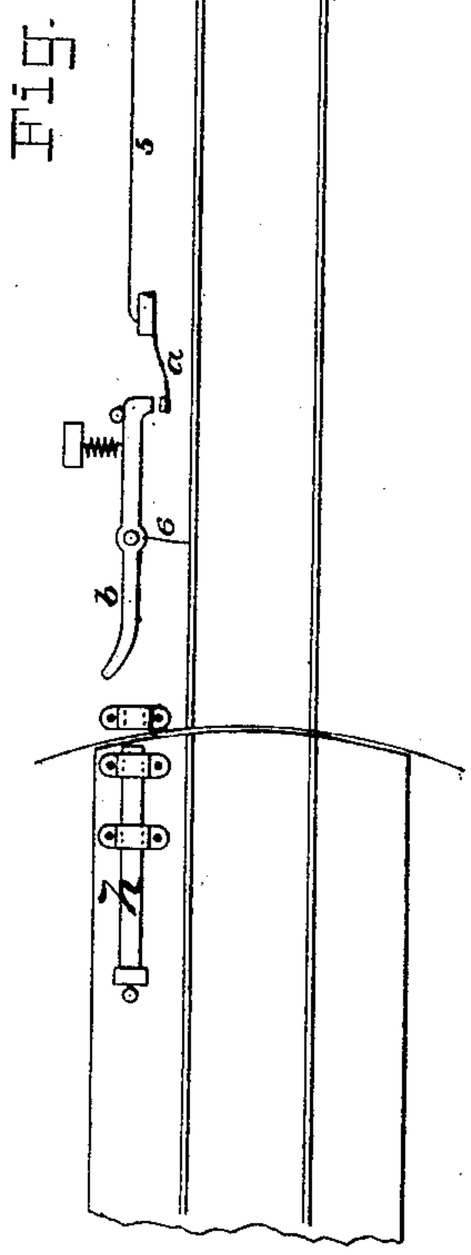
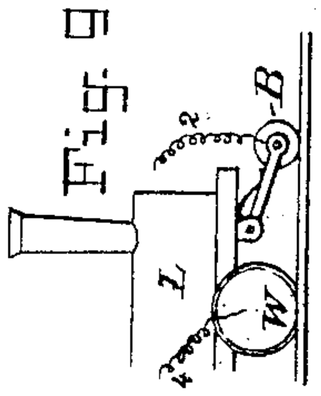


Fig. 9.



ATTEST:

E. B. Bolton

Geo. Bairstow

INVENTOR:

Theodore A. B. Putnam,

By his Attorneys,

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UNITED STATES PATENT OFFICE.

THEODORE A. B. PUTNAM, OF NEW YORK, N. Y., ASSIGNOR OF ONE-THIRD TO THOMAS C. MILES, OF SAME PLACE, AND ONE-SIXTH TO EDGAR S. BLACKWELL, OF LONG ISLAND CITY, N. Y.

ELECTRIC DANGER-ALARM FOR RAILWAYS.

SPECIFICATION forming part of Letters Patent No. 243,619, dated June 23, 1881.

Application filed March 14, 1881. (No model.)

To all whom it may concern:

Be it known that I, THEODORE A. B. PUTNAM, a citizen of the United States, residing in the city, county, and State of New York, have invented certain new and useful Improvements in Electric Danger-Alarms for Railways, of which the following is a specification.

The object of my invention is to warn the engineer of a train when there is danger ahead. I provide for this purpose an automatic electric alarm on the locomotive, which shall operate whenever the train is following too closely after its leader, whenever it is approaching an open draw or misplaced switch or other source of danger, whenever it is approaching another train on a single track, or whenever there is a defect in any of the electric circuits employed.

In the accompanying drawings, Figure 1 is a side elevation, showing a portion of track with two locomotives passing in the same direction, the electric devices being shown in diagram. Fig. 2 is a plan of a single-track railway, with electrical devices shown in diagram. Fig. 3 is a side elevation of the alarm on the locomotive. Fig. 4 is a side elevation of one of the danger-signal transmitters along the track. Fig. 5 is a diagram in plan view, showing the electrical attachments connected with a switch. Fig. 6 is a fragment of Fig. 5, showing the switch misplaced; and Fig. 7 is a diagram showing the electrical attachments connected with a draw-bridge.

In all the figures like letters or numbers of reference designate like parts.

Referring first to Fig. 1, let R designate the railway-track, which we will assume to be one track of a double-track road, on which trains run in the direction of arrow 1. L L are locomotives thereon.

G is an electric-current generator on each locomotive, which may be, as shown, a magneto-electric machine run by a donkey-engine, or it may be a battery.

A is an alarm apparatus in the cab of the locomotive, which is adapted to give a visual or audible signal of danger to the engineer, and which tends constantly to give such signal, but is normally restrained therefrom by the armature of an electro-magnet, C, which is normally attracted by said magnet.

B is a metallic or conducting brush carried by the locomotive, and arranged to sweep the rail in advance of the forward wheel or following the rear wheel, as preferred. This brush serves to form an electric connection with the rail, and is insulated from the locomotive. A wheel pressed into constant contact with the rail may be substituted for the brush, as shown in Fig. 9. I will, however, assume, for the purpose of this description, that a brush is used, and that it is arranged at the front of the locomotive, forward of the front wheels, as shown in Fig. 1. A wire, 2, connects the brush B with the magnet C, another wire, 3, connects said magnet with the generator G, and another wire or other conductor, 4, connects said generator with one of the wheels of the locomotive. In practice this connection 4 will be through the metal frame-work or other parts of the locomotive, through the axle-boxes of the wheels, and through the wheels (usually the wheel W nearest the brush) to the rail.

Instead of using the wheel W as the second conductor, a second brush may be applied behind the first, as shown in Fig. 10.

In ordinary running, as shown in the left-hand or following locomotive in Fig. 1, a closed electric circuit is maintained on the locomotive, the current flowing from G, through 3 C 2 B, the rail W, and 4, back to the generator, or in the contrary direction. Only one of the rails need be used as a part of this circuit. So long as this closed circuit is maintained the alarm A is restrained from denoting danger; but whenever the circuit is broken or the current ceases flowing the alarm is no longer restrained, and it at once acts and the engineer is warned of danger, whereupon he will decrease his speed and proceed with great caution.

Fig. 1 shows the track provided with means for "block-signaling," in order that a train may receive warning in case it is following too close after a preceding train. The track is divided into sections or blocks, the dividing-points of which I have marked "Point A," "Point B," &c. At each of these points I place an insulated section of rail, I, between the ends of adjacent rails H and J of the track R. From the rail H a wire, 5, extends to a contact-point or screw, *a*, and from the rail I a wire, 6, leads to a contact lever or key, *b*. When *b* is in contact

with *a* the circuit I 6 *b a* 5 H is complete, with the exception of the break between rails H and I, and when the locomotive reaches the right-hand position in Fig. 1, with its brush B on the rail I and its wheel W on the rail H, the circuit from generator G passes through 3, C, 2, B, I, 6, *b*, *a*, 5, H, W, and 4, and is not broken; but if *b* is away from *a*, then such circuit is broken at *a b*, and when the locomotive reaches said position, (which I call the "signal-receiving position,") with its conductors W B straddling or bridging the break between H and I, then the circuit is broken, the magnet C releases the alarm A, and the danger-alarm is given to the engineer.

The lever *b* is acted on by two electro-magnets, D and S. D is the "danger-magnet," being the one which sets the apparatus to "danger"—that is, when it is charged it draws the lever *b* out of contact with the point *a*, so that the danger-alarm will be given to the engineer. S is the "safety-magnet," which, when excited, draws the lever *b* into contact with the point *a*, so that a passing locomotive shall receive no signal. A wire, 7, leads from rail I to magnet D, a wire, 8, leads thence back to the magnet S at the preceding point, and another wire, 9, leads thence forward again to the rail J at the starting-point, as clearly shown. An earth-circuit may be substituted for either 8 or 9.

When the locomotive has advanced shortly beyond the signal-receiving position it reaches the signal-transmitting position shown in dotted lines in Fig. 1, wherein the conductors B W straddle the break between rails J and I. In this position the circuit flows through 3, C, 2, B, J, 9, (back to preceding point,) S, 8, (forward again,) D, 7, I, W, and 4. In so doing it excites magnet D at, for instance, point C, thereby setting the signaling apparatus there to "danger," and it also excites magnet S at the preceding point—for instance, point B—thereby setting the signaling apparatus there to "safety." Thus the locomotive, in its passage, first assumes a position to receive a danger-signal, if there be one to receive, and it then assumes a position to set the signaling apparatus which it has just passed to "danger" and the one at the preceding point to "safety." If the following locomotive reaches the "receiving position" at the preceding point before the advance locomotive reaches the "transmitting position" at the next succeeding point, it receives the danger-alarm. Otherwise it receives no alarm.

In practice I alternate the signal-points—that is to say, I place point C′ between points C and D and point B′ between points C and B—and establish the electrical connection between points B′ and C′, that I have already described between points B and C. I have omitted this arrangement from Fig. 1 to avoid complicating the diagrams there, and because it forms no novel part of my present invention, this alternate arrangement being well known in block-signals.

Fig. 2 shows the arrangement employed on a single track to warn trains when they are approaching each other and prevent collisions. In this case the same signaling apparatus is used at the signal-points, and the same arrangement of rails, H I J, is employed, except that both are duplicated, each of the two track-rails (the upper and lower rails in Fig. 2) being thus provided. The locomotive-conductors W B are arranged to connect with only the right-hand rail, in whichever direction the locomotive is running, as shown by arrows 10 11. The circuit-connections are somewhat different, owing to the necessity for telegraphing to the signal-point ahead to set its signaling apparatus for the opposite rail to "danger," and then when that signal-point is reached to set said signaling apparatus to "safety."

I will assume that a train is traveling in the direction of arrow 10 in Fig. 2. When its conductors W B bridge lower rails H I at point B it is in position to receive the danger-alarm, which it will receive if another train be approaching it and has passed point C, but not otherwise. I will assume that no alarm is received. When conductors W B bridge lower rails I J at point B the current flows from locomotive through brush B, lower rail J, wire 12 to magnet S at the signaling apparatus for the upper (opposite) rail at point B, thereby setting that apparatus to "safety;" thence through wire 8 to magnet D at the signaling apparatus for the said upper rail at point C ahead, thereby setting that apparatus to "danger;" thence through wire 7, upper rail I, (at point C,) wire 9, (which may be an earth-circuit,) lower rail I at point B, and back to locomotive through wheel W. If, now, a train approaches point C in the direction of arrow 11, it will receive an alarm, and it will set the lower signaling apparatus at point B to "danger."

In practice two intermediate points, B′ and B″, are interposed between points B and C, the several points B′ C′ D′, &c., being in electrical connection with each other, and the several points B″ C″ D″, &c., being electrically connected. I have indicated the location of these points in Fig. 2; but for the sake of clearness I have omitted their electrical provisions, which are the same as those shown. Two locomotives approaching each other will thus both receive the alarm when they are at least as far apart as the length of two blocks or sections, so that each will have one section to stop in.

In practice I shall combine the electrical arrangements shown in Figs. 1 and 2, so that a train shall telegraph both forward for the opposite rail and backward for its own; but to avoid complexity in the diagrams I have omitted from Fig. 2 the provisions shown in Fig. 1.

Fig. 4 shows the signaling apparatus in its preferred form on a larger scale. The lever *b* bears the armature of magnet D. The armature of magnet S is borne by a catch-lever, *c*, whose hooked end *d* engages the end of lever

b, being drawn down by spring *e*. When magnet D is charged it draws lever *b* out of contact with screw *a* (thereby breaking the circuit 5 6) and under hook *d*, which drops and holds it back until magnet S is charged, when the hook is lifted, permitting spring *f* to draw lever *b* back against screw *a*. The simpler arrangement shown in Figs. 1 and 2 may be substituted for this, but will require some additional provision to retain the armature at either side after the magnetic attraction ceases.

The device shown in Fig. 4 is well known, and I make no claim to it except in connection with the arrangement of insulated rails and partial circuit essential to my invention.

Figs. 5 and 6 show an arrangement for giving an alarm in an approaching locomotive in case a switch is misplaced. The entire track and switch are shown in Fig. 5, where the switch is set to the main track M. At the signaling-point there is a break or insulation between the rails H I. The rail H connects by a wire, 5, to a contact-spring, *a*, at the switch. The vertical shaft *g* for shifting the switch has a radial projection, *b*, which, when the switch is set to the main track, is in contact with *a*, as shown in Fig. 5; but if the switch be shifted to either siding or branch track, it is turned around away from *a*, as shown in Fig. 6. In the former case the current from the locomotive flows through rail I, pitman 6, shaft *g*, projection *b*, spring *a*, wire 5, and rail H back to the locomotive. In the latter case there is a break at *a b*, and the alarm is given on the locomotive. If the train is to run into one of the side tracks, the engineer will expect an alarm. I also provide for signaling a train approaching the switch on one of the side tracks.

a' is another contact-spring, engaged to make contact with projection *b* when the switch is set to track N. A wire, 13, connects rail I of track N to shaft *g*, and another wire, 14, connects spring *a'* with track H at the signaling-point, which is not shown, but is the same as that shown on the main track. A train approaching on N receives the alarm in case the switch is not set to N.

Fig. 7 shows the alarm-circuit in connection with a draw-bridge. The arrangement is such that unless the draw is closed and bolted the alarm will be given. A lever, *b*, is arranged to be pressed against a contact-spring, *a*, by contact of the bolt *h* in the draw, when that bolt is thrust home to lock the draw. Lever *b* connects by wire 6 to rail I, and spring *a* connects by wire 5 to rail H. The locomotive receives the alarm when crossing the break or insulation between H and I, as already described in the other cases. I have shown this switch and draw-bridge arrangement for the purpose of illustrating the capabilities of my system, and not for the purpose of claiming them specifically in this application, as I contemplate making them the subjects of future applications for patents.

Fig. 3 shows the alarm apparatus on the locomotive. Whenever the mechanism is released a gong is struck once for each revolution of the driving-wheel. A connecting-bar, *i*, is linked to the valve-rod so as to reciprocate with it, and it connects to one arm of a lever, *j*, whose other arm connects with a sliding bar, *k*, which bears a shoulder, *l*. The armature *m* of the magnet C is mounted on a lever, *n*, which bears the hammer-arm *o*, and is drawn by a spring, *p*, against a stop, *q*, whenever the armature is released by the cessation of the current through the magnet C. A snap-dog or click, *r*, is jointed to the lever *n* and kept pressed to place by a spring, *s*. The shoulder *l*, in moving from the position shown in full lines to that shown in dotted lines, presses back this dog, which at once returns to its normal position. Then when it is making its return movement (to the right) it catches against the dog and moves the entire lever *n* with it, thereby distending spring *p* and bringing armature *m* toward magnet C; but before the armature gets so close to the magnet that the attraction of the latter exceeds the tension of the spring the shoulder *l* slips from under dog *r*, whereupon spring *p* draws lever *n* back, causing hammer *o* to strike gong *t* a blow. The bar *k* is constantly reciprocating while the locomotive is running, its speed depending on the speed of the engine, so that it causes the alarm to ring more violently the faster the train is running. The alarm, when once released, will ring until it is set back by the engineer, which he does by pulling down a rod, *u*, until the armature *m* is brought up close to the magnet C again, when it will be attracted and held there if the circuit be closed again; but if the circuit be still broken it will not be upheld and the alarm will continue to sound. As the cessation in the locomotive-circuit is only instantaneous while the conductors B W are passing over the break between rails H I, the engineer, if he cannot set back the alarm, will know that the circuit on the locomotive is faulty, or that the generator G is not in operation. In case any track-circuit is faulty the alarm will invariably be given in passing the signal-point connected with that circuit, so that from repeatedly receiving the danger-alarm at that point when there is no danger the engineer can readily ascertain that the defect exists, when he can report it to the proper officer.

Instead of forming the shoulder *l* on the bar *k*, that bar may be omitted, and the end of the lever *j* may serve as the said shoulder, the position of the lever being changed, as shown in Fig. 8. The lever *j* may receive its motion from any other constantly-moving part of the locomotive instead of from the valve-rod.

Instead of providing a constantly-sounding alarm, the means for constantly ringing may be omitted and some visual danger-signal may be provided, to be brought into view when the armature *m* is released, as indicated by dotted lines at P in Fig. 3. In this case the gong will

ring only once—as the semaphore comes into view.

A lever, *v*, is arranged adjacent to the magnet C, and bears a marking-point, *v'*, which may be a pencil or pen or a mere sharp point, as shown. A spring forces the point forward, except when the armature *m* is adhering to the magnet, at which time the end of the armature-lever *n* deflects the lever *v* and draws back the point *v'*. A strip, *w*, of paper or other material, graduated or divided into hours or other periods of time, is passed slowly across the point *v'*, which, when drawn back, does not quite touch it, but which, when forward, as shown, punctures or indents it. The strip is drawn slowly from a reel, *w'*, by the revolution of rollers or griping-wheels *x x*, which receive their motion from a clock-work contained in the box *y*, seen behind the other parts. Whenever the alarm is released and operates the point *v'* marks the strip *w*, which thus records the time at which the alarm was given. In case of accident this record will show whether the engineer disregarded a warning of danger or not. It will also show how prompt he has been in setting back the apparatus after an alarm.

I am aware that danger-alarms on locomotives are not new, and that they have been operated by a battery carried by the locomotive, as well as by batteries arranged along the track; but in all cases the circuit has been normally broken, and the alarm has been released by its momentary closure, in case of danger, by the contact of conductors on the locomotive with fixed conductors along the track. The arrangement and construction of such contacting conductors have been found difficult and expensive, and in case of any defect in the circuits along the line the danger-signal has not been given, thereby depriving the system of that entire reliability which any signaling system should possess. My present invention retains all the well-known advantages of this system of alarms, and also secures the further advantages of greater cheapness and absolute reliability. The cost of the insulation of occasional rails and of the circuit-connections therewith which I employ is insignificant in comparison with that of the elaborate track devices heretofore used. In case of any probable defect in the connections the engineer is sure to receive warning, and so is put on his guard.

I claim as my invention—

1. A locomotive provided with a partial electric circuit, including a generator and the electro-magnet controlling an alarm, and terminating in two conductors arranged in electrical contact with the rail, whereby the circuit is normally completed between said conductors through the rail, substantially as set forth.

2. A locomotive provided with an electro-magnetically-controlled alarm adapted to operate and signify "danger" to the engineer whenever the circuit which includes its electro-magnet is broken, an electric generator designed to maintain a constant electric current, two conductors, arranged one in advance of the other and both in electrical contact with one rail, and circuit-connections from one conductor to the generator, thence to the electro-magnet of the alarm, and thence to the other conductor, whereby the circuit will be completed through the rail between the two conductors, except when the latter are passing over a break or insulation between two adjoining rails, substantially as set forth.

3. A railway-track having rails H and I, insulated from each other, electrical conductors adapted to form an electrical connection between them, and means of breaking and closing said connection, in combination with a locomotive carrying an electric generator and an alarm, both included in an incomplete circuit which terminates in two conductors, arranged one in advance of the other and both in contact with one rail, substantially as set forth.

4. The combination of rails H and I, insulated from each other, partial circuit 5 6, connecting them, circuit-breaking device *a b*, interposed in said circuit, and means for operating the said device to break the said circuit in case a danger-alarm is to be given to the engineer of a passing train, in combination with a locomotive provided with a partial electric circuit, including a generator and an electro-magnetic alarm, and terminating in two conductors, arranged one in advance of the other, in electrical contact with the rail, substantially as set forth.

5. A railway-track having rails H and I, insulated from each other, a partial circuit connecting them, a circuit-breaking device included in said circuit and operated by the armature of an electro-magnet, D, and the said magnet D, included in a partial circuit connecting rails I and J, insulated from each other, in combination with a locomotive provided with a partial circuit including a generator and electro-magnetic alarm, and terminating in two conductors, arranged one in advance of the other, and both in electrical contact with the rail, substantially as set forth.

6. A railway-track having rails H and I, insulated from each other, a partial circuit connecting them, and including a circuit-breaking device which is operated to close the circuit by the attraction of the armature of an electro-magnet, S, and said electro-magnet S included in a partial circuit connecting rails I and J, which are insulated from each other, substantially as set forth.

7. A railway-track provided at a signaling-point with rails H and I, insulated from each other, a partial circuit connecting said rails, and including a circuit-breaking device which is arranged to be operated to break said circuit by the charging of an electro-magnet, D, and to close it by the charging of an electro-magnet, S, said magnet D included in a partial circuit connecting two rails, I and J, which

are insulated from each other, and said magnet S included in another partial circuit connecting two other rails, I and J, which are also insulated from each other, substantially as set forth.

8. In a block signaling system for railways, a railway-track provided with rails H, I, and J at each of the dividing-points between the several blocks or sections, said rails being insulated from each other, a partial circuit connecting rails H and I, and including a circuit-breaking device controlled by oppositely-acting electro-magnets D and S, and another partial circuit connecting the rails I and J at each point, and including the magnet D at that point and the magnet S at a remote point, or vice versa, substantially as set forth.

9. The combination of rails H and I, insulated from each other, partial circuit 5 6, connecting them, a contact-point and contact lever or key tending to make contact therewith, and both interposed in said partial circuit, an electro-magnet adapted to draw said key back out of contact with said point, a catch adapted to keep it back, and an electro-magnet adapted to release said catch, substantially as and for the purposes set forth.

10. The combination, on a locomotive, of a partial electric circuit terminating in rail-conductors B W, and including generator G and electro-magnet C, with an alarm consisting of said magnet C, lever *n*, bearing armature *m* and hammer-arm *o*, gong *t*, retracting-spring *p*, tending to draw armature from magnet and hammer toward gong, and resetting-rod *u*, substantially as set forth.

11. The combination, on a locomotive, of a partial electric circuit terminating in rail-conductors B W, and including generator G and electro-magnet C, with an alarm consisting of said magnet C, lever *n*, bearing armature *m* and hammer-arm *o*, gong *t*, spring *p*, reciprocating shoulder or hook *l*, adapted to engage said lever *n* when moving in one direction, and thereby to draw the hammer away from the gong and to release the same, and thereby permit the hammer to fly back and strike the gong, and upon its return-stroke to re-engage said lever *n*, with mechanism interposed between said shoulder *l* and some moving part of the locomotive, whereby the shoulder is caused to reciprocate with a speed proportioned to the speed of the locomotive, substantially as set forth.

12. The combination, on a locomotive, of a partial electric circuit terminating in rail-conductors B W, and including generator G and electro-magnet C, with an alarm consisting of said magnet C, its armature *m*, normally attracted thereto, armature-lever *n*, bearing hammer and its arm *o*, gong *t*, and spring *p*, tending to draw armature from magnet and hammer toward gong, and with a recording device consisting of a lever, *v*, bearing marking-point *v'*, and tending to press said point against a graduated strip, *w*, feeding-rollers *x x*, adapted to move said strip past said point, and a suitable clock-work to rotate said rollers, arranged substantially as set forth, whereby, when the armature is adjacent to the magnet, the point *v'* is retracted from said strip, and when the armature is drawn away from the magnet the said point marks said strip.

In witness whereof I have hereunto signed my name in the presence of two subscribing witnesses.

THEODORE A. B. PUTNAM.

Witnesses:

ARTHUR C. FRASER,

HENRY CONNETT.