No. 843,550. PATENTED FEB. 5, 1907.

F. W. PRENTICE.

ELECTRIC SIGNALING SYSTEM.

APPLICATION FILED MAR. 24, 1906.

4 SHEETS—SHEET 1.

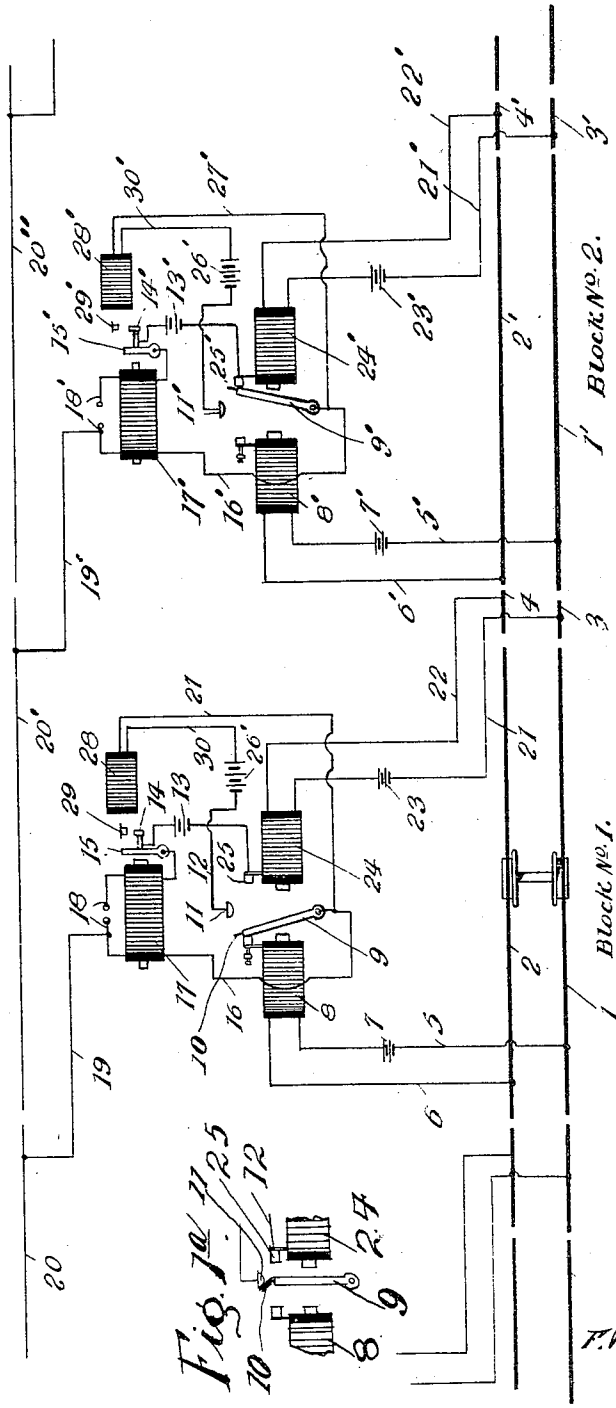

Fig. 1.

Fig. 1a.

Witnesses

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4 SHEETS—SHEET 2.

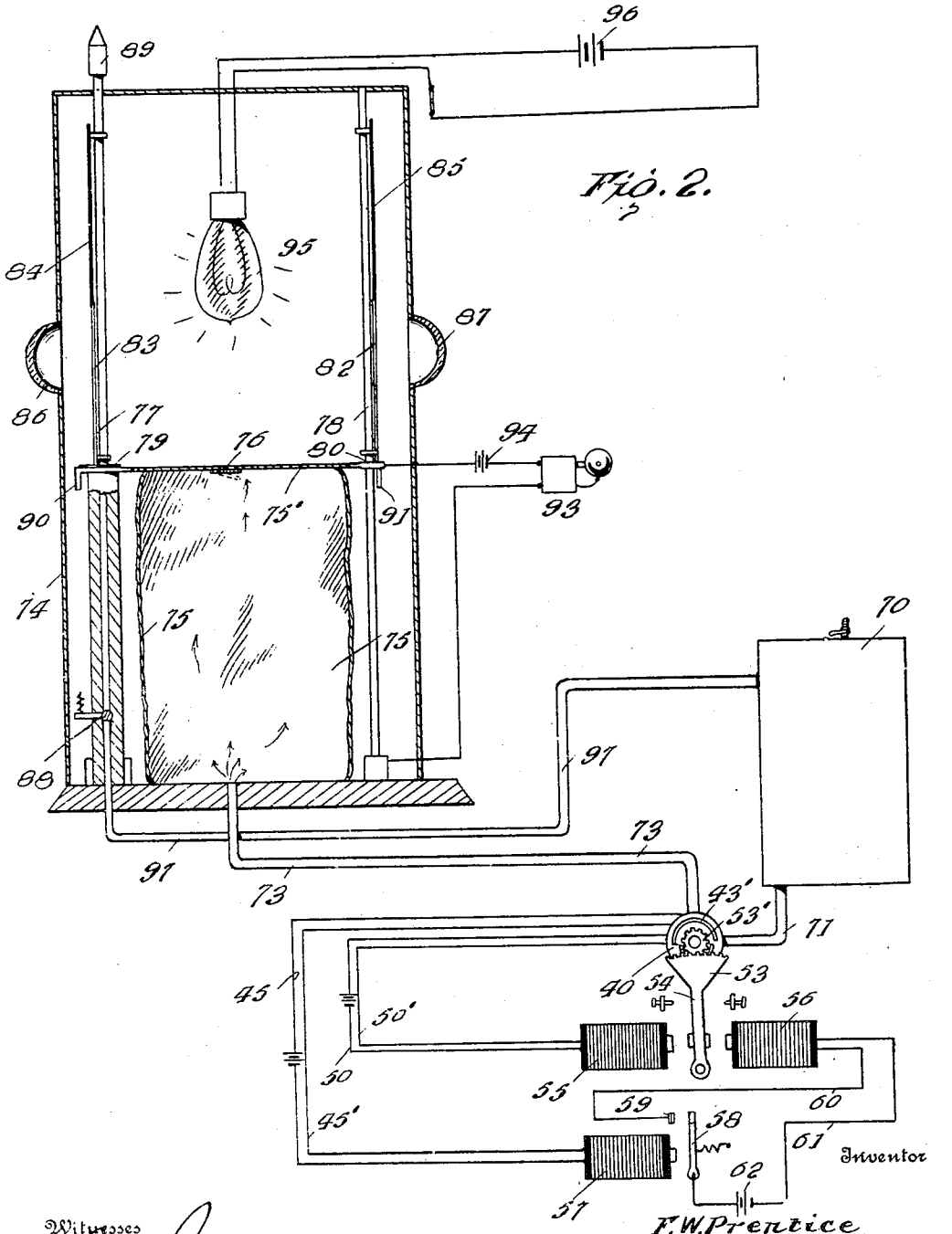

FIG. 2.

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4 SHEETS—SHEET 3.

Fig. 3.

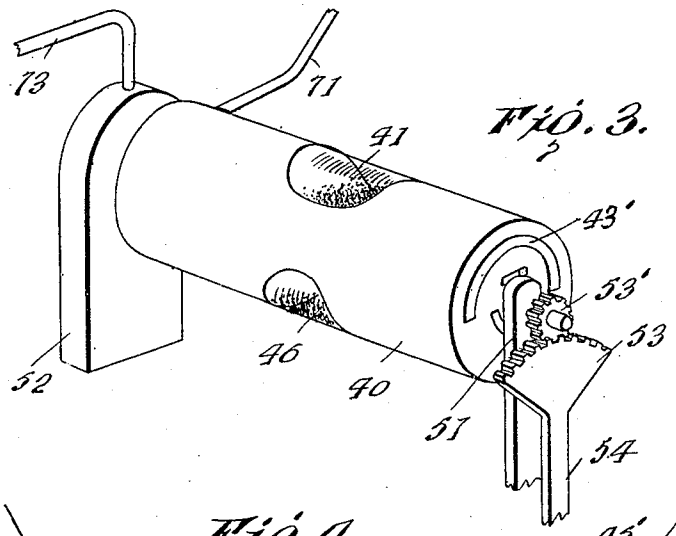


Fig. 4.

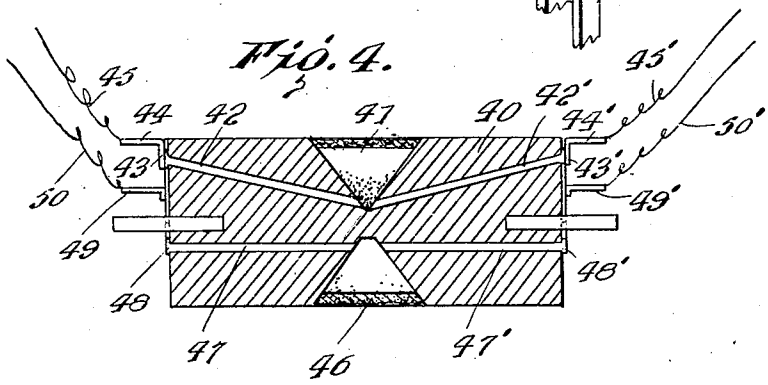


Fig. 5.

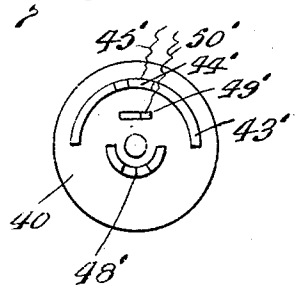
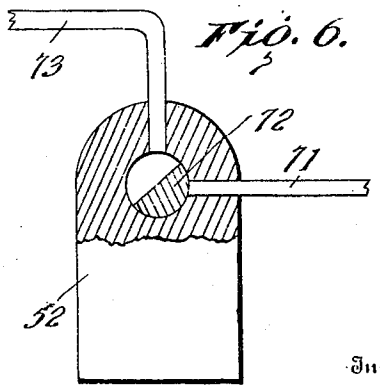


Fig. 6.



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4 SHEETS—SHEET 4.

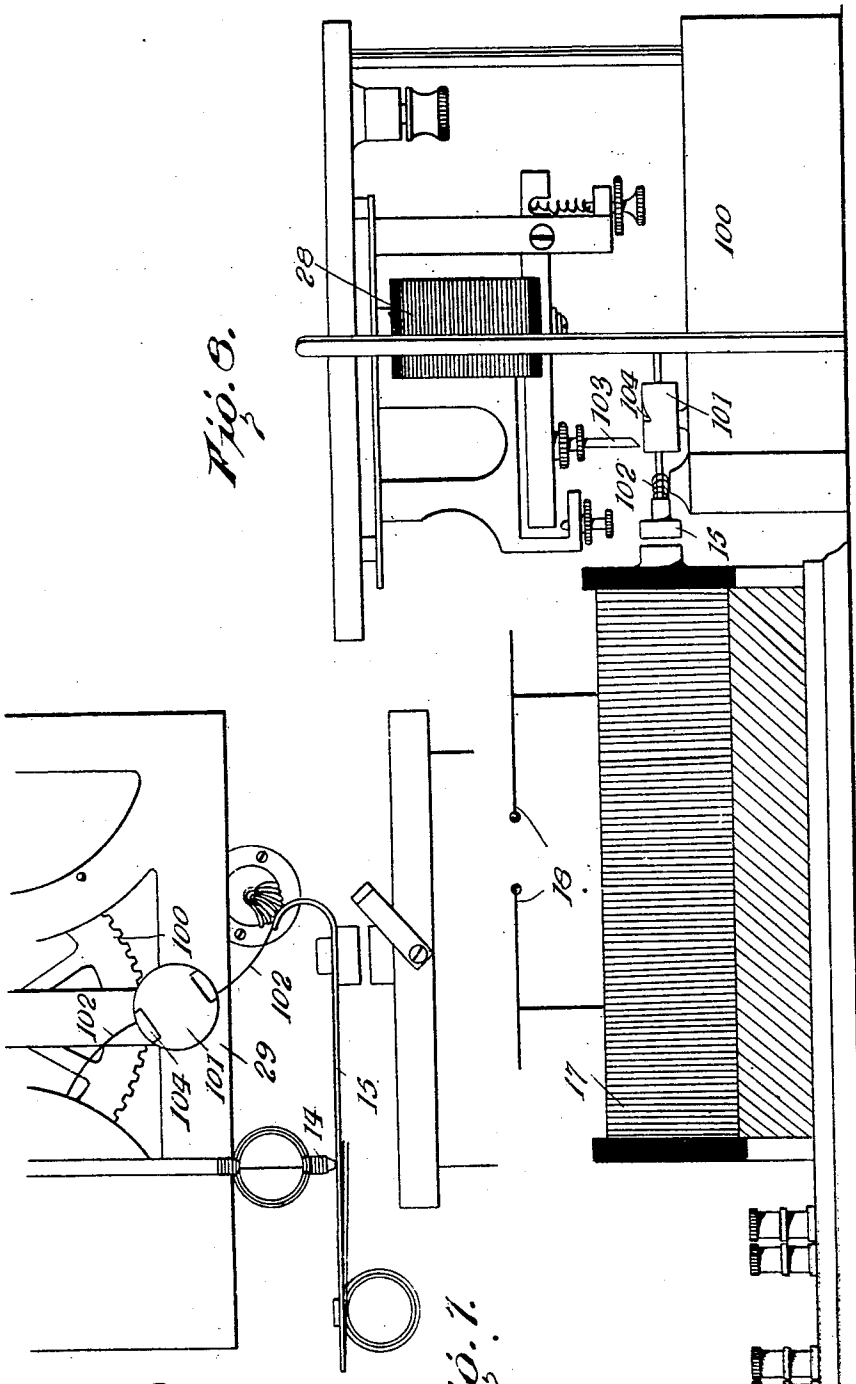

Fig. 6.

Fig. 7.

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UNITED STATES PATENT OFFICE.

FRANK W. PRENTICE, OF CHICAGO, ILLINOIS.

ELECTRIC SIGNALING SYSTEM.

No. 843,550. Specification of Letters Patent. Patented Feb. 5, 1907.

Application filed March 24, 1906. Serial No. 307,852.

To all whom it may concern:

Be it known that I, FRANK W. PRENTICE, a citizen of the United States of America, and a resident of the city of Chicago, county of Cook, and State of Illinois, have invented certain new and useful Improvements in Electric Signaling Systems, of which the following is a specification.

My invention relates to electric signaling systems for railways, and more particularly cab and block-signal systems employing so-called "Hertzian" waves or like electrical oscillations for controlling signal devices upon a car or engine to indicate the condition of the right of way with respect to the presence or absence of other vehicles or with regard to any of the usual conditions of danger or safety of the track within prescribed limits.

To this end the invention comprises a generator or transmitter of electrical oscillations for each block or section of the road, which is normally operative when conditions of safety maintain in the block or section to be guarded and is rendered inoperative or inert when conditions of danger exist, and receivers on the cars or engines influenced by the oscillations and adapted to control signal devices which indicate whether the section is "safe" or "blocked."

Generically, the invention comprises a cab and block system in which "safety" is indicated in a given block by the generation of oscillations in the transmitter controlling such block and in the car or cab by signal devices controlled by a receiver influenced by such oscillations, and "danger" is indicated by the absence of such oscillations and a consequent non-action of the receiver in the car or cab.

In the accompanying drawings, Figure 1 is a diagrammatic representation of a sectional rail cab and block signal system embodying the invention upon the east-bound track of a double-track railroad. Fig. 1ª is an enlarged fragmentary detail of the track-relays and the contacts controlled thereby. Fig. 2 is a diagram of the apparatus on each car or cab or other vehicle. Fig. 3 is a fragmentary perspective view of a coherer or wave-responsive device and appurtenant apparatus. Fig. 4 is a longitudinal section thereof. Fig. 5 is an end view of the same. Fig. 6 is a detail of the compressed-air valve controlled by the coherer. Fig. 7 is a fragmentary plan view of the mechanism for starting the emitter or generator of electrical oscillations. Fig. 8 is a side elevation of the emitter and the mechanism for starting the same.

Referring to Fig. 1 of the drawings, 1 2 and 1′ 2′ indicate the rails of two adjacent blocks or sections into which the track is divided, said sections being designated "Block No. 1" and "Block No. 2." respectively. It will be understood, of course, that the west-bound track is similarly equipped, as shown above, the apparatus being in reverse position to that shown in Fig. 1. In using a single track or line of road for moving trains in both directions on the one track or line of road each side of the track is equipped with apparatus, as shown in Fig. 1, one on one side for west-bound and on the other side for east-bound trains, cars, cabs, or vehicles. The entire track or road is similarly divided into blocks or sections of any desired or prescribed length, each block defining the limits within which but one train, car, cab, or vehicle is allowed at one and the same time under proper conditions of operation, as will be understood by those skilled in the art.

Bridging the rails 1 and 2 of block No. 1 is a magnet 8, connected to the respective rails by wires 5 and 6 and including a battery 7. Said magnet 8 controls a pivoted armature 9, which normally engages a contact 25, forming one terminal of the circuit of an emitter or generator of Hertzian waves or electrical oscillations 11, which circuit includes a conductor 12, battery 13, back contact 14, and armature 15 of induction-coil 17, and wire 16, which leads from the other terminal of said induction-coil 17 to armature 9.

When block No. 1 is not occupied by a car or train, armature 9 is attracted from magnet 8, closing the circuit through the induction-coil or transmitter 17 and sending a series of electrical oscillations generated at the spark-gap or terminals 18 of the secondary by way of conductor 19 to an overhead wire or conductor 20, paralleling and coextensive with the track section or block in rear of block No. 1. As long as block No. 1 is unoccupied these oscillations are generated and conducted along the wire 20, which serves the same purpose as the ordinary aerial to indicate upon any train or car entering the rear section by apparatus to be hereinafter described that a condition of safety maintains in block No. 1. When a train or car occupies block No. 1, the wheels of said train

bridging rails 1 2 close the circuit of battery 7, which energizes magnet 8, which attracts armature 9, thereby opening the circuit of the induction-coil 17 at C and 25 and stops the generation and propagation of electrical oscillations by said induction-coil along conductor 20, so that a train entering or occupying the section in rear of block No. 1 receives no oscillations and the operator is apprised of a condition of danger existing in block No. 1.

Block No. 2 is provided with a like installation of electrical apparatus, by means of which electrical oscillations are generated and propagated along a conductor 20, paralleling block No. 1, as long as said block No. 2 is unoccupied, and the said oscillations are discontinued when block No. 2 is occupied to indicate upon a car or train in block No. 1 that the former block is at "danger." Similarly each other block or section is equipped to send oscillations along a wire paralleling the next block in rear to indicate "safety" and to suppress said oscillations to indicate "danger."

It is to be particularly noted that the arrangement of the track and the generators or emitters of electrical oscillations controlled thereby, so that the existence of oscillations shall indicate "safety," and the absence of such oscillations shall indicate "danger," through the agency of any suitable receiver or responsive apparatus upon a car or train constitutes a complete and effective signaling system.

It is also to be observed that the combination of a track divided into blocks or sections with an emitter or generator of electrical oscillations in each section and receivers or responsive devices on the trains or cars operating on the track is generically within the purview of my invention, provided the presence of oscillations in a given section shall indicate "safety" and the absence thereof shall indicate "dangers," even though the control of the oscillations be effected by means other than track or rail circuits—as, for example, when an emitter or generator for a given block or section is controlled by the relative position of a semaphore, a switch-operating mechanism, a draw-bridge, or any other apparatus or appurtenance of a railroad to generate oscillations when the way is safe and to suppress such oscillations when it is dangerous for an oncoming car or train to proceed beyond the next advance section.

To extend and increase the efficiency of the system, as hereinbefore described, and to insure a rapid, certain, and positive operation under all conditions, I provide auxiliary means for starting the emitter when the danger condition has terminated. Referring to block No. 1 of Fig. 1 and to Figs. 7 and 8 will disclose this operation. The induction-coil 17 is of course provided with the usual form of make-and-break mechanism, comprising the armature 15 and back-stop 14, the armature resting against the back-stops when the induction-coil is inactive and vibrating rapidly between the pole-piece of the induction-coil and back-stops when the coil is operating. It has been found that, owing to the inertia of the parts or from other causes, the armature 15 sometimes fails to be drawn away from the contact 14 when the circuit of the coil 17 is completed, with the result that no effective secondary current is induced in the coil and no oscillations set up at the terminals 18. In order to insure a positive action of the armature in starting the induction-coil, the armature is strucka blow to move it away from the contact 14 at the moment the circuit of the induction-coil is completed. This is effected by means of two brushes or wipers 102, Figs. 7 and 8, mounted upon a rotary disk 101, which is driven by a train of clockwork 100, said brushes being so arranged that they strike the curved end of the spring-arm of the armature 15 and force said armature toward the pole-piece of coil 17 every time the clockwork is actuated. The clockwork 100 is normally held inactive by means of a pawl or detent 103, adapted to engage one of two ratchet-like notches or depressions 104 in the top disk 101, and said pawl is controlled by the armature of an electromagnet 28, which when energized attracts its armature and disengages pawl 103 from disk 101 and allows the clockwork to start. When the magnet 28 is deënergized, the armature falls away and pawl 103 engages the next notch 104 that passes under it and stops the clockwork.

Magnet 28 may be energized by any suitable arrangement of circuit that is adapted to be completed when the condition of danger in a given block or section is terminated.

In the form of the invention illustrated the magnet 28 is energized when the car or train leaves the guarded block by means of a circuit 21 22, leading from a battery 23, and a magnet 24, placed in opposition to magnet 8 and connected, respectively, to two short insulated rail-sections 3 and 4 at the end of the block, so that when the last wheels of a car or train leave rails 1 2 of block No. 1 and pass over rail-sections 3 and 4 magnet 24 is momentarily energized, and as magnet 8 is then deënergized said magnet 24 attracts the armature 9, which has on its free end a spring-contact 10, and armature 9 in moving toward magnet 24 makes a momentary contact with disk 11, thereby closing momentarily a circuit through magnet 28, which is traced as follows: battery 26, wire 30, magnet 28, wire 27, disk 11, spring-contact 10 on armature 9, back to battery 26.

The circuit of magnet 28 is closed only

momentarily, or sufficiently long to permit the disk 101 to make half a revolution and one of the spring wiper-arms 102 carried thereby to strike armature 15 of induction-coil 17 and start the same vibrating.

Armature 9 comes in contact with 25, thereby closes the circuit of the induction-coil 17, and as the armature of the latter is immediately thereafter started to vibrate by the wiper 102, as described, the operation of the induction-coil at the proper time is positively assured, and the electric oscillations, which indicate a clear block, are sent along the wire 20 as long as block No. 1 is unoccupied. It will be understood that a similar arrangement of apparatus is provided for each of the other blocks or sections to insure the proper positive starting of the respective induction-coils or transmitter of oscillation.

As hereinbefore referred to, each car or engine is provided with a suitable receiver or responsive device which operates under the influence of the Hertzian waves or oscillations to effect a predetermined signal or indication on the car or engine. Such receiver and signal may be of any of the usual coordinations of Hertzian-wave-receiving devices—such, for example, as an ordinary coherer and signal-circuit controlled thereby—which operates to close a local circuit to actuate the signal when a Hertzian wave traverses or effects the coherer and to open the circuit and discontinue the signal when the Hertzian waves or oscillations cease or are interrupted, it being understood that the continuance of the signal or indication due to the transmission of the local circuit through the coherer, which the latter is rendered operative by the Hertzian waves, signifies a condition of "safety" as to the guarded block or section, and the discontinuance of the signal by the interruption of the current at the coherer indicates a condition of "danger."

In the present embodiment of this principle I provide in each cab, car, vehicle, or train a signal apparatus comprising the following instrumentalities: A coherer 40 which consists of a generally cylindrical body having in two diametrially opposite faces recesses 41 and 46, each covered by a suitable cap or cover of glass or similar material. In 41 is placed suitable metal filings or other material that is responsive to ethereal waves, which cause the filings to cohere and transmit an ordinary voltaic current, but which when subjected to a slight jar or alteration in their relative positions interpose such high a resistance as to fail to transmit such voltaic current. Traversing the cylinder 40 and having their inner terminals embedded in the filings in recess 41 are two conductors 42 and 42′, which are connected with contacts 43 and 43′ on the ends of the cylinder, said contacts 43 and 43′ being adapted when recess 41 is uppermost to be engaged by brushes 44 and 44′, respectively, which are connected by wires 45 and 45′ with a relay 57. Recess 46 is partially filled with some material that is normally conductive of voltaic currents such as mercury or the like, and two conductors 47 47′, lead from the lower part thereof to two contacts 48 and 48′, respectively, on the ends of the cylinder 40, which when recess 46 is uppermost are engaged by brushes 44 44′, respectively, which connect, by wires 50 and 50′, a magnet 55 through a suitable battery to engage said magnet. Relay 57 controls, through its armature 58 and front stop 59, the circuit of a magnet 56, placed in opposition to magnet 55, said circuit comprising leads 60 and 61 and a battery 62. Between magnets 55 and 56 is an armature 54, which normally tends to occupy a mid-position with respect to said magnets. On the end of said armature 54 is secured a segmental gear 53, which engages a pinion 53′ on the shaft of cylinder 40, so that as said armature is attracted to one or the other of said magnets 55 and 56 the coherer-cylinder 40 is rocked through one hundred and eighty degrees, thereby bringing recess 41 or 46 therein uppermost.

In the recess bearing post 52 of the coherer the shaft of cylinder 40 is cut away so as to form with the cylindrical hole forming the shaft-bearing a valved passage 72 and connected therewith by two passages, as shown in Fig. 6, and two pipes 71 and 73, leading from a compressed-air tank 70 and to bellows 75 of a signal-controlling device, respectively. For both extreme positions of the cylinder 40 the passage-way 72 is closed by the shaft; but as the cylinder is rotated in one direction or the other connection is established during practically three-fourths of the movement between tank 70 and bellows 75, admitting air to the latter and causing it to expand.

The signal-controlling device consists of a casing 74, to the base of which is secured the generally cylindrical expansible bellows 75, having in its top an inwardly-opening valve 75′, which closes when air-pressure is admitted and permits the air to escape slowly. Secured to the top of bellows 75 is a frame 76, having at its ends rings or collars 79 80, which loosely engage vertical guides 77 and 78 and also serve to raise and lower two frames 82 and 83, guided on the rods 77 78 and carrying in their upper portions red glasses 84 and 85, moved by the contraction and expansion of the bellows 75 into and out of registry with two lenses 86 and 87 in casing 74, so as to cause a light 95 in the casing to show either red or white through said lenses. Guide 77 is preferably formed of a hollow tube, connected by a pipe 97 with air-tank 70 and having at its outer end a whistle or similar alarm 89. In the lower part of said tubular member 77 is a spring-closed stop-cock 88, having a lateral arm adapted

to be engaged by a detent 90 on ring 79 to open the valve and sound the whistle when the bellows collapses. Upon ring 80 is a contact 91, which engages a fixed contact 92 at the base of rod 78 when the bellows collapses to close the circuit of a battery 94 and ring a bell 93.

The cab signaling device as thus described operates as follows: When the car or engine occupies a block—as, for instance, block No. 1—and the adjacent block No. 2 is unoccupied, the Hertzian waves transmitted along wire 20′ and radiating from said wire through the air pass through and energize the coherer 40, closing the circuit of relay 57, which closes the circuit of magnet 56, causing the armature 54 to move to the right and rotating the coherer 40 through one hundred and eighty degrees, thereby disturbing the filings in 41, breaking the circuit of relay 57, and deënergizing magnet 56. Recess 46 is thereby brought uppermost, and the circuit of magnet 55 is momentarily closed, attracting armature 54 and returning the coherer 40 to its original position. As the coherer-cylinder rotates passage-way 72 is opened and air is admitted from tank 70 to bellows 75. As the coherer is rapidly rotated or oscillated to and fro by the recurrent action of magnets 55 and 56 as the material in 41 is successively cohered and decohered air-pressure quickly accumulates in bellows 75, and the latter is inflated, causing the red or danger glasses to be moved out of registry with lenses 86 and 87 and showing a white or safety light. This condition will maintain as long as block No. 2 is clear, and the Hertzian waves are sent out by induction-coil 17′. Should the operation of induction-coil 17′ be suspended by the presence of a car or train in block No. 2 and no waves be sent along wire 20′, the coherer 40 would cease to operate, but would assume the position indicated in Fig. 3, and air-pressure from tank 70 would be shut off from bellows 75. The air in the latter would escape through valve 75′ and the bellows would deflate, causing the red glasses 86 and 87 to cover lenses 86 and 87, showing a red or danger signal. When the bellows are nearly deflated, valve 88 will be opened by detent 90, admitting air to whistle 89, causing the latter to sound a danger-signal, and contact 91, engaging contact 92, will close the circuit of bell 93, giving an additional audible danger-signal to warn the operator to stop his car or train until the succeeding block is cleared, to be evidenced by the coherer again taking up its operation, due to the restored oscillation, and setting the visual signal at "safety" and discontinuing the operation of the whistle and bell.

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

1. In a railway block-signaling system, a generator of electrical oscillations for each block normally operating to indicate a condition of safety and means operating under conditions of danger in any block to suspend the operation of the generator transmitting oscillations to the next adjacent block.

2. In a railway block-signaling system, a series of blocks or sections, a generator of electrical oscillations for each block normally operating to indicate a condition of safety in its block to the adjacent block and means controlled by the presence of a car or train in any block to suspend the operation of the generator, thereby indicating danger in next adjacent block.

3. In a railway signaling system, a generator of Hertzian waves controlled by conditions of safety to propagate such oscillations and by conditions of danger to suspend the propagation thereof, and means at the place of warning to indicate the presence or absence of such oscillations.

4. In a railway signaling system, a generator of electrical oscillations, a track-circuit controlling said generator to propagate such oscillations during the continuance of safety conditions within the area guarded by said track-circuit and to suspend said oscillations during the presence of conditions of danger within said area, and means at the place of warning to indicate the presence or absence of such oscillations.

5. In a railway signaling system, a generator of electrical oscillations, a track-circuit controlling said generator to propagate such oscillations during the continuance of safety conditions within the area guarded by said track-circuit and to suspend said oscillations during the presence of conditions of danger within said area and means on a car or train approaching the track-circuit to indicate the presence or absence of such oscillations.

6. In a railway cab and block signaling system, a series of blocks, generators of Hertzian waves for the respective blocks normally operative to propagate oscillations along an adjacent block when the respective blocks are safe track-circuits controlling the respective generators and operative to stop said generators when the corresponding blocks are at danger and means on a car or train to indicate the presence or absence of oscillations from the generator of the block being approached.

7. In a railway cab and block signaling system, a series of blocks generators of Hertzian waves for the respective blocks normally operative to propagate oscillations along an adjacent block when the respective blocks are safe, track-circuits controlling the respective generators and operative to stop said generators when the corresponding blocks are at danger, a rotary coherer on a car or train capable of responding to the

oscillations, an electromagnet controlled by said coherer for rotating and deënergizing the latter, a pneumatic system controlled by the movement of the coherer, and signals controlled by said pneumatic system.

8. In a railway cab and block-signaling system, a generator of Hertzian waves for each block, a wire for conducting the same, parallel with the block adjacent thereto, a track-circuit for each block operative to stop the generator when a car is in the corresponding block and a coherer-controlled signal on each car for indicating the condition of the generator in the adjacent block.

9. In a railway cab and block signaling system, a generator of Hertzian waves for each block, a wire for conducting the same parallel with the block adjacent thereto, a track-circuit for each block operative to stop the generator when a car is in the corresponding block, a track-circuit for each block to start the generator when a car leaves the same, and a coherer-controlled signal on each car for indicating the condition of the generator in the adjacent block.

Signed by me at Chicago, county of Cook, State of Illinois, this 14th day of December, 1905.

FRANK W. PRENTICE.

Witnesses:

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