E. R. BRODTON.

WIRELESS RAILWAY SIGNAL SYSTEM.

APPLICATION FILED JUNE 29, 1908.

936,405. Patented Oct. 12, 1909.

3 SHEETS—SHEET 1.

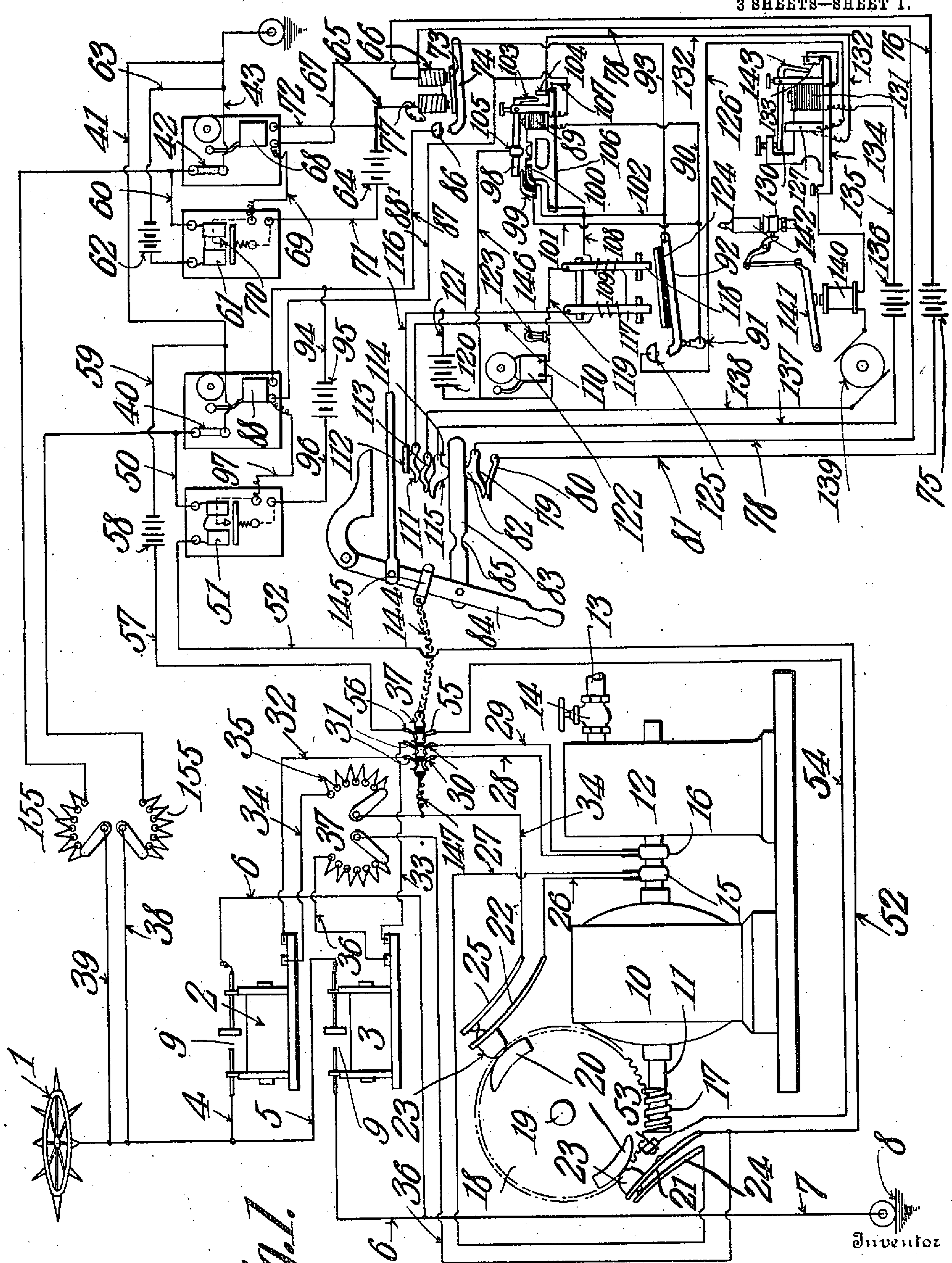

Fig. 1.

Witnesses

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Fig. 2.

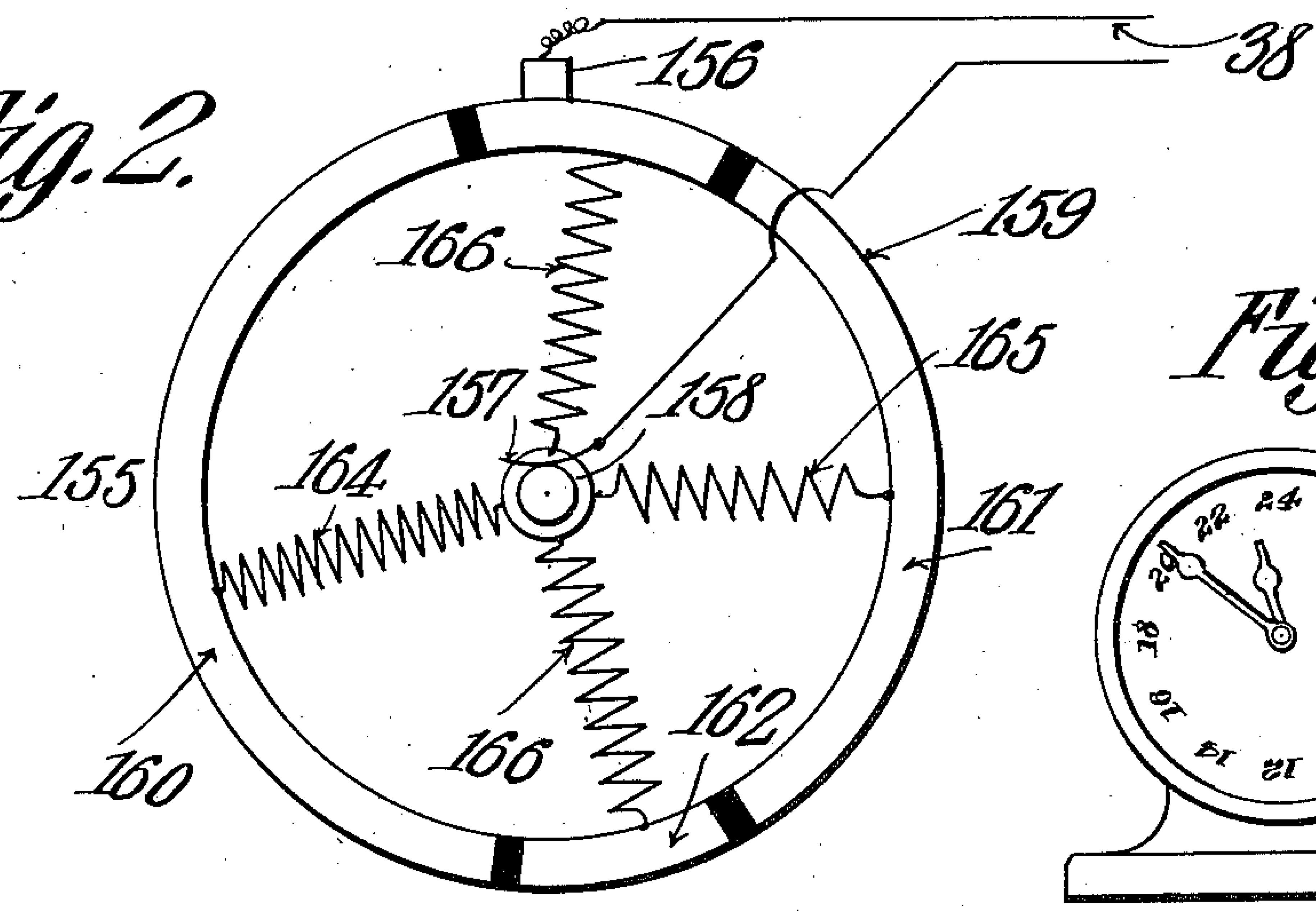


Fig. 3.

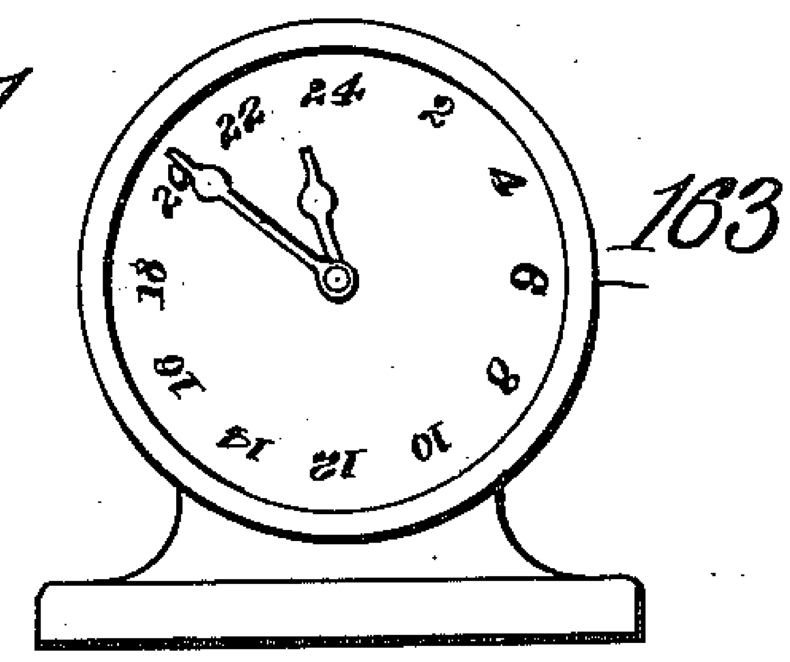


Fig. 4.

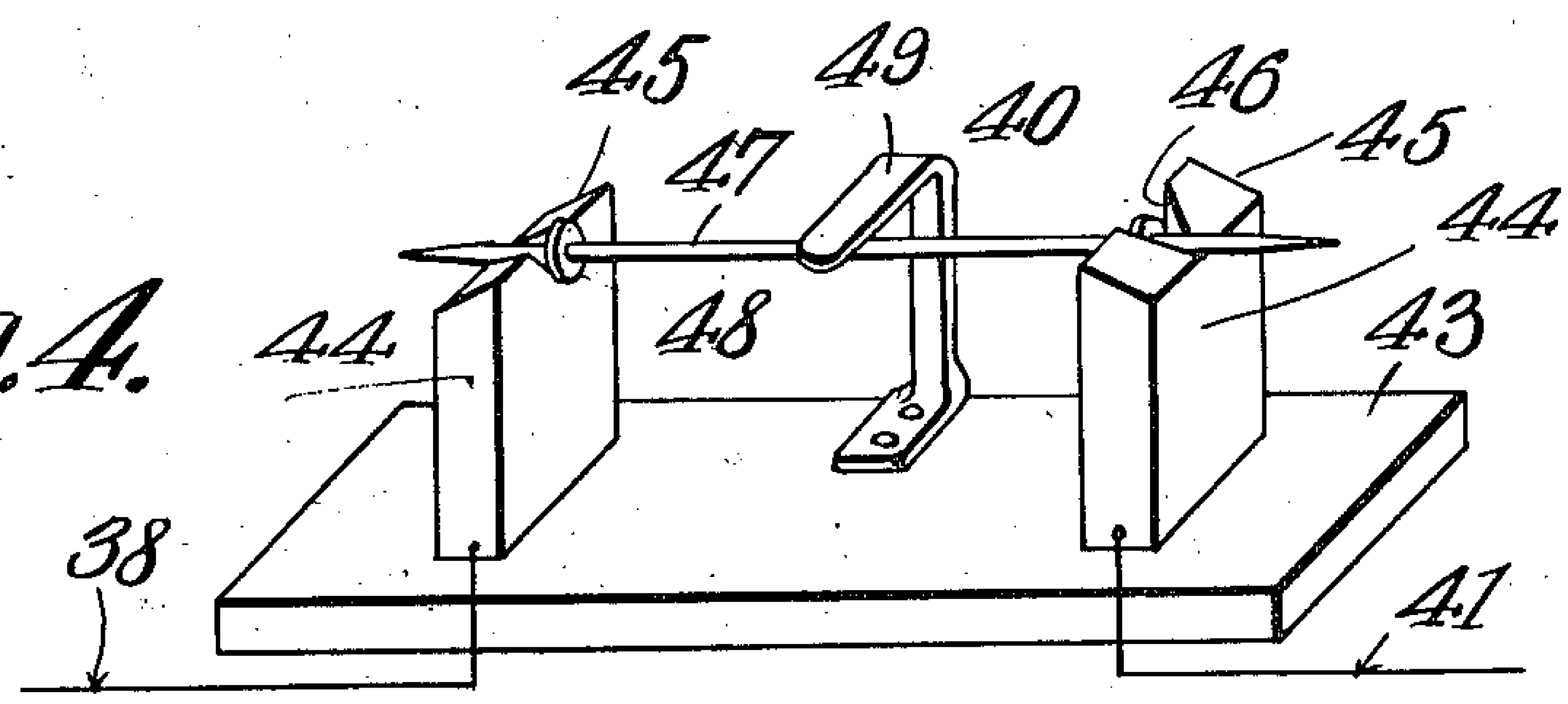
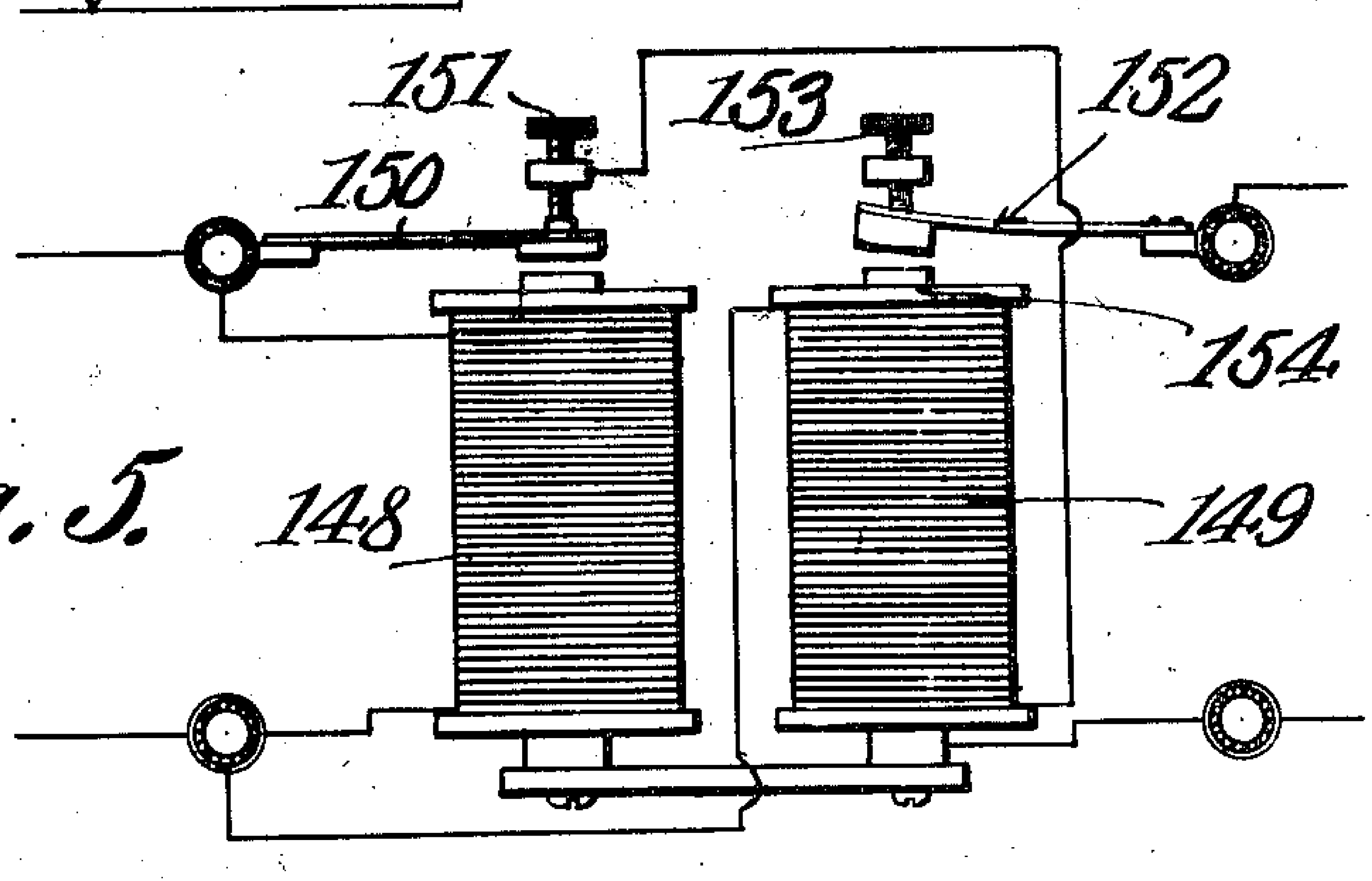


Fig. 5.



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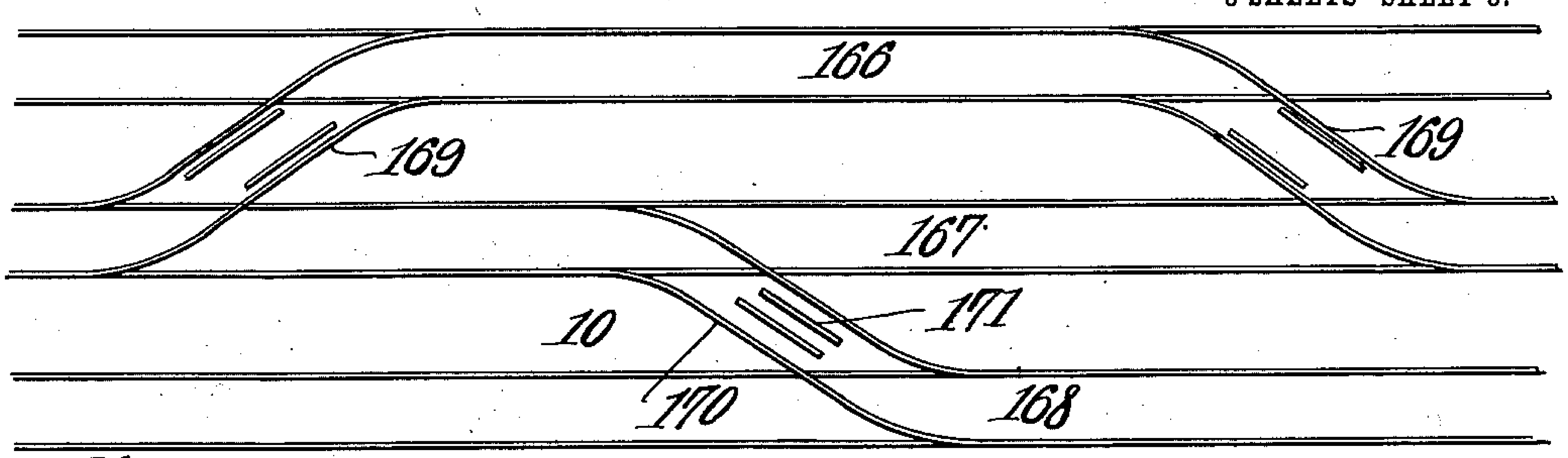


Fig. 6.

Fig. 7.

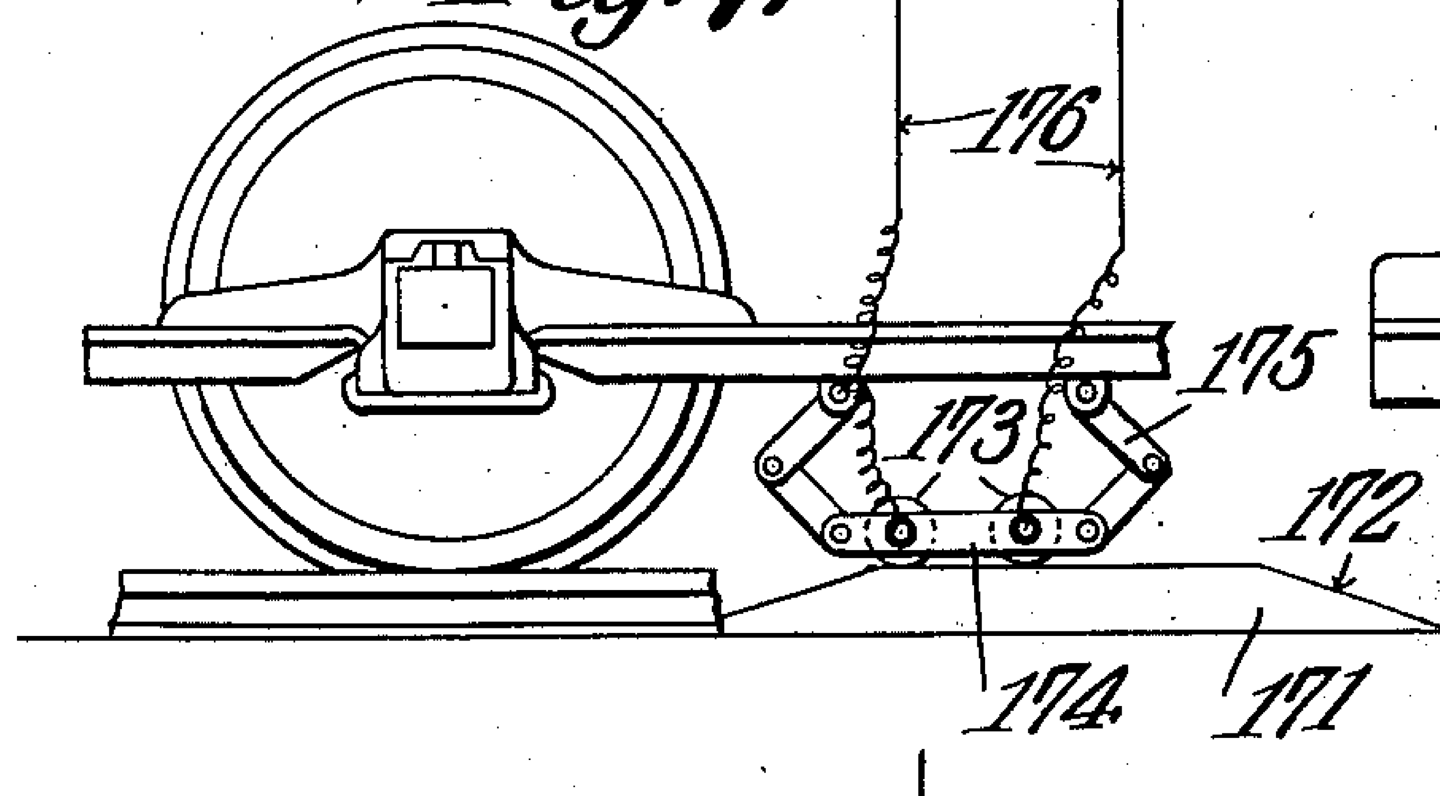


Fig. 8.

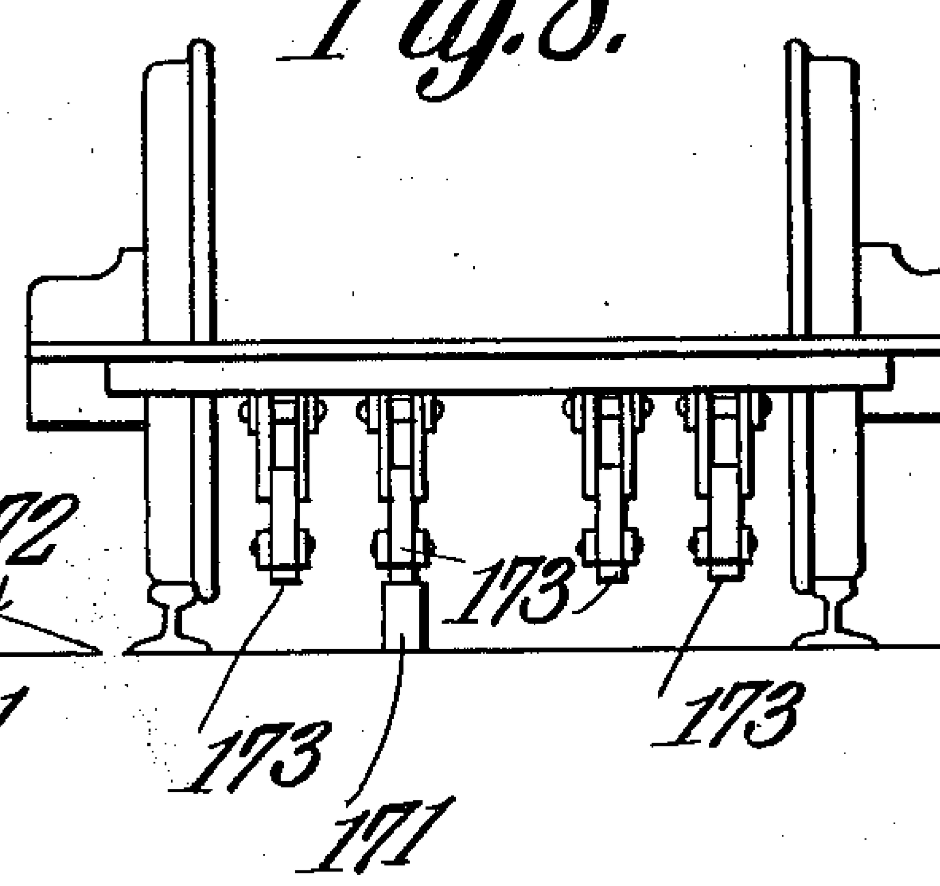


Fig. 9.

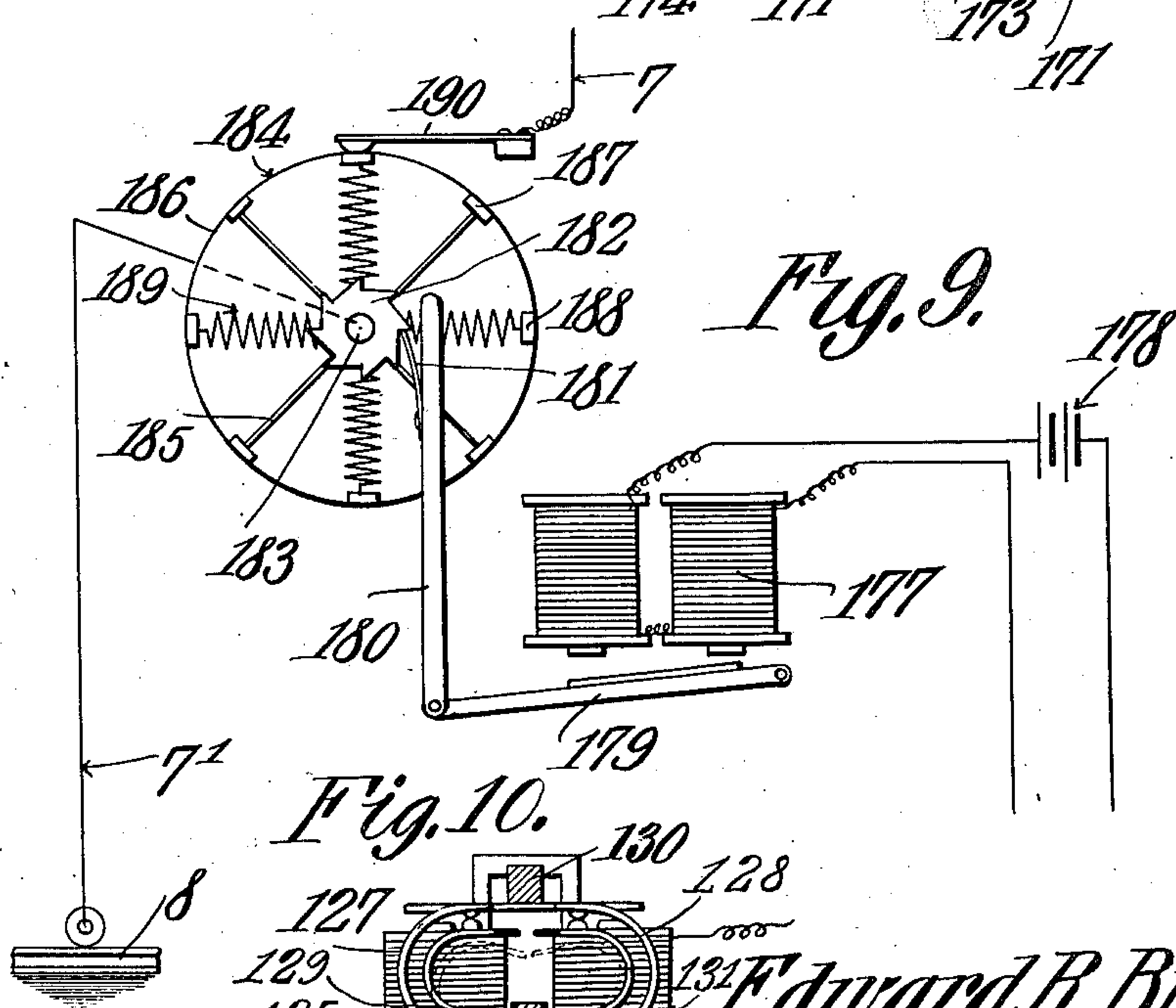
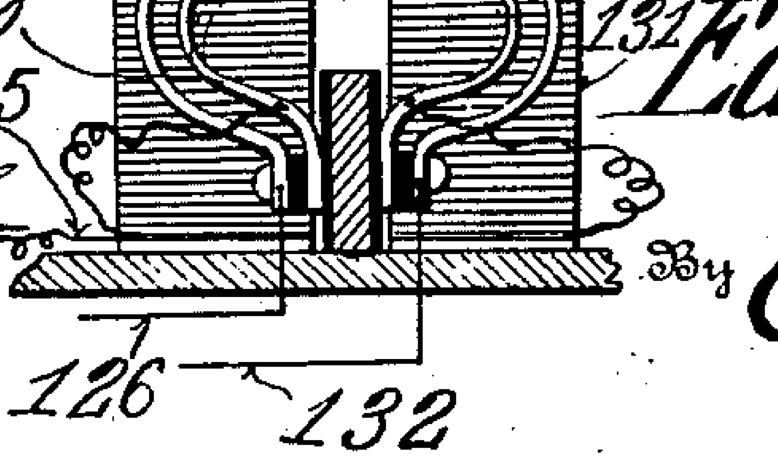


Fig. 10.



Witnesses

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UNITED STATES PATENT OFFICE.

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WIRELESS RAILWAY SIGNAL SYSTEM.

936,405. Specification of Letters Patent. **Patented Oct. 12, 1909.**

Application filed June 29, 1908. Serial No. 440,900.

To all whom it may concern:

Be it known that I, Edward Robert Brodton, a citizen of the United States, residing at Mobile, in the county of Mobile and State of Alabama, have invented a new and useful Wireless Railway Signal System, of which the following is a specification.

This invention has reference to improvements in wireless signal systems intended more particularly for the transmission of signals upon railways.

The purpose of the present invention is to apprise the engine man of a train of the proximity of a dangerous condition, whether such dangerous condition be due to the presence of another train within dangerous proximity of the train upon which the signals are produced, or whether such dangerous condition be due to an open switch or an open draw bridge, or some other condition which would make it dangerous for the moving train to approach unless under full control, or under some circumstances where it would be best to bring the approaching train to a standstill before it enters fully into the danger zone.

In accordance with the present invention each train and preferably the engine of the train, is provided with a means for the propagation of Hertzian or ether waves of sufficient power to surround the moving train with a zone of electrical impulses, progressing with said train and capable of operating suitable receiving devices anywhere within such zone, so that the train has constantly projected therefrom in all directions a means for preventing the approach of other trains within a predetermined distance of the moving train. The train is also provided with receiving instruments responsive to like electrical impulses coming from other sources, so that should a train approach within the danger zone, or even within a caution zone, suitable signal devices will be set into operation, such devices being either visual or audible or both. Provision is also made on each train for the operation of suitable train controlling devices should the engine man ignore or fail to observe the signals when the train enters the caution zone so that when the train enters the danger zone the train controlling devices will be operated in such manner as to bring the train to a standstill irrespective of the volition of the engine man.

Moreover, the present invention provides means whereby the train controlling devices may be so controlled that after once being set the train may proceed into the danger zone without being again under the control of the continuously arriving electrical impulses from the danger point, the means for setting the train controlling devices out of operation being automatic in its nature.

Furthermore, the present invention contemplates means whereby the effective area of action of the propagated ether waves will be maintained constant or substantially constant during both day time and night time, this being performed automatically.

The invention contemplates other means which will appear from the following detail description taken in connection with the accompanying drawings forming a part of this specification.

It will be understood however, that the invention is not to be confined to the particular details of construction set forth or even to the exact arrangement of the parts, or all the particular combinations shown and hereinafter described, since many modifications may be made in structure and operation and arrangement of parts without in any manner departing from the invention or sacrificing any of the salient features thereof.

In the drawings, Figure 1 is a diagram showing one train-carried unit of the system. Fig. 2 is a diagram illustrating a means for controlling the zone of influence of the system. Fig. 3 is a face view of a time piece used in conjunction with the structure of Fig. 2. Fig. 4 is a view of a preferred form of coherer. Fig. 5 is a diagrammatic view showing a form of relay used in conjunction with the system, and more particularly in conjunction with the aerial. Fig. 6 is a diagram showing the track means for changing certain characteristics of the train carried circuit when moving from track to track. Fig. 7 is a detail view of a contact used. Fig. 8 is another view of the contact structure. Fig. 9 is a diagram illustrating a portion of the circuit operating in conjunction with the structures of Figs. 6, 7 and 8. Fig. 10 is a detail view of a portion of the structure shown in Fig. 1.

Referring to Fig. 1 there is shown an aerial 1, which may be of any suitable form but is preferably of the star type as illustrated, the aerial head being shown slightly in perspective in the diagram to give an idea of its shape.

While the system forming the subject matter of the present invention may have each train carried unit mounted upon any part of the train, such units are preferably mounted upon the engine so as to be in easy view of the engine man, and in the following description it will be assumed that the train-carried unit is always mounted on the engine, with the understanding however, that it may be mounted upon any part of the train.

Each train unit comprises a transmitting mechanism and a receiving mechanism. The transmitting mechanism is capable of propagating at regular intervals trains of Hertzian or ether waves, and in the practical embodiment of the invention each train will have a characteristic rate of propagation so that by a predetermined code any train may be identified by the particular rate of propagation of the trains of ether waves. The same will be of course true of block stations, or switches, or draw-bridges, or wherever it is advisable to locate a sending station. Each sending station may have its corresponding receiving apparatus, although under some circumstances it may not be necessary to provide a receiving apparatus for every sending apparatus or unit.

Considering the structure of the diagram of Fig. 1 as mounted upon a moving engine, it will be understood that the aerial can project upward only a very limited distance, such distance being limited by the height of tunnels, or bridges, or other structures under which the engine must pass. It is found in practice, however, that the upward extent of the aerial may be very limited and still transmit impulses over an area of several miles in diameter. It is found that a propagating distance of two miles with energy enough to actuate a receiving unit is amply sufficient for the purposes of the invention, and some such predetermined limited distance is not only enough to prevent trains from coming into dangerous proximity to the point of danger, but too great a zone of influence from a train will be found detrimental to the best operation of the system.

For the generation of the Hertzian or ether waves there are provided two Ruhmkorff coils 2 and 3. Although a greater number of such coils may be used it is found that two coils are usually sufficient, and in the following description but two coils will be referred to with the understanding, however, that a greater number of coils may be used with each coil generating a train of waves of characteristics individual to the particular coil and circuit including the same.

The coil 2 has one side of its secondary winding connected by a conductor 4 to the aerial 1, and one side of the secondary winding of the coil 3 is also connected to the aerial 1 by another conductor 5. The other sides of the secondary windings of the coils 2 and 3 are connected in multiple by conductors 6 to a common ground wire 7 which may lead to the frame of the engine and be grounded through the wheels of the engine to the traffic wheels 8. The terminals of the secondary windings of the two coils 2 and 3 are also connected through a suitable spark gap 9 as is usual in instruments of this character and for this purpose.

The primary windings of each coil 2 and 3 are supplied with currents from a suitable generator 10, which by preference is an alternating current generator so as to avoid the use of rheotomes or other circuit making or breaking apparatus for supplying intermittent current to the primary coils of the Ruhmkorff coils 2 and 3. Practice has demonstrated that rheotomes are unreliable instruments for supplying the primary windings of the coils with suitable current impulses while a proper alternating current generator will supply the proper current without any of the objectionable features of rheotomes or circuit breakers. An alternating current generator will supply alternating current of a predetermined frequency with great regularity and constancy of current and may be relied upon at all times. For this reason it is preferred in connection with the present invention that the current sources for the generation of the Hertzian waves be in the form of alternating current generators, although of course, not necessarily confined to such generators.

The generator 10 may have its armature shaft 11 in one piece with the shaft of a motor 12, which latter is preferably a steam turbine, although it may be any other type of steam motor. The motor 12 is supplied with steam from the boiler of the engine through a pipe 13 in which may be included a suitable valve 14 for the control of the motor. Any approved governing means may be employed to insure constancy of speed of the generator 10 so that the constancy of its frequency may be maintained at all times. Since there are numerous forms of reliable governors for this purpose it is not deemed necessary to illustrate any such governor in the drawings.

The shaft 11 carries two collecting rings 15 and 16 and also terminates at one end in a worm 17 which latter is in mesh with a worm wheel 18 mounted upon a shaft 19 which latter may be journaled in any suitable part of the framework of the structure, which framework however is not shown in the drawings.

The worm wheel 18 carries upon one face two diametrically opposed cam blocks 20, and in the path of these blocks are two elastic or spring arms 21 and 22, each carrying at its free end a block 23 for engagement with the two cam blocks 20. The blocks 23 may be of insulating material and of such size and thickness as to thoroughly insulate the arms 23 from the worm wheel 18, so that there may be no short circuit between the arms 21 and 22. In the path of the arm 21 is another spring arm 24, and in the path of the arm 22 is a spring arm 25, the arrangement being such that when a cam block 20 comes into engagement with the block 23 on the arm 21, it will ultimately move the arm 21 away from the worm wheel 18, until the said arm makes electrical contact with the arm 24, the said arm 24 giving somewhat to insure good electrical contact, and the arm 23 when engaged by a cam block 20 will be moved toward the arm 25 until it ultimately makes contact therewith. It will be observed that the block 23 on the arm 21 is of less radial thickness than the block 23 on the arm 22. This arrangement is provided so that the arm 22 will make contact with the arm 25 before the arm 21 makes contact with the arm 24, and the arm 21 will break contact with the arm 24 before the arm 22 breaks contact with the arm 25. By this means a circuit controlled by the arms 22 and 25 is closed prior to the closure of the circuit controlled by the arms 21 and 24, and remains closed for a longer time. This is for a purpose which will presently appear.

Leading from suitable brushes bearing upon the ring 15, or if desired from a single brush bearing upon such ring are two conductors 26 and 27. The conductor 26 leads to the spring arm 22 while the conductor 27 leads to the spring arm 24.

Bearing upon the ring 16 are suitable brushes from which lead conductors 28 and 29, each terminating in a spring finger or brush 30, and opposed to the spring fingers 30 are other spring fingers 31, one connected by a conductor 32, to one terminal of the primary winding of the coil 2, and the other connected by a conductor 33 to one side of the primary winding of the coil 3. The other side of the primary winding of the coil 2 is connected by a conductor 34 to the spring arm 25 and this conductor 34 includes an adjustable rheostat 35. The other side of the primary winding of the coil 3 is connected by a conductor 36 to the arm 21 and this conductor 36 includes an adjustable rheostat 37.

The circuit between the spring fingers 30 and 31 of each conductor 28 and 29 on the one side, and the conductors 32 and 33 on the other side is normally maintained by a bridging plug 37 provided with insulated bridging blocks so that there shall be no short circuit between the individual fingers 30 or the individual fingers 31. The purpose of this bridging plug 37 will appear further on.

If it be assumed that the generator 10 is in motion then this part of the structure will operate as follows. As the shaft 11 rotates, the worm wheel 18 is rotated at a much slower rate. At intervals the cams 20 are brought into contact with the blocks 23. Ultimately the spring arm 22 is brought into electrical contact with the spring arm 25 and the circuit from the generator to the coil 2 is completed, and electrical impulses traveling through this circuit set up other electrical impulses in the secondary winding of the coil 2, and a series of sparks pass through the spark gap 9 thus causing the emanation of ether waves from the aerial 1 in the form of a train of waves of individual frequencies corresponding to the period of the generator 10. Shortly after the circuit of the primary winding of the coil 2 has been completed the other cam 20 engages the block 23 on the arm 21 and forces it into engagement with the arm 24 thus completing the generator circuit through the primary winding of the coil 3, and there is generated another train of waves commencing at a predetermined time period after the commencement of the train of waves generated by the coil 2. The length of time during which these waves are generated will depend upon the length of the cams 20, and this of course may be predetermined.

By making the cams 20 of appropriate shape the blocks 23 of both arms 21 and 22 may ride off the cams at the same instant thus breaking the primary circuit of both coils at the same time and thereby simultaneously stopping the propagation of the ether waves. Or these cams may be so shaped that the arm 22 will maintain its contact with the arm 25 for a short time period longer than the contact of the arm 21 with the arm 24. This however, is unnecessary and I prefer that the circuit of the two coils 2 and 3 should be simultaneously broken. It is however, of importance in the present instance that one circuit should be completed a time period before the completion of the other circuit for the proper operation of the receiving instrument, as will appear farther on. The rheostats 35 and 37 provide a means for adjusting these primary circuits of the coils 2 and 3 so that these circuits may have different characteristics and the propagated ether waves may have like different characteristics.

In the operation of the system it is desirable that each transmitting unit as a whole should be characteristically different from every other transmitting unit so that each transmitting unit may be readily recognized at any receiving station. This may be done by varying the rate of transmission by giving different speeds to the generators 10 or different diameters to the worm wheels 18 so that the cams 20 may be differently spaced. In fact any means by which the intervals of transmission of the propagated waves is characteristically differentiated from the intervals of the other sending units will answer the purpose of the invention.

In the operation of the system the propagation of the ether waves is supposed to take place continuously at regular intervals depending on the rate of rotation of the worm wheel 18 so long as the generator 10 remains in action, or the circuit through the coils 2 and 3 remains intact. As will hereinafter appear provision is made for breaking the primary circuit of the coils 2 and 3.

Coming now to the receiving side of the train carried set, or of any other set included in the system, there are connected to the aerial 1 two conductors 38 and 39. The conductor 38 leads to a coherer 40 and from the coherer is a conductor 41 leading to a suitable ground which may be identical with the ground 8, that is with the traffic rails. The other conductor 39 leads to a coherer 42 which in turn is grounded through a conductor 43 like the grounding of the coherer 40 through the conductor 41.

The coherers may be of any approved type but I prefer to use a coherer such as shown in Fig. 4, where the coherer 40 is shown as composed of a suitable base 43 upon which is mounted two spaced blocks 44 preferably made of carbon with their upper edges beveled as shown at 45 and each provided in the beveled edge with a central notch 46 of substantially triangular shape. Supported by the block 44 and resting in the notches 46 is a needle or bar 47 which is preferably silver plated to prevent corrosion, and near each end of the needle are small washers 48 of insulating material which washers are so located as to prevent endwise movement of the bar or needle 47, and the bracket 49 overhanging the needle is secured to the base 43 to prevent the needle from jumping out of the notches 46.

The local circuit of the coherer 40 is by way of the conductor 50 through the magnets of a suitable relay 51, thence by a conductor 52 to the spring arm 21 before described, and forming part of the transmitting unit. In the path of the spring arm 21 is a fixed contact 53 with which the spring arm engages when not moved under the influence of the cams 20. The contact 53 is connected by a conductor 54 to a spring finger 55 opposed to which is another spring finger 56 connected by a conductor 57 to one side of a battery 58 or other suitable source of current. The other side of the battery 58 is connected by a conductor 59 to the conductor 41 and then back to the coherer 40. The two spring fingers 55 and 56 are in the path of the members 37 so that when this member is inserted between the spring fingers 30 and 31 the circuit through the conductors 54 and 57 is established through the spring fingers 55 and 56, and the local circuit of the coherer 40 is thus established, but when the member 37 is withdrawn from between the several spring fingers then the local circuit of the coherer 40 is ruptured. The purpose of this will appear further on.

The local circuit of the coherer 42 is by way of the conductor 60 to the magnet of the relay 61, thence to the battery 62 and by a conductor 63 back to the coherer 42. As soon as the relay 61 is closed, then there is established a circuit from a battery 64 or other source of electrical energy by way of a conductor 65 to electromagnets 66, and then by way of a conductor 67 to one terminal of an electric bell 68, but not through said bell, and then by a conductor 69 to one contact terminal 70 of the relay. From the other terminal of the relay 61 the circuit to the battery 64 is completed by the conductor 71. Branched off from the conductor 65 is another conductor 72 leading to the other terminal of the bell 68 so that the magnets 66 and the bell 68 are in multiple with the battery 64. Thus when the relay 61 is energized and its controlling circuit is closed, then the current from the battery 64 will energize the bell 68 and also the magnets 66 at the same time. However the bell 68 which may be of the trembler type would cause the magnets 66 to chatter if it were in series therewith, but being in multiple relation thereto, the operation of the bell 68 has no effect on the magnets 66.

When the circuit controlled by the battery 64 is closed then the magnets 66 are energized and attract an armature 73 fast on an armature lever 74. As soon as the armature 73 is brought into contact with the cores of the magnets 66 then there is another circuit established beginning with a battery 75 or other source of current, and proceeding by way of a conductor 76 to the core of one of the magnet coils 66, then by way of the armature 73 to the core of the other magnet coil 66, and by a conductor 77 connected to the conductor 65 to the coils of the magnets 66. On leaving the coils of the magnets 66, the circuit is traced by way of a conductor 78 to a spring or spring controlled contact terminal 79 in the path of which there is a spring contact finger 80 connected by a conductor 81 to the other side of the battery 75. The spring finger or contact 79 has a projection 82 normally in contact with one edge of a sliding bar 83 fast to the throttle lever

84 of the engine. This bar 83 has on each edge a notch 85 and when the throttle lever 84 is moved to the position to cut off steam from the engine then one of the notches 85 is coincident with the projection 82 on the terminal finger 79, and the said projection will enter said notch and permit the terminal finger 79 to move out of contact with the terminal finger 80, thus breaking the circuit fed by the battery 75. The purpose of this will appear further on.

In the path of the free end of the armature lever 74 is a contact terminal 86 and this terminal is connected by a conductor 87 to a bell 88 and through the same and by a conductor 88′ through an electromagnet 89, to a conductor 90, which latter ultimately terminates at a contact terminal 91, with which latter there is in normal electrical engagement an armature lever 92, connected by a conductor 93 to the armature lever 74.

Branched off from the conductor 87 is another conductor 94 leading to a battery 95 or other source of electrical energy. The battery 95 on its other side is connected by a conductor 96 to one of the circuit terminals controlled by the relay 51, and the other circuit terminal of this relay is connected by a conductor 97 to the bell 88 on the same side of the latter to which the conductor 88′ is connected.

The magnet 89 controls an armature 98 and in the path of this armature are two insulated spring fingers 99 and 100. The finger 99 is connected by a conductor 101 to the conductor 90 and the finger 100 is connected by a conductor 102 to the conductor 93. The end of the armature 98 remote from that engaging the fingers 99 and 100 is provided with a toe 103 in the path of which when the armature is attracted is an insulated block 104 constituting a contact terminal. The armature 98 also carries an insulated contact 105 adapted when the armature lever 98 is attracted by the magnet 89 to make electrical contact with a suitable portion of the frame supporting the armature 98 and magnet 89 and other parts coacting therewith. The frame 106 is in electrical connection with the conductor 88′ by means of a conductor 107, and also leading from the frame 106 is another conductor 108 connected to the conductor 102 and also connected to one side of the coils of an electromagnet 109, the other side of which coils is connected by a conductor 110 to a spring contact finger 111 on one side of which is a fixed contact terminal 112, and on the other side of which is a spring or movable contact 113. The contacts 111, 112 and 113 are in operative relation one to another, and to another spring contact or movable contact 114 similar to the movable contact 79 before referred to, and provided with a side extension 115 adapted to engage one edge of the bar 83 under the control of the throttle lever 84, and also adapted to enter the corresponding notch 85 in the edge of said bar 83, when the throttle lever is moved to shut off steam from the engine. The construction of the several movable or spring fingers is such that when the throttle lever is moved to the open position then the contact 114 is moved into engagement with the contact 113 and the latter is moved into engagement with the contact 111, and the last named contact is moved into engagement with the contact 112, so that all four contacts are in engagement one with the other.

The contact 112 is connected by a conductor 116 to the core 117 of one of the windings of the electromagnet 109, and the core 118 of the other winding of the magnet 109 is connected by a conductor 119 to one side of a battery or other suitable source of current 120, this said battery 120 having its other terminal connected by a conductor 121 to the conductor 116. Included in the conductor 119 is an audible signal preferably in the form of a bell 122, and also a visual signal in the form of an incandescent lamp 123, but other forms of electrically operated signals may be employed.

The armature lever 92 has secured thereto an armature 124 under the control of the magnet 109 but this armature 124 so carried by the armature lever 92 is insulated therefrom as indicated. The armature 124 is adapted to bridge the two cores 117 and 118 when the magnet 109 is energized and the armature is brought into contact with the ends of these cores.

In the path of the free end of the armature lever 92 is a contact terminal 125, and this terminal is connected by a conductor 126 to one of a pair of spring fingers or contacts 127 and 128. The spring fingers 127 and 128 are best shown in Fig. 10 and interior thereto are other spring fingers 129, the said spring fingers 129 being at their free ends normally in electrical contact with the respective fingers 127 and 128. The fingers 129 are in the path of an armature lever 130 under the control of an electromagnet 131 and this magnet is bridged between the two spring fingers 129. Assuming that the spring finger 127 is the one that is connected to the conductor 126 then the other spring finger 128 is connected by a conductor 132 to the contact block 104 before referred to.

One side of the magnet coil 131 is connected to an insulated contact post 133 mounted on the framework which supports the said magnet 131 and coacting parts. The other terminal of the magnet 131 besides being connected to the spring fingers 129 which are in electrical contact with the frame 134 but insulated from the spring fingers 127 and 128, is also connected by a conductor 135 to a battery 136, or other source of electrical energy. The other side of the battery 136 is connected by a conductor 137 to the movable terminal 114 and the terminal 113 is connected by a conductor 138 to the frame 134. The conductor 138 includes an electric motor 139 and an electromagnet 140, the said electromagnet having under its control an armature 141 operatively connected to a steam whistle 142 which may receive steam from the engine boiler.

The motor 139 is assumed to operate train-controlling devices, such for instance as the throttle 84, or air brake mechanism or both. If desired the motor 139 may be omitted and the blowing of the whistle 142 be depended upon entirely, or both may be used as desired.

The armature lever 130 is provided with a contact toe 143 which when the armature lever 130 is attracted by the magnet 131 makes electrical contact with the block 133 in its path.

The circuit closing plug 37 before referred to is connected by a chain 144 or other flexible connection and a suitable clip 145 to the throttle lever 84 for a purpose which will presently appear.

Let it be assumed that the train is traveling along the line of way and comes within the zone of influence of a transmitting set such as shown in Fig. 1 but located at some other point than on the train, say on another train, or at a switch, or on a draw-bridge, or any other point whereat dangerous conditions may occur. The first series of ether waves will be received by the coherer 42 since the coherer 40 is in a circuit not responsive to the particular characteristics of the waves first transmitted. Even if the coherer 40 were responsive to the first set of waves, there might be a signal produced at the bell 88 but all the other circuits are under such circumstances out of action. As soon as the coherer 42 is properly energized or affected by the incoming ether waves, then the relay 61 is energized and the local circuit controlled by the battery 64 is closed. This causes the magnets 66 to attract the armature 73 and this latter by bridging the cores of the magnets 66 closes the circuit of the battery 75 so that the magnets 66 become energized by the battery 75 even after the relay 61 is dead. As soon as the magnet 66 is energized and its armature 73 has been attracted the armature lever 74 completes the circuit at the contact 86. There is now established a circuit from the battery 95 through the conductor 87 and contact 86, by way of the armature lever 74, and conductor 93 through the armature 92 and contact 91 by way of the conductor 90 to the magnet 89, and from thence by the conductor 88′ to the circuit terminals of the relay 51, and back to the battery 95 by the conductor 96, the circuit however being broken at the relay 51. Now the second coherer 40 may receive the second set of impulses and the circuit terminals at the relay 51 will be closed thereby, thus completing the circuit of the battery 95. There is established a local circuit from the battery 95 through the bell 88 thus causing the latter to ring and at the same time the magnet 89 is energized but is unaffected by the ringing of the bell 88. The energization of the magnet 89 will cause the attraction of the armature 98 thus closing a number of circuits. There is established a circuit between the conductors 90 and 93 by way of the conductors 100 and 101 and the contact fingers 99 and 100 by the action of the armature 98 in bringing the fingers 99 into contact with the finger 100. At the same time the toe 103 is brought into contact with the conducting terminal 104, and the insulated contact 105 is brought into contact with the frame 106. There is established a circuit from the battery 120 through the conductor 146 connecting the contact 105 with one side of the battery 120 and the path of the current from the contact 105 may be traced through the frame 106 by way of the conductor 108, through the coils of the magnet 109, thence by the conductor 110 and contacts 111 and 112 back to the battery 120, by way of the conductors 116 and 121. As soon as the magnet 109 is energized its armature 124 is attracted and bridges the two cores 117 and 118, and at the same time the armature lever 92 is brought into contact with the circuit terminal 125. As soon as the two cores 117 and 118 are bridged there is then established a circuit from the battery 120 by way of the conductor 119, the core 118, armature 124, core 117, back to the battery 120, thus causing the bell 122 to ring and the light 123 to glow, thus notifying the engine man of the close proximity of danger so that he may bring the train to a standstill by a suitable manipulation of the throttle lever 84 to cut off the steam. The magnet 89 remains energized after the second set of ether waves have ceased because of a circuit established from the battery 120 by a conductor 146 to the frame 106, thence by magnet 89, conductors 90 and 101, fingers 99 and 100, conductor 102 to conductor 108 and magnet 109, and back to the battery by the path already described. If, in practice, it be found that the connection between the frame 106 and conductor 102 tends to short circuit the magnet 89, then this conductor may be made of high enough resistance to divert sufficient current through the magnet 89 to cause the energization of the latter.

Should the engine man on hearing the danger signal not cut off the steam, then another impulse following a few seconds after will cause closure of the circuit controlled by the battery 95 to act through the conductor 94 and conductor 87 through the armature 74 to the armature 92, thence to the contact 125 and by conductor 126 to one of the springs, say the spring 127. This spring 127 being in contact with the spring 129 under normal conditions, the circuit is continued through the magnet 131 thence back to the other spring 129, and finally to the spring 128, and by the conductor 132 to the contact 104, thence by the toe 103 to the frame 106, and by the conductor 88′ finally returning to the battery 95. On the energization of the magnet 131 the armature 130 is attracted and engaging the springs 129 move them out of contact with the springs 127 and 128 thus rupturing the circuit of the battery 95 at this point. But the movement of the armature 130 has brought the toe 143 into contact with the contact block 133 thus establishing another circuit from the battery 136 to the magnet 131, then to the contact 133 to the toe 143, and to the frame 134, thence by the conductor 138 and movable contacts 113 and 114 back to the battery 136. This new circuit remains energized even after the impulses which cause its closure have ceased. Since the whistle 142 is under the control of this circuit through the magnet 140 and armature 141, the whistle will continue to blow so long as the circuit remains closed, and since the motor 139 is also included in this circuit when a motor is used, the motor will be energized to cause the actuation of the train-controlling devices, whether such devices be the throttle lever 84 or the air brake system, or both, and the train will untimately be brought to a standstill even without the volition of the engine man.

Usually the employment of the whistle 142 which will continue to sound so long as the circuit of the battery 136 remains closed, will be found sufficient to draw attention to the fact that the train has entered the danger zone, and impel the engine man to stop the train, even though from carelessness or other cause he neglected to stop the train on the first signal given by the bell 122 and lamp 173. As an extra cautionary practice, the motor 139 may be used so that if from neglect on the part of the engine man, the train enters too far into the danger zone, the train controlling devices may be automatically operated, and the train be brought to a standstill.

When the engine man has moved the throttle lever to the closed position, then the enlargements 82 on the contact 79 and 115 on the contact 114, enter the recesses or notches 85 in the bar 83, and the several spring contacts 80, 111, and 113, will be brought out of contact with each other and the respective movable contacts 79 and 114 and the several circuits normally closed by these several fingers will be opened or ruptured. The result of this is that when the throttle lever is closed to shut off steam all the several circuits which have been permanently established by the operation of the device become opened and all the parts return to their normal position, it being understood of course, that the several armatures and other parts are spring controlled or otherwise controlled so as to return to normal position when relieved of the pull of the respective magnets. When the engine man moves the throttle lever 84 in a direction to close the throttle, then the connection 144 will cause the movement of the plug 37 sufficiently to break the circuit between the fingers 30 and 31 and fingers 55 and 56. When this occurs the sending and receiving circuits are broken and consequently there is neither reception of signals nor the transmission thereof when the train is brought to a standstill. This is more particularly useful when a train is placed on a siding and the main track is clear. Under such conditions there is no danger to traffic and no need of sending out danger signals. Should a train break down on the main track and so be a menace to an approaching train, then the clip 145 may be removed from the throttle lever 84 and the plug 37 may be reinserted between the spring fingers 30, 31, 55 and 56, and so the apparatus will be in both sending and receiving condition.

By means of a suitable spring the plug 37 may be made to return automatically to the active position whenever the throttle lever 84 is moved in a direction to permit steam to enter the engine cylinders, and the adjustment of the parts may be such that the plug 37 will be moved sufficiently to break the circuit between the several spring fingers when the throttle lever 84 is moved to close off the steam, without however removing the plug entirely from between said fingers. A spring for this purpose is diagrammatically represented at 147. It is desirable that during the sending of a message the instrument should not be in a receptive condition, and for this reason the contact 53 is employed, so that the local relay circuit of the coherer 40 is automatically broken while the sending impulses are active, and the circuit is again established as soon as the sending impulses cease, the spring arm 21 being moved out of operative relation to the contact 53 whenever engaged by the cams 20, and moving into contact with the contact terminal 53 as soon as the cams 20 have passed from engagement with the respective arm 21.

As has already been stated there are two or more trains of waves propagated from each sending station. The first set of waves prepares the receiving instrument for the reception of the second set of waves, and the slight time interval by which the first set of waves precedes the second set of waves, gives time enough for the first set of waves to operate the necessary mechanism to put the receiving instrument into condition to receive the second set of waves, and then the two sets proceed simultaneously and may cease simultaneously. If more than two sets of trains of waves are used, then the same overlapping intervals are provided so that the third train of waves does not actively reach the receiving apparatus until after the first set of waves has acted to put the receiving instrument in condition to receive the second set of waves, and the second set of waves has put the instrument in condition to receive the third set, and so on. However, in the practical embodiment of the invention, two overlapping sets of trains of waves with the beginning of the first set preceding the beginning of the second set by a slight time interval are usually found to be ample.

The purpose of having at least two sets of waves in overlapping relation is to prevent the operation of the receiving instrument by wireless impulses coming from outside sources. If the receiving side of the system were responsive to but one train of waves then it might respond to trains of waves coming from wireless telegraph systems having nothing to do with the railway signaling apparatus, and so there would be danger of the train being unnecessarily stopped. For this reason the system is so devised that at least two succeeding trains of waves are necessary in order to operate the system, and preferably these trains of waves have a periodicity to which the receivers are properly attuned. With these precautions there is practically no danger of the receiving units being operated except from properly propagated trains of waves proceeding from a danger point.

The relays 51 and 61 as shown in Fig. 1 are illustrated as the typical form of relay and such form of relay is eminently adapted to the present invention, but it is sometimes desirable that a train should be permitted to approach a station or enter a siding even after having gotten within the danger zone. For this reason the present invention provides means whereby the relay will operate up to a certain point that is up to within a certain distance of the danger point, and will then cut itself out of action so that the train may proceed with the engine man having full knowledge of the dangerous conditions in the neighborhood. To accomplish this purpose each relay may be constructed as shown in Fig. 5. In this case the relay is made up of two electromagnets 148 and 149, the electromagnet 148 being included in the charged local coherer circuit, and the magnet 149 also being included in the said circuit but in multiple with the magnet 148. Included in the circuit of the magnet 149 there is an armature 150 under the control of the magnet 148, and normally in contact with a back stop 151 included in the same circuit. Under the control of the magnet 149 is another armature 152 normally in engagement with an inert adjustable back stop 153. The armature 152 forms one terminal of the circuit controlled by the relay and the other terminal of this circuit is formed by the core of the magnet 149, this core being shown at 154. Suppose now that impulses come over the line through the coherer then when these impulses become strong enough, the magnet 149 is sufficiently energized to attract the armature 152 until it is in electrical contact with the core 154 thus establishing the circuit controlled by the relay. Under these circumstances the magnet 148 will not be operatively affected by the impulses coming over the coherer circuit and will consequently remain inactive. When however, the train approaches the point of propagation of the ether waves to a sufficient extent these waves become sufficiently strong to cause the operation of the magnet 148 and its armature 150 is attracted thus breaking the circuit through the magnet 149, and the armature 152 controlled by the said magnet 149 is thereby relieved from the attraction of said magnet and immediately breaks the circuit between the said armature and the core 154. So long as the impulses received by the coherer are sufficiently intense the magnet 148 will be operatively energized and the circuits controlled by the relay will thereby be cut out and remain inactive. Under these circumstances the engine may proceed toward a station or into a siding even though it be in close proximity to the point of danger. The relay shown in Fig. 5 may be adjusted quite closely by a suitable manipulation of the adjustable back stops 151 and 153.

In order that the coherer's circuit may be made responsive to a sufficient extent to operate the relays only within a certain predetermined distance of the propagating point of the ether waves, there is introduced into each conductor 38 and 39 an adjustable resistance or rheostat 155.

It has been observed in the operation of wireless systems that the effective zone of influence of the ether waves is of much greater extent at night than during the day time. Consequently without some means for adjusting the system for this difference in the effective zones of the ether waves during day time and night time, it would be found that the danger zone would become much more extensive during the night than during the day. By the present invention this discrepancy between the night propagation of ether waves and the day propagation of such waves is neutralized by automatic means. Such means are diagrammatically illustrated in Figs 2 and 3. The means shown in Fig. 2 are typically but not actually shown by the rheostats 155 of Fig. 1, and it is to be understood with relation to Fig. 1 that the rheostats 155 are to be of the automatic character illustrated in Fig. 2. The continuity of the conductor 38 or 39 as the case may be is broken and one end terminates at a brush 156 and the other at another brush 157, the latter brush resting upon a shaft or arbor 158. The brush 156 is in engagement with a conducting ring 159 made up of two segments 160 and 161 with intermediate segments 162 between the contiguous ends of the two larger segments 160 and 161. The segments 162 are insulated at each end from the segments 160 and 161, and if more than one segment 162 is interposed between the contiguous ends of the segments 160 and 161, then these several smaller segments are insulated one from the other. The ring 159 is assumed to be mounted upon the shaft 158 for rotation therewith and the said shaft 158 may be the arbor of a clock 163 indicated in Fig. 3, and which clock may be of any suitable type. In the particular instance shown the clock is indicated as a 24-hour clock but of course an ordinary 12-hour clock may be used. When a 24-hour clock is used then the shaft 158 may be identical with the arbor of the clock and the ring 159 may make one rotation every 24 hours. If a 12-hour clock be used then the ring 159 and shaft 158 must be geared up to the clock movement so as to make but one rotation in 24 hours, with the disposition of the segments as shown in Fig. 2. Of course other arrangements may be used for the purpose which will hereinafter appear. Furthermore, the ring 159 is assumed to be insulated from the shaft 158. The segment 160 is connected to the shaft 158 by a resistance 164 of predetermined value. The segment 161 is connected to the shaft 158 by a resistance 165 of a lesser predetermined value, and the segments 162 are each connected to the shaft 158 by a resistance 166 of another predetermined value intermediate between that of the resistance 164 and 165.

Let it be assumed that the segment 161 corresponds to the day time indications of the clock dial. Then the resistance 165 is of such value as to permit electric impulses to reach the coherer 40 or 42 as the case may be, with an intensity to operate the respective relay when the danger zone has been approached within a certain predetermined distance, say about 2 miles, more or less. As night approaches the propagating distance or effective zone of the ether waves becomes greater and therefore the intermediate segments 162 are introduced with somewhat higher resistance so as to increase the resistance of the receiving conductor 38 or 39. Finally when night fall has been reached then the segment 160 is introduced in the circuit with the suitable higher resistance 164, which is so adjusted with reference to the other resistance 165 as to maintain the effective zone of influence of the ether waves practically constant during the whole 24 hours. This operation is entirely automatic and requires no attention on the part of the engine man except to see that the clock is in running order, and it also insures a practically constant danger zone both day and night.

In railroads having two or more parallel main tracks it is advisable to have the signal transmitting and receiving systems differently tuned for the different tracks so that trains approaching and passing on neighboring tracks will not interfere with each other in the operation of their signaling systems. For this purpose the trains of one track have their signaling systems attuned characteristically different from those on the neighboring tracks, so that their receiving units will not respond to ether waves propagated by the sending units of a train on an adjacent track. However, it is sometimes necessary for trains or engines to pass from one track to the other, and for this purpose the present invention contemplates the retuning of the circuits automatically on the passing of the train from one track to the other, so that the signal units are always responsive to others upon the same track.

In Fig. 6 is shown a railway having three parallel tracks, 166, 167 and 168 with cross-overs 169 and 170. In the cross-overs between the traffic rails are situated blocks 171. Each block 171 has its ends inclined as shown at 172 so as to be easily engaged by the wheels 173 of a trolley frame depending from the main frame of the locomotive or one of the cars of the train. The trolley frame indicated at 174 may be supported at each end by link connections 175 so as to yield vertically and may be either forced downward by a suitable spring or gravity may be depended upon for this purpose. The wheels 173 are spaced apart and are insulated from each other and from the frame 174. The two wheels or rollers 173 constitute the terminals of an electric circuit, the conductors 176 of which lead to an electromagnet 177 and in the circuit is included a battery 178 or other source of electrical energy. In operative relation to the magnet 177 is an armature 179 and this armature carries a link 180 at the free end of which is a pawl 181 which may be in the form of a spring tooth as illustrated. The pawl 181 is in operative relation to a ratchet wheel 182 mounted on a shaft 183 to turn therewith, and also mounted on the shaft 183 is a wheel 184 having radial members 185 which may serve as spokes for supporting a rim 186, which rim may be of insulating material. The outer ends of the spokes 185 end in contact plates 187, and at points on the rim 184 intermediate of the contact plates 187 are other contact plates 188 connected to the shaft 183 by suitable means for adjusting the tuning of the aerial circuit. In the drawings these means are shown diagrammatically as simple resistances 189 but may be any other suitable means for the purpose. Bearing on the rim 184 is a brush 190 connected to the wire 7 and leading from the shaft 183 is ground wire 7′ constituting a continuation of the ground wire 7. The wire 7′ leads to the engine frame or other suitable device in contact with one of the traffic rails 8. The spokes 185 are of practically no resistance, that is the resistance is negligible.

Where there are several tracks in the railroad system paralleling one another there will be a number of trolleys 174 with contact wheels 173 spaced apart and insulated as shown in Fig. 8, and there will be an equal number of tuning devices shown in Fig. 9.

Let it be supposed that a train is normally running on track 167, and that it is desired to run the train over to track 168. The train will switch over on the cross-over 170 and a suitable one of the pairs of trolley wheels 173 will engage the appropriate block 171, and this block being of conductive material the circuit including the battery 178 will be closed through the block 171. This will energize the magnet 177 and the wheel 184 will be turned the distance of a notch of the ratchet 182. This movement will turn the wheel 184 so that the brush 190, if originally resting on a contact 188 will be moved to a contact 187. This will change the electrical conditions of the aerial circuit so that it will no longer respond to the impulses to which it was set to respond when on track 167, but the arrangement is such that it will now respond to impulses that are sent out from sending units adapted to the track 168. When the train returns again to the track 167, the magnet 177 will be again energized and the wheel 184 will be so turned as to bring the brush 190 on to a contact 188 if that be the initial position of the wheel with respect to the brush 190. The blocks 171 are differently spaced for different cross-overs between different tracks, and the trolley wheels 173 are correspondingly spaced. For instance, if the train should pass from track 167 to 166 over a cross-over 169, then another magnet 177 would be energized, and another wheel 184 would be actuated. There need therefore, be no interaction between trains running in opposite directions on parallel tracks in the same system, and whenever trains cross from one track to the other, their signaling systems are automatically adjusted to respond to the impulses of the particular track system.

While the time rheostat of Fig. 2 has been described as being used in the conductors 38 and 39, such a time rheostat will also be used in place of the rheostats 35 and 37 in the sending circuit, and it will be understood that the rheostats 35 and 37 in Fig. 1 are to be taken as typical of either ordinary adjustable rheostats or of time rheostats as described with reference to Fig. 2.

What is claimed is:

1. In a wireless signal system for railways, means for the propagation of trains of waves in sets of two or more trains of waves, means for the reception of such sets of trains of waves responsive to respective trains of waves of a set, one receiver remaining inactive until another receiver responsive to another train of waves of the set has become active, a circuit controlled by the said receivers, and responsive to a subsequently propagated set of trains of waves, signal means controlled by the first named receiver and train-controlling means in turn controlled by the energization of the said circuit caused by the subsequently received set of trains of waves.

2. In a wireless signal system for railways, means for the propagation of electric waves in groups of two or more overlapping trains of waves, receivers responsive to such trains of waves, an electric circuit controlled by one receiver, another electric circuit controlled by another receiver, and itself also controlling the first named circuit to close the same at a point not controlled by the first named receiver, and an electric circuit including the means for controlling the first named circuit and rendered active on the closure of the second named circuit to maintain said circuit positively closed after the trains of waves have ceased to act on the receiver controlling said circuit.

3. In a wireless signal system for railways, a signal circuit having normally open circuit means for closing said circuit, means for moving the circuit closing means to the closed position, said means being under the control of trains of waves emanating from a distant source, and a charged electric circuit including the means for actuating the circuit closing means, said circuit being closed by the actuation of the circuit closing means to the closed position and acting to maintain said circuit closing means in the closed position after the cessation of the trains of waves coming from the distant source.

4. In a wireless signal system for railways, a plurality of receivers responsive to propagated trains of waves coming from a distant source, an electric circuit under the

control of one of the receivers and including an electrically operated circuit controlling means, another circuit under the control of another of the receivers and also under the control of the circuit closing means of the first circuit, a circuit controlling means under the control of the second circuit, a third circuit closing means under the control of the circuit closing means of the second circuit, and a signal circuit rendered active by the circuit closing means under the control of the third circuit.

5. In a wireless signal system for railways, means responsive to electrical emanations coming from a distance, electric circuits controlled by the receivers and rendered successively active to said control, a signal circuit rendered active by a subsequently active circuit controlled by the receivers, another circuit closed by the closure of the signal circuit, another circuit responsive to receive electrical trains of waves and arranged to control devices of a different character than the first named signal devices, and circuit closing means for the last named circuit closed by the action of a circuit responsive to the electrical emanation for establishing and maintaining a path for the current in the said last named circuit by the current in said circuit.

6. In a wireless signal system for railways, receivers responsive to electrical emanations coming from a distance, electric circuits controlled by the receivers, means controlled by said circuit for the successive closure of other circuits including signal means, and means for the rupturing of all the electric circuits simultaneously.

7. In a wireless signal system for railways, a signal receiving means adapted to be mounted on the engine of a train, means responsive to electrical emanations coming from a distance for effecting the successive closures of electrical circuits and the ultimate production of signals by said circuit, and means under the control of the throttle lever of the engine for rupturing all the circuits when steam is shut off from the engine.

8. In a wireless signal system for railways, means for propagating electrical emanations, said means being mounted upon the engine of the train, receiving means also mounted upon the engine and adapted to respond to electrical emanations coming from a distance, electrical signal circuits controlled by the receiving means, and means under the control of the throttle lever of the engine for simultaneously rupturing the receiving signal circuit and the transmitting circuit of the generator of electrical emanations on the engine when the throttle lever is moved to shut off steam.

9. In a wireless signal system for railways, an electric circuit controllable by electrical emanations coming from a distance, electromechanical means included in said circuit, a whistle under the control of said electromechanical means, electrical means for closing the circuit controlling the whistle and responsive to the means controlled by the electrical emanations, a source of energy in the said circuit controlling the whistle, and means for rendering said source of energy active to maintain the said circuit closed after the cessation of the electrical emanations coming from a distance.

10. In a wireless signal system for railways, a charged electric circuit, electromechanical means controlled thereby and in turn controlling a whistle, an electrically actuated switch for closing the circuit and itself controlled by electrical emanations coming from a distance, another circuit closing means rendered active by the charged circuit for maintaining said circuit intact after the cessation of the electrical emanations, and means under the control of the throttle lever of the engine for rupturing said circuit when steam is shut off.

11. In a wireless signal system for railways, means for maintaining the zone of influence of the electrical emanations substantially constant irrespective of the time of day.

12. In a wireless signal system for railways, a generator of Hertzian or ether waves, a receiver responsive to such waves, and means in both the generator circuit and the receiver circuit for rendering the zone of influence of the system substantially constant day and night.

13. In a wireless signal system for railways, a generator of Hertzian or ether waves, and a time controlled rheostat included in the generator circuit.

14. In a wireless signal system for railways, a generator of Hertzian or ether waves, including a Ruhmkorff coil, and a time controlled rheostat included in the primary circuit of the said coil.

15. In a wireless signal system for railways, a means for maintaining the zone of influence of the electrical emanations substantially constant, comprising a rheostat having its resistances varied in conformity to the differences in the day and night conditions for the propagation of the said emanations.

16. In a wireless signal system for railways, a means for maintaining the zone of influence of the electrical emanations, substantially constant, comprising a rheostat having its resistances varied in conformity to the differences in the day and night conditions for the propagation of the said emanations, and a time piece for actuating said rheostat.

17. In a wireless signal system for railways, a time piece, and a rheostat actuated thereby, said rheostat having means con-

trolled by the time piece for determining the daylight zone of influence of the electrical emanations, and other means controlled by the time piece for maintaining the night time zone of influence of the electrical emanations substantially the same as the day time zone.

18. In a wireless signal system for railways, a means for maintaining the zone of influence of the electrical emanations substantially constant, comprising a closed series of contact segments, and resistances introduceable separately into the circuit and varying in conformity with the variation in daily conditions for the propagation of Hertzian or ether waves.

19. In a wireless signal system for railways, means controlled by Hertzian or ether waves for controlling the movement of a train on approaching a danger point, and means for rendering the controlling means inactive by a closer approach to the danger point.

20. In a wireless signal system for railways, means controlled by Hertzian or ether waves for controlling the movement of a train on approaching a danger point, and means for automatically rendering the controlling means inactive by a closer approach to the danger point.

21. In a wireless signal system for railways, means for controlling the movement of a train on approaching a danger point, rendered active by the proximity of the train to the danger point, and means for rendering the controlling means inactive by the closer approach of the train to the danger point.

22. In a wireless signal system for railways, a relay responsive to Hertzian or ether waves within a predetermined distance from the source, and means responsive to stronger waves to cut out said relay.

23. In a wireless signal system for railways, two or more receivers responsive to a like number of trains of waves in overlapping succession, means controlled by one receiver for rendering the next receiver active to respond to a train of waves, signal means controlled by the receiver, and a relay for the first of the receivers responding to the trains of waves having means for automatically rendering the relay inactive when the active trains of waves have reached a predetermined intensity.

24. In a wireless signal system for railways, a wireless signal means on each train adjusted to be characteristic to a predetermined one of two or more tracks, and means rendered active by the passage of a train from one track to another to adjust the characteristic of a train-carried means into conformity of that of the other track.

25. In a wireless signal system for railways, a wireless signal means carried on each train, adjusted to be characteristic to a predetermined one of two or more tracks, means on each train for adjusting the characteristic of the train-carried means into conformity with that of any of the other tracks, and coacting means in the cross-overs from track to track for effecting the adjustment of the characteristic of the train means by the passage of a train from one track to another.

26. In a wireless signal system for railways, a wireless signal means on each train responsive to electrical emanations characteristic to one of two or more tracks, means on each train for adjusting the characteristic responsiveness of the signal means into conformity with the other track or tracks, electromechanical means for effecting the adjustment, and means along the line of way in the cross-overs from track to track for rendering said electromechanical means active by the passage of the train along said cross-overs.

27. In a wireless signal system for railways, a wireless signal means on each train responsive to electrical emanation characteristic to one of two or more tracks, means on each train for adjusting the characteristic responsiveness of signal means into conformity with that of the other track or tracks, electromechanical means for effecting the adjustment, electric circuits on the train including said electromechanical means, and means along the line of way in the cross-overs from track to track for closing said electric circuits on the train to cause the actuation of said electromechanical means by the passage of the train along said cross-overs.

28. In a wireless signal system for railways, an aerial carried by each train, transmitters and receivers of electrical emanation connected to said aerial, tuning means included in said aerial for changing its characteristic responsiveness, and means actuated by the passage of a train from one track to another for changing the characteristic adjustment of the aerial into conformity with the track upon which the train has passed.

29. In a wireless signal system for railways, wireless transmitting and receiving units mounted upon a train, means upon each train for adjusting the characteristic responsiveness of the train transmitting and receiving units in conformity with the change of the train from one characteristic track to another, and the return of the train to the original track.

30. In a wireless signal system for railways, an aerial carried by each train and having characteristic responsiveness, circular series of adjusting means and inert means interspersed, and introduceable into the aerial circuit, electromechanical means on each train for effecting the operation of

said circular series of adjusting and inert means, an electric circuit on the train for each of said circular series of adjusting and inert means, and circuit closing means in the cross-overs from track to track for causing the closing of the said electric circuit as the trains pass over said cross-overs to actuate the circular series of adjusting means and inert means to bring the aerial into a condition characteristic of the track upon which the train is traveling.

In testimony that I claim the foregoing as my own, I have hereto affixed my signature in the presence of two witnesses.

EDWARD ROBERT BRODTON.

Witnesses:

E. H. Robertson,

D. P. Bester, Jr.