H. D. BETZ.

WIRELESS AND AUTOMATIC RAILWAY SAFETY SYSTEM.

APPLICATION FILED MAR. 1, 1915.

1,308,925.

Patented July 8, 1919.

4 SHEETS—SHEET 1.

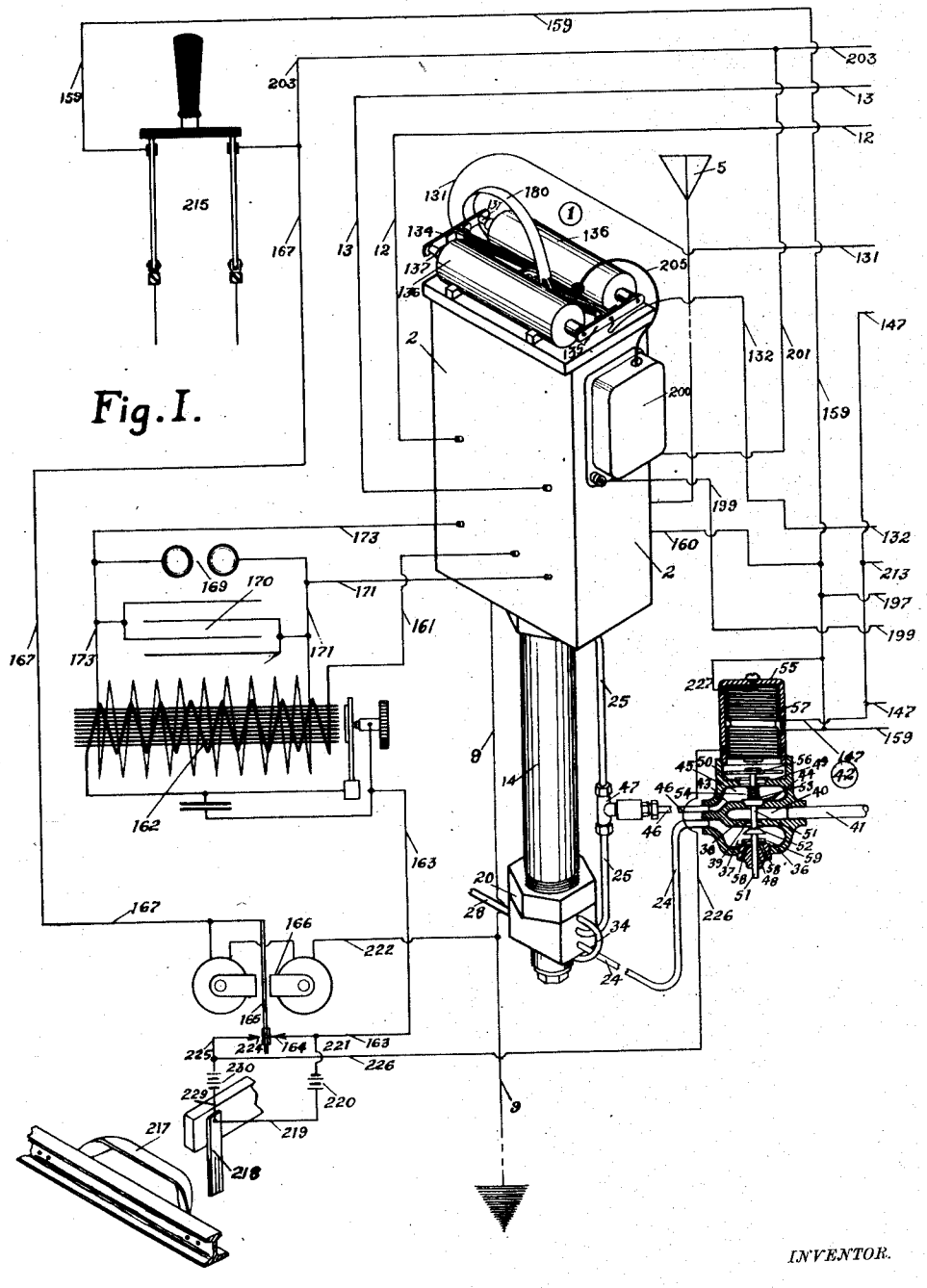


Fig. I.

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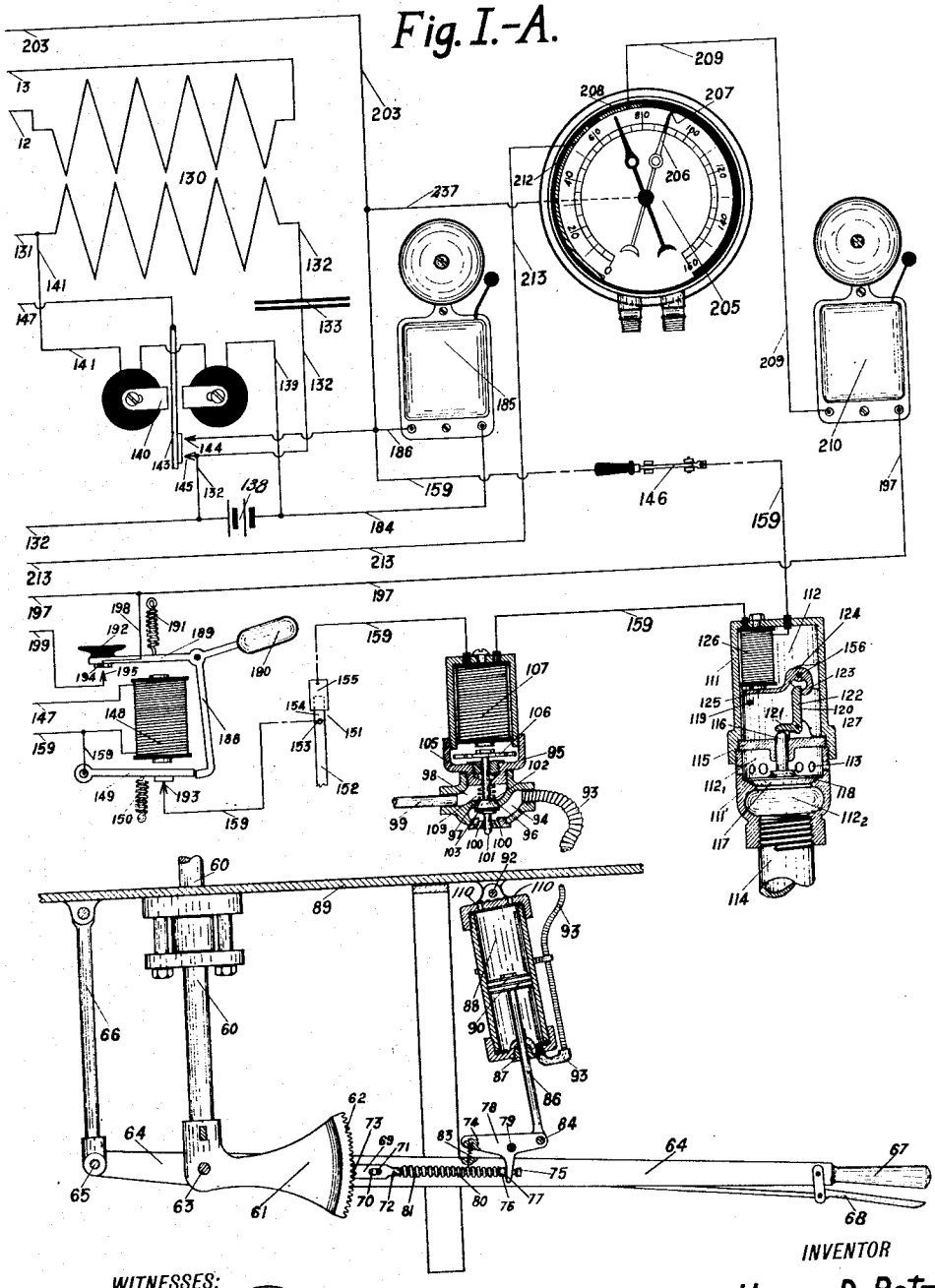
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Fig. I.-A.



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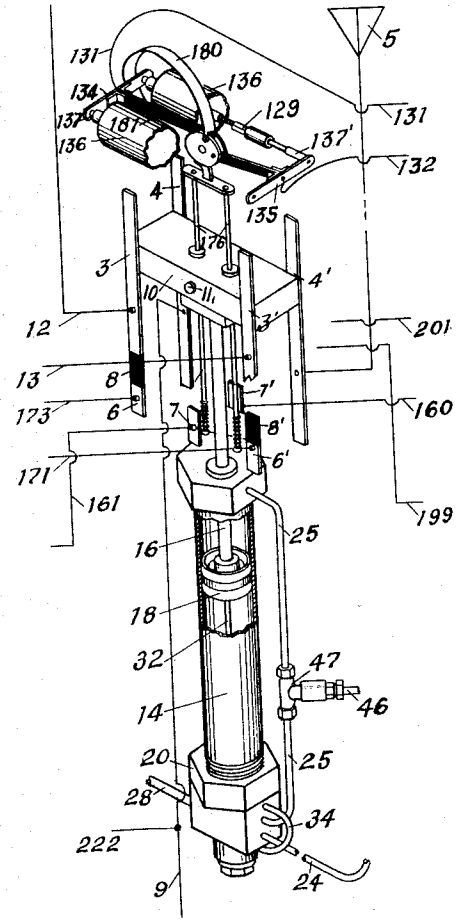
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Fig. I.B.



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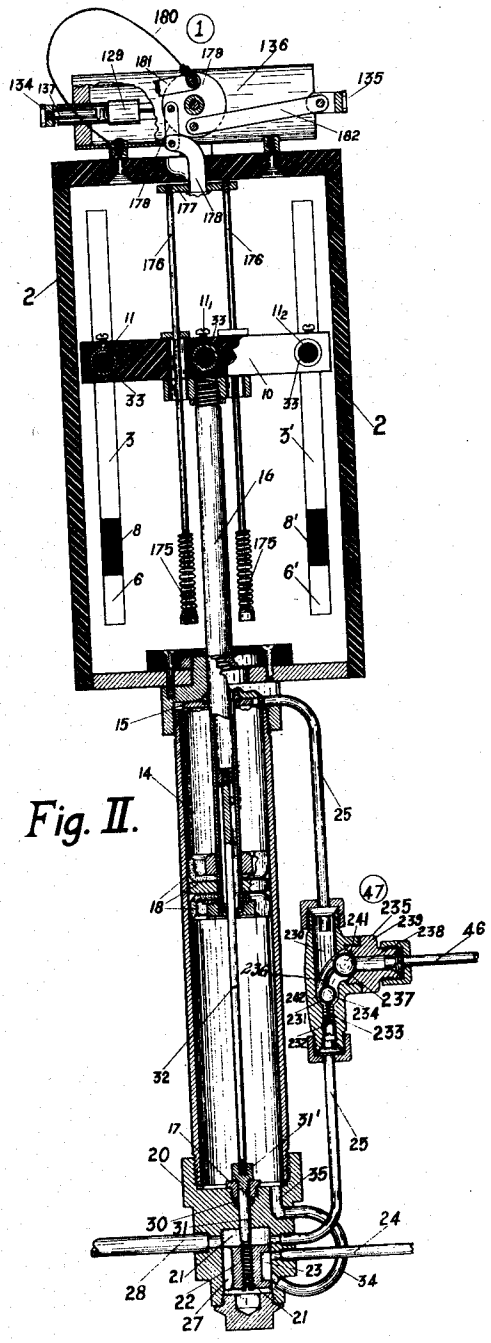


Fig. II.

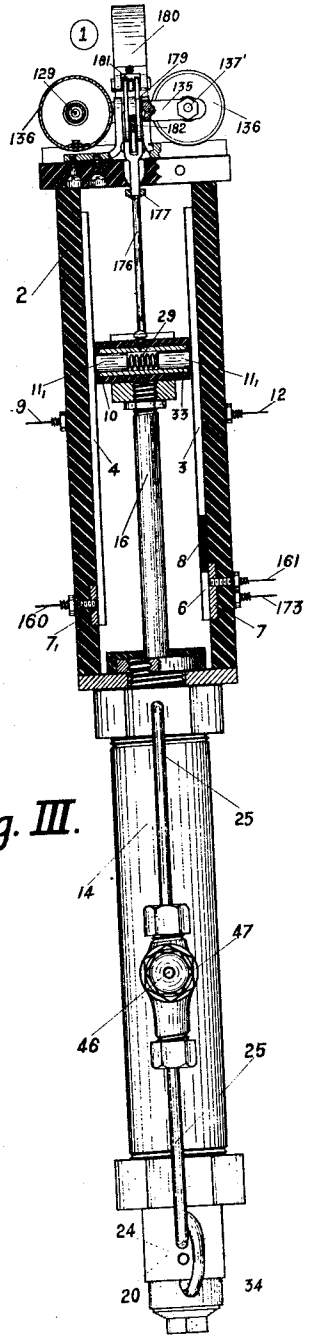


Fig. III.

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UNITED STATES PATENT OFFICE.

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WIRELESS AND AUTOMATIC RAILWAY SAFETY SYSTEM.

1,308,925. Specification of Letters Patent. Patented July 8, 1919.

Application filed March 1, 1915. Serial No. 11,416.

To all whom it may concern:

Be it known that I, HARRY D. BETZ, a citizen of the United States, residing at Kansas City, in the county of Jackson and State of Missouri, have invented certain new and useful Improvements in Wireless and Automatic Railway Safety Systems; and I do declare the following to be a full, clear, and exact description of the invention, such as will enable others skilled in the art to which it appertains to make and use the same, reference being had to the accompanying drawings, and to the letters and figures of reference marked thereon, which form a part of this specification.

My invention relates to a wireless and automatic railway safety system, and more particularly to a system for use on a plurality of railway locomotives, locomotive tenders or railway cars for automatically preventing collisions: the principal object of the invention being to provide means for stopping a train as it enters a danger zone and thereby eliminate the uncertainties of the human element that are so frequently an incident to railway accidents.

In describing the use of my invention I have referred to it as being mounted on locomotives only, but have done so merely as a matter of brevity and convenience.

My system, in a general way, embodies a wireless apparatus mounted upon each locomotive, locomotive tender or railway car, which apparatus is adapted for sending and receiving Hertzian, radio electric or etheric waves and for alternating the sending (transmitting) and receiving periods of each apparatus so that the sending mechanism of each apparatus will affect and operate the receiving mechanism of like apparatus on other locomotives when within the danger zone and also that the receiving mechanism of the apparatus on any locomotive will be affected and operated by the apparatus located at any stationary sending station, when such receiving apparatus is within the effective zone of such sending station; the transmitting and receiving mechanism (instruments) of each apparatus being so arranged and constructed that they act independently of and are not affected by each other, so that the waves transmitted by the sending mechanism and those received by the receiving mechanism of each apparatus will only affect and be affected by the respective transmitting and receiving mechanisms of like apparatus on other locomotives or those located at fixed stations.

In the accompanying drawings wherein my improved system is illustrated I have shown specific forms of instruments, together with ordinary locomotive controlling and indicating apparatus, and have illustrated some of the parts as operable by air pressure from the main reservoir.

In these drawings, however, I have not attempted to show the parts in their relative dimensions or arrangements on a locomotive, as such relative arrangement, independent of the wiring, is immaterial and it has been necessary to enlarge some and reduce other of the parts for better illustration.

Figures I—I^{A} illustrate a diagrammatical view of the system.

Fig. I^{B} is a detail view of the flasher or switching device with the cover removed.

Fig. II is a longitudinal sectional view of the flasher, and

Fig. III is a longitudinal view of the flasher taken at right angles to Fig. II.

Referring to the drawings, it should be understood that each locomotive is equipped with a complete apparatus, including receiving and sending instruments, with the locomotive controlling and indicating members and in the following description I will principally refer to the apparatus on a single locomotive, with the understanding that such description relates with like force to the apparatus on each locomotive equipped with my system.

In the drawings 1 (inclosed in a circle, to indicate that it refers to an assembled mechanism) designates the automatic controller by means of which the apparatus is placed alternately in sending (transmitting) and receiving position or condition, and which controller, together with the covers inclosing the coherers and the movable coherer contact members, protects the receiving element (the coherers) from local waves during the transmitting period. The said controller comprises a form of flasher or automatic switching device for making and breaking electrical circuits, in combination with a piston or engine, here shown as operable by compressed air, preferably obtained from the main reservoir of the locomotive (but which may be operated by steam, or water under pressure), by means of which piston or engine the movable parts of the flasher or switching device are automatically shifted

to different contact positions in order to change the circuits and thereby energize the sending mechanism of the apparatus and place the receiving mechanism of the apparatus in receiving position or condition alternately.

When the movable parts of the switch are in receiving position or condition as herein described, an electrical circuit of high resistance will be completed from the battery 138 over conductor 139, thence through polarized relay 140, conductor 141, conductor 131, contact carrying member 134, contact member or members 137, coherer or coherers 129, contact member or members 137′, contact carrying member 135 and over conductor 132 to the opposite pole of battery 138. By an electric circuit of high resistance, as used herein, I mean, a circuit containing a coherer or other suitable receiving instrument that normally offers a high resistance to the passage of an electric current and whose resistance will be lowered by the action of Hertzian waves thereon, thus permitting low voltage current to pass. However such circuit will not normally offer a sufficiently low resistance to permit a low voltage current to pass thereover and thus allow the polarized relay 140 to receive a sufficient volume of energy to move its armature 143 and compel it to contact the points 144 and 145. The normal high resistance of such a circuit is due to the presence therein of crystals or filings forming loose or imperfect contacts, making such a circuit practically impassable to a low voltage current but yet providing a circuit whose resistance to a current may be greatly reduced, and a low voltage current allowed to pass, by the action of Hertzian waves upon such crystals or filings.

I have heretofore and will hereinafter frequently make mention of danger zones; by danger zones I mean the distances at which the receiving instruments of each locomotive will be affected by the transmission of waves from the transmitting instruments of another locomotive, which will, of course, vary according to the strength of the transmitters.

The flasher (controller) or switching device which I prefer to use comprises a box 2 within which are mounted four sets of contact members to-wit: 3 and 3′, 4 and 4′, 6 and 6′ and 7 and 7′ and slidably mounted within the flasher box and between the spaced contact members above mentioned, is a plunger 10 which may be constructed of any suitable insulating material and which houses and carries three sets of conducting contact brushes, to-wit: 11_1 and 11_2, each set preferably comprising two brushes (see Fig. III in which but one set is shown in detail) with a spring 29 placed therebetween, which spring is adapted to at all times forcibly space said brushes in the conductive tubes 33 and thus compel a wiping engagement with the contact members 3 and 3′, 4 and 4′, 6 and 6′ and 7 and 7′; the arrangement of said contact members and said conducting contact brushes being such that when the plunger is in the receiving (upper) position connection will be made between the antenna, ground and receiving instruments, so that any wave picked up by the antenna 5, which in practice may be carried at the side or any other suitable place on the locomotive, will be conducted to the contact member 4′ of the flasher box 2, through the brushes 11_2, which brushes are carried by the plunger 10, to the contact member 3′ on the opposite side of said flasher box, and from thence over the conductor 13 to the primary of the tuning coil 130, through said coil, over conductor 12 to contact member 3 of the flasher box 2, through brushes 11, also carried by the plunger 10, to contact member 4, thence over the conductor 9 and metallic parts of the locomotive to the rail or possibly the ground; hence any wave picked up by the antenna that is capable of passing the tuner will pass by induction to the secondary side of the tuner and thence through circuits hereinafter described to instruments controlling the devices for stopping the locomotive upon which the apparatus is mounted.

On one side near the corner of and within the flasher box 2 (which may be made of any suitable insulating material or materials) contact members 3 and 6 are separated by insulation 8, and on the same side near the opposite corner of and within said flasher box, contact members 3′ and 6′ are separated by insulation 8′ and when the plunger is in the lower (transmitting) position, the brushes 11 contact with contact members 4 and 6, brushes 11_1 contact with the contact members 7 and 7′ and brushes 11_2 contact with contact members 6′ and 4′ and thus a circuit is closed from the service switch 215 over wires 159 and 160 to the flasher contact member 7′ and through brushes 11_1 to contact member 7, mounted on the opposite side of the flasher box 2, over wire 161 to the primary side of the transmitter or spark coil 162, thence through the primary of such transmitter over wire 163 to a contact point 164, with which the armature 165 of a relay 166 normally contacts, thence through said armature and over wire 167 to the switch 215.

A circuit being thus completed through the primary side of the transmitter or spark coil 162 as described in the preceding paragraph, energy will be produced in the secondary side of said transmitter 162 and such energy will be conveyed therefrom over the conductors 171 and 173 respectively to the spark gap 169, across which is shunted condenser 170, and thence from one side of the

spark gap 169 over the extended conductor 173 to contact member 6, of the flasher box 2, through brush 11, which is carried by the plunger 10, to the contact member 4, thence from 4 over the conductor 9 or through the metallic parts of the locomotive to the rails or possibly the ground and from the other side of the spark gap, over the extended conductor 171 to the contact member 6′, of the flasher box 2, through brush 11_2, which brush is likewise carried by the plunger 10, to the contact member 4′ and thence to the antenna 5; thus radiating energy that will be capable of operating the receiving mechanism or instruments of any and all locomotives similarly equipped which happen within the effective radius of the waves produced by such energy, and stop such locomotives.

As a means for reversing the action of the plunger 10 so as to alternate the contacts for the purpose of alternately energizing the sending instruments and placing the receiving instruments in receiving position or condition, I provide an engine, preferably operable by compressed air which engine is rigidly mounted at its upper end, to or in the bottom of the flasher box 2, and the upper end of this engine contains a stuffing box 15, through which the piston rod 16 is slidably projected.

Fixed to the lower end of the piston rod 16 is a piston 18 which is adapted for travel within the engine cylinder 14. The lower end of the cylinder 14 carries a valve housing 20, containing a chamber 21, within which a slide valve 22 is adapted for limited movement; the said valve being provided with a recess 23 for establishing communication between the pipe 24 which leads from the air supply pipe, and pipe 25, which leads to the upper portion of the cylinder when the valve is in upper position, and for establishing communication between the pipe 24, pipe 34 and passage 35 and thus admits air to the lower portion of the cylinder when valve 22 is in its other (lower) position. The valve 22 is substantially shorter than the chamber 21 and thus affords a passage between the top of the valve and top of chamber 21, for the passage of the exhaust from the upper portion of the cylinder and pipe 25 to the exhaust pipe 28, when in lower position, and allows the exhaust from the lower portion of the cylinder to pass through a vertical passage 35 and pipe 34 into the lower portion of chamber 21 and therefrom through a vertical channel 27 to exhaust pipe 28, when said valve is in its other (upper) position, in order to force air to one end of the cylinder while air is being exhausted at the other end thereof and vice versa.

The slide valve 22 is mounted on a rod 30′ that extends through a stuffing box 17 provided with packing 30 into the cylinder 14 and carries a stop or shoulder 31′ near the lower end of the cylinder 14; the part 32 of the rod above the stop or shoulder 31′ extending to near the top of the cylinder and passing through the piston 18 into the hollow piston rod 16; the upper end of the portion 32 of said valve rod being enlarged or capped to form an abutment or shoulder that the piston 18 will encounter in moving to its upper position, so that while the valve rod may slide freely within the piston rod the former will be lifted by its engagement with the piston when the latter is forced to the upper part of the cylinder and thereby shift the slide valve 22. When the piston is nearing its lower position it seats on the stop or shoulder 31′ on the valve rod 31 so that in its farther downward progress it forces said rod downwardly and shifts the valve to its lower position, wherein the pipe 25 communicates with the exhaust to clear the upper portion of the cylinder.

When the parts are in the last named or lower position, with the upper end of the cylinder opened to the exhaust, the recess 23 of the slide valve establishes communication between the air supply pipe 24 and the pipe 34, so that air from the supply pipe is admitted through the pipe 34, into a channel or passage 35 in the valve housing 20, that opens into the lower end of the cylinder below the piston 18 to admit air pressure for lifting the piston to the upper limit of its travel, thereby raising the plunger 10 to reestablish the original contacts and circuits and thus place the receiving instruments again in receiving condition or position. The piston when rising engages the upper end of the slide valve rod as it approaches the top of the cylinder and in so doing lifts the slide valve and shifts the path of the air and in this way automatically alternates travel of the plunger, the energization of the sending instruments and the placing of the receiving instruments of the wireless apparatus in receiving position or condition.

The pipe 24, through which air is supplied to the slide valve and thence to the cylinder of the engine operating the flasher apparatus, leads from a valve housing 36 and directly from a chamber 37 that is formed in the bottom of the housing 36, by the base of the housing and a diaphragm 38 having a port 39 normally open from an intake chamber 40 that is fed by a pipe 41 preferably from the main air reservoir (not shown).

Above the intake chamber 40 is a diaphragm 43, having a normally closed port 44, which port when open leads to a chamber 45, and leading from the chamber 45 is a pipe 46 that communicates with a check valve 47, which valve is adapted, under air pressure received through pipe 46, to open a passage to that portion of pipe 25 above

said valve 47 and at the same time close the passage to that portion of pipe 25 below said valve so that the air may travel to the top of the cylinder and forcibly lower the piston together with the plunger to establish the sending or transmitting circuits and at the same time protect the receiving instruments, as presently described.

The check valve 47 (shown in section in Fig. II), which is installed in the pipe line 25, preferably comprises a casing having a vertical channel 230, which is normally open to the passage of air in said pipe, and the channel 230 having an upwardly facing valve seat 231 in the lower portion thereof. Threaded into the walls of the channel 230 below the valve 242 is a sleeve 232 and seated on said sleeve is a spring 233 adapted for normally preventing the closing of the valve 242 by a sustaining ball 234, which is rigidly connected by connector 236 with a ball 235 against the seat 237 of the plug 239 to prevent the passage of air from the channel 230 to the passage 238 and pipe 46.

I preferably provide a valve of this type so that when the parts are in the last named position a free passage of air is permitted through the channel 230 and pipe 25, so that when the supply of air to pipe 24 is cut off and pipe 24 is opened to atmosphere, the air supply is shifted to pipe 46 by means of the operation of the valves in the valve housing 36 (Fig. I) and the ball 235, which is preferably larger than the ball 234, is forced from its seat 237 and the ball 234 is, against the tension of spring 233, simultaneously forced to seat 231 by the action of the air pressure on ball 235 and the balls are held in this position by the action of the air on ball 235 and the upper hemisphere of ball 234 keeping the valve port 141 open and the valve port 142 closed, so that the supply of air to the lower portion of pipe 25 will be cut off, and the air admitted through the upper portion of pipe 25 to the top of cylinder 14, for the purposes herein set forth.

The valve controlling the supply of air to the controller ①, and its various parts, is indicated on the drawing by the numeral ㊷ (inclosed in a circle in order to designate that it refers to an assembled mechanism.) The various parts of the valve ㊷ and their relations to one another and to other parts of my apparatus may be described as follows, to wit: Projecting through the valve ports 39 and 44, and through a port or bearing 49 in the top 50 of the chamber 45, and the port or bearing 48 at the bottom of the chamber 37 is a rod 51, and fixed on said rod are valves 52, 53 and 59 which are adapted for closing and opening the ports 39, 44, 58 and 58′ respectively; the faces of the valves 52 and 53 being reversed so that when the rod 51 is raised the valve 52 will seat to prevent the passage of air between chambers 40 and 37 and the valve 53 is opened to admit air to the chamber 45 and at the same time valve 59 is lifted, thus opening ports 58 and 58′ and allowing air to escape to atmosphere from chamber 37 and vice versa.

The diaphragm 50, above the upper chamber 45 is provided with a port or bearing 49, through which the valve rod 51 is projected, and fixed to this valve rod above the diaphragm 50 is the armature 56 of an electro-magnet 57 which magnet is located in the circuit controlled by the receiving instruments, so that when the wireless apparatus is affected by the apparatus on another locomotive similarly equipped, the magnet 57 is energized and lifts the armature 56 and the rod 51 against the spring 54 so that air may pass from the pipe 41 through the open port 44 into chamber 45 and thence through valve 47 to the top of cylinder 14, as heretofore explained, which forces the piston 18 and the plunger 10 to their lower position, in which position they remain until liberated, as later explained, and the apparatus is thus compelled to continuously transmit waves.

The housing 55 of the magnet 57 is preferably constructed of iron so that it will aid the magnetic field and thus increase the efficiency of the magnet.

The receiving instruments of each apparatus are protected from the influence or effect of the transmitting instruments of the same apparatus, during the transmitting periods of the apparatus in the following manner:

One or more coherers, or one or more of any other instrument, device or contrivance for detecting or receiving electrical waves, preferably of a loose or imperfect contact variety may be used; but such instrument, device or contrivance must perform the same or like function as that of the coherer here shown and I prefer to use two coherers, one of which, 129, is shown, the other not shown, except in Fig. III, in connection with the receiving instruments of each apparatus and these, as would be the case were any other detector or receiver of electric waves used, are preferably placed or mounted on top of flasher box 2, and these coherers are, as would be necessary with any other electrical wave detector or receiver, and must be mounted within cases, which cases may be constructed of any suitable electrical conducting material or materials, but preferably of brass.

The cases shown in my drawing I have numbered 136 (Fig. I) and, as shown within its respective case, each coherer rests at each end in a bushing (shown in section in Fig. II), which bushings are preferably mounted centrally at and extended through the ends of the coherer cases and may be composed of any suitable insulating material or materials. When the plunger 10 descends to a

position below the receiving strips 3 and 3' it will strike the springs 175 which surround the lower portions of rods 176 and in its further descent force said rods, their connector 177 and the strips 178 connecting same to the wheel 179 downward so that the wheel will be turned against the resisting spring 180 and force the arms 181 and 182 with their respective duplex contact carrying members 134 and 135, outwardly where they will remain until the plunger again ascends to the receiving position. Such action disconnects the coherers and draws the coherer contact carrying members 134 and 135, with their four contact members 137 and 137', a safe distance from the coherers during the transmitting periods of the apparatus. Said contact members enter the cases 136 through the bushings above referred to.

Likewise, were any other electrical wave detector or receiver used, in addition to being mounted within a metallic case or cases, in order to protect such detector or receiver from the operation of the transmitting instruments of the apparatus, it would be necessary to disconnect the contact members or terminals from the wave detector or receiver within such cases or immediately outside thereof and in either instance to withdraw or separate the contact members a safe distance from the electrical wave detector or receiver during the transmitting periods of the local apparatus.

As I have heretofore stated, the apparatus is so designed that when the receiving instruments are in receiving (upper) position or condition and a wave is received from another like apparatus within the danger zone of which this apparatus enters, the devices for stopping the locomotive are automatically actuated; such devices in part comprising the locomotive or engineer's throttle 64 and an air relief valve for automatically setting the air brakes (not shown), which devices are controlled in the following manner:—

The throttle lever is connected with the steam rod 60 which carries a quadrant 61, having teeth 62 and having pivotally mounted thereon at 63, the throttle lever 64, one end of which is pivotally mounted at 65 on a bracket, or the like 66 and the other end of which is provided with a handle 67 and grip rod 68, which grip rod is adapted for pulling or sliding the dog 69 outwardly from engagement with the teeth 62 of the quadrant 61 when the grip rod is actuated.

The pin 71 is within the slot 70 of the dog 69, which slot travels back and forth about said pin. The pin guides and aids in holding the dog on the throttle lever and still allows the dog to be actuated. The dog 69 carries teeth 73 for engaging the teeth 62 of quadrant 61 and has a rod 81 slidably projected through a boss 76 rigidly mounted on the throttle lever 64. Said rod 81 is mounted so that it may be actuated on the throttle lever and is provided with a nut or head 75 which is adapted for engagement by the arm 77 of a lever 78 (presently described).

A spring 80 surrounds the rod 81 and at one end bears against the boss 76 and at the other end against the shoulder 72 of the dog 69 to yieldingly tension said dog 69 to its engagement with the teeth 62 of the quadrant 61, and a spring 83 is mounted between the throttle lever and one of the arms 74 of the lever 78 to yieldingly tension the lever 78 to its idle position; such lever 78 being pivotally mounted to throttle lever at 79.

Pivotally mounted to the third arm 84 of the three-arm lever 78 is a rod 86 which extends through a stuffing box 87 into the cylinder 88 which is pivotally mounted at 92 to the boiler head 89 so that it may swing with the throttle lever. The end of the rod 86 within the cylinder carries a piston 90, of any suitable construction.

Opening into the end of the cylinder 88 at the side of the stuffing box 87 is a pipe 93 which connects with the chamber 94 of a valve housing 95, which chamber is adapted for communication through the port 96, in the diaphragn 97, with the intake chamber 98 that is fed through a pipe 99, preferably from the main air reservoir (not shown) although, if desired, the same may be operated by steam. The housing 95 has relief ports 100 therein, and mounted on a rod 101, which extends through the port 96, are opposed valves 102 and 103 which are adapted for closing the intake and relief ports 96 and 100 respectively when the rod 101 is in reverse positions.

It is apparent that, with this construction, the circuit including magnets 107 and 126, which is normally closed, energizes the magnet 107 to normally retain its armature 106 in its elevated position against the resistance of a spring 109 that surrounds the valve stem 101 and bears against the bottom of the cup 105 and against the top of the valve 102, thereby preventing the flow of air to the chamber 94 and throttle cylinder 88, and permitting the outer end of the cylinder 88 to be opened to the atmosphere through the pipe 93, chamber 94 and ports 100 in the valve housing; the inner or boiler end of the cylinder being opened to atmosphere through the constantly open ports 110 at said inner end of the cylinder.

With the parts in this condition the throttle lever may be operated in the ordinary manner by the engineer. Should the receiving instruments of the apparatus receive Hertzian or similar waves from the sending or transmitting instruments of a like apparatus on another locomotive which has en-

tered the danger zone relative to the one upon which the present apparatus is mounted, the receiving instruments of the apparatus will operate and break the circuit last above mentioned, thereby deënergizing the magnets 107 and 126 so that the air pressure aided by the spring 109 will open the valve port 96 and allow air, preferably from the main reservoir, to flow into the head of the cylinder 88 and force the piston inwardly in said cylinder. This movement of the piston draws the rod 86 to rock the three-arm lever 78 into engagement with the head or nut 75 on rod 81 and pull the dog 69 out of locking engagement with the quadrant 61 to release the throttle rod 64; further movement of the piston drawing the throttle lever inwardly to close the throttle and shut off the steam.

Also controllable by the circuit containing magnets 107 and 126 is an air relief valve, comprising a housing 111 and 111′ composed of two parts or sections having chambers 112, 112_1 and 112_2, although 112_2 is not essential, 112_1 being provided with ports 113 communicating with atmosphere and 112_2 having connection with a train-line air pipe 114. Located within the housing 111 is a diaphragm 115 and slidably mounted in said diaphragm is the shank 116 of a valve 117, which valve is adapted to seat in a valve seat 118 to shut off the flow of air from the train-line air pipe to the ports 113.

Pivotally mounted in the housing above the diaphragm 115 is a two-arm lever 120, having an arm 121 for engaging the end of the valve shank 116, and having an arm 122 adapted for engagement by the latch 123 on a pivoted lever 124, the opposed arm 125 of which comprises the armature of an electro-magnet 126 which is served or energized by the said circuit. With this construction the magnet is normally energized through the said circuit to retain the two-arm lever 120 in engagement with the valve shank to retain the valve in its seat.

When the said circuit is indirectly broken by the reception of Hertzian or similar waves from a like apparatus on another locomotive, the armature is released and the pressure of the train-line air forces the valve open to relieve the air in the train-line air pipe and thus automatically apply the brakes.

In chamber 112 and within and rigidly fastened to the housing 111 of the air relief valve, is a pin 119 against which arm 125 of the pivoted lever 124 will drop when magnet 126 is deënergized, where it will remain until magnet 126 is again energized, whereupon said lever 125, comprising the armature of electro-magnet 126, will be magnetically lifted to engagement with the magnet, which will in turn lift the longer arm 122 of the two-arm lever 120 and lower the shorter arm 121 of said lever and thus force the valve 117 to its seat 118.

The housing 95 of magnet 107 and housing 111 of magnet 126 respectively are preferably constructed of iron in order to aid the magnetic field and thus increase the efficiency of the magnets.

As the signals indicating and resetting members are controlled by various means and circuits, such means and circuits will be mentioned in connection with the description of such apparatus and the electrical circuits controlling the same, and as the main, receiving, sending, shunt and other circuits overlap at numerous points I will describe the operation of the devices and instruments and trace the circuits and controlling means in their order of operation and use.

When the plunger 10 is in receiving (upper) position, as hereinbefore described, and Hertzian or electric waves are received by the antennæ, a circuit will be completed from the antennæ and ground contact members 4 and 4′ through the brushes mounted within the plunger 10 to the opposite strips 3 and 3′ and from there to the primary side of a tuner 130, so that if the waves picked up by the antennæ are capable of passing the tuner they will, by induction, pass to the secondary side thereof, and thence over the conductors 131 and 132 respectively, and through the condenser 133, duplex-contact carrying members 134 and 135 and the contact members which pass through and are insulated from the heads of cases 136; said members being located at the ends of the coherers 129 (only one of the coherers being shown in one of the phantom drawn cases 136) and thus cohere the filings or crystals within one or both of the coherers.

The four contact members 137 and 137′ are rigidly fastened to said duplex contact carrying members 134 and 135 and are adapted to contact with the coherers 129 within the protective cases 136 and thereby conduct waves to the coherers and cohere the particles of metal or crystals therein.

I preferably provide two coherers to at all times insure an operative receiving apparatus, but only one is essential. When one or both of the coherers are cohered, as above described, by reason of the decreased resistance within the coherer or coherers, the circuit through the relay 140 will at once become active so that sufficient electrical energy will pass through the contact members 137′, duplex contact carrying member 135, conductor 132, battery 138, wire 139, polarized relay 140, wire 141, conductor 131, duplex contact carrying member 134 and its contact members 137 back to the coherer or coherers to energize the polarized relay 140 and cause its armature 143 to move and contact with the points 144 and 145 respectively and close the circuit from the service wire

203 at the contact point 144 through the armature 143, wire 147, and through one of the windings of the compound-wound magnet 57, over the conductor 227 to the other side of the service wire 159 and simultaneously with the closing of a circuit through magnet 57, a circuit will likewise be closed from the wire 147, through the magnet 148 to the other service wire 159, thus energizing magnets 57 and 148. When the magnet 148 is energized its armature 149 is drawn thereto against the tensioning of the yielding spring 150, thereby simultaneously breaking the normally closed circuit from the source of electrical supply through the throttle and air-line magnets 107 and 126 respectively at the contact point 193.

The normally closed circuit frequently mentioned, comprises a source of electric supply, supplied through the switch 215 to the circuit comprising the conductor 159, an armature 149, contact point 193, magnets 107 and 126 and a conductor 203. The circuit in detail may be traced as follows: Starting from the electrical supply switch 215, the electrical energy is normally carried over the conductor 159, to armature 149, thence to contact point 193, thence to switch 151, through said switch to and through magnet 107, to and through magnet 126, to and through switch 146, and to conductor 203 and over conductor 203 to the opposite side of switch 215. I do not desire to be restricted to using this circuit normally closed or the other mechanism in its normal position.

When the circuit is broken through the magnets 107 and 126, the armature 106 of the magnet 107, controlling the valves 102 and 103 which are rigidly attached thereto by the connecting rod 101, is forced from its normal position, by the spring 109 aided by the air pressure contained within chamber 98 acting on the top of the valve 102, thereby forcing the normally closed valve 102 from its seat, thereby opening valve 102 and closing the normally open ports 100, so that the air from the main reservoir may flow from the pipe 99 and chamber 98, through the aperture produced by the open valve 102, and through the passage 94 and the pipe 93 (preferably consisting principally of steel tubing) to the cylinder 88 and thereby forcing the piston 90 and piston rod 86, mounted therein, toward the boiler head 89, thus allowing the piston rod 86, the end of which is fastened to the trigger lever 78 to rock said lever on its fulcrum 79 against the yielding spring 83, thereby forcing the right angle arm 77 of said lever to draw the rod 81 and the dog 69 connected therewith, outwardly against the tension of the yielding spring 80, releasing the dog 69 from engagement with the teeth in the quadrant 61, which quadrant is rigidly attached to the steam-rod 60, so that the dog 69 will be released before the spring end of the lever 78 strikes the engineer's throttle lever 64 to draw said throttle lever inwardly and cut off the supply of steam to the steam cylinders of the locomotive; the cylinder 88 being supplied with apertures 110 at its boiler end and the normally open ports 100 in the controlling valve mechanism, in order to eliminate all possibility of an air cushion being produced within either end of the cylinder.

The air-brake valve housing preferably comprises two members; the upper member 111 is fastened to the lower member 111′ into which one end of pipe 114 is inserted, the other extremity of the pipe being connected to the train-line air-pipe, the air-brake valve being provided for releasing the air in the train-line air-pipe when the magnet 126 is deënergized, the train brakes are thereby automatically applied and the train stopped.

When the magnet 126 is deënergized, its normally engaging armature lever 125 is released and turns at its fulcrum 156, by the force of gravity acting on its longer end, so that the hooked end will permit the dog 120 to turn on its fulcrum 127 because of the train-pipe air acting upon the valve 117 which is forced from its seat and allows the train-pipe air to escape through the apertures 113 to atmosphere.

The quickness of the stop of the locomotive may be varied by varying the diameter of the valve 117.

Simultaneously with the closing of the relay 140 and the energizing of the magnets 57 and 148, the armature 56 of the valve ⓐ which valve controls the supply of air to the cylinder of the engine which operates the flasher mechanism, and its valves 53, 52 and 59 rigidly connected therewith by the connecting rod 51 within the valve housing 36, will be attracted against its yielding spring 54, and thereby open the valve port 44 and ports 58 and 58′ so that the air from the main reservoir entering the chamber 40 through the pipe 41 will pass through the open valve port 44 into the chamber 45, and thence through pipe 46 to the double-acting check-valve 47, from whence it passes into that portion of the pipe 25 above the valve 47 and thence into the top of cylinder 14, and thereby forces the piston 18 to the foot of said cylinder so that the plunger 10 will be forced into sending position and thus complete the circuit from the service wires 159 and 160 to the flasher contact member 7′ and through the center brushes 11_1 mounted within the plunger 10, to contact member 7 on the opposite side of the flasher box to which is connected a wire 161 which runs to the primary side of the spark coil 162, which may

as well be a transformer, thence through the spark coil, over wire 163 to a contact point 164 with which the armature 165 of a relay 166 normally contacts and thence to the service wire 167.

When the circuit is completed through the primary side of the spark coil 162, as has just been described, energy will be produced in the secondary side thereof, and carried therefrom over the conductors 171 and 173 to the spark gap 169, across which is shunted condenser 170, and from thence over the extended conductor 171, contact member 6′ in the flasher box 2, the brush 11_2 carried within the plunger 10 to the contact strip 4′ at the opposite side of said flasher box and to which the antennæ are connected, and simultaneously from the other side of spark gap 169, energy will pass over the extended conductor 173 to contact member 6, through a brush 11 mounted within the plunger 10, to the contact strip 4, mounted at the opposite side of said flasher box, and from thence conducts energy through the metallic parts of the locomotive to the rails and possibly the ground.

When the circuit is completed through the transmitter, as heretofore described, a succession of Hertzian waves will be radiated from the antennæ on the locomotive carrying said apparatus, which will affect any other like apparatus within a definite radius and thereby operate the receiving instruments of such other apparatus on any locomotive so equipped and within the danger zone, and stop the latter.

The flasher (controller) is of such construction that its plunger 10 in being forced downward will disengage the brushes carried within said plunger from the receiving strips 3 and 3′ and pass over insulated portions 8 and 8′ to the sending contact members 6 and 6′. It is apparent that there is only an instant, while the brushes are sliding over the insulated portions, when the apparatus is in neutral position, *i. e.*, when no waves are transmitted or received. The contact member 7′ is preferably shorter than the members 6, 7 and 6′, so that the respective brushes will preferably have a full contact face on the latter members before the center brush contacts the shorter member 7′ and completes the circuit through the primary side of the transmitter. When the plunger descends to a position below the receiving contact strips 3 and 3′ it will strike the springs 175, which surround the lower portions of rods 176 and in its further descent force said rods, their connector 177, and the strips 178 connecting same to the wheel 179 downward, so that the wheel 179 will be turned against the resisting spring 180 and force the arms 181 and 182, which arms are of insulating material or materials, with their respective duplex contact-carrying members 134 and 135 outwardly where they will remain until the plunger again ascends to the receiving position. Such or similar action is necessary in order to protect the coherers mounted within their respective cases from local waves during the transmitting period.

In order to obviate the possibility of synchronism in the different apparatus, the flashers may be so constructed that the receiving and transmittting periods of the different instruments will vary or it may be accomplished by varying the rapidity of travel of piston and plunger of the different apparatus.

When the polarized relay 140 is completely energized following the reception of Hertzian wazes from a stationary or from other movable transmitting station equipped with my apparatus, the circuit through the magnets 57 and 148 is completed, as has previously been described, and an auxiliary circuit will also be completed from battery 138, wire 184, bell 185, wire 186, contact point 144, through armature 143, point 145 and back to battery 138 which will cause bell 185 to ring and notify the engineer that another train is within close proximity and that his train is being automatically stopped.

When the magnet 148 is energized to attract its armature 149, the arm 188 of the latch-lever 189 is released, so that the weight 190 or, if preferred, a spring 191, will cause the hooked end of the arm 188 to drop under the armature 149 and hold the normally closed circuit through the magnets 107 and 126 open until such time as it is desired to again start the train.

The lever 189 is preferably provided with a seal if desired, so that when the engineer wishes to start his train after it has been automatically stopped through the operation of the previously described receiving apparatus, it is necessary for him to break the seal and push the button 192 to move the arm 188 out of the path of the armature 149 so that the spring 150 may pull the armature 149 to contact with the point 193 and permit the contact member 194 to contact the point 195 and close the circuit from the service line 159 over wire 197, wire 198, contact member 194 of lever 189, and from thence by contacting with point 195, over wire 199, through a decoherer indicated by the box 200 and striking arm 205, (which may be the mechanism of an ordinary electric bell), which is preferably attached to the outside of the flasher box 2, to wire 201 and through said wire to the service line 203. Thus the decoherer 200 is energized and causes the striking arm 205 of the decoherer to strike the coherer cases 136, whereupon the filings or crystals within the coherers decohere, which permits the armature 143 of the polarized relay 140 to return to its normal open

position, whereupon the magnets 57 and 148 are deënergized and their armatures permitted to return to their initial positions and the armature 149 of magnet 148 allowed to contact point 193 and thus renew the circuit through the magnets 107 and 126, so that the valve 117 of air relief valve will be automatically reset and at the same time the air will be permitted to escape from the air cylinder 88, which cylinder thereupon releases control of the engineer's throttle 64 and likewise of the steam supply to the cylinders of the locomotive, and the locomotive may then be operated as before.

I provide the sealed lever 189 so that when a locomotive is inspected after its run the inspector, upon finding the seal broken, may require a statement from the engineer regarding the reason for the use of the deco-hering apparatus and thus make it possible for the railroad company to keep a check on the use of the apparatus, as well as to prevent tampering with same.

To provide automatic means for notifying the engineer when his air is not at proper pressure, I line the present air gage 205 with segments, some of which are of any suitable electrical conducting material or materials and others of which are of any suitable electrical insulating material or materials, as shown on the air gage in the drawing, and connect one side of the service line 203 to the air gage by means of the conductor 237 in order to conduct current to the hands of the air gage and preferably to the main reservoir hand 206. A contact member 207 is securely fastened to the end of the hand 206, so that when the main reservoir pressure drops to any predetermined point, say eighty pounds, it will contact the segment 208, which segment is of conductive material and thereby complete the circuit over the wire 209 with the signal bell 210 and from thence over wire 197 to the opposite side of the service line. The bell 210 is thereby rung and warns the engineer that the air pressure is down.

If it were desirable, the train could be automatically stopped (should the pressure continue to drop, for instance, to sixty pounds) by a circuit being completed from the hand 206 to segment 212 and over wires 213 and 147, through magnets 57 and 148 respectively and in turn deënergize magnets 107 and 126. If the automatic stop were used as above described, in the event of low air pressure, it will be observed that when magnet 57 is energized the piston and plunger of the flasher will be forced to their lower or sending positions for the purpose hereinbefore explained. The piston and plunger will then remain in sending (lower) position until the air pressure is raised to normal and the button 192 is depressed to release the automatic stop apparatus and reestablish the initial position or condition of the apparatus, so that the locomotive may be operated in the usual way. When the magnet 57 is energized the armature 56 will be attracted thereto and inasmuch that the armature 56, rod 51, valves 52, 53 and 59 move as a unit, the course of the air will be shifted from its normal course to pipe 46, valve 47, the upper section of pipe 25 and into the top of cylinder 14, which air will force the piston 18 and the plunger 10, of the controller ① to transmitting position. It is obvious that after the circuit through the magnets 126 and 107 has been broken, thus causing the train to stop, it will no longer be necessary for the wireless apparatus to be in receiving position, but that it will still be necessary to transmit waves in order to obviate the possibility of other trains colliding with the one thus stopped, and as we are in this instance assuming that something has happened to the air pumps, reservoirs, feed valves or some other essential part of the air mechanism, it is obvious that air under sufficient pressure to actuate the piston in the usual way may not long exist. This action does not in any way interfere with the efficiency of the apparatus, because the steam on the present locomotive is cut off by the closing of the throttle, the air applied to the brakes and the locomotive is being stopped, there is no longer any need for reception of waves by the receiving instruments thereof, but every need for protecting the present locomotive against other approaching locomotives by the constant transmission of waves.

Any suitable type of generator may be used for supplying the necessary electrical energy to operate my apparatus through switch 215 and over the service wires 159, 203 and 167, or two or more generators, of any suitable class, may be supplied that will automatically connect the second generator to the supply switch 215, in the event that the first fails to produce sufficient energy.

The amount of steam required to operate the generator or generators and the amount of air used for other purposes will be so small, that the cost of so operating such a system will be practically nothing.

With the parts constructed and arranged as described, should two locomotives traveling in opposite directions or should two locomotives traveling in the same direction, come into such close proximity to each other as to come within the danger radii or zones of the apparatus mounted on the respective locomotives, the transmitting energy of the locomotive into the danger zone or radius of which the other locomotive first comes will immediately act upon the receiving instruments of the other locomotive and automatically stop the same as hereinbefore explained.

Upon the receiving instruments of such locomotive being affected by the waves sent out by the transmitting instruments of another locomotive, the apparatus on the locomotive whose receiving instruments are affected will at once begin to continuously send out Hertzian waves, so that the other locomotive into the danger zone of which it has entered will immediately upon entering the latter's danger zone be automatically stopped in like manner. Such action is practically simultaneous on both locomotives and, therefore, both trains are automatically stopped before there is any danger of collision; the radii of the danger zones preferably being greater than the greatest distance the locomotives and their trains can travel after the throttles are closed and the brakes set, even when running at their maximum speed.

I am fully aware of the fact that it is frequently necessary for trains to come into close proximity to each other, such as when entering or leaving stations, on switches or in switch yards and when passing on double tracks and that in such cases it would occasion great annoyance and inconvenience were my wireless apparatus in use and no means provided for preventing in such instances automatic stops.

In view of the foregoing, I provide a contact member of any suitable form which may be used at any suitable place and which I have illustrated in the drawing as a metallic track strip 217, fastened between the rails, or in such other position as may be desired, say four inches from the rail and connected metallically therewith. These are, as heretofore mentioned placed where it may be desired to prevent the automatic operation of my wireless apparatus and such strips are likewise placed at such points as it is desired to automatically again place the safety apparatus in operative position after being cut off as above mentioned.

While I have described a specific mechanism and use of the invention, such specific description has been merely illustrative, as it is apparent that it may be applied with different combinations of instruments and mechanism or with the same combination applied differently and that different supply sources and uses of the apparatus may be substituted therefor.

When a locomotive so equipped passes over the strip 217, a circuit will be completed at the point of contact between the strip 217 and a brush on member 218, through a wire 219 to the negative pole of the battery 220 and therefrom to the positive pole of the battery, thence through wire 221 to contact point 164, through armature 165, to relay 166, thence through said relay to wire 222, thence over wire 222, which is connected to the metallic body of the locomotive, so that the circuit may be completed through the wheels of the locomotive to the track strip 217.

The strip 217 is used for the purpose of contacting the brush or contact member 218, which member is securely fastened to the lower part of the locomotive at some convenient place and is insulated from the metallic parts thereof. When the battery circuit is completed, as just described, the relay 166 is energized to draw the armature over to contact point 224 and thereby break the circuit just traced, as well as the circuit through the transmitter, and to complete the circuit from the service line 167 through the armature 165, contact point 224, over wires 225 and 226, through compound wound magnet 57 of the valve ㊷, to the opposite service wire 159, the object being that magnet 57 will be energized to attract its armature 56 and open the valve 53 and passages 58 and 58′ and close the normally open port 39, so that air will be forced to the top of the cylinder 14, causing the piston 18 and the plunger 10 to move to their lowest position, whereupon the apparatus is in sending position with the receiving instruments shut off from all incoming waves.

It is apparent that when the circuit is broken through the transmitter at the point 164, no waves will be transmitted and the apparatus will remain silent, that is, will neither send nor receive waves until the position of the armature 165 of the relay 166 is reversed.

When after the apparatus on a locomotive has been automatically put in silent position for any of the purposes hereinbefore mentioned and it, the locomotive, again reaches a point where it is essential that the apparatus again alternately transmit and receive Hertzian or similar waves, it will pass over a like contact strip 217 located at such point, which will result in completing the circuit at the contact point between the strip 217 and the flexible contact number 218, over wire 229 to the positive pole of battery 230, through battery to the negative pole thereof, over wire 225 to contact point 224, contacting armature 165 and thence to relay 166, through said relay to wire 222, thence through the metallic body of the locomotive and wheels thereof to the track and the strip 217, thus completing the circuit.

It is apparent that but one flexible contact member 218 is needed, that this contact member must be double acting and that the poles of batteries 230 and 220 are reversibly and alternately connected with the relay 166, so that every time flexible contact member 218 contacts a strip 217 for the purpose of temporarily silencing the apparatus, the direction of the electrical current supplied to relay 166 will be reversed when the locomotive or train makes a similar contact upon reaching a point where it is desired that the

apparatus be operative and hence the magnetism resulting therefrom will reverse the direction in which the armature 165 moves and change the point of contact thereof.

If a side or switch track is equipped at the switch with contact strips 217, when a locomotive passes over such a strip the safety apparatus on such locomotive will be rendered dead, so far as the prevention of collisions by the wireless means is concerned, and will remain so until the same or another contact strip is contacted by the flexible contact member 218, whereupon the apparatus will resume its important duty.

It is apparent that if both roads were equipped with my safety apparatus there would be no need to install a transmitter at a crossing or make any provision to protect the trains at such point, because my safety apparatus mounted on the locomotives would stop the trains and prevent accident.

By the use of this system, as described herein, it will be impossible for collisions to occur between two or more locomotives or trains, regardless of direction of approach while the trains are under the protection of my wireless apparatus. When a locomotive or train leaves the protected field of this wireless safety system, as when entering a depot or yard zone, or wherever such locomotive runs over a track strip as represented on the drawing, Fig. I, by the numeral 217, which silences the wireless apparatus, it may be protected by a manually operable block system as is now customary in most depot zones, or it may, if so desired, be controlled by a track circuit within such zones, or at such other places where same is deemed necessary, that will in case of danger release or throw an automatic trip (not shown) that will, in practice be located between the tracks or other convenient place, or it, the automatic trip, may be suspended over the track at a convenient height for engagement with a member projecting from the locomotive, so that when the member that is carried by the locomotive engages with said trip it will automatically break the circuit through the magnets 107 and 126, preferably by automatically opening a switch 151 installed in the latter circuit and in such position on the locomotive as is necessary for automatic operation by said trip, and thereby automatically stop such locomotive or train equipped with my safety system when the locomotive passes over or under the automatic trip and thereby opens said switch. If desired, the trip may be controlled by the tower man, by his depressing a button or in some other manner completing the circuit to the automatic trip, thereby causing such trip to move to such position as is necessary to engage the switch 151 and cause its arm or switch blade 152 to rock on its fulcrum 153 and move the portion 154 of said blade from its normal engagement with the post 155 and break the circuit through magnets 107 and 126, which will, in turn, automatically cut off the supply of steam to the cylinders of the locomotive and apply the brakes and thus stop the locomotive or train.

Again, if so desired, another switch 146 may be placed in the circuit of magnets 107 and 126, and within easy reach of the engineer, fireman, or both, so that such switch may be manually opened in case an emergency stop, not under control of said safety system, is necessary, as in the case of the fireman seeing the necessity for an emergency stop, not observed by the engineer or in case the engineer's air-brake valve becomes inoperable through accident, or for any other cause. With the present locomotive equipment, should the fireman see a necessity for a stop which escapes the engineer's notice, he must call to the engineer and apprise him of the danger before the latter will make any attempt to stop the train.

Having thus described my apparatus for use on locomotives, I do not wish to be understood as limiting my system and apparatus to locomotives, as it is obvious that such a system may be used with like results for the prevention of collisions between any two or more ships or vessels, street railway and interurban cars, or any other mechanically, or power driven vehicles, regardless of their direction of travel or approach. The only changes necessary being in the adaptation of my apparatus to the particular ships or vessels or other vehicles to be equipped.

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

1. A wireless apparatus comprising sending and receiving instruments, circuits for the sending and receiving instruments having common antennæ and ground members, separate contacts in the circuits, a switch for alternately connecting the circuit contacts with the antennæ and ground members, a primary circuit for the sending instrument having contact points adapted for connection by said switch when the parts are in sending position, a coherer device in the receiving instrument comprising movable contacts, and connection between the switch and movable contacts for automatically withdrawing said contact members from the coherer to render the receiving instruments inoperative when the parts are in sending position.

2. A wireless apparatus comprising sending and receiving instruments, circuits for the sending and receiving instruments having common antennæ and ground members,

separate contacts in the circuits, a switch for alternately connecting the circuit contacts with the antennæ and ground members, a primary circuit for the sending instrument having contact points adapted for connection by said switch when the parts are in sending position, a coherer device in the receiving instrument comprising a suitable case composed of electrical conducting material or materials, movable contacts, and connection between the switch and movable contacts for automatically withdrawing said contact members from the coherer to render the receiving instruments inoperative when the parts are in sending position.

3. A wireless apparatus comprising sending and receiving instruments, antennæ and ground members having separate contact points, primary and secondary sending and receiving circuits having contact members insulated from each other, spaced contact members in a primary circuit of the sending instrument, a common switch for connecting the spaced contact members and for connecting the antennæ and ground contact members with the receiving and sending contact members, means for automatically actuating said switch to alternately energize the sending and in part the receiving instruments, a coherer having fixed contact members, movable contact members adapted for contacting with said coherer, and means operable from the switch for automatically actuating said movable contact members to render the receiving instrument active or inactive according to the position of the switch.

4. A wireless apparatus comprising sending and receiving instruments, antennæ and ground members having separate contact members, sending and receiving circuits having contact members insulated from each other, a circuit running through the sending instrument and having spaced contact members, a common switch for connecting the spaced contact members and for connecting the antennæ and ground contact members with the receiving and sending contact members, means for automatically actuating said switch to alternately energize the sending instruments and place the receiving instruments in receiving condition or position, a coherer having fixed and movable contact members, means operable by the movable portion of the switch for actuating said movable contact members to render the receiving instruments active or inactive according to the position of the movable portion of the switch, and yielding means for urging the movable contacts to operative position.

5. A wireless apparatus comprising sending and receiving instruments having primary and secondary sides, means for electrically energizing said instruments, common antennæ and ground contact members for the sending and receiving instruments, contact members for the primary side of the sending instrument, a switch having a constantly moving member for contacting with the antennæ and ground contact members and at the same time for independently and alternately contacting with the receiving or the sending contact members, and means for actuating said switch and automatically reversing its direction of travel to alternate the sending and receiving periods of the apparatus.

6. A wireless apparatus comprising sending and receiving instruments, means for electrically energizing said instruments to active condition, common antennæ and ground contact members for the sending and receiving instruments, contacts for the primary side of the sending instrument, a switch having constantly movable members for contacting with the antennæ and ground contact members and adapted for independently and alternately contacting with the receiving and with the sending contact members, and means for actuating said switch and automatically reversing its direction of travel to alternate the sending and receiving periods of the apparatus; the receiving contacts being of greater length than the sending contacts to produce a long receiving period and relatively short sending period.

7. A wireless apparatus comprising sending and receiving instruments, a source of electrical supply, separate circuits for the sending and receiving instruments, common antennæ and ground members for said instruments, a switch for closing the sending circuit or placing the receiving instruments in receiving position in the circuit of the antennæ and ground members and coöperative sending instruments, means operable by a fluid pressure medium for actuating said switch, means for controlling the actuating of said switch, a normally open valve having a conduit leading to the switch controlling means, an auxiliary conduit leading from the valve, means for directing the flow of fluid medium to force the switch to and retain the same in its sending position, and a magnet for shifting the said valve to direct the flow of medium through the auxiliary conduit when desired, said magnet having a circuit adapted for energization from the main supply circuit following the complete energization of the receiving instruments.

8. A wireless apparatus, comprising sending and receiving instruments having separate circuits comprising antennæ and ground members and the coöperative instruments of a coöperative apparatus when within range, a switch for closing the local sending circuit and the local receiving circuits through the antennæ and ground members when the coöp-

erative apparatus is within range, a plunger housing, a plunger in said housing having operative connection with the switch, a piston housing with a piston in said housing, a slide valve housing, separate conduits leading from the slide valve housing to opposite ends of the piston housing, a fluid pressure medium valve having a conduit leading to the slide valve housing, means whereby the position of the slide valve is shifted at opposite ends of the piston stroke to alternate delivery of the fluid pressure medium to opposite ends of the piston housing, a separate conduit leading from said fluid pressure medium valve to one end of the piston housing, whereby fluid pressure medium may be delivered from said valve to the piston housing to move the piston and switch or plunger to and retain the same in sending position, and means for shifting said valve to such position upon the energization of the receiving instruments.

9. A wireless apparatus comprising sending and receiving instruments having circuits comprising local antennæ and ground members and coöperative members and instruments of a coöperative apparatus within relative close proximity, spaced contact members for the antennæ and ground members and the receiving and sending instruments, a switch block slidably mounted between said contacts and having brushes adapted for constant engagement with the antennæ and ground contacts and alternate engagement with the receiving and sending contacts, a primary circuit for energizing the sending instrument, spaced contact members in said circuit, brushes carried by the switch adapted for engagement with the primary contact members of the sending instrument practically simultaneously with the engagement of the other or secondary members of the sending instrument with the antennæ and ground members, and means for actuating said switch to place the apparatus alternately in sending and receiving condition.

10. A wireless apparatus comprising sending and receiving instruments and having circuits comprising antennæ and ground members and like members, and opposite instruments of a coöperating apparatus within its operative zone, a switch for alternately placing each apparatus in sending and receiving condition; the receiving instrument of each apparatus comprising a coherer having fixed and movable contacts, arms attached to the movable contacts, an actuating member connected with said arms, connection between the actuating members, and switch members for moving the movable contacts to inoperative position as the switch member moves to sending position and returning the contacts to operative position as the switch member returns to receiving position.

11. A wireless apparatus comprising sending and receiving instruments and each having local circuits; the receiving instruments being under the control of the antennæ and ground members and the transmitting instruments of a coöperating apparatus, a switch for alternately placing the apparatus in sending and receiving condition; the receiving instrument of each apparatus comprising a coherer having fixed and movable contacts, arms connected with the movable contacts, an actuating member connected with said arms, connection between the actuating member and switch member for moving the movable contacts to inoperative position as the switch member moves to sending position and returning the contacts to operative position as the switch member returns to receiving position, and a spring for yieldingly urging the movable contacts to receiving position.

12. A wireless apparatus comprising Hertzian wave transmitting instruments, Hertzian wave receiving instruments, a plurality of circuits for the apparatus, a local circuit common to the transmitting and receiving instruments, a switch for alternately connecting the local circuit with the transmitting and receiving instruments, a normally closed circuit under control of the receiving instruments, a magnet in the last named circuit adapted to control the flow of fluid pressure medium to a piston and cylinder having control of the movable object's motive power, said normally closed circuit being under the control of the receiving instruments, and normally operable means for restoring all of said instruments and circuits to normal following energization of the receiving instruments.

In testimony whereof I affix my signature in presence of two witnesses.

HARRY D. BETZ.

Witnesses:
RETTA F. THOMAS,
LETA E. COATS.