H. v. KRAMER.

MEANS FOR THE REGULATION AND CONTROL OF RAILWAY AND LIKE TRAFFIC.

APPLICATION FILED APR. 11, 1912.

1,056,104.

Patented Mar. 18, 1913.

4 SHEETS—SHEET 1.

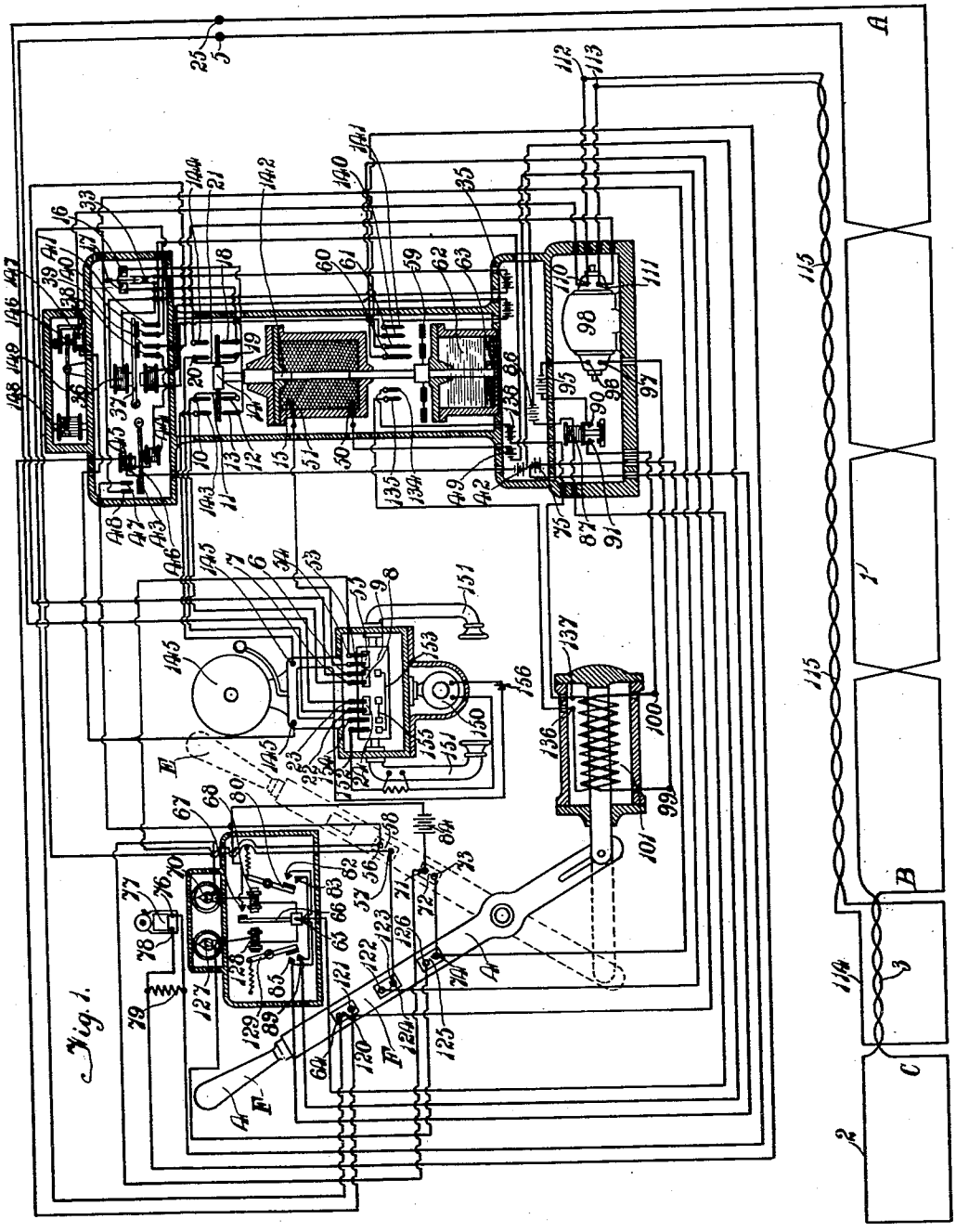

Fig. 1.

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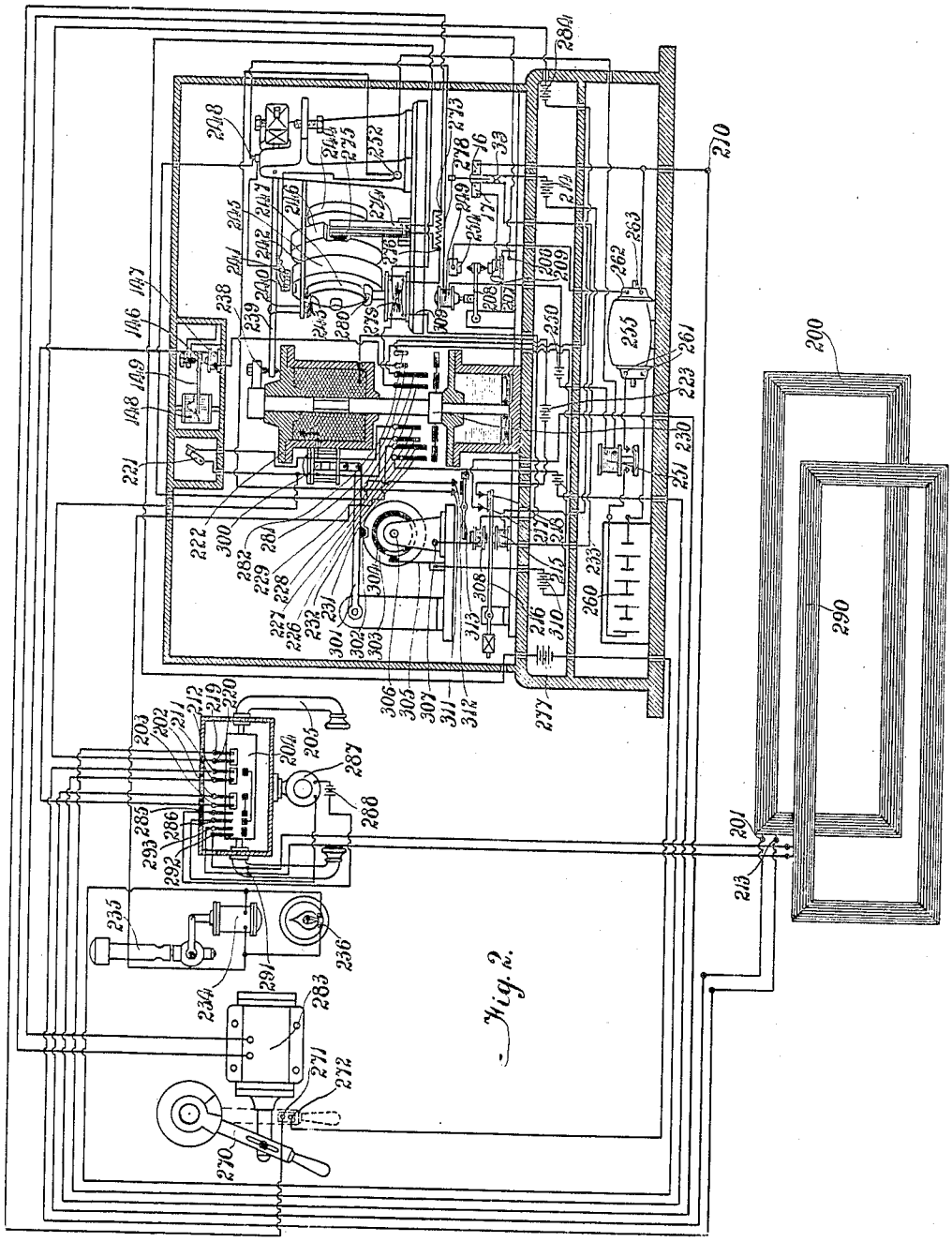

Fig. 2.

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Fig. 3.

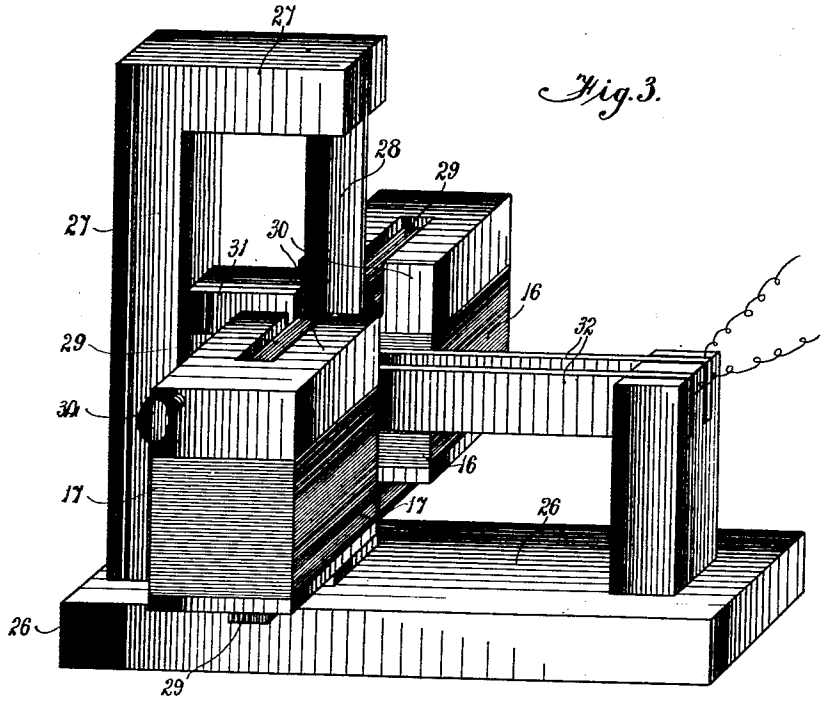
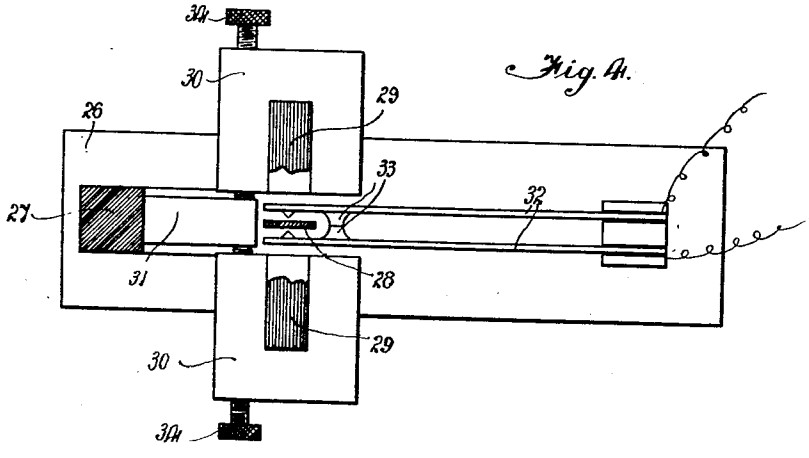


Fig. 4.



Witnesses

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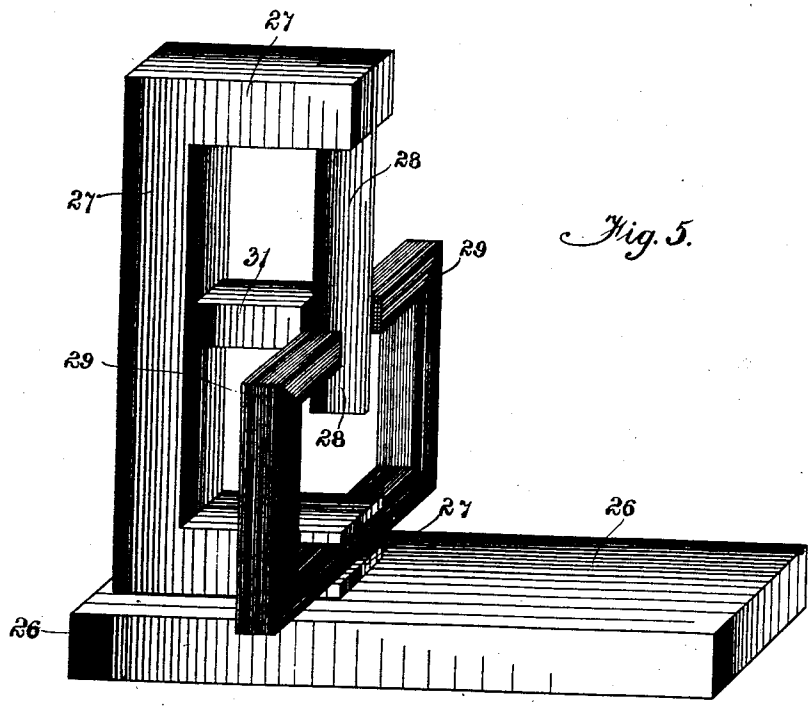

Fig. 5.

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UNITED STATES PATENT OFFICE.

HANS v. KRAMER, OF BIRMINGHAM, ENGLAND.

MEANS FOR THE REGULATION AND CONTROL OF RAILWAY AND LIKE TRAFFIC.

1,056,104. Specification of Letters Patent. Patented Mar. 18, 1913.

Application filed April 11, 1912. Serial No. 690,217.

To all whom it may concern:

Be it known that I, HANS VON KRAMER, subject of the King of Great Britain, residing at 21 Wood End road, Erdington, Birmingham, in the county of Warwick, England, have invented a new and useful Improved Means for the Regulation and Control of Railway and Like Traffic; and I do hereby declare the following to be a full, clear, and exact description of the same.

My invention comprises improvements in signaling means for railways and other similar purposes and refers to that class of such in which the signaling instructions or control is effected inductively between a line wire laid parallel to the direction in which the train or other vehicle is traveling, and a frame or coil carried by the vehicle.

In the various forms of inductive signaling heretofore proposed they have usually been so arranged as to convey a momentary warning to the signal box or station when the train passes a given point. Automatic inductive signaling systems have also been proposed, but in all cases they have necessitated the use of very heavy currents in the sending circuit which disturb neighboring telephonic and other circuits; the heavy currents making the commercial or practical adoption under modern conditions and especially where a large amount of traffic has to be negotiated useless; and it is the object of the present invention to provide a signaling system or apparatus having receiving circuits which may be operated by extremely feeble alternating currents of order of those used in telephony.

In my prior specification Serial No. 590726, filed 4th November, 1910, relating to telephony, a frame or frames is mounted upon the vehicle and designed to travel in inductive relation with a wire laid parallel to the track and whereby speech may take place to and from a moving train, but although a sufficient current may be inductively transmitted to actuate a microphone receiver of a telephone yet it is too feeble to operate any known relay devices.

According to this invention the difficulty is overcome by the employment of an improved relay device the coils of which are energized by a very feeble induced alternating current of a suitable periodicity whereby a tuned reed is caused to vibrate and to thereby make or break a local circuit; which circuit controls another circuit or circuits and whereby ultimately the desired signaling is effected.

The main or fixed line circuit is preferably divided into three sections or parts in the form of wires laid parallel to the direction of travel and in suitable proximity to the vehicle, such sections being, (*a*) a main section extending for the greater part of the length of the block starting from the train admission end; (*b*) a current restoring section for starting up an alternating current generator carried by the train when it passes over this current restoring section; and (*c*) a clearing section in passing over which the train automatically advises the signalman that it is about to pass out of the block. By these series of circuits and certain apparatus carried on the train when a train enters the block, an alternating current is passing through the frame carried by the train which induces a current in the main section and through the relay causes the following operations to take place. First, the signalman is warned that a train has entered the block which may be conveniently effected by causing it to ring a bell in the signalman's cabin and to pass current through a red lamp, which latter is maintained while the train is in the section, and even after the admission signal has been again blocked. After giving its warning the train is automatically restored to a condition ready for receiving signals either from another train or from the signal cabin; it remains in this condition until it leaves the section. When the train passes ove the current restoring section an alternating current generator is automatically started on the train which is controlled by a suitable time switch so arranged that when the train passes over the clearing section a current is induced therein to give notice to the signalman (or to the driver if desired) that the train is leaving the block, this current in the train frame being continued for a sufficient length of time to send out warning or signaling currents into the next block when it first enters same.

Means are also provided whereby if the train is stopped in the clearing section when it is generating alternating sending currents the time switch is automatically arrested whereby it cannot run down before enter

ing the new block, whereas the generation of alternating current continues for the time during which the train is stopped; when the train is allowed to proceed it will automatically give notice of its entry into a new block, although it had been stopped for a considerable time before entering same.

Means are also provided whereby in case of negligence after a train has entered a block the signal lever is automatically pulled over to its blocked position and will be locked in this position. If in spite of this two trains get on to the same block an alarm signal is given in the signal cabin and both trains will be automatically pulled up. This incident will also be automatically recorded by a recording instrument.

The signaling apparatus is also adapted for use in connection with telephony or telegraphy or both, so that the signalman or station official may communicate with the train, whether the latter is moving or standing still.

An improved fog signaling apparatus is also provided which may be used to assist the traffic regulation in cases of fog or blinding snow storms and the like.

Now by the complete system as described above the passage of any trains through a block or section is automatically indicated to the signalman, and may be recorded if so desired. In addition any mistake in the signaling regulations made by a train driver or a signalman is in the first instance recorded and then immediately and automatically steps are taken to prevent all danger of accidents by collisions which would otherwise ensue from the forgetfulness or negligence of the railway staff entrusted with the working of the trains and signal boxes.

My improved signaling system may be employed therefore in conjunction with the signaling arrangements now generally adopted on railways and my system in no way interferes with the existing rules, but merely operates in cases of negligence to prevent the result of such mistakes taking place and this automatically, viz:—without the aid of those who made the mistakes.

Referring to the drawings:—Figure 1 is a diagram illustrating the stationary part of the apparatus, parts of same being in section. Fig. 2 is a similar view of the apparatus carried by the train. Fig. 3 is a perspective view of one form of the improved polarized relay. Fig. 4 is a plan of same with the polar extremities broken away to show the flanking contact springs. Fig. 5 illustrates the magnet and polar extensions forming the skeleton of the complete relay.

In order that my invention may be clearly understood I will now describe same with reference to the application thereof illustrated in the accompanying drawings. the stationary apparatus being first described.

Stationary apparatus.

First circuit.—This part of the apparatus includes a line wire 1 laid parallel to the direction in which the train travels, such line wire being preferably laid so that the out and return portions of the wire are crossed at intervals to render the circuit non-inductive to outside influences and to enable telephony to take place over this line wire without being disturbed by such outside influences. The main section is arranged to extend substantially say for four fifths of the length of the signaling block, *i. e.* from A to B one tenth *i. e.* from C to D being in the form of an extension of the main section and forming a clearing section 2, the wires 3 connecting these two parts being twisted or crossed so as to avoid inductive distrubance between same and the wires of the current restoring section which will be hereinafter described.

There is one main or controlling circuit which includes the main section 1 and clearing section 2, this circuit being normally dead, no current passing except when a train enters the signaling block discharging alternating current of a suitable frequency. Therefore it will readily be understood that nothing takes place in connection with the stationary part of the signaling apparatus until a train enters the block, and to enable the apparatus to be understood it will now be described in detail with its various effects as when a train enters the block, the lever 4 being then in the dotted position E which indicates that the block is clear.

The one terminal 5 of the main section 1 is connected to the contact 6 and thence by a contact plate 8 on the drum 9 to a second contact 7, this contact 7 being connected to contact 10 then by a wire 11 to a contact 12. Normally this contact 12 is connected to contact 13 by the bridge piece 14 which may however move when the solenoid 15 is energized in manner hereinafter explained. The contact 13 is connected to the magnets 16, 17, of the polarized relay which will be more fully described hereinafter. The winding 17 is connected to contact 18 which in turn is connected to contact 19 by the bridge piece 14. Contact 19 is connected to contact 20 by the wire 21, and the contact 20 is connected to contact 22, contact 22 being connected to contact 23 by a plate 24 on to aforementioned drum 9, contact 23 being connected to a terminal 25 of the main section 1.

The relay is an important feature of this invention and is of the resonating type, being according to my application No. 690,194 this relay being so designed that when extremely feeble currents are passed through the polarized windings a reed tuned to the periodicity of the alternating current

is caused to make or break a local circuit, one form of this relay being shown at Figs. 3, 4 and 5. This relay consists of an insulated base 26 to which is secured a permanent horse shoe magnet 27 to the upper end of which the fixed end of the steel reed 28 is secured, the free end of the reed projecting downwardly. To the lower end of the magnet the core 29 is secured, this core being laminated and preferably in the form of thin wires in order to avoid eddy currents. Around this core the electromagnetic coils 16—17 are wound, these two coils being in series and forming part of the circuit in which the feeble alternating current occurs which is intended to work the relay, *i. e* the circuit No. 1. The extremities of the cores form one pole of the permanent magnet while the other pole is at the upper end, *i. e.* at the point at which the fixed end of the reed is secured. The steel reed is tuned to the periodicity of the alternating current in the controlling circuit and obviously when an alternating current is passed through the coils it will cause the reed to vibrate between the extremities of the cores and it will be clear that the maximum amplitude of the excursion of the reed to each side will be obtained by an alternating current having a periodicity per second corresponding with the natural period of vibration of the reed. The vibrating reed is employed for closing or opening a local circuit and in the accompanying drawings it is illustrated as being employed for opening a circuit. At either side of the reed are two flanking contact springs 32, but out of contact and insulated therefrom as by ruby contacts, these springs 32 being however horizontally disposed and having a natural period of vibration different to the reed 28, these two springs 32 having projections 33 and together forming the engaging contacts of the circuit which is to be opened by the relay. When an alternating current is passed through the coils the reed is caused to vibrate which causes the springs 32 to also vibrate but at a much slower rate than the reed 28, and it will be obvious that when these two springs 32 vibrate they will move out of mutual contact.

It will be obvious that for the relay to work with the extremely feeble alternating currents of the order specified, an extremely accurate adjustment of the air gap between the cores and reed will be required. For this purpose the cores are provided with ivory or other insulated members 30 through which pass set screws 34 the extremities of these screws engaging a brass or equivalent extension or attachment 31 of the permanent magnet. The adjustment is effected by tightening up one or both of the screws the effect of tightening up a screw being to force the core outwardly and to correspondingly enlarge the air gap.

Second circuit.—This circuit normally has current passing through it from the battery 35 which is connected to the winding of the magnet 36, thence to contact reed 32, while the other pole of the battery is connected to the second contact reed 32. The normal excitation of this magnet lifts the lever 37 thereby keeping open two other circuits at 38, 39 and 40, 41. When this second circuit is opened at contacts 33 the lever 37 will fall, making other circuits at these contacts 38, 39, and 40, 41. When the train runs into the block the signal lever is in the dotted position marked E, and the effect of closing the circuit at 38, 39, will be first considered.

Third circuit.—The terminal 39 is connected to the terminal 64, which is connected to battery 42, terminal 43, magnetic winding 44, and thence to contact 38. It will be seen that although this circuit passes through the point 43 it will not pass through the winding of the upper magnet 45, but only through the winding 44, its effect being to excite the lower magnet 44 and hold the lever 46, which will hold open the circuit at 47, 48, although the winding 45 will be put into circuit when the lever is moved to the position F.

Fourth circuit.—The part 41 is connected to battery 49 and thence to the winding 50, 51 of the solenoid 15 which is connected to contact 53 normally connected to contact 54 by a plate 55 on the drum 9, the contact 54 being connected to the point 56, which is connected to the contact 57 by a connecting plate 58 on the lever when it is in the position marked F, the contact 57 being connected to the contact 40. Therefore when the contact 40, 41 is completed the solenoid 15 is excited thereby raising the plunger 59, the first effect of which is to complete another circuit at 60, 61, but this plunger is so arranged that it may in addition to completing the circuit at 60, 61 complete other circuits when it has risen to a higher position. The movement of the plunger 59 is controlled by an oil dash pot 62 having a piston 63 in such manner that the plunger 59 will only move slowly except under the influence of a considerable force, thus returning to its original position very slowly.

Fifth circuit.—The contact 60 is connected to the terminal 65 to which is also connected an armature switch 66 adapted to engage a contact 67 and also to the winding 68, of an electromagnet in series with which is a lamp 70 which is preferably red. The lamp 70 is connected to a terminal 71 and thence by a plate 72 on the lever 4 to another contact 73 which is connected to a further contact 74 which in turn is connected to a battery 75. The battery 75 is connected to the terminal 76 of a bell 77, the other terminal 78 of which is connected to the contact 61,

the connections to the bell being taken across a resistance 79 to prevent the lamp flickering. It will therefore be obvious that the making of the contact at 60, 61, will ring a bell and also cause the red lamp to glow. As previously stated the current will pass through the winding 68 of an electromagnet, the effect of which is to attract the armature 66 and also the armature 80, the former making contact with 67, while the latter completes a circuit at 82, 83. As will be apparent when the lever is moved from the position E to F as the signalman should do when the bell is rung and the lamp glows then this fifth circuit will be broken at the point 73, 71, and as it is desired to keep the red lamp glowing as long as the train is in the main section a supplementary circuit is provided. When the armature 66 makes contact with 67 it is also connected to battery 84 which is connected to the terminal 71 which is in the circuit previously described. Thus current is supplied to the lamp by the batteries 75 and 84 arranged in parallel, and even if the one circuit is broken by shifting the lever from E to F the battery 84 will still maintain the lamp, the circuit being from battery 84 to contact 71, lamp 70, magnet 68, contact 65, armature 66, contact 67, to the other terminal of the battery. The ringing of the bell and the glowing of red lamp 70 are intended to be the first indications to the signalman that a train has entered the section; and it is then the duty of the signalman to move the lever to the position F. When he does so the bell ceases to ring but the lamp continues to glow.

Sixth circuit.—When the armature 80 is attracted by the excitement of magnet 68, it completes a sixth circuit at 82, 83, this circuit being as follows:—contact 82, contact 85, battery 86, solenoid winding 87, contact 89 and contact 83. The effect of exciting this solenoid is to complete a seventh circuit by raising the motor starting switch 90, 91.

Seventh circuit.—The seventh circuit is as follows:—contact 90, battery 95 terminals 96, 97 of the field winding of the motor generator 98, series winding 99, 100 of the solenoid 101 and then to the contact 91. The effect of this seventh circuit is to start up the motor generator and the solenoid 101 will also lock the signal lever in the position F as long as the circuit is complete, which is the case as long as a train is in the section, but the winding 99, 100 is not strong enough to pull over the lever from the position E to the position F.

Eighth circuit.—The alternating current terminals 110, 111 of the motor generator are connected to the terminals 112, 113 of the current restoring section 114, and the effect of starting this motor generator is to pass a current through the current restoring section which will automatically start in alternating current generating apparatus situated on the train when it passes over this current restoring section in manner hereinafter explained with reference to the train equipment. As illustrated the two feeding wires 115 of the current restoring section are mutually crossed or twisted at suitable intervals in order to prevent induction between same and the main section.

Ninth circuit.—By now the signalman is pulling the lever back to the position F. This has two effects, first it breaks the magnet circuit 50, 51, and consequently circuits 60, 61, whereas all other circuits above described are active. The second effect of this is that the current passes out of the battery 42 through contact 64, plate 120, contact 121, into the magnet winding 45, and back to the other pole of the battery 42. Magnet 45 is not however in a position to attract the lever 46 as the circuit through the magnet 44 is still closed the train not having stopped sending.

Tenth circuit.—The train now ceases sending, the period say of 30 seconds having expired and in consequence the circuit through the relay contacts 33 will be closed, magnet 36 energized, contacts 38, 39, and 40, 41, broken, and consequently magnet 44, deënergized with the result that the lever 46 is now attracted by the magnet 45, and short circuits contacts 47, and 48. The effect of this is to put the circuits in a condition for receiving signals in manner hereinafter explained.

Eleventh circuit.—It is assumed that the lever is in the position F and that the train has passed the current restoring section 114, and is now passing over the clearing section 2, the alternating current generator on the train being now in inductive relation with this clearing section. The clearing section is part of circuit No. 1, and the effect of this alternating current will be the same as that described with reference to this circuit, the second circuit being broken at 33, and the contacts 38, 39, and 40, 41 being again made, but as the lever is now in the position F different circuits will result.

Twelfth circuit.—When contacts 38, 39 are closed they induce current through magnet 44, the magnet however is not designed to actuate lever 46 which is still in the top position being held by magnet 45, owing to the lever 4 being in the position F.

Thirteenth circuit.—This circuit is made by connecting the contacts 40, 41, contact 41 being connected to battery 49, winding 50, 51 of electromagnet 15, contacts 53, 54, contact 56, terminals 47, 48, contact 122, plate 123, contact 124, contact 57, and contact 40. The effect of this is to again lift the plunger making a circuit at 60, 61.

Fourteenth circuit.—The fourteenth cir-

cuit is as follows:—contact 61, bell 77, battery 75, contact 74, plate 125, contact 126, green lamp 127, magnetic winding 128, terminal 65, contact 60. The effect of this is to cause the green lamp to glow and to ring the bell, indicating to the signalman that a train is passing out of the block, but in addition to this the excitation of the magnet 128 attracts the armature 129 which completes a circuit at 85, 89, corresponding with circuit No. 6, but it will be obvious that the time taken by a train in passing over the clearing section is so short that these circuits will be almost immediately broken and restored to their original condition through the plunger 59 falling.

Fifteenth circuit.—The contact 135 is connected to the winding 136, 137 on the solenoid 101, this winding being of a sufficient strength to pull the lever from the position E to the position F, and being connected to the battery 138 and to the contact 134. In the event of a second train coming into the same block when the lever is in the position F the apparatus is so arranged that both trains will be automatically stopped. As this lever is now in the position F when a second train runs into the block the plunger 59 will rise to its full height putting out the red lamp, putting the green lamp into circuit and ringing the bell 77.

The first and second circuits are again completed, contacts 38, 39 and 40, 41 being again made, but as the lever is in the position F contact 121 will be connected to contact 64 by the plate 120, and as the contact 121 is connected to the magnet 45 the lever 46 will be raised against the action of the magnet 44 thus closing the circuit at 47, 48, which again puts the solenoid 15 in circuit but this time the plunger will rise to its full height putting out the red lamp, putting the green lamp into circuit and ringing the bell.

Sixteenth circuit.—As the plunger rises it completes a circuit at 140, 141, which holds the lever 37 down keeping closed the contacts, 38, 39, and 40, 41, until the plunger has traveled to its full height. If desired any suitable or known recording instrument may be included in this circuit to provide a permanent record of the signalman's negligence.

Seventeenth circuit.—The plunger 59, will however continue to rise, and after completing the circuit at 134, 135 it will have risen a sufficient distance to make contact with the part 142 from which it is normally disconnected and separated. When 59 reaches the part 142 the contact bar 14 will be lifted, simultaneously connecting contact 143 to contact 10 and contact 20 to contact 144.

Eighteenth circuit.—This circuit is as follows:—contact 143, alarm bell 145, recording instrument, terminals 146, 147, which are connected to the alternating current terminals 110, 111 of the alternating current generator, contacts 144, 20, 22, 23, terminal 25, through the main section to terminal 5, contacts 6, 7, and back to contact 10. The illustrated recording instrument embodies a permanently rotating drum 148 and a pivoted lever 149, the lever acting as the armature of the magnet 146, 147, and obviously when the magnet is energized the lever will be moved, and as its extremity is in contact with the drum it will indicate its movement thereon. The effect of this is to ring the alarm bell, to operate the mistake recording instrument and to operate warning devices on the engine, and to ultimately stop both trains by actuating the steam valve. Thus the apparatus will rectify mistakes of the signalman and it will record such mistakes. When trains are so stopped owing to a mistake on the part of the signalman it will be his duty to establish telephonic communication with them for which purpose a telephone set is provided. The same result will also follow if the train is stopped inadvertently before it leaves the clearing section, by the closure of the signal in the next block. This instrument includes a transmitter 150 of any suitable construction, but preferably having three induction coils. A double receiver 151 is provided the arms of this receiver being mounted upon the drum 9 and being so arranged that when the receiver is lifted to a horizontal position from its normal hanging position the drum will be rotated thereby connecting the terminal 6 to the terminal 152 by plate 153, and the terminal 23 to the terminal 154 by plate 155, these terminals 152, 154, being connected to a telephone set including the transmitter 150 and battery 156 when speech may be transmitted. The receiver 151 is also connected to two points on the transmitting circuit between which there is a sufficient voltage drop to provide a current. The telephone set is thus put into direct communication with the terminals 5, and 25, and the signalman may telephone to an official on the train.

It will be obvious that instead of employing a telephone set in combination with the signaling apparatus, a telegraphic set might be used, as by substituting a Morse tapper for the transmitter.

The above described apparatus may be obviously employed without necessitating the removal or replacement of any existing signaling appliances. Therefore the signalman may work to the old form of his signaling arrangement, the bell and lamp being merely an addition to same.

Train equipment.

First circuit.—The primary circuit of the

train equipment includes a frame or coil 200 which is in the form of a considerable number of turns of wire wound around the inside of the carriage or otherwise arranged in any suitable manner. The terminals of this frame are marked 201 and 213, the connections being as follows:—terminal 201, contact 202, which is connected to a contact 203, by a plate on a rotating drum 204 controlled by the telephone receiver 205 in the same way as that described with reference to the stationary apparatus. The contact 203 is connected to terminal 206, on the frame 207, and then by the solenoid switch arm 208, contact 209, insulated from the frame 207 and contact 206 through the polarized relay winding 17, 16, terminal 210, to the contact 211 connected to contact 212 by a plate on the drum 204, and thence to terminal 213. There is therefore a complete circuit through which alternating current is passed when the train passes over the current restoring section.

Second circuit.—This is a closed circuit energized by the battery 214, which is connected to the winding 215 of an electromagnet which normally holds down the lever 216, the polarized relay contacts 33 being in this circuit. When an alternating current passes through the circuit the contacts 33 are broken deënergizing the magnet 215 which permits the lever 216 to rise by the counterweight thus completing the circuit at 217, 218.

Third circuit.—This circuit is as follows:—contact 217, and contacts 219, 220, switch 221, which is kept closed except during fog signaling, electromagnet 222, battery 223, contact 218. The contacts 226, 227, 228, 229, are only in action during fog signaling, and therefore it is not necessary to refer to them in connection with the normal working of the apparatus.

Fourth circuit.—The object of energizing the magnet 222 is to lift the plunger 230 which completes the circuit at 231, 232, contact 231 is connected to battery 233, magnet 234, controlling steam whistle 235, and lamp 236, which in turn is connected to contact 232, and the effect of energizing the magnet 222 is to cause the lamp to glow and to blow the steam whistle which gives the warning to the driver. If the train is only passing over the current restoring section the induced current will be very short in duration so that the plunger will not rise to its full height, the current being quickly broken.

Fifth circuit.—When the plunger 230 commences to rise it lifts the pin 238 which allows the counterweighted lever 239 to rise, which lifts the two contact brushes 240, 241, and also the lever 242 with its stop 243 thus starting the sending part of the train apparatus. This sending apparatus consists of a spring drum 244, clockwork, or equivalent device tending to rotate the shaft on which is located two gapped rotating contact drums 245, and 246 and also a brake drum 247. When the lever 239 and the other parts are raised in manner previously described the drum 245 will rotate. This drum has a conducting periphery gapped or insulated at one point so that the brushes 240, 241 are opposite the gapped part when the apparatus is stationary. When the lever 239 has fallen and the drum 245 is rotating brush contacts 240, 241 are connected, completing a circuit which is as follows:—the brush 240 is connected to the terminal 248 which in turn is connected to the solenoid winding 249 and then through the battery 250 to the solenoid switch 251 and back to the terminal 252 which is connected to the brush 241. Thus the effect of rotating this drum is to lift the solenoid switch arm 208 into engagement with the contact 254, completing a circuit for the generation of alternating current and also by operating the solenoid switch 251 to start the motor generator 255.

Sixth circuit.—The raising of the solenoid switch 251 puts the battery 260 into connection with the armature and field winding of terminals 261 of the motor generator, which is thus started.

Seventh circuit—alternating current transmission.—The terminal 262 of the generator is connected to the contact 254 which is connected to the frame 207 when the arm 208 is raised, this part being connected to contacts 203, 202, terminal 201, frame 200, terminal 213, contacts 212, 211, 210, back to the terminal 263 of the motor generator. The effect of this is that a current is sent through the frame 200 while the drum 245 is making one complete revolution, and as this rotation of the drum 245 is commenced when the train passes over the current restoring section the duration of this single revolution of the drum 245 is so timed that it will continue while the train is passing over the clearing section and until it has entered the next main section into which it sends its warning signal for a period of say 30 seconds with the effect on the stationary apparatus previously explained.

If the train stops from any cause a circuit is completed which applies a brake to the sending apparatus keeping it in its proper position, so that when re-started it will recommence its discharge of alternating current if it was sending when pulled up. This circuit is completed by a plate on the throttle lever 270 which completes the connection between the contacts 271, 272. Contact 271 is connected to terminal 273 which in turn is connected to the brush contact 274 conducting rim 246, second brush contact 275, terminal 276, battery 277, and back to

the contact 272. It will be obvious, however, that a circuit will only be completed when the drum 246 is rotating, as when in its stationary position, the brushes are opposite an insulating gap, the current then passing through the resistance 278 located between the terminals 273, 276. Included in this circuit is a magnet 279 which is so arranged that if the train stops when the sending apparatus is rotating this magnet will apply a brake 280 to the drum 247 and arrest the rotation, but if this part of the apparatus is stationary the current will have to pass through the resistance 278 in series with the magnet which will prevent the application of the brake, and while the train and clockwork are both going. As illustrated the brake drum 247 has a notch in its periphery and when the apparatus has made a complete revolution the part 243 or the weighted lever 242 will fall back into the notch and arrest rotation.

If the current is sent through the train apparatus for a sufficient time the plunger will rise until it completes a contact at 281, 282. Contact 281 is connected to a recording apparatus of a similar construction to that in the stationary apparatus which is connected to a magnet 283 controlling the steam valve which in turn is connected to the battery 284 and back to the contact 282, and obviously the effect of completing this circuit would be to energize the magnet and close the steam valve, thus automatically stopping the train.

As previously stated the telephone receivers 205 are connected to a drum 204 which is provided with a series of contacts whereby when the receiver is raised the contacts 202 and 212 are respectively connected to the contacts 285 and 286. The contact 212 is connected to the terminal 202 of the frame 200 the other terminal 201 of which is connected to the terminal 213.

The contacts 285 and 286 are connected to the telephone transmitter 287 and battery 288, and obviously when the receivers are raised the battery and transmitter are put into circuit with the frame 200. The second frame 290 is connected to the terminal 291 of the receiver and to the contacts 292, 293, so that when the receiver is raised the contacts 291, 292 are connected by a plate on the drum 204 automatically putting the telephone set into condition for receiving as well as for transmission.

Fog signaling.—In combination with the signaling apparatus previously described I provide an apparatus or system adapted to be brought into operation during fogs and on special occasions.

It will be obvious that the system of signaling previously described, including as it does the telephonic arrangement, provides ample means whereby in emergencies the signalman and engine driver or train official may get into telephonic or other communication. I go further than this however and provide a means whereby during fogs the movements of the train may be absolutely controlled from the signal box.

For fog signaling the same apparatus is used at the signal box, but additional circuits are provided on the trains which are brought into automatic operation by the simple act of opening the switch 221.

The apparatus is again controlled by passing an alternating current through the line wire which is in inductive relation with the frame 200 and in which corresponding alternating current is thus induced. The effect of an induced current in the frame 200 is similar to that previously described, the relay 16, 17 being operated which deënergizes the magnet 215 and which then allows the lever 216 to rise and complete a circuit 217, 218.

Contact 217 is connected to contacts 219, 212, and to solenoid winding 300 it being in this case impossible for the current to pass through the switch 221 which is now opened. Current therefore passes through the solenoid 300 which is in circuit with the magnet 222 which is connected to the battery 223 and contact 218. The effect of completing this circuit is to simultaneously raise the plunger 230 and to lift the lever 301. This lever 301 has a projection 302 which engages a notch on the drum 303 and normally prevents this drum rotating which rotation may be effected by spring or clockwork apparatus similar to that previously described. Secured to the spindle carrying the drum and clockwork apparatus is a contact rim 304 broken or insulated at one point; the relation of the notch and the gap in this rim being such that when the projection 302 on the lever 301 is holding the apparatus stationary the brush 305 is opposite the gap in the rim thereby breaking the circuit. When the lever 301 is raised this rim 304 rotates, the brush 305 then making contact with the periphery of the rim which is in circuit with the spindle 306 in turn in circuit with the terminal 307 which is connected to the magnet 308 in turn connected to one winding 309 of the magnetic brake 280, this winding being connected to the contacts 228, 229 which are connected when the plunger 230 rises. Contact 229 is connected to the battery 310 and back to the brush 305. Therefore when the plunger rises and the magnet 300 is energized the rim 304 rotates and at the same time applies the brake 280 which prevents rotation of the ordinary sending apparatus, the lever 216 being held up against the magnet 308 until this circuit is broken by the fall of the plunger. Contacts 231 and 232, 217 and 218 being therefore completed another circuit is established. The

effect of energizing the magnet 308 is to close the contacts 311, 312, by lever 313, contact 311 being connected to contact 252 while contact 312 is connected to contact 248. Contact 248 connected to the solenoid 249 is in turn connected to the battery 250 motor starting switch 251 and contact 252 thus completing the circuit. The effect of energizing this circuit is firstly to start the motor generator 255 and secondly by the solenoid 249 to lift the lever 208 connecting contacts 254 and terminal 206 thus putting the motor generator into circuit with the frame 200, current being thereby passed through this frame which energizes the station apparatus and through it puts the main section under current and warns any train which may have got into the block, and also indicates its presence to the signalman.

The continued current inducted in the frame 200 will however cause the plunger 230 to further rise making the contacts 226, 227. These contacts being connected to the solenoid 300 the effect of which is to short circuit this solenoid and allow the lever 301 to fall, the movement of the fog signaling sending apparatus being thereby arrested. A continued movement of the plunger will complete another circuit at 281, 282 which will have the effect of energizing the magnet 283 controlling the steam valve and thereby stopping the engine. The signalman may then get into telephonic communication with the train and give instructions to an official thereon.

In addition to the previously described automatic signaling system I provide another means for assisting traffic regulation in the form of a semi-automatic installation of harmonic inductive telephone or telegraphy by tuned signals between the trains and signal boxes. Each train is arranged to emit an alternating current either continuously or intermittently, this alternating current having a predetermined periodicity of say, between 300 and 1,000 per second. For instance all goods or mineral trains may have a fixed frequency of 300–350 periods per second, and it will then obviously be possible for the signalman with the aid of a suitable telephone receiver to hear and detect its presence in the block. In a similar way a local train, *i. e.* a train which stops at all stations may be equipped with an apparatus producing an alternating current of say 500–550 periods per second, or an express train might be sending out a note of say 800–900 periods per second. The periodicity of the various trains being known it is thus obviously possible for the signalman to determine what train or trains are in the block with the aid of suitable ordinary or tuned telephone receiver.

Another means of communicating, either direct or automatic, consists in the provision of a number of differently tuned relays of the description mentioned in this specification, for instance an "up" train, running over the same loop as a "down" train may work with 5 to 7 per cent. higher, or lower, periodicity and so keep the various trains distinguished from each other.

A simple system for "calling up" any train from a signal box is to provide a number of alternating current generators of different periodicities if such calling up is to be done simultaneously and to equip each train according to its class and direction with a tuned relay and a local circuit relay for the purpose of ringing a bell on a train or giving any signals that may be caused by relays or magnets. If for instance a goods train "up" is tuned for ninety periods per second a relay only responding to this period will answer. A local "down" train may have 95 periods per second and call an express "up" say 100 per second. If it is only desired to call up one train at a time one generator only is sufficient—the speed of which may be regulated and so any of the trains' periodicities can be obtained.

Further means for my direct or automatic systems of wireless inductive control of railway traffic are the provision of two or several frames on the moving vehicle and of two or more alternating current generators, also of two or more tuned relays such as described in this specification and of similar sets of apparatus at the stations and whereby I can send and receive simultaneously two or more signals provided always that the periodicities of such currents are not interfering with each other, and that the receiving relays are properly tuned to the respective induced currents to which they have to respond.

By a suitable combination of local circuit relays and other apparatus approximately of the same type as those mentioned in the description of the above automatic control system effects may be achieved which in principle are similar to those claimed in this invention.

What I claim then is:—

1. In an inductive railway signaling system the combination of a line wire laid parallel to the track, and extending for the length of the track controlled by one signal station; an alternating current generator located at the line station; means for putting said alternating current generator in circuit with the line wire; a relay device located at the line station and actuated by the passage of alternating current in the line wire; a signal receiving device actuated by the relay; an induction frame carried by the train; an alternating current generator carried by the train; means for putting the alternating current generator on the train into circuit with the induction frame at cer-

tain predetermined times; a relay device carried by the train and actuated by the passage of alternating current in the induction frame; a signal receiving device carried by the train and actuated by the relay on the train, means whereby when a train enters a signaling section the alternating current generator on the train is caused to pass alternating current through the frame for a certain limited predetermined time, current being thereby induced in the line wire to operate the relay and signal receiving device both located at the line station; and means whereby before the train leaves the signaling section the alternating current generator on the train is re-started so that alternating current is being generated on the train and induced in the line wire at the time when it enters the next signaling section in order that it may indicate its entry into said section; substantially as set forth.

2. In an inductive railway signaling system the combination of a line wire laid parallel to the track and forming part of a circuit extending for the length of the track controlled by one signal station; an alternating current generator located at the line station; means for putting said alternating current generator in circuit with the line wire; a second circuit located at the line station; a relay device located at the line station and controlled by the passage of alternating current in said line wire; a contact device forming part of said second circuit and operated by the relay at the line station; a wire frame carried by the train in inductive relation with the line wire and forming part of a circuit; an alternating current generator carried by the train; means for putting the alternating current generator on the train into circuit with the said wire frame; a second circuit on the train; a relay device carried by the train and controlled by the passage of alternating current in said frame a contact device forming part of said second circuit on the train and operated by the relay also on the train, means whereby when the train enters a signaling section the alternating current generator on the train is caused to pass alternating current through the frame for a certain limited predetermined time current being thereby induced in the line wire to operate the relay at the line station and the relay on any other train if in the same signaling section, and to thus warn the signalman and any other train which may be in the section; means for putting the train apparatus ready for receiving inductive signals after the generation of alternating current has ceased; and means whereby before the train leaves the signaling section the alternating current generator on the train is re-started so that alternating current is being generated on the train and induced in the line wire at the time when it enters the next signaling section in order that it may indicate its entry into said section; substantially as set forth.

3. In an inductive railway signaling system the combination of a line wire laid parallel to the track and forming part of a circuit extending for the length of the track controlled by one signal station; an alternating current generator located at the line station; means for putting said alternating current generator in circuit with the line wire; a second circuit located at the line station; a relay device located at the line station and controlled by the passage of alternating current in said line wire; a contact device forming part of said second circuit and operated by the relay at the line station; a wire frame carried by the train in inductive relation with the line wire and forming part of a circuit; an alternating current generator carried by the train; means for putting the alternating current generator on the train into circuit with the said wire frame; a second circuit on the train; a relay device carried by the train and controlled by the passage of alternating current in said frame; a contact device forming part of said second circuit on the train and operated by the relay on the train, means whereby when the train enters a signaling section the alternating current generator on the train is caused to pass alternating current through the frame for a certain limited predetermined time current being thereby induced in the line wire to operate the relay at the line station and the relay on any other train if in the same signaling section, and to thus warn the signalman and any other train which may be in the section; means for putting the train apparatus ready for receiving inductive signals after the generation of alternating current has ceased; means whereby before the train leaves the signaling section the alternating current generator on the train is re-started so that alternating current is being generated on the train and induced in the line wire at the time when it enters the next signaling section in order that it may indicate its entry into said section; and means actuated by the passage of alternating current in the line wire when the train is leaving the signaling section whereby an indication is given to the signalman that the train is leaving the section; substantially as set forth.

4. In an inductive railway signaling system the combination of a line wire laid parallel to the track and forming part of a circuit extending for the length of the track controlled by one signal station; an alternating current generator located at the line station; means for putting said alternating current generator in circuit with the line wire; a second circuit located at the line

station; a relay device located at the line station and controlled by the passage of alternating current in said line wire; a contact device forming part of said second circuit and operated by the relay at the line station; a wire frame carried by the train in inductive relation with the line wire and forming part of a circuit; an alternating current generator carried by the train; means for putting the alternating current generator on the train into circuit with the said wire frame; a second circuit on the train; a relay device carried by the train and controlled by the passage of alternating current in said frame; a contact device forming part of said second circuit on the train and operated by the relay on the train, means whereby when the train enters a signaling section the alternating current generator on the train is caused to pass alternating current through the frame for a certain limited predetermined time current being thereby induced in the line wire to operate the relay at the line station and the relay on any other train if in the same signaling section, and to thus warn the signalman and any other train which may be in the section; means for putting the train apparatus ready for receiving inductive signals after the generation of alternating current has ceased; means whereby before the train leaves the signaling section the alternating current generator on the train is restarted so that alternating current is being generated on the train and induced in the line wire at the time when it enters the next signaling section in order that it may indicate its entry into said section; a time switch carried by the train for controlling the duration of alternating current passing in the frame; and means for arresting the time switch when the train stops without stopping the generation of the alternating current; substantially as set forth.

5. In an inductive railway signaling system the combination of a line wire laid parallel to the track and forming part of a circuit extending for the length of the track controlled by one signal station; an alternating current generator located at the line station; means for putting said alternating current generator in circuit located at the line station with the line wire; a second circuit; a relay device located at the line station and controlled by the passage of alternating current in said line wire; a contact device forming part of said second circuit and operated by the relay at the line station; a wire frame carried by the train in inductive relation with the line wire and forming part of a circuit; an alternating current generator carried by the train; means for putting the alternating current generator on the train into circuit with the said wire frame; a second circuit on the train; a relay device carried by the train and controlled by the passage of alternating current in said frame; a contact device forming part of said second circuit on the train and operated by the relay on the train, means whereby when the train enters a signaling section the alternating current generator on the train is caused to pass alternating current through the frame for a certain limited predetermined time, current being thereby induced in the line wire to operate the relay at the line station and the relay on any other train if in the same signaling section, and to thus warn the signalman and any other train which may be in the section; means for putting the train apparatus ready for receiving inductive signals after the generation of alternating current has ceased; means whereby before the train leaves the signaling section the alternating current generator on the train is re-started so that alternating current is being generated on the train and induced in the line wire at the time when it enters the next signaling section in order that it may indicate its entry into said section; means actuated by the passage of alternating current in the line wire when the train is leaving the signaling section whereby an indication is given to the signalman that the train is leaving the section; a time switch carried by the train for controlling the duration of alternating current passing in the frame; and means for arresting the time switch when the train stops, without stopping the generation of the alternating current; substantially as set forth.

6. In an inductive railway signaling system, the combination of a line wire laid parallel to the track and forming part of a circuit extending for the length of the track controlled by one signal station; an alternating current generator located at the line station; means for putting said alternating current generator in circuit with the line wire; a second circuit located at the line station; a relay device located at the line station and controlled by the passage of alternating current in said line wire; a contact device forming part of said second circuit and operated by the relay at the line station; a wire frame carried by the train in inductive relation with the line wire and forming part of a circuit; an alternating current generator carried by the train; means for putting the alternating current generator on the train into circuit with the said wire frame; a second circuit on the train; a relay device carried by the train and controlled by the passage of alternating current in said frame; a contact device forming part of said second circuit on the train and operated by the relay on the train, means whereby when the train enters a signaling section the alternating current

generator on the train is caused to pass alternating current through the frame for a certain limited predetermined time, current being thereby induced in the line wire to operate the relay at the line station and the relay of any other train if in the same signaling section, and to thus warn the signalman and any other train which may be in the section; means for putting the train apparatus ready for receiving inductive signals after the generation of alternating current has ceased; means whereby before the train leaves the signaling section the alternating current generator on the train is restarted so that alternating current is being generated on the train and induced in the line wire at the time when it enters the next signaling section in order that it may indicate its entry into said section; means actuated by the passage of alternating current in the line wire when the train is leaving the signaling section whereby an indication is given to the signalman that the train is leaving the section; a time switch carried by the train for controlling the duration of alternating current passing in the frame; means for arresting the time switch when the train stops, without stopping the generation of the alternating current; a signal lever and means actuated through the aforesaid relay at the line station for pulling over the signal lever to its blocked position in case of negligence on the part of the signalman; substantially as set forth.

7. In an inductive signaling system the combination of a line wire laid parallel to the track and forming part of a circuit extending for the length of the track controlled by one signal station; an alternating current generator located at the line station; means for putting said alternating current generator in circuit with the line wire; a second circuit located at the line station; a relay device located at the line station and controlled by the passage of alternating current in said line wire; a contact device forming part of said second circuit and operated by the relay at the line station; a wire frame carried by the train in inductive relation with the line wire and forming part of a circuit; an alternating current generator carried by the train; means for putting the alternating current generator on the train into circuit with the said wire frame; a second circuit on the train; a relay device carried by the train and controlled by the passage of alternating current in said frame; a contact device forming part of said second circuit on the train and operated by the relay on the train, means whereby when the train enters a signaling section the alternating current generator on the train is caused to pass alternating current through the frame for a certain limited predetermined time, current being thereby induced in the line wire to operate the relay at the line station and the relay on any other train if in the same signaling section, and to thus warn the signalman and any other train which may be in the section; means for putting the train apparatus ready for receiving inductive signals after the generation of alternating current has ceased; means whereby before the train leaves the signaling section the alternating current generator on the train is re-started so that alternating current is being generated on the train and induced in the line wire at the time when it enters the next signaling section in order that it may indicate its entry into said section; a telephone apparatus located at the line station; means for putting said telephone apparatus into circuit with the line wire; a telephone apparatus carried by the train; and means for putting said train telephone apparatus into circuit with the induction frame; substantially as set forth.

8. In an inductive railway signaling system, the combination of a line wire laid parallel to the track and forming part of a circuit extending for the length of the track controlled by one signal station; an alternating current generator located at the line station; means for putting said alternating current generator in circuit with the line wire; a second circuit located at the line station; a relay device located at the line station and controlled by the passage of alternating current in said line wire; a contact device forming part of said second circuit and operated by the relay at the line station; a wire frame carried by the train in inductive relation with the line wire and forming part of a circuit; an alternating current generator carried by the train; means for putting the alternating current generator on the train into circuit with the said wire frame; a second circuit on the train; a relay device carried by the train and controlled by the passage of alternating current in said frame; a contact device forming part of said second circuit on the train and operated by the relay on the train, means whereby when the train enters a signaling section the alternating current generator on the train is caused to pass alternating current through the frame for a certain limited predetermined time, current being thereby induced in the line wire to operate the relay at the line station and the relay on any other train if in the same signaling section, and to thus warn the signalman and any other train which may be in the section; means for putting the train apparatus ready for receiving inductive signals after the generation of alternating current has ceased; means whereby before the train leaves the signaling section the alternating current generator on the train is re-started so that

alternating current is being generated on the train and induced in the line wire at the time when it enters the next signaling section in order that it may indicate its entry into said section; means actuated by the passage of alternating current in the line wire when the train is leaving the signaling section whereby an indication is given to the signalman that the train is leaving the section; a telephone apparatus located at the line station; means for putting said telephone apparatus into circuit with the line wire; a telephone apparatus carried by the train; and means for putting said train telephone apparatus into circuit with the induction frame; substantially as set forth.

9. In an inductive railway signaling system the combination of a line wire laid parallel to the track and forming part of a circuit extending for the length of the track controlled by one signal station; an alternating current generator located at the line station; means for putting said alternating current generator in circuit with the line wire; a second circuit located at the line station; a relay device located at the line station and controlled by the passage of alternating current in said line wire; a contact device forming part of said second circuit and operated by the relay at the line station; a wire frame carried by the train in inductive relation with the line wire and forming part of a circuit; an alternating current generator carried by the train; means for putting the alternating current generator on the train into circuit with the said wire frame; a second circuit on the train; a relay device carried by the train and controlled by the passage of alternating current in said frame; a contact device forming part of said second circuit on the train and operated by the relay, means whereby when the train enters a signaling section the alternating current generator on the train is caused to pass alternating current through the frame for a certain limited predetermined time, current being thereby induced in the line wire to operate the relay at the line station and the relay on any other train if in the same signaling section, and to thus warn the signalman and any other train which may be in the section; means for putting the train apparatus ready for receiving inductive signals after the generation of alternating current has ceased; means whereby before the train leaves the signaling section the alternating current generator on the train is re-started so that alternating current is being generated on the train and induced in the line wire at the time when it enters the next signaling section in order that it may indicate its entry into said section; and means whereby in case of fog or other emergency the train apparatus may be so arranged that the train may be positively controlled by the signalman; substantially as set forth.

10. In an inductive railway signaling system the combination of a line wire laid parallel to the track and forming part of a circuit extending for the length of the track controlled by one signal station; an alternating current generator located at the line station; means for putting said alternating current generator in circuit with the line wire; a second circuit located at the line station; a relay device located at the line station and controlled by the passage of alternating current in said line wire; a contact device forming part of said second circuit and operated by the relay at the line station; a wire frame carried by the train in inductive relation with the line wire and forming part of a circuit; an alternating current generator carried by the train; means for putting the alternating current generator on the train into circuit with the said wire frame; a second circuit on the train; a relay device carried by the train and controlled by the passage of alternating current in said frame; a contact device forming part of said second circuit on the train and operated by the relay, means whereby when the train enters a signaling section the alternating current generator on the train is caused to pass alternating current through the frame for a certain limited predetermined time, current being thereby induced in the line wire to operate the relay at the line station and the relay on any other train if in the same signaling section, and to thus warn the signalman and any other train which may be in the section; means for putting the train apparatus ready for receiving inductive signals after the generation of alternating current has ceased; means whereby before the train leaves the signaling section the alternating current generator on the train is re-started so that alternating current is being generated on the train and induced in the line wire at the time when it enters the next signaling section in order that it may indicate its entry into said section; means actuated by the passage of alternating current in the line wire when the train is leaving the signaling section whereby an indication is given to the signalman that the train is leaving the section; a time switch carried by the train for controlling the duration of alternating current passing in the frame; means for arresting the time switch when the train stops, without stopping the generation of the alternating current; a signal lever means actuated through the aforesaid relay at the line station for pulling over the signal lever to its blocked position in case of negligence on the part of the signalman; a telephone appa-

ratus located at the line station; means for putting said telephone apparatus into circuit with the line wire; a telephone apparatus carried by the train; and means for putting said train telephone apparatus into circuit with the induction frame; substantially as set forth.

In testimony whereof, I have signed my name to this specification in the presence of two subscribing witnesses.

HANS v. KRAMER.

Witnesses:
HAROLD J. AONESTER,
NORMAN S. BARLOW.