No. 791,574. PATENTED JUNE 6, 1905.

F. P. J. PATENALL & G. H. DRYDEN.

AUTOMATIC RAILROAD SIGNALING.

APPLICATION FILED MAR. 13, 1905.

2 SHEETS—SHEET 1.

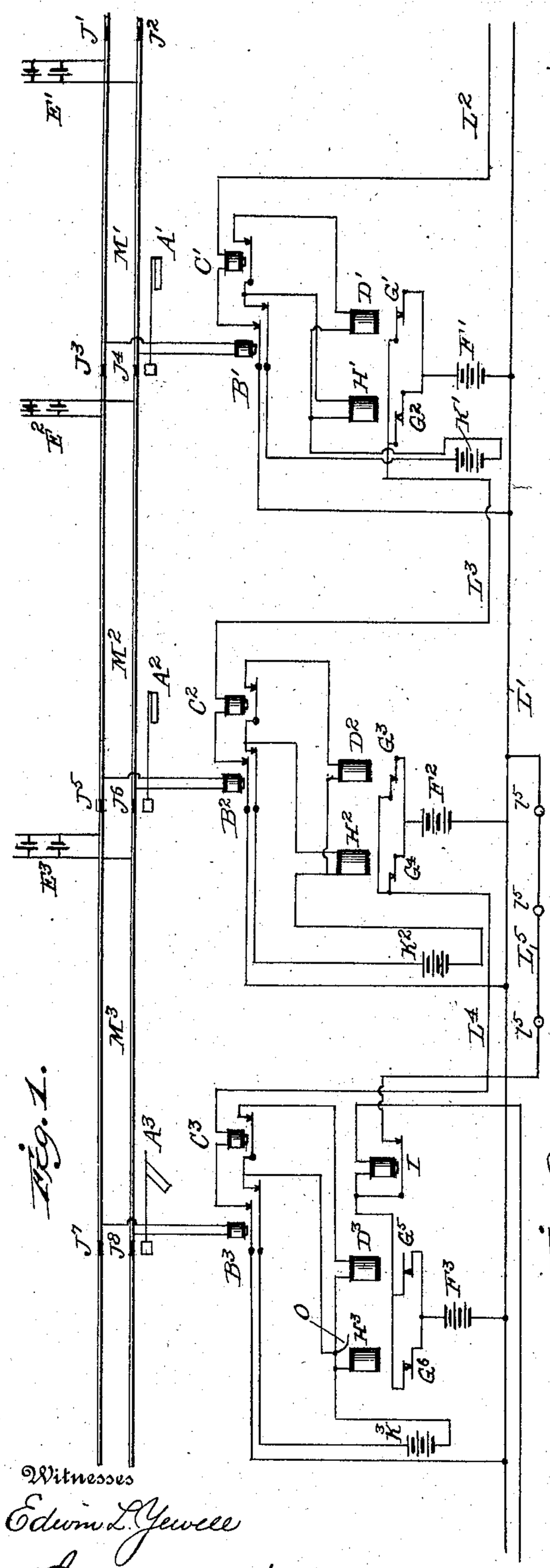

Fig. 1.

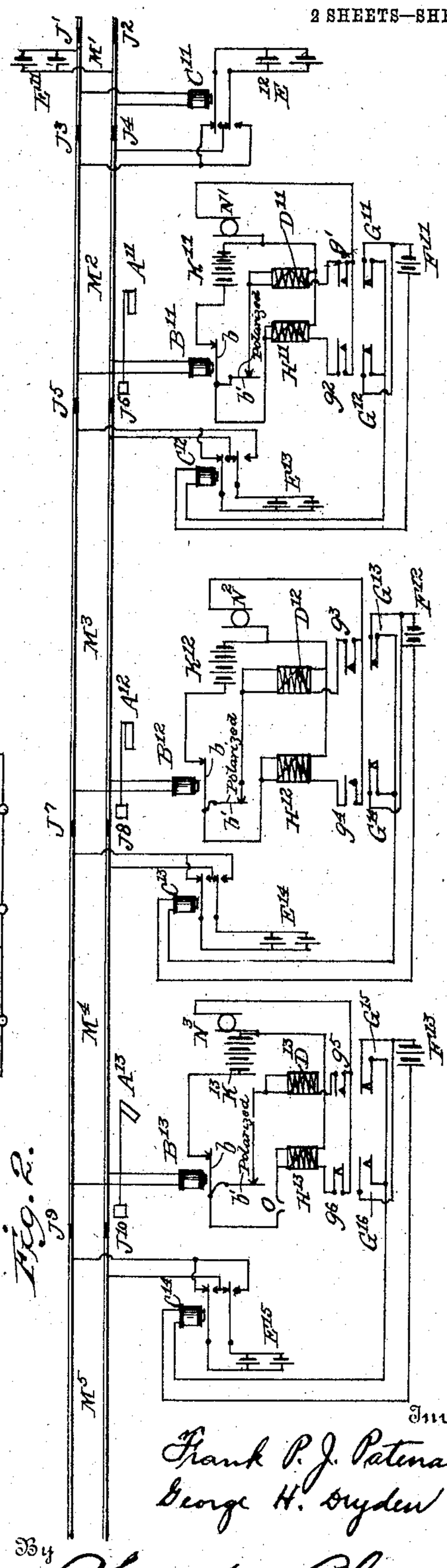

Fig. 2.

Witnesses

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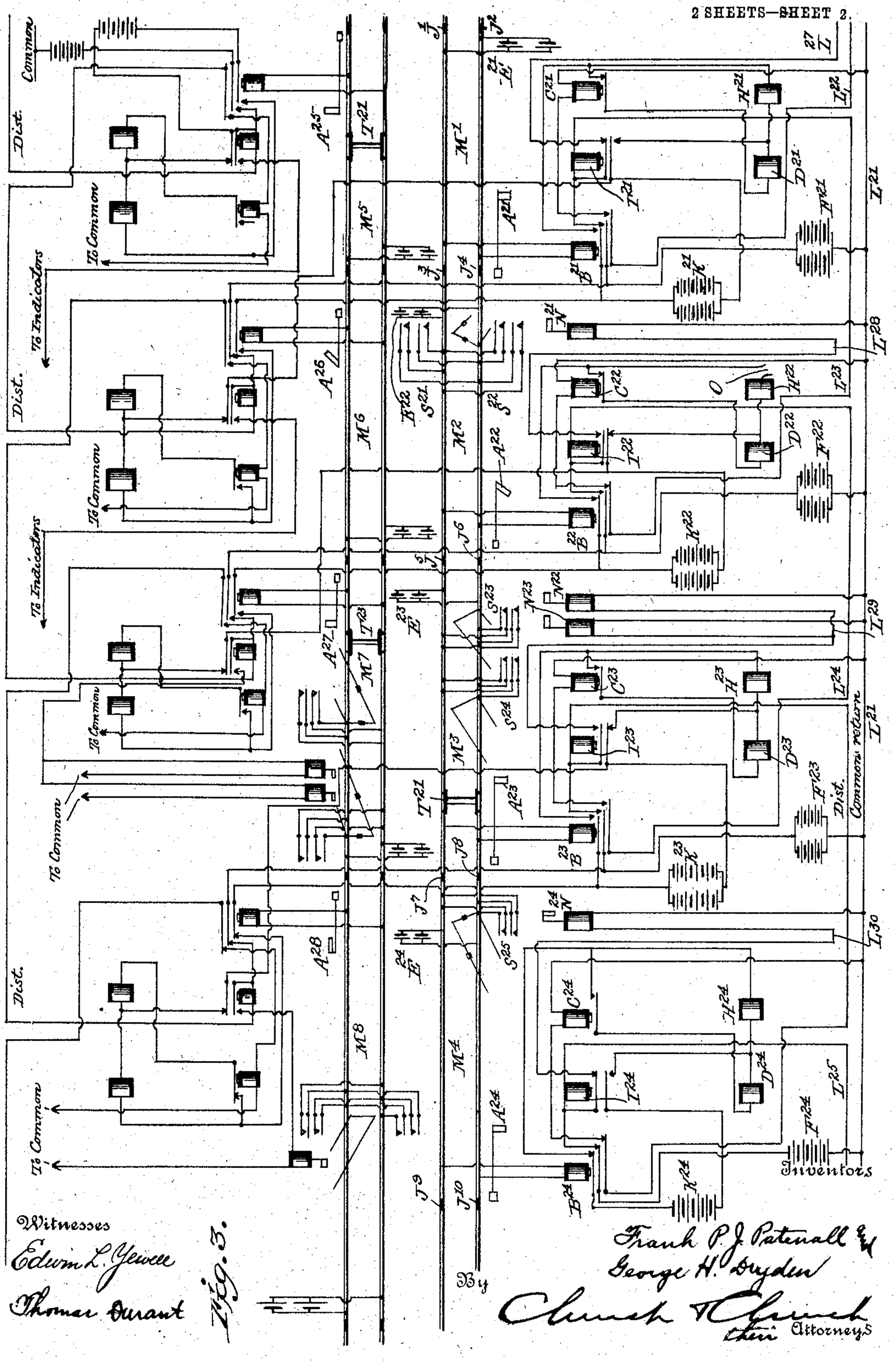

Witnesses
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Fig. 3.

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No. 791,574. Patented June 6, 1905.

UNITED STATES PATENT OFFICE.

FRANK P. J. PATENALL AND GEORGE H. DRYDEN, OF BALTIMORE, MARYLAND.

AUTOMATIC RAILROAD SIGNALING.

SPECIFICATION forming part of Letters Patent No. 791,574, dated June 6, 1905.

Application filed March 13, 1905. Serial No. 249,850.

To all whom it may concern:

Be it known that we, FRANK P. J. PATENALL and GEORGE H. DRYDEN, citizens of the United States, residing in the city of Baltimore, Maryland, have invented certain new and useful Improvements in Automatic Railroad Signaling; and we do hereby declare the following to be a full, clear, and exact description of the same, reference being had to the accompanying drawings, forming a part of this specification, and to the letters of reference marked thereon.

This invention relates to automatic railroad signaling systems, and is more especially, though not exclusively, applicable to that type of signaling systems wherein the track-rails are used as conductors, said rails being divided into sections insulated from each other, as is now well understood in this art.

In automatic signaling systems as at present installed a failure or breakage in the system or mechanism controlled thereby will result in a blocking of the trains at one or more of the block-stations by reason of the fact that the mechanism cannot be automatically cleared, and it is an object of the present invention to so arrange the circuits and mechanism that in case of failure or derangement of any of the parts or circuits in connection with the home signaling mechanism or circuit the distant side of the mechanism and circuits will give a caution indication whenever two blocks in advance of an approaching train are unoccupied, thus obviating the necessity of stoppage of trains and at the same time making the passage of trains absolutely safe even though the home side of said signaling mechanism has failed to perform its function and give a clear indication.

A further object of the invention is to provide a signaling system wherein the signaling mechanism and its direct-operating circuits are entirely separate from the line circuits or conductors, whereby the destructive influences of lightning discharges or influx of heavy currents from outside sources is to a large extent overcome.

The invention consists in certain novel details of construction and in the novel arrangements of the circuits and wiring to be hereinafter described, and pointed out particularly in the appended claims.

Referring to the accompanying drawings, Figures 1 and 2 are diagrammatic illustrations of automatic systems embodying the present improvements, said systems being based on the "normal clear" principle; but it will be understood that with minor changes in wiring alone the invention is equally applicable to automatic systems based on the "normal danger" principle. Fig. 3 is a diagrammatic illustration of a system based on the normal danger principle and is shown in connection with a double-track road.

The invention will be best understood from its embodiment in a simple normal clear system, as illustrated in Fig. 1. This figure illustrates a system with three complete sections of track wiring and circuits embodying the present improvements, the signal clutch and relay wiring alone being shown, whereas in Fig. 2 a system adapted for motor-operated signals is shown, although, as before stated, the invention is applicable in any system or is adapted for use in connection with any other type of signaling mechanism giving clear and caution indications. In all of the drawings visual signals of the three-position type are employed.

Referring specifically to Fig. 1, A', A^2, and A^3 are automatic three-position signals. B' B^2 B^3 are track-relays. C' C^2 C^3 are relays for the partial government of the distant side of signals. D' D^2 D^3 are distant clutch-magnets. E' E^2 E^3 are track-batteries adapted to normally energize the track-relays and hold both armatures of each in position to close the circuits controlled thereby, said track-batteries being adapted to be short-circuited by a train entering the block, so as to deënergize the track-relays and release their armatures. F' F^2 F^3 are batteries for the operation of the distant relays and, when desired, for the operation of indicator-relays, switch-indicators, &c. G' G^3 G^5 are circuit-controllers on the distant side of the signaling mechanism, while G^2 G^4 G^6 are circuit-controllers on the home side of the signaling mechanism,

H' H^2 H^3 are home clutch-magnets. I is an indicator-relay. J' to J^8 are track-insulating joints for separating the tracks into block-sections. K' K^2 K^3 are batteries for the operation of the signal-clutches. L' is a common return-wire. L^2 L^3 L^4 are wires connecting the distant stations for operating the relays C' C^2 C^3 and may conveniently be termed the "distant wires," as they control the distant side of the signaling mechanism. L^5 is an indicator-circuit wire, and M' M^2 M^3 indicate the track-sections, which may be of various lengths to correspond to the length of the block-sections. As shown in the drawings, the signals A' A^2 are both in the vertical or clear position, indicating that block-sections M' M^2 are clear or unoccupied by a train or other obstruction. The circuits are all intact and operative, and it will also be understood that the block-section in advance of the section M' is also clear and unoccupied. Signal A^3 is shown in its caution position, not due to the fact that a block-section in advance of its station is occupied, but due to the fact that the circuit or mechanism, or both, governing the home side of the signaling mechanism has failed. This signal A^3, it will be further noted, has been changed from the stop or danger position to its caution position by the mechanism on the distant side of its operating mechanism and circuits, whereas with the systems at present in use this signal would have remained at "danger" or in its stop position, thereby blocking all trains and holding them until repairs could have been made to that part of the home side of the mechanism which had failed. To make this clear, it will be noted that track-sections M' M^2 M^3 are all unoccupied by trains, and consequently track-relays B' B^2 B^3 and distant relays C' C^2 C^3 are all closed; but the circuit governing the clutch-magnet H^3 has failed, this failure being shown by a break at the point indicated at O and which break might result from any of a number of causes—such as lightning, neglect in maintenance, corrosion of wires, &c.—and would heretofore result in the signaling mechanism being maintained in the stop or danger position; but in the present system the distant side of the signaling mechanism through its circuit-controllers and relays is enabled to perform the function of energizing the signaling mechanism for its perfect operation to the caution position even though the home side either in its circuits or mechanism, or both, have failed to operate. In performing the functions stated the track-batteries E' E^2 E^3, through their respective track-sections M' M^2 M^3, energize relays B' B^2 B^3, which relays alone govern the home side of the signaling mechanism H' H^2 H^3, respectively. Batteries F' F^2 F^3 operate the distant relays C' C^2 C^3 through the respective relay-points of relays B' B^2 B^3 and circuit-controllers G' to G^6. The home clutch-magnets H', H^2, and H^3 are governed locally through the relay-points of track-relays B' B^2 B^3, and the distant clutch-magnets D' D^2 D^3 are also governed locally, first, through the relay-points of track-relays B' B^2 B^3, and, secondly, through the relay-points of distant relays C' C^2 C^3. From the foregoing it will be seen that the home clutch-magnet H^3 having failed by the opening of its circuit at O still the relay B^3 is energized and the circuits controlled thereby closed because track-section M^3 is unoccupied, and it receives its current from the track-battery E^3 through the track-rails. Distant relay C^3 is also energized, because track-sections M^2 M^3 are unoccupied, and relays B^2 B^3 are as a consequence closed. Therefore with signal A^2 in either its clear or caution position the circuit governing the distant relays is complete at G^3 or G^4. Under these conditions—namely, track-relay points B^3 closed and distant relay-points C^3 also closed—the local circuit governing the distant clutch-magnet D^3 is complete through the points of said relays B^3 and C^3, causing the signal to display a caution indication in spite of the fact that its home mechanism has failed or become deranged, as before pointed out. It will be further noted that signal A^3, with its home side inoperative or having failed, could not display a caution indication through the operation of the distant side of its mechanism unless block-sections M^2 and M^3 are clear or unoccupied by train, and signal A^2 indicates either "caution" or "clear," because the track-relays of both of these sections must be energized and the signal A^2 either in caution or clear position before the distant relay C^3 can be energized, and without the relay C^3 being energized the local circuit controlling the caution position of the signal A^3 cannot be completed for setting the signal.

In Fig. 2 of the accompanying drawings a system is illustrated embodying a motor-operated signal mechanism, the system of this figure being that known to those skilled in the art as a "wireless" system—that is to say, a system which does not employ overhead wires for the government of the distant side of the signal, but the conductors between the stations are formed by the track-rails exclusively. In Fig. 2, A^{11} A^{12} A^{13} are automatic three-position signals. B^{11} B^{12} B^{13} are track-relays; but in this instance they are polarized relays, each having one neutral armature b, which remains closed when battery is flowing through the coils in either direction, and one polarized armature b', which is governed by the direction in which the battery flows through the relay. This polarized relay is a well-known construction and is illustrated, for example, in the patent to Taylor, No. 762,009, dated June 7, 1904. C^{11} C^{12} C^{13} C^{14} are pole-changing relays, the first of which, C^{11}, is shown governed direct from track-section M' and battery E^{11}, and the last three—namely, C^{12} C^{13} C^{14}—are governed by the home or distant

sides of the signal mechanism through circuit-controllers G^{11} to G^{16}. D^{11} D^{12} D^{13} are the distant clutch-magnets, each of which is wound with a low resistance, as is customary in this type of device, the low resistance being in circuit only while the signal is at "danger" or is clearing, the high resistance remaining in circuit while the signal is at "clear," the low resistance at this time having been cut out by the movement of the signal mechanism to its caution or clear position by switch-points g' to g^6. The high-resistance coil is always in circuit whenever the governing relay-points are closed. The low-resistance coils are in series with the signal-motors N' N^2 N^3, and consequently in moving the signal to the clear or caution position by either the home or distant side of the mechanism the low-resistance circuit is opened at G^{11} G^{12}, &c., leaving the signal locked in its clear or caution positions through the high-resistance side of the clutch, as will be more readily understood by reference to the patent to Schreuder, No. 638,478, dated December 5, 1899. E^{11} is a track-battery for the government of pole-changing relays C^{11}, while E^{12} to E^{15}, inclusive, are track-batteries, the poles of which are controlled by relays C^{11} to C^{14} to properly operate the polarized track-relays B^{11}, B^{12}, and B^{13} through the track-sections M^2 to M^5, inclusive. F^{11}, F^{12}, and F^{13} are batteries for the operation of the pole-changing relays C^{12} to C^{14}, while G^{11}, G^{13}, and G^{15} are circuit-controllers operated by the changing of the distant side of the signal mechanism. G^{12}, G^{14}, and G^{16} are circuit-controllers operated by the changing of the home side of the signaling mechanism. H^{11}, H^{12}, and H^{13} are home clutch-magnets, which in construction correspond to the clutch-magnets D^{11}, D^{12}, and D^{13} in that they have high and low resistance coils, the low resistance being in circuit and in series with the motor only while the signal is at "danger" or is clearing, the high resistance remaining in circuit while the signal is at "caution," and the proper connections being established through the circuit-controllers G^2, G^4, and G^6, before referred to. The latter may, if desired, be constructed as in the before-mentioned patent to Schreuder. J' to J^{10} are track-insulating joints. K^{11}, K^{12}, and K^{13} are batteries for the operation of the signal clutches and motors N', N^2, and N^3, while the track-sections are indicated by M' to M^5, inclusive. In this Fig. 2 it will be noted that signals A^{11} A^{12} are both in the vertical or clear position, indicating that sections M' M^2 M^3 are clear and unoccupied by train, while all of the circuit connections are intact and operative. Signal A^{13} is shown in its caution position, due not to the fact that any of the sections are occupied by a train, but to the fact that the circuit or operating mechanism, or both, governing the home side of this signal have failed and that the signal has been changed from the stop or danger position to the caution position by the mechanism on the distant side of the signal-operating devices, and consequently with this system trains will not be unnecessarily stopped until repairs can be made, but may proceed under caution orders, and no blockage of the track will result. The operation will be clear from the following: Bearing in mind the fact that the track-sections are unoccupied by trains, it will be seen that track-relays C^{11} B^{11} B^{12} B^{13} are closed on all sides—that is to say, both the neutral and polarized armatures are closed. The circuit governing the home clutch-magnet H^{13} of the signal A^{13}, however, is inoperative or its circuit is broken, as indicated at O, which might result from causes before set forth in connection with Fig. 1; but at the same time the distant side of the signal mechanism of signal A^{13}, through its circuit-controllers, relay-points, and motor, is enabled to operate the signal to its caution position, as the local circuit controlling the motor and the clutch D^{13} is established through both the neutral and polarized armatures of the track-relay B^{13}, and the operation of this portion of the mechanism will continue independent of the operation of the home side of said mechanism which is supposed to have failed, as before stated. It will be noted, however, that signal A^{13}, or any one of the signals in which the home side of the mechanism has failed, could not display a caution indication as stated unless the block-sections M^3 M^4 were unoccupied by trains and their circuits intact, and in addition the signal A^{12} must indicate either "caution" or "clear" because the following conditions exist: Track-sections M' and M^2 being unoccupied, pole-changing relay C^{11} is closed, track-relay B^{11}, with its neutral and polarized armatures and switch-points, are all closed, and signal A^{11} is consequently displaying a clear indication. Therefore pole-changing relay C^{12} and track-relay B^{12}, with its neutral and polarized armatures and switch-points, are all closed, and signal A^{12} is consequently displaying a clear indication. Track-section M^4 being also unoccupied, pole-changing relay C^{13} and track-relay B^{13}, with its polarized armatures and switch-points being closed, would normally permit signal A^{13} to display a clear indication also; but because of the failure at the point O before referred to the home side of this signal is inoperative and the distant side is brought into operation to give a caution indication. Thus trains will not be blocked, but may proceed, and repairs can be perfected without interrupting traffic only in so far as such interruption is due to caution orders instead of a clear track through a given block in which the derangement may have occurred.

In both Figs. 1 and 2 it will be noted that the home and distant sides of the signal-operating mechanism are in multiple with each other, but the distant side D^{11}, &c., is con-

trolled through two switch-points dependent for their operation one upon the track-relay of the block for that station and the other upon the signaling mechanism of the next adjacent station, while the home side of said operating mechanism is controlled by one switch-point operated only by the track-relay of the track-section for that station alone. In Fig. 2 the pole-changing relay C^{13} operates to govern the polarized relay B^{13} in such manner that when deënergized, as would be the case if signal A^{12} were at "danger," the armature of the polarized relay B^{13}, which controls the home-clutch H^{13}, alone would be operated, and the signal A^{13} under such circumstances could not be cleared nor moved to caution position because of the failure of this side of the mechanism at O. If the failure at O did not exist, then the home side of the signal mechanism could move the signal to "caution," and, in fact, this would be the normal working of the system if there were no failure and a train were in the second section ahead, so as to set signal A^{12} at "danger."

Fig. 3 illustrates an arrangement of the circuits and apparatus embodying the present invention applicable to signaling systems on the normal danger principle. Two tracks have been shown in this figure simply to illustrate the connections between signals located opposite to each other and avoiding the duplication of a large number of the circuit connections and batteries; but for the purpose of understanding the invention a description of the appliances and circuit arrangement used in connection with one track only is all that is necessary, especially as those skilled in this art will readily understand that the invention is applicable to one, two, or more tracks, if so desired. Referring to Fig. 3, A^{21} to A^{24}, inclusive, are automatic three-position signals, B^{21} to B^{24}, inclusive, are track-relays, C^{21} to C^{24} are relays for the partial government of the distant side of signals, D^{21} to D^{24} are distant clutch-magnets, E^{21} to E^{24} are track-batteries, F^{21} to F^{24} are batteries for the operation of the distant relays and indicator-relays where the latter are employed, together with switch or tower indications, H^{21} to H^{24} are home clutch-magnets, I^{21} to I^{24} are indicator and clearing relays, J' to J^{10} are track-insulating joints, K^{21} to K^{24} are batteries for the operation of the signal-clutches, L^{21} is a return-wire or common return, L^{22} to L^{25} are distant wires, L^{27} to L^{30} are indicator-wires, M' to M^8 are the insulated track-sections forming track-circuits or block-sections and may be of any desired length, N^{21} to N^{24} are switch-indicators, and S^{21} to S^{25} are switch instruments. The signals A^{21}, A^{23}, and A^{24} are shown in the horizontal (danger or block) position, this being the normal position of the signals under the normal danger system, as under this system the signals remain at "danger" until the train enters the first or second block in the rear. In the method of wiring shown in Fig. 3 it is intended that the signals operate when the train passes into the first section in the rear if at this time the first track-section in advance of the signal is unoccupied and all circuits and mechanism are intact and operative. If the second track-section in advance of the signal is occupied by a train, a caution indication will be given; but if two sections in advance of the signal are unoccupied a clear indication will be given. The operation will now be readily understood. Sections M' M^2 of the track being unoccupied by a train and section M^3 occupied by a train, (indicated at T^{21},) signal A^{22} should give a clear indication; but, as shown, this signal indicates "caution," because its circuits or mechanism, or both, have failed, as heretofore pointed out and as indicated at O. Track-relays B^{21} to B^{24} when their respective track-sections M' to M^4 are unoccupied remain closed, these relays alone governing the home side of signal mechanism. Distant relays C^{21} to C^{24} and indicator-relays I^{21} to I^{24} are each governed from two sections by track-circuit, as shown, and each are also governed by the track-relays. The distant relays govern the distant clutches, said clutches being also governed by the track-relays. The distant and home clutch magnets, it will be noted, are located in parallel with each other, the arrangement in this respect corresponding to the arrangement heretofore described in connection with Figs. 1 and 2; but in the arrangement of Fig. 3 an additional control is introduced by the clearing-relays I^{21} to I^{24} inclusive, in order to adapt the system for operation on the normal danger principle. The indicator and clearing relays I^{21} to I^{24} are wired in series with the distant relays in the rear and perform two functions—*i. e.*, first, that of governing the indicators in advance of the signal, and, secondly, that of operating as a clearing-relay for the signal in advance of the approaching train. The train T^{21} has short-circuited the battery E^{23} and the three switch-points on relay B^{23} are open. This relay governs, first, its home clutch H^{23}; secondly, its indicator and clearing relay I^{23} with the distant relay C^{21} in the rear, and, thirdly, its own distant relay C^{23} and the indicator-relay I^{22} in advance. The opening of indicator-relay I^{22} completes the circuit for the clutch-magnets D^{22} and H^{22} of signal A^{22} and would cause the same normally to display a clear indication whenever the two track-sections in advance are unoccupied. As shown, the track-sections M' and M^2 are unoccupied, but the signal-clutch H^2 or its mechanism have failed, as before pointed out, and in accordance with the methods of wiring commonly used would not admit of a caution-signal being displayed; but under the present arrangement a caution indication is displayed by signal A^{22}. This result, it will be noted, is attained by the wir-

ing governing the distant clutch being so arranged that when a failure occurs in the home circuit, mechanism or both the distant side of the circuit and mechanism are made serviceable because all track and distant relays are closed, as is also the distant side of clutch through the track-relay and distant relay, and therefore said distant clutch performs the function of giving a caution indication, which function should have been normally performed by the home mechanism and circuits had they not failed. The practical result of the arrangement is that unnecessary stoppages of trains are avoided; but at the same time the safety of the trains is insured, the only delay being that incident to the running of the train through a single block under caution orders instead of with a clear track.

With this system it will be noted that there is no direct circuit connections between the signal-clutches and the line wires or tracks, although the distant and indicator relays are governed or operated together with the switch-indicators through the line-wire connections. This arrangement avoids failures, which in practice have been annoying and due to lightning or the influx of heavy currents, such as would injure delicate and expensive mechanism of the clutches. The relays themselves or switch-indicators may be more easily protected against such discharges and in case of breakage may be more cheaply and readily replaced.

Switch instruments S^{21} and S^{22} are diagrammatically illustrated as located at a facing-switch and work in conjunction therewith, so that when the switch is open a double shunt of the track-circuit takes place through the switch instruments, thereby insuring that the track-relay B^{22}, for instance, will be opened by the short-circuiting of battery E^{22}. Two switch instruments are provided at facing-switches in order to insure complete protection. Switch instruments S^{23} S^{24} S^{25} are also shown to form a double shunt, but are adapted to be operated by a single operating mechanism connected with the switch-operating mechanism, as will be readily understood. Switch-indicators N^{21} to N^{23} are shown in position indicating "danger," indicator N^{21} being governed by indicator-relay I^{22}, which in turn is governed by relays B^{22} and B^{23}. Indicators N^{22} and N^{23} are governed by indicator-relay I^{23}, which latter is in turn governed by track-relay B^{23}, and indicate "danger," because the circuits are not intact, as heretofore explained.

The left-hand or upper track in the illustration of Fig. 3 is equipped similarly to the track just described save that its equipment makes use of the same common return and operating batteries K^{21}, &c., and F^{21}, &c., and the same explanations will apply. As illustrated, two trains T^{22} and T^{23} are occupying track-sections M^5 and M^7 and the circuits and mechanism are shown as intact. Under these circumstances signal A^{26} indicates "caution" because track-section M^7 is occupied and the train in the preliminary section M^5 can only clear its signal A^{26} to the caution indication, even though section M^6 is unoccupied. The relay-points are shown in the positions they would occupy in actual service. Signals A^{25} and A^{27} indicate "danger" and cannot be cleared by an approaching train so long as the track-sections they govern are occupied by trains T^{22} and T^{23}. Signal A^{28} indicates "clear" because two track-sections in advance of this signal are unoccupied, and the circuit and mechanism including the clearing-relay governed from track-section M^7 are open, thus completing the circuit to both the home and distant clutches.

Referring again to Fig. 1, it will be seen that at station B^3 an indicator-relay I is included in the distant wire running back to the preceding station, and this indicator-relay controls a circuit L^5, which is a branch from the distant circuit and receives its energy from the battery F^3. It usually contains indicators l^5, which may be appropriately located to indicate to the operators the fact that the circuit is made or broken and that the track conditions are safe or unsafe, as the case may be. An indicator-circuit is not shown in the other two stations of Fig. 1, inasmuch as it is desired to avoid as far as possible any confusion or complication in this illustration, and for a like reason some of the circuit continuations in connection with the left-hand track of Fig. 3 are not shown; but each terminal is marked to indicate to what point it is intended that it shall extend.

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

1. In a railway signal system the combination of signal mechanism adapted to indicate danger, caution and clear of controlling mechanism for the clear and caution positions one operated from the home and the other from both the home and a distant station, whereby upon failure of one the other will perform its functions; substantially as described.

2. In an automatic railway block system the combination of the following instrumentalities to wit: a series of block-stations, signals at each station adapted to indicate danger, caution and clear conditions, controlling mechanism for the clear and caution indications, electric circuits including said controlling mechanism, one of said circuits being established by the mechanism at the home station and the other being established by the mechanism at the home station in conjunction with the mechanism at a distant station; substantially as described.

3. In an automatic railway block-signal system the combination of the following instrumentalities, to wit: a series of block-stations,

signals at each station adapted to indicate danger, caution and clear conditions, controlling mechanisms operating in conjunction for giving a clear indication, and either individually to give a caution indication circuit connections for operating one of said controlling mechanisms dependent upon both the mechanism at the home and at a distant station and circuit connections for operating the other of said controlling mechanisms dependent upon the mechanism at the home station alone; substantially as described.

4. In an automatic railway block-signal system, the combination of the following instrumentalities, to wit: a series of block-stations, track-circuits for each a track-relay controlled from each track-circuit, signals at each station adapted to indicate danger, caution and clear conditions, controlling mechanisms for the caution and clear indications, circuit connections for both said mechanisms controlled by the track-relay, the circuit connections for one of said controlling mechanisms being also controlled by the mechanism at a distant station; substantially as described.

5. In an automatic railway block-signal system, the combination of the following instrumentalities, to wit: a series of block-stations, track-circuits and signals indicating clear when two blocks ahead are unoccupied and caution when the second block ahead is occupied and means whereby when two blocks ahead are unoccupied the signal will indicate caution in case of partial failure of the signal-operating mechanism; substantially as described.

6. In an automatic railway block-signal system, the combination of the following instrumentalities, to wit: a series of block-stations, signals indicating danger, caution or clear conditions, electrically-operated control mechanisms for the safety and caution indications, electrically-operated switches in the circuits of said control mechanisms, adapted to be operated one from the home block and the other from a distant block and circuits for said control mechanisms one established through both of said switches and the other established through one only of said switches, whereby upon the failure of one of said control mechanisms the other will give a caution indication; substantially as described.

7. In an automatic railway block-signal system, the combination of the following instrumentalities, to wit: a series of block-stations, signals indicating danger, caution or clear conditions, electrically-operated control mechanisms, individually operating to give a caution indication and collectively operating to give a clear indication, two electrically-operated switches both included in the circuits of one of said control mechanisms and one only included in the circuit of the other of said control mechanisms, said last-mentioned switch being itself controlled from the home block and the other switch being controlled from a distant block, whereby upon the failure of the control mechanism included in the switch-circuit of the home block, the other control mechanism will give a caution-signal; substantially as described.

8. An automatic railway block-signal system embodying a home circuit operated from the block for each station, a distant circuit operated from a distant station, a switch controlled by each of said circuits, a signal at each station, two control mechanisms therefor, one included in a circuit passing through both of said switches and the other included in a circuit passing through one only of said switches; substantially as described.

9. An automatic railway block-signal system each station embodying a home relay-switch operated from the block for that station, a distant relay-switch operated from the next succeeding block-station, a three-position signal at each station two electrically-operated control mechanisms therefor, one of said control mechanisms being governed by a circuit including both said switches and the other control mechanism being governed by a circuit including the home relay-switch only; substantially as described.

10. An automatic railway block-signal system each station embodying a home relay-switch operated from the block for that station, a distant relay-switch operated from the next succeeding block-station, a three-position signal at each station, two electrically-operated control mechanisms therefor located in parallel branches of a common-battery circuit, one of said branches including the two switches in series and the other branch including one only of the switches, whereby when the last-mentioned control mechanism breaks down the former will give a caution indication; substantially as described.

11. An automatic railway block-signal system each station embodying a home relay-switch operated from the block for that station, a distant relay-switch, a circuit including the latter relay and a switch at the next succeeding station closed when the signal at the latter station is either clear or at caution, a signal at each station indicating clear, caution or danger, two electrically-operated control mechanisms for each signal, one of said control mechanisms being governed by a circuit including both the home and distant relay-switches and the other control mechanism being governed by a circuit including the home relay-switch only; substantially as described.

12. An automatic railway block-signal system, each station embodying a home relay-switch operated from the block for that station, a distant relay-switch, having its relay included in a circuit also including a switch at

the next succeeding station adapted to be closed when the signal is clear or at caution, a clearing relay-switch having its relay included in a circuit also including the home relay-switches of its own and the next preceding station, a signal at each station indicating clear, caution or danger, two electrically-operated control mechanisms for each signal, one of said control mechanisms being governed by a circuit including the home, distant and clearing relay-switches at that station and the other control mechanism being governed by a circuit including the home and clearing relay-switches; substantially as described.

13. An automatic railway block-signal system, each station embodying a home relay-switch operated from the block for that station, a distant relay-switch having its relay included in a circuit also including a switch at the next succeeding station adapted to be closed when the signal is either clear or at caution, a clearing relay-switch having its relay included in the distant relay-circuit of the next preceding station, a signal at each station indicating clear, caution or danger, two electrically-operated control mechanisms for each signal, one of said control mechanisms being governed by a circuit including the home, distant and clearing relay-switches at that station and the other control mechanism being governed by a circuit including the home and clearing relay-switches; substantially as described.

14. An automatic railway block-signal system, each station embodying a home relay-switch operated from the block for that station, a distant relay-switch having its relay included in a circuit also including a switch at the next succeeding station adapted to be closed when the signal is either clear or at caution, a clearing relay-switch having its relay included in the distant relay-circuit of the next preceding station, a signal at each station indicating clear, caution or danger, two electrically-operated control mechanisms for each signal, one of said control mechanisms being governed by a circuit including the home, distant and clearing relay-switches at that station, the other control mechanism being governed by a circuit including the home and clearing relay-switches, an indicator and an indicator-circuit therefor including a switch operated by the clearing-relay to close the indicator-circuit when the control-mechanism circuit is broken by said switch; substantially as described.

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