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AUTOMATIC ELECTRICAL SIGNALING APPARATUS FOR RAILWAYS.

APPLICATION FILED APR. 21, 1911.

1,015,778.

Patented Jan. 30, 1912

3 SHEETS—SHEET 1.

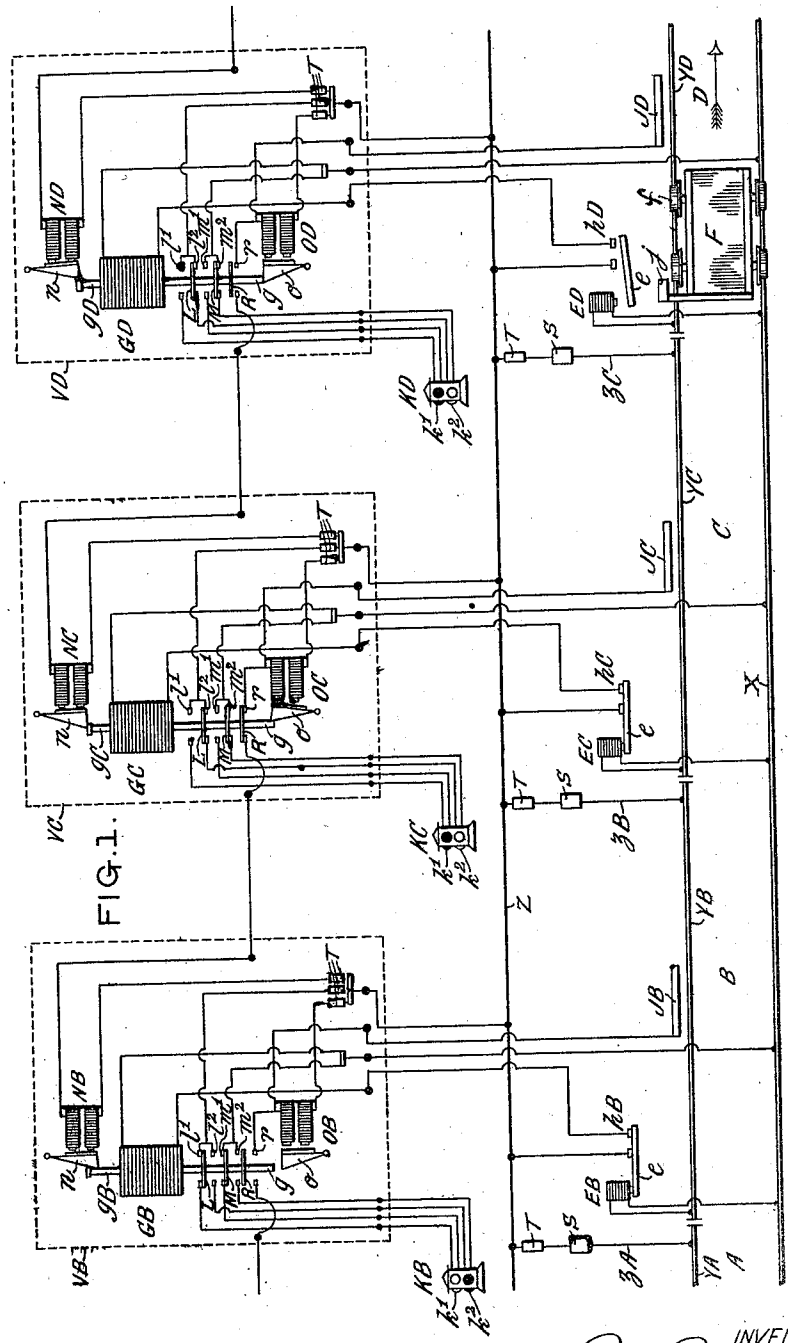

FIG. 1.

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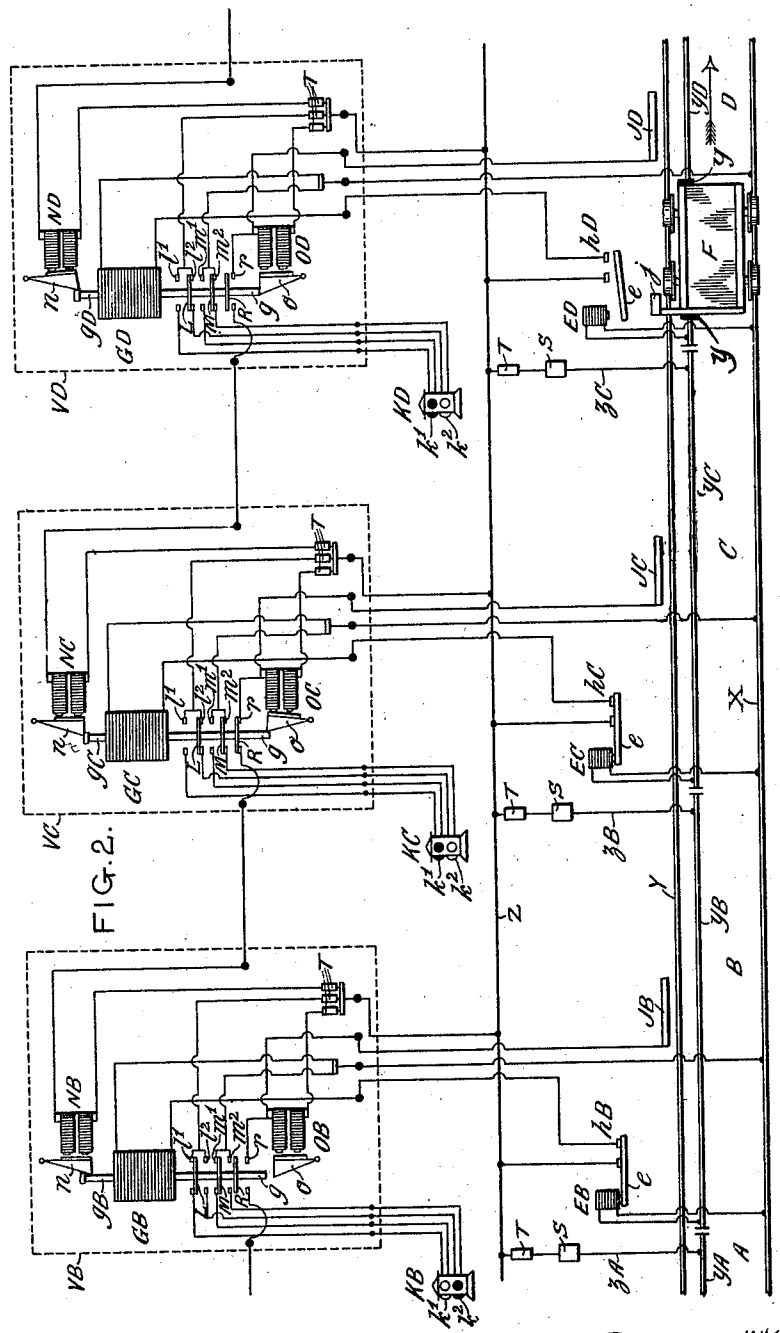

FIG. 2.

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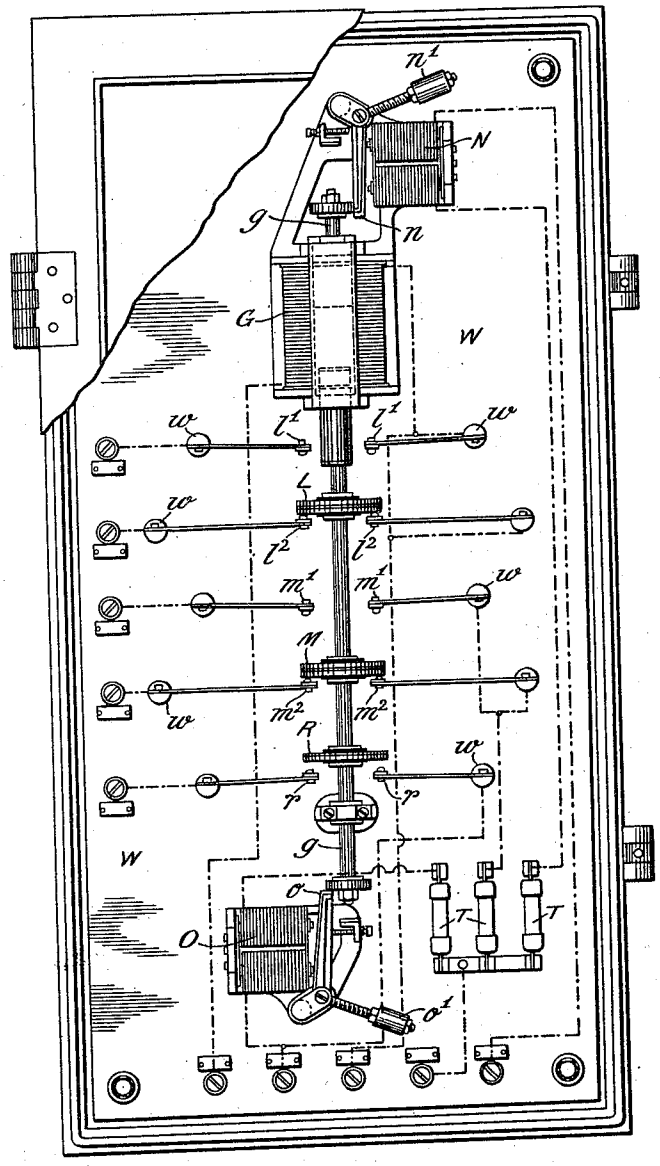
3 SHEETS—SHEET 3.

FIG. 3.



WITNESSES

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AUTOMATIC ELECTRICAL SIGNALING APPARATUS FOR RAILWAYS.

1,015,778. Specification of Letters Patent. Patented Jan. 30, 1912.

Application filed April 21, 1911. Serial No. 622,455.

To all whom it may concern:

Be it known that I, ROBERT PERCY BROUSSON, a subject of the King of Great Britain, and resident of 3 Highbury Place, London, N., England, electrical engineer, have invented certain new and useful Improvements in Automatic Electrical Signaling Apparatus for Railways, of which the following is a specification.

This invention relates to automatic electric signaling for railways worked on the sectional block system with normally clear signals commanding the entrace to electrically insulated track-sections, wherein the switches for controlling the respective circuits through which current is conveyed for maintaining the signals in the "clear" condition are held normally closed, in opposition to gravity or spring pressure, by means of solenoids whose energization is dependent upon that of relays in series with the several track-circuits; the arrangement being such that on the one hand, the entrance of a train into any particular block-section will bring about the interruption of the circuit of the solenoid which governs the switch appertaining to the signal at the entrance to said section, with the result that this signal will be put to "danger" and the solenoid-controlled switch will thereupon become automatically locked in the corresponding position, and that on the other hand, the entrance of the train into a subsequent block-section and its final exit from the block-section first mentioned will bring about the re-closure of the solenoid circuit, the electro-magnetic release of the switch-lock, and the consequent restoration of the signal to its normal or "line clear" condition. This electro-magnetic release of the switch-lock at the proper moment is effected by the passage of an appropriate operative member mounted on the rear end of the train, over a treadle-device situated within the subsequent block-section above referred to, and serving to close the circuit of the electro-magnet whereby the switch-block just mentioned is released. In such systems hitherto, failure in the transmission of current (when such transmission is required) in any part of the signal-controlling connections has been liable to cause considerable inconvenience in the traffic arrangements. Thus, on the one hand, accidental failure of current in the circuit of the solenoid which governs any one of the signal-controlling switches, will result in said switch not only assuming, but also becoming locked in, the position wherein it causes the corresponding signal to be put to "danger", so that thereafter, even if the supply of current be resumed, this signal will remain at "danger" and hence, until the switch-lock has been released, no train will be able to pass the signal without special precautions being adopted to prevent accidents. On the other hand, failure of the train, on passing into the block-section in advance, to cause transmission of current through the circuit of the electro-magnet which controls the switch-lock (whether such failure be due to accidental failure of current-supply in said circuit, or to faulty action on the part of the treadle-device operated by the train) will result in that signal (which commands the entrance to the block-section in rear of the train) remaining locked at "danger"; so that, assuming a supply of current to be available in the circuit of the electro-magnet in question, it is necessary to despatch another train over the line, under special precautions, in order to bring about the release of the switch-lock referred to and the restoration of the signaling apparatus to normal condition. According to the present invention, which is designed to overcome these defects, means are provided whereby, on cessation of current in the winding of the solenoid which governs any signal-controlling switch, this switch, although permitted to assume an intermediate position wherein the signal which it controls is put to "danger", it will be there arrested by a stop whereby the switch will be prevented from passing to the final position wherein it becomes automatically locked as before until or unless certain conditions have supervened. That is to say, the signal-controlling switch will remain in the intermediate or unlocked position until, in the ordinary course of working, a treadle-device (which may be the treadle-device employed to effect the release of the switch-lock at the entrance of a block-section in rear of that commanded by the signal in question) has been brought into operation by the train on the latter passing into the block-section commanded by the signal already referred to; the result of the operation of this treadle-device being to close the circuit of an elec-

tro-magnet whereby the stop, which arrested the switch in the intermediate position, is withdrawn.

As a result of the present improvement, in the event of the cessation of current in the solenoid-winding being due, not to the passage of a train into the block-section commanded by the signal to which such solenoid appertains, but to accidental and temporary failure in the supply of current, the renewal of the current-supply will at once and automatically bring about the restoration of the solenoid-controlled switch to normal position and the consequent clearing of the signal. Furthermore, as the solenoid-controlled switch remains unlocked when in the intermediate position, subsequent failure of the treadle-device, situated within the entrance of the block-section in advance of that occupied by the train, to effect the withdrawal of the switch-lock at the entrance of the section just vacated by the train, will not prevent the clearing of the signal in rear of the train; and hence such clearing will now take place automatically so soon as the train has finally left the section commanded by the signal.

In the accompanying drawings, Figure 1 is a diagram illustrating the invention as applied to an underground or other electric railway wherein the "danger" and "line clear" signals respectively consist of differently colored lamps, and wherein the track rails are not used for the conveyance of the traction-current. Fig. 2 is a similar diagram wherein the track rails are assumed to be used as traction-current conductors. Fig. 3 is a detail view showing, in front elevation, the solenoid-controlled switch for governing a signal, together with the parts more immediately associated with the switch itself.

Referring first to Figs. 1 and 2, each diagram shows in succession, part of a block-section A of the track, two complete block-sections B and C, and part of another block-section D; the direction of the traffic being from left to right. Inasmuch as the apparatus used for the several block-sections is of identically similar character in all cases, corresponding parts or elements of the apparatus and connections, throughout all the sections, will be denoted (for the sake of clearness) by similar reference symbols with the qualifying addition of the letter A, B, C or D appertaining to the particular section which for the time being is in question. In Fig. 3, which shows separately, a portion of the apparatus common to all the block-sections, the letters A, B, C, D, are omitted.

Referring now more particularly to Fig. 1, it will be seen that the one track-rail X is continuous throughout all the sections of the line, and serves, electrically, as a common return for the entire system, while the other rail is divided into insulated lengths YA, YB, YC, and YD corresponding to the respective block-sections. Electric power for working the signals is derived from a cable Z common to all the sections, which latter severally derive current in parallel from the cable through branch conductors z, whereof zA, zB, and zC alone are shown, the connection being indicated as permanently established at the advance ends of the section in each case. At the rear ends of the several sections, the rails X and Y at opposite sides of the track are connected through the windings of relays E, whereof EB, EC and ED alone are shown. As usual, each relay is energized (by current of low voltage) so as to attract its armature e, only so long as current is supplied from the cable Z, and if at the same time the track-section to which the relay appertains is not occupied by a train; whereas, on cessation of current, either through failure in the supply or in consequence of the winding being short-circuited as the result of the presence of a train F in the section (as indicated in the case of section D), the relay becomes deënergized and its armature e falls. The several armatures e serve to operate switches as at h controlling the supply of current from the cable Z to the windings of solenoids G, whereof GB, GC and GD alone are shown, one end of each solenoid-winding being connected to the cable Z through the corresponding armature-switch h, in such manner that only so long as the corresponding relay E is energized will the connection be closed, while the opposite end of the solenoid-winding is connected directly to the common-return rail X. The entrances to the several block-sections of the line are governed by signals K, whereof KB, KC and KD alone are shown, each signal comprising a green or "safety" signal-lamp k^1 and a red or "danger" signal-lamp k^2. The circuits of these lamps are in each case controlled by a multiple-switch operated by the core-stem g of the corresponding solenoid G; the stem carrying for this purpose two conductive disks L and M. The core-stem g of each solenoid is capable of occupying three positions. Of these the raised or normal position (shown in the case of GB) wherein the disk L closes at a pair of contacts l^1 the power side of the circuit of the green or "safety" lamp k^1 of the corresponding signal K, while the disk M closes at a pair of contacts m^1 the return side of the same circuit, is maintained solely as a result of current passing in the solenoid-winding as heretofore. In the fully lowered position (shown in the case of GC), wherein the disk L closes at a pair of contacts l^2 the power side of the circuit of the

red or "danger" lamp k^2 of this signal while the disk M closes at a pair of contacts m^2, the return side of the same circuit, the stem g is automatically locked by a gravity-operated (or spring-pressed) latch n which then engages over the top of the stem, and which is capable of being withdrawn from active position by means of an electro-magnet N as heretofore; the respective latches and the corresponding electro-magnets being shown at NB, NC, and ND. According to the present invention the stem g is capable of occupying a third or intermediate position (shown in the case of GD), wherein the disks L and M close at l^2 and m^2 respectively the power and return sides of the circuit of the red or "danger" lamp k^2 as when in the fully lowered position; this intermediate position being reached, however, before the stem g has descended so far as to become locked by the latch n. The intermediate position is determined by the lower end of the stem g encountering and resting upon a stop o, which is normally presented (by gravity or spring-pressure) in the path of the stem, and which is capable of being withdrawn from such position by means of an electro-magnet O; the respective stops and the corresponding electro-magnets being shown at OB, OC and OD. The circuit of each electro-magnet N is controlled by means of a third conductive disk R carried (in addition to the disks L and M) by the core-stem g of the solenoid G appertaining to the multiple-switch which controls the signal commanding the entrance to the block-section in advance, this disk R being adapted to close said circuit by bridging a pair of contacts r. The construction is such that the circuit in question remains broken at the contacts r so long as the stem g is in the highest and intermediate positions, as indicated in the case of the solenoids GB and GD respectively, and is closed at this point only when said stem reaches the lowest position, as indicated in the case of the solenoid GC. The completion of the circuit of each electro-magnet N is effected by the action of the train, upon the latter passing clear within the block-section in advance; the train at the same time bringing about the closure of the circuit of the electro-magnet O appertaining to the multiple-switch which controls the signal commanding the entrance to said advance section. For this purpose treadle-devices J (whereof JB, JC and JD alone are shown) are placed alongside the track at points within the entrances of the respective block-sections as heretofore, these tradle-devices being severally adapted, in conjunction with the appropriate operative member mounted on the rear of the train, to admit current to the circuits referred to. In the example illustrated in Fig. 1, the train carries at its rear end a brush j which is to be understood as maintaining permanent contact with the return-rail X through the medium of the metallic frame, axle, and hind wheels of the rear vehicle, this brush j being adapted to establish connection with each of the treadle-contacts JB, JC and JD in succession. The contact JB is connected to one end of the winding of the electro-magnet OB and also (in parallel therewith) to one of the corresponding pairs of contacts r, the other contact r of this pair being connected by a line-wire to one end of the winding of the electro-magnet N appertaining to the solenoid (not shown) at the entrance of the block-section A, while the other ends of the winding of the same electro-magnet N and of the electro-magnet OB are connected to the power-cable Z. Similarly, the contact JC is connected to one end of the winding of the electro-magnet OC and also (in parallel therewith) to one of the corresponding pair of contacts r, the other contact r of this pair being connected by a line-wire to one end of the winding of the electro-magnet NB, while the other ends of the windings of the electro-magnets OC and NB are connected to the cable Z; and so on as indicated. It is to be observed that the treadle-contacts J should be made of sufficient length to insure effective transmission of current in succession through those electro-magnets O and N which are connected to the respective contacts J.

The normal working is as follows:—Assuming a train such as F to enter the block-section B from the block-section A of the line, the entrance into section B of the leading pair of wheels f (which are assumed to be electrically connected through their axle) will cause the relay EB to be short-circuited, with the result that the circuit of the solenoid GB will be broken at the switch hB and the core-stem gB of this solenoid will drop until arrested at the intermediate position by its stop o, the fall of this stem g causing current to be switched at L, M from the green lamp k^1 of the signal KB to the red lamp k^2 of the same signal. On the brush j at the rear end of the train encountering the treadle-contact JB, the circuit of the electro-magnet OB will be completed and current will be transmitted through the winding of this electro-magnet, with the result that the corresponding stop o will be withdrawn and the stem gB allowed to fall to the lowest position. In this position the disk R carried by the stem gB bridges the corresponding pair of contacts r, with the result that current will now be transmitted through the winding of the electro-magnet N appertaining to the solenoid at the entrance to the block-section A, the effects of this being similar, as regards said solenoid, to those about to be

described with reference to the solenoid GB. On the brush j leaving the treadle-contact JB, the electro-magnet OB will cease to be energized, and the corresponding stop o will become free to return to normal position when the core-stem gB of the solenoid GB is raised as hereafter described. After the train F has advanced so that its leading pair of wheels f enter the block-section C, the conditions already brought about as above described with reference to section B will continue so long as any pair of electrically connected wheels of the train remain still within section B, the red lamp k^2 of the signal KB remaining lighted; but, the relay EC being now short-circuited by the presence of the train in section C, the solenoid GC will be deënergized and its core-stem gC will drop to the intermediate position, with the result that, in the case of the signal KC, the green lamp k^1 will be extinguished and the red lamp k^2 lighted. On the last pair of wheels of the train passing out of the block-section B, the relay EB will cease to be short-circuited, and consequently the circuit of the solenoid GB will be again closed at the switch hB. Since, however, the core-stem gB of this solenoid is locked in the fully lowered position by its latch n, the connections already established by the disks L, M and R in the case of the solenoid GB will remain unaffected, and the signal KB will still remain at "danger". On the brush j at the rear end of the train encountering the treadle-contact JC, the electromagnet OC will become energized, and, the corresponding stop o being withdrawn from under the core-stem gC, this stem will drop to the lowest position, with the result that, while the signal KC will remain at "danger", the disk R carried by the stem gC will bridge the contacts r and the electro-magnet NB will become energized. Hence, the stop n controlled by this electro-magnet will be withdrawn, and, the solenoid GB still remaining energized, the core-stem gB will be raised to the highest position, with the result that the red lamp k^2 of the signal KB will be extinguished and the green lamp k^1 of the same signal re-lighted. At the same time the circuit controlled by the disk R carried by the stem gB wil be broken. On the brush j leaving the treadle-contact JC, the electro-magnet OC will cease to be energized, and the corresponding stop o will become free to return to normal position when the core-stem gC is afterward raised. So long as a pair of wheels of the train remain in section C, the signal KC will remain at "danger" but at the same time, when the train has advanced so that its leading pair of wheels enter section D, the relay ED will be short-circuited, the solenoid GD will be deënergized, and the core-stem gD will drop, so that the green lamp k^1 of the signal KD will be extinguished and the red lamp k^2 of the same signal will be lighted. On the last pair of wheels of the train passing out of section C, the relay EC will cease to be short-circuited, and the solenoid GC will again be energized, but its stem gC will remain in the lowest position; this being the situation indicated in Fig. 1. The same sequence of operations will be repeated, during the progress of the train, every time the latter passes from one block-section of the line to another, as will be readily understood. Let it now be assumed that an accidental failure of current takes place in the circuit either of one of the track-relays E, or of one of the solenoids G. In either case the solenoid immediately concerned will become deënergized, and its core-stem g will drop so as to change the corresponding signal from "line clear" to "danger". The core-stem g will, however, be arrested in the intermediate position by its stop o, so that, as the corresponding latch n will not have been permitted to come into operation to lock the stem g, the latter will be able to rise again to normal position, so as to restore the corresponding signal to "line-clear," immediately a flow of current recommences in the circuit wherein failure occurred. In the event of a failure of current in the circuit of one of the electromagnets O, the stop o which it controls will not be withdrawn from operative position when the corresponding treadle-device J is actuated. Hence the core-stem g of the corresponding solenoid will not descend so as to become locked by its latch n, but this fact will not affect the condition of the signal governed by said core-stem, inasmuch as this signal will be put to "danger" on the entrance of a train into the block-section commanded by the signal, and will be returned to "line clear" on the exit of the train from said section, as usual. In the event of failure on the part of the train to actuate one of the treadle-devices J, or defective working in the device J itself, neither of these will affect the condition of the two signals to which the particular treadle-device J appertains. That is to say, on the one hand, failure of the treadle-device J to transmit current through the winding of the corresponding electro-magnet O will merely result in the stop o being left in operative position, with the result that the core-stem g of the corresponding solenoid will not descend so as to become locked by its latch n. But the signal controlled by this solenoid will be put to "danger" and returned to "line clear" on the entrance and exit of a train into and from the block-section commanded by said signal, as usual. On the other hand, the effect of the core-stem g (of the solenoid referred to)

being prevented from descending to its lowest position by the non-withdrawal of the corresponding stop o, will be to leave open the circuit of the electro-magnet N appertaining to the solenoid at the entrance of the preceding block-section, and consequently the core-stem g of this latter solenoid, having already fallen to and become locked in its lowest position, will remain so locked until the passage of the next train or the restoration of the defective treadle-device J to working condition.

Referring now more particularly to Fig. 2, it will be observed that the arrangement remains the same as that just described with reference to Fig. 1, except as regards the rails. That is to say, whereas in Fig. 1 (wherein the track-rails X and Y are not employed to convey the traction current but only serve to carry the track-circuit current) the rail Y is itself divided into insulated lengths corresponding to the respective block-sections; in Fig. 2 (wherein the track-rails X and Y carry the traction current) the rail Y is continuous, while a contact-rail is laid alongside of and parallel to it so as to serve for track-circuit purposes only, this contact-rail being divided into insulated lengths corresponding to the respective block-sections, as indicated in the case yA, yB, yC and yD. In both arrangements the track-rail X serves as a common return for the entire electrical system. Since, in the arrangement illustrated in Fig. 2 the sectional rail yA, yB, etc., does not carry the train wheels, the train is provided at each end with a brush, as indicated at y, adapted to contact constantly with said sectional rail; each brush y being in electrical connection with the rail X through the frame, an axle, and the corresponding wheel of the first or last vehicle of the train, as the case may be, so as to cause the presence of the train in any block section A, B, etc., of the line to bring about the short-circuiting of the corresponding track relay EA, EB, etc., so long as any part of the train remains within the section.

It is unnecessary to describe the action of the apparatus with reference to Fig. 2, as this is identical with that already described with reference to Fig. 1. In both arrangements, the dotted rectangles VB, VC and VD indicate the casings wherein are housed the solenoids G and multiple-switches for controlling the signals which command the entrances to the block-sections D, C and D of the line respectively.

S indicate resistances and T fuses interposed in the various circuits.

Referring to Fig. 3, it will be seen that the pairs of contacts l^1, l^2; m^1, m^2; and r, are all constituted by leaf-springs which normally extend in a horizontal direction from their points of fixture w to the back-board W of the casing inclosing the solenoid G and the parts more immediately associated therewith, the free ends of the springs of the respective pairs being presented in the paths of the corresponding disks L, M and R, which are fixed on the core-stem g but insulated therefrom and from each other. n^1 and o^1 are adjustable counterweights carried by the latch n and stop o respectively, these being constituted by the armature-levers of the respective electro-magnets N and O. The weights n^1 and o^1 serve to maintain the latch n and stop o in normal or active position so long as the respective armatures are not attracted in consequence of the energization of the electro-magnets. In the highest position of the stem g, the disks L and M respectively bridge the spaces between the free ends of the pairs l^1 and m^1, while in the intermediate and lowest positions of the stem, the respective disks bridge the spaces between the free ends of the pairs l^2 and m^2; the flexibility of the pairs of springs l^2 and m^2 being made sufficient to permit of these springs bending so as to maintain contact with the respective disks L and M when the stem and disks descend by gravity so far below the intermediate position as to enable not only the disk R to bridge the space between the free ends of the pair of springs r, but also the stem g to become locked by the latch n.

Claims:

1. An electrically operated, automatically acting, block-signaling system for use on a railway line, consisting in the combination of electrical track-circuits corresponding respectively to the several block-sections of the line; electrically operated signals for commanding the entrance to the respective block-sections; gravity-operated switches for controlling the circuits of the respective signals and capable of occupying three positions alternatively, namely, two extreme positions wherein the corresponding signals are put to "line clear" and "danger" respectively, and an intermediate position wherein said signals are also put to "danger"; solenoids for retaining the respective signal-controlling switches in the position corresponding to "line clear"; electro-magnetic relays interposed in the respective track-circuits, and armatures therefor; switches, controlled by the respective relay-armatures, for normally closing the circuits of the corresponding solenoids; gravity-operated latches for locking the respective signal-controlling switches in the extreme position corresponding to "danger"; electro-magnets and armatures therefor, for withdrawing the respective latches from operative position; gravity-operated stops for arresting the respective signal-controlling switches in the intermediate position; electro-magnets and armatures there-

for, for withdrawing the respective stops from operative position; means adapted to coöperate with a train on the latter passing wholly within the respective block-sections, for controlling the circuits of the respective stop-withdrawing electro-magnets; and switches, movable as one with the respective signal-controlling switches, for closing the circuits of the respective latch-withdrawing electro-magnets appertaining to the several signal-controlling switches which are respectively situated at the entrances of the block-sections in rear of the signal-controlling switches with which said switches move as one, substantially as and for the purpose set forth.

2. A multiple-switch instrument for use in the automatic electric block-signaling system specified, consisting in the combination of the vertically extending solenoid core-stem g; the solenoid G for holding said core-stem in the extreme raised position; the latch n, and counterweight n^1 for holding the same in position to prevent the rise of the core-stem g in the extreme lowered position; the electro-magnet N for withdrawing the latch n from operative position; the stop o, and counterweight o^1 for holding the same in position to arrest the fall of the core-stem g at an intermediate position; the electro-magnet O for withdrawing the latch o from operative position; the insulated conductive disks L, M and R carried by the core-stem g; the pairs of electrical spring contacts l^1 and m^1 adapted to be bridged by the respective disks L and M when in the fully raised position; the pairs of electrical spring contacts l^2 and m^2 adapted to be bridged by the respective disks L and M when in both the intermediate and the fully lowered positions; and the pair of electrical spring contacts r adapted to be bridged by the disk R when in the fully lowered position alone, substantially as described.

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