E. UNVERRICHT.

AUTOMATIC RAILWAY SAFETY DEVICE.

APPLICATION FILED OCT. 30, 1909.

1,050,316.

Patented Jan. 14, 1913.

3 SHEETS—SHEET 1.

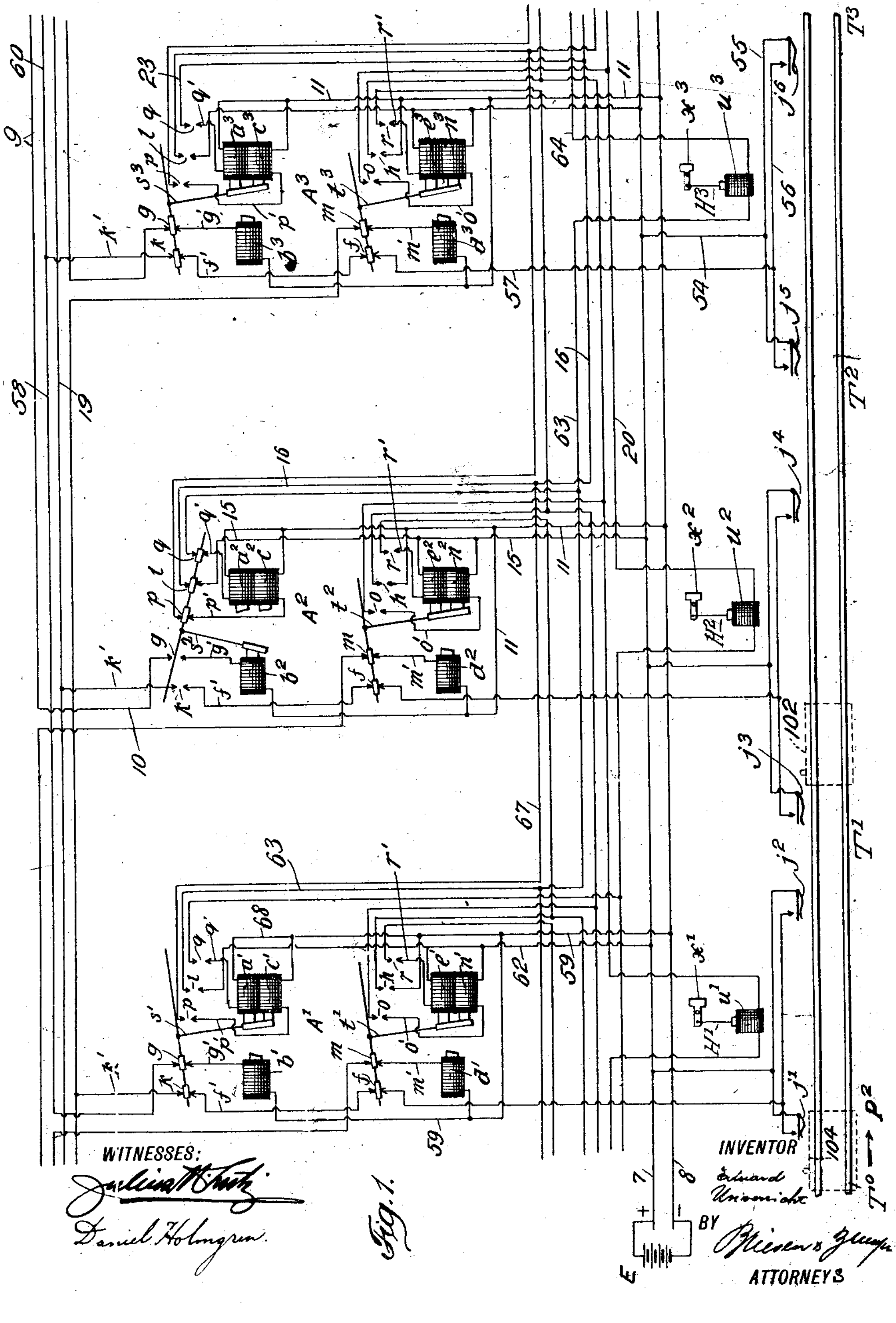

Fig. 1.

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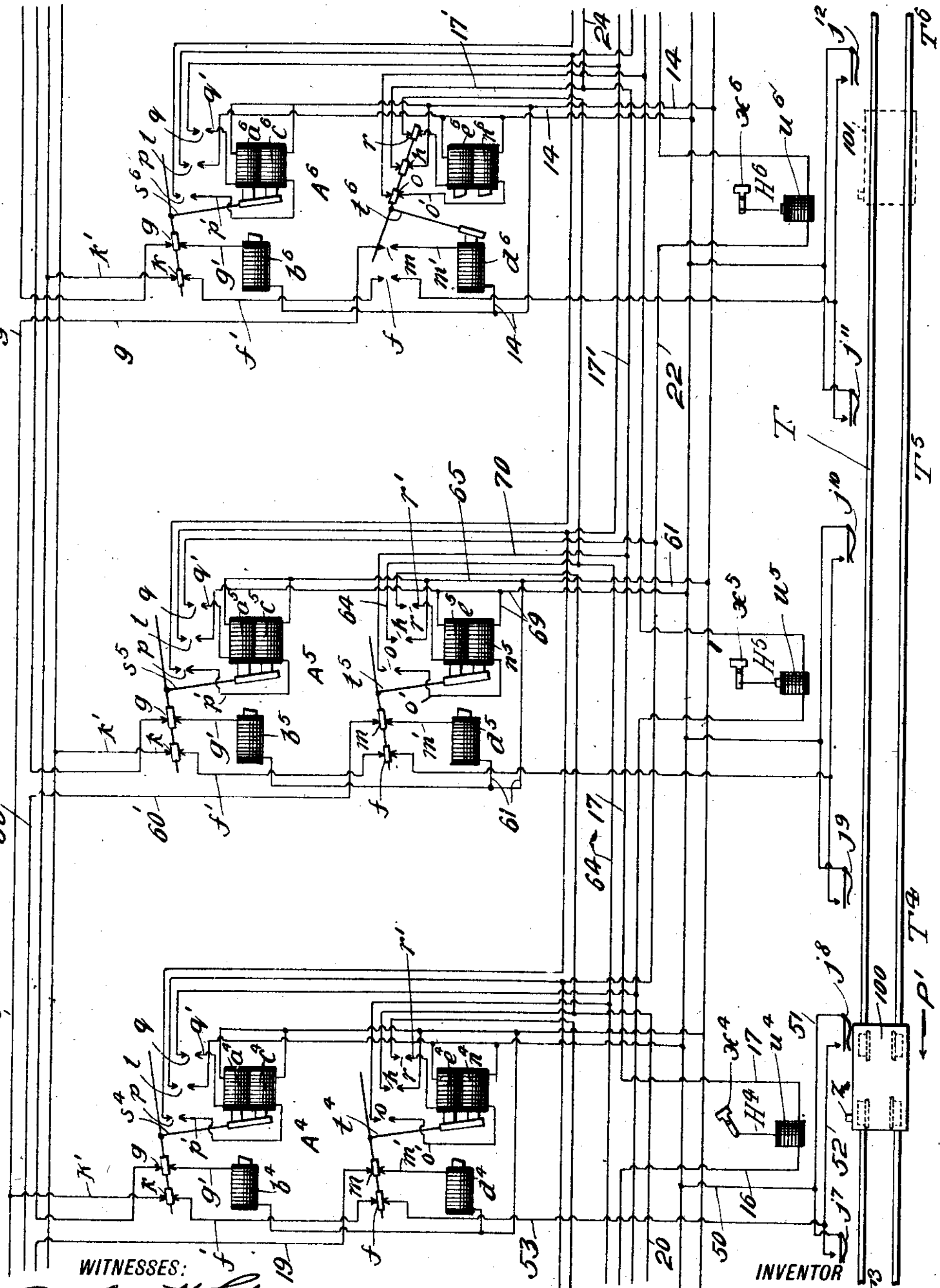

Fig. 2.

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3 SHEETS—SHEET 3.

Fig. 4.

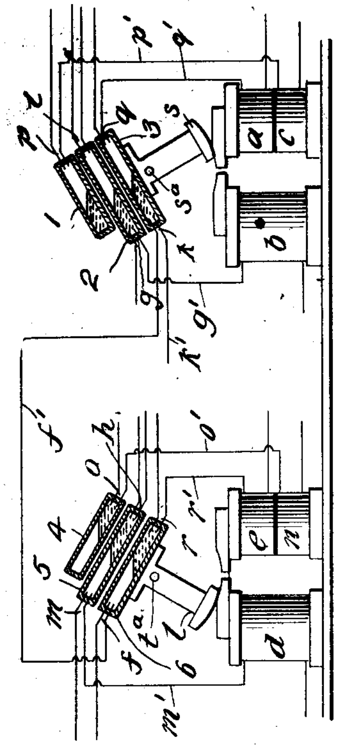
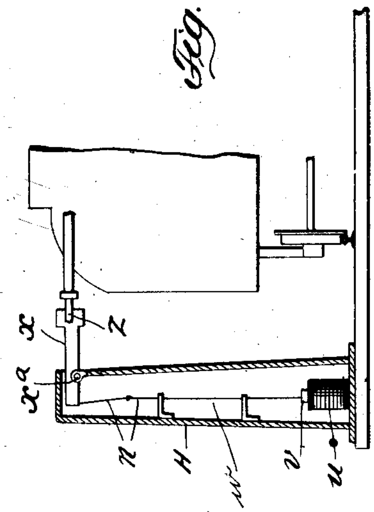


Fig. 5.



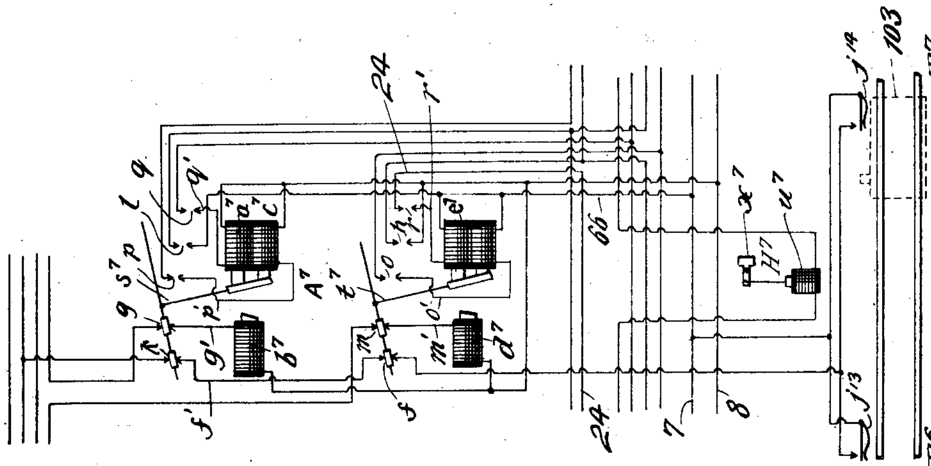


Fig. 3.

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AUTOMATIC RAILWAY SAFETY DEVICE.

1,050,316. Specification of Letters Patent. **Patented Jan. 14, 1913.**

Application filed October 30, 1909. Serial No. 525,413.

To all whom it may concern:

Be it known that I, Eduard Unverricht, a citizen of Germany, residing at Hamburg, Germany, have invented certain new and useful Improvements in Automatic Railway Safety Devices, of which the following is a specification.

This invention relates to a novel safety device for railways that effectively prevents head-on as well as rear-end collisions. For this purpose, the track comprises a plurality of safety-zones, each of which is protected by a trip or train-stop adapted to be engaged by a frangible cap closing the air brake conduit of the passing train, said trips also constituting visible means for indicating to the engineer whether the track is clear or not. Each trip is so constituted that it normally occupies by its own weight the danger position, while it is raised into the clear track position by a motive power such as electricity. In case of a cessation of this motive power for any reason whatsoever, the trip will instantly drop into the danger position and prevent the passage of trains until the current is again supplied. The trips coöperate with duplex circuit changers, which are automatically actuated by passing trains and are so interrelated that trains running in the same direction or in opposite directions can under no circumstances approach each other within dangerous limits.

In the accompanying drawings: Figures 1–3 are wiring diagrams of consecutive portions of a single track railway provided with my safety device, the continuation toward the right of that part of the system found upon any one view being shown in the next view. Fig. 4 is a diagrammatic view of one of the circuit changers, and Fig. 5 a detail showing the frangible air brake cap and coöperating parts.

The letter T indicates a single track which comprises a suitable number of safety zones T^0, T^1, T^2, . . . T^7 seven of such zones being illustrated in Figs. 1–3. At each junction between adjoining zones there is provided a trip or train stop x pivoted at x^a to a post H, the consecutive posts being labeled H^1, H^2, . . . H^7. The trips are movable from a lower horizontal or "danger" position into an upper inclined or "clear track" position, the construction being such that the trips will normally occupy by their own weight the "danger" position, while they may be swung up into the "clear track" position by a suitable motive power such as electricity. The drawing shows each trip post provided with a solenoid or electromagnet u, the core v of which is by a link system w connected to the outer arm of trip x. The posts are placed at such a distance from the tracks that their trips permit an unobstructed passage of a car or train, while said trips when dropped are adapted to be struck by frangible caps z projecting from said car, etc., and closing the conduit of the air brakes thereof. The trips which are preferably arranged at a distance above the road bed as illustrated in Fig. 5 thus likewise constitute visible means for indicating the condition of a track, while furthermore cap z will be broken to automatically stop the train if the engineer should overrun a trip which occupies the "danger position."

The means for operating the trips x consist essentially of circuit changing devices A^1, A^2, . . . A^7 one of which is provided for each trip. The circuit changing devices coöperate with track instruments j^1, j^2, j^3, j^4, . . . j^{13}, j^{14}, two of such instruments being provided for each circuit changer and arranged at both sides of the trip at a distance therefrom. The track instruments are adapted to be temporarily closed by a passing car or train, and according to the travel of the train either the instruments j^1, j^3, j^5 . . . or the instruments j^2, j^4, j^6 . . . are closed before said train reaches the corresponding trip and circuit changer.

The circuit changing devices are preferably duplex so as to be operable from opposite sides and thereby prevent head-on as well as rear end collisions, as will hereinafter be more fully explained. Each circuit changer comprises essentially a first and a second set of electromagnets and a first and a second set contact device operable respectively by said first and second sets, the contact devices embracing swinging armatures s, t, which are substantial duplicates of each other. Armature s is pivoted at s^a and is adapted to be oscillated by a pair of electromagnets, one of which is provided with a winding b, while the other carries two windings a, c. Armature s supports a number of insulating tubes 1, 2, 3 that are partly filled with mercury, so that upon a rocking movement of the tubes, the mercury may flow to one or the other end thereof. Into the right ends of tubes 1, 2, 3 are respectively sealed the double contacts p, l, q, while into the left ends of tubes 2, 3 are sealed the double contacts g, k. Of these, one of the contacts p is by wire p^1 connected to electromagnet winding c, one of the contacts q is by wire q^1 connected to winding a and one of the contacts g is by wire g^1 connected to electromagnet b, while the remaining contacts are connected to other devices as hereinafter more fully described. In like manner, armature t is fulcrumed at t^a and is adapted to be rocked by a pair of electromagnets carrying the windings d and e, n respectively. Armature t supports mercury tubes 4, 5, 6 into the right ends of which are respectively sealed the double contacts o, h, r, while into the left ends of tubes 5, 6 are sealed the contacts m, f. One of the contacts o is by wire o^1 connected to winding n, one of the contacts r is by wire r^1 connected to winding e, and one of the contacts m is by wire m^1 connected to winding d, while one of the contacts f is by wire f^1 connected to one of the contacts k. It will be seen that after the armatures s and t have been tilted beyond their dead centers by energizing the corresponding electromagnets, the mercury flowing from one end of each tube to the other end thereof assists said electromagnets in their operation, to finally cause the armatures to remain in the positions to which they have been set.

The manner in which the several electromagnets hereinabove referred to are energized is apparent from Figs. 1-3, which illustrate seven consecutive safety zones of a single track railway. A train 100 is shown to pass through safety zone T^4 in the direction of arrow P^1, the trip x^4 of post H^4 being raised by said train in manner hereinafter more fully described to permit a free passage thereof. The several contacts and mercury tubes are here replaced by contacts which are adapted to be closed by contact members, that are illustrated as oblongs carried by a common rocking rod. As will hereafter be more fully explained when describing the various circuits, the three coöperating trips are arranged in overlapping order, so as to increase the reach of their track control, the trips x^1, x^3, x^5 operating together, as do also the trips x^2, x^4, x^6, etc. When the coöperating zones are clear *i. e.*, when no train is passing thereover, all armatures s, t occupy their normal position *i. e.* such a position, that the mercury will close the left hand contacts thereof, while the right hand contacts are open. Thus after train 100 has closed track instrument j^8, a circuit is established, the current flowing from main 7 through wires 50, 51, instrument j^8, wires 52, 53 closed contacts f of circuit changer A^4, wire f^1, closed contacts k, wires k^1, 9 and 10 to the still closed contact g of circuit changer A^2 (Fig. 1 illustrating the position of the armature s^2 of said circuit changer after track instrument j^8 has been closed). From this contact g the current flows through wire g^1, electromagnet b^2 and conductor 11 to main 8, thereby energizing said electromagnet and causing the armature s^2 of circuit changer A^2 to be tilted into the position shown in Fig. 1. Through this movement of armature s^2, contacts g, k are opened, while contacts l, p, q of circuit changer A^2 are closed. By the above closing of track instrument j^8, a second circuit will be established, the current flowing as above described from main 7 to wire k^1 of circuit changer A^4 and thence through wires 9, to the still closed contact m of circuit changer A^6 (Fig. 2 illustrating the position of the armature t^6 of said circuit changer, after track instrument j^8 has been closed). From said contact m the current flows through wire m^1, electromagnet d^6 of circuit changer A^6 and wire 14 to main 8. In this way, electromagnet d^6 of this circuit changer is energized to throw its armature t^6 into the position illustrated in Fig. 2, thereby opening the corresponding contacts f, m and closing contacts h, o, r. By the simultaneous closing of contacts l of circuit changer A^2 and of contacts h of circuit changer A^6, a circuit is established, the current flowing from main 7 through wire 15 of circuit changer A^2, contacts l, wire 16, solenoid u^4 of trip x^4, wires 17, 17^1 closed contacts h of circuit changer A^6, and conductor 14 to main 8. By this current, solenoid u^4 of trip x^4 is energized so as to raise said trip and permit a free passage of train 100.

From the above it will be seen that train 100 is only able to raise the trip x^4 into the "clear track" position when contacts l of circuit changer A^2 and contacts h of circuit changer A^6 are simultaneously closed, or in other words, when the contacts l and h of the second forward and the second rear track sections respectively have been previously closed. Thus for instance if a train 101 should enter track section T^6, while the train 100 is still within track section T^4, the operation previously described in connection with train 100 for raising the corresponding trip x^4 into the clear track position could not take place. Or in other words, as train 100 was supposed to be the only train temporarily traveling over track sections T^2 to T^6, said train was free to raise trip x^4 as soon as it entered track section T^4. Train 101 in entering track section T^6 however is not able to raise trip x^6 after closing track instrument j^{12}. This is due to the fact that in order to establish the circuit for energizing solenoid u^6 of trip x^6, electromagnet b^4 should be energized in order to close contacts l of circuit changer

A^4, said contacts constituting part of the circuit of solenoid u^6. The circuit necessary for closing electromagnet b^4 is a duplicate of that described in connection with train 100 for energizing electromagnet b^2 of circuit changer A^2 which latter circuit depended upon the closing of contacts f of circuit changer A^4, as above clearly described. For energizing electromagnets b^4, the contacts f of circuit changer A^6 had therefore to be closed, but as these contacts have previously been opened by train 100 upon closing track instrument j^8, electromagnet b^4 cannot be energized, so that armature s^4 cannot be tilted and contacts l of circuit changer A^4 remain open. Thus the necessary energizing current cannot be supplied to solenoid u^6 through wire 22, when track instrument j^{12} is closed, and trip x^6 remains in the "danger" position, thereby protecting train 100 against a rear end collision with train 101. Train 100 while passing track section T^4 is also protected against a head-on collision with a train 102 which may now be supposed to enter track section T^1 from the left. Train 102 however is not able to raise trip x^2 after it has closed track instrument j^3, so that it cannot proceed. As has already been brought out, an energizing current can only be sent through solenoid u^2 when the contacts l and h of the respective circuit changers which are located second next on both sides of the solenoid are closed. In order to close the contact h of circuit changer A^4 which constitutes part of the circuit of solenoid u^2, electromagnet d^4 of circuit changer A^4 must be energized, so as to tilt armature t^4 into the position opposite to that shown in Fig. 2. The circuit necessary for closing electromagnet d^4 is a duplicate of that described in connection with train 100 for energizing electromagnet d^6 of circuit changer A^6 which latter circuit depended upon the closure of the contacts k of circuit changer A^4. Thus for energizing electromagnet d^4 it is necessary in analogous manner, that the contacts k of circuit changer A^2 be closed. As however these contacts have previously been opened by train 100 upon closing track instrument j^8, the necessary energizing current cannot be supplied to electromagnet d^4 through wire 19, thereby preventing the tilting of armature t^4. In this way, contacts h of circuit changer A^4 remain open, and the necessary energizing current cannot be supplied to solenoid u^2 through wire 20, so that trip x^2 remains in the "danger" position, thereby protecting train 100 against a head-on collision with train 102.

It may here be stated that if train 100 has a clear track while passing from track section T^4 to section T^3 the same operation which has above been described with relation to trips x^2, x^4, and x^6 will be repeated for trips x^1, x^3, x^5, etc., the circuits established being duplicates of those described. In addition to the connections which bring about an interrelation between the trip-actuating circuit changers A^2, A^4, A^6 additional connections are provided between these circuit changers and the flanking or intermediate circuit changers A^1, A^3, A^5, A^7. It is obvious that before train 100 closed track instrument j^8 it has closed track instrument j^{10}, so that strip x^5 was raised into its unobstructive or "clear-track" position, while trips x^3 and x^1 were maintained in the "danger" position. Or in other words, the armatures s^3, t^7 of circuit changers A^3, A^7 occupy the same positions as the respective armatures s^2, t^6 of circuit changers A^2, A^6 illustrated in Figs. 1 and 2. Before train 100 is thus able to raise trip x^3 after entering track section T^3 and closing track instrument j^6, it is therefore necessary that the armatures s^3 and t^7 be returned to their normal positions, so as to permit an establishing of the proper solenoid circuits. This operation is effected upon the closing of track instrument j^8 by train 100 in the following manner: As contacts l of circuit changer A^2 have been closed by the previously described energizing of electromagnet b^2, a circuit is established, the current flowing from main 7 through conductor 15 of circuit changer A^2, closed contacts l, wires 16, 23, contacts q of circuit changer A^3 (which are still closed, as above described) electromagnet a^3 and conductor 11 to main 8. Electromagnet a^3 is thus energized to attract armature s^3, thereby opening its contacts l, p, q and closing its contacts g, k. Owing to the closing of contacts k, the circuit for energizing the electromagnet b^1 of circuit changer A^1 is established so that after the closing of track instrument j^6 by the advancing train 100 a current will flow from main 7 through wires 54, 55, closed track instrument j^6, wires 56, 57, closed contacts f of circuit changer A^3, wire f^1, closed contacts k, wires k^1, 58, closed contacts g of circuit changer A^1, wire g^1, electromagnet b^1 and wire 59 to main 8. Electromagnet b^1 will thus be energized to tilt armature s^1, and close contacts l of circuit changer A^1, such closing being a condition precedent for permitting the flow of an energizing current through solenoid u^3 of trip x^3. As contact m of circuit closer A^5 is already in its closed position, the electromagnet d^5 is energized upon a closing of track instrument j^6 by a current flowing to wire k^1 of circuit changer A^3 as described and thence through wires 60, 60^1, closed contacts m, wire m^1, electromagnet d^5 of circuit changer A^5 and wire 61 to main 8. Armature t^5 will thus be tilted to close contacts h, thereby closing the circuit of the solenoid u^3 of trip x^3, the current flowing from main 7 through wire 62, contacts l of circuit changer A^1 (which are now closed as above described), wire 63, solenoid u^3 of trip x^3, wire 64, closed contacts h of circuit changer A^5 and wires 65, 61 to main 8. Solenoid u^3 is thus energized to raise trip x^3 into the "clear track" position, and thus permit a continued passage of train 100.

In addition to establishing the various circuits described, the closing of track instruments j^8 by train 100, further establishes a circuit for returning armature t^7 to its normal position, as illustrated in Fig. 3. This armature had previously been tilted into the oppositely inclined positions, while train 100 passed track section T^5, so as to protect this train against a rear-end collision. The current for returning armature t^7 to its normal position by the closing of track instrument j^8 flows from main 7 through wire 66, magnet e^7 of circuit changer A^7, wire r^1, contacts r (which are still closed as above explained) wires 24, 17^1, closed contacts h of circuit changer A^6 and wire 14 to main 8. In this way electromagnet e^7 is energized to return armature t^7 to its normal position, thereby interrupting contacts h, o, r and closing contacts f, m of circuit changer A^7. As both contacts f and k of this circuit changer are now closed, a circuit is prepared for energizing the electromagnet b^5 of circuit changer A^5 and for energizing the electromagnet d of the second circuit changer to the right of circuit changer A^7 (not shown), thereby permitting a train 103 after entering track section T^7 to raise trip x^7 into the "clear-track" position. At the same time, the previously closed circuit that controls solenoid u^5 and raises trip x^5 into the "clear track" position is interrupted owing to the above described opening of the contacts l of circuit changer A^3 and of the contacts h of circuit changer A^7 so as to cause trip x^5 to drop into the "danger" position and to thus protect train 100 against a rear end collision.

If the direction of travel of train 100 is reversed the same protection against head-on and rear end collisions is afforded as before. Thus for instance if train 100 were to approach trip H^4 from the left instead of from the right, the previous closing of track instrument j^5 will permit a raising of trip x^3 into the "clear track" position, while trips x^1 and x^5 are maintained in their "danger" position. In this case the operation of circuit changers A^1, A^3, A^5 is exactly the same as above described in connection with train 100 when running toward the left and thereby closing track instrument j^6. This is obvious from the fact that the two track instruments flanking each trip are connected by a common wire to the contacts f of the circuit changers pertaining to said trip. When however the train runs toward the right instead of toward the left, the electromagnets c and n come into action for rendering operable the trips which were previously maintained in their lowered or "danger" position. Thus it may be assumed that a train (not shown) has entered track section T^2 from the left and depressed track instrument j^3 in which case two circuits are first established, the current of one circuit passing from main 7 through wire 51, closed instrument j^3, wire 57, closed contacts f of circuit changer A^3, wire f^1, closed contacts k, wire k^1, wire 58, closed contacts g of circuit changer A^1, wire g^1, electromagnet b^1, and wire 59 to main 8. Electromagnet b^1 is thus energized to attract armature s^1, thereby closing contacts l of circuit changer A^1. The current of the second circuit flows from wire k^1 of circuit changer A^3 through wire 60, 60^1, closed contacts m, wire m^1, electromagnet d^5, and wire 61 to main 8. Electromagnet d^5 will thus tilt armature t^5 to close contacts h of circuit changer A^5. As thus both the contacts l of circuit changer A^1 and the contacts h of circuit changer A^5 are closed, the previously described circuit for energizing the solenoid u of trip x^3 will be established thereby raising the latter into its "clear track" position, so that the train may proceed, trips x^1, x^5 being simultaneously rendered inoperable by the tilting of armatures s^1, t^5 so as to protect the train against rear end and head on collisions, all as previously fully brought out. When during its run toward the right, the train closes track instrument j^7 of track section T^3, the following circuits will be established for bringing the previously inoperable trips x^1, x^5 into operable condition. Owing to the closing of track instrument j^7 the same circuits are established as previously described when train 100 closed track instrument j^8, *i. e.* armature s^2 of circuit changer A^2 and armature t^6 of circuit changer A^6 occupy the positions illustrated in Figs. 1 and 2. A circuit will thus be established for rendering trip x^1 operable, the current flowing from main 7 through wire 15, closed contacts l of circuit changer A^2, wires 16, 67, contacts p of circuit changer A^1 (which are still closed owing to the previous passage of the train through section T^3 as just described), wire p^1, electromagnet c^1, and wires 68, 59 to main 8. In this way, electromagnet c^1 will be energized to tilt armature s^1 thereby closing contacts k and opening contacts l of circuit changer A^1. At the same time another circuit is established, the current flowing from main 7 through wire 69, electromagnet n^5 of circuit changer A^5, wire o^1, contacts o (which are still closed as above described), wires 70, 17^1, closed contacts h of circuit changer A^6 and wire 14 to main 8. Thus electromagnet n^5 is energized to tilt armature t^5 thereby closing contact f and opening contact h of circuit changer A^5.

By the tilting of armatures s^1 and t^5 said armatures are returned to their normal positions, so that the coöperating trips x^1, x^5 are rendered operable owing to the closing of contacts k and h respectively. Simultaneously with the establishing of the above circuits, trip x^3 which still occupies its "clear track" position is released to drop by its own weight into the "danger" position. As above described the energizing current of solenoid u^3 that has raised trip x^3 into the "clear track" position flowed through the then closed contacts l of circuit changer A^1 and through the closed contacts h of circuit changer A^5. As both of these contacts are however opened for bringing trips x^1 and x^5 in operable condition, the circuit of solenoid u^3 is simultaneously interrupted, so that the latter is deënergized, and trip x^3 drops automatically by its own weight into the "danger" position.

To recapitulate the general operation of the system without again referring in detail to the circuits established, it is evident that if a train has a clear track, it will automatically raise the trip of the track section through which it temporarily passes. At the same time, the trips of the second next forward and of the second next rearward track sections are automatically rendered inoperable. As has been fully brought out, the circuit of each trip solenoid includes two pairs of contacts l and h, one pair of said contacts being located in say the second next forward track section, while the other pair of contacts is located in the second next rearward track section. Each solenoid can therefore only then be energized when both of said contact pairs pertaining to the solenoid circuit are simultaneously closed. It is further evident that the armatures s and t pertaining to the several track sections are normally so tilted as to maintain the contacts h and l in their open position. From Fig. 2 it is also evident that in the track section whose trip is raised by a passing train, the contacts h and l are open. The conditions which will therefore prevail when two trains approach each other from opposite directions on a single track railway are as follows: Let it be assumed that train 100 passes track section T^4 in the direction of arrow P^1 while train 104 passes track section T^0 in the opposite direction P^2. As both trains are now at a distance that exceeds the reach of their track control, *i. e.* as train 100 did not yet enter track section T^3 controlled by train 104, and as the latter did not enter track section T^1 controlled by train 100, both trains are thus free to proceed. As all the various circuits controlled by a train have previously been fully discussed, it is unnecessary to follow up each circuit which has been established upon the closing of track instruments j^8 and j^1 by the trains 100, 104 respectively. It suffices to reiterate that upon the closing of track instrument j^8, trip x^4 is raised to give the "clear" signal to train 100, while at the same time the several contacts which must be closed for permitting the raising of trip x^2 are opened thus preventing a current from being sent through solenoid u^2. In this way trip x^2 is rendered inoperable when train 104 enters track section T^2. The opened contacts in question are the contacts k of circuit changer A^2 which prevent the energizing of electromagnet d^4 of circuit changer A^4, so that armature t^4 cannot be tilted for closing contacts h of said track section. Thus solenoid u^2 of trip x^2 cannot be energized, and the trip remains in its "danger" position, thereby causing train 104 to come to a standstill in track section T^1. As by the previous raising of trip x^1 through train 104, trip x^3 has been rendered inoperable in a similar manner, train 100 is not able to raise said trip upon closing track instrument j^6, so that this train comes to a standstill in track section T^3. In this way the trains 100, 104 are prevented from approaching each other within a dangerous distance, so that all head-on collisions are effectively prevented. Similar conditions would prevail if train 101 should follow train 100 and enter track section T^6, while train 100 is still in track section T^4, as has already been fully explained, thereby effectively preventing rear-end collisions.

Attention may further be called to the fact that with my device a trip of a safety zone is raised into the "clear track" position by a passing train only after the two protecting trips in the front and rear have been rendered inoperable by the same train. From the foregoing it is evident that by the closing of a track instrument in a safety zone, the armatures of the coöperating protecting zones in the front and rear are rocked thereby opening the trip-actuating solenoid-circuits of said protecting zones. As these solenoids can consequently not be energized, their trips are effectively prevented from being raised by any other trains. Only after the armatures of the protecting zones have been rocked, the solenoid-circuit of that trip is established which pertains to the zone through which the train temporarily travels, so that this trip is raised to permit an unobstructed advance of the train. It will thus be seen that my improved safety device affords reliable and novel protection against head-on and rear-end collisions of cars and railway trains.

I claim:

1. Safety system for railways comprising in combination positive and negative electrical mains, a series of circuit closing means, a series of trips normally held in danger

position, electro-magnetic devices adapted to be connected across said mains, each such device having operative connection with a respective trip, a series of circuit changers, one of such changers being provided for each trip, electro-magnetic devices adapted to be connected across said mains and each operative upon a respective circuit changer, and electrical connections between each circuit closing means and two electromagnetic devices of the circuit changer situated respectively in advance and in the rear of said circuit closing means, the operation of any one of such means by the train causing the appropriate two of such circuit changers to actuate that electro-magnetic device which is operatively connected to the trip immediately in front of the train substantially as set forth.

2. Safety system for railways comprising a series of circuit closing means, a series of coöperating trips, electro-magnetic devices for said trips, a series of circuit changers each of such changers corresponding with a respective trip, electromagnetic devices constituting part of said circuit changers, electrical connections between each circuit closing means and two electromagnetic devices of the circuit changers situated respectively in advance and in the rear of said circuit closing means electrical connections between the magnetic device of the circuit changer corresponding with the last named closing means, and the contacts of said circuit changers in advance and in the rear, and electrical connections between the electromagnetic device of each trip and the circuit changers in advance and in the rear, the closing operation of any one of said circuit closing means by the train causing the advance and rear circuit changers to simultaneously close the circuit of the electromagnetic device operative upon the trip pertaining to said circuit closing means, and at the same time preventing the trips pertaining to said advance and rear circuit changers from being moved to inoperative position substantially as set forth.

3. In a railway safety system, a track divided into a first, second, third, fourth and fifth section, circuit closing means, a trip and a circuit changer provided for each of said sections, each circuit changer being composed of a first and a second set of electromagnets and of a first and a second contact device operable respectively by said first and second sets, an additional electromagnet provided for each trip, a first electric circuit including the third circuit closing means and an electromagnet of the first set of the first circuit changer, a second electric circuit including said third circuit closing means and an electromagnet of the second set of the fifth circuit changer, a third electric circuit including the first contact device of the first circuit changer and an electromagnet of the second set of the third circuit changer, a fourth electric circuit including the second contact device of the fifth circuit changer and an electromagnet of the first set of said third circuit changer, a fifth electric circuit including the electromagnet of the first trip and the second contact device of the third circuit changer, a sixth electric circuit including the electromagnet of the fifth trip and the first contact device of the third circuit changer, a seventh electric circuit including the first contact device of the first circuit changer and an electromagnet of the first set of the second circuit changer, and an eighth electric circuit including the first contact device of the first circuit changer, the electromagnet of the third trip and the second contact device of the fifth circuit changer, the closing of the third circuit closing means causing the closing of the first and second circuits thereby respectively operating the first and second contact devices of the first and fifth circuit changers, said operation effecting firstly the breaking of the third and fourth circuits whereby the fifth and sixth circuits can no longer be closed, secondly the closing of the seventh circuit, thereby moving the first contact device of the second circuit changer into its normal position, and thirdly the closing of the eighth circuit thereby operating the third trip.

4. In a railway safety system, a track divided into a first, second, third, fourth, fifth and sixth section, circuit closing means, a trip and a circuit changer provided for each of said sections, each circuit changer being composed of a first and a second set of electromagnets and of a first and a second contact device operable respectively by said first and second sets, an additional electromagnet provided for each trip, a first electric circuit including the third circuit closing means and an electromagnet of the first set of the first circuit changer, a second electric circuit including said third circuit closing means and an electromagnet of the second set of the fifth circuit changer, a third electric circuit including the first contact device of the first circuit changer and an electromagnet of the second set of the third circuit changer, a fourth electric circuit including the second contact device of the fifth circuit changer and an electromagnet of the first set of said third circuit changer, a fifth electric circuit including the electromagnet of the first trip and the second contact device of the third circuit changer, a sixth electric circuit including the electromagnet of the fifth trip and the first contact device of the third circuit changer, a seventh electric circuit including the second contact device of the fifth circuit changer and an electromagnet of the second set of the sixth cir-

cuit changer, and an eighth electric circuit including the first contact device of the first circuit changer, the electromagnet of the third trip and the second contact device of the fifth circuit changer, the closing of the third circuit closing means causing the closing of the first and second circuits thereby respectively operating the first and second contact devices of the first and fifth circuit changers, said operation effecting firstly the breaking of the third and fourth circuits whereby the fifth and sixth circuits can no longer be closed, secondly the closing of the seventh circuit, thereby moving the second contact device of the sixth circuit changer into its normal position, and thirdly the closing of the eighth circuit thereby operating the third trip.

5. In a railway safety system, a track divided into a first, second, third, fourth, fifth and sixth section, circuit closing means, a trip and a circuit changer provided for each of said sections, each circuit changer being composed of a first and a second set of electromagnets and of a first and a second contact device operable respectively by said first and second sets, an additional electromagnet provided for each trip, a first electric circuit including the third circuit closing means and an electromagnet of the first set of the first circuit changer, a second electric circuit including said third circuit closing means and an electromagnet of the second set of the fifth circuit changer, a third electric circuit including the first contact device of the first circuit changer and an electromagnet of the second set of the third circuit changer, a fourth electric circuit including the second contact device of the fifth circuit changer and an electromagnet of the first set of said third circuit changer, a fifth electric circuit including the electromagnet of the first trip and the second contact device of the third circuit changer, a sixth electric circuit including the electromagnet of the fifth trip and the first contact device of the third circuit changer, a seventh electric circuit including the first contact device of the first circuit changer and an electromagnet of the first set of the second circuit changer, an eighth electric circuit including the second contact device of the fifth circuit changer and an electromagnet of the second set of the sixth circuit changer, and a ninth electric circuit including the first contact device of the first circuit changer, the electromagnet of the third trip and the second contact device of the fifth circuit changer, the closing of the third circuit closing means causing the closing of the first and second circuits thereby respectively operating the first and second contact devices of the first and fifth circuit changers, said operation effecting firstly the breaking of the third and fourth circuits whereby the fifth and sixth circuits can no longer be closed, secondly the closing of the seventh circuit, thereby moving the first contact device of the second circuit changer into its normal position, thirdly the closing of the eighth circuit, thereby moving the second contact device of the sixth circuit changer into its normal position, and fourthly the closing of the ninth circuit, thereby operating the third trip.

6. In a railway safety system, a track divided into sections, a train stop for each section, car-controlled means for moving each train stop to inoperative position as the car approaches it, means adjacent to a train stop in front of and another behind the one approached by the car for rendering inoperative said first named means except when said two last named train stops are in operative position, whereby the train stop approached cannot be rendered inoperative unless said two train stops are operative.

7. In a railway safety system, a track divided into sections, a train stop for each section which normally occupies its operative position, car-controlled means for moving each train stop to inoperative position as the car approaches it, means adjacent to a train stop in front of and another behind the one approached by the car for rendering inoperative said first named means except when said two last named train stops are in operative position, whereby the train stop approached cannot be rendered inoperative unless said two train stops are operative.

8. In a railway safety system, a track divided into sections, a train stop for each section which normally occupies its operative position, an electric circuit adapted to be closed by a car as the latter approaches a train stop, means controlled by said circuit for moving said last named train stop to inoperative position, means adjacent to a train stop in front of and another behind the one approached by the car for keeping open the circuit controlling said first named means except when said two last named train stops are in operative position, whereby the train stop approached cannot be rendered inoperative unless said two train stops are operative.

9. In a railway safety system, a track divided into sections, a train stop for each section, car-controlled means for moving each train stop to inoperative position as the car approaches it, means adjacent to a train stop located in front of the one approached by the car for rendering inoperative said first named means except when said last named train stop is in operative position, whereby the train stop approached cannot be rendered inoperative unless the train stop located in front of the one approached is operative.

10. In a railway safety system, a track divided into sections, a train stop for each

section which normally occupies its operative position, an electric circuit adapted to be closed by a car as the latter approaches a train-stop, means controlled by said circuit for moving said last named train stop to inoperative position, means adjacent to a train stop located in front of the one approached by the car for keeping open the circuit controlling said first named means except when said last named train stop is in operative position, whereby the train stop approached cannot be rendered inoperative unless the train stop located in front of the one approached is operative.

11. In a railway safety system, a track divided into sections, a train stop for each section, a first electric circuit adapted to be closed by a car as the latter approaches a train stop, a second electric circuit controlled by said first electric circuit for moving said last named train stop to inoperative position, means adjacent to a train stop in front of and another behind the one approached by the car for preventing said first electric circuit from operating except when said two last named train stops are in operative position, whereby the train stop approached cannot be rendered inoperative unless said two train stops are operative.

12. In a railway safety system, a track divided into sections, a train stop for each section, a first electric circuit adapted to be closed by a car as the latter approaches a train stop, a second electric circuit controlled by said first electric circuit for moving said last named train stop to inoperative position, means adjacent to a train stop in front of the one approached by the car for preventing said first electric circuit from operating except when said front train stop is in operative position, whereby the train stop approached cannot be rendered inoperative unless the train stop in front of the latter is operative.

13. In a railway safety system, a track divided into sections, a train stop for each section, a first electric circuit adapted to be closed by a car as the latter approaches a train stop, a second electric circuit controlled by said first electric circuit for moving said last named train stop to inoperative position, and circuit changers adjacent to a train stop in front of and another behind the one approached by the car for preventing said first electric circuit from being closed except when said two last named train stops are in operative position, whereby the train stop approached cannot be rendered inoperative unless said two train stops are operative.

14. In a railway safety system, a track divided into sections, car operated circuit closing means, a train stop and a circuit changer provided for each section, said circuit changer comprising an electromagnetic device and a contact device operated thereby, an additional electromagnetic device provided for and operatively connected to each train stop, a first circuit adapted to conductively connect the circuit closing means of any one section with the electromagnetic devices of the circuit changers located respectively in the front and rear of said section, and a second circuit adapted to conductively connect the contact devices of said front and rear circuit changers with the electromagnetic device of the train stop pertaining to the first named section.

15. In a railway safety system, a track divided into sections, car operated circuit closing means, a train stop and a circuit changer provided for each section, said circuit changer comprising an electromagnetic device and a contact device operated thereby, an additional electromagnetic device provided for and operatively connected to each train stop, a first circuit adapted to conductively connect the circuit closing means of any one section with the electromagnetic devices of the circuit changers located respectively in the front and rear of said section, a second circuit adapted to conductively connect the contact devices of said front and rear circuit changers with the electromagnetic device of the train stop pertaining to the first named section, and a third circuit adapted to conductively connect the contact device of the circuit changer of the front section with the electromagnetic device of a circuit changer located intermediate the circuit changer of the section to which said last named circuit closing means pertain and the circuit changer of said front section.

16. In a railway safety system, a track divided into sections, car operated circuit closing means, a train stop and a circuit changer provided for each section, said circuit changer comprising an electromagnetic device and a contact device operated thereby, an additional electromagnetic device provided for and operatively connected to each train stop, a first circuit adapted to conductively connect the circuit closing means of any one section with the electromagnetic devices of the circuit changers located respectively in the front and rear of said section, and a second circuit adapted to conductively connect the contact devices of said front and rear circuit changers with the electromagnetic device of the train stop pertaining to the first named section, the interrelation between the parts being such that upon the operation of a circuit closing means by a car, said first and second circuits are consecutively closed.

17. In a railway safety system, a track divided into sections, car operated circuit closing means, a train stop and a circuit changer provided for each section, said circuit

changer comprising an electromagnetic device and a contact device operated thereby, an additional electromagnetic device provided for and operatively connected to each train stop, a first circuit adapted to conductively connect the circuit closing means of any one section with the electromagnetic devices of the circuit changers located respectively second in the front and rear of said section, a second circuit adapted to conductively connect the contact devices of said front and rear circuit changers with the electromagnetic device of the train stop pertaining to the first named section, a third circuit adapted to conductively connect the contact device of the circuit changer of said front section with the electromagnetic device of the circuit changer located intermediate the circuit changer of the section to which said last named circuit closing means pertain and the circuit changer of said front section, and a fourth circuit adapted to conductively connect the contact device of the circuit changer of said rear section with the electromagnetic device of the circuit changer located behind said last mentioned rear circuit changer.

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

EDUARD UNVERRICHT.

Witnesses:

ERNEST H. L. MUMMENHOFF,

IDA CHRIST HAFERMANN.