

April 26, 1932.

P. H. CRAGO

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RAILWAY TRAFFIC GOVERNING APPARATUS

Filed Aug. 20, 1930

2 Sheets-Sheet 1

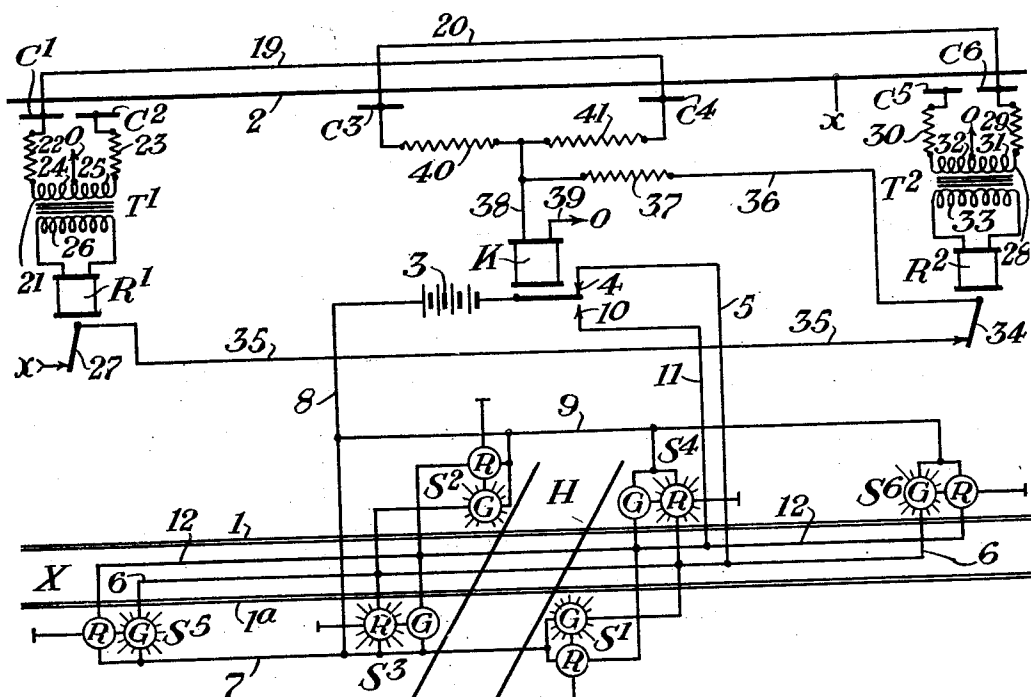


Fig. 1.

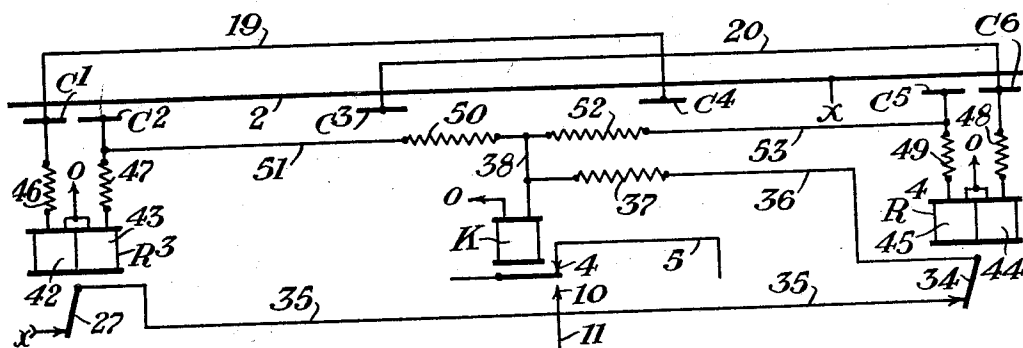


Fig. 2.

INVENTOR:
P. H. Crago,
by A. Z. Vencill
His Attorney

April 26, 1932.

P. H. CRAGO

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2 Sheets-Sheet 2

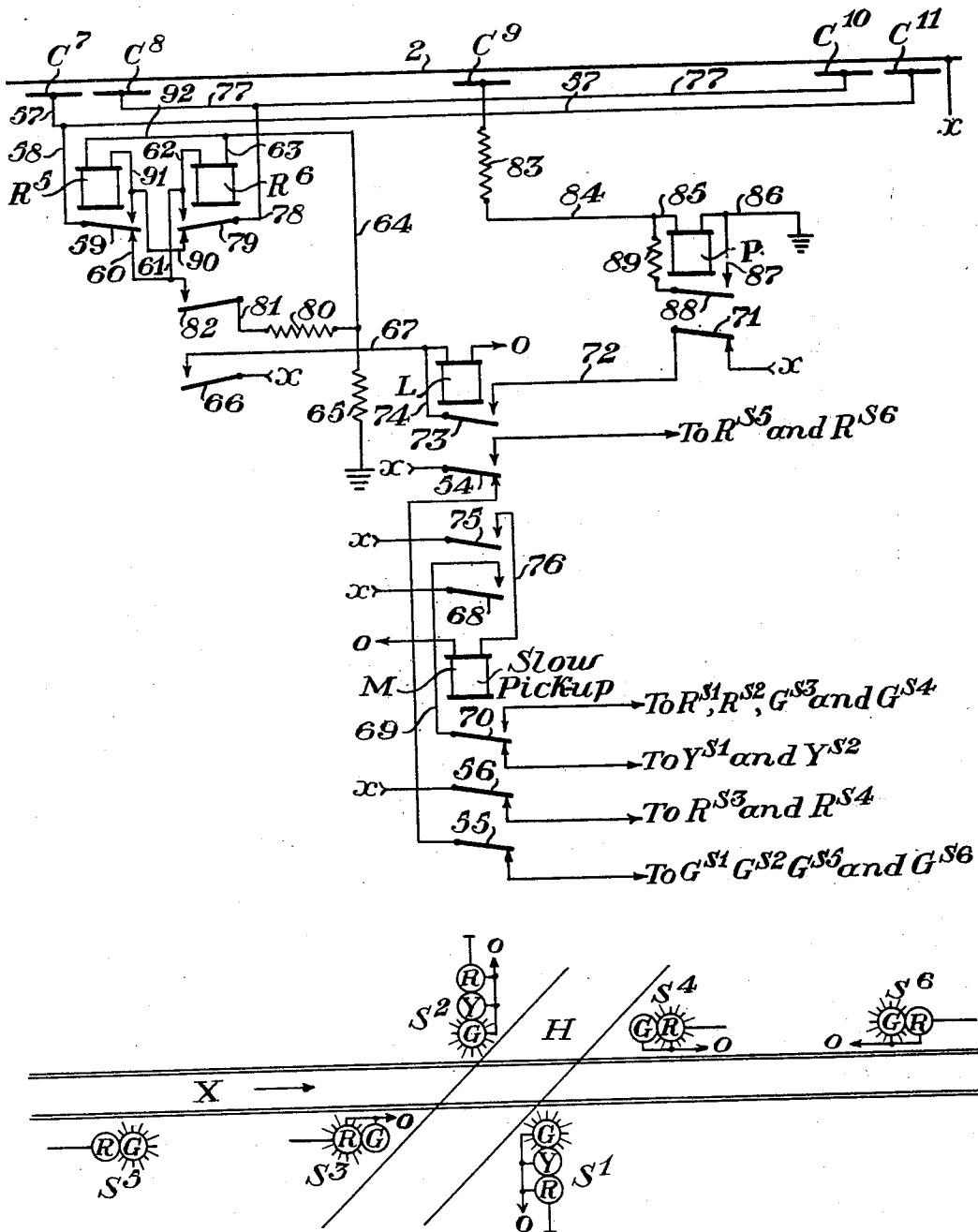


Fig. 3.

INVENTOR:
P. H. CRAGO,
BY *A. R. Venable*
His ATTORNEY

UNITED STATES PATENT OFFICE

PAUL H. CRAGO, OF WILKINSBURG, PENNSYLVANIA, ASSIGNOR TO THE UNION SWITCH & SIGNAL COMPANY, OF SWISSVALE, PENNSYLVANIA, A CORPORATION OF PENNSYLVANIA

RAILWAY TRAFFIC GOVERNING APPARATUS

Application filed August 20, 1930. Serial No. 476,502.

My invention relates to railway traffic governing apparatus and particularly to highway crossing signaling systems for single track electric railways.

One feature of my invention is the provision of polarized relays receiving energy from the trolley wire or any other conductor which supplies propulsion energy to the vehicle and which operates contacts for controlling the signals or other traffic governing means at the highway crossing.

Another feature of my invention is the provision of means for indicating to an approaching trolley car the signal indication being displayed on the highway, and for indicating to a following car, traffic conditions between the following car and the crossing, as well as for indicating to vehicles on the highway, traffic conditions on the railway track in the vicinity of the highway.

I will describe three forms of apparatus embodying my invention, and will then point out the novel features thereof in claims.

In the accompanying drawings, Fig. 1 is a diagrammatic view of one form of railway traffic governing apparatus embodying my invention. Fig. 2 is a similar view showing another form of apparatus embodying my invention. Fig. 3 is a similar view showing still another form of apparatus embodying my invention.

Similar reference characters refer to similar parts in each of the several views.

Referring first to Fig. 1 of the drawings, the numerals 1 and 1^a designate the rails of a stretch of electric railway track X which is provided with a current supplying conductor 2, such as a trolley wire or third rail, adapted to be traversed by a suitable train-carried current collecting device, not shown. The conductor 2 is connected with one terminal *a* of a source of energy, not shown in the drawings, the other terminal *o* of which will usually be grounded. A highway H intersects the track X and is protected on opposite sides of the intersection by crossing signals S¹ and S². Signals S³ and S⁴ are also provided adjacent the track X on opposite sides of its intersection with the highway H to indicate to the trainman the condition of the

crossing signals S¹ and S², and the signals S⁵ and S⁶ are likewise provided along the track X at points remote from the highway to indicate to an approaching train traffic conditions between it and the highway H, in a manner presently to be described. The signals S¹, S², S³, S⁴, S⁵ and S⁶ may be either of the two or three-position type but for the purpose of this description are shown as being two-position signals, each comprising a green lamp G indicating "proceed", and a red lamp R indicating "stop" and are energized by electric current supplied from a local battery 3, through circuits controlled by a neutral control relay K.

Considering the parts in a normal condition, as shown in the drawings, current from the battery 3 will flow from one terminal thereof, through front contact 4 of neutral relay K, wires 5 and 6, lamp G of signal S¹, and wires 7 and 8 back to battery 3 and also from wire 6, through lamp G of signal S², and wires 9 and 8 to battery 3, thereby displaying "proceed" indications to traffic moving in either direction over the highway. Under these conditions, current from the battery 3 also flows from one terminal thereof through front contact 4 of neutral relay K, wires 5 and 6, lamp R of signal S³, and wires 7 and 8 to the other terminal of battery 3; and also from wire 6 through lamp R of signal S⁴, and wires 9 and 8 back to battery 3, thereby displaying "stop" indications to traffic moving in either direction over the railway track X and notifying the operator of the car that "proceed" indications are displayed at the highway H to traffic on the highway.

Also current from the battery 3 flows from one terminal thereof through front contact 4 of neutral relay K, wires 5 and 6, lamp G of approach signal S⁵, and wires 7 and 8 back to battery 3, and also from wire 6 through lamp G of approach signals S⁶, and wires 9 and 8 back to battery 3.

When the neutral relay K is deenergized, as will presently be described, the front contact 4 thereof is opened, and a back contact 10 of this relay is closed. This opens all of the circuits previously traced and establishes a circuit from one terminal of battery 3 through

back contact 10 of neutral relay K, wires 11 and 12, lamp R of signal S¹, and wires 7 and 8 to the other terminal of battery 3 and also from wire 12 through lamp R of signal S² and wires 9 and 8 back to battery 3, thereby displaying "stop" indications to traffic approaching the crossing from either direction over the highway. Under these conditions current from the battery 3 also flows from one terminal thereof through back contact 10 of relay K, wires 11 and 12, lamp G of signal S³ and wires 7 and 8 back to battery 3 and also from wire 12, through lamp G of signal S⁴, and wires 9 and 8 to battery 3, thereby displaying "proceed" indications to traffic moving toward the crossing in either direction over the track X. Also current from one terminal of battery 3 flows through back contact 10 of neutral relay K, wires 11 and 12, lamp R of approach signal S⁵, and wires 7 and 8 to battery 3, and also from wire 12, through lamp R of approach signal S⁶ and wires 9 and 8 to battery 3.

From the foregoing, it will be apparent that when the crossing signals S¹ and S² indicate "proceed", the crossing signals S³ and S⁴ indicate "stop", and the approach signals S⁵ and S⁶ display "proceed" indications, and conversely, when the highway crossing signals S¹ and S² display "stop" indications, the trackway crossing signals S³ and S⁴ display "proceed" indications and the approach signals S⁵ and S⁶ display "stop" indications to a following car. The signals S⁵ and S⁶ are located at a sufficient distance from the highway H that a car on the railway will have ample time within which to decrease its speed or stop before reaching the highway H in the event that the signal S¹ or S² fails, through any cause, to display a "stop" indication to traffic over the highway upon the approach of a car on the track X.

A plurality of contactors C¹, C², C³, C⁴, C⁵ and C⁶ are arranged at spaced intervals along the conductor 2 and are adapted to be successively engaged in the order named by a current collecting device such as a trolley wheel or shoe carried by a car or train as it proceeds over the track from left to right, as viewed in the drawings, and in the reverse order by a train traveling in the opposite direction. The contactors C¹, C² and C³ are located on one side of the highway H and the contactors C⁴, C⁵ and C⁶ are located on the opposite side of the highway H.

The contactors C¹ and C² are spaced relatively close together and constitute what I shall term a first pair of contactors and the contactors C⁵ and C⁶ are also spaced in close proximity with one another and constitute a second pair. The contactor C¹ of the first pair is connected with the contactor C⁴ by a wire 19 and the contactor C⁵ of the second pair is connected with the contactor C³ by a wire 20.

A transformer T¹ is associated with the first pair of contactors, one terminal of the primary 21 of this transformer being connected with the contactor C¹ through a resistor 22, and the other terminal of the primary being connected with the contactor C² through a resistor 23. The primary 21 is also connected, at its mid point, with a terminal o of the source of electrical energy, thereby dividing the primary into two windings 24 and 25. The secondary 26 of the transformer T¹ is connected with the winding of a polarized relay R¹ which is provided with a contact 27 and which is of the type that remains in the position to which it was last moved until positively energized to another position.

A transformer T² is associated with the second pair of contactors C⁵ and C⁶, and one terminal of the primary 28 of this transformer is connected with the contactor C⁶ through a resistor 29, and the other terminal of the primary is connected with the contactor C⁵ through a resistor 30. The primary 28 is connected at its mid point with a terminal o of the source of electrical energy, thereby dividing the primary 28 into two windings 31 and 32. The secondary 33 of the transformer T² is connected with the winding of a polarized relay R² which is provided with a contact 34 and which is similar to relay R¹.

The neutral relay K receives energy through a circuit passing from terminal o, through contact 27 of polar relay R¹, wire 35, contact 34 of polar relay R², wire 36, resistor 37, wire 38, winding of neutral relay K and wire 39, to terminal o. The wire 38 is also connected with the contactor C³ through a resistor 40, and with the contactor C⁴ through a resistor 41, thereby rendering it possible to at times energize the relay K, independently of the circuit just traced through the contacts 27 and 34, by current through the contactors C³ and C⁴, as will presently be described.

I will now assume that the parts are in the condition shown in Fig. 1 of the drawings in which the contacts 27 and 34 of relays R¹ and R² are closed. With the apparatus in this condition the relay K is energized and front contact 4 of this relay is closed. This causes the illumination of the lamps G of the highway crossing signals S¹ and S² and the lamps R of the trackway crossing signals S³ and S⁴ and also the lamps G of the approach signals S⁵ and S⁶, through circuits previously traced for these lamps.

If, now, an eastbound train approaches the crossing over the track X the current collecting device (not shown) carried thereby will first engage the contactor C¹. This will cause a momentary flow of current from the conductor 2 through the current collecting device, contactor C¹, resistor 22 and the winding 24 of transformer T¹ to terminal o. The direction of flow of current in the winding 24 is such as will induce a current in the sec-

ondary winding 26 of the polar relay R¹ of a polarity that will cause the contact 27 to open. When the current collecting device moves out of contact with the contactor and breaks the circuit therethrough, the collapse of the field in the transformer T¹ induces a current in an opposite direction in the secondary winding 26 of polar relay R¹, such as will cause the contact 27 to close. As the current collecting device moves into engagement with the contactor C², current will flow in the winding 25 and in a direction such as will tend to maintain the contact 27 closed. The contactors C¹ and C² are spaced sufficiently close together so that the current collecting device moves out of engagement with the former and into engagement with the latter substantially simultaneously. When the current collecting device moves out of engagement with the contactor C² a pulse or surge of current will be produced in the winding 25 and in the secondary 26 of the transformer T¹ of proper polarity to cause the contact 27 of relay R¹ to again open and interrupt the circuit through the neutral relay K. This causes relay K to become deenergized and open its front contact 4 and close its back contact 10. The circuits through the lamps G of the signals S¹ and S² and the lamps R of the signals S³ and S⁴ as well as the lamps G of the approach signals S⁵ and S⁶ are thus opened, and the circuits previously traced through the lamps R of the signals S¹ and S², the lamps R of the approach signals S⁵ and S⁶, and the lamps G of the signals S³ and S⁴ are closed. This causes a "stop" indication to be displayed to traffic on the highway a "proceed" indication to the approaching train, and a "stop" indication to following trains.

As the current collecting device passes over the contactor C³, which is employed for traffic in an opposite direction only, the resistor 40 so limits the passage of current that the relay K will not be energized sufficiently to open its back contact 10. If, however, the front contact 4 of this relay is closed at this time, as will be in the case of traffic in an opposite direction, the current passing through the resistor 40 is sufficient to maintain the contact 4 closed.

After the train passes the highway crossing H the current collecting device carried thereby next engages the contactor C⁴ which is connected with the contactor C¹ by the wire 19. The effect is therefore exactly the same as that when the current collecting device engaged the contactor C¹, namely, that when contact is first made between the current collecting device and the contactor C⁴, a surge or impulse of current is produced in the winding 24 of the transformer T¹ which operates to open contact 27 of the polar relay R¹, and that when the current collecting device moves out of engagement with the contactor C⁴, the

interruption of current through winding 24 creates an impulse of current in relay R¹ which closes contact 27. The closing of the contact 27 reestablishes the circuit previously traced through the neutral relay K and causes this relay to close its front contact 4. The circuits initially traced through the lamps G of the crossing signals S¹ and S² and the approach signals S⁵ and S⁶ and also those through the lamps R of the signals S³, S⁴ will therefore be reestablished in their normal condition.

The current collecting device next engages the contactor C⁵ and causes an impulse of current in the winding 32 of the transformer T² which induces an impulse in the secondary 33 of this transformer in such a direction as to hold the contact 34 of the relay R² in its normally closed position. When, however, the current collecting device moves out of engagement with the contactor C⁵, an impulse of current of an opposite polarity will be produced in the secondary 33, thereby operating relay R² to open contact 34. The current collecting device next breaks contact with the contactor C⁵, thus interrupting the flow of current through winding 32, and then engages contactor C⁶ to supply a surge of current to winding 31. Both of these operations aid in creating in secondary 33 a surge of current which operates relay R² to open contact 34. When the current collecting device engages contactor C⁶, however, current flows from the contactor, through wire 20, contactor C³, resistor 40, wire 38, winding of relay K, and wire 39 to terminal o. Current supplied over this circuit would not be sufficient to energize the relay K if it were deenergized, but is sufficient to hold this relay in its energized position which it now occupies. It follows that relay K holds its front contact closed, so that the signals controlled thereby are unaffected, while the current collecting device on the train passes contactors C⁵ and C⁶. When the current collecting device moves out of engagement with the contactor C⁶, the interruption of current in winding 31 causes a surge of current in the secondary 33 of transformer T² which causes relay R² to close contact 34 and restore the normal circuit for relay K.

The operation of the apparatus in response to the movement of a westbound train through the portion of the track shown in the drawings is similar to that described for eastbound movement and will be understood from the foregoing without further explanation.

The signals S⁵ and S⁶ prevent a following train from passing the contactors C¹ and C² before the first train clears the highway crossing H. Were it not for these signals a second train might follow the first train past the contactors C¹ and C² with the result that as soon as the first train passed the contactor C⁴, the highway crossing signals S¹ and S² would indicate "proceed" to traffic over the

highway notwithstanding the approach of the second train.

In Fig. 2, I have shown another embodiment of my invention in which I accomplish the same result by a slight change and rearrangement of the parts. In this embodiment of my invention I control the operation of the several signals by means of polar relays R^3 and R^4 . Relay R^3 is provided with two windings 42 and 43 and a contact 27 arranged to be closed when winding 42 is energized and to be opened when winding 43 is energized, but to remain in the position to which it was last moved until positively moved to a different position. Relay R^4 is similar to relay R^3 and comprises two windings 44 and 45 and a contact 34 controlled thereby. One terminal of the winding 42 of the relay R^3 is connected through a resistor 46 with the contactor C^1 , and the other terminal thereof is connected with the terminal o of the source of electrical energy. Also one of the terminals of the winding 43 of the relay R^3 is connected, through a resistor 47, with the contactor C^2 , and the other terminal of this winding is connected with the terminal o . In a like manner one of the terminals of the winding 44 of the relay R^4 is connected, through a resistor 48, with the contactor C^3 , and the other terminal of this winding is connected with the terminal o . Also, one terminal of the winding 45 of this relay is connected, through a resistor 49, with the contactor C^5 , and the other terminal of this winding is connected with the terminal o .

The wire 38 leading to one terminal of the neutral relay K is connected with the contactor C^2 through a resistor 50 and a wire 51, and with the contactor C^5 through a resistor 52 and a wire 53. In all other respects the construction shown in Fig. 2 is similar to that described in connection with that disclosed in Fig. 1.

Considering the parts as being in the positions shown in Fig. 2, I will assume that an eastbound car carries its current collecting device into engagement with the contactor C^1 . This causes a momentary flow of current in the winding 42 of the polar relay R^3 and holds contact 27 closed. When the current collecting device moves out of engagement with the contactor C^1 and into engagement with the contactor C^2 , a flow of current will result in winding 43 of the relay R^3 , which will energize this relay to open the contact 27, and break the circuit through this contact and the relay K . The relay K , however, remains energized as long as the current collecting device is in contact with the contactor C^2 by virtue of current flowing from this contactor, through an auxiliary circuit including wire 51, resistor 50, wire 38, and winding of relay K , but this condition has no useful function in connection with eastbound traf-

fic, being employed only for westbound traffic. As soon, however, as the current collecting device moves out of engagement with the contactor C^2 , the circuit through the auxiliary circuit just traced for relay K is opened, thereby permitting the contact 4 of relay K to open and the contact 10 of this relay to close. This causes the several signals to display "stop" indications to traffic over the highway and "proceed" indications to a train approaching the highway H in a manner similar to that described in connection with the apparatus illustrated in Fig. 1.

When the current collecting device engages the contactor C^3 a circuit is completed through the wire 20 and winding 44 of polar relay R^4 which energizes this winding and tends to close the contact 34. This contact, however, is already closed and consequently, no change in the condition of the several circuits results. As soon as the train passes the highway H the current collecting device carried thereby engages the contactor C^4 and causes the energization of winding 42 of the polar relay R^3 . This causes the contact 27 to close and re-establish the circuit through this contact and the neutral relay K , thereby opening the contact 10 and closing the contact 4 of this relay. This returns the apparatus to its normal condition by re-establishing the several circuits through the lamps G of the crossing signals S^1 and S^2 and the approach signals S^5 and S^6 , and also the lamps R of the signals S^3 and S^4 as explained in connection with Fig. 1.

As the train proceeds along the track its current collecting device next engages the contactor C^5 and completes a circuit from the conductor 2 through winding 45 of the polar relay R^4 , which causes the contact 34 to open and break the circuit therethrough which has been maintaining the neutral relay K energized. An auxiliary circuit is, however, also established from the contactor C^5 through the wire 53, resistor 52, wire 38, and winding of neutral relay K , which maintains this relay energized notwithstanding the fact that the contact 34 is open. The system consequently remains undisturbed in its normal condition. As the current collecting device moves out of engagement with the contactor C^5 and into engagement with the contactor C^6 the auxiliary circuit just traced is opened but a circuit is also established from the contactor C^6 through the winding 44 of the polar relay R^4 which closes the contact 34, thereby returning the system to its normal condition.

The operation of the apparatus for westbound traffic is similar to that above-described in connection with eastbound traffic and will be understood without further explanation.

In Fig. 3, I have shown still another form of my invention in which I employ three position signals for highway protection. In this embodiment of my invention, a plurality of

contractors C⁷, C⁸, C⁹, C¹⁰ and C¹¹ are arranged at spaced intervals along the conductor 2, the contactors C⁷ and C⁸ being located in close proximity with one another on one side of the highway H, the contactor C⁹ at or adjacent the crossing, and the contactors C¹⁰ and C¹¹ in juxtaposition on the other side of the crossing. The apparatus also embodies a pair of slow releasing relays R⁵ and R⁶, a stick relay L, a slow pick-up relay M controlled by the relay L, and a slow releasing relay P.

Normally, that is to say, when the stretch of track between the contactors C⁷ and C¹¹ is unoccupied by a car approaching the crossing from either direction, all of the relays above-mentioned are in a deenergized condition and the lamps G of the signals S¹, S², S⁵ and S⁶ are illuminated by virtue of a circuit passing from terminal *x*, through back contacts 54 and 55 of relays L and M respectively, and lamps G to terminal *o*, thus indicating "proceed" to traffic both over the track X and on the highway. Also, with the parts in this condition, the lamps R of the signals S³ and S⁴ are likewise illuminated by virtue of a circuit passing from terminal *x*, through back contact 56 of relay M, and lamps R to terminal *o*.

I will now assume that an eastbound car approaching the intersection in the direction of the arrow in Fig. 3, carries its trolley wheel, or other current collecting device, into engagement with the contactor C⁷. This will cause a momentary flow of current from the conductor 2, through the contactor C⁷, wires 57 and 58, back contact 59 of relay R⁵, wires 60, 61 and 62, winding of relay R⁶, wires 63 and 64 and resistor 65 to ground. The resulting energization of relay R⁶ completes a pick-up circuit for the stick relay L passing from terminal *x*, through front contact 66 of relay R⁶, wire 67 and winding of relay L to terminal *o*. The energization of relay L opens its back contact 54, which interrupts the circuit previously traced through this contact for the lamps G of the signals S¹, S², S⁵ and S⁶ but establishes a circuit passing from terminal *x*, through front contact 54 of relay L, and lamps R of signals S⁵ and S⁶ to terminal *o*, thereby causing the illumination of these lamps and indicating to a following train that the stretch of track between the contactor C⁷ and the highway crossing is occupied.

The energization of relay L also establishes a circuit for the lamps Y of the signals S¹ and S² passing from terminal *x*, through front contact 68 of relay L, wire 69, back contact 70 of relay M, and lamps Y to terminal *o*, thereby indicating "caution" to traffic on the highway. The energization of relay L also completes a stick circuit for this relay passing from terminal *x*, through back contact 71 of relay P, wire 72, front contact 73 of relay L, wires 74 and 67, and winding of relay L to terminal *o*, which maintains relay

L energized and the circuits for the several signals intact after the current collecting device carried by the car moves out of engagement with the contactor C⁷.

The energization of relay L also establishes a pick-up circuit for relay M passing from terminal *x*, through front contact 75 of relay L, wire 76, and winding of relay M to terminal *o*. The relay M, however, being slow-acting in character, does not respond until the expiration of a time interval of predetermined duration, at which time it opens its back contacts 55, 56 and 70, thereby interrupting the circuit previously traced for the lamps G of the signals S¹, S², S⁵ and S⁶ at another point, the circuit for the lamps R of the signals S³ and S⁴, and the circuit for the lamps Y of the signals S¹ and S². When the relay M responds it establishes a circuit passing from terminal *x*, through front contact 68 of relay L, wire 69, front contact 70 of relay M and the lamps R of the signals S¹ and S² and the lamps G of the signals S³ and S⁴, thereby indicating "danger" to traffic on the highway and "proceed" to the car approaching the crossing. It will be noted from the foregoing that when the current collecting device engages the contactor C⁷, lamps G of the signals S¹ and S² are extinguished and the lamps Y of the signals S¹ and S² and the lamps R of the signals S⁵ and S⁶ are illuminated simultaneously, and that after a predetermined time interval has elapsed, which interval is determined by the adjustment of the relay M, the lamps Y of the signals S¹ and S² are extinguished and the lamps R of these signals and the lamps G of the signals S³ and S⁴ are simultaneously illuminated.

During the above-described operations, the current collecting device moves into engagement with the contactor C⁸ and establishes a stick circuit for relay R⁶ passing from conductor 2, through the current collecting device, contactor C⁸, wires 77 and 78, front contact 79 of relay R⁶, wire 62, winding of relay R⁶, wires 63 and 64, and resistor 65 to ground. This stick circuit maintains relay R⁶ energized to prevent the energization of relay R⁵. The energization of relay R⁶ also establishes a snubbing circuit for this relay passing from one terminal of the winding of relay R⁶, through wires 63 and 64, non-inductive resistor 80, wire 81, front contact 82 of relay R⁶, wires 61 and 62, to the other terminal of the winding of relay R⁶. This snubbing circuit is described in detail in my copending application, Serial No. 398,339, filed Oct. 9, 1929, and not only delays the release period of the relay R⁶ but reduces shock at the pole faces of the relay. The current collecting device next moves out of engagement with the contactor C⁷ and interrupts the pick-up circuit for relay R⁶ previously traced through contactor C⁷. The current collecting device next moves out of engage-

ment with the contactor C⁸ and interrupts the stick circuit for relay R⁶ but this relay does not open its front contacts until a predetermined time interval has elapsed, due to the effect of the snubbing circuit above traced. When, however, such time interval expires, front contacts 66, 79 and 82 of relay R⁶ all open and back contact 79 thereof closes, thus breaking the stick circuit and snubbing circuit for relay R⁶ previously traced through front contacts 79 and 81, respectively of this relay and also interrupting the pick-up circuit for relay L previously traced through front contact 66 of relay R⁶. Relay L, however, remains energized by virtue of its stick circuit previously traced through its front contact 73 and consequently the several signal circuits last described remain intact.

When the car reaches the highway crossing its current collecting device engages the contactor C⁹ and completes a pick-up circuit for relay P passing from the conductor 2 through the current collecting device, contactor C⁹, resistor 83, wires 84 and 85, winding of relay P, and wire 86 to ground. The energization of relay P causes it to open its back contact 71, thus interrupting the stick circuit for relay L previously traced through this contact. This causes the deenergization of relay L which immediately opens its front contacts 54, 68, 73 and 75 and closes its back contact 54, thereby re-establishing the normal signal circuits initially described. The energization of relay P also establishes a snubbing circuit for this relay passing from one terminal of its winding, through wires 86 and 87, front contact 88 of relay P, non-inductive resistor 89 and wire 85 to the other terminal of the winding. The current collecting device next moves out of engagement with the contactor C⁹ and interrupts the pick-up circuit for relay P but the snubbing circuit just traced prevents this relay from again closing its back contact 71 until the relay L has had time to open its front contact 73 and prevent the re-establishment of its stick circuit.

As the car recedes from the crossing it next carries its current collecting device into engagement with the contactor C¹⁰ and establishes a pick-up circuit for relay R⁵ passing from contactor C¹⁰, through wires 77 and 78, back contact 79 of relay R⁶, wires 90 and 91, winding of relay R⁵, wires 92 and 64 and resistor 65 to ground. The energization of relay R⁵ causes it to open its back contact 59 and to close its front contact 59.

The current collecting device next engages the contactor C¹¹ and establishes a stick circuit for relay R⁵ passing from contactor C¹¹, through wires 57 and 58, front contact 59 of relay R⁵, wire 91, winding of relay R⁵, wires 92 and 64, and resistor 65 to ground. The opening of back contact 59 of relay R⁵ above described prevents energization of the relay R⁶ and the operation of the signals by an eastbound car after it has passed the crossing, it being obvious that if the back contact 59 of relay R⁵ is closed when the current collecting device engages the contactor C¹¹, the operation of the apparatus would be the same as when the contactor C⁷ is engaged by the current collecting device, as previously described.

The operation of the apparatus for westbound traffic is similar to that above-described in connection with eastbound traffic and will be understood without further explanation.

From the foregoing it will be apparent that I have provided a very simple and efficient apparatus operable by the current in the propulsion conductor for governing the operation of wayside and highway crossing signals for traffic in opposite directions over a single track railway and in which a minimum number of relays are employed.

Although I have herein shown and described only three forms of railway traffic governing apparatus embodying my invention, it is understood that various changes and modifications may be made therein within the scope of the appended claims without departing from the spirit and scope of my invention.

Having thus described my invention, what I claim is:

1. In combination, a stretch of railway track intersected by a highway, a first signal for governing traffic on said highway at such intersection and adapted to display a plurality of aspects, a second signal for governing traffic over said stretch at such intersection and adapted to display a plurality of aspects, a third signal located at a point remote from said second signal for indicating traffic conditions between said third signal and such intersection and adapted to display a plurality of aspects, train controlled means located at a point remote from such intersection for causing certain of said signals to display certain aspects, and train controlled means located at a point adjacent such intersection for causing said signals to display certain other aspects.

2. In combination, a stretch of railway track intersected by a highway, a first signal for governing traffic on said highway at such intersection and normally displaying a "proceed" indication, a second signal located at a point remote from such intersection for indicating traffic conditions on said stretch between said second signal and such intersection and normally displaying a "stop" indication, train controlled means located at a point remote from such intersection for causing said first and second signals to change their aspects, and train controlled means located at a point adjacent such intersection for

causing said first and second signals to again display said normal aspects.

3. In combination, a stretch of railway track intersected by a highway, a first signal for governing traffic on said highway at such intersection, a second signal for governing traffic over said stretch at such intersection, a third signal located at a point remote from said second signal for indicating traffic conditions between said third signal and such intersection, train controlled means located at a point remote from such intersection for causing said first signal to display a certain aspect, said second signal to display a "proceed" indication and said third signal to display a "stop" indication, and train controlled means located at a point adjacent such intersection for causing said first signal to display a different aspect, said second signal to display a "stop" indication, and said third signal to display a "proceed" indication.

4. In combination, a stretch of railway track intersected by a highway, a first signal for governing traffic on said highway at such intersection, a second signal for governing traffic over said stretch at such intersection, a third signal located at a point remote from said second signal for indicating traffic conditions between said third signal and such intersection, train controlled means located on one side of such intersection for causing said first signal to display a certain aspect, said second signal to display a "proceed" indication and said third signal to display a "stop" indication, and train controlled means located on the other side of such intersection for causing said first signal to display a "proceed" indication, said second signal to display a "stop" indication, and said third signal to display a "proceed" indication.

5. In combination, a stretch of railway track, traffic governing means for said stretch, a contact device for controlling said governing means, a polarized relay for controlling said contact device, a first train operated device located on one side of said governing means for controlling the energization of said relay by current of a certain polarity, a second train operated device associated with said first device for controlling the energization of said relay by current of a reverse polarity, and a third train operated device located on the opposite side of said traffic governing means and electrically connected with said first train operated device for controlling the energization of said relay by current of said certain polarity.

6. In combination, a stretch of railway track intersected by a highway, a crossing signal adjacent such intersection, approach signals associated with said crossing signal, a contact device for jointly controlling said crossing signal and said approach signal, a

polarized relay for controlling said contact device, a transformer having its primary connected at an intermediate point with ground and the terminals of the secondary thereof connected with the terminals of the winding of said relay, a group of contactors located on one side of said intersection and arranged for successive operation by a train approaching said intersection for controlling said relay, one of said contactors being connected with one terminal of the primary of said transformer and another of said contactors of said group being connected with the other terminal of said primary, and an additional contactor located on the opposite side of said intersection and connected with one of the contactors of said group.

7. In combination, a stretch of railway track intersected by a highway, a signal adjacent such intersection, a contact device for controlling said signal, a first group of contactors located on one side of said intersection and arranged for successive operation by a train approaching said intersection in one direction, a second group of contactors located on the other side of said intersection and arranged for successive operation by a train approaching said intersection in an opposite direction, a first single contactor located on the opposite side of said intersection from said first group of contactors and electrically connected with one of the contactors of said first group, a second single contactor located on the opposite side of said intersection from said second group of contactors and electrically connected with one of the contactors of said second group, a first pair of windings controlled jointly by said first group of contactors and said first single contactor for controlling said contact device for traffic over said stretch in one direction, and a second pair of windings controlled jointly by said second group of contactors and said second single contactor for controlling said contact device for traffic over said stretch in an opposite direction.

8. In combination, a stretch of railway track intersected by a highway, a signal adjacent such intersection, a relay for controlling said signal, a first group of contactors located on one side of said intersection and arranged for successive operation by a train approaching said intersection in one direction, a second group of contactors located on the other side of said intersection and arranged for successive operation by a train approaching said intersection in an opposite direction, a first single contactor located on the opposite side of said intersection from said first group of contactors and electrically connected with one of the contactors of said first group, a second single contactor located on the opposite side of said intersection from said second group of contactors and electrically connected with one of the contactors of said second

ond group, a first pair of windings controlled jointly by said first group of contactors and said first single contactor for controlling said relay for traffic over said stretch in one direction, a second pair of windings controlled jointly by said second group of contactors and said second single contactor for controlling said relay for traffic over said stretch in an opposite direction, and means for preventing the operation of said relay when certain of said contactors are operated by a train approaching said intersection in one direction and when certain other of said contactors are operated by a train approaching said intersection in an opposite direction.

9. In combination, a stretch of railway track intersected by a highway, a signal adjacent such intersection, a relay for controlling said signal and having one terminal thereof connected with one terminal of a source of electrical energy, a first group of contactors located on one side of said intersection, a second group of contactors located on the other side of said intersection, a first single contactor located on the opposite side of said intersection from said first group of contactors and electrically connected with one of the contactors of said first group and with the other terminal of said relay, a second single contactor located on the opposite side of said intersection from said second group of contactors and electrically connected with one of the contactors of said second group and also with said other terminal of said relay, said contactors being adapted to be successively operated by trains moving over said stretch in opposite directions to connect the other terminal of said source with said relay, a first pair of windings controlled jointly by said first group of contactors and said first single contactor for controlling said relay for traffic over said stretch in one direction, a second pair of windings controlled jointly by said second group of contactors and said second single contactor for controlling said relay for traffic over said stretch in an opposite direction, and a resistor connected in series between each of said single contactors and said other terminal of said relay for preventing said relay from operating if in an energized condition when the contactors with which said relay is connected are operated by a train approaching said intersection in either direction.

10. In combination, a stretch of railway track intersected by a highway, a first signal for governing traffic on said highway at such intersection, a second signal located at a point adjacent to such intersection for governing traffic over said stretch at such intersection, a third signal located at a point remote from such intersection for indicating traffic conditions between said third signal and such intersection, a train controlled contact device for causing said first sig-

nal to display a "caution" indication and said third signal to display a "stop" indication, and a time element device controlled by said contact device for subsequently causing said first signal to display a "stop" indication and said second signal to display a "proceed" indication.

11. In combination, a stretch of railway track intersected by a highway, a first signal for governing traffic on said highway at such intersection, a second signal located at a point adjacent such intersection for governing traffic over said stretch at such intersection, a third signal located at a point remote from such intersection for indicating traffic conditions between said third signal and such intersection, a first train controlled contact device located at a point remote from such intersection for causing said first signal to display a "caution" indication and said third signal to display a "stop" indication, a time element device controlled by said first contact device for subsequently causing said first signal to display a "stop" indication and said second signal to display a "proceed" indication, and a second train controlled contact device located at a point adjacent to such intersection for causing said first signal to display a "proceed" indication, said second signal to display a "stop" indication, and said third signal to display a "proceed" indication.

12. In combination, a stretch of railway track intersected by a highway, a first signal for governing traffic on said highway at such intersection and normally displaying a "proceed" indication, a second signal located at a point adjacent such intersection for governing traffic over said stretch at such intersection and normally displaying a "stop" indication, a third signal located at a point remote from such intersection for indicating traffic conditions between said third signal and such intersection and normally displaying a "proceed" indication, a first train controlled contact device located at a point remote from such intersection for causing said first signal to display a "caution" indication and said third signal to display a "stop" indication, a time element device controlled by said contact device for subsequently causing said first signal to display a "stop" indication and said second signal to display a "proceed" indication, and a second train controlled contact device located at a point adjacent such intersection for restoring said signals to their normal conditions.

13. In combination, a stretch of railway track intersected by a highway, a first signal for governing traffic on said highway at such intersection, a second signal located at a point adjacent such intersection for governing traffic over said stretch at such intersection, a third signal located at a point remote from such intersection for indicating traffic condi-

tions between said third signal and such intersection, a stick relay for controlling said third signal, a slow-acting relay controlled by said stick relay for controlling said first and second signals, a pick-up circuit for said stick relay controlled by a train at a point remote from such intersection, and a stick circuit for said stick relay controlled by a train at a point adjacent such intersection.

10 In testimony whereof I affix my signature.
PAUL H. CRAGO.

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