

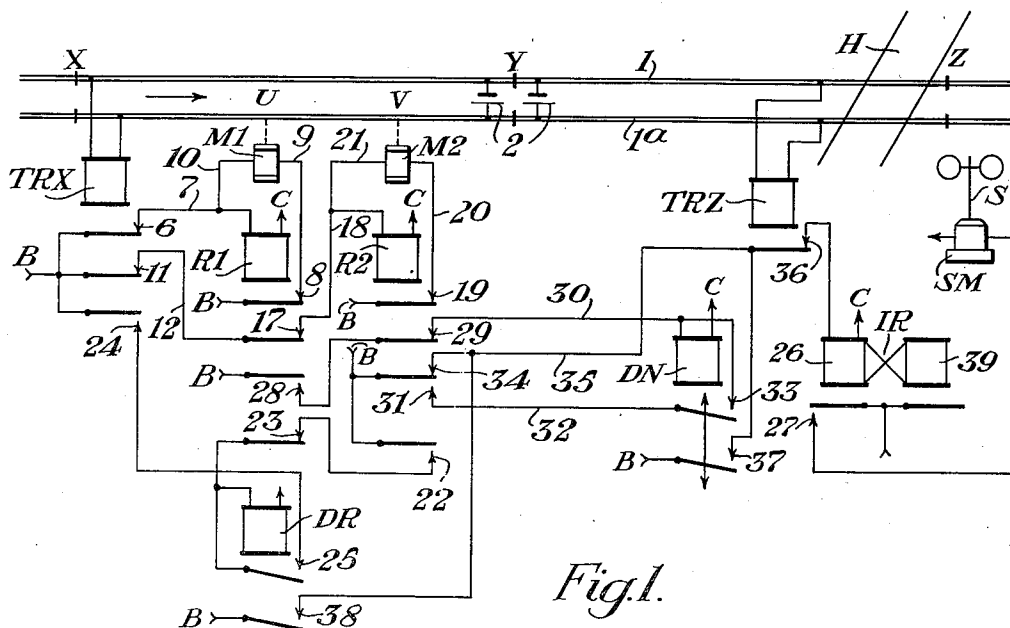
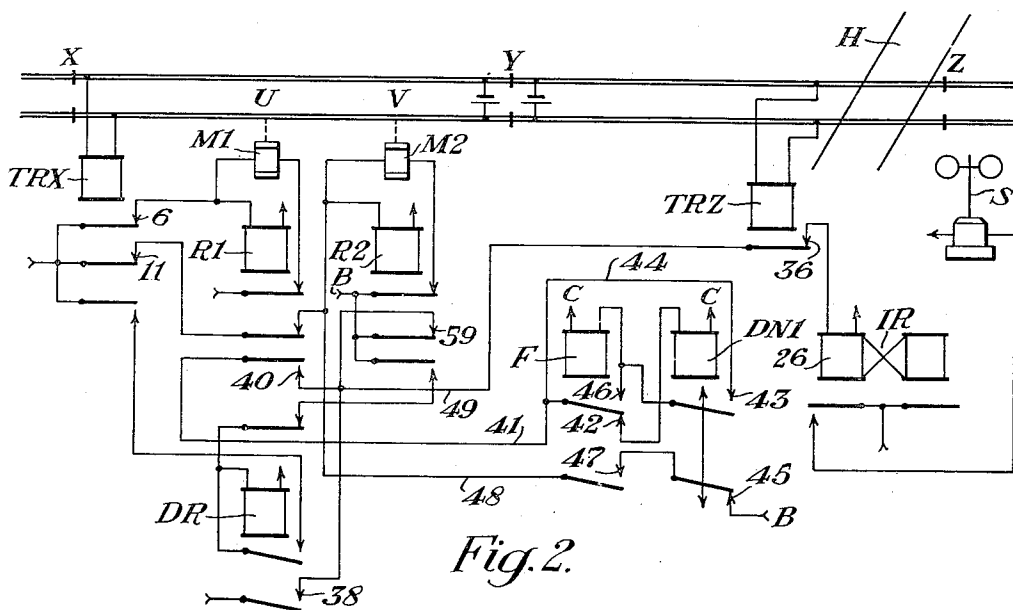
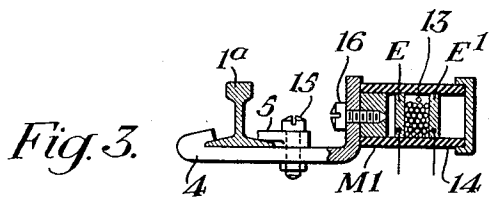
Dec. 5, 1939.

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2,182,158

APPARATUS FOR THE CONTROL OF HIGHWAY CROSSING SIGNALS

Filed Dec. 10, 1935



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2,182,158

APPARATUS FOR THE CONTROL OF HIGHWAY CROSSING SIGNALS

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Application December 10, 1935, Serial No. 53,759

15 Claims. (Cl. 246—130)

My invention relates to apparatus for the control of highway crossing signals, and has for an object the provision of apparatus controlled by a train approaching a highway crossing for starting the operation of the signal in accordance with the speed of the train. Other objects and advantages of my invention will appear as the specification progresses.

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

For a better understanding of my invention, reference may be had to the accompanying drawing in which Figure 1 is a diagrammatic view of one form of apparatus embodying my invention, and Figure 2 is a diagrammatic view of a second form of apparatus which also embodies my invention. Figure 3 is a vertical sectional view showing one form of a rail microphone which may be used in the apparatus shown in Figures 1 and 2. In each of the different views, like reference characters designate similar parts.

Referring to Figure 1, the reference characters 1 and 1^a designate the track rails of a stretch of railway track over which traffic normally moves in the direction indicated by an arrow, and which rails are intersected at grade by a highway H. A highway crossing signal S is located adjacent the intersection and is indicated on the drawing conventionally as a flashing light signal. As is common practice, the signal S is set to be plainly exhibited to highway users approaching the intersection, the arrangement being such that when operating current is supplied to an operating mechanism SM a warning is displayed by alternately flashing two red lights, but that when operating current is not thus supplied to the mechanism the lights are dark. In actual practice, two signals would preferably be provided and would be set to face in opposite directions and the two signals would be operated in multiple. It will be understood, of course, that my invention is not limited to this form of highway crossing signal and other forms may be used if desired.

As here shown, the immediate control of signal S is accomplished through an interlocking relay IR, the left-hand winding 26 of which when deenergized and its full down contact 27 closed completes a simple circuit easily traced for supplying current to the mechanism SM, but when the winding 26 is energized or when it is deenergized subsequent to deenergizing of a right-hand winding 39, the contact 27 is open and current is

not thus supplied to the mechanism SM. It is to be pointed out that the right-hand winding 39 of relay IR may be controlled by traffic to the right of the highway H, the necessary apparatus being not shown, however, since it forms no part of my present invention.

In Figure 1, the track rails 1 and 1^a are divided by the usual insulated rail joints to form two track sections X—Y and Y—Z, which sections are traversed successively in the order named by a train approaching the highway when moving in the normal direction of traffic. Each track section is provided with a track circuit comprising a battery 2 connected across the rails at one end of the section and a track relay designated by the reference character TR plus an exponent corresponding to the location connected across the rails at the other end of the section. The track section Y—Z is arranged for its exit end Z to be adjacent the highway H and its entrance end Y to be far enough away from the highway to provide a predetermined minimum period of operation of the signal S prior to the arrival of a train at the intersection when the train is operating at a speed not exceeding a certain prescribed speed, operation of the signal being initiated when the train reaches the location Y. The track section X—Y may be any convenient length and in practicing my invention the location X will usually be an automatic block signal location. In order to more easily understand the apparatus embodying my invention, I shall assume that the location Y is located in the rear of the highway H a distance sufficient to provide 20 seconds operation of the signal S prior to arrival of a train at the intersection when the train is moving at 45 miles per hour, the operation of the signal being, as stated above, initiated as the train enters the section Y—Z. Hence, under these conditions the section Y—Z is substantially 1320 feet in length since a train traveling at a speed of 45 miles per hour will advance approximately 1320 feet in 20 seconds.

Two rail microphones M1 and M2 are located spaced apart along the section X—Y. These rail microphones are preferably alike and may be of the type described and claimed in the United States Letters Patent No. 1,834,077, granted December 1st, 1931, to A. J. Sorensen. Referring particularly to Figure 3, the microphone M1 is attached to the rail 1^a by means of a clamp 4 which is secured to the flange of the rail by a lug 5 and a bolt 15. The microphone comprises an insulating housing 14 attached to the clamp 4 by a screw 16, which housing con-

tains two spaced vertically disposed metal electrodes E and E'. The space between these electrodes is at least partly filled with carbon granules 13. The parts are so proportioned that under normal conditions and the device is not vibrated the resistance between the electrodes E and E' through the carbon granules is relatively low, but when the microphone is vibrated and the carbon granules are agitated, the resistance between the two electrodes is increased several times its normal value. As stated above, the microphone M2 is preferably similar in construction to the microphone M1.

Looking again at Figure 1, the microphone M2 is attached to the rail 1^a, as indicated by a dotted line, at a location V and which location is a distance from the highway H sufficient to provide a predetermined period of operation of the signal S prior to arrival of a train at the intersection when the train is operating at the maximum speed for all trains. Thus, if 90 miles per hour be assumed as the maximum speed for all trains and the desired operating period for the signal S is 20 seconds, the location V is substantially 2,640 feet from the highway and is 1,320 feet to the rear of location Y. The microphone M1 is located at a location U to the rear of location V. This space between locations U and V is, in effect, a timing track section for determining the speed of a train and in accordance with which speed the time of starting operation of the highway crossing signal is determined. This timing track section may be of any convenient length and will be made to agree with the desired operating period of a timing device to be referred to hereinafter, and also in accordance with the speed of trains at this particular locality. In order to agree with the train speeds I have assumed above and to agree with a preferred form of timing device about to be described, I shall assume for this description a timing section, the distance between locations U and V, of 270 feet. That is, the two microphones M1 and M2 are located 270 feet apart which is the distance traveled by a train in 4 seconds when the train speed is slightly above 45 miles per hour. It is apparent that such timing section does not require any subdivision of the track circuit as established for the usual wayside signal system, since these microphones may readily be applied to the rail at any point.

A repeater relay is associated with each of the microphones M1 and M2, a relay R1 being associated with microphone M1 and a relay R2 being associated with the microphone M2. Each of these repeater relays is provided with a pickup circuit and a stick circuit. The pickup circuit for the relay R1 may be traced from the B terminal of any convenient source of current, such as a battery, not shown, over front contact 6 of the track relay TRX, wire 7, winding of relay R1 and to the opposite terminal C of the same source of current. The stick circuit for relay R1 includes battery terminal B, its own front contact 8, wire 9, electrode E of microphone M1 (see Figure 3), the carbon granules 13, electrode E', wires 10 and 7, winding of relay R1 and to the battery terminal C. The pickup circuit for the relay R2 passes from the B battery terminal over front contact 11 of relay TRX, wire 12, front contact 17 of relay R1, wire 18, winding of relay R2 and to the C battery terminal; and the stick circuit for this relay includes battery terminal B, its own front contact 19, wire 20, the electrodes and carbon granules of microphone M2, wires 21 and 18, winding of relay R2, and thence to the C battery

terminal. A directional relay DR is also provided and is controlled by virtue of a pickup circuit including a back contact 22 of relay R2, a front contact 23 of relay R1 and the winding of relay DR; and also by a stick circuit including back contact 24 of relay TRX and a front contact 25 of the directional relay DR, as will be readily understood by an inspection of Figure 1.

The apparatus includes a time element device operative to determine the time consumed by a train in traveling the timing section U—V, and which device permits operation of the signal S when a train travels this timing section at a speed above a predetermined speed, here assumed to be 45 miles per hour, and delays the starting of the operation of the signal S until the train reaches the location Y when the train travels the timing section at a speed less than such predetermined speed. As here shown, the time element device DN is a direct current slow pickup relay, and which relay is also slightly slow releasing. The pickup period for the relay DN, in order to agree with the timing section and the train speeds assumed hereinbefore, will be 4 seconds. The release period for the relay DN will be relatively short and will be just sufficient to span the time required for the relay R2 to move from engagement with its front contacts to engagement with its back contacts. The relay DN is normally de-energized and is provided with a pickup circuit passing from the B battery terminal over back contact 28 of relay R1, front contact 29 of relay R2, wire 30, winding of relay DN and to the opposite terminal C of the current source. Once picked up the relay DN may be retained energized over a stick circuit including the B battery terminal, back contact 31 of relay R2, wire 32, front contact 33 of relay DN, winding of the relay and to the opposite terminal C of the current source. Hence, the relay DN is energized in response to the release of relay R1 and is retained energized in response to release of the relay R2 providing 4 seconds elapse between the time the relay R1 is released and the time the relay R2 is released.

A control circuit network is provided for supplying current to the winding 26 of the interlocking relay IR and which network includes three branches. The winding 26 is normally energized over a first branch of this network and which branch may be traced from the B battery terminal over front contact 34 of relay R2, wire 35, front contact 36 of track relay TRZ, winding 26 and to the opposite terminal C of the current source. A second branch extends from the B battery terminal over front contact 37 of the time element relay DN, front contact 38 of relay TRZ and then as before traced; and the third branch includes a front contact 38 of the directional relay DR, wire 35 and then as traced for the first branch.

In describing the operation of the apparatus of Figure 1, I shall first assume a train traveling at the maximum speed of 90 miles per hour approaches the highway H from the left. This train upon entering the track section X—Y will shunt the track relay TRX, opening the pickup circuits for the relays R1 and R2 at contacts 6 and 11, respectively. These two relays R1 and R2 are now retained energized over their respective stick circuits which in each case includes the associated microphone. When the head end of the train reaches the location U, the microphone M1 will be vibrated and the relay R1 will be released, due to the increase in the resistance of the microphone and the resultant decrease in the energization of the relay. The release of relay R1 75

and the closing of its back contact 28 completes the circuit for supplying current to the time element relay DN and that relay will be energized. This train traveling at 90 miles per hour will advance from location U to the location V in about one and one-half seconds, and the microphone M2 will be vibrated and the relay R2 will be released when the head end of the train reaches location V. The release of relay R2 opens the energizing circuit for the relay DN at front contact 29. Since the pickup time of relay DN is 4 seconds, it will not be picked up prior to the release of relay R2 and, hence, will not be further energized for this train. The release of relay R2 and the opening of its front contact 34 will remove current from the winding 26 of the interlocking relay IR and that winding will be deenergized since the other two branches of its circuit network are now open. Deenergizing of winding 26 and the closing of the full down contact 27 will set the signal S into operation. It follows that the signal S will be set into operation upon arrival of this train at the location V and since the location V is 2,640 feet from the highway, 20 seconds operation of the signal prior to the arrival of the train at the intersection will be effected.

I shall next assume a train approaches the highway H from the left traveling at the speed slightly less than 45 miles per hour. This train entering the track section X—Y will shunt the track relay TRX and open the pickup circuits for the relays R1 and R2 the same as described before. Furthermore, when this train reaches the location U and causes the microphone M1 to be vibrated, the relay R1 will be released and current will be supplied to the time element device DN and that device rendered active. This train traveling at a speed of a little less than 45 miles per hour will consume something over 4 seconds in passing from location U to location V and, hence, the relay DN will be picked up and its front contact 33 closed prior to the release of relay R2 when the microphone M2 is vibrated in response to the train reaching the location V. Relay DN will now be retained energized over the stick circuit including back contact 31 of relay R2 since relay DN is slightly slow releasing and will not release during the interval between the opening of the front contact 29 of relay R2 and the closing of its back contact 31. With relay DN picked up, the winding 26 will receive current over the branch circuit including the front contact 37 of relay DN after relay R2 is released and its front contact 34 is opened. When this train enters the track section Y—Z and shunts the relay TRZ, the opening of front contact 36 of relay TRZ will remove current from the winding 26 of the interlocking relay and the signal S will be set into operation. The location Y being 1320 feet in the rear of the highway H, 20 seconds operation of the signal S prior to the arrival of the train at the intersection will be provided for this train traveling at a speed substantially 45 miles per hour.

It is clear, therefore, that for trains traveling at speeds above 45 miles per hour, operation of the signal S will be started when the train reaches the location V and a minimum warning period of 20 seconds will be obtained, but that for trains traveling at speeds less than 45 miles per hour the time element relay DN will be operated and operation of the signal S will be delayed until the train reaches the location Y and which location is sufficiently remote from the intersection that a minimum warning period of 20 seconds will be assured. Although definite values have been as-

sumed for the apparatus of Figure 1, it will be understood that such values are for illustration only and the apparatus can be proportioned and adjusted, within limits, of course, to best suit the location at which the apparatus is installed.

For a train traveling from right to left in Fig. 1, that is, moving against the normal direction of traffic, the signal S will not be operated as the train recedes from the highway through the section Y—Z due to the usual interlocking feature of interlocking relay IR. When the train reaches the location V and causes release of the relay R2 due to vibration of the microphone M2 the directional relay DR will be picked up over the back contact 22 of relay R2 and front contact 23 of relay R1 and when once picked up the relay DR will be retained energized over its stick circuit including back contact 24 of the track relay TRX since that track relay is now shunted. With the directional relay thus picked up and its front contact 38 closed, current is supplied to the winding 26 of the interlocking relay and, hence, operation of the signal S will be avoided while the train passes through the section X—Y.

Referring now to Fig. 2, the apparatus is the same as described for Fig. 1 except the time element device and it is thought that the description of the apparatus need not be repeated except insofar as to describe the time element device and its related circuits. In this form of the invention, the time element device comprises a slow pickup slow release relay DN1 and an associated stick relay F, the arrangement being such that the complete cycle of operation of the time element relay DN1 is employed in timing a train over the timing section U—V. On the assumption the timing section U—V and the train speeds are the same as used in describing the apparatus of Figure 1, the pickup period for the relay DN1 would be 2 seconds and its release period would be 2 seconds, thereby providing a complete cycle of operation of 4 seconds for the relay.

It is believed that the apparatus of Figure 2 may best be understood by describing the operation thereof and to that end I shall first assume a train traveling at a speed of less than 45 miles per hour approaches the highway H from the left. This train upon entering the track section X—Y will shunt the track relay TRX and open the front contacts 6 and 11 thereof, leaving the two relays R1 and R2 held energized over their stick circuits which in each case includes the associated microphone. When the train reaches location U and causes release of the relay R1 due to vibration of the microphone M1, current will be supplied to the time element relay DN1 from the B battery terminal over front contact 59 of relay R2, back contact 40 of relay R1, wire 41, back contact 42 of relay F, winding of relay DN1 and to the C battery terminal, and relay DN1 will be energized and at the end of 2 seconds the relay will be picked up and its front contact 43 closed. Current will now flow over the same circuit just traced up to wire 41 and thence over wire 44, front contact 43 of relay DN1, winding of relay F and to the opposite terminal C, and relay F will be at once picked up opening the circuit for the relay DN1 at the back contact 42. The relay DN1 will now be deenergized and its back contact 45 closed and its front contact 43 opened at the end of its slow release period which, as set forth above, is 2 seconds. Although the first traced circuit for relay F is now open at the front contact 43 of relay DN1, relay F will be retained energized over its stick contact 46. Since this train moving less

than 45 miles per hour will require something over 4 seconds in advancing through the timing section U—V, the above described cycle of operation for the relays DN1 and F will be completed prior to the arrival of the train at the location V. The repeater relay R2 associated with the microphone M2 will now be supplied with current from the B battery terminal over back contact 45 of relay DN1, front contact 47 of relay F, wire 43, winding of relay R2 and to the C battery terminal, and relay R2 will be retained picked up subsequent to the train arriving at the location V and causing microphone M2 to be vibrated. The winding 26 of the interlocking relay IR of Figure 2 is normally supplied with current over front contact 59 of relay R2, wire 42, front contact 36 of relay TRZ and, consequently, winding 26 will remain energized subsequent to the arrival of the train at the location V, since relay R2 is held energized due to the operation of the relays DN1 and F. When this train enters the section Y—Z and shunts relay TRZ, the opening of front contact 36 of that relay will remove current from the interlocking relay and the signal S will be set into operation. Thus, for all trains traveling at a speed below the predetermined speed of 45 miles per hour, the full operating cycle of the time element relay DN1 will be completed and operation of the highway crossing signal S will be delayed until the train reaches the location Y.

I shall now assume a train moving at some speed higher than 45 miles per hour approaches the highway from the left. This train upon entering the section X—Y will shunt the relay TRX and open the pickup circuits for the relays R1 and R2 as in previous cases. Furthermore, when this train reaches the location U and causes microphone M1 to be vibrated the relay R1 will be released and current will be supplied to the time element relay DN1 to operate that relay. This train will, however, advance and reach the location V in something less than 4 seconds and will thus cause relay R2 to be released prior to the completion of the full cycle of operation of the relay DN1 and, consequently, the relay F, and in turn the relay R2, will not be retained energized subsequent to the arrival of the train at the location V, with the result that the winding 26 of the interlocking relay will be deenergized and the signal S set into operation. As explained in connection with Figure 1, the location V is sufficiently remote from the highway H that at least 20 seconds operation of the signal S prior to the arrival of the train at the intersection is assured even when the train is traveling at the maximum speed of 90 miles per hour. The directional relay DR of Figure 2 will function to prevent operation of the signal when a train traveling against the normal direction of travel recedes from the highway through the section X—Y the same as explained in connection with Figure 1.

Although I have described only two forms of apparatus embodying my invention, it is to be understood that various changes and modifications may be made 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 highway crossing signal located at the intersection, two microphones attached to a rail one at each of two selected locations along the stretch to one side

of the highway, said microphones each characterized by increasing its resistance when the rail is vibrated by the passage of a train, a relay for each microphone, a pick-up circuit for each relay including a winding of the relay and a contact governed by a train approaching the microphones, a stick circuit for each relay including the associated microphone, operating means for starting operation of the signal when a train approaches the highway and including a front contact of the relay associated with the microphone nearer the highway, a time element device provided with an operating cycle of a predetermined time interval but normally inactive, means controlled by a train approaching the highway for rendering said device active and including a back contact of the relay associated with the microphone more remote from the highway, and means controlled by the time element device when its operating cycle is completed prior to arrival of a train at the microphone nearer the highway for rendering said operating means ineffective.

2. In combination, a stretch of railway track intersected by a highway, a highway crossing signal located at the intersection, two microphones attached to a rail one at each of two selected locations along the stretch to one side of the highway, said microphones each characterized by increasing its resistance when the rail is vibrated by the passage of a train, a relay for each microphone, a pick-up circuit for each relay including a winding of the relay and a contact governed by a train approaching the microphones, a stick circuit for each relay including the associated microphone, operating means for starting operation of the signal when a train approaches the highway and including a front contact of the relay associated with the microphone nearer the highway, a slow acting relay having a predetermined pick-up period but normally deenergized, means for energizing said slow acting relay including a back contact of the relay associated with the microphone more remote from the highway and a front contact of the relay associated with the microphone nearer the highway, and means for rendering said operating means ineffective and including a front contact of said slow acting relay.

3. In combination, a stretch of railway track intersected by a highway, a highway crossing signal located at the intersection, two microphones attached to a rail one at each of two selected locations along the stretch to one side of the highway, said microphones each characterized by increasing its resistance when the rail is vibrated by the passage of a train, a relay for each microphone, a pick-up circuit for each relay including a winding of the relay and a contact governed by a train approaching the microphones, a stick circuit for each relay including the associated microphone, operating means for starting operation of the signal when a train approaches the highway and including a front contact of the relay associated with the microphone nearer the highway, a slow acting relay having a predetermined slow pick-up period and also a slow release period but normally deenergized, a pick-up circuit for energizing said slow acting relay including a back contact of the relay associated with the microphone more remote from the highway and a front contact of the relay associated with the microphone nearer the highway, a stick circuit for said slow acting relay including a back contact of the relay associated with the microphone nearer the highway, 75

and means for rendering said operating means ineffective and including a front contact of said slow acting relay.

4. In combination, a stretch of railway track intersected by a highway, a highway crossing signal located at the intersection, two microphones attached to a rail one at each of two selected locations along the stretch to one side of the highway, said microphones each characterized by increasing its resistance when the rail is vibrated by the passage of a train, a relay for each microphone, a pick-up circuit for each relay including a winding of the relay and a contact governed by a train approaching the microphones, a stick circuit for each relay including the associated microphone, operating means for starting operation of the signal when a train approaches the highway and including a front contact of the relay associated with the microphone nearer the highway, a slow acting relay and another relay and both normally deenergized, a pick-up circuit for energizing the slow acting relay and including a back contact of the relay associated with the microphone more remote from the highway and a back contact of said other relay, means including a front contact of the slow acting relay for energizing said other relay, and means including a back contact of the slow acting relay and a front contact of said other relay for rendering said operating means ineffective.

5. In combination, a stretch of railway track intersected by a highway, a highway crossing signal located at the intersection, two microphones attached to a rail one at each of two selected locations along the stretch on one side of the highway, operating means controlled by the microphone nearer the highway for starting operation of the signal when a train approaching the highway reaches the location of said nearer microphone, a slow acting relay having an operating cycle comprising a predetermined pick-up period and a predetermined release period, means controlled by the microphone more remote from the highway for initiating an operation of the slow acting relay when a train approaching the highway reaches the location of the more remote microphone, means including a back contact of the slow acting relay operative only when the relay has been picked up and released to complete its operating cycle for rendering said operating means ineffective to start operation of the signal, and means controlled by the microphone nearer the highway for discontinuing the operation of the slow acting relay when a train reaches the location of said nearer microphone prior to completion of said operating cycle.

6. In combination, a stretch of railway track intersected by a highway, a highway crossing signal located at the intersection, two microphones attached to a rail one at each of two selected locations along the stretch on one side of the highway, operating means controlled by the microphone nearer the highway for starting operation of the signal when a train approaching the highway reaches the location of said nearer microphone, a slow acting relay having an operating cycle comprising a predetermined pick-up period and a predetermined release period and normally deenergized, another relay normally deenergized, means controlled by the microphone more remote from the highway and including a back contact of said other relay for energizing said slow acting relay and operative only when a train approaching the highway reaches the location of the more re-

mote microphone, a pick-up circuit for said other relay including a front contact of the slow acting relay, stick circuit means for energizing said other relay including its own front contact, means including a front contact of said other relay and a back contact of the slow acting relay for rendering said operating means ineffective to start operation of the signal, and means controlled by the microphone nearer the highway for rendering said stick circuit means ineffective to energize said other relay when a train reaches the location of said nearer microphone prior to completion of the operating cycle by the slow acting relay.

7. In combination, a stretch of railway track intersected by a highway, a highway crossing signal located at the intersection, operating means controlled by a train approaching the highway upon reaching a fixed point for starting operation of the signal, a timing track section of a predetermined length, a slow acting relay and a quick acting relay and both normally deenergized, said slow acting relay provided with a predetermined pick-up period and a predetermined release period, means controlled by a train upon entering said timing section and including a back contact of the quick acting relay for energizing said slow acting relay, a pick-up circuit including a front contact of the slow acting relay for energizing the quick acting relay, stick circuit means for energizing the quick acting relay including its own front contact, means including a front contact of the quick acting relay and a back contact of the slow acting relay for rendering said operating means ineffective to start operation of the signal, and means controlled by a train upon reaching the exit of the timing section for rendering the stick circuit means ineffective to energize said quick acting relay when a train reaches the exit of the timing section prior to the release of the slow acting relay.

8. In combination, a stretch of railway track, a first and a second microphone attached to a rail a predetermined distance apart, said microphones each characterized by increasing its resistance when the rail is vibrated by the passage of a train, a relay for each microphone, a pick-up circuit for each relay including a winding of the relay and a contact governed by a train when approaching the microphones in the direction to pass from the first to the second microphone, a stick circuit for each relay including the associated microphone, a signal, a time element device normally inactive, a circuit to render the device active and including a back contact of the relay controlled by the first microphone and a front contact of the relay controlled by the second microphone whereby said device is active during the interval consumed by a train in passing through the distance between the microphones when moving in the direction to pass from the first to the second microphone, and means governed by said device for controlling the signal.

9. In combination, a stretch of railway track, a first and a second microphone each attached to a rail at a selected location along the stretch with said locations a given distance apart, said microphones each characterized by increasing its resistance when the rail is vibrated by the passage of a train, a relay for each microphone, a pick-up circuit for each relay including a winding of the relay and a contact governed by a train when approaching the microphones in the direction to pass from the first to the second microphone, a stick circuit for each relay including the associated

microphone, a signal, an operating circuit for controlling the signal and including a front contact of the relay associated with the second microphone, a time element device normally inactive, a circuit including a back contact of the relay associated with the first microphone for rendering said device active, and means controlled by the time element device for rendering the operating circuit ineffective to control the signal when a train consumes an interval greater than a predetermined interval in passing between the locations of said microphones.

10. In combination, a stretch of railway track intersected by a highway, a highway crossing signal located at the intersection, two microphones attached to a rail one at each of two selected locations along the stretch on one side of the highway, said microphones each characterized by increasing its resistance when the rail is vibrated by the passage of a train, a relay for each microphone, a pick-up circuit for each relay including a winding of the relay and a contact governed by a train approaching the microphones, a stick circuit for each relay including the associated microphone, operating means for starting operation of the signal and including a front contact of the relay associated with the microphone nearer the highway, a time element device normally inactive, means for rendering said device active and including a back contact of the relay associated with the microphone more remote from the highway and a front contact of the relay associated with the microphone nearer the highway, means controlled by said time element device for at times rendering said operating means ineffective to start operation of the signal, a directional relay, means including a back contact of the relay associated with the microphone nearer the highway and a front contact of the relay associated with the microphone more remote from the highway for energizing said directional relay, and other means including a front contact of the directional relay for rendering said operating means ineffective to start operation of the signal.

11. In combination, a stretch of railway track, a first and a second microphone each attached to a rail at a selected location along the stretch with said locations a given distance apart, said microphones each characterized by increasing its resistance when the rail is vibrated by the passage of a train, a circuit for each microphone including the microphone and a relay as well as a current source whereby each relay is normally energized but becomes deenergized when the rail is vibrated to the passage of a train, a signal, an operating circuit for controlling the signal and including a front contact of the relay associated with the second microphone, a time element device, a circuit including a back contact of the relay associated with the first microphone and a front contact of the relay associated with the second microphone for operating said device, and means governed by said device for modifying the control of said operating circuit over said signal in accordance with the time said device is operated.

12. In combination, a stretch of railway track intersected by a highway and formed with an insulated track section to one side of the highway, a highway crossing signal at the intersection, a track circuit for said section including a track relay, two microphones attached to a rail one at each of two selected locations along said section, a control relay for each microphone, a

pick-up circuit for each control relay including a front contact of said track relay, a stick circuit for each control relay including the associated microphone, operating means for starting the operation of said signal when a train approaches the highway and including a contact of the relay associated with the microphone nearer the highway, a normally inactive time element device, means including a back contact of the control relay associated with the microphone more remote from the highway for rendering said time element device active, and means governed by said time element device for at times rendering said operating means ineffective.

13. In combination, a stretch of railway track intersected by a highway and formed with a first and a second insulated track section to one side of the highway, a highway crossing signal located at the intersection, a track circuit for each section including a track relay, two microphones attached to a rail one at each of two selected locations along said first section, a control relay for each microphone, a pick-up circuit for each control relay including a front contact of the track relay of said first section, a stick circuit for each control relay including the associated microphone, a control circuit for said signal including a front contact of the control relay associated with the microphone nearer the highway and a front contact of the track relay for said second section, a normally inactive time element device, means including a back contact of the control relay associated with the microphone more remote from the highway for rendering said time element device active, and a branch circuit shunting around the front contact of said control relay of said control circuit and including a contact of said device closed when a train consumes an interval greater than a predetermined interval in passing between the locations of said microphones.

14. In combination, a stretch of railway track intersected by a highway and formed with an insulated track section to one side of the highway, a highway crossing signal at the intersection, a track circuit for said section including a track relay, a microphone attached to a rail along said section, a control relay, a pick-up circuit for said control relay including a front contact of said track relay, a stick circuit for said control relay including said microphone, a control circuit for said signal including a front contact of said control relay, a directional relay, a pick-up circuit for said directional relay including a back contact of said control relay, a stick circuit for said directional relay including a back contact of said track relay, and a shunt path for said control circuit including a front contact of said directional relay.

15. In combination, a stretch of railway track intersected by a highway and formed with a first and a second insulated track section to one side of the highway, a highway crossing signal at the intersection, a track circuit for each section including a track relay, two microphones attached to a rail one at each of two selected locations along said first section, a time element device normally inactive, means controlled jointly by said two microphones for causing the time element device to be active during the time a train approaching the highway is passing between the locations of said microphones, operating means for operating the signal governed by the microphone nearer the highway and said device as well as the track relay of said second

section, a first directional means controlled in part by the track relay of said second section to render said operating means ineffective when a train recedes from the crossing through said second section, and another directional means including a relay governed jointly by said micro-

phones and the track relay of said first section to render said operating means ineffective and said time element device inactive when a train recedes from the crossing through said first section.

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