

Oct. 13, 1942.

S. J. MACKEY

2,298,575

HIGHWAY CROSSING SIGNALING SYSTEM

Filed Oct. 8, 1938

FIG. 1.

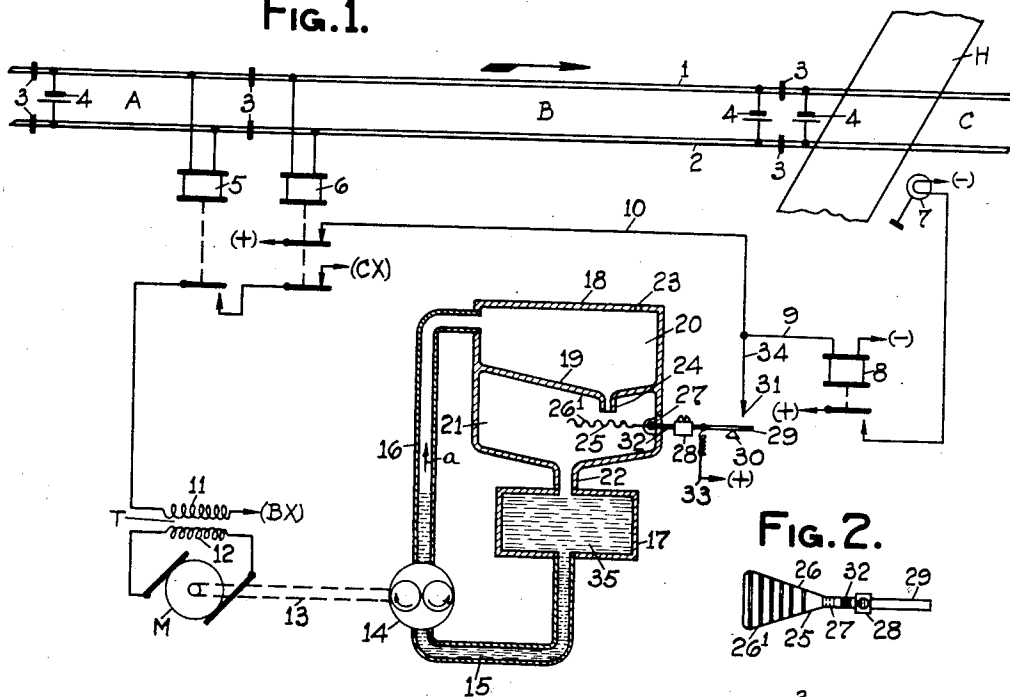


FIG. 2.

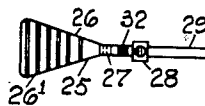


FIG. 4.

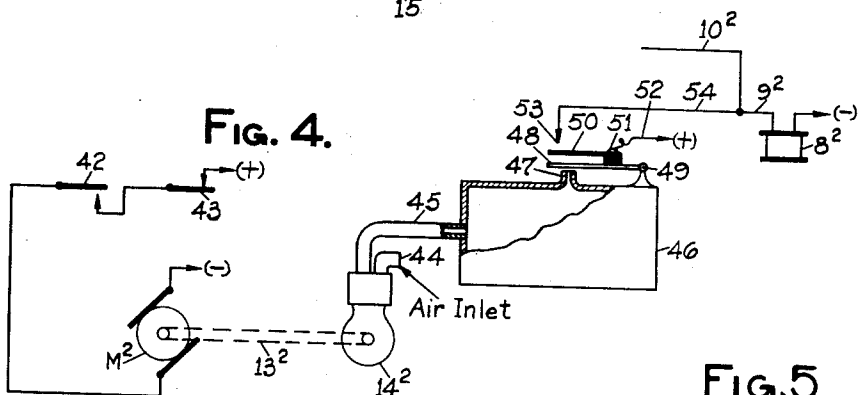


FIG. 5.

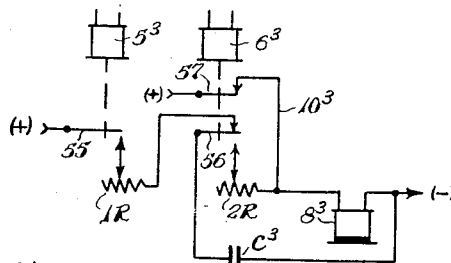
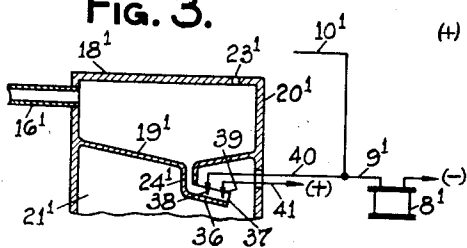


FIG. 3.



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2,298,575

HIGHWAY CROSSING SIGNALING SYSTEM

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Application October 8, 1938, Serial No. 234,074

7 Claims. (Cl. 161—1)

This invention relates in general to signaling systems, and has more particular reference to an improved apparatus for controlling highway crossing signals.

The present application is a continuation in part of application Ser. No. 152,962 filed July 10, 1937, for Highway crossing signaling systems.

It is desirable to provide warning signal means at points where highways cross railroad tracks in order to warn traffic on the highway of the approach of a train to the crossing. If the signal be automatically initiated by the train at a given point in the track, then the time between the initiation of the signal and the time when the train reaches the crossing will vary in accordance with the speed of the train, being shorter or longer accordingly as the train speed is faster or slower.

It is therefore recognized as desirable to give highway traffic a uniform time of warning prior to the arrival of a train at the crossing, regardless of the speed of the approaching train, whereby to permit traffic either to come to a stop before reaching the railroad, or to pass over the crossing prior to the arrival of the train.

Various means have been provided for accomplishing this desired feature of a uniform warning time regardless of the speed of the approaching train, and these means very generally provide a point in the trackway which, when reached by the train, will initiate the crossing signal unless the signal be withheld by another means. This withholding means is controlled by the passage of a train through a measuring section whereby to withhold the initiation of the signal a greater or lesser time depending on whether the speed of the train is lesser or greater. It is obvious that if the withholding means fails to properly function, as by not starting, the signal is initiated at once upon the train reaching the control point, and if the withholding means does not continue to function after once starting it will withhold the initiation of the signal indefinitely, whereby to give no indication of the approaching train. To provide against this latter possibility, various means have been provided for checking the proper operation of the withholding means.

With the above and other considerations in mind, it is proposed, in accordance with the present invention, to provide a means for initiating the signal after a measured time has elapsed following the arrival of the train at a given point in the trackway, the measured time depending upon the speed of the approaching train. And

this same withholding means is of such a character that it is self-checking, so that in the event of its failure to start its operation, the signal will be initiated at once, and, what is more important, in the event of its failure to continue its operation so as to run out the withholding period, its failure will result in immediately initiating the signal. This is all accomplished without the necessity for an auxiliary checking means for checking the proper operation of the withholding means.

One object of the present invention is to provide novel and improved timing means for systems of the kind in question.

Further objects, purposes and characteristic features of the invention will appear as the description progresses, reference being made to the accompanying drawing showing, in a diagrammatic and wholly schematic manner, several forms which the invention can assume. In the drawing:

Fig. 1 is a schematic showing of one embodiment of this invention.

Fig. 2 is a detailed view of a part of the apparatus shown in Fig. 1.

Fig. 3 is a fragmentary schematic showing of a modified form of the invention.

Fig. 4 is a schematic fragmentary showing of another modified form of this invention.

Fig. 5 is a fragmentary schematic showing of another modified form of this invention.

Referring now to the drawing and first to Fig. 1, there is here represented a stretch of single track comprising rails 1 and 2 divided in a usual manner by insulating joints 3 into electrically isolated track sections A, B and C, each such section having a source of energy in the form of a battery 4 connected across one of its ends, and usual track relays, such as 5 and 6, connected across their other ends. Crossing the railroad, as shown in this figure at block C, is a highway H, adjacent which is a warning signal 7, shown in the form of a light signal, but which may be of any usual or desired character, and which also may be arranged, in any usual manner, for traffic passing along the highway in the opposite direction, that is, from top to bottom of the page.

The signal 7 is shown in this particular case as a light signal which, when energized, becomes active to give a warning of an approaching train, and is controlled by a circuit including a contact finger and back point of a signal control relay 8, the signal control relay 8 being energized through one circuit including the relay

8, wires 9 and 10 and a contact finger and front point of track relay 6 of section B.

As thus far described, upon the entrance of a train into track section B, relay 6 releases to deenergize signal control relay 3 and initiate the highway crossing signal 7.

According to this invention, a withholding means is provided which withholds the initiation of the signal upon the entrance of a train into block B, a length of time which varies inversely with the speed of the approaching train. This withholding means includes a motor M having constant speed characteristics and shown diagrammatically as an alternating current synchronous motor, although any other character of motor either of the direct current or alternating current type, which has constant speed or substantially constant speed, characteristics, can be employed. The motor M is energized through a back point of the track relay 5 and a front point of the track relay 6 as is obvious from the drawing. When this circuit is closed, the primary 11 of transformer T is energized to thereby energize the secondary 12 of this transformer and thus energize motor M.

From the above it will be readily apparent that upon the entrance of a train into block A, track relay 5 releases to energize the motor, and this motor operation continues until the train enters block B, whereupon track relay 6 releases to deenergize the motor, whereby the time of operation of the motor is equal to the time required by a train to traverse block A.

As shown in Fig. 1, motor M, through a shaft or the like 13, drives a pump 14 of any usual or desired character, such as a gear pump, or the like. Connected to the pump 14 is an inlet pipe 15 and an outlet pipe 16, the inlet pipe being connected to the bottom of a reservoir 17, with the outlet pipe connected to the top of a control tank 18 having a dished partition 19 therein, separating tank 18 into an upper chamber 20 and a lower chamber 21, with the lower chamber 21 connected to the top of tank 17 by means of a pipe 22. A vent 23 is formed in the top of tank 18 for a purpose to appear below.

The partition 19, as stated, is dished downwardly so as to form a sloping bottom to the chamber 20, having a spout 24 formed in the lowest part thereof to readily and completely drain all liquid from the chamber 20 into the chamber 21 from whence it can pass back into the chamber 17.

Positioned directly beneath the spout 24 is a control member 25, shown in the portion beneath the spout 24, in the form of a relatively broad, generally flat surfaced, paddle 26, furnished with corrugations or grooves 26¹. The control member 25 is pivoted as at 27, to rock toward and away from spout 24. The outer end of control member 25 extends beyond the tank and carries a biasing weight 28 arranged to rock the member 25 on its pivot 27 so as to bring the end contact member 29 of control member 25 against a back stop 30 and out of contact with a front contact 31, the contact 29 being preferably insulated electrically from the tank and the paddle by an insulating section 32. A source of energy has one terminal connected, as by a wire 33, to contact member 29.

It can be seen from the above that a second energizing circuit for the signal control relay 8 has been furnished by the control member 25 when rocked upwardly away from its back stop 30 and into contact with contact member 31.

With this position of the control member 25, a withholding circuit is completed for energizing relay 8 and preventing the initiation of the highway signal despite the fact that the normal control circuit for the relay 8 has been broken by the release of track relay 6 due to the entrance of a train into block B. The withholding circuit referred to includes wire 33, contact 29, contact 31, wires 34 and 9 and the winding of relay 8.

It may be well at this point to consider the operation of the pump 14 and its associated parts. The liquid 35, represented as being in the tank 17, and in the pipes 15 and 16 and the pump 14, is of any suitable character but preferably is of a character which does not vary greatly in viscosity upon changes in temperature, and can be oil or mercury or some other material although a relatively thin grade of oil would appear to be suitable. As the pump operates, liquid is pumped in a direction as indicated by the arrow *a* from the chamber 17 into the chamber 20, it being free to enter this chamber without obstruction due to the vent 23. The liquid pumped into chamber 20 runs out through the spout 24 to impinge upon the paddle 26, from which it runs off and into chamber 21, from which it passes back into chamber 17, from whence it came. The liquid striking on paddle 26 exerts a force thereon which rocks the control chamber 25 on its bearing 27 to move contact 29 against contact 31 and thereby complete the holding circuit, referred to above, for relay 8.

The member 25 may be rocked on its pivot either primarily because of the momentum of the liquid impinging upon the paddle, or primarily because of the weight of liquid 11 on the paddle so long as the liquid flow continues, it taking an appreciable time of course for liquid which strikes the paddle, to run off the paddle due to its horizontal position and due to its relatively rough surface produced, as by corrugations 26. Thus the operation of the paddle can depend upon the force with which the liquid strikes the paddle, or upon the weight of the liquid on the paddle during its time of running off, or can depend upon both of these actions. Thus the control member 25 can be variously designed to operate due to various causes, the controlling factor being that the control member 25 shall be moved to operative position and remain therein so long, and only so long, as liquid continues to flow out of chamber 20; to return to its biased inoperative position, with contacts 29 and 31 opened, substantially immediately upon the cessation of flow of liquid from chamber 20.

The pipe 16, through which liquid is pumped into the upper chamber 20, has a considerably larger cross section and hence conveys a considerably greater volume of liquid per unit of time into chamber 20, than is permitted to flow out of chamber 20 by means of spout 24, which latter is considerably smaller in cross section than is pipe 16. It thus results that the excess of fluid pumped into chamber 20, over and above the flow out of chamber 20, causes a steady accumulation of fluid into chamber 20 so long as the pump continues to operate, and so long as any fluid remains in the intake pipe 15 of the pump, to be pumped thereby.

As the result of the above, the amount of fluid stored in chamber 20 will depend directly upon the length of time which the pump has been operating and this in turn will depend upon the time required for an approaching train to trav-

erse track section A. Furthermore, the time during which fluid will flow out of the spout 24, after the pump 14 has stopped operating, will be in direct proportion to the amount of liquid which has been stored in chamber 20 and thus the time during which contact 29 of control member 25 will be held against contact member 31, and thus the time during which the withholding circuit for signal control relay 8 is maintained closed, will depend directly upon the time required for an approaching train to traverse track section A.

The operation of the system as described above is briefly as follows. Assume a train to be approaching the highway H. Upon the train entering the measuring track section A, track relay 5 releases to energize motor M as above described to thereby drive pump 14. Pump 14 is driven until the train enters track section B whereupon track relay 6 releases to deenergize the motor and interrupt the drive of the pump.

All the time that pump 14 is being driven, liquid is being pumped from chamber 17 into chamber 20 at a faster rate than it can pass out of chamber 20 and back into chamber 17. Furthermore, all the time during which liquid is passing out of chamber 20, the withholding circuit for the signal control relay 8 is closed due to control member 25 being rocked in a counter clockwise direction and held against front contact 31.

Upon the train entering track section B, no more fluid is pumped into chamber 20 and thus, after a period of time depending upon the amount of accumulated liquid in chamber 20, liquid flow through spout 24 ceases, whereupon the biased control member 25 moves against its back stop 30 to interrupt the withholding circuit for relay 8, and since the normal circuit for energizing this relay is already open at the contact and front point of track relay 6, the highway signal 7 is initiated.

It will be obvious that the greater the speed of the approaching train, the less will be the time required to traverse the measuring section A, and as a result the less will be the accumulation of liquid in chamber 20 and hence the less will be the withholding time for initiating the highway signal. Conversely, the slower the train, the greater will be the withholding time. The various parts are so proportioned and arranged that regardless of the speed of the train approaching the highway the highway signal is initiated at a given time prior to the arrival of the train at the crossing, and in many cases a proper time for safely warning approaching traffic has been considered to be in the order of 20 seconds.

In the system as described above, if a train enters track section A, and then should stop on the section, to remain a considerable time, the pump would continue to operate during all this time but after it had succeeded in transferring all the liquid from chamber 17 into chamber 20, its further operation would have no effect upon the withholding time of the signal. Accordingly, the amount of liquid placed in this system and contained normally in chamber 17, is proportioned so that the entire body of liquid will pass through spout 24 in time enough to initiate the highway signal a safe time prior to the arrival of the slowest train under consideration at the crossing. It may be so proportioned that a train traveling as slowly as 10 miles an hour will consume enough time traversing track section A to permit the pump 14 to transfer all of the liquid into the upper chamber 20. In this case, the out-

let from chamber 20 is so proportioned that the signal will be withheld a sufficient time after this slow moving train has entered track section B, to initiate the signal approximately 20 seconds before the slow moving train reaches the highway H.

Since, regardless of how long the pump operates, it can never do more than transfer all of the liquid into the upper chamber 20, there is no need for any cutout means for the motor M after a given period of time, since its continued operation, as for example, when a train stops for a considerable time in track section A, cannot extend the withholding time beyond a safe period.

It is furthermore obvious that should the liquid fail to run out of chamber 20, due to any cause whatsoever, as a clogging, for example, of the spout 24, the signal will be initiated immediately upon the failure of the continued flow of liquid and thus initiate the signal in time to avoid any danger.

Shown in a fragmentary form in Fig. 3 is a modified form of the invention, which form, however, embodies the same desirable features as described above.

In the form of invention shown in Fig. 3, there is a tank 18¹, having an inlet pipe 16¹, and a partition 19¹, with an outlet spout 24¹, all as in the form of Fig. 1. Likewise, a motor of the constant speed type, such as the motor M of Fig. 1, is controlled by approaching traffic, in exactly the same manner as described in connection with Fig. 1, to operate a pump which pumps liquid from a chamber such as 17 of Fig. 1, into the chamber 20¹ of Fig. 3, from which it runs out through the spout 24¹, all exactly as in the form shown in Fig. 1.

In this form of invention in Fig. 3, there is also a signal control relay 8¹, which controls a highway crossing signal in exactly the same manner as described in connection with Fig. 1 and the normal energizing circuit for the control relay 8¹ is the same as in Fig. 1, and includes wires 9¹, 10¹ and a front contact of a track relay as in Fig. 1.

In the form of invention shown in Fig. 3, the withholding energizing circuit for the control of relay 8¹ is slightly different from what is shown in Fig. 1. In this form of invention the spout 24¹ terminates in an open channel 36 sloping only slightly to the horizontal and having an open end 37, to allow liquid passing therethrough to readily pass out of the channel and into the lower chamber 21¹. Dipping into this channel are two contacts 38 and 39, connected to wires 40 and 41, these contacts being slightly spaced from each other and arranged to be bridged across by liquid so long as liquid is flowing out of chamber 20¹ and into chamber 21¹. In this case, the liquid pumped through the system is of an electrically conductive character such as mercury, or a suitable water and salt solution, or any other desired or usual liquid which, when bridging across spaced contacts, will complete the circuit through the contacts. The tank 18¹ is furnished with a vent opening 23¹ for the same purpose as explained in connection with the form of invention shown in Fig. 1.

In operation the invention shown in Fig. 3 is very similar to what was described above in connection with Fig. 1. The flow of liquid out of chamber 20¹ into chamber 21¹ bridges across the contacts 38 and 39 so long as the flow continues, to open a gap between these contacts imme-

diately upon the cessation of liquid flow. Thus, depending upon the speed of an approaching train, the period during which these contacts 38 and 39 are closed after a train has entered track section B, depends inversely upon the speed of the approaching train, and hence the period during which signal control relay 8¹ is held up by its withholding circuit depends upon the speed of the approaching train, the withholding circuit including wire 41, contacts 38 and 39 bridged by the liquid, wires 40 and 9¹, and the winding of relay 8¹.

The invention as shown in Fig. 3 embodies all the advantages set forth in connection with Fig. 1. It appears to have the added advantage that no moving parts are involved in connection with the withholding circuit, except the flowing liquid and thus there is no possibility whatsoever of mechanically moving parts jamming or failing to move as intended. In this form of invention, as in the form previously described, there is no need for the motor to be equipped with a cutout switch or the like, since the amount of liquid in the system is so proportioned as to give a sufficient withholding time for the slowest train under consideration. Accordingly, if a train enters track section A and stays there for any length of time, even though the pump continues to operate, it can never accomplish more than the transfer of the entire body of liquid into the upper chamber 20¹. Here again, in this form of the invention, if anything fails to operate as intended, the signal is immediately initiated, thereby making every failure to be on the side of safety.

A further embodiment of this invention, is shown in Fig. 4, in which there is a motor M² which is controlled by traffic in the same manner as described in connection with the other forms of invention, that is, it is normally deenergized, but, upon the entrance of a train into a measuring track section, the track relay of that section releases to close a back contact 42 and energize the motor, and upon the entrance of the train into the following track section, a track relay releases to open a front contact 43 and deenergize the motor M². In this form of invention a shaft 13² connects the motor M² with an air pump 14² which operates to draw air through an air inlet 44 and pump it through an outlet pipe 45 and into a pressure storage tank 46, having a restricted nozzle outlet 47, against which normally bears an operating blade 48, pivoted as at 49, and carrying a contact 50 connected to the blade 48 by an insulating block 51. One terminal of a source of energy is connected, by wire 52, to the contact 50, which, when it is moved by the blade 48 being rocked away from the nozzle 47, contacts with a front point 53 to complete a withholding energizing circuit for a signal control relay 8², the withholding circuit including wire 52, contacts 50 and 53, wires 54 and 9² and the winding of relay 8².

This relay 8² has a normal energizing circuit controlled in accordance with traffic in the same manner as described in connection with Fig. 1, and including wires 9² and 10².

In the form of invention just described, and as shown in Fig. 4, the pump 14² is driven at a constant speed by the motor M² to pump a given quantity of air at atmospheric pressure into the tank 46 during each unit of time. This pump is preferably of a character such as to prevent any back flow of air under pressure from the receiving tank, when the pump is not in operation. If

the pump be of another character, there should then be employed a check valve in the pipe 45 to prevent any such back flow. The inlet pipe 45 to the tank 46 is considerably larger in cross section than is the outlet nozzle 47, whereby to cause pressure to gradually build up in the tank 46 as the pump continues to operate. In this manner the longer the pump operates the greater is the pressure built up in tank 46, up to a limiting point, and thus the greater is the time required for the stored up air in the tank 46 to pass out through the nozzle 47 and restore the pressures to the normal atmospheric pressure, after a train has entered track section B. Thus, in this form of invention, as in the other forms described above, the signal is withheld a time dependent upon the speed of the train approaching the crossing.

In the form shown in Fig. 4, a fluid is used, such as air for example, which is compressible, but which is unlimited in quantity. In this form of the invention, however, after the pressure in the tank 46 has reached a predetermined amount, the air passing out through the nozzle 47 at this relatively high pressure will be the same in amount, as is being pumped into the tank by the pump, and hence a stable condition will be obtained after which continued operation of the pump will not result in an increased pressure and hence will not result in an increased time for withholding the initiation of the signal. Thus, in this form of invention, there is no need for a cutout switch or the like for the motor M² which might continue to operate a relatively long time, due, for example, to a train standing in track section A. In this event the pressure will build up in tank 46 to a point where the outflow from the tank will equal the inflow to the tank after which continued operation of the motor will cause no change in the amount of stored up fluid in tank 46 and thus will cause no change in the withholding time for the signal.

In this form of invention (Fig. 4), in the same manner as in the other forms, the parts are so proportioned and designed as to give a proper maximum withholding period for the slowest train under consideration, whereupon the withholding period for faster trains are correspondingly less, whereby to give a substantially constant period of energization prior to arrival of a train at a crossing, regardless of train speed.

Referring now to Fig. 5, there is here shown, in a schematic form, a fourth form of the invention, in which control relays 5³ and 6³ correspond, respectively, to the two track relays 5 and 6 of Fig. 1, while relay 8³ corresponds to relay 8 of Fig. 1. Only so much of the circuit arrangement in this form of invention, as is necessary to describe the invention, has been included in the Figure 5 of drawing.

In measuring the time for withholding the signal, in this form of invention, there is employed a condenser C³, which has the characteristic of requiring a considerable time for fully charging the same and which discharges relatively slowly, so that the time for charging, and likewise the time for discharging, can vary from a few seconds to preferably several minutes. However, as the description progresses, it will be seen that condensers having other time characteristics can be employed, by properly adjusting the lengths of the track sections involved. This condenser C is preferably of the electrolytic type, but can also be of the usual common type having two plates of conducting material spaced by a dielectric of air,

paper or the like, and having a sufficient capacity to provide the desired time characteristics.

The manner in which a system of this form of invention operates can be readily understood from considering the passage of a train eastwardly, over the highway (Fig. 1). Upon the train entering block A, relay 5³ releases, to start the charging of condenser C³, through a circuit including contact finger 55 and back point of relay 5³, adjustable resistance 1R, contact finger 56 and front point of relay 6³, and the condenser C³. This charging continues until track section B is entered, to thus vary the amount of charge in the condenser inversely in accordance with the speed of the train traversing section A.

Upon the train entering section B, relay 6³ releases to open the charging circuit referred to above; to deenergize signal withholding relay 8³ by the opening of contact finger 57 from its front point; and to close contact finger 56 on its back point to thereby place the charged condenser C³ across signal withholding relay 8³, through the variable resistance 2R, as is obvious from the drawing. Relay 8³ can be made slightly slow to release whereby to bridge over the time interval while contact finger 56 is moving from its front, to its back, point. Also, if desired, contact finger 56 can have a make-before-break contact, whereby to avoid momentary deenergization of relay 8³. In this manner withholding relay 8³ is held up, to withhold the signal for a period of time depending upon the amount of charge in the condenser C³, and hence in inverse proportion to the average speed of the train as it traversed section A.

Condenser C³ can be chosen of such a capacity that it will be fully charged, only by the slowest train under consideration; possibly a train proceeding at about ten miles per hour. In the event the train should stop in section A, so as to continue the charging beyond the contemplated period of time, the condenser will become fully charged, so that the charging will not continue indefinitely.

Thus, in connection with this fourth form of the invention, as with the other forms, a timing means has been provided which stores up electrical energy in accordance with the speed of an approaching train and discharges the stored energy at a predetermined rate whereby to become exhausted after a time dependent upon the quantity of stored energy. If for any reason, the condenser should fail to discharge, the signal will be initiated at once, while if the condenser discharges as contemplated, it will become sufficiently discharged within a period of time of withholding the signal which will result in putting the signal into operation the required time interval prior to the arrival of the train at the crossing, regardless of the speed of the approaching train.

The variable resistances 1R and 2R, and the condenser C³ can be so chosen and adjusted as to properly cooperate with the track sections employed in the system, to give the proper timing characteristics, as is readily understood by those skilled in this particular art.

In the forms of invention described above, it is to be understood that any usual or suitable form of pump can be employed in any of the embodiments, and any usual or suitable form of driving means, such as a motor, whether alternating current or direct current, can be employed so long as it is substantially constant in its speed.

Furthermore, different liquids and fluids can be employed as are suitable or conveniently at

hand so long as they fulfill the requirements as enumerated above.

It is furthermore to be understood that the pivoted control member 25 of Fig. 1 can be varied in shape and size and in its position with respect to the horizontal, as desired, in order to obtain various operative characteristics, and the surface thereof can be cupped or domed or roughened as may be found suitable for producing operating characteristics coming within the above description.

In connection with the form shown in Fig. 3, the channel for the outflow of liquid from the top chamber can be more or less inclined to the horizontal, and can be deeper or shallower as desired, or as conditions may dictate, and the contacts dipping into the channel can be variously conditioned and spaced.

With regard to the invention shown in Fig. 4, it is to be understood that while it is suggested that air be employed as the fluid used in this system, other fluids can be employed having various expansion characteristics. It is furthermore to be understood that the outlet nozzle 47 can be variously formed and shaped and the cooperating contact operating blade 48 can be either rigid and pivoted as described, or can be flexible and rigidly fastened at one end, such as would be the case with a flexible reed; or any other usual or desired form of device can be employed which will respond to the flow of fluid to close a contact and respond to the cessation of flow of fluid to open a contact.

The above forms of invention are all self-checking inherently in that, during the measuring period, that is, during the time an approaching vehicle traverses the measuring track section A, a condition is being brought about in the accumulation of a fluid or the accumulation of electrical energy, which condition must be restored to normal before the signal is initiated, provided the fluid or the electrical energy flows and continues to flow as contemplated. Since it is the existence of a flow of fluid or electrical energy which withholds the signal, upon the flow ceasing or diminishing in any substantial amount, the signal is at once initiated whereby to cause any such failure to be on the side of safety.

In other words, this system is self-checking because of the fact that the withholding of the signal is dependent upon the flow of material, that is, of water, oil, gas, mercury, and of electricity, or the like, and the initiation of a signal is dependent upon the cessation of flow due to the material being exhausted, and if the flow ceases for some reason or other, such as the clogging of the outlet, or the breaking of a circuit, or the like, this cessation of flow will act as if the stored material had been exhausted and hence will at once initiate the signal.

The above rather specific description of several forms which this invention can assume, have been given for the purpose of example, and in no manner whatsoever in a limiting sense. It is to be understood that the present application contemplates covering all such modifications, variations and substitutions of materials and dimensions and relationships of parts as come within the scope and spirit of the present invention.

Having described my invention, I now claim:

1. In a timer, control means normally ineffective to control, a storage tank, a restricted outlet in the tank, supply means including normally inoperative mechanism operable for causing storing or fluid in the storage tank by virtue of supply-

ing the tank over various time periods; with the fluid at a rate greater than it can escape from the tank through the outlet, whereby to accumulate various amounts of fluid in the tank at the time the supply period terminates, said control means being acted upon only by, and throughout the duration of, fluid flow through the outlet to make it effective to control only during, and throughout the duration of, outlet flow.

2. In a control system, a timer, including, an upper receptacle, a lower receptacle, a restricted outlet from the upper to the lower receptacle, a pipe of larger cross section than the said outlet interconnecting the two receptacles, a quantity of liquid in the lower receptacle, a pump in said pipe for transferring liquid from the lower to the upper receptacle at a rate faster than it can run out through the outlet and over various time periods whereby to accumulate various amounts of liquid in the upper receptacle at the time the supply period terminates, and control means associated with the outlet and dependent upon the flow through the outlet to be effective so long as outlet flow continues.

3. In a control system, a timer, comprising, an upper receptacle, a lower receptacle, a restricted outlet from the upper to the lower receptacle, a pipe of larger cross section than the said outlet and interconnecting the two receptacles, a quantity of fluid in the lower receptacle, a pump in said pipe for transferring fluid from the lower to the upper receptacle at a rate faster than it can run out through the outlet and over various time periods, whereby to accumulate various amounts of fluid in the upper receptacle at the time the supply period terminates, and control means associated with the outlet and responsive to the flow through the outlet to be effective only so long as flow continues.

4. In a control system, a timer, comprising, an upper receptacle, a lower receptacle, a restricted outlet from the upper to the lower receptacle, a pipe of larger cross section than the said outlet and interconnecting the two receptacles, a quantity of liquid in the lower receptacle, a pump in said pipe for transferring liquid from the lower to the upper receptacle at a rate faster than it can run out through the outlet, the liquid

being electrically conductive in character, an inclined runway through which the liquid from the outlet passes on its way to the lower receptacle, and two spaced contacts so positioned in the runway as to be electrically bridged by flowing liquid.

5. In a control system, a timer, including, a closed chamber, a restricted outlet in the chamber, an inlet pipe of larger capacity than the outlet, a pump for supplying liquid to the chamber at a faster rate than it can escape by force of gravity from the outlet and over various periods of time, whereby to accumulate various amounts of liquid in the chamber at the time the supply is discontinued, a source of liquid for the pump, and a control member active only while liquid flows through the outlet.

6. In a control system, a timing means, comprising, a control circuit, an upper receptacle, a lower receptacle, a restricted outlet from the upper to the lower receptacle, a pipe of larger cross section than the said outlet and interconnecting the two receptacles, a quantity of liquid in the lower receptacle, a pump in said pipe for transferring liquid from the lower to the upper receptacle at a rate faster than it can run out through the outlet, and means in the form of a pivoted member, with a flat paddle like end positioned below the outlet, and a contact maker at the other end, associated with the outlet and operable by the flow through the outlet to maintain the circuit ineffective.

7. In a control system, a timing means, comprising, an upper receptacle, a lower receptacle, a restricted outlet from the upper to the lower receptacle, a pipe of larger cross section than the said outlet and interconnecting the two receptacles, a quantity of electrically conductive liquid in the lower receptacle, a pump in said pipe for transferring liquid from the lower to the upper receptacle at a faster rate than it can run out through the outlet, and spaced contacts associated with the outlet and affected by the flow of liquid through the outlet to be electrically interconnected by the liquid only so long as it flows therepast.

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