

May 6, 1941.

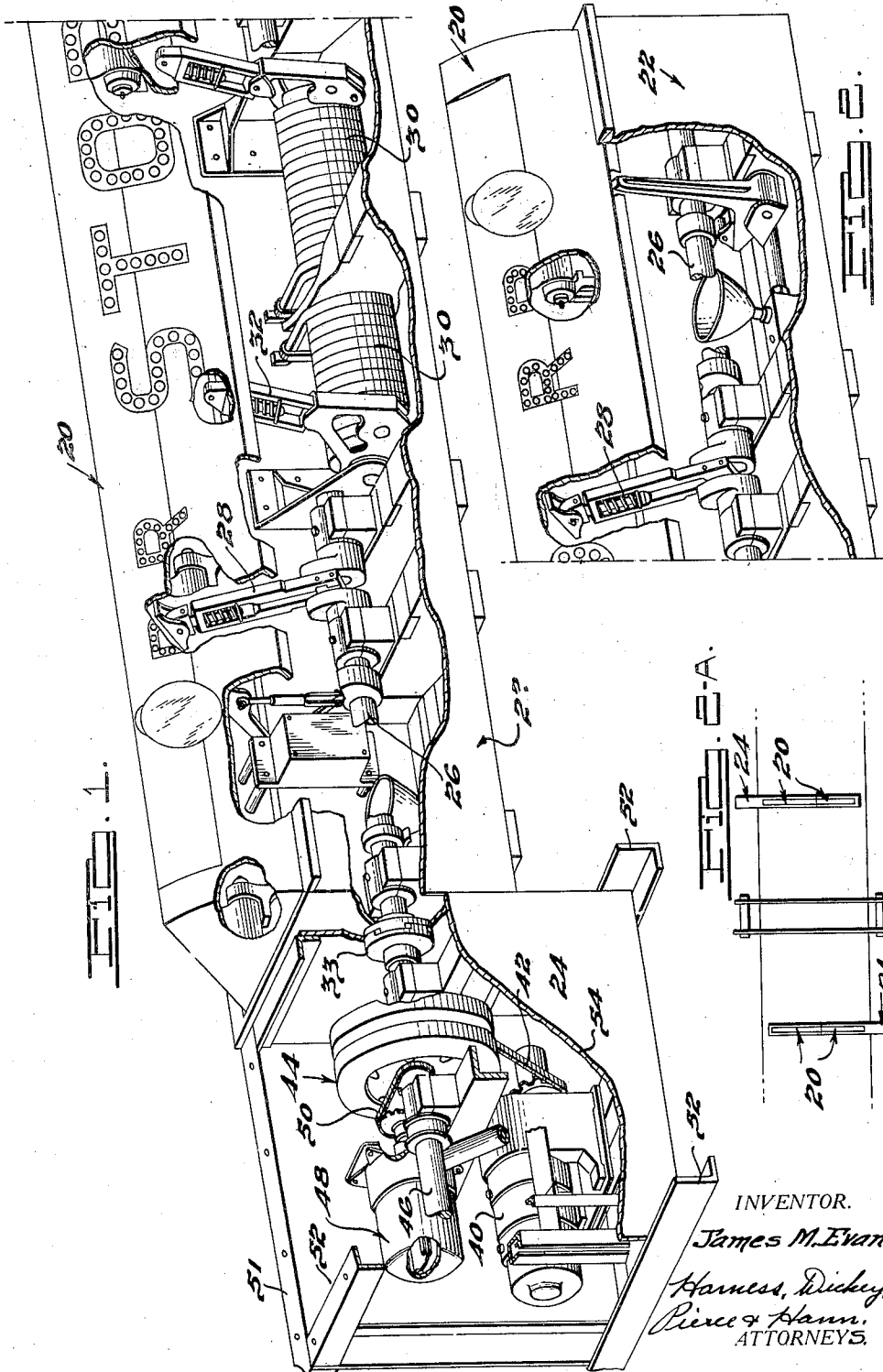
J. M. EVANS

2,240,948

DRIVE MECHANISM FOR CROSSING PROTECTIVE SYSTEMS OR THE LIKE

Filed Nov. 9, 1936

5 Sheets-Sheet 1



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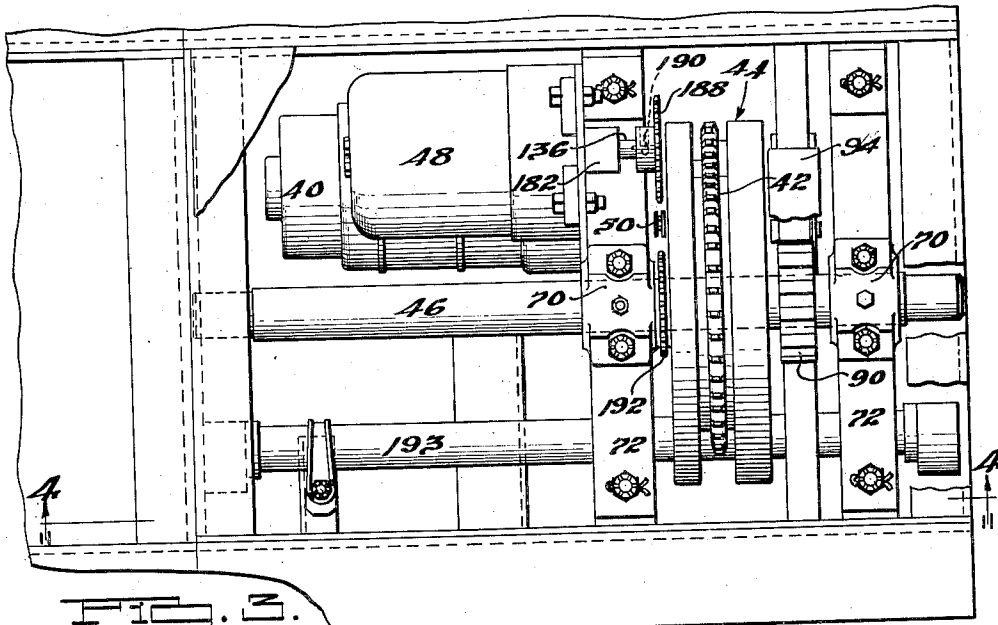
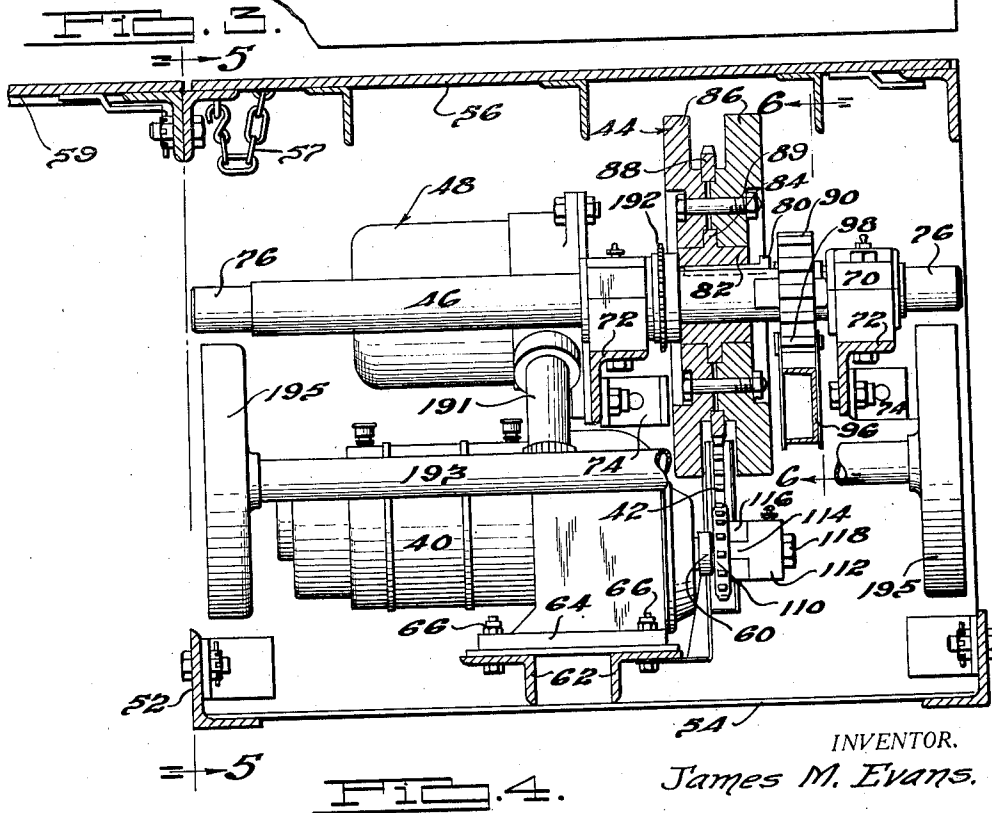
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5 Sheets-Sheet 2



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5 Sheets-Sheet 3

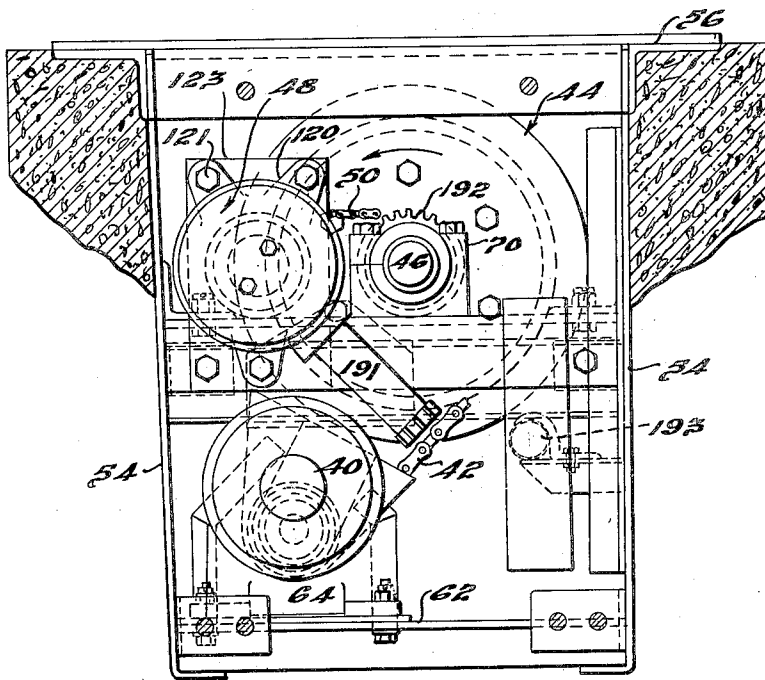


FIG. 5.

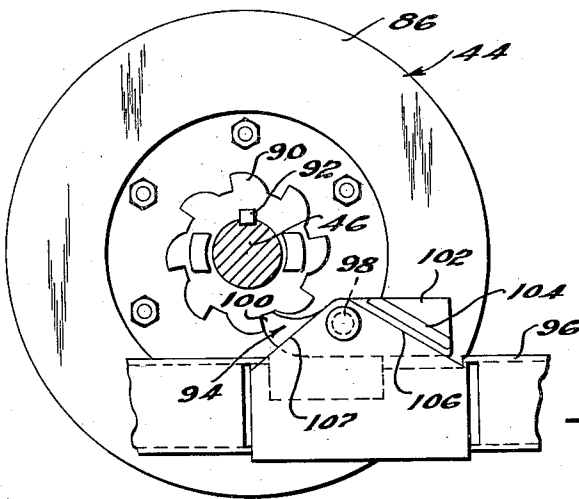


FIG. 6.

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5 Sheets-Sheet 4

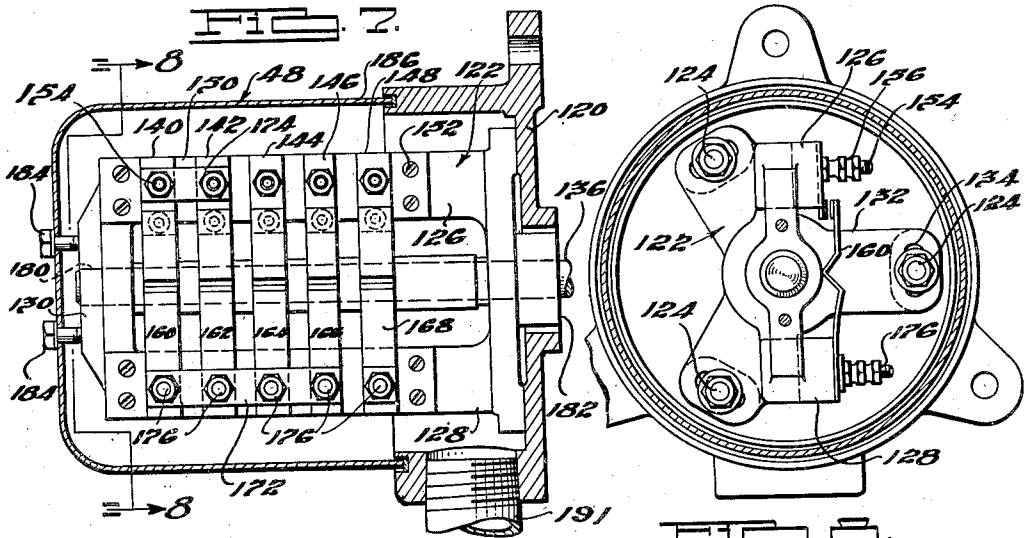
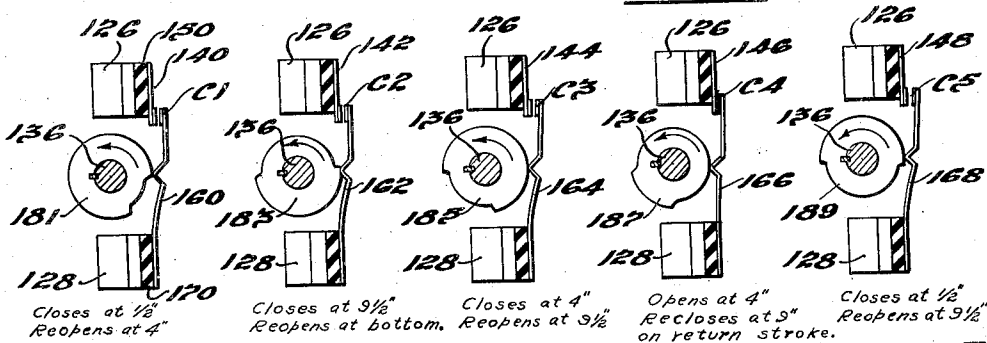
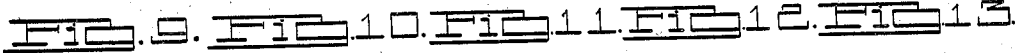
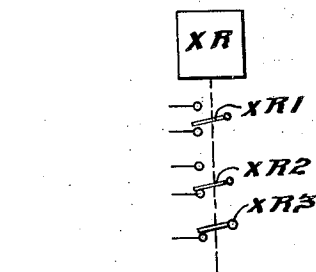


FIG. 14.

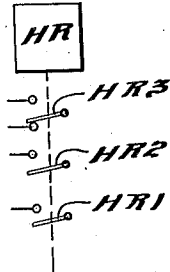


FIG. 15.

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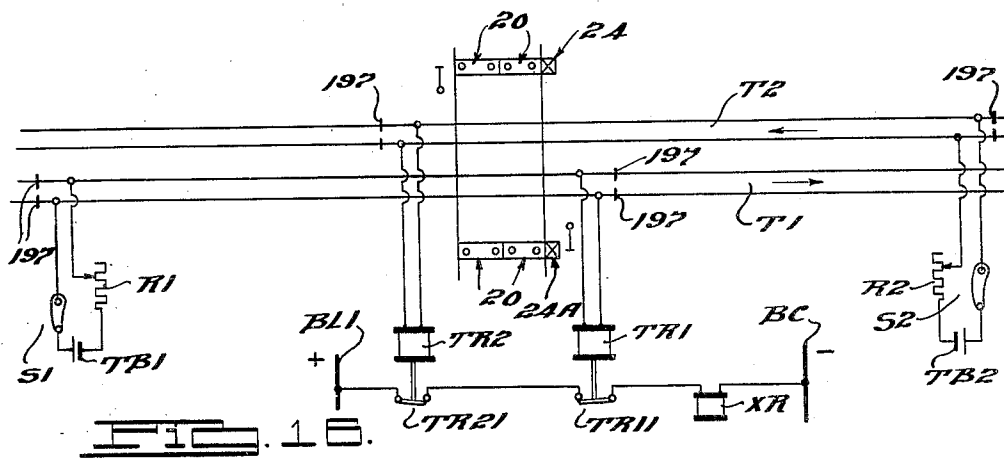
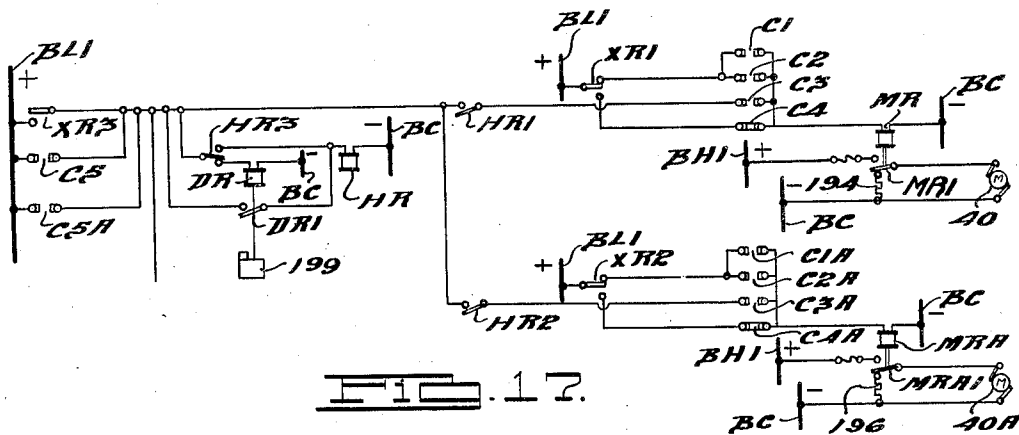
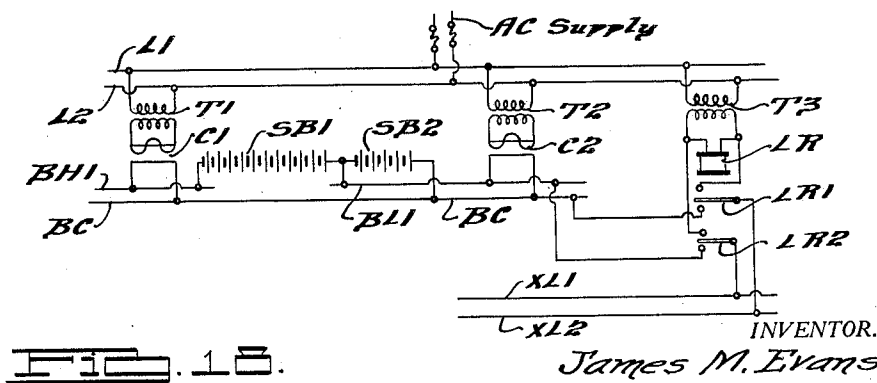
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5 Sheets-Sheet 5



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UNITED STATES PATENT OFFICE

2,240,948

DRIVE MECHANISM FOR CROSSING PROTECTIVE SYSTEMS OR THE LIKE

James Moore Evans, Detroit, Mich., assignor to
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a corporation of Tennessee

Application November 9, 1936, Serial No. 109,941

9 Claims. (Cl. 39—6)

The present invention relates to drive units and control systems therefor, and in particular provides an improved driving unit and control system for a barrier type protective system.

The co-pending applications of the present applicant, Serial No. 108,149, filed October 29, 1936, now Patent No. 2,164,410, issued July 4, 1939, and of William G. Miller, Serial No. 125,081, filed February 10, 1937, now Patent No. 2,178,830, issued Nov. 7, 1939, both assigned to the assignee of the present application, disclose and claim certain features of an improved crossing protective system of the barrier type, that is, a system embodying a plurality of retractable and projectable barriers, imbedded in a highway at opposite sides of a railway crossing or other intersection. In the preferred use of the barriers, the approach to the crossing of, for example, a train, causes each of the barriers at the particular intersection to start upwardly. The upward motion is interrupted at an intermediate stage for a predetermined interval, and then is continued until the barriers reach a maximum elevated position. The departure of the train or other actuating vehicle from the intersection automatically causes the barriers to again move to the retracted position.

Specifically, the present invention is directed to the provision of an improved driving unit and control system therefor, responsive to the approach and departure of a train or other vehicle to and from a railway block or section associated with a crossing, for the protective device of the above identified co-pending application of the present applicant. It will be appreciated, however, from a complete understanding of the present invention that the drive unit thereof is applicable to uses other than the just specified use and may be used with signals and barriers of constructions other than the particular construction disclosed in the above identified co-pending application. Similarly, the improved control system of the present invention may be embodied in protective and other systems differing from the particular embodiments thereof shown herein. The description and illustration of the present invention, in conjunction with a particular type of barrier system, is, therefore, to be regarded in an illustrative and not in a limiting sense.

With the foregoing considerations in mind, an object of the present invention is to provide an improved motor driven drive unit for a barrier device or a similar reciprocable or otherwise intermittently operable element, which is simple in construction, embodies relatively few operating parts,

and which may be economically manufactured, assembled and maintained.

Further objects of the present invention are to provide an improved drive unit embodying a motor element and a flywheel element connected thereto and adapted to be interposed between the motor element and the load to absorb shocks; to provide such a drive unit embodying servo mechanism driven by the motor for controlling the operation of the motor; and to provide such a drive unit embodying a brake associated therewith and selectively actuatable in connection with the motor unit, so that the drive unit may be selectively released for operation or selectively locked in a predetermined rotative position.

Further objects of the present invention are to provide a drive unit, as above generally stated, embodying an improved releasable clutch connection between the motor and an operating shaft of the drive unit; and to provide such a unit embodying selectively releasable ratchet mechanism for locking the drive unit in a predetermined operating position.

Further objects of the present invention are to provide an electrical controller for use in a drive unit of the above stated character or the like, embodying a rotatable shaft and a plurality of contact actuating cams mounted thereon; and to provide such a controller embodying a plurality of adjustably positioned moving contacts, disposed to be actuated by the controller cams, between contact closing and contact opening positions.

Further objects of the present invention are to provide an improved control system for a drive unit of the above stated character, including switching mechanism responsive to a predetermined operating condition for starting the motor element of the drive unit, in combination with means including the electrical controller for bringing the motor to rest after a predetermined period of travel and for retaining it at rest for a predetermined interval; to provide such a system in which the motor unit is automatically again set in operation at the expiration of the predetermined interval, and is again brought to rest after an additional predetermined period of travel; to provide such a system in which, in response to a second predetermined operating condition, the motor unit is again placed in operation and rotates continuously until the drive unit is in the original operating position; and to provide such a system in which means, including the electrical controller, are provided to insure the just stated operating cycle even in the event of variations in

the just stated predetermined operating condition.

With the above and other objects in view, which appear in the following description and in the appended claims, a preferred but illustrative embodiment of the present invention is shown in the accompanying drawings, throughout which corresponding reference characters are used to designate corresponding parts, and in which:

Figures 1 and 2, taken together, with Fig. 2 considered as positioned to the right of Fig. 1, comprise a perspective view of the improved drive unit of the present invention shown as connected for operating a highway protective device;

Fig. 2A is a schematic view, illustrating the preferred arrangement of barriers adjacent a crossing;

Fig. 3 is a top plan view of the improved drive unit;

Fig. 4 is a view in elevation, taken along the line 4—4 of Fig. 3;

Fig. 5 is a view in end elevation, taken along the line 5—5 of Fig. 4;

Fig. 6 is a detail view of ratchet locking structure, taken along the line 6—6 of Fig. 4;

Fig. 7 is a view in central longitudinal section of the drum type electrical controller of the present invention;

Fig. 8 is a view in vertical transverse section, taken along the line 8—8 of Fig. 7;

Figs. 9, 10, 11, 12 and 13 are detail views of the cam and contact structures utilized in the electrical controller of Fig. 7 and showing the angular relation of the contact actuating cams;

Figs. 14 and 15 are diagrammatic views, illustrating the mechanical operating relation between certain of the coils and the contacts controlled thereby, of relay structures utilized in the invention, which contacts and coils are shown in spaced relation in Fig. 17;

Fig. 16 is a schematic diagram of a preferred track control system for initiating the operation of the drive unit;

Fig. 17 is a schematic diagram of a preferred control system for the drive unit, disposed to respond to the control system of Fig. 16; and

Fig. 18 is a schematic diagram of a preferred circuit for supplying electric power to a track system with which the drive unit of the present invention may be associated.

Referring first to Figs. 1, 2 and 2A, the illustrated barrier device comprises an elongated shell-like member 20, generally triangular in transverse vertical section, which is pivotally connected at a rear corner to the rear wall of an associated casing 22. Barrier 20 is illustrated as in the projected position, in which the generally arcuately formed front face thereof presents an impact surface in the path of oncoming vehicles, and which is sufficiently high and properly inclined to bring the vehicle to rest.

As best shown in Fig. 2A, a complete installation of the devices preferably comprises four barriers 20 for each intersection, two thereof being disposed in end to end relation at one side of the railway crossing and the other two being disposed at the other side. One device 20 at each side is associated with the oncoming traffic lane, and the other device at the same side is associated with the outgoing traffic lane. As described in the above identified co-pending application Serial No. 108,149, it is preferred to provide each barrier associated with an oncoming lane with means to positively lock or hold it in the projected position upon its arrival at such projected position. It is preferred, however to enable vehi-

cles otherwise entrapped between the barriers to pass over and depress a barrier associated with an outgoing lane. Accordingly, the oncoming and outgoing lanes at each side of the intersection are provided with barriers individual thereto. The casings 22 are suitably embedded within the roadway surface in such position that when the associated barriers are in the retracted position, the enclosed upper surfaces thereof lie substantially flush with the roadway, and thus form a continuation thereof.

Preferably and as illustrated, one drive unit, designated as a whole as 24, is provided for each side of the intersection, and each such drive unit is common to both of the barriers at that side.

Each barrier 20 is provided with a crank shaft 26, which extends longitudinally therethrough, and the offsets in which are connected to the barrier by retracting arms 28, each of which preferably embodies a resilient element. Each connection between a retracting arm 28 and the associated crank shaft is of the lost motion type, so arranged that a rotation of the crank shaft in either direction from the illustrated position through an angle of approximately 180° forcibly pulls the barrier to the retracted position, against the force of the lifting torsional springs 30 associated therewith. During rotation of the crank shaft from such opposite position to the illustrated position, the barrier is caused to rise under the influence of the torsional springs 30, one end of each of which is connected to the casing 22 and the other end of each of which is connected to the barrier through resilient arms 32. The rate at which the barrier rises under the influence of the springs 30 is controlled by the rate of rotation of the crank shaft 26. In view of the lost motion connection between the arms 28 and the crank shaft 26, it will be appreciated that while the crank shaft is effective to control the rate of rise of the barrier, it is ineffective to apply a lifting force to the barrier. Accordingly, the barrier may be forcibly pushed down or depressed against the force of the torsion springs 30 independently of the rotative position of the crank shaft. It will also be appreciated that a complete barrier operating cycle, including a movement from the normal retracted position to the illustrated projected position, and a return movement thereof to the retracted position, may be effected during a single complete revolution of the crank shaft 26.

A resilient coupling 33, which may be of conventional construction and hence has not been illustrated in detail, is preferably provided to form a connection between the shaft of the drive unit and the crank shaft 26 of the adjacent barrier 20. A similar flexible coupling may be provided to form a connection between the other end of the crank shaft 26 and the crank shaft of the immediately adjacent barrier.

As shown generally in Fig. 1, and in greater detail in Figs. 3, 4, 5 and 6, the drive unit 24 comprises a combined motor, brake and reduction gear unit 40 which is connected through a sprocket chain 42 to the sprocket associated with a combined fly-wheel and sprocket 44. The latter element is drivingly connected to the main drive shaft 46 with which coupling 33 is associated, and also drives an electrical drum type controller 48 through a sprocket chain 50.

The drive unit is housed in a casing framed by angle members 51 and 52 and enclosed by walls 54. The top of the casing is enclosed by a removable cover 56, the locking chain 57 of which

may be released by lifting the cover 59 of an adjacent manhole. The casings may be suitably secured to the end of the associated barrier casing 22 with the top thereof substantially flush with the top of the casing 22 and with the drive shaft 46 thereof substantially axially aligned with the crank shaft 26 associated with the barrier.

The combined motor, reduction gear and brake is a commercially available article and the construction in detail thereof forming no part of the present invention, has not been illustrated in detail. It is sufficient for the present description to note that the shaft of the motor element, which may be constructed to utilize either direct current or alternating current, is connected through suitable speed reducing gears to a shaft 60 which extends externally of the motor housing. A conventional spring applied electromagnetically released brake is secured to the motor shaft within the housing. The internal connections for the motor unit are such that completion of the motor armature circuit also completes the circuit for the electromagnets provided to release the brake. Each starting operation thus simultaneously completes the motor power circuit and also releases the brake. Each stopping operation simultaneously interrupts the motor power circuits and also interrupts the brake circuit, bringing the motor to rest with the brake applied. The support for the motor unit 40 is provided by a pair of angle members 62 which extend between the side walls of the associated casing and are suitably supported upon the angle brackets which define the casing. The base 64 of unit 40 is secured to angle brackets 62 by a plurality of studs 66.

The drive shaft 46 is rotatably journaled in a pair of pillow blocks 70 which in turn are supported within the casing on transversely extending angle members 72, the opposite ends of which are secured to the opposite walls of the casing as by brackets 74. The ends 76 of drive shaft 46 are each of reduced section to accommodate the hub of a flexible coupling such as the previously mentioned coupling 33, and each end extends to a point closely adjacent the associated end of the drive unit casing. With this arrangement, either end of the shaft 46 may be coupled to the crank shaft of an associated barrier, or, stated in another way, a drive unit may be connected at either end of an associated barrier.

The combined fly-wheel and sprocket member 44, which is drivably connected to shaft 46 through a key 80, preferably comprises a hub 82 having an annulus 84, a pair of similar oppositely disposed relatively heavy fly-wheel members 86, and a ring-like sprocket member 88. The fly-wheel members, which are secured together by a plurality of circumferentially arranged studs 89, retain the sprocket member 88 between them and, as will be evident, are fixed in place axially of the hub 82 by the annulus 84. As will be appreciated, the fly-wheel effect of member 44 absorbs any operating shocks transmitted from the barrier to the drive unit and prevents such shocks from unduly loading the motor unit 40.

In order to provide for manual operation of the barrier, in the course of maintenance or inspection work, the shaft 46 is provided with a ratchet wheel 90 fixed thereto by a key 92, the periphery of which is adapted to receive a usual spanner wrench or other tool, and also to cooperate with a locking dog 94. Dog 94 is pivotally mounted upon a transversely extending channel member 96 by means of a pin 98. The

nose 100 of dog 94 is disposed in axially offset relation to the main body portion 102 thereof and an extension 104 is disposed in oppositely axially offset relation to the body portion 102. The projection 104 rests upon a supporting member 106 to prevent rotation of the dog in a clockwise direction from the position illustrated in Fig. 6. The dog normally occupies a position angularly displaced from that shown, with the projection 104 resting upon the base 107 of the supporting member, in which position the nose 100 is free of the ratchet 90.

In order to release the shaft 46 from the effect of the brake associated with the motor unit 40 in the event of manual operation, the motor drive pinion 110 is connected to the shaft 60 of the motor drive unit by a releasable clutch. In the form illustrated, a clutch body 112 is splined or keyed to the shaft 60 and is provided with axially projecting diametrically opposed fingers 114 adapted to be received in slots formed in the hub 116 of the drive pinion, which pinion is freely rotatable upon the shaft 60. A stud 118 is threaded into an axially extending passage in shaft 60 and serves to retain the clutch body in assembled relation to the pinion. By backing off stud 118, clutch body 112 may be moved axially of shaft 60 to the right, as viewed in Fig. 4, retracting the fingers 114 from the associated slots in the pinion. Thus, disengaged from the clutch body, the pinion 110 may be freely rotated relative to shaft 60.

For manual operation the just described clutch is released, rendering the previously mentioned torsion springs effective to raise the associated barriers to the full height. This raising movement may involve rotation of shaft 46 in either direction since, as previously stated, the barrier crank shafts occupy substantially dead center positions when the barriers are retracted. To manually lower a barrier, the dog 94 may be rotated to the illustrated position, and the shaft 46 may then be rotated in step by step fashion by applying a spanner wrench to the ratchet wheel 90. In each such ratchet position, dog 94 is effective to retain shaft 46 against rotation under the influence of the torsion springs.

Referring particularly to Figs. 7 to 13, inclusive, the controller 43 comprises generally a cup-shaped base member 120 upon which the contact carrying structure 122 is supported by a plurality of studs 124. The base 120 is flanged and is secured by studs 121 to an upright member 123 carried upon member 72 (Fig. 5). The contact carrying structure 122 includes an upper longitudinally extending bar or arm 126 and a similar lower bar or arm 128, which arms are connected together adjacent the left-hand ends thereof, as viewed in Fig. 7, by a cross-member 130 and are connected together at the right-hand end thereof by a three legged bracket 132, each leg of which is provided with an elongated opening 134 for cooperation with an associated supporting stud 124. As will be appreciated, the elongated openings 134 permit the contact carrying structure 122 to be bodily rotated through a limited angle relative to the base 120 and also relative to the controller shaft 136 to thereby adjust the rotative positions of the latter at which the various contacts are opened and closed.

The upper arms 126 carries five stationary contact strips 140, 142, 144, 146 and 148 electrically insulated from the arm 126 by a block of insulating material 150 secured to arm 126 by studs 152. The contact strips are secured to arm

126 by studs, such as 154 (Fig. 8), which carry the usual terminal nuts, such as 155. The lower arm 128 is provided with a corresponding series of movable contacts 160, 162, 164, 166 and 168, each of which is formed of flexible, electrically conducting material and which are insulated from the arm 128 by a strip of insulating material 170. The movable contacts 160, 162, 164 and 166 are connected together for reasons explained hereinafter by a jumper 172. The stationary contacts 140 and 142 are similarly connected together by a jumper 174. A terminal stud, such as 176, is associated with each moving contact, as clearly appears in Fig. 8. For purposes of convenience, the pairs of contacts 140—160, 142—162, 144—164, 146—166 and 148—168 are designated C1, C2, C3, C4 and C5, respectively.

The controller drive shaft 136 is journaled in a bearing 180 provided therefor in the previously mentioned cross-member 130 and a second bearing provided therefor by the hub 182 of the contact carrying member 122. The cross-member 130 also serves to support the studs 184 by which the enclosing casing 186 is secured to the base member 120. The axially projecting end of the shaft 136 is provided with a sprocket wheel 188 keyed thereto by a key 190 (Fig. 3). Sprocket 188 is driven by the previously mentioned chain 50 which passes around a similar sprocket 192 secured upon the drive shaft 46. The driving relation is illustrated as one in which a complete revolution of the drive shaft 46 results in a corresponding complete revolution of the controller shaft 136.

The controller shaft 136 carries a plurality of contact actuating cams 181, 183, 185, 187 and 189, each of which is suitably keyed thereto and each of which is disposed to permit its associated movable contact to remain closed throughout a predetermined portion of a complete revolution of the drum controller and to cam such contact to an open position during movement of the drum controller throughout the balance of a complete revolution.

The various contact pairs C1 through C5 are shown in the positions occupied thereby when the barrier is at rest in the retracted position and legends are applied adjacent these figures to identify the parts of the barrier travel during which the respective contacts are closed or opened. It will be appreciated that the figures given in the legends are illustrative and may, in practice, vary considerably. It may be noted that the four inch level appearing in the legend represents the intermediate hesitation or stopping point, and that the nine and one-half inch level represents the fully projected position. Referring to the legends underneath Figs. 9 to 13, contact C1 is open at all times except when, during an elevating movement, the barrier elevation is between one-half inch and four inches. Contact C2 is open throughout each entire elevating movement but is closed when the barrier reaches its maximum elevated position (9½ inches) and remains closed until the retracted position is reached. Contact C3 is open at all times except when, during an elevating movement, the barrier elevation is between four inches and nine and one-half inches, the maximum elevated position. Contact C4 is normally closed but opens when, during an elevating movement, the barrier elevation reaches four inches and remains open until the barrier passes the maximum elevated position and, in its downward movement, reaches an elevation of nine

inches, or slightly below the maximum elevated position. The final contact C5 is open at all times except when, during an elevating movement, the barrier elevation is between one-half inch and nine and one-half inches, the maximum elevated position.

A conduit 191 is provided for introducing conductors into the controller 48. A similar conduit 193, provided with terminal boxes 195, extends between the ends of the drive unit casing and serves to carry the conductors which connect the drive unit and the barrier to the external source of supply.

Track and drive unit control systems

The electrical control system for the barrier is shown in the control diagrams of Figs. 16, 17 and 18. The control system comprises generally a system of track circuits (Fig. 16), a system of circuits including the just described electrical controller, responsive to the track circuits (Fig. 17) and a preferred arrangement of power supply circuits (Fig. 18).

Referring first to Fig. 16, four barriers 20 are shown associated with a railroad crossing and arranged in the manner described with reference to Fig. 2A. The two barriers 20 at one side of the crossing are provided with a drive unit 24 and the two barriers at the other side of the crossing are provided with a similar drive unit 24A. The two parallel railway tracks are designated generally as T1 and T2, and it may be assumed that the tracks are used by trains traveling in the direction indicated by the arrows. In accordance with conventional practice, the rails of track T1 are provided with blocks of insulation 197 which divide the track into a signaling block which extends from a substantial distance in advance of the crossing in the direction of train travel to a distance slightly beyond the crossing. The rails of track T2 are similarly provided with insulating blocks 197, which divide track T2 into a signaling block of similar length but extending in opposite relation to the crossing.

The block associated with track T1 is provided with an illustrative source of track current supply, shown as a battery TB1 connected across the rails adjacent one end of the block. The circuit for battery TB1 includes a current limiting resistor R1 and a control switch S1. A track relay TR1 is connected directly across the two rails of track T1 adjacent the other end of the associated block. A similar track battery TB2 is directly connected across the rails of track T2, in series with a current limiting resistor R2 and a suitable control switch S2. A corresponding track relay TR2 is directly connected across the rails of track T2 adjacent the end of the associated block which is remote from the connection for battery TB2.

The switches S1 and S2 remain closed as long as the track system is in service and it will be appreciated accordingly that as long as no train or other vehicle, effective to shunt the track relays TR2 or TR1, occupies the track sections associated with the relays, these relays are continuously energized through circuits which include the connecting rails. The energized conditions of these relays causes them to close their associated contacts TR11 and TR21, thus completing an energizing circuit for the coil of the crossing protective relay XR. If a train or other vehicle, effective in accordance with conventional signaling practice to complete a shunt circuit between the two rails of either track, enters either the block associated with track T1 or the block associated

with track T2, part of the current otherwise supplied to the associated track relay TR1 or TR2 is diverted through the shunt path thus provided, causing such relay to fall to the de-energized position, opening its contact TR11 or TR21, as the case may be. The opening of either contact TR21 or contact TR11 interrupts the just described energizing circuit for relay XR.

As soon as the train or other vehicle leaves the block associated with the crossing, the relay TR1 or TR2 is again energized and again actuates the contacts TR21 or TR11, as the case may be, to the closed position, re-completing an energizing circuit for the crossing relay XR. It will be seen, therefore, that the presence of a train, or other vehicle designed to operate the barrier, within a track section associated with either of the two tracks TR1 or TR2, causes the crossing relay XR to fall to the de-energized position, in which it remains as long as a vehicle is in either of the track sections associated with the crossing.

Referring now to Fig. 17, the control system there shown includes a plurality of contacts numbered XR1, XR2 and XR3 which are directly operated by the above described crossing relay XR. The mechanical relation between coil XR and contacts XR1, XR2 and XR3 is shown in Fig. 14. In Fig. 17 they are shown remotely from the associated operating coil in order to simplify the drawings. Fig. 17 also includes the contacts C1, C2, C3, C4 and C5 associated with the controller of drive unit 24 (Fig. 16), as well as a corresponding series of controller contacts C1A, C2A, C3A, C4A and C5A associated with the controller of drive unit 24A. Additional control relays MR, HR and DR are also shown in the circuits, the purpose and operation of which are described in connection with the description of operation of the system. The motor units are designated 40 and 40A.

It will be appreciated from the foregoing that in the normal condition of the system, that is when no vehicle occupies either track section associated with the barriers the relays TR1, TR2 and XR occupy the energized positions, and they are shown in this relation in Fig. 16. Similarly, in Fig. 17 the contacts XR1, XR2 and XR3 associated with the relay XR are shown in the upper positions occupied thereby when the coil of the relay XR is energized. In addition, the controller contacts C1, C2, etc. are shown in Fig. 17 in the positions occupied thereby when the associated barriers are retracted.

With the barriers in the retracted positions, the controller contacts C1, C2, C3 and C5, and C1A, C2A, C3A and C5A are open. The controller contacts C4 and C4A are closed, but the associated circuits are open at the contacts XR1 and XR2. Accordingly, no circuit is completed for the motor unit control relays MR or MRA and the barriers remain at rest in the retracted positions.

Assuming that a vehicle enters one or the other of the two track sections associated with the crossing of Fig. 16, either relay TR1 or TR2 is de-energized, correspondingly deenergizing the crossing relay XR. In response to this action, the contacts XR1, XR2, and XR3 fall to positions the opposite of those illustrated in Fig. 17.

This action completes the circuit for both motor relays MR and MRA, the circuit for relay MR extending from the positive line conductor BL1 through contact XR1, controller contact C4 and the coil of motor relay MR to the negative line conductor BC. A similar circuit is completed for

the motor relay MRA through contact XR2 and controller contact C4A.

Upon being energized, the two motor relays MR and MRA move their associated contacts MR1 and MRA1 to the upper positions thereof. Contact MR1 completes a circuit for the motor unit 40 extending from line conductor BH1 through a conventional overload device and through the motor unit armature to the negative line conductor BC. A similar circuit is completed for motor unit 40A. Upon completion of these circuits motor units 40 and 40A start in rotation and initiate raising movements of the associated barriers.

When the motor units 40 and 40A have rotated sufficiently to raise the associated barriers 20 to an elevation of substantially four inches, the controller contacts C4 and C4A are actuated to the open position, as described with reference to Fig. 12. This action interrupts the previously described circuits for the motor relays MR and MRA, which relays fall to the de-energized positions, releasing their contacts MR1 and MRA1 to the illustrated positions and interrupting the previously described circuits for the motor units 40 and 40A. As previously pointed out the interruption of the motor armature circuits causes the associated brakes (not shown) to be applied. Relays MR and MRA also complete so-called dynamic braking circuits through the resistors 194 and 196, which are disposed to be connected directly across the associated motor armatures, and assist the brakes in stopping the motors. Accordingly, the barriers associated with the motor units 40 and 40A are each brought to rest at an elevation of substantially four inches, the motor brakes acting to hold the barriers against the lifting forces of the torsion springs.

The initial closure of the crossing relay contacts XR3 completes the circuit for the time delay relay DR, which circuit extends from the positive line conductor BL1 through contacts XR3 and HR3, and through the coil DR to the negative line conductor designated BC.

The armature of relay DR is provided with a dashpot 199 or other suitable delaying mechanism which delays the closure of the contact DR1 for an appreciable period after the completion of the energizing circuit for the coil of relay DR. The time interval provided is preferably adjusted to expire several seconds after the barriers are brought to rest at the four inch points, so that the barriers remain stationary at the intermediate positions to provide a warning period.

As pointed out in more detail in the above identified co-pending applications, the feature of causing the barriers to remain stationary for a predetermined period at an intermediate projected position is of substantial importance. The movements of the barriers to this intermediate or warning position is sufficient to expose the warning lettering or characters on the faces thereof, thus advising approaching traffic that the barriers are about to move to their fully projected positions. At the same time, the intermediate or warning positions of the barriers are sufficiently low so that vehicles, which have already approached too closely to the intersection to permit a stop in advance of the barriers, can pass thereover without encountering a substantial obstructing effect.

Upon the timing out of the dashpot 199 relay contacts DR1 close, completing the circuit for the coil of the holding relay HR, which extends from the positive line conductor BL1 through the closed

contact XR3, contact DR1, and coil HR to the negative line conductor BC. Upon completion of this circuit, relay HR closes its contacts HR1 and HR2 and transfers contact HR3 to the upper position. Contact HR3 completes a self-holding circuit for the coil HR and also opens the previously described energizing circuit for the coil of the time delay relay DR. Relay DR thus again resumes the de-energized position, which action is without effect in view of the closure of the holding contact HR3.

Closure of contact HR1 re-completes the circuit for the coil of the motor relay MR which circuit extends from line conductor BL1 through contact XR3 and through the now closed controller contact C3 (see Fig. 11) to the coil of relay MR and thence to the negative line conductor BC. A similar circuit is completed through contact HR2 and controller contact C3A for the coil of the motor relay MRA. Upon completion of these circuits the motor relays MR and MRA again close, placing the associated motor units 40 and 40A in operation and thereby cause the associated barriers to resume their elevating movements.

When the two motor units 40 and 40A have rotated sufficiently to permit the barriers associated therewith to reach the upper limit position thereof, or to have reached the nine and one-half inch positions indicated in the legends under Figs. 9 to 13, the controller contacts C3 and C3A, respectively, open, interrupting the previously described energizing circuits for the motor relays MR and MRA and bringing the barriers to rest at such positions, in which positions they remain until the vehicle or vehicles which initiated the starting thereof pass beyond the intersection. It will be appreciated that the length of the blocks and the rate of travel of the barriers are so related to the expected rates of travel of the traffic on the tracks T1 and T2 as to effect the raising of the barriers to their fully projected positions somewhat prior to the actual arrival of the traffic at the crossing.

Assuming that the vehicle which initially de-energized the crossing relay XR passes beyond the intersection, the track relay TR1 or TR2, as the case may be, again becomes energized, re-completing the energizing circuit for relay XR. On completion of this circuit, relay XR moves to the illustrated closed position, opening contact XR3 and throwing contacts XR1 and XR2 to the upper positions thereof.

As described with reference to Fig. 10, the controller contacts C2 and C2A close when the associated drive units are in positions corresponding to maximum or nine and one-half inch elevations of the barriers. Accordingly, the movement of contacts XR1 and XR2 to the upper positions thereof completes circuits for the motor relays MR and MRA. The circuit of motor relay MR extends from the positive line conductor BL1 through contacts XR1, controller contacts C2 and through the coil of motor relay MR to the negative line conductor BC. The circuit for motor relay MRA is similar.

Upon completion of these circuits, accordingly, the motor relays MR and MRA actuate the associated motor units 40 and 40A to begin a downward or retracting movement of the barriers connected thereto. It is noted that the rotation of the motor units 40 and 40A continues in the same direction as in the case of the elevating movement, it being noted in the previous description that the barrier elevating movements occur during approximately 180° of barrier crank shaft travel and that the barrier retracting movements

occur during the remaining 180° approximately of barrier crank shaft travel.

When the motor units 40 and 40A have rotated sufficiently to bring the associated barriers again to the retracted positions, the controller contacts C2 and C2A re-open, interrupting the previously traced circuits for the motor relays MR and MRA, respectively, and bringing the associated barriers again to rest in the lowered positions, in which positions they remain as long as the crossing relay XR remains energized.

It may occur from time to time, where the barriers are used in connection with multiple track systems, such as shown in Fig. 16, that, after one vehicle has passed beyond an intersection and started the barrier downwardly, a vehicle will approach the crossing on one or another of the other tracks and again de-energize the crossing relay XR before the barrier has reached the fully retracted position. In accordance with the present invention, an occurrence of this kind does not interrupt the barrier movement but instead provides circuits by which the barrier is caused to continue its downward movement and immediately begin an upward movement.

If the barriers are moving downwardly, as described in the above paragraph, the motor relay circuits extend through contacts XR1 and XR2 and controller contacts C2 and C2A, respectively. Shortly after the downward movement is initiated and when the barriers reach the nine inch positions, the controller contacts C4 and C4A re-close, as described with reference to Fig. 12. Closure of these contacts prepares circuits for the motor relays MR and MRA, which circuits are, however, open at the contacts XR1 and XR2. Assuming now that a second train approaches the intersection and again de-energizes relay XR, the motor relay circuits previously completed through the controller contacts C2 and C2A are interrupted at contacts XR1 and XR2. The dropping of these contacts to the illustrated positions, however, re-completes motor relay circuits through the controller contacts C4 and C4A, so that the barrier movement is not interrupted by the approach of the second train. Since contacts C4 and C4A remain closed until the barriers have passed the retracted position and again risen to the four inch position, it will be appreciated that the barrier movements will not be stopped when the retracted positions are reached thereby. The remainder of the operating cycle is as previously described, except the period of rest at the four inch point is necessarily shortened an amount equal to the time required for the barrier to finish the already started lowering movement. Thus, the barrier will reach the re-elevated position just as promptly as though the barrier had been in the fully retracted position at the time such second train entered the block.

It may also occur from time to time, through one cause or another, that one of the track relays TR1 and TR2 will be temporarily de-energized, the period of de-energization being too short to give the barriers time to rise to the fully elevated position. This may occur, for example, when a train or vehicle moves into a section a short distance and then retires therefrom. In accordance with the present invention, however, the arrangement is such that even such a momentary de-energization of the track relay is effective to cause both barriers to move to the fully projected positions and then return to the retracted positions.

Assuming for example that relay XR is temporarily de-energized, the de-energization there-

of causes the contacts XR1, XR2 and XR3 to assume the illustrated positions, which action, as previously described, starts both motor units 40 and 40A into operation. After a slight amount of barrier movement of the order for example of one-half inch, the controller contacts C5 and C5A close (see Fig. 13) and form parallel shunt circuits around the crossing relay contact XR3. The just stated shunt action is obtained, therefore, even though only one of the barriers rises to the height required to cause closure of the contacts C5 or C5A. After closure of either of contacts C5 or C5A, it will be appreciated that a re-opening of contact XR3 is without effect upon the system. The just mentioned slight initial movements of the barriers also cause closure of the controller contacts C1 and C1A. After the closure of these contacts, a transfer of the relay contacts XR1 and XR2 to the upper positions thereof resulting from the re-energization of relay XR is without effect upon the system. Contacts C1 and C1A re-open at the four inch level of the barriers in order to give the usual hesitation to the barrier movement, the remaining upward movement of the barriers being effected through the contacts C3 and C3A, as described with reference to the first sequence of operation. The contacts C5 and C5A re-open at the barrier nine and one-half inch points without effect, since the then closed contacts C2 and C2A effect the return movements to the retracted positions.

It will be noted from Fig. 17 that two separately identified positive line conductors BL1 and BH1 are indicated. This is for the reason that it is preferred to provide a higher voltage source of power for operating the motor units 40 and 40A than for operating the relays associated with the motor units.

A preferred but illustrative power supply system for the control system (Fig. 17) is shown in Fig. 18, in which conductors L1 and L2 are connected to terminals of a conventional alternating current supply system. A transformer T1 is connected across the line conductors L1 and L2 and, through a conventional rectifier C1, delivers direct current of a voltage suitable for operating the motor units 40 and 40A to the line conductor BH1 and the common return line BC, extensions of which conductors are shown and correspondingly designated in Fig. 17. A similar transformer T2 is connected across the line conductors L1 and L2 and, through a similar conventional rectifier C2, delivers direct current of a voltage suitable for operating the relays described with reference to Fig. 17 to the line conductor BL1 and to the common return line BC.

In order to insure the provision of an adequate power supply for operating both the motor units and the relay mechanism, even in the event of failure of the just described alternating current supply system, two batteries, designated as SB1 and SB2, are preferably provided. The two terminals of battery SB2, constructed to deliver a voltage corresponding to that of transformer T2, are connected directly across the line conductors BL1 and BC. The two batteries SB1 and SB2 are interconnected, in additive relation, and the free terminal of battery SB1 is connected to the line conductor BH1. Batteries SB1 and SB2, in series, are constructed to deliver a voltage substantially equal to the secondary voltage of transformer T1. A third transformer T3, intended primarily to supply alternating current for lighting warning signals and other signals preferably provided in connection with the bar-

riers, is connected across the line conductors L1 and L2. The secondary thereof directly supplies the coil of a transfer relay LR. As long as the line conductors L1 and L2 remain energized, relay LR remains energized and holds contacts LR1 and LR2 in the upper positions, in which positions the line conductors XL1 and XL2 are directly supplied with alternating current through transformer T3. In the event of failure of the alternating current source or failure of transformer T3, the contacts of the relay LR drop, connecting the conductors XL1 and XL2 directly across the low voltage direct current lines BL1 and BC, thus supplying the lighting circuits from the direct current source.

Although a specific embodiment of the present invention has been described, it will be appreciated that various changes in the structure and arrangement may be made within the spirit and scope thereof.

What I claim is:

1. In a control system for a protective device embodying a retractable and projectable barrier provided with a motor operatively connected to said barrier and effective through unidirectional operation to project and retract said barrier, a circuit for said motor, a controller for said motor effective to complete said circuit to cause said motor to start in operation and actuate said barrier to a projected position, and to thereafter recomplete said circuit to cause said motor to actuate said barrier to a retracted position, and means including timing mechanism for interrupting said circuit for a predetermined interval during said projecting movement.

2. In a control system for a protective device embodying a barrier adapted to assume projected and retracted positions and provided with a motor for actuating it between said positions, relay mechanism and means responsive thereto effective upon operation to cause said motor means to start and actuate said barrier to a projected position, means including timing mechanism responsive to said relay mechanism for stopping said motor for a predetermined interval at an intermediate stage of said projecting movement, means associated with said motor effective upon de-operation of said relay mechanism for causing said motor to actuate said barrier to the retracted position, said first mentioned means being responsive to a re-operation of said relay mechanism during a retracting movement of said barrier for continuing said barrier movement to the retracted position.

3. In a control system for a protective device embodying a barrier adapted to assume projected and retracted positions and provided with a unidirectionally operable motor for actuating it between said positions, a circuit for said motor, relay mechanism effective upon operation to cause completion of said circuit to thereby cause said motor to project said barrier, means including timing mechanism responsive to said relay mechanism for stopping said motor for a predetermined interval at an intermediate stage of said projecting movement, and additional means responsive to de-operation of said relay mechanism to cause completion of said circuit to thereby cause a retracting movement of said barrier.

4. In a control system for a protective device embodying a barrier adapted to assume projected and retracted positions and provided with a motor for actuating it between said positions, relay mechanism and means responsive thereto effective upon operation to cause said motor means to start and actuate said barrier to a pro-

jected position, means including timing mechanism responsive to said relay mechanism for stopping said motor for a predetermined interval at an intermediate stage of said projecting movement, means associated with said motor effective upon de-operation of said relay mechanism for causing said motor to actuate said barrier to a retracted position, said first mentioned means being responsive to a re-operation of said relay mechanism during a retracting movement of said barrier for continuing said barrier movement to the retracted position and for causing said motor to remain in operation and actuate said barrier to the projected position.

5. In a control system for a protective device embodying a barrier adapted to assume projected and retracted positions and provided with a motor for actuating it between such positions, relay mechanism for placing said motor in operation to thereby initiate a projecting movement of said barrier, a controller for said motor controlled in accordance with the position of said barrier and including means for maintaining said motor in operation independently of the condition of said relay mechanism, and means including timing mechanism responsive to said relay mechanism for stopping said motor for a predetermined interval at an intermediate stage of said projecting movement and for restarting said motor at the end of said interval.

6. In a control system for a protective device embodying a barrier adapted to assume projected and retracted positions and provided with means including a motor for actuating it between said positions, relay mechanism for placing said motor in operation to initiate a projecting movement of said barrier, a controller for said motor actuated in accordance with barrier movement and effective after said barrier has reached a predetermined elevation to continue said motor in operation independently of the condition of said relay mechanism, and means including timing mechanism responsive to said relay mechanism for stopping said motor for a predetermined interval at an intermediate stage of said projecting movement and for restarting said motor at the end of said interval.

7. In a control system for a protective device embodying a retractable and projectable member provided with a motor operatively connected to said member and effective through unidirectional operation to project and retract said member, the combination of an operating circuit for said motor, means operable to cause completion of said circuit so that said motor starts to move

said member from said retracted to said projected position, additional means operable to cause completion of said circuit so that said motor starts to move said barrier from said projected to said retracted position, and timing mechanism associated with said first means for causing an interruption of said operating circuit for a predetermined interval during said projecting movement.

8. In a control system for a protective device embodying a retractable and projectable member provided with a motor operatively connected thereto and effective through unidirectional operation to project and retract said member, the combination of an operating circuit for said motor, relay mechanism operable to cause completion of said operating circuit so that said motor starts said member from said retracted to said projected position, a controller operable in accordance with the movement of said motor for interrupting said operating circuit at an intermediate point in said movement, timing mechanism associated with said motor for causing recompletion of said circuit so as to continue said movement of said member, and additional mechanism operable to cause completion of said operating circuit so that said motor moves said member from said projected to said retracted position.

9. In a control system for a protective device embodying a retractable and projectable member provided with a motor operatively connected thereto and effective through unidirectional operation to project and retract said member, an operating circuit for said motor, relay mechanism operable between first and second positions, a controller for said motor controlled in accordance with the position thereof and having means responsive to an operation of said relay mechanism to said first position for causing closure of said operating circuit to cause said motor to start said member in a projecting direction, timing mechanism associated with said controller for interrupting said operating circuit at an intermediate point in said projecting movement and for causing recompletion thereof at the expiration of a predetermined interval, and additional means forming part of said controller and responsive to an operation of said relay mechanism to said second position for causing closure of said operating circuit to cause said motor to move said member from said projected to said retracted position.

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