Nov. 14, 1944. S. MISKELLY 2,362,710

GRADE CROSSING GATE

Filed April 21, 1941 7 Sheets-Sheet 1

Fig. 1

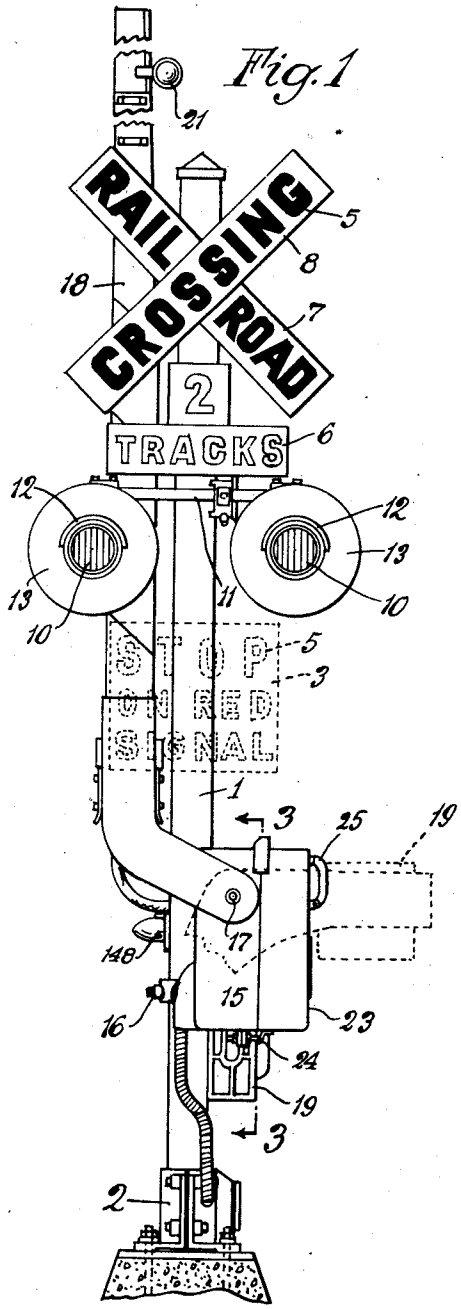
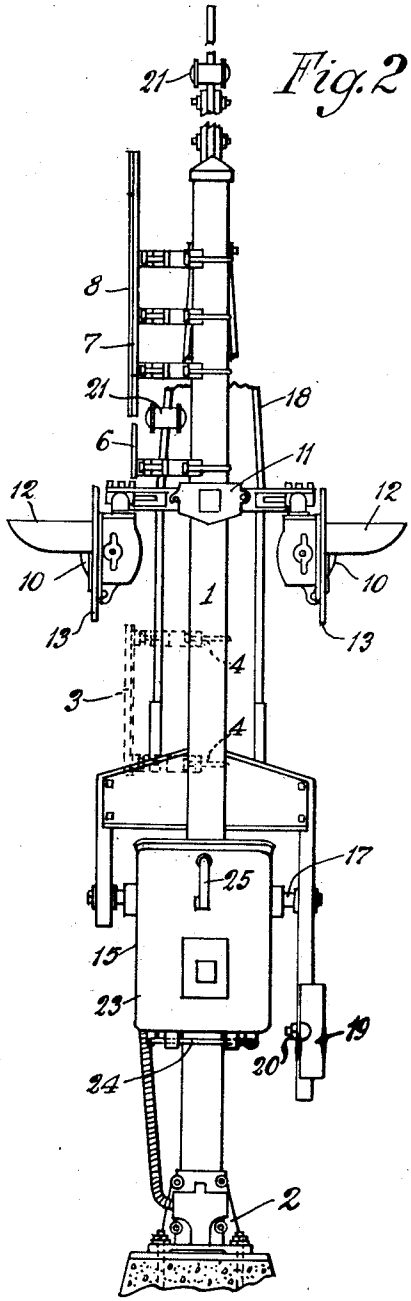


Fig. 2



Inventor
Samuel Miskelly
by A. P. Lewis
Attorney.

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GRADE CROSSING GATE

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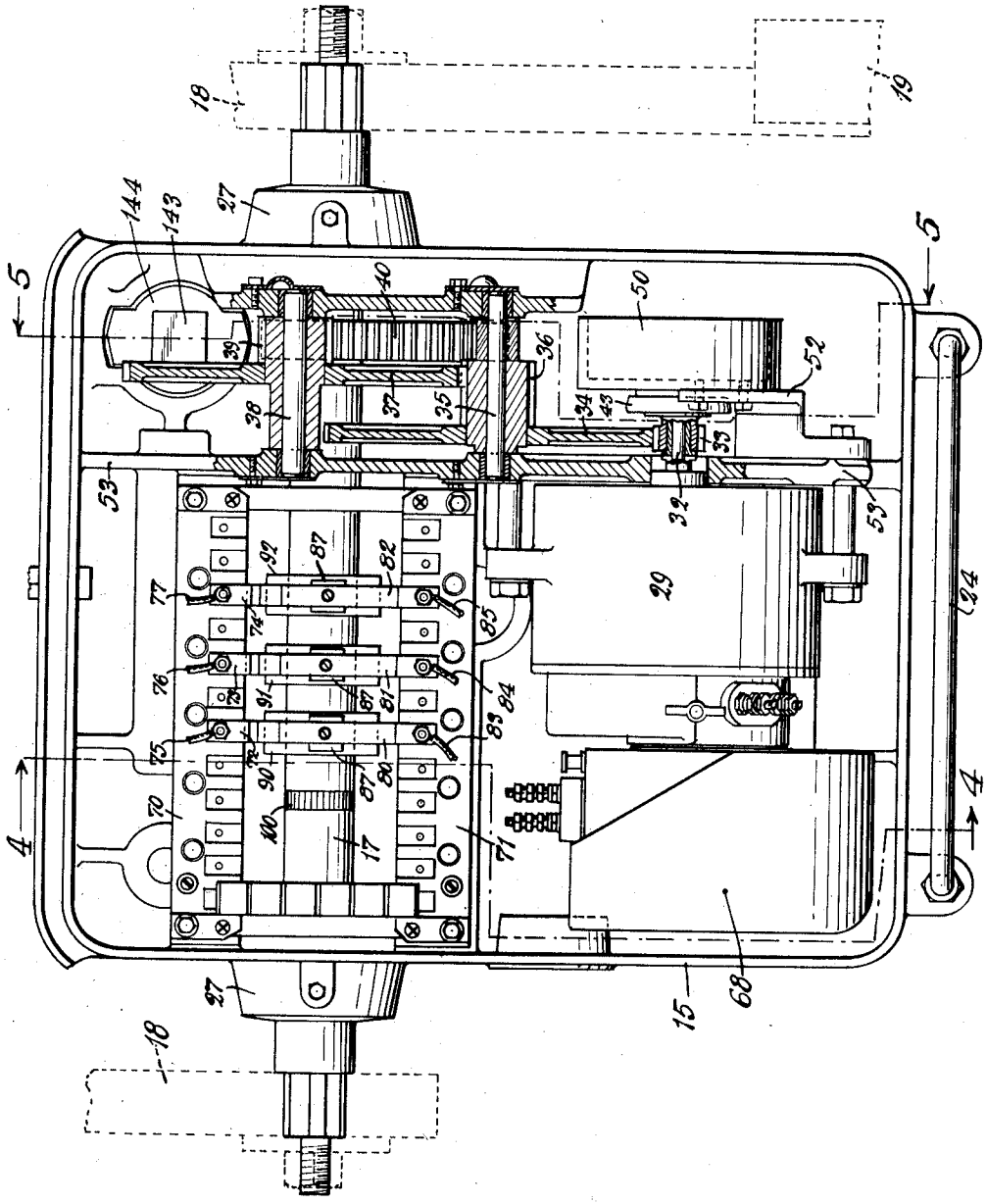


Fig. 3

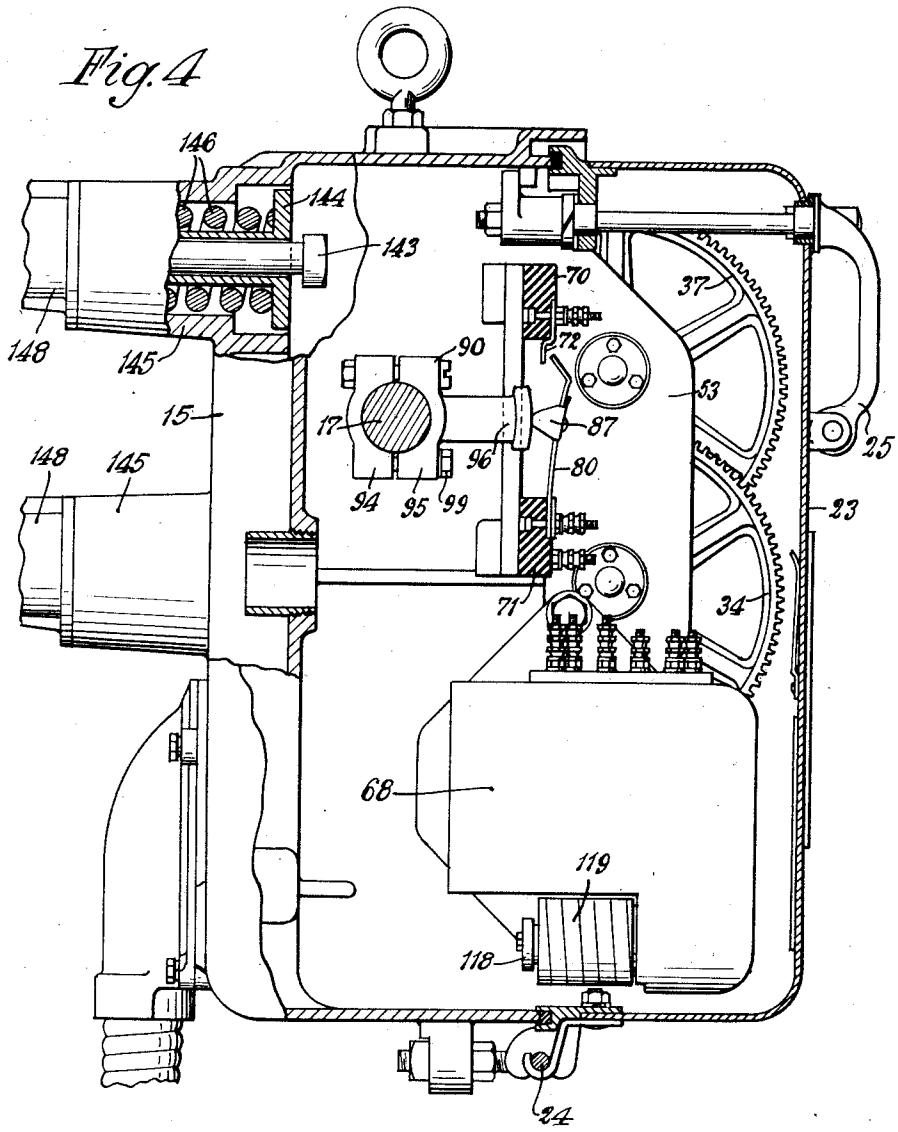
Inventor
Samuel Miskelly
by A. D. Ellis
Attorney.

Nov. 14, 1944. S. MISKELLY 2,362,710

GRADE CROSSING GATE

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Fig. 4



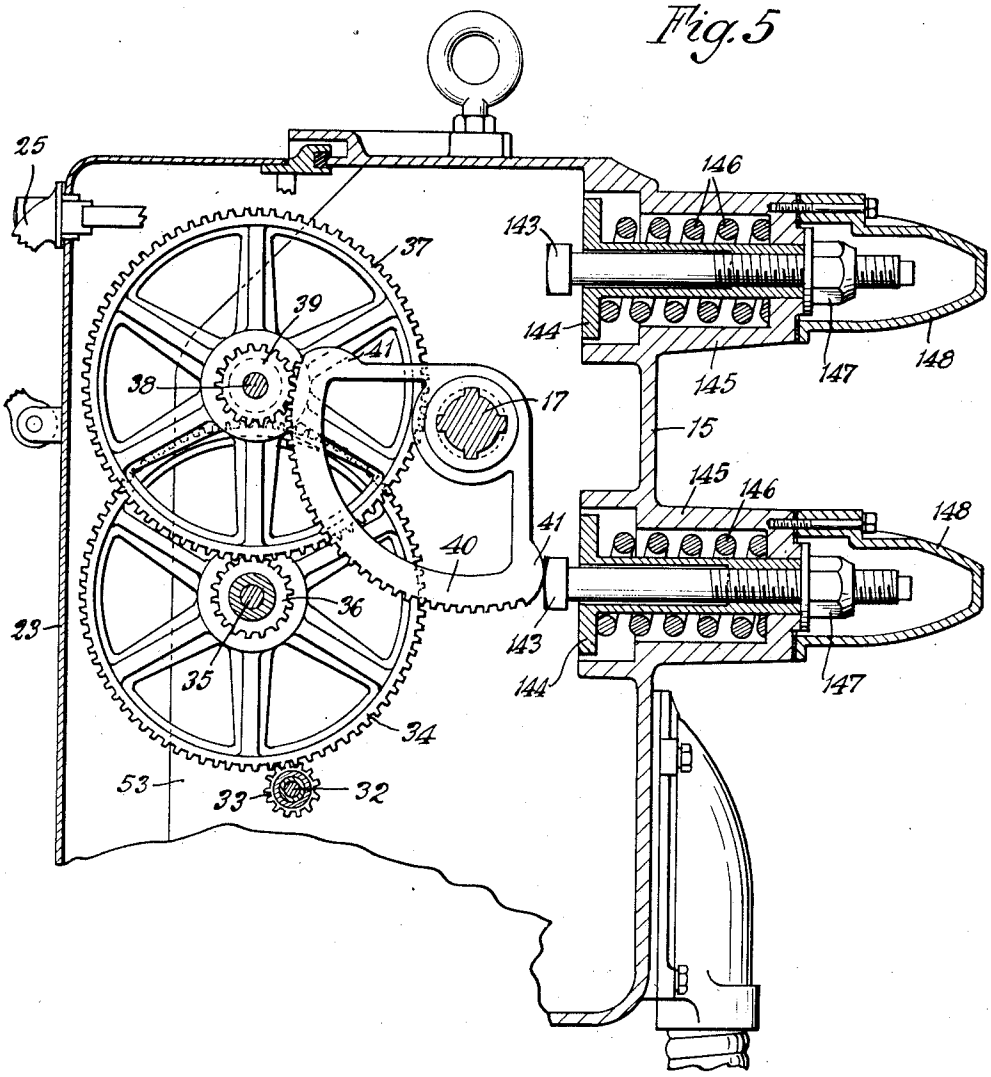
Inventor
Samuel Miskelly
by W. D. Lewis
Attorney.

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GRADE CROSSING GATE

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Fig. 5



Inventor
Samuel Miskelly
by W. A. Lewis
Attorney.

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GRADE CROSSING GATE

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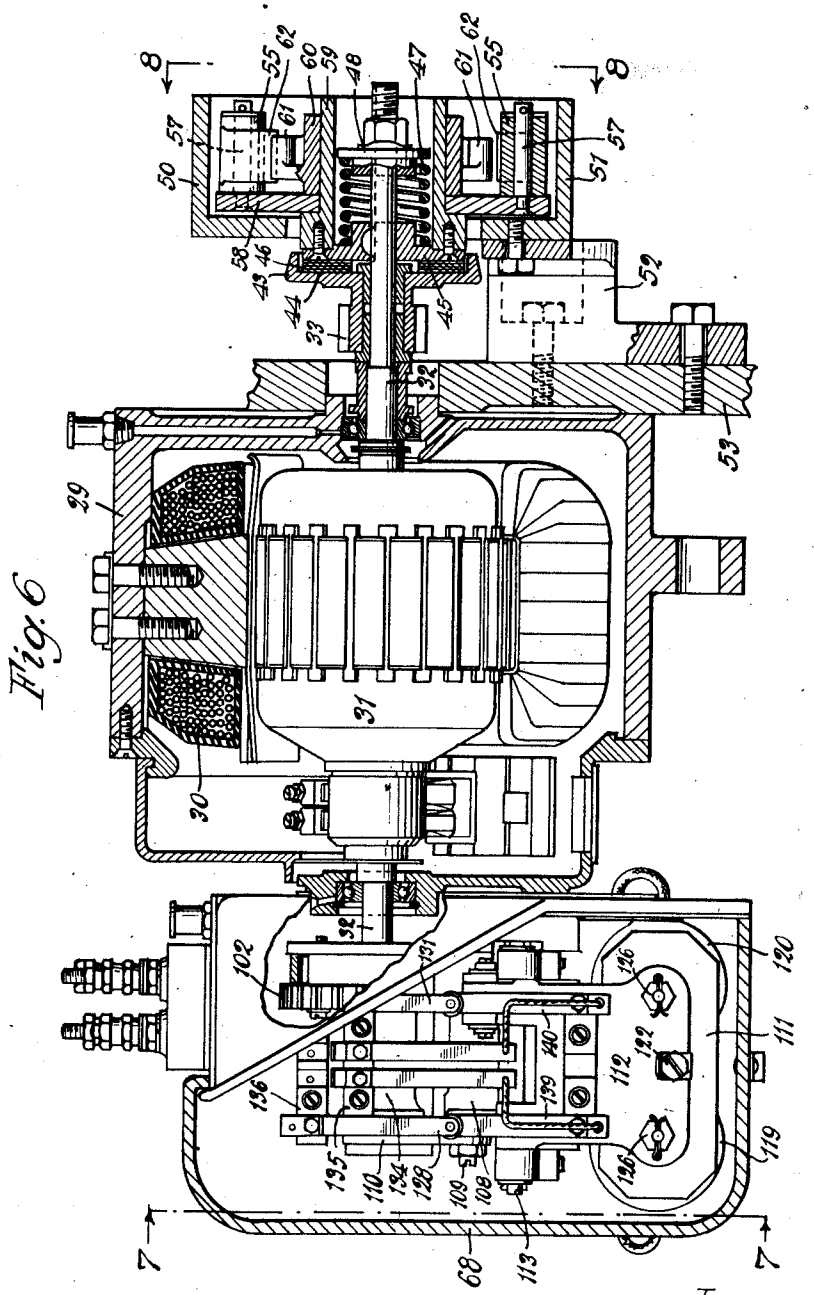


Fig. 6

Inventor
Samuel Miskelly
by W. J. Gleeson
Attorney.

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GRADE CROSSING GATE

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Fig. 7

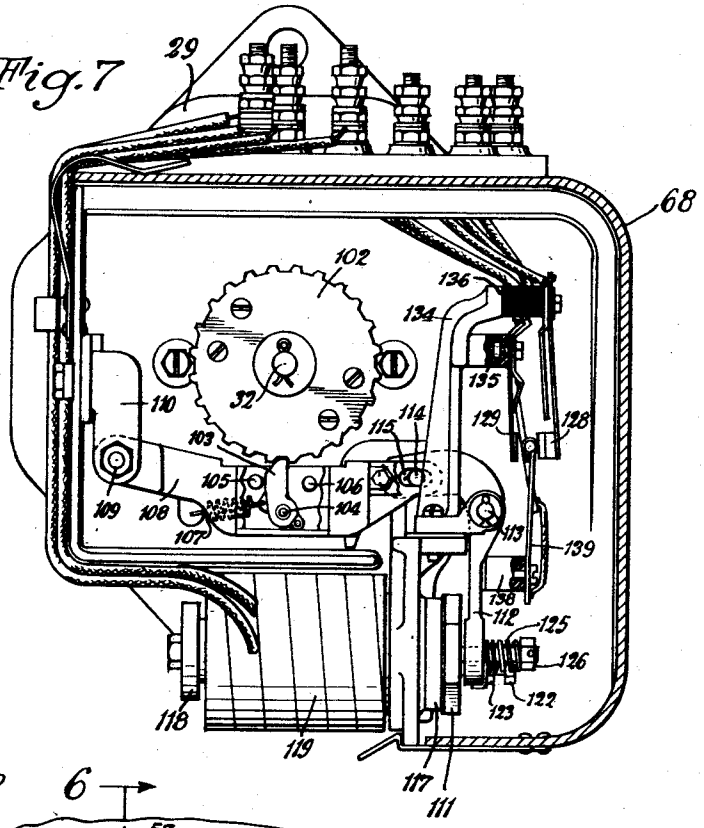
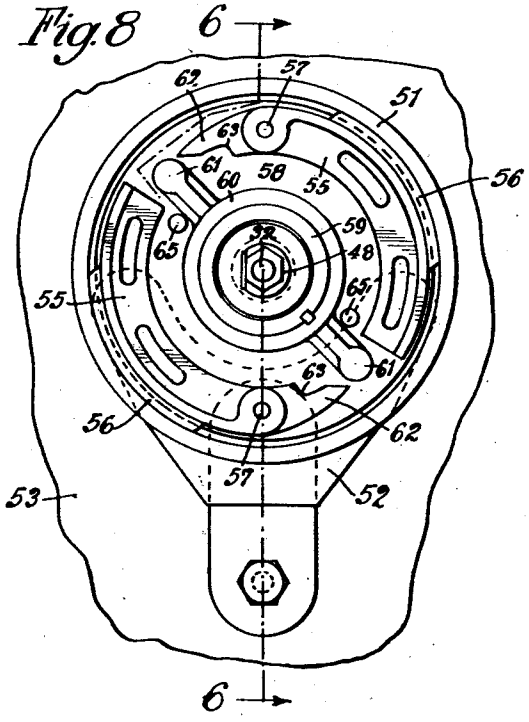


Fig. 8



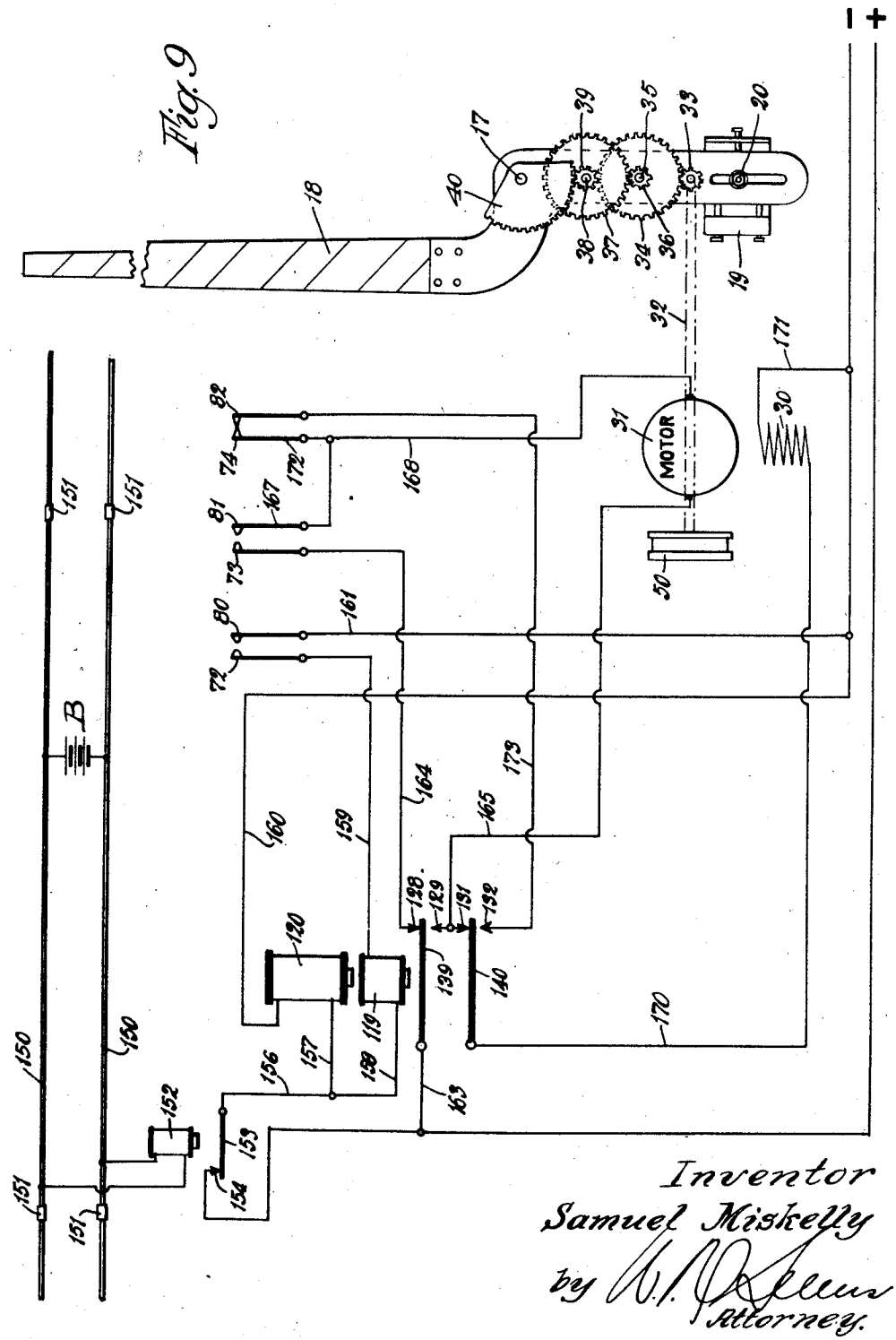
Inventor
Samuel Miskelly
by A. N. Lewis
Attorney.

Nov. 14, 1944. S. MISKELLY 2,362,710

GRADE CROSSING GATE

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Fig. 9



Inventor
Samuel Miskelly
by [illegible]
Attorney.

Patented Nov. 14, 1944

2,362,710

UNITED STATES PATENT OFFICE

2,362,710

GRADE CROSSING GATE

Samuel Miskelly, Downers Grove, Ill., assignor to Western Railroad Supply Company, Chicago, Ill.

Application April 21, 1941, Serial No. 389,541

9 Claims. (Cl. 39—7)

The present invention relates to railroad grade crossing gates and more particularly to a new and novel grade crossing gate-actuating mechanism which is so constructed and arranged as to provide positive performance under all operating conditions and which is of great simplicity.

The grade crossing gate located at the intersection of the railroad and the highway plays an important part in American life today. Upon it reliance is placed by travelers both upon the railroad and upon the highway. Such gates must be reliable in that they must be positive acting under all conditions. It is not sufficient that these gates perform their warning and life-protecting function when conditions are most favorable, but rather it is necessary and to a higher degree that they perform their function under adverse conditions. It is to a gate which is so characterized that the present invention is directed. A gate which will move positively to both the raised and the lowered positions against the opposition of adverse winds and under the added loads of collected ice. Its electric circuit is relatively simple, in fact simpler than many gates which do not incorporate its advantageous characteristics.

It is an object of the present invention to provide a new and improved grade crossing gate. It is another object of the present invention to provide a new and improved grade crossing gate-actuating mechanism. It is a still further object of the invention to provide a new and improved actuating mechanism for grade crossing gates which is positive in its action both when raising and lowering the gate arms. Still another object of the invention is to provide a rugged, dependable grade crossing gate including arm-counterbalancing means, the lowering torque being a maximum with the gate in the clear position. A still further object of the invention is to provide a grade crossing gate in which the gate is power driven in its downward direction, the driving means including automatic means to prevent an excessive speed of arm movement. A still further object of the invention is to provide a grade crossing gate in which the gate arm is motor-driven to the clear position, and is moved to the closed position by a driving motor and by gravity, automatic centrifugally operating braking means being provided to prevent excessive lowering speed. A still further object of the invention is to provide a grade crossing gate in which the electrical connections of the gate-operating motor are controlled by the position of the gate arms and by the holding coil armature.

These and other more specific objects will appear upon reading the following specification and claims and upon considering in connection therewith the attached drawings to which they relate.

Referring now to the drawings in which a preferred embodiment of the present invention is disclosed, and in which the same reference characters refer to the same parts throughout:

Figure 1 is a front view looking towards the railroad track at a grade crossing gate constructed in accordance with the present invention and with the gate arm positioned in the raised or "clear" position;

Figure 2 is a side view of the grade crossing gate illustrated in Figure 1 looking from right to left in that figure;

Figure 3 is a vertical section through the gate-actuating mechanism upon the line 3—3 of Figure 1;

Figure 4 is a vertical section through the gate-actuating mechanism upon the line 4—4 of Figure 3;

Figure 5 is a vertical section upon the line 5—5 of Figure 3 and illustrates the gears connecting the motor shaft to the gate arm shaft, and also the resilient stops which determine the clear and closed positions;

Figure 6 is a section through the slot, motor, and centrifugal brake which are illustrated in side elevation with other parts in Figure 3;

Figure 7 is an end view of the slot mechanism inside the slot casing as seen from the line 7—7 of Figure 6;

Figure 8 is an end view of the centrifugal brake looking in the direction of the arrows upon the line 8—8 of Figure 6;

Figure 9 is a diagrammatic showing of the electrical circuit of the gate-actuating mechanism and its connection to the track relay.

Referring now to Figures 1 and 2 in particular, a complete grade crossing gate constructed in accordance with the present invention is illustrated. A mast 1 having a base 2 is securely fastened on a concrete foundation. The mast supports and carries a warning sign of a common and well known type which is indicated by the reference character 3 which is securely fastened to the mast as by U-bolts 4. Sign 3 carries the usual warning "Stop on red signal" formed of letters 5 which may be of any suitable material and preferably are light-reflecting. A second sign, indicated by the reference character 6 carries an indication of the number of tracks guarded by the gates, and in the present instance reads

"2 track." Cross arms 7 and 8 carry the usual words "Railroad crossing" formed of letters 5 which are also preferably of light-reflecting elements. Flashing lights 10 are secured suitably to the mast 1 by means 11 and in compliance with preferred design include hoods 12 and background discs 13.

The main housing of the gate-actuating mechanism is carried by the mast 1 at about four feet above the base thereof and is fixedly and securely positioned thereon as by securing means 16. Housing 15 contains the entire actuating mechanism of the gate arms which will be hereinafter fully disclosed, but referring particularly to Figures 1 and 2 it is seen that the gate-arm-supporting shaft 17 extends laterally through and from the sides of the housing 15 and supports the lower extremities of a gate arm 18. One side of the gate arm 18 is extended a short distance beyond the pivotal axis comprising the shaft 17 and there carries a counterbalancing weight 19. The latter is seen to be positioned substantially directly below the pivotal axis 17 with the gate arm in the vertical or "clear" position as illustrated in Figure 1. The weight-carrying end of the gate arm, which may be referred to as the heel, adjustably supports the counterbalancing weight 19 so that the latter may be moved manually toward or from the pivoting axis 17 in order that it can exert a greater or a lesser counterbalancing force upon the arm. The manually operable locking means which permit of this weight adjustment are indicated generally by the reference character 20, and may be of any desired well known type. It is noted that the gate arm 18 carries suitable flashing lights 21 which may be of any desired type and which may be operated in any preferred manner.

As previously stated, the gate-actuating mechanism is positioned within the housing 15 and the latter is provided with a cover 23 which may be pivoted manually to an open position upon its supporting means 24 by the use of the handle 25 provided for that purpose. Upon opening the housing 15 by pivoting downwardly the cover 23, the gate arm-actuating mechanism is exposed and is as illustrated in Figure 3 with the exception that certain parts are there shown in section. This structure, and the details comprising it, are disclosed in detail in Figures 3 to 8, inclusive, which are now to be discussed with particularity.

The gate arm shaft 17 is seen to be rotatably mounted within bearings the housings 27 of which are carried by the side walls of the housing 15. To drive the gate arms up and down positively through rotating the shaft 17, there is provided a driving motor which is indicated generally by the reference character 29. Motor 29 includes a stator 30 and an armature 31 which is rotatably mounted upon a motor shaft 32 extended substantially parallel to the gate arm shaft 17. As is best illustrated in Figures 3 and 5, the driving motor shaft 32 is connected to the driven gate arm shaft 17 through a plurality of pinions and gears which effect a reduction in the speed of the gate arm shaft relative to the speed of the motor shaft. Referring to Figure 5 in particular, it is seen that the motor shaft 32 carries a pinion 33 which meshes with a gear 34 which is rotatably mounted upon a shaft 35 and which is fixedly connected to a second pinion gear 36. A second driven gear 37 meshes with the second pinion gear and is driven thereby and is itself carried by a supporting shaft 38. Fixed to and rotating with the second driven gear 37 is a third pinion gear 39 and with this pinion gear meshes a toothed right angle sector or quadrant 40 which is fixed rigidly to and is rotatable with the gate arm shaft 17.

Sector 40 is formed at its extremities with reinforced abutment surfaces, indicated generally at 41, for a purpose hereinafter to become apparent.

While it was stated that the first driving pinion 33 was mounted on the motor shaft 32 and actuated thereby, in fact the drive therebetween is through an overload clutch 43 which is most clearly illustrated in Figure 6. This clutch comprises an enclosing housing 44 fixedly secured to and rotatable with the pinion 33 and which may be formed integrally therewith; a driving plate 45 which is keyed to the shaft 42 and which is spaced from the driven housing 44; and friction plates 46, of which there may be a plurality, which are interposed therebetween. Driving plate 45, while keyed to motor shaft 32, is in fact longitudinally slidable thereon and is spring urged so as to compress the friction plate 46 against the driven housing 44 by means of an encircling coil spring 47 which abuts thereagainst at is inner end and against an abutment 48 at its outer end which is held in position by a nut 49 screw threaded onto the end of the motor shaft. Obviously the construction provides an overload release clutch the characteristics of which are determined by the pressure exerted by the spiral spring 47 which in turn is controlled by the manually operable abutment element and nut 48 and 49, respectively.

A centrifugal brake, indicated generally by the reference character 50, is positioned immediately adjacent the overload clutch 43 and comprises a fixed enclosing drum 51 which is secured to a bracket 52 which in turn is fixedly carried by the wall 53 within the mechanism housing 15. The inner wall surface of drum 51 is smooth and is adapted to act as the brake surface for a pair of centrifugally operated brake shoes 55. Shoes 55 carry brake shoe linings 56 along their outer surfaces, which are curved to conform to the inner surface of the drum 51, and each shoe is pivotally mounted near one of its ends upon a pin 57. Each pin 57 is fixedly carried by a plate 58 upon a cylindrical sleeve 59 which is concentric with the clutch-tensioning spring 47. Sleeve 59 is fixedly secured by screws to the drive plate 45 of the overload clutch. As distinguished from the pin-carrying plate 58, which is relatively loosely mounted upon the carrying sleeve 59, there is provided immediately adjacent thereto and in such position relative thereto as to fix its longitudinal position, a second sleeve 60 which is driven or sweated upon its supporting sleeve 59 so as to be fixed and non-rotatable thereon. Sleeve 60 is formed at diametrically spaced points with radially extending driving abutments or stops 61 which are rounded at their outer extremities. Each of these stops, when the sleeve 60 is advanced in a clockwise direction as viewed in Figure 8, the gate-raising direction, is adapted to contact a cam end 62 of the adjacent brake shoe 55, and to cam that end outwardly so as to move the main body of the brake shoe radially inwardly from contact with the drum 56, the abutment finally seating against the seat 63 formed on the brake shoe to receive it. Upon the opposite side of each driving abutment 61 from the cam end 62 is positioned a pin 65 carried by the plate 58 which also carries the brake shoes 55. In the gate-lowering or counter-clockwise

rotation of the motor shaft, and so of the abutment elements 61 (reference being had again to Figure 8), each of these elements moves from under the end of the adjacent brake shoe 55 and contacts the pin 65 to cause the rotation of the shoe-supporting plate 58 with the motor shaft and in the opposite direction. In this relationship the driving abutments 61 do not cam the brake shoes 55 inwardly but instead permit those shoes to be thrown outwardly by centrifugal force into contact with the enclosing brake drum 51 and to exert a braking force thereagainst which will vary with the speed of rotation of the motor shaft 32 and, of course, of the gate arm shaft 17.

The means which effects the energization of the motor to drive the gate arms upwardly and downwardly under the predetermined conditions which are hereinafter discussed, and which incidentally reverses the direction of rotation of the driving motor 29, comprises generally: (1) a slot 68, which includes certain hold clear magnets and certain contacts; and (2) a plurality of contacts which are positioned and operated by controller cams mounted directly upon the gate arm shaft 17. These latter contacts and their controllers will now be discussed.

Referring now to Figures 3 and 4 in particular, two parallel insulator mountings 70 and 71 are seen to extend substantially parallel to the shaft 17. Spaces are provided on each for a multiplicity of binding posts and contacts and in the commercial embodiment as many of these may be provided as is necessary to operate bells, relays, etc., but for the purposes of the present invention, and for the controlling of the gate-actuating mechanism, there is need but for three pairs of these. The stationary contacts are shown carried by the upper insulator mounting 70 and are indicated by the reference characters 72, 73 and 74, and from these extend leads 75, 76 and 77, respectively. The movable contacts which are adapted to make contact with stationary contacts 72, 73 and 74, respectively, are indicated by the reference characters 80, 81 and 82 and from them extend leads 83, 84 and 85, respectively. Each movable contact carries near its midpoint an insulated abutment element, indicated generally by the reference character 87, which is adapted to be contacted by a controller cam carried by the adjacent gate arm shaft 17 in certain positions of the latter for the purpose of establishing or breaking the contact between each pair of contacts. It is clear that by suitably relating the controller cam relative to the gate arm shaft 17 the individual pairs of contacts can be opened and closed as desired with respect to each other and to the angular position of the gate arms.

The controller cams carried by the gate arm shaft 17 and adapted to position the movable contact elements 80, 81 and 82, are indicated respectively by the reference characters 90, 91 and 92. Each controller cam comprises body sections 94 and 95, the latter including the cam proper indicated at 96. Sections 94 and 95 are interconnected by a pair of parallel screws 98 and 99, the former comprising an adjusting screw, which cooperates with a spiral threaded groove 100 formed in the shaft 17 immediately thereunder, while the second screw 99 is adapted to clamp the two body portions together when the adjustment by means of the adjusting screw 98 has been properly made. The cam controllers 90, 91 and 92 are so positioned angularly relative to the gate arm shaft 17 as to open and close the movable contacts 80, 81 and 82 in the desired sequence and when the gate arm is in certain positions, as will hereinafter be fully explained.

Turning now to the slot, indicated generally by the reference character 68, this device is seen to be positioned immediately adjacent the driving motor 29 upon the opposite side thereof from the overload clutch 43 and also the centrifugal brake mechanism 50. A primary function of the slot is to secure the gate arms 18 in the open or clear position when the track section which controls the gate is clear. This primary function is accomplished by the provision of a ratchet gear 102 which is mounted upon and rotatable with the extended end of the motor shaft 32. Cooperating with the rotatable ratchet 102 is the locking or retaining pawl 103 which is pivotally mounted at 104 so as to be angularly movable between two stop pins 105 and 106, there being a spiral spring 107 provided which positions the pawl 103 substantially centrally between the two stop pins and which resiliently opposes its movement in the direction of the pin 106. The pawl 103 and its pivot point is carried by a relatively heavy locking arm 108 which is pivotally mounted at 109 upon a bracket 110 fixed to the rear wall of the slot casing. Pawl-carrying arm 108 is a weighted element which tends under the force of gravity to fall from the ratchet wheel 102 to a lower position in which the pawl 103 just clears the ends of the teeth of ratchet 102. At the outer or forward end of pawl-carrying arm 108 is an L-shaped armature bar 112 pivoted at 113 and carrying a pin at its upper end, as indicated at 114, which pin supports the arm 108 through slidingly seating in a slot 115 formed therein. As is perhaps best illustrated in Figure 6, the pawl-carrying arm 108 is in fact a pair of arms as is the upper end of the armature bar 112. At its lower end, however, the armature bar 112 is a plate-like element which is connected to the armature proper 111.

The pivotal movement of the armature bar 112, and so the raising and lowering of the pawl-carrying arm 108, is accomplished by the movement of the armature 111 toward and from the magnetic pole face 117 which extends adjacent and parallel thereto. The pole face 117 carries a core, as indicated at 118, and is adapted to be magnetized by one or both of a plurality of coils indicated at 119 and 120, respectively. The coils 119 and 120 may have divided windings which have high and low resistance characteristics, or one coil may be a high resistance coil and the other a low resistance coil. The low resistance coil in the present example will be illustrated by the coil 119, while the high resistance coil will be indicated by the reference character 120. In either event the high resistance coil is adapted to consume a lesser amount of current and to perform the function of an armature-holding coil, while the second low resistance coil performs the function of an actuating coil and is more powerful as it draws a greater current. The armature arm 112 at its lower end has a movement toward and from the pole face 117, together with the armature 111, which is substantially one quarter inch in extent and which is controlled by an adjustable stop screw indicated generally by the reference character 122 and which includes a locking nut 123. A pair of coil springs 125, encircling armature-carried headed bolts 126, are positioned at the opposite ends of the armature bar 112 and contact the outer face thereof. These springs serve as resilient buffers and take-ups and

not only limit the force exerted by the armature 111 on the pawl 103 in holding the latter in locking position, but also acts as a shock absorber to absorb the shock when the heavy pawl-carrying arm 108 falls from its locking position under the force of gravity.

This construction of the slot to perform its primary locking function is seen, then, to comprise a rotatable ratchet wheel 102 which is adapted to be locked in various positions by a pivoted pawl 103, the position of which is controlled by a pair of hold clear coils 119 and 120, one of which is a low resistance high-current-consuming actuating coil and the other of which is a high resistance low-current-consuming holding coil. Additionally, the curvature of the teeth of the ratchet 102 and the shape and position of the pawl 103 are such that with the pawl-carrying arm 108 in its upper position and the pawl 103 in contact with the ratchet teeth, the ratchet wheel will be locked from rotation in a clockwise direction, as seen in Figure 7, but a tendency to move in the counter-clockwise direction will result in the pivotal movement of the pawl 103 to the stop 106, the pawl being so shaped that the ratchet teeth can then pass thereover.

In addition to its primary function of locking in position the motor shaft 32, and so the gate arm 17 which is gear connected thereto, the slot 68 has the function of opening and closing certain contacts which will now be described. These contacts are seen to comprise two pairs of spaced stationary flexible front and back contacts which are illustrated in Figures 6, 7 and 9, the first pair being indicated by the reference characters 128 and 129, and the second pair by the reference characters 131 and 132, respectively. Both pairs of stationary contacts are supported upon a bracket arm 134 within the slot and directly upon insulator mountings 135 and 136 carried by that bracket. Suitable current-conducting leads are connected to these front and back contacts as will hereinafter be set forth. Attention is directed to the fact that each front and back contact includes a spring strip which positions it for slight displacement forwardly or rearwardly of the slot. Preferably the front contacts 128 and 131 are of graphite while the rear contacts 129 and 132 are silver faced. Carried by the armature bar 112, and more directly by an insulated mounting 138 thereon, are a pair of movable contacts 139 and 140, the former being adapted to make contact selectively with front and back stationary contacts 128 and 129, while the second movable contact 140 is adapted to make selective contact with stationary front and back contacts 131 and 132. As movable contacts 139 and 140 move with the armature bar 112, it is clear that they will make simultaneous contact with the front contacts or with the two rear contacts.

From the foregoing it is clear that when the armature 111 is drawn against pole face 117 upon the actuating hold clear coils 119 being energized, that movable contacts 139 and 140 will make contact with the front contacts 128 and 131. It is also clear that with the hold clear coils de-energized and the pawl-carrying arm 108 in its lower position, and therefore with the armature 111 spaced from the pole face 117, that the movable contacts 139, 140 will make contact with the back contacts 129 and 132.

The foregoing substantially completes the mechanism which raises and lowers the gates, holds them in given positions, and opens and closes the various contacts which are necessary for the mechanism's operation. The operation of the construction is much improved, however, by the presence of bumper elements which absorb the shock incident to the gate reaching the end of its movement. Reference to Figures 4 and 5 disclose that above and below the gate arm shaft 17, and positioned so as to be abutted by the reinforced portions 41 upon the toothed quadrant 40, are a pair of spring-held abutment pins 143. These pins are screw threaded into the flanged sleeve 144 which seats slidingly in a socket 145 formed in the side wall of the mechanism casing 15. A coiled spiral spring 146 abuts the outer wall of the socket 145 and at its inner end abuts the head or flange of the sleeve 144 and urges that element, together with the abutment pin 143 screw threaded therein, in the direction of the interior of the mechanism casing 23. The position of the head of pin 143 is determined by its position in the sleeve 144 and by a positioning nut 147 which is screw threaded upon its projecting outer end outside of the socket 145. A screw-held detachable protecting cap 148 encloses and protects the adjustment nut 147.

The abutment pins 143 are so positioned relative to the arcuate sector 40 that immediately prior to the gate arm reaching its upper or clear position the upper abutment surface 41 will contact the upper abutment pin 143. With the gate arm moving to its lower position the lower abutment surface 41 will contact the lower pin 143 just prior to reaching that position, and remains in contact as is clearly illustrated in Figure 5. When contacted a pin 143, together with its sleeve 144, is forced outwardly against the resisting force of the spring 146 by the gate arm momentum and in opposing each movement reduces the shock of stopping the gate in its final position. The strength of the spring 146 and the position of the pin 143 are so adjusted as to absorb all of the shock.

Turning now to Figure 9 in particular, the electrical circuit of applicant's device and its relationship to the controlling track and track relay is clearly illustrated. In the diagrammatic circuit illustrated a track comprising rails 150 is divided into an insulated section by insulators 151. Across this track section is a battery B and a track relay 152 having a movable contact 153. The front contact 154 of the track relay is directly connected to line while to the movable contact 153 is connected a lead 156 which divides into conductors 157 and 158 which connect to the low resistance actuating coil 119 and the high resistance coil holding 120, respectively. From the former a lead 159 extends to stationary contact 72 which is one of the contacts controlled by the gate arm shaft 17 as above described. From the high resistance hold clear coil 120 a conductor 160 extends directly to the opposite side of the incoming power line. It is clear then that this latter high resistance hold clear coil will at all times be energized with the track relay picked up, that is, at all times when the track is in the clear condition. A lead 161 connects the movable contact 80, which cooperates with stationary contact 72, directly to the opposite side of the incoming power line and so it is clear that the current will pass through the actuating low resistance hold clear coil 119 whenever both the track relay and the contacts 72 and 80 are closed. The controller cam 90 which controls the opening and closing of contacts 72 and 80 by directly positioning contact 80, is so positioned relative to the gate arm shaft 17 that

contacts 72 and 80 are closed with the gate arm between 0° and 88° and are open at 88° to 90°, the latter being the vertical position. This de-energization of the actuating low resistance coil 119 between 0° and 88° is desirable in that when the gate arm is in the vertical position and the ratchet-locking pawl 103 is in operative locking position relative to the ratchet 102, the armature 111 having been moved magnetically to its position adjacent the pole face 117, the magnetic force required to hold the parts is less than the force required to initiate the movement to that position, and the assistance of the coil 119 is not required. The strength of the high resistance holding coil is sufficient to maintain the locking position whereas it might be insufficient to accomplish the movement of the parts to that position in the first place.

The movable contact 139, which is actuated by the hold clear coils 119 and 120, is seen to be connected by a conductor 163 to the positive incoming current source and is adapted to make contact, as previously described, between front and back contacts 128 and 129. Front contact 128 is connected by conductor 164 directly to the stationary contact 73 controlled by the gate shaft 17 while the back contact 129 has a common connection with the front contact 131 and, through a conductor 165, connects to one side of the motor armature 31. The gate arm-controlled movable contact 81, which cooperates with the stationary contact 73, connects through a conductor 167, and then conductor 168, to the opposite side of the motor armature 31. It is clear that with the hold-clear-coil actuated contact 139 in its front position, and so in contact with front contact 128, the current comes from the positive side of the incoming line through the lead 164 to contacts 73 and 81, and then to one side of the motor armature. Also it is clear that when the hold clear coils are de-energized and the movable contact 139 is in its de-energized position, in which it makes contact with back contact 129, that a connection is made therethrough and through the lead 165 from the positive side of the incoming line to the opposite side of the armature. In other words, the movement of the contact 139 reverses the connection of the positive side of the incoming current to the motor armature 31. The controller cam 91 upon the gate arm shaft 17 is so positioned angularly that contacts 73 and 81 are closed between 0° and 88° and open between 88° and 90°, exactly as in the case of contacts 72 and 80.

The second movable slot-controlled contact 140 is seen to be connected at its heel by a conductor 170 to one side of the motor field 30, the opposite side of the field being connected by a conductor 171 to the negative side of the current source. Movable contact 140 is adapted to make contact with front contact 131 or back contact 132, as described above, and when in its energized position and in contact with the latter conducts current from the negative current source which has passed through the motor field 30 directly to one side of the motor armature 31. When the contact 140 is in this position, it is to be noted, the first movable slot contact 139 is connected to the opposite side of the motor through contact 128, lead 164, and gate-arm-controlled contacts 73 and 81, the closed position of the latter being assumed. With the movable slot-controlled contact 140 in its down or de-energized position it makes contact with back contact 132 which is directly connected by means of a conductor 173 to the movable contact 82 actuated and controlled by the gate arm shaft. Cooperating contact 74, which is adapted to be engaged by contact 82, is connected through a conductor 172 to the conductor 168 and by the latter to one side of the motor armature 31. When the slot-controlled contact 140 is in this second and de-energized position it is to be noted that the other slot-controlled contact 139 has moved into contact with back contact 129 and that current from the positive source is conducted to the opposite side of the motor through the lead 165.

Controller cam 92 carried by the gate arm shaft is so positioned and contoured as to open contacts 74 and 82 between 0° and 45° and to close them between 45° and 90°. When contacts 74 and 82 are closed and the slot-controlled contacts 139 and 140 are in their de-energized positions, the motor is rotating in a direction to drive the gate downwardly. The angle through which the motor positively drives the gate downwardly may be varied to suit in that the closure period of contacts 74 and 82 may be changed from 90° to 45° to any desired angularity, as for example, 90° to 5°.

The driving motor is indicated in Figure 9 and is seen to be directly connected to the gate arm shaft 17 through the aforedescribed gears and pinions. The operation of the unit will now be described.

In the track clear condition the track relay 152 is energized and the contacts 153 and 154 are closed. Energy passes through the holding coil 120 and the ratchet-locking pawl 103 is held in its upper locking position and the clockwise rotation of the motor shaft 32 (as viewed in Figure 7), which would result in a lowering of the gate, is prevented. The gate is then held in the vertical position and no current passes through the actuating hold clear coil 119, the contacts 72 and 80 being open, their closed range being 0° to 88°. Contacts 73 and 81, having the same range, are also open and current cannot pass to the motor from that source. Contacts 74 and 82 are closed but no current to the motor can pass therethrough as the sole possible source of incoming current, comprising the lead 173, connects to the contact 132 which is open. In this relationship, it is seen, therefore, that the gate arm is in the vertical position and is retained there by the slot.

Upon a train entering the insulated track section, formed by the rails 150, the track relay 152 is shorted and contact 153 falls from contact 154. The slot hold clear coils 119 and 120 are immediately de-energized and the pawl arm 108 carrying the locking pawl 103 falls permitting the motor shaft 32 to rotate in a clockwise direction, as viewed in Figures 1 and 7, and the gate arm moves downward. The falling of the pawl-carrying arm 108 pivots the armature bar 112 counterclockwise about its pivot point 113, as viewed in Figure 7, and with the bar the slot-actuated contacts 139 and 140 move from their front contacts 128 and 131 to their back contacts 129 and 132. Current then flows from the positive source through the contacts 139 and 129, the lead 165 to one side of the motor, and from the other side of the motor through the leads 168, 172 to the closed contacts 74 and 82 (closed range=90° to 45°) and therefrom through the lead 173 to the back contact 132 from whence it passes through the movable slot contact 140 to the lead 170, through the motor field 30, and then by the lead 171 back to the negative side of the line. When

so connected the motor drives the gate arm down and this operation continues until the contacts 74 and 82 are opened when the gate arm reaches the selected angular position which is between 45° and 5° preferably. Thereafter the downward movement of the gate continues under gravity and by virtue of its own momentum. As the gate arm moves downward the net torque due to gravity acting upon the gate arm is reduced by gravity acting upon the counterbalance weights 19, and constantly decreases, it having been a maximum with the gate in the clear position, in which the counterbalancing weight 19 had a zero lever arm, and it being a minimum with the gate in substantially the horizontal position. This decrease in the downward torque due to gravity is due to the fact that the center of gravity of the counterbalancing weight 19 increases its lever arm from zero to a maximum whereas the gate arm center of gravity has an initial lever arm and does not increase in the same proportion.

As the gate approaches the end of its movement the lower shock-absorbing abutment pin 143 is contacted by the sector 40 and the gate is eased to its final horizontal position. The pairs of contacts 72, 80 and 73, 81 respectively, are closed, in fact have been closed since the gate arm moved downwardly past 88° from the horizontal, but no current passes therethrough or to the motor. This is so for pair 73, 81 for with the slot de-energized its contacts 139, 128 are open. As to pair 72, 80, the opening of the track relay 152 caused its movable contact 153 to move to open position thereby cutting off circuit from both hold clear coils 119 and 120 and so from contacts 72, 80 which are in series with coil 119.

As long as the train remains in the insulated track section the relationship just described continues and the motor remains de-energized as do the hold clear coils 119 and 120.

Upon the train passing from the insulated track section the track relay 152 is again energized and movable contact 153 picks up and contacts front contact 154, whereupon hold clear coils 119 and 120 are energized and the pawl 103 is moved by its carrying arm 108 to its upper or ratchet-locking position. As described, however, the pawl shape and position are so related to the ratchet and its teeth that the movement of the ratchet in a counter-clockwise direction, as viewed in Figure 7, is not prevented and when the motor shaft 32 is moving in that direction the gate arm is being raised. Also, as a result of the energization of the hold clear coils, 119 and 120, the movable contacts 139 and 140 are moved from their back contacts 129 and 132 and into contact with their front contacts 128 and 131. Immediately current passes from the positive source through contact 139, lead 164 to the closed contacts 73, 81, and from there through conductors 167 and 168 to one side of the motor armature 31; and from the opposite side of the motor through the lead 165 to the contact 131 and out through the contact element 140 to the lead 170 from which it passes through the field winding 30 and through the lead 171 to the negative source of current. The motor is thus energized and with reversed polarity and the gate arm begins to rise. This movement under the driving force of the motor continues until the gate arm has reached 88° from the horizontal at which time contacts 73 and 81 break and current to the motor is cut off. At the same time contacts 72 and 80 open and current through the low resistance actuating hold clear coil 119 is cut off, the current continuing to pass through the high resistance coil 120, however. The circuit is now back in the condition in which it originally was as described above in the track clear condition, and now awaits the entrance of another train into the section in order to drive the gate arm downwardly. As in the case of its downward movement, the shock of the gate arm stopping in its uppermost position was absorbed by the quadrant 40 contacting the upper abutment pin 143. Under certain external conditions the gate arm will tend to go downwardly at an excessive rate of speed, due either to the wind blowing behind the gate to force it downwardly, or to the presence of collected ice which increases the weight of the gate arm. To prevent an excessive lowering speed under these and other conditions the centrifugal brake 50 was provided. When the motor is driving the arms upwardly, the direction of rotation of the motor shaft 32 is such that each of the abutment elements 61 on the sleeve 60, which sleeve is at all times fixed relative to the shaft, forces itself under the adjacent cam end 62 of the brake shoe 55, and moves those elements inwardly so that it can perform no braking action against the enclosing drum 51. With the motor shaft rotating in the opposite direction upon the gate arm being lowered, however, the abutment element 61 moves from under the cam end 62 and contacts the adjacent pin 65. In this relationship the brake shoes 55 are free to fly outwardly under centrifugal force and should the arms move downwardly at excessive speed, the motor shaft would also rotate at an excessive speed and the shoes 55 would be thrown centrifugally against drum 51. The friction between the brake shoes 55, and more particularly between the brake lining 56 and the drum, provides a load which brakes and retards the lowering speed.

Should anything obstruct the movement of the gate arm in either direction the shearing and breaking of a gear or pinion is prevented through the provision of the overload clutch 43 in which the tension upon the spring 47 determines the force required to make the clutch slip and should be so adjusted that relative movement will take place between the two parts of the clutch, that is parts 44 and 45, before a load point has been reached which could result in the breakage of any gear or pinion.

I claim:

1. In a railroad crossing signal, a gate arm pivoted about an horizontal axis, counterbalancing means connected to said arm and arranged as to exert a greater counterbalancing force with the arm in the "warning" position and a minimum force with the arm in the "clear" position, an actuating mechanism geared to said arm and including a reversible electric motor and an electric circuit to pass current through said motor in opposite directions in different angular positions of said arm, and a centrifugal brake connected to the motor shaft and operative above a predetermined speed to limit the speed of movement of said gate arm in one direction only.

2. In a railroad highway crossing gate, a gate arm, a gate-arm-actuating mechanism comprising a reversible driving motor connected to said arm for up and down propulsion, a centrifugal brake connected to the shaft of said motor at one side thereof, and an overload clutch between said brake and said motor and including a part ro-

tatable with and axially displaceable with a part of said brake.

3. In a railroad highway crossing gate, a gate arm, a gate-arm-actuating mechanism comprising a reversible driving motor connected to said arm for up and down propulsion, said motor including a stator and a rotor having a shaft, a centrifugal brake including rotatable parts carried by said shaft at one end, an overload clutch on the same end of said shaft positioned between said brake and said motor and having parts in common with said brake, and a slot to lock said shaft against rotation positioned upon the opposite side of said rotor and including rotatable parts carried by said shaft.

4. In a railroad highway crossing gate, an arm pivoted for vertical movement between an horizontal "warning" position and a vertical "clear" position, counterbalancing means connected to said arm and arranged to exert a maximum counterbalancing force with said arm in the horizontal position and a minimum force with said arm in the vertical position, means positively to drive said arm in both directions, and centrifugally operated brake means operable at any time in the presence of excessive speed to limit the speed of descent of said arm.

5. In a railroad highway crossing gate, an arm pivoted for vertical movement between an horizontal "warning" position and a vertical "clear" position, counterbalancing means connected to said arm and arranged to exert a maximum counterbalancing force with said arm in the horizontal position and a minimum force with said arm in the vertical position, means positively to drive said arm in both directions, and a combination overload release clutch and centrifugal brake to connect said driving means to said arm and to limit the speed of descent of said arm.

6. In a railroad highway crossing gate, an arm pivoted for vertical movement between a horizontal "warning" position and a vertical "clear" position, counterbalancing means connected to said arm and arranged to exert a maximum counterbalancing force with said arm in the horizontal position and a minimum force with said arm in the vertical position, means positively to drive said arm in both directions, and centrifugally operated brake means to limit the speed of descent of said arm and including means to render itself inoperative in the movement of said arm from the horizontal to the vertical position.

7. In a railroad highway crossing gate, an arm pivoted for movement in a vertical plane, counterbalancing means to exert a minimum torque with said gate in the vertical position, driving means to lift said arm from the horizontal to the vertical position and to lower said arm, centrifugal brake means including a stationary drum and a shoe to limit the speed of descent of said arm and including means to cam said shoe from contact with said drum with said arm ascending.

8. In a railroad highway crossing gate, an arm pivoted for movement in a vertical plane, counterbalancing means to exert a minimum torque with said gate in the vertical position, driving means to lift said arm from the horizontal to substantially the vertical position and to drive said gate downwardly from the vertical position to approximately 45° from the horizontal with sufficient speed to insure its descent to the horizontal position by its own momentum and under the influence of gravity only.

9. In a railroad highway crossing gate, an arm pivoted for movement in a vertical plane, counterbalancing means to exert a minimum torque with said gate in the vertical position, driving means to lift said arm from the horizontal to substantially the vertical position and to drive said gate downwardly from the vertical position to approximately 45° from the horizontal with sufficient speed to insure its descent to the horizontal position by its own momentum and under the influence of gravity only, and centrifugal brake means to limit the speed of descent of said arm and including means to render itself inoperative in the movement of said arm to the vertical position.

SAMUEL MISKELLY.