Sept. 8, 1942. S. MISKELLY 2,295,419

AUTOMATIC CROSSING GATE

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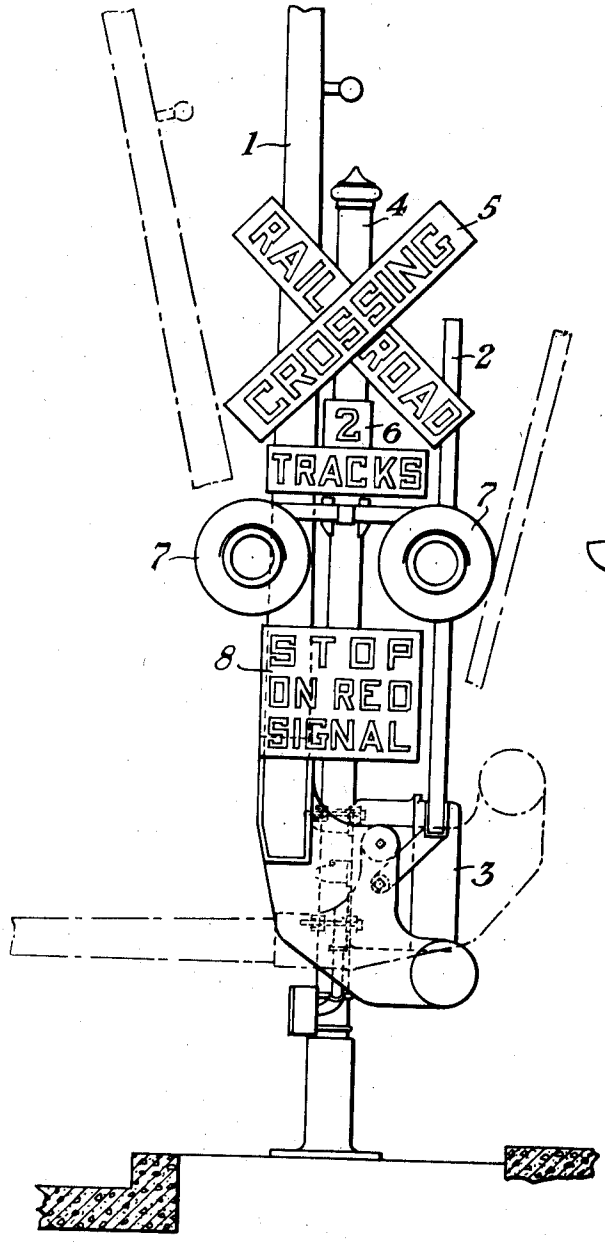


Fig. 1.

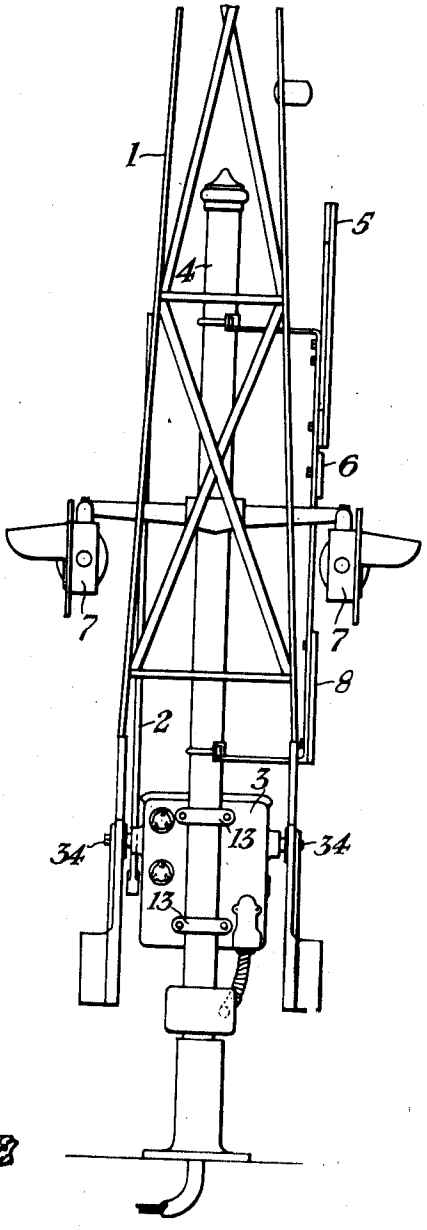


Fig. 2.

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AUTOMATIC CROSSING GATE

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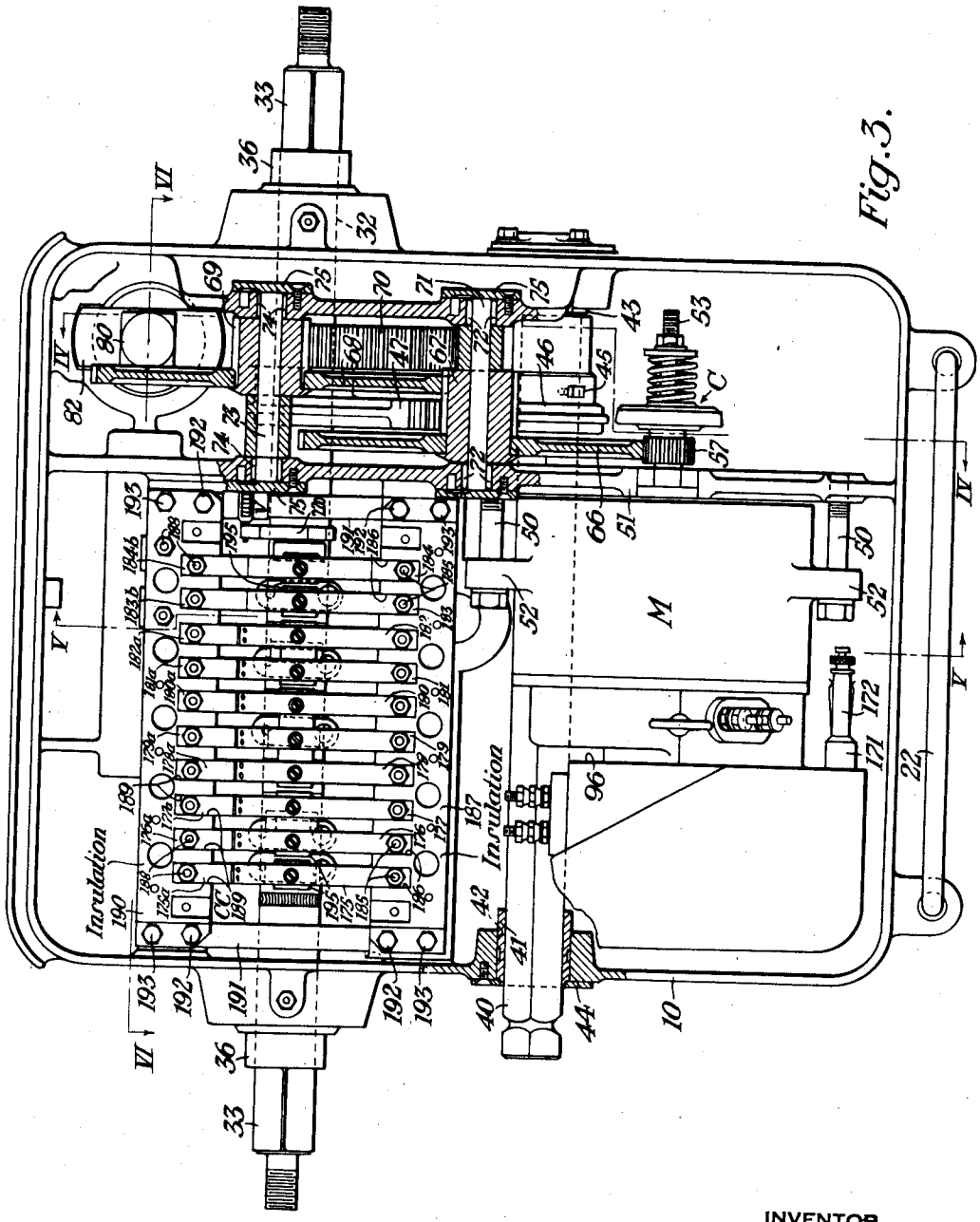


Fig. 3.

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AUTOMATIC CROSSING GATE

Filed March 10, 1939 7 Sheets-Sheet 3

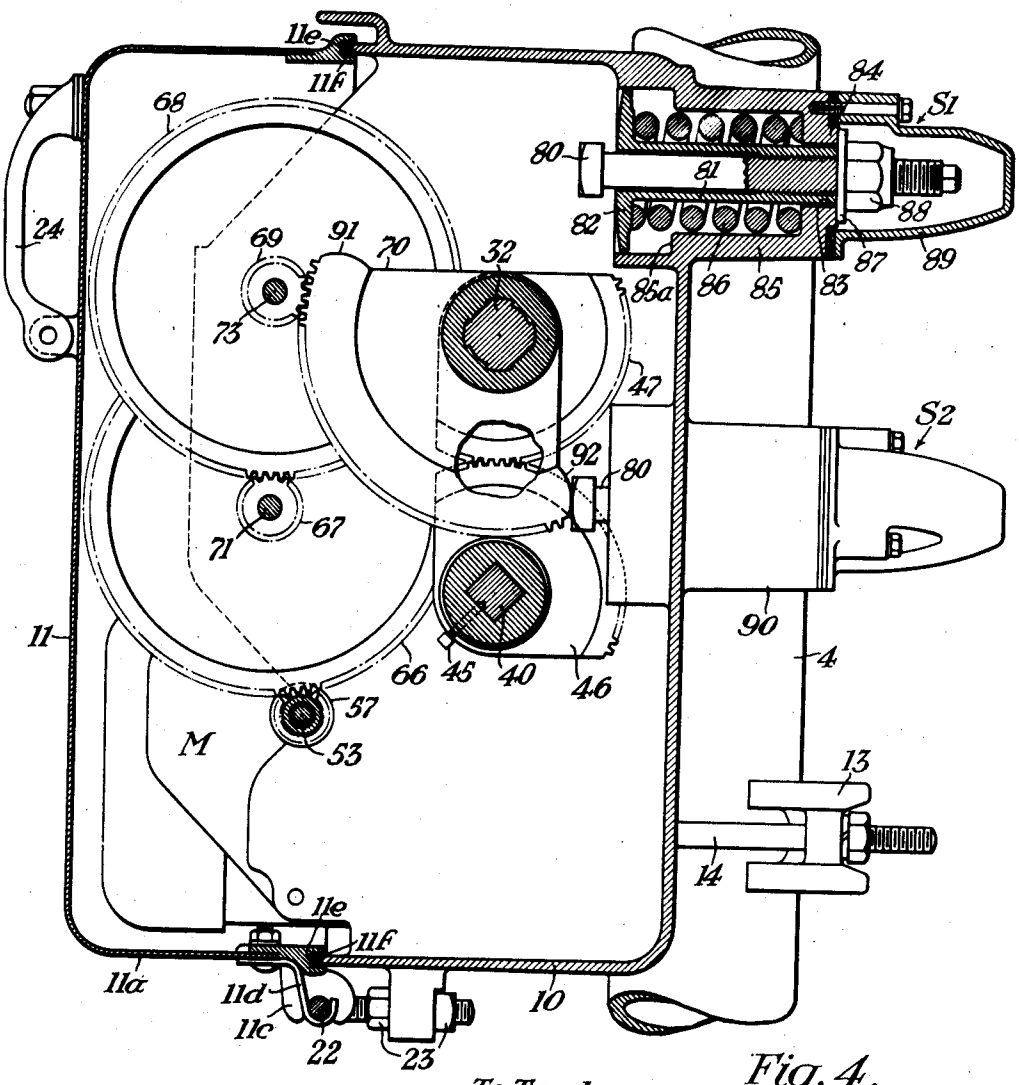


Fig. 4.

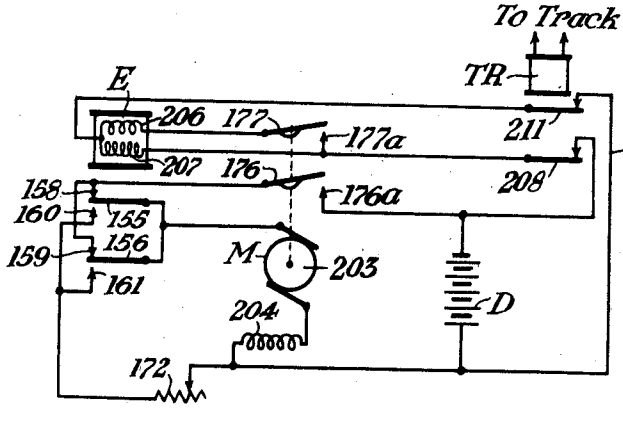


Fig. 14.

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AUTOMATIC CROSSING GATE

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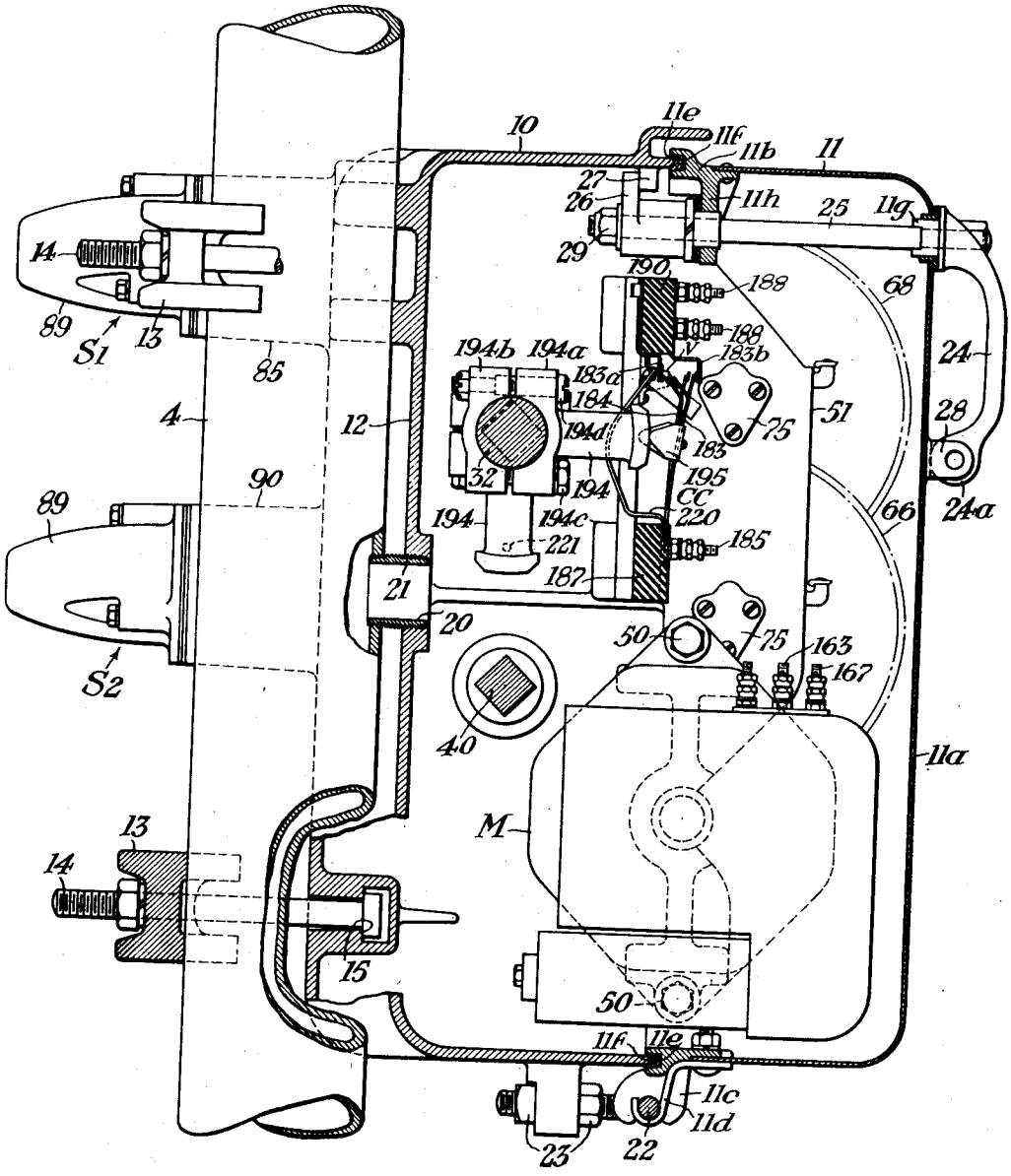


Fig. 5.

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AUTOMATIC CROSSING GATE

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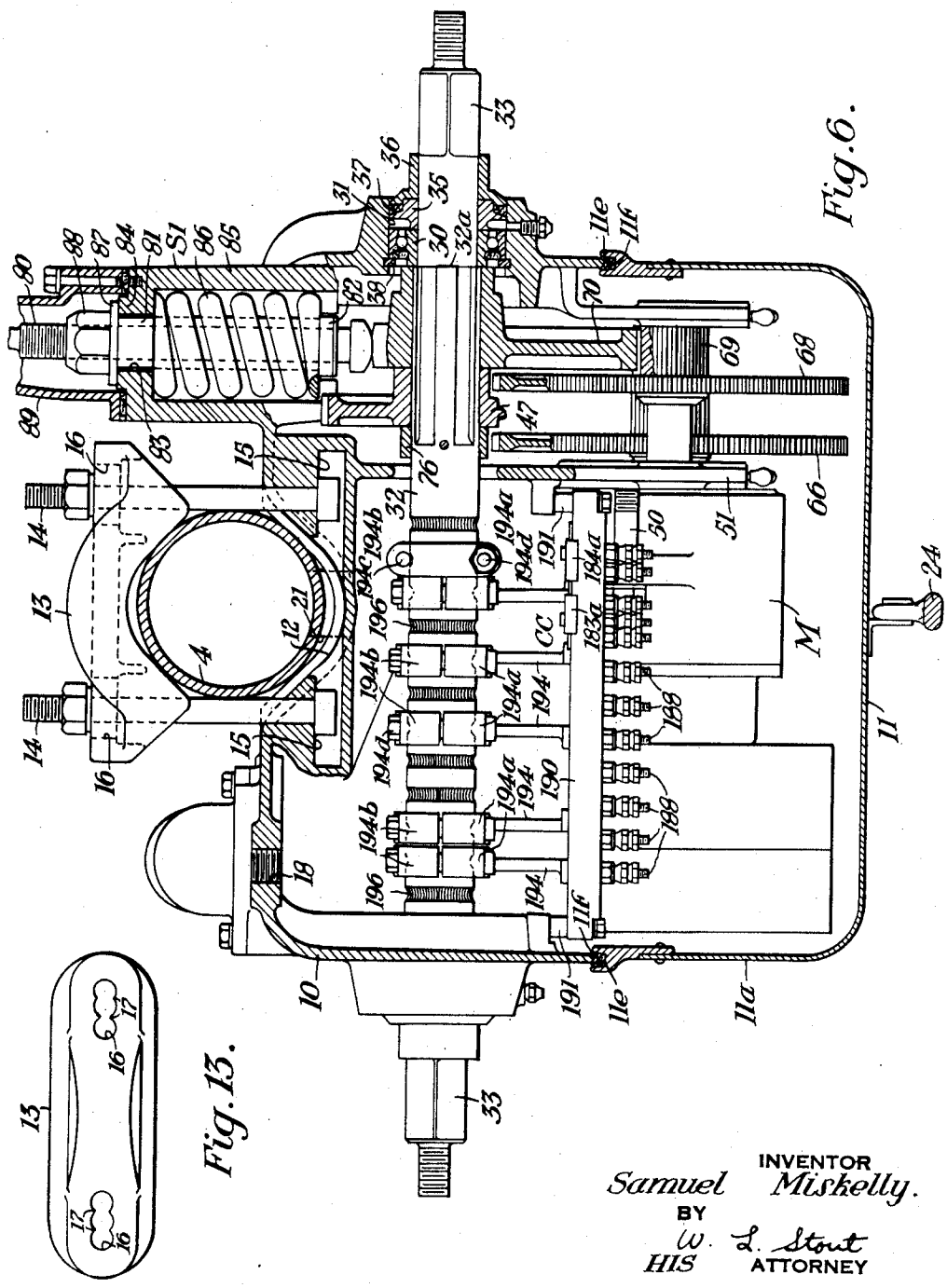


Fig. 6.

Fig. 13.

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AUTOMATIC CROSSING GATE

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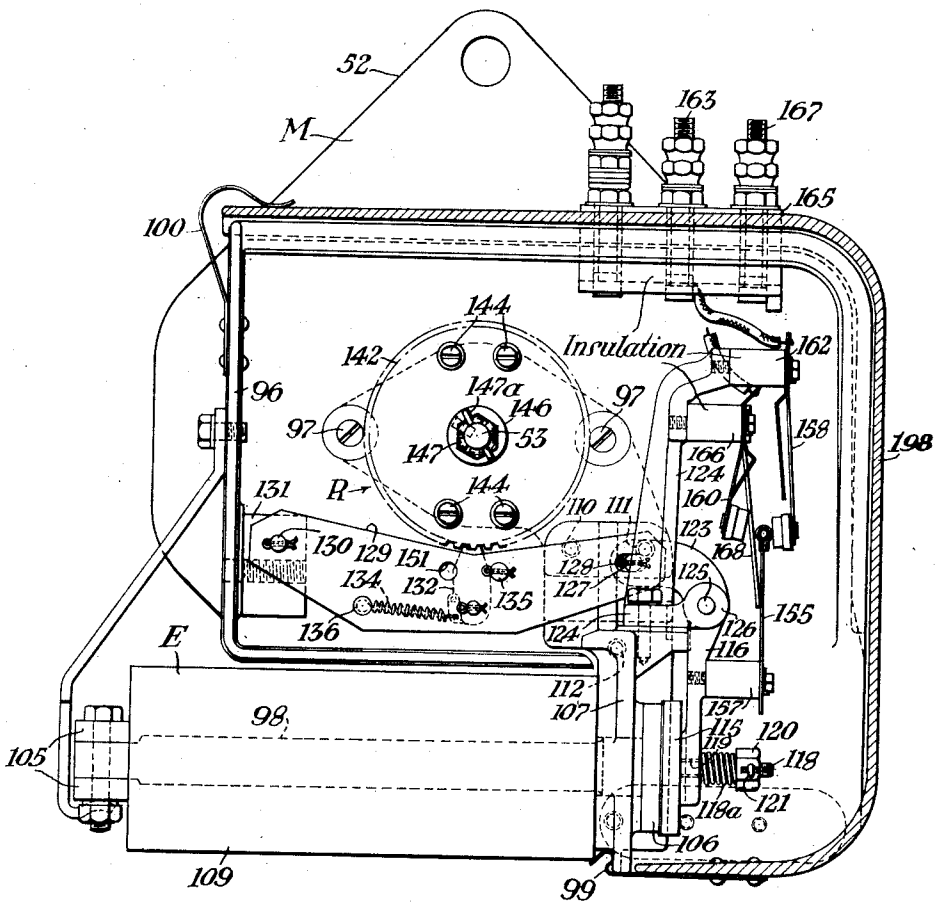


Fig. 7.

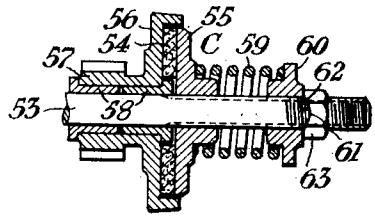


Fig. 12.

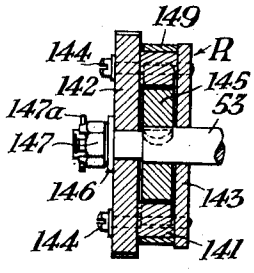


Fig. 11.

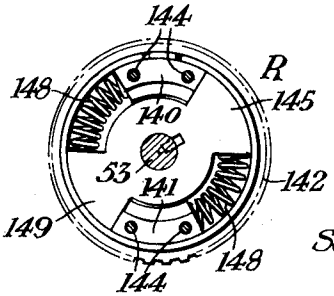


Fig. 10.

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AUTOMATIC CROSSING GATE

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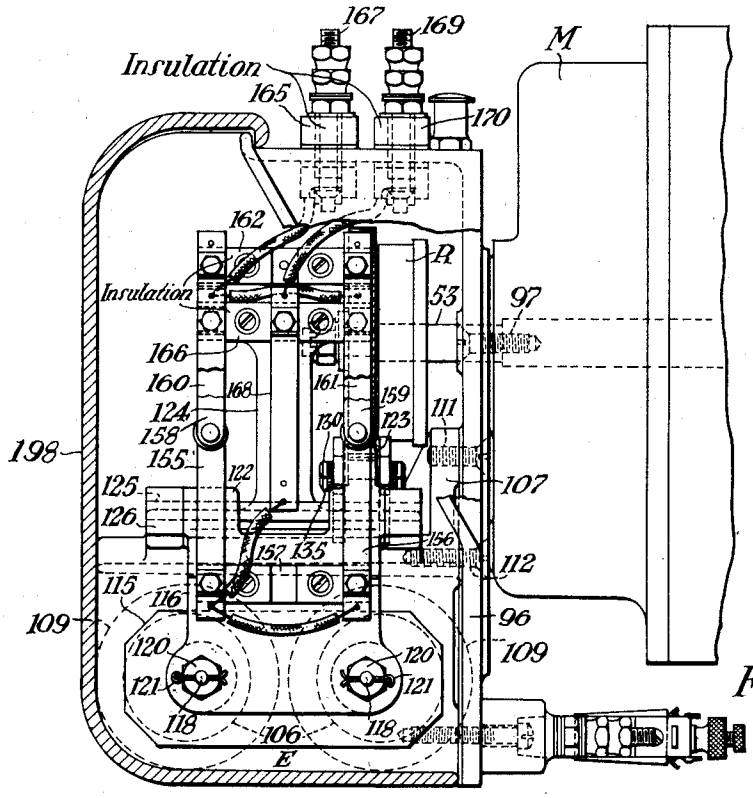


Fig. 8.

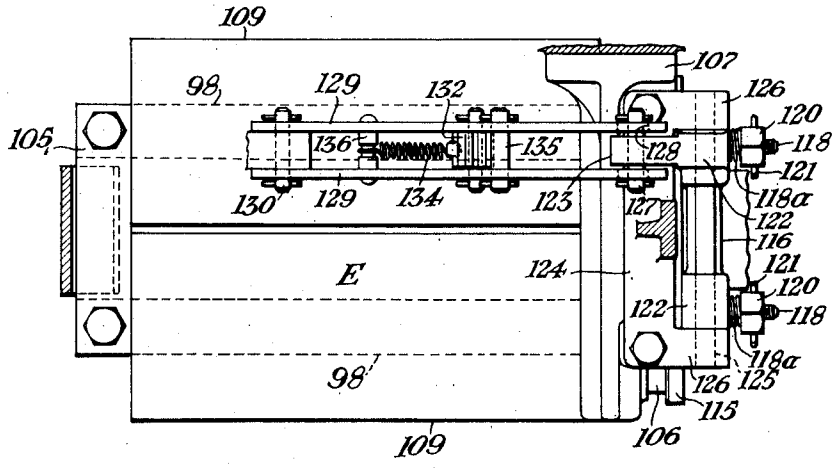


Fig. 9.

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Patented Sept. 8, 1942 2,295,419

UNITED STATES PATENT OFFICE

2,295,419

AUTOMATIC CROSSING GATE

Samuel Miskelly, Downers Grove, Ill., assignor to Western Railroad Supply Company, Chicago, Ill., a corporation of Delaware

Application March 10, 1939, Serial No. 261,103

4 Claims. (Cl. 39—7)

My invention relates to automatic crossing gates, that is, to gates adapted to be located adjacent the intersections of highways and railways for preventing users of the highway from crossing the railway when a train is approaching the intersection.

More particularly, my present invention relates to operating mechanisms for gates of the type described, and one object of my invention is to provide an improved operating mechanism which can be readily mounted on the same pole which is used to support other conventional warning devices.

Another object of my invention is to provide a gate operating mechanism which is readily adaptable to either the right-hand or left-hand side of the highway, and which can be used for operating single or double bearing gate arms.

A further object of my invention is to provide a mechanism in which the movement of the roadway arm to its lowered or traffic obstructing position is effected by gravity, and its movement to its raised or proceed position is effected by means of an electric motor through a friction clutch and suitable reduction gearing, the arm being held in its proceed or clear position by maintaining electrical energy on a hold clear magnet.

A further object of my invention is to provide a mechanism of the type described which is so arranged that the raised or clear position of the sidewalk arm can be adjusted between limits varying between approximately 72° and 90° from its lowered or traffic obstructing position.

A further object of my invention is to provide a mechanism which can be equipped when desired with a shaft for operating a sidewalk arm.

A further object of my invention is to provide a mechanism having a large number of circuit controlling contacts which can be adjusted to open or close at any desired point in the travel of the gate arm to enable the contacts to be readily used for controlling the mechanism itself, as well as other warning devices which may be provided.

A further object of my invention is to provide a mechanism which will operate efficiently, is rugged in construction, and can be manufactured at a minimum cost.

Other objects and characteristic features of my invention will become apparent as the description proceeds.

I shall describe one form of crossing gate embodying my invention, and shall then point out the novel features thereof in claims.

In the accompanying drawings, Fig. 1 is a front elevational view of a crossing gate embodying my invention mounted in the intended manner on a pole or mast together with other customary warning devices, the mechanism being arranged on the sidewalk side of the pole and the main or highway arm 1 being of the double bearing type. Fig. 2 is a left-hand side view of the gate mechanism and associated warning devices shown in Fig. 1. Fig. 3 is an enlarged elevational view of the gate operating mechanism shown in Figs. 1 and 2 with the cover removed to better illustrate the construction of the various operating parts. Figs. 4, 5 and 6 are sectional views taken on the lines IV—IV, V—V and VI—VI, respectively, of Fig. 3. Fig. 7 is an enlarged front view of the hold clear magnet and associated parts forming part of the mechanism shown in Figs. 3 to 6, inclusive. Fig. 8 is a right-hand end view of the parts shown in Fig. 7. Fig. 9 is a top view of the lock arm and hold clear magnet assembly forming part of the gate operating mechanism. Figs. 10 and 11 are vertical sectional views of the ratchet wheel assembly R shown in Fig. 7 taken at right angles to each other. Fig. 12 is an enlarged cross sectional view of the friction clutch assembly C. Fig. 13 is a back view of the clamping block 13 forming part of the means for securing the mechanism to its supporting pole or mast. Fig. 14 is a diagrammatic view showing one circuit arrangement for controlling the gate operating mechanism.

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

Referring first to Figs. 1 and 2, a crossing gate embodying my invention is here shown as comprising the usual roadway and sidewalk arms 1 and 2 operated by a mechanism 3 secured to the lower end of a pole or mast 4. The pole 4 may be located at either side of the highway, as will appear more fully hereinafter, and in addition to serving as a support for the gate may also be used as a support for other customary warning devices, here shown as comprising a pair of crossed arms 5 bearing the designation "railroad crossing," a sign 6 which indicates the number of tracks at the crossing, two pairs of flashing light signals 7, one pair of which faces the crossing and the other pair of which faces away from the crossing, and another sign 8 containing the warning "stop on red signal." The various warning devices may be fastened to the pole in any desired manner, but the fastening means employed should be so constructed that adequate clearance will be provided between the warning devices and both gate arms in all positions of the gate arms.

Referring now to Figs. 3, 4, 5 and 6, the mechanism 3 comprises a suitable housing 10, which is closed at its forward end by a removable cover 11 through which convenient access to the interior of the housing for inspection or repair of the mechanism may be had. The housing 10 is secured to the pole 4 by means of two vertically spaced pole clamps disposed adjacent the top and bottom respectively of the housing, and in order to facilitate fastening the housing to the pole, the rear wall of the housing is formed with a rounded centrally disposed vertically extending recess 12. Each pole clamp includes a clamping block 13 and a pair of bolts 14 disposed on opposite sides of the pole, and to enable the housing to be readily clamped to any pole falling within the range of diameters commonly encountered in practice, the heads of the bolts are disposed in T-shaped transversely extending laterally aligned slots 15 formed in the rear wall of the housing, and the shanks of the bolts extend through transversely extending laterally aligned slots 16 provided in the clamping block 13. (See Figs. 5, 6 and 13.) Furthermore, the clamping block is provided with projections 17 (see Fig. 13) which extend partway into the slots 16 and embrace the bolts in a manner to properly space them for each diameter of pipe within the range of adjustment provided for.

The housing is further formed with a wire inlet 18 which is so arranged that adapters to suit either flexible conduit, parkway cable, or other wiring arrangements can be bolted on as required, and with another wire inlet 20 to enable wires to be brought into the housing directly from the pole 4. The wire inlet 20 is threaded to receive a pipe nipple 21, and when this inlet is not needed the nipple can be removed and the inlet closed by a sheet metal plate.

The cover 11 is made up of a sheet metal portion 11*a* riveted to a cast iron rim 11*b*. The rim 11*b* is provided with slotted hinge lugs 11*c* which hook over a U-bolt 22. Hinge straps 11*d* bolted to the rim 11*b* hold the cover in position on the U-bolt, but can be readily removed in case it becomes necessary or desirable to completely remove the cover from the housing. A groove 11*e* is formed in the rim 11*b* for the reception of packing 11*f* which, when the cover is closed, engages against the forward edge of the housing to seal it against the entry of dirt and moisture, and the nuts 23 on the U-bolt 22 are provided with sufficient adjustment to enable the proper degree of tension on the packing to be obtained.

The cover is fastened in place at the top by a latch assembly (see Fig. 5) made up of a handle 24 secured to the outer end of a shaft 25, the inner end of which carries a latch cam 26. The latch cam 26 cooperates with a depending lug 27 formed on the top wall of the housing 10. The shaft 25 is journalled adjacent its outer end in a bushing 11*g* provided in the sheet metal portion 11*a* of the cover, and at its inner end in a depending lug 11*h* formed on the rim 11*b*. The shaft 25 is rotatable by means of the handle 24 between a latching position in which the latch cam hooks behind the lug 27 and an unlatching position in which it clears the lug 27, and formed in the lower end of the handle is an eye 24*a* which, when the shaft 25 occupies its latching position, engages an apertured lug 28 provided on the cover. It will be obvious that by passing a padlock through the eye 24*a* and the lug 28, the cover may be locked against removal by anyone except authorized persons. The latch cam is secured in place on the inner end of the shaft 25 by means of a nut 29 in such manner that it can be adjusted to different longitudinal positions on the shaft to enable the compression of the packing 11*f* to be adjusted to the desired value.

Mounted in ball bearings 30 (see Fig. 6) disposed in bearing recesses 31 provided in the opposite side walls of the housing 10 is a horizontal shaft 32. The opposite ends of this shaft project outside of the housing, and are provided with squared portions 33 which receive the hubs of the main roadway arm, and with screw threaded portions which receive nuts 34 (Fig. 2) for securing the hubs in place on the squared portions. Two sleeves 35 and 36 having a ring 37 of packing disposed between them at their outer edges are interposed between each hub and the associated bearing, and act when the associated nut 34 is tightened to compress the packing 37 to seal the bearing opening, and also to hold the bearing in the position on the shaft in which the inner edge of the inner race engages a shoulder 32*a* formed on the shaft. The outer race of each bearing cooperates at its inner edge with a snap ring 38 which permits suitable end play. The ball bearings are provided with felt seals on the inside, and provision is made for greasing the bearings with pressure lubrication.

The mechanism also includes a square shaft 40, one end of which is adapted to receive the hub of the sidewalk arm 2. This shaft extends parallel to the shaft 32 in vertical alignment therewith, and has secured thereto at the sidewalk arm end a journal 41 (see Fig. 3) which rotates in a bearing 42 machined in the sidewall of the housing 10. The opposite end of the shaft 40 is machined round, and is journaled in a bushing 43 bolted to the sidewall of the housing 10. An end plate 44 provided with an opening having an inside diameter which is smaller than the outside diameter of the journal 41 is secured to the housing 10 at the outer end of the journal 41, and serves with the bushing 43 to position the shaft 40 lengthwise in the housing.

The shaft 40 as shown in Fig. 3 is arranged with the end which carries the sidewalk arm projecting from the left-hand side of the housing. The parts are so constructed that this end can be made to project from the other side of the housing by interchanging bushing 43 and end plate 44 and turning the shaft end for end.

In some installations the shaft 40 may not be required, and when this is the case, this shaft can be removed and the bushing 43 and end plate 44 can be replaced by blank plates to close the openings in the housing.

Secured by means of a set screw 45 to the square portion of the shaft 40 is a gear segment 46 (see Figs. 3 and 4) which meshes with a similar gear segment 47 secured to the shaft 32. It will be apparent, therefore, that any rotation of the shaft 32 will not only raise or lower the roadway arm, depending upon the direction of such rotation, but will also similarly raise or lower the sidewalk arm.

The two arms 1 and 2 are biased by gravity to horizontal positions which I shall term for convenience "stop" positions, and are arranged to be moved to upper or proceed positions by a motor M which is connected with the shaft 32 through the medium of a friction clutch C and a train of gears.

The motor M is secured by means of two studs 50 to a partition wall 51 which divides the housing 10 into two compartments. The studs pass through clearance holes formed in projecting lugs 52 provided on the top and bottom respectively of the motor case, and are screwed into tapped holes provided in the partition wall 51. The motor may be of any suitable type, but as here shown it is a four pole D. C. low voltage series motor with field, armature, brushes and bearings completely enclosed. The motor shaft 53 is of special heat treated spring steel, and extends beyond the motor housing at both ends for a purpose which will be made clear presently.

The friction clutch C is provided to prevent the motor from becoming overloaded, and also to protect the gear train and shafts from excessive strains such as might occur in the event that the roadway arm 1 becomes broken off and the mechanism comes to a sudden stop after moving rapidly to the clear position. It is mounted on the right-hand end of the motor shaft 53 as viewed in Fig. 3, and in the form here shown comprises a friction disc 54 (see Fig. 12) disposed between a driving flange 55 and a driven flange 56. The driven flange 56 is formed integrally with a pinion 57 comprising part of the previously referred to gear train, and the hubs of these two parts are provided with self lubricating bushings 58 which rotatably receive the motor shaft. The driving flange 55 is splined on shaft 53, and is biased to the longitudinal position in which the two flanges and the friction disc are frictionally held together by means of a coil spring 59 which surrounds the motor shaft between the driving flange and a washer 60. The washer 60 is also splined on the shaft 53, and is provided on its outer face with rounded diametrically opposite projections 61 which cooperate with rounded diametrically opposite recesses 62 formed on the inner face of a nut 63 screwed onto the outer end of the motor shaft. It will be apparent that the force required to slip the clutch will depend upon the amount of compression of the spring 59, and that the compression of this spring can be readily varied by adjusting nut 63. It will also be apparent that the cooperation between the recesses 62 in the nut 63 and the projections 61 on the spring washer 60 makes the nut self locking in positions a half turn apart, thereby enabling the desired adjustment to be readily obtained.

The previously referred to gear train comprises, in addition to the pinion 57, a first intermediate gear assembly comprising a first intermediate gear 66 secured to one end of a first intermediate pinion 67 and meshing with the pinion 57, a second intermediate gear assembly comprising a second intermediate gear 68 secured to a second intermediate pinion 69 and meshing with the first intermediate pinion 67, and a segmental gear 70 splined to the shaft 32. The first intermediate gear 66 and pinion 67 are mounted on a shaft 71 which is journalled at its ends in roller bearings 72 provided in the housing 10, and the second intermediate gear 68 and pinion 69 are similarly mounted on a shaft 73 which is journalled at its ends in roller bearings 74 provided in the housing 10. The roller bearings are arranged for oil lubrication, and are held in place by end plates 75.

The segmental gear 70 is normally retained in the proper longitudinal position on the shaft 32 by the previously described gear segment 47 (see Fig. 6) which cooperates with the gear segment 46 to drive the shaft 40 and by a spacing sleeve 76 pinned to the shaft, and when the sidewalk arm is not required the gear segment 47 is replaced by a suitable sleeve (not shown) which serves to retain the segmental gear 70 in its proper longitudinal position on the shaft 32 under these latter conditions.

The segmental gear 70, in addition to serving as a part of the gear train for driving the shaft 32, cooperates with two adjustable stop assemblies S1 and S2 which are provided to position the gate arms in both their stop and clear positions. These stop assemblies also provide means for absorbing shock at the end of the travel of the gate arms in normal operation, when the gate arms are being whipped by high winds, and also when the mechanism is suddenly stopped while moving at high speed as might happen if the roadway arm 1 became broken off, and the operating mechanism subsequently moved at high speed to its clear position due to the absence of the load normally provided by the roadway arm.

The stop assemblies S1 and S2 are similar and a description of one will therefore suffice for both. Referring particularly to the stop assembly S1, this assembly is mounted in a cylindrical projection 85 cast integrally with the back wall of the housing 10, and comprises a bolt 80 which is adjustably screwed into a sleeve 81, one end of which is provided with a flange 82. The sleeve 81 is slidably mounted at the end opposite to the flange in an axial hole 83 provided in the outer end wall 84 of the projection 85, and is surrounded intermediate its ends by a coil spring 86, one end of which abuts against the end wall 84, and the other end of which abuts against the flange 82. The bolt 80 is also provided with a washer 87 which engages the outer end of the sleeve 81, and with a lock nut 88 which is screwed onto the bolt adjacent the outer side of the washer. A frusto-conical cover 89 is secured to the outer side of the end wall 84 and serves to protect the exposed end of the bolt 80.

The stop assembly S2 is mounted in a cylindrical projection 90 which is also cast integrally with the housing 10, and the two stop assemblies S1 and S2 are so disposed that when the gate arms occupy their stop positions the edge 91 of the segmental gear 70 will engage the head of the bolt 80 of the assembly S1, whereas when the gate arms occupy their clear positions in which they are shown in the drawings, the edge 92 of the segmental gear 70 will engage the head of the bolt 80 of the assembly S2.

Adjustment for positioning the gate arms in either the stop or clear position is made by loosening lock nut 88 on the bolt 80 of the proper stop assembly, and then turning the bolt by means of the square section provided on its outer end. Sufficient adjustment is provided to take care of normal manufacturing variations, and also so that the two arms may be stopped in clear positions varying between the vertical positions shown in full lines in Fig. 1 and the inclined positions shown in dotted lines, the inclined positions being spaced approximately 12° from the vertical.

It will be apparent that when the segmental gear 70 moves into engagement with the bolt 80 of either stop assembly, the bolt will move in the direction to compress the associated spring 86, whereby the spring will absorb the shock. The amount the spring 86 can become compressed is limited by means of a stop shoulder 85a formed

at the inner end of the cylindrical projection 85 in a position to be engaged by the flange 82 on the associated sleeve.

The mechanism further comprises a hold clear magnet E (see Figs. 7, 8 and 9) and holding mechanism controlled thereby for retaining the gate arms in their proceed positions against the action of gravity after they are moved to these positions by the motor M. These parts are all enclosed within an auxiliary casing 96 which is secured to the left-hand end of the motor M, as viewed in Fig. 3, by means of two filister hand screws 97 (Fig. 7), and it will be seen, therefore, that by removing the screws 97, the entire casing with the various parts mounted therein can be removed as a unit from the mechanism 3. The casing is closed by an aluminum cover 198 which is held in place by a snap spring 99 and a leaf spring 199. To remove the cover, the snap spring 99 is first released, and the cover is then pulled toward the right, as viewed in Fig. 7.

The hold clear magnet E comprises two parallel magnetizable cores 98 secured together at one end by means of magnetizable bars 105, and provided at the other end with enlarged pole pieces 106. The cores 98 are pressed at the ends which are provided with the pole pieces into holes in a non-magnetizable bracket 107, and are riveted to the bracket by means of suitable rivets (not shown) which pass through aligned holes formed in the bracket and in the pole pieces. Mounted on the cores are magnet coils 109 which, as will appear hereinafter, include a pick-up winding and a holding winding.

The bracket 107 is secured to the casing 96 by means of three screws 110, 111 and 112. The cores 98 and coils 109 are disposed horizontally to conserve space, and the coils are located outside of the casing 96 to facilitate assembly and maintenance. The cores at the ends which are connected by the bars 105 are anchored securely to the casing 96 to prevent any vibration or other movement from affecting the relation between the magnet assembly and the casing.

The pole pieces 106 of the electromagnet cooperate with an armature 115. This armature is yieldably attached to an armature support 116 of non-magnetizable material, such as cast aluminum, by means of spaced studs 118 which are secured to the armature and which extend through clearance holes 119 in the support, and compressed coil springs 119a which surround the studs between the support and castellated nuts 120 screwed onto the outer ends of the studs. The nuts 120 are locked in adjusted positions on the studs by cotter keys 121.

The armature support 116 is provided at its upper end with a pair of spaced lugs 122, and with a curved arm 123, and is pivotally attached by means of a pin 125 to a bracket 124, bolted to the upper side of the bracket 107. The pin 125 passes through clearance holes in the lugs 122 and in spaced lugs 126 formed on the bracket 124 and disposed on opposite sides of the lugs 122. The arm 123 carries a pin 127 the ends of which extend into elongated slots 128 formed in spaced plates 129 comprising part of a lock arm assembly.

This lock arm assembly is pivoted at the end opposite to the arm 123 on a pin 130 mounted in a block 131 secured to the casing 96, and is provided intermediate its ends with a pivoted locking pawl 132 which cooperates with a ratchet wheel assembly R mounted on the motor shaft 53. The pawl 132 is biased by means of a spring 134 in a clockwise direction, as viewed in Fig. 7, to a position in which it engages a stop pin 135 mounted in the spaced plates 129. The spring 134 is secured at one end to the pawl and at the other end to a tie bar 136 riveted to the plates. The parts are so proportioned that when the electromagnet E becomes energized and attracts the armature 115, the armature will act through the armature support 116 and pin 127 to move the lock arm assembly to an upper position in which the teeth provided on the pawl 132 mesh with teeth provided on the ratchet wheel of the ratchet wheel assembly as shown in Fig. 7, but that, when the electromagnet is deenergized, the lock arm assembly will drop by gravity to a position in which the teeth on the pawl 132 are out of engagement with the teeth on the ratchet wheel of the ratchet wheel assembly and will act through the pin 127, and armature support to rotate the armature 115 away from the electromagnet to a released position. To insure that the force of gravity will exert sufficient torque on the assembly to cause it to drop to the desired position the arm may be weighted by any suitable means, such for example, as a metal block (not shown) riveted between the plates adjacent the end which is pivotally connected to the armature support.

The ratchet wheel assembly R (see Figs. 10 and 11) comprises two arcuate segments 140 and 141 clamped in diametrically opposite positions between a ratchet wheel 142 and a circular plate 143 by means of screws 144. The ratchet wheel and plate are loosely journalled on the motor shaft 53 on opposite sides of a driving piece 145 which is keyed to the shaft and the whole assembly is positioned lengthwise on the shaft by means of the ratchet wheel 142 which is disposed between a shoulder formed on the shaft and a washer 146 held in place by a castellated nut 147 provided with a cotter key 147a. Sufficient clearance is provided between the washer and the ratchet wheel to permit the ratchet wheel and plate 143 to rotate freely on the motor shaft. The driving piece 145 is formed with fan shaped ends, and disposed between two of the radially extending sides of these ends and the adjacent radially extending sides of the segments 140 and 141 are recoil springs 148 (see Fig. 10) which normally maintain the ratchet wheel 142 and plate 143 in a predetermined angular position relative to the driving piece, but which permit a limited amount of angular movement between the ratchet wheel and plate and the motor shaft in one direction if sufficient force is exerted to compress these springs. The assembly is closed at its outer edge by a ring 149 which is pressed onto the plate 143 and the one side of which abuts against the inner side of the ratchet wheel. The previously referred to teeth which cooperate with the teeth on the pawl 132 are formed on the outer edge of the ratchet wheel.

When the motor M is rotating in the direction to raise the gate arm, the ratchet wheel assembly will be rotated in a clockwise direction, as viewed in Fig. 7, and it will be apparent that with the ratchet wheel and latch arm assemblies constructed in the manner just described, if the magnet E is then energized, so that the latch arm assembly is held in its upper position, the teeth on the ratchet wheel assembly will cooperate with the teeth on the pawl 132 to rotate the pawl in opposition to the bias of the spring 134 to a position in which the teeth slip past each other. As soon, however, as the motor stops rotating, the

pawl will immediately move to the position in which it engages the stop pin 135 and will thus prevent the motor shaft from rotating in the direction to permit the gate arms to move to their stop positions as long as the magnet E remains energized. The function of the springs 148 is to cushion the parts against shock when the gate arms first become latched in their clear positions, or sway in the wind after becoming latched in their clear positions.

It should be pointed out that the springs 118a which comprise part of the means for securing the armature 115 to the armature support 116 give special assurance against the holding device becoming improperly released under adverse conditions.

It should also be pointed out that the parts of the lock arm assembly and ratchet wheel assembly are so arranged that they can be assembled for either right-hand or left-hand operation. As shown in the drawings they are assembled for left-hand operation, and when it is desired to assemble them for right-hand operation all that needs to be done is to move the stop pin 135 from the position shown to the holes 151 in the plates 129, remove spring 134 from the lower hole in the pawl 132 and place it in the upper hole, and remove the recoil springs 148 and place them on the opposite sides of the driving piece 145.

The armature support 116, in addition to being operatively connected with the lock arm assembly, operates contact mechanism the function of which will be made clear presently. As here shown, this contact mechanism comprises two movable contact fingers 155 and 156 mounted at one end on an insulating block 157 secured to the support 116, and provided at their opposite ends with low resistance contact members which engage cooperating low resistance contact members formed on fixed contact fingers 158 and 159 or 160 and 161 to close front contacts 155—159 and 156—159 or back contacts 155—160 and 156—161 according as the armature 115 occupies its attracted or its released position. The fixed contact fingers 158 and 159 are secured by means of an insulating block 162 to the support 124, and are both electrically connected by means of suitable wires with a terminal post 163 mounted in an insulating terminal block 165 provided on the top of the casing 96. The fixed contact fingers 160 and 161 are similarly secured by means of an insulating block 166 to the support 124 and are both electrically connected by means of suitable wires with a terminal post 167 mounted in the insulating terminal block 165. The movable fingers 155 and 156 are connected by means of suitable wires to the lower end of a terminal strip 168 mounted on block 166, and the strip 168, in turn, is connected at its upper end by a suitable wire with a terminal post 169 mounted in an insulating terminal block 170 provided on the top of casing 96. The two terminal blocks 165 and 170 are provided with other terminal posts for the reception of the leads for the two windings of electromagnet E.

A terminal block 171 is secured to the outer side of the casing 96 adjacent its lower right-hand corner, as viewed in Fig. 3, and has mounted thereon an adjustable resistor 172 for a purpose which will be made clear presently.

The mechanism also comprises a suitable circuit controller CC which is provided for governing the various circuits which control the mechanism, as well as certain ones of the other warning devices. This circuit controller in the form here shown comprises a plurality of flexible contact fingers 175, 176, 177, 178, 179, 180, 181, 182, 183 and 184 which cooperate respectively with fixed front contact fingers 175a, 176a, 177a, 178a, 179a, 180a, 181a, 182a, 183a and 184a to form front contacts 175—175a, 176—176a, 177—177a, 178—178a, 179—179a, 180—180a, 181—181a, 182—182a, 183—183a and 184—184a. The flexible contact fingers are secured by means of terminal posts 185 within slots 186 formed in an insulating terminal board 187, and the fixed contact fingers are similarly secured by means of terminal posts 188 within slots 189 formed in an insulating terminal board 190. The flexible contact fingers may also be made to cooperate with fixed back contact fingers, only two of which 183b and 184b are shown in the drawings. These latter fingers are secured to the terminal board 190 in a manner similar to the other fingers but when both fixed front and back contact fingers are provided, the two sets of fixed fingers will be offset from each other in the manner shown.

The two terminal boards 187 and 190, in turn, are secured at their opposite ends to two connecting bars 191 by means of bolts 192, and the contact assembly thus formed is secured as a unit by means of stud bolts 193 to lugs provided on the housing 10.

The flexible contact fingers are all biased by their own resiliency to positions in which the front contacts formed thereby are closed, and are arranged to be moved to their open positions in which the back contacts become closed by means of cams 194 which are secured to the shaft 32, and which cooperate with insulating cam followers 195 secured to the fingers. Each cam comprises an operating portion 194a and a clamp portion 194b secured together by means of an adjusting screw 194c and a clamping bolt 194d. Each adjusting screw 194c cooperates intermediate its ends with an annular threaded groove 196 formed in the shaft 32 in such manner that by first backing off the nut on the clamping bolt 194d and then rotating the adjusting screw 194c the cam can be readily moved to any desired angular position relative to the shaft. After the desired adjustment has been made, the clamping bolt is again tightened and the cam will then be securely held in its adjusted position.

The face of each cam is made relatively wide and the cams are so constructed that they can be assembled on the shaft in either of two positions in one of which the cam face will be directly opposite an associated one of the movable contact fingers, and in the other of which the face of the cam will be midway between two fingers. With this arrangement, each cam can be made to operate 1, 2 or 3 contacts to provide any desired contact combinations by assembling the cam on the shaft in the proper position, and by the proper choice of cam followers. For example, if it is desired to operate only one contact from a cam, the flexible finger of this contact will be provided with a cam follower which is only slightly wider than the finger, as shown in connection with the finger 175, and the associated cam will be assembled on the shaft in the position in which its cam face is directly opposite the follower. If, however, it is desired to operate two contacts simultaneously by means of the same cam, a follower which is approximately twice as long as the follower secured to the finger 175 will be secured to both fingers, as shown in connection with the fingers 176 and

177, and the associated cam will be assembled with its cam face midway between the fingers. When it is desired to operate three contacts simultaneously a follower which is long enough to bridge all three of the flexible fingers will be secured to the flexible fingers, as shown in connection with the fingers 178, 179 and 180, and the associated cam will be assembled on the shaft in the position in which its cam face is directly opposite the middle finger. It will be apparent from an inspection of the drawings that the shaft 32 is provided with as many grooves 196 as there are contacts, and that one of these grooves is located opposite each contact. The parts are so proportioned that when any cam follower is engaged by the face of the associated cam, the finger or fingers to which it is attached will be moved to such position or positions that the back contact or contacts controlled thereby will then be closed and the front contacts will be open.

Referring now to the wiring diagram for the gate shown in Fig. 14, as here illustrated motor M is provided with an energizing circuit which passes from a suitable source of current here shown as a battery D through contact 176—176a of circuit controller CC, contact 155—158 controlled by electromagnet E connected in multiple with contact 156—159 controlled by electromagnet E, the armature 203 of motor M, and series field winding 204 of motor M back to battery D. This circuit is closed when and only when electromagnet E is energized and contact 176—176a is closed, and the parts are so arranged that when this circuit is closed the motor will operate in a direction to move the gate arms toward their clear positions. The contact 176—176a is so adjusted that it will be closed at all times except when the gate arms occupy their upper or clear positions, which will usually be somewhere between 72 and 90 degrees from their stop positions, and it will be apparent, therefore, that when the energizing circuit for motor M becomes closed the motor will move the gate arms to their clear positions, whereupon contact 176—176a will open and will deenergize the motor.

Motor M is also provided with a snubbing circuit which may be traced from the upper terminal of armature 203 through contacts 155—160 and 156—161 of electromagnet E connected in multiple, adjustable resistor 172, and field winding 204 back to the other terminal of armature 203. This circuit is closed whenever electromagnet E is deenergized, which as will appear presently, is the case when the gate arms are descending, and its purpose is to cause the motor to function as a generator during the descent of the gate arms and thus act as a brake to retard the descent of the arms. As will be readily understood, the braking effort exerted by the motor when this circuit is closed depends upon the resistance of this circuit, and it will be seen, therefore, that by adjusting the resistor 172 to different values this braking effort can be readily varied within certain limits.

The pick-up winding of electromagnet E is designated by the reference character 206, and is provided with a circuit which passes from battery D through front contact 208 of a relay TR, contact 177—177a of circuit controller CC, winding 206 of electromagnet E, front contact 211 of relay TR, and wire 212 back to battery D.

Relay TR will usually be controlled by a track circuit not shown, and will be energized at all times except when a train is approaching the crossing adjacent which the crossing gate is located.

The contact 177—177a of circuit controller CC is adjusted to open at the same point in the stroke of the gate arms as contact 176—176a, and it will be seen, therefore, that whenever track relay TR becomes energized winding 206 will become energized provided the gate arms then occupy any positions but their upper or clear positions. The parts are so proportioned that when winding 206 is energized, armature 115 will move to its attracted position in which the pawl 132 engages ratchet wheel 142, and in which contacts 155—158 and 156—159 are closed, and contacts 155—160 and 156—161 are open.

The holding winding of electromagnet E is designated by the reference character 207, and is provided with a circuit which passes from battery D through front contact 208 of relay TR, winding 207 of electromagnet E, front contact 211 of track relay TR, and wire 212 back to battery D. This circuit is closed whenever relay TR is energized, and the parts are so proportioned that the winding 207 will require less energizing current than winding 206, but when energized will cause sufficient force to be exerted on armature 115 to hold it in its attracted position once it has been moved to this position.

As shown in the drawings, all parts occupy the positions which they normally occupy when no train is approaching the crossing. That is to say, relay TR is energized, the holding winding 207 of electromagnet E is energized and the pick-up winding 206 is deenergized, motor M is deenergized, and the gate arms are held in their upper or clear positions by engagement of the pawl 132 with the ratchet wheel 142 of the ratchet wheel assembly R.

In explaining the operation of the crossing gate as a whole, I shall assume that relay TR becomes deenergized due to a train approaching the crossing. The deenergization of relay TR will interrupt, at its front contacts 208 and 211, the circuit which was previously closed for the holding winding 207 of electromagnet E, and since both the pick-up and holding windings are then deenergized, electromagnet E will become deenergized. When electromagnet E becomes deenergized, the force exerted by armature 115 on the lock arm assembly will be removed, and the lock arm assembly will therefore move, due to its gravity bias, to its lowermost position, thereby moving pawl 132 out of engagement with ratchet wheel 142, and armature 115 to its released position in which contacts 155—158 and 156—159 become opened and contacts 155—160 and 156—161 become closed. The movement of pawl 132 to its released position will remove the force which previously prevented armature 203 of motor M from rotating, and the gate arms will therefore start to descend by virtue of their gravity bias, and will act, through the previously described gear train and friction clutch C, to rotate the motor in the opposite direction to that in which it rotates by virtue of its energizing circuit. The closing of contacts 155—160 and 156—161 completes the snubbing circuit for motor M, and since the motor is now rotating in the opposite direction from that which it rotates when it is energized by its energizing circuit, the motor will function as a generator, and will thus exert a braking force on the gate arms. As was previously pointed out, this braking force depends upon the adjustment of the resistor 172, and this resistor will be so adjusted that it will

cause the gate arms to descend at the desired slow rate. When the gate arms reach their horizontal or stop positions, the segmental gear 70 will move into engagement with the head of bolt 80 of the stop assembly S1, which will cause the spring 86 of this stop assembly to become compressed and thereby stop the further descent of the gate arms without shock. The rotation of the shaft 32 which takes place during the descent of the gate arms will of course operate the contacts of the circuit controller CC in accordance with the settings of the various cams, it being remembered that the two contacts 176—176a and 177—177a are adjusted to become closed as soon as the gate arms move away from their full clear positions.

I shall now assume that with the gate arms in their lowermost or stop positions relay TR becomes energized. Under these conditions, the resultant closing of contacts 208 and 211 of relay TR will complete the previously described circuits for both the pick-up winding 206 and holding winding 207 of electromagnet E, and these windings will cause armature 115 to move to its attracted position. The movement of armature 115 to its attracted position will open contacts 155—160 and 156—161 and will close contact 155—159 and contact 156—159, thereby interrupting the snubbing circuit for motor M and completing its energizing circuit. Motor M will therefore become energized, and will act through the friction clutch C and the previously described gear train to move the gate arms toward their upper or clear positions. The movement of the armature 115 to its attracted position will also move the lock arm assembly to its upper position in which the pawl 132 engages the ratchet wheel 142, but since the motor is now rotating in the direction to raise the arms, the ratchet wheel teeth will merely rotate the pawl 132 away from stop pin 135 in opposition to the bias of the spring 134 to the position in which the teeth on the ratchet wheel slip past the teeth on the pawl. When the gate arms reach their upper or clear positions contact 176—176a of circuit controller CC will open and will deenergize motor M, and contact 177—177a of circuit controller CC will also open, and will deenergize the pick-up winding 206 of electromagnet E. Winding 207 of electromagnet E will remain energized, however, and pawl 132 will therefore now cooperate with the ratchet wheel 142 to hold the gate arms in their upper or clear positions. The stop assembly S2 is so adjusted that the segmental gear 70 will move into engagement with the bolt 80 of this assembly substantially simultaneously with the opening of the contacts 176—176a and 177—177a, and it will be seen therefore that this stop assembly will act to bring the gate arms to rest in their upper or clear positions without shock. The friction clutch C will preferably be so adjusted that as the gate arms come to rest the clutch will slip sufficiently to prevent shock to the gearing due to the inertia of the motor armature. When the gate arms finally come to rest all parts will then be restored to the positions in which they are shown in the drawings.

It should be pointed out that in actual practice, the gate arm 1 will usually be provided with a suitable counterweight which will be so arranged and so proportioned that as this gate arm descends the moment of the counterweight will increase faster than that of the arm, so that the resultant moment will become less and less until the arm reaches the horizontal or stop position, at which time the turning moment of the arm per se and that of the counterweight will be practically equal. This feature insures relatively quick starting of the arms downwardly when the electromagnet E becomes deenergized, and also insures the lowest torque when starting the arm upwardly on application of current to the motor to restore the arm to its clear position. Furthermore, the high turning torque at the start of the arm from the clear position rapidly turns the motor in reverse direction, and generates a counter E. M. F. which quickly produces a snubbing action at the start. Stated in another way, the counterweight is so positioned and of such size that the gate arm will fall rapidly for the first five degrees or so, and will then continue to descend at practically constant speed after the snubbing action takes effect due to the motor having picked up speed. The gearing, of course, will assist in retarding the descent of the gate arm by virtue of its inherent friction.

It should also be pointed out that while as shown in Fig. 1, the gate mechanism is located on the sidewalk side of the pole, the mechanism can readily be turned through an angle of 180° relative to the pole to permit it to be located on the street side of the pole. Furthermore, the gate arm 1 can be secured to the shaft 32 with the arm at either side of the pole, and this gate arm 1 which is of the double bearing type, that is to say, of the type having a hub secured to each end of the shaft, can be replaced by a gate arm of the single bearing type, that is to say, one in which the arm has only one hub which is secured to one end or the other of the shaft 32. When a single bearing type of arm is used, the end of the shaft which does not have the arm attached to it, will be provided with a sleeve of the same length as the hub of the arm to maintain the proper bearing seal.

Under some conditions of operation it may be desirable to determine the number of times the gate has operated within a given period, and for this purpose a suitable counter V is provided. This counter is secured to the right-hand bar 191 of the circuit controller CC, as viewed in Fig. 3, and is provided with a weighted arm 220 which cooperates with a laterally projecting post 221 secured to the right-hand cam 194 in such manner that the counter will be operated once for each operation of the gate arm.

One advantage of a gate mechanism embodying my invention is that it can be adapted for use under all types of operating conditions, which makes it universal in its applications.

Another advantage of a gate mechanism embodying my invention is that all parts of the mechanism are readily accessible and can be readily removed from the mechanism for inspection, adjustment, repair or to adapt the mechanism to any special operating requirement.

Another advantage of a gate mechanism embodying my invention is that by adjusting the spring stop assemblies S1 and S2, which may be readily done by merely removing the covers 89, the gate arms can be adjusted to occupy any clear position falling between approximately 72 and 90° from the lowered or horizontal positions.

Although I have herein shown and described only one form of crossing gate embodying my invention, it is to be understood that various changes and modifications may be made therein within the scope of the appended claims without departing from the spirit and scope of my invention.

Having thus described my invention, what I claim is:

1. In a highway crossing gate, in combination, a housing provided with two cylindrical projections each provided at its outer end with an axial hole, two sleeves one slidably mounted in each of said holes and each provided with a screw threaded axial hole and with a flange at one end, two bolts one screwed into the threaded hole in each sleeve and each provided at its outer end with a nut, two compressed coil springs one surrounding each sleeve between the associated flange and the outer end of the associated projection and each biasing the associated sleeve to an inner position which depends upon the adjustment of the associated nut, a rotatable shaft journalled in said housing, means secured to said shaft and adapted to engage said bolts for limiting the movement of said shaft between two extreme positions, and a gate arm secured to said shaft and rotatable therewith.

2. A highway crossing gate comprising a housing adapted to be secured to a signal pole, a main gate arm shaft journalled in said housing, a main gate arm secured to said main gate arm shaft and biased by gravity to a stop position, power means in said housing operatively connected with said shaft for moving said main gate arm in opposition to its bias to a clear position, a sidewalk arm shaft having secured thereto adjacent one end a journal which rotates in a bearing machined in the one sidewall of said housing and having the other end journalled in a bushing bolted to the opposite sidewall of said housing, an end plate surrounding said sidewalk arm shaft and bolted to said housing adjacent the outer end of said journal and engaging the outer end of said journal to hold said shaft in place in said housing, said sidewalk arm shaft being of such length that the end adjacent said journal projects outside of said housing far enough to receive a sidewalk arm and being operatively connected with said main gate arm shaft to operate in unison therewith, and the parts being so constructed that the end of said sidewalk arm shaft which carries the sidewalk arm can be made to project from the opposite side of said housing by interchanging said bushing and said end plate and turning said shaft end for end.

3. A highway crossing gate comprising a housing adapted to be secured to a signal pole, a main gate arm shaft journalled in said housing and carrying a main gate arm biased by gravity to a stop position, power means in said housing operatively connected with said main gate arm shaft for moving said main gate arm in opposition to its bias to a clear position, a sidewalk arm shaft having a sidewalk arm secured to one end thereof, means for journalling said shaft in said housing in such manner that the end carrying the sidewalk arm can be disposed at either side of the housing, and means for operatively connecting said two shafts together to cause them to operate in unison.

4. In a highway crossing gate, in combination, a housing provided with a cylindrical projection having an axial hole at its outer end, a sleeve slidably mounted in said hole and provided with a screw threaded axial hole and with a flange at one end, a bolt screwed into the threaded hole in said sleeve and provided at its outer end with a nut, a compressed coil spring surrounding said sleeve between said flange and the outer end of said projection and biasing said sleeve to an inner position which depends upon the adjustment of said nut, a member mounted to rotate within said housing and adapted to engage said bolt for limiting the movement of said member in one direction, and a gate arm operatively connected with said member.

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