THE 3597-FC-301 EXIT GATE MECHANISM FROM WESTERN-CULLEN-HAYES, INC.

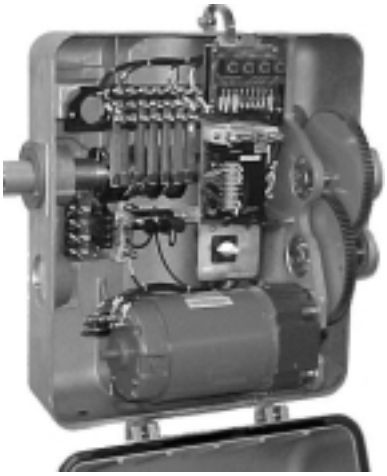
U.S. Patent 6,307,339

The 3597-FC-301 offers the same proven reliability as previous Western-Cullen-Hayes mechanisms but with the added performance of our patented Electronic Gate Monitor (EGM), and a new high torque permanent magnet motor.

The Electronic Gate Monitor protects the mechanism from damage if:

- The counterweights crash after the gate arm is knocked off.
- The gate arm crashes up caused by loss of power.
- The gate arm pumps.
- The motor overloads due to an obstructed gate arm.

The Model 3597-FC-301 also features, as standard, a power down and test switch that operates the mechanism to the horizontal position without a gate arm in place. This switch enables signal maintenance personnel to replace a damaged gate arm safely.



The Model 3597-FC-301 Gate Mechanism is intended for installation on the EXIT side of a railroad crossing. When commanded to raise or when power is lost, the gate raises to the clear or near vertical position. The installation and setup of the 3597-FC- 301 is considerably different than any other mechanism. Please carefully read, and follow these instructions to insure the proper operation of the 3597-FC-301 Exit Gate Mechanism.

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Contact Western-Cullen-Hayes at 773-254-9600 with any questions concerning these instructions before attempting to setup the 3597-FC-301 Mechanism.

SECTION 1
TECHNICAL SEQUENCE OF OPERATION AND FIELD WIRING REQUIREMENTS.

Electronic Gate Monitor (EGM) Description:
The Western-Cullen-Hayes, Inc. Model 3597-FC-301 Gate Mechanism incorporates an Electronic Gate Monitor (EGM) System that protects against damage to the gate mechanism when common failure conditions occur.

The EGM operates by sensing voltage. If conditions exist that enables the DC mechanism motor to generate electricity, the EGM will sense the generated voltage which is greater than the normal dc power supply. When this over voltage condition occurs, the EGM de-energizes the two internal relays. A second circuit exists that accumulates voltage during normal, pumping and gate obstruction conditions. When the accumulated voltage reaches a certain threshold, the EGM de-energizes the two relays and connects the braking circuit.

Nominal 12 vdc is supplied to the EGM. When power is present, a red LED indicator on the EGM illuminates. When conditions are normal, the EGM relays are energized and a green LED indicator on the EGM illuminates. When a failure has occurred to cause the EGM to de-energized the relays, the green LED goes dark.

There are three 1/4" studs on the EGM that are for connecting the main control relay outputs to the motor and the shorting resistor. The relay provides one set of Form C contacts (SPDT). Terminal common connects to motor terminal B, normally open connects to the cam switch and normally closed connects to the shorting resistor. During normal operation the voltage path is through the normally open contacts of the relay. During a fault event, the relay de-energizes and connects motor terminal A to the shorting resistor and back to motor terminal B which completes the dynamic braking circuits.

The orange wire lead is connected to motor terminal A. The yellow lead is connected to terminal 16 on the cam switch and then connected to motor terminal B. The two voltage monitoring systems within the EGM are fed from these wires.

The blue wire lead is connected to relay 2MCR. This wire provides the path of voltage to reset the EGM. The reset signal is sent to the EGM each time a gate clear command is received from the control case and during normal gate up operation. A fault condition can also be reset by the push-button located on the EGM.

Normal 3597 Gate Mechanism Operation:
Mechanism operating voltage is 12 vdc nominal. Static voltage is not to exceed 17 vdc. Voltage at the circuit controller terminals should not drop below 11 vdc during normal operations. Positive voltage is applied to terminal 6A and negative is applied to terminal 7A on the circuit board. Mechanism control voltage is connected to terminal 5A on the circuit board. To lower the gate, the crossing control system gate relay (XGR) must de-energize, or drop. To raise the gate, the XGR must energize, or pick.

Manual Electric Gate UP Operation:
When a gate down command is present and the gate is in the horizontal position, the gate can be raised by operating the cam switch to the test position. When the cam switch is operated to the run position, and the reset button on the EGM is depressed, the gate will operate to horizontal. This operation is also a test of the EGM.

EGM Controlled and Fault Operations of the 3597-FC-301 Gate Mechanism:

Gate Arm Knocked-Off Operation:
If the gate arm is knocked off in the horizontal position, and the gate down command is present, the mechanism counterweight assembly should remain in the horizontal position. That is because the motor brake is applied. If the gate arm is knocked off in any position except the full horizontal position, the force of gravity could pull the counterweights violently downward.
If this condition occurs, the EGM senses a sharp increase in voltage being generated by the forced rotation of the motor. The relays in the EGM de-energize, the green LED will go dark and dynamic breaking controls the decent of the weights and protects against damage to the mechanism. The dynamic braking is accomplished by shorting the A and B terminals of the motor through an adjustable resistor.

Open Electrical Circuit Failure:
The gate mechanism could display the operational characteristics of the gate arm being knocked off if an open failure in the mechanism electrical circuit were to occur, such as a relay contact not making contact, an open resistor or an open condition in the wiring. When such an event happens, the EGM will control the fault the same as described for the knock-off operation provided the EGM is connected and there are not any opens in the EGM circuit, the shorting resistor or the motor. Supply power does not have to be present at the EGM for it to control a fault.

Horizontal Gate Arm Pumping Operation:
If a mechanical or electrical failure of the motor brake occurs, the gate arm will oscillate (pump) in the horizontal position. When this happens, the motor powers the gate until the #1F power down contact opens. If the gate cannot be mechanically held in the horizontal position, the force of gravity causes the arm to begin to rise, the #1F contact closes, power is applied to the motor and the gate is driven back to horizontal. This series of events continuously repeats. Each time a pulse of voltage is received at the motor a certain amount of voltage is stored within the EGM.

When the stored voltage reaches a threshold, the EGM de-energizes it's relays, the green LED goes dark, the pumping ceases and the gate arm rises to vertical position through the controlled dynamic breaking circuit. The gate arm will remain in the vertical position until the EGM receives a pulse of 12 vdc positive voltage at the reset wire lead. This is created by a gate up command sent from the external crossing control system, or the manual reset button located on the EGM is depressed. When reset, the green LED illuminates.

Gate Hang-up / Obstruction Failure Operation:
If the gate arm becomes obstructed while power is applied to the motor, after a period of time the EGM will de-energize it's relay to prevent electrical component burn-up. When power is applied to the motor, a certain amount of the voltage is stored within the EGM. When the stored voltage reaches a threshold, the EGM de-energizes it's relays, the green LED goes dark and power is removed from the motor. When the EGM removes motor power the gate will rise to the near vertical position and float free as the motor brake is not applied. When the gate up command is received, the EGM will reset. If the gate has come to a rest at a point greater than 60 degrees but less than 75 degrees, the motor will start and power the gate to the full vertical position. If the gate has come to rest at a point greater than 75 degrees, it will free float. The next gate down command will lower the gate. The next gate up command will cause the gate to rise and latch in the full vertical position, provided the obstruction mode has not repeated its operation.

EGM Operation Annunciation:
The EGM annunciation relay connection should not be used as the normal gate up operation of the 3597-FC-301 causes the EGM to trip every time the gate is commanded to rise.

3597-FC-301 Gate Mechanism Arm Service Operation:

Gate Arm Service (Power Down) Mode:
To lower the gate counterweight assembly (raise weights), control the gate down with the crossing system controls. The motor brake will hold the mechanism in the horizontal position for gate arm service. Another method of raising the counterweights is outlined below:
The 3597-FC-301 incorporates a three position cam switch for this purpose. In the run position, the gate operates normally and the EGM is connected into the circuit. In the test position, the circuitry is disconnected from the motor and the EGM is connected to the circuit. In the down position, full power down is applied to the motor to drive the counterweights to the horizontal position. In this position the EGM is disconnected from the circuits. The counterweights are held in the horizontal position via a 1/2" ratchet wrench with 7/8" socket. When the cam switch is released, it automatically spring returns to the test position and places the EGM back into the circuit.

To lower the gate counterweight assembly (raise weights):

a. Attach a 7/8" socket to a 1/2" drive ratchet wrench. Select the OFF position on the ratchet so that the ratchet free wheels counterclockwise. Insert the socket onto the motor pinion gear hex surface.
b. Securely grasp the ratchet wrench handle with your right hand.
c. Jog the cam switch to the down position with your left hand. The weights will rise and the ratchet wrench will free wheel.
d. Once the weights have risen to a horizontal position, release the cam switch knob. The knob will spring return to the test position.

e. Carefully rotate the ratchet wrench clockwise until it rests on the upper cluster gear pin. Release the wrench.
f. Install a pin or bolt into a hole in the cluster gear for added safety.
g. When the gate arm has been attached, rotate the ratchet wrench away from the cluster gear pin then remove ratchet wrench.
h. Operate the cam switch to the run position and press the reset button on the EGM. Remove the jumper wire from the circuit controller. If a gate up command is present the gate will clear.

The service mode of the 3597-FC-301 mechanism allows for a total of 12, forty-seven pound counterweights to be operated when a minimum of 11 vdc power is maintained at the mechanism motor.

Wiring requirements.

The 3597-FC-301 mechanism will draw up to 55 amps when it is obstructed and up to 40 amps while lifting weights. **To allow proper mechanism operation, wire size for the motor power circuit must be calculated so that voltage does not drop below 11 vdc during normal operations, or drop below 9 vdc during lifting of weights, vertical mechanism pumping or mechanism obstruction.**
The selected wire must be installed from the power source to the terminals at the mechanism circuit controller. If it is not physically possible to run the wire from the junction box base to the mechanism, then at a minimum, one 3/16" bond strand conductor must be installed from the junction box base terminals to the mechanism circuit controller terminals. Do not install #9 or #10 wire at any point in the motor power circuit. Refer to the following example and formulas.

VOLTAGE DROP EXAMPLES AT 55 AMP LOCKED ROTOR CURRENT

WIRE LENGTH IN FEET	VOLTAGE DROP USING 1-#6 CABLE	PERCENT DROP @ 12 V SUPPLY	PERCENT DROP @ 15 V SUPPLY
50	2.3	19.16	15.33
100	4.6	38.33	30.66
150	6.9	57.5	46
200	9.2	76.6	61.3

WIRE LENGTH IN FEET	VOLTAGE DROP USING 2-#6 CABLE	PERCENT DROP @ 12 V SUPPLY	PERCENT DROP @ 15 V SUPPLY
50	1.15	9.58	7.66
100	2.3	19.16	15.33
150	3.45	28.75	23
200	4.1	34.16	27.33

WIRE LENGTH IN FEET	VOLTAGE DROP USING 3-#6 CABLE	PERCENT DROP @ 12 V SUPPLY	PERCENT DROP @ 15 V SUPPLY
50	0.76	6.33	5.06
100	1.53	12.75	10.2
150	2.3	19.16	15.33
200	3.06	25.5	20.4

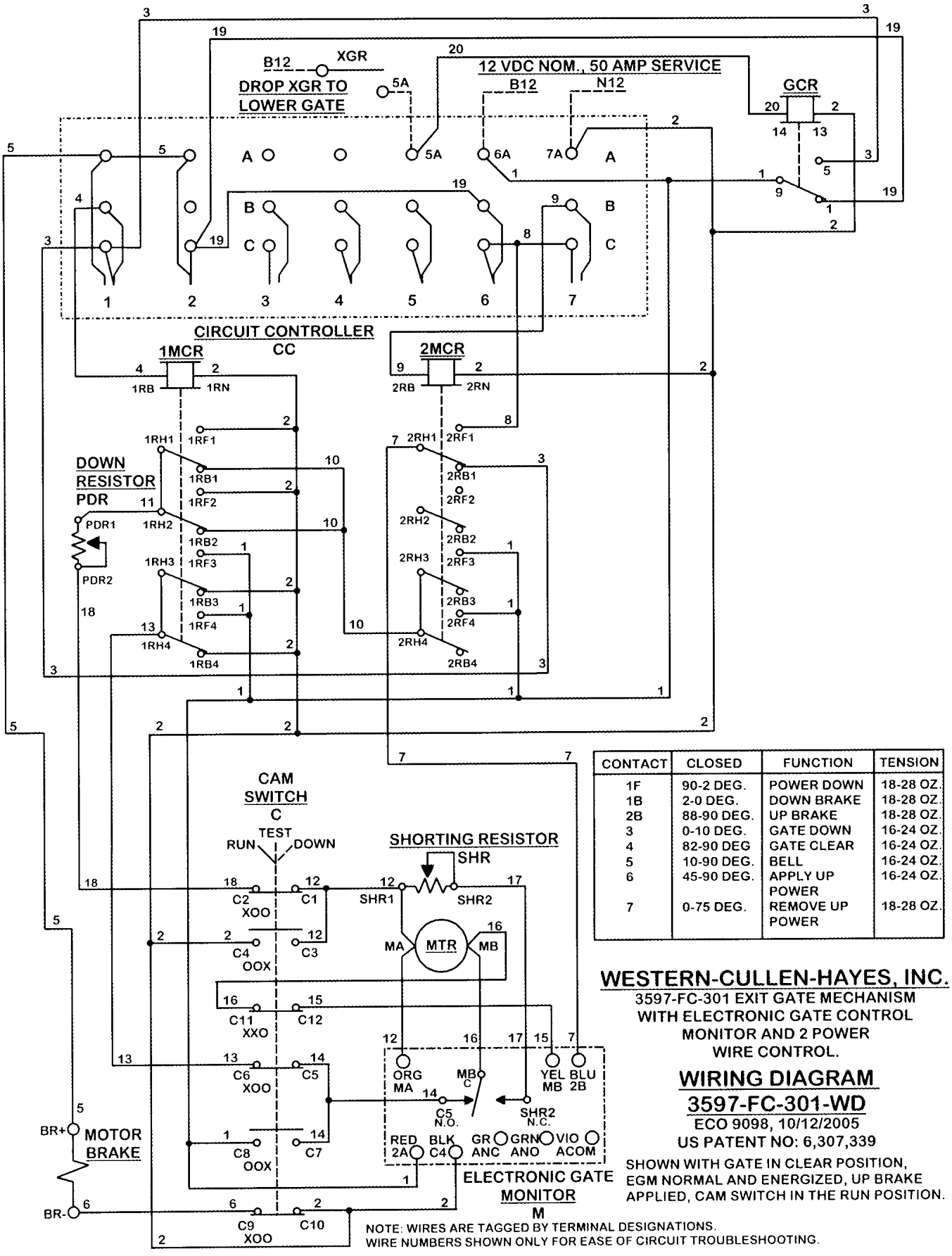
WIRE LENGTH IN FEET	VOLTAGE DROP USING 1-3/16" BOND STRAND	PERCENT DROP @ 12 V SUPPLY	PERCENT DROP @ 15 V SUPPLY
10	0.35	2.91	2.33

WIRE LENGTH IN FEET	VOLTAGE DROP USING 1-#10 WIRE	PERCENT DROP @ 12 V SUPPLY	PERCENT DROP @ 15 V SUPPLY
10	1.17	9.75	7.8

TO CALCULATE OTHER LENGTHS OF RUN USE THE FOLLOWING FORMULA.

$$\frac{22 \times \text{WIRE LENGTH IN FEET} \times 55}{\text{CIRCULAR MILS}}$$

WIRE SIZE	CIRCULAR MILS	WIRE SIZE	CIRCULAR MILS
#10	10400	3/16"	35140
#9	13100	#4	41700
#6	26300	#2	66400



CONTACT	CLOSED	FUNCTION	TENSION
1F	90-2 DEG.	POWER DOWN	18-28 OZ.
1B	2-0 DEG.	DOWN BRAKE	18-28 OZ.
2B	88-90 DEG.	UP BRAKE	18-28 OZ.
3	0-10 DEG.	GATE DOWN	16-24 OZ.
4	82-90 DEG	GATE CLEAR	16-24 OZ.
5	10-90 DEG.	BELL	16-24 OZ.
6	45-90 DEG.	APPLY UP POWER	16-24 OZ.
7	0-75 DEG.	REMOVE UP POWER	18-28 OZ.

WESTERN-CULLEN-HAYES, INC.

3597-FC-301 EXIT GATE MECHANISM WITH ELECTRONIC GATE CONTROL MONITOR AND 2 POWER WIRE CONTROL.

WIRING DIAGRAM

3597-FC-301-WD

ECO 9098, 10/12/2005

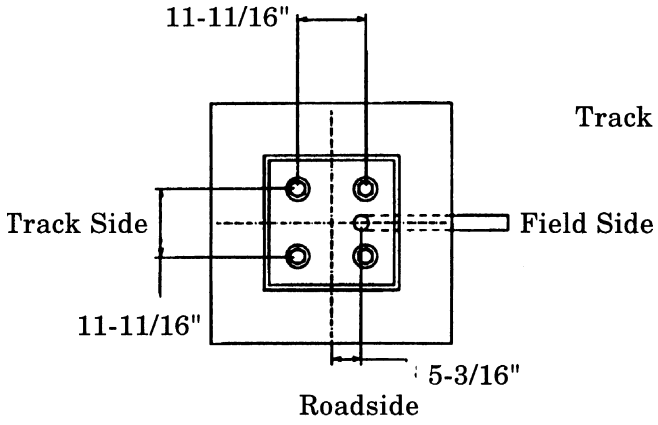
US PATENT NO: 6,307,339

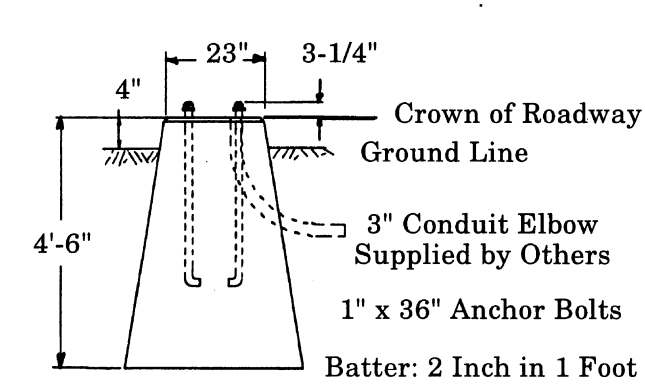
SHOWN WITH GATE IN CLEAR POSITION, EGM NORMAL AND ENERGIZED, UP BRAKE APPLIED, CAM SWITCH IN THE RUN POSITION.

NOTE: WIRES ARE TAGGED BY TERMINAL DESIGNATIONS.
WIRE NUMBERS SHOWN ONLY FOR EASE OF CIRCUIT TROUBLESHOOTING.

SECTION 2
INSTALLATION INSTRUCTIONS - MODEL 10 SIGNAL

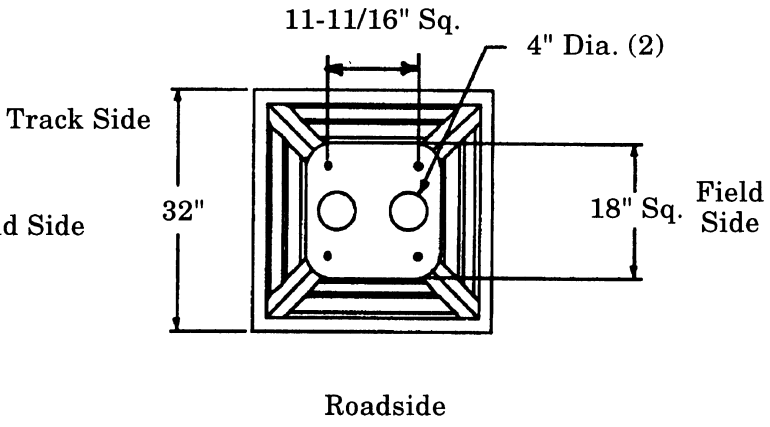
1. Install foundation in proper location per the requirements of the installation. Refer to figures 1 and 2 for typical foundation details.

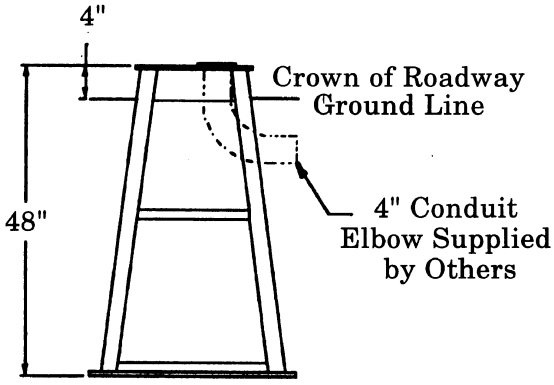




Suggested Concrete Foundation for Model 10 Gate Signal Using 2149 Junction Box Base

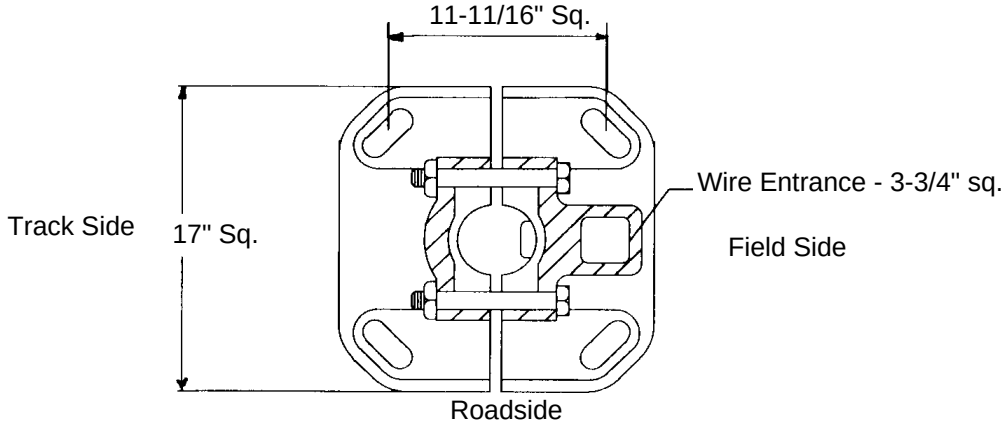
Figure 1





Galvanized Steel Foundation No. 1181-9

Figure 2



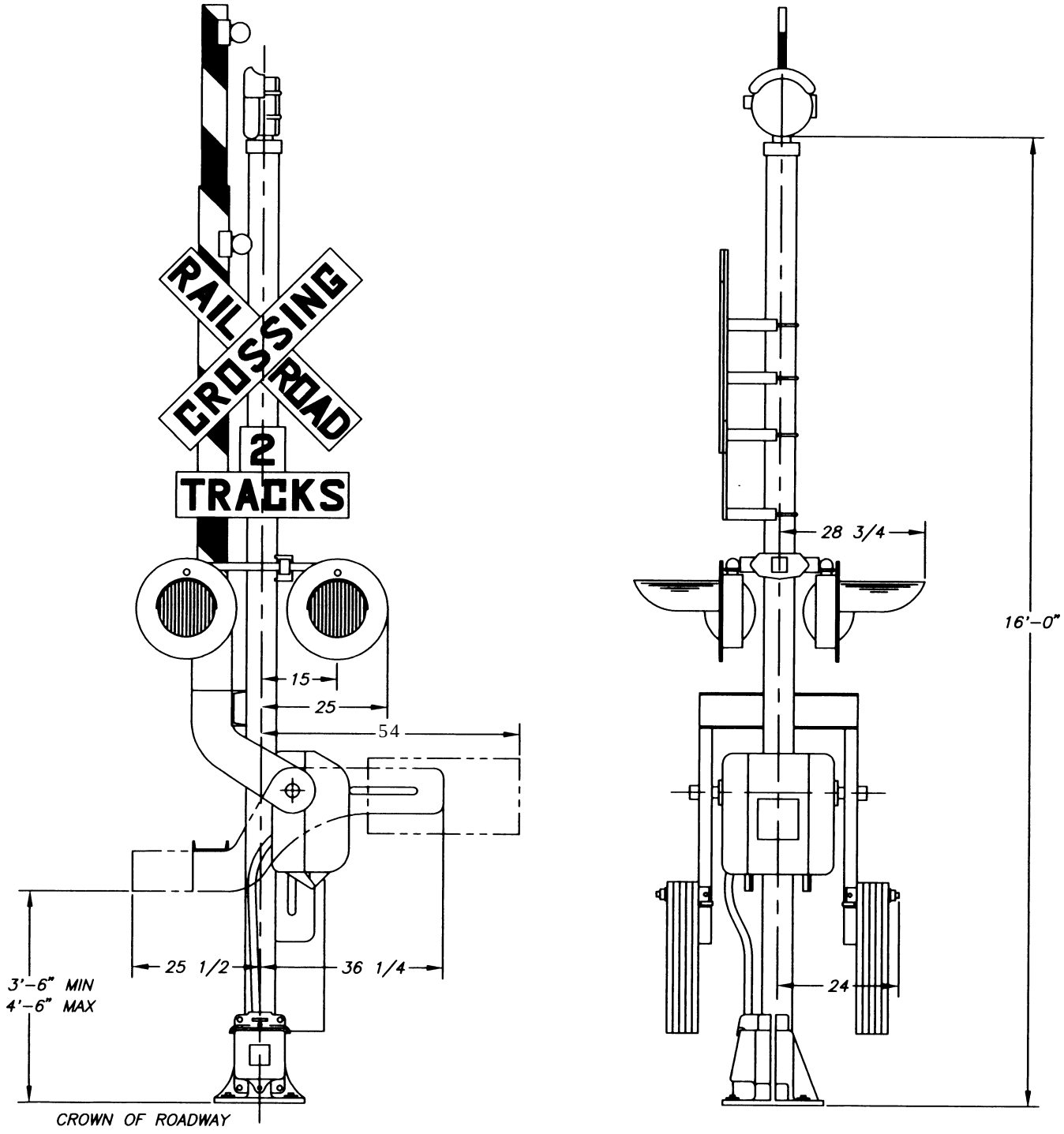
Plan View of Type 2149 Junction Box Base

Figure 2A

2. Remove the junction box cover to access the conduit adapter and hardware kit. Attach the conduit adapter to the top of the base. Loosen the base clamp bolts and install the lower pipe shield in the bottom of the base. Insert the signal mast into the base and tighten the base clamp bolts. Place the base and mast assembly on the foundation with the junction box cover facing oncoming traffic as shown in figure 3. Secure the assembly to the foundation anchoring bolts.

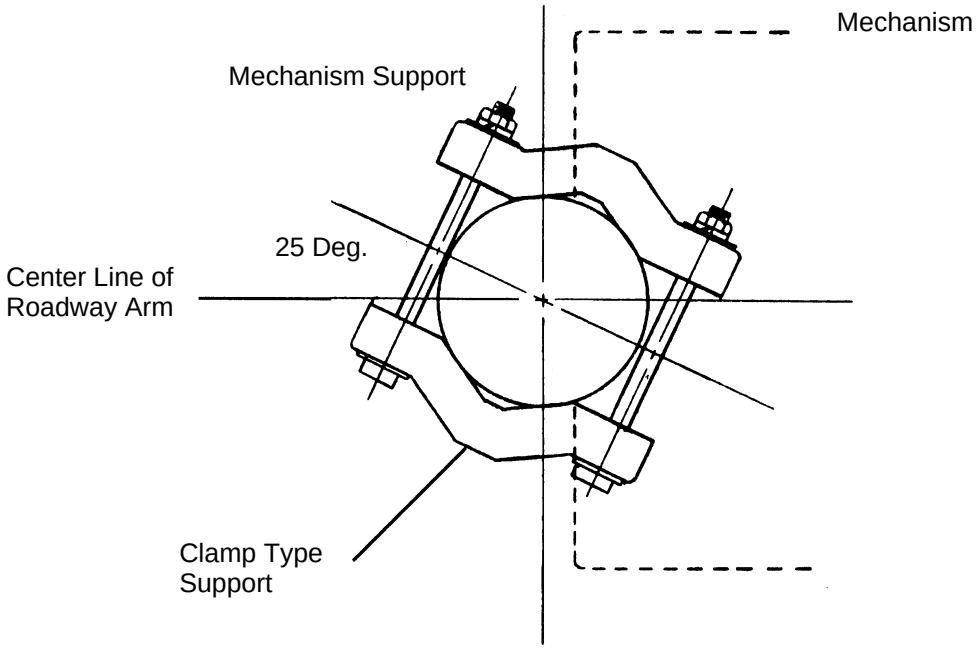
Typical Model 10 Signal

Figure 3



3. Secure the mechanism support assembly to the mast 48 inches above the top of the foundation in a position as shown in figure 4. **Note:** Adjustment may be required to position the gate arm at 3-6" to 4-6" above the roadway crown after the mechanism and gate arm are installed.

4. Install 4 square head bolts into the slots in the rear of the mechanism case. Set the mechanism onto the support assembly. Install saddle clamps and nuts.



Clamp Type Mechanism Support Installation

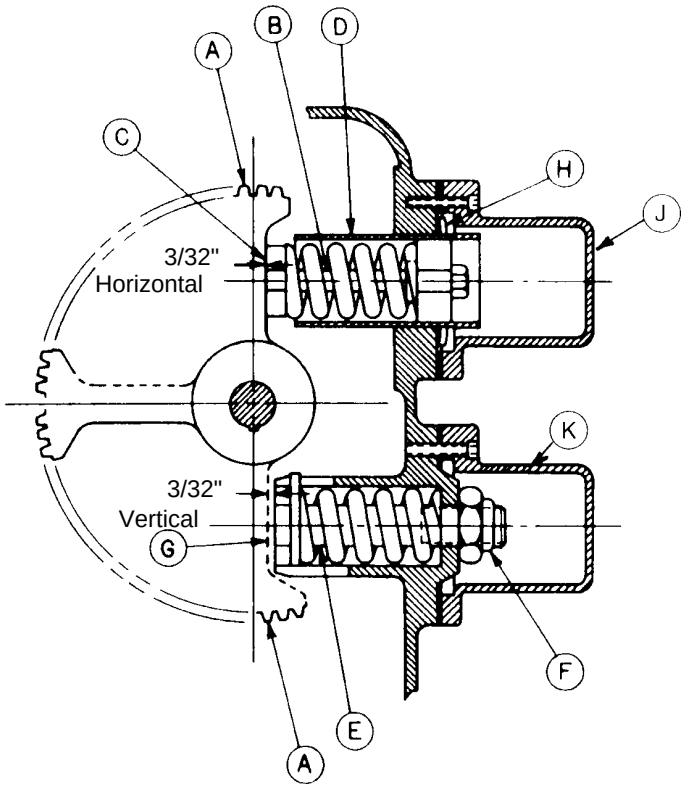
Figure 4

5. Remove hole plugs from mechanism case. Install conduit fittings, adapters, cable grip and ventilator. Install the 1-1/2" sealtite from the base to the mechanism. Be sure enough slack is available to allow rotation of the mechanism.

6. Remove nuts, washers and spline protectors from the ends of the mechanism main shaft.

7. Make sure the main shaft is in the position it assumes when the gate arm is down (horizontal). This condition exists when segment gear (A) is resting on the horizontal stop pin (B) at point (C) as shown in figure 5.

Ref. No.	Description
A	Segment Gear
B	Horizontal Stop Pin
C	Clearence Gap 3/32" Minimum
D	Horizontal Stop Spring Housing
E	Vertical Stop Pin
F	Vertical Stop Pin Nut
G	Clearance Gap 3/32" Minimum
H	Horizontal Stop Pin Locknut
J	Horizontal Stop Pin Cover
K	Verical Stop Pin Cover



Stop Detail

Figure 5

8. Refer to figure 6. Apply gate and counterweight support arms (B) to the mechanism main shaft (A). Keeping the gate end of the supports in the down (horizontal) position, install washers and hand tighten nuts on the main shaft.

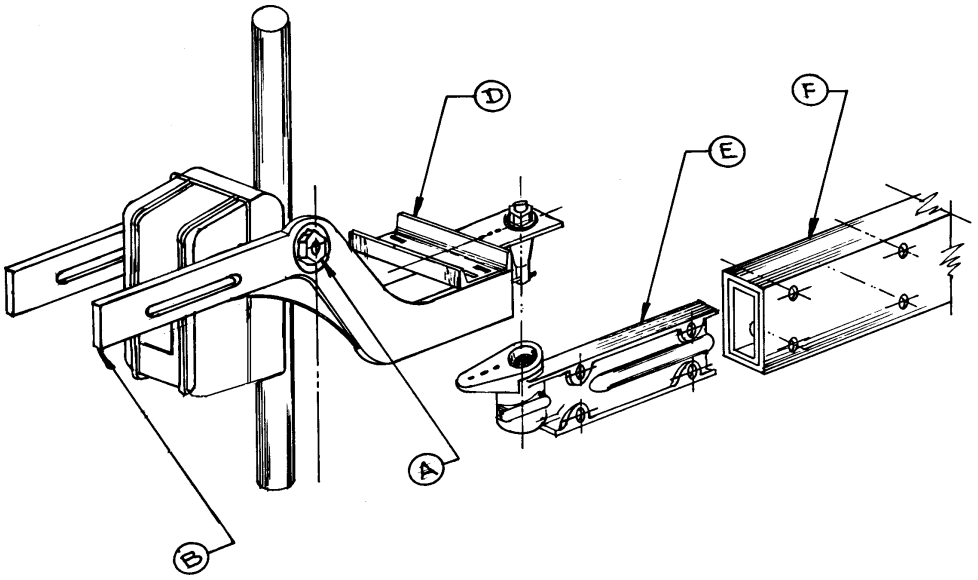
CAUTION: Do not apply counterweight before the roadway gate arm is installed.

9. Install conversion bracket, breakaway adapter channel, or Gate Gard (D) to the counter-weight support arms (B). Secure with provided hardware. The square head bolts fit into the recess on the support arm with the threads facing outward.

10. Tighten all installed hardware.

11. **Installation of fiberglass or aluminum/fiberglass gate arms.**

Assemble the arm by sliding sections together to achieve desired length. In some cases, it may be necessary to drill holes in the inserted arm section. Secure sections with provided hardware.



Gate and Counterweight Support Installation

Figure 6

Ref. No.	Description
A	Main Shaft
B	Gate and Counterweight Support Arms
D	Conversion Bracket or Adapter
E	Cast Breakaway Adapter
F	Gate Arm Section

PIVOT TYPE BREAKAWAY ADAPTER

Referring to figure 6, page 12, insert the cast breakaway adapter (E) into the gate arm end section (F) and secure with provided hardware. Position the gate arm with adapter attached 90 degrees from the mechanism assembly. Slip adapter onto mounting pin. Rotate arm 90 degrees, until the holes in the adapter align with the holes in the conversion bracket.

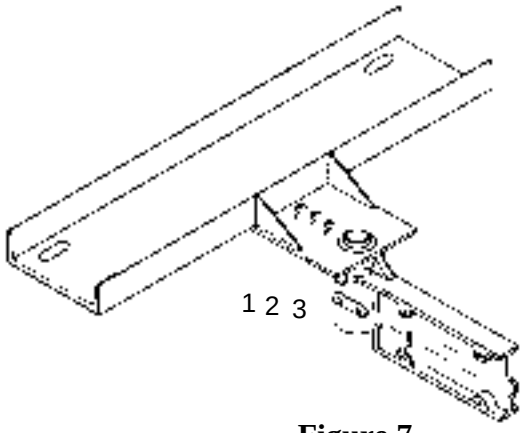


Figure 7

Install brass shear bolts in holes as instructed below. Gate arm length is measured from the centerline of the signal mast.

0-18' Gate Arms - Holes 2 and 3
19'-28' Gate Arms - Holes 1 and 2
Over 29' Gate Arms - Holes 1, 2 and 3

GATE GARD ADAPTER

Referring to figure 6, page 12. Install the Gate Gard (D) adapter onto the counterweight arms (B). Observe instruction sheet provided with the Gate Gard. Install gate arm (F).

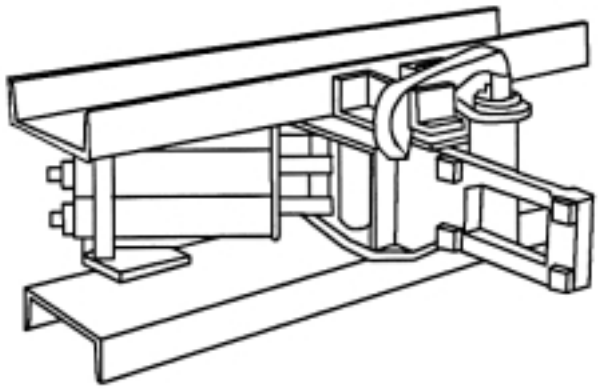
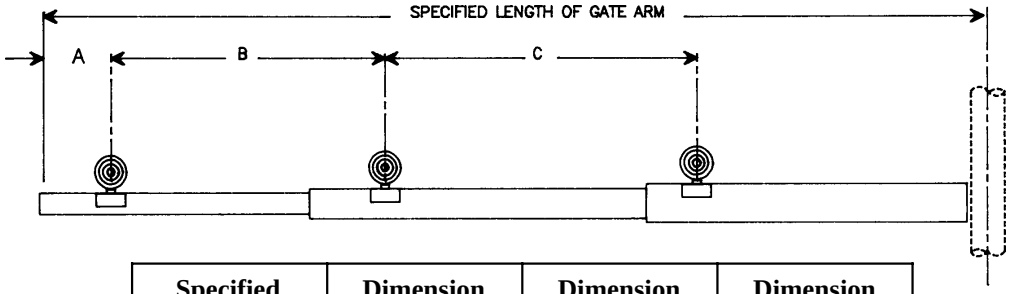


Figure 8

12. Install gate arm lights using provided hardware. Attach cable to the arm using eyelets provided. Leave slack in th cable between eyelets to provide drip points. Route cable through cable grip installed in the mechanism and terminate wires at required binding posts or fuse block panel. Refer to figure 9 for proper lamp spacing.

13. Install signal light units, signs and bell or pinnacle as required. Complete electrical wiring to these units.



Specified length of gate arm	Dimension "A"	Dimension "B"	Dimension "C"
14 Ft.	6"	36"	5'-0"
15 Ft.	18"	36"	5'-0"
16-17 Ft.	24"	36"	5'-0"
18-19 Ft.	28"	41"	5'-0"
20-23 Ft.	28"	4-0"	5-0"
24-28 Ft.	28"	5-0"	5'-1"
29-31 Ft.	36"	6-0"	6'-0"
32 Ft.	36"	7-0"	7'-6"

Suggested Roadway Gate Arm Light Spacing
Figure 9

NOTE: THE INSTALLATION MUST BE PROPERLY WIRED AND POWER APPLIED AT THIS TIME, AND FROM THIS TIME FORWARD.

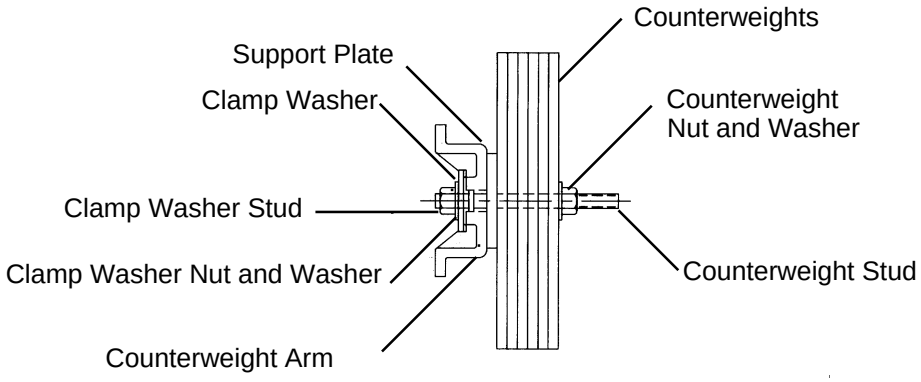
14. **Installation of Counterweights**

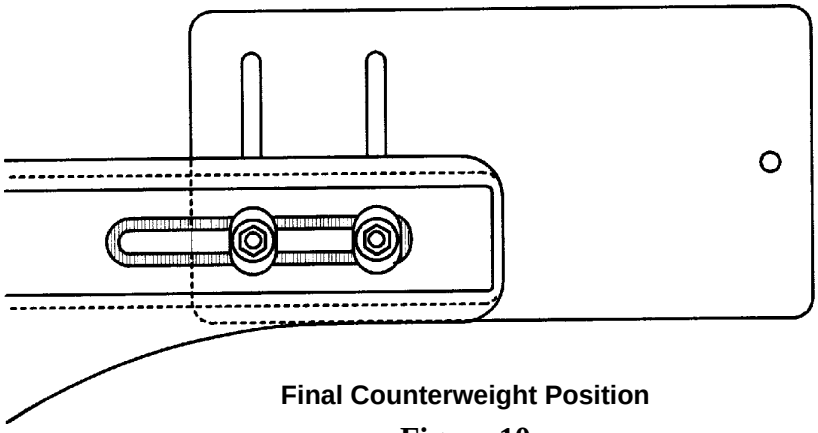
Oblong counterweights on cast iron or aluminum counterweight arms
Refer to figure 10 and table 1, page 15.

Install the counterweight support plate to the counterweight arm by inserting the clamp washer (short) studs through the slot from the outside of the arm. Install the clamp washers, flat washers and nuts to the studs. Locate the support plate at the furthermost end of the slot in the counterweight arm. Tighten the clamp washer nuts. Be sure that the teeth in the clamp washers are seated into the teeth on the inside of the counterweight arm.

Raise and secure the gate arm in the up (vertical) position. Install the counterweights to the counterweight (long) studs. Install the flat washers and nuts to these studs and hand tighten the nuts. If two counterweight arms are supplied, distribute the weights evenly on the two arms. Align the weights and insert the alignment bolt into the holes at the bottom of the weights.

Install washers and nut onto the alignment bolt and securely tighten. Now position the weights at the furthermost travel, way from the roadway, in the slots in the weights. Securely tighten the counterweight nuts. Lower the gate arm to the horizontal position.





Final Counterweight Position

Figure 10

Table 1
Table of weight for
fiberglass and aluminum/fiberglass gate arms

Gate Arm Length in Feet	Counterweight in Pounds	Counterweight at 47lb.
18	386	8
19 Thru 24	433	9
25 Thru 28	470	10
29 Thru 32	517	11

There are no vertical or horizontal torque values for the 3597-FC-301 Gate Mechanism.

SECTION 3
INTERNAL ADJUSTMENTS

1. Power Down Operation, Horizontal Position Adjustment.

When the crossing system gate relay de-energizes, drops, the motor brake is released. Then through the #1 front power down contact, relays 1MCR energize and apply power to the motor through the down resistor (PDR). When the gate reaches the horizontal position, the #1 contact transfers to the back, removes motor power and then applies power to the brake to hold the gate horizontal. This action is enhanced via a high rise sliding cam assembly.

The horizontal position is controlled by the position of the #1 contact cam.
The gate horizontal position would place the gate parallel to the crown of the roadway and between 3'- 6" to 4' 6" above the crown of the roadway.

If horizontal adjustment is required, adjust the #1 contact cam. Place the gate in the horizontal position. From the brake terminal block, located at the rear of the motor, install a jumper wire from terminal BR+ to terminal 6A on the circuit board, and a jumper from terminal BR- to terminal 7A on the circuit board. This will apply the brake. Adjust the cam while being sure that the sliding portion of the cam is fully upward in the cam frame. Remove jumper wire, cycle gate and re-check position. Repeat this procedure as necessary to achieve proper horizontal gate position.

When complete, check the mechanism horizontal stop pin clearance. Check this with 3/32" wire gauge, PN: 3590-1013. The minimum gap between the segment gear and the horizontal stop pin is 3/32". The maximum gap is 1/8".

DO NOT PLACE HANDS INTO THE GEAR AREA WHEN CHECKING THIS CLEARANCE.

If horizontal stop pin adjustment is required, refer to figure 5, page11. Remove the stop pin cover (J). Loosen the stop pin locknut (H). Turn the stop pin assembly (D) as required to obtain the specified clearance between the segment gear (A) and stop pin (B) at point (C). Tighten the lock nut and replace the cover.

2. Power Descending Time.

Check the gate power down time. The gate should descend between 10 and 15 seconds from the time the gate down command is given to the time the gate is horizontal. This speed is adjusted with the Down Resistor, (PDR) located on the back wall of the mechanism case. To increase the speed, move the resistor slide up, to decease the speed, move the resistor slide down. Be sure the slide shoe rests on top of the resistor wire.

NOTE: Never set a gate to descend at more then 15 seconds.

3. Gate Up Operation, Vertical Gate Position. Contact Cam Adjustments and Vertical Stop Adjustment.

When the crossing system gate control relay de-energizes, drops, the motor brake is released. The counterweights begin to fall thus raising the gate. The electronic gate monitor (EGM) will trip and apply the shorting resistor circuit. The gate speed will then be reduced as per the adjustment of the shorting resistor (SHR).

Once the gate reaches 45 degrees, the #6 contact closes which resets the EGM and applies up power to the motor. At 75 degrees, the #7 contact will open and remove up power from the motor.

The #2 back contact controls the final vertical position of the gate. After the #7 contact opens and removes motor power, the gate will coast until the #2 back contact closes and applies power to the brake.

If vertical adjustment is required, adjust the #2 contact cam. Place the gate in the vertical position. From the brake terminal block, located at the rear of the motor, install a jumper wire from terminal BR+ to terminal 6A on the circuit board, and a jumper from terminal BR- to terminal 7A on the circuit board. This will apply the brake. Adjust the cam while being sure that the sliding portion of the cam is fully downward in the cam frame. Remove jumper wire, cycle gate and re-check position. Repeat this procedure as necessary to achieve proper vertical gate position.

If the #2 cam was adjusted, check the position of the gate clear contact cam #4. Adjust the cam so that the cam follower is resting completely on the end of the cam surface, not on the cam ramp, when the gate is in the vertical position.

When complete, check the mechanism vertical stop pin clearance. Check this with a 3/32" wire gauge, PN:3590-1013. This is the minimum clearance between the segment gear and the vertical stop pin. There is no maximum specification.

DO NOT PLACE HANDS INTO THE GEAR AREA WHEN CHECKING THIS CLEARANCE.

If vertical stop pin adjustment is required, refer to figure 5, page 11. Remove th stop pin cover (K). Turn the stop pin nut (F) as required to obtain the minimum 3/32" clearance between the segment gear (A) and the stop pin (E) at point (G). When complete, replace the stop pin cover.

4. Gate Up Time.

To adjust the speed of the gate as it rises, it will be necessary to adjust the shorting resistor (SHR). This resistor is located on the mechanism relay panel.

To increase the gate speed, move the resistor slide to the right. To reduce the speed, move the resistor slide left.

5. Contact Cam General Information.

Refer to figures 11A and 11B, page 20.

Cams and contacts are factory set at the positions shown on the wiring diagram, plus or minus 2 degrees. This setting is considered a starting point as some cams will be adjusted during installation.

Be sure that the slots in the sliding cams are kept free of foreign material at all times and that cam and cam follower surfaces are clean.

There are three different cams in the 3597-FC-301 mechanism. Cam #1 is a sliding high-rise cam PN: 38-0045-531, cam #2 and #7 are standard sliding cam PN: 38-0045-92, and the remaining cams are standard fixed cams PN: 38-0045-55.

When replacing a cam, be certain that the proper cam is used in the proper position.

When adjusting or replacing any cam, care should be taken when tightening the capscrew. Referring to figure 11B. The motor up cam has a slotted insert (G), which allows for radial travel. When cam insert (H) is rotated to the closest point toward cap screw (L), a mini mum gap of 1/16" must be maintained between the cap screw and the cam insert at location (J).

Referring to figure 11A, for all fixed cams a minimum gap of 1/16 inch must be maintained between cam insert (E) and cap screw (A) at position (K).

Contact #3, 4 and 5 are for customer use and there are no other specific instructions.
Contact #4 is for customer use to indicate a gate clear condition. Specific instructions for this cam are given in paragraph 3 of this section. Specific instructions for cams #1,2,6 and 7 are discussed in paragraphs 1 and 3 of this section.

6. Circuit Controller Contact Adjustment

Contact Tension is listed on the wiring diagram and should be periodically checked.

To adjust a contact, it will be necessary to bend the contact spring to achieve the following specifications by using the contact adjusting tool, PN: ES-6104-2, an ounce spring scale,PN: 3565-211 and a 1/16 inch insulated gauge PN: 3590-1010.

When adjusting contacts, gently bend the contact spring by applying several gentle upward or downward forces against the contact spring. Recheck the gap or pressure after each operation. Repeat this proce dure until specification is achieved. Overbending may damage the contact and make it impossible to achieve proper contact spring pressure. Always apply the adjusting tool at the top of the contact directly beneath the circuit controller board. Never bend the contact body or at the bend near the contacting surface. Do not twist the contact while bending. Minimum contacting area must be 1/4 inch.

a. To adjust contacts 3 thru 7 follow these procedures. Inspect and adjust any contact that appears to have 1/8 inch or greater gap. Refer to figure 11A.

   1. With the contact in the fully open position, the clearance between the cam follower (B) and the metal frame of the cam (C) must be a minimum of 1/16 inch. To adjust, bend the back or heel contact until specification is achieved.

   2. With the contact in the fully open position, the clearance between the contacting surfaces (D and F) must be a minimum of 1/16 inch. To adjust, bend the front contact until specification is achieved.

Using an ounce spring scale, PN: 3565-211, and contact adjusting tool, PN: ES-6104-2, adjust contact spring pressure as follows. Refer to figure 11A and specification items (D) and (F).

Position the gate so that the contact cam follower (B), is well upon the cam surface (E) or (H) and the contact is fully closed. Hook the end of the scale to the front contact at the bend (F), near the contacting surface and lift gently until the contact opens. To adjust, bend the front contact while the contact is closed. To reduce pressure, bend the contact away from the cam. To increase pressure, bend the contact toward the cam.

b. There is a front and back contact at position #1, and a back contact at position #2. Refer to figure 11A. The gap specification for the #1 contact is a minimum of 1/8 inch. Inspect and adjust if the gap appears to be greater then 3/16 inch. The gap specification for the #2 contact is minimum of 1/16 inch. Inspect and adjust if the gap appears to be geater than 1/8 inch.

To adjust the front contact, follow the proceeding procedure. To adjust the back contacts, follow these procedures:

1. To check and adjust the #1 back contact, place the gate vertical. Check the gap (D) using a 1/8 inch or 2, 1/16 inch insulated gauges.

2. Lower the gate. Install a jumper wire from circuit controller terminal 2A to terminal 6A. This will apply the brake. Attach the scale to the heel contact at a position just below the cam follower (B) and lift gently until the contact just opens. Note the scale reading.

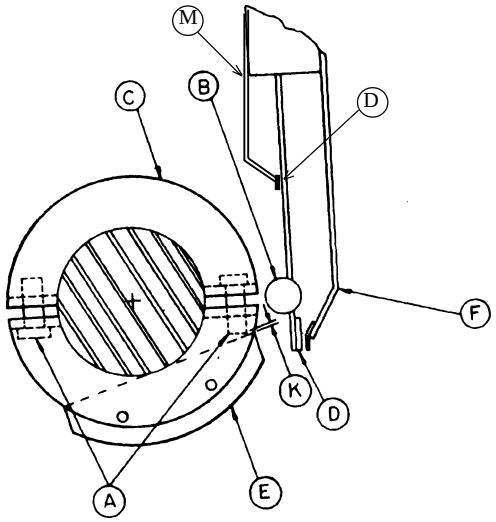
3. To check the #2 back contact, place the gate horizontal. Check the gap (D) using a 1/16 inch insulated gauge.

4. Raise the gate. From the brake terminal block, located at the rear of the motor, install a jumper wire from terminal BR+ to terminal 6A on the circuit board, and a jumper from terminal BR- to terminal 7A on the circuit board. This will apply the brake. Attach the scale to the heel contact at a position just below the cam follower (B) and lift gently until the contact just opens. Note the scale reading.

   DO NOT CHECK THESE CONTACT WITHOUT THE JUMPER WIRE INSTALLED, AS WHEN THE CONTACT OPENS THE BRAKE RELEASES AND THE GATE AND GEARS WILL MOVE. BE CAREFUL NOT TO SHORT THE CONTACTS WITH THE SCALE. INSTALL JUMPER WIRE DESCRIBED ABOVE TO PREVENT MOVEMENT.

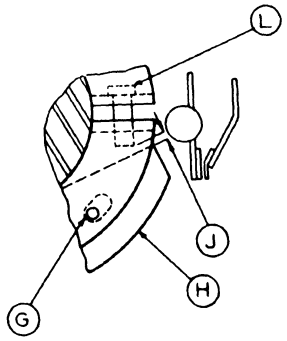
5. To adjust the gap or tension, adjust the back contact (M) using PN: ES-6104-1 contact bending tool for contacts with stiffeners. Always bend the contact while it is closed. To reduce pressure, bend the contact toward the cam. To increase pressure, bend the contact away from the cam.

CAUTION: Do not overbend the contacts. Overbending may damage a contact and make it impossible to achieve the correct gap or contact spring pressure.



Cam and Contact Detail

Figure 11 A



Sliding Cam Detail

Figure 11 B

Contact Tension: #1, 2 and 7 = 18 to 28 oz.
All others = 16 to 24 oz.

Ref. No.	Description
A	Cap Screw
B	Cam Follower
C	Cam Frame
D	1F and 1B minimum gap 1/8" All others minimum gap 1/16"
E	Cam Insert Surface
F	Attached Spring Scale

Ref. No.	**Description**
G	Cam Slot
H	Cam Insert Surface
J	Minimum Gap 1/16"
K	Minimum Gap 1/16"
L	Cap Screw
M	Back Contact

SECTION 4
GENERAL MAINTENANCE

Please contact Western-Cullen-Hayes at 773-254-9600 if you have any questions or need assistance with any aspect of the 3597-FC-301 Gate Mechanism.

1. Service and Tests.

All mechanisms are given a final inspection and are properly lubricated and adjusted before shipment from the factory. Following is a list of setup and general checks.

a. Supply voltage should be maintained between 12 and 16 volts DC. Check supply voltage at the 6A and 7A circuit controller terminals.

b. Operate the mechanism through an up-down cycle and note operating voltage. As the gate goes down, voltage should not drop below 11 volts and current should range from 15 to 30 amps. Readings will vary depending on the length of gate arm. If voltage drops below 9 volts, check power supply between the battery and the mechanism terminal points for proper wire sizing and voltage drop. Refer to wiring specifications in section 1.

c. Perform a gate up test. Lower the gate. Place the cam switch in the test position. The gate will begin to rise, then the EGM will trip thus slowing the gate. When the gate is near vertical, it will swing free as the brake is not applied when the cam switch is in the test position. When complete, press the EGM reset button and place the cam switch in the run position. The gate will power down.

d. Raise the gate. Check the gate power down time. The gate should descend between 10 and 15 seconds from the time the gate down command is given to the time the gate is horizontal. This speed is adjusted with the Down Resistor, (PDR) located on the back wall of the mechanism case. To increase the speed, move the resistor slide up, to decease the speed, move the resistor slide down.

NOTE: Never set a gate to descend at more than 15 seconds.

e. Check the clearing time. The gate should clear between 7 to 11 seconds. To adjust the speed of the gate as it rises, it will be necessary to adjust the shorting resistor (SHR). This resistor is located on the mechanism relay panel. To increase the gate speed, move the resistor slide to the right. To reduce the speed, move the resistor slide left.

f. Check for grounds in the battery and control circuit wiring.

g. Check relays as required by your railroad procedures and intervals.
The (MCR) relay specifications are: Voltage: 12vdc
Coil Resistance: 33 +/- 10% , Power: 4.4W
Nominal pull in voltage: 9.6
Nominal drop out voltage: 1.2 or more
Replace any relay that fails to pick by 10 vdc.

The (GCR) relay specifications are: Voltage: 12 vdc
Coil Resistance: 188 ohm +/- 15%
Nominal pull in voltage: 9.6
Nominal drop out voltage: 1.2 or more
Replace any relay that fails to pick by 10 vdc.

h. Perform a gate obstruction test. Place a DC voltmeter onto the power supply terminals. B on terminal 6A and N on terminal 7A. Place the gate in the vertical position with the crossing controls. Place a bolt or pin into a hole in the lower cluster gear. Place the test switch in the test position. The gate will release which will allow the cluster gear to rotate and the blocking bolt to rest upon the mechanism case. Then press the EGM reset button and place the cam switch in the run position. Check to be sure that voltage does not drop below 9 volts. After a time delay of not more than 30 seconds, the EGM should trip and release power from the motor. The gate should then hang free. If voltage drops below specification and the EGM does not release motor power, refer to the wiring requirements located in section 1.

NOTE: The mechanism can be used even if excessive voltage drop causes a failure of this test. However, the obstruction and/or the horizontal gate arm anti-pumping will be inoperative which may cause damage to control components.

i. If a total failure of the EGM unit occurs, the gate will not be operational.

Do not attempt to operate a 3597- FC-301 mechanism if the EGM unit has failed. Remove the gate from service and replace the EGM as soon as possible.

To remove a single 3597-FC-301 from service, hold the gate in the vertical position. From the brake terminal block, located at the rear of the motor, install a jumper wire from terminal BR+ to terminal 6A on the circuit board, and a jumper from terminal BR- to terminal 7A on the circuit board. This will apply the brake. Then place the cam switch in the test position. While wired and set in this manner the 3597-FC-301 will not operate.

j. The potentiometer of the EGM is factory set to trip at a minimum of 19 VDC. Field adjustment should not be required. To field test the EGM trip voltage:

1. Attached a recording DC voltmeter to the MA (orange) and MB (yellow) terminals on the EGM.
2. Lower the gate with the crossing controls. Place the cam switch in the test position. Observe the peak voltage on the meter, as the gate raises.
3. If the reading is above 20 volts, the test is complete. Press the EGM reset button and place the cam switch in the run position to lower the gate.
4. If the voltage is less than 20 volts, adjust the potentiometer clockwise one turn. Repeat this test and adjustment until a reading of 20 to 21 volts is achieved.
5. Press the EGM reset button and place the cam switch in the run position to raise the gate.

k. The motor brake does not require any service. Brake coil resistance is 11 ohms. Current draw at 12vdc is 1.09 amps, or 13 watts.

l. To lower the gate counterweight assembly (raise weights) control the gate down with the crossing system controls. The motor brake will hold the mechanism in the horizontal position for gate arm service.

m. The red LED is lit when nominal 12 vdc power is present. The green LED is lit when the EGM is normal and the EGM relays are energized. If the green LED is not lit, try to reset the EGM by pressing the reset button. Both LED's must be lit for proper gate operation.

2. Lubrication.

Time interval for periodic lubrication will be governed by usage.

The mechanism gear train, main shaft and motor bearings are pre-lubricated and sealed. No periodic lubrication is required for these bearings.

The gear teeth are to be lubricated periodically with, PN: 3590-1650, Bison all-temperature lubricating grease.

3. Motor Service.

Refer to figure 13, page 28.

The motor has a totally enclosed, non-ventilated housing and has prelubricated sealed bearings.

The motor brushes should be periodically inspected for wear. Replace brush (11 and 12) when carbon portion has worn to 5/8 inch length or less.

NOTE: Motor brush caps (13) screw on. Remove caps by turning counterclockwise. Hand tighten only when replacing caps. Always remove motor brushes (11) when gate arm is in the vertical position. No dynamic braking is provided with a brush removed. Always replace brushes EXACTLY in the position they were in.

SECTION 5
OPTIONAL EQUIPMENT

1. Heater may be attached to the mechanism for prevention of frost formation on controller contacts, (figure 17, page 32).

2. Gate lamp fuse kit PN:38-0045-540 (figure 16, page 31).

3. Setup and adjustment tools are listed on the last page of the mechanism parts section.

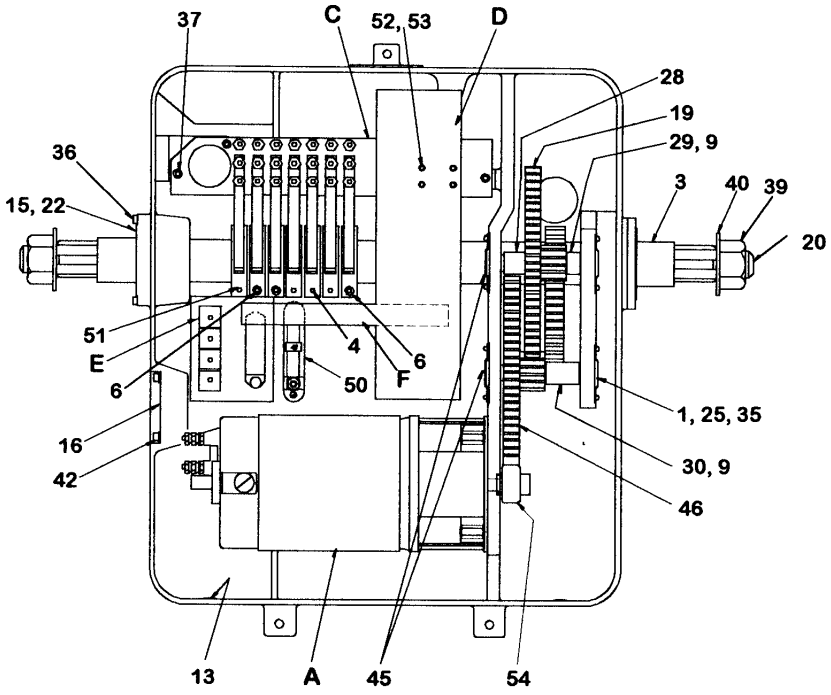
SETUP CHECKLIST

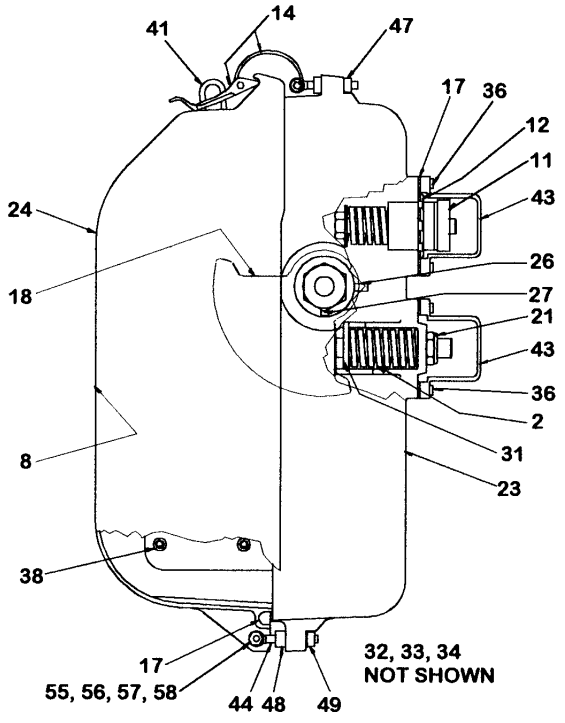
Location: _____ In Service Date: _____

1.	Supply voltage between 12 and 16 vdc.	_____
2.	Voltage during gate down cycle.	_____ volts
3.	Amperage during gate down cycle.	_____ amps
4.	Gate up / EGM test.	_____
5.	Check and adjust descending time. Resistor thumb screws tight.	_____ seconds
6.	Check and adjust gate clearing time. Resistor thumb screw tight.	_____ seconds
7.	Check for grounds in wiring.	_____
8.	Obstruction test.	Pass_____Fail_____
9.	Gate parallel to roadway surface.	_____
10.	Counterweights installed all the way back and all the way up, as viewed with the gate in the horizontal position.	_____
11.	3/32 inch clearance between segment gear and horizontal and vertical stops.	_____
12.	Contact cams adjusted per instructions.	_____

Installed By: _____ Checked By: _____

SECTION 6
3597-FC-301 CROSSING GATE MECHANISM
REPLACEMENT PARTS
Figure 12





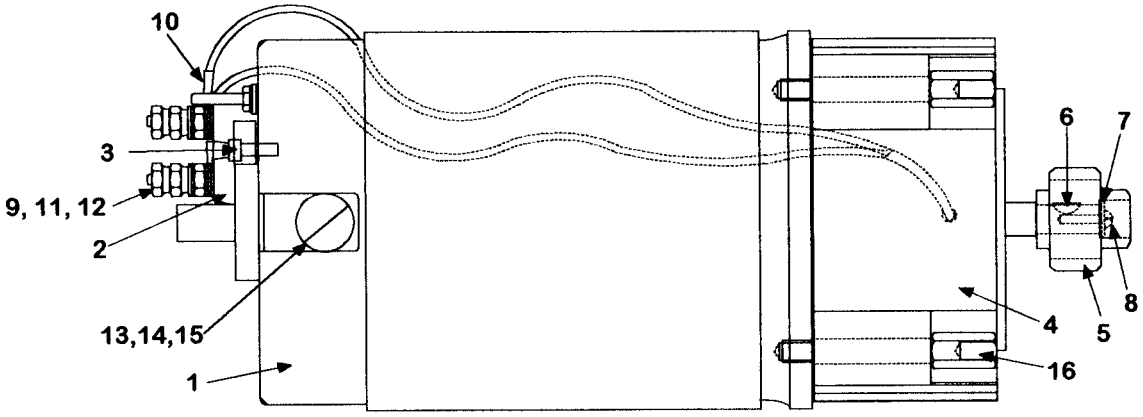
3597-FC-301 CROSSING GATE MECHANISM
REPLACEMENT PARTS
Refer to Figure 12

Ref. No.	Description	Part No.
1	Bearing Cover	38-0045-30
2	Spring, Vertical Stop	38-0045-38
3	Spacer Tube	38-0045-42
4	Cam Assembly	38-0045-55
A	Motor Assembly	3597-20-22
6	Sliding Cam Assembly	38-0045-92
D	Relay Panel Assmbly	3597-38
8	Wiring Diagram	3597-FC-301-WD
9	Cluster Gear Shaft	38-0045-267
10	Plastic Plug	38-0045-274
11	Horizontal Stop Pin Assembly	38-0045-305
12	2" Conduit Locknut	38-0045-314
13	Ventplug	1265-6-B
14	Hasp Assembly	1265-40-1
15	Main Shaft Bearing	3580-166
16	End Cap	3580-291
17	Gasket	3580-281
18	Segment Gear	3590-219-F
19	Cluster Gear	3590-220-F
20	Main Shaft Bearing	3590-222
21	Nylock Nut for Vertical Stop Assembly	3590-231
22	Main Shaft Cap	3590-232
23	Mechanism Case	3590-234-7-M
24	Mechanism Cover Sub-Assembly	3590-240-2-M
25	Bearing	3590-249
26	Set Screw	3590-251
27	Woodruff Key	3590-254
28	Spacer	3590-277
29	Spacer	3590-278
30	Spacer	3590-279
31	Vertical Stop Pin Assembly	3590-293
32	Mounting and Hardware Kit	3590-294

3597-FC-301 CROSSING GATE MECHANISM
REPLACEMENT PARTS (CONTINUED)
Refer to Figure 12

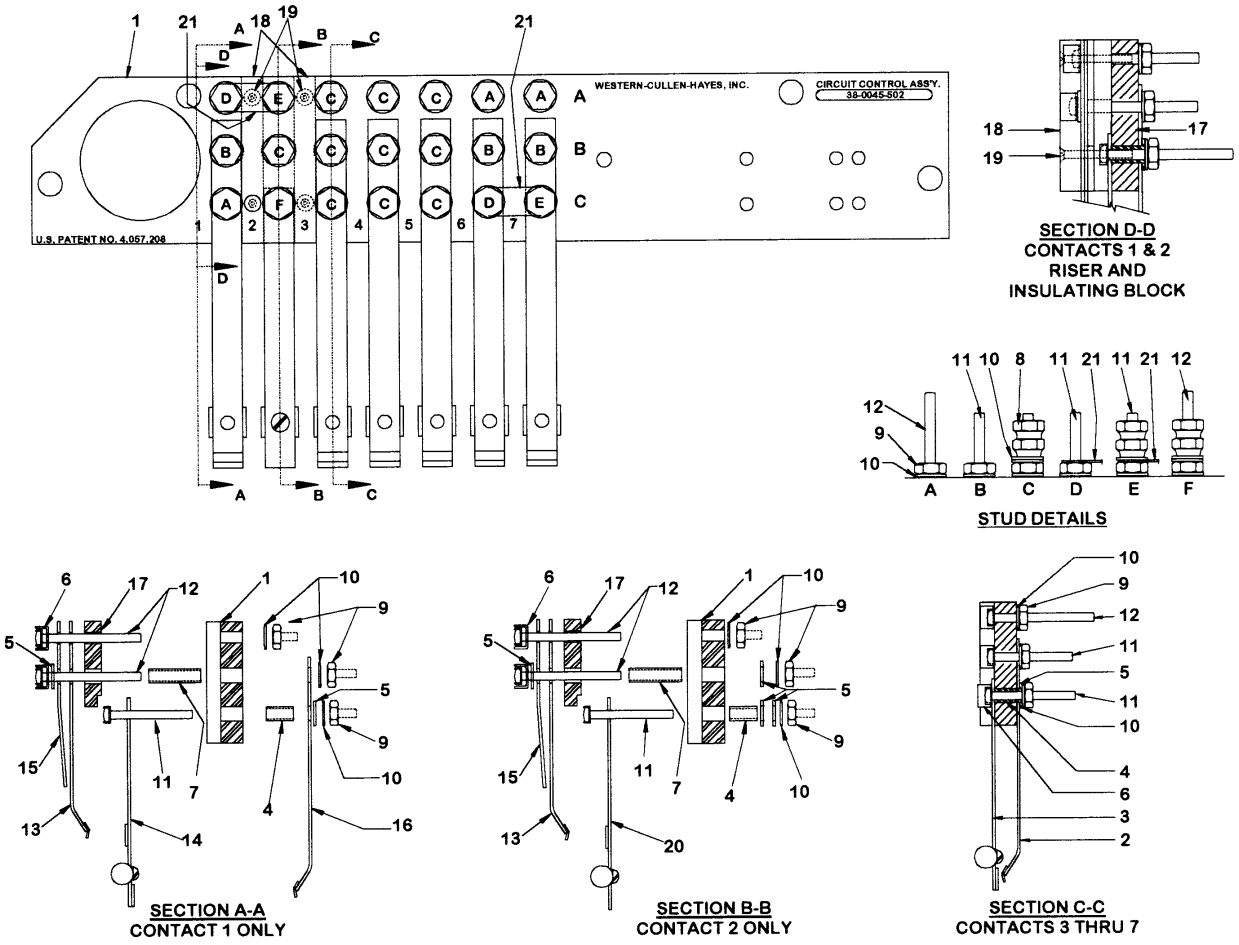
Ref. No.	Description	Part No.
33	Bison Grease	3590-1650
34	Pipe Plug	6560-51
35	8-32 x 3/8" Button Head Socket Head Cap Screw	BB-32-BB-3-0037
36	1/4-20 x 3/4" Hex Head Socket Cap Screw	BB-23-EE-3-0075
37	1/4-20 x 1/4" Hex Head Socket Cap Screw	BB-23-EE-3-0125
38	3/8-16 x 3/4" Low Head Socket Cap Screw	BB-59-JJ-3-0075
39	1-1/4" Hex Nut	JJ-12-AD-3
40	1-1/4" Plain Washer	3570-114
41	Staple	1265-4
42	1/4-20 x 3/8" Hex Head Socket Cap Screw	BB-23-EE-3-0037
43	Stop Assembly Cover	38-0045-329-M
44	Eyebolt	3590-381
45	Bearing Cap Spacer	3590-275
46	Four Hole Cluster Gear	3590-220-H
47	3/8-16 HD Square Nut	HH-11-JJ-3
48	3/8 Split Lockwasher	RR-00-AM-3
49	3/8-16 Nylock Hex Nut	AL-12-JJ-3
50	1/3 ohm Resistor (PDR)	1110-33
51	Hi-Rise Sliding Cam Assembly	35-0045-531
52	#10-24 x 1-1/4" Round Head Machine Screw	AA-10-CC-3-0125
53	#10 Split Lack Washer	RR-00-AH-3
54	Pinion Gear	3597-22
55	5/16"-18 x 2-1/4 Hex Head Bolt	CC-12-GG-3-0225
56	38"-16 Hex Nut	HH-12-HH-3
57	1/4" Plain Washer	PP-00-AJ-3
58	5/16"-18 Hex Nylock Nut	AL-12-GG-3
C	Circuit Controller Assembly	38-0045-502
E	Gate Lamp Fuse Panel	38-0045-540
F	Contact Heater	

3597-20-22 MOTOR ASSEMBLY
REPLACEMENT PARTS
Reference A
Figure 13



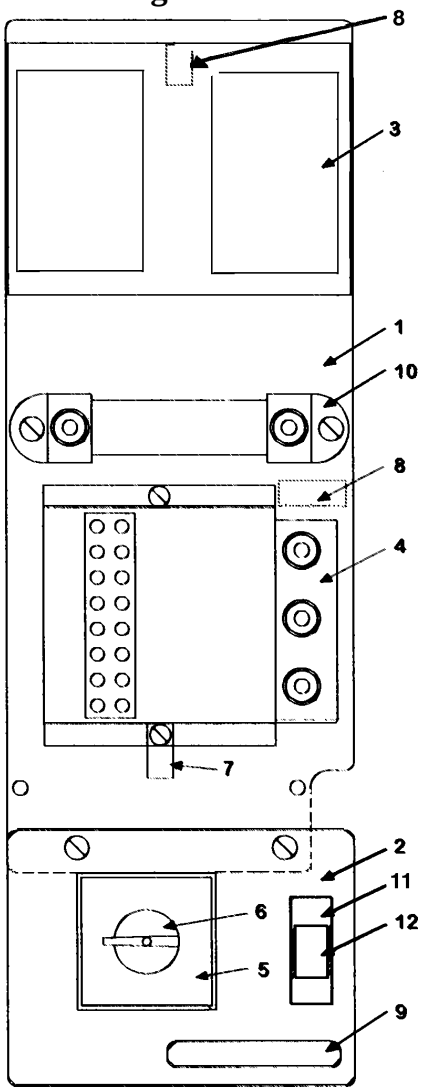
Ref. No	Description	Part No.
	Motor Assembly Complete	3597-20-22
1	Motor	3597-20-2
2	Terminal Block	2506-2
3	1/4-20 x 3/4" Nylock Hex Head Screw	3597-23
4	Motor Brake	3597-16
5	Motor Pinion	3597-22
6	1/8" x 1/4" Woodruff Key	3597-21
7	Washer	38-0045-241
8	8-32 x 1/2" Nylock Round Head Machine Screw	BJ-10-BB-3-005
9	AAR Washer	10708
10	Crimp Terminal	31908-MT
11	Clamp Nut	10707
12	Binding Nut	10706
13	Motor Brush	3597-20-13
14	Brush Cap	3597-20-12
15	Brush Holder	3597-20-14
16	Coupler Bolt	3597-24

38-0045-502 CIRCUIT CONTROLLER ASSEMBLY
REPLACEMENT PARTS
Reference C
Figure 14



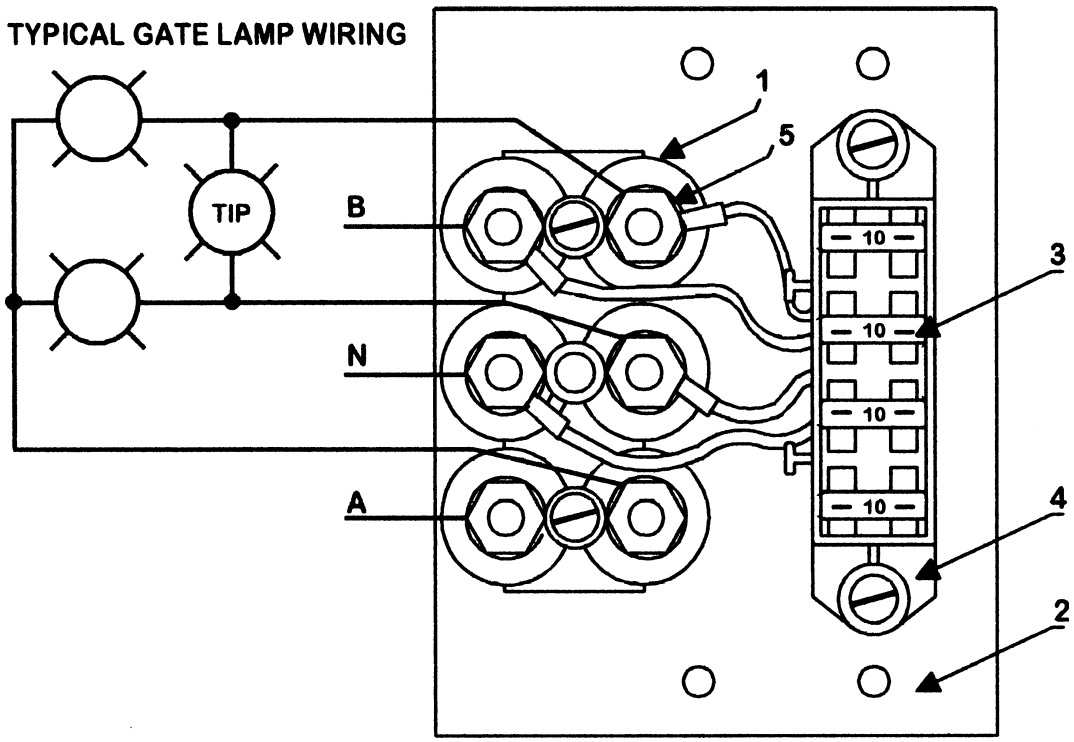
Ref. No.	Description	Part No.
1	Terminal Board	38-0045-502-1
2	Back Contacts 3 thru 7	38-0045-27
3	Front Contact 3 thru 7	38-0045-28
4	Insulator Sleeve	38-0045-29-A
5	Insulator Washer	38-0045-29-B
6	Binding Post Seat	38-0045-77
7	Insulator Sleeve	38-0045-525
8	Binding Nut	10706
9	Clamp Nut	10707
10	AAR Washer	10708
11	1-7/8" Binding Post	10709-2
12	2-1/4" Binding Post	10709-3
13	Back Contacts 1 & 2	38-0045-520
14	Heel Contact. Contact 1	38-0045-521
15	Contact Stiffener	38-0045-522
16	Front Contact. Contact 1	38-0045-523
17	Insulating Block	38-0045-505
18	Riser Block	38-0045-526
19	6-32 x 1-1/4" Phillister Head Machine Screw	38-0045-527
20	Heel Contact. Contact 2	38-0045-524
21	Connecting Plate	1705-4

3597-38 RELAY PANEL ASSEMBLY
REPLACEMENT PARTS
Reference D
Figure 13



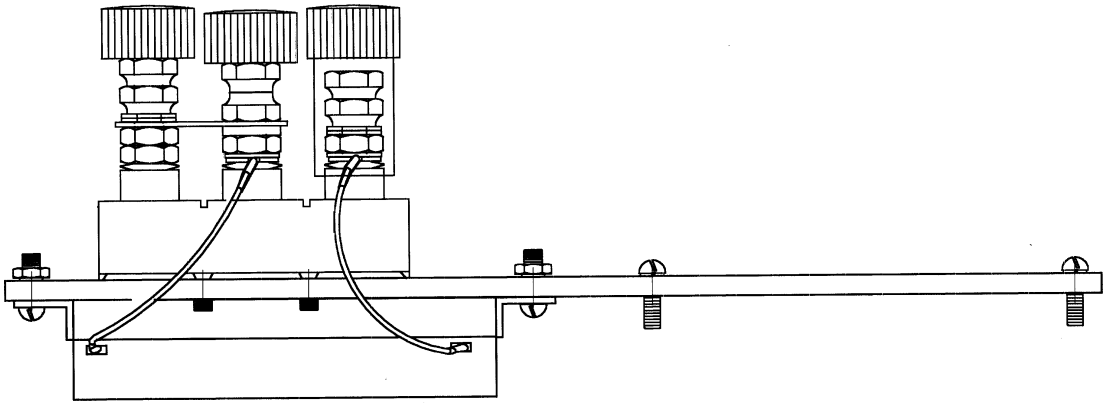
Ref. No	Description	Part No.
1	Relay Panel	3597-3-1
2	Cam Switch Panel	3597-3-22
3	Relay with Cover	91254-12
4	Electronics Gate Monitor	3597-1
5	Cam Switch	3597-2
6	Cam Switch Knob	3597-2-1
7	Cable Clamp	1953-6-A
8	Cable Clamp	1953-12-B
9	Cam Lube Label	38-0045-500
10	2.2 Ohm Resistor	1110-3
11	12 vdc Relay	50-3012-12
12	Relay Socket	50-3013

38-0045-540
GATE LAMP FUSE PANEL
REPLACEMENT PARTS
Reference E
Figure 16



Ref. No	Description	Part No.
1	Terminal Block	2508-69-4
2	Panel	38-0045-541
3	10 AMP Type ATC Fuse	400-35-50
4	Fuse Holder	50-0274
5	Crimp Terminal	31908-MT

3597-FC-301 CROSSING GATE MECHANISM
CONTACT HEATER ASSEMBLY
Reference F
Figure 17



Ref. No.	Description	Part No.
F	Contact Heater Assembly Complete, 115 VAC, 50 Watt, 500 Ohms	3597-4
F1	Contact Heater Assembly Complete, 24 VDC, 50 Watt, 25 Ohms	3597-5
F2	Contact Heater Assemmbly, 12 VDC, 50 Watt. 10 Ohms	3597-6

Set-Up and Adjustment Tools

Spring Scale, PN: 3562-210
Used for measuring gate arm torque.

Torque wrench with socket, PN: 3590-K-9.
Used for measuring gate arm torque.

Snap ring pliers, PN: 3590-1007
Used for ratchet wheel removal.

.020 gauge, PN: 3590-1012
Used to adjust ratchet wheel to hold clear pawl clearance.

.032 gauge, PN: 3590-1011
Used to adjust gap on hold clear mounted power down contact.

Ounce spring scale, PN: 3565-211
Used to measure contact spring pressure.

1/16" insulated gauge, PN: 3590-1010

1/8" insulated gauge, PN: 3590-1015
Used to check contact gap.

Contact bending tool for contacts without stiffeners, PN: ES-6104-2

Contact bending tool for contacts with stiffeners, PN: ES-6104-1
Used to adjust circuit board contact.

Angle finder, PN: 3590-1014
Used to set contact cam operating position.

3/32" wire gauge, PN: 3590-1013
Used to check vertical stop to segment gear clearance.

Tool kit, PN: 3590-K-11
Includes snap ring pliers, 3/32", 3/16" and 7/32" To handle allen wrenches, 7/16" combination wrench and canvas pouch.

Bison all temperature lubricating grease, PN: 3590-1650
For lubrication of gears and contact cams, 1 quart can.