Division / Business Unit: Engineering and Systems
Function: Signalling
Document Type: Standard

Level Crossing and Pedestrian Crossing Maintenance

ESM-03-01

Applicability

ARTC Network Wide

Publication Requirement

Internal / External

Primary Source

SMP 36 v1.2

Document Status

Version#	Date Reviewed	Prepared by	Reviewed by	Endorsed	Approved
1.2	06 Sep 22	Standards	Stakeholders	Manager Signalling Standards	A/General Manager Technical Standards 05/10/2022

Amendment Record

Amendment Version #	Date Reviewed	Clause	Description of Amendment
1.0	12 Jan 21	Major Rewrite	First issue to supersede SMP 36 (v1.2). Document template and number updated, extended to Network wide applicability. Updated the definitions and responsibilities. Requirements of engineering instruction ESI-05-01N Level Crossing Monitor – Hardware Reset incorporated into this document.
1.1	28 Mar 22	Numerous	Relevant information included from ESM-00-05, ESM-00-06, ESI-03-01 and ESD-03-02. Removed duplicated

			information for focusing requirement already included in ESC-03-01 and provided reference to ESC-03-01.
1.2	06 Sep 22	Numerous	Relevant information included from SMS 13 and SMS 14 for level crossing and pedestrian crossing maintenance.

Table of Contents

1 Introduction

1.1 Purpose

This standard specifies the maintenance procedures to be followed when working on active level crossing equipment or active pedestrian crossings to ensure safe and reliable operation throughout the life of the equipment.

1.2 Scope

This standard covers the maintenance, defect management, repair and testing responsibilities for maintenance, repair and reinstating active level crossing and active pedestrian crossing protection equipment.

1.3 Standard Owner

The General Manager Technical Standards is the Document Owner. For any query, initial contact to be made at standards@artc.com.au.

1.4 Responsibilities

The Area Managers are responsible for the implementation of this standard and their application to all level crossing assets.

The Signal Work Group Leaders are responsible for:

- Ensuring all defects are recorded in Ellipse and repairs or reassessments are scheduled within an appropriate timeframe based on discussion and agreement with the relevant signal maintenance engineer. This includes defects rectified during the performance of the service tasks.

Signal Electricians are responsible for:

- Routine maintenance and inspection of equipment in accordance with equipment service schedules and the Technical Maintenance Plan.
- Inspection of the equipment for signs of deterioration or damage.
- Recording defects, signs of abnormal deterioration or damage in Ellipse and bringing this to the attention of the Signal Work Group Leader and/or Signal Maintenance Engineer.
- Raise critical defects discovered during maintenance and failure with Signal Work Group Leader and Signal Maintenance Engineer.

The Signal Maintenance Engineer or equivalent role for the area is responsible for:

- Managing the electronic retention of the history cards to ensure they are available for future reference, incident investigations and audit.
- Undertaking Engineering Inspections which include a sample level crossing by each maintenance team of signal electricians.
- Compile an inspection report to provide to the Signal Work Group Leaders and Area Manager so that any defects that have been overlooked by Signal Electricians are corrected.
- Ensure that maintenance staff are completing the maintenance to the required standard.

1.5 Reference Documents

The following documents support this standard:

- AS1742.7 Manual of uniform traffic control devices - Railway crossings
- AS7658 Railway Infrastructure – Railway Level crossing
- ESM-26-02 Signals Technical Maintenance Plan (TMP)
- ESW-26-01 Signal Service Schedule/Standard Jobs
- ESM-00-01 Signal Inspections
- SMS 02 Cerberus Level Crossing Monitoring Equipment
- EGP-10-01 Asset Management System
- ESC-03-01 Level Crossing Equipment
- ESC-07-03 Small Buildings, Location Cases, Terminal Cases and General Purpose Cases
- ESM0301F-01 Active Level Crossing Maintenance History Card
- ESM0301F-02 Active Level Crossing – Engineer's Inspection Record
- ESM-00-02 Failures
- ESM-00-03 Signalling Irregularities and Wrong Side Failures
- SMP 08 Booking Signalling Equipment Out of Use
- ESM-00-12 Disconnection of Signalling Apparatus
- SMP 10 Testing and Certifying Equipment Worked on or Altered During Maintenance
- ESM-00-20 Like for Like Renewals
- Operating Rules: Code of Practice (SA), Network Rules (NSW) and TA20 (Vic)

1.6 Definitions

The following terms and acronyms are used within this document:

Term or acronym	Description
Area Manager	Manager of multi-disciplinary maintenance teams and is the local asset manager – may be referred to by different names (e.g. Team Manager) as a result of future organisational restructure
CAN	Condition Affecting the Network – see ARTC Code of Practice (SA), Network Rules (NSW) and TA20 (Vic)
Ellipse	The Asset Management System that records all of the infrastructure assets. It also issues work orders against the Technical Maintenance Plan and against recorded defects
OEM	Original Equipment Manufacturer
Technical Maintenance Plan (TMP)	This details the services required to be undertaken and the period between each service
Signal Electrician	A person with the Signal Electrician Statement of Competency
Signal Maintenance Engineer	A person with the Signal Maintenance Engineer Statement of Competency
Service Schedule	Part of the Technical Maintenance Plan that details what activities are undertaken during a maintenance service of the specific equipment

2 General

Level crossing and pedestrian crossing protection systems are to be maintained in accordance with the Signalling TMP and Signals Service Schedules for Level Crossing Protection Equipment, Level Crossing Equipment – ESC-03-01, Cerberus Level Crossing Monitor Equipment – SMS 02 and OEM manuals where not covered by the above mentioned documents.

In addition, the level crossing equipment including signage, lights, booms or gates (if applicable) and bells, are to be examined for damage and vandalism wherever a remote monitored level crossing is traversed when travelling or carrying out other maintenance duties.

The condition of the roadway and pathways including tactile markings, road markings, road approach signage to be checked and defects reported to the Area Manager via the Civil Team Leader or Work Group Leader.

Further to the normal preventative maintenance schedules by the signal electrician there will be an additional level of inspection and test by a Signal Engineer or other suitably accredited and authorised delegate, refer ESM-00-01 Signal Inspection and the Technical Maintenance Plan.

2.1 Safe Work Practices

Maintenance personnel must ensure safe work procedures are applied:

- to prevent workers being struck by trains or motor vehicles,

Correct operation of the level crossing protection equipment is not be relied upon as the only means of protection. A worksite protection plan is essential when maintaining, testing, inspecting, adjusting, repairing and fault finding active level crossing protection equipment.

In addition, maintenance personnel must take adequate measures to avoid risk of injury due to:

- pinch points,
- strike by boom or operating arm or
- entrapment by boom or
- strike by pedestrian gate operating mechanisms.

2.2 Maintenance Frequency

The maintenance periodicity specified in the TMP assumes the equipment to be in good condition and operating reliably. Equipment not meeting this condition shall be managed under the requirements of ESM-26-02 Technical Maintenance Plan Section 3 & 4.

2.3 Maintenance Records and Configuration Management

A level crossing location maintenance history card shall be kept in each level crossing location/cupboard where all tests and observations carried out each maintenance or repair visit are to be recorded.

Generally, current and one previous history card are to be kept in location box. Remaining history cards shall be scanned or photographed and stored in pdf format. The Signal Electrician is responsible for ensuring these electronic records are forwarded to the Signal Work Group Leader and Signal Engineer for filing. The original history cards are preferred to be retained on site if possible, for comparing maintenance test results, they are to be stored in a suitable protective plastic cover or laminated.

The maintenance history and tests recorded on the maintenance history cards are to be retained as records for the life of the level crossing protection system installed. The Signal Engineer or equivalent for the area is responsible for managing the electronic retention of the history cards to ensure they are available for future reference, incident investigations and audit.

3 Boom Mechanisms and Barriers

The Road Level Crossing Equipment procedure as mentioned in Service Schedule and/or the OEM's maintenance manual as applicable are the references for maintenance of this equipment.

The moving parts of power-operated boom gates and half boom barriers shall be kept clean, adequately lubricated and checked for efficient operation at each rostered maintenance visit by the signal electrician. Boom gates and half boom barriers are balanced when installed and the balance shall not be altered unless an alteration has been made to the booms or fittings.

Where automatic half boom barriers are provided, the signal electrician shall observe the operation of the mechanism and check the operating time. All cases where the descending or clearing times are considered abnormal shall be reported to the Signal Maintenance Engineer for investigation.

There have been several different types of road barrier mechanisms used from different suppliers since they were first introduced. All have the same operating principles and all mount onto a 140mm steel post.

Generally,

- The mechanisms are rated 8 to 20 volts DC.
- The electric motor drives the mainshaft (gate arm shaft) through a reduction gear train and, on some mechanisms, through an overload clutch.
- A hold clear device is provided on the motor shaft to retain the barrier in the raised position.
- Power down operation is provided between 90^0 and either 50^0 or 45^0.
- A circuit controller, driven off the main shaft, and motor control relay are provided.
- Snubbing is provided over the last 5^0 or 10^0 of downward barrier movement.

Even though there are internal component differences, the principle of operation of all boom barrier mechanisms should be as below.

Generally, 8 to 20 Vdc series wound motor drives a double ended main (or gate arm) shaft through a reduction gearbox. A circuit controller is driven either directly or indirectly from the main shaft and a hold clear mechanism operates on the motor shaft. Drive is applied from 0° to 87° or 88° in the upward direction and from 90° to 50° or 45° in the downward direction. The motor is snubbed (i.e. loaded when acting as a generator) between 5B and 0B to brake the barrier descent.

Control of the mechanism may be 4 wire (control +, control -, motor +, motor -) or 3 wire (control +, motor +, common -).

The motor control relay within the mechanism is activated by the control circuit. The motor supply runs through a contact (or contacts) of the motor control relay and through the 0° to 87° (or 88°) contact on the circuit controller to drive the barrier up. Concurrently, the pick-up and hold clear coils of the hold clear device are energised and the motor rotates against the ratchet of the hold clear

When the barrier reaches 87° or 88°, power to the motor (and in some cases the motor control relay) and pick-up coil of the hold clear mechanism is cut off, but is retained to the hold clear coil or magnetic brake that holds the barrier in the up position.

To lower the gate, the motor control relay is de-energised. This de-energises the hold clear coil and reverses the drive on the motor so that it drives the barrier down from 90° to 45° where the drive ceases and the barrier drop under gravity. At 5° a snubbing resistor is brought into circuit to act as a brake to slow the barrier descent.

In those mechanisms where the motor control relay is de-energised while the gate is in the raised position, the hold clear coil is switched directly by the gate control relay and a contact in the hold clear mechanism controls the drive down function.

NOTE: Maintenance personnel shall take care when maintaining the boom barrier equipment. Injury to level crossing users, vehicles and maintainers may result from the boom counterweight being incorrectly adjusted or the power supply removed from the boom holding mechanism.

NOTE: The motor snubbers shall always be connected when power is removed from the level crossing boom motor. The motor shall not be isolated by removal of links that disconnect the snubbing circuit from the motor.

4 Road Approach Warning Lights

AS1742.7 Manual of uniform traffic control devices - Railway crossings and manufacturer's manuals as applicable are the references for maintenance of this equipment.

It is essential that the visibility of the lights to road users be maintained *at the highest level practical*.

The basic Type F flashing light assembly consists of a pair of red lights supported on a horizontal crossarm at approximately 760mm centres. See figure 1 below. The lights are generally 200mm (8") diameter although some small numbers of 300mm (12") lights have been used. Flash rate can be between 35-65 flashes per minute.

Most commonly two pairs of lights are mounted back-to-back on a single post to form a four light assembly. A typical simple level crossing installation consists of two four light assemblies, one either side of the level crossing.

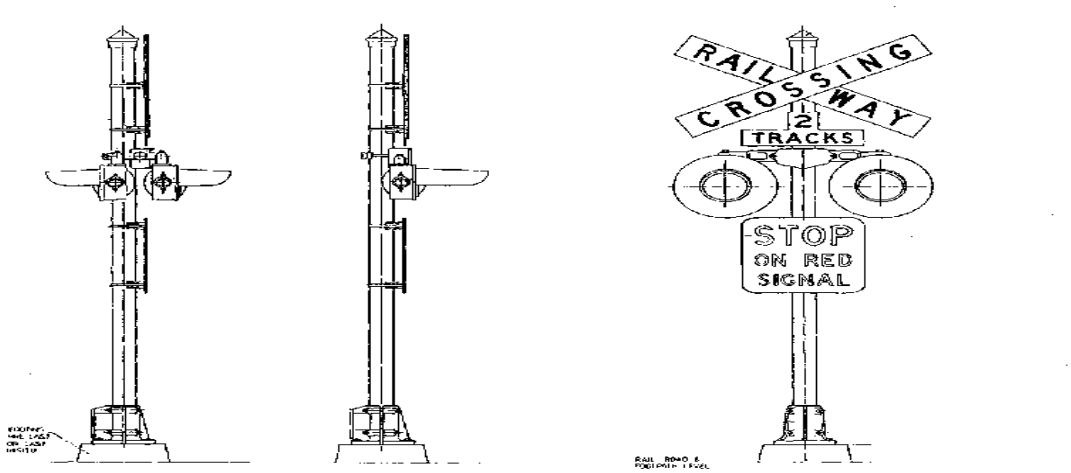


Figure 1 – Two-light and four light Type F assemblies

Prior to the introduction of LED technology, each light unit was made up of a cast aluminium or steel lampcase fitted with a reflector and a 10V 25W single filament precision incandescent lamp. The front of the lamp case had a red moulded acrylic or polycarbonate roundel (lens).

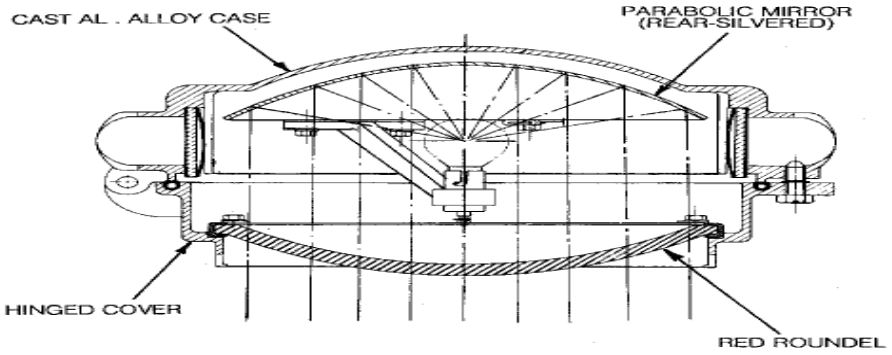


Figure 2 – Type F light unit with Incandescent Lamp

The development of LED technology has been rolled out from a number of suppliers and typically can be made up of 150 ultra-bright red LEDs mounted into a printed circuit board which fits within a polycarbonate housing with a clear cover. This cover may or may not contain moulded lenses to concentrate or spread the light beam from each LED.

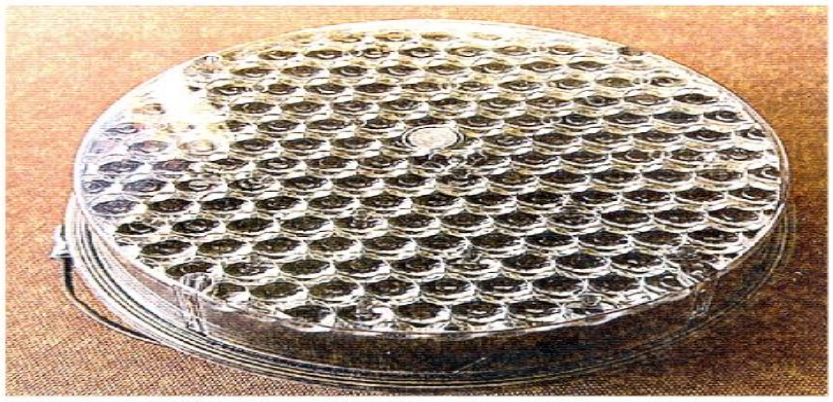


Figure 3 – Type F light unit with Incandescent Lamp

Problems where viewing of flashing lights are affected by direct sunlight shining on the lens, especially for incandescent lamps are to be investigated thoroughly for practical solutions. The Signal Maintenance Engineer shall be consulted for advice.

The operation and focus of Type "F" flashing lights shall be checked regularly, the lenses and reflectors for incandescent lamps kept clean and replaced when scratched or tarnished and lamps replaced as necessary. The voltage on each of the incandescent lamps (where applicable) shall be checked under operating conditions (with the test switch off) to meet the recommended value during maintenance visit.

Where the lamps are of the LED type, the diode array is to be checked to ensure that at least 75% of the lamp is still functioning, where this is not the case the LED unit is to be replaced with a P1 defect as per EGP-10-01. Where resistors are installed to adjust the lamp current, they are to be inspected for deterioration and heat damage and replaced if necessary.

It is the responsibility of the Signal Electrician to check light focus and intensity as part of the maintenance visit to ensure that road users achieve good sighting of the level crossing lights. Focussing shall be undertaken in accordance with ESC-03-01 Section 2.3.1.

4.1 Active Advance Warning Lights (AAWL) (ref AS1742.7 Appendix E)

AAWLs are provided for the motorist where the approach to an actively protected level crossing provides only marginal reaction and braking time given the approach sighting distance and road speed or where the crossing is the first signal control encountered following a long distance of uninterrupted travel.

These early warning lights, which usually take the form of a pair of flashing orange lights are maintained by the Road Authority and are activated by a control from the level crossing equipment usually before the Type “F” lights commence to flash.

As the early warning signals are maintained by the Road Authority they are not covered in this procedure. However, signal maintenance staff are required to operate the level crossing with the test switch and observe that AAWLs are working. Signal maintenance staff are required to bring to the attention of the local Road Authority through the Area Manager/Signal Maintenance Engineer where the warning lights or signage are noticed to be not working, obscured, missing or damaged. Any such report to the local Road Authority shall be recorded.

5 Road Bells and Audible Warning Devices

Level crossings fitted with Type F signals are normally provided with one bell or audible warning device while those fitted with Type F lights and booms are provided with two bells or audible warning devices, one each side of the crossing.

These devices provide an audible warning to add to the visual warning provided by the Type F lights.

Older style mechanical bells are 300mm diameter electromagnetically operated with a ringing rate of 150-200 strikes per minute. Soft tone (nylon) hammers have been provided in some locations close to residences, hotels or motels to reduce the sound level of the bell. In other locations one of the two bells has been suppressed at night. Active pedestrian facilities have volume adjustable sirens, so in these cases both audible warning devices have been suppressed at night at a small number of locations with the pedestrian siren remaining active to provide an audible warning.

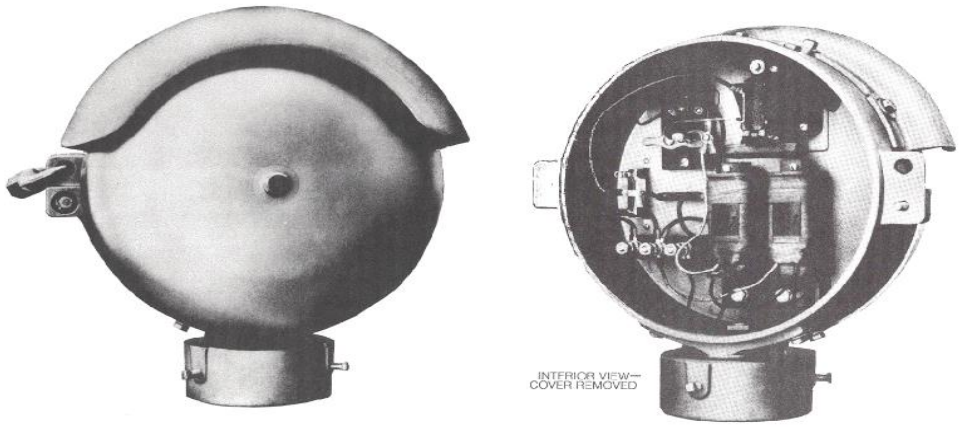


Figure 4 – Western Cullen Hayes Type 333 level crossing bell - Mechanical

Newer audible warning devices, known as electronic bells, have replaced mechanical bells and are still top of post mounted – supplied by Western Cullen Hayes.

Figure 5 – Western Cullen Hayes Level crossing bell – Electronic Bell

6 Pedestrian Boom and Swing Gates

Pedestrian boom barriers are operated by a workshop modified GRS upper quadrant signal mechanism with the safety latch (which prevented the arm being lifted) removed.

The spectacle plate is replaced by an arm support bracket with in-built counter-weighting so that the load on the motor is similar to that of an upper quadrant signal arm and the restoring force is sufficient to return the boom to horizontal under all conditions. There is no power down in this mechanism.

Operation is identical to that of an upper quadrant signal except there is no 45^0 position.

From around 1997, swing gate mechanisms have replaced the boom barriers for pedestrian control since the swing gate assembly is more resistant to vandalism and, unlike the boom, provides a barrier down to ground level.

The gate is operated by an electric motor driving through a gearbox, breakaway coupling and crank to the gate shaft. The motor is a three phase type adapted to operate from a single phase. The motor is able to be stalled mid-stroke without risk of electrical damage (if a gate is held part open) and continue to close or open when this obstruction is removed. Power is on the motor at all times in both open and closed positions.

In the event of power failure, a spring will move the gate to the closed position. Contacts for control and indication are driven off the gearbox output shaft.

7 Pedestrian Warning Lights

The first pedestrian warning lights were generally a road traffic lantern lampcase with a red outer lense with the word “STOP” stencilled in black, using a lamp to illuminate behind the red lens. As the word “STOP” disappeared from road traffic signals, some pedestrian crossings with booms were fitted with plain red lights.

The next version utilised the standard pedestrian road crossing “DON’T WALK” in red.

Current active pedestrian crossings the standard ‘don’t walk’ symbol or ‘red man’ using LED technology.

8 Pedestrian Tone Generator (Siren)

Many pedestrian crossings are very close to residential buildings so a device which could be clearly heard by a pedestrian approaching the crossing but which would not intrude into surrounding residential buildings was required.

The road level crossing audible warning device is only suitable for pedestrians where no dedicated crossing facilities are installed. A tone generator (siren) with volume control and with a strongly directional sound output was introduced. This enabled the audible warning to be directed toward the approaching pedestrian and set at a volume, which, while clearly audible within 10 or so metres of the crossing, was not unduly obtrusive in surrounding residential buildings.

9 Signage

Refer to AS1742.7 Manual of uniform traffic control devices - Railway Crossings for level crossing signage requirements.

9.1 Road Approach Signage

Roadway markings and signs outside the railway boundary are not the responsibility of ARTC, however signal maintenance staff are required to bring to the attention of the local Road Authority situations where these signs and roadway markings are noticed to be obscured or missing or damaged or significantly degraded.

Formal communication notifying the local road authority of the issue/s is to be sent via the ARTC Area Manager and advised to the Signal Maintenance Engineer.

9.1.1 Active Crossings

RX-5

The RX7 assembly is used at crossings fitted with Type F flashing lights (whether or not booms are fitted)

The W7-4 is used to give advance warning of a level crossing controlled by Type F flashing lights.

W7-4

9.2 Level Crossing Protection Signage

The level crossing protection signages are to be maintained by the Signal Electrician in accordance with the TMP and service schedule. Faded, degraded, obscured, misaligned or insecure signage is to be repaired or replaced.

10 Power Supply Indicator

The Signal Electrician shall investigate immediately any report that the power supply indicator (PSI) alarm lights are extinguished in the level crossing test switch box or other facility as applicable.

Using the test switch box where provided or other appropriate means the level crossing shall be operated for a minimum of 2 minutes and the power supply indicator (PSI) alarm lights shall be checked that they remain lit after the operation.

11 Emergency Switches Box

The maintenance of the level crossing equipment requires operation of the emergency key. The Signal Maintainer shall ensure that the door cannot be closed with the key in the keyswitch. This is to be undertaken at every maintenance service for the level crossing. The emergency key may become worn in service. The Signal Maintainer shall test that the key cannot be withdrawn from the keyswitch when it is in the reverse position. This is to be ensured at every maintenance service for the level crossing.

12 Level Crossing Monitor

12.1 Fault and Warning Indications

Fault and warning indications displayed by the level crossing monitor or reported by the level crossing monitor are to be investigated and rectified.

Alarms raised at the Network Controller level are to be managed as per ESM-00-04 Management of Signalling and Control System Failures and as per safe working standards.

12.2 Cerberus (Ref: SMS02 Cerberus Level Crossing Monitor Equipment)

12.2.1 General

The level crossing monitor system has a facility to override alarms being reported when maintenance is carried out. The fault reset button is to be pressed and held until the LOGIC led starts to flash (about 5 seconds) in order to temporarily disable reporting of alarms and warnings. At the completion of maintenance activities all fault and warning conditions brought up by any of the maintenance actions shall be cleared and then the fault reset button pressed to resume normal operation.

The maintenance disable shall be checked that it does time out (nominally 45 minutes) and any alarms and warnings that have not been cleared will be reported to the control centre.

All fault and warning conditions detected by the level crossing monitor shall be confirmed that they are latched and shall be cleared by maintenance staff in accordance with the level crossing monitor equipment manual.

Fault and warnings will not clear until the level crossing monitor has detected that the actual fault or warning condition has been rectified. For example, all lamps operate for at least 20 seconds after a failed lamp has been replaced to clear a lamp fault.

If the level crossing lamps are replaced or re-adjusted, then the crossing should be operated for 30 seconds to confirm that the level crossing monitor's lamp detection is working correctly. If a lamp fault or warning occurs or lamp replaced, then the lamp learn procedure is to be carried out in accordance with the level crossing monitor equipment manual.

Refer to the ARTC maintenance manual SMS02 Cerberus Level Crossing Monitor Equipment for detailed information on maintenance, adjustment, testing and fault finding.

12.2.2 Investigation of Alarms

When a Cerberus Level Crossing monitor gives a Yellow or Red Alarm, then the cause is to be investigated and determined immediately. Logs are to be downloaded and analysed.

The warning alarm is to remain on the system until the cause is identified and rectified. If the cause of the Alarm is not determined, then further advice is to be sought from the Signal Maintenance Engineer.

The attending maintenance staff shall confirm to the Network Controller the details of the alarm as follows: level crossing name, type of alarm and person attending the alarm. The Network Controller should record this information in the shift journal.

When the cause of the Alarm is determined and rectified, the attending maintenance staff should advise the Network Controller of the cause of the alarm; rectification action undertaken; time when the actions were completed and the name of the person who certified the alarm as resolved.

All Hardware Resets are to be recorded by ARTC maintenance staff on the level crossing maintenance history card.

13 Function Test Following Maintenance or Repair

Upon completion of maintenance or repair actions, and before leaving the level crossing, the Signal Electrician shall test the active level crossing protection system to ensure that the crossing is fully operational including booms, lights, bells and that nothing has been left switched off, disconnected or unlocked including boom, lights, bells, battery chargers, test switches and emergency switches.

13.1 Specific Requirements for Predictor controlled Level Crossings

This section addresses the requirements for recalibration of predictor controlled level crossings following maintenance or track work operations.

13.1.1 Maintenance replacement of level crossing predictor modules

Depending on the nature of the replacement undertaken the level crossing predictor may prompt a complete recalibration of the entire system or a new setup for the particular module employed. The manufacturers' documentation should be consulted whenever a module is replaced. In the case of a prompted setup for a prediction track or island track; the calibration procedure for the track concerned in the manufacturers' documentation shall be followed.

If the predictor prompts the reset of all functions to default values then all of the values given on the record card or circuit book shall be re-entered. In all cases where a module has been changed in the predictor or it has been powered down all the setup values shall be checked for compliance with the record card for the site. The recalibration or reset of the functions shall not be undertaken with a train present.

13.1.2 Maintenance replacement of leads, bonds, couplers, dummy loads or shunts

Where replacement of track equipment is required due to a defect the following shall be followed

- Replacement of a single bond, track lead connection, shunt or coupler can be made without a track setup being undertaken provided the track voltage setup parameters as displayed on the level crossing predictor are unchanged from those on the record card.
- Replacement of a pair of track connections or a dummy load requires that a full track setup be undertaken for the track/s concerned including a linearization adjustment.
- If a temporary bond is added around a rail defect this is to be treated as for the failure of a single bond.

13.1.3 Maintenance attendance after track works

Where replacement of rail or upgrade track occurs within a prediction track the following shall be followed

- Replacement of a single rail, removal of bonded out joints or minor sleeper replacement can be made without a track setup being undertaken provided the track voltage setup parameters as displayed on the level crossing predictor are unchanged from those on the record card.
- Upgrade of a section of track requires that a full track setup be undertaken for the track/s concerned including a linearization adjustment.

14 Damage to Level Crossing Equipment

It is essential that repair of damage to level crossing equipment is completed to such that the system operates safely and the site is secure.

Details of incidents of damage involving the replacement, reconnection or readjustment of level crossing equipment shall be reported to the Signal Maintenance Engineer who shall satisfy him/herself that the matter has received appropriate attention and shall instigate corrective action to prevent a recurrence, as required.

The Signal Maintenance Engineer shall maintain a record or database of damage to level crossing equipment, recording full details of the incident and personnel involved, and the repairs required and affected.

Repairs shall be carried out by suitably accredited personnel to proper standards and to the satisfaction of the Signal Maintenance Engineer responsible for the maintenance of the equipment.

Repairs shall be carried out in accordance with the respective standard, work instructions and safe-working procedures for working on level crossing equipment.

Where temporary repairs are made to level crossing equipment, they shall only be carried out with the permission of the Signal Maintenance Engineer; all temporary repairs shall be documented and forwarded to the Signal Maintenance Engineer as soon as possible.

The copy of the signalling circuits shall be marked up, certified and submitted to the Drawing Management System for updating As-Built drawings.

The repaired equipment shall be tested by a suitably accredited person to ensure that the function operates correctly, safely and reliably.

When repairs to damaged level crossing equipment have been affected, a Detailed Report shall be submitted to the Signal Maintenance Engineer by the signal maintainer attending.

Full details of the cause of the damage shall be given.

If a temporary repair has been made, the Signal Maintainer shall ensure that permanent repairs are carried out at the earliest opportunity and advise the Signal Maintenance Engineer for the records to be updated in Ellipse.

15 Failures and Irregularities

Failures and irregularities are to be managed in accordance with ESM-00-02 Failures and ESM-00-03 Signalling Irregularities and Wrong Side Failures.

16 Equipment Deficiencies

Defects including failures, damage, degradation are to be recorded and managed within the Alarms and Defects module [MSEWDA] of the Ellipse system in accordance with EGP-10-01 Asset Management System by signal maintenance staff in consultation with the Signal Maintenance Engineer. The assessment and risk management requirements may involve regular inspection of the defect to determine viability of keeping the equipment in service or increasing the maintenance frequency.

Appendix A: Operational and functional Check – Level Crossings

Hold Clear Device

Observe the operation of the hold clear device when the boom drives to the vertical position. If of the ratchet and pawl type, the pawl should engage cleanly and should not slip past any ratchet teeth when the motor stops driving. If the pawl does slip past any teeth, then either:

- The pawl and/or ratchet are worn and shall be replaced
- The holding coil is not retaining the armature securely (may be due to foreign matter between armature and coil increasing the air gap, low voltage on the coil, defective coil)

Similarly, the magnetic brake on the Harmon H1 mechanism should engage as soon as the motor stops driving and there should be little or no slip back.

If there is slip back, then the magnetic brake is worn and shall be replaced.

On the mechanisms with ratchet and pawl hold clear devices, check the condition of the teeth on the ratchet for wear or burrs, check that the edges of the pawl are sharp. (Note that on Western Cullen mechanisms, the pawl is reversible if one side is worn). Replace either or both ratchet and pawl if there is obvious wear.

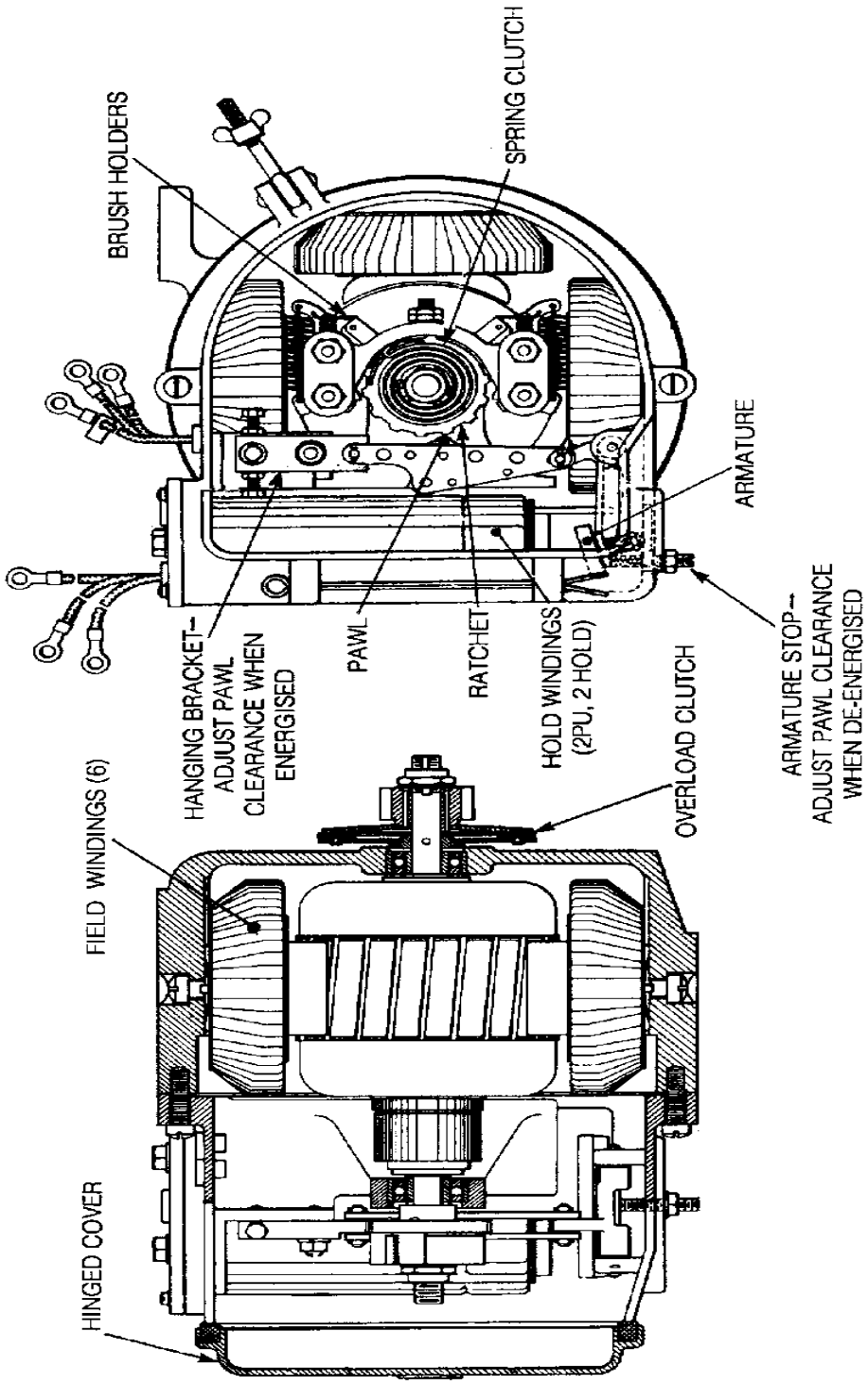


Figure 6 – WRRS B and D Type mechanism motor and hold-clear

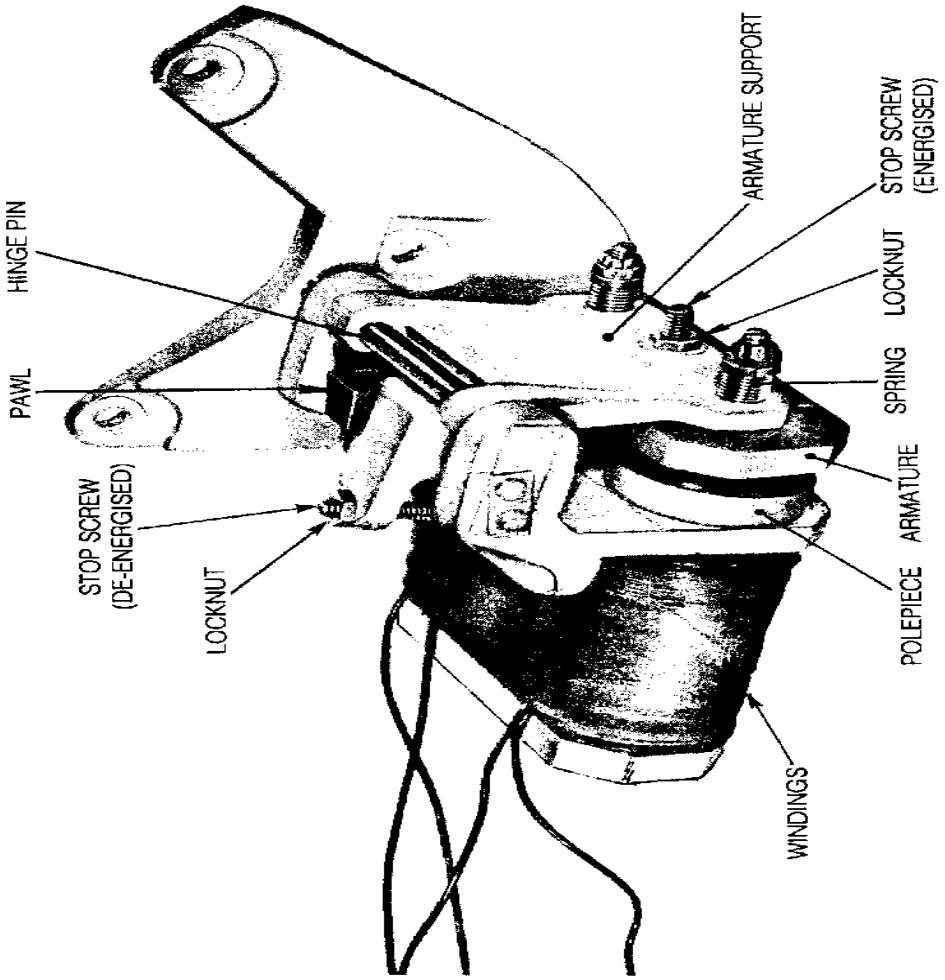


Figure 7 – Western Cullen Hayes mechanism – hold-clear assembly

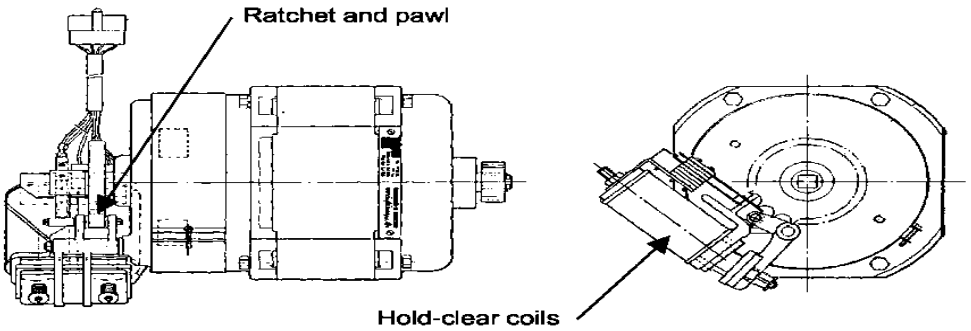


Figure 8 – Westinghouse EB – Motor and Hold-clear

Check the clearance between the pawl and the root of the ratchet teeth in the energised position. This should be not more than 0.25mm from WRRS and Western Cullen Hayes mechanisms.

In WRRS mechanisms this clearance is adjusted by re-positioning the hanging bracket (figure 6), in Western Cullen mechanisms by adjusting the stop screw in the armature casting between the spring loaded armature studs (figure 7).

Check the clearance between the pawl and the ratchet in the de-energised position. This should be 0.25 and 0.5mm.

In WRRS mechanisms this clearance is controlled by the stop screw which passes through the base of the motor casting. In Wester Cullen mechanisms, adjustment is made by the stop screw on the top of the armature support casting.

For Westinghouse EB mechanisms, energised and de-energised clearances are not adjustable.

For Harmon H1 mechanisms check the clearance between the brake facings when de-energised. This should be 0.75mm or greater. Replace the brake if the clearance is less than 0.75mm.

Boom Angle

Check that the boom is not driven past 90° but is driven to at least 88° (86° for Westinghouse EB). Use a protractor on the underside of the boom arm if required.

Adjust the motor cut-out contacts if necessary.

Mechanism	Contact Number
WRRS Type B	2 – 4
WRRS Type D	1B – 1C
Western Cullen Hayes Type 3590	1B – 1C
Western Cullen Hayes Type 3593	4B – 4C
Harmon Type H1	1B – 1C
Westinghouse Type EB	3-1 / 3-2

Speed of Operation

Check the time taken for the mechanism to drive the boom up to the clear position. Generally, this should be 6 to 8 seconds and never be more than 10 seconds.

If the clearing time is between 8 and 10 seconds, correction should be carried out. If the clearance time exceeds 10 seconds, correction shall be carried out immediately.

If the time is greater than 8 seconds, then either:

- The voltage at the motor is too low
- The motor is defective
- The gear train / main shaft is defective or lack lubrication, or
- The boom is not properly counterweighted.

If the voltage at the motor is too low,

- Check the battery and battery charger no load voltages. Nickel Cadmium battery no load voltage with charger off should be at least 14.4 volts. Battery charger float voltage should be 17.5 volts.
- Check the battery loaded voltage with charger off. This should be not less than 12.5 volts. If it is, either the battery is not fully charged or one or more cells is defective and shall be replaced.

Note: *There will be a very high current drawn by the mechanism motors at start. This is likely to drag the battery voltage below 10 V for 250 to 500 milliseconds. This reading, if seen, should be ignored.*

If the battery voltage is correct but the motor voltage is low, there is high resistance in the circuit between battery and motor. This shall be traced and corrected.

If the gear train or main shaft are defective or there is a problem with lubrication, it is very likely that the boom will be slow to drop as well as slow to lift.

If no fault is found with power supply, motor or gear train then it is probable that the boom is not properly counterweighted. Carry out the horizontal and vertical torque adjustment tests.

Check the boom descent time based on design of the particular crossing.

If the descent time is too fast, it is probable that the boom is not correctly counterweighted. (This would usually be accompanied by too slow a lift).

If the descent time is too slow, then either

- The gear-train and/or main shaft are defective (again probably accompanied by slow lift), or

The boom is not correctly counterweighted (this may be accompanied by a very quick lift)

Appendix B: On-Site Maintenance for Boom Mechanism – Level crossing

A. WRRS B Type Mechanism

Circuit controller adjustment and settings

There are two types of contacts in the Type B mechanism circuit controller. Those which wipe directly on the drum segments which are known as “drag” contacts and those actuated by rollers in contact with the drum segments. The latter type is heavy duty and in the case of those controlling the motor and control relay, are ‘snap’ action. Circuit controller construction is shown in figure 9.

To adjust the angular operator, point of a “drag” contact, loosen its terminal nuts and reposition the slotted contact finger. Be sure to relocate the spigot of the locking finger in a convenient hole before re-tightening the terminal nuts.

The contact pressure for a drag contact should be 340 to 450 grams. The contact surface of the drag contact should not rub on the surface of the drum between segments. These contacts may be sparingly lubricated with CRC2-26 cleaner/lubricant or equivalent.

To adjust a heavy duty contact, re-position the roller bearing bracket on the slotted contact finger by loosening the locknuts which fix it to the finger. The spigot of the locking finger shall be relocated in a convenient hole before tightening the lock nuts.

The pressure exerted by the roller operated contact on the fixed contact should be between 400 and 560 grams. When open the moving contact should be at least 3.0mm clear of the fixed contact. When closed the fixed contact should be displaced from its keeper by approximately 1mm.

Motor

Motor maintenance is limited to examination/replacement of brushes and commutator cleaning.

Brushes should be replaced when there is obvious heavy arcing between brush and commutator or when the distance between the commutator and the nearest point on the brush holder has decreased to 6mm.

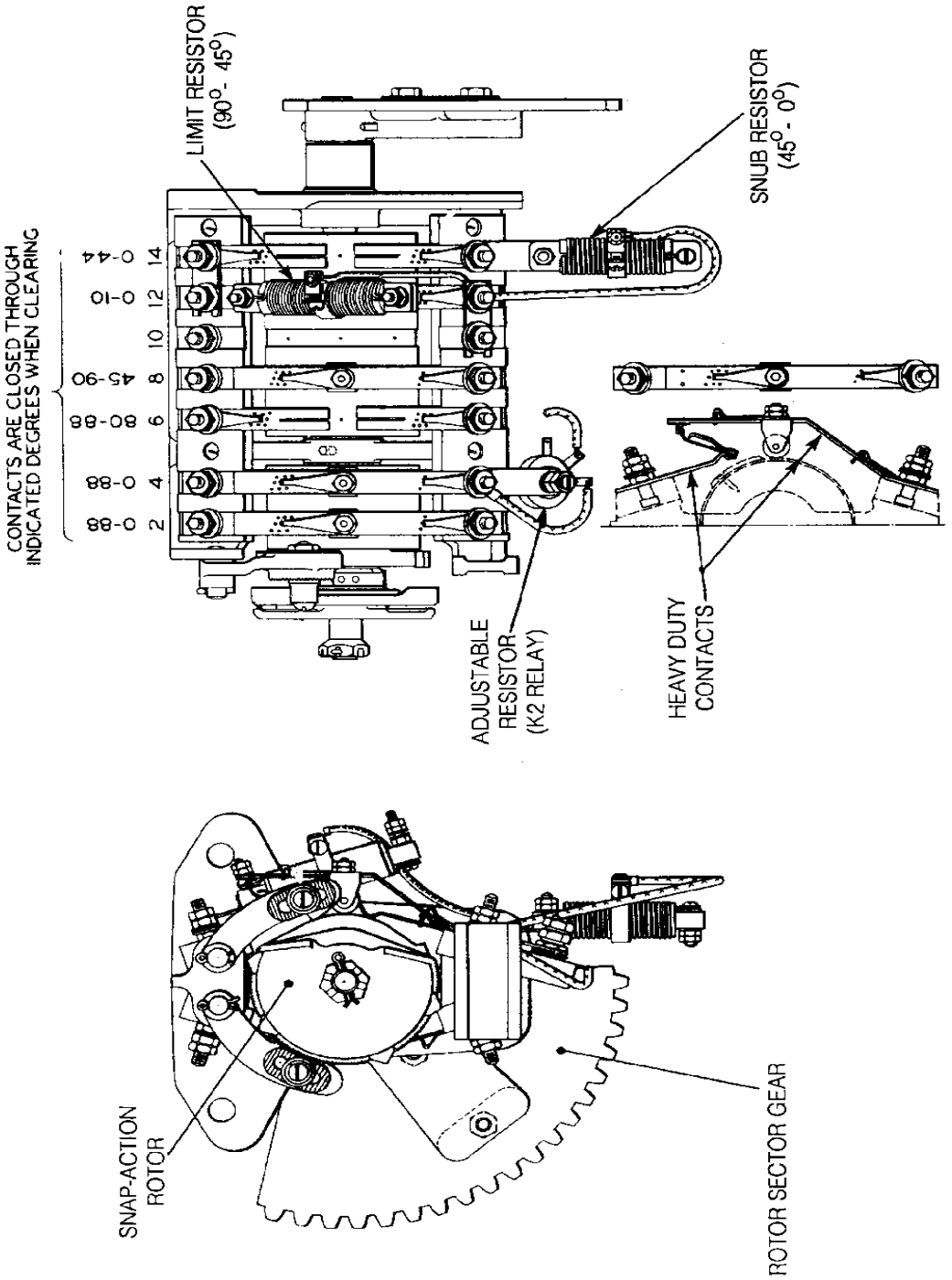


Figure 9 - WRRS B Type Mechanism – Circuit Controller

WARNING

Do not remove the brushes from the motor while the boom is vertical unless the boom has been tied back to the post.

If the hold mechanism is de-energised and there are no brushes in the motor, the boom will fall at high speed due to the complete absence of braking.

WARNING

If the boom is tied up or swung away from the road, the level crossing shall be protected in accordance with the appropriate Safeworking Unit.

To gain access to the brushes, open and remove the cover of the hold clear mechanism. Observe motor operation and examine the colour of the commutator. If it is an even bronze or coffee colour on the brush track no cleaning is necessary.

If there are blackened areas, indicating heavy arcing, unclip and remove the brushes. Clean the commutator with 500 or 600 grade wet and dry paper. Ensure that all traces of grit and dust are removed.

Fit new brushes (never renew one brush only) and bed in by rocking 400 grade wet and dry paper between the brush and commutator. Remove all dust and grit.

B. WRRS Type D Mechanism

Circuit controller adjustment and settings

The WRRS Type D circuit controller has pairs of flat contact springs which are actuated by cams on the main shaft. Each moving contact finger is provided with a moulded follower which rides on the cam surface.

The cams are not adjustable on the main shaft but the contact which controls the motor cut-off in the vertical position is fitted with an adjustable follower. By loosening the follower and moving it upward, the boom angle is reduced and by moving it downward, the boom angle is increased.

The only other available adjustments on Type D circuit controllers are the contact openings. These are:

- No 1 contact 1.8 to 2.0mm
- No 2 contact 1.2 to 1.4mm
- Nos 3 to 7 contacts 1.3 to 1.8mm

Note: *that the motor cut-off contact, No 1, is given a snap action by a drag link which supports the contact follower until it drops over the edge of the link. At this point the link snaps clear allowing the contacts to open quickly. When the cam is driven in the opposite direction, boom descending, the link is pushed clear until the follower reaches the main cam surface. The contacts then close, but only after the boom has dropped about 10°, which prevents "jazzing" if there is momentary power loss to the hold clear mechanism.*

Motor

Motor maintenance is described in Section A of Appendix above for WRRS B Type mechanisms.

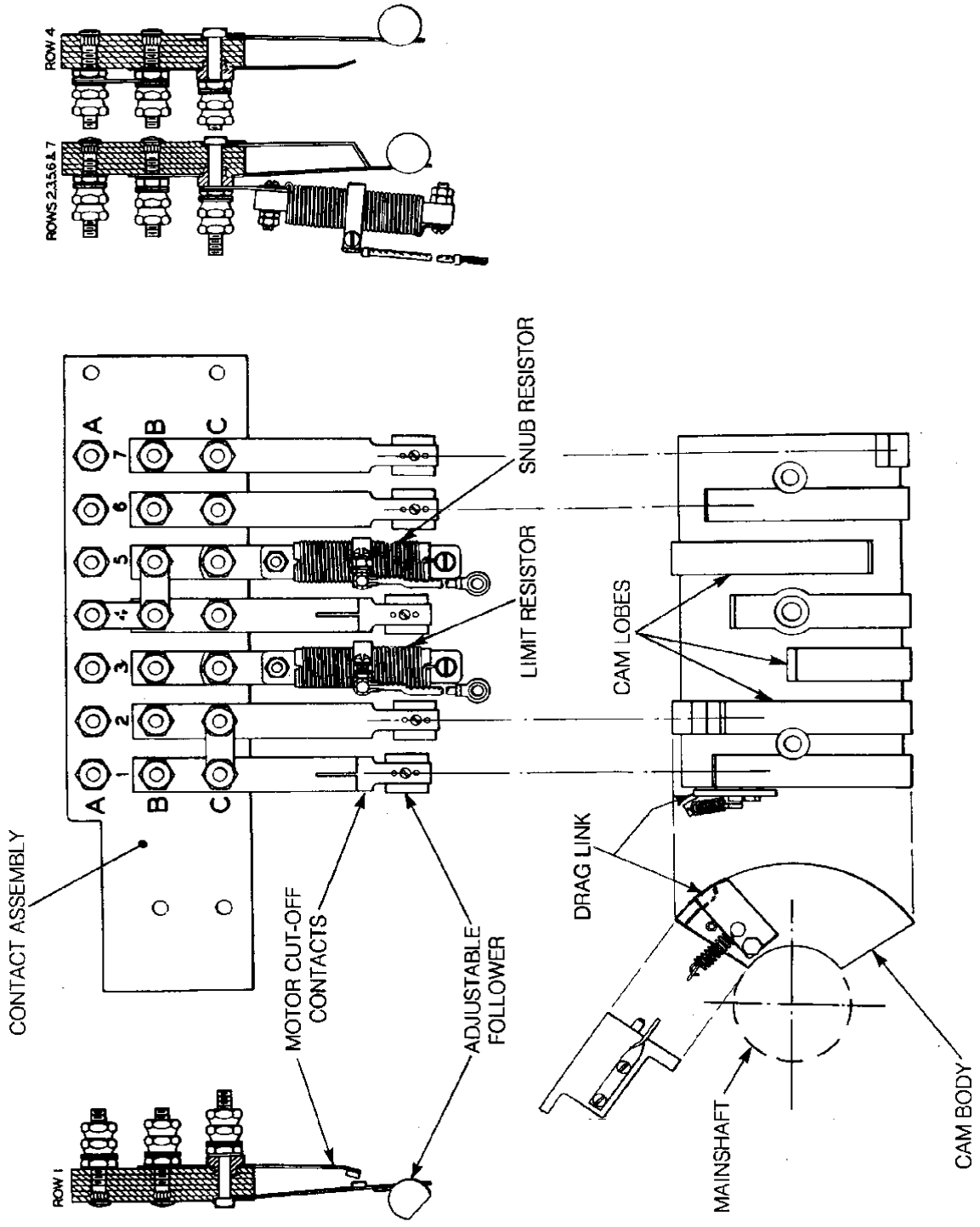


Figure 10 - WRRS D Type Mechanism – Circuit Controller

C. Western Cullen Hayes Type 3590 and 3593 Mechanisms

Circuit controller adjustments and settings

The Western Cullen Hayes circuit controller is similar to the WRRS Type D except that the cams are adjustable on the main shaft.

Normally, the only cam which should need adjustment is No 1 which operates the motor cut-off, although any cam may be adjusted by slackening the cap screws and rotating the cam on the shaft.

When tightening the cams be sure to maintain the 1.5mm clearance shown in figure 11 between the cap screw and the cam insert.

The cam inserts in cams 2 to 7 are fixed. The insert in cam 1 is free to move about 5mm radially to provide a fast opening action to the contact by sliding away from the follower when it reaches the end of the insert surface.

Contact pressures should be 390 to 680 grams when closed and when open there should be a gap of 1.5mm between the cam follower and cam surface.

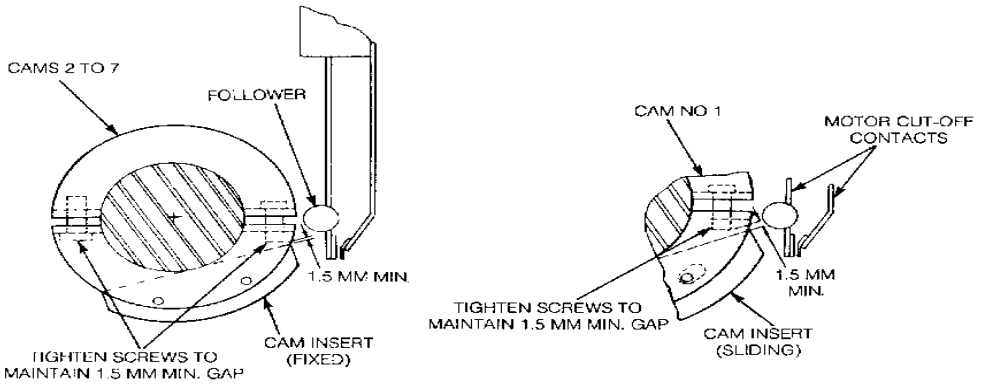


Figure 11 - Western Cullen Hayes Circuit Controller

Motor

Only the brushes can be serviced in Western Cullen Hayes Motors. The commutator is not accessible unless the motor is stripped down and this is not to be attempted in the field. If commutator attention is required, the motor shall be forwarded for overhaul.

To remove the brushes unscrew the threaded caps and remove each brush complete with its spring. Measure the brush length. If the carbon portion is 16mm or less, the brush shall be replaced. Slightly hollow the commutator face of the new brushes if this has not already been done.

WARNING

Do not remove the brushes from the motor while the boom is vertical unless the boom has been tied back to the post.

If the hold mechanism is de-energised and there are no brushes in the motor, the boom will fall at high speed due to the complete absence of braking.

WARNING

If the boom is tied up or swung away from the road, the level crossing shall be protected in accordance with the appropriate Safeworking Unit.

Insert the brushes and refit and tighten the caps. Do not replace one brush, always replace as a pair.

D. Harmon H1 Mechanism

Circuit Controller adjustment and settings

The Harmon Type H1 circuit controller is similar to the Western Cullen Hayes with adjustable cams. Again No. 1 cam should be the only one requiring adjustment, but all can be adjusted if necessary.

Adjustment is carried out by slackening the Allen head screws and rotating the cam, upwards to increase angle and downwards to reduce it.

Contact pressures when closed should be 340 to 450 grams and when open the gap between contacts should be at least 1.5mm. In addition, when the contacts are open the followers (rollers) of the moving contact should rest lightly on the cam surface.

Motor

The Harmon Type H1 motor has four brushes spaced at 90° around the commutator.

To gain access to the brushes and commutator, remove the circular cover from the end of the motor housing opposite the drive pinion.

Brushes are retained in rectangular guides by threaded caps and springs. If the remaining spring travels is less than 2mm (best determined as the cap is being unscrewed – if the spring is not obviously bearing against the cap after it has been unscrewed 2mm then remaining travel is at the limit), all brushes shall be replaced.

WARNING

Do not remove the brushes from the motor while the boom is vertical unless the boom has been tied back to the post.

If the hold mechanism is de-energised and there are no brushes in the motor, the boom will fall at high speed due to the complete absence of braking.

WARNING

If the boom is tied up or swung away from the road, the level crossing shall be protected in accordance with the appropriate Safeworking Unit.

Bed in new brushes by rocking 400 grade wet and dry paper between the brush and commutator. Remove all traces of grit and dust.

The commutator should appear to be a polished bronze or coffee colour and, if so, no further action is necessary. If there are blackened areas, indicating arcing, the commutator should be cleaned with 500 or 600 grade wet and dry paper. Remove all traces of grit and dust.

E. Westinghouse EB Mechanism

Circuit Controller adjustment and settings

The contacts in the Westinghouse EB mechanism are semi-sealed and cannot be cleaned or adjusted. If there is any problem with any contact assembly, then that assembly shall be replaced.

The cams which drive the linkages to the contacts are, however, adjustable by slackening the clamp screws and rotating the cam on the shaft. It should not normally be necessary to adjust cams in the field.

Power down contact

With the armature of the hold clear mechanism closed (hold clear engaged) and power down contact open, the gap between contact springs should be 2.5 to 2.8mm. Set the lower contact spring to obtain this setting.

With the armature released and power down contact closed, contact pressure should be 80 to 100 grams. Set the upper contact to obtain this pressure.

Motor

The commutator on these motors is not accessible and no field maintenance is possible.

Brushes may be removed and checked by removing the brush holder covers, detaching the pigtail from the brush terminal and lifting the brush spring. The brush shall not be less than 16mm long.

WARNING

Do not remove the brushes from the motor while the boom is vertical unless the boom has been tied back to the post.

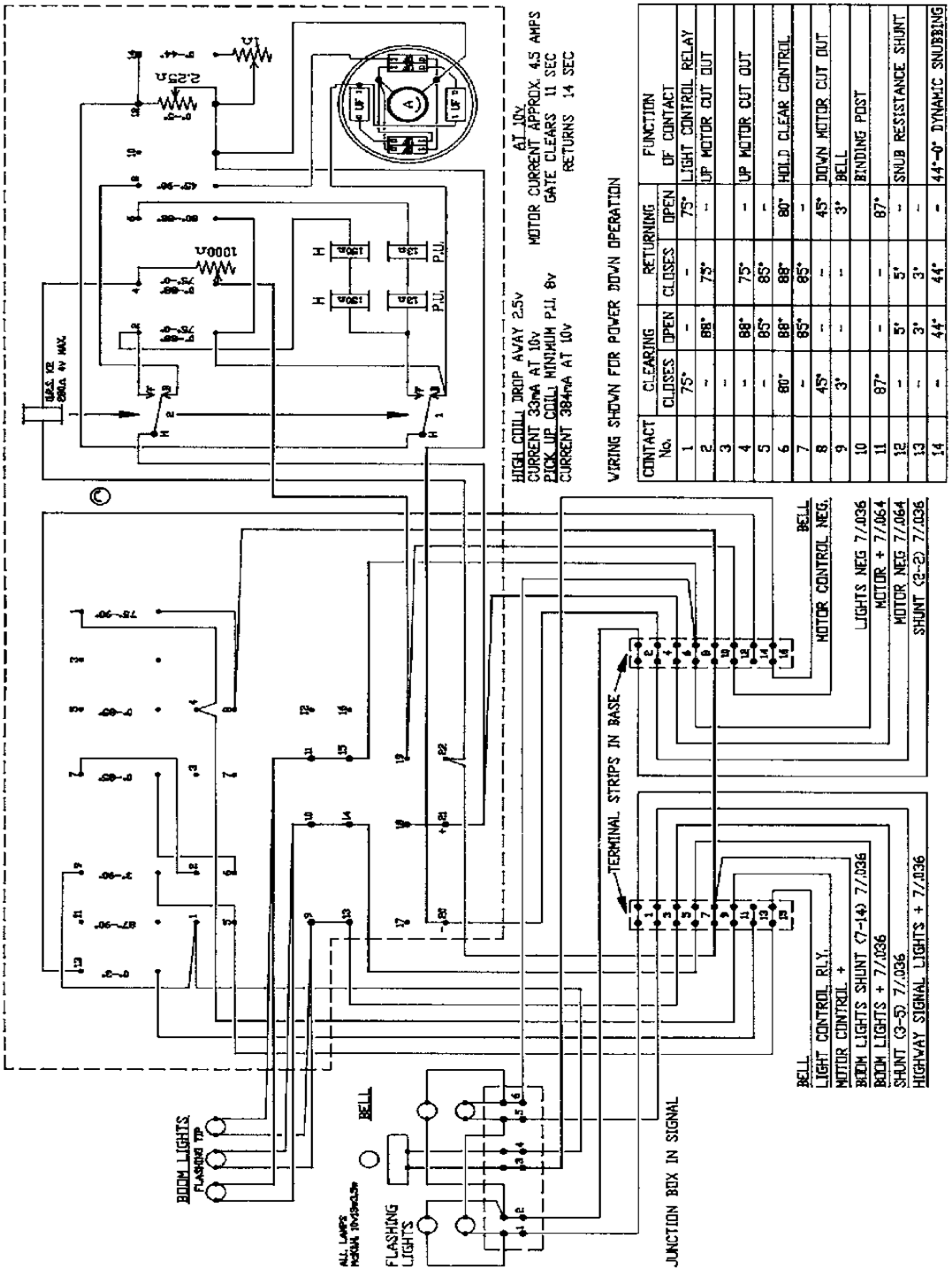
If the hold mechanism is de-energised and there are no brushes in the motor, the boom will fall at high speed due to the complete absence of braking.

WARNING

If the boom is tied up or swung away from the road, the level crossing shall be protected in accordance with the appropriate Safeworking Unit.

New brushes should be slightly hollowed on the face contacting the commutator (this may have been done during manufacture) before installing.

Ensure that the brush moves freely in the guide and the spring is seating properly on the bush. Terminate the pigtail and refit the brush covers.



CONTACT No.	CLEARING		RETURNING		FUNCTION OF CONTACT
	CLOSES	OPEN	CLOSES	OPEN	
1	75°	-	-	75°	LIGHT CONTROL RELAY
2	"	88°	75°	"	UP MOTOR CUT OUT
3	"	"	"	"	
4	"	88°	75°	-	UP MOTOR CUT OUT
5	"	85°	85°	-	
6	80°	88°	88°	80°	HOLD CLEAR CONTROL
7	"	85°	85°	-	
8	45°	"	"	45°	DOWN MOTOR CUT OUT
9	3°	"	"	3°	BELL
10					BINDING POST
11	87°	-	-	87°	
12	"	5°	5°	"	SNUB RESISTANCE SHUNT
13	"	3°	3°	"	
14	"	44°	44°	-	44-0° DYNAMIC SNUBBING

Figure 12 - WRRS B Type mechanism circuit

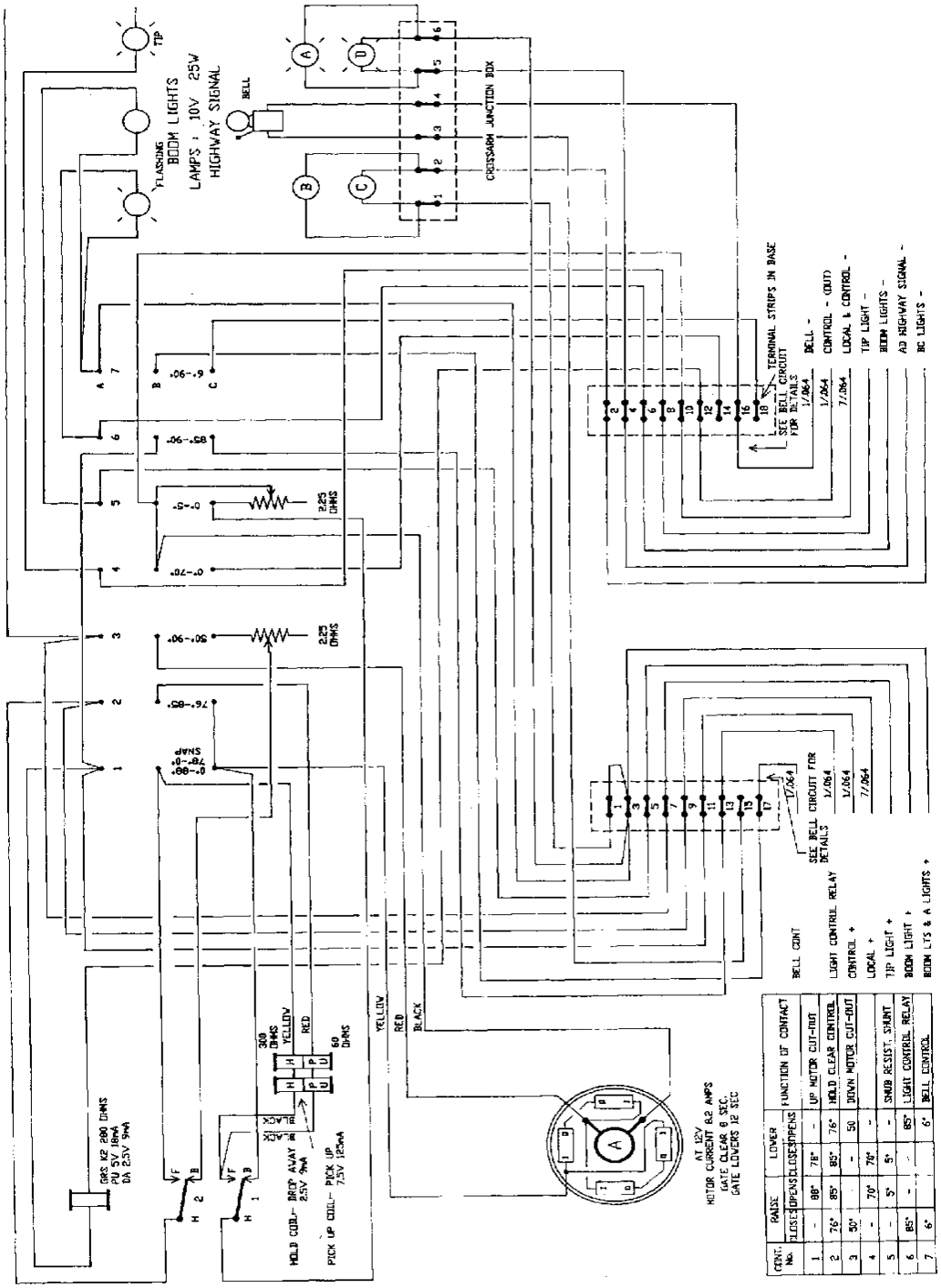


Figure 13 - WRRS D Type mechanism circuit

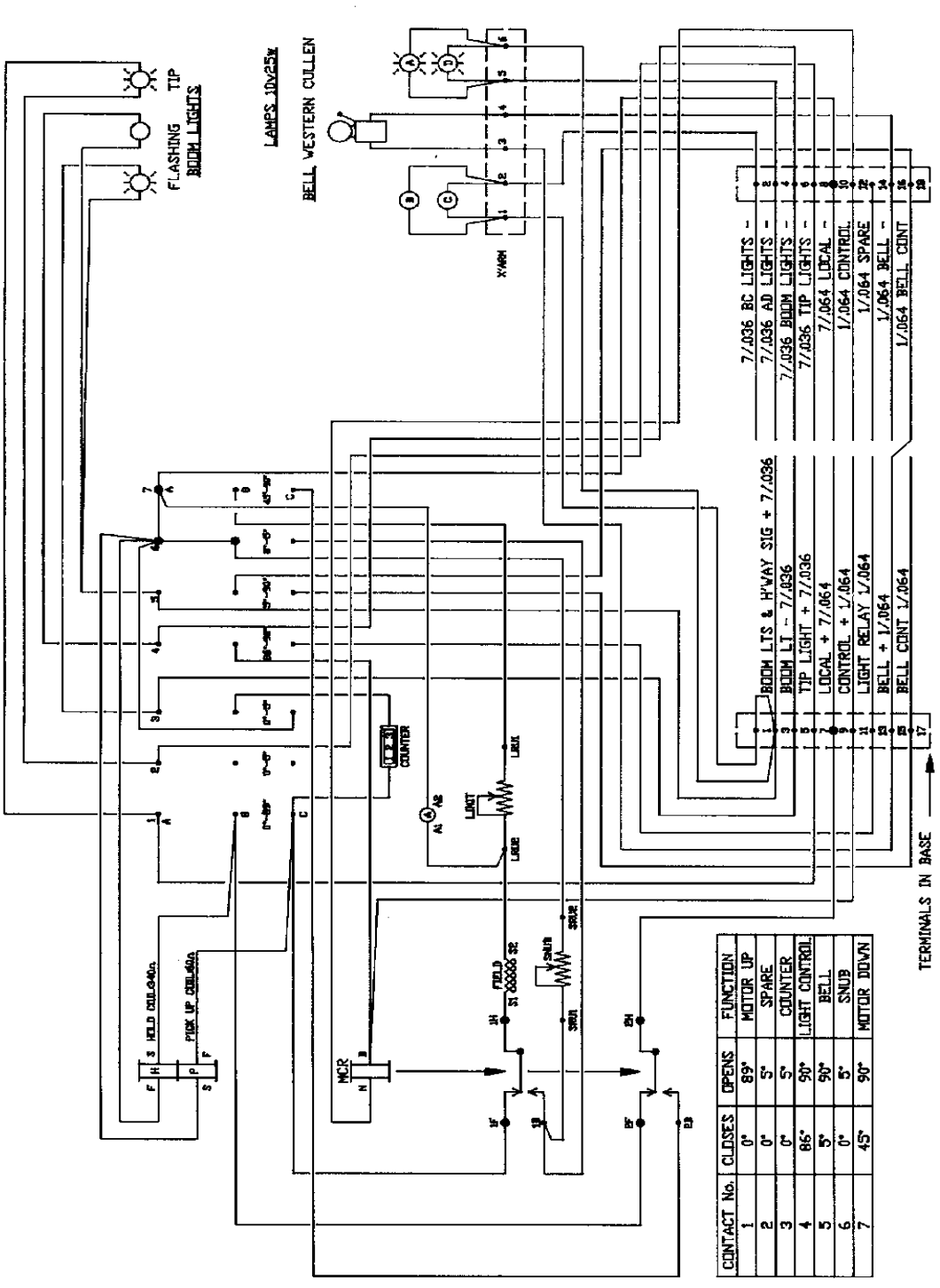


Figure 14 - Western Cullen Hayes 3590 mechanism circuit

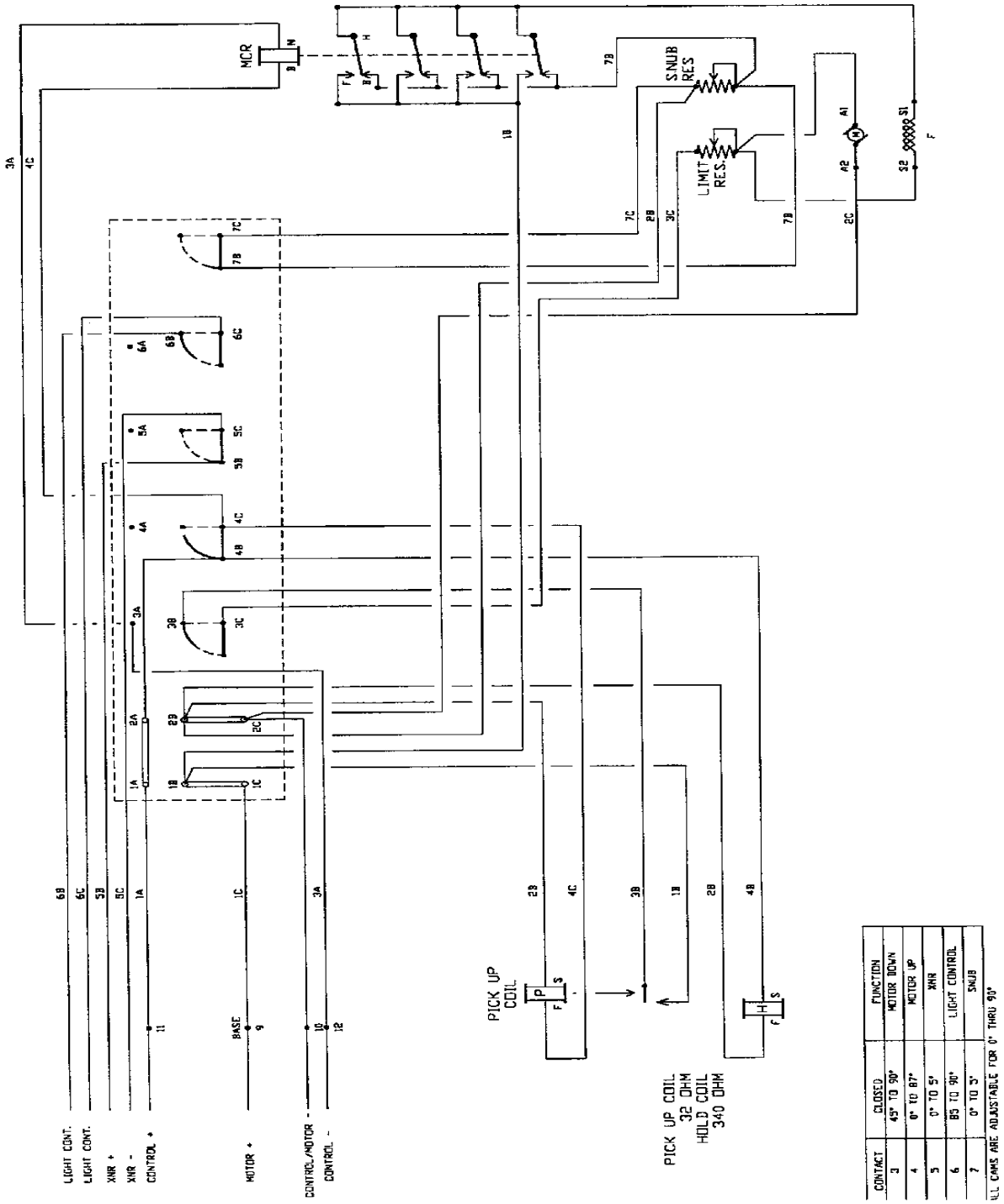


Figure 15 - Western Cullen Hayes 3593 mechanism circuit

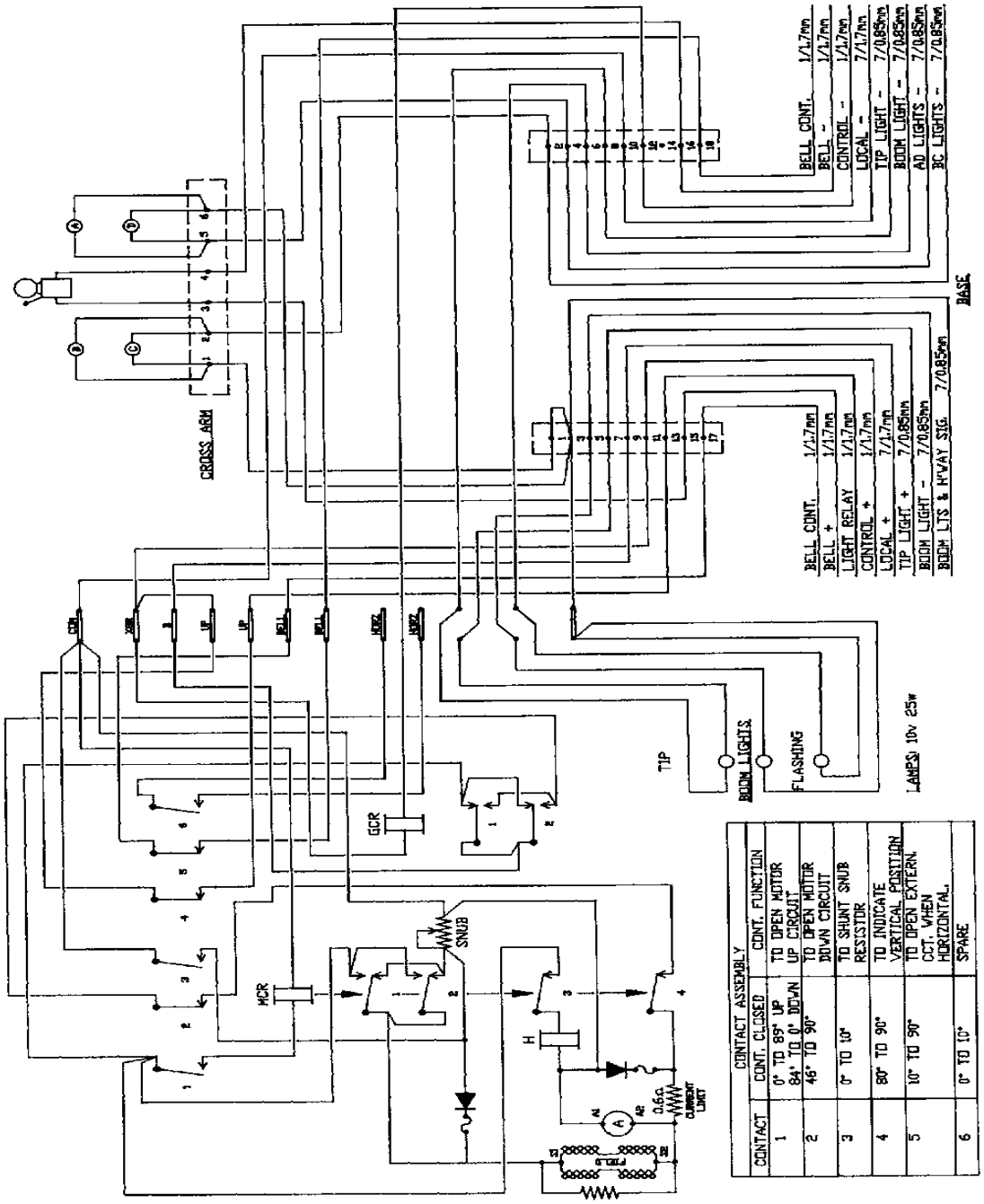


Figure 16 - Harmon Type H1 mechanism circuit

Appendix C: Operational and functional Check – Pedestrian Crossings

Pedestrian Boom Mechanisms (GRS 2a Signal Motor)

Observe the operation of the mechanism, in particular arm lowering. There shall be no hesitation in the boom beginning to drop when power is removed from the motor.

If hesitation is evident, it is due to either:

- A defective hold clear mechanism which is not releasing cleanly Binding in the main shaft bearings.
- An incorrectly counterweighted boom.

Whichever fault is present shall be corrected immediately.

Examine the hold clear mechanism and check that there is 0.8 to 1.0 mm gap between the pawl and ratchet when the hold clear is in the de-energised position.

Rotate the motor shaft to ensure that the ratchet is running concentrically. If any eccentricity is evident the motor shall be replaced.

Check that the pawl moves freely in the link assembly when the boom is being driven up.

Drive the boom to the up position, disengage the hold clear pawl then re-engage when the boom has dropped 10 to 20 degrees. The hold clear clutch should only allow the motor to rotate 2 to 3 turns maximum. If more slip is evident or if less than one revolution of slip is evident, adjust the clutch.

Check that there is a minimum of 1 mm lift on the front and back contacts operated by the hold clear mechanism.

Examine the motor commutator and brushes. If the commutator is a reasonably even bronze colour, no further attention is necessary. If there is evidence of arcing brush length and condition shall be checked. Length can most easily be checked by observing the gap at the rocker arm stops. If nearly closed, the brushes shall be replaced.

Examine the circuit controller contacts. If the contacts are clean, with no evidence of arcing or grooving, no cleaning or polishing is necessary.

If contacts are burnt or pitted, or if there is obvious grooving, the contacts affected shall be replaced.

Check that the opening of the heavy duty motor contacts is at least 3.0 mm and that when closed, the fixed contact is lifted at least 1.0 mm clear of its keeper.

Check that the rollers of the moving contacts either rest lightly on the drum or are not more than 0.5mm clear with the contacts closed.

Check the contact pressure of the remaining contacts by observing the finger contact when off its segment (open circuit position). The finger should be between 0 and 0.5 mm clear of the wooden drum.

Check the motor operating and hold clear currents. For a 10volt DC mechanism motor operating should be 2.1 to 2.5 amps and hold clear 0.018 amps

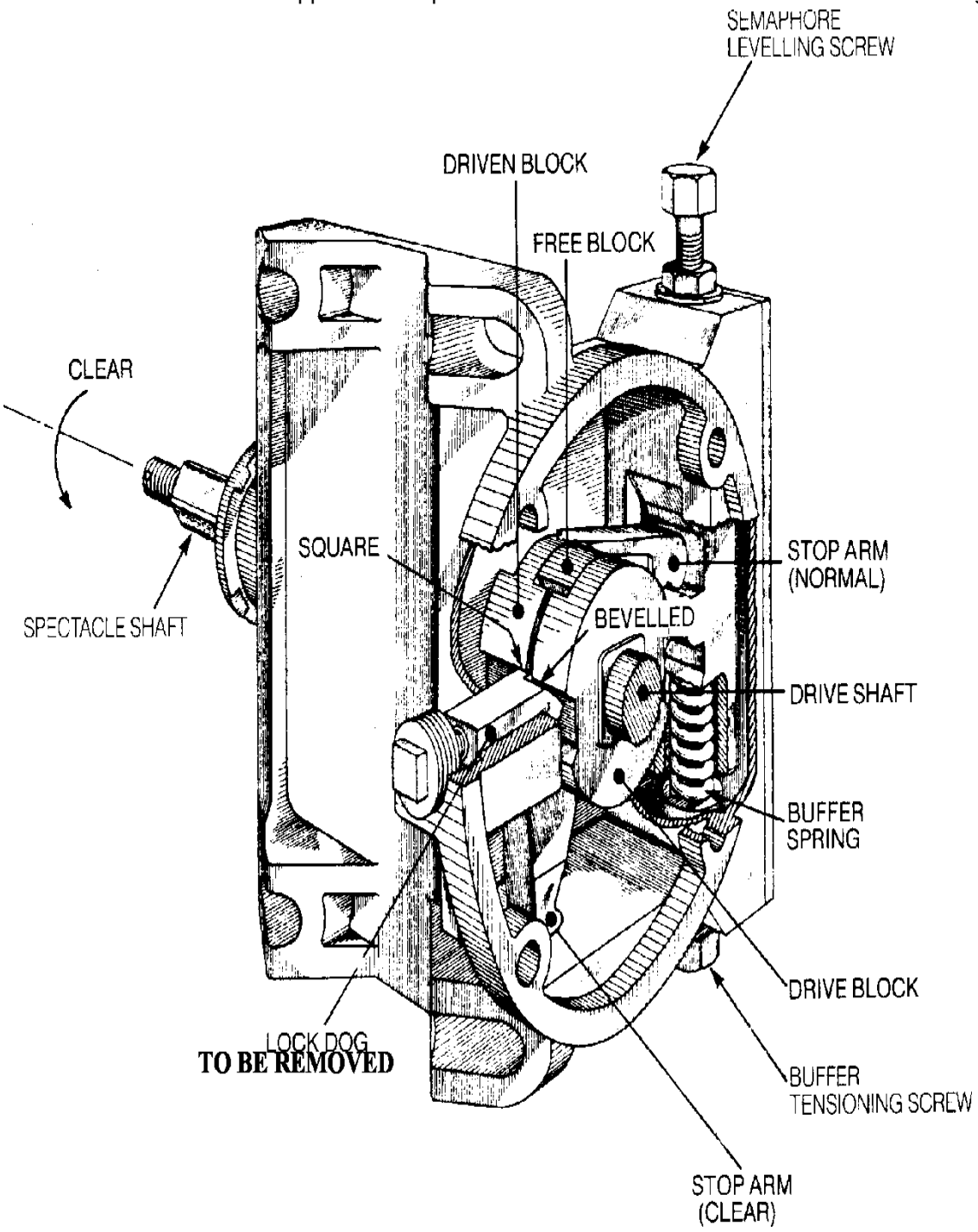


Figure 17 - GRS 2a mechanism coupling

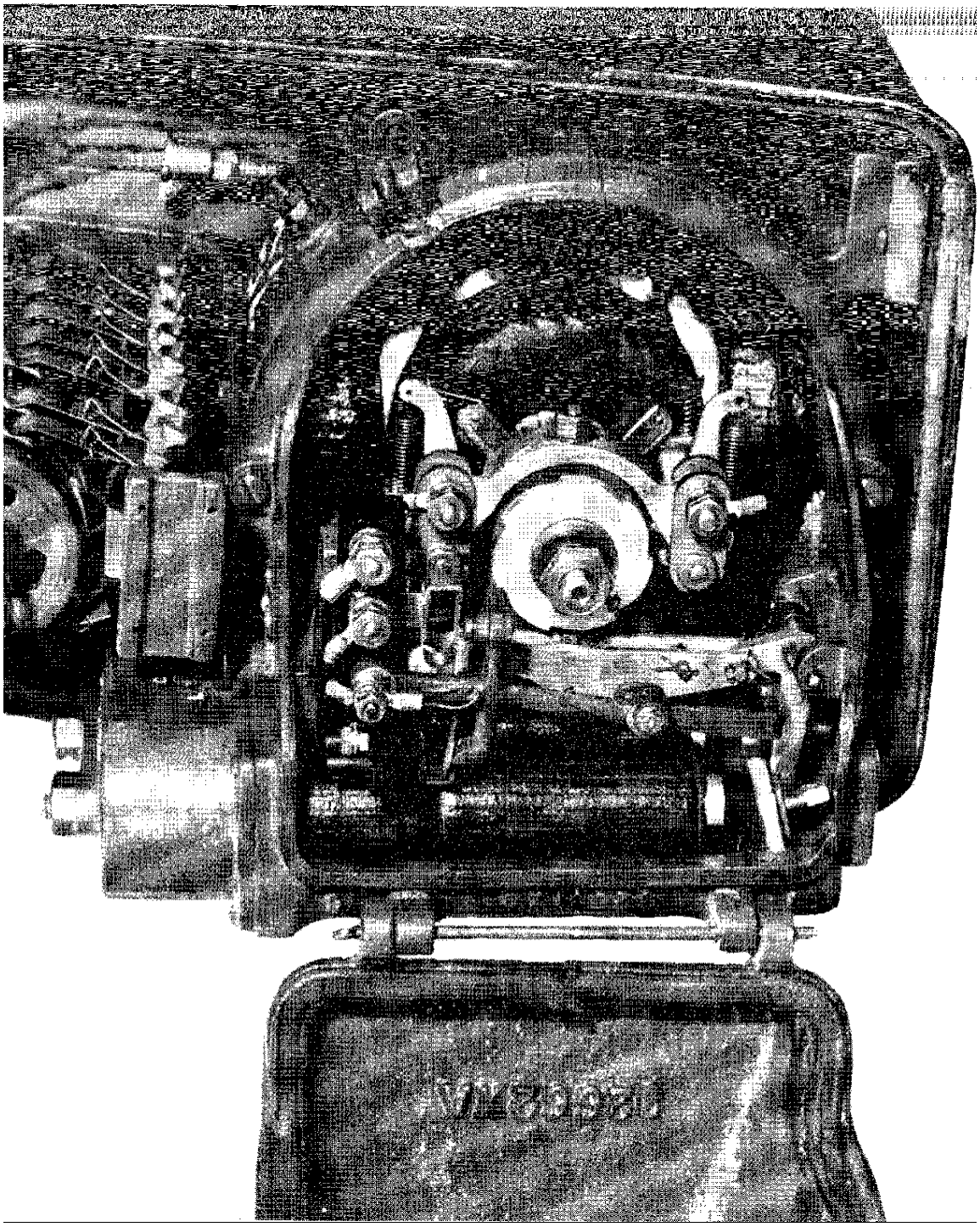


Figure 18 - GRS 2a mechanism motor and hold clear

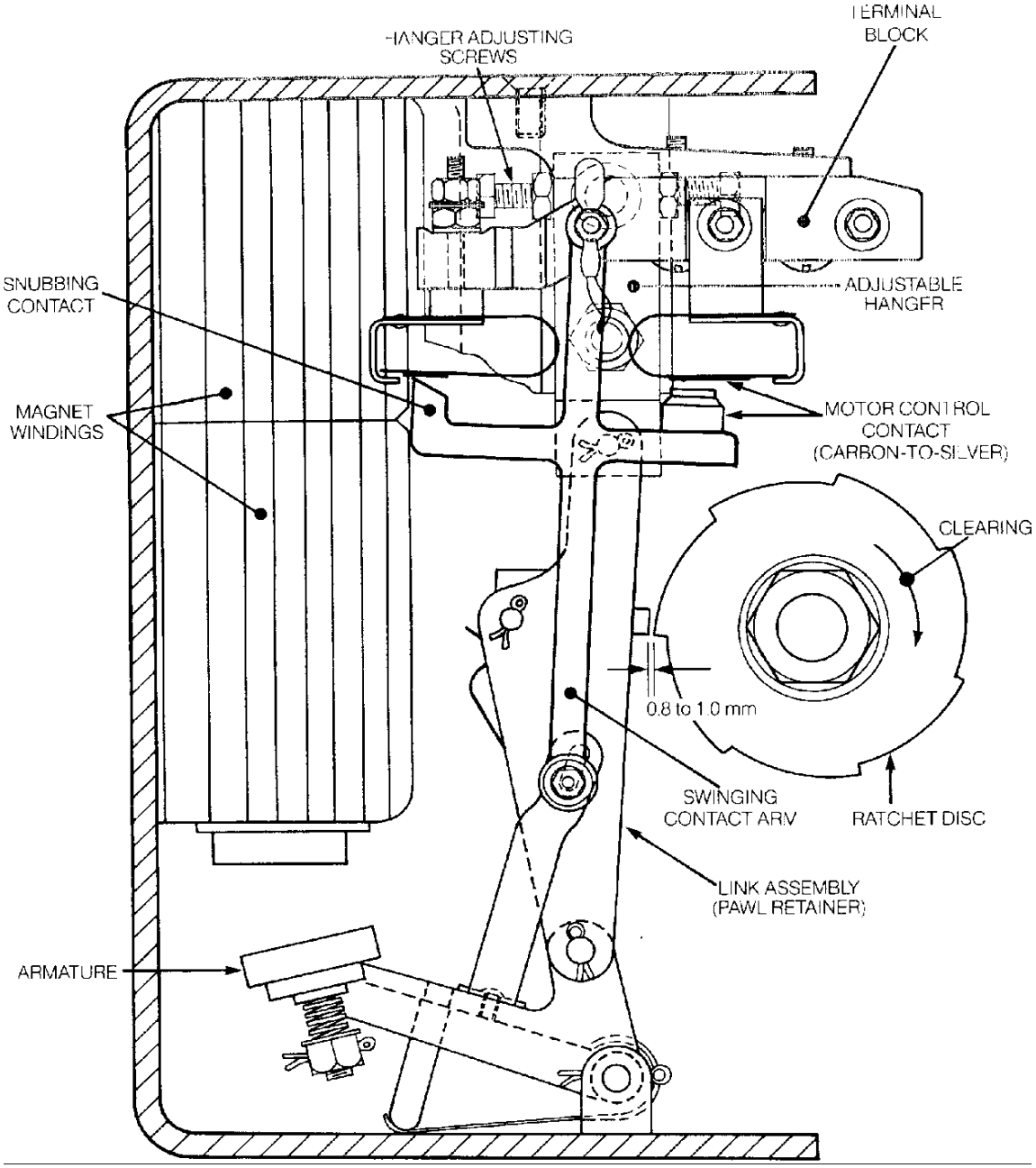


Figure 19 - GRS 2a mechanism hold clear mechanism – pawl clearance

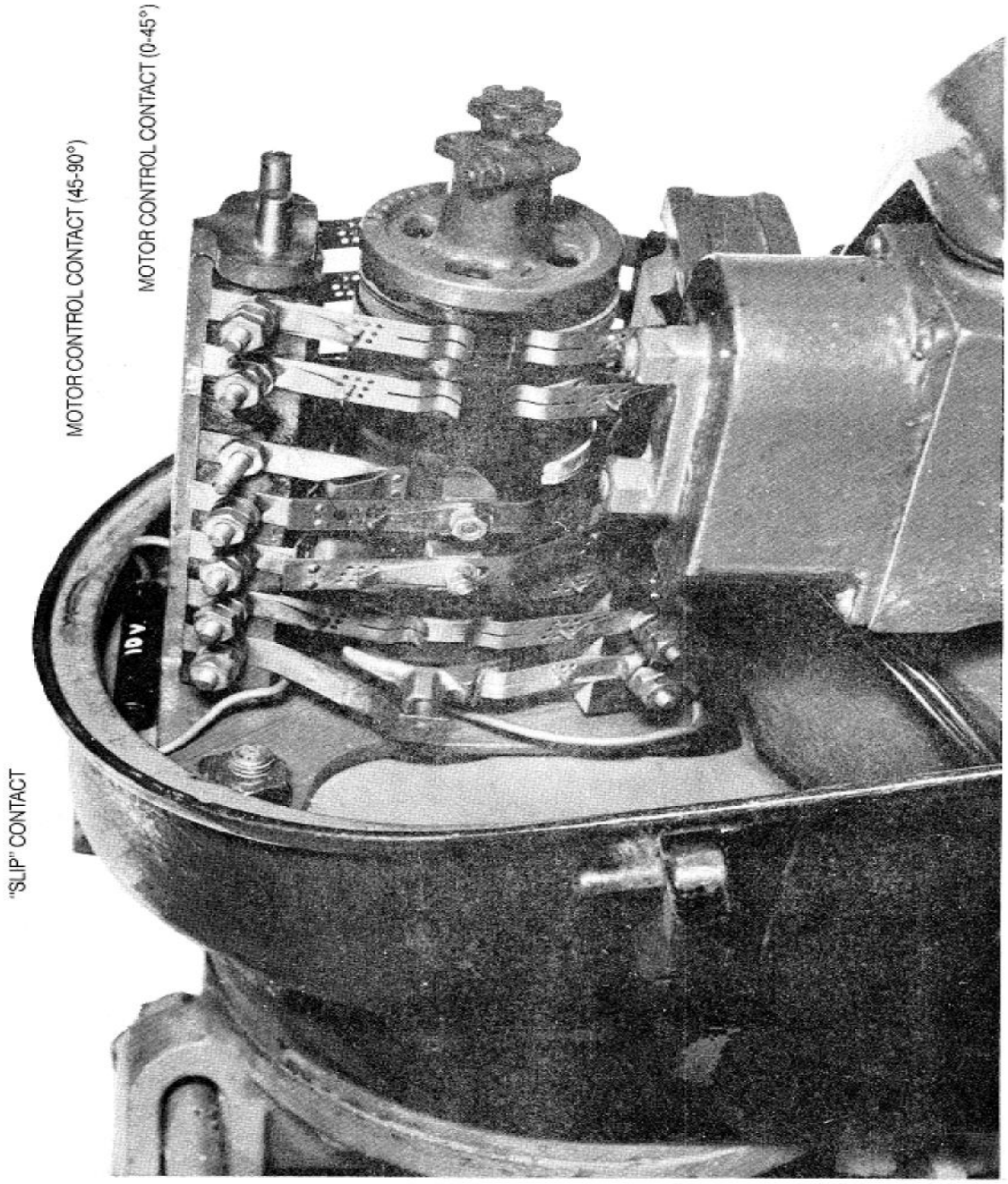


Figure 20 - GRS 2a mechanism circuit controller

Pinion Clutch

If the pinion clutch has been found to either slip too easily or cause the motor to stall if the boom is restrained the motor shall be removed from the mechanism and taken to a location where the clutch can be serviced.

Remove the hold clear assembly from the motor and dismantle the clutch. Clean all the clutch components with a suitable degreasing solvent.

WARNING

Take all health and safety precautions recommended by the solvent manufacturer

Slide the pinion onto the motor shaft and ensure that it rotates freely.

Measure the friction washer thickness - it shall be 1.55 to 1.65mm. If too thick rub down on a flat surface. If too thin, replace.

Apply a light smear of Molybond GA 10 grease between the shaft and pinion and re-assemble the clutch.