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TRAFFIC CONTROLS INSTRUCTION MANUAL

EF TYPE MULTI-DIAL CONTROLLERS

Eagle Signal Corporation
Transportation & Public Safety Division
a Gulf + Western Manufacturing Company

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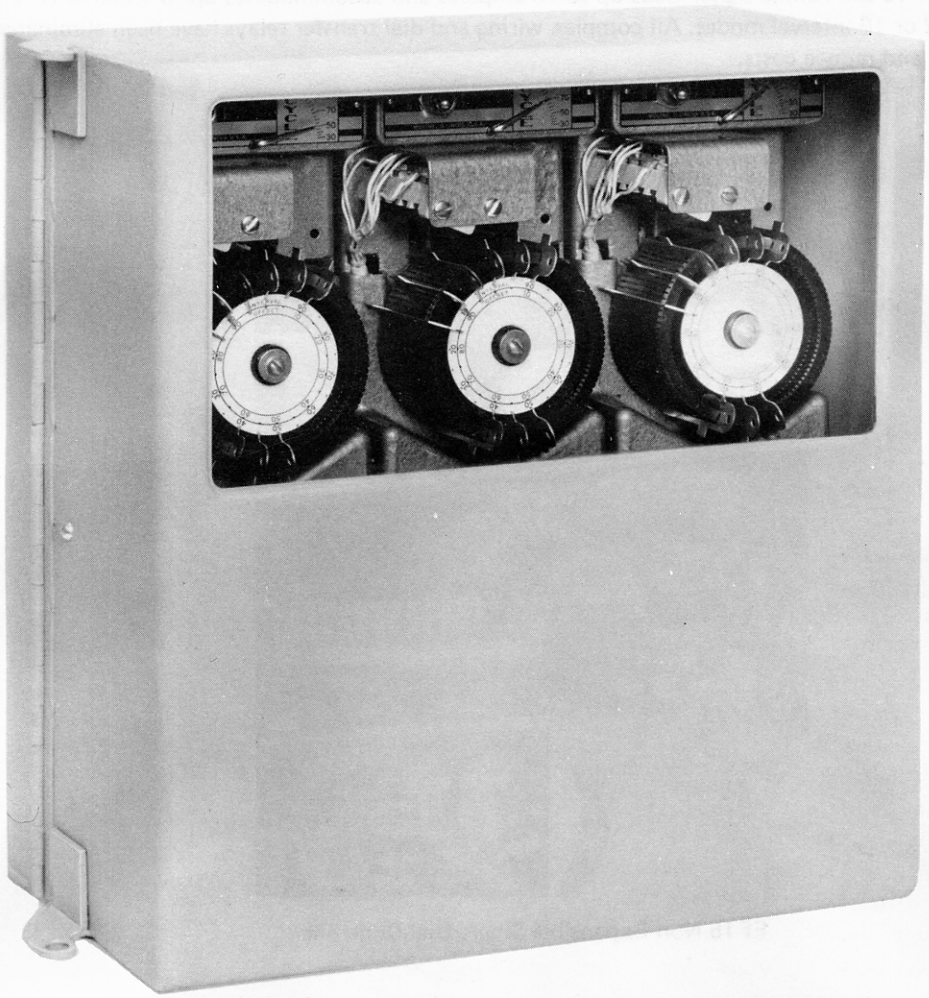


EF TYPE CONTROLLER

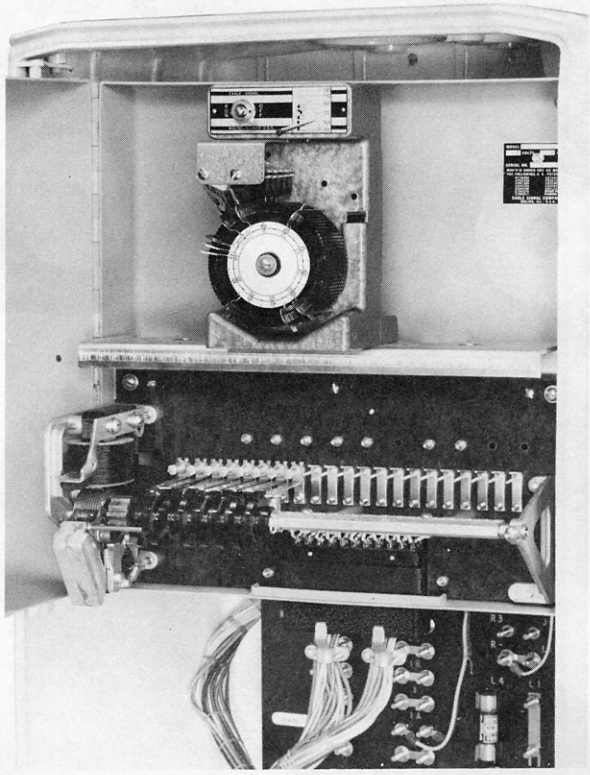
INTRODUCTION

These instructions cover the EF Type Controllers such as the EF15, EF20, and EF70. They are readily identified by the presence of one or more of the Eagle Signal Cycle Units. Although the EF Controllers are custom wired in the terminal facilities, the information given in this manual is applicable to all the major components. Each controller is accompanied by a packet of drawings containing the exact wiring information and any special operating instructions covering special configurations.

Parts interchangability on the cycle units reduces inventory to a minimum. Several contact types are for the most part interchangeable. However, contacts should be replaced in pairs and should match the physical configuration of those being replaced unless a full set has been obtained for updating purposes. When improved parts have been developed, the factory will ship the improved parts for replacement purposes. Instructions for installation will be included, if considered necessary.

EF15 Non-Expansible Single Dial Controller

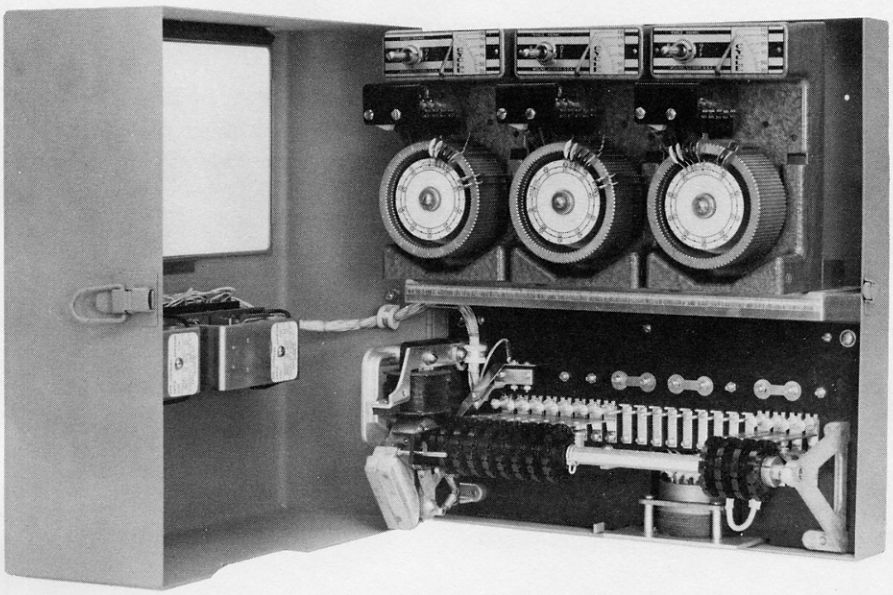
An EF15 provides one cycle length with three offsets for use in a coordinated system as a backup controller. The standard EF15 can handle signal loads up to 10 amperes and accommodates up to 19 circuits. The camshaft is available in either 12 or 16 interval modes. All complex wiring and dial transfer relays have been eliminated to simplify the controller and reduce costs.



EF15 Non-Expansible Single Dial Controller

EF20 Expansible, Three-Dial Controller

The EF20 has provisions for up to three dial units and three offsets which permits timeclock selection of three cycle lengths, splits and intervals at an isolated intersection. In a progressive coordination system, the EF20 is capable of operating in all desired configurations. The EF20 handles busebar input loads to 10 amperes and 19 circuits; camswitch is available in 12 or 16 interval configurations. A complete controller includes dial transfer relays and local controls as required.



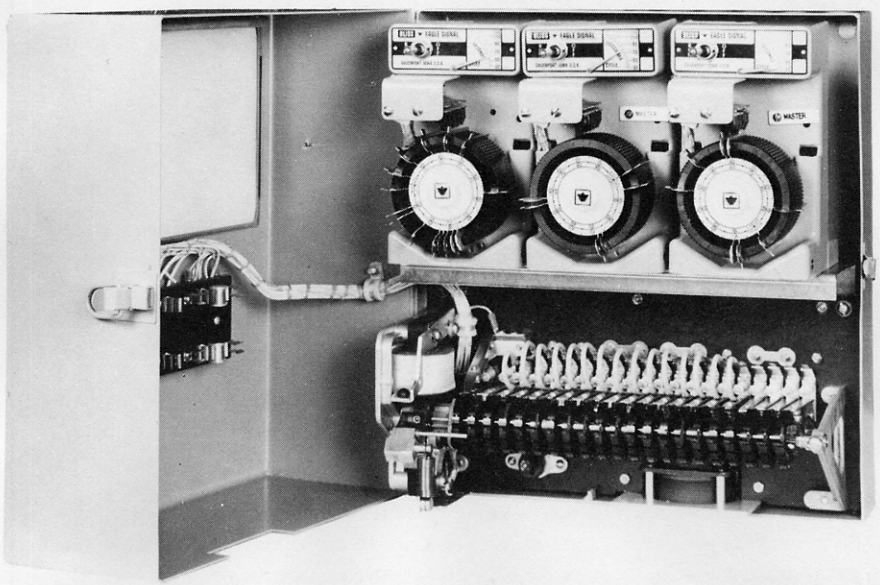
EF20 Expansible, Three-Dial Controller

EF70 Model 1 Heavy Duty Controller

This three-dial controller has been designed for heavier duty applications. It contains a 47 pin MS connector with split load inputs capable of 15 amperes each to handle a total signalization load up up to 30 amperes. An EF70 features the three dial units for time-clock selection of control at an isolated intersection and accommodates all co-ordination methods. Up to 19 circuits are available for loads and special control functions in either 12 or 16 intervals.

EF70 Model 2 Heavy Duty Controller

The Model 2 EF70 controller is similar to the Model 1 but has been designed for increased expansion capability. A 47 pin MS connector is used to permit an increased number of 15 ampere busbar circuits and control functions. The standard version is rated at a total load of 30 amperes but contains the latest contact, busbar and contact materials for increased reliability and flexibility at the higher loads. "Atomi Clad" contact materials are featured in all load circuits with heavy duty mechanical/electrical contact arms. The camshaft has an improved, positive-action drive motor with no increase in complexity.



EF70 Model 2 Heavy Duty Controller

SECTION I

GENERAL INFORMATION

1-1. GENERAL DESCRIPTION.

The EF type local controller is designed for three types of operation:

a. An isolated non-interconnected local controller.

b. A local controller in an interconnected progressive system of local controllers and a master.

c. A combination master-local controller which will supervise the timing and remote features of other local controllers.

It has been designed with three major precepts in mind:

a. To provide ease, flexibility and durability of operation.

b. To reduce maintenance costs (this item is becoming more important every day).

c. To allow the customer to install in the field with ease such additional or auxiliary equipment necessary for proper operation in the future.

One of the advantages of the last point mentioned is that specialized controllers such as are used in conjunction with railroad signals or pedestrian actuated signals will have almost identical switching mechanisms. Only the terminal facility wiring will differ.

1-2. NOMENCLATURE.

In the text that follows, certain terms will be used to define the operation and maintenance of this controller. To avoid confusion these terms are explained below:

"CYCLE." A complete series of signal switching starting at the beginning of Main Street Green (usually initiated by the No. 1 Dial Key) and continuing through the signal sequence until the Main Street Green is due to start again.

"PHASE." One particular traffic movement. Two or more phases will make one cycle.

"INTERVAL." The adjustable period of timing during which the signal cams do not move and supply power to the traffic lights. The operation of the ratchet motor will move the camshaft forward for one step or interval at a time.

"SEQUENCE." The predetermined consecutive order of the display of traffic lights during a complete cycle.

"CYCLE UNIT." The plug-in unit containing the timing dial drum, the dial impulse and camshaft release keys, the dial offset (reset) keys and the motor. This dial motor may or may not, depending on the usage, have a dial clutch or a relay performing the same functions as the clutch. The cycle unit plugs into the shelf above the Camshaft Switching Mechanism.

"CABINET." The welded aluminum external enclosure of dust-tight and weather-proof construction containing the controller mechanism housing on a swinging bracket and the terminal facilities.

"HOUSING." The stamped sheet metal enclosure which contains the Cycle Units with the timing dials and the Camshaft Switching Mechanism.

"CAMSHAFT SWITCHING MECHANISM." The device by which the signal sequence is transmitted to the traffic lights. This unit consists of the ratchet motor, camshaft and signal contact fingers.

"SIGNAL BUSBAR." The source of power which is fed to the signal lights through the signal contacts. It is located directly behind the camshaft.

"CYCLE GEAR." The gear which may be easily changed to allow the total cycle of the signal lights to vary. This gear is driven directly by the motor on the back of each cycle unit.

"MOTOR." The type of motor used on the cycle unit is a synchronous motor. The synchronous motor will have a relay which functions as the clutch assembly.

1-3. MECHANICAL CONSTRUCTION.

The EF type controller consists essentially of:

a. A signal cam **controller switching mechanism assembly.**

b. One to three **timing dial cycle units** in the mechanism housing.

c. **Terminal facilities assembly.**

The complete unit is housed in a weather-tight, welded sheet aluminum cabinet. (1) The door of this cabinet usually has a round, soft cotton wicking which seals against a turned out flange of the cabinet shell.

Connection between the controller housing and the terminal facilities is made with (2) a multiple jack socket and cable.

The jack socket should be clamped to the housing with the bracket and thumb screw furnished to insure against interruption of service due to traffic vibration. (**IMPORTANT.** Make sure bracket holds jack socket securely.) The cable and socket allow the controller housing to be swung completely free of the cabinet for inspection or maintenance while the controller is in operation.

The terminal panel permits convenient connection of signal conductors, the interconnecting cable and power supply. All connections are made to the left side of the three rows of terminals as is shown in the external hookup diagram included with this manual. (Unless specifically noted on hookup diagram furnished with controller.)

Ample space for cables has been left below the terminal panel. All extra feature wiring, such as Remote Flashing, Remote Signal Shutdown, Local Dial Selector Switch, etc., has been so designed that each wire has its own terminal connection. As a result, any feature may be added in the future without disturbing the present wiring or without splicing wires.

a. **Controller Switching Mechanism Assembly.**

The EF type switching mechanism consists of a sturdy, welded steel sheet metal housing containing the control apparatus of the equipment. This apparatus is divided into two parts, the Signal Light Switching Mechanism and the Timing Unit.

The switching element (refer to Fig. 1-1, No. 10) is composed of a (3) ratchet feed motor, (4) signal camshaft, (5) signal busbar (EF20 only) and (6) signal contact fingers. To operate the motor, an impulse of power is fed from the timing unit to the motor coil. Due to a displaced magnetic circuit, the armature of the motor will turn, lifting a (7) solid weight on the front of the armature. (Refer to Fig. 1-1.)

As the armature turns and the weight reaches its maximum height determined by the position of the bumper bracket, a feed pawl drops into a notch on the OILITE ratchet wheel at the left end of the signal camshaft. When the motor coil is deenergized, the weight on the armature drops, turning the camshaft one notch or interval. The camshaft is prevented from moving back at this point by the ratchet cam stop pawl resting on the same ratchet wheel as the feed pawl. When the next impulse of power is delivered by the Timing Unit to the motor coil, the ratchet cam stop pawl holds the camshaft in place as the feed pawl rides over the ratchet wheel to the next notch. This operation is repeated each time the ratchet motor is first energized and then deenergized.

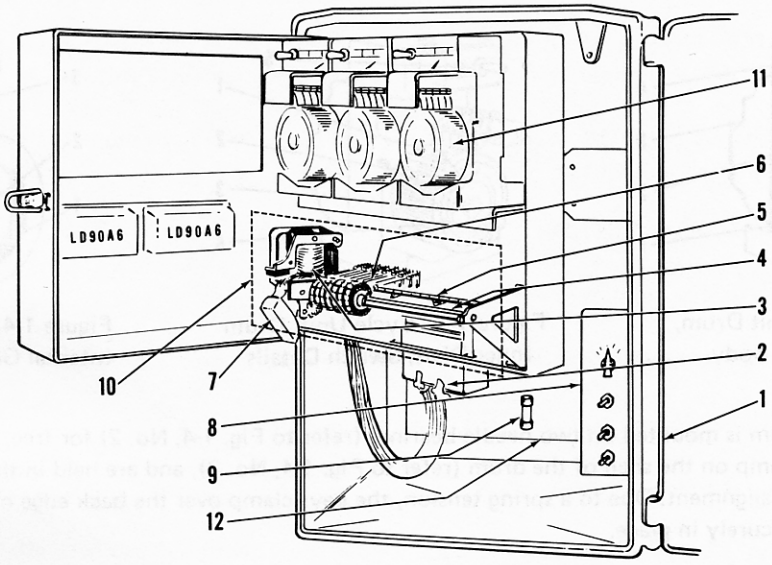


Figure 1-1. Controller Mechanism

The camshaft is composed of a steel hexagonal bar, keyed along one edge to provide proper alignment of signal cams, and with OILITE bushings riding on hardened and polished dowel bearings. The previously mentioned ratchet wheel is a cast OILITE ratchet pressed onto the end of the camshaft. It is also lubricated for life by the source of oil contained within itself.

The cams are made of molded bakelite and have either twelve or sixteen easily removed sections which prevent the signal contact fingers from closing. The breaking out of one or more of these segments will allow the particular signal contact finger resting on it to drop, making contact with the signal busbar and thus lighting its traffic light during the interval.

The number of notches in the ratchet wheel corresponds to the number of segments on the signal cams. So for every actuation of the ratchet motor, the signal sequence may change. Since the signal color cycle must have a number of intervals which corresponds to the number of cam segments or a number which can be evenly divided into the number of segments, a color sequence may be repeated on the camshaft as many as four times and as few as one. Due to operational limitations, the largest number of intervals possible is twelve on a twelve interval camshaft and sixteen on a sixteen interval camshaft. The smallest is four on either type.

The signal contact fingers are suspended in the back by an ingenious arrangement of a compression spring and ball joint which allow them to pivot freely. An adjustable tension keeps the tip of the signal contact fingers riding on the perimeter of the cams. These signal contact fingers are easily removed or adjusted. (This is covered in the section of this manual on maintenance.)

b. Timing Dial Cycle Units.

The Timing Unit located just above the switching mechanism contains from one to three cycle units. These units are completely self-contained and may be easily added or removed for flexibility of the controller.

The operation of one or another of the cycle units is selected by the dial transfer relays (refer to Fig. 1-1) which are jack mounted on the controller housing door.

Parts of the cycle unit are the (1) dial drum, (2) dial contact block, (3) motor and (4) cycle unit body casting. (Refer to Fig. 1-2.) The dial drum is a hollow zinc die casting with dial key slots (refer to Fig. 1-3, No. 1) cut paralleling the axis of rotation on the outer surface and an internal gear drive on the back inner surface. (Refer to Fig. 1-4, No. 1.)

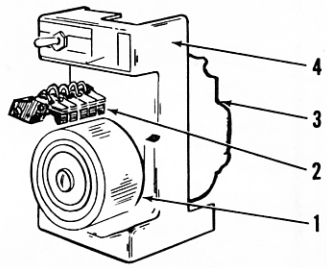


Figure 1-2. Cycle Unit Drum, Contacts, Motor, Body

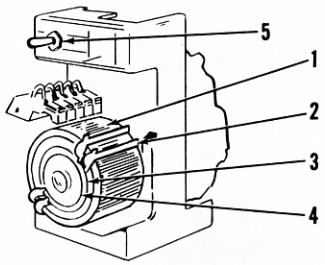


Figure 1-3. Cycle Unit, Drum Inner Dials, Switch Details

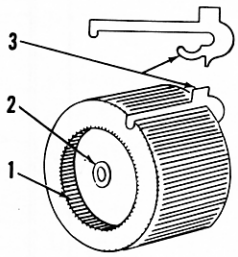


Figure 1-4. Cycle Unit Drum Internal Gear, Bearings, Keys

The drum is mounted on two needle bearings (refer to Fig. 1-4, No. 2) for free, easy rotation. The dial keys clamp on the shell of the drum (refer to Fig. 1-4, No. 3), and are held in the grooves to assure correct alignment. Due to a spring tension, the keys clamp over the back edge of the drum holding them securely in place.

A calibration dial covers the face of the drum. This dial has two calibrated circles. The outer circle is calibrated in percent; one percent for each groove on the surface of the drum. This makes one percent the smallest setting or step possible for the impulse keys.

The inner dial, also set up on a percent basis, is the offset (reset) relationship of the local controller in respect to the time base of the master. It is suggested that no offset (reset) key be set closer than two percent (2%) to any dial impulse key since the ratchet motor may receive an excessively long pulse of power during dial resynchronization with the Master Controller. (Refer to Fig. 1-3, Nos. 3 and 4.)

Directly above the dial is located the dial contact block assembly. Molded of black bakelite, the block may be removed for inspection or adjustment if necessary. (Refer to Fig. 1-2, No. 2.)

In the block assembly, phosphor bronze contact springs with heavy duty coin silver contacts ride directly on the molded nylon contact riders. Past tests have shown that this type of construction will give many millions of trouble free operations. Beginning with the front key, they control, in order, the Camshaft Impulse Circuit, the Camshaft Release or Resynchronizing Circuit, Offset (Reset) No. 1, and, if used, Offset (Reset) No. 2, and Offset (Reset) No. 3.

Behind the drum and the body casting is the motor. (Refer to Fig. 1-2, No. 3.) This type is used exclusively for controllers which are either master-local or non-interconnected controllers. Adjustments and regulation of this motor is covered elsewhere in this manual.

The synchronous motor, which is also used to operate the cycle unit, is a precision built clock-like motor. If used in interconnected operation the relay will function as the clutch. When this relay is energized it opens the Motor Circuit and the motor stops immediately.

To remove the motor assembly from the cycle unit, tilt cycle unit forward then disconnect the motor cable from the cycle unit by the small jack socket at the top, then loosen the thumbnut located on the top. The motor assembly is then lifted along the edge of the body casting until free of the lock catch. (This is shown later on.)

To change cycle gears, the motor is removed from the cycle unit. On the back of the casting can be seen the cycle gear in use, held in place on the jack shaft by a thumbnut. Remove the nut and the gear slips off the shaft quite readily. These gears are direct reading. That is, the number of teeth on the gear corresponds to the number of seconds in a complete cycle produced by that gear. The number of teeth is stamped on the gear. Directly behind the cycle gear is the backlash adjusting screw. The motor mounting plate contains a die cast half-nut which locks the position of the motor with respect to the cycle gear when assembled.

Since the adjusting screw is factory set during assembly, it is not usually necessary to adjust.

In the upper left of the back of the casting can be seen the cycle length pointer arm. The position of the motor will vary up and down with the cycle gear used, so this positioning is utilized to indicate the cycle gear in use on the front of the cycle unit.

On the top left hand side of the front of the body casting is the switch controlling the motor. (Refer to Fig. 1-3, No. 5.) In the "off" position power is removed from the motor. Its brake will stop the unit in a two to four percent dial movement. (This depends on the size cycle gear used.)

In "run" position the motor is connected to the input power through the contacts of the dial transfer relays (LD90A6) on the inside of the housing door. In case of a one dial controller, barrel jumpers take the place of transfer relays. To the right of the motor switch can be seen the cycle length indicator pointer and calibrations.

In operating position the cycle unit may be swung out from the housing by pulling forward on the top of the cycle unit. The casting will pivot on a hinge assembly which is fastened to the shelf by a slot and thumbscrew arrangement (refer to Fig. 2-5). In the forward position of the cycle unit, the motor may be easily removed and/or inspected. (Shown later on.)

If removal of the cycle unit is desired or necessary, the thumbscrew holding the hinge bracket to the shelf should be loosened by turning it in a counter-clockwise direction a few turns, so as to allow the tilting of the hinge bracket enough room to clear the tabs from the slots in the shelf. The cycle unit will then be clear of the mechanism.

With the cycle unit in the forward position, the electrical connections between the unit and the controller will be broken, but it is simply and easily reconnected by swinging the body back into the housing. Special care must be taken to be sure the plug is properly seated in the socket on the shelf.

Once the housing door is closed, it is impossible for the cycle units to become loose, for a stop, covered by a rubber bumper, is built in the top of the housing door and this, when the door is closed, presses against the top of the cycle units, preventing them from falling forward due to vibration caused by traffic.

c. Terminal Facilities Assembly.

Below and behind the controller mechanism housing is mounted the terminal panel. (Refer to Fig. 1-1, No. 12.) All control switches, with the exception of the dial motor switches are mounted on a sturdy aluminum switch panel in the lower right hand corner of the terminal panel.

Three double rows of terminals are provided. The left hand row of each double row is used for field connections. (Unless specifically noted on hookup diagram furnished with controller.) The left hand row of the double row of terminals of the right hand group is used for connection to the interconnecting cable and the power source. The other two groups of rows provided for field connections are used for traffic signal field connections. For every sequence of three signal light terminations, a spare set of terminals has been provided. This is for addition of the Remove Separate Flashing and Emergency Firelane features. Later on it is shown how these circuits are used in wiring in any combination of the mentioned features. Unless otherwise used for special applications there are available nineteen signal circuits. Normally only six signal circuits are supplied for immediate use.

Above the terminal panel is located the auxiliary equipment mounting panel. This panel is of sheet steel and will only be used when extra features are desired. Each feature has its own position on the panel.

1-4. ELECTRICAL CONSTRUCTION.

The single switch at the top of each cycle unit, as has been mentioned, is to control the synchronous motor. Putting the switch in the "off" position will stop the dial drum in two to four percent movement, depending on the length of the cycle used.

On the terminal panel the bottom switch controls both the Signal Shutdown and the local operation of the Flashing feature, if it is used. (Refer to Fig. 2-7.) In the left position, normal operation is had with the signal lights on. In the right position, the separate flasher is initiated and the remote flash relays, if used, are actuated to transfer the signal circuits. In the center position, the signal lights are turned off and the flasher does not operate.

Above the signal switch is the Auto to Hand Control Switch, if used. In the left hand position the impulses from the cycle unit dial contact block will control the camshaft. However, when this switch is moved to the right, the Hand Control Pushbutton Switch connected between L4 and M1 on the terminal panel will provide the impulse to operate the ratchet motor instead of the dial unit. It should be remembered that actual switching of the signal lights does not occur until the pushbutton is released and not when it is pushed.

The next switch up the panel is the Power Switch, if used. This will disconnect the input power to the controller ahead of the fuse. The advantage of this method is that it is the same as removing the power leads from the equipment. Replacing the fuse, or other maintenance work, can be done without danger in bad weather.

In the case of an interconnected controller, there might still be power in the equipment since the master controller sends out power to the local to operate the remote features. Also available as an added feature is the Local Dial Selector Switch. With it the operation of any dial installed may be checked or control returned to the Master Controller, if used, or time switch control of the dials affected. Each operation of the switch is isolated from the others to prevent power feed back in the interconnecting cable or other circuits.

In the Master-Local Type of controller, the power switch is not available standardly. In place of this switch, a remote operation switch of the system of controllers is used. This switch permits manual selection of normal automatic operation, system flashing, time switch control of system flashing or signal shutdown and manual control of Remote Signal Shutdown. This selector switch is of the heavy duty type. To permit control of a large number of local controllers, a heavy duty rotary selector switch is also used in the dial selection position. An additional selector switch is added to the Master Controller for control of the reset impulse sent out. This is for use in systems where triple offset (reset) is used. In the single offset (reset) systems the switch is left in the offset (reset) No. 1 position.

To the left of the switch panel near the bottom of the terminal panel is the power fuse.(Refer to Fig. 1-1, No. 9.) This fuse protects all components of the controller which receive power locally for operation. This does not include the relays and clutches actuated by the interconnecting cable. The latter equipment is protected by the fuse in the master equipment. The interconnecting cable may be fused economically if requested, but this is not done in standard controllers.

The connection between the controller mechanism and the terminal panel is made through a flexible cable made of color-coded heavy duty stranded wire. All connections to the panel are made in the back. The cable is terminated in a socket type connector which fits into a mating plug located in the bottom of the controller housing.

Three types of power are fed into the housing through this cable:

a. L4 POWER – Power obtained directly from the fuse on the panel to operate the cycle unit motors and ratchet motor.

b. L8 POWER – That power monitored by the signal switch and the remote features such as Remote Signal Shutdown, Remote Emergency Firelane and Remote Separate Flashing for control of the signal lights. It is fed directly to the signal busbar located behind the camshaft.

c. RESYNCHRONIZING POWER – Power sent out from the Master Controller for operating the relays of the synchronous motors.

The power from the master is interrupted at the master for three percent (3%) of the total cycle at which time (presuming the local controllers are in step) the dial contacts of the local controllers in series with the clutch are closed. All other wires in the cable are signal circuit wires or those used in the triple reset system and control of the dial selection relays.

The following is a description of the operation of the controller in a normal sequence. Assuming that Dial One is in operation, as it rotates in a clockwise direction, the dial impulse keys will trigger the No. 1 dial contact (the one closest to the front of the contact block). This will be a momentary closure and is the pulse of power fed to the ratchet motor.

As the ratchet motor is energized the rotor will lift the weight attached to it and will hold it there until the dial impulse key passes the twelve o'clock position.

The power being removed from the ratchet motor, the weight drops, advancing the camshaft one notch or interval. This action in turn causes the signal contact fingers riding on the cams to make or break circuit with the signal busbar, turning on or off the signal lights as desired. These signal cams will normally be cut to produce the sequence desired by the customer, if that sequence has been supplied to the factory.

The dial drum and the camshaft are constantly being kept in step as illustrated in the circuit diagram Figure 1-5.

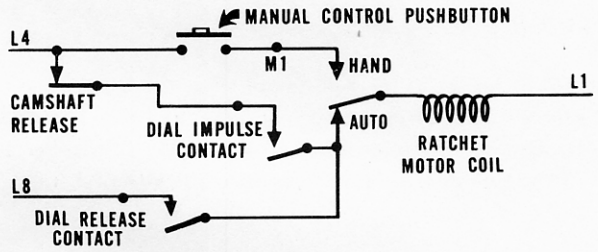


Figure 1-5. Dial Drum and Camshaft Sync Circuit

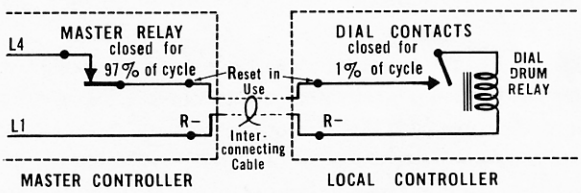


Figure 1-6. Dial Drum Resync Circuit

If the Auto to Hand switch is in the automatic operation position as shown above, the dial impulse keys will operate the ratchet motor. The impulse contact is the first set of contacts on the contact block of the dial timer and the release contact is the second one from the front. These two are operated by the dial keys.

All dial keys operate the first contact with the exception of one to operate the second or "release" contact and one to three offset (reset) dial keys, depending on the number of offsets used.

The contact marked "Camshaft Release" in the diagram is the second cam contact on the camshaft. This contact is closed for all intervals except the first, which is almost invariably the Main Street Green interval.

Should the dial drum and camshaft be out of step, the camshaft will rotate to the No. 1 interval since the dial key which operates the second dial contact (release) is set to close to initiate the second interval of the cycle. The camshaft will wait until this set of contacts close before continuing the cycle. In other words, the camshaft will dwell in the first interval or Main Street Green until the key operating the second contact allows power to be sent to the ratchet motor.

Should the Signal Switch, Remote Flashing, Remote Signal Shutdown or Emergency Firelane features be in operation, power to the dial release contact would be broken. Thus the camshaft will advance to the No. 1 interval and dwell there so that the lights will always start in the Main Street Green after these features have been deactivated.

In interconnected operation the Master Controller can send out power over the reset No. 1, No. 2, or No. 3 wire to the local for ninety-seven percent (97%) of the signal cycle. Figure 1-6 shows how this controls the resynchronizing of the dial drum.

Assuming that the local controller dial drum is out of step with the master dial, it will continue to run until the dial key which operates the third set of dial contacts reaches the twelve o'clock position and actuates the contacts. This allows the power from the master relay contacts (controlled by the dial contacts of the master dial) to energize the local dial motor relay.

The relay disconnects the motor power and the motor stops. Thus the local controller dial will stop and wait until the master dial contacts close, once again picking up the master relay. The normally closed contacts of the master relay then open and the power to the local motor relay is removed, the motor starts, the local dial drum starts to rotate in step with the master.

They continue to rotate in unison and even though the dial contacts of the local controller close each cycle, the master contacts will open the power circuit at the same instant and the local dial relays will not operate.

All cycle gears on dial one of the master controller and local controller must be the same size. This holds true for dial two and dial three. Otherwise the controllers could not stay in step.

SECTION II
INSTALLATION

2-1. MOUNTING INSTRUCTIONS.

The welded sheet aluminum cabinet may be:

a. Pedestal mounted with a slip fitter.

b. Wood pole mounted with straps and lag bolts.

c. Steel pole mounted with straps and machine bolts. (Refer to Figure 2-1.)

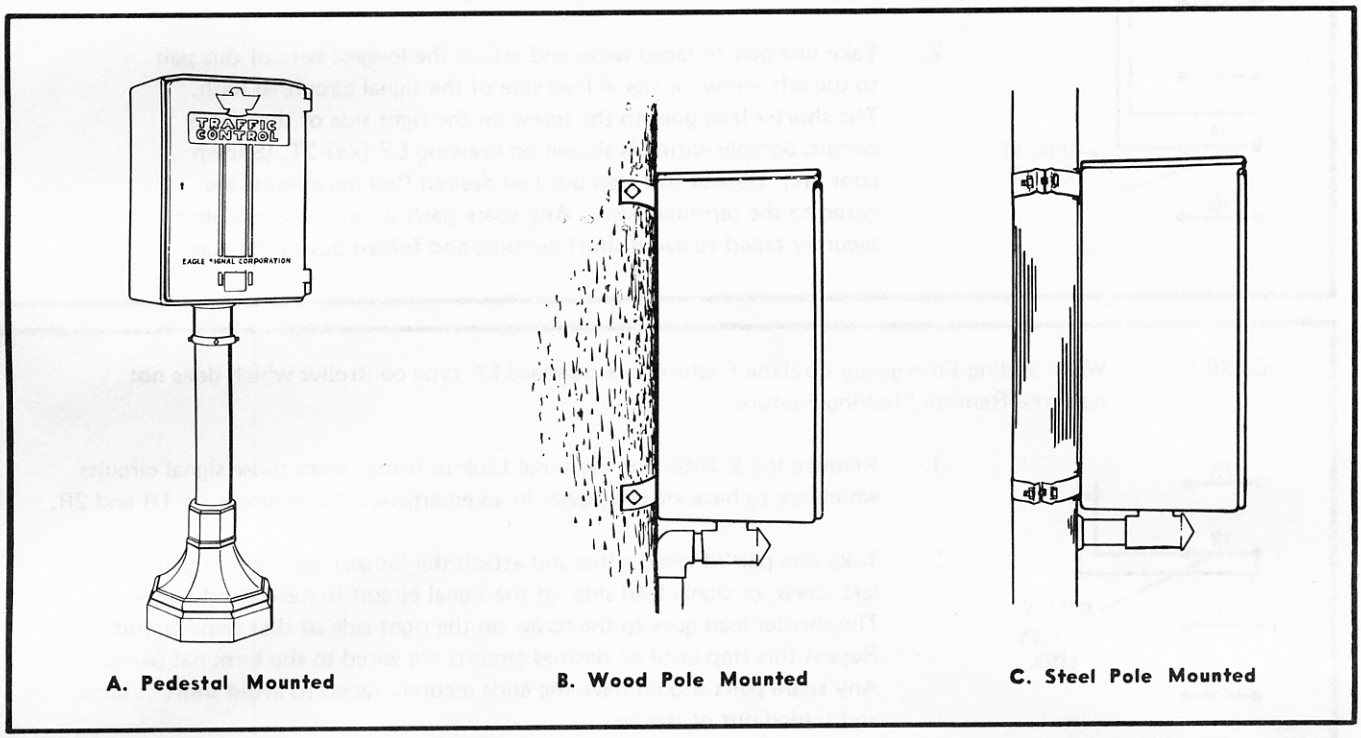


Figure 2-1. Typical Mountings

2-2. PRECAUTIONARY MOUNTING HINTS.

The controller cabinet should be located in a protected area to prevent unnecessary damage from vehicles. If it is necessary to place the controller near the roadway, locate it in such a position that its door does not overhang the thoroughfare, as passing vehicles may strike it, resulting in injury to the equipment or to the inspecting personnel.

In installations where there is a possibility of conduit gas or other dangerous vapors entering the cabinet, it is advisable to use a cabinet vent which would be located on the top surface of the cabinet. Vents are also used where it is found that excessive condensation occurs inside the cabinet due to its location or local weather conditions.

2-3. EXTERNAL HOOKUP.

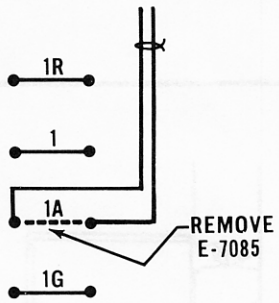
After the controller cabinet is mounted, power, signal light control cables and the interconnecting cable (if used) are brought into the cabinet and wired to the terminals per the external hookup diagram included with this manual. Where economically feasible, separate signal cables should be used from each group of signal heads so that, in event of damage to one group, its cable may be disconnected, leaving the rest of the signals in operation. This will provide some measure of protection to the intersection during repair or replacement.

If color coded wire is used in the signal cable lead-ins, it is a good practice to follow the same coding at all intersections. All wires from the cables should be routed or fanned out to their respective terminals to facilitate maintenance in years to come.

IMPORTANT. All connections from the field to the controller should be made to the left hand screw of each set of signal terminals unless otherwise specified on the hookup diagram furnished with the controller.

2-3-1. Information On How To Wire Remote Flashing And Emergency Firelane Features. (Refer to Figure 2-2.)

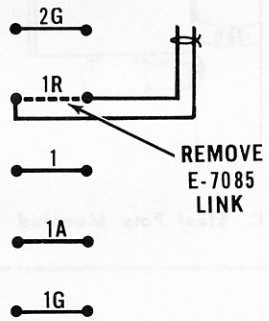
CASE A — When adding Remote Flashing Feature to a standard EF type controller which does **not** have the Emergency Firelane Feature:



1. Remove the E-7085 flat Terminal Link or bridge from those signal terminals which are to flash, for example, at 1A and 2R.

2. Take one pair of laced wires and attach the longest wire of this pair to the left screw, or signal lead side of the signal circuit to flash. The shorter lead goes to the screw on the right side of that same circuit. Sample wiring is shown on drawing EF (xx)-2T. (Shown later on.) Repeat this step until all desired flashing circuits are wired to the terminal panel. Any spare pairs should have the ends securely taped to avoid short circuits, and folded out of the way.

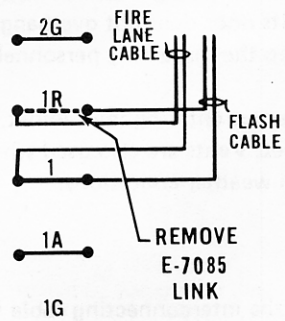
CASE B — When adding Emergency Firelane Feature to a standard EF type controller which does **not** have the Remote Flashing Feature.



1. Remove the E-7085 flat Terminal Link or bridge from those signal circuits which are to have steady power in an emergency, for example, at 1R and 2R.

2. Take one pair of laced wires and attach the longest wire of this pair to the left screw, or signal lead side, of the signal circuit to have steady power. The shorter lead goes to the screw on the right side of that same circuit. Repeat this step until all desired circuits are wired to the terminal panel. Any spare pairs should have the ends securely taped to avoid short circuits, and folded out of the way.

CASE C — When both the Remote Flashing and the Emergency Firelane Features are used, the following steps are taken:



1. The pair of laced wires from the flasher panel are wired to the right hand screws of the circuit to be flashed and the nearest numbered terminal. For example, 1R and 1, 2A and 2, 3R and 3, etc. The longest wire goes to the numbered terminal and the shortest wire to the circuit terminal.

2. The pair of wires from the Emergency Firelane relay panel is wired to the left hand screws of the same signal circuit and numbered terminal used in step 1. The long lead goes to the left screw of the circuit terminal and the shortest lead to the numbered terminal. The terminal bridge should be removed at the signal circuit.

NOTE: When any feature is removed from the terminal panel, the E-7085 links must be replaced.

Figure 2-2. Remote Flashing and Emergency Firelane Wiring

2-4. CONTROLLER ADJUSTMENT.

After all connections to the terminal panel have been made and the fuse is pulled from the panel to prevent power being fed to the controller prematurely, mount the controller mechanism in the cabinet. This is done by pulling the mounting bracket pivoted on the left side of the cabinet to the outside position. This will expose two dowels on its inner surfaces, one at the top pointing down and one at the bottom pointing up.

On the left side of the mechanism housing are two brackets with holes to match the dowels. Feed the hole in the top housing bracket onto the top dowel and lift the housing until the housing bracket is against the top part of the mounting bracket on the cabinet. Next, line up the hole in the bottom housing bracket with the lower dowel on the mounting bracket and lower the housing until it sits on the bracket. The controller may now be swung in and out of the cabinet as the occasion demands. (Refer to Fig. 2-3.)

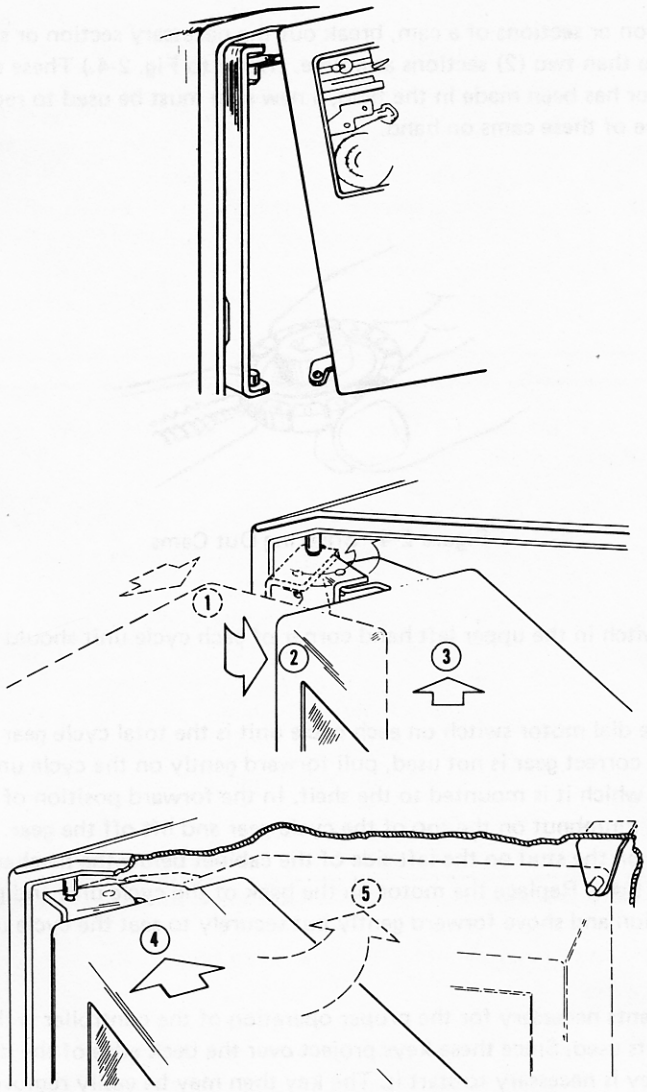


Figure 2-3. Controller Mechanism Mounting

Connect the terminal facilities to the controller mechanism by assembling the jack connector socket to the mating plug on the bottom of the mechanism. In the small cloth bag tied to the terminal facilities harness will be the socket clamp and thumbscrew used to hold the socket to the housing. This must be used to prevent traffic vibration from disconnecting the socket and interrupting operation of the controller.

Next swing the controller mechanism as far out as possible and unlatch the door. As the door of the housing is opened, it may be seen that the Dial Cycle Units and the Camshaft Switching Mechanism are in position to be adjusted or inspected as needed.

Dial motors and relays are shipped separately in order to protect them. Later on it is shown how to mount the motor. (Follow instructions carefully.) When mounting the relays, it is necessary that they are mounted securely and that jack clamps are tight, insuring a good electrical connection.

The cams controlling the signals are usually cut to the customer's specifications if these are forwarded to the factory at the time of the original order.

If cams are not cut, do so at this time to obtain the desired sequence. It must be remembered that the removal of a segment of a cam in any one interval will cause the signal contact finger for that cam to be closed and light the traffic signal in that interval.

To remove a section or sections of a cam, break out the necessary section or sections with pliers. For best results, do not break out more than two (2) sections at a time. (Refer to Fig. 2-4.) These segments cannot be replaced once they are broken out. If an error has been made in the field, a new cam must be used to replace that cam. It is a good practice to have a small reserve of these cams on hand.

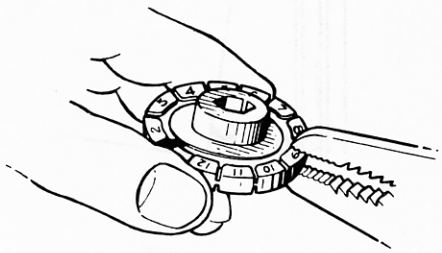


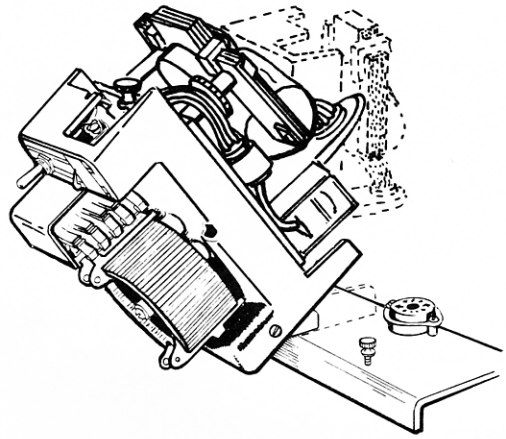
Figure 2-4. Breaking Out Cams

The dial motor switch in the upper left hand corner of each cycle unit should be placed in the "run" position.

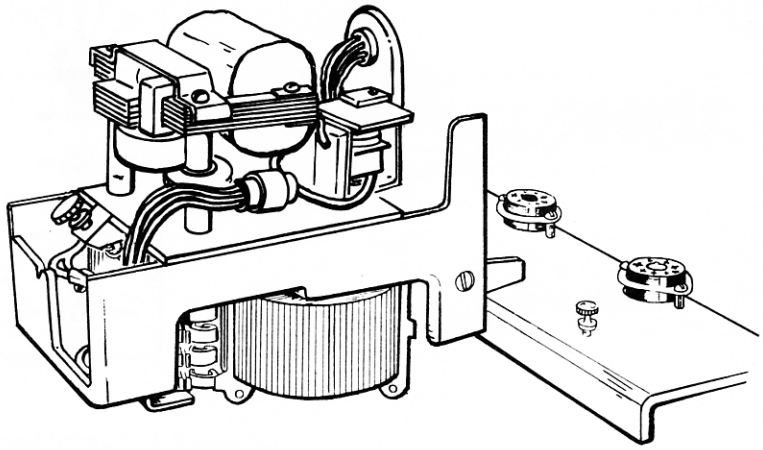
To the right of the dial motor switch on each cycle unit is the total cycle gear indicator. Check these for the proper gear desired. If the correct gear is not used, pull forward gently on the cycle unit body casting and it will pivot on the hinge bracket by which it is mounted to the shelf. In the forward position of the cycle unit the motor may be removed. Remove the thumbnut on the top of the cycle gear and lift off the gear. Replace with the correct gear from the spares mounted on the stud on the left side of the cabinet below the mechanism. Reassemble the thumbnut, being sure that the nut is tight. Replace the motor on the back of the cycle unit and plug in its cable. Lift the cycle unit back to the vertical position and shove forward gently but securely to seat the cycle unit plug in the socket on the shelf.

The final adjustments necessary for the proper operation of the controller is the setting of the dial keys in the one or more dial cycle units used. Since these keys project over the back edge of the dial cycle drum, a small jerk or pull on the front end of the key is necessary to start it. The key then may be easily removed and replaced in the slot desired to obtain the necessary percentage split.

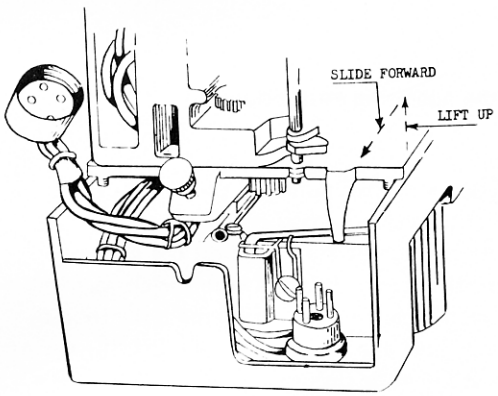
Close the controller mechanism door and latch securely with the spring type catch. Swing the controller into the cabinet. As the controller is moved back into the cabinet it will stop against the catch attached to the top casting of the cabinet. This catch has a pin which is designed to slide into a matching hole in the back of the housing by slightly raising housing. A notch on the pin then positions the housing inside the cabinet to prevent it riding forward until it is lifted slightly by inspecting personnel. (Refer to Fig. 2-3.)



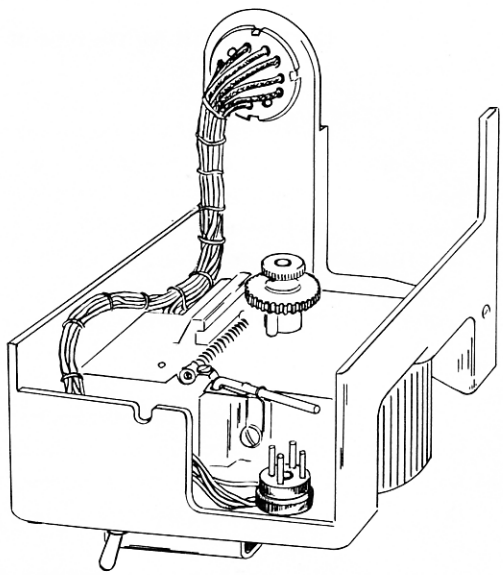
Grasp cycle unit near the top of the die casting and pull forward gently to loosen connecting plug from cycle unit shelf. Once the plug is free from the socket, the cycle unit will rotate forward on the hinge in the base of the unit, to a horizontal position.



Remove motor plug located in the back of the top of the top half of the cycle unit. Loosen knurled screw near the front of the motor for at least four full turns. The motor is now loose on the cycle unit.



To remove the motor grasp both sides with one hand and lift the edge nearest you, pull forward slowly. This action will disengage the half-nut on the synchronous motor from the back lash adjusting screw on the cycle unit body.



Directly behind the motor on the cycle unit, and readily visible when the motor is removed, is the cycle gear. This cycle gear is held in place with a thumb nut on a jack shaft. To replace with another gear, remove the thumb nut and gear. Hold dial while doing this. In mounting the new gear align one of the holes in the gear with the pin on the hub of the jack shaft, and replace the thumb nut.

Follow the above procedure in reverse to replace the motor and remount the cycle unit.

Figure 2-5. Directions For Changing Cycle Gears

Figure 2-6. Typical Control Switches

Below the controller on the terminal panel are the control switches. (Refer to Fig. 2-7.) The normal starting positions for these switches before initial operation of the controller is as follows:

Local Dial Selector Switch in the "D1" (Dial One position) (if used)

Power-Off – Switch in "Off" position (if used)

Auto-Hand – Switch in the "Auto" position (if used)

Signal-Off-Flash – Switch in the center or "Off" position

See Section III for the type of operation desired. This will give the operating instructions.

SECTION III

OPERATING INSTRUCTIONS

3-1. NON-INTERCONNECTED OPERATION.

To set the EF type local controller in non-interconnected operation the following steps are used:

1. Insert the fuse into jacks for that purpose on the terminal panel.

2. Place the POWER-OFF Switch in the "Power" position if this switch is used.

3. Set up what ever time switches are used for local control of features or dial selection according to the clock instructions included for that purpose.

The controller dial in the number one position should now be running. Allow the dial to rotate through at least two complete cycles to insure that the camshaft will have stopped in the first interval.

Check the movement of the traffic. If the movement of vehicles is moving on the main street (the street whose lights are connected to the 1G, 1A and 1R terminals on the terminal panel), turn the SIGNAL-OFF-FLASH Switch to the "Signal" position.

This will turn on the signal lights at a time when the traffic is moving with it and prevent a conflicting indication. The camshaft will rest in the first interval until the dial drum resynchronizes with it. This may take as much time as slightly less than the total cycle length. Observe the camshaft and check to see that it stays in step with the controller dial in operation.

Check each group of signals for proper operation and sequence through at least three complete cycles. If one or more of the lights do not operate, turn the signal switch off and remove the fuse. Check the wiring external to the controller against the hookup diagram furnished.

A common error in new installations is when the traffic bulbs are not screwed in tightly. If all the lights are working properly but the correct sequence is not shown, double check the camshaft to make sure that the segments removed from the cams are according to the color cycle cam chart included in this manual. It must be remembered that when a four, six or eight interval sequence is used, it will be repeated two or three times on the camshaft. Then repeat Steps One through Three given above.

If the controller is not interconnected, the reset feature of the controller is not used. Therefore, the reset keys on the dial drums may be removed to avoid confusion in the future. Place these in the small cloth bag for use later when the controller may be interconnected.

In those controllers using the Local Dial Selector Switch for local control of the dials while using the mechanism in a non-interconnected system, place the switch in the position calling for the dial desired.

In some cases time switches (mounted on the cabinet door) will be used for dial control. In that event, place the switch in the "CL" or clock position. The "RM" position is only used when the interconnecting cable of a progressive system is connected to the terminal panel.

After the above checks have been made, close and latch the controller housing door and swing the mechanism into the cabinet. Be sure to move the housing back until it rests on its stop. Check to see that the cable from the terminal panel to the controller is free of all equipment in the cabinet and close the cabinet door. Press firmly on the door near the lock bolt to insure proper latching.

The controller should now run for an indefinite period without further attention, other than the usual periodic routine inspections.

3-2. INTERCONNECTED OPERATION.

To set the EF type local controller in interconnected operation of a progressive system, the following steps are used:

1. Check all switches to be sure that they are in the positions called for in the last part of Section II. Check all dials to be sure that the Reset Number One Dial Keys are in the proper place.

CAUTION

The calibration for the reset keys is on the inner circle of the drum dial face plate. Reset keys protrude down past the outer circle of calibration to the inner circle. Reset number one will operate the third set of dial contacts. Reset Number Two (if used) operates the fourth . Reset Number Three (if used) the fifth or one closest to the body casting.

2. Check to make sure that the interconnecting cable is connected to the terminal panel from the master controller. To insure that resynchronizing power is being delivered by the master controller, a test lamp (115 volts) may be connected from terminal R1, R2, or R3 (depending on which is used) to terminal R- on the panel. It should light for a period slightly less than the total cycle used. For instance, on a fifty second total cycle, it will light for about forty-eight seconds and go out for about one or two seconds.

3. Insert the fuse into jacks for that purpose on the terminal panel.

4. Place the POWER-OFF Switch in the "Power" position if this switch is used.

5. Place the Local Dial Selector Switch if furnished in the "RM" or remote control position. This connects the dial transfer relays on the housing door with the interconnecting cable from the master controller. If the master is calling for Dial Two or Dial Three operation, the cycle unit in the first position will stop when the controller has shifted the camshaft into the first interval. Then Dial Two or Dial Three will start at the same instant.

6. Set up whatever time switches are used for local control of features or dial selection according to the clock instructions included for that purpose.

Allow the cycle unit dial in use to run for at least one complete revolution to insure that the camshaft will be in the main street green position or interval number one.

NOTE

The dial may stop for a time while it resynchronizes with the master controller dial in use.

When the dial runs continuously for one or two complete revolutions, check the movement of the traffic. If the movement of vehicles is moving on the main street (the street whose lights are connected to the 1G, 1A and 1R terminals on the terminal panel), turn the SIGNAL-OFF-FLASH Switch to the "Signal" position.

This will turn on the signal lights at a time when the traffic is moving with it and prevent a conflicting indication. The camshaft will rest in the first interval until the dial drum resynchronizes with it. This may take as much time as slightly less than the total cycle length. Observe the camshaft and check to see that it stays in step with the controller dial in operation.

If the cycle unit dial drum pauses once each cycle, the total cycle gear in use is not the same as on the master cycle unit.

Check each group of signals for proper operation and sequence through at least three complete cycles. If one or more of the lights do not operate, turn the signal switch off and remove the fuse. Check the wiring external to the controller against the hookup diagram furnished.

A common error in new installations is when the traffic bulbs are not screwed in tightly. If all the lights are working properly but the correct sequence is not shown, double check the camshaft to make sure that the segments removed from the cams are according to the color cycle cam chart included in this manual. It must be remembered that when a four, six or eight interval sequence is used, it will be repeated two or three times on the camshaft. Then repeat Steps One through Six given on page 3-2.

After the above checks have been made, close and latch the controller housing door and swing the housing into the cabinet. Be sure to move the housing back until it rests on its stop. Check to see that the cable from the terminal panel to the controller is free of all equipment in the cabinet and close the cabinet door. Press firmly on the door near the lock bolt to insure proper latching.

The system should now run for an indefinite period and in perfect coordination with the master without further attention, other than the periodic routine inspections.

3-3. MASTER-LOCAL OPERATION.

If the EF type controller is of the master-local type, the following steps should be taken to place the controller in operation in control of a progressive system of local controllers:

1. Check all switches to be sure that they are in the positions called for in the last part of Section II. In addition, place the system Dial Selector Switch in either the position of the dial selected for use or in the "CL" clock position as required. The operation switch should be in the "AUTO" position, the one that produces normal stop and go operation. If the system to be controlled is only Single Reset or "offset," the Reset Selector Switch should be left in the "R1" position. In those cases where Double or Triple reset are used, this switch is placed in either the position of the reset selected for use or in the "CL" clock position as required.

2. Check to make sure that the interconnecting cable is correctly wired to the terminal panel. See the external hookup diagram provided for this purpose.

3. Insert the fuse into jacks for that purpose on the terminal panel.

4. Set up whatever time switches are used for control of features or dial and reset selection according to the clock instructions included for that purpose.

Allow the cycle unit dial in use to run for at least one complete revolution to insure that the camshaft will be in the main street green position or interval number one. Check the movement of the traffic.

If the movement of vehicles is moving on the main street (the street whose lights are connected to the 1G, 1A and 1R terminals on the terminal panel), turn the SIGNAL-OFF-FLASH Switch to the "Signal" position.

This will turn on the signal lights at a time when the traffic is moving with it and prevent a conflicting indication. The camshaft will rest in the first interval until the dial drum resynchronizes with it. This may take as much time as slightly less than the total cycle length.

Observe the camshaft and check to see that it stays in step with the controller dial in operation.

Check each group of signals for proper operation and sequence through at least three complete cycles. If one or more of the lights do not operate, turn the signal switch off and remove the fuse. Check the wiring external to the controller against the hookup diagram furnished.

A common error in new installations is when the traffic bulbs are not screwed in tightly. If all the lights are working properly but the correct sequence is not shown, double check the camshaft to make sure that the segments removed from the cams are according to the color cycle cam chart included in this manual. It must be remembered that when a four, six or eight interval sequence is used, it will be repeated two or three times on the camshaft. Then repeat Steps One through Four given above.

After the above checks have been made, close and latch the controller housing door and swing the mechanism into the cabinet. Be sure to move the housing back until it rests on its stop. Check to see that the cable from the terminal panel to the controller is free of all equipment in the cabinet and close the cabinet door. Press firmly on the door near the lock bolt to insure proper latching.

The system should now run for an indefinite period and in perfect coordination without further attention, other than the usual periodic routine inspection.

3-4. STANDARD FEATURES.

3-4-1. Local Dial Selector Switch.

This switch is a two bank, five position switch.

a. CLOCK (CL) POSITION. This position allows Dial 2 and Dial 3 to be operated through time clocks located on the door of the cabinet. In this position the controller is completely isolated from the power on the interconnected cable. When Dial 2 and Dial 3 are not in operation Dial 1 will operate.

b. REMOTE (R.M.) POSITION. This position allows the dials and their associated impulse contacts along with the features to be controlled by the master through the interconnecting cable. They are completely isolated from the local power or time clock power in this position.

c. DIAL ONE (D1) POSITION. In this position Dial 1 and its associated impulse contact will be operated through local power and will be completely isolated from the power of the interconnecting cable and the time clock power.

d. DIAL TWO (D2) POSITION. In this position Dial 2 and its associated impulse contact will be operated through local power and will be completely isolated from the power of the interconnecting cable and the time clock power.

e. DIAL THREE (D3) POSITION. In this position Dial 3 and its associated impulse contact will be operated through local power and will be completely isolated from the power of the interconnecting cable and the time clock power.

The importance of the isolation of power in the selector switch is to prevent a feed-back of power through other wires of the interconnecting cable and also to prevent different powers located in the controller and interconnecting cable from coming together, for in case these different powers were of different polarity and they were together on the switch, it would blow the fuse.

3-4-2. Remote Flashing (Two circuits).

Remote flashing of two circuits is had by applying power from the interconnecting cable which energizes the flash relay coil. When this happens, signal busbar power is shut off and local power through flasher unit through the relay contacts to 1A and 2R signals causes them to flash.

3-4-3. Remote Flashing (Five circuits).

Remote flashing on five circuits is accomplished in the same fashion as on two circuits except another flash relay is installed and the relay is energized by local power through the #1 contact in the first relay. The same flashing power from Relay 1 is then applied to 3R, 4R and 5R signals, causing them to flash.

(Refer to paragraph 1-4, to show how different desired signals may be caused to flash.)

3-4-4. Emergency All Red (Two circuits).

Emergency All Red on two circuits is accomplished by applying power through the interconnecting cable to the firelane relay coil. This allows local power to be applied to 1R and 2R signals. Signal busbar power is cut off in this process.

(Refer to paragraph 1-4, to show how different desired signals may be caused to operate.)

3-4-5. Emergency All Red (Five circuits).

Emergency All Red on five circuits is accomplished in the same fashion as on two circuits except another relay is added and local power through the No. 1 contact of the first relay energizes the second relay coil and sends power to 3R, 4R and 5R signals. Signal busbar power is cut off in the process.

NOTE

Emergency All Red supercedes Remote Flashing in operation.

(Refer to paragraph 1-4, to show how different desired signals may be caused to operate.)

3-4-6. Remote Flashing Time Switch.

The Remote Flashing Time Switch operates the same way as the Remote Flashing except that the power used to energize the first relay coil is provided by a time switch instead of from the interconnecting cable.

3-4-7. Dial Two Time Switch.

The Dial Two Time Switch allows the controller to be controlled by Dial 2 at times selected by the time switch mounted on the cabinet door. Power from the time switch energizes the Dial 2 Transfer Relay located on the inside of the controller door. This causes the Dial 2 motor and impulse to begin operation the next time the latch toggle closes.

NOTE

The Local Dial Selector Switch (if furnished) must be in the Clock Position in order for the time switch to operate.

3-4-8. Dial Three Time Switch.

The Dial Three Time Switch operates the same way as the Dial 2 Time Switch. It is mounted on the cabinet door next to Dial Two Time Switch.

NOTE

The Local Dial Selector Switch (if furnished) must be in the Clock Position in order for the time switch to operate.

3-4-9. Power Switch

The Power Switch is a double pole, single throw switch connected between the incoming local power and the fuse.

3-4-10. Remote Signal Shutdown (N.C. contacts).

The Remote Signal Shutdown with normally closed contacts consists of a relay through which power to the signal lights can be cut off.

Remote power through the interconnecting cable to the coil of this relay will cause it to energize, thus opening the contacts and cutting off the power to the signal lights.

3-4-11. Remote Signal Shutdown (N.O. contacts).

The Remote Signal Shutdown with normally open contacts is positioned in the line the same as the normally closed contact shutdown relay, except that the remote power must energize the coil in order for the contacts to close and allow power to get to the signal lights. If the power from the interconnecting cable shuts off or goes below a certain voltage, power to the signal lights will be cut off.

3-4-12. Remote Signal Shutdown (Position only).

The Remote Signal Shutdown position only consists of the mounting panel and all wiring. For future operation to remove the jumper on the frontside of the relay panel and insert relay.

3-4-13. Line Filter.

The Line Filter is used to ground out radio interference frequencies caused by the electrical functions of the controller.

3-5. CYCLE UNIT OPERATION.

3-5-1. The Cycle Unit Assembly.

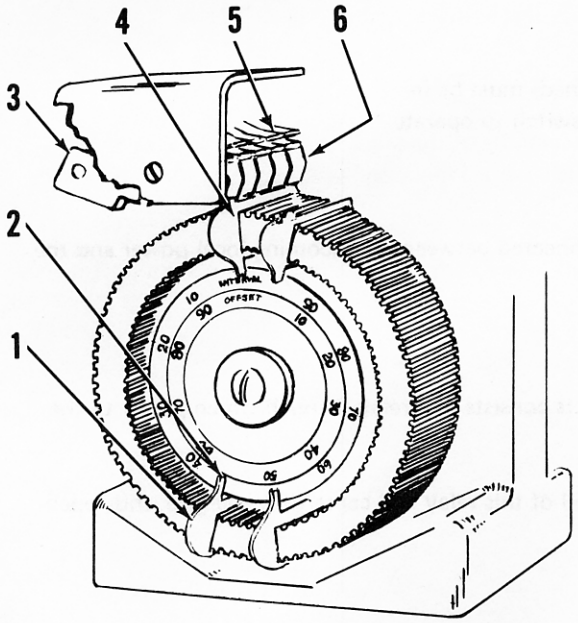
Figure 3-1 shows components required for selecting the various timing functions. The dial assembly basically consists of:

A cylinder with 100 equally spaced slots in 1% increments for receiving dial keys and controlling from two to five individual pairs of contacts.

Two pairs of contacts are for controlling and maintaining proper timing relationship between the dial and camshaft assembly. These contacts are the first two sets from the front of the dial and are designated as impulse and release contacts.

Three additional pairs of offset (reset) contacts, if required, are used in keeping local controllers synchronized with the master controller (single reset (offset) systems require use of R1 contacts only – Triple offset (reset) systems require use of all three pairs of contacts R1, R2, and R3 – Non-interconnected controllers do not use any of the offset (reset) contact assemblies).

There are two types of dial keys for actuating the impulse and release circuits. The impulse keys, not color coded, actuate the first pair of contacts from the front of the dial. The release key actuates the second pair of contacts and is color coded green.



Identification Number	Description
1	Release Key (Green)
2	Indicating Tab
3	Contact Block Assembly
4	Impulse Key-Set at "0" Start of Main Street Green
5	Contacts normally do not require adjustment. If more contact movement is required, Remove Shield and adjust Upper Contact Finger by bending toward axis of Drum
6	Nylon Cam Followers

Figure 3-1. Setting Dial For 50/50 Split, 7 Percent Amber

There are three types of offset (reset) keys for actuating the three pairs of offset (reset) contacts – R1 is color coded red, R2 is color coded yellow and R3 is color coded white.

The Calibrated dials, with the outer set of numbers reading in counter-clockwise direction, is for use with Impulse and Release key only. The Inner dial, with numbers reading in clockwise direction, is for use with reset keys and determines the offset timing. (i.e., lag to beginning of Main Street green interval from the master reference time.)

3-5-2. To Set Dial For Percentage Split.

NOTE

The first two pairs of contacts and associated keys only, are used in setting percentage split.

Refer to Figure 3-2 for typical cam chart (or to cam chart prepared specifically for intersection in question). Three impulse keys, not color coded, and one release key, color coded green, are required.

a. Insert impulse key (not color coded) in slot of cylinder with indicating tab of key directly on the "0"% calibration of the interval dial. This key will cause camshaft to be rotated to Main Street green interval.

b. Insert release key (color coded green) in cylinder slot on 43% calibration. This key designated as the release key will cause camshaft to be rotated to Main Street amber interval. Also the Release key will keep dial in proper relationship with camshaft.

c. Insert impulse key (not color coded) in 50% slot. Camshaft will be rotated into Cross Street green interval.

d. Insert impulse key (not color coded) in 93% slot. Camshaft will be rotated into Cross Street amber interval.

Figure 3-2 illustrates a 4 interval color sequence. Sequences that utilize more intervals will require additional keys. (i.e., 6 interval operation will require 5 in place of 3 impulse keys.)

The No. 1 impulse key is always at "0" calibration and the release key always is the second key (in 6 or more interval operation and the release key may not start the amber interval as illustrated in Figure 3-2).

3-5-3. To Establish Offset Timing Relationship.

The offset timing relationship is the amount of time the beginning of the Main Street green interval is set to lag from the reference line (point where master controller checks local controllers once each cycle) of the time space diagram.

The physical settings of offset is identical to those required for percentage splits with the exception that keys are set to and associated with the inner (offset) dial.

Refer to Figure 3-3 (typical offset (reset) chart) – Offset No. 1 Chart.

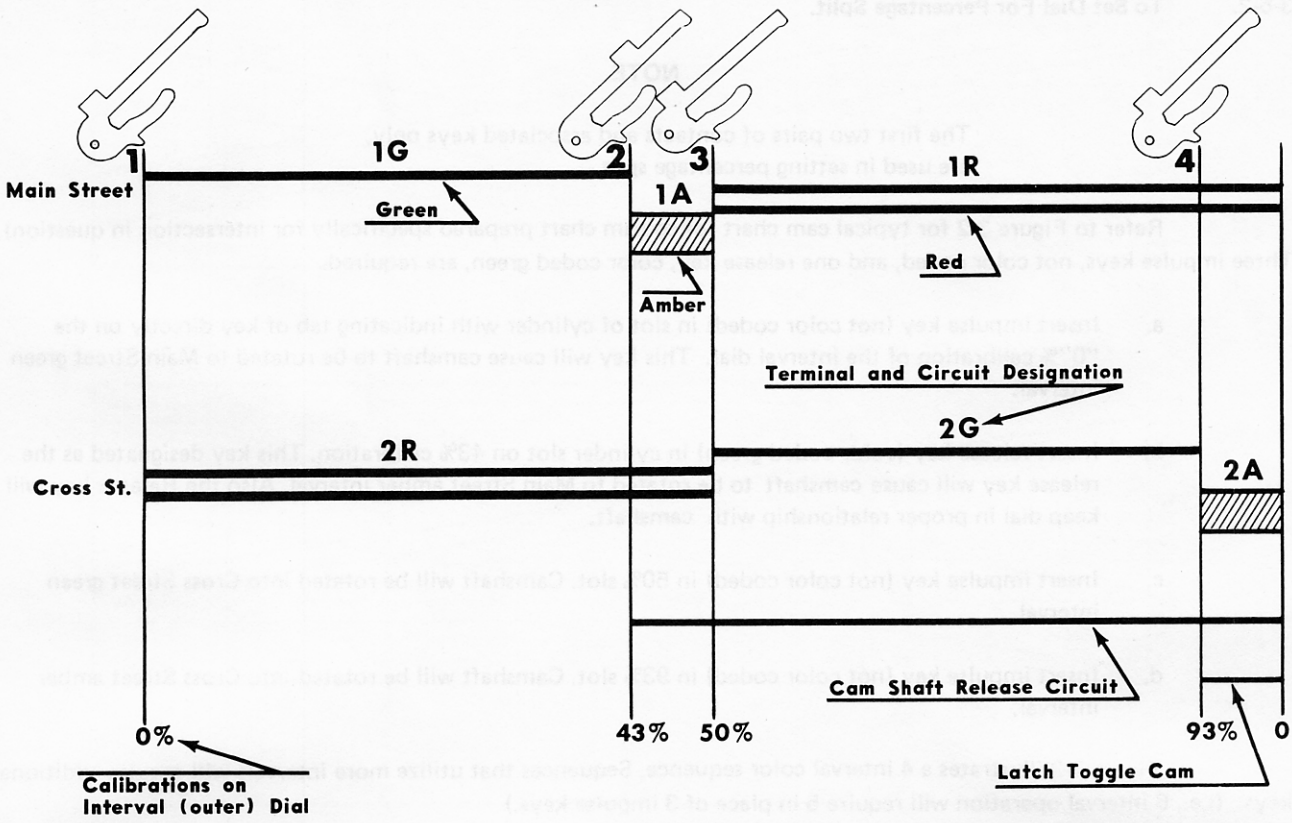
Place keys in slots of drum as shown in composite chart with actual dial settings.

If possible, it is recommended that controllers be preset in maintenance shop before installation. The system automatically adjusts itself within one cycle.

Bulletins are available on request for a more detailed explanation of determining offset (reset) settings.

TYPICAL CAM CHART

with a 50-50 percentage split and 7% amber setting on main and cross streets



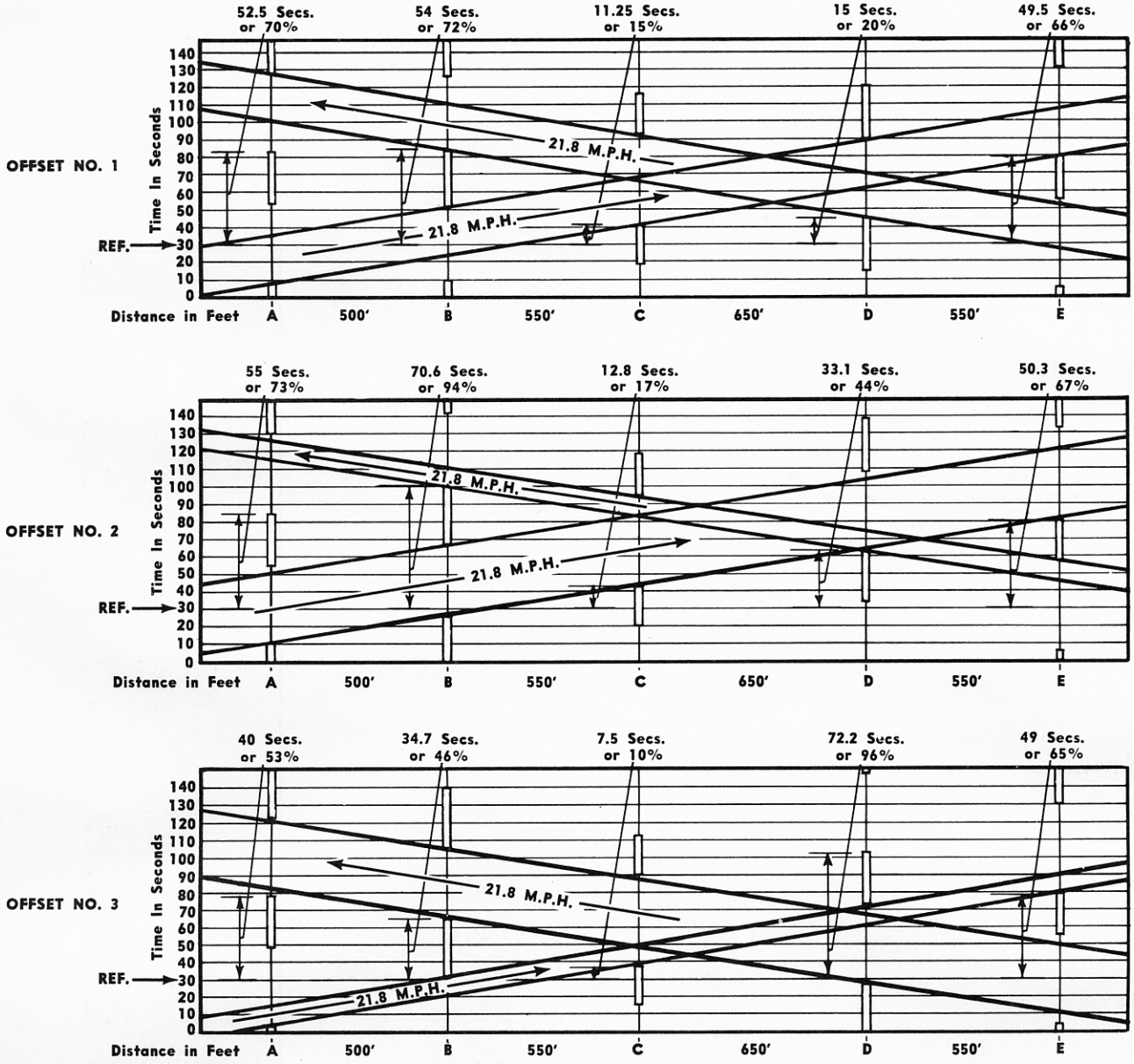
Break out cam segments as indicated below

*LT				4				8				12
*CSR		2	3	4		6	7	8		10	11	12
1G	1				5				9			
1A		2				6				10		
1R			3	4			7	8			11	12
2G			3				7				11	
2A				4				8				12
2R	1	2			5	6			9	10		

*Note:
LT—Latch Toggle (Dial-Transfer)
CSR—Cam Shaft Release

Figure 3-2. Typical Cam Chart

TRIPLE OFFSET TIME SPACE CHARTS



NOTE: A four interval cycle and four second amber were assumed.

Total Cycle Length 75 seconds

Speed 21.8 M.P.H.

COMPOSITE CHART FROM TIME SPACE DIAGRAM

	R1		R2		R3	
	SECONDS	%	SECONDS	%	SECONDS	%
INTERSECTION A	52.5	70	55	73	40	53
INTERSECTION B	54	72	70.6	94	34.7	46
INTERSECTION C	11.25	15	12.8	17	7.5	10
INTERSECTION D	15	20	33.1	44	72.2	96
INTERSECTION E	49.5	66	50.3	67	49	65

Actual Dial Settings

Figure 3-3. Triple Offset Time Space Charts

SECTION IV

MAINTENANCE

4-1. ADJUSTMENTS.

4-1-2. To Add or Change Cams Proceed in Order Listed Below.

a. TO REMOVE CAMSHAFT (refer to Fig. 4-1), loosen right hand bearing setscrew (A), slide bearing (B), to the right to free camshaft, and rotate camshaft as per arrow (D), while pulling to the right.

b. TO ADD OR CHANGE CAMS remove spring (E). When adding cams, flat surface (H), on hexagonal shaft and flat surface on cams must coincide.

c. TO REMOVE A SECTION or sections of a cam, break out necessary segments with pliers. For best results, do not break out more than two sections at a time. To replace camshaft, raise rotor (C), hold pawls (P), (refer to Fig. 4-2) clear of the ratchet wheel and slip shaft onto left hand bearing. Push shaft to the left, rotating in the same direction as before. Insert the right hand bearing (B). Allow approximately 0.020 inches endplay in the camshaft. Tighten bearing setscrew (A).

d. End play of camshaft should be 0.015 to 0.020 inch.

e. Hold the camshaft firmly to the right against bearing (B) and apply slight down pressure (maximum 50 grams) to the toggle cam (F). The #1 contact finger should not raise the flash contact finger, but they may touch the lever (EF20-91).

f. The camshaft check pawl (PKC-41) should latch when the rotor weight assembly is slowly lowered to its rest position, or when a maximum of 50 grams is exerted on the upper portion of the weight. If the stop pawl does not latch properly, or if the camshaft can be moved backwards after rotor weight bottoms, loosen setscrew in check pawl and adjust accordingly.

4-1-3. Rotor and Check Pawl Adjustments.

a. On an assembled controller, attempt to manually rotate the cam shaft and cams (figure 4-1) clockwise (upward) as viewed from the camshaft support bracket (G).

b. The check pawl (J) should stop the camshaft rotation before the ratchet pawl (P, figure 4-2) can move the rotor assembly (C) in an upward direction.
Adjust the check pawl bracket (K) if necessary, to prevent upward rotor assembly movement.
Remove the rotor assembly spring if necessary when making this adjustment.

c. Replace the rotor assembly spring and manually lift the rotor assembly fully upward to the bumper pad (L). Observe the ratchet pawl as it moves away from the check pawl bracket. The ratchet pawl's rounded end can be allowed to just make contact with the check pawl bracket as it moves with the rotor assembly. Allow the rotor assembly to return to its resting position.

d. Again manually lift the rotor assembly upward to the bumper pad and then lower it manually to its full rest position. The check pawl must at least partly engage a gear tooth on the cam shaft operating gear. The check pawl should then completely engage a gear tooth when the rotor assembly is allowed to fall free from its upward position to its resting position.

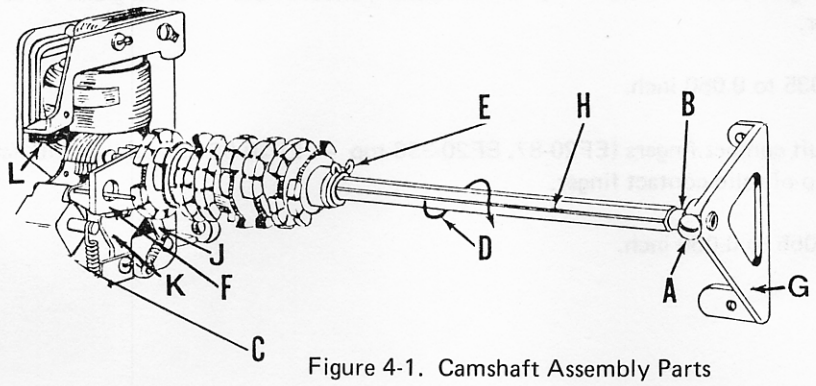
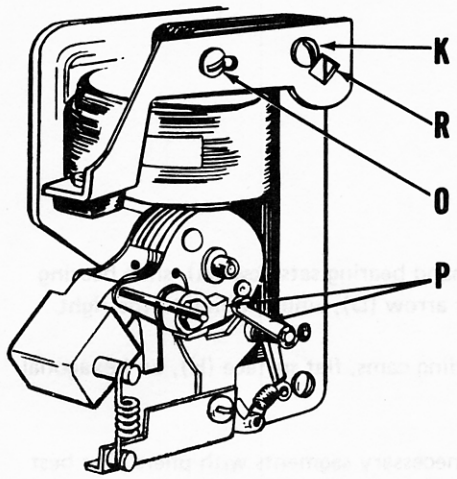


Figure 4-1. Camshaft Assembly Parts



NOTE:
To change equipment from twelve interval operation to sixteen interval operation, remove screw (K), and loosen screw (O), slide bumper bracket forward so that square hole (R) is aligned with tapped hole and replace screw (K).

Substitute sixteen interval rotor, camshaft and cams for twelve interval equipment. See parts list for replacement part numbers.

Figure 4-2. Changing Interval Operation

4-2. SIGNAL CONTACT ADJUSTMENTS.

The contact fingers are suspended from the back by an arrangement of a compression spring and a ball joint (refer to Fig. 4-3) which allow them to turn freely. An adjustment tension keeps the tip of the contact fingers riding on the perimeter of the cams. To adjust the tension and set the gap, see Figures 4-4, 4-5 and 4-6.

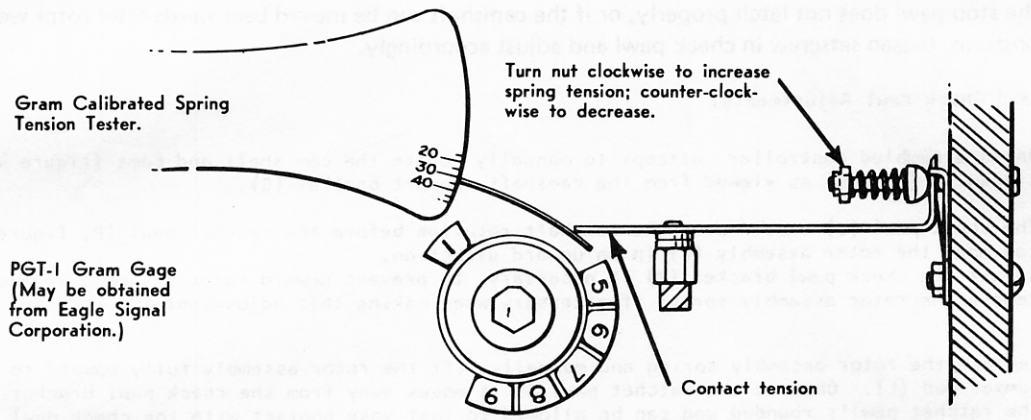


Figure 4-3. Signal Contact Adjustments

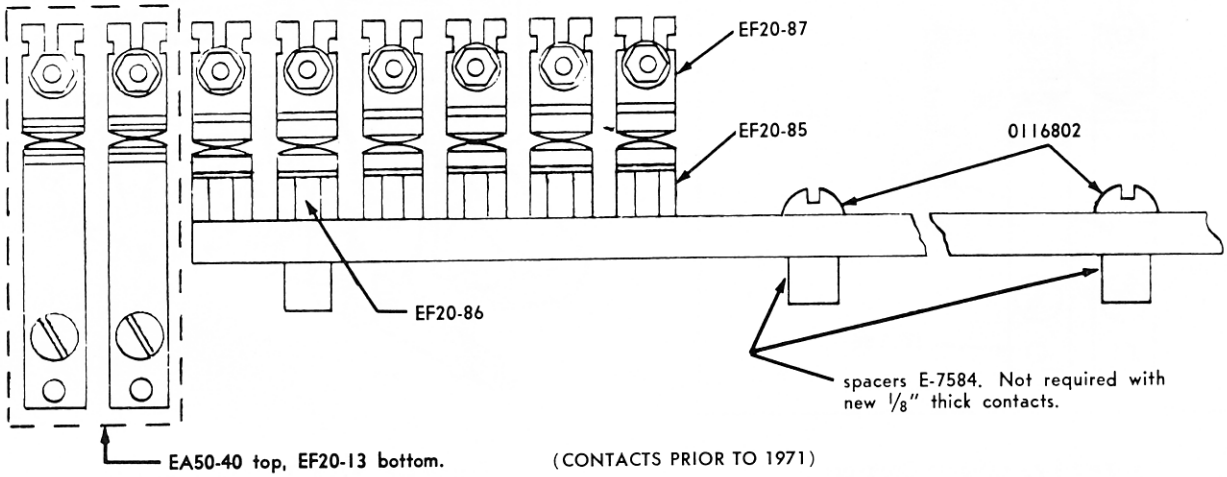
4-2-1. Isolated Circuits.

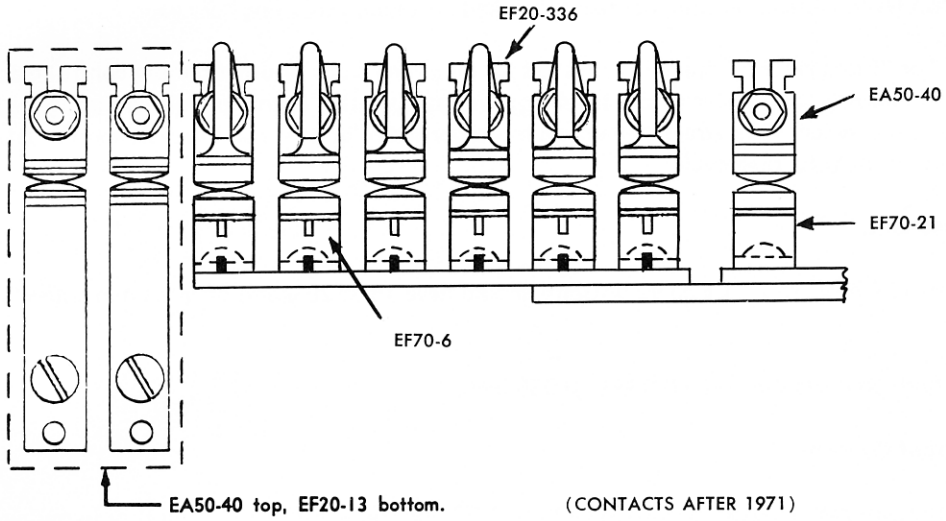
Isolated circuit contact fingers (EA50-40 top – EF20-13 bottom) should have 14 to 22 grams of tension measured at tip of solid contact finger.

Gap setting should be 0.035 to 0.050 inch.

Heavy Duty isolated circuit contact fingers (EF20-87, EF20-336 top – EF20-88 bottom) should have 32 to 40 grams of tension measured at tip of solid contact finger.

Gap settings should be 0.055 to 0.060 inch.





NOTES:

1. The EA50-40 top – EF20-13 bottom should have 14 to 22 grams of tension measured at tip of solid contact finger. Gap settings should be 0.035 to 0.050 inch.

2. Busbar contacts EF20-87, EF20-336 top and EF20-85, EF20-86 or EF70-6 on bottom and EF20-87 top and EF20-88 bottom should have 28 to 42 grams of tension measured at tip of solid contact finger. Gap settings should be 0.040 to 0.090 inch.

3. Light duty contact fingers EA50-40 top and EA50-29 or EF70-21 bottom should have 14 to 22 grams tension measured at tip of solid contact finger. Gap settings should be 0.035 to 0.050 inch.

4. Check each moveable contact finger (EA50-40, EF20-65 and EF20-336) for clearance between next full cam segment following a broken-out cam interval. Rotate cam in normal direction against feed pawl manually; clearance should be at least 0.027 inch.

Figure 4-4. Contact Details

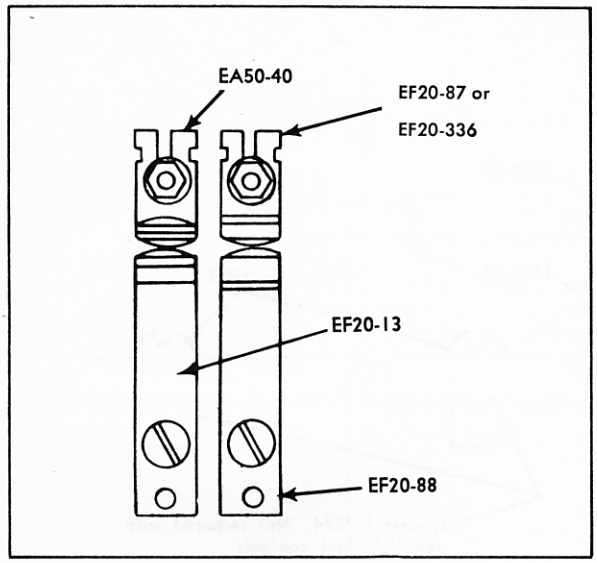


Figure 4-5. Isolated Contacts

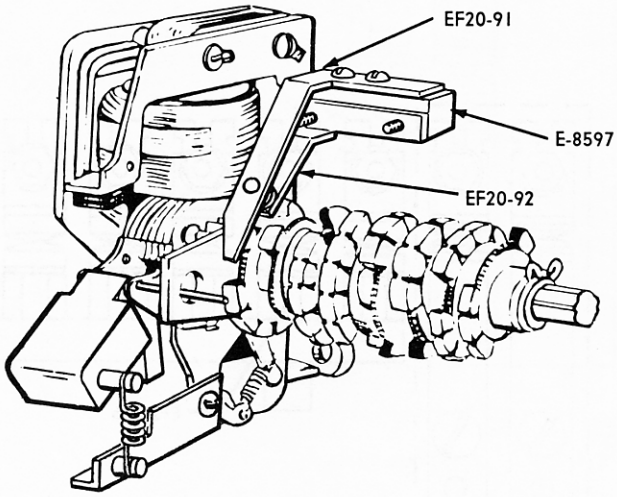


Figure 4-6. Flash Transfer Contacts

4-3. FLASH TRANSFER.

The Flash Transfer Contacts are mounted directly over the Dial Transfer Circuit at the left hand side of the camshaft (refer to Fig. 4-6). A field conversion kit (EF20-95) is available for the conversion of existing EF20 Controllers. The kit contains a contact lever, contact bracket, contact block and necessary mounting hardware.

When "FLASH-ON" or "FLASH-OFF" operation is called for by a time clock or other remote control mechanism, the flash control circuit will insure that transfer to and from stop and go operation is only permitted during the 1st interval of the common main street green. Main street green must be comprised of at least two intervals and the 1st interval must be the no. 1 interval in the total time cycle.

4-3-1. Flash Contact Adjustment.

Flash Contact Fingers (EF20-91 top – EF20-92 bottom) should have 18 to 26 grams of tension measured at tip of solid contact finger.

Gap setting for the flash contacts should be 0.025 to 0.055 inch.

4-3-2. Adjusting Flicker-Proof Contacts.

Flicker-proof type contacts may be used in isolated circuits (EF20-65 top – EF20-13 bottom) or in busbar applications (EF20-65 top – EA50-29, EF70-21 bottom) as shown in Figure 4-7. The contact settings for both types will be as follows:

Flicker-proof contacts should have 24 to 28 grams of tension measured at the tip of the solid contact finger. The solid contact finger should then float approximately at the center and an equal amount of contact should be visible above and below. (Refer to Fig. 4-7.) In no case shall the flexible leaf contact be less than 0.030 or more than 0.045 inch from the solid contact finger, as measured from the front. (Open end of the leaf.)

Gap setting for flicker-proof type contacts should be 0.025 to 0.035 inch.

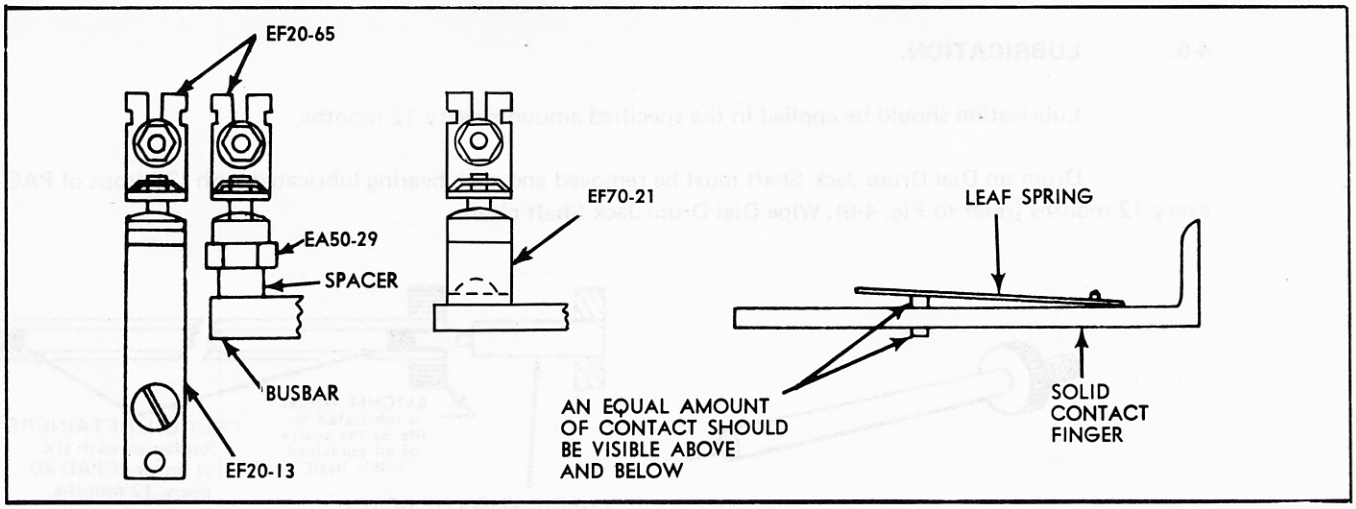


Figure 4-7. Flicker-Proof Contacts

4-4. MOTOR COIL.

All current production models of camshaft operated controllers and some models manufactured prior to 1966 contain DC Ratchet Motor Coils. The above plug-in bridge assembly pertains only to EF15, EF20, EF70, EC15, and ET121.

For improved reliability, the coil assemblies of all Eagle camshaft operated controllers have been changed from AC operative to DC operative. A diode network provides full wave rectification of the applied 115 Volt AC line power. (Refer to Fig. 4-8.)

The Ratchet Motor Coils are not interchangeable and if replacement becomes necessary, be sure to specify the correct coil part number.

AC COIL	DC COIL
EA50-5	EF70-154

Care should be exercised when testing etc., that AC power is not applied to a DC coil and vice versa.

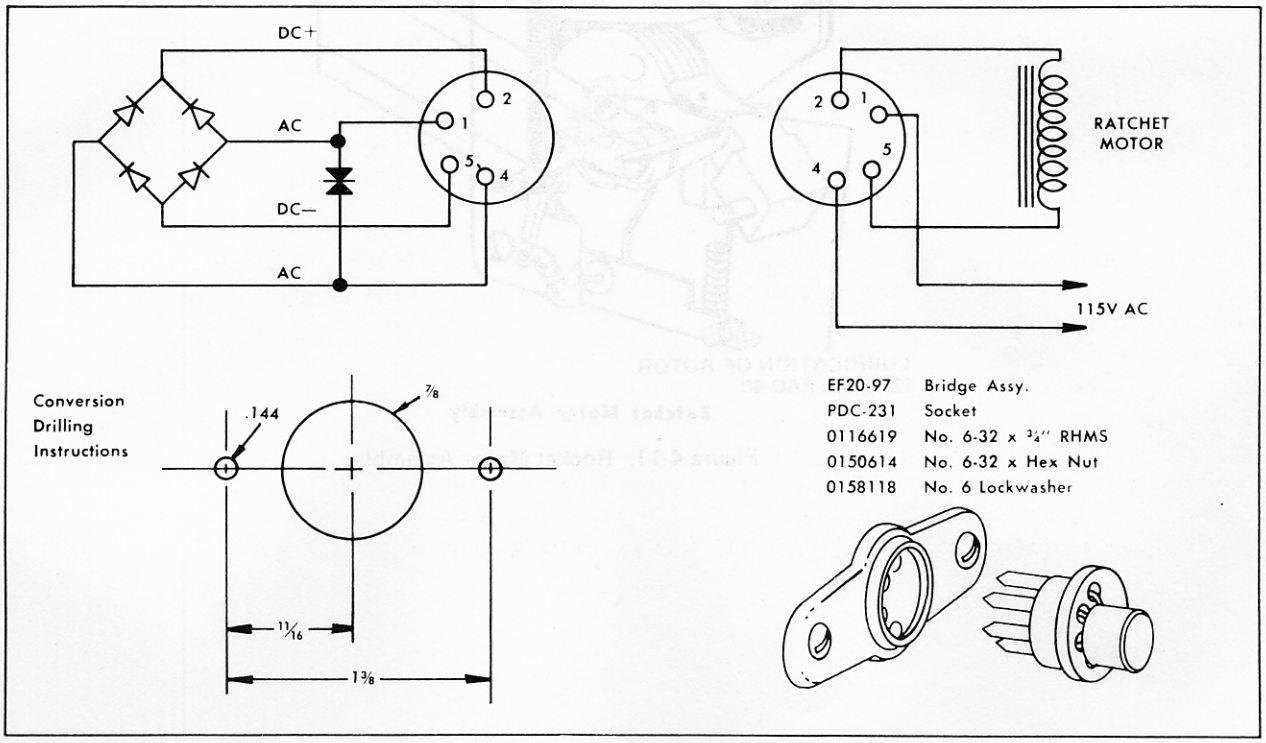


Figure 4-8. Bridge Rectifier Plug and Socket Details

4-5. LUBRICATION.

Lubrication should be applied in the specified amounts every 12 months.

Drum on Dial Drum Jack Shaft must be removed and each bearing lubricated with (3) drops of PAO-40 every 12 months (refer to Fig. 4-9). Wipe Dial Drum Jack Shaft clean.

Figure 4-9. Dial Drum Jack Shaft Lubrication

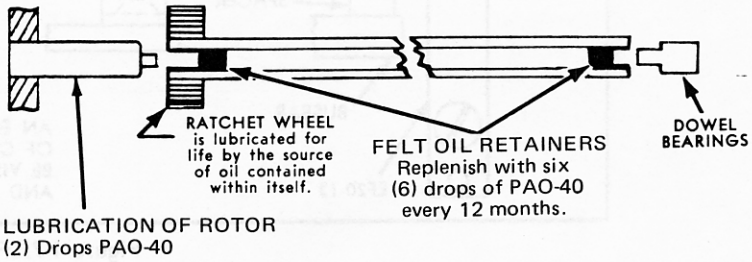


Figure 4-10. Controller Mechanism Camshaft

Controller Mechanism Camshaft. The ratchet motor linkage and camshaft stop pawl should be oiled with one (1) drop of oil every 12 months (refer to Fig. 4-10). The camshaft bearings should be checked to see that the felt oil retainers at each end are not dry. If they are, use six (6) drops of PAO-40 to replenish each.

All bearings require PAO-40 Silicone Oil, available from Eagle Signal (refer to Fig. 4-11).

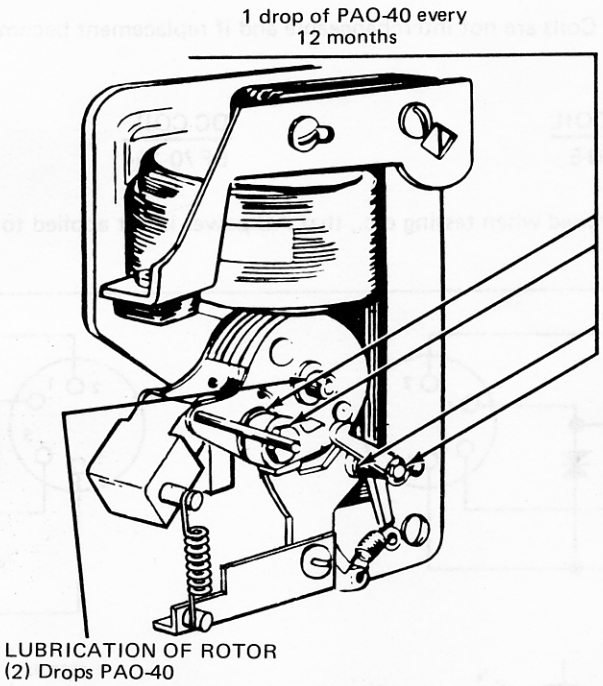


Figure 4-11. Rocket Motor Assembly

SECTION V

DIAGRAMS

5-1. INTRODUCTION.

This section contains typical wiring diagrams of EF20 and EF70 Controllers, figures 5-1 and 5-2, plus master/local facilities differences, figure 5-3. Figure 5-4 is a Time Switch Connection Diagram, and figure 5-5 shows adapter cable wiring, EF70 to EF20. Figure 5-6 is a typical line-to-line terminal facility wiring diagram using an EF70 Controller. The simplified circuit diagrams, figures 5-7 through 5-18 are based on figure 5-6 and show individual circuit functions.

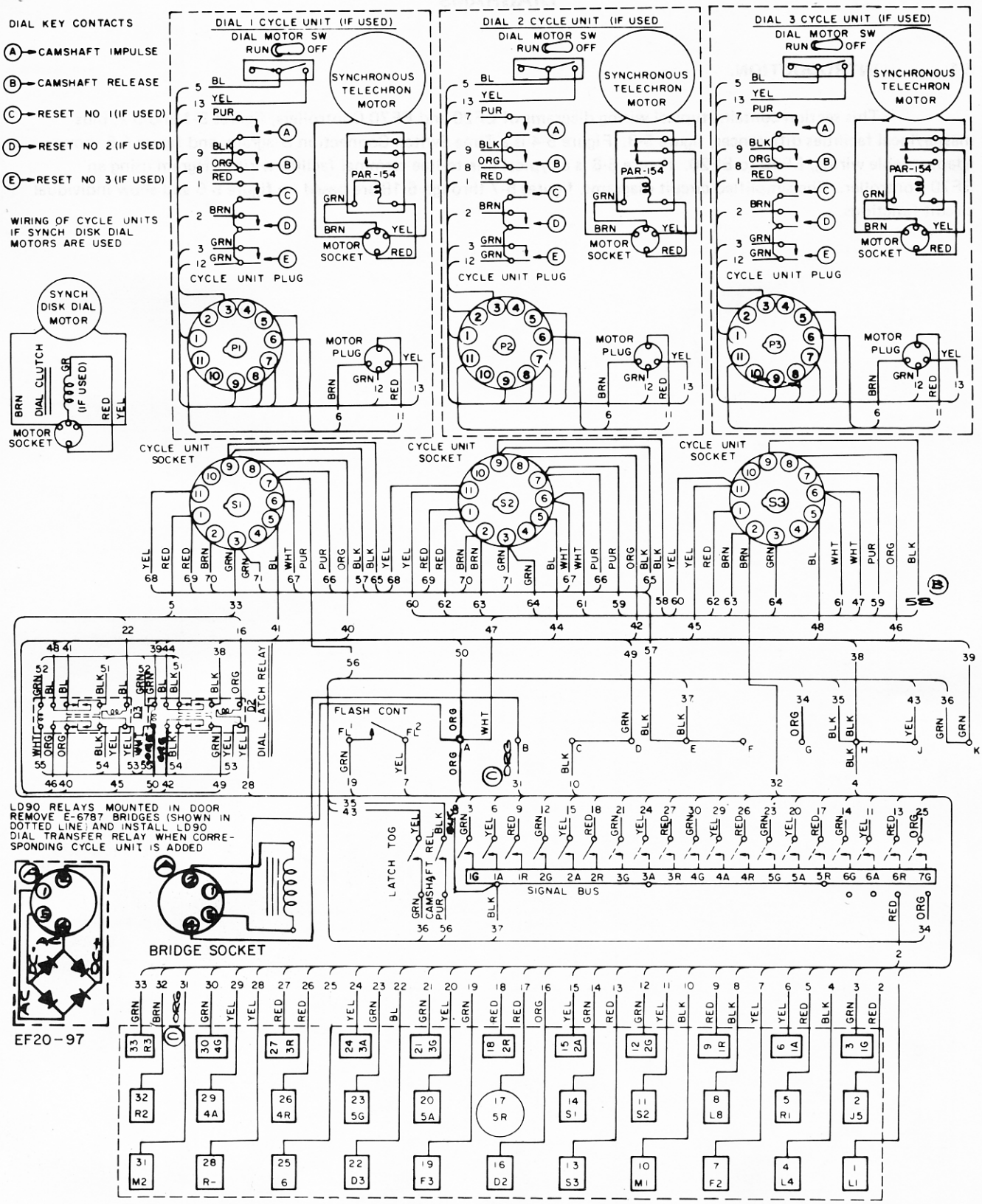


Figure 5-1. EF20 Controller, Typical Wiring Diagram

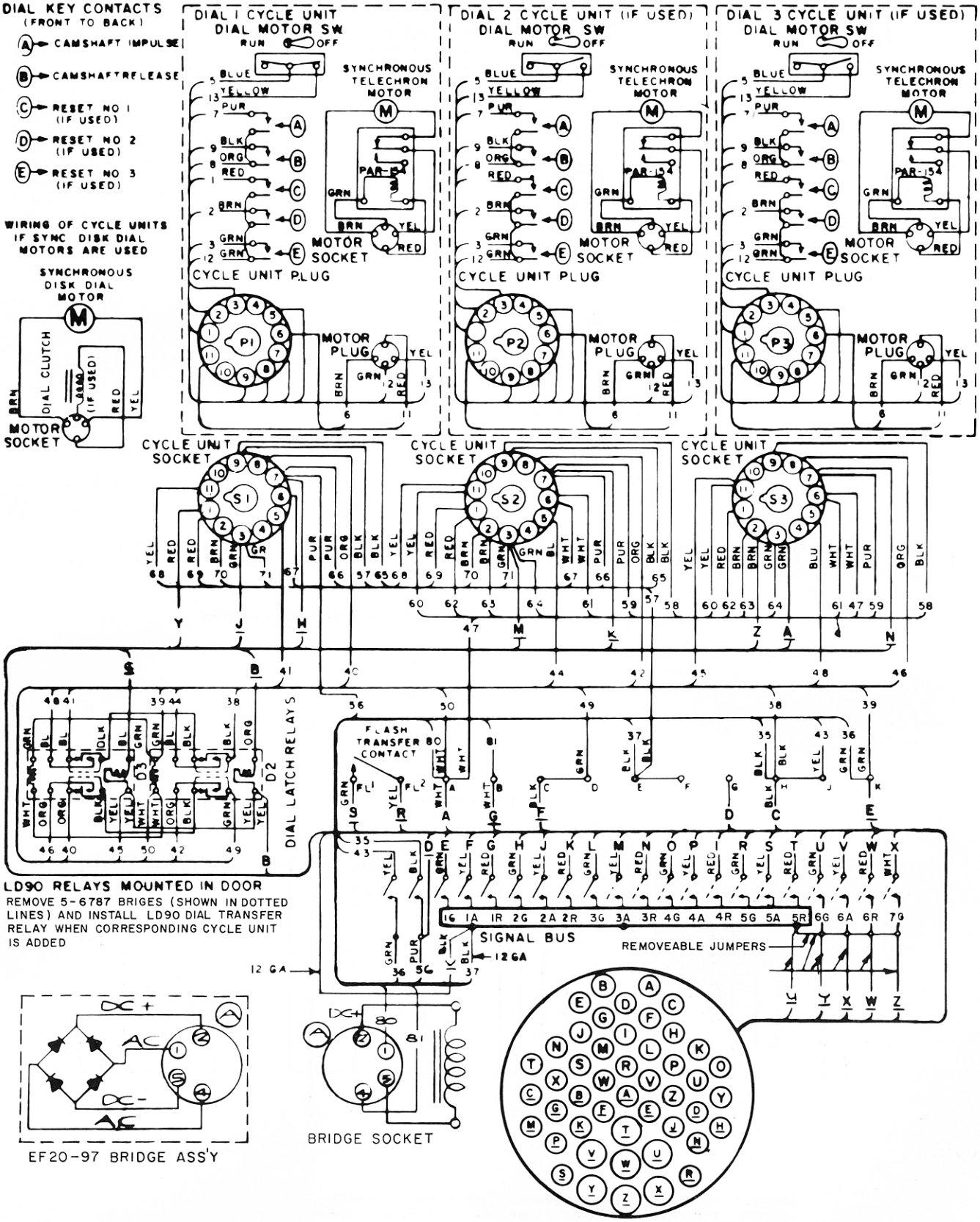


Figure 5-2. EF70 Controller, Typical Wiring Diagram

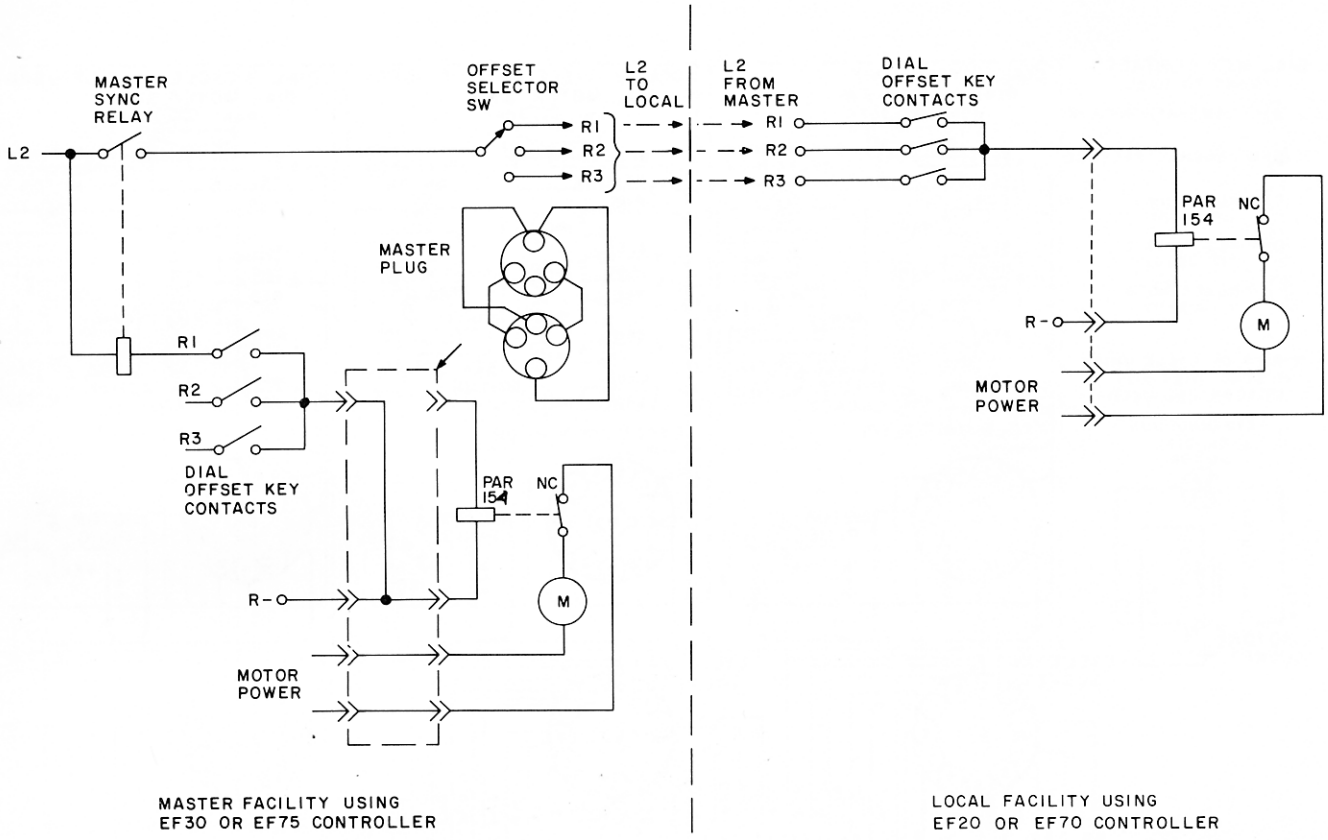


Figure 5-3. Differences Between Typical Master and Local Facilities

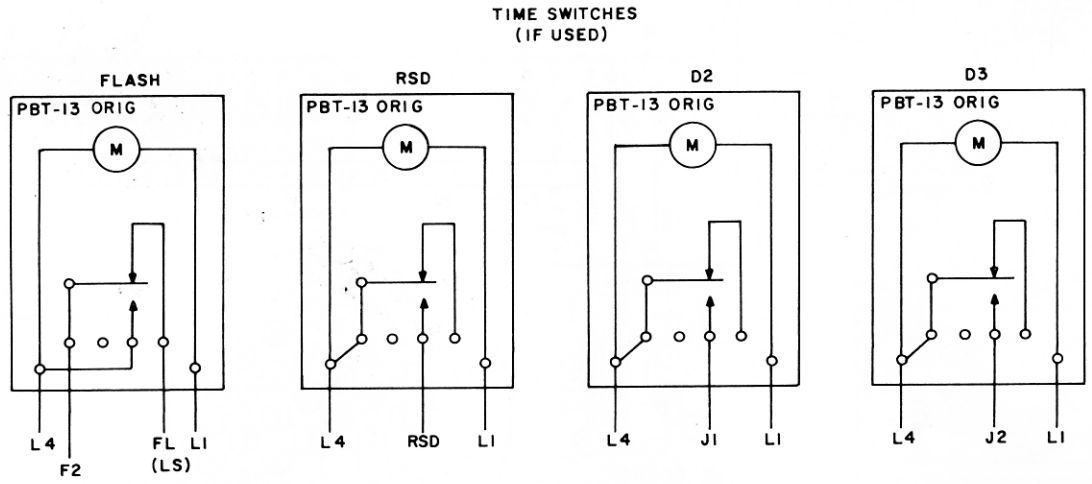
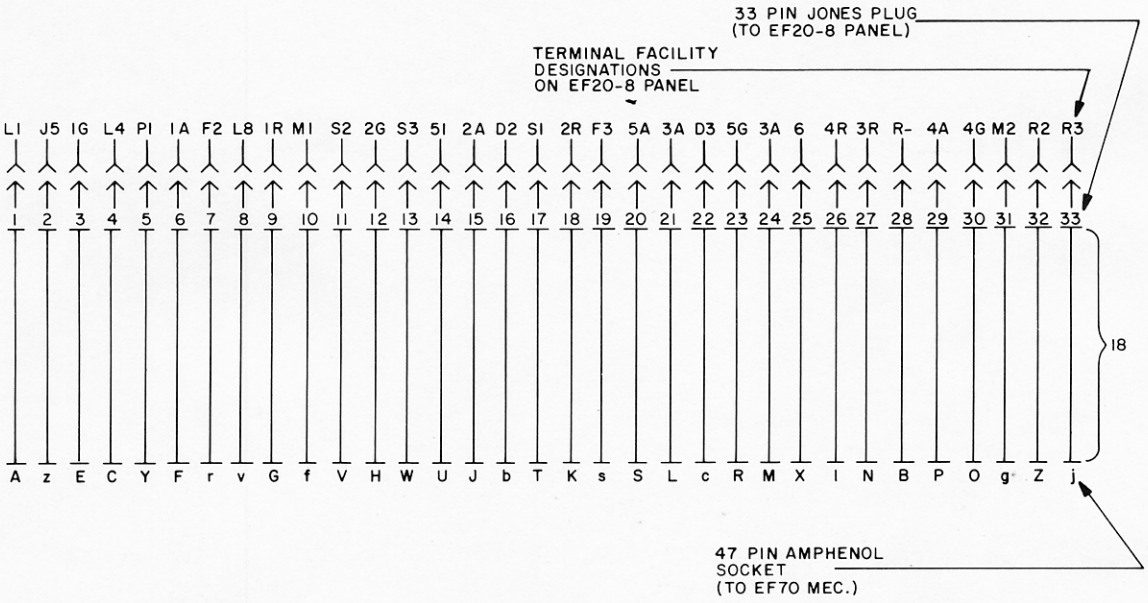


Figure 5-4. Time Switch Hookup Diagram For Flashing Interconnected Local Controller



NOTES:

1. ASSEMBLE E-8014 TO PDC-172 PER EC10-6.
2. REMOVE COVER FROM PDC-36 AND EXT.
3. BRACKET ON PDC-5 PLACE PDC-36 COVER ON 33 PIN PLUG.

Figure 5-5. Adapter Cable EF70 Mech. To EF20 Terminal Panel Diagram

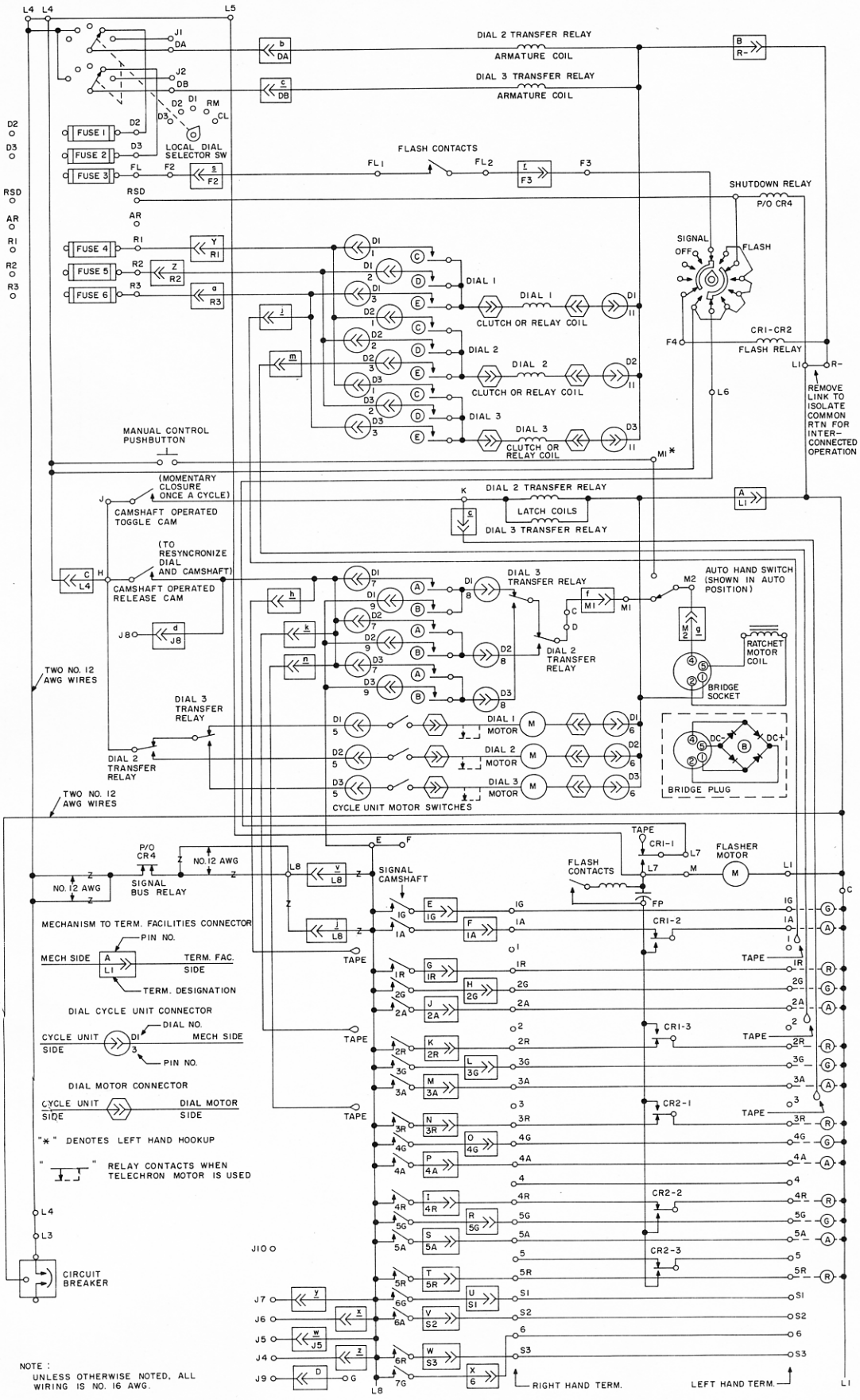


Figure 5-6. Typical Terminal Facility Wiring Diagram

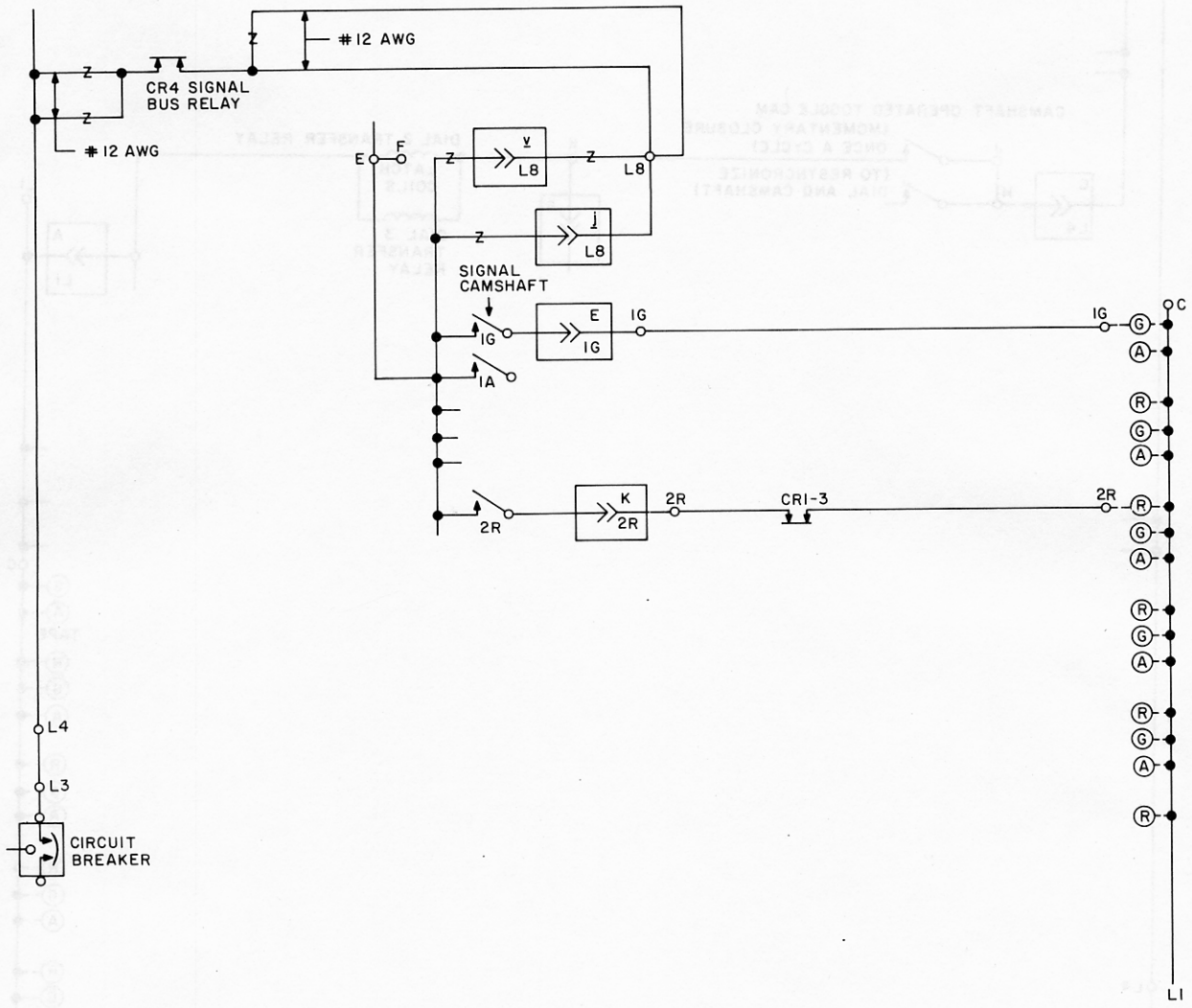


Figure 5-7. Signal Circuit, Simplified Circuit Diagram

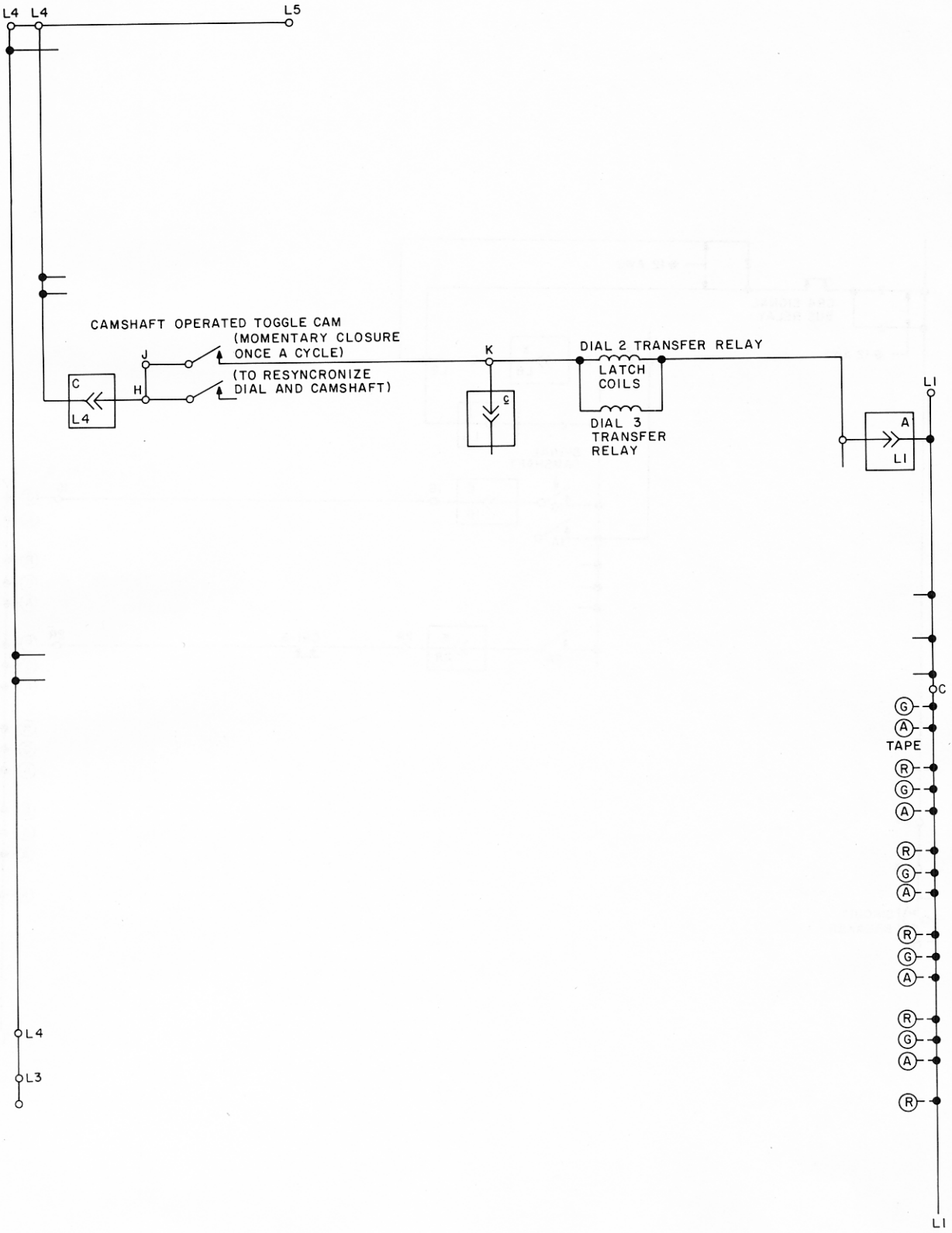


Figure 5-8. Latch Transfer Circuit, Simplified Circuit Diagram

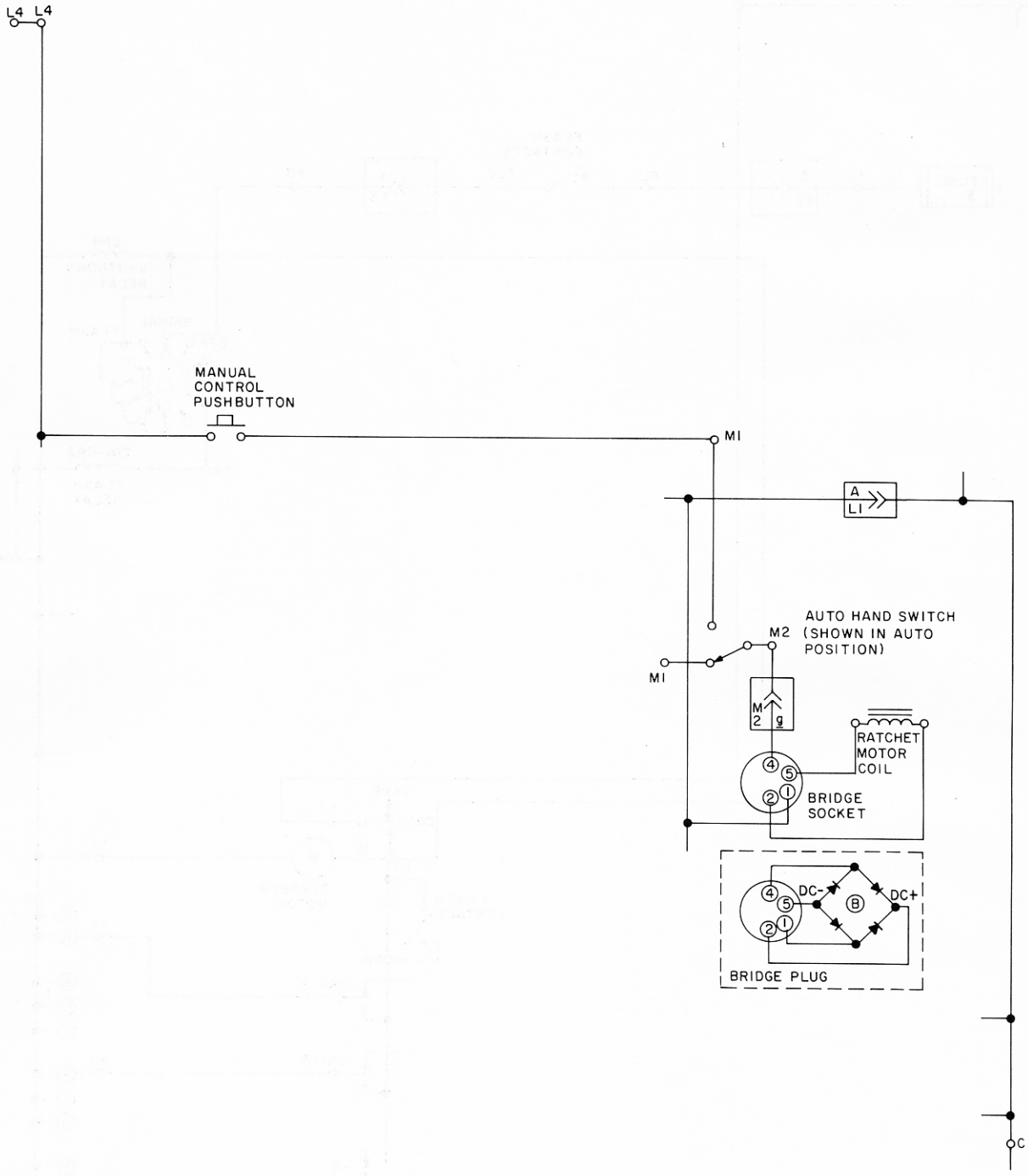


Figure 5-9. Hand Control Circuit, Simplified Circuit Diagram

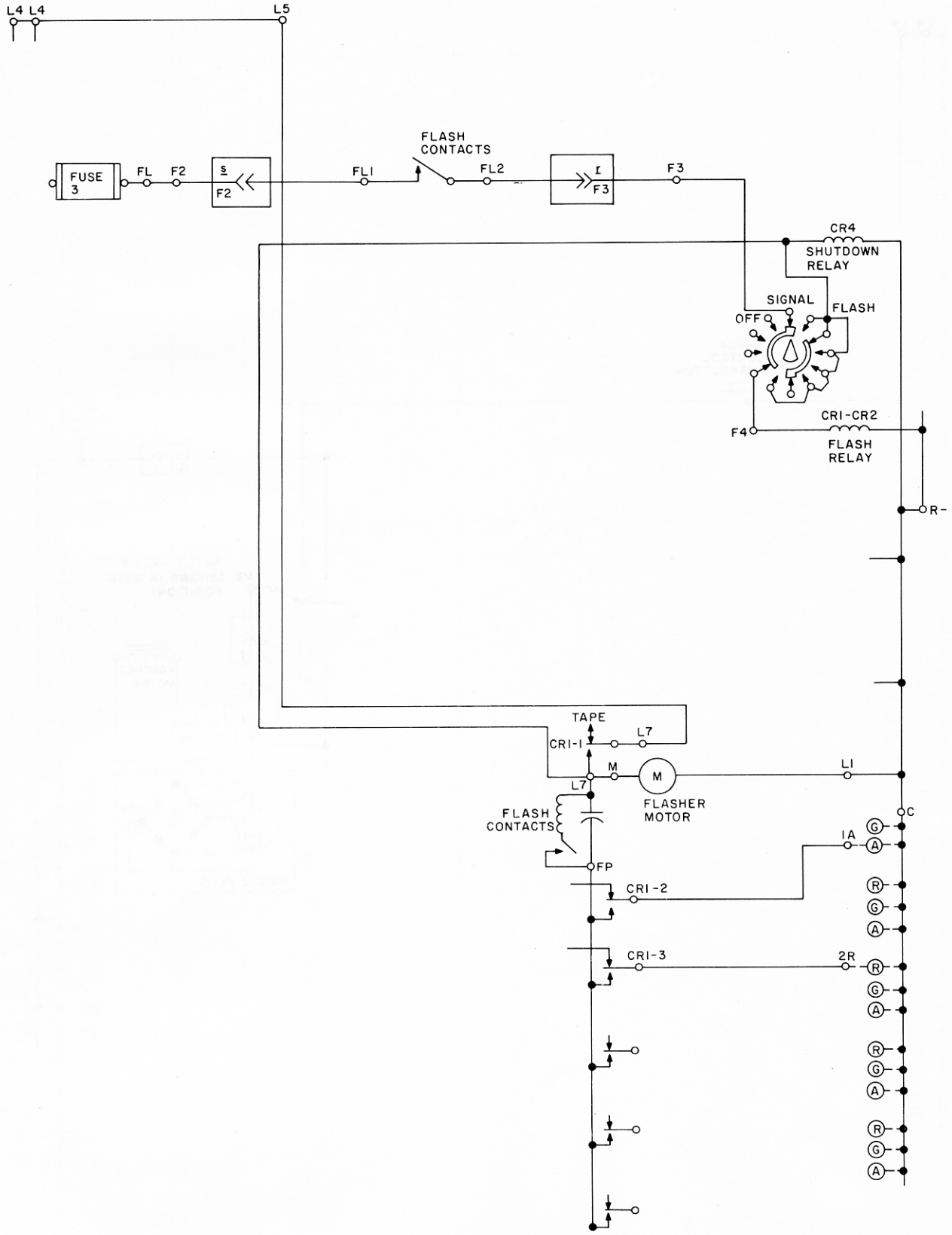


Figure 5-10. Remote Flash Circuit, Simplified Circuit Diagram

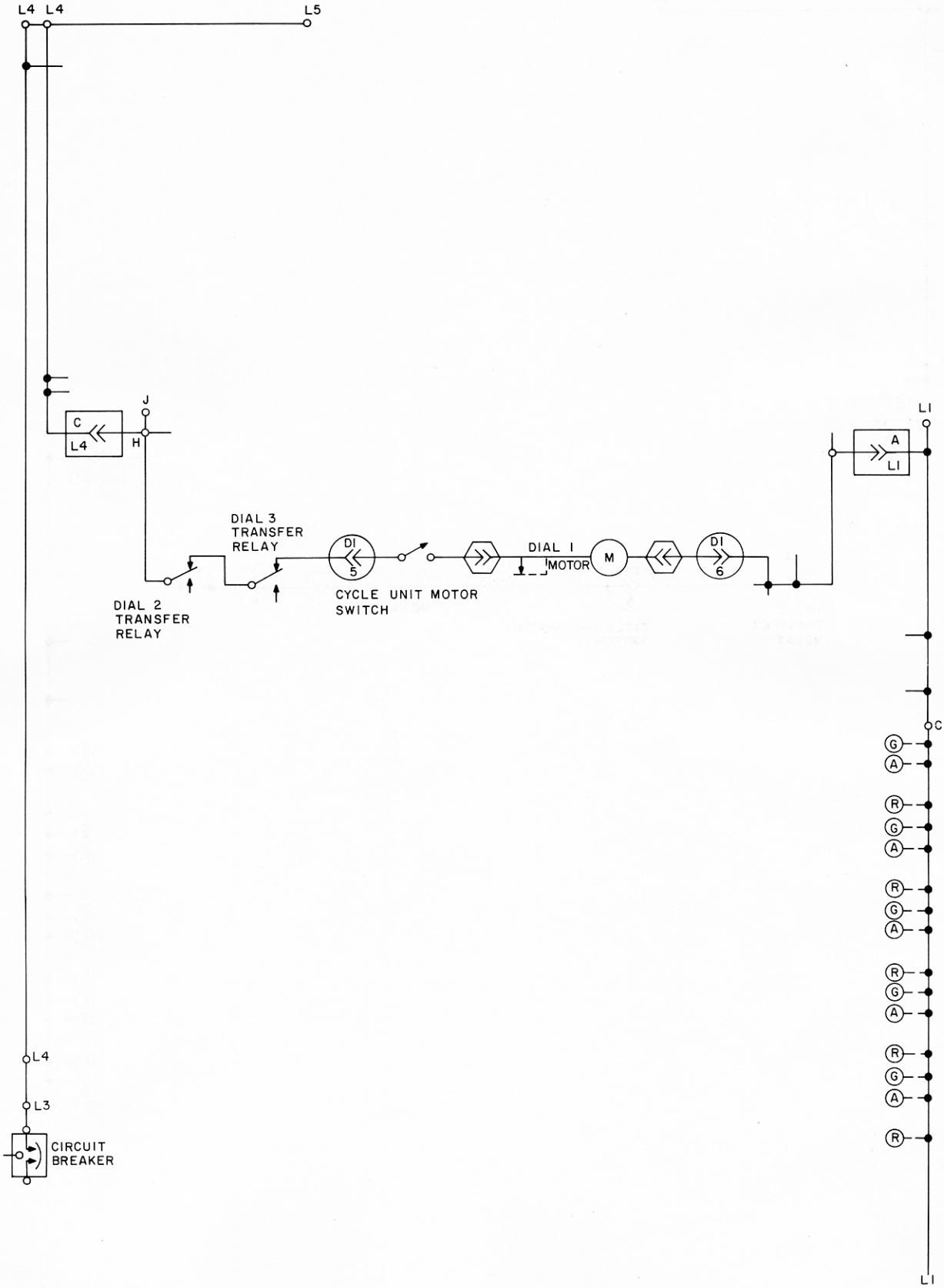


Figure 5-11. Dial 1 Motor Circuit, Simplified Circuit Diagram

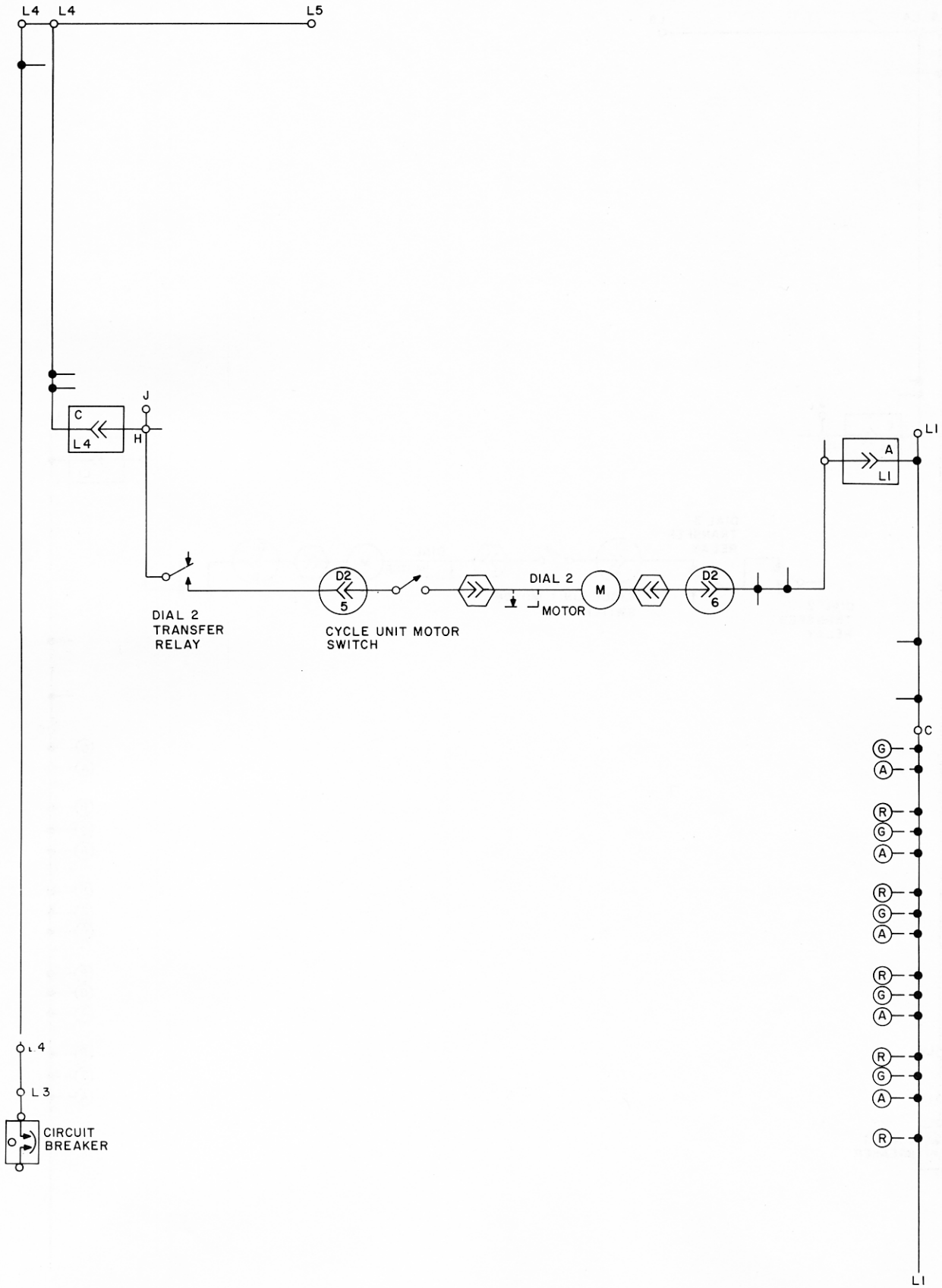


Figure 5-12. Dial 2 Motor Circuit, Simplified Circuit Diagram

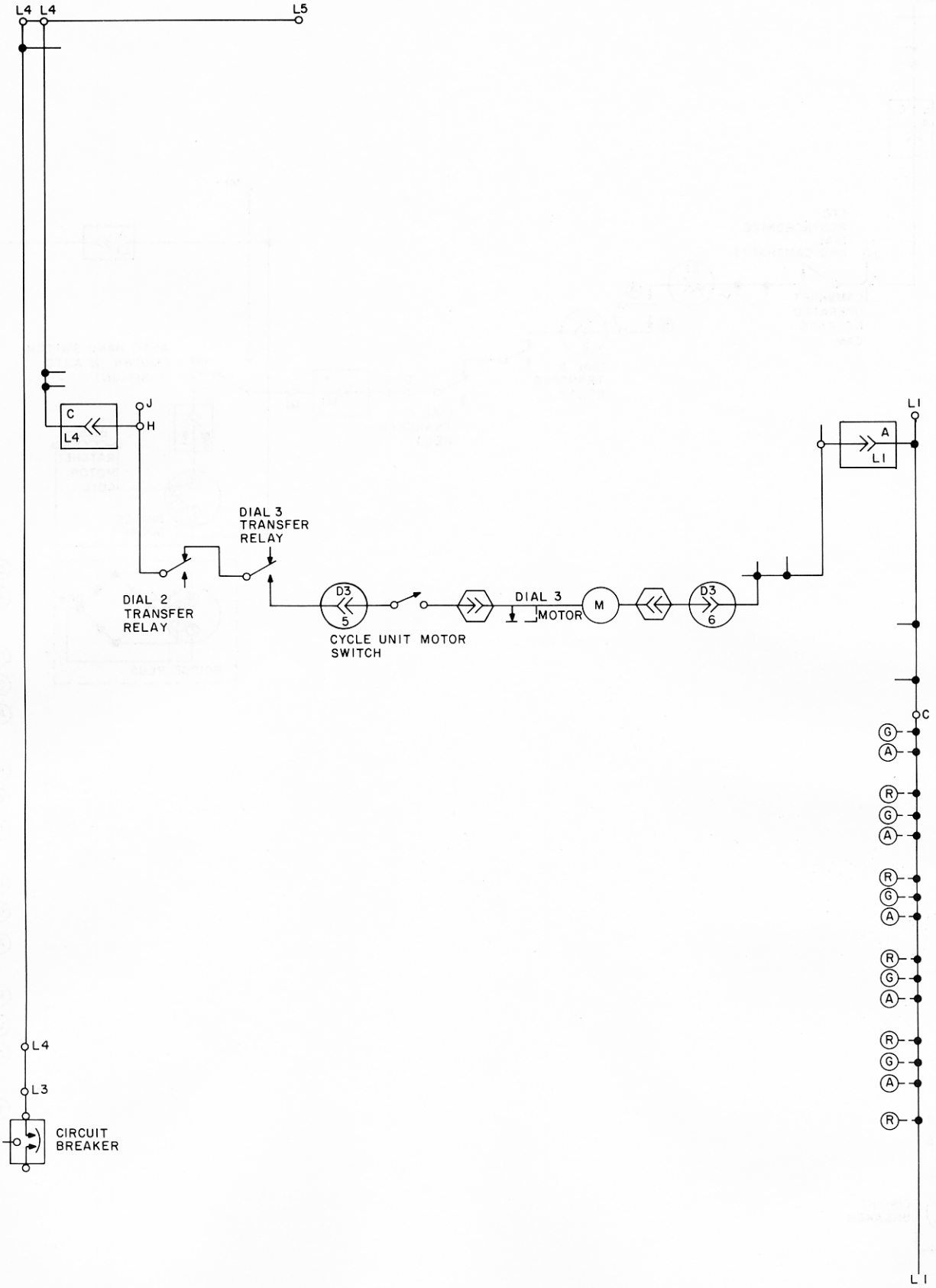


Figure 5-13. Dial 3 Motor Circuit, Simplified Circuit Diagram

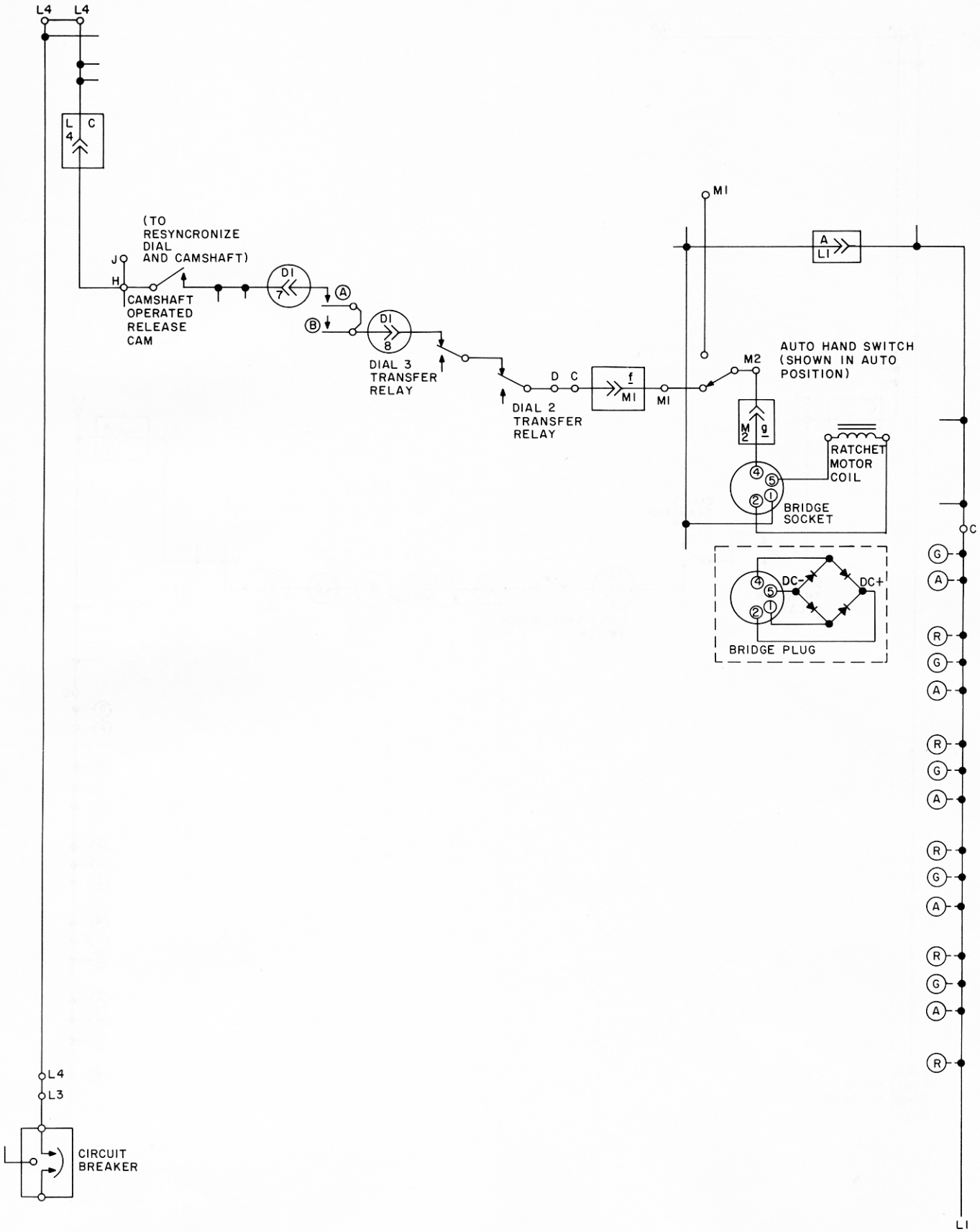


Figure 5-14. Dial 1 Impulse Circuit, Simplified Circuit Diagram

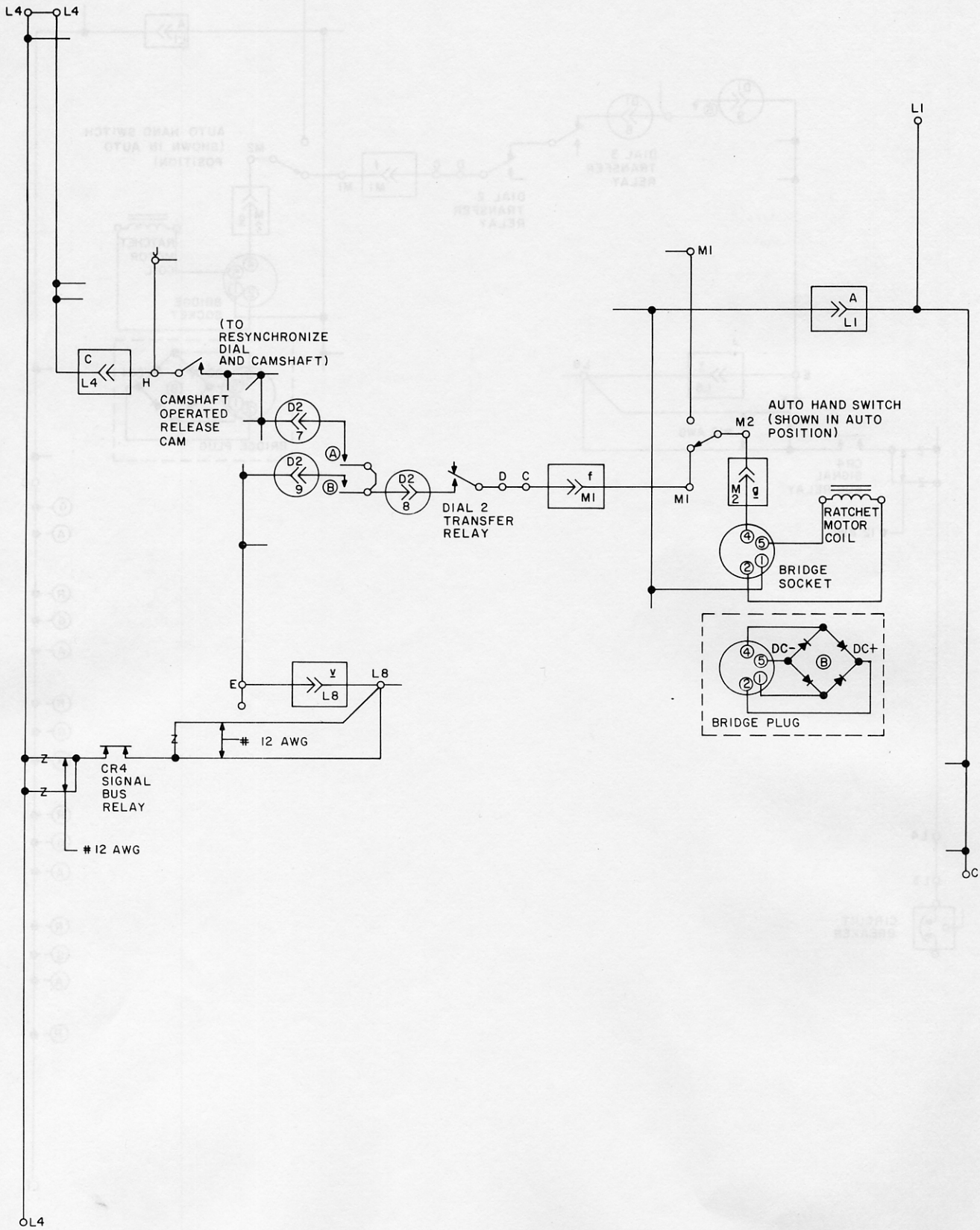


Figure 5-15. Dial 2 Impulse Circuit, Simplified Circuit Diagram

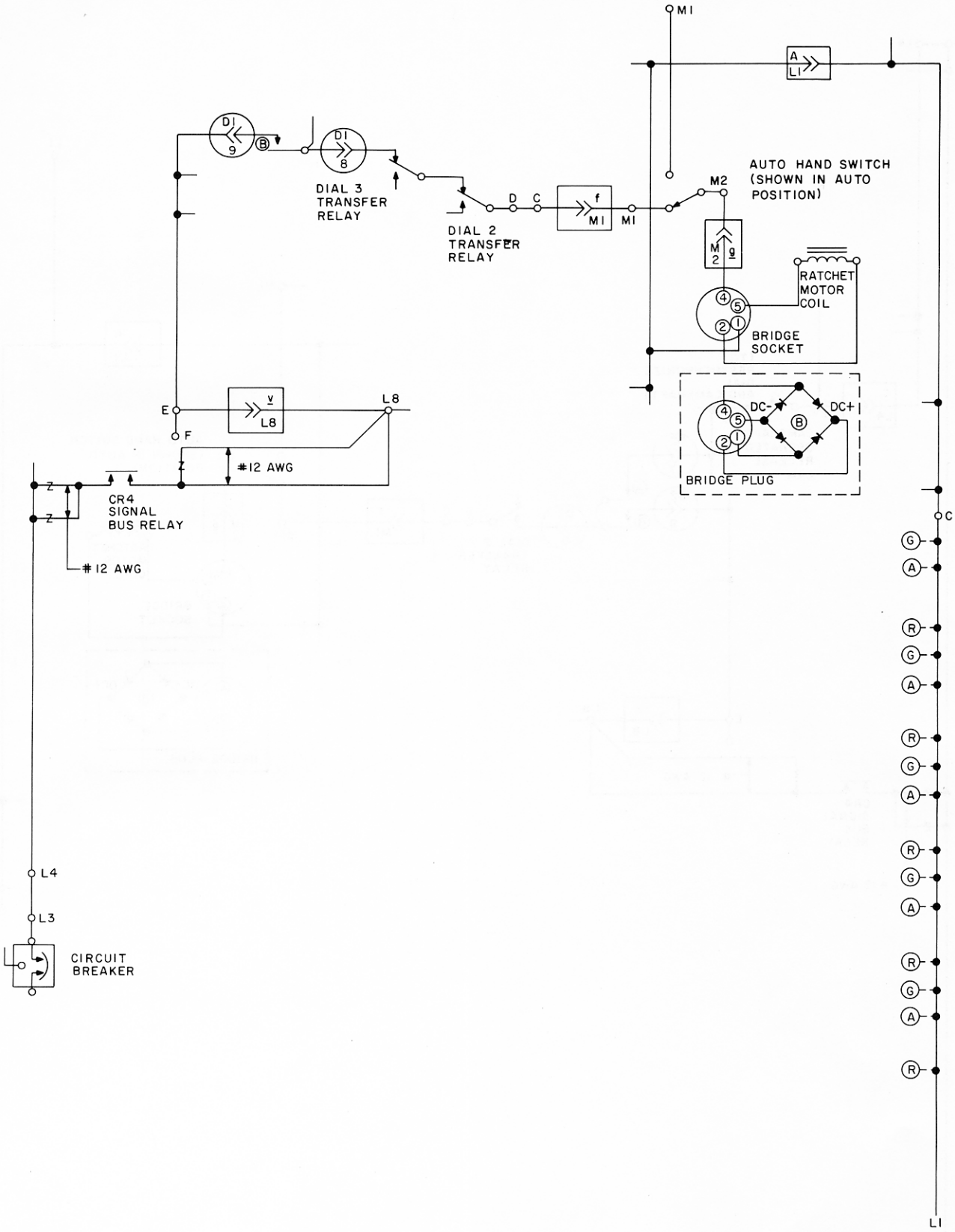


Figure 5-16. Dial 1 Release Circuit, Simplified Circuit Diagram

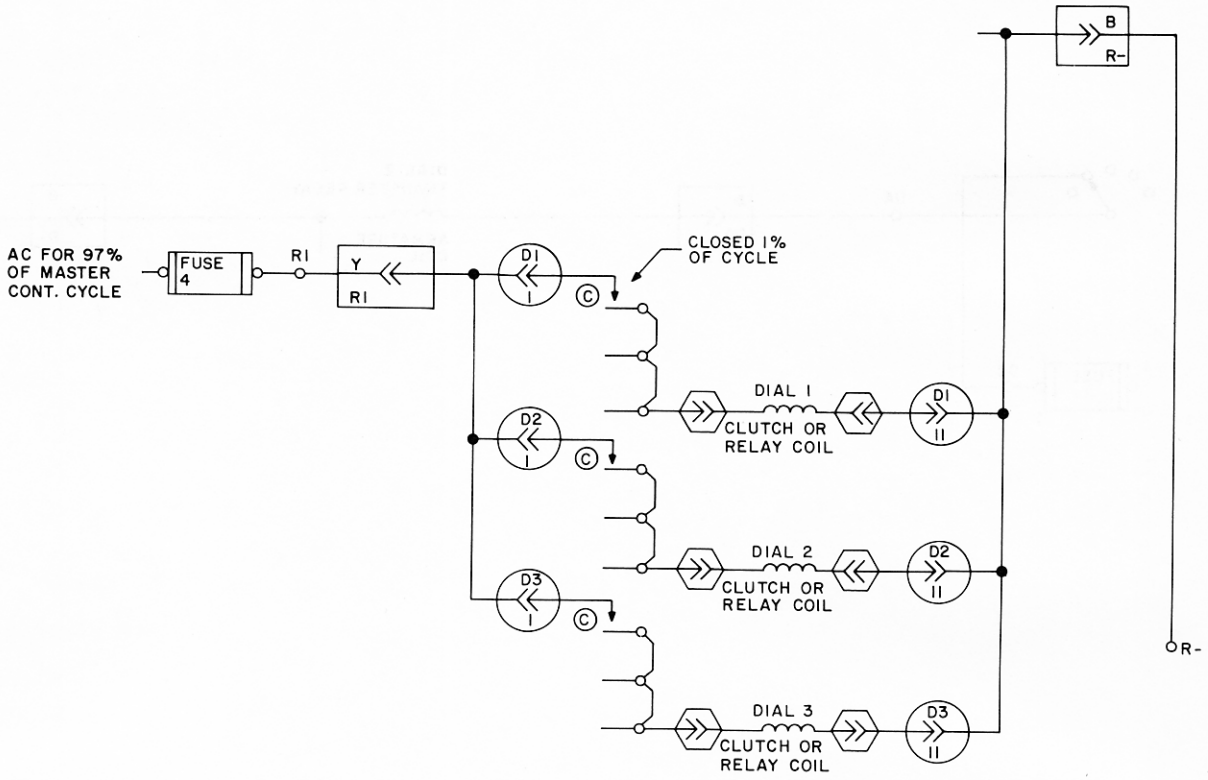


Figure 5-17. Reset 1 Circuit, Simplified Circuit Diagram

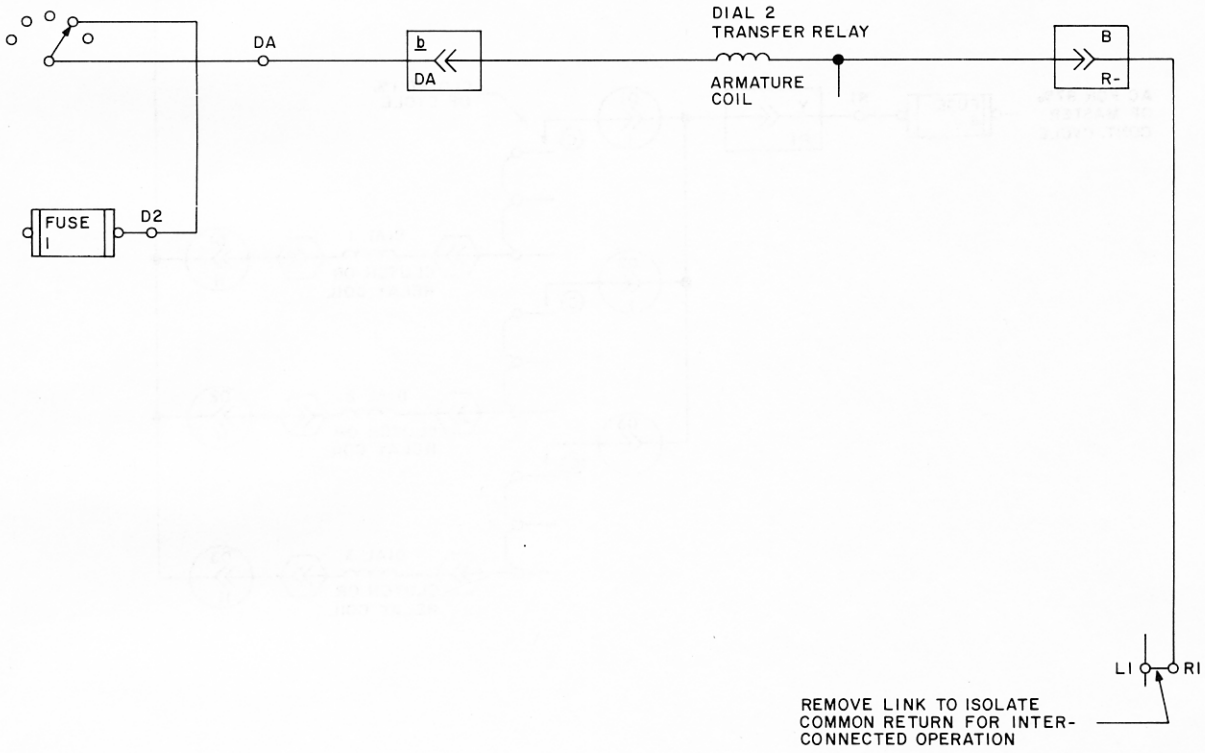


Figure 5-18. Dial 2 Transfer Relay Circuit, Simplified Circuit Diagram