

MOTOR CONTROLLER KS-5647 STARTER KS-15821 REQUIREMENTS AND ADJUSTING PROCEDURES

1. GENERAL

1.01 This section covers the KS-5647, Lists 1 to 4, inclusive, motor controllers and the KS-15821, List 1 starter manufactured by the Ward Leonard Electric Company.

1.02 This section is reissued to include the KS-15821, List 1 starter. Detailed reasons for reissue will be found at the end of the section.

1.03 Reference shall be made to Section 020-010-711 covering general requirements and definitions for additional information necessary for the proper application of the requirements listed herein.

1.04 *Phi* (ϕ): Requirements are marked with a phi when they are not required to be checked before turnover.

1.05 *Asterisk* (*): Requirements are marked with an asterisk when to check for them would necessitate dismantling or dismounting of apparatus, or would affect the adjustment involved, or other adjustments. No check need be made for these requirements unless the apparatus or part is made accessible for other reasons, or its performance indicates that such a check is advisable.

1.06 For the purposes of this section, whether contacts are said to be normally open (NO) or normally closed (NC) depends on the position of these contacts when no operating current is flowing in the coil and not on the position the contact may normally be in for a particular application. NO contacts and NC contacts are sometimes known as front and back contacts, respectively.

1.07 *Operate*: A relay is said to operate when the armature has moved sufficiently for NC contacts to open and NO contacts to close with reliable contact.

1.08 *Release*: A relay is said to release when the armature has moved sufficiently for NO contacts to open and NC contacts to close with reliable contact.

1.09 For the maintenance of the AR contactor KS-5722, List 1 which is used in the KS-5647, Lists 2, 3, and 4 motor controllers, refer to Section 026-355-701.

1.10 *Precautions Against High Voltage*: If this type relay is in a circuit where 150 volts or more are applied across terminals on the relay, the voltage should be removed from the terminals before performing any work on the relay or checking requirements other than electrical or temperature requirements. If the relay operates in an automatic control circuit,

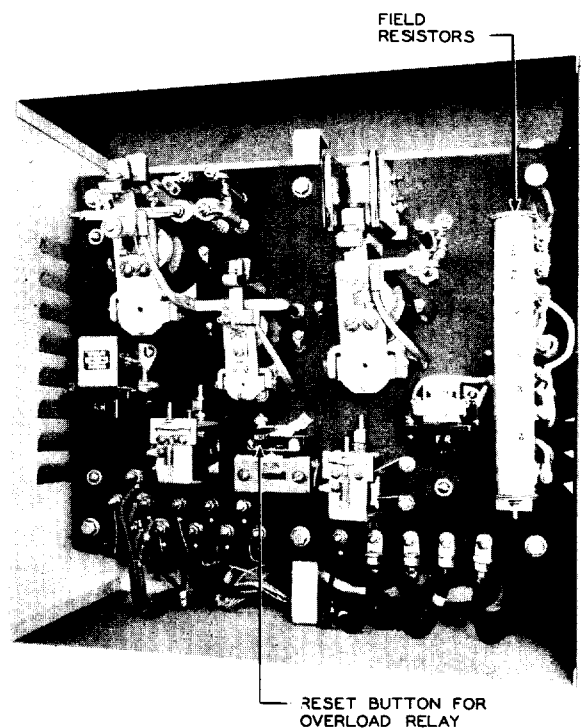


Fig. 1 - KS-5647, List 4 Motor Controller Front View

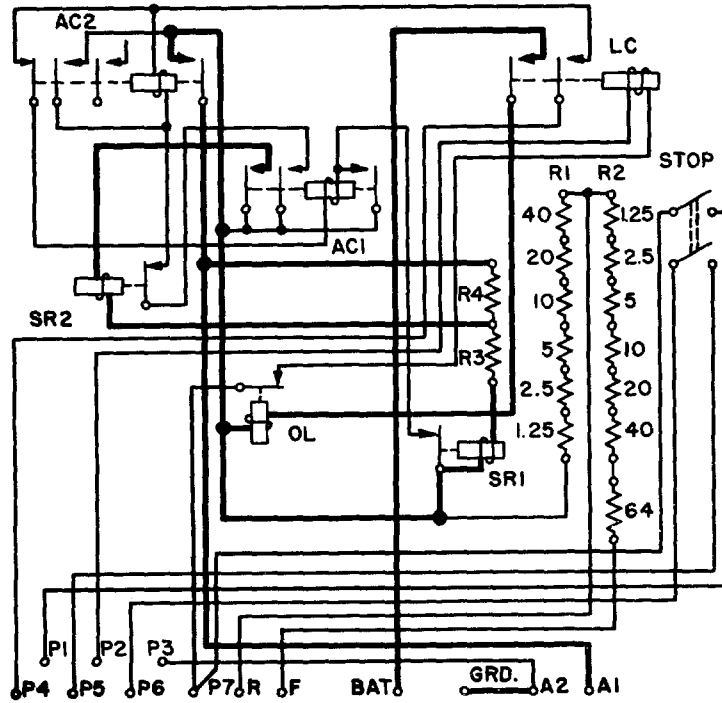


Fig. 2 - Schematic for KS-5647, List 1

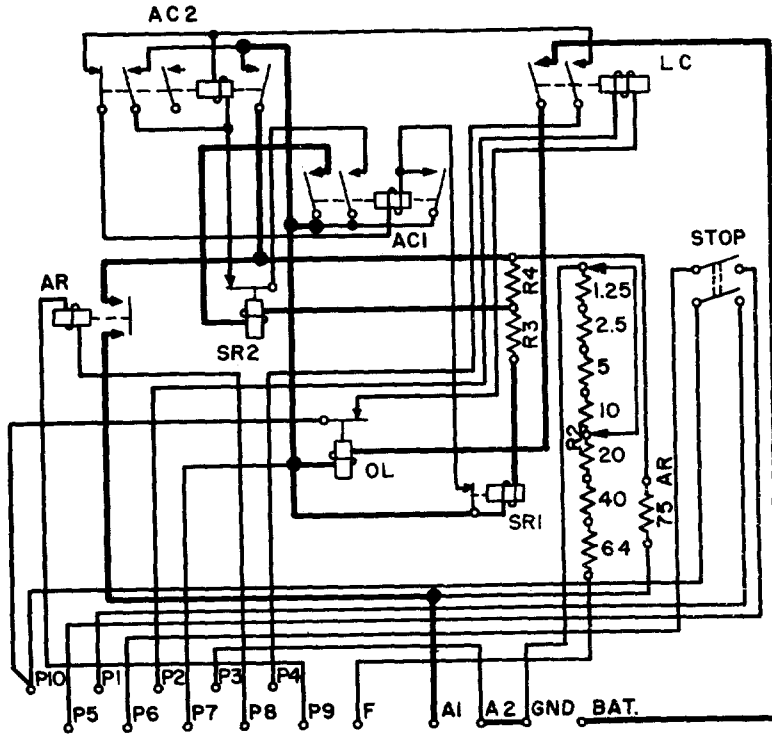


Fig. 3 - Schematic for KS-5647, Lists 2 and 3

before work is started on the relay the automatic control should be made inoperative. In circuits where less than 150 volts are applied across terminals on the relay, service may be maintained while working on the relay by bridging and insulating the contacts as covered in 3.002. In some cases, it may be necessary to disconnect leads to maintain service.

1.11 When work is being done on a relay in an operating circuit, see that service is maintained.

2. REQUIREMENTS

φ2.01 Mounting

(a) The controller and starter shall be securely mounted.

Gauge by feel.

(b) All components shall be securely mounted to their respective supports. Screws or bolts used for holding components together shall be drawn up tightly.

Gauge by feel.

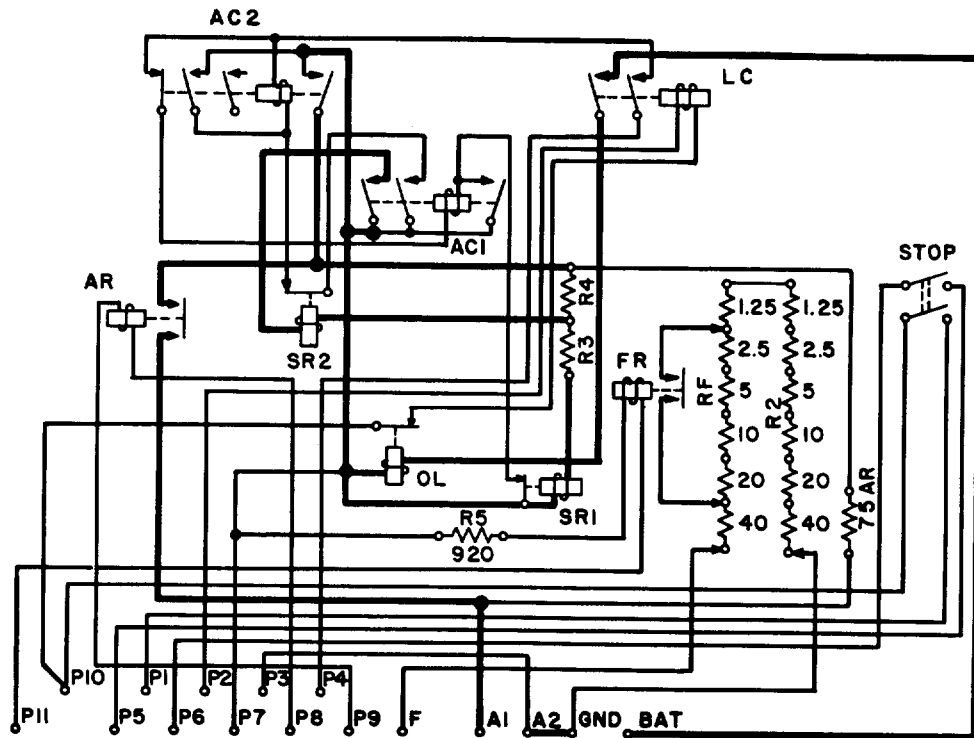


Fig. 4 - Schematic for KS-5647, List 4

SECTION 024-345-701

2.02 Cleaning Contacts

(a) Contacts shall be clean and free from build-ups which might interfere with reliable contact.

Gauge by eye.

(b) Contacts shall not be lubricated.

2.03 Contact Pressure

(a) The pressure between closed main contacts shall be:

CODE	RELAY DESIGNATION	PRESSURE
KS-5647, Lists 1,2,3, and 4	LC and AC2	Min 3 pounds
	AC1	Min 10 ounces
KS-15821, List 1	LC and AC2	Min 3 pounds
	AC1	Min 10 ounces

Use R-2771 spring balance.

To check this requirement, pass a loop of cord around the head of the bolt which attaches the moving contacts to its support. Place the hook of the spring balance in this loop and with the relay held operated manually, exert a pressure away from the stationary contact. Read the balance as the moving contact leaves the stationary contact.

(b) For relays not specified above, the contact pressure shall be such that the contacts operate without excessive heating or roughening of their surfaces.

Gauge by eye.

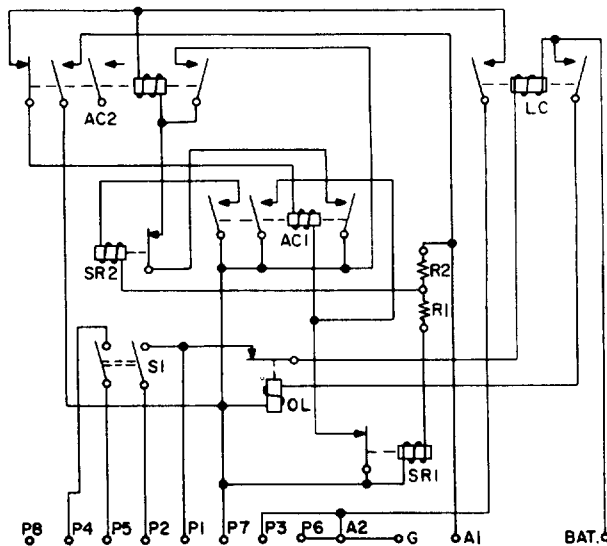


Fig. 5 - Schematic for KS-15821, List 1

2.04 Contact Follow

(a) *Fig. 8(A)* --- The follow of the main contacts of the LC and AC relays when making contact shall be:

CODE	RELAY DESIGNATION	FOLLOW
KS-5647, Lists 1,2,3, and 4	LC and AC2	Nom 1/16 inch
	AC1	Min 1/32 inch
KS-15821, List 1	LC, AC1, and AC2	Nom 1/16 inch

(b) The follow of the NO auxiliary contacts of the LC, AC1, and AC2 relays when making contact shall be

Min 3/64 inch.

Gauge by eye.

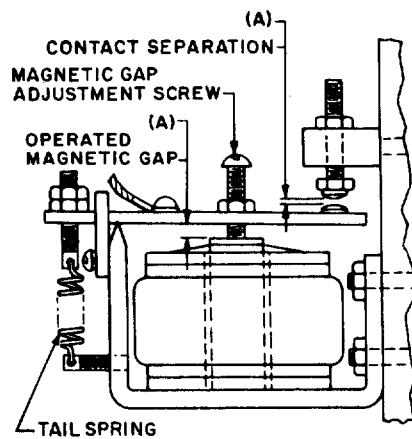


Fig. 6 - SR Relay Shown in Operated Position

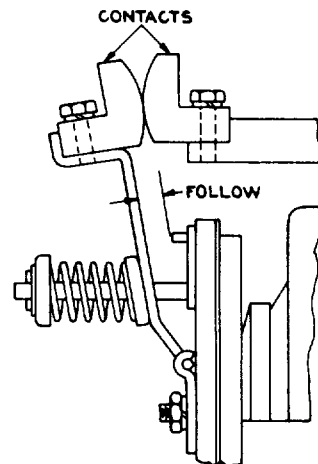


Fig. 7 - Follow of Main Contacts (Fixed Stop)

2.05 Contact Gap and Operated Magnetic Gap

(a) The contact gaps for relays designated AC and LC measured between contacting surfaces shall be:

CODE	RELAY DESIGNATION	MAIN CONTACTS
KS-5647, Lists 1,2,3, and 4	LC, AC2, AC1	Min 11/16 inch Min 1/2 inch
KS-15821, List 1	LC, AC2, AC1	Min 11/16 inch Min 1/2 inch

Use the R-8550 steel scale.

(b) The contact gap of the NC auxiliary contacts on the AC2 relays shall be:

CODE	CONTACT GAP
KS-5647, Lists 1, 2, 3, and 4	Min 5/32 inch
KS-15821, List 1	Min 1/16 inch

Use the R-8550 steel scale.

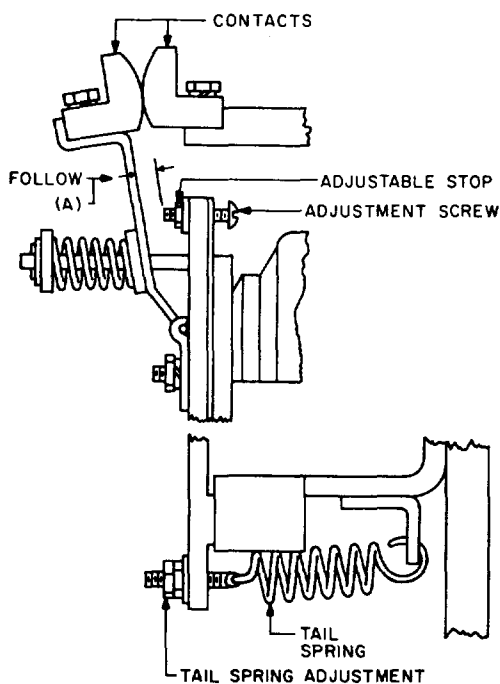


Fig. 8 - Follow of Main Contacts (Adjustable Stop)

(c) **Fig. 6(A)** — For the SR relays the contact gap and operated magnetic gap shall be:

CODE	CONTACT GAP	OPERATED MAGNETIC GAP
KS-5647, Lists 1, 2, 3, and 4	Min 0.025 inch	Max 0.140 inch
KS-15821, List 1	Min 0.025 inch	Max 0.190 inch

Use the No. 131A and KS-6909 gauges.

2.06 Electrical Requirements

(a) The relays shall meet the electrical requirements specified in the circuit requirement table or other job information.

(b) Where electrical requirements are not specified in the circuit requirement table, the following shall apply.

(1) LC and AC relays shall operate on the following voltages.

CODE	CONTACTOR	VOLTAGE MIN
KS-5647, Lists 1, 2, 3, and 4	AC1, AC2, LC	125 20
KS-15821, List 1	AC1, AC2, LC	125 102

Use 35-type test set.

(2) SR relays shall operate on the motor starting inrush current, opening its NC contacts before its associated AC relay operates. It shall release, as the current decreases, as follows.

CODE	MIN	AMP	MAX
KS-5647, Lists 1, 2, and 4	50		56
List 3	95		105
KS-15821, List 1	70		80

Use an ammeter.

SECTION 024-345-701

Γ φ(3) The OL relays of the KS-5647 controllers shall release the controllers within 2 hours on the following currents.

CODE	AMPERES
KS-5647, Lists 1, 2, and 4	42.5
List 3	75

φThe OL relay of the KS-15821, List 1 starter shall release the starter within 7 to 30 minutes on a current of 80 amperes at ambient temperatures of 24°C to 30°C.

L Use an ammeter and watch.

(c) Check of electrical requirements may be made at the temperature at which the relay is found unless H (hot) or C (cold) is specified on the circuit requirement table.

(d) Where H is specified in the circuit requirement table without heating instructions, the relay coils shall be energized for at least 1 hour prior to the test.

(e) Where C is specified on the circuit requirement table without cooling instructions, the relay shall be de-energized for at least 2 hours prior to the test.

*2.07 **Temperature:** The temperature shall not exceed:

	MAX
→ Coils	105°C (221F)
→ Frames and other parts in contact with insulation	95°C (203F)

Use thermometer.

ΓIf the temperature is thought to be excessive, check as follows. Hold the bulb of the thermometer against the hottest spot in question, covering the part of the bulb not in contact with the apparatus with a piece of felt or the equivalent.

3. ADJUSTING PROCEDURES

3.001 *List of Tools, Gauges, Materials, and Test Apparatus*

CODE OR SPEC NO.	DESCRIPTION
TOOLS	
265C	Contact Burnisher Holder
365 (As reqd)	Connecting Clip

CODE OR SPEC NO.	DESCRIPTION
TOOLS	
417A	1/4- by 3/8-inch Hex. Open Double-end Flat Wrench
418A	5/16- by 7/32-inch Hex. Open Double-end Flat Wrench
KS-6278 (As reqd)	Connecting Clip
KS-6367	7/16- by 5/8-inch Open Double-end Flat Wrench
→KS-6780 (As reqd)	Connecting Clip
KS-6854	Screwdriver
→KS-14208 (Two reqd)	Brush
—	5-inch Regular Screwdriver
GAUGES	
→131A	Gauge
KS-6909	Gauge
R-2771	Spring Balance 0 to 6 pounds
ΓR-8550	6-inch Steel Scale
—	-5 to +150°C Thermometer, Weksler Instruments Corp, No. 368KB71 (or equivalent spirit-filled thermometer)
L	
MATERIALS	
→108 (As reqd)	Cord Tip
KS-7187	Bond paper
→KS-8272	Stabilized Trichloroethylene
→---	Abrasive Paper, 150 Grade
—	Felt Pad
→---	1-ounce Bottle
TEST APPARATUS	
35 Type	Test Set
1W13A (As reqd)	Cord (each end equipped with a No. 365 connecting clip or KS-6278 connecting clip)

CODE OR SPEC NO.	DESCRIPTION
TEST APPARATUS 1W13B (As reqd)	Cord (each end equipped with a No. 365 connecting clip or KS-6278 connecting clip)
—	Voltmeter, dc, Weston Model 931, Ranges 300/150/75/30 (or replaced 281) (if 35-type test set equipped to indicate voltage is not available)
—	Ammeter, dc, Weston Model 901, With 50 Millivolt Drop External Shunt, KS-9442, List 6 for 150 Amperes or KS-9442, List 14 for 1500 Amperes as Required
—	Wire, No. 14 Gauge or Lamp Cord, 2 Conductors

3.002 *Maintaining Service While Working on Relay*

- (1) **General:** If less than 150 volts are applied across terminals and it is not practicable to disconnect the relay from the power supply (see 1.10), bridge the current-carrying contacts and insulate live parts as covered in (2) and (3), respectively.

Caution: *Use care when working in close quarters with live parts.*

- (2) **Bridging Contacts:** To maintain service while work is being done affecting closed contacts carrying current in working circuits, bridge the contacts at the most convenient points in the circuit other than at the relay, if practicable. No. 1W13A cords (3 feet long) or No. 1W13B cords (6 feet long) with KS-6278 connecting clips (jaws insulated with No. 108 cord tips) are satisfactory for strapping purposes. Lengths of No. 14 gauge insulated wire or flexible cord such as is commonly used in lighting circuits, with KS-6780 connecting clips (jaws insulated with No. 108 cord tips), are equally satisfactory.

- (3) **Insulating Contacts and Parts:** KS-7187 bond paper should be used for insulating live parts and should be shaped or bent as necessary to provide protection with minimum interference to the work being done. To prevent closure of open contacts in a live circuit, place bond paper, as required, around the fixed contact or disconnect the lead to the contact spring.

3.003 *General Procedure*

- (1) Where it is not practicable to disconnect the relay from the power supply, bridge around the contacts as covered in 3.002, insulate between contacts with a strip of bond paper, and disconnect leads, as necessary, in order to maintain circuit conditions unchanged. If it becomes necessary to remove the relay from its mounting in order to obtain access to the parts, proceed as follows. Patch through any working circuit and disconnect all power supply from the winding and contact circuits by opening switches, if provided, or by removing the fuse or fuses. Then disconnect the leads from the terminals. Remove the mounting screws.

Caution: *Use care when working in close quarters with live parts.*

- (2) In working circuits, contacts which are found closed and carrying current which should not be interrupted should be bridged. In working circuits, contacts which are found open and which should not be closed shall be kept separated by inserting a strip of bond paper between the movable and stationary contacts, or by disconnecting a lead. To close a NO contact, hold the armature against the pole face, taking care not to disturb the alignment of the armature. NC contacts of a relay which is found operated in a working circuit may be closed by opening one connection to the coil, after first bridging or insulating the other contacts, as necessary.

3.01 *Mounting* (Req't 2.01)

- (1) Tighten all loose screws and nuts using a screwdriver or wrench as required.

3.02 *Cleaning Contacts* (Req't 2.02)

- (1) The purpose of cleaning contacts is to remove any gummy or dirty substance that would interfere with reliable contact. It is not

necessary or desirable to keep contacts polished or shining. The contacts should be disconnected from the power supply during the cleaning operation. To remove dirt and gummy substance, clean the contacts with KS-8372 trichloroethylene as covered in (a) and (b) and then brush them with a dry, clean KS-14208 brush as covered in (c).

(a) Pour a small quantity of the trichloroethylene into a 1-ounce bottle. It is important to avoid the use of contaminated trichloroethylene in cleaning the contacts. Therefore, discard the trichloroethylene as soon as it appears dirty.

(b) Dip the hairs of a clean KS-14208 brush their full length in the trichloroethylene. Remove excess fluid by wiping the brush on the edge of the bottle. Then with the contacts open, brush the entire surface of the contact to be cleaned with the moist brush.

(c) Brush the contacts with a dry, clean KS-14208 brush. If necessary, burnish the contacts as covered in (2).

(2) There shall be as little smoothing of contacts as is consistent with satisfactory operation. Contacts should be smoothed while closed. To close NO contacts, hold the relay operated manually or electrically. In the case of contacts not connected to the power supply, insert a No. 265C burnishing tool or strip of abrasive paper (with contacts connected to the power supply, abrasive paper only) between the contacts to be cleaned, and draw it back and forth until the build-ups are removed entirely or are reduced sufficiently to insure reliable contact. Then clean the contacts as outlined in (1) above.

(3) If the contacts become badly worn, replace the contacts where possible. If not, replace the relay in question.

3.03 Contact Pressure (Reqt 2.03)

(1) Contact pressure for the main contacts of the LC and AC relays is not adjustable and will fall below minimum values given only as a result of excessive wear or filing of the contacts, or weakening of the pressure spring. If contact heating or excessive build-ups develop, check the pressure and replace the contacts and the spring.

(2) The contact pressure of the SR relays is dependent upon the tension in the tail spring. If the pressure of the contact is thought to be insufficient, readjust the contact gap toward the minimum and increase the tension of the armature spring. See that requirements 2.05 and 2.06 are met.

3.04 Contact Follow (Reqt 2.04)

(1) The contact follow for the main contacts of the LC and AC relays is adjusted by loosening the locknuts which hold the follow adjustment screw and moving the screw as required. Tighten the locknut after adjustment.

(2) The NO auxiliary contacts of the LC and AC relays are adjusted for follow by loosening the mounting nuts which hold the stationary contact post in the panel and moving the post, as required. Tighten the nuts after the adjustment is completed.

(3) If the contacts of the OL relay show overheating or roughening, the contact pressure spring should be replaced.

3.05 Contact Gap and Operated Magnetic Gap (Reqt 2.05)

(1) If the contact gap of the LC and AC relays is less than the minimum, inspect the relay for obstructions which prevent it from releasing completely and remove them as required. The separation is not adjustable on some controllers. For controllers and starters which have the adjustment screw, proceed as in 3.04(1).

(2) To adjust the NC auxiliary contacts of the AC2 relays, loosen the nuts which lock the threaded push rod in its support and rotate it to secure the required separation. Tighten the locknuts.

(3) To adjust the SR relays, operate them manually and set the operated magnetic gap at the maximum. This gap is determined by the length of the magnetic adjustment screw projecting through the armature and resting against the pole piece. To adjust, loosen the adjusting screw locknut and adjust the screw as required. Tighten the locknut. After this gap has been set, hold the relay

operated and adjust the contact gap to the minimum by means of the contact screw. Either the contact separation or the operated magnetic gap may require readjustment away from the extreme limits to meet requirement 2.06.

3.06 *Electrical Requirements* (Req't 2.06)

(1) Where requirements are expressed in volts, a 35-type test set equipped to indicate volts should be used. If the available test set is not so equipped it should be supplemented by a dc voltmeter. Where test set preparation has not been specified on the circuit requirement table, it is suggested that both of the relay coil terminals be disconnected and battery and ground be furnished through the test set with B/G/V or B/G preparation. The operate voltage required for the LC and AC relays may be raised or lowered by increasing or decreasing the tail spring tension.

(2) To check the SR series relays, connect the ammeter in series with the controller or starter, start the motor, and observe the current at the moment when the SR relay releases. In addition to the usual adjustment for tail spring tension, the operate value may be raised by increasing the contact gap and the release value lowered by decreasing the operated magnetic gap.

(3) The OL relay of the KS-5647, Lists 1 to 4 motor controllers and KS-15821, List 1 starter is not adjustable and if defective should be replaced.

3.07 *Temperature* (Req't 2.07)

(1) If the temperature exceeds the specified limit, check that requirements 2.02, 2.03, and 2.04 are met. If these requirements are met and the temperature is still above the specified limit, with nameplate rated voltage not exceeded, refer the matter to the supervisor as the controller or starter may have to be replaced.

REASONS FOR REISSUE

1. To add the KS-15821, List 1 starter.
2. To delete the paragraph covering the use of the number sign (#) (1.06 of previous issue).
3. To revise the paragraph covering the use of the asterisk (*) (1.05).
4. To add information covering the use of the phi sign (ϕ) (1.04).
5. To add schematic for KS-15821, List 1 starter. (Fig. 5.)
6. To add a check method for temperature measurements (2.07).
7. To revise the list of tools, gauges, materials, and test apparatus (3.001).
8. To add information on the use of trichloroethylene for cleaning contacts [3.02(1)].
9. To add information for adjustment of contact follow [3.04(1)] and contact gap [3.05(1)].