CONTROL RELAYS
KS-5350, KS-5451, KS-5728, KS-15503, KS-15598 AND KS-15806 TYPES
AND
KS-5265 TRANSFER SWITCHES
REQUIREMENTS AND ADJUSTING PROCEDURES

1. GENERAL

1.01 This section covers the KS-5350, KS-5451, KS-5728, KS-15503, KS-15598, and KS-15806 control relays and KS-5265 transfer switches.

1.02 This section was reissued as issue 6 to include the KS-15806 control relay, to specify normally closed contacts instead of normally open contacts for the KS-15503 control relay, to replace a mercury filled thermometer by a spirit filled thermometer, to add the information covering the use of petroleum spirits for cleaning purposes, and is now reissued as issue 7 to correct Fig. 1. The arrows indicate changes from issue 5.

1.03 Reference shall be made to Section 020-010-711 for the proper application of the requirements listed herein.

*1.04 Asterisk: Requirements are marked with an asterisk (*) when to check for them would necessitate the 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.

1.05 For the purpose of this section, whether contacts are said to be normally open (NO) or normally closed (NC)

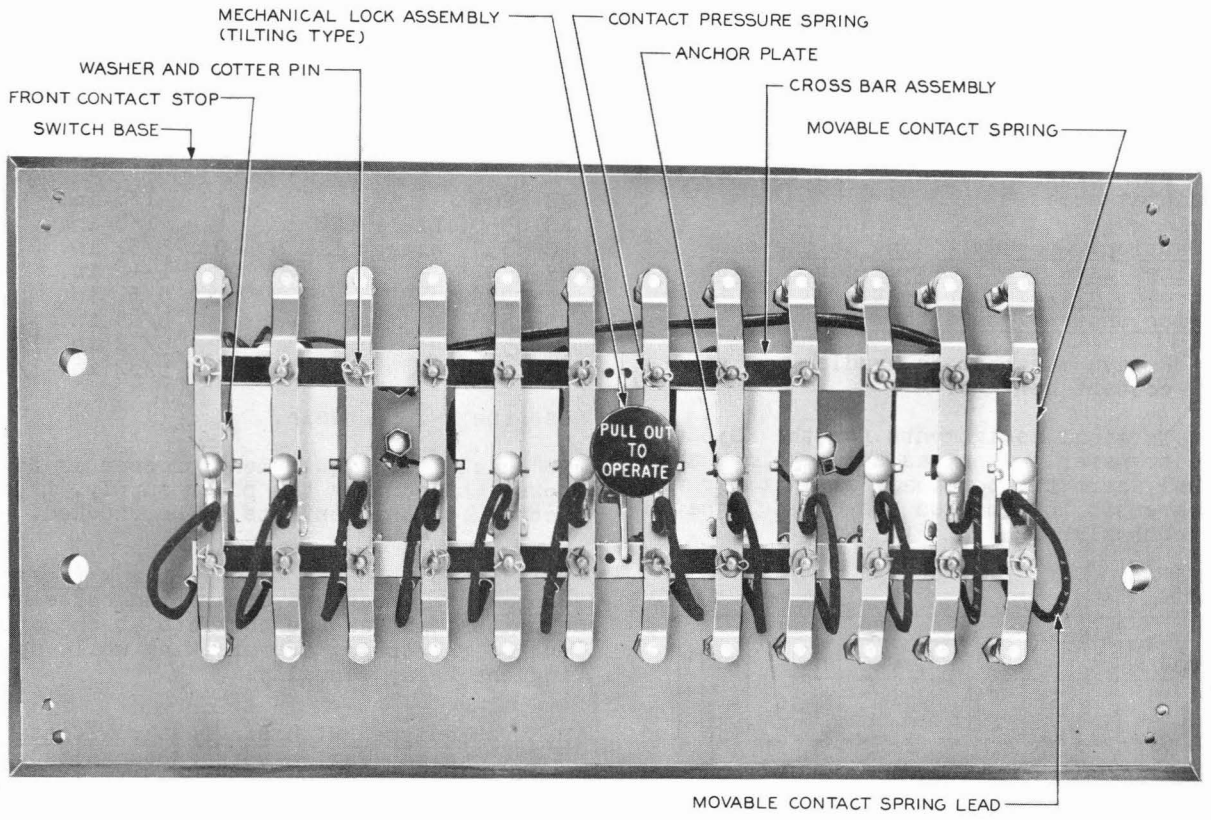

Fig. 1 - KS-5264 Transfer Switch

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.

1.06 A relay or switch is said to operate when the armature has moved sufficiently for NC contacts to open and NO contacts to close with reliable contact.

1.07 A relay or switch is said to release when the armature has moved sufficiently for NO contacts to open and NC contacts to close with reliable contact.

1.08 A relay or switch, except one whose coil is rated in amperes alternating current, is said to be nonoperate when, at the specified value, the armature has not moved sufficiently for NO contacts to close or for reliable contact on NC contacts to be interrupted. A relay whose coil is rated in amperes alternating current is said to be nonoperate when, at the specified value, there is a clearance of from 1/64 inch to 1/16 inch between the movable contact spring associated with an NC contact and the shoulder on the crossbar.

1.09 When checking requirements or making adjustments, disconnect the relay or switch from the power supply, if practicable. Where it is not practicable, bridge around and insulate the contacts as covered in 3.002. Disconnect the leads as necessary to maintain circuit conditions unchanged.

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

Caution: Do not touch, at the same time, live terminals or parts which are at different potentials, or otherwise short-circuit them.

1.11 Relays must not be handled by the contact springs.

1.12 Terminal assignments for the KS-5264 transfer switch, as shown below, are for use where the terminals are not marked or where job information has not designated the terminals.

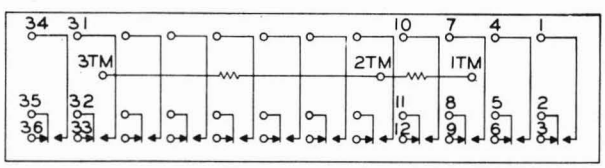

Fig. 2 - Terminal Assignments for the KS-5264 Transfer Switch

2. REQUIREMENTS

2.01 Relay Mounting and Tightness of Assemblies

(a) The relay shall be fastened securely to its mounting.

(b) Coils and contact post assemblies shall be fastened securely to the relay or switch base. Fastenings holding components together shall be secure.

Gauge by feel.

2.02 Freedom of Operation: Armature shall move freely on its fulcrum or hinge.

Gauge by feel.

2.03 Cleaning Contacts: Contacts shall be clean and free from build-ups which might interfere with reliable contact.

Gauge by eye.

2.04 Contact Alignment: Contacts shall be aligned so that when the contacts are completely closed, the outer edge of one contact does not extend over the outer edge of the other by

Max 1/32 inch

Gauge by eye.

2.05 Contact Separation: The separation between movable and stationary contacts shall be

	Min	Max
KS-5264	1/8 in.	-
KS-5350, L12 & L20	1/8 in.	-
KS-5350, except L12 & L20	5/32 in.	-
KS-5451	1/16 in.	-
KS-5728	5/32 in.	-
KS-15503	5/64 in.	-
KS-15598	5/32 in.	7/32 in.
→ KS-15806	5/32 in.	7/32 in.

Use the R-8550 scale.

To check this requirement proceed as follows. Disconnect the power supply, if connected, to the contacts to be checked.

Relays Equipped With Double-throw (Transfer) Contacts: Check the separation between contacts just as the contacts at the other end of the spring are breaking while operating the relay manually.

Relays Equipped With Single-throw Contacts: Check the separation between contacts with the relay operated manually when checking NC contacts or with the relay in its unoperated position when checking NO contacts.

2.06 Spring Clearance (KS-15598 Relays): Fig. 4(A) - With the adjacent contacts closed, there shall be a separation between the movable contact arm and the crossbar shoulder of

Min 0.020 inch

Use the No. 67B gauge.

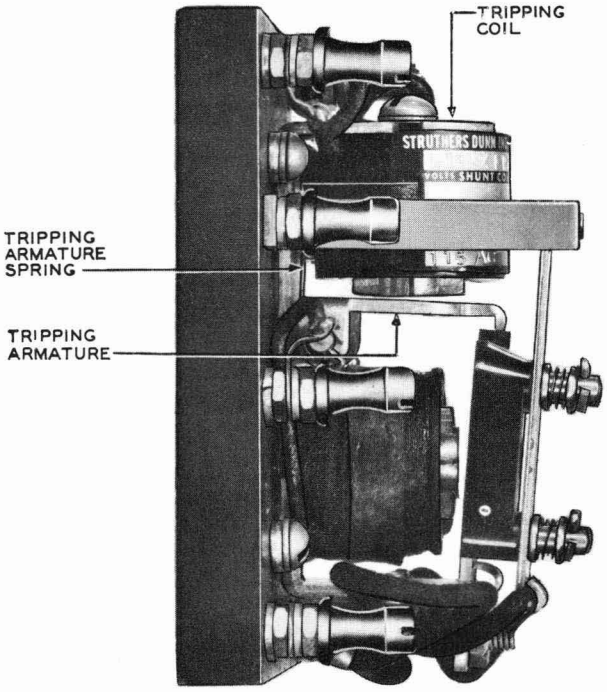

Fig. 3 - KS-15503 Control Relay

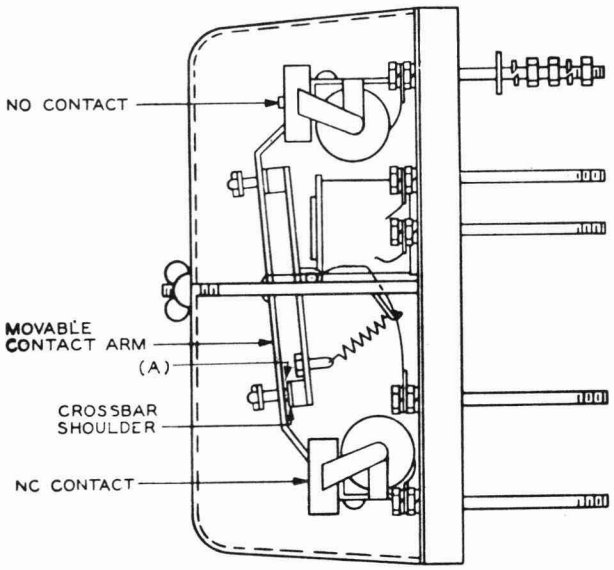

Fig. 4 - KS-15598 Control Relay

2.07 Contact Sequence

(a) All NO contacts shall make and break simultaneously.

(b) All NC contacts shall break and make simultaneously.

Gauge by eye. When in doubt, use the No. 81A test set, or, as covered in Section 100-100-101, the lamp of the 35-type test set. When contacts are paralleled, insulate those not being checked.

2.08 Contact Pressure: The pressure between closed contacts shall be

	Contacts	Grams Minimum	
KS-5264	All	28	
KS-5350	NO	42	
KS-5350	NC	28	
KS-5451	NO	20	
KS-5451	Single Pole, NC	20	
KS-5451	Multipole, NC	10	
KS-5728	NO	50	
KS-5728	NC	45	
KS-15503	NC	20	←
KS-15598	NO	40	
KS-15598	NC	30	
KS-15806	NO	42	←

Use the No. 70D or 79C gauge.

To measure the contact pressure of the NO contacts, energize the operating coil, or hold the armature securely against the pole face with a screwdriver, taking care not to press on any part of the contact spring which supports the moving contact. Place the gauge against the contact spring as near to the moving contact as possible and exert a pressure with the gauge away from the stationary contact. Read the gauge as the moving contact leaves the stationary contact.

To measure the contact pressure of the NC contacts, proceed in a manner similar to that covered above but allow the armature to be held in its unoperated position by the pull of its spring. Do not use the mechanical lock.

2.09 Electrical Requirements

(a) The relay or transfer switch 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, operation of a voltage-rated relay shall be checked at the minimum coil voltage specified on the nameplate. Similarly, operation of a current relay should be checked at the minimum coil current specified. Do not confuse the coil current rating with the contact current rating which is also shown on the nameplate.

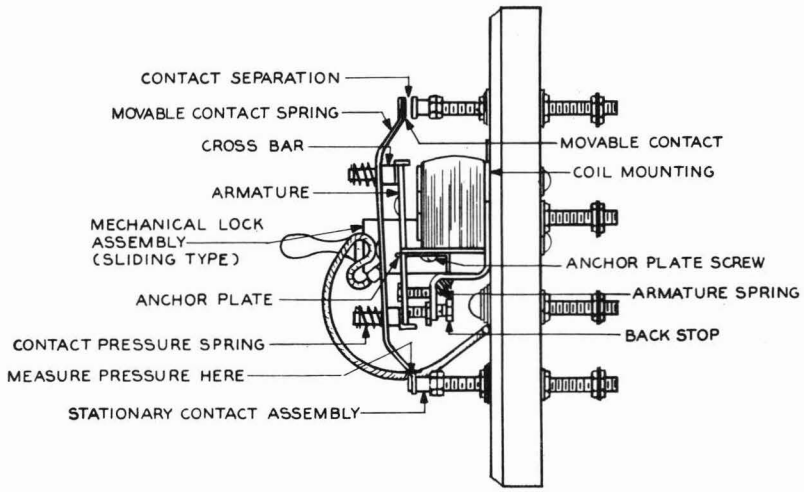

Fig. 5 - KS-5264 Transfer Switch - End View

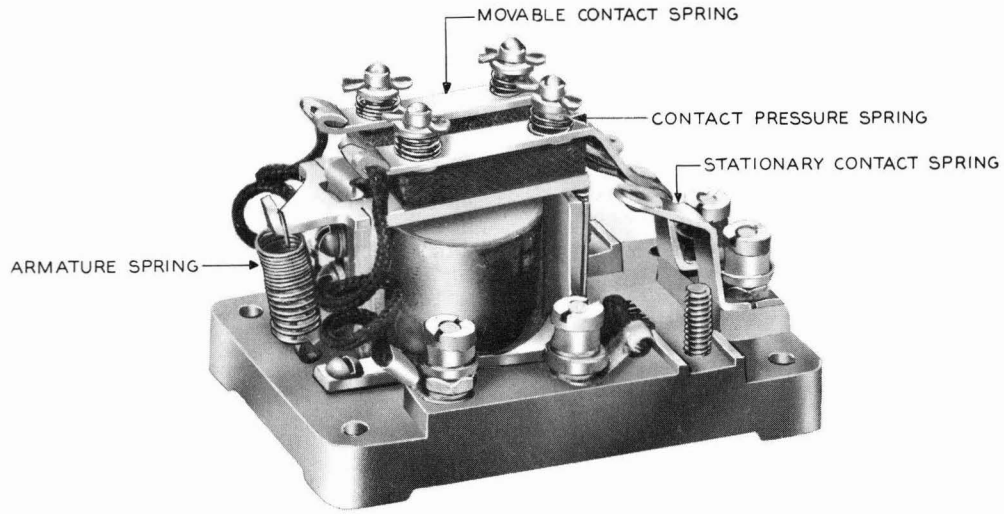

Fig. 6 - KS-5451 Control Relay

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

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

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

*2.10 Temperature: The temperature shall not exceed

	Maximum
Coils	95C (203F)
Contacts	115C (239F)

→Use the Kimble thermometer.

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

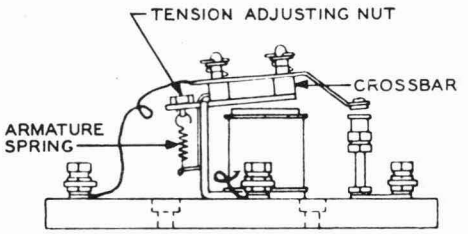

Fig. 7 - KS-5350 Control Relay

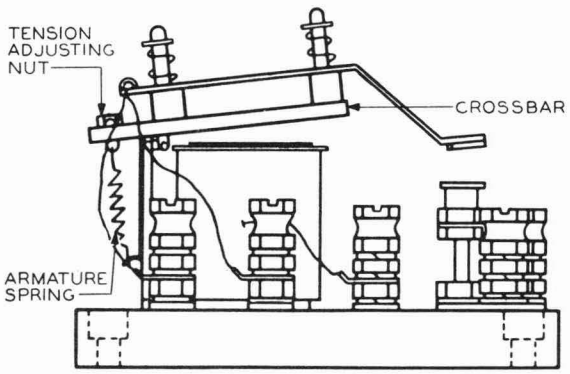

Fig. 8 - KS-15806 Control Relay

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 required)	Connecting Clip
417A (2 required)	1/4-inch and 3/8-inch Open Double-end Flat Wrench
485A	Smooth-jaw Pliers
KS-6278	Connecting Clip
KS-6780 (as required)	Connecting Clip
	6-1/2-inch P-long-nose Pliers
-	3-inch Cabinet Screwdriver
- (as required)	Wrenches
Gauges	
66D	Thickness Gauge Nest
70D	50-0-50 Gram Gauge
79C	0-200 Gram Push-Pull Tension Gauge
R-8550	6-inch Steel Scale
-	-20° to +151C Thermometer Kimble Co. No. 43732 (or equivalent spirit filled thermometer)
Materials	
KS-2423	Cloth
KS-7187	Bond Paper
KS-7860	Petroleum Spirits
-	Abrasive Cloth 150 Grade
-	Felt Pad
- (as required)	No. 14 Wire
Test Apparatus	
35 Type	Test Set
81A	Test Set
1W13A (as required)	Cord (each end equipped with a No. 365 connecting clip or KS-6278 connecting clip)
1W13B (as required)	Cord (each end equipped with a No. 365 connecting clip or KS-6278 connecting clip)
352AL	Transformer
-	Ammeter, ac, Weston Model 528, range 10 or range 50
-	Autotransformer, continuously tapped, (variac, 2.5 amp, 230-volt input, Type V-5 HMT or equivalent; General Radio Co, Cambridge, Mass. suggested)
-	Voltmeter, ac, Weston Model 528, ranges 300-150
-	Voltmeter, dc, Weston Model 281, ranges 150-60-3 (or replaced 280)

3.002 Strapping and Insulating: To maintain service while work is being done

affecting closed contacts of working circuits, bridge the current-carrying contacts, making the connections at the most convenient points in the circuit other than at the relay, if practicable. For strapping where the voltage does not exceed 150 volts, 1W13A or 1W13B cords are suggested, with No. 365 connecting clips or KS-6278 connecting clips at both ends. Lengths of No. 14 wire, or of flexible cord, such as is commonly used in lighting circuits, with KS-6780 connecting clips, are required where the voltage exceeds 150 volts. The KS-7187 bond paper should be used for insulating live parts, including open contacts, and should be shaped or bent, as necessary, to provide protection with a minimum of interference with the work being done.

3.003 General Procedure

(1) Where it is not practicable to disconnect the relay from the power supply, bridge around contacts (see 3.002), insulate between contacts with a strip of the KS-7187 bond paper, and disconnect leads, as necessary, in order to maintain circuit conditions unchanged. If it becomes necessary to remove the relay or switch 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 using a suitable screwdriver or wrench. Remove the mounting screws with the screwdriver.

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 broken should be bridged. (See 3.002.) In working circuits, contacts which are found open and 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 an 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.

3.004 When using KS-7860 petroleum spirits for cleaning purposes in the power room, provide as much ventilation as practicable. After using the petroleum spirits, the commutators of all dc machines in the power room should be burnished in accordance with approved procedures for the machines involved, since the fumes from the petroleum → spirits may soften commutator film and thus → adversely affect commutation.

3.01 Relay Mounting and Tightness of Assemblies (Rq 2.01)

(1) Tighten loose mounting screws with a screwdriver and loose mounting nuts with a wrench.

(2) To tighten a loose coil on the KS-5264 switches, insert a screwdriver in the hole in the back of the panel and tighten the magnet core screw that secures the coil to its mounting.

(3) To tighten a loose coil on the KS-5350, KS-5728, KS-15503, KS-15598, → or KS-15806 relay, remove the relay from the panel. Remove the sealing compound which covers the magnet core screw and coil mounting screws. Tighten the magnet core screw and coil mounting screws. Remount the relay.

(4) To tighten a loose coil on the KS-5451 relay, remove the three screws which secure the coil to its mounting with a screwdriver and remove the coil, first disconnecting the coil leads. This will permit the tightening of the magnet core screw located at the bottom of the coil. Reassemble in the reverse order.

3.02 Freedom of Operation (Rq 2.02)

(1) To check an armature for freedom of operation, operate the armature by hand, observing its action. Remove dirt or other obstructions.

3.03 Cleaning Contacts (Rq 2.03)

(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. Clean contacts by wiping with a KS-2423 cloth moistened with KS-7860 petroleum spirits, followed by wiping with a dry cloth. The contacts should be disconnected from the power supply during the cleaning operation.

(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 operate the mechanical latch, if provided. Otherwise hold the contacts closed manually. In the case of dead contacts, insert a No. 265C burnisher or strip of abrasive cloth (with live contacts, abrasive cloth 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 covered in (1) above.

(3) Replace contacts which are badly worn. When replacing worn movable contacts, replace a complete contact spring, which includes the lead.

3.04 Contact Alignment (Rq 2.04)

(1) Using the No. 485A pliers, adjust a contact spring that is slightly bent or out of alignment. Any contact spring that becomes badly bent out of shape should be removed and straightened or replaced with a new contact spring.

(2) If alignment cannot be obtained, replace the relay.

3.05 Contact Separation (Rq 2.05)

(1) KS-5350, KS-5728 (NO Contacts), and KS-15806 Relays and KS-5264 Switches: ← Loosen the locknut and move the stationary contact as required. Tighten the locknut. Use two No. 417A wrenches. Do not adjust the movable spring.

(2) KS-5451, KS-15503, and KS-5728 (NC Contacts) Relays: Adjust the stationary contact spring, as required, using the No. 485A pliers.

(3) KS-15598 Relay: Adjust the movable contact arm, as required, using the No. 485A pliers applied to the short portion of the arm near the bend from the long straight portion.

(4) After making any adjustments as covered above, check that the other contacts of the relay or switch meet the requirement and all contacts meet requirements 2.04, 2.07, 2.08, and 2.09.

3.06 Spring Clearance (Rq 2.06)

(1) The clearance between the movable contact arm and the crossbar shoulder may be changed either by adjusting the arm as covered in 3.05(3) or by adjusting the tension of the armature spring. To adjust the spring, raise the threaded rod to which the spring is attached until the adjusting nut clears the stops. Then, while holding the rod in this position, turn the nut in to increase the tension or out to decrease the tension. With the spring adjusted, release the rod making sure that the nut rests between the stops. Take care that requirements 2.05 and 2.08 are met.

3.07 Contact Sequence (Rq 2.07)

(1) If associated contacts do not make or break simultaneously, inspect the movable contacts or the stationary contacts as a group, and if one contact is higher or lower than the others of the group, correct by adjusting springs or by raising or lowering contacts on studs, as applicable. After any change, check requirements 2.04, 2.05, 2.06, 2.08, and 2.09.

3.08 Contact Pressure (Rq 2.08)

(1) Contact pressures are specified on a minimum basis and have a direct bearing

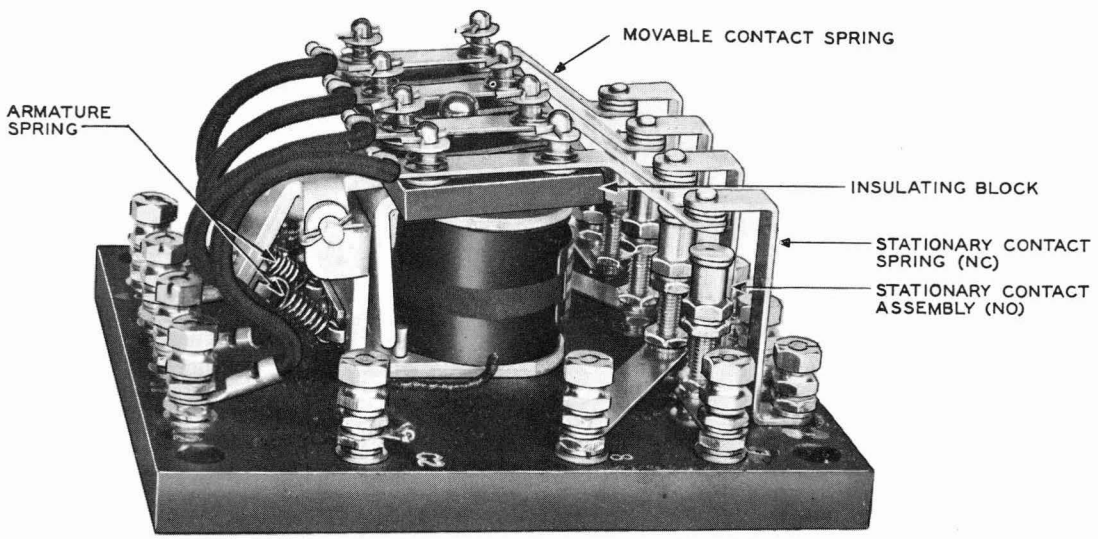

Fig. 9 - KS-5728 Control Relay

on the electrical requirements. If the pressure is greatly in excess of the specified minimum limit, the relay may fail to meet its electrical requirements, in which case, it will be necessary to reduce the spring tension. In readjusting, it is desirable to have as much tension as possible on the various springs consistent with meeting other requirements. In adjusting the contact springs, tension the corresponding springs of the assemblies on both sides of the armature so that the tensions are approximately equal unless difference is necessary to meet other requirements. When one contact spring is adjusted or otherwise changed, or when the position of a stationary contact is changed, recheck the contact pressure on all the contacts on the relay.

(2) Hum or chatter in ac relays is usually due to too much tension in the armature spring. This tension may be reduced as required, but not to an extent that would interfere with meeting other requirements. Hum or chatter may also be due to too much pressure on the NO contacts. As a last resort, the contact pressure may be reduced, but not below the specified minimum.

(3) Contact pressure may be adjusted by relocating stationary contacts [3.05(1) and (2)] or by changing the adjustment of mechanical stops, if present and adjustable. In the case of NC contacts, resort to this only after getting all the adjustment that can be had by changing the tension of the armature spring as covered below.

(4) To change the tension of the armature spring, raise the threaded rod so that the hexagonal nut clears the stops and turn the adjusting nut (usually with the fingers) clockwise to increase and counterclockwise to decrease the tension. Further adjustment is available at the other end of the spring by moving the anchor plate. After loosening the anchor plate with the screwdriver, move it down to increase, or up to decrease, the tension, and retighten with the screwdriver. Where the threaded rod and nut are not available (for example, some KS-5451 relays) the tension may be changed by moving the anchor plate or adjusting, with the P-long-nose pliers, the tang to which the armature spring is attached. If the anchor plate serves also as a backstop, it should not be moved for the purpose of adjusting spring tension. The tension of the KS-5728 relay may be changed by adjusting with the P-long-nose pliers, the tangs to which the armature springs are attached.

(5) In general, with proper contact separation and proper pressure, there will be some compression of one of the contact pressure springs and a slight clearance between the contact spring and the crossbar or insulating block on which the contact springs are supported.

3.09 Electrical Requirements (Rq 2.09)

(1) A check of the operation of a voltage-rated relay or switch is made by connecting a voltmeter across the coil terminals. If there is no indication on the voltmeter, a study of the associated circuit is necessary to determine whether the absence of voltage indicates a circuit fault or is a condition to be overcome by blocking a relay or otherwise changing circuit conditions. Failure to operate with rated voltage at the coil terminals may sometimes be corrected by readjustment but in some cases it may be due to an open coil. To check for an open, connect the voltmeter in series with the operating voltage and the coil, with parallel coils, if any, disconnected. If no indication appears on the voltmeter, the coil is open and should be replaced.

(2) A check of the operation of a current-rated relay is made by connecting an ammeter in series with the coil. If there is no indication on the ammeter, a study of the associated circuit is necessary to determine whether the absence of current indicates a circuit fault or is a condition to be overcome by blocking or otherwise changing circuit conditions. Failure to operate with rated current in the coil necessitates readjustment of the relay. If there is no indication on the ammeter, check with a voltmeter for voltage across the coil terminals. If voltage is present the absence of current indicates that the coil is open and should be replaced.

(3) When readjusting or when checking for any electrical requirement except the check of operation discussed in (1) and (2) above, proceed as covered in 1.09.

(4) Where requirements are expressed in milliamperes, direct current is meant unless otherwise specified, and a 35-type test set should be used. Where requirements are in volts, direct current is meant unless otherwise specified, and a 35-type test set should be used, supplemented by a dc voltmeter if the test set is without one. Where test set preparation has not been specified on the circuit requirement table, disconnect both relay coil terminals and furnish both battery and ground through the test set with B/G or B/G/V preparation as covered in Section A804.001.

(5) Where electrical requirements are expressed in volts alternating current, connect the ac supply to the input of a continuously tapped autotransformer protected by a 2-1/2- or 3-ampere fuse. Con-

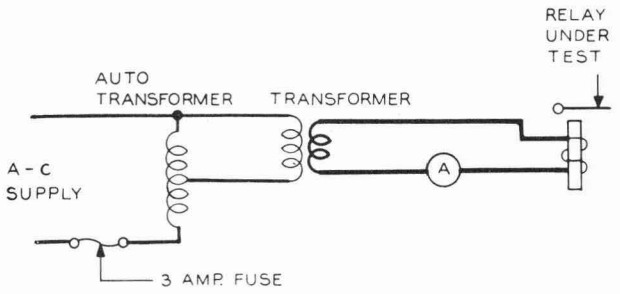

Fig. 10 - Test Connections Where Relay Is Rated in Amperes AC

nect the relay coil and a voltmeter across the output of the autotransformer and adjust to specified values. Where available, the ITE1888 Palmer voltage relay test set, which forms a part of the Western Electric Co. No. 270 Palmer master switch kit, may be used as the autotransformer, but it does not have sufficient range or capacity to test all relays.

(6) Where electrical requirements are expressed in amperes alternating current, an autotransformer should be used. Where current in excess of the output rating of the autotransformer is required, a transformer should be added as shown in Fig. 10. If the 352AL transformer is used, terminals 1 and 3 are connected to the relay and terminals 4 and 210, 230, or 250, depending on line voltage, are connected to the output of the autotransformer. With the above arrangement, current up to 60 amperes at 2.5 volts alternating current can be obtained by manipulation of the autotransformer. For test purposes, the current should be gradually increased to the specified operate value and gradually reduced to the specified release value.

(7) Operate, nonoperate, and release adjustments are made, as far as possible, by changing contact pressures (3.08). In no case should the pressure be less than the specified minimum. Additional changes in these values are made by changing the airgap between the armature and the pole face.

(8) Airgaps are changed as covered below. After any change in the airgap, recheck requirements 2.04, 2.05, 2.06, 2.07, and 2.08.

(a) With backstops, obtain what adjustment is possible by loosening the backstop with a screwdriver and moving it. Further adjustment is obtained by shaping the backstop with the P-long-nose pliers. If the airgap is being increased, a screwdriver used as a wedge is convenient for bending the backstop.

(b) Where NC contacts serve as backstops, the contacts are moved as covered under contact separation (3.05).

(9) If the relay does not release, check each armature for binding on its fulcrum or hinge and clean or replace. Check each armature spring to see that it has sufficient tension to return the armature to its open position. Replace, if necessary. If the antifreeze pin in the armature face of dc coil relays allows the armature to come in direct contact with the pole face and stay there after the actuating current or voltage is interrupted, replace the armature.

(10) In the KS-15503 relay, the tripping armature spring and airgap are not adjustable. As required, clean the parts of dirt which may obstruct the operation, or replace the relay.

3.10 Temperature (Rq 2.10)

(1) If the temperature exceeds the specified limit, see that requirements 2.01, 2.04, and 2.08 are met. If these requirements are met and the temperature is still above the specified limit with nameplate-rated voltage or current not exceeded, refer the matter to the supervisor as the coil or the contacts may have to be replaced.